Mastering Ionic 2

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Thanks to...

The team at Ionic for creating such a phenomenal product that allows millions of developers worldwide to realise their ideas quickly and easily

To every developer who ever helped me with a question that I had or a software bug that I was trying to fix - I may not remember all of your names but that doesn’t mean I don’t appreciate the assistance you provided at the time!

To those who believed in me and gave me a chance when many others didn’t or wouldn’t

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Version History

Date	Changes
November 23rd 2016	Mastering Ionic 2 published!
November 25th 2016	Resolved some page formatting issues Changed URL's for file downloads
December 1st 2016	Updated content to reflect changes in Ionic 2 RC3 Added further links to file downloads
December 30th 2016	Updated forms section to cover alternate FormControl syntax in HTML field Added note to **The ionic white screen of death** section in Troubleshooting your Ionic 2 App

Introduction

Thank you for purchasing this copy of Mastering Ionic 2.

My goal with this book is to take you through using Ionic 2; beginning with an understanding of the individual products and services of the Ionic ecosystem and their underlying technologies before moving on to the different features of Ionic 2.

Later chapters of the book guide you through creating fully fledged mobile apps and understanding how to submit those to both the Apple App and Google Play stores.

If you are familiar with using Ionic 1 you might be surprised, and possibly feel a little overwhelmed, at the changes within Ionic 2. If this is the case, or you're maybe a little hesitant at moving straight into Ionic 2 development, I'll take you through those changes, helping you to not only understand them but also familiarise yourself and become comfortable working with the new syntax - I promise that before you know it you'll be hitting the ground running!

Please be aware that this book will not cover Ionic 1 development, unless mentioned in passing, and the development focus will be solely from a Mac OS X perspective - you will, however, be able to use all of the non Xcode related coding examples regardless of what platform you use.

Prerequisites

You should already understand and be familiar with using HTML5, CSS3, Sass, Angular JS and JavaScript in your projects as this book will not teach you how to use those languages other than providing examples for you to build on your existing knowledge with.

If you are not familiar with any of these languages I recommend you start with the following resources before reading this book:

- HTML5 and CSS3 for the real world
- Beginning JavaScript 5th Edition
- Jump Start Sass

Although this isn't mandatory you should already have some familiarity with using the command line interface (CLI). If you're new to this don't worry - it's very quick and easy to learn from the examples that I take you through.

You should also be familiar with object-oriented programming (OOP) concepts such as classes, inheritance and access modifiers.

I will explain and elaborate on these concepts in the context of Ionic 2 but it will help greatly if you already have some prior knowledge of and experience working with object-oriented programming.

If you don't I would recommend the following resource to start with: https://developer.mozilla.org/en-US/docs/Learn/JavaScript/Object-oriented

So why choose Ionic 2?

Out of the numerous other mobile development frameworks that are available why should you choose to develop with Ionic 2?

In my humble opinion Ionic 2 offers the best feature set and related product/service ecosystem of any mobile development framework on the market today.

Built on Apache Cordova and Angular Ionic 2 brings the features and functionality of those frameworks while providing a generous library of pre-built components and device plugins to choose from.

All of which are based on modern standards and able to be built on top of by other developers (and I'll cover all of these points throughout the book so you have a thorough understanding of what Ionic 2 is from the ground up).

Oh, and in addition to these technologies Ionic 2 is free to download and use in your projects.

Need I say more?

My background

My first introduction to cross-platform mobile development frameworks started with jqTouch back in mid-2010 followed by jQuery Mobile and then a brief flirtation with Sencha Touch before finally settling on Ionic Framework in August 2014 when it was nearing version 1 of the SDK.

Since then I’ve used Ionic to develop a number of mobile/tablet apps for both iOS and Android on client projects as well as internal projects for my own company, Saints at Play Limited.

So what made me choose Ionic over other frameworks that I’ve used (or could have used instead)?

Well, where to start?

With Ionic I get access to the plug-in/device API architecture of Apache Cordova, in addition to being able to publish my app to different mobile platforms, as well as the modularity, rich event handling and data binding capabilities of Angular 2.

Then there’s the considerable library of pre-built UI components, command line tools, support for modern web technologies, extensive online API documentation of the framework itself and, if all else fails, the well managed and helpful support forums to find answers to those seemingly unanswerable questions that often plague us as developers.

All of these, in particular the seamless integration with Apache Cordova and Angular 2, makes developing mobile apps with the Ionic framework not only easier but also quicker - and a lot more fun too!

And, for the purposes of disclosure, I am NOT affiliated with either the Angular or Ionic teams nor am I sponsored to promote their products in any way, shape or form whatsoever - I’m just a developer who likes using their tools.

Just so you know!

Conventions used within this book

You'll be pleased to know that there's only a small number of conventions used in this book (which means you can spend more time reading and learning than trying to remember what such and such a convention is used for!)

Where code examples are listed these are always displayed within grey rounded rectangles, and may (or may not) contain comments for further context, like so:

```
// Installing the Ionic CLI
sudo npm install -g ionic cordova
```

Important information covered within each chapter is prefixed with the capitalised word important like so:

IMPORTANT - pay attention here

Code that has been previously covered will, where further additions to that example are being shown, be displayed using a placeholder in the following format:

...

Code may sometimes run onto a second line with a hyphen inserted into the code to show that the first line is connected with the second line. Such hyphens do NOT form part of the code.

Summaries are provided at the end of most chapters to help quickly consolidate key concepts and topics covered.

Resources for further learning are also listed as hyperlinks, if and where necessary, throughout each chapter to help the reader build upon what they learn at each stage of this book.

Support

To accompany this e-book I've developed a website: http://masteringionic2.com which contains the following resources:

- Articles covering aspects of developing with Ionic 2
- Video screencast tutorials
- Lists any book errors that have been found
- Contains downloads for code covered in this e-book (you WILL need these!)
- Support forms where you can contact me directly
- Links to further e-books and products

Please feel free to drop me a line and get in touch; whether it's potential issues with the e-book, sharing your thoughts, suggestions for content or just to say hello, I'd love to hear from you!

Links to the project code samples for this book are listed on page 636.

Technical Terms

Before we complete our introduction there are some programming related terms that will be popping up throughout the book that, to avoid any confusion, should best be explained here.

If you're already familiar with these terms, and I imagine most of you reading this book will be, then press on to the next chapter! If not, please take a moment to read through the following terms and their definitions:

Bootstrapping

A term used in programming to describe the first piece of code that runs when an application starts and is responsible for loading the remainder of the application code

Class based language

A style of object-oriented programming where objects are generated through the use of classes

CLI
Short for Command Line Interface which is a means of interacting with a program through inputting text commands on the screen

DOM
Short for Document Object Model - a cross platform API that implements a tree-like structure to represent HTML, XHTML and XML documents

ECMAScript
The language standard that governs the core features of JavaScript (which is a superset of ECMAScript)

ES6
Short for ECMAScript 6 (also known as ECMAScript 2015) which is the next version of the JavaScript language that introduces class based object oriented programming features to the language

Hybrid Apps
These are applications developed using web based languages such as HTML, CSS and JavaScript and then published within a native wrapper so they are able to run on different mobile platforms such as iOS & Android

JSON
Short for JavaScript Object Notation - a language independent data format based on a subset of JavaScript

Keychain Access
An Apple software utility that lists all the passwords, private/public keys and digital certificates that you have previously generated and stored

Native Apps
Applications that have been developed to be used only on a specific platform or device and are often able to interact with the operating system/software of that specific platform

Node
An open-source, cross platform JavaScript environment for developing server-side web applications

Object-oriented programming
An approach to programming organised around the concept of objects

OS
Short for operating System

Package Manager
A tool, or collection of tools, for managing the installation, configuration, upgrading, removal and, in some cases, browsing of software modules on a user’s computer

Prototype based language
A style of object-oriented programming that, instead of using classes, relies on the cloning of objects, with each generated object inheriting behaviour from their parent

Superset
A programming language that contains all of the features of its parent or associated language but implements additional features not found within the parent language

Version control
Both software tools for and an approach to the management of changes to files and applications over time

Virtual machine
A software representation of a physical computer running an operating system and applications on the same device as the native operating system. For example, a virtual machine can allow a host OS such as Mac OS X to run a Windows OS or Linux OS on the same computer

Xcode
An integrated development environment developed and maintained by Apple that is used to create, test, compile and publish Mac OS X & iOS applications

The last decade

It’s been an interesting journey.

As mobile app developers we’ve come a long way since the introduction of the first iPhone at the Macworld Conference & Expo in January 2007, followed by the first commercial release of Android in September 2008.

Following from both of these global interest in smartphones exploded and public adoption quickly followed but there was one major stumbling block for developers...

Unless you used platform specific APIs you couldn’t join the party.

This meant you had to learn, if you weren’t already familiar with, Objective-C (iOS), Java (Android) and C# (Windows Mobile Apps) if you wanted to develop apps for these popular mobile platforms (despite Windows Mobile rating a very distant third compared to iOS & Android).

Unfortunately this issue of platform specific APIs also brought with it the cost, complications and headaches of having to plan, create, debug, publish, maintain and coordinate separate codebases for the same app for each mobile platform being targeted.

Predictably, and understandably, this was not the most attractive proposition for any development team or client looking to manage their time, resources and, ultimately, expenditure.

In 2009 an iPhoneDevCamp event in San Francisco was to provide an opportunity for two developers to start exploring an idea that would change this approach.
Rob Ellis and Brock Whitten began work on a development framework that would allow web developers to create mobile apps through simply packaging HTML5, CSS & JavaScript code that they had written into native containers that could then be published for specific mobile platforms.

This framework would eventually morph into the free, open-source Apache Cordova project - as well as the separate but similar Adobe PhoneGap service.

Now there was no need for a developer to have to learn Objective-C, Java or C# in order to develop mobile apps. They could simply stick with the familiar day-to-day web technologies that they used and package these into native containers instead.

As if this wasn't groundbreaking enough developers could now use one codebase to publish to different platforms with. Opportunities for mobile app development were finally accessible to web developers without the burden of having to learn multiple different languages.

Thanks to this innovation hybrid apps were not only a reality but were now able to be created at a fraction of the cost and time of "traditional" native apps.

Aside from the cost and time benefits of not having to create and maintain a number of separate codebases for the same app, these hybrid app development frameworks also provided developers with one very important tool: a plugin architecture offering a simple but powerful JavaScript API.

This allowed device functionality such as geolocation, capturing images using the camera hardware or accessing address book contacts to be integrated directly through JavaScript - giving hybrid apps a tremendous amount of parity with their native counterparts (although, at the time, there were still some notable differences in performance, particularly with intensive gaming applications).

And the aesthetics/user experience - such as implementing the smooth transition from one screen view to the next or providing a standardised, user friendly UI?

These could now be handled using different front-end development frameworks such as Onson UI, Framework 7, jQuery Mobile, Sencha Touch, Kendo UI or Ionic Framework.

And so it is, within the space of a decade since the release of the first iPhone, that app development has evolved, and continues to evolve, at such a rapid pace with no signs of slowing down any time soon.

As a developer you now have the flexibility and freedom to be able to code for iOS, Android, Windows or all 3 platforms using a set of, mostly free, open-source tools without having to learn a variety of programming languages in the process - something that was impossible to accomplish back in the nascent days of mobile app development.

Ionic 2 is just one of these open-source tools and it’s this particular app development framework that we will focus our attention on over the remaining chapters of this book...

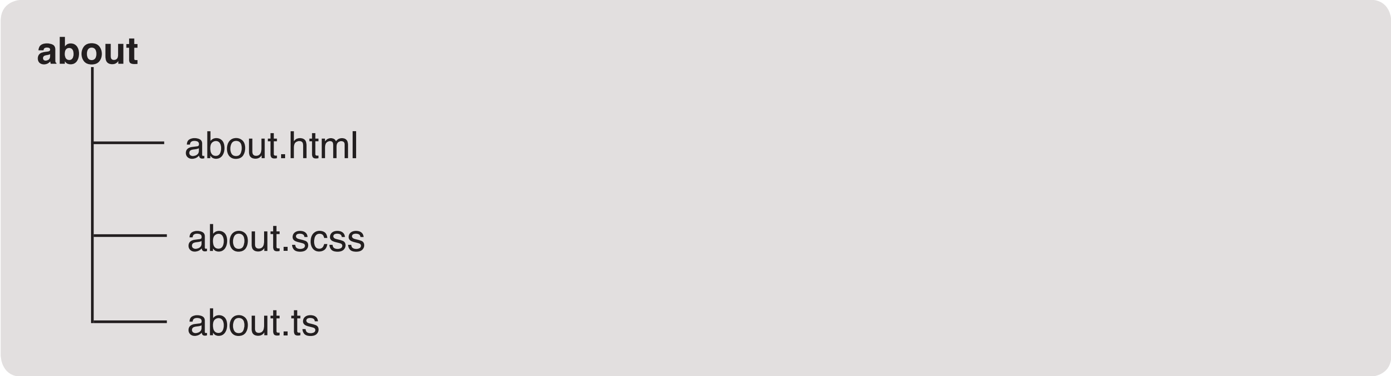
Changes from Ionic 1

Ionic 2 brings with it a whole different way of developing mobile apps compared to version 1 of the framework. Built on top of Angular 2 Ionic can now take advantage of a number of improved and additional features that the previous version of the framework couldn’t (or didn’t) offer which include:

- Web Components
- TypeScript
- Native support for Promises
- Observables
- Improved navigation
- Arrow functions
- Ahead-of-Time compilation
- Improved error handling/reporting

Web Components
A concept inherited from Angular 2 components are self contained packages of HTML, TypeScript and Sass which help form the individual pages for our Ionic apps.

If, for example, we created an about page for an Ionic 2 app all of the logic, markup and styling information for that page would be self-contained within a directory named after the page like so:



TypeScript
TypeScript is a superset of JavaScript - which means it contains all of the features of JavaScript but implements additional features not found within the language - and provides class based object oriented programming and static typing.

We’ll be covering TypeScript in more detail in subsequent chapters, particularly for those developers not familiar with the language, but we’ll quickly examine a sample TypeScript file (which is always identified by the suffix .ts) below:

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';
import {LegalPage} from '../legal/legal';
import {NetworkService} from './providers/network-service/network-service';

/*
  Generated class for the AboutPage page.

  See http://ionicframework.com/docs/v2/components/#navigation for more info
on
  Ionic pages and navigation.
*/
@Component({
  selector: 'page-about',
  templateUrl: 'about.html'
})
export class AboutPage
{
    constructor(public navCtrl: NavController, public navParams: NavParams)
    {


    }

}
```

Even though this is a very basic example there’s quite a few things going on here:

- All modules used in the page are imported using the **import** command (this will include default Ionic/Angular components as well as custom pages, providers, directives and pipes created by the developer)
- The **@Component** decorator provides metadata about the class such as which

view template to use (we’ll cover decorators and templates in later chapters)
- A class named **AboutPage** contains the necessary logic for our page and this is able to be imported as a module into other pages of the app through use of the **export** declaration
- The constructor for our class uses dependency injection to allow access to the modules we imported (**NavController** and **NavParams**)
- Use of types within our constructor parameters to allow the injected modules to be accessed by reference (I.e. **navCtrl** for the **NavController** module and **navParams** for the **NavParams** module)
- Use of access modifiers (I.e. **public** or **private** keywords) which declares the “availability” of the references to the injected modules in our class constructor

Promises

Promises are essentially an agreement for how asynchronous operations, such as managing ajax calls or retrieving records from an SQLite database, will handle data that is expected but hasn’t been returned to the application yet.

Traditionally JavaScript developers would have used callbacks to handle these but Promises provide a much more efficient way of handling the success or failure of such an operation.

The following example demonstrates how a Promise can be created using the **new Promise()** constructor along with the use of the resolve and reject functions:

```
var promise = new Promise(function(resolve, reject)
{
  // Perform a task here, probably asynchronous

  if (/* task was successful */)
  {
    resolve("Everything worked");
  }
  else
  {
    reject(Error("Big time fail!"));
  }
});
```

Results from the Promise can then be accessed like so:

```
promise.then(() =>
{
  // Handle the result here
})
.catch(() =>
{
  // Handle error situation here
});
```

The **then()** method returns the results of the Promise object which can then be handled and manipulated by the script as required.

If the Promise is rejected this is able to be handled using the **catch()** method.

Mozilla Developer Network - the Promise object
Promise then method
Promise catch method
Promise resolve method
Promise reject method

Observables
Introduced with Angular 2 Observables, similar to Promises, are also used to handle asynchronous operations but, unlike Promises, provide the following advantages:

- Allows for the detection of real-time changes
- Can handle multiple values over time
- Supports array operators such as filter, map and reduce

- Are able to be cancelled

This would make features like live updates, such as those found in a Twitter feed for example, a perfect case use for Observables.

So what might an Observable look like?

```
nameOfService.load().subscribe(
  data =>
  {
    console.dir(data);
  },
  error =>
  {
    console.log(error);
  });
```

Doesn’t look all that different from how a Promise handles returned data does it?

The important difference though is the use of the **subscribe()** method which allows for events to be “listened” to and the detection of changes in real-time.

Ionic 2 implements Observables through Angular 2’s use of the Reactive Extensions for JavaScript library, otherwise known as RxJS.

We’ll be looking at Observables in action in subsequent chapters.

Reactive Extensions library
Introducing the Observable
RxJS and Observables

Improved navigation

In Ionic 1 you might have relied on the underlying Angular **stateProvider** or similar for implementing navigation logic within your app, like so:

```
.config(function($stateProvider, $urlRouterProvider)
{
   $stateProvider

      .state('index',
      {
         url                          :   '/',
         templateUrl                  :   'assets/templates/home.html',
         controller                   :   'HomeController'
      });

     $urlRouterProvider.otherwise("/");
});
```

Ionic 2, in contrast, streamlines navigation making it even easier by using the **NavController** and **NavParams** components to simply pass and receive data between pages of the app.

This allows for navigation to be controlled on a page by page basis directly from within the TypeScript file for each specific page.

We'll be looking at navigation in more detail in a subsequent chapter but for now an example of what this might look is as follows (key aspects highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';
import {AccessoryDetailPage} from '../accessory-detail/accessory-detail';

@Component({
  selector: 'page-accessories',
  templateUrl: 'accessories.html'
})
export class AccessoriesPage
{
  constructor(
        public navCtrl: NavController)
  {

  }

  viewAccessory(accessory)
  {
     this.navCtrl.push(AccessoryDetailPage, accessory);
  }


}
```

How the above TypeScript file implements navigation is as follows:

- Imports the **NavController** component (for setting navigation items)
- Imports the page that we want to navigate to (AccessoryDetailPage)
- In the class constructor we inject our imported component as a dependency to be used by our script - assigning that to a public property named **navCtrl**
- A function called **viewAccessory**, which can be called via a click event in the page template, is used to implement the actual page navigation
- This function, using the **navCtrl** property as a reference, implements the push method of the **NavController** component to state which page to navigate to and what parameters will be passed to this page

And the page that we want to receive the passed in data to?

That script might look something like this (key aspects highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController, NavParams } from 'ionic-angular';

@Component({
  selector: 'page-accessory-detail',
  templateUrl: 'accessory-detail.html'
})
export class AccessoryDetailPage
{
  constructor(
         public navCtrl: NavController,
         public navParams: NavParams)
  {
    console.dir(navParams.data);
  }

}
```

So what our above TypeScript file does is:

- Import the **NavParams** component (for managing received navigation data that was set in our previous TypeScript file by the **NavController** component)
- In the class constructor we inject our imported components as dependencies to be used by our script making reference to the **NavParams** component through the **navParams** property
- Render the passed data from the **navParams** property to the browser console

Compared to the Ionic 1 way of implementing navigation this is actually a much more streamlined and vastly simplified way of navigating between pages.

NavController
NavParams

Arrow functions

TypeScript (as well as the latest version of JavaScript, which is guided by the ECMAScript 6, or ES6 for short, language specification) supports a feature known as Arrow Functions (often referred to as fat arrow syntax):

```
() =>
{
  // logic executed inside here
}
```

Arrow functions may look a little odd at first but they are, essentially, a simplified way of writing function expressions.

We'll be making use of these throughout the code samples displayed over following chapters so don't worry if they feel a little "uncomfortable" at first.

ES6 Arrow functions

Ahead-of-Time compilation

The underlying Angular 2 framework compiles apps using one of two approaches:

- **Just-in-Time (JiT)** - Executed at runtime (in the browser)
- **Ahead-of-Time (AoT)** - Executed once at build time

Ionic 2 implements AoT to pre-compile templates during the build process instead of during the browser runtime or on the fly. Doing so helps to catch TypeScript errors as well as increase overall performance through decreasing app boot-up times and optimising the code to run faster.

Ahead-of-Time compilation
Ionic 2 AoT
Angular 2 Ahead-of-Time compilation

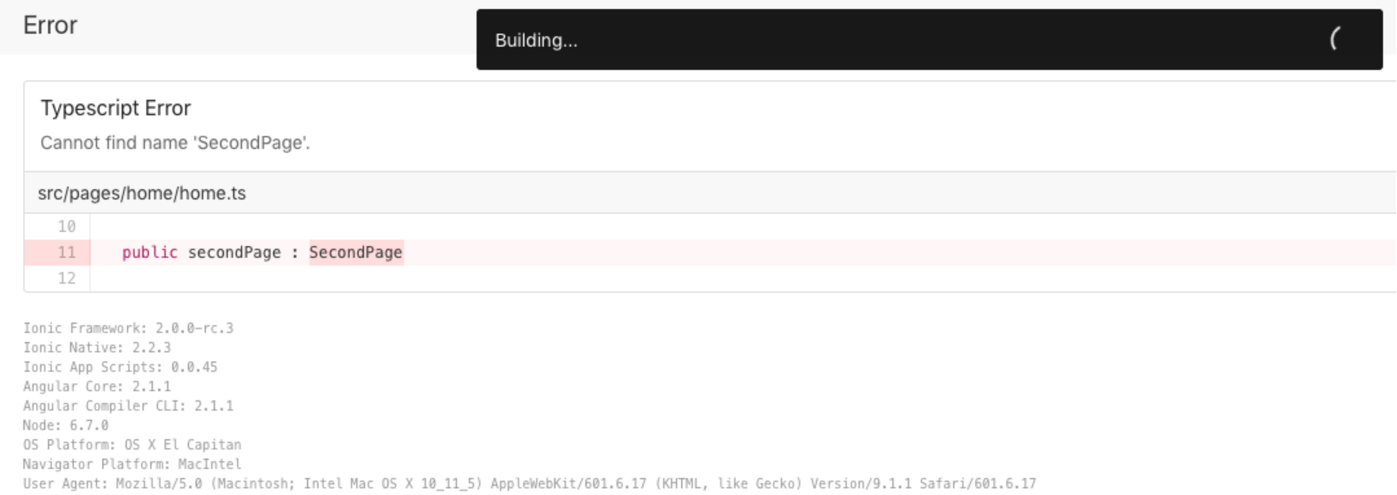
Improved error handling/reporting

Ever encountered the dreaded "white screen of death" during development?

If so, you'll be all too familiar with how much time can be lost trying to figure out what is causing your app to break.

The team at Ionic have been hard at work building tools and features into the latest version of the software to make this experience a thing of the past.

When build processes fail with the new App Scripts library detailed information about the failure is printed to the screen allowing the developer to diagnose with greater precision the cause of the problem:



Error

Building...

Typescript Error

Cannot find name 'SecondPage'.

src/pages/home/home.ts

```
  public secondPage : SecondPage
```

```
Ionic Framework: 2.0.0-rc.3
Ionic Native: 2.2.3
Ionic App Scripts: 0.0.45
Angular Core: 2.1.1
Angular Compiler CLI: 2.1.1
Node: 6.7.0
OS Platform: OS X El Capitan
Navigator Platform: MacIntel
User Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_11_5) AppleWebKit/601.6.17 (KHTML, like Gecko) Version/9.1.1 Safari/601.6.17
```

As you might appreciate this is a hugely useful feature - being able to track the causes of build failure with greater accuracy has the knock-on effect of reducing time on app development and debugging.

Always good where deadlines and budgets are concerned!

We've only really scratched the surface with this overview of the changes and new features in Ionic 2 but I'm sure you get a feel for how useful they will be as part of your app development toolkit.

Over subsequent chapters we'll explore these in more detail but for now let's take a look at the underlying core technologies used in Ionic 2...

Core tools
& technologies

Ionic 2 is built on and uses the following tools & languages:

- Apache Cordova
- Angular 2
- Sass
- TypeScript

If we take a little time to understand each of these tools then we'll have a much clearer picture of why Ionic is one of the most popular app development tools on the market right now.

Apache Cordova

Apache Cordova is a free, open-source mobile development framework that:

- Allows standard web development technologies (HTML5, CSS3 and JavaScript) to be used for cross platform development
- Packages apps in native wrappers targeted at different platforms
- Supports a variety of platforms including - iOS, Android, Blackberry 10, Window Phone 8, Windows, OSX and Ubuntu
- Allows apps to access device level API's such as geolocation, media capture, network and accelerometer through an easy to implement plug-in architecture

The simple fact that you can target different platforms with the same codebase, instead of having to write for each platform separately, is incredibly powerful and drastically cuts down on both development time and costs.

As Ionic 2 is built directly on top of Apache Cordova this means that you can directly benefit from the tools and features of that architecture when developing your mobile apps.

To learn more about Apache Cordova visit the following resources:

- Apache Cordova
- Apache Cordova Internals

Angular 2

Angular 2 is an MVVM (Model-View View-Model) front-end development framework, created by Google, that provides developers with the following key features and functionality:

- Separation of template manipulation from application logic
- Extends the HTML language through directives to make page templates more dynamic and customisable
- Supports dependency injection
- Implements data binding to avoid DOM manipulation
- Provides routing and deep linking for SPA's (Single Page Applications) to improve SEO and Usability
- Implements Providers (external scripts which can be injected as dependencies)
- Well documented development API

Angular 2 is a significant overhaul of the framework, representing a departure from the way in which developers would have worked in Angular 1, focussing on, amongst other changes and improvements, the following:

- Built around Web Components for improved modularity
- Implements Promises and Observables for handling asynchronous operations
- Use of TypeScript or JavaScript for creating applications
- Improved form handling (better validation options)
- Improved performance

As the Ionic 2 architecture makes heavy use of Angular 2 - particularly with components - we will, over the course of following chapters, be familiarising ourselves with some of the tools and syntax of this particular front-end development framework when developing our apps.

Some good online resources to learn more about Angular 2 are listed below:

- Angular IO
- Angular 2 Github repository
- Learning Angular 2

TypeScript

We touched on TypeScript in the last chapter describing how it’s a superset of the JavaScript language - which means it contains all of the features of JavaScript but offers additional features not found within the language such as:

- Static typing
- Class based object oriented programming

For the beginning JavaScript developer who might not be familiar with higher level programming concepts such as classes and static typing the benefits of TypeScript might not be immediately obvious.

To explain this we first have to realise that part of JavaScript’s strength (as well as its appeal and popularity) has always been its flexibility.

For example, if we wanted to define/create an object in JavaScript we could choose any of the following approaches:

#1 - Use an Object constructor

```
var myObj              =  new Object();
myObj.property1        =  "Value 1";
myObj.property2        =  "Value 2";
console.log("Value is: " + a.property1);
```

#2 - Use an object literal

```
var myObj  = {
   property1 :  "Value 1",
   property2 :  "Value 2"
};
console.log("Value is: " + myObj.property1);
```

#3 - Use a factory function

```
function myObj()
{
  return {
    property1: "Value 1",
    property2: "Value 2"
  };
}

var o = myObj();
console.log("Value is: " + o.property1);
```

#4 - Use prototypes

```
function myObj()
{
  this.property1                    =  "Value 1",
  this.property2                    =  "Value 2"
}

myObj.prototype.getProperty1        =  function()
{
    console.log("Value is: " + this.property1);
}

var o                               =  new myObj();
o.getProperty1();
```

#5 - Use Self-invoking function expressions

```
var OBJ = (function()
{

  var _privateMethodOne  =  function()
  {
     _privateMethodTwo();
  },

  _privateMethodTwo      =  function()
  {
     console.log('Hello!');
  };

  return {
    publicMethodOne      :  _privateMethodOne
  }

})();

OBJ.publicMethodOne();
```

Now that's a lot of different ways to accomplish the same result!

This flexibility though is also part of JavaScript's weakness as there was, until very recently, no one standardised way to create objects - until ECMAScript 6 that is (the latest language specification that helps guide the evolution of JavaScript).

This might not sound like a bad thing but it can, and often does, create problems for the following reasons:

- When you have to work on another developer's code (especially if you are having to familiarise yourself with different ways of generating objects)

- If you’re learning JavaScript as a beginner (particularly if you come from a class based object oriented programming language)
- Managing the scalability of the codebase over large projects
- Understanding the potential quirks and bugs that can come with different ways of object generation in JavaScript
- All object members are public (only revealing module/prototype pattern provides emulation of private members in pre-ES6 JavaScript)
- Performance variations between different ways of generating objects

Additionally as JavaScript variables are mutable - which means that variables can change data types (I.e. from string to number) - this can clearly present problems in development as it’s easy to introduce bugs into scripts without necessarily being aware of what has been happening.

The following is, admittedly, a somewhat silly example but it illustrates the point:

```
var prop = 2;
console.log(typeof prop);
// number

prop = "Man"; // We now assign a different value to the variable
console.log(typeof prop);
// string
```

These were precisely the type of problems that TypeScript was designed to help overcome by providing developers with a much stricter language syntax that uses class based object oriented programming principles over a looser, more flexible approach that long-term JavaScript developers are familiar with (although ES6, the latest specification for the language, provides many of the features of TypeScript).

Some of the useful features that TypeScript introduces are as follows:

- Modules
- Data types
- Classes

- Access modifiers
- Multiline Strings/String interpolation

Modules
A module is simply a container for organising and grouping your code that is then able to be exported and imported for use into another script like so:

#1 - Import modules

```
import {Page, NavController, NavParams} from 'ionic-angular';
```

#2 - Export modules

```
export class AboutPage { // class properties & methods contained in here }
```

Data types
Until ES6 JavaScript didn't provide the ability for developers to specify the data type for their variables so they would simply have been declared like so:

```
var firstName,
    lastName,
    age;
```

With TypeScript we can explicitly declare the data types for each variable - these are known as type annotations - which help us to ensure strict data/logic integrity in our coding.

If, for example, we were to assign a numeric value to a variable with a string data type the TypeScript compiler would throw an error and our scripts would not work.

As you might already have gathered this makes type annotations pretty useful for avoiding logic errors.

If we were to now use type annotations our previous example would look like this:

```
var firstName : string,
     lastName : string,
     age : number;
```

By default the following type annotations are supported in TypeScript:

- string (for text data types)
- number (for numeric data types)
- boolean (for true/false data types)
- any (catch all data type)
- void (used with a method where no return type is required)

There are additional types available for use within TypeScript such as the Union, Intersection and Tuple types but these are generally used in more advanced case scenarios.

TypeScript annotations

Classes

Classes are used in object-oriented programming as a kind of blueprint to generate objects from.

Classes allow scripts to be structured and organised by purpose (I.e. a class for defining a person, another class for defining their activities etc.) and contain properties and methods relevant to the purpose of that class (I.e. a property of name for a person class and a method of walk for an activity class).

Classes in TypeScript are simply defined as follows:

```
class nameOfClassHere {
  // Properties and methods for the class within here
}
```

Access modifiers

Access modifiers control access to a class member, such as a property or method, which is a highly technical way of stating whether or not that member can be used solely within that class or outside of that class too.

TypeScript provides 3 access modifiers:

- Public (can be accessed by all scripts)
- Private (can only be used within the class where the member is defined)
- Protected (can be accessed by a sub-class)

By default each member in TypeScript is public.

The following examples show how we might use each of the above access modifiers in TypeScript:

#1 - public

```
class Human {
   public gender: string;
   public constructor(genderType: string)
   {
     this.gender = genderType;
   }

   public sleep(durationOfSleep: number) {
      console.log(`${this.gender} slept ${durationOfSleep} hours.`);
   }

}
```

#2 - private

```
class Human {
   private gender: string;
   constructor(genderType: string)
   {
      this.gender = genderType;
   }
}

new Human("Male").gender; // Error - ‘gender’ is private
```

#3 - protected

```
class Human {
   protected gender: string;
   protected name: string;
   constructor(theirName : string, genderType: string)
   {
     this.gender = genderType;
     this.name = theirName;
   }
}

class Activity extends Human {
   private sleeping: number;

   constructor(genderType: string, hoursSlept: number)
   {
      super(name);
      this.sleeping = hoursSlept;
   }

   public sleepDuration() {
      return `${this.name} slept for ${this.sleeping} hours.`;
   }
}
```

```
let activity = new Activity("Gabriel", 6);
console.log(activity.sleepDuration());
console.log(activity.name); // error
```

The above syntax is very similar to that used within languages such as Java or PHP and provides a more consistent, uniform way in which to implement object-oriented programming for front-end development (instead of the numerous different ways with which we could have created objects in pre-ES6 JavaScript).

Not all developers agree that using TypeScript or ES6 is the right way to go.

They point to JavaScript being a prototype based language, not a class based language, and that introducing such enhancements actually limit the flexibility, power, expressiveness and appeal of JavaScript.

I personally don’t think it’s a bad thing, even though I fully understand and respect the arguments presented, as any tools or language enhancements that can improve the way in which we as developers work has to have its merits.

Multiline Strings/String Interpolation

Ironically this might be one of the most under-appreciated, yet incredibly useful, features of TypeScript.

In JavaScript, if you needed a newline within a string value, you’d usually escape the string with the backslash character followed by a space and then the \n newline character as shown in the following example:

```
var sentence = "To be or not to be \
\nThat is the question";
```

In TypeScript we can simply use a template string instead:

```
var sentence = `To be or not to be
That is the question`;
```

Notice the use of the backtick character to start and end the string in addition to the absence of the backslash and newline characters?

Much simpler.

Similarly a template string also allows us to mix string values and variables together using templating logic and interpolation so instead of resorting to something like this (as we would have done in the ‘old days’ of JavaScript):

```
var sentence = 'To be or not to be',
    elem     = '<div>' + sentence + '</div>';
```

TypeScript instead allows us to do this:

```
var sentence = 'To be or not to be',
    elem     = `<div>${sentence}</div>`;
```

The backtick characters are used to create the template string while the interpolation (the **${ }** construct) allows the value contained within it to be treated and evaluated as a JavaScript expression.

This is so simple yet so powerful as it makes situations where we need to write strings that require variables to be contained within them so much quicker and easier to accomplish.

Before we forget.....transpiling

One last, and very important, point concerning TypeScript.

TypeScript has to be converted, or - in its technical term - transpiled, into a format that browsers can understand (which at this moment in time is ECMAScript 5).

This means that you will code your Ionic 2 app in TypeScript but your published script will be converted into JavaScript instead.

We will be exploring TypeScript in greater detail in following chapters but you can learn more about the language through the following resources:

- Official TypeScript language website
- TypeScript blog

Sass

Syntactically awesome style sheets (or simply Sass) is a popular CSS pre-processor (a software tool that converts the input data into a format that is able to be read by a web browser - in this case CSS) that allows developers to:

- Use variables, functions and similar programmatic objects to create CSS
- Nest CSS rules for more logical grouping and organisation
- Create reusable scripts to generate specific CSS rules (Mixins and functions)
- Import CSS rules from other Sass files
- Publish their Sass files into CSS

Sass makes writing and organising CSS rules so much more manageable and, dare I say, interesting? This is great for both the individual developer and also for teams as it makes style editing less prone to overwrite conflicts when multiple developers are working on a project's CSS rules.

Ionic 2 uses Sass to set default styles for theming apps which are able to be easily customised and we'll look at how to theme our app in a later chapter.

To learn more about Sass feel free to visit the following resources:

- Sass language
- The Sass Way

Summary

- Ionic 2 makes use of the following core technologies: Apache Cordova, Angular 2, TypeScript & Sass
- Angular 2 is built around the concept of Web Components (essentially these are self-packaged modules of HTML, JavaScript & CSS)
- TypeScript is a programming language that provides static typing and class based object oriented programming features that JavaScript lacks (or rather - did lack prior to ES6)
- Sass is a CSS pre-processor that allows developers to structure their CSS in a more modular fashion and adds functionality such as loops, variables & functions to help create style rules

Now that we’ve looked into the core tools & technologies used within Ionic 2 let’s take a look at the different products & services that form the Ionic ecosystem and see how Ionic 2 fits into this...

The Ionic ecosystem

Originally conceived back in 2012 by Ben Sperry, Adam Bradley and Max Lynch the Ionic framework is actually one tool in a broader, interconnected ecosystem that consists of the following core products and services:

- Ionic Lab (deprecated)
- Ionic View
- Ionic Creator
- Ionic Market
- Ionic Cloud
- Ionic Framework
- Ionic Framework Enterprise
- Ionic Native
- Ion Icons

Each of these offer additional benefits and incentives to developing with the Ionic framework so it's important that we have, at the very least, an understanding of what they are designed to do, how this can help us as app developers and how each one fits into and complements the broader ecosystem of product and services that are available to us.

Ionic Lab

NOTE: Product is considered deprecated as of late December 2016 and the team at Ionic have stated that Ionic Lab will no longer be available for download after this time.

Lab is a free desktop app for Mac, Linux and Windows platforms that provides developers with a software GUI through which to create apps, install platforms & plugins, preview, test, build and deploy their apps to simulators/handheld devices and also share with other team members if required.

Available for the following platforms:

- Mac OS X 10.9 or later
- Windows 7, 8 & 10

- Linux X86/X64

Lab is able to be downloaded here: http://lab.ionic.io

Ionic View

Ionic View is an iOS/Android app that allows developers to load, test and view the apps that they are currently developing in addition to being able to share those with other interested parties such as fellow developers or clients.

Further information here: http://view.ionic.io

Ionic Creator

Creator is an iOS/Android app prototyping tool that provides a selection of pre-made mobile components that can be dragged and dropped to create mock-ups which can then be previewed and shared with colleagues and clients and even exported as an Ionic project or even native IPA and APK files for device installation.

Further information here: http://ionic.io/products/creator

Ionic Market

An online marketplace for developers to access community made resources for their Ionic app development; from pre-built starter apps to plugin and themes.

Further information here: http://market.ionic.io

Ionic Cloud

Scalable cross platform app development from the Cloud offering a variety of backend services including push notification, user authentication, app version rollback, deployment of UI and code updates to published apps and app binary deployment.

Further information here: http://ionic.io/cloud

Ionic Framework

A free, open source mobile SDK built on top of Apache Cordova, Angular 2 & Sass which offers a library of pre-built HTML and CSS (and sometimes JavaScript) components as well as a command line interface for the rapid development of native and progressive web apps.

The SDK supports the following platforms:

- iOS 7+
- Android 4.1+
- Windows Phone 8
- Windows 10 Universal Apps (as of version 2 of the SDK)

Further information here: http://ionicframework.com

Ionic Framework Enterprise

Provides all the features of the free Ionic Framework SDK with additional enterprise level features including support SLA, code support and access to fixes for the Ionic framework that don't have publicly available solutions.

Further information here: https://ionic.io/enterprise

Ionic Native

A repository of ES5/ES6 & TypeScript wrappers for Cordova & PhoneGap plugins that allow developers to implement native functionality within their apps - such as detecting network connection capabilities, accessing geolocation features etc.

Further information here: http://ionicframework.com/docs/v2/native/

Ion Icons
Free, open source font icons for use with the Ionic framework.

Further information here: http://ionicons.com

The main driver behind all of these products and services however is the Ionic framework itself and it's this particular aspect of the Ionic ecosystem that we shall work with throughout the entire book (although we will explore and use some of the aforementioned products and services along the way).

Let's begin by familiarising ourselves with configuring our development environment, installing version 2 of the SDK and creating a very basic app.

Configuring your environment

Getting started with the Ionic framework requires that you install and configure the following software on your system - if you haven't already (this does presume you are using an Apple Mac computer, as stated in the introduction):

- Apache Cordova (version 5+)
- Node JS (version 5+)
- NPM (Node Package Manager - version 3+)
- Xcode (for iOS app development)
- Android SDK (for Android development)

You will find that there are additional dependencies required while installing some of the above applications and you may even need to update core system software too (such as the version of the JDK you might have currently installed).

The following documentation should be helpful in ensuring that you have all the necessary software & related dependencies installed and configured correctly for your system:

- https://cordova.apache.org/docs/en/latest/guide/platforms/ios/index.html
- https://cordova.apache.org/docs/en/latest/guide/platforms/android/index.html
- https://developer.android.com/studio/intro/update.html

As you work through the installation process you'll also need to set the paths for certain software. This is typically performed, on unix based systems, using a file called **.bash_profile** which is usually located at the root of your user directory.

The **.bash_profile** is specific to each user on your system and is used to set and configure environment variables, software paths and preferences for the command line interface you'll be using (normally the Terminal application if you're on Mac OS X).

More information on the **.bash_profile** file, along with example configurations, can be found here: https://natelandau.com/my-mac-osx-bash_profile/.

Windows users

Unfortunately Xcode is available for Mac OS X only but if you're developing on Windows and want to create iOS apps it's not all bad news - you do have a number of alternative options available to you which we'll explore below:

1. VirtualBox

This free application from Oracle allows you to set up virtual machines through which you can install and run multiple operating systems - whether those be former versions of the host OS or those from different vendors is entirely up to the developer. Unfortunately it appears that you would have to install downloadable pirated versions of Mac OS X (which is not something I would condone or recommend) in order for this method to work.

Virtual Box can be downloaded here: http://virtualbox.org

2. Visual Studio 2015

Microsoft's Visual Studio 2015 provides a range of cross platform development tools specifically for developers looking to create, amongst others, iOS apps.

Visual Studio 2015 can be downloaded here: https://www.visualstudio.com/en-us/features/mobile-app-development-vs.aspx

3. Ionic Cloud

Alternatively you could opt to use the Ionic Platform, take advantage of the cloud based services on offer and develop cross platform apps through this suite of online tools instead.

Further information here: http://ionic.io/cloud

Linux Users

Like Windows users those using Linux and looking to develop iOS apps will have to explore using alternatives such as:

1. Buddy Build

Buddy Build provides a continuous integration and delivery service that allows developers to push code to Git based source control repositories which the service will then use to create a build environment, securely compile the app, run unit tests and prepare the app for the Apple App Store.

More information here: https://buddybuild.com

2. Mac In Cloud
A cloud based service that allows a user to rent a remote Mac computer which can be accessed from the user’s mobile device or desktop browser.

More information here: http://www.macincloud.com

3. Ionic Cloud
Using Ionic’s cloud service and suite of available tools cross platform apps can be developed, deployed, packaged and submitted here instead.

Further information here: http://ionic.io/cloud

Okay, at this point I assume you’ve installed the dependencies listed at the start of this chapter? If you haven’t then do so now and come back to this page once all has been successfully installed.

If you have then let’s start installing Ionic 2!

Installing the Ionic SDK

On your Mac open up a Terminal shell (the Terminal software application is available at the following location: *Applications/Utilities/Terminal* - I would recommend adding the Terminal to your Mac OS X dock, if you haven’t already done so, for faster access in the future) and type out the following command:

```
sudo npm install -g ionic cordova
```

You will be prompted for your system password, once you've entered this and hit the enter key sit back and wait for the software to be installed (which should only take a couple of minutes or less depending on the speed of your internet connection).

If you're curious here's what each part of the above command breaks down to:

- The **sudo** command grants temporary root like privileges to install the software to the system (and helps to avoid any permission denied errors)
- **npm** is the node package manager tool which identifies the software package to be installed from the last part(s) of our command
- **-g** is a flag to inform the node package manager that we want this to be globally available to our system
- **ionic** indicates that this is the ionic framework that we want installed
- **cordova** indicates this is the apache cordova framework that we want installed

Windows users

As the sudo command is only specific to unix based systems you can simply type the following instead in the Command Prompt:

```
npm install -g ionic cordova
```

To test that your installation has been successful type the following command in the Terminal/Command Prompt:

```
ionic -v
```

This should return back the version and build number of the Ionic SDK that has just been installed.

A little NPM primer

Before we begin building our first Ionic App it's probably best that we look at the Node Package Manager (NPM) and understand, for those who may not be familiar with NPM, how this relates to Ionic development as we're going to be spending time dipping in and out of using this package manager throughout remaining chapters.

As the name implies NPM is a package manager which allows developers to source self contained modules, or packages, of JavaScript code that have been specifically developed to solve particular tasks (such as generating code documentation from inline comments or optimising images for best compression rates for example) from an official online registry.

This is particularly useful for developers as the NPM registry provides high quality, pre-existing solutions, built to an agreed standard, that can be quickly and easily integrated into projects where required.

No having to invent solutions when they already exist - and, with the NPM registry, the chances are very high that should you require a pre-existing solution for a particular task you'll be able to find it there.

As for sourcing packages this can be done through browsing the registry directly at npmjs.com or via the CLI using the following command:

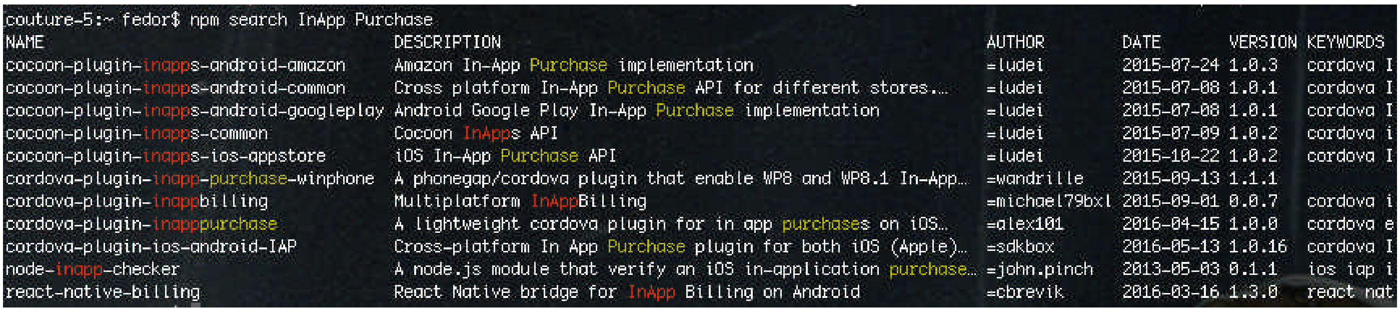
```
npm search <name of package here>
```

Pretty straightforward right?

So, if I wanted to search for available In-App Purchase plugins for example, I could type the following command in my Terminal/Command Prompt:

```
npm search In-App Purchase
```

Which, if any packages can be found that match the provided search term, should return results akin to the following:



```
couture-5:~ fedor$ npm search InApp Purchase
NAME                                    DESCRIPTION                                                   AUTHOR        DATE       VERSION KEYWORDS
cocoon-plugin-inapps-android-amazon     Amazon In-App Purchase implementation                         =ludei        2015-07-24 1.0.3   cordova I
cocoon-plugin-inapps-android-common     Cross platform In-App Purchase API for different stores.…     =ludei        2015-07-08 1.0.1   cordova I
cocoon-plugin-inapps-android-googleplay Android Google Play In-App Purchase implementation            =ludei        2015-07-08 1.0.1   cordova I
cocoon-plugin-inapps-common             Cocoon InApps API                                             =ludei        2015-07-09 1.0.2   cordova i
cocoon-plugin-inapps-ios-appstore       iOS In-App Purchase API                                       =ludei        2015-10-22 1.0.2   cordova I
cordova-plugin-inapp-purchase-winphone  A phonegap/cordova plugin that enable WP8 and WP8.1 In-App… =wandrille    2015-09-13 1.1.1
cordova-plugin-inappbilling             Multiplatform InAppBilling                                    =michael79bxl 2015-09-01 0.0.7   cordova i
cordova-plugin-inapppurchase            A lightweight cordova plugin for in app purchases on iOS…     =alex101      2016-04-15 1.0.0   cordova e
cordova-plugin-ios-android-IAP          Cross-platform In App Purchase plugin for both iOS (Apple)…   =sdkbox       2016-05-13 1.0.16  cordova I
node-inapp-checker                      A node.js module that verify an iOS in-application purchase… =john.pinch   2013-05-03 0.1.1   ios iap i
react-native-billing                    React Native bridge for InApp Billing on Android              =cbrevik      2016-03-16 1.3.0   react nat
```

Packages can then be installed into our Ionic projects directly via the Ionic CLI tool using the following command:

```
ionic plugin add <name of package here>
```

So, if we wanted to install, for example, the cordova-plugin-inapppurchase package from the above search results we would simply run the following in our Terminal/ Command Prompt:

```
ionic plugin add cordova-plugin-inapppurchase
```

If you’re working on a Mac/Linux platform you may need to prefix the above command with sudo (to overcome any permission denied errors):

```
sudo ionic plugin add cordova-plugin-inapppurchase
```

To see all plugins installed in your project simply type out the following (prefix with sudo if you are on a Mac/Linux platform and experience permission denied errors):

```
ionic plugins ls
```

This will print out a list of all installed plugins displaying their NPM package title, version number and name.

Ionic and NPM

Currently the important core Ionic 2 packages available through NPM are:

- Ionic CLI
- Ionic-Angular

The Ionic CLI tool comes with an in-built development server, build & debugging tools and allows developers to create a project, generate components, deploy to simulators and build native apps (more on all of these later on in the book).

This was previously installed with the following command:

```
sudo npm install -g  ionic
```

The Ionic-Angular package is the actual framework of core HTML, CSS and JS components for Ionic that's installed when you create a project through the CLI tool.

We'll start exploring the Ionic CLI in more detail throughout the next chapter.

Resources
Android Studio/SDK Manager: https://developer.android.com/studio/index.html
Apache Cordova: https://cordova.apache.org
Node & NPM: https://nodejs.org/en/

When installing the above software follow the documentation and pay attention to any dependencies that may also be required - particularly when configuring system paths - doing so will pay dividends later on as we work through different code examples while building sample Ionic apps.

Beginning Ionic 2 Development

Using Ionic

Now that we're familiar with the core technologies behind Ionic 2, understand why they're there and we've installed the Ionic CLI, along with all required dependencies, let's begin using the tool by creating a project.

Open up your Terminal, navigate to a directory on your machine where you want this project to be located and then type the following commands:

```
mkdir apps
chmod -R 775 apps
cd apps
ionic start myApp blank --v2
```

For those of you not familiar with the command line what we are doing here is quite simple:

- We create a directory called **apps** (where we want to store all the Ionic apps we'll be creating)
- The permissions of the **apps** directory and its contents are set to be readable, writeable & executable by the owner and only readable/executable by others
- Change into the apps directory
- Run the Ionic CLI tool to create a project called myApp with Ionic 2 (denoted via the use of the --v2 flag) from a blank template

Depending on the speed of your internet connection you should see the progress of your project build being printed to your Terminal window like so:

```
Creating Ionic app in folder /apps/myApp based on blank project

Downloading: https://github.com/driftyco/ionic2-app-base/archive/master.zip
[==============================]  100%  0.0s
Downloading: https://github.com/driftyco/ionic2-starter-blank/archive/master.zip
[==============================]  100%  0.0s
Installing npm packages...
```

```
.... (*MY COMMENT HERE - CLI will print LOTS of scripts and modules that are being installed)

Adding initial native plugins
Initializing cordova project without CLI
I
Adding in iOS application by default
Saving your Ionic app state of platforms and plugins
Saved platform
Saved plugins
Saved package.json

□ □ □ □  Your Ionic app is ready to go! □ □ □ □

Some helpful tips:

Run your app in the browser (great for initial development):
  ionic serve

Run on a device or simulator:
  ionic run ios[android,browser]

Test and share your app on device with Ionic View:
  http://view.ionic.io

Build better Enterprise apps with expert Ionic support:
  http://ionic.io/enterprise

New! Add push notifications, live app updates, and more with Ionic Cloud!
  https://apps.ionic.io/signup

New to Ionic? Get started here: http://ionicframework.com/docs/v2/getting-started
```

From this we have learned that the Ionic CLI has:

- Created a blank project
- Installed NPM packages
- Added initial native plugins (more on these later)
- Added the iOS platform by default (only mobile platform to be installed)
- Provided us with hints about what we might want to do next

Instead of a blank project we could have chosen any of the following instead:

```
// Create a project with the sidemenu template
ionic start myApp sidemenu --v2

//Create a project with the tabs template
ionic start myApp tabs --v2

//Create a project with the tutorial template
ionic start myApp tutorial --v2
```

If you had omitted the project type the Ionic CLI would have defaulted to using tabs for your project.

Before we go any further though we need to understand one very important point about how we set the project up.

We instructed the CLI to build for Ionic 2 (using the **--v2** flag).

If we had omitted this flag when creating our project then we would have ended up with an Ionic 1 codebase that uses JavaScript instead of TypeScript.

I'll be driving this point home throughout the book - if you want to create Ionic 2 apps then you MUST add the **--v2** flag when creating a project from the command line.

Added to this is also remembering to specify the project type (I almost always choose a blank template for my project builds) otherwise you end up with tabs by default.

Now let’s take a look at some of the Ionic CLI commands that you’ll most likely use for development:

```
Note: cd into the root directory of your Ionic 2 app before running the following
commands

// Add Android platform
ionic platform add android

// Remove Android platform
ionic platform rm android

// Remove iOS platform
ionic platform rm ios

// Run your Ionic app in the web browser
ionic serve

// Display Ionic app in the web browser as separate iOS / Android / Windows
// Phone views by adding a lowercase L as a flag
ionic serve -l

// Run your app on a connected iOS device
ionic run ios

// Run your app on a connected Android device
ionic run android

// Prepare & compile your app for iOS
ionic build ios

// Prepare & compile your app for Android
```

```
ionic build Android

// Print details about your system environment
ionic info

// Install plugins
ionic plugin add <name-of-plugin-here>

// Remove installed plugin
ionic plugin remove <name-of-plugin-here>

// List all installed plugins
ionic plugin ls

// Add a page to your Ionic app
ionic g page name-of-page-here

// Add a service to your Ionic app
ionic g provider name-of-service-here

// Add a pipe to your Ionic app
ionic g pipe name-of-pipe-here

// Add a directive to your Ionic app
ionic g directive name-of-directive-here

// We'll explore adding pages, services, directives & pipes in following chapters
// so don't worry if these make no sense to you at the moment!
```

As you can see that's quite a powerful range of commands that we have available for app development and it's not hard to see why the Ionic CLI is the digital Swiss army knife of developing Ionic apps.

Let's use some of these commands to see our app in action.

Making sure you are at the root directory of your newly created app run the following command in the Terminal:

```
ionic serve
```

This will run the built in server for the Ionic CLI and allow us to preview our app in a web browser. As the command is being executed you'll see that the CLI runs the following tasks, prior to serving the app in the browser:

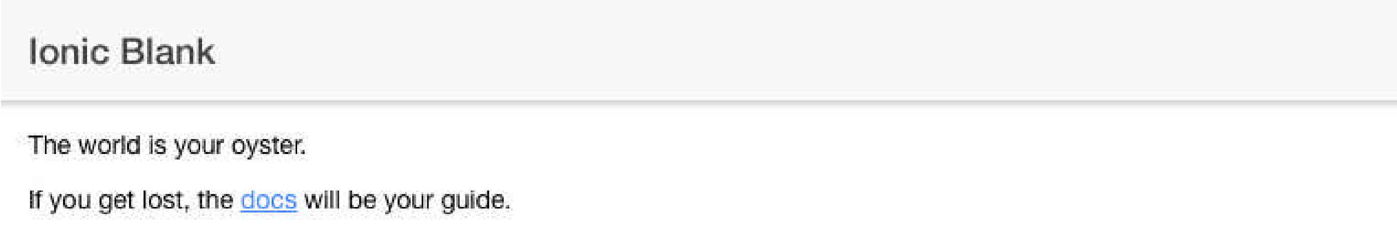
```
> ionic-hello-world@ ionic:serve /apps/myApp
> ionic-app-scripts serve

[20:02:29]  ionic-app-scripts 0.0.45
[20:02:29]  watch started ...
[20:02:29]  build dev started ...
[20:02:29]  clean started ...
[20:02:29]  clean finished in 2 ms
[20:02:29]  copy started ...
[20:02:29]  transpile started ...
[20:02:34]  transpile finished in 4.93 s
[20:02:34]  webpack started ...
[20:02:35]  copy finished in 5.48 s
[20:02:46]  webpack finished in 11.27 s
[20:02:46]  sass started ...
[20:02:48]  sass finished in 2.99 s
[20:02:49]  build dev finished in 19.22 s
[20:02:49]  watch ready in 19.37 s
[20:02:49]  dev server running: http://localhost:8100/
```

The tasks that are run by this command consist of:

- Cleaning the contents of the **www** directory
- Linting TypeScript files for the app then transpiling and concatenating those into a single JavaScript file
- Compiling Sass to CSS and concatenating all of the app stylesheets into a single CSS file

- Copying the newly generated JavaScript and CSS files to the re-created **www/build** directory
- Copying custom assets, such as images, from the **src/assets** directory to the **www/assets** directory
- Listening for changes to the Sass/TypeScript/HTML files used within the app, re-running these tasks and reloading the app within the browser to display these changes

And here's what our initial Ionic 2 app looks like when previewed in the browser:


Ionic Blank

The world is your oyster.

If you get lost, the docs will be your guide.

Congratulations, you've just run your first Ionic 2 app!

Granted there's not much to see and it's certainly not going to win any design awards but, incredibly, we can go one step further with our browser output.

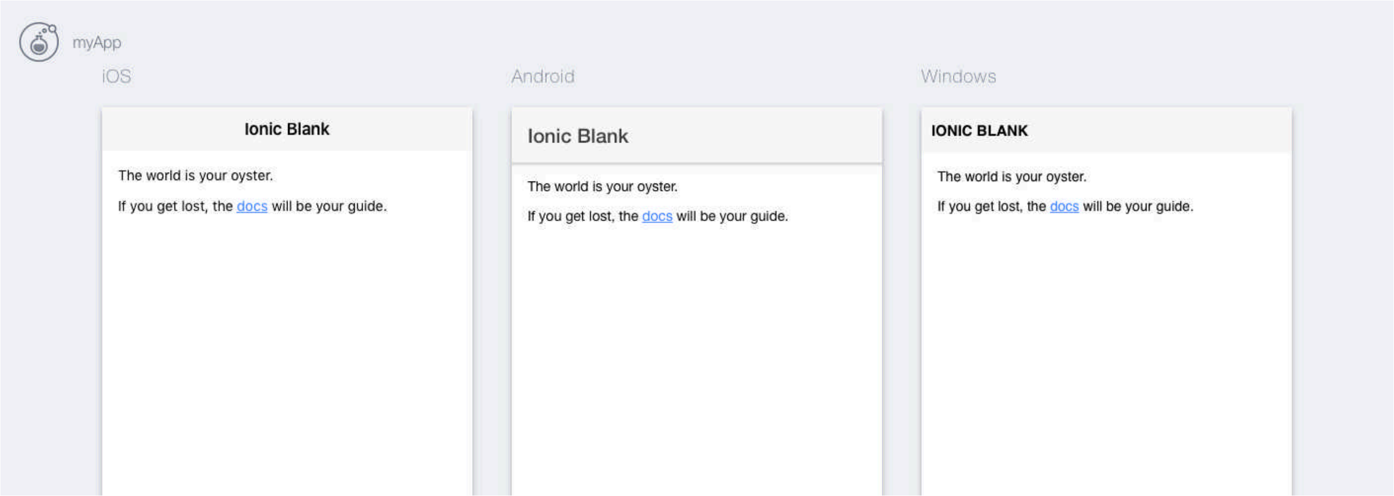
Using Ionic serve, in and of itself, is pretty useful but there's one great additional feature - we can actually preview our app is if it were running on the following 3 platforms simultaneously:

- iOS
- Android
- Windows Phone

And we accomplish this using the following (slightly modified) command:

```
// Add the letter L (in lowercase) as a flag after the ionic serve command
ionic serve -l
```

Which, once the command has successfully completed, will render the following output to the browser window:



The world is your oyster.

If you get lost, the docs will be your guide.

That’s pretty incredible isn’t it?

You can see, from the above screen capture, the subtle changes in typography and styling between the different platform views.

These are implemented through the following platform specific Sass files found in the **node_modules/ionic-angular/themes** directory:

- ionic.globals.ios.scss
- ionic.globals.md.scss
- ionic.globals.wp.scss

Platform styles are also imported for use in each Ionic UI component through the following Sass file:

- node_modules/ionic-angular/themes/ionic.components.scss

And this is how Ionic 2 manages the separation and customisation of the app styling on a platform by platform basis.

We’re going to look into theming our Ionic 2 app a little later on in the chapter titled *Theming your Ionic 2 Apps.*

IMPORTANT - when attempting to run CLI instructions on Unix based systems such as Mac OS X you might find yourself running into permission denied errors.

If this should happen re-run the failed command with the sudo prefix such as:

```
sudo npm install -g  ionic
```

You will be prompted for your account password and, once entered, this should be enough to overcome any permission denied errors.

Bear this in mind for future command line work!

That concludes everything we need to cover in this chapter so now lets spend time familiarising ourselves with the structure of the Ionic 2 app we created earlier...

The architecture of an Ionic 2 app

If we navigate to the root directory of the Ionic app that we created in the previous chapter we should see a structure that resembles the following:

```
// myApp root directory
|
|—— .editorconfig
|—— .gitignore
|—— config.xml
|—— hooks/
|—— ionic.config.json
|—— node_modules/
|—— package.json
|—— platforms/
|—— plugins/
|—— resources/
|—— src/
|—— tsconfig.json
|—— tslint.json
└—— www/
```

For those new to Ionic 2 development the above structure, with all its different files and directories, might seem a little intimidating at first but over the following pages we'll break each part of the app down so we fully understand their function and why they are there.

.editorconfig

This file defines the coding styles to be used for the app across different editors and IDE's - which might be helpful for development teams to ensure consistency in code formatting is maintained between different developers working on Ionic 2 projects.

.gitignore

If you're using a git based repository (such as Github or Bitbucket) for your version control then this file simply states what should be excluded from commits/pushes to the repository.

config.xml

Provides global configuration options for the app which can include:

- Meta-data for app store listings (such as the app description and author name)
- Control options for certain plugins used within the application (I.e. splash screen settings)
- Platform specific settings (I.e. iOS, Android)
- Determining the level of access to external URLs for the app
- Configure app launch icon and splash screen images per platform

We'll be working with this file and relevant configuration options later on in the book, particularly in the chapter where we prepare our apps for submission to the Apple App and Google Play stores.

hooks

Deriving from the underlying Apache Cordova framework this directory is used to store scripts, known as hooks, which could be added to the application to execute Cordova related commands prior to, for example, adding a new platform, before compiling and building our app or after installing a plugin.

These hooks might perform actions such as, for example, linting JavaScript so as to avoid any potential script execution errors when using the app.

This directory is now considered deprecated (although this can still be used deprecated simply means that future versions of the Cordova framework won't support using this directory and might even remove it altogether).

The official Apache Cordova documentation recommends that developers looking to use hooks in their application should define these in the following files instead:

- **config.xml** (for all application related hooks)
- **plugins/plugin-name-here/plugin.xml** (for hooks related to a plugin)

More information on Cordova hooks can be found here: https://cordova.apache.org/docs/en/latest/guide/appdev/hooks/index.html.

ionic.config.json
A JSON file displaying the configuration options for the Ionic app. These are created from the initial CLI start command but additional options can be added to the file if required.

node_modules
Contains all of the different software modules used within the Ionic 2 app, the most notable being the angular 2 framework.

It is highly unlikely that you will ever need to, and it's strongly advised that you refrain from, performing any code edits to the files contained with these directories as these form the core default logic for the app. Doing so could have unintended consequences for your app.

Mess with these at your peril!

IMPORTANT - When you create a new app you will need to run the *npm install* command within the root of the newly created app directory. This will install all the required dependencies listed in the **package.json** file, along with any additional packages that they may depend on.

package.json
This serves to manage locally installed NPM packages (those in the node_modules directory) and Cordova plugins, helps document which NPM packages & versions

are installed in your project and makes a project easier to share with other developers (as they can quickly see what software dependencies the project requires).

platforms

Contains the different mobile platforms that the app is being developed for. Ionic 2 by default adds iOS when creating your app from the command line.
All other supported mobile platforms have to be manually added to the app through the Ionic CLI.

plugins

Contains all of the Cordova and third party supported plugins for the app.
Default plugins that were installed on app creation are as follows:

- Console
- Device
- Splashscreen
- Status Bar
- Whitelist
- Ionic Keyboard

We'll look into managing and using plugins in the aptly named *Plugins* chapter.

resources

Contains all of the default iOS & Android launch icons and splash screen images, contained within their own sub-directories, for use on both mobile and tablet screen sizes and orientations.

These assets can be updated/replaced and we'll look at how to do that in the *Preparing apps for release* chapter.

src
This is the directory where all of the development work for your app will take place as well as storing any custom assets used within your app.

The **src** directory, by default, contains the following:

- **app/** - Contains application configurations and bootstrapping - see below
- **assets/** - Contains assets to be used for the app such as, for example: images, videos or JSON files
- **declarations.d.ts** - Provides information to the TypeScript compiler about the type information for scripts and third-party libraries used within the app
- **index.html** - the HTML wrapper for the app which includes links to the base styles and JavaScript files to be used by the app
- **manifest.json** - Provides support for Progressive Web Apps
- **pages/** - contains all of the pages - aka components - for the app (each of which are separately packaged into named directories, that correspond to each page, and include HTML templates, TypeScript and Sass files)
- **service-worker.js** - provides basic functionality, which can be customised and extended further, to control how the Ionic 2 app accesses and uses the network it connects to
- **theme/** - contains all of the default Sass files for styling the app

The **app/** directory is one of the most important directories within an Ionic 2 application as it helps structure and bootstrap the app through the following files:

- **app.component.ts** - the app's root component (every app has a root component which controls the rest of the application)
- **app.module.ts** - the root module for your app which basically describes how the application fits together and what it's constituent parts are (this helps instruct the Ionic compiler on how to prepare the app for being launched)
- **app.scss** - used to store and organise style rules that a developer may want to be implemented globally within the application
- **main.dev.ts** - used during application development
- **main.prod.ts** - used for production of the application

In addition any services and pipes that you create using the Ionic CLI will be stored in their own named sub-directories within the **src** directory - such as **src/pipes/** or **src/providers/** for example.

Any directives generated via the CLI will be stored in the **src/components** directory instead.

We'll be working a lot with the **src** directory in following chapters.

For more information on service workers please access the following links:

- An introduction to Service Workers
- Progressive Web App support in Ionic
- Service Workers Cookbook

tsconfig.json

A configuration file that indicates the directory it is contained within is the root of a TypeScript project. This file, amongst other options, lists the TypeScript files to be processed and what compiler settings should be used when converting, or transpiling, TypeScript into JavaScript for web/mobile browsers to be able to execute.

More information on the different **tsconfig.json** configuration options is available here: http://www.typescriptlang.org/docs/handbook/tsconfig-json.html.

tslint.json

A configuration file used to lint, or check, TypeScript files for any formatting issues and code errors.

www

Directory that contains the **index.html** file, and **assets** and **build** sub-directories which are copied and replaced from the **src** directory whenever we build an app using the Ionic CLI tool.

The **index.html** file loads the necessary CSS and JavaScript files for the Ionic app as well as containing the <ion-app> directive within the body of the HTML document (which is the wrapper where view templates are rendered for display).

The app stylesheet, generated from ALL of the imported Sass files used within the **node_modules/ionic-angular/themes**, **src/theme** and **src/pages** component directories, is loaded within the head of the document HTML.

All JavaScript files are loaded underneath the <ion-app> root component, towards the bottom of the document, and consist of the following 3 files:

- **cordova.js** - Required for Cordova apps (remember that Apache Cordova is the framework that Ionic uses for publishing to mobile/tablet devices)
- **polyfills.js** - A polyfill for legacy browsers that don’t support certain ES6 features such as Promises
- **main.js** - Transpiled TypeScript code from the **src/** directory that contains the custom logic for your app

IMPORTANT - Any images, fonts and other assets (such as JSON files or video media) that are to be used within your app should be stored within the **src/assets** directory. After a successful build operation these will be copied to the **www/assets** directory.

So that’s a very basic introduction and breakdown to the structure of a freshly created Ionic 2 App which will hopefully give you a good understanding of what all the various parts do and how they fit together.

We’ll keep revisiting some of the topics that we’ve covered here, as well as those from previous chapters, as we continue with our learning so don’t worry if it seems a little overwhelming right now - you’ll be up to speed with Ionic 2 in no time!

In the next chapter we’ll start digging into some code and familiarising ourselves with decorators and classes in Ionic 2.

Decorators & Classes

Within the recently created myApp open the **src/pages/home/home.ts** component file contained within there.

This is the automatically generated TypeScript file for your app’s home page and consists of a very simple code structure which the page logic can be entered into and built up from.

This file should look like the following:

```
import {Component} from '@angular/core';
import {NavController} from 'ionic-angular';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

  constructor(public navCtrl: NavController) {

  }

}
```

There are 3 main elements to this file:

- Modules
- Decorator
- Class

Modules
At the top of the page a couple of import statements were automatically added when we created our app using the Ionic CLI tool.

By default these import the **Component** and **NavController** modules (which are pre-existing classes that provide functionality to help manage our component as well as navigation related tasks for the page) but we can, of course, import additional modules into this page, such as custom providers or further core Angular/Ionic specific modules.

We'll look at doing this a little later on in the chapter.

IMPORTANT - Whenever you create a component, pipe, directive or provider using the Ionic CLI import statements for specific modules are automatically added for each generated file. Further modules can then be manually added as and where required.

Decorators

After the import statements for our modules we come across the following decorator:

```
@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
```

It might look a little odd if you've not come across one before but the role of a decorator, which accompanies every class created in an Ionic 2 application (and always sits above the class), is to provide metadata for the class itself.

In the **src/pages/home/home.ts** file the decorator declares that the class is a component and contains metadata concerning the template and the CSS selector the class will use.

Decorators can declare a variety of meta data such as:

- The page selector
- The URL to the template this class will use
- Which providers, directives and pipes (or filters) that the class might use

Don’t worry if you don’t know what providers, directives and pipes are - we will be covering these in subsequent chapters!

A more complex decorator might look like the following:

```
@Component({
    selector: 'page-home',
    templateUrl: 'home.html'
    entryComponents: [
    AboutPage,
    Contact,
    TechnologiesPage,
    Tweets
  ]
})
```

For your initial Ionic 2 development needs though you will probably only use very basic decorators like the following:

```
@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
```

IMPORTANT - Any components, directives, pipes or providers declared in the decorator would first have to be imported into the script through an import statement towards the top of the file.

Decorators used within Ionic 2 come in a few different types:

- @Component
- @Directive
- @Pipe
- @Injectable

@Component
This is the most common decorator that you will be using when developing your Ionic 2 applications. The @Component decorator simply defines that the class, and its associated template, will be published as a component.

Before we go any further it's important to be aware that the term component can be a little misleading in Ionic 2 as it is often used to refer to 3 different contexts:

- Custom components (these, typically, would be the pages for your app that are packaged into sub-directories consisting of the prerequisite TypeScript, Sass and HTML files - although, just to confuse matters, they could be singular UI elements to be implemented on a page such as a shopping cart or captcha widget)
- Existing Ionic components for building the app interface (such as modals, form buttons, checkboxes etc. - which primarily consist of HTML & CSS although some components also include JavaScript functionality)
- A type of decorator that provides metadata about the class

As components are a major feature of Angular 2 it makes sense that Ionic 2 would not only implement components but also make heavy use of them with a library of pre-built components.

Further information here: http://ionicframework.com/docs/v2/components/

@Directive
When you are looking to modify the behaviour of an existing component then you would create your own custom directives using this decorator to provide metadata about the directive.

Use of this decorator might look something like the following:

```
@Directive({
  selector: '[custom-map]'
})
```

Which might then be added as an attribute to an HTML element to implement that directive’s functionality like so:

```
<section custom-map></section>
```

@Pipe
This decorator is used when creating classes to handle the filtering of data within your app template (I.e. capitalising the first letter of each word in a string).

Use of this decorator might look something like the following:

```
@Pipe({
  name: 'CapitaliseWordsPipe'
})
```

Which might, when implemented as a data filter in your app templates, look like the following (this assumes the logic for the pipe has also been written!):

```
<p>{{ stringBeingRendered | CapitaliseWordsPipe }}</p>
```

The pipe would then parse the data it is assigned to, filtering that before it is finally rendered to the template.

Personally I would always try to filter the data within the component class itself, or through using a provider, so that it is already ‘sanitised’ before being parsed in the page template. This can be helpful with improving the performance of the app too.

Sometimes this isn’t always possible though which is where pipes come in handy for performing those necessary transformations on data values in your app templates.

@Injectable
This decorator defines a provider - also known as a service (which is simply a class that contains re-usable code that can be shared across an application).

This provider can then be used in other classes as a dependency.

For example, if you find yourself using an SQLite database to handle data storage and retrieval in your app it really wouldn’t make much sense to re-create the same database methods on each page where such functionality is required.

A much more sensible solution would involve creating a dedicated database provider - which can then be “injected” where required for classes to access those methods - which might look something like the following:

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Injectable()
export class Database {
  public storage : any   =   null;
  public records : any;

  constructor(public http: Http)
  {  }

  createDatabase()
  {
    this.storage    =   new SQLite();
    this.storage.openDatabase({
      name          :        'myDatabase.db',
      location      :        'default' // the location field is required
    })
    .then((data) => {
      this.createTable();
    });
  }

  createTable()
  {
    this.storage.executeSql('CREATE TABLE IF NOT EXISTS myTable (id
INTEGER PRIMARY KEY AUTOINCREMENT, name TEXT)', {})
    .then((data) =>
    {
      console.log("myTable created: " + JSON.stringify(data));
    });
  }

  retrieveData()
  {
    return new Promise(resolve =>
    {
      this.storage.executeSql('SELECT * FROM myTable', {})
      .then((data) =>
      {
        this.records      = [];
        if(data.rows.length > 0)
        {
          var k;
          for(k = 0; k < data.rows.length; k++)
          {
            this.record.push({
              name: data.rows.item(k).name
            });
          }
        }
        resolve(this.records);
      });
    });
  }
}
```

This provider would then be imported into the **src/app/app.module.ts** file and listed in the providers array like so:

```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { Database } from '../providers/database';
import { HomePage } from '../pages/home/home';

@NgModule({
  declarations: [
    MyApp,
    HomePage
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage
  ],
  providers: [Database]
})
export class AppModule {}
```

Providers can also be imported and used within the **src/app/app.components.ts** file if, for example, we needed to run or make certain functionality available BEFORE importing and using the provider directly in our page components.

An example of how this might look is as follows (amendments highlighted in bold):

```
import { Component } from '@angular/core';
import { Platform } from 'ionic-angular';
import { StatusBar, Splashscreen } from 'ionic-native';
import { Database } from '../providers/database';
import { HomePage } from '../pages/home/home';
```

```
@Component({
  template: `<ion-nav [root]="rootPage"></ion-nav>`
})
export class MyApp {
  rootPage = HomePage;

  constructor(platform: Platform, private db: Database)
  {
    platform.ready().then(() =>
    {
        // Okay, so the platform is ready and our plugins are available.
        // Here you can do any higher level native things you might need.
        StatusBar.styleDefault();
        Splashscreen.hide();
        db.createDatabase();
    });
  }
}
```

In this example we import the Database provider, inject that as a parameter into the MyApp class constructor - setting that to a private property of **db** - then we run the **createDatabase()** method of the Database provider within the **platform.ready()** method (which ensures that any native plugin calls can be run as the platform is loaded and accessible).

Within a page component (in this case the **src/pages/home/home.ts** file) we might use the Database provider like so (amendments highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController, Platform } from 'ionic-angular';
import { Database } from '../../providers/database';

@Component({
   selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

  public movies           : any = [];
  public storedData       : any;

  constructor(
    public navCtrl        : NavController,
    public db             : Database,
    public platform       : Platform)
    {
      platform.ready().then(() =>
      {
        setTimeout(() => {
          this.renderData();
        }, 750);
      });
    }

    renderData()
    {
      this.db.retrieveData()
      .then(
        (data) =>
        {
          let existingData     = Object.keys(data).length;
          if(existingData !== 0)
          {
            this.storedData  = data;
          }
        });
    }
}
```

Notice that we perform the following to use the database provider in the above class:

- Import the provider
- Pass the provider as a parameter within the class constructor
- Call the **retrieveData** method from our provider (using a promise to handle return of asynchronous data through the **then** method)

Using providers (more commonly referred to as services) is an effective way to create a scalable and modular codebase that allows for better structuring and management of an application's logic while avoiding code duplication.

Simply plan out the requirements for your application, determine where reusable logic can be implemented and structure your code accordingly.

Spending time doing so will save you a great deal of hassle in the future should you need to grow the codebase or debug/troubleshoot any issues that may arise.

That pretty much concludes our discussion of decorators and the different types that are used within Ionic 2:

- @Component
- @Pipe
- @Directive
- @Injectable

The important thing to take away from this is that decorators are simply used to provide information about the class that they are associated with.

Essentially they are metadata for the application logic.

Classes

In the chapter titled **Core tools & technologies** we discussed the importance and relevance of classes in providing a standardised method of generating a blueprint from which objects could be created (or, for the more technical term, *instantiated*).

Class based object oriented programming is implemented within Ionic 2 through the use of Angular 2/TypeScript and would resemble something akin to the following fictional component:

```
import { Component } from '@angular/core';
import { NavController, NavParams } from 'ionic-angular';
import { EquipmentItemPage } from '../equipment-item/equipment-item';
import { DB } from '../../providers/db/db';

@Component({
  selector: 'page-equipment',
  templateUrl: 'equipment-items.html'
})
export class EquipmentItemsPage {
   public items      : any;
   public name       : string;

   constructor(
         public nav   : NavController,
         public np    : NavParams,
         public db    : DB)
   {
    this.items   =   this.db.retrieveSingleRecord(np.data.id);
    this.name    =   np.data.name;
  }

  viewEquipmentItem(item)
  {
    console.log(item.name);
    this.nav.push(EquipmentItemPage, item);
  }

}
```

Looking at this script here’s how the structure breaks down:

- Imported modules
- Class decorator
- Class declaration
- Constructor

Modules

Modules and packages that are required for use in Ionic 2 classes are brought in through the use of import statements.

In the above example we are importing the following modules:

- **Component** from **@angular/core** that implements the **@Component** decorator for our class
- **NavController** from **ionic-angular** which provides the ability to navigate to other pages in our app
- **NavParams** from **ionic-angular** which provides the ability for our app to retrieve data passed through navigation from the previous page
- **EquipmentItemPage** which is a custom created class
- **DB** which is a custom created database provider

Class decorator

The **@Component** decorator, using the Component module that was imported earlier, provides metadata about the CSS page selector and the HTML template used for this class (which we covered earlier in this chapter).

Class declaration

The actual class itself is defined as follows:

```
export class EquipmentItemsPage
{
   // Class contents displayed in here
}
```

The **export** keyword allows our class of EquipmentItemsPage to be able to be imported as a module for use in other classes if we so wish.

Constructor

A constructor is used in class based object oriented programming to help prepare and set up the class for creating objects; often setting member properties based on parameters passed into the constructor.

The constructor function in Ionic 2 must be named constructor (as a rule from the design of the TypeScript language) and can be used to instantiate properties from any parameters that are injected into it.

These properties are public by default but can be set to private or protected access (as discussed in the chapter **Core tools & technologies**).

IMPORTANT - IF you want to reference such properties in your HTML templates they MUST be set to public access, due to Ionic 2’s Ahead of Time compiling logic, otherwise the TypeScript compiler will throw a warning and such properties will not be able to be accessed through the HTML template.

So in our previous class example we have the following constructor function:

```
constructor(
   public nav       : NavController,
   public np        : NavParams,
   public db        : DB)
{
    this.items   =   this.db.retrieveSingleRecord(np.data.id);
    this.name    =   np.data.name;
}
```

Which contains the following parameters:

- NavController
- NavParams
- DB

Remember - these parameters were imported as modules at the beginning of our class file before they were injected into the constructor.

Each of these parameters is then associated with a public property (nav, np and db) and subsequently used within the constructor to access methods and data.

IMPORTANT - If a class extends another class then the class that is performing the extending (known as the derived class) must include a call to the super method in its constructor function.

The super method simply refers to the parent class constructor and allows for both public/protected variables and methods from the parent class (known as the base class) to be used in the derived class - for example:

```
class Human {
   protected gender: string;
   protected name: string;
   constructor(theirName : string, genderType: string)
   {
      this.gender = genderType;
      this.name = theirName;
   }
}

class Activity extends Human {
   private sleeping: number;

   constructor(genderType: string, hoursSlept: number)
```

```
    {
        super(name);
        this.sleeping = hoursSlept;
    }

    public sleepDuration()
    {
        return `${this.name} slept for ${this.sleeping} hours.`;
    }
}
```

Creating new components

Okay, so that pretty much covers the use of decorators and classes in Ionic 2, now let’s create a new component for our app.

In the Mac OS X Terminal make sure that you are within the root of the myApp project before using the Ionic CLI to issue the generate page command:

```
ionic g page about
```

And, with one simple command, we should have generated a new component for our app (which as the name suggests will be the about page) which contains the following files:

- **about.html** (the template for our page)
- **about.scss** (the style rules for our page)
- **about.ts** (the logic for our page)

Each time you generate a component using the Ionic CLI you will end up with a named directory which contains Sass, TypeScript and HTML files.

Our newly generated component can be found in the following directory structure:

```
// app root directory

├── src/
    │
    ├── app/
    ├── assets/
    ├── declarations.d.ts
    ├── index.html
    ├── manifest.json
    ├── pages/
    │   │
    │   ├── about/
    │   │   │
    │   │   ├── about.html
    │   │   ├── about.scss
    │   │   └── about.ts
    │   └── home/
    ├── service-worker.js
    └── theme/
```

Let’s take a look at each of the above files for the about component and see what the Ionic CLI has generated for us.

myApp/src/pages/about/about.html
This is the template for our page and contains the necessary HTML for rendering output to the app user.

```
<ion-header>

  <ion-navbar>
    <ion-title>about</ion-title>
  </ion-navbar>

</ion-header>

<ion-content padding>

</ion-content>
```

In the **about.html** template file we see the following core Ionic directives being used (these core Ionic directives are simply custom HTML tags that can be dropped into an app to quickly add specific types of interface elements):

- <ion-header>
- <ion-navbar>
- <ion-title>
- <ion-content>

The <ion-header> directive in our template contains the header bar navigation for our app with the title for this page.

The <ion-content> directive is where we will display our page content. You can see that it has an attribute of padding which, as you might have guessed, adds padding to the inside of the content area.

We can add different HTML tags and/or ionic directives inside the <ion-content> directive if we want to, as well as display data and use functions that are defined in the class associated with this template - if we couldn’t, it wouldn’t be much use!

We’ll go through templates in more detail in the *Templates* chapter.

myApp/src/pages/about/about.scss

```
page-about {

}
```

Here we have a selector which would be used to nest any style rules that we may wish to add that are applicable for the about page.

This selector is referenced in the @Component decorator for the class as follows:

```
@Component({
  selector: 'page-about',
  templateUrl: 'about.html'
})
```

Style rules entered into the **about.scss file**, along with other core and custom component Sass files, will be published into a single CSS stylesheet for the app whenever a build process is run through the Ionic CLI.

We'll go through theming in more detail in the chapter *Theming Ionic 2 Apps*.

myApp/src/pages/about/about.ts

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';

@Component({
  selector: 'page-about',
  templateUrl: 'about.html'
})
export class AboutPage {

  constructor(public navCtrl: NavController)  {  }
ionViewDidLoad() {
    console.log('Hello AboutPage Page');
  }
}
```

We can see that the **Component** and **NavController** modules are imported for use in the class, the **@Component** decorator states which template will be used for the page, the **AboutPage** class itself is able to be exported for use as a dependency in other classes (through the implementation of the **export** keyword) and our constructor contains a single parameter of **NavController** which is set to a public property of **navCtrl**.

There's also an ionViewDidLoad method which is triggered when the view template has loaded - in this instance to print a simple console log.

There's one further step we must take when adding a new component to our Ionic 2 projects - importing and registering the component with the root module for the app: the **myApp/src/app/app.module.ts** file.

The following amendments to the **myApp/src/app/app.module.ts** file demonstrate how a new component must be registered (highlighted in bold):

```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { HomePage } from '../pages/home/home';
import { AboutPage } from '../pages/about/about';

@NgModule({
  declarations: [
    MyApp,
    HomePage,
    AboutPage
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage,
    AboutPage
  ],
  providers: [{provide: ErrorHandler, useClass: IonicErrorHandler}]
})
export class AppModule {}
```

You MUST import and declare all page components used within your app (whether they are imported into other page components or not) inside of the **app.module.ts** file otherwise the compiler will complain when trying to publish your app.

Component output

We can add our own logic, in the form of properties and methods, to the **AboutPage** class and subsequently transpile and publish this to a single JavaScript file (which contains all of the necessary logic from different TypeScript files used for our app) whenever we run a build process through the Ionic CLI.

This file - **www/build/main.js** - renders the transpiled **AboutPage** class using the JavaScript revealing module pattern:

```
var __decorate$104 = (undefined && undefined.__decorate) || function (deco-
rators, target, key, desc) {
    var c = arguments.length, r = c < 3 ? target : desc === null ? desc = Object.
getOwnPropertyDescriptor(target, key) : desc, d;
    if (typeof Reflect === "object" && typeof Reflect.decorate === "function") r =
Reflect.decorate(decorators, target, key, desc);
    else for (var i = decorators.length - 1; i >= 0; i--) if (d = decorators[i]) r = (c <
3 ? d(r) : c > 3 ? d(target, key, r) : d(target, key)) II r;
    return c > 3 && r && Object.defineProperty(target, key, r), r;
};
var __metadata$3 = (undefined && undefined.__metadata) II function (k, v) {
    if (typeof Reflect === "object" && typeof Reflect.metadata === "function")
return Reflect.metadata(k, v);
};
/*
  Generated class for the About page.

  See http://ionicframework.com/docs/v2/components/#navigation for more info
on
  Ionic pages and navigation.
*/
var AboutPage = (function () {
    function AboutPage(navCtrl) {
        this.navCtrl = navCtrl;
    }
    AboutPage.prototype.ionViewDidLoad = function () {
        console.log(‘Hello About Page’);
    };
    AboutPage = __decorate$104([
        Component({
            selector: 'page-about',
             template: '<!--\n  Generated template for the About page.\n\n  See
http://ionicframework.com/docs/v2/components/#navigation for more info on\n
Ionic pages and navigation.\n-->\n<ion-header>\n\n  <ion-navbar>\n    <ion-ti-
tle>about</ion-title>\n  </ion-navbar>\n\n</ion-header>\n\n\n<ion-content pad-
ding>\n\n</ion-content>\n'
        }),
        __metadata$3('design:paramtypes', [NavController])
    ], AboutPage);
    return AboutPage;
}());
```

As you can see the transpiled version of the class is quite messy and somewhat convoluted as a result of the conversion to ES5 compliant syntax.

That covers this initial introduction into components; from their generation using the Ionic CLI tool through to the architecture of a component and the separation of styles, logic and presentation into different files.

We'll be exploring and using components throughout the rest of the book so don't worry if it's not quite sunk in yet - it will!

One of the great things about the Ionic CLI is that, whenever you create a page, it automatically generates a basic TypeScript/Sass/HTML structure for you to build upon.

As you might appreciate this is a great timesaver as it means you don't have to keep typing out the same structure for each new page you create.

Summary

We've covered decorators and classes quite a bit in this chapter as well creating our first basic page component using the Ionic CLI.

Unfortunately, if we launch our app using the *ionic serve* command, we won't be able to see the about page as there's currently no way to navigate there.

So let's take a look at how we can implement navigation in our Ionic 2 apps in the next chapter...

Ionic 2
Navigation

If you cut your teeth developing with Ionic 1 you'll probably be familiar with the Angular 1 concept of routing using URL's or states, like so:

```
.config(function($stateProvider, $urlRouterProvider)
{
   $stateProvider

      // Home
      .state('index',
      {
         url                      :   '/',
         templateUrl              :   'assets/templates/home.html',
         controller               :   'HomeController'
      });

      $urlRouterProvider.otherwise("/");
});
```

Ionic 2 changes all of that completely with root pages and navigation stacks - the latter of which we'll turn our attention to first.

Welcome to your stack

App navigation in Ionic 2 centres around the concept of a navigation stack:

- To navigate to a page you **push** that page onto the top of the stack
- To go back you **pop** that page off the stack

It might help to visualise your app navigation as essentially a stack of pages with the currently viewed page being at the top of that stack. When you navigate backwards the last viewed page is popped (or removed) from that stack.

To push and pop pages for this navigation stack Ionic 2 provides the NavController class (which you'll notice, the more you develop with Ionic 2, is always imported into every new page you create using the Ionic CLI).

Navigate to the root of the myApp project directory and open the **src/pages/home/**

home.ts file to see the following TypeScript:

```
import {Component} from '@angular/core';
import {NavController} from 'ionic-angular';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
  constructor(public navCtrl: NavController)  {

  }
}
```

This imports the **NavController** class which is passed into the **HomePage** class constructor and set to a property of **navCtrl**. Using the **navCtrl** property we can start navigating to other pages within our app (which, as we currently only have one other page in our app, would be the about page).

To navigate to the About page we would begin by importing that page and then pushing that into our navigation stack like so (amendments to the **src/pages/home/home.ts** file are highlighted in bold):

```
import {Component} from '@angular/core';
import {NavController} from 'ionic-angular';
import {AboutPage} from '../about/about';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
  constructor(public navCtrl: NavController)
  {
  }

  setNavigationLink() {
    this.navCtrl.push(AboutPage);
  }
}
```

The above **setNavigationLink** method uses the **NavController** push method to add the **AboutPage** to the navigation stack.

Now we need to incorporate the **setNavigationLink** method into our Home page template so we can actually link from the Home page to the About page.

If we open the **src/pages/home/home.html** template we can add some custom HTML to accomplish this (shown in bold below):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Ionic Blank
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
  The world is your oyster.
   <span (click)="setNavigationLink()">Why not explore it?</span>
  <p>
    If you get lost, the <a href="http://ionicframework.com/docs/v2">docs</a>
will be your guide.
  </p>
</ion-content>
```

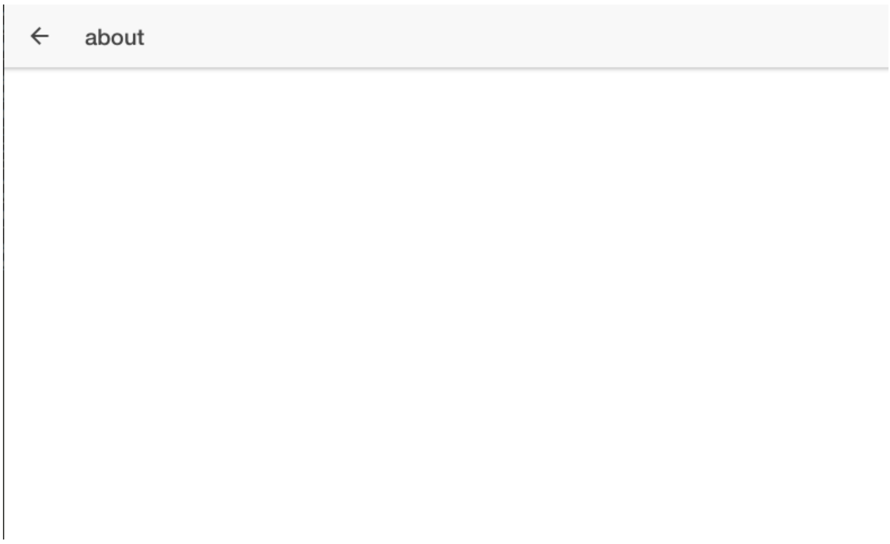
In our custom HTML snippet we add a click event to a span tag which triggers the **setNavigationLink** method in the **HomePage** class to be fired.

This method, when called, pushes the **AboutPage** into the navigation stack allowing us to navigate directly to that page.

To see this working in our web browser we need to open up our Terminal application, navigate to the root directory of our project and run the following command:

```
ionic serve
```

And, providing you've added the highlighted code into the same areas of both your **home.ts** and **home.html** files, you should be able to click on the *Why not explore it?* text and navigate directly to the about page like so:



Congratulations!

It might not be the most visually appealing or exciting of pages but our navigation logic works and Ionic helpfully adds a back button into our app header so we can return to the home page (which will 'pop' the visited about page from our navigation stack).

If we wanted to manually remove a page from the navigation stack we would use the following command within our class:

```
this.navCtrl.pop(NameOfPageToRemoveFromNavigationStackHere);
```

As you can see navigating between pages is pretty simple but there will be situations where we want to pass data from one page to another.

Within the **src/pages/home/home.ts** file add the following (highlighted in bold):

```
import {Component} from '@angular/core';
import {NavController} from 'ionic-angular';
import {AboutPage} from '../about/about';

@Component({
   selector: 'page-home',
   templateUrl: 'home.html'
})
export class HomePage {
  public params : any;

  constructor(public navCtrl: NavController)
  {
     this.params = {
         id: 1,
         name: "Sample App",
         description : "A sample application for helping to learn Ionic 2"
     }
  }

  setNavigationLink()
  {
    this.navCtrl.push(AboutPage, this.params);
  }

}
```

Now that a navigation parameter has been added to the NavController push method the receiving page needs to be able to process the supplied data.

Within the **src/pages/about/about.ts** file add the following (highlighted in bold):

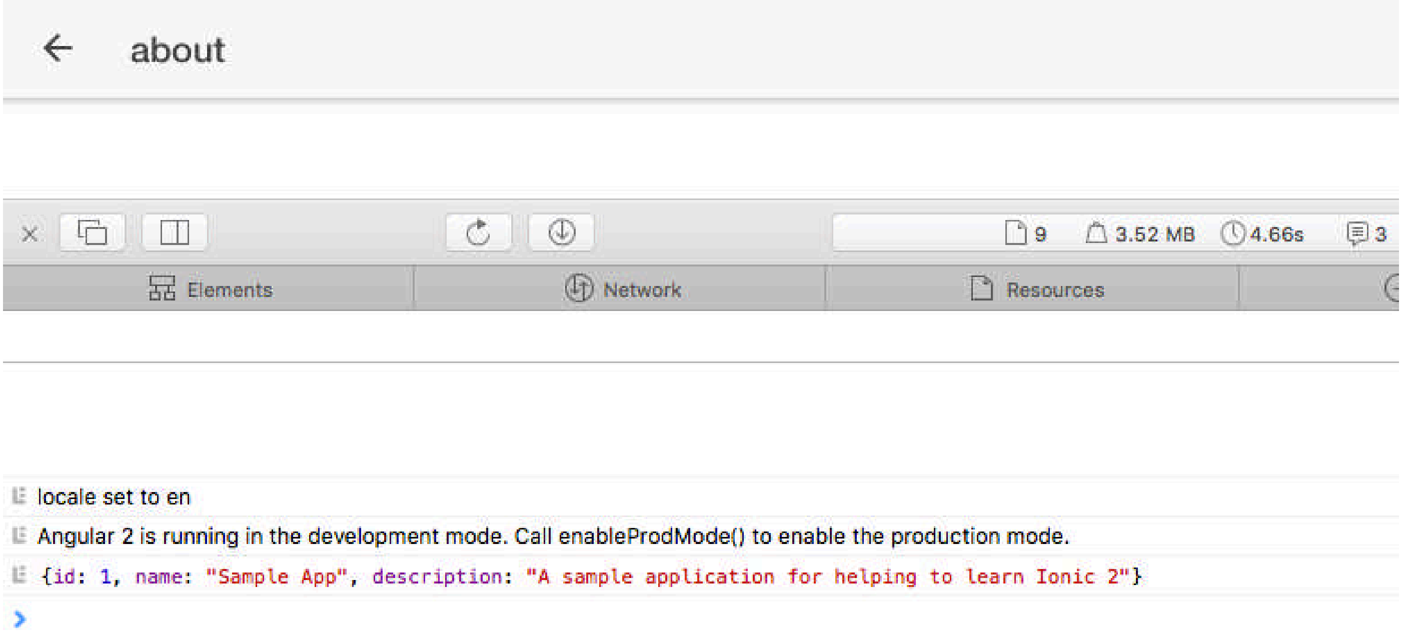
```
import { Component } from '@angular/core';
import { NavController, NavParams } from 'ionic-angular';

@Component({
  selector: 'page-about',
  templateUrl: 'about.html'
})
export class AboutPage {

   constructor(public navCtrl: NavController, private np: NavParams)
   {
      console.dir(np.data);
   }

}
```

We’ve only made 3 very simple additions to the script:

- Imported the **NavParams** class to help us access parameters that have been passed via the **NavController** object from the home page of our app
- Injected the **NavParams** object into the constructor for the **AboutPage** class and then associate that with the private property of **np**
- Within our constructor we then print to the web browser console all the supplied navigation parameters using the data member of the **NavParams** object

If *Ionic serve* is running it will automatically rebuild our app and refresh the web browser for us after saving the changes to the **src/pages/about/about.ts** file.

If not, run the *ionic serve* command and, once the app is published in the browser, if we navigate to the about page we should see the following output rendered to the Web browser console:



```
locale set to en
Angular 2 is running in the development mode. Call enableProdMode() to enable the production mode.
{id: 1, name: "Sample App", description: "A sample application for helping to learn Ionic 2"}
```

Nice and easy!

What if we only want to access certain parameters though?

Simple - just append the names of those supplied parameters to the end of the data member in the **src/pages/about/about.ts** file like so (highlighted in bold):

```
export class AboutPage {

  constructor(
        public navCtrl: NavController,
        public np: NavParams)
  {
        console.log(np.data.id);
        console.log(np.data.name);
        console.log(np.data.description);
  }
}
```

Now each supplied navigation parameter will be individually printed to the browser console.

In the next chapter we'll render this supplied data to the page template (which is, of course, a lot more useful than console logging when developing our applications!)

Now that we’ve covered passing data between templates let’s look at some further options we have available to us for managing navigation within our Ionic 2 apps.

Customising the transition

The NavController class provides the following methods which allow developers to control how the current transition behaves:

- **animate** (Whether or not the transition should animate - accepts a boolean value)
- **animation** (The type of animation the transition should use - currently any of the following strings: md-transition [android animation], ios-transition [iOS animation] and wp-transition [Windows Phone animation])
- **direction** (The direction in which the user is navigating - accepts a string value of forward or back)
- **duration** (The length in milliseconds that the animation will take to complete)
- **easing** (The type of easing for the animation to use)

These can be supplied as an optional configuration object to the NavController push method in the **src/pages/home/home.ts** file like so (highlighted in bold):

```
export class HomePage {
  public params : any;

  constructor(public navCtrl: NavController) {
    ...
  }

  setNavigationLink()
  {
    let opts = { animate: true, animation: "wp-transition", duration: 2500}
    this.navCtrl.push(AboutPage, this.params, opts);
  }
}
```

Take some time to play around with different values for these configuration options and get a feel for how your app behaves accordingly.

Lifecycle events

We can also control what happens within our app before, during and after pages have loaded with the following navigation life cycle events:

- **ionViewDidLoad** (triggered only once per page after the page has completed loading and is now the active page)
- **ionViewWillEnter** (run when the requested page is about to enter and become the active page)
- **ionViewDidEnter** (run when the page has completed entering and is now the active page)
- **ionViewWillLeave** (run when the page is about to leave and no longer be the active page)
- **ionViewDidLeave** (run when the previously active page has completed leaving)
- **ionViewWillUnload** (run when the page is about to be destroyed and all of its elements removed)
- **ionViewCanEnter** (runs before the page view can enter)
- **ionViewCanLeave** (runs before the page view can leave)

Within the **src/pages/about/about.ts** file add the following (highlighted in bold):

```
export class AboutPage {

  constructor(
        public navCtrl: NavController,
        public np: NavParams)
  {
        ...
  }

  ionViewWillEnter()
  {
    console.log("We are now entering the About view");
  }

  ionViewWillLeave()
  {
    console.log("We are now leaving the About view");
  }

}
```

Once you’ve saved these changes to the **src/pages/about/about.ts** file and Ionic serve has finished rebuilding and refreshing the app you should see console logs being generated on entry to and exit from the about page.

Such life cycle events might be useful for tasks such as setting up/initialising page values or clearing values from a localStorage object for example.

Setting the root page

In Ionic 2 the root page is the first page to be loaded by the app and is defined in the **src/app/app.component.ts** file with the following code (highlighted in bold):

```
import { HomePage } from '../pages/home/home';

@Component({
  template: `<ion-nav [root]="rootPage"></ion-nav>`
})
export class MyApp {
  rootPage = HomePage;

```

So we can see that Ionic knows which page to display when our app loads as:

- The root property is set on the <ion-nav> component to a value of **rootPage**
- The **rootPage** property is defined in the **MyApp** class with a value of **HomePage**

You do however have the flexibility to change what you want the rootPage to be at any point in your application using the **setRoot** method of the NavController object:

```
this.nav.setRoot(whateverPageYouWantToBeTheRootPage);
```

This is something you might want when, for example, dealing with the following:

- Redirecting an authenticated user to the "logged-in" experience of the app
- Redirecting a user after a successful account sign-up

I’m sure you’ll agree - having the ability to change the root page definitely makes for a better user experience with the above scenarios.

You will see the terms root component and root page often used throughout this book - it’s important to note at this point that the root component is NOT the same as the root page.

Every app has a root component, driven from the **app.component.ts** file, which is the first component to be loaded for the app and is used to load other components.

The root page, as we’ve recently covered, is essentially the first page that is loaded for our app. The root page can, if required, be changed at any point throughout our application whereas the root component cannot.

Additional navigation options

As briefly mentioned in the chapter titled *Beginning Ionic 2 development* we can also create Ionic apps that use navigation features such as tabs or side menus with the following CLI commands:

```
//Create a project with the tabs template
ionic start myApp tabs --v2

// Create a project with the sidemenu template
ionic start myApp sidemenu --v2
```

Tabs template

If you open the **src/pages/tabs/tabs.html** file of a newly created Ionic 2 app that uses the tabs template you'll see the following markup:

```
<ion-tabs>
  <ion-tab [root]="tab1Root" tabTitle="Home" tabIcon="home"></ion-tab>
  <ion-tab [root]="tab2Root" tabTitle="About" tabIcon="information-circle"></
ion-tab>
  <ion-tab [root]="tab3Root" tabTitle="Contact" tabIcon="contacts"></ion-tab>
</ion-tabs>
```

The multiple root pages references displayed here are defined in the **tabs.ts** file (that is contained within the same directory as the **tabs.html** file):

```
import { Component } from '@angular/core';
import { HomePage } from '../home/home';
import { AboutPage } from '../about/about';
import { ContactPage } from '../contact/contact';

@Component({
  templateUrl: 'tabs.html'
})
export class TabsPage {
  // this tells the tabs component which Pages
  // should be each tab's root Page
  tab1Root: any = HomePage;
  tab2Root: any = AboutPage;
  tab3Root: any = ContactPage;

  constructor() {

  }

}
```

As you can see each tab has its own root page and, like a blank ionic app, the root page for each tab can use the NavController object to push or pop and manage the navigation history for that tab.

Side Menu template

Implementing a side menu within an Ionic app is really only a UI enhancement as, unlike the tabs template, there is only a single root page and the NavController object is used to push and, if necessary, pop pages for the navigation stack based on the selected menu option.

That said there are a few things to be aware of when developing apps using this particular template.

If you create a new Ionic 2 app using the sidemenu template and open the **src/app/app.html** file you'll see the following markup:

```
<ion-menu [content]="content">
  <ion-header>
    <ion-toolbar>
      <ion-title>Menu</ion-title>
    </ion-toolbar>
  </ion-header>
  <ion-content>
    <ion-list>
      <button menuClose ion-item *ngFor="let p of pages" (click)="openPage(p)">
        {{p.title}}
      </button>
    </ion-list>
  </ion-content>
</ion-menu>
<!-- Disable swipe-to-go-back because it's poor UX to combine STGB with side menus -->
<ion-nav [root]="rootPage" #content swipeBackEnabled="false"></ion-nav>
```

There are a few things to pay attention to here:

- The **<ion-menu>** element is used to create the side menu
- This has a **[content]** property with a value of **content**
- The content value for this property is a reference to the local variable set on the **<ion-nav>** element as **#content**
- The navigation items for the side menu are injected as buttons through the use of an **ngFor** loop (we'll cover these in the next section) which pulls values from a pages object
- Each button injected into the menu by the **ngFor** loop has a click event which calls an **openPage** function that is passed the page object from the loop

If we take a look at the **src/app/app.component.ts** file (which is the root component for the app) we can understand the logic behind the side menu template:

```
import { Component, ViewChild } from '@angular/core';
import { Nav, Platform } from 'ionic-angular';
import { StatusBar, Splashscreen } from 'ionic-native';

import { Page1 } from '../pages/page1/page1';
import { Page2 } from '../pages/page2/page2';


@Component({
  templateUrl: 'app.html'
})
export class MyApp {
  @ViewChild(Nav) nav: Nav;

  rootPage: any = Page1;

  pages: Array<{title: string, component: any}>;

  constructor(public platform: Platform) {
    this.initializeApp();

    // used for an example of ngFor and navigation
    this.pages = [
      { title: 'Page One', component: Page1 },
      { title: 'Page Two', component: Page2 }
    ];

  }

  initializeApp() {
    this.platform.ready().then(() => {
      // Okay, so the platform is ready and our plugins are available.
      // Here you can do any higher level native things you might need.
      StatusBar.styleDefault();
      Splashscreen.hide();
    });
  }

  openPage(page) {
    // Reset the content nav to have just this page
    // we wouldn't want the back button to show in this scenario
    this.nav.setRoot(page.component);
  }
}
```

Okay, so there’s a few things to understand here:

- Our class imports and uses the Angular 2 **ViewChild** component (which allows access to a different component class and its methods) to allow the side menu template to be able to implement the methods of the **NavController** object
- The menu options are defined as an array called **pages**, which is subsequently initialised within the class constructor (this is then able to be iterated through and used to create navigation buttons for the **<ion-menu>** element in the **src/app/**

app.html template using the **ngFor** directive)
- The openPage function uses the **setRoot** method of the **NavController** class to avoid usability issues with the back button being displayed when a side menu navigation option is selected

That pretty much wraps up the basics of navigation within Ionic 2 apps but, if you should find yourself struggling with any development challenges when it comes to working with navigation, the following resources should be a good place for finding answers:

http://ionicframework.com/docs/v2/api/components/nav/NavController/
http://ionicframework.com/docs/v2/api/components/menu/Menu/
http://ionicframework.com/docs/v2/api/components/tabs/Tabs/

In the next chapter we'll turn our attention to a pretty important part of developing apps using Ionic 2: Templates.

Resources

All project files for this chapter can be found listed in the download links on page 636.

Templates

As the public facing part of your app templates are pretty important when it comes to rendering content in an aesthetic, usable interface that users can enjoy interacting with - get this right and you're off to a good start!

When you create pages for your app using the Ionic CLI tool (these pages, as we covered in previous chapters, are actually components) you'll find very basic HTML templates being generated like the following:

```
<ion-header>
  <ion-navbar>
    <ion-title>Name of page here</ion-title>
  </ion-navbar>
</ion-header>
<ion-content padding>
</ion-content>
```

You'll notice the template contains the following pre-built Ionic components which, if you haven't used previous versions of the Ionic framework, you might not be familiar with:

- <ion-header>
- <ion-navbar>
- <ion-title>
- <ion-content>

The <ion-header> component is a parent wrapper that is displayed as the header bar at the top of the page. This contains the <ion-navbar> component which is used to provide the navigational toolbar for the app.

The <ion-navbar> component displays the page title for the app, using the <ion-title> component, and can contain any number of buttons, a searchbar or dividers.
A back button will be automatically displayed here whenever a new page is pushed to the navigation stack.

The <ion-content> component is where the main content for our page is displayed and is a scrollable area able to be controlled with various methods listed here:

http://ionicframework.com/docs/v2/api/components/content/Content/

A full list of the available UI components for interface development can be accessed through the online API documentation: http://ionicframework.com/docs/v2/api/

In this chapter we'll be implementing the following Ionic UI components in our app:

- List
- Slides
- Modal

Let's begin by modifying the **myApp/src/pages/home/home.html** template to use a List component with the following changes (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Ionic Blank
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
  <ion-list>
    <ion-item
         *ngFor="let page of pages"
         (click)="setNavigationLink(page)">
      {{ page.title }}
    </ion-item>
  </ion-list>
</ion-content>
```

If we break the above code down here is what we have implemented:

- Created a list using the <ion-list> component

- Used the Angular **ngFor** directive (more on this in a moment) to iterate through an array of data called **pages** (which we'll define in our class shortly)
- On each loop iteration we attach a click event to an **<ion-item>** component which fires the **setNavigationLink** method (that we created in the **Navigation** chapter), that receives the current iterated item from the array as a parameter
- Using "handlebar" syntax we display the title property for each iterated array item between the **<ion-item>** tags

If we try to preview this using ionic serve we will receive an error as the pages array object does not exist.

Let's correct that by opening the **myApp/src/pages/home/home.ts** file and making the following changes to the class (highlighted in bold):

```
import {Component} from '@angular/core';
import {NavController} from 'ionic-angular';
import {AboutPage} from '../about/about';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
  public pages : Array<{title: string, link: any}>;

  constructor(public navCtrl: NavController)
  {
     this.pages = [
      { title : 'About',
        link : AboutPage
      },
      { title : 'Contact Us',
        link : ContactPage
      },
      { title : 'Tweets',
         link : TweetsPage
       }
     ];
  }

  setNavigationLink(page)
  {
    this.navCtrl.push(page);
  }
}
```

You'll see that we have defined our **pages** array and initialised that within the class constructor.

There is a problem here however. We have added entries for the following pages:

- ContactPage
- TweetsPage

But these don't exist yet and if we run ionic serve from the command line we will be greeted with the following errors:

```
TypeScript error: /myApp/src/pages/home/home.ts(17,16): Error TS2304: Cannot find name 'ContactPage'.
TypeScript error: myApp/src/pages/home/home.ts(20,16): Error TS2304: Cannot find name 'TweetsPage'.
```

If you come from a JavaScript background and are new to TypeScript you might find such compiler errors irritating at first but over time you'll come to appreciate just how invaluable these are when trying to understand why your code might not be working.

In the beginning it does take some getting used to though!

Okay, so the next thing we need to do is create these pages before we can preview the app using ionic serve.

Whilst in the terminal press the Ctrl + C keys on your keyboard to quit ionic serve and then type out the following commands to create both the **ContactPage** and **TweetsPage** components (waiting for the first component to be generated before issuing the next command):

```
ionic g page contact
ionic g page tweets
```

With these components successfully generated lets add the following to the **myApp/src/pages/home/home.ts** file (amendments highlighted in bold):

```
import {Component} from '@angular/core';
import {NavController} from 'ionic-angular';
import {AboutPage} from '../about/about';
import {ContactPage} from '../contact/contact';
import {TweetsPage} from '../tweets/tweets';
```

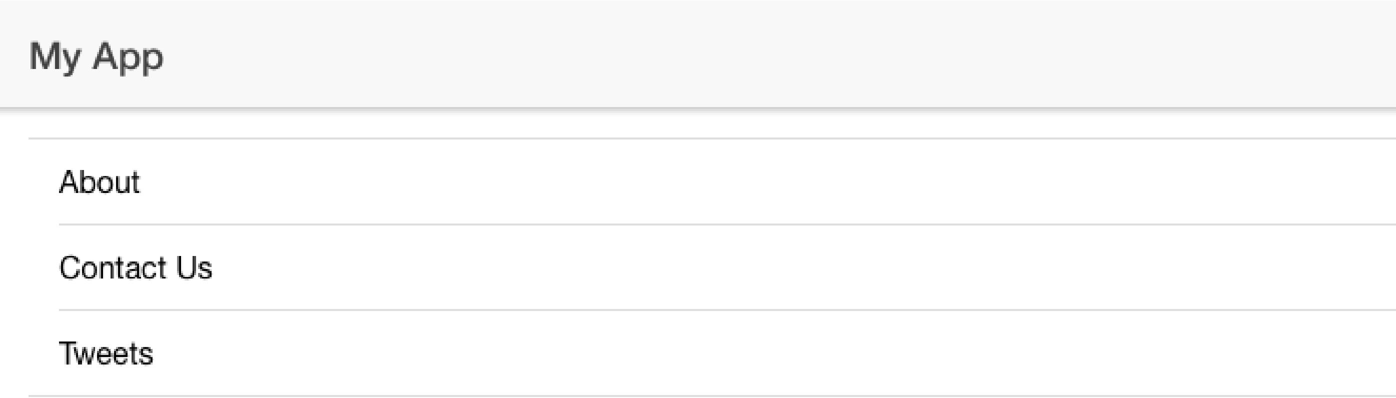
The next step is to register these newly added components with the root module for the app - the **myApp/src/app/app.module.ts** file (amendments highlighted in bold):

```
import { NgModule } from '@angular/core';
import { IonicApp, IonicModule } from 'ionic-angular';
import { MyApp } from './app.component';
import { HomePage } from '../pages/home/home';
import { AboutPage } from '../pages/about/about';
import { ContactPage } from '../pages/contact/contact';
import { TweetsPage } from '../pages/tweets/tweets';

@NgModule({
  declarations: [
    MyApp,
    HomePage,
    AboutPage,
    ContactPage,
    TweetsPage,
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage,
    AboutPage,
    ContactPage,
    TweetsPage
  ],
  providers: []
})
export class AppModule {}
```

With the saved changes for the following files:

- **myApp/src/pages/home/home.ts**
- **myApp/src/pages/home/home.html**
- **myApp/src/app/app.module.ts**

Return to the terminal and run the ionic serve command to preview the app in the browser. Assuming you have implemented those changes correctly you should see your app being rendered like so:



Which although basic is pretty cool nonetheless.

It might not seem like much but you've successfully modified your template to build navigation links from an array of pages that was defined in the component class and, when you click on those links in the browser, you're able to quickly and easily navigate to and from those pages.

Not bad!

IMPORTANT - DON'T forget, when creating new components to be used within your app, to import these into the **src/app/app.module.ts** file and then add their class names to the following areas of the @NgModule configuration:

- declarations
- entryComponents

Next steps

There's a lot more we can do with our List component though but before we do that let's take a little detour and familiarise ourselves with the following concepts and features when working with templates:

- Event binding
- Angular 2 template directives
- Property binding

Event binding

Angular event binding allows our pages to be able to detect and respond to user interactions such as typing text into an input field, submitting a form or selecting options from lists for example.

Without event binding our apps would be both limited in usability and provide a pretty poor experience for our users!

We’ve already used event binding in our **myApp/src/pages/home/home.html** template to set the navigation link for each list item:

```
<ion-item *ngFor="let page of pages" (click)="setNavigationLink(page)">
```

The syntax for event binding consists of a target event (such as a mouse click or key press) within parentheses to the left of the equals sign followed by a template statement (which is used to respond to the event) appearing in quotes on the right.

In the above example we can see that the target event, in parentheses, is the click event and the template statement, in quotes, is the **setNavigationLink** method that we defined in the **myApp/src/pages/home/home.ts** class file.

This pretty much covers the basics of event binding, their syntax and how to use that within our templates.

For further information on the topic visit the following Angular 2 documentation:
https://angular.io/docs/ts/latest/guide/template-syntax.html#!#event-binding

Angular 2 template directives

One of the major hurdles when learning a new framework is getting to grips with the syntax that needs to be used.

Thankfully with Angular 2 that isn’t as difficult as it might first appear.

When templating our application Angular 2 provides the following built-in directives that we can use for manipulating elements/rendering data:

- ngFor
- ngSwitch
- ngIf
- ngStyle
- ngClass

ngFor

The **ngFor** directive is used to iterate through items in an array and render those to the page. This can be applied as an attribute on both Ionic 2 UI components as well as standard HTML tags.

The **ngFor** directive is prefixed with an asterisk like so:

```
<div *ngFor="let page of pages">
```

This might look a little odd (especially if you come from using Angular 1) but the asterisk is simply used to signify that on each loop iteration the current element will be transformed into an embedded template where the data will be rendered to.

An embedded template for the above would look like the following:

```
<template [ngFor]="let page of pages">
   // Render each template content here
</template>
```

Essentially the asterisk functions as shorthand for managing template embedding without displaying the actual background HTML modifications involved.

This might sound a little confusing or complex but for a more in-depth explanation of the asterisk prefix and embedded templates please view the following Angular 2 documentation: https://angular.io/docs/ts/latest/guide/template-syntax.html#!#star-template

You'll also notice from the above **ngFor** example the use of the **let** keyword.

Introduced in both TypeScript and ES6 the **let** keyword allows for block level or lexical scoping of variables.

This provides 3 advantages for declaring variables over the traditional JavaScript method of using var:

- Variables declared as block scope are not visible outside of their parent block
- Block scope variables cannot be read from or written to before they are actually declared
- Block scope variables cannot be redeclared inside the same scope

This helps avoid problems with variable overwriting and hoisting (which you will, if you've spent an appreciable amount of time coding in JavaScript, be aware of the bugs that can be caused with this behaviour and the difficulty involved in tracking these down and resolving them).

The following examples will demonstrate these advantages of using block scoped variables when writing our code:

```
// 1 - Error will be thrown as the variable cannot be used before being declared
i++;
let i;

// 2 - Error will be thrown as variable "i" is not accessible outside of for loop
var tech = ["Ionic 2", "Angular 2", "Apache Cordova", "TypeScript"];
for(let i = 0; i < tech.length; i++)
{
  console.log(`Technology: ${tech[i]}`);
}
console.log(i);

// 3 - Error will be thrown as variable cannot be redeclared in the same scope
let technology = "TypeScript";
let technology = "Angular 2";
```

Believe it or not this is actually a good thing as it forces developers to write cleaner, better structured code that is less prone to bugs (not to mention making it easier for other developers working with that code to understand the logic flow).

We can also extend our **ngFor** directive to provide an index for each item that has been iterated through like so (highlighted in bold):

```
<div *ngFor="let page of pages; let i = index">{{ i + 1 }}</div>
```

Notice the use of the curly braces (referred to as interpolation braces) for displaying the value of the index variable?

Interpolation braces are used to render values to the page and they additionally provide automatic escaping of any HTML content that might be pulled through from the component class.

ngSwitch

This would be used where we want to display one possible option, from a range of options, based on a condition being met.

For example:

```
<span [ngSwitch]="technology">
  <span *ngSwitchCase="Apache Cordova">Apache Cordova</span>
  <span *ngSwitchCase="TypeScript">TypeScript</span>
  <span *ngSwitchCase="Angular 2">Angular 2</span>
  <span *ngSwitchCase="Ionic 2">Ionic 2</span>
  <span *ngSwitchDefault>Other</span>
</span>
```

In the above example we have 3 built-in directives at work:

- ngSwitch
- ngSwitchCase
- ngSwitchDefault

If the <span> match value is equal to that of the switch value then only that <span> element is added to the page.

If no matches are found then the default <span> (signified by the *ngSwitchDefault directive) is added to the page instead.

ngSwitch (and its associated directives) could be applied to any HTML element or Ionic UI component not just <span> tags.

Be aware that only the **ngSwitchCase** and **ngSwitchDefault** are prefixed with an asterisk.

ngIf

Any HTML element or Ionic UI component can be added or removed from the page by binding the **ngIf** directive to it.

That element/component will then only be added to the page if a certain condition is true.

For example:

```
<div *ngIf="technology">Technology used is {{ technology.name }}</div>
```

Note this directive is also prefixed with an asterisk like the **ngFor**, **ngSwitchCase** & **ngSwitchDefault** directives.

ngStyle

Inline styles can be set dynamically on an HTML element or UI component, based on its state (such as a form that is currently submitting data to a remote server script or refreshing an embedded twitter feed with the latest tweets for example), using the **ngStyle** directive.

These inline styles would be defined within the component class using a key/value object structure. Each key would be a particular style name and its value would directly relate to that particular style.

In our component TypeScript class we could, for example, create a method to define these inline styles like the following:

```
elementStyles() {
  let styles = {
    'color':   'rgb(68, 68, 68)',
    'font-weight': 'bold',
    'font-size':  '1.1em'
  };
  return styles;
}
```

We could then use a property binding to add these inline styles to a HTML element in our template like so:

```
<div [ngStyle]="elementStyles()">
  Text content will now be bold, set at 1.1em’s in size and rendered in charcoal
   black.
</div>
```

Property binding is an Angular 2 syntax for using brackets to bind values to an element’s property - and even though this might look a little strange the square brackets are actually valid HTML.

For a more detailed look at Angular 2 property binding feel free to visit the following blog article: http://blog.thoughtram.io/angular/2015/08/11/angular-2-template-syntax-demystified-part-1.html

ngClass

Multiple CSS classes can be added dynamically to elements within a template using the ngClass directive.

These classes would firstly be defined within the Sass file for the page component and then programmatically assigned through a method within the component class before finally being bound to an element (or elements) within the template using the ngClass directive.

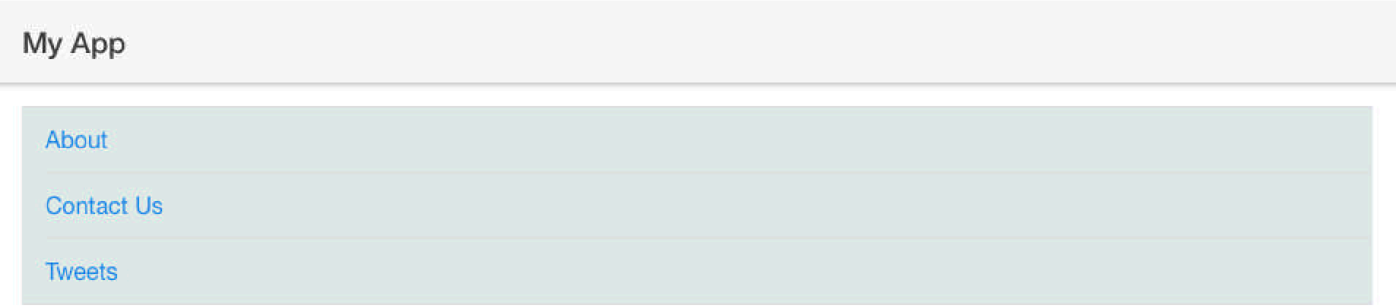
Here’s how this process might look across a page component’s Sass, TypeScript and HTML files (changes highlighted in bold):

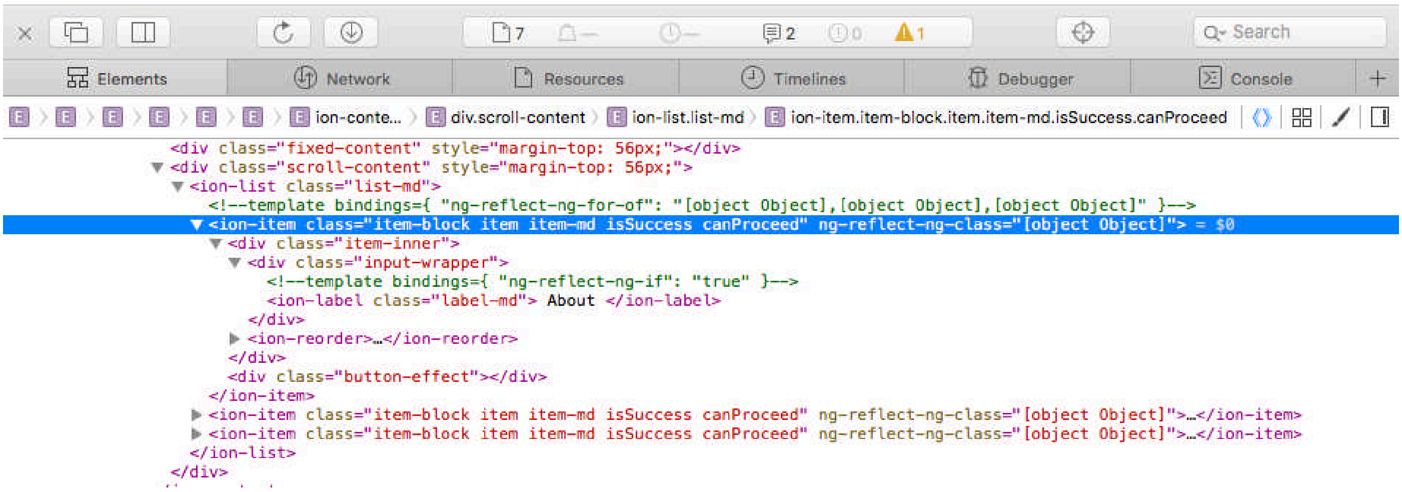
```
// 1 - src/pages/home/home.scss
page-home {
  .isSuccess {
        color: #1E88E5 !important;
  }

  .isError {
        color: #D43669 !important;
  }

  .isWarning {
        color: #d4d34f !important;
  }

  .canProceed {
        background-color: #deeae8;
  }
}


// 2 - src/pages/home/home.ts
export class HomePage {
  ...
  public isSuccess: boolean;
  public isError: boolean;
  public isWarning: boolean;
  public canProceed: boolean;
  constructor(public navCtrl: NavController) {
    ...
    this.isSuccess = true;
    this.isError      = false;
    this.isWarning  = false;
    this.canProceed  = true;
  }

  elementClasses() {
   let classes =  {
     isSuccess: this.isSuccess,
     isError: this.isError,
     isWarning: this.isWarning,
     canProceed: this.canProceed
  };
  return classes;
}
  ...
}


// 3 - src/pages/home/home.html
<ion-content padding>
  <ion-list>
<ion-item *ngFor="let page of pages" (click)="setNavigationLink(page.link)"
[ngClass]="elementClasses()">
```

The important thing to note here is that multiple styles are bound within a key/value object (defined within the **elementClasses** method) within the component class.

Each key in this object is the name of a CSS class (as defined in our Sass file) with a corresponding boolean value to determine whether that class will be rendered in the component HTML template.

Which, when previewed in our browser using ionic serve, will display the following style changes to our HTML template:





```
        <div class="fixed-content" style="margin-top: 56px;"></div>
      ▼ <div class="scroll-content" style="margin-top: 56px;">
        ▼ <ion-list class="list-md">
            <!--template bindings={ "ng-reflect-ng-for-of": "[object Object],[object Object],[object Object]" }-->
          ▼ <ion-item class="item-block item item-md isSuccess canProceed" ng-reflect-ng-class="[object Object]"> = $0
            ▼ <div class="item-inner">
              ▼ <div class="input-wrapper">
                  <!--template bindings={ "ng-reflect-ng-if": "true" }-->
                  <ion-label class="label-md"> About </ion-label>
                </div>
              ▶ <ion-reorder>…</ion-reorder>
              </div>
              <div class="button-effect"></div>
            </ion-item>
          ▶ <ion-item class="item-block item item-md isSuccess canProceed" ng-reflect-ng-class="[object Object]">…</ion-item>
          ▶ <ion-item class="item-block item item-md isSuccess canProceed" ng-reflect-ng-class="[object Object]">…</ion-item>
          </ion-list>
        </div>
```

We can also see in the Web Inspector console that the **isSuccess** and **canProceed** CSS classes have been attached to the <ion-item> UI component.

ngClass is useful for attaching multiple classes to a page element but what if we only wanted to attach/remove a single class?

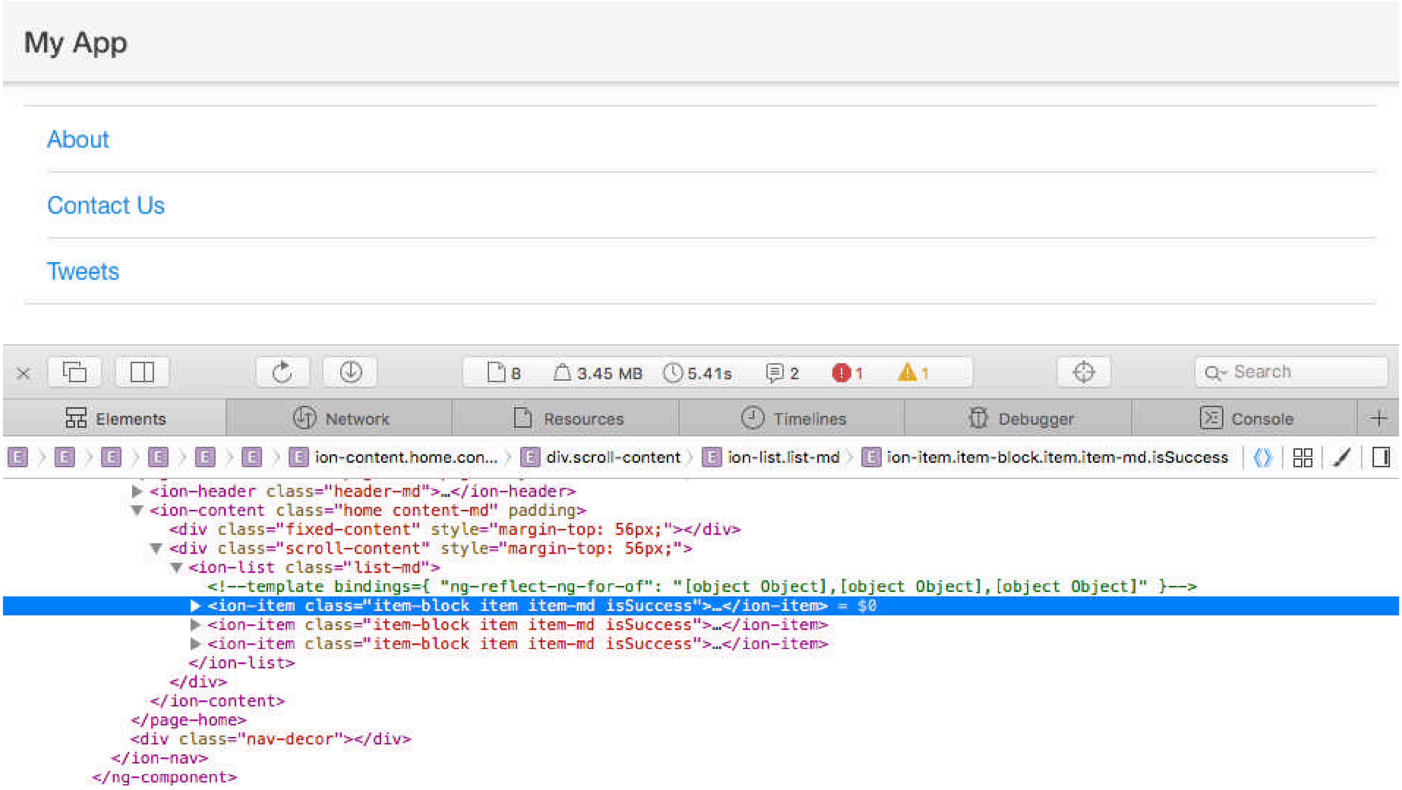
This is easily achieved using a class binding which allows a CSS class to be added or removed from an element depending on whether a certain condition is true or not.

Say we only wanted to attach the **isSuccess** CSS class to each iterated item in our home page template we would use a class binding like so (highlighted in bold):

```
<ion-item *ngFor="let page of pages" (click)="setNavigationLink(page.link)"
[class.isSuccess]="isSuccess">
```

You’ll notice that we bind to a CSS class of **isSuccess** and then assign its value to the related **isSuccess** property from our component class. This will then determine whether this CSS class is displayed or not.

When we view our app in the browser now we should see something like the following being displayed:



```
      ▶ <ion-header class="header-md">…</ion-header>
      ▼ <ion-content class="home content-md" padding>
          <div class="fixed-content" style="margin-top: 56px;"></div>
        ▼ <div class="scroll-content" style="margin-top: 56px;">
          ▼ <ion-list class="list-md">
              <!--template bindings={ "ng-reflect-ng-for-of": "[object Object],[object Object],[object Object]" }-->
            ▶ <ion-item class="item-block item item-md isSuccess">…</ion-item> = $0
            ▶ <ion-item class="item-block item item-md isSuccess">…</ion-item>
            ▶ <ion-item class="item-block item item-md isSuccess">…</ion-item>
            </ion-list>
          </div>
        </ion-content>
      </page-home>
      <div class="nav-decor"></div>
    </ion-nav>
  </ng-component>
```

Voilà!

Now the **isSuccess** CSS class is attached to each list item.

That pretty much covers all we really need to know about using Angular 2’s built-in template directives (and we will be revisiting and using some of these in subsequent chapters) so let’s return to working with our Ionic List component.

Managing our home page list

As you can see our list looks plain and, well, kind of boring if I’m going to be honest. It’s not particularly appealing even if it does get the job done (and that job is done quite well I might add) and definitely needs some further design enhancements.

We could modify the styling for our List component using the application Sass files but that would be a little overkill when we can rely on a far easier option instead.

Let’s look at what the Ionic Component API offers and how we might be able to use that to give our list a little more “oomph”.

At the moment we have implemented a basic list but there’s lots of list variations we could choose from:

- Inset Lists
- List Dividers
- List Headers
- Icon List
- Avatar List
- Multi-line List
- Sliding List
- Thumbnail List

Further information on the List Component API options is available via the Ionic online docs: http://ionicframework.com/docs/v2/components/#lists

Let’s play with a couple of these List variations in our app.

Exercise 1 - Adding a Multi-line List

As the name implies a Multi-line List displays multiple items in each <ion-item> component over more than one line.

When an <ion-item> component contains multiple lines of content its height will be automatically adjusted to fit these items making it an ideal choice for displaying elements such as headings, thumbnail images and short summaries.

To implement this list type in our home page component firstly take a moment to navigate to the following location in the download files for this chapter: **Templates/multi-line-list/myApp/src/assets/**

and copy the images directory contained within there to the **myApp/src/assets** project directory on your own machine.

Once this is completed (and you will need the images located within that directory for this exercise) open your local **myApp/src/pages/home/home.ts** file and make the following changes to the class (highlighted in bold):

```
export class HomePage {
  public pages : Array<{title: string, thumb: string, description: string, link:
any}>;

  constructor(public navCtrl: NavController) {
     this.pages = [
      { title : 'About',
        thumb : 'assets/images/about.png',
        description: 'Who we are. What we do. Why we&rsquo;re here',
        link : AboutPage
      },
      { title : 'Contact Us',
        thumb : 'assets/images/contact.png',
        description: 'Drop us a line and get in touch we&rsquo;d love to
hear from you!',
        link : ContactPage
      },
      { title : 'Tweets',
        thumb : 'assets/images/tweet.png',
        description: 'The latest news updates from our Twitter account',
        link : TweetsPage
      }
     ];
  }

  ...
}
```

All we’ve done here is add 2 additional keys to our pages object:

- **thumb** (reference to the thumbnail image we want to use for each list entry)
- **description** (a quick summary helping to describe the page)

It’s also important to note that we’ve added these as type definitions to the pages property towards the top of our class.

Without these type definitions the TypeScript compiler would throw up errors as we have modified the pages object and need to state the property types in the pages Array definition.

Now open your **myApp/src/pages/home/home.html** file and make the following changes (highlighted in bold):

```
<ion-list>
  <ion-item *ngFor="let page of pages" (click)="setNavigationLink(page.link)">
   <ion-avatar item-left>
    <img src="{{ page.thumb }}">
   </ion-avatar>
   <h2>{{ page.title }}</h2>
   <p [innerHTML]="page.description"></p>
  </ion-item>
```

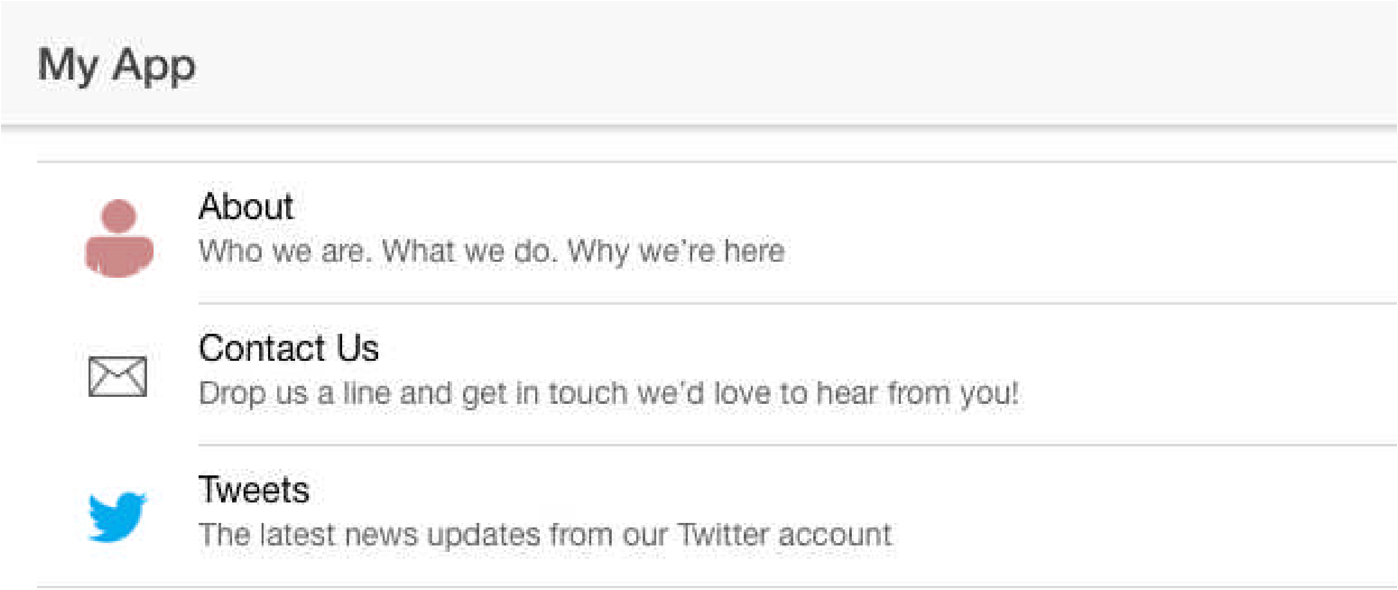
We’ve added an <ion-avatar> component, aligned it to the left of the row (using the item-left attribute), embedded the thumb image from our pages object along with an additional description for the page.

Before we go any further though what’s this [innerHTML] property binding syntax on the **page.description** paragraph tag?

This is an Angular 2 property which allows us to embed HTML content. As some of the values for the page descriptions contain entity encoded characters we need to ensure they display properly which is why we use the [innerHTML] property.

This is a handy little tool to use whenever you're working with entity encoded content (such as HTML returned in JSON from an Ajax call) that might need to be displayed within your apps.

Okay, so now those amendments have been made and saved the ionic server (if running in your Terminal) should refresh your browser and display the following list:



My App

About
Who we are. What we do. Why we're here

Contact Us
Drop us a line and get in touch we'd love to hear from you!

Tweets
The latest news updates from our Twitter account

Now isn't that a much nicer list?

Let's take a look at one more type of list we can make use of in our apps before exploring some additional components that we can add to our page templates.

Exercise 2 - Adding a Sliding List
This type of list contains items that can be swiped left or right to reveal previously hidden button options. For those of you with iPhones you'll probably be most familiar with this feature when using the Messages or Mail applications to delete individual messages.

Now we'll return to the home page component for our app and make adjustments to implement a Sliding List.

Open up the **myApp/src/pages/home/home.html** template and implement the following changes (highlighted in bold):

```
<ion-list>

  <ion-item-sliding *ngFor="let page of pages">
    <ion-item (click)="setNavigationLink(page.link)">
      <ion-avatar item-left>
        <img src="{{ page.thumb }}">
      </ion-avatar>
      <h2>{{ page.title }}</h2>
      <p [innerHTML]="page.description"></p>
    </ion-item>
    <ion-item-options side="right">
      <button ion-button color="primary" (click)="buttonOne(page.title)">
      <ion-icon name="text"></ion-icon>
        BUTTON 1
      </button>
      <button ion-button color="secondary"
        (click)="buttonTwo(page.title)">
        <ion-icon name="call"></ion-icon>
          BUTTON 2
      </button>
    </ion-item-options>
  </ion-item-sliding>

</ion-list>
```

We've added an <ion-item-sliding> component inside of the <ion-list> on which we place our ngFor directive for looping through the pages object.

Within our <ion-item-sliding> component we have 2 components:

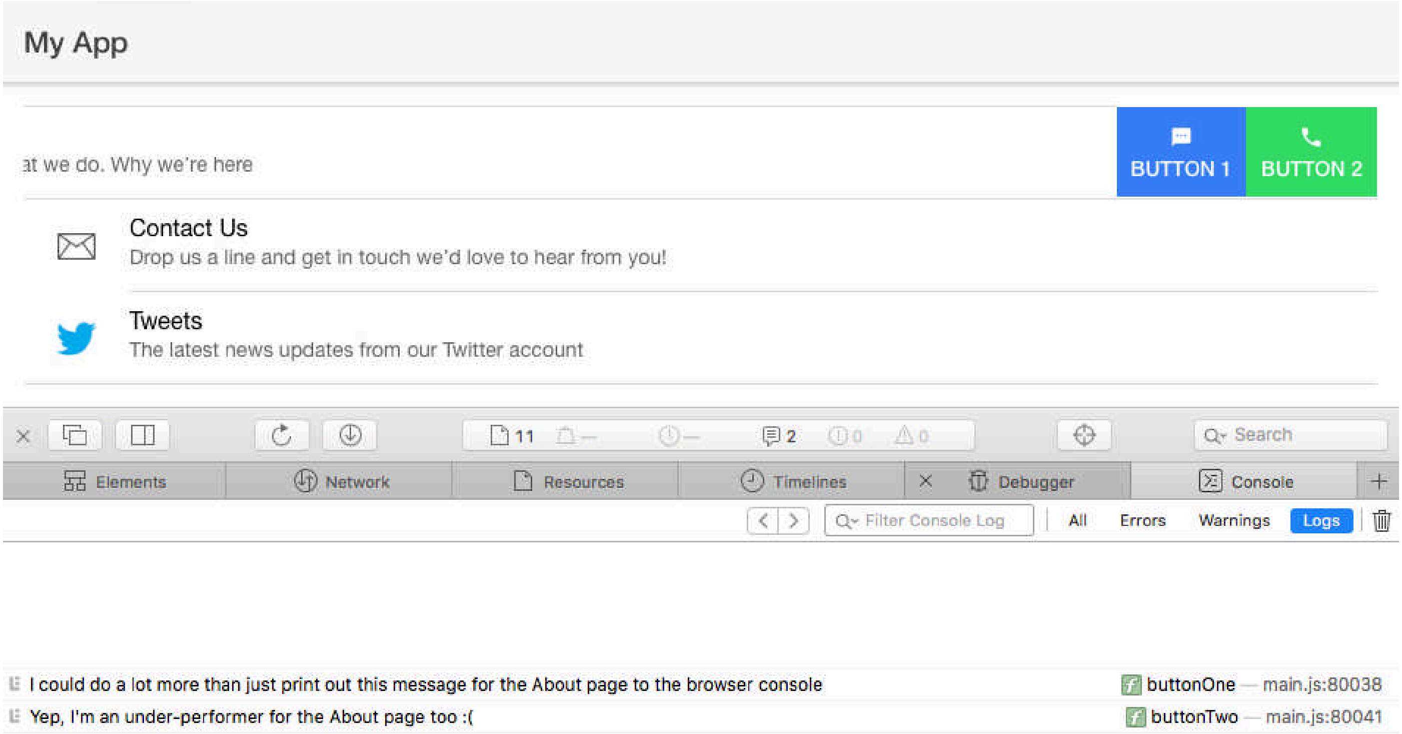
- <ion-item> for organising the content for the list
- <ion-item-options> which contains two hidden buttons (with click events bound to them) that are activated when swiping in from the right

We will now add the following methods for these click events to the component class in the **myApp/src/pages/home/home.ts** file (highlighted in bold):

```
...
export class HomePage {


  ...


  constructor(public navCtrl: NavController) {
    ...
  }


  ...


   buttonOne(page)
   {
      console.log(`I could do a lot more than just print out this message for
the ${page} page to the browser console`);
   }

   buttonTwo(page)
   {
      console.log(`Yep, I'm an under-performer for the ${page} page too :(`);
   }


  ...


}
```

Nothing terribly exciting here - all we're doing is printing a message to the browser console.

If we preview our app in the browser now we should see those hidden buttons being revealed when we swipe our links to the right and, when we click onto each button, a console log being generated in the Web Inspector window like so:



```
I could do a lot more than just print out this message for the About page to the browser console    buttonOne — main.js:80038
Yep, I'm an under-performer for the About page too :(                                               buttonTwo — main.js:80041
```

Now that's pretty impressive isn't it?

With a handful of pre-existing components we can create an attractive, usable and engaging interface for our users in very little time at all.

Exercise 3 - Adding the Slides component

The Slides component allows multiple content to be loaded (I.e. images, video or plain text), as individual slides, into a single container which can then be swiped through without the user leaving the current page - similar to a jQuery slideshow plugin.

The slides container is defined with the <ion-slides> component and each slide is created using the <ion-slide> child component.

From the download files for this chapter copy the images in the following directory: **Slides/myApp/src/assets/images/** to the same directory in your own local app.

Let's make the following changes to the **myApp/src/pages/about/about.html** template (highlighted in bold):

```
<ion-content padding>

  <ion-slides #picSlider
    (ionDidChange)="onSlideMoved()" [options]="opts">
    <ion-slide>
      <ion-item>
        <h1># 1</h1>
        <img src="assets/images/slide1.jpg">
        <h2>Paris (2007)</h2>
        <p>Monument to the tomb of the unknown soldier</p>
      </ion-item>
    </ion-slide>

    <ion-slide>
      <ion-item>
        <h1># 2</h1>
        <img src="assets/images/slide2.jpg">
        <h2>Paris (2007)</h2>
        <p>Parisian sculpture/monument</p>
      </ion-item>
    </ion-slide>

    <ion-slide>
      <ion-item>
        <h1># 3</h1>
        <img src="assets/images/slide3.jpg">
        <h2>Paris (2007)</h2>
        <p>View from the Arc d’triomphe</p>
      </ion-item>
    </ion-slide>
  </ion-slides>

</ion-content>
```

If we break the above code snippet down here's what we've done:

- Added a slide container with the **<ion-slides>** component
- On the **<ion-slides>** component we've added a local *template reference variable* called **picSlider**, a target event for the **ionDidChange** event (which triggers a method called **onSlideMoved**) and set the options property of the component to a value of **opts**, using property binding
- We then created 3 separate slides within our **<ion-slides>** component using the **<ion-slide>** component
- Within each **<ion-slide>** component we wrap our content for the slide within an **<ion-item>** component

Template reference variables

This is the first time we've used a *template reference variable* in our templates so let's cover what these are and why they're useful.

A template reference variable is a reference to a native DOM element, Angular 2 directive or any custom web component and can be added on the same element, sibling elements or child elements within the template.

The hash prefix for the #picSlider template reference variable simply means we are defining a variable called picSlider. This could also be written as ref-picSlider instead of #picSlider.

So, in the above code #picSlider is a reference to the <ion-slides> container.

We will then make this reference available in the associated TypeScript class so we can access the <ion-slides> component methods where necessary.

Scripting the logic for our Slides component

Now that we have set up our template with the slides and their content we need to add the necessary logic in the TypeScript class to be able to interact with the slides.

Actually we could use the Slides component without adding any logic to our TypeScript class but it’s more fun to see how we could interact with this component’s API methods and properties instead.

In the **myApp/src/pages/about/about.ts** file add the following (highlighted in bold):

```
import { Component, ViewChild } from '@angular/core';
import { NavController, Slides } from 'ionic-angular';

@Component({
  selector: 'page-about',
  templateUrl: 'about.html'
})
export class AboutPage {
  @ViewChild('picSlider') viewer: Slides;

  constructor(public navCtrl: NavController)  {  }

  slideOpts = {
    pager: true,
    speed: 750
  };

  onSlideMoved()
  {
      let currIndex = this.viewer.getActiveIndex(),
           numSlides = this.viewer.length(),
           firstSlide = this.viewer.isBeginning(),
           lastSlide = this.viewer.isEnd();

      console.log(`Current index is, ${currIndex}`);
      if(firstSlide)
      {
         console.log(`This is the first slide of ${numSlides} slides`);
```

```
     }
    else if(lastSlide)
    {
      console.log(`This is the last slide of ${numSlides} slides`);
    }
  }

}
```

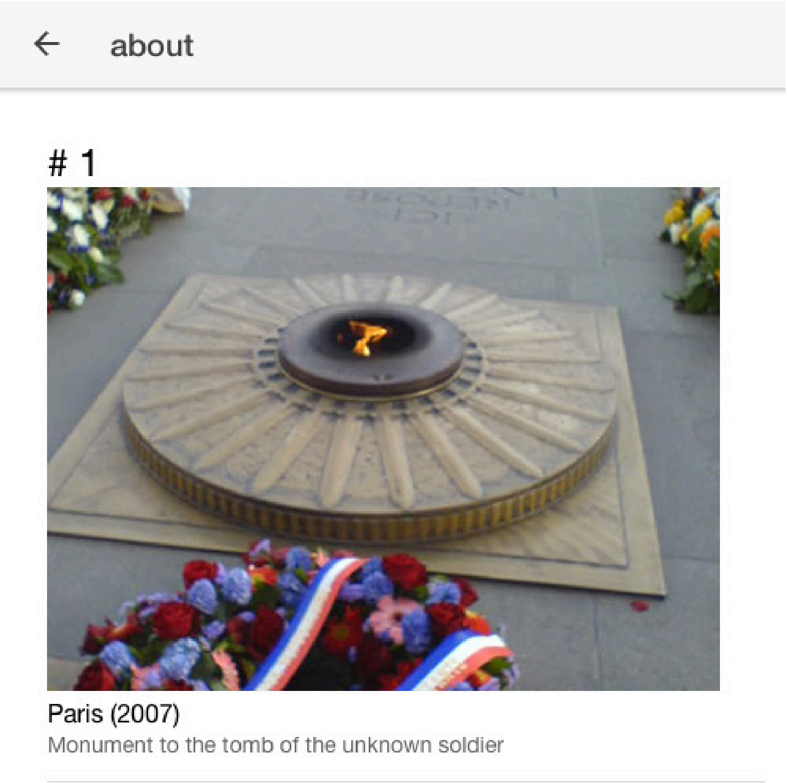
There's quite a bit going on here so let's look at each key change in further detail:

- We import the **ViewChild** and **Slides** components at the top of our file
- We use the @ViewChild annotation to access the methods for the Ionic Slides component, passing in the template reference variable of **picSlider**, assign that to a property of **viewer** while providing a type definition of **Slides**
- Next we create an object called **slideOpts** which stores the configuration options for our **Slides** component (these are part of the Slides component API - the pager property defines whether we display pagination bullets and the speed property defines, in milliseconds, how long the transition between slides will last
- Following from this we then create a method of **onSlideMoved** which utilises the **viewer** property (created from the @ViewChild annotation earlier in the class) to access the Slides component API methods
- The **onSlideMoved** method simply logs the current slide index and whether or not this is the first or last slide to the browser console

All in all, this is a pretty basic script, it doesn't do anything particularly useful or fancy but that's not the point.

What we're really interested in here is seeing the Slides component in action and how we can plug into its methods using the template reference variable of **picSlider**.

Save the changes to both of these files and then, if Ionic serve is still running (and if it isn't - then run it from your terminal!), you should be able to navigate to the about page and preview these changes in your browser like so:



Paris (2007)
Monument to the tomb of the unknown soldier

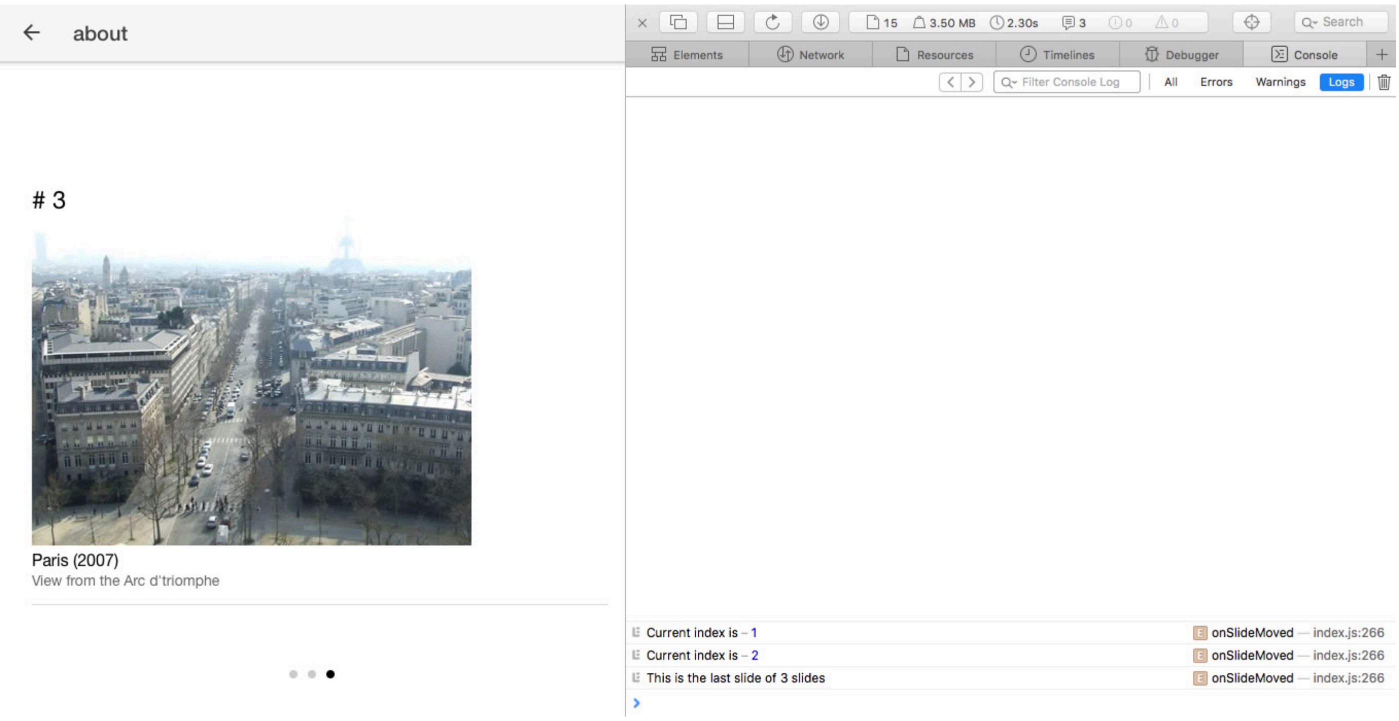
You should see, as shown in the image on the left, the first of the slides being displayed with a paging indicator towards the bottom of the screen.

Basic but nice.

Now if you drag with your mouse (or trackpad if using a laptop) from the right of the current slide to the left of the screen you should see this slide starting to disappear and the next slide in our series transition into view instead.

And the logic that we added into the class for the **myApp/src/pages/about/about.ts** file?

Open the browser Web Inspector, select the console tab (if it isn't already selected), and, when the transition from one slide to the next has completed, you should see the following output printed to the console:



Paris (2007)
View from the Arc d'triomphe

```
Current index is – 1                         onSlideMoved — index.js:266
Current index is – 2                         onSlideMoved — index.js:266
This is the last slide of 3 slides           onSlideMoved — index.js:266
```

For the eagle eyed amongst you'll notice that the current index for the last slide is logged to the web console as 2 yet we have a total of 3 slides.

No - this isn't a mistake. The index for the first slide in the <ion-slides> container always starts at 0 not 1.If you swipe back to the first slide you'll see the current index being listed in the browser console as 0.

In this exercise not only have we added the Slides component to our page but also hooked into its methods and used those to extract data about the current slide and then print that to the browser console once the slide has completed transitioning into view.

For further information about this component and its available methods visit the online documentation here: http://ionicframework.com/docs/v2/api/components/slides/Slides/

Exercise 4 - Adding the Modal component

A modal is a form of temporary UI that slides into the screen, over the page content, and is often used for login/registration forms, composing messages or presenting app configuration options for example.

For the last exercise in this chapter we'll incorporate the Modal component into a template within our app and play with some of the available methods and properties in the process.

Let's create a new page for our app with the following command in our Terminal:

```
ionic g page technologies
```

This page will contain a list of technologies used within the app that, when an individual technology listing is clicked on, will open a modal overlay with further information about that selected listing.

Once this page has been successfully created through the Ionic CLI open the

myApp/src/pages/technologies/technologies.html template and make the following changes (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>Technologies</ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
  <ion-list>
    <ion-list-header>
      Technologies
    </ion-list-header>
    <ion-item
         *ngFor="let technology of technologies"
         (click)="activateModal(technology)">
         {{ technology.name }}
    </ion-item>
  </ion-list>
</ion-content>
```

The only “surprise” in the above code would be the inclusion of the <ion-list-header> component which adds a header to our list.

The **<ion-list>** and **<ion-item>** components, Angular 2 ***ngFor** directive and event binding should be familiar from previous examples in this chapter.

Now we need to amend our **myApp/src/pages/technologies/technologies.ts** file to create the technologies object and the **activateModal** method which are being implemented into each iterated <ion-item> component in the above template.

Open the **myApp/src/pages/technologies/technologies.ts** file and make the following changes (highlighted in bold):

```
import { Component } from '@angular/core';
import { ModalController, NavController} from 'ionic-angular';
import { Modals } from '../modals/modals';

@Component({
  selector: 'page-technologies',
  templateUrl: 'technologies.html'
})
export class TechnologiesPage {
  public technologies:  Array<{name: string, date: string, summary:
string, website: any}>;

   constructor(public nav: NavController, public modalCtrl: ModalController)
   {
      this.technologies = [
      {
         name: "Angular JS",
         date: "October 20th 2010",
         summary: "Web application framework developed and maintained
by Google",
         website: "http://www.angular.org"
      },
      {
         name: "Apache Cordova",
         date: "2009",
         summary: "Develop mobile apps with HTML, CSS &amp; JS and
publish to multiple platforms from one single codebase",
         website: "https://cordova.apache.org"
      },
      {
         name: "TypeScript",
         date: "October 1st 2012",
         summary: "Strict superset of JavaScript developed and maintained
by Microsoft",
      website: "http://typescriptlang.org"
    }];
  }



  activateModal(link)
  {
    let modal = this.modalCtrl.create(Modals, link);
    modal.present();
  }

}
```

If we break this down here’s what we are accomplishing with the above class:

- Imported the **ModalController** component
- Imported a custom component called **Modals** (which we will create shortly!)
- Created a **technologies** array - which is then initialised within the constructor
- Created the **activateModal** method which calls the **create** and **present** methods of the **ModalController** class

At this point we need to pay attention to the **activateModal** method and its use of one particular method of the **ModalController** class - **create**.

This method accepts 3 parameters:

- Component Type - The modal view
- Data - Any data to be passed to the modal (optional)
- Modal options - Configuration options for the modal (optional)

The first parameter - the component type - refers to a class which is used to define the modal view.

There’s only one little snag with our use of this class in the **activateModal** method.

The Modals class doesn’t exist!

Using the Ionic CLI let’s create a new page called modals:

```
ionic g page modals
```

Now open the newly created **myApp/src/pages/modals/modals.ts** file and make the following amendments (highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController, ViewController, NavParams } from 'ionic-angular';

@Component({
  selector: 'page-modals',
  templateUrl: 'modals.html'
})
export class Modals {
   public name : string;
   public summary : string;
   public website : string;

   constructor(
      public navCtrl: NavController,
      public params: NavParams,
      public viewCtrl: ViewController
   )
   {
      this.name          = this.params.get('name');
      this.summary       = this.params.get('summary');
      this.website       = this.params.get('website');
   }
   closeModal()
   {
      this.viewCtrl.dismiss();
   }
}
```

In the **Modals** class we use the **NavParams** object to extract the data passed to our modal through the **activateModal** method from the **TechnologiesPage** class.

We then assign this data to properties which will then be implemented in the **myApp/src/pages/modals/modals.html** template.

Finally we create a **closeModal** method which will allow the modal window when open to be closed.

In your favourite IDE (I'm a fan of Sublime Text but take your pick of whichever software works best for you) open the **myApp/src/pages/modals/modals.html** file and make the following amendments (highlighted in bold):

```
<ion-header>
   <ion-toolbar>
      <ion-title>
         Description
      </ion-title>
      <ion-buttons start>
         <button ion-button color="primary" (click)="closeModal()">
            <span>Close</span>
            <span showWhen="ios">Cancel</span>
            <ion-icon name="md-close" showWhen="android,windows"></
ion-icon>
         </button>
      </ion-buttons>
   </ion-toolbar>
```

```
</ion-header>
<ion-content>
  <ion-list>
    <ion-item>
      <h2>{{ name }}</h2>
      <p [innerHTML]="summary"></p>
      <p>
        <br>
        <a href="{{ website }}" target="_blank">Visit website</a>
      </p>
    </ion-item>
  </ion-list>
</ion-content>
```

Okay, nothing too involved or complex here.

Within our **<ion-header>** component we add an **<ion-toolbar>** component which contains an **<ion-buttons>** component to display the button to close our modal.

In our **<ion-content>** section we create a list to display the properties from the **ModalsPage** class.

Unfortunately, if we try to run this in our browser with Ionic serve we won’t actually be able to get to the technologies page as we don’t have any link from our home page to get there!

Let’s change that by adding the following addition to the pages object in the **myApp/src/pages/home/home.ts** file (highlighted in bold):

```
import {TechnologiesPage} from '../technologies/technologies';

...
constructor(public navCtrl: NavController) {
```

```
this.pages = [
     {
        ...
     },
     {
        ...
     },
     {
       title : 'Technologies',
       thumb : 'assets/images/tech.png',
       description: 'Third party resources used by this app',
       link : TechnologiesPage
     },
     {
        ...
     }
    ];
```

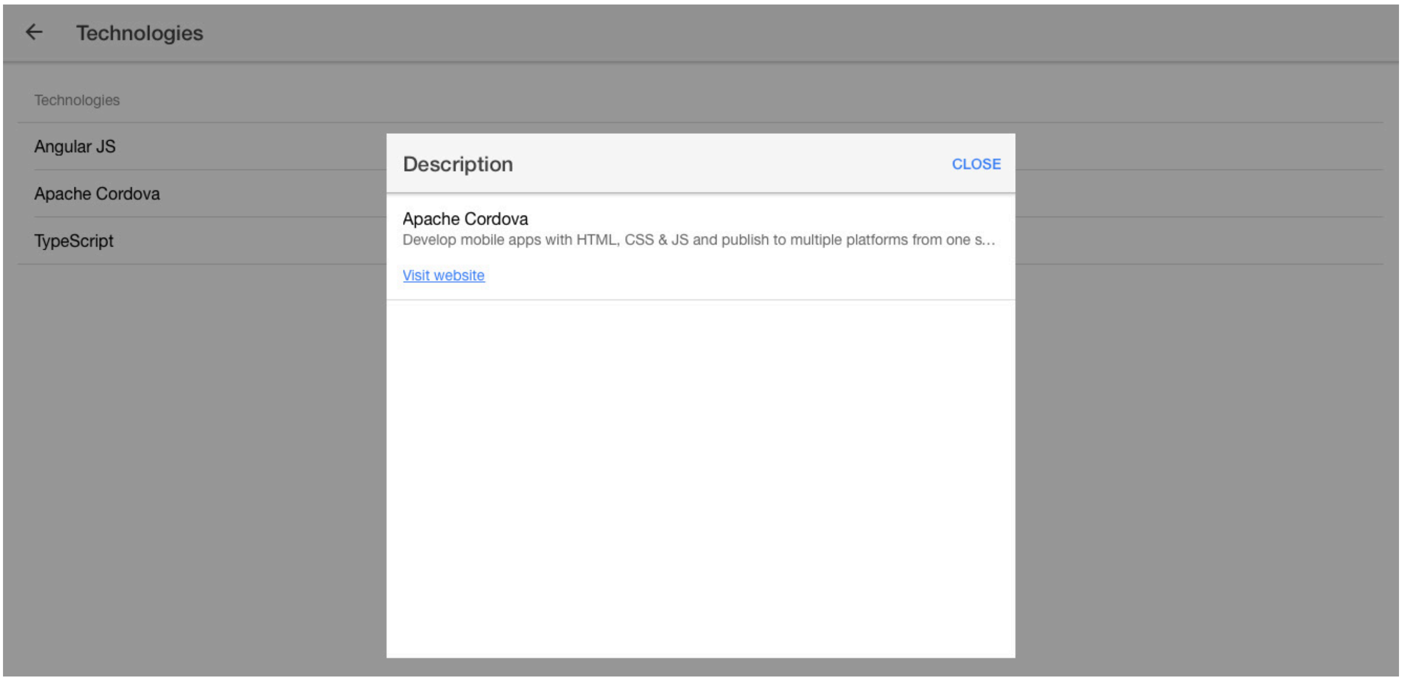
The penultimate step now involves registering the technologies and modals components with the root module for the app - the **myApp/src/app/app.module.ts** file (amendments highlighted in bold):

```
import { NgModule } from '@angular/core';
import { IonicApp, IonicModule } from 'ionic-angular';
import { MyApp } from './app.component';
import { HomePage } from '../pages/home/home';
import { AboutPage } from '../pages/about/about';
import { ContactPage } from '../pages/contact/contact';
import { TechnologiesPage } from '../pages/technologies/technologies';
import { TweetsPage } from '../pages/tweets/tweets';
import { Modals } from '../pages/modals/modals';

@NgModule({
  declarations: [
    MyApp,
    HomePage,
    AboutPage,
    ContactPage,
    TechnologiesPage,
    TweetsPage,
    Modals
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage,
    AboutPage,
    ContactPage,
    TechnologiesPage,
    TweetsPage,
    Modals
  ],
  providers: []
})
export class AppModule {}
```

Finally, from the download files for this chapter copy the images in the **Modal/ myApp/src/assets/images/** directory to the same directory in your own local app.

Once this has been done we can then preview the app in the browser by running the **ionic serve** command from the Terminal/Command Prompt.

When published to the browser navigate to the Technologies page, click on the Apache Cordova link and you should be greeted with the following modal window:



Technologies

Technologies

Angular JS

Apache Cordova

TypeScript

Description

Apache Cordova

Develop mobile apps with HTML, CSS & JS and publish to multiple platforms from one s...

Visit website

Result!

Of course there's a lot more we could do with the Modal component but I'll leave that to you to play around with and subsequently build on the above example.

You can read the API docs for the Modal component here: http://ionicframework.com/docs/v2/api/components/modal/ModalController/.

What's impressive about Ionic 2's component API is that we can quickly and easily implement functionality such as Lists, Slides and Modals into our pages - and these are only a fraction of the UI components provided by the framework.

For further information the online documentation for all Ionic 2 UI components is available here: http://ionicframework.com/docs/v2/components/.

If you're feeling brave, you might try devoting some time to peering into the source code for each Ionic UI component located within the following app directory: **node_modules/ionic-angular/components/**.

During subsequent chapters we'll start to use more of these components but here we conclude our basic introduction to templating and instead turn our attention in the next chapter to theming Ionic 2 apps.

Resources

All project files for this chapter can be found listed in the download links on page 636.

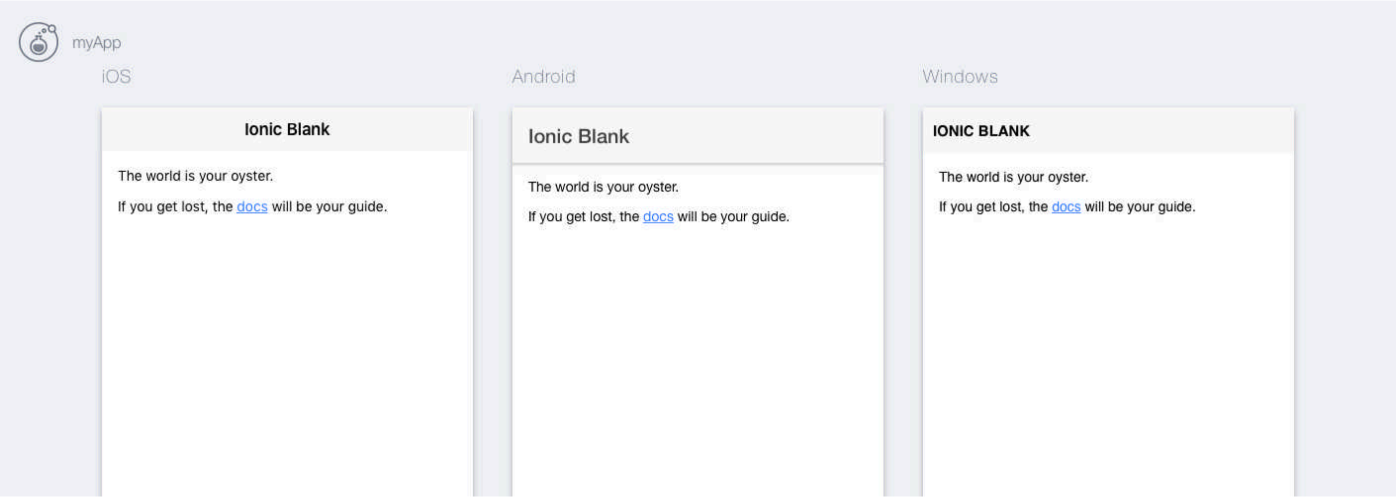
Theming
Ionic 2 apps

By default every app you develop with Ionic 2 comes with pre-built themes for iOS, Android & Windows Phone. This means that UI components that are added to our templates are already styled to not only appear aesthetically pleasing but also match the style conventions of the platform that the app is being published to.

If we take a look at the technologies screen of the myApp project, for example, across iOS, Android & Windows Phone using the following command:

```
// Add lowercase L as a flag after the command
ionic serve -l
```

We can see the following variations, displayed side by side, in how font sizes & styles, header bars and the alignment of page headings are rendered on the screen for each different platform:



Ionic Blank

The world is your oyster.

If you get lost, the docs will be your guide.

Ionic Blank

The world is your oyster.

If you get lost, the docs will be your guide.

IONIC BLANK

The world is your oyster.

If you get lost, the docs will be your guide.

These style variations are driven through the use of the following platform specific Sass files:

- **node_modules/ionic-angular/themes/ionic.globals.ios.scss**
- **node_modules/ionic-angular/themes/ionic.globals.scss**
- **node_modules/ionic-angular/themes/ionic.globals.md.scss**
- **node_modules/ionic-angular/themes/ionic.globals.wp.scss**

We'll take a look at each of these files in more detail below.

ionic.globals.ios.scss
This Sass file imports globally shared style rules and iOS specific rules only - all of which are targeted, as you might have guessed, for use on Apple mobile & tablet devices.

The Apple human interface guidelines for iOS design/development are available here: https://developer.apple.com/ios/human-interface-guidelines/

ionic.globals.scss
This Sass file imports Sass functions, mixins and defines variables that will be used globally for the app.

ionic.globals.md.scss
Imports style rules, globally shared and Android specific only, targeted specifically for use on the Android platform.

The md in the name of the file stands for Material Design which is a visual language developed by Google that aims to describe and promote good design principles and practice for the Android platform.

More information on Material Design is available here: https://material.google

ionic.globals.wp.scss
This is where style rules, globally shared and those that are Windows Phone only, are imported for use on the Windows Phone platform.

Design & UI information for developers targeting Windows 10 based devices is available here: https://developer.microsoft.com/en-us/windows/design.

You'll never have a call to amend these files but it's important to be aware of how each platform is initially themed through their use.

Custom Themes

The **src/themes** directory allows us Sass variables to be implemented through the **variables.scss** file.

Global styles

Style rules to be applied globally as well as those that are platform specific should be written within the **src/app/app.scss** file.

Variables

The **src/themes/variables.scss** file contains various Ionic Sass functions, mixins and variables (which are applicable across all targeted platforms) imported from the **node_modules/ionic-angular/themes/ionic.globals.scss** file as well as sections that are devoted solely for implementing platform specific variables.

Some of the cross-platform variables are displayed in the following $colors map:

```
$colors: (
  primary:      #387ef5,
  secondary:  #32db64,
  danger:        #f53d3d,
  light:            #f4f4f4,
  dark:             #222,
  favorite:       #69BB7B
);
```

Ionic uses keys from the above $colors map as component properties, typically on buttons, to provide their CSS style which we can see implemented in some of the components that we worked with during the last chapter.

For example, if you go back to the Sliding Lists exercise in the last chapter you'll see this little snippet of code which defines the hidden buttons for our list that are revealed when an item is swiped:

```
<ion-item-options side="right">
        <button ion-button color="primary" (click)="buttonOne(page.title)">
          <ion-icon name="text"></ion-icon>
          BUTTON 1
        </button>
        <button ion-button color="secondary" (click)="buttonTwo(page.title)">
          <ion-icon name="call"></ion-icon>
          BUTTON 2
        </button>
</ion-item-options>
```

Notice the primary and secondary values (highlighted in bold)?

These are keys drawn from the $colors map in our **variables.scss** file which can, of course, be edited to use whatever colors you desire and there’s nothing stopping you from adding new key/value pairs too.

Let’s say you wanted to provide specific style rules for different types of social media sharing buttons.

We could add these to the $colors map like so:

```
$colors: (
  ...
  twitter:(
    base: #55acee,
    contrast: #ffffff
  ),
  facebook:(
    base: #38669f,
    contrast: #ffffff
  )
);
```

This is a little different to the existing key/value pairs but what we have done in the above is define the key for each social media component and then supply multiple values in the form of a map for each key.

The keys that are supplied in the twitter and facebook maps are as follows:

- base (acts as the background color for a component)
- contrast (acts as the text color for the component)

The base and contrast keys are recognised defaults and parsed by Ionic using colour handling functions provided by the **node_modules/ionic-angular/themes/ionic.functions.scss** file.

By supplying a map of key/value pairs to our social media keys we have greater flexibility in how we can customise style data that we want to add to the $colors map.

UI Components

If you look inside the **node_modules/ionic-angular/components** directory of your app you'll see all of the available UI components for quickly implementing interface elements such as an alert box, modal window or slideshow.

With a few exceptions almost all of these UI components mirror one another in terms of the Sass files they contain:

- component-name-here.scss
- component-name-here.ios.scss
- component-name-here.md.scss
- component-name-here.wp.scss

Each platform specific Sass file imports the global Sass file for that platform into itself as shown in the following for the List component **list.ios.scss** file:

```
@import " ../../themes/ionic.globals.ios";
```

This is a pattern that you'll notice throughout the pre-built Sass files contained within your app - the segregation and modularisation of different types of style rules that are then imported into other Sass files as and where required.

Themes

In addition to each component's respective Sass files our app also contains a *node_modules/ionic-angular/themes* directory which contains the following two pre-baked themes:

- Dark
- Default

The Default theme (which IS the default theme for the app if you hadn't already guessed from the name!) for each platform is imported into their respective files:

- node_modules/ionic-angular/themes/ionic.globals.ios.scss
- node_modules/ionic-angular/ themes/ionic.globals.md.scss
- node_modules/ionic-angular/ themes/ionic.globals.wp.scss

These themes are then imported into the platform specific Sass files for each UI component and the following specific Sass files:

- node_modules/ionic-angular/themes/components.scss
- node_modules/ionic-angular/platform/cordova.ios.scss

What this means is that the team at Ionic have already done the work of not only providing theming for your app but also ensuring that such theming is also tailored on a platform by platform basis too.

This is pretty powerful and gives you the flexibility to develop and publish your app without any CSS modifications whatsoever.

A word of warning here though - Do not EVER manually edit these theme files or the Sass UI component files to change any of the existing Sass rules/variable values that are contained within.

First off, there should NEVER be a need to do this and secondly, doing so could introduce some pretty serious layout & styling bugs or have other unforeseen and unintended consequences - just sayin'!

And if you want to change the default Ionic theme to use the dark theme instead?

Simply include the following import statement for the dark theme towards the top of your **src/theme/variables.scss** file like so:

```
@import "ionic.build.dark";
```

This change would then be seen across all targeted platforms.

Simple as!

This pre-built theming does create a problem though with the potential for many Ionic apps to look the same as one another on the Apple App or Google Play stores unless some level of CSS customisation involved.

Okay, with that said how do we roll our own themes then?

Custom Theming

If all App Store apps looked the same it would be pretty bad - not to mention being downright suspicious, bland, boring and ultimately unattractive right?

If we want our apps to look unique, communicate their own specific branding and ultimately stand out amongst others apps in the online marketplace then we have to implement our own custom theming.

With Ionic 2 there are a number of ways we could achieve this:

- Modifying attributes & theme values
- Override existing Sass variables
- Define custom Sass variables
- Define custom component styles
- Setting mode configurations

Modifying attributes & theme values

The quickest and least disruptive method of customising the app design would be to edit the **src/app/app.scss** file and/or **src/theme/variables.scss** file.

Editing the **src/theme/variables.scss** file gives us the advantage of simply amending preset values to match those of the design palette for our app.

In this file, as we saw earlier in the chapter, we can add additional key/value pairs to the $colors map (amendments displayed in bold):

```
$colors: (
  primary:    #387ef5,
  secondary:  #32db64,
  danger:     #f53d3d,
  light:      #f4f4f4,
  dark:       #222,
  favorite:   #69BB7B,
  twitter:(
    base: #55acee,
    contrast: #ffffff
  ),
  facebook:(
    base: #38669f,
    contrast: #ffffff
  )
);
```

The twitter and facebook keys can then be used as attributes on UI components and DOM elements in our page templates.

Let’s see this at work in our app.

In the **myApp/src/pages/home/home.html** file replace the primary and secondary color values with twitter and facebook values instead (displayed in bold below):

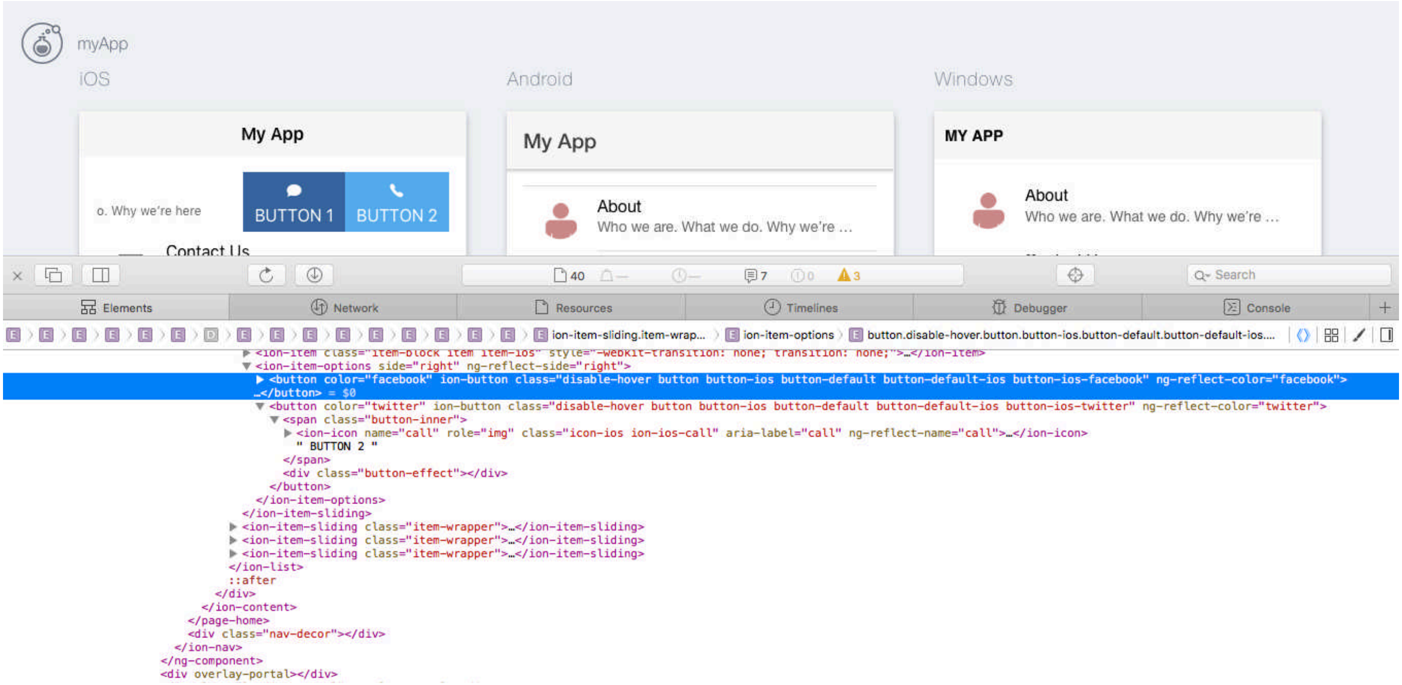
```
<ion-item-options side="right">
   <button ion-button color="facebook" (click)="buttonOne(page.title)">
        <ion-icon name="text"></ion-icon>
        BUTTON 1
   </button>
   <button ion-button color="twitter" (click)="buttonTwo(page.title)">
        <ion-icon name="call"></ion-icon>
        BUTTON 2
   </button>
</ion-item-options>
```

All we’re doing here is simply changing the colours of the background/text colour for the buttons that are revealed when we swipe our list item to the left.

And yes, I DO know they’re not social media buttons!

That’s not the point for this example though as we’re doing this to prove that we can add/change attributes to the **myApp/src/theme/variables.scss** file that can then be used in our page templates as and where required.

If we run the ionic serve command (with or without the lowercase L as an additional flag - the choice is yours!) we should be able to see the changes to these buttons as shown in the following screenshot:


myApp
iOS
Android
Windows
My App
BUTTON 1
BUTTON 2
Contact Us
My App
About
Who we are. What we do. Why we're ...
MY APP
About
Who we are. What we do. Why we're ...
Elements
Network
Resources
Timelines
Debugger
Console
Search
ion-item-sliding.item-wrap...
ion-item-options
button.disable-hover.button.button-ios.button-default.button-default-ios....

```
▶ <ion-item class="item-block item item-ios" style="-webkit-transition: none; transition: none;">…</ion-item>
▼ <ion-item-options side="right" ng-reflect-side="right">
  ▶ <button color="facebook" ion-button class="disable-hover button button-ios button-default button-default-ios button-ios-facebook" ng-reflect-color="facebook">
  …</button> = $0
  ▼ <button color="twitter" ion-button class="disable-hover button button-ios button-default button-default-ios button-ios-twitter" ng-reflect-color="twitter">
    ▼ <span class="button-inner">
      ▶ <ion-icon name="call" role="img" class="icon-ios ion-ios-call" aria-label="call" ng-reflect-name="call">…</ion-icon>
        " BUTTON 2 "
      </span>
      <div class="button-effect"></div>
    </button>
  </ion-item-options>
</ion-item-sliding>
▶ <ion-item-sliding class="item-wrapper">…</ion-item-sliding>
▶ <ion-item-sliding class="item-wrapper">…</ion-item-sliding>
▶ <ion-item-sliding class="item-wrapper">…</ion-item-sliding>
</ion-list>
::after
</div>
</ion-content>
</page-home>
<div class="nav-decor"></div>
</ion-nav>
</ng-component>
<div overlay-portal></div>
```

Here we see the facebook and twitter styles being applied and those attributes displayed on each button component in the browser console.

It's important to note that we could define any type of CSS property, not just background/text colours, in the **myApp/src/theme/variables.scss** file.

If, for example, we wanted to change font sizes, paddings, margins or positioning of elements doing so would be relatively simple using this Sass file.

Using attributes is one of the easiest, fastest and most effective ways to style your app as there are so many pre-existing attributes that can be used and/or modified as required.

Now let's look at overriding existing Sass variables.

Overriding Sass variables

We can also override Ionic Sass variables used in both the themes directory and UI components by simply adding the desired variable name(s) of our choice to the **myApp/src/theme/variables.scss** file like so (indicated in bold):

```
$colors: (
  ...
);

$text-color:                       #686868;
$font-size-base:                   1.6rem;
$list-ios-background-color:        #ffffff;
$list-md-background-color:         #ffffff;
$list-wp-background-color:         #ffffff;
```

Notice in the above examples we have specific platform variants of the same style rules, signified through the presence of ios, md or wp in the naming of the style rule.

This gives you the option of modifying existing styles for a single platform or multiple platforms - the choice is entirely yours.

For a complete list (and be warned - it is a VERY large list) of all the Ionic Sass variables that can be overwritten using the **src/theme/variables.scss** file refer to the following: http://ionicframework.com/docs/v2/theming/overriding-ionic-variables/.

Custom Sass variables

Of course there may be elements in your app design that require Sass variables that have to be created from scratch.

As in previous examples, these can be added to the **src/theme/variables.scss** file but, before you do this, it really is worth your time to check the Ionic variables documentation to ensure that you're not recreating the wheel!

The beauty of creating your own variables is that they can be referenced in multiple classes/Sass files but any edits that are required will only ever involve a change to that variable definition in the **src/theme/variables.scss** file.

For example, if we have a variable called $my-padding which is used to provide the padding values for page elements we could supply something like the following in our **src/theme/variables.scss** file:

```
$colors: (
  ...
);


...
$my-padding: 20px;
```

Then we could supply this as a value for style rules in other classes for our application like so:

```
padding: $my-padding;
```

Now if we want to edit the padding value we only need to make a change in one location: the $my-padding variable in the **src/theme/variables.scss** file.

This makes the inclusion of Sass a no-brainer when it comes to effectively managing the styling for your Ionic app.

Custom component styles

Components generated through the Ionic CLI will contain Sass files that can be used for adding style rules specific to that page only.

The freshly generated **myApp/src/pages/about/about.scss** file, for example, will contain the following selector:

```
page-about {

}
```

This selector matches that listed in the @Component decorator for the **myApp/src/pages/about/about.ts** file (highlighted in bold):

```
@Component({
  selector: 'page-about',
  templateUrl: 'about.html'
})
```

When the build process is triggered through the Ionic CLI all of the application’s Sass files - both Ionic UI and custom Sass files - are converted and compiled into a single CSS file which is published to the following location: **www/build/main.css**.

For example, style rules entered in the **myApp/src/pages/home/home.scss** file are published in the **www/build/main.css** file as:

```
page-home .isSuccess {
  color: #1E88E5 !important;
}

page-home .isError {
  color: #D43669 !important;
}
```

Setting mode configurations

Each platform has a specific mode associated with it by default:

- md (Android)
- ios (iOS)
- wp (Windows Phone)
- md (Core - used for any platform other than the above)

You will have seen examples of variables using these modes earlier in this chapter in the section titled **Overriding Sass variables**.

We can also configure mode values for each platform using the Config API - typically within the imports section of our **src/app/app.modules.ts** file like so:

```
imports: [
    IonicModule.forRoot(MyApp, {
         backButtonText: "",
         backButtonIcon: "md-arrow-back",
         iconMode: "md",
         modalEnter: "modal-md-slide-in",
         modalLeave: "modal-md-slide-out",
         pageTransition: "md",
   });
],
```

The above configuration settings give us the ability to theme our current iOS app to adopt an Android material design look (this is purely for demonstrative purposes as altering the expected iOS UI look & feel/conventions isn't recommended for providing a good user experience - not to mention it might just work against you when submitting your app for Apple's App Store moderation process).

We can however fine tune our configuration settings so they are targeted at specific platforms instead (amendments highlighted in bold):

```
imports: [
    IonicModule.forRoot(MyApp, {
         platforms: {
           android: {
             backButtonText: "",
             backButtonIcon: "md-arrow-back",
             iconMode: "md",
             modalEnter: "modal-md-slide-in",
             modalLeave: "modal-md-slide-out",
             pageTransition: "md",
           },
           ios : {
             backButtonText: "Previous",
             backButtonIcon: "ios-arrow-back",
           iconMode: "ios",
           modalEnter: "modal-ios-slide-in",
           modalLeave: "modal-ios-slide-out",
           pageTransition: "ios",
         }
       }
     });
],
```

Now we have far more granular control of configuring mode settings for each target platform.

The Config API also gives us the ability to individually set platform specific options in our TypeScript classes using the following method:

```
config.set('ios', 'textColor', '#AE1245');
```

This method accepts 3 parameters:

- platform (optional - 'ios' or 'android', if omitted this will apply to all platforms)
- key (optional - The name of the key used to store our value I.e. 'textColor')
- value (optional - The value for the key I.e. '#AE1245')

Keys that are set can then be retrieved using the Config API get method:

```
config.get('textColor');
```

Finally, we also have the ability to set available configuration values at a component level like so:

```
<ion-tabs tabsPlacement="bottom">
  <ion-tab tabTitle="Dash" tabIcon="pulse" [root]="tabRoot"></ion-tab>
</ion-tabs>
```

Personally I prefer to supply a Config object within the import section of the **src/app/app.modules.ts** file (as displayed earlier) but however you want to configure your app Ionic 2 gives you plenty of options to choose from.

That concludes our coverage of the different ways in which we can implement styling and theming for our Ionic 2 apps.

As a general rule, stick to modifying and using existing Sass variables wherever possible as this will definitely help in the long run to limit any potential difficulties with managing your app styling.

Doing so also has the hugely important advantage of not interfering with the pre-configured iOS/Android/Windows Phone styling conventions either - as this is not a behaviour you want to or should break!

With that said let's now turn our attention to using native plugins within our app.

Plugins

One of the key selling points of the Ionic framework is its integration with Apache Cordova allowing mobile/tablet developers to take advantage of its powerful but streamlined plugin API.

Native functionality such as network detection, In-App purchases & media capture, to name but a few, are able to be accessed and used within Cordova based apps on a plugin by plugin basis simply and quickly thanks to this API.

These plugins expose methods that are made accessible through both JavaScript and TypeScript which can then be used to interact with the mobile/tablet device for the purposes that the plugin was designed for.

Without this API our apps would be little more than pre-packaged mobile websites; incredibly limited in scope and not particularly compelling for an end user to want to interact with.

When we create an Ionic app using the CLI tool there are a number of pre-installed plugins available for immediate use within our apps:

- Console (Provides additional console logging functionality for native platforms)
- Device (Provides information about the device hardware and software)
- Splashscreen (Helps control the app splashscreen loading & display)
- Statusbar (Provides ability to customise iOS/Android StatusBar)
- Whitelist (Controls access to external website content)
- Ionic Plugin Keyboard (Assists with keyboard events and interactions)

These are installed in the **plugins** directory which is the designated location for all Cordova based plugins that are to be used within an Ionic 2 app.

If you take a peek inside this directory you'll see most of the plugins are prefixed with cordova-plugin (which, as you've probably guessed, indicates they are Apache Cordova plugins) but the last listed plugin is prefixed with ionic-plugin instead.

This is installed from a Cordova based plugin system called Ionic Native.

Ionic Native

Ionic Native is simply a curated set of Cordova plugins that have been modified to provide wrappers for ES5/ES6 & TypeScript making them compatible with and available for use in Ionic 2 based apps.

This is the successor to the previous ngCordova plugin ecosystem that provided Cordova based plugins for use within Ionic 1 apps.

Using Ionic Native we can choose from over 80 plugins that provide anything from Background Geolocation and accessing the device camera to managing phone contacts and working with SQLite databases.

We'll be working with some of the Ionic Native plugins a little later on in this chapter, and throughout the remainder of this book, but for now further information about this aspect of the Ionic ecosystem, and a full list of curated plugins, can be found here: http://ionicframework.com/docs/v2/native/

A full listing of available plugins for the Apache Cordova framework's can be found here: https://cordova.apache.org/plugins/ and the API methods for non-third party plugins can be found here: https://cordova.apache.org/docs/en/latest/#plugin-apis.

Managing plugins

Even though we have a basic set of initial plugins already installed our app would be pretty limited in functionality if we couldn't add more plugins as and where required.

To add a plugin to your app you would simply use the Ionic CLI tool and, providing you've navigated to the root of your app directory, run the following command:

```
ionic plugin add name-of-plugin-to-be-installed-here
```

And that's pretty much it - Mac/Unix users might need to prefix the above with sudo.

Depending on the speed of your network connection and the plugin repository status the process of installing your plugin can take up to a few minutes to complete.

But how would we know the name of the plugin we want to install?

There's a couple of methods we can use to ascertain this information.

The first method would be to browse either of the following online resources, select the plugin you're most interested in and follow the related instructions:

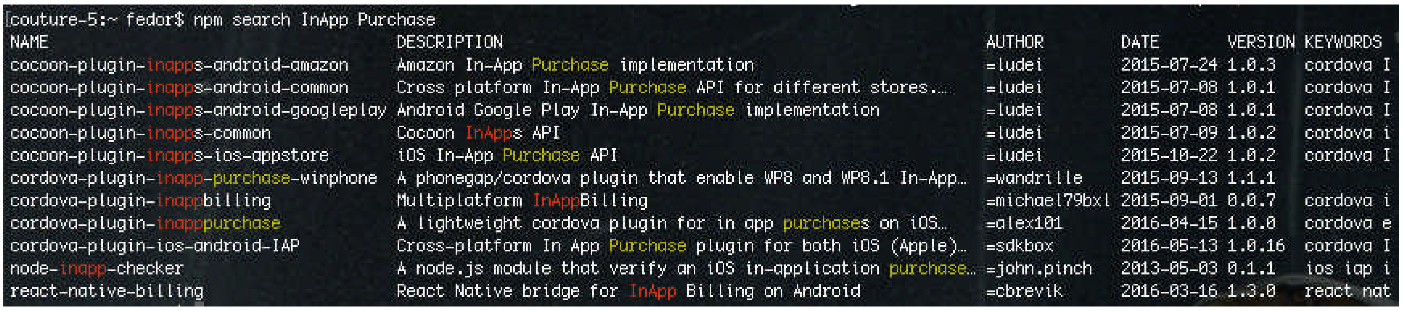
- Ionic Native
- Apache Cordova

The second method involves using the npm CLI tool to search the NPM registry and browse available Cordova plugins.

Let's say I wanted to source all the possible plugins for being able to implement In-App purchase functionality I could perform a search like the following:

```
npm search InApp Purchase
```

Which, if any packages can be found that match the provided search term, should return results akin to the following:



```
couture-5:~ fedor$ npm search InApp Purchase
NAME                                   DESCRIPTION                                                    AUTHOR         DATE       VERSION KEYWORDS
cocoon-plugin-inapps-android-amazon    Amazon In-App Purchase implementation                          =ludei         2015-07-24 1.0.3   cordova I
cocoon-plugin-inapps-android-common    Cross platform In-App Purchase API for different stores.…      =ludei         2015-07-08 1.0.1   cordova I
cocoon-plugin-inapps-android-googleplay Android Google Play In-App Purchase implementation            =ludei         2015-07-08 1.0.1   cordova I
cocoon-plugin-inapps-common            Cocoon InApps API                                              =ludei         2015-07-09 1.0.2   cordova i
cocoon-plugin-inapps-ios-appstore      iOS In-App Purchase API                                        =ludei         2015-10-22 1.0.2   cordova I
cordova-plugin-inapp-purchase-winphone A phonegap/cordova plugin that enable WP8 and WP8.1 In-App…    =wandrille     2015-09-13 1.1.1
cordova-plugin-inappbilling            Multiplatform InAppBilling                                     =michael79bxl  2015-09-01 0.0.7   cordova i
cordova-plugin-inapppurchase           A lightweight cordova plugin for in app purchases on iOS…      =alex101       2016-04-15 1.0.0   cordova e
cordova-plugin-ios-android-IAP         Cross-platform In App Purchase plugin for both iOS (Apple)…    =sdkbox        2016-05-13 1.0.16  cordova I
node-inapp-checker                     A node.js module that verify an iOS in-application purchase…   =john.pinch    2013-05-03 0.1.1   ios iap i
react-native-billing                   React Native bridge for InApp Billing on Android               =cbrevik       2016-03-16 1.3.0   react nat
```

Notice the Cordova prefixed plugin listings under the NAME column? These are the ones we're interested in.

Browsing online is far more effective than searching the npm registry from the command line (but it's kind of interesting to know that you can find plugins this way).

Let's say though that we wanted to install one of the above Cordova packages. We could do this using the following ionic command (prefix with the sudo command on Mac/Unix systems to overcome any permission errors that you may encounter):

```
ionic plugin add cordova-plugin-inapppurchase
```

This would then be installed to the plugins directory of our app and also for the device platform directories, such as Android, that we may have installed too.

Currently in our app there is only the iOS platform and you will have noticed that the Ionic CLI informs us that the plugin is being installed for iOS.

Now that this plugin has been successfully installed we can also use the Ionic CLI to provide a complete listing of all the currently installed plugins:

```
ionic plugin ls
```

Which will output the following list to the CLI console:

```
cordova-plugin-console 1.0.3 "Console"
cordova-plugin-device 1.1.2 "Device"
cordova-plugin-inapppurchase 1.0.0 "In App Purchase"
cordova-plugin-splashscreen 3.2.2 "Splashscreen"
cordova-plugin-statusbar 2.1.3 "StatusBar"
cordova-plugin-whitelist 1.2.2 "Whitelist"
ionic-plugin-keyboard 2.2.1 "Keyboard"
```

There may be times when we need to remove plugins though.

This might, for example, be the case should a plugin we’ve installed be causing our app to crash (it’s rare but it can happen) or we simply don’t need to use that particular plugin.

Accomplishing this is fairly straightforward - as shown in the following command where we remove the plugin that we installed earlier:

```
ionic plugin rm cordova-plugin-inapppurchase
```

Now if we list the installed plugins via the Ionic CLI we should see the following output displayed (minus the removed In-App Purchase plugin):

```
cordova-plugin-console 1.0.3 "Console"
cordova-plugin-device 1.1.2 "Device"
cordova-plugin-splashscreen 3.2.2 "Splashscreen"
cordova-plugin-statusbar 2.1.3 "StatusBar"
cordova-plugin-whitelist 1.2.2 "Whitelist"
ionic-plugin-keyboard 2.2.1 "Keyboard"
```

That pretty much covers the basics of plugins and their management, now let's take a look at one example of how we can use some of these Cordova plugins within our Ionic 2 apps.

Geolocation

One of the handiest features of modern smartphones is geolocation functionality which allows apps to determine/display the user's current geographic location (or closest approximation to).

We'll use the Ionic Native Geolocation and Google Map plugins to implement this functionality in a brand new app.

Start by running the following commands at the root of your **apps/** projects directory:

```
ionic start geoApp blank --v2
cd geoApp
npm install
ionic platform add android
ionic plugin add cordova-plugin-geolocation
```

Notice that we haven't installed the Google Maps plugin?

Before we do that there's a couple of steps we need to take:

- Edit the **config.xml** file to set the ID for our app
- Generate Google Map API keys for both iOS & Android

In your **config.xml** file enter a suitable ID for your app - typically this would follow a reverse domain naming convention - such as the following (highlighted in bold - please note I’ve broken the tag attributes/values over separate lines to help with readability):

```
<widget
  id="com.saintsatplay.geoApp"
  version="0.0.1"
  xmlns="http://www.w3.org/ns/widgets"
  xmlns:cdv="http://cordova.apache.org/ns/1.0">
```

This amendment might seem insignificant but the App ID will be important when you create and configure the API keys for Google Maps.

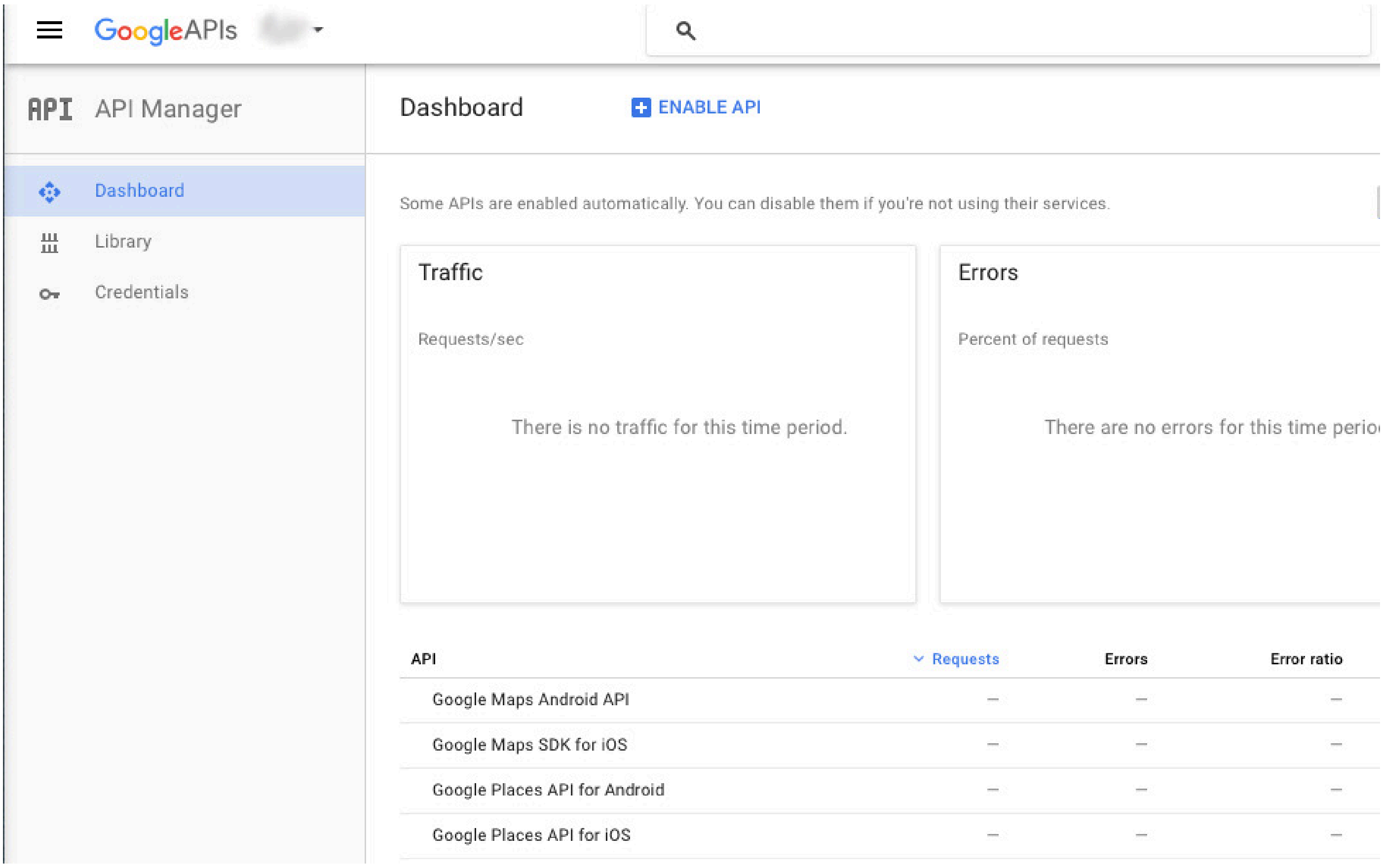
Make a note of this as you will be needing the App ID during the next step!

Now that amendment has been made to your **config.xml** file log into your Google Developers Console account (if you’re not already registered with the service create a free account now - https://console.developers.google.com - and, once completed, return back to this page) where you will subsequently:

- Enable the Google Map API
- Generate iOS & Android API keys

There’s quite a bit involved with generating the iOS & Android API keys so follow closely and be patient!

Once you’re logged in to your Developers Console account you should see the following screen displayed:



Some APIs are enabled automatically. You can disable them if you're not using their services.

There is no traffic for this time period.

There are no errors for this time perio

API	Requests	Errors	Error ratio
Google Maps Android API	–	–	–
Google Maps SDK for iOS	–	–	–
Google Places API for Android	–	–	–
Google Places API for iOS	–	–	–

If you’re not seeing the API Manager dashboard click on to the menu icon at the top left hand side of the page and select the API Manager link from the sidebar that animates into view.

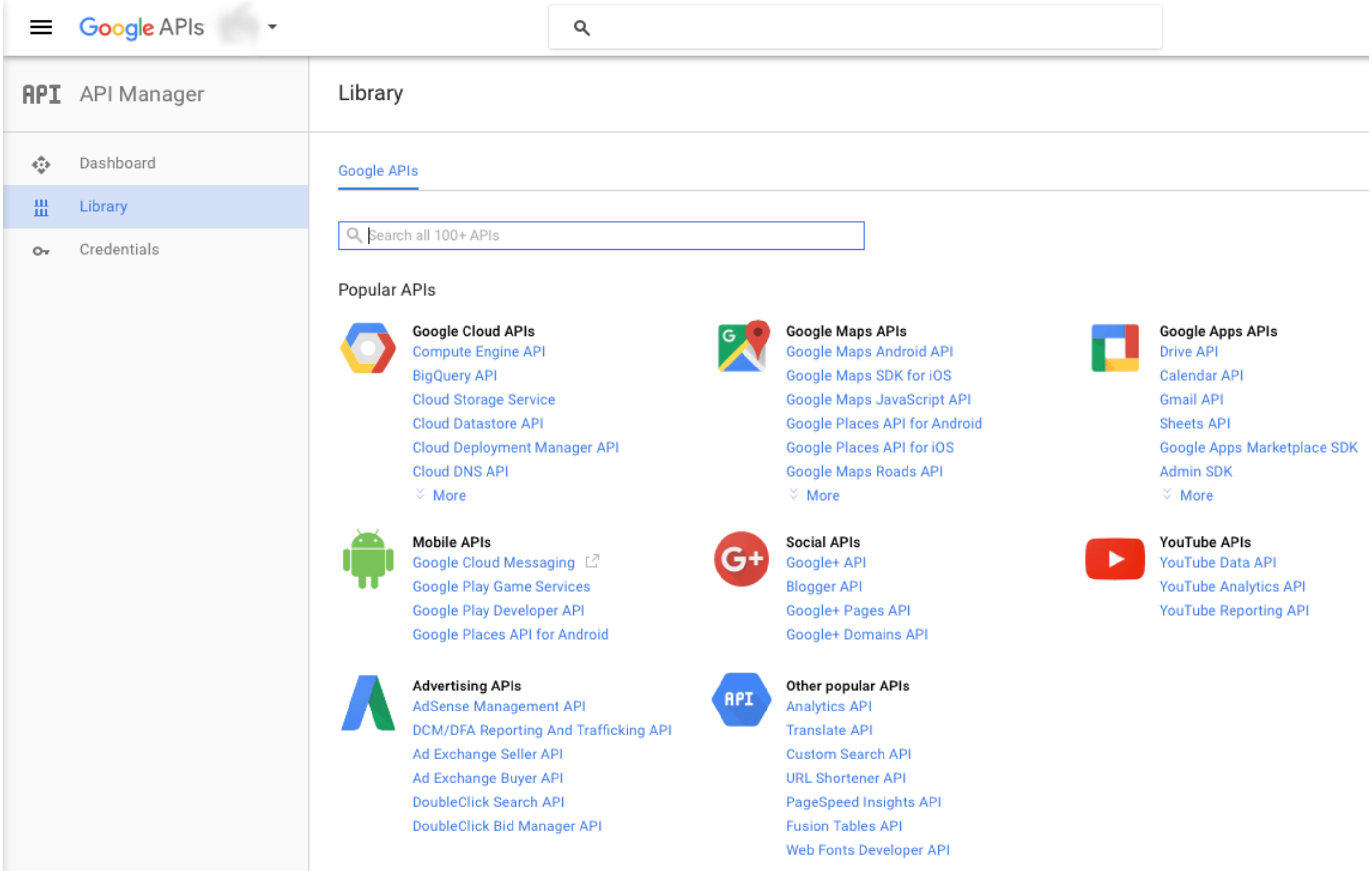
The API Manager displays all of the Google API’s that you have enabled for your projects.

You’ll need to enable the following API’s (if they aren’t already listed):

- Google Maps Android API
- Google Maps SDK for iOS

To do this click on the ENABLE API link at the top of the Dashboard.

A list of all the publicly available Google API’s is then displayed as shown in the following screenshot:



Popular APIs

Google Cloud APIs
Compute Engine API
BigQuery API
Cloud Storage Service
Cloud Datastore API
Cloud Deployment Manager API
Cloud DNS API
More

Google Maps APIs
Google Maps Android API
Google Maps SDK for iOS
Google Maps JavaScript API
Google Places API for Android
Google Places API for iOS
Google Maps Roads API
More

Google Apps APIs
Drive API
Calendar API
Gmail API
Sheets API
Google Apps Marketplace SDK
Admin SDK
More

Mobile APIs
Google Cloud Messaging
Google Play Game Services
Google Play Developer API
Google Places API for Android

Social APIs
Google+ API
Blogger API
Google+ Pages API
Google+ Domains API

YouTube APIs
YouTube Data API
YouTube Analytics API
YouTube Reporting API

Advertising APIs
AdSense Management API
DCM/DFA Reporting And Trafficking API
Ad Exchange Seller API
Ad Exchange Buyer API
DoubleClick Search API
DoubleClick Bid Manager API

Other popular APIs
Analytics API
Translate API
Custom Search API
URL Shortener API
PageSpeed Insights API
Fusion Tables API
Web Fonts Developer API

From the list click onto and enable the following API's:

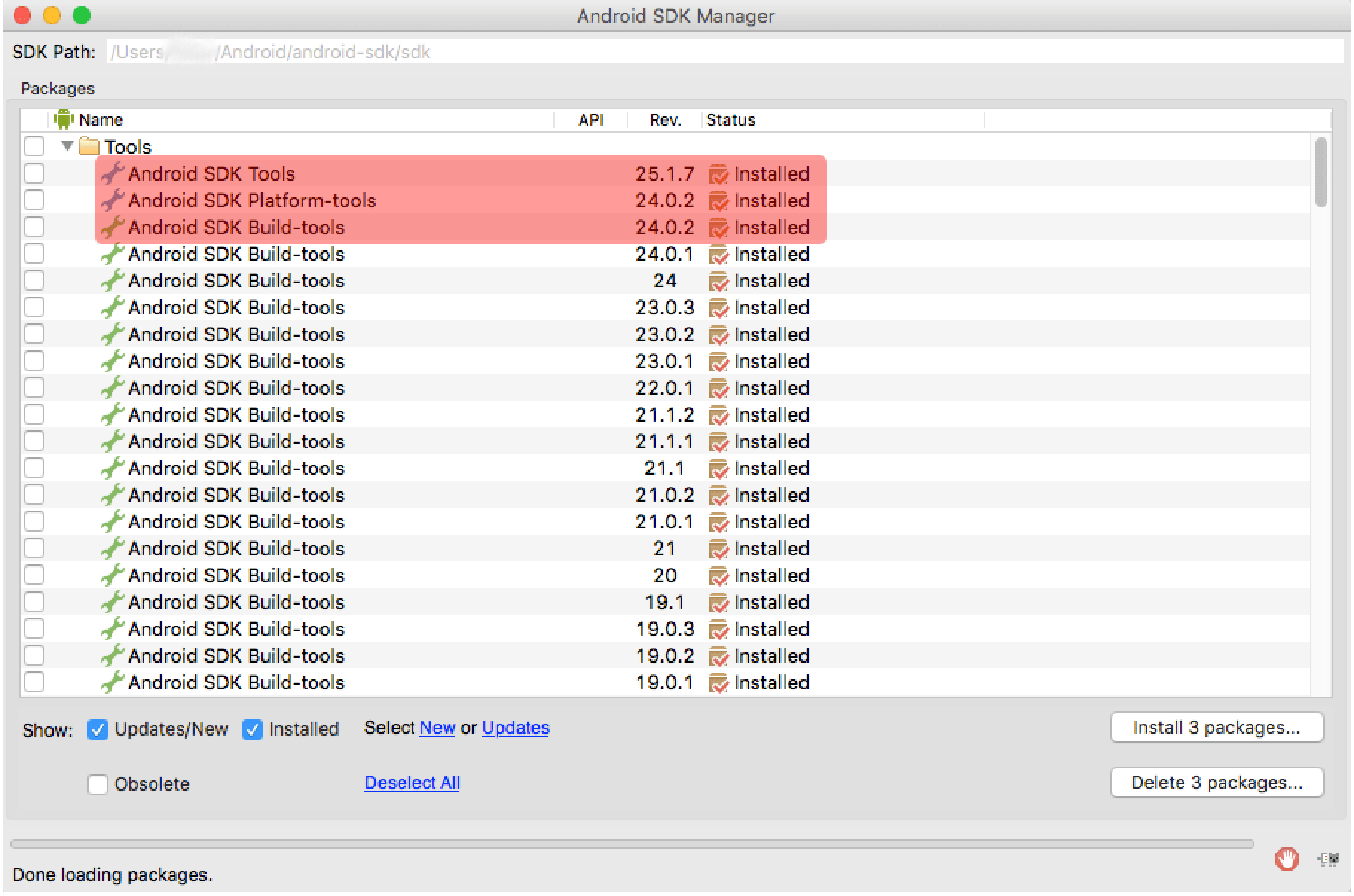
- Google Maps Android API
- Google Maps SDK for iOS

Once these have been enabled you'll need to perform a little command line work before being ready to generate API keys for both iOS and Android.

Prior to commencing with this though you'll need to ensure that the latest versions of the following software are installed on your system in the Android SDK Manager:

- Android SDK Tools
- Android SDK Platform Tools
- Android SDK Build Tools
- Android Support Repository
- Android Support Library

These are shown highlighted in red in the following screenshots:



Android SDK Manager

SDK Path: /Users/[redacted]/Android/android-sdk/sdk

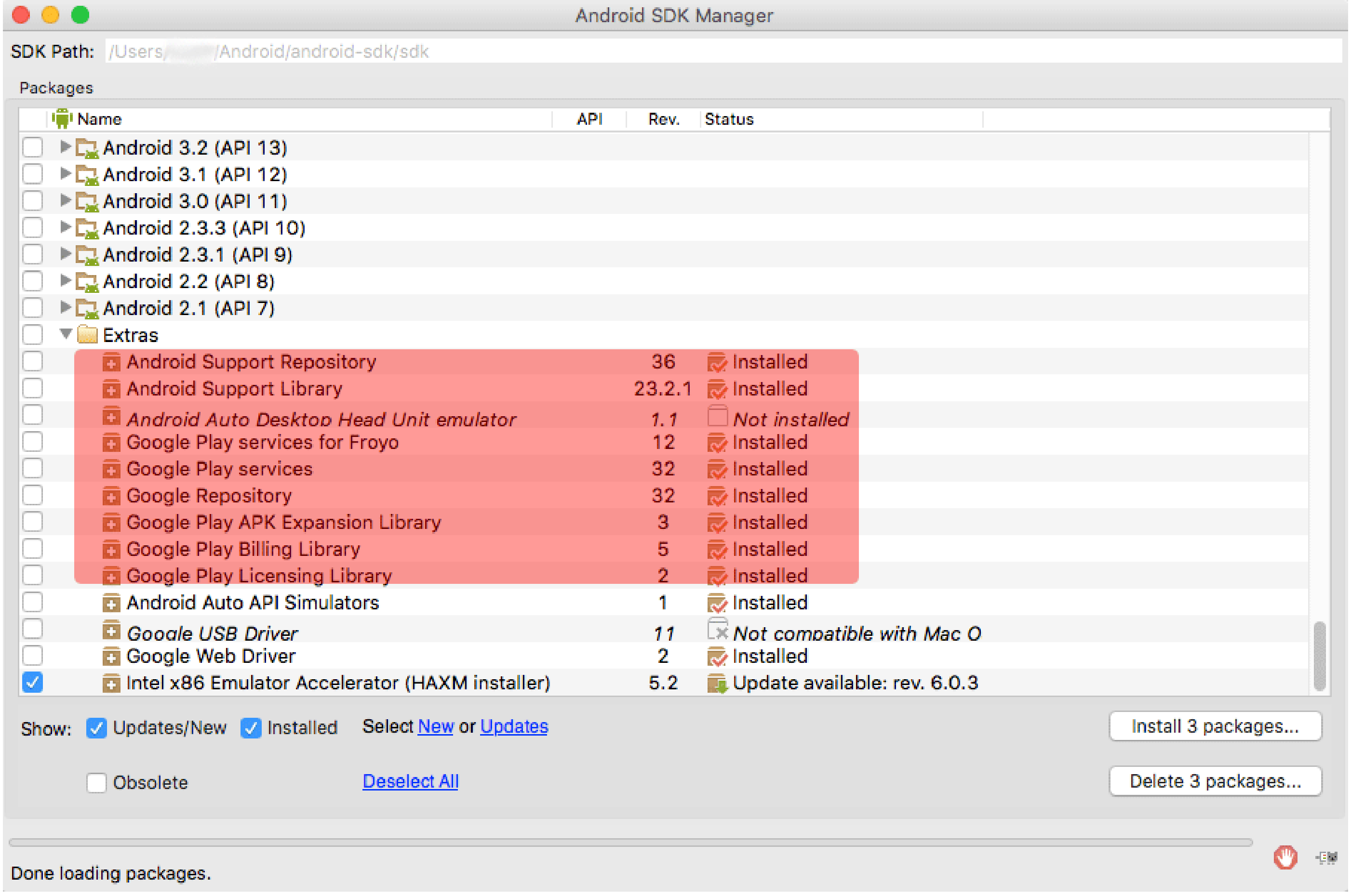
Packages

	Name	API	Rev.	Status
□	▼ Tools			
□	Android SDK Tools		25.1.7	Installed
□	Android SDK Platform-tools		24.0.2	Installed
□	Android SDK Build-tools		24.0.2	Installed
□	Android SDK Build-tools		24.0.1	Installed
□	Android SDK Build-tools		24	Installed
□	Android SDK Build-tools		23.0.3	Installed
□	Android SDK Build-tools		23.0.2	Installed
□	Android SDK Build-tools		23.0.1	Installed
□	Android SDK Build-tools		22.0.1	Installed
□	Android SDK Build-tools		21.1.2	Installed
□	Android SDK Build-tools		21.1.1	Installed
□	Android SDK Build-tools		21.1	Installed
□	Android SDK Build-tools		21.0.2	Installed
□	Android SDK Build-tools		21.0.1	Installed
□	Android SDK Build-tools		21	Installed
□	Android SDK Build-tools		20	Installed
□	Android SDK Build-tools		19.1	Installed
□	Android SDK Build-tools		19.0.3	Installed
□	Android SDK Build-tools		19.0.2	Installed
□	Android SDK Build-tools		19.0.1	Installed

Show: ☑ Updates/New ☑ Installed Select New or Updates

☐ Obsolete Deselect All

Done loading packages.



Android SDK Manager

SDK Path: /Users/[redacted]/Android/android-sdk/sdk

Packages

	Name	API	Rev.	Status
□	▶ Android 3.2 (API 13)			
□	▶ Android 3.1 (API 12)			
□	▶ Android 3.0 (API 11)			
□	▶ Android 2.3.3 (API 10)			
□	▶ Android 2.3.1 (API 9)			
□	▶ Android 2.2 (API 8)			
□	▶ Android 2.1 (API 7)			
□	▼ Extras			
□	Android Support Repository		36	Installed
□	Android Support Library		23.2.1	Installed
□	*Android Auto Desktop Head Unit emulator*		*1.1*	*Not installed*
□	Google Play services for Froyo		12	Installed
□	Google Play services		32	Installed
□	Google Repository		32	Installed
□	Google Play APK Expansion Library		3	Installed
□	Google Play Billing Library		5	Installed
□	Google Play Licensing Library		2	Installed
□	Android Auto API Simulators		1	Installed
□	*Google USB Driver*		*11*	*Not compatible with Mac O*
□	Google Web Driver		2	Installed
☑	Intel x86 Emulator Accelerator (HAXM installer)		5.2	Update available: rev. 6.0.3

Show: ☑ Updates/New ☑ Installed Select New or Updates

☐ Obsolete Deselect All

Done loading packages.

You'll also need to make sure you've configured your system properly as explained in the *Configuring your Environment* chapter.

Generating your signing key

Assuming that this has all been done you'll now be generating a signing key for the Android version of the GeoApp example project.

This signing key can be used to authenticate generated APK files for the app so that they can be submitted to the Google Play store. That's beyond what we're looking to achieve in this chapter - instead we want to simply obtain the SHA-1 fingerprint for this signing key.

This SHA-1 fingerprint is required by Google when we generate our Android API key so as to restrict usage for that API key to a specified app. Put simply - no SHA-1 signing certificate fingerprint, no Android API key.

To obtain that SHA-1 fingerprint though we need to firstly generate our signing key.

In your Terminal, and while at the root of the geoApp project, run the following command:

```
keytool -genkey -v -keystore geo-app-release-key.keystore -alias geoAppKey
-keyalg RSA -keysize 2048 -validity 10000
```

The keytool application (which comes installed with your system's JDK software) is used to manage cryptographic keys and trusted certificates.

In the above command we are using this utility to generate a private key that we are naming **geo-app-release-key.keystore**.

When you run this command you will be prompted to create a password for the keystore and then answer a series of questions before the key is created. When this process has been completed the generated file - **geo-app-release-key.keystore** - will be saved in the root directory of your app.

IMPORTANT - It would be wise, in future projects, to move this file out of any project directories and store it somewhere safe.

You definitely do NOT want this file to be added, or made available, to version control (as this would present a huge security risk) and nor should it be in the published IPA/APK binaries for your apps that are distributed via the Apple & Google Play App stores or via ad-hoc distribution.

If someone were to reverse-engineer the code for those binaries this means they would gain access to the keystore if it were present in the codebase.

Remember, a good developer is a security conscious developer!

For the purposes of this example though we can keep the keystore where it is (as we aren't going to be adding this app to version control or distributing the app for other users to interact with) but in your own projects definitely move the keystore file out of your Ionic apps and store it somewhere safe.

If you've tried running the above command and are experiencing problems please refer to the following Android installation guide to make sure that the necessary software is installed on your environment and system paths are correctly configured: http://cordova.apache.org/docs/en/latest/guide/platforms/android/index.html.

Obtaining the keystore SHA-1 fingerprint

You should, assuming there were no errors with running the keytool command, now have a keystore file residing in the root directory of the geoApp project.

In order to generate an Android API key we need to obtain the SHA-1 fingerprint for this signing key.

In your Terminal application run the following command:

```
keytool -list -v -keystore geo-app-release-key.keystore
```

You'll be prompted for the password you used to create the keystore with and, once successfully entered, you should see output akin to the following being displayed in the Terminal:

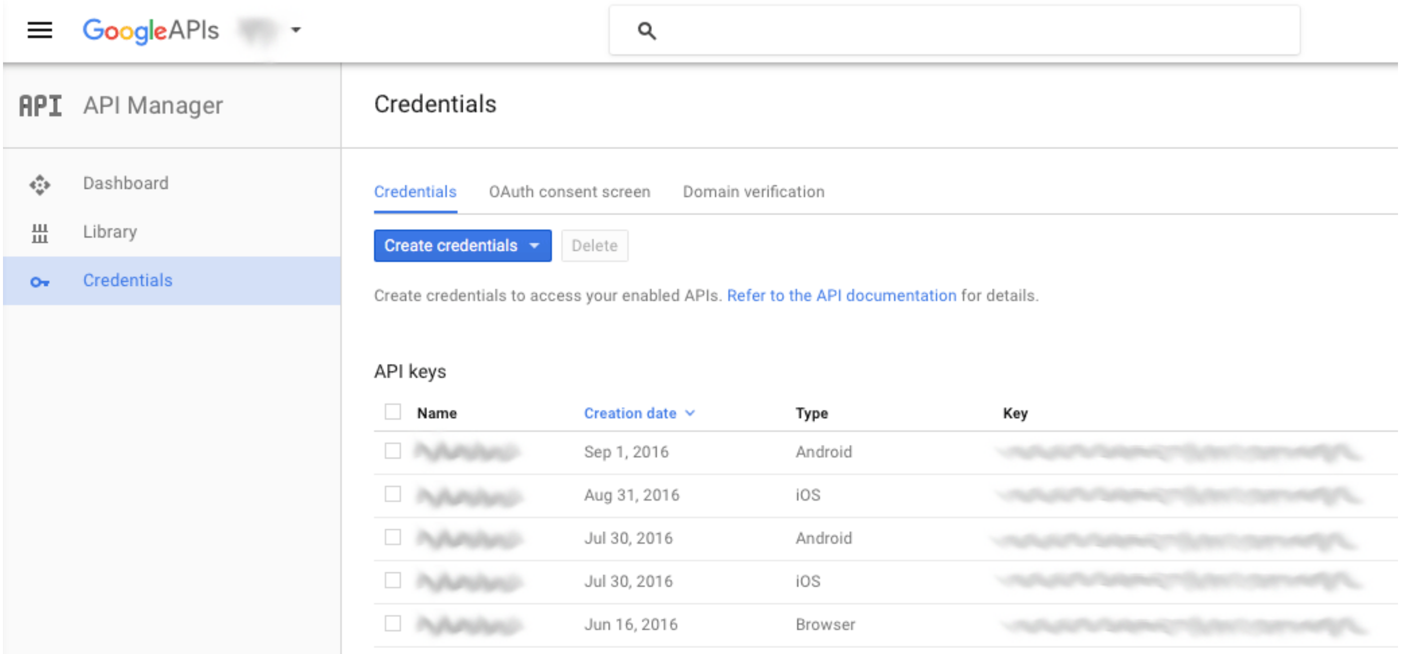
```
Keystore type: JKS
Keystore provider: SUN

Your keystore contains 1 entry

Alias name: alias_name
Creation date: 01-Sep-2016
Entry type: PrivateKeyEntry
Certificate chain length: 1
Certificate[1]:
Owner: CN=Saints at Play, OU=Saints at Play Limited, O=Saints at Play Limited, L=London, ST=Greater London, C=UK
Issuer: CN=Saints at Play, OU=Saints at Play Limited, O=Saints at Play Limited, L=London, ST=Greater London, C=UK
Serial number: aaaaaaa0
Valid from: Thu Sep 01 13:57:31 BST 2016 until: Mon Jan 18 12:57:31 GMT 2044
Certificate fingerprints:
         MD5:  15:4A:1C:BD:45:6B:E9:76:87:43:A1:43:76:C4:E0:2E
         SHA1: 86:8F:54:4F:B5:C9:3E:19:0B:E8:11:3F:C5:56:CB:23:1E:B7:89
         SHA256: 02:91:47:03:23:27:4A:50:1B:CE:B8:CE:11:B8:75:AD:B0:57:F6
         Signature algorithm name: SHA256withRSA
         Version: 3

Extensions:

#1: ObjectId: 1.7.12.31 Criticality=false
```

```
SubjectKeyIdentifier [
KeyIdentifier [
0000: AD 62 FC 20 04 0B DB DB   F3 8B 11 B4 EC 48 33 39  .b. .........H39
0010: D3 79 29 94                                         .y).
]
]

*******************************************
*******************************************
```

In the section titled Certificate fingerprints locate the SHA-1 entry and, from your own generated output, proceed to copy the output that is shown in bold.

Generating Google API Keys

Now that you've obtained the SHA-1 fingerprint for your own signing key return to your Google Console Developer account and select the Credentials link under the API manager.



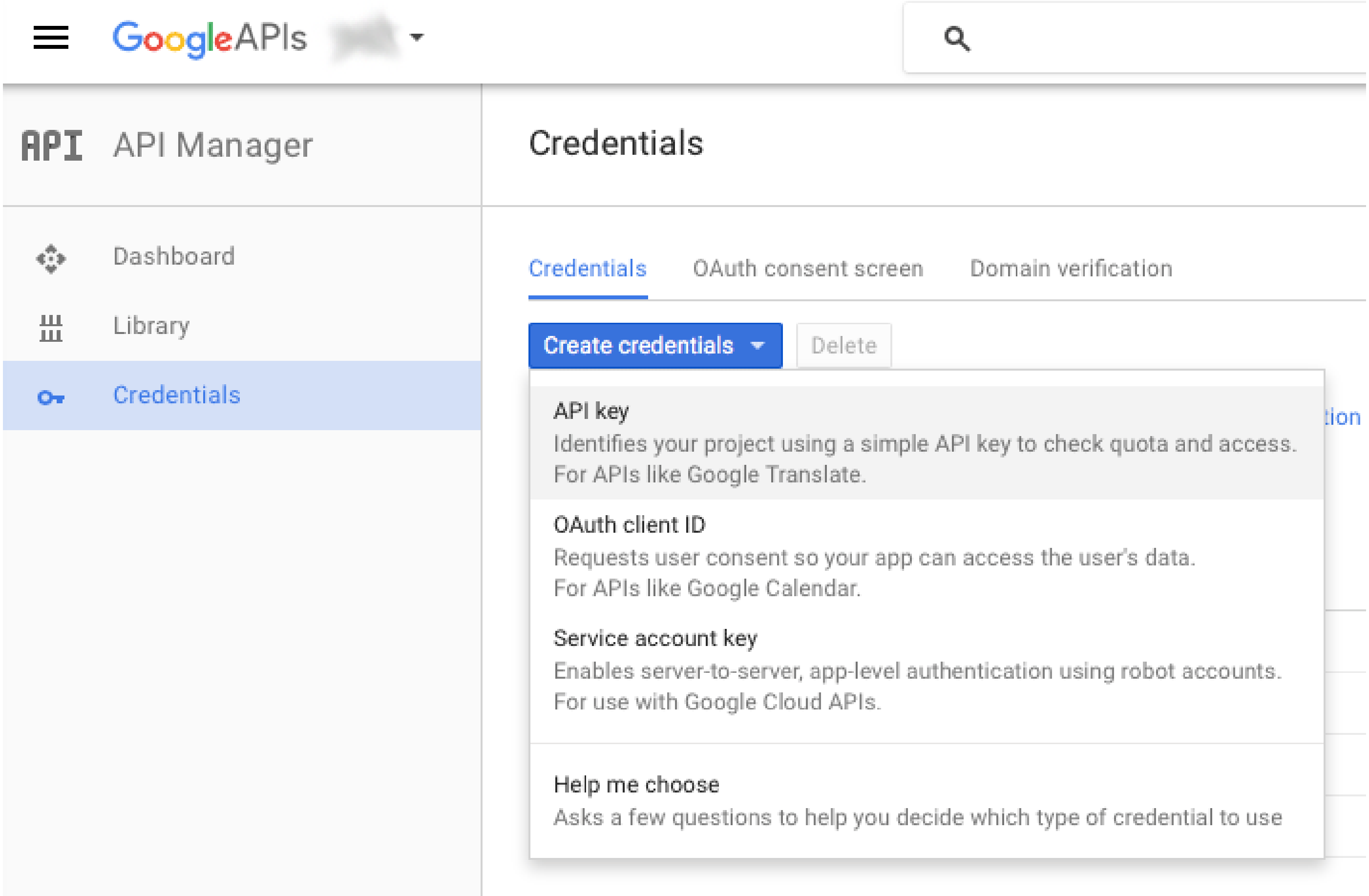
Create credentials to access your enabled APIs. Refer to the API documentation for details.

API keys

□ Name	Creation date	Type	Key
□	Sep 1, 2016	Android	
□	Aug 31, 2016	iOS	
□	Jul 30, 2016	Android	
□	Jul 30, 2016	iOS	
□	Jun 16, 2016	Browser	

If you have any pre-existing credentials these will be displayed here.

Open the Create credentials menu and select API key from the displayed options.



API key
Identifies your project using a simple API key to check quota and access.
For APIs like Google Translate.

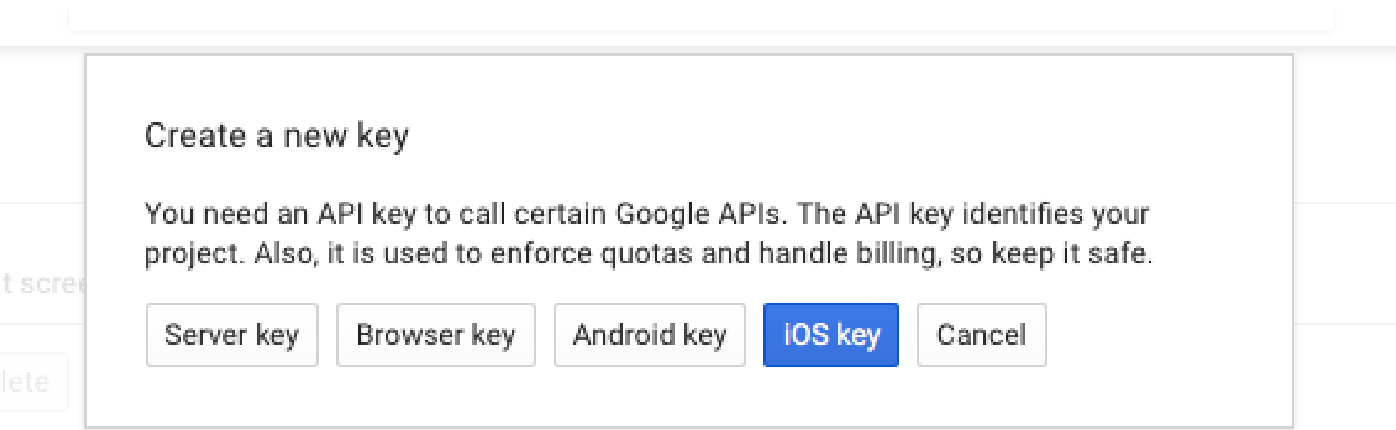
OAuth client ID
Requests user consent so your app can access the user's data.
For APIs like Google Calendar.

Service account key
Enables server-to-server, app-level authentication using robot accounts.
For use with Google Cloud APIs.

Help me choose
Asks a few questions to help you decide which type of credential to use

We'll need to create both an iOS key and an Android key from the available key types.

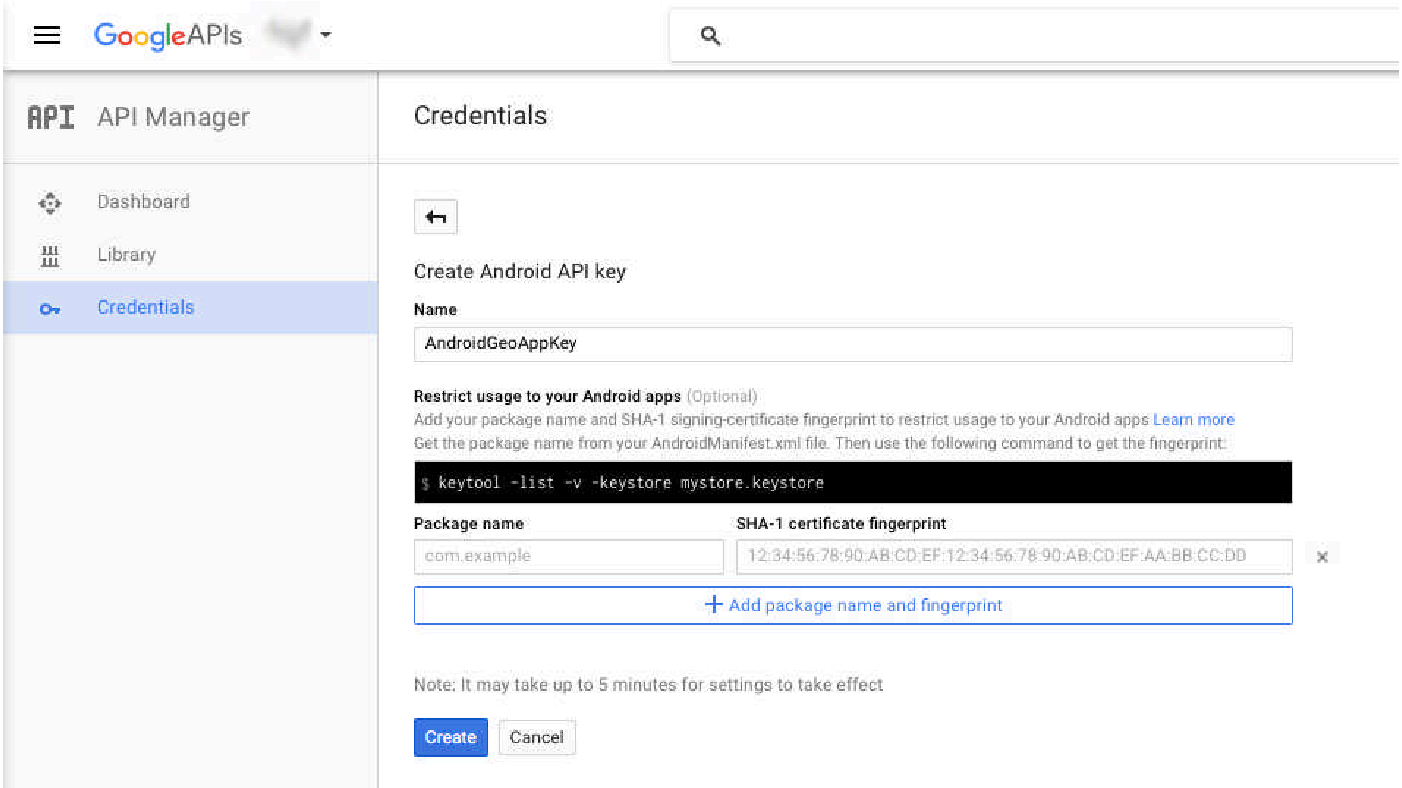
Let's start by creating an Android key as we already have the SHA-1 fingerprint that we generated in the previous section copied and waiting for this purpose.



Create a new key

You need an API key to call certain Google APIs. The API key identifies your project. Also, it is used to enforce quotas and handle billing, so keep it safe.

When the Create Android API Key screen loads click on the Add package name and fingerprint button to reveal the Package name and SHA-1 certificate fingerprint fields.



Create Android API key

Name

AndroidGeoAppKey

Restrict usage to your Android apps (Optional)

Add your package name and SHA-1 signing-certificate fingerprint to restrict usage to your Android apps Learn more

Get the package name from your AndroidManifest.xml file. Then use the following command to get the fingerprint:

```
$ keytool -list -v -keystore mystore.keystore
```

Package name: com.example

SHA-1 certificate fingerprint: 12:34:56:78:90:AB:CD:EF:12:34:56:78:90:AB:CD:EF:AA:BB:CC:DD

Note: It may take up to 5 minutes for settings to take effect

I've used the name AndroidGeoAppKey to identify this Android API key but you can use whatever name you feel works best.

In the Package name field enter the same App ID value that was entered into the geoApp **config.xml** file (which, in this example, would be com.saintsatplay.geoApp).

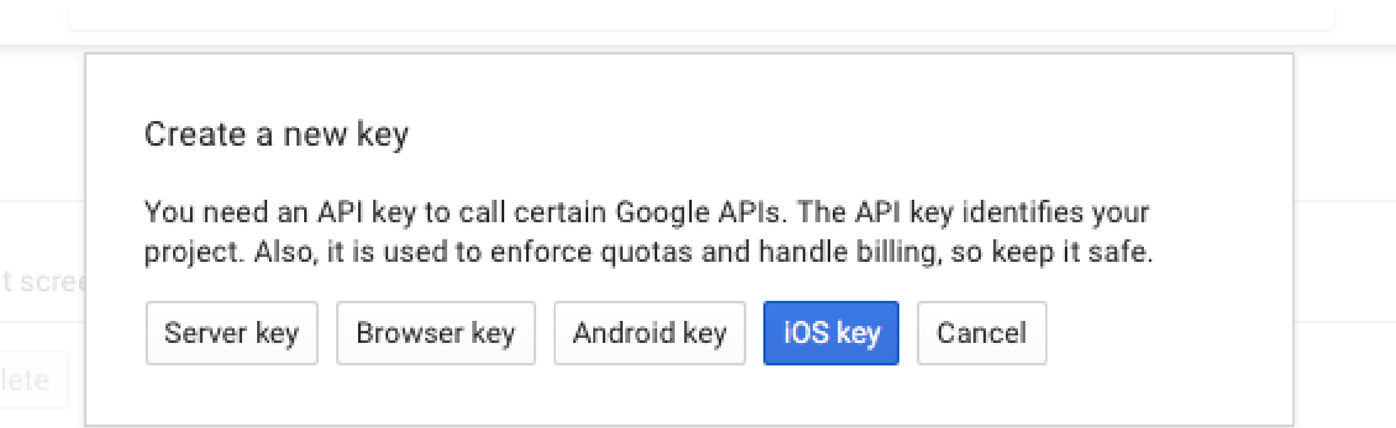
In the SHA-1 certificate fingerprint field paste the keystore SHA-1 fingerprint you copied from the Terminal in the previous section.

Once this is completed, click on the Create button and, after being returned to the Credentials dashboard, you'll see your newly generated API key listed.

Copy the string that is displayed under the Key column for our newly created API key and paste this into a temporary text file. We'll use this value in the next section when we install the Google maps plugin.

Now we need to generate the iOS key.

Repeat this process but select iOS key from the **Create a new key** options.



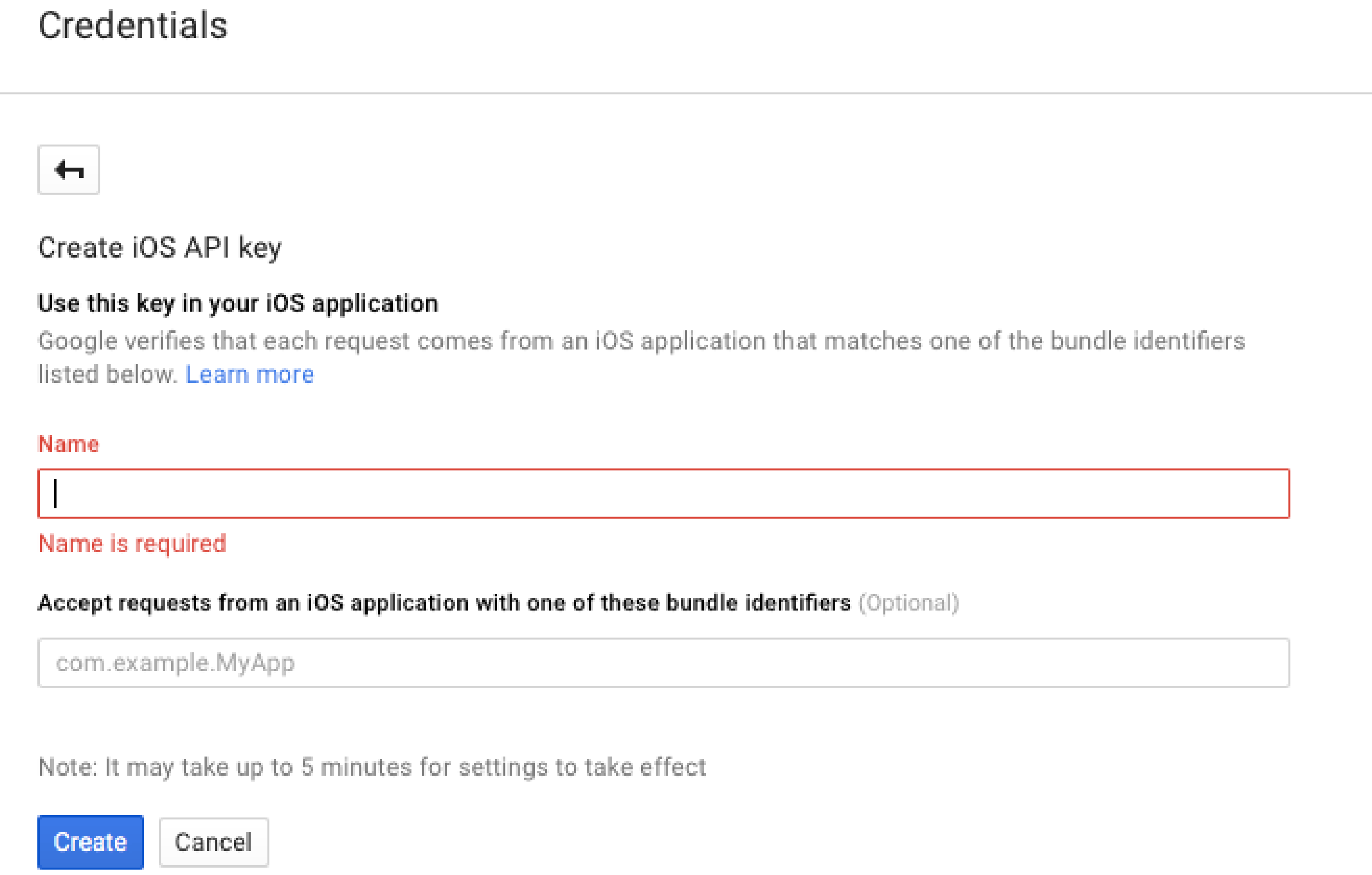
Create a new key

You need an API key to call certain Google APIs. The API key identifies your project. Also, it is used to enforce quotas and handle billing, so keep it safe.

On the Create iOS API key screen you'll only have to be concerned with entering the name and bundle identifier for your key.

By default Google already prefills the name for you but you can always change this value to something more project specific (such as, for example, iOSGeoAppKey).

In the bundle identifiers field enter the App ID value found in the widget id field of the geoApp **config.xml** file (which, in this example, would be com.saintsatplay.geoApp).



Credentials

Create iOS API key

Use this key in your iOS application

Google verifies that each request comes from an iOS application that matches one of the bundle identifiers listed below. Learn more

Name

Name is required

Accept requests from an iOS application with one of these bundle identifiers (Optional)

com.example.MyApp

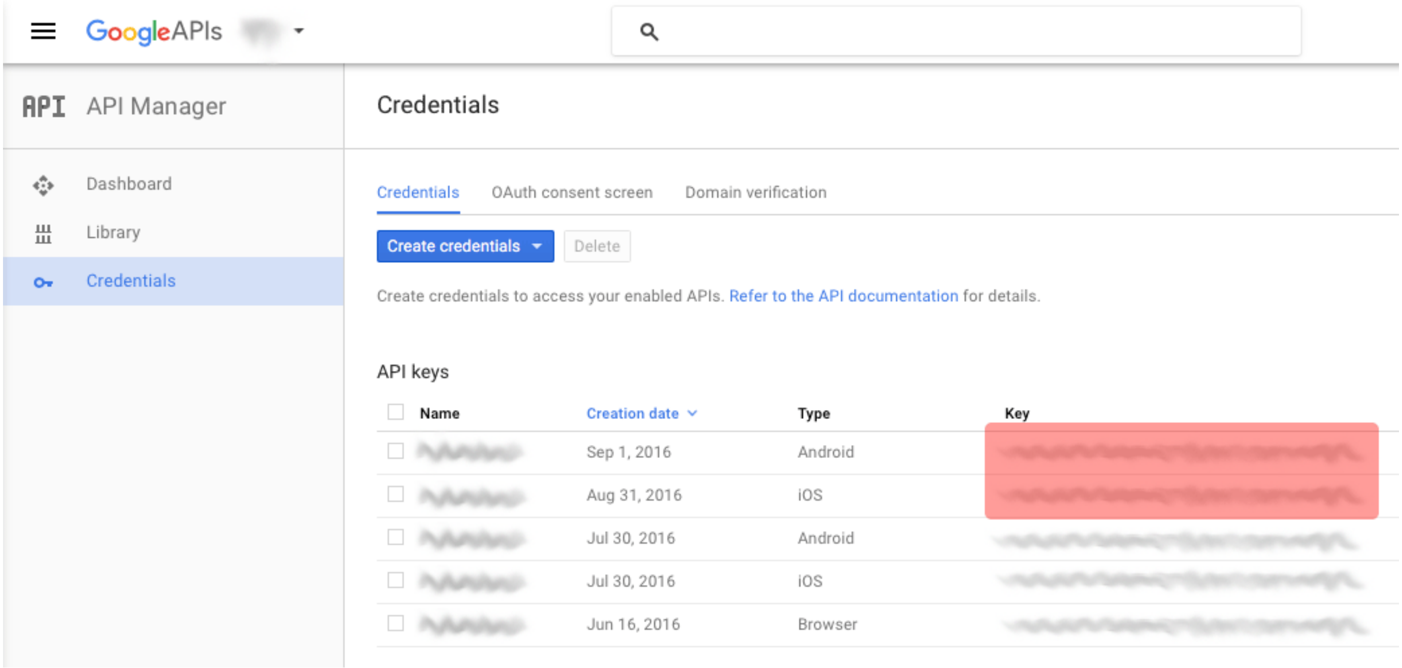
Note: It may take up to 5 minutes for settings to take effect

Once this is completed click on the Create button and after you've been returned to the Credentials dashboard, you'll see your newly generated iOS API key listed.

Repeat the action you performed for the Android API key and copy the string value displayed for the iOS API key under the Key column and also paste this into the same temporary text file we used for the Android API key value.

We'll use both of these values in the next section when we install the Google maps plugin - just remember which key value is which!

The below screenshot shows where these string values need to be copied from (highlighted in red):



Create credentials to access your enabled APIs. Refer to the API documentation for details.

API keys

□	Name	Creation date	Type	Key
□	[redacted]	Sep 1, 2016	Android	[redacted]
□	[redacted]	Aug 31, 2016	iOS	[redacted]
□	[redacted]	Jul 30, 2016	Android	[redacted]
□	[redacted]	Jul 30, 2016	iOS	[redacted]
□	[redacted]	Jun 16, 2016	Browser	[redacted]

Now we've created and configured the required API keys let's move on to installing the Google Maps plugin.

Installing Googlemaps

There are a few Google Maps plugins available for use with the Apache Cordova framework (remember that Ionic 2 is built on top of this framework and, as a result, is able to take advantage of its extensive range of publicly available plugins).

We're going to use the cordova-googlemaps-plugin which is available through Ionic Native but we'll install that directly from the github master link for the plugin instead.

We do this because, at the time of writing, this is the only stable version of the plugin that won't cause errors that break our app when we run a build process.

In your Terminal and at the root of the geoApp project directory enter the following command (substitute YOUR_APP_KEY_VALUE_HERE for the respective iOS and Android key values you copied and stored for safekeeping in the last section - BUT do make sure you enter the iOS key value for iOS and the Android key value for Android otherwise the Google Maps functionality won't work!):

```
cordova plugin add https://github.com/phonegap-googlemaps-plugin/cordova-plugin-googlemaps --variable API_KEY_FOR_ANDROID="YOUR_APP_KEY_VALUE_HERE" --variable API_KEY_FOR_IOS="YOUR_APP_KEY_VALUE_HERE"
```

This might take a few minutes depending on the speed of your network connection and possible server latency where the requested plugins are being downloaded and installed from.

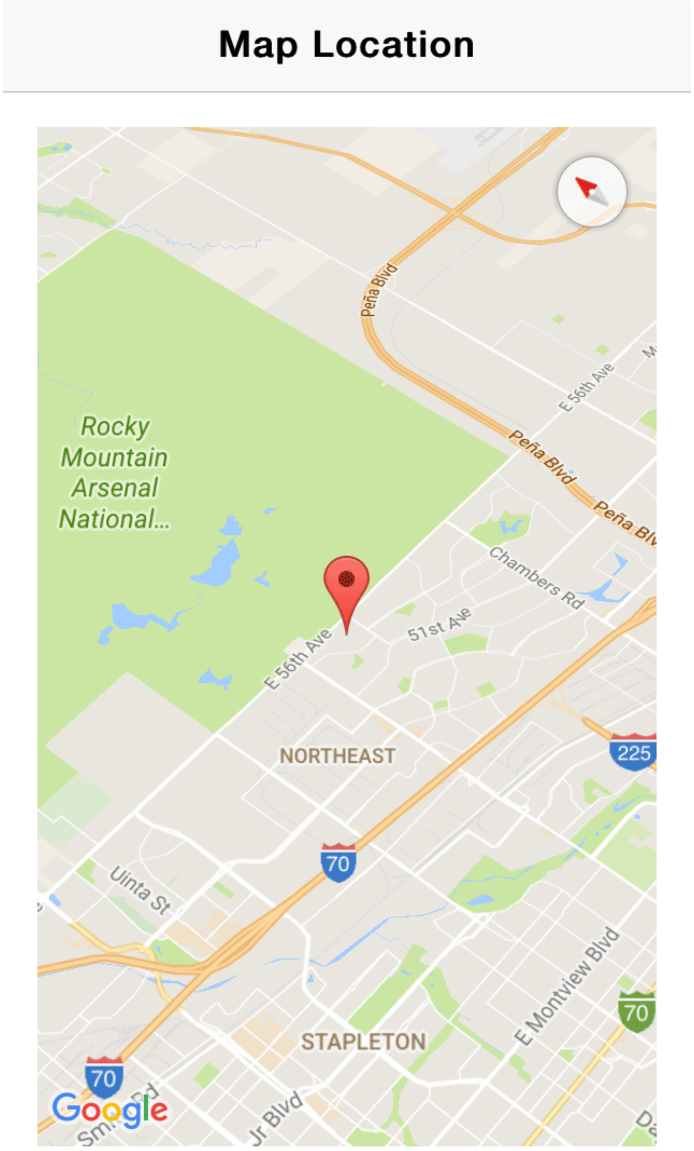
The App

Now that we've installed these plugins let's take a look at the app that we're going to be developing over the following pages.

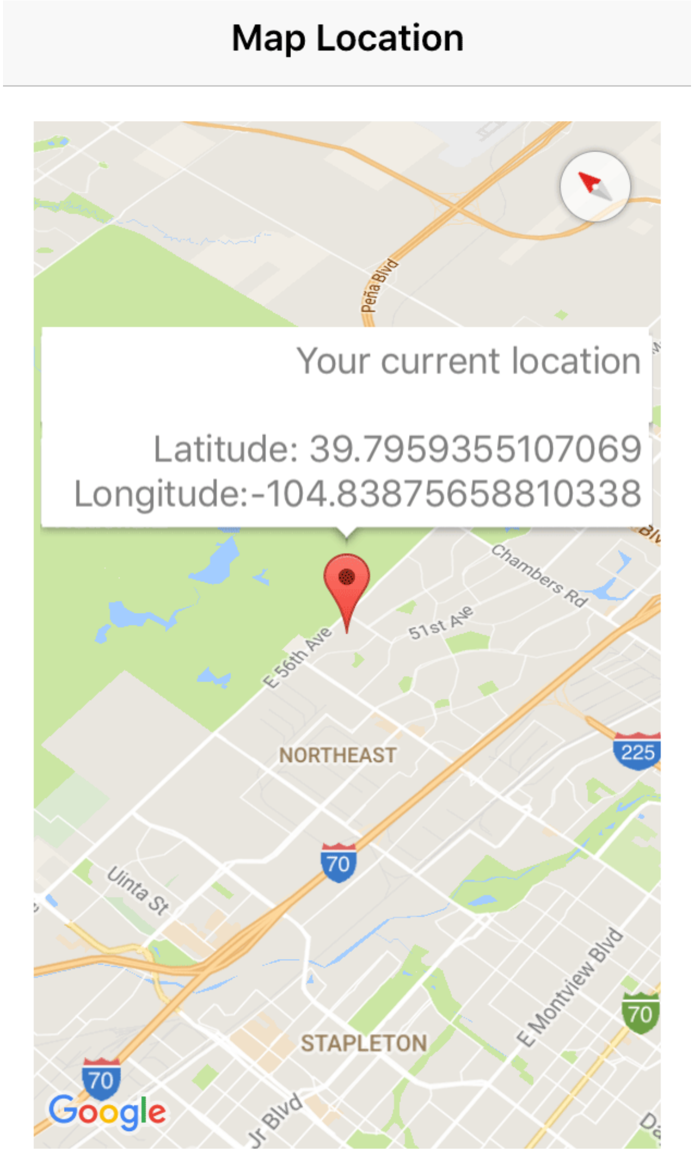
It's pretty basic in terms of both appearance and functionality but we're going to generate a Google Maps view that displays our current location, using the Geolocation and Google Maps plugins that we've just installed.

We'll make use of Google Maps markers & infoWindows as well as adding in some animation just to add a little something extra to the user experience.

The end result of our development should resemble something like the following screenshots (I am assuming here that your location WILL be different to my own!):



Map Location



Map Location

Your current location

Latitude: 39.7959355107069
Longitude:-104.83875658810338

Nothing earth shattering I’m sure you’ll agree but it will provide some nice visuals and functionality for us to play with while we acquaint ourselves with using the Google Maps and Geolocation plugins.

IMPORTANT - you might want to understand how the Google Maps plugin works.

With the preview covered for what we’re aiming to build we can now get cracking with the actual development!

Open the **geoApp/src/pages/home/home.ts** file and make the following amendments to the code (highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController, Platform } from 'ionic-angular';
import { Geolocation } from 'ionic-native';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
  public coords : any;
  public isActive : boolean = false;

  constructor(
         public navCtrl: NavController,
         public platform: Platform
  )
  {
         this.platform.ready().then(() =>
         {
             Geolocation.getCurrentPosition().then((resp) =>
             {
                  this.coords = {
                      lat:        resp.coords.latitude,
                      lng:        resp.coords.longitude
                  };
                  this.isActive = true;
            })
            .catch((error) => {
                 console.dir(error);
            });
       });
  }
}
```

So what we're doing here is:

- Importing the **Geolocation** class from Ionic Native
- Importing the **Platform** class which will allow us to obtain information about the device the app will be running on
- Call the **ready** method of the **Platform** class within our class constructor so that any native functionality we want to implement can be triggered when the DOM is fully loaded and available for use
- Call the **GetCurrentPosition** method of the **Geolocation** class inside a platform ready call so that the plugin is triggered only when the device is ready
- Use a Promise on the **GetCurrentPosition** method to handle how information about the device's location is returned back to the script
- If the Promise is resolved, then retrieve the user's current latitude/longitude
- If the Promise is rejected, then handle the error that is returned

Now turn your attention to the **geoApp/src/pages/home/home.html** file and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Map Location
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
        <div *ngIf="isActive">
                <p>My current location is: {{ coords.lat }}, {{ coords.lng }}</p>
        </div>
</ion-content>
```

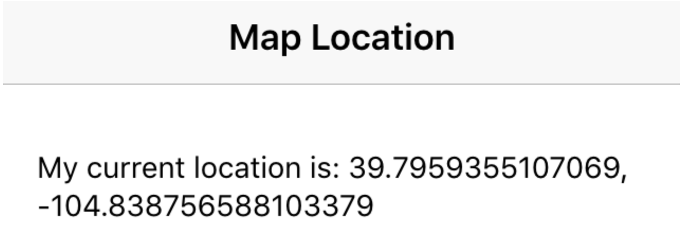
There shouldn't be any surprises with the above additions.

We simply detect whether or not there's any location data to render to the screen (using the **isActive** boolean property that we defined in our class) and, if there is, we simply use the **coords** object to output the **lat** and **lng** properties.

Now connect your mobile device to the computer and, in your console of choice, run the following commands, one after the other - waiting for the first CLI command to successfully execute before running the next command (substitute android for iOS if you're using that platform):

```
ionic build ios
ionic run ios --device
```

Assuming all went well we should see output akin to the following being published to your handheld device:



Map Location

My current location is: 39.7959355107069,
-104.838756588103379

Good stuff! We've successfully implemented the Geolocation plugin, used this to determine our current location and then render that to the HTML for our page in the form of latitude and longitude coordinates.

Not a bad result but it is a little boring and limited isn't it?

Let's build on this by integrating our existing code with the Google Maps plugin we installed a few pages back using that to help make our app a little more useful.

In the **geoApp/src/pages/home/home.html** file locate and replace everything between the <ion-content></ion-content> tags with the following (amendments highlighted in bold):

```
<ion-content padding>
        <div id="map"></div>
</ion-content>
```

Now open the **geoApp/src/pages/home/home.ts** file and make the following changes (highlighted in bold):

```
...
import { Geolocation,
          GoogleMap,
          GoogleMapsAnimation,
          GoogleMapsEvent,
          GoogleMapsLatLng } from 'ionic-native';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
  ...
  private map: GoogleMap;
  private location: any;

  constructor( ...)
  {

    this.platform.ready().then(() =>
    {
      GoogleMap.isAvailable()
      .then((isAvailable: boolean)=>
      {
        if(!isAvailable)
        {
          console.log('GoogleMap plugin is NOT available');
        }
        else
        {
          console.log('GoogleMap plugin is available');
          Geolocation.getCurrentPosition().then((resp) =>
          {
            ...
           this.location = new GoogleMapsLatLng(this.coords.lat, this.
coords.lng);
            this.map = new GoogleMap('map', {
              'backgroundColor': 'white',
              'controls'      : {
                'compass': true,
                'indoorPicker': true,
                'zoom': true
              },
              'camera': {
                'latLng': this.location,
                'tilt': 90,
                'zoom': 12,
                'bearing': 50
              },
              'gestures': {
                'scroll': true,
                'tilt': true,
                'rotate': true,
                'zoom': true
              }
            });

            this.map.on(GoogleMapsEvent.MAP_READY).subscribe(() =>
            {
              console.log('Map is ready!')
            });
          })
          .catch((error) =>
          {
                  console.dir(error);
               });
            }
         });
      });
   }
}
```

Breaking the above additions to the script down here’s what we’re doing:

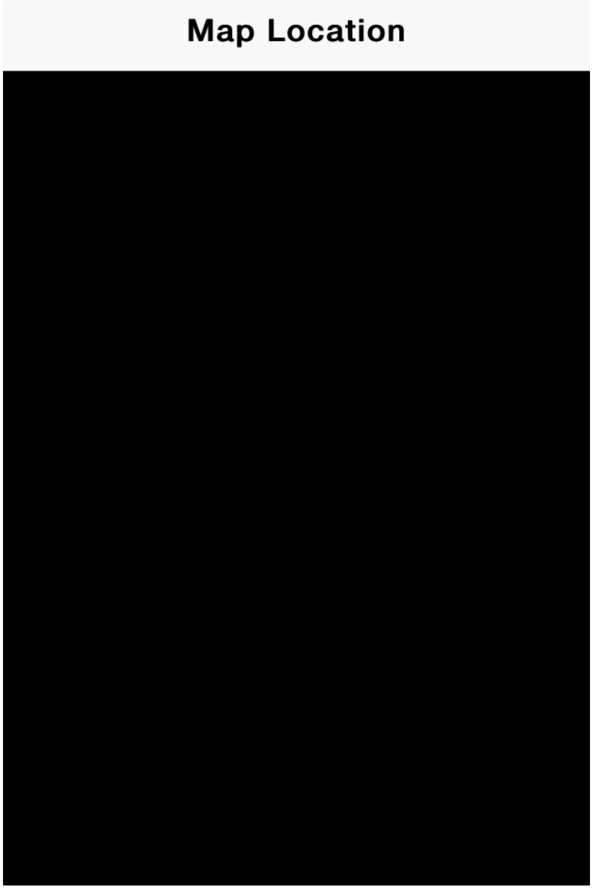
- Importing classes from the Google Maps plugin that we will use to implement map related functionality later on in the class
- Used the **isAvailable** method of the **GoogleMap** class to determine whether we can access the API
- Created a **GoogleMap** object that references the DOM element in our HTML with an ID of map and passes in a JSON object of map keys/values for initialising the GoogleMap
- Created a **GoogleMapsLatLng** object that uses the returned Geolocation latitude and longitude coordinates for the **GoogleMap** object to be centred to
- Use the **MAP_READY** event to run any code we might want to be triggered once the **GoogleMap** object is fully initialised (currently we’re just logging a message to the browser console)

For a full list of the different options available for map initialisation visit the online Google Maps API documentation: https://developers.google.com/maps/documentation/javascript/reference#MapOptions

With your mobile device connected to the computer and in the Terminal run the following command (substitute android for iOS if you’re running an android device):

```
ionic run ios --device
```

Surprisingly, and unexpectedly, we see a black screen right where the Google Maps object should be displayed.



If you should encounter this (oddly, on visits to online forums, not all developers have experienced this issue when using the plugin) it appears to be a bug with the current version of Ionic 2 that is caused by a <div> with a class of nav-decor that overlays and hides the Google Maps object from view.

More information on this bug can be accessed via the following forum threads:

- https://github.com/driftyco/ionic/issues/7205
- https://forum.ionicframework.com/t/why-appears-nav-decor-after-pressing-back-button/59791

Other rendering issues with the Google Maps plugin that developers have reported experiencing are covered in the following resource: https://github.com/mapsplugin/cordova-plugin-googlemaps/wiki/TroubleShooting:-Blank-Map

Developing from these online resources the current bug fix for this issue involves using CSS to set the background colour to a transparent value for elements with the following classes:

- nav-decor
- _gmaps_cdv_

In the **geoApp/src/pages/home/home.scss** file let's target these classes with the following style rule added to the bottom of the file:

```
ion-app.gmapscdv_ .nav-decor,
._gmaps_cdv_,
.nav-decor{
        background-color: rgba(0, 0, 0, 0) !important;
}
```

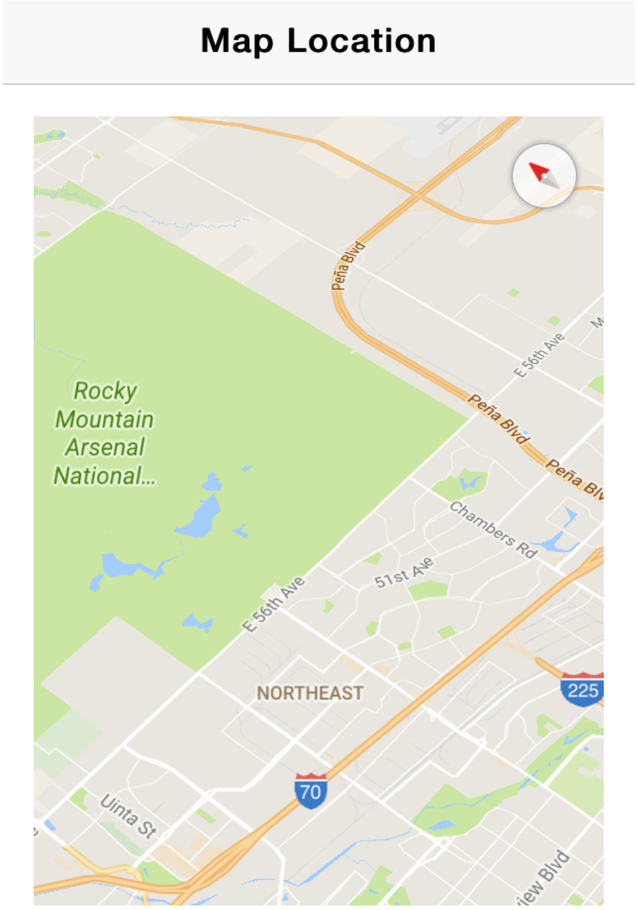
While we're here we should also set a style rule for rendering the Google Maps container to full screen (highlighted in bold):

```
page-home {
  ion-app.gmapscdv_ .nav-decor {
    background-color: rgba(0,0,0,0) !important;
  }
  #map {
    height: 100%;
    width: 100%;
  }
}
```

With these style tweaks added save the **geoApp/src/pages/home/home.scss** file and, returning back to the console, re-run the following Ionic CLI command:

```
ionic run ios --device
```

Once the changes have been published the Google Maps object should be clearly rendered to your current location like so:



Amazing what a simple style rule can do isn't it?

Aside from the additional CSS rule the key piece of the code that enables the map to be rendered to the screen is the Google Maps plugin conditional check:

```
GoogleMap.isAvailable()
.then((isAvailable: boolean)=>
{
   if(!isAvailable)
   {
      console.log('GoogleMap plugin is NOT available');
   }
   else
   {

   }
})
```

One potential error to be aware of

The <div> overlay issue is frustrating to encounter but thankfully easy to resolve with some simple CSS style rules.

There is one other occasion that I’ve experienced where the map might not render and it’s not immediately obvious why this is happening. If you’re trying to run the app on your device and see the following error being output to the Terminal:

```
ClientParametersRequest failed, 7 attempts remaining (0 vs 7). Error Do-
main=com.google.HTTPStatus Code=400 "(null)" UserInfo={data=<3c48544d
4c3e0a3c 48454144 3e0a3c54 49544c45 3e426164 20526571 75657374
3c2f5449 544c453e 0a3c2f48 4541443e 0a3c424f 44592042 47434f4c
4f523d22 23464646 46464622 20544558 543d2223 30303030 3030223e
0a3c4831 3e426164 20526571 75657374 3c2f4831 3e0a3c48 323e4572
726f7220 3430303c 2f48323e 0a3c2f42 4f44593e 0a3c2f48 544d4c3e 0a>}
```

Chances are that this error is caused by one of the following:

- The API for that platform has not been enabled
- You entered an incorrect API key when installing the plugin

Fixing the first possible cause is pretty simple - log into your Google Console Developer account and ensure the following API’s are enabled for use:

- Google Maps Android API
- Google Maps SDK for iOS

Fixing the second possible cause (if the above remedy didn’t work) involves removing the plugin and then reinstalling that while paying close attention that the API key being entered matches that platform (I.e. Android API key for Android).

Enhancing our app

Okay, so now that we’ve successfully rendered our location to the map let’s add two final enhancements before we close out this chapter.

A map marker should animate into view and, once situated on the map, should be able to display an infoWindow listing the coordinates for our current location. This infoWindow will be able to be toggled into and out of view by clicking directly on the marker itself - its default state will be non-active.

In the **geoApp/src/pages/home/home.ts** file make the following amendments (displayed in bold):

```
...
export class HomePage {
  ...

  constructor( ...)
  {
    this.platform.ready().then(() =>
    {
      GoogleMap.isAvailable()
      .then((isAvailable: boolean)=>
      {
        if(!isAvailable)
        {
          ...
        }
        else
        {
          Geolocation.getCurrentPosition().then((resp) =>
          {
            ...
            this.map.on(GoogleMapsEvent.MAP_READY).subscribe(() =>
            {
              console.log('Map is ready!')
              this.listLocation();
            });
          })
```

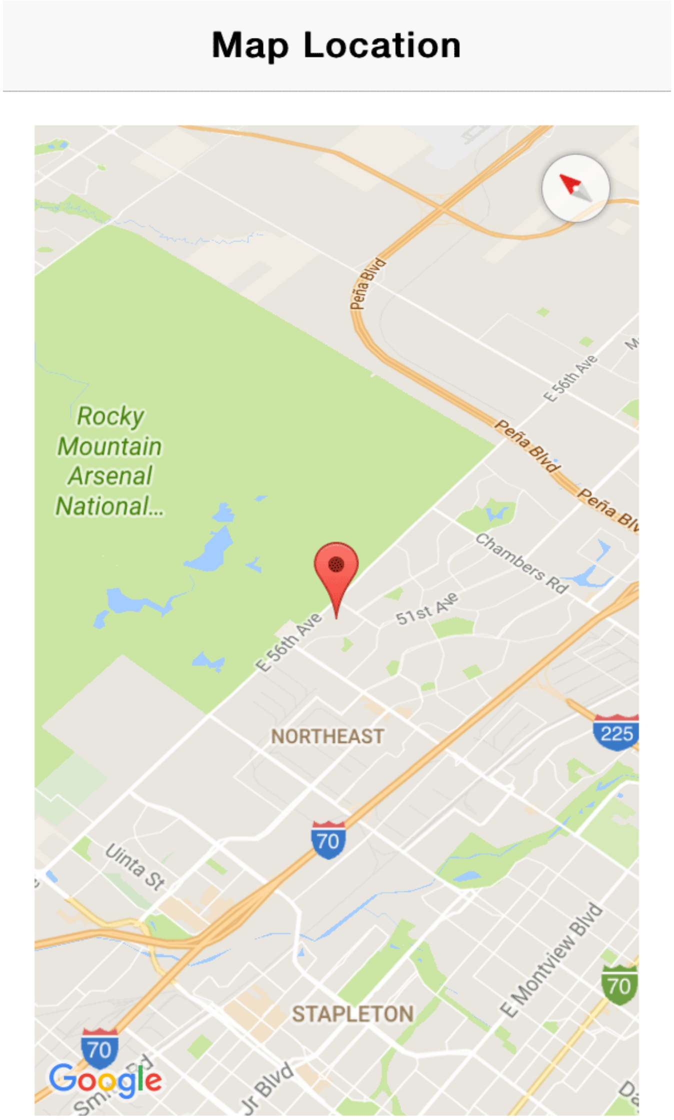
```
               .catch((error) =>
               {
                  ...
               });
            }
         });
      });
   }

   listLocation()
   {
      let title         = `Your current location\n\nLatitude: ${this.coords.lat}\
nLongitude:${this.coords.lng}`;
      this.map.addMarker({
         'position': this.location,
         'title': title,
         animation: GoogleMapsAnimation.DROP,
         'styles' : {
            'text-align': 'right',
            'color': 'grey'
         }
      });
   }
}
```

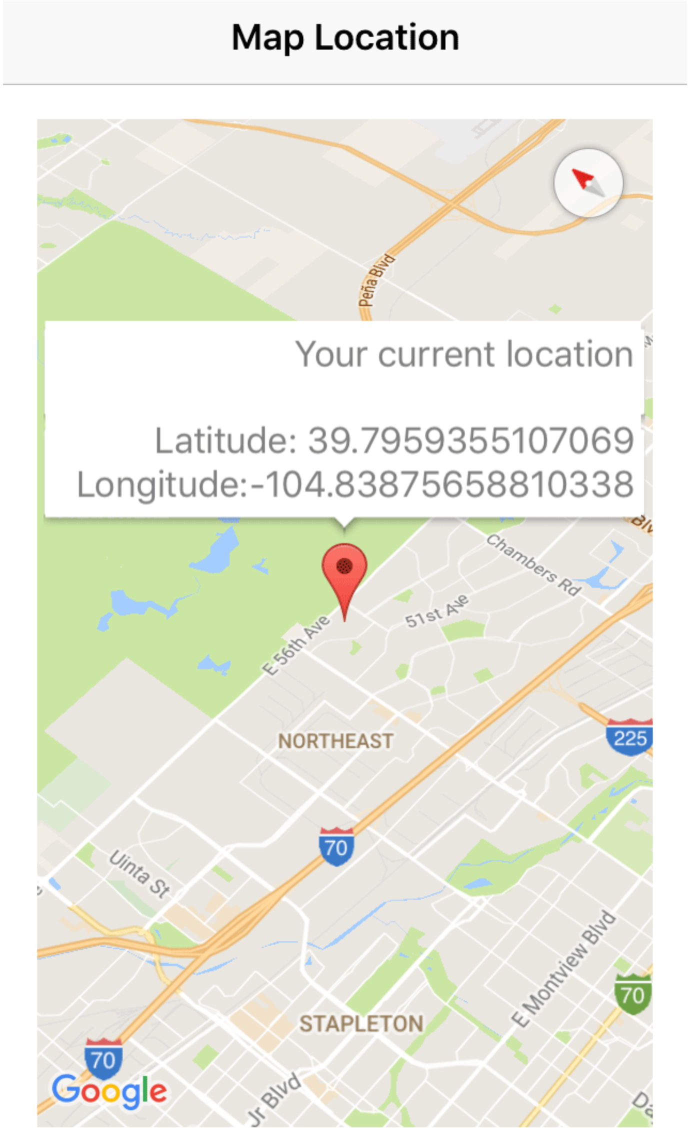
In the above code the Google map MAP_READY event now calls a method named **listLocation()**.

This method creates 2 items: a map marker, which is animated into view using the **GoogleMapsAnimation** object, and an **infoWindow** to displays coordinates for our current location that are styled in grey and aligned to the right of the **infoWindow**.

Save these additions to the script and execute the *ionic run ios --device* command in your Terminal.

Once successfully executed you should now see something akin to the following being rendered to your device:


Map Location


Map Location

Your current location

Latitude: 39.7959355107069
Longitude:-104.83875658810338

Congratulations! You've successfully created an Ionic app using the Geolocation and Google Maps plugins.

Your location has been plotted to the map with a marker that can be tapped on to toggle an infoWindow revealing the coordinates for your current location and you can also zoom in, zoom out, drag and rotate the map to view the location from different perspectives.

Not bad eh? You've learnt how to install, un-install and configure plugins while building a basic but interactive and engaging app along the way.

Of course there's a lot more that could be done with the app that we've built; such as plotting multiple markers, changing marker icons, creating overlays etc. but that's beyond the scope of this example.

If you're feeling adventurous you can always dive into the online documentation and start experimenting with the different plugin options in your own time through the following link: https://github.com/mapsplugin/cordova-plugin-googlemaps/wiki

In the next chapter we turn our attention to loading and parsing data in our Ionic 2 apps.

Resources
Ionic Native
Cordova Googlemaps Plugin
Geolocation Plugin
Google Developer Console
How the Google Map Plugin works

All project files for this chapter can be found listed in the download links on page 636.

Loading Data

From working with social media API's, remote database driven records or handling content stored in external JSON files most modern apps rely, to some degree, on imported data.

Without this data to drive the content for such apps even the most shiny, sparkling UI isn't going to count for much.

Thankfully, as Ionic 2 is built on top of the Angular 2 framework, we can use the built-in HTTP service to simplify the process of loading, retrieving and parsing external data for our apps.

Before we do this though we need to familiarise ourselves with the following:

- Promises
- Observables
- Maps
- Filters

Promises

A Promise is used to handle asynchronous operations (meaning that our scripts do not wait for a certain piece of code to finish executing before moving onto the next line), such as retrieving remote server data or completing an SQLite transaction, by providing an object that represents the value of that operation.

This value may be available immediately, at some point in the near future or never returned at all but the Promise object acts as a kind of agreement that whatever the outcome it will handle the operation while the rest of the script continues executing without interruption.

If you've been working with JavaScript for a while you're probably familiar with using callbacks to handle asynchronous operations (I.e. when processing a SQLite database transaction).

As useful as callbacks are Promises provide a much finer tuned mechanism for handling asynchronous requests, especially the success or failure of the operation.

In our Ionic apps we can use the **then** method of the Promise object to handle how the returned value is processed. Let's say for example that we have a method that retrieves data from a remote server, the Promise object might handle the success or failure of the asynchronous request in the following way:

```
retrieveRemoteData.then((data) => { // Success
  console.dir(data);
},
(data) => { // Failure
  console.dir(data);
});
```

In the above snippet the **then** method allows us to handle the fulfilment or rejection of the Promise within a few simple lines of code.

For more information on Promises visit this Mozilla Developer Network article: https://developer.mozilla.org/en/docs/Web/JavaScript/Reference/Global_Objects/Promise

Observables

If you've ever implemented listeners for DOM events then essentially what you are doing is observing the DOM for a specified event and then performing some action based on this event taking place.

An Observable, in practice, is doing pretty much the same thing except it can listen for multiple values emitted over time in both DOM events and asynchronous events.

This makes it ideal for real-time change detection such as retrieving stock market data or city traffic updates, where values will consistently be changing in relatively short periods of time.

Using Observables in Ionic 2 is made easy through the Reactive Extensions for JavaScript library (abbreviated to rxJS) which comes with the Angular 2 framework.

The rxJS library handles asynchronous and event based operations using both Observable collections and ES5 Array extras such as ForEach, reduce, map and filter (we'll explore some of these features shortly).

When we use Observables in our Angular/Ionic 2 apps we are, for all intents and purposes, subscribing to the data stream that it emits, and we accomplish this using the **subscribe** method.

An example of how this might look is as follows:

```
retrieveRemoteData.subscribe((data) =>
{
  console.dir(data);
});
```

Observables provide a number of methods for managing data streams, a handful of which are listed below:

- **dispose** - Cancel the observable stream
- **retry** - Repeats the sequence a specified number of times (or until accomplished)
- **toArray** - Creates a list from the Observable stream
- **toPromise** - Converts an Observable stream into a Promise
- **concat** - Concatenates specified Observable streams
- **merge** - Merges specified observable streams into a single observable stream

A full list of all the Observable methods can be found here: https://github.com/Reactive-Extensions/RxJS/blob/master/doc/api/core/observable.md

Map

The **map** method is used to create a new array from an existing array. It takes the supplied array, runs that through a function (which can be used to perform certain operations on the supplied array - such as, for example, converting each array item value to uppercase) and subsequently returns a new array once completed.

Let’s say we have a situation where we need to retrieve only the country name from an associative array of data.

Using the **map** method we might accomplish this in the following way:

```
var newArr = [
            { id: 1, country: "England" },
            { id: 2, country: "Scotland" },
            { id: 3, country: "Wales" },
            { id: 4, country: "Northern Ireland" },
            { id: 5, country: "Republic of Ireland" },
            { id: 6, country: "France" },
            { id: 7, country: "Germany" },
            { id: 8, country: "Italy" },
            { id: 9, country: "Spain" },
            { id: 10, country: "Belgium" },
            { id: 11, country: "Holland" },
            { id: 12, country: "Czech Republic" }
];

countries = newArr.map(function(x)
{
  return x.country
});

console.dir(countries);

// Outputs following to web console
["England", "Scotland", "Wales", "Northern Ireland", "Republic of Ireland",
"France", "Germany", "Italy", "Spain", "Belgium", "Holland", "Czech Republic"]
```

Filter

When using the **map** method to create new arrays every value from the original array is mapped to the new array. As useful as this is there are times when you only want to retrieve specific values from an array.

Using the **filter** method values can be retrieved if they meet a specific criteria.

Let’s take our previous example and use the **filter** method to only return every 4th item from the associative array:

```
var newArr = [
            { id: 1, country: "England" },
            { id: 2, country: "Scotland" },
            { id: 3, country: "Wales" },
            { id: 4, country: "Northern Ireland" },
            { id: 5, country: "Republic of Ireland" },
            { id: 6, country: "France" },
            { id: 7, country: "Germany" },
            { id: 8, country: "Italy" },
            { id: 9, country: "Spain" },
            { id: 10, country: "Belgium" },
            { id: 11, country: "Holland" },
            { id: 12, country: "Czech Republic" }
];

var countries = newArr.filter(function(x)
{
  if(x.id % 4 === 0)
  {
    return x;
  }
});

console.dir(countries);
```

```
// Outputs following to web console
[{id: 4, country: “Northern Ireland”},
 {id: 8, country: “Italy”},
 {id: 12, country: “Czech Republic”}]
```

By using the modulus operator within the **filter** method we successfully retrieve every 4th item from the original array.

We can also combine the **filter** and **map** methods for the above examples so we end up with an array populated solely with the names of every 4th country like so:

```
var newArr = [
              { id: 1, country: "England" },
              { id: 2, country: "Scotland" },
              { id: 3, country: "Wales" },
              { id: 4, country: "Northern Ireland" },
              { id: 5, country: "Republic of Ireland" },
              { id: 6, country: "France" },
              { id: 7, country: "Germany" },
              { id: 8, country: "Italy" },
              { id: 9, country: "Spain" },
              { id: 10, country: "Belgium" },
              { id: 11, country: "Holland" },
              { id: 12, country: "Czech Republic" }
],
countries = newArr.filter(function(x)
{
  if(x.id % 4 === 0)
  {
    return x;
  }
})
.map(function(x)
{
  return x.country
});

console.dir(countries);

// Outputs following to web console
["Northern Ireland", "Italy", "Czech Republic"]
```

Maps and filters are quite handy when parsing data retrieved with Observables so you’ll find yourself using these quite a bit in your own Ionic 2 projects.

That covers the concepts behind retrieving data now let’s explore the Angular 2 HTTP service and learn how Promises and Observables can be used within our apps.

Angular and HTTP methods

Angular 2’s http service allows developers to perform asynchronous requests using the following methods (all of which return an Observable):

- **request** (accepts any type of http method I.e. GET, POST etc.)
- **get** (Retrieve any information identified by the URI)
- **post** (Usually used to create a new resource I.e. posting data to be added to a remote database)
- **put** (Most often used to update existing resources I.e. posting data to update an existing record in a remote database)
- **delete** (Most often used to remove an existing resource I.e. removing a remote database record)
- **patch** (Used to make changes to a resource not the complete resource itself)
- **head** (identical to the HTTP GET method except the server must not return a message-body in the response)
- **options** (Request for information about communication options that are available when communicating with a specific resource)

The more seasoned developers amongst you will no doubt have noticed that these angular methods are named exactly the same as the HTTP protocol methods themselves.

This is no accident as it makes sense to identify the purpose of each method by its associated HTTP counterpart (when working with RESTful services this is especially important).

An explanation of the different methods used by the HTTP protocol are available here: http://www.w3.org/Protocols/rfc2616/rfc2616-sec9.html

We will typically be working with just the **get** and **post** methods in our apps so let’s start with how we would retrieve data and import that for use.

Importing data

Using the **get** method of the angular http service we might asynchronously request a resource and parse any retrieved data in the following manner:

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class MyPage {
  constructor(
         public navCtrl : NavController,
         private http     : Http)
  {
  }

  this.http.get('http://www.mywebsite.com/data/remote.php')
  .map(res => res.json())
  .subscribe(data => {
    console.dir(data);
  });
}
```

We begin by importing the Http service and map operator from the rxJS library towards the top of our script.

We then inject the Http service into the class constructor, assigning that to a property of http which is subsequently used to create a request to a remote PHP script using a **get** method.

The http service returns an Observable so we use the **map** method to convert any returned data into a JavaScript object (thanks to the **json** method) which makes iterating through and parsing the data so much easier.

As this request is asynchronous this means that our script will continue to execute while the request is being made and we will only be able to act on any returned data from within the **subscribe** method of the Observable (as data values will be available at this stage).

This is very important - You can only access the returned data for an Observable from within the **subscribe** method. If you need to implement any data handling logic this is where you would place that.

In the above example the **console.dir()** call has been placed there and NOT outside of the Observable as it wouldn’t be able to output the returned data to the console otherwise.

We could have used a Promise instead of an Observable to make this request but

Observables provide quite a few advantages over Promises such as the ability to cancel a request, repeat a request a specified number of times, merge separate request streams and a lot more besides.

A full list of all Observable methods is available here: https://github.com/Reactive-Extensions/RxJS/tree/master/doc/api/core/operators

Now let's take a look at posting data to a remote script.

Posting data

With the **post** method of the angular http service data can be submitted to a remote script asynchronously like so:

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';
import { Http, Headers, RequestOptions } from '@angular/http';
import 'rxjs/add/operator/map';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

   constructor(
      public navCtrl          : NavController,
      private http            : Http)
   {
      this.postURI();
 }



   postURI()
   {
      let body      =     "name=James&description=Web%20developer",
          type      =     "application/x-www-form-urlencoded; charset=UTF-8",
          headers   =     new Headers({ 'Content-Type': type}),
          options   =     new RequestOptions({ headers: headers }),
          url       =     "http://www.saintsatplay.com/remote.php";

      this.http.post(url, body, options)
      .map(res => res.json())
      .subscribe(data =>
      {
        console.log(data);
      });
    }

  }
```

We import modules to be used in our script with particular emphasis on the following for sending and parsing remote data:

- Http
- Headers
- RequestOptions
- The rxJS map operator

We call a **postURI** method in our constructor so that it is triggered upon initialisation of the class.

This creates an Observable using the Angular http service **post** method which:

- Defines the remote URI we want to access
- Supplies a string of data to be posted to the remote URI
- Declares the content type for the request headers
- Fires off a post request - using the above configuration and supplied data
- Converts returned data into a JavaScript object

- Logs the returned data within the **subscribe** method of the Observable

The remote script that handles this request might look something like this:

```
<?php
header('Access-Control-Allow-Origin: *');

// Retrieve posted data
$name            = strip_tags($_POST['name']);
$description     = strip_tags($_POST['description']);

echo json_encode("Hello. My name is " . $name . " and I am a " . $description);
exit;
```

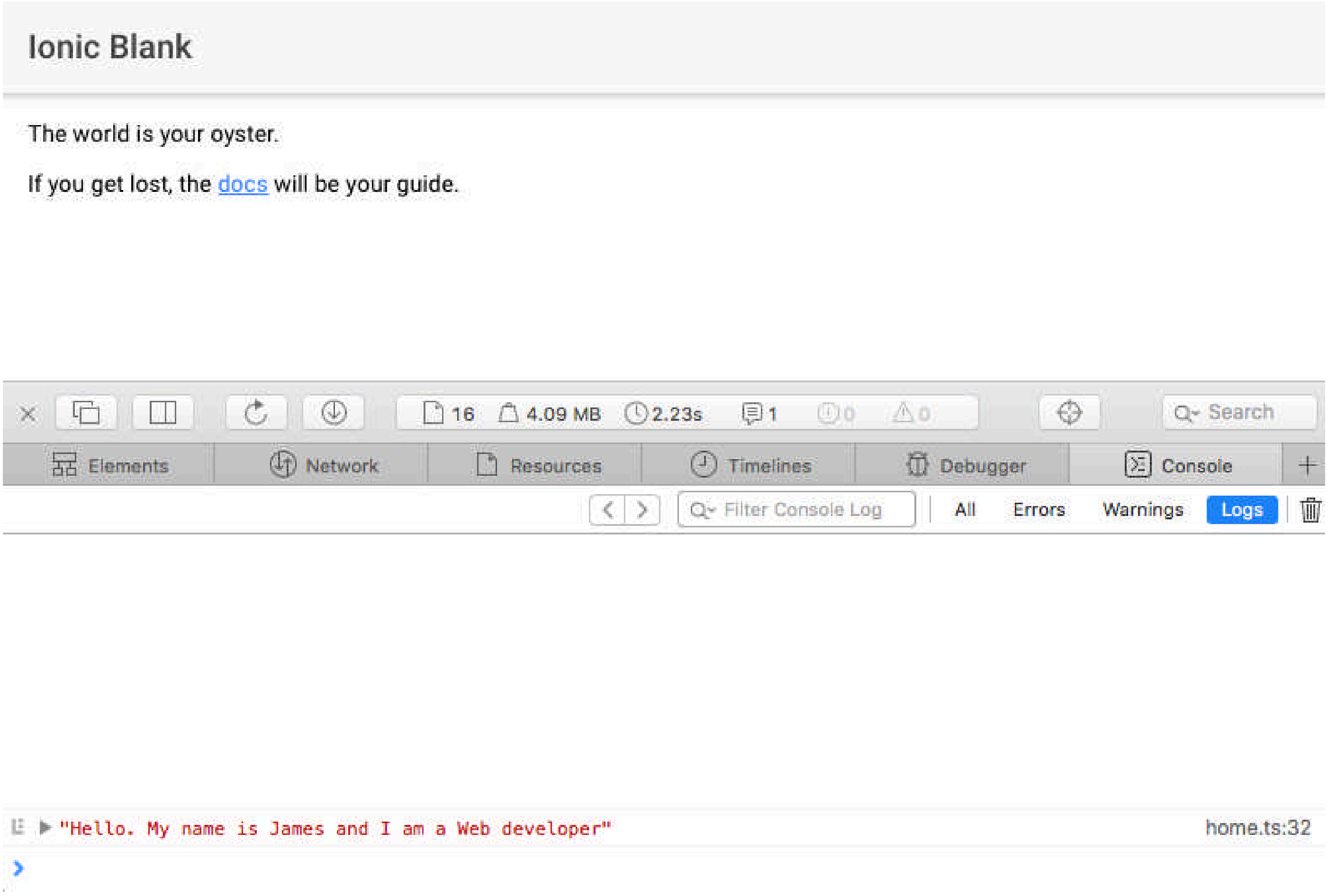
This is, of course, a very basic script using PHP (which could be implemented using any server side language such as Ruby, Perl or ASP.net instead) that firstly sets a header allowing universal access to help overcome CORS (Cross-Origin Resource Sharing) related problems (in a real-world situation you might not be so permissive and instead limit the scope for access to the script).

Then posted data is retrieved using the **strip_tags** function to remove any potential script injection attacks (as a developer you should always sanitise user-submitted data to prevent, as far as possible, any malicious attempts to hack your scripts and/or server).

Finally the **json_encode** function is used to encode a message populated with values from the posted data.

We could have made this example more functional by storing the submitted data, once sanitised, into a remote database or providing the scripting to e-mail that to our inbox but all we're interested in doing here is demonstrating how data can be posted and retrieved using Angular 2's Http service.

If we ran this example with *ionic serve* we should see the http service executing and returning a message that is then logged to the browser console like so:



The world is your oyster.

If you get lost, the docs will be your guide.

```
"Hello. My name is James and I am a Web developer"                home.ts:32
```

As you can see the Angular 2 Http service makes loading and retrieving remote data relatively straightforward and quick to implement.

That pretty much covers all we need to know for this chapter. We've learnt about Promises and Observables (and some of the available ES5 array methods), why Observables are preferred over Promises for data handling and explored how the **get** and **post** methods of the Angular 2 Http service can be used to retrieve and submit data for our Ionic apps.

As mentioned previously there's a lot more we can do with Observables but we'll be exploring that in further detail in the Case Studies section.

In the next chapter we turn our attention to using forms and handling data input in our Ionic 2 apps.

Resources

Mozilla Developer Network - Promises
Reactive Extensions JavaScript Library
ES5 Array Extras
Array map method
Array Filter method
HTTP protocol methods
Using HTTP methods for RESTful services
Angular 2 http service
Cors

Forms
& Data Input

Handling data input is an integral part of most web & mobile applications and thanks to the Angular 2 framework we have a number of ways in which we can handle data input in our Ionic 2 apps:

- Two-way data binding using ngModel
- Formbuilder
- Template-driven forms

Option 1 - Two-way data binding using ngModel

Angular 2's ngModel directive allows us to implement a concept known as two-way data binding to form input fields in our templates.

Two-way data binding is a term used to describe the association between the value of a template input field and the value of a variable in the component class.

Using the ngModel directive values can be set in both directions, hence the term two-way data binding.

For example, in the component class we can set a value for a variable that is bound to the template input field. We can then update the value of that variable by modifying the value in the template input field.

Let's make a start with exploring two-way data binding by creating a new Ionic app, in the root of your apps directory, with the following commands:

```
ionic start simpleForm blank --v2
cd simpleForm
npm install // Install additional node modules
```

We won't be adding any platforms or plugins here, just some straightforward code in our class and template files.

In your code editor open the **simpleForm/src/pages/home/home.html** template and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Your personal details
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
   <form (ngSubmit)="saveDetails()">
      <ion-list>
         <ion-item>
            <ion-label>Your Name</ion-label>
            <ion-input
              type="text"
              [(ngModel)]="details.name"
              name="name"></ion-input>
         </ion-item>

         <ion-item>
            <ion-label>Your Occupation</ion-label>
            <ion-input
              type="text"
              [(ngModel)]="details.occupation"
              name="occupation"></ion-input>
         </ion-item>

         <ion-item>
            <ion-label>Favourite Platform</ion-label>
            <ion-select
              [(ngModel)]="details.platform"
              name="platform">
               <ion-option value="Android">Android</ion-option>
```

```
          <ion-option value="iOS">iOS</ion-option>
          <ion-option value="WP">Windows Phone</ion-option>
          <ion-option value="Other">Other</ion-option>
        </ion-select>
      </ion-item>

      <button
        ion-button
        color="primary"
        text-center
        block>
          Save Details
      </button>
    </ion-list>
  </form>

</ion-content>
```

Each of the 3 fields in our above form has an ngModel directive attached to it whose value links that template input field to a specified property in the component TypeScript class.

The value for each ngModel directive is declared in dot syntax form to represent the name of the object and its property that the input field is being linked with.

Each field also has a name attribute whose value matches that of the property declared in the related ngModel directive.

IMPORTANT - If you are using the ngModel directive in a form you MUST supply the name property on an input field OR use the [ngModelOptions]="{standalone: true}" directive wherever the ngModel directive is also being used.

The following example illustrates how this would be implemented on a form input field (displayed in bold):

```
<ion-input
   type="text"
   [(ngModel)]="details.occupation"
   [ngModelOptions]="{standalone : true}"></ion-input>
```

Now that we’ve created a form and used ngModel directives to begin implementing two-way data binding for our input fields let’s modify the class for this template and script the logic to enable this functionality.

Open your **simpleForm/src/pages/home/home.ts** file and make the following amendments (displayed in bold):

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

   public details : any = {
      name        : 'James Griffiths',
      occupation  : 'Code Monkey',
      platform           : 'Other'
   };

   constructor(public navCtrl: NavController)
   {

   }

   saveDetails()
   {
      console.log(`My name is ${this.details.name}`);
      console.log(`I work as a ${this.details.occupation}`);
      console.log(`My favourite platform is ${this.details.platform}`);
   }
}
```

You’ll notice that we set a public property named **details** which is an object that contains the name, occupation and platform keys that the template input fields reference through the ngModel directives.

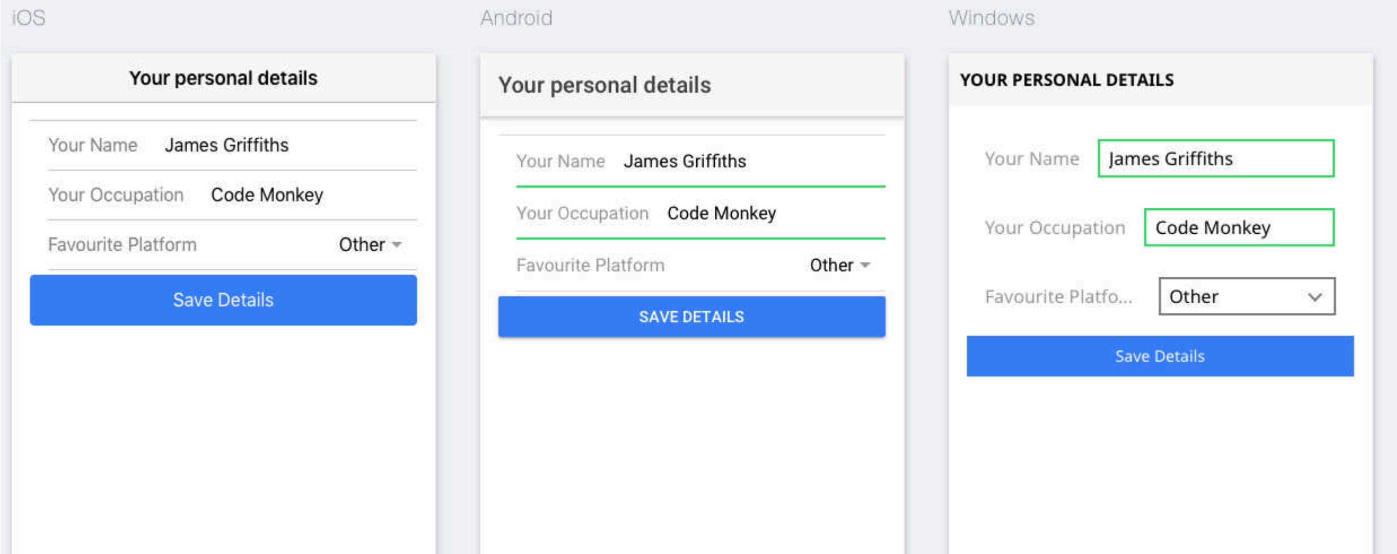
In the above example I’ve pre-filled this object with key/value pairings but I could easily have opted to initialise an empty object instead of supplying these values.

The **saveDetails** method, which the ngSubmit directive in our form template uses, simply console logs out the value for each form input field.

Let’s preview this in the browser using the following command:

```
// Preview this across iOS, Android & Windows Phone with lowercase L flag
ionic serve -l
```

And you should now see the following screen being rendered with those form input fields pre-filled/pre-selected with the values supplied from the **details** object in the component class:



iOS

Your personal details

Your Name James Griffiths

Your Occupation Code Monkey

Favourite Platform Other

Android

Your personal details

Your Name James Griffiths

Your Occupation Code Monkey

Favourite Platform Other

Windows

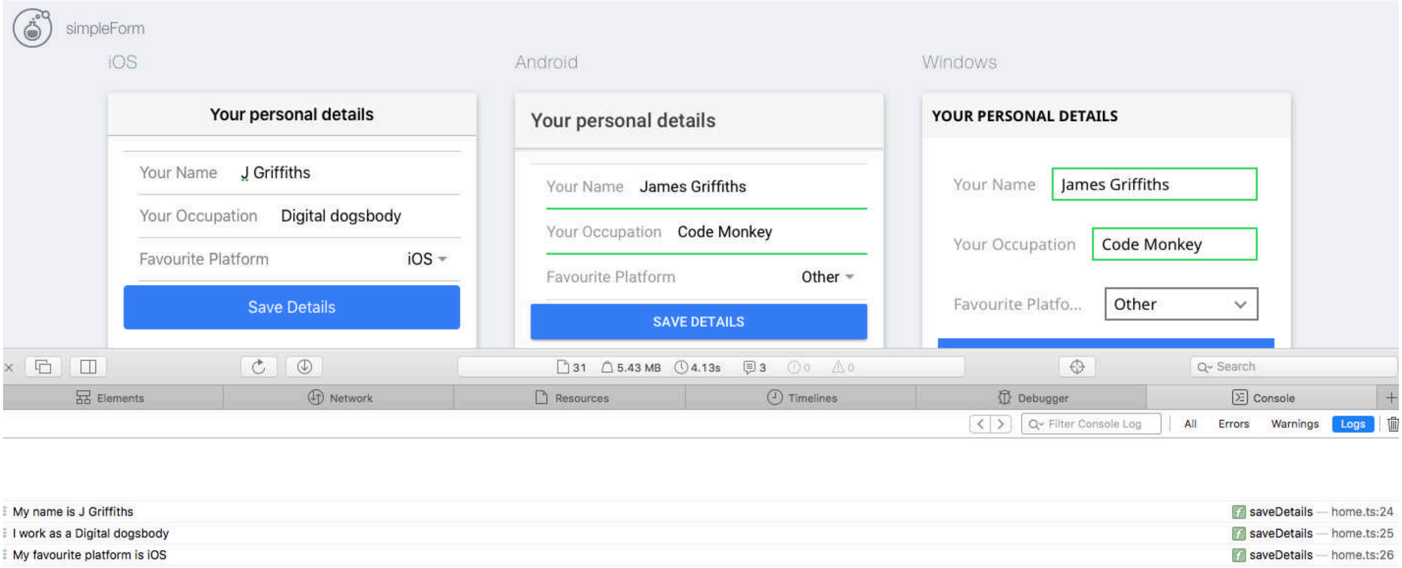
YOUR PERSONAL DETAILS

Your Name James Griffiths

Your Occupation Code Monkey

Favourite Platfo... Other

Feel free to change these input field values in one of the displayed platforms, submit the form and then inspect the values that are logged to the console window in the web inspector like so:



Your personal details

Your Name J Griffiths

Your Occupation Digital dogsbody

Favourite Platform iOS

Save Details

Your personal details

Your Name James Griffiths

Your Occupation Code Monkey

Favourite Platform Other

SAVE DETAILS

YOUR PERSONAL DETAILS

Your Name James Griffiths

Your Occupation Code Monkey

Favourite Platfo... Other

```
My name is J Griffiths                 saveDetails — home.ts:24
I work as a Digital dogsbody           saveDetails — home.ts:25
My favourite platform is iOS           saveDetails — home.ts:26
```

Two-way data binding is pretty neat - and is similar to how forms were handled in Angular 1/Ionic 1 - but using this approach does present the following challenges:

- Hard to unit test
- Less programmatic control over the form by the class

Option 2 - Formbuilder

Angular 2 introduces the FormBuilder, a helper class that allows developers to build forms that are able to take advantage of the following functionality:

- Implementing validation rules for input fields
- Updating the form UI to help guide user behaviour (I.e. disabling buttons where required input fields have not been completed & displaying error messages)
- Listening for value changes on input fields

Using the FormBuilder we can programmatically build our forms and use that logic to control the input fields and form state in our templates.

Navigate to the root of your apps directory and, using the Ionic CLI, run the following commands:

```
ionic start advancedForm blank --v2
cd advancedForm
npm install // Install additional node modules
ionic g provider Validator
```

With this new project we’re going to use the Angular 2 FormBuilder service to implement validation functionality and update the form UI to reflect changes such as errors and successfully completed fields.

Let’s start by generating some validation rules to use with the FormBuilder service.

Open the **advancedForm/src/providers/validator/validator.ts** file and make the following changes (highlighted in bold):

```
import { Injectable } from '@angular/core';
import { FormControl } from '@angular/forms';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Injectable()
export class Validator {

  constructor(private http: Http)
  {

  }

  emailValid(control: FormControl)
  {
    return new Promise(resolve =>
    {
      let emailPattern = /^\w+([\.-]?\w+)*@\w+([\.-]?\w+)*(\.\w{2,3})+$/;
```

```
         if(!emailPattern.test(control.value))
         {
            resolve({ InvalidEmail : true });
         }
            resolve(null);
      });
   }

   nameValid(control: FormControl)
   {
      return new Promise(resolve =>
      {
         let pattern = /[0-9]/;
         if(pattern.test(control.value))
         {
            resolve({ InvalidName : true });
         }
            resolve(null);
      });
  }

}
```

In our service we begin by importing the Angular Forms **FormControl** class which we will use in our subsequent methods to obtain the value from the input field that we are looking to validate.

We then create 2 methods: **emailValid** and **nameValid**; each of which use promises to return the results of tests that we perform on the supplied input field value using regular expressions.

If our regular expressions fail we return a JSON object that we will use to display error messages in the HTML template, otherwise we return a null value (which, believe it or not, means our validation was successful).

Now that we’ve created the validation service let’s plug this into our class using the **FormBuilder** service.

Open the **advancedForm/src/pages/home/home.ts** file and make the following amendments (displayed in bold):

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';
import {
        FormBuilder,
        FormGroup,
        Validators
} from '@angular/forms';
import { Validator } from '../../providers/validator';


@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

   private form          : FormGroup;
   private name          : any;

   constructor(
               private navCtrl    : NavController,
               private fb         : FormBuilder,
               private val        : Validator
               )
   {
      this.form           = fb.group({
        'name'            : ['', Validators.required, val.nameValid],
        'email'           : ['', Validators.required, val.emailValid],
        'platform'        : ['', Validators.required]
      });

      this.name           = this.form.controls['name'];

      this.name.valueChanges.subscribe(
        (value: string) =>
        {
          console.log(`Entered name is ${value}`);
        });

      }

      saveDetails(value)
      {
        console.log(value);
      }

}
```

Here we import the Validator service that we previously created as well as the following Angular services:

- FormBuilder
- FormGroup
- Validators

These will be used to manage the input field logic and validation functionality for the page template.

A **FormGroup** allows us to manage more than one input field (which is quite handy if we have forms with multiple fields that we need to work with) allowing our app to programmatically determine the state of each specified input field (I.e. whether it is valid, has changed etc.) and its value.

Validators, as the name implies, provide the ability to validate input fields.

The **FormBuilder** service will be used as a utility wrapper to help manage the **FormControl** and **FormGroup** services.

In the class constructor we inject the **FormBuilder** and **Validator** services, assign those to their respective private properties and then use the **FormBuilder** service to create a new **FormGroup**.

This FormGroup contains 3 **FormControls** (rendered as key/value pairs) which are used to target each individual input field in our form.

Each **FormControl** is assigned its respective Validators where, for the name and email controls we assign our custom validation methods from the Validator service.

We also listen to value changes in the name input field using the **valueChanges** method of the **FormControl** object (which gives us access to the **EventEmitter**, an Observable that allows us to track custom events in our applications).

Finally we implement the **saveDetails** method which will be used to retrieve the submitted form data.

Now we'll turn our attention to rendering the HTML for our template and tying in the **FormBuilder** logic.

Open the **advancedForm/src/pages/home/home.html** template and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Your Personal Details
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>

  <form [formGroup]="form" (ngSubmit)="saveDetails(form.value)">
    <ion-list>
      <ion-item margin-bottom>
        <ion-label>Your Name</ion-label>
        <ion-input
          type="text"
          [formControl]="form.controls['name']"></ion-input>
      </ion-item>

      <ion-item margin-bottom>
        <ion-label>Your Email address</ion-label>
        <ion-input
          type="email"
          [formControl]="form.controls['email']"></ion-input>
      </ion-item>

      <ion-item margin-bottom>
        <ion-label>Favourite Platform</ion-label>
        <ion-select [formControl]="form.controls['platform']">
          <ion-option value="Android">Android</ion-option>
          <ion-option value="iOS">iOS</ion-option>
          <ion-option value="WP">Windows Phone</ion-option>
          <ion-option value="Other">Other</ion-option>
        </ion-select>
      </ion-item>

      <button
        ion-button
        color="primary"
        text-center
        block [disabled]="!form.valid">Save Details</button>
    </ion-list>
  </form>

  <div *ngIf="form.controls['name'].dirty && !form.controls['name'].
valid">
    <p *ngIf="form.controls['name'].errors.InvalidName">
      Your name cannot contain any numbers.
    </p>
  </div>

  <div *ngIf="form.controls['email'].dirty && !form.controls['email'].valid">
    <p *ngIf="form.controls['email'].errors.InvalidEmail">
      You must enter a valid e-mail address
    </p>
  </div>

</ion-content>
```

Here we implement the **formGroup** property on our HTML form to create a link with the **FormBuilder** logic in the component class and the template input fields.

You'll notice the **formGroup** property is set to a value of form which matches the same property name used in the component class (where we created a **FormGroup** using the **FormBuilder** helper).

Each input field has a **formControl** assigned to it whose value is mapped to the specified **FormControl** object in the component class (this relationship allows the **FormBuilder** helper to retrieve each field’s input value).

We can implement our HTML **FormControl** with either of the following syntax:

```
[formControl]="form.controls['name']"
// OR
formControlName="name"
```

Either way is perfectly valid.

The ability to submit the form is determined through the **FormBuilder** object assessing the state of each input field, whether it has data and has successfully passed all applied validation criteria - if not the submit button state remains disabled.

This is quite a nice, default UX touch as the button state visually guides the user in understanding that the form cannot be submitted until data entry has been successfully completed.

The **FormBuilder** component logic listens for data entered, determines its validity and whether any errors have occurred (and, if so, displays these under the form).

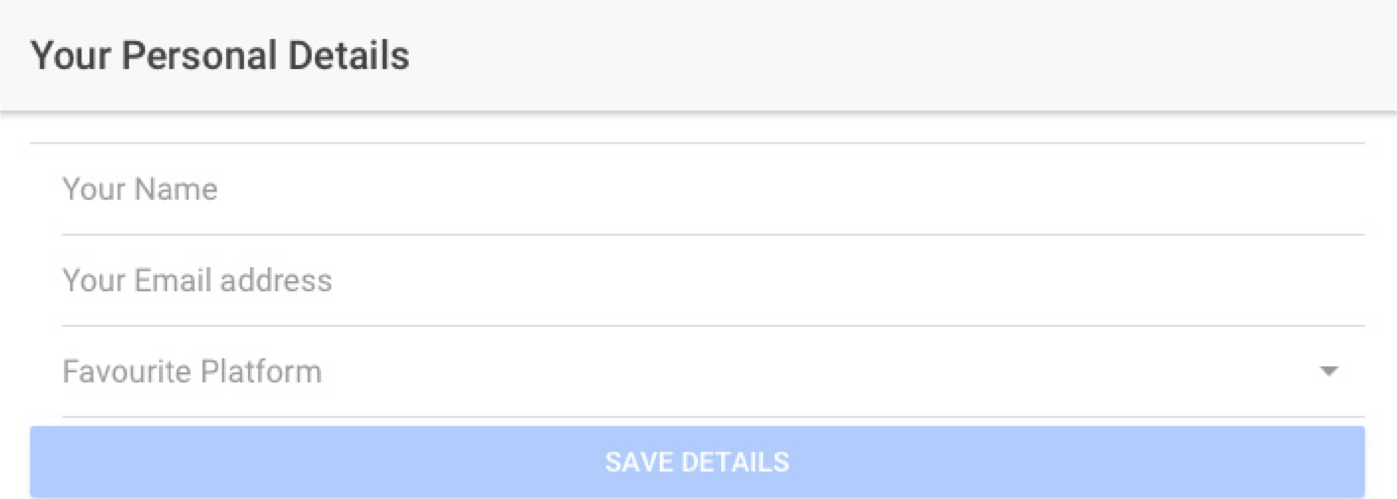
Add the following to **advancedForm/src/app/app.module.ts** (highlighted in bold):

```
import { NgModule } from '@angular/core';
import { IonicApp, IonicModule } from 'ionic-angular';
import { MyApp } from './app.component';
import { Validator } from '../providers/validator/';
import { HomePage } from '../pages/home/home';

@NgModule({
  declarations: [
    MyApp,
    HomePage
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage
  ],
  providers: [Validator]
})

export class AppModule {}
```

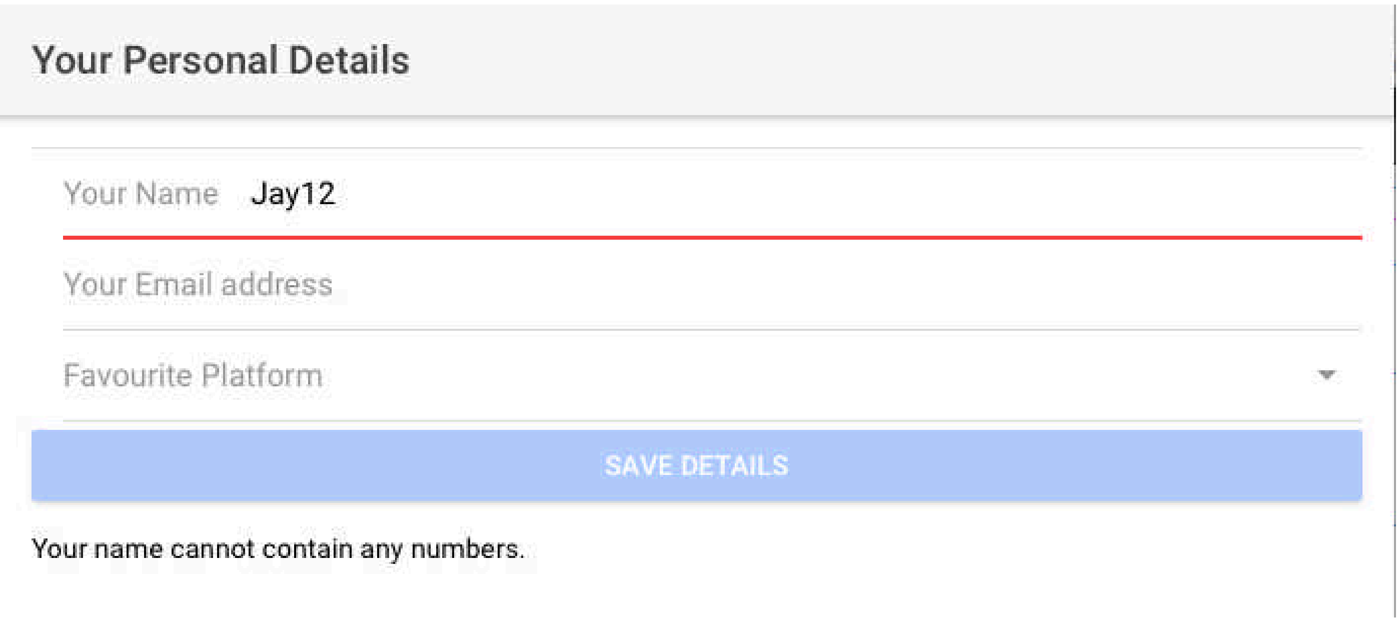
With the Validator service in place along with the completed component class and template we can now preview and test our **FormBuilder** example in the browser using the following command:

```
ionic serve
```

We should be greeted with a basic form consisting of three fields and a disabled submit button (in its initial state) like the following screen capture:



When validation errors are detected (thanks to the use of our custom validation methods and the **FormBuilder** helper) the app will display a message to the user informing them of the nature of the error and what they must do to rectify this:



Your Name Jay12

Your name cannot contain any numbers.

The above error for the name input field is triggered by numbers being entered for a person’s name.

Notice how the form border colour changed to red to indicate that there was an error with the data entry for this field?

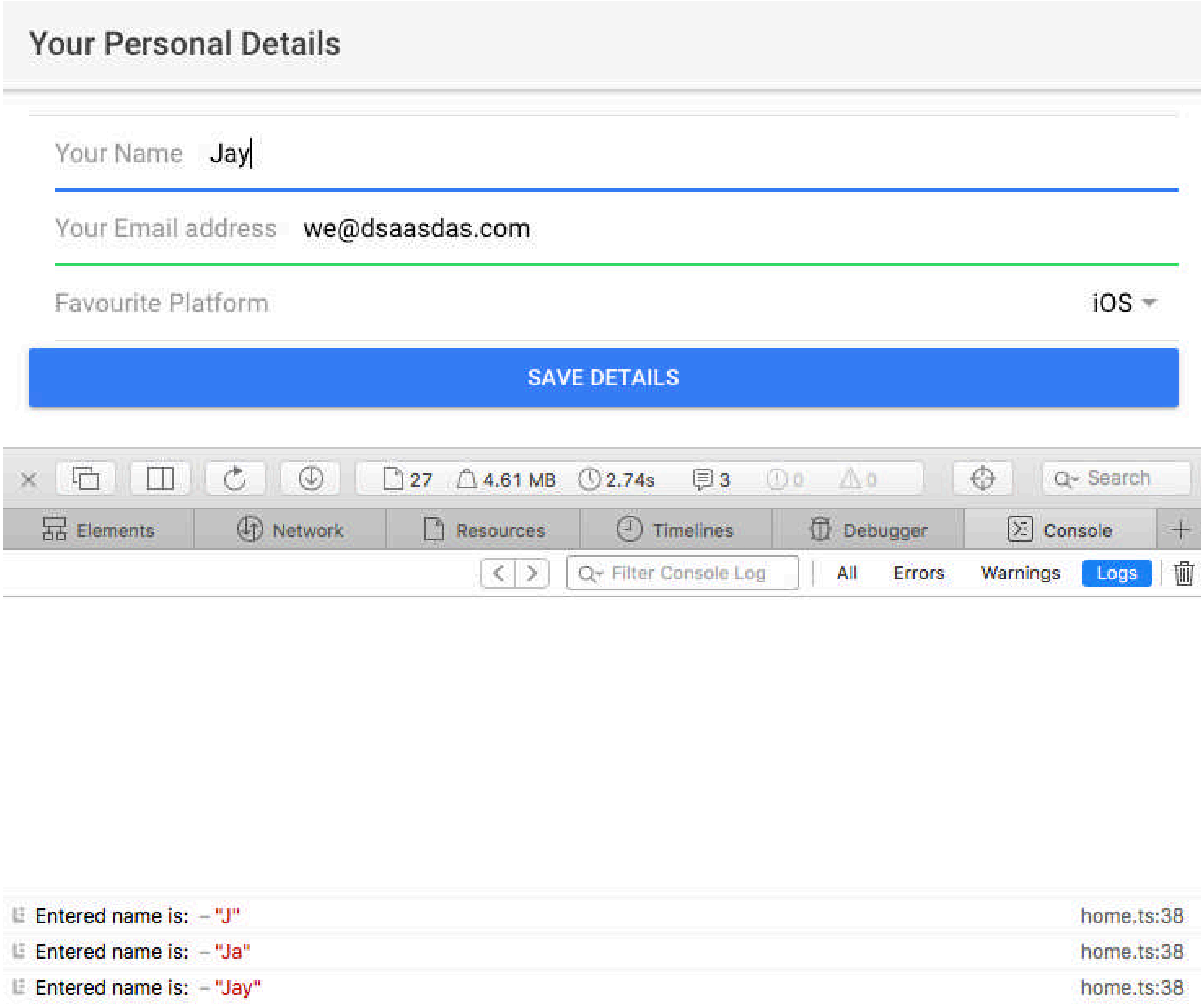
The underlying Angular 2 framework detects the state of the input field and applies its own specific classes to reflect those states:

- **ng-dirty** (Input field has been interacted with)
- **ng-touched** (Input field has received focus)
- **ng-valid** (Data entry has passed validation)
- **ng-invalid** (Data entry has not passed validation)

These add quite a nice UX touch and provide helpful visual feedback to the user concerning their data entry.

Finally, remember how we added an **EventEmitter** to track real-time changes to the name input field?

The following screenshot displays how the browser console logs each time a character is entered into this field:



Your Personal Details

Your Name Jay

Your Email address we@dsaasdas.com

Favourite Platform iOS

```
Entered name is: – "J"                                    home.ts:38
Entered name is: – "Ja"                                   home.ts:38
Entered name is: – "Jay"                                  home.ts:38
```

And that wraps up our exploration of using the **FormBuilder** to programmatically generate forms for our apps.

This approach might seem like a lot more work than using simple model driven forms but through the **FormBuilder** service we get a lot more control over error detection, state change and handling our data through one single object instead of tracking multiple objects.

Now we'll turn our attention to the third way in which we can implement forms in Ionic 2 - template driven forms.

Option #3 - Template-driven forms

The final way in which we can build forms for our apps involves removing the logic from the class and implementing that directly within the form itself.

Let’s look at how this works by creating a template driven form.

Navigate to the root of your apps directory and, using the Ionic CLI, run the following commands:

```
ionic start templateForm blank --v2
cd templateForm
npm install // Install additional node modules
```

We’ll start by editing the class as this is the simplest part of our application to work with.

Open the **templateForm/src/pages/home/home.ts** file and make the following amendment (highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
   constructor(public navCtrl: NavController)
   { }

   saveDetails(value)
   {
      console.dir(value);
   }
}
```

We add a single method of **saveDetails** to the class which will be used to retrieve data entered into the form.

Now onto the amendments for the **templateForm/src/pages/home/home.html** file (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Your Personal Details
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
   <form #f="ngForm" (ngSubmit)="saveDetails(f.value)">
      <ion-list>

         <ion-item margin-bottom>
            <ion-label>Your Name</ion-label>
            <ion-input
                  type="text"
                  name="name"
                  ngModel></ion-input>
            </ion-item>

            <ion-item margin-bottom>
            <ion-label>Your Email address</ion-label>
            <ion-input
                  type="email"
                  name="email"
                  ngModel></ion-input>
            </ion-item>
            <ion-item margin-bottom>
```

```
          <ion-label>Favourite Platform</ion-label>
          <ion-select name="platform" ngModel>
            <ion-option value="Android">Android</ion-option>
            <ion-option value="iOS">iOS</ion-option>
            <ion-option value="WP">Windows Phone</ion-option>
            <ion-option value="Other">Other</ion-option>
          </ion-select>
        </ion-item>
        <button
            ion-button
            color="primary"
            text-center
            block>
                  Save Details
      </button>
    </ion-list>
  </form>
</ion-content>
```

Here we use a local template variable, referenced as #f, and pass in the **NgForm** directive as a value. Doing this allows us to create a **FormGroup** on the template itself (in this case the form IS the FormGroup). When we submit the form we pass the value of the form itself as arguments in the **saveDetails** method on the ngSubmit action.

The value of the form is submitted in key/value pairs, making it easy to iterate through the data.

Our input fields are each assigned an ngModel attribute with no value. This creates a one-way data binding which sends data from the form to the component class only.

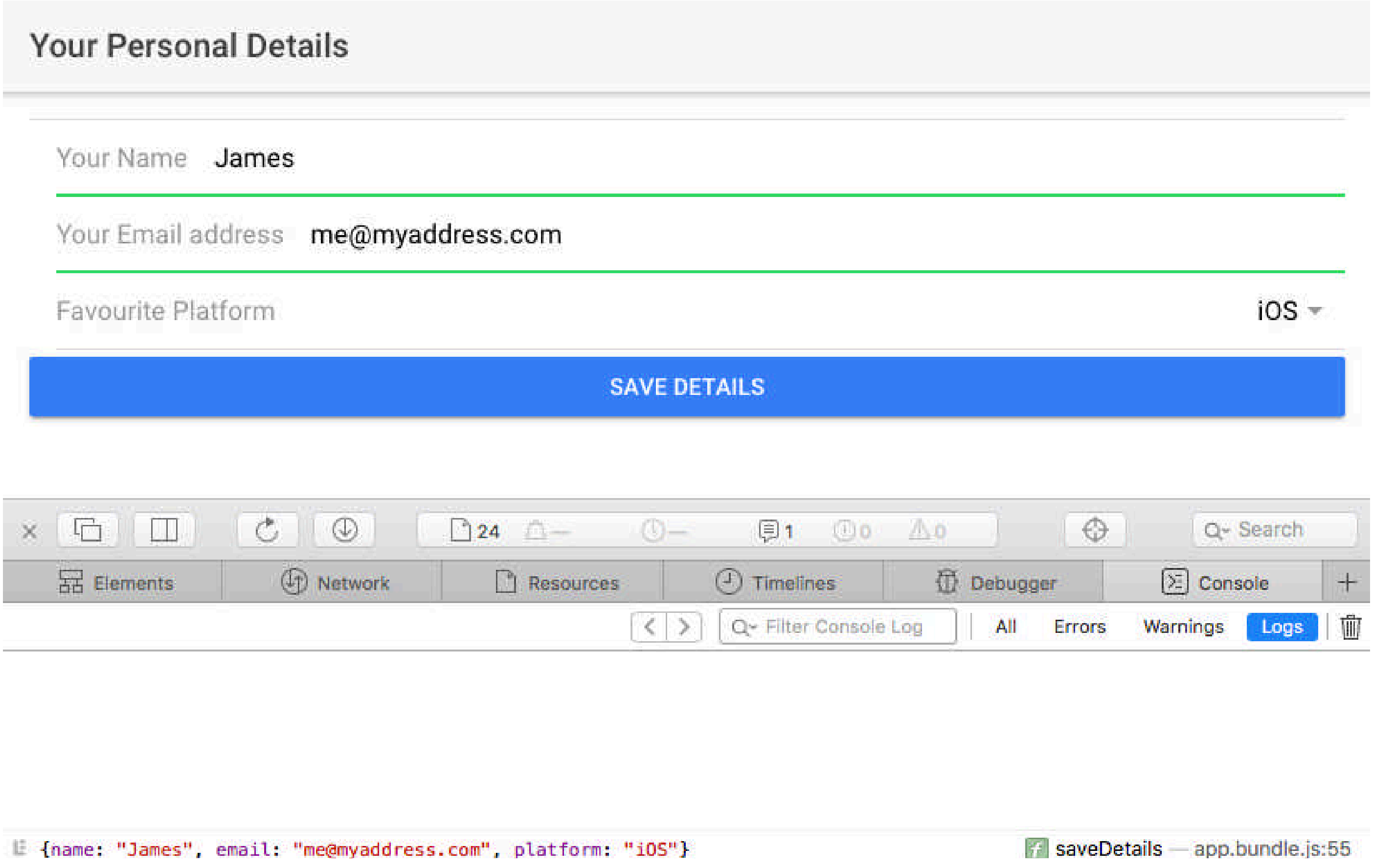
Using the ngModel directive as a value-less attribute implicitly adds a **FormControl** to each input field (the name for each **FormControl** is generated from the value of

the name attribute on that input field).
This **FormControl** is automatically added to the **FormGroup** which, in turn, is able to simply pass the value of the entire form as an argument through the ngSubmit action.

This approach places all of the logic directly in the form template itself and all our component class has to do is parse the received data - which we can test in the browser with the following command:

```
ionic serve
```

We should be greeted with the same basic form as we’ve seen displayed in the previous two examples:



Your Personal Details

Your Name James

Your Email address me@myaddress.com

Favourite Platform iOS

```
{name: "James", email: "me@myaddress.com", platform: "iOS"}          saveDetails — app.bundle.js:55
```

You can see the form object being logged to the browser console, as key/value pairs, after the form has been submitted.

Template driven forms are relatively simple to implement and are, essentially, a slightly modified version of model driven forms.

That covers our exploration into the different approaches to handling form input within Ionic 2.

Before we wrap up though let’s take one last look at the ngModel syntax we used in our model driven forms example.

We wrote our model, encapsulated with parentheses and brackets, like so:

```
[(ngModel)]
```

Which looks a little weird on first encounter right?

There is a reasoning behind this syntax though, which, believe it or not, is referred to as banana in a box!

As we are implementing two-way data binding the brackets are intended to signify the input aspect of the binding while the parentheses signify the output aspect of the binding.

In the next chapter we turn our attention to the most effective ways in which we can store and persist data for use in our Ionic 2 apps.

Resources
All project files for this chapter can be found listed in the download links on page 636.

Data Storage

Let’s face it, without some way of persisting data your apps are going to be pretty useless in the long run.

Whether you want to, for example, load & display a list of user scores for previous sessions of a game or allow users to manage personal data they’ve entered into the app the ability to both store & retrieve data is hugely important.

In this chapter we’ll explore how we can persist data across different sessions of the app using the following approaches:

- Local Storage
- SQLite database

If you’ve been exploring the Ionic Native repository you’ll probably be aware that there’s a couple of plugins we can use to help us implement the above functionality (and throughout this chapter we’ll certainly make use of both of those plugins!)

Let’s make a start though with Local Storage and explore how this technology can be used to manage data storage and retrieval in our apps.

Local Storage

Local Storage was first introduced with HTML5 and provided developers with a mechanism through which they could store data that would overcome some of the limitations inherent with using browser cookies.

These had traditionally been relied upon by front-end developers to persist data across that particular session or subsequent browser sessions but relying on using cookies presented one major problem.

The amount of data that could be stored was limited to a maximum size of 4KB.

This severely restricted what and how much data could be stored in the front-end and often meant that a server side solution, such as PHP and a MySQL database, had to be used in conjunction with the front-end in order to store/retrieve data.

Just to be clear, there's absolutely nothing wrong with this approach (I regularly work with this setup for various client projects) but it does add additional layers of different technologies that have to be integrated with one another.

Even for experienced developers you know what a pain this can be at times.

For individual developers or small teams though this can prove quite challenging if there are multiple specialisms required such as server configuration, back-end scripting and database administration. Add on top of this the constraints of a limited budget and project deadlines and things can get pretty tight in a hurry.

This is where Local Storage can help BUT, and it's a pretty big but......

Not all browsers support Local Storage.

Yep, there's always a gotcha in the world of web/mobile development and quite often that comes down to whether or not the browser/device will support the specific technology we want to use.

The following list displays, at the time of writing, the minimum browser versions that support LocalStorage:

- IE 8+
- Edge 12+
- Firefox 3.5+
- Chrome 4+
- Safari 4+
- Opera 11.5+
- iOS 3.2+
- Android 2.1+
- IE Mobile 10+

It's worth looking at the following resource for known issues/further information with the Local Storage API: http://caniuse.com/#search=Local%20Storage - particularly when, even with 100% iOS & Android support for LocalStorage, there is a problem with its persistence of data in the WebView on both platforms.

The Cordova plugin NativeStorage project (available through Ionic Native - http://ionicframework.com/docs/v2/native/nativestorage/ was designed to address and overcome this problem, as well as other limitations, to present a more effective option for data persistence.

We'll explore using this plugin in an app that we're going to build called moviesApp (that will be located within the apps directory that was created in the **Beginning Ionic 2 development** chapter).

Using the Ionic CLI run the following commands:

```
ionic start moviesApp blank --v2
cd moviesApp
npm install
ionic platform add android
ionic plugin add cordova-plugin-nativestorage
ionic g provider localStorage
```

There's a fair bit going on here so let's break it down step by step:

- We create a new blank Ionic 2 app called moviesApp
- Changing into the root directory of our newly created app we install the required additional node modules using the **npm install** command
- Next we install the android platform
- We then install the NativeStorage plugin
- And, finally, we create a localStorage service to handle API calls to NativeStorage

The moviesApp (as if you probably haven't already guessed from the name) will allow details of favourite movies to be entered/displayed and the localStorage service will retain these details for later retrieval.

Open the **moviesApp/src/providers/local-storage/local-storage.ts** service and make the following modifications (displayed in bold):

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import { NativeStorage } from 'ionic-native';
import 'rxjs/add/operator/map';

@Injectable()
export class LocalStorage {
   private storedData : any;

   constructor(private http: Http) { }

   setItem(itemName, itemValue) : any
   {
      return new Promise(resolve => {
         NativeStorage.setItem(itemName, itemValue)
        .then(
              (data) => {
               resolve(true);
              },
              (error) => {
               console.log("Fail to set storage key value");
              }
         );
      });
   }


   getItems(itemKey)
   {
      return new Promise(resolve => {
         NativeStorage.getItem(itemKey)
         .then(
            (data) => {
                    this.storedData = JSON.parse(data);
                    resolve(this.storedData);
                },
                (error) => {
                    console.log("We don’t get data!");
                }
            )
        });
    }

}
```

We could have placed these NativeStorage API methods directly within the **moviesApp/src/pages/home/home.ts** file but by implementing them in a service we make our code more modular, portable and scalable.

If we had multiple pages in our app that required the use of NativeStorage we could simply import the service for those pages instead of repeatedly coding the same methods for each page.

As you can see within the service we provide our own method wrappers around the NativeStorage API methods, which themselves are contained within Promises that return the results of the NativeStorage API method that is being executed.

We are only implementing 2 methods for this example: **setItem** and **getItem**.

We could also choose to remove items that have been set in the NativeStorage object or completely remove the NativeStorage object altogether.

In the Movies App Case study, featured later on in this book, we’ll explore using these methods as well as redeveloping and extending the example app for this section.

For now though we’ll simply explore setting items to and retrieving items from NativeStorage.

Open the **moviesApp/src/app/app.module.ts** file and make the following additions (highlighted in bold):

```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { HomePage } from '../pages/home/home';
import { LocalStorage } from '../providers/local-storage';

@NgModule({
  declarations: [
    MyApp,
    HomePage
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage
  ],
  providers: [{provide: ErrorHandler, useClass: IonicErrorHandler}, LocalStorage]
})
export class AppModule {}
```

There should be nothing complicated here, we’re just importing the LocalStorage provider and then passing that into the **ngModule** as part of the app initialisation.

Now implement the following amendments in the **moviesApp/src/pages/home/**

home.html file (highlighted in bold) so we actually have some method of inputting movie data as well as listing saved movies to the page:

```
<ion-header>
  <ion-navbar>
    <ion-title>
      My Fave Films
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
   <form
      [formGroup]="form"
      (ngSubmit)="saveMovie()">
      <ion-list>
         <ion-item margin-bottom>
            <ion-label>Title</ion-label>
            <ion-input
               type="text"
               formControlName="movieName"
               [(ngModel)]="filmTitle"></ion-input>
         </ion-item>

         <button
            ion-button
            color="primary"
            text-center
            block
            [disabled]="!form.valid">Save Movie</button>
      </ion-list>
   </form>

   <ion-list *ngIf="isData">
```

```
    <ion-list-header>
      Your saved movies
    </ion-list-header>
    <ion-item *ngFor="let data of storedData">
      {{ data.movie }}
    </ion-item>
  </ion-list>

</ion-content>
```

There are a few things to pay attention to here.

Firstly, we create a form template and bind that to a model using the **formGroup** attribute. Doing this helps us to implement validation rules for our form.

This binding is then used to enable/disable the form button depending on whether or not any data has been added to the form.

Our form only has a single input field which uses a **formControlName** directive to retrieve data entered into the field on submission of the form. We also add the ngModel directive to initialise and reset the field on page load and form submission.

Secondly, we use an <ion-list> component to display our list of retrieved movies from the NativeStorage object. This list is only displayed depending on the value of **isData** being true for the attached **ngIf** directive.

Now we proceed onto the final part of the code; implementing the necessary logic to use the LocalStorage service to set and retrieve movies for the app.

In the **moviesApp/src/pages/home/home.ts** file make the following amendments (highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController,
         Platform,
         ToastController } from 'ionic-angular';
import { FormGroup,
         FormControl,
         Validators,
         FormBuilder } from '@angular/forms';
import { LocalStorage } from '../../providers/local-storage';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

  public form                  : FormGroup;
  public storageKey            : string          = "MoviesObj";
  public isData                : boolean         = false;
  public storedData            : any             = null;
  public movies                : any             = [];
  public filmTitle             : any;

  constructor(
    public navCtrl             : NavController,
    public localStore          : LocalStorage,
    public fb                  : FormBuilder,
    public toastCtrl           : ToastController,
    public platform            : Platform
  )
  {
    platform.ready().then(() => {
      this.renderMovies();
```

```
   });
   this.form = fb.group({
      "movieName"          : ["", Validators.required]
   });
   this.clearFieldValues();
}


renderMovies() : void
{
   this.localStore.getItems(this.storageKey)
   .then(
      (data) => {
         let existingData     = Object.keys(data).length;

         if(existingData !== 0)
         {
            this.storedData     = data;
            this.isData         = true;
         }
         this.resetMovies(this.storedData);
      }
   );
}


resetMovies(data)
{
   let k;
   this.movies.length = 0;
   for(k in data)
   {
      this.movies.push(
      {
        movie    : data[k].movie
      });
    }
  }



  saveMovie()
  {
    let movie : string    =  this.form.controls["movieName"].value,
        i     : number    = 0,
        k;

    for(k in this.storedData)
    {
      if(this.storedData[k].movie === movie)
      {
        i++;
      }
    }

    if(i === 0)
    {
      this.movies.push(
      {
        movie : movie
      });
      this.storeMovie(this.movies, movie);
    }
    else
    {
      let message      =      `The movie ${movie} has already been stored.
Please enter a different movie title.`;
```

```
         this.storageNotification(message);
      }
   }



   storeMovie(movies, movie)
   {
      let moviesStored  = JSON.stringify(movies);

      this.localStore.setItem(this.storageKey, moviesStored).then(
         (data) => {
            this.renderMovies();
            let message  = `The movie title ${movie} was added successfully`;
            this.clearFieldValues();
            this.storageNotification(message);
         },
         (error) => {
            let message = `Whoops! Something went wrong. The movie title
${movie} was NOT added`;
            this.storageNotification(message);
         }
      );
   }



   clearFieldValues()
   {
      this.filmTitle                  = "";
   }

   storageNotification(message)  : void
   {
      let notification = this.toastCtrl.create({
```

```
      message          : message,
      duration         : 3000
    });
    notification.present();
  }
}
```

That’s quite a lot of code to digest!

Let’s break each part of the code down in more detail so we understand exactly what each stage is designed to accomplish and how it fits into the overall purpose of the application.

```
import { Component } from '@angular/core';
import { NavController,
         Platform,
         ToastController } from 'ionic-angular';
import { FormGroup,
         FormControl,
         Validators,
         FormBuilder } from '@angular/forms';
import { LocalStorage } from '../../providers/local-storage';
```

Here we import specific Ionic/Angular classes that we want to use - in particular the angular 2 form building and validation classes.

These will allow us to declare form bindings and validation routines for the movie input field in the page HTML template.

We also import the **ToastController** which we’ll use to provide user notifications for the success or failure of certain operations while using the app.

```
export class HomePage {

  public form                : FormGroup;
  public storageKey          : string          = "MoviesObj";
  public isData              : boolean         = false;
  public storedData          : any             = null;
  public movies              : any             = [];
  public filmTitle           : any;

  constructor(
    public navCtrl           : NavController,
    public localStore        : LocalStorage,
    public fb                : FormBuilder,
    public toastCtrl         : ToastController,
    public platform          : Platform
  )
  {
    platform.ready().then(() =>
    {
      this.renderMovies();
    });
    this.form = fb.group({
      "movieName"          : ["", Validators.required]
    });
    this.clearFieldValues();
  }
```

At the top of our class we define some public properties that will be used within both the methods of the class and the HTML template.

The **form** property is used to create the model binding for the HTML form and the **storageKey** property is used to define the name of our NativeStorage object.

Within our constructor we call the **renderMovies** method (which will be used to retrieve all of the saved movies in the NativeStorage object and output those to the HTML template) within the platform.ready() method.

Using the **platform.ready()** method allows the NativeStorage plugin to access device storage once the DOM has been loaded and the device is ready.

We then create a form validation rule that we associate with the **formControlName** directive that is bound to the HTML form input field.

Finally, we initialise the HTML input field using the **clearFieldValues** method.

```
renderMovies() : void
{
   this.localStore.getItems(this.storageKey)
   .then(
      (data) =>
      {
         let existingData      = Object.keys(data).length;

         if(existingData !== 0)
         {
            this.storedData        = data;
            this.isData       = true;
         }
         this.resetMovies(this.storedData);
      }
   );
}
```

The **renderMovies** method, as previously explained, calls the **getItems** method of the **LocalStorage** class, passing in the name of the NativeStorage object we want to retrieve all saved movie data from.

If the NativeStorage object returns any data back we allow this to be rendered to the

HTML template using the **storedData** property while also setting the **isData** property to true so that the returned data can be displayed in the HTML template.

Finally we call the **resetMovies** method:

```
resetMovies(data)
{
   let k;
   this.movies.length = 0;
   for(k in data)
   {
      this.movies.push(
      {
         movie        : data[k].movie
      });
   }
}
```

This method allows us to reset and repopulate the movies array so as to avoid any duplicate data whenever we save/retrieve movie data from the NativeStorage object.

```
saveMovie()
{
   let movie        : string     =      this.form.controls["movieName"].value,
        i           : number     =      0,
        k;

   for(k in this.storedData)
   {
      if(this.storedData[k].movie === movie)
      {
         i++;
      }
   }
   if(i === 0)
   {
      this.movies.push(
      {
         movie       : movie
      });
      this.storeMovie(this.movies, movie);
   }
   else
   {
      let message =  `The movie ${movie} has already been stored. Please
enter a different movie title.`;
      this.storageNotification(message);
   }
}
```

Our **SaveMovie** method retrieves the value for the movieName **formControlName** directive from the input field in the HTML template, loops through the **storedData** object to determine whether the movie name already exists.

If it doesn’t the movie name is pushed into the movies array and then passed into the **storeMovie** method.

If the movie name already exists then a notification is published informing the user of this fact.

```
storeMovie(movies, movie)
{
   let moviesStored     = JSON.stringify(movies);
   this.localStore.setItem(this.storageKey, moviesStored).then(
      (data) =>
      {
```

```
      this.renderMovies();
      let message =  `The movie title ${movie} was added successfully`;
      this.clearFieldValues();
      this.storageNotification(message);
    },
    (error) =>
    {
      let message = `Whoops! Something went wrong. The movie title
${movie} was NOT added`;
      this.storageNotification(message);
    }
  );
}
```

The **storeMovie** method accepts 2 parameters: the array of movies to be saved to the NativeStorage object and the name of the movie that is being added.

If the movies are able to be saved we clear the input field in the HTML template and inform the user that the movie was added successfully. Otherwise we return a notification to the user informing them that something went wrong.

```
clearFieldValues()
{
  this.filmTitle          =      "";
}
```

The **clearFieldValues** method simply sets the **filmTitle** property to an empty string.

As this property is bound by the ngModel directive to the input field in the HTML template any value that has been entered into there will be removed.

This ensures that our form is kept clean as well as disallowing the same value to be immediately re-submitted.

```
storageNotification(message)  : void
{
  let notification = this.toastCtrl.create({
    message      : message,
    duration     : 3000
   });
  notification.present();
}
```

Our final method, **storageNotification**, is used to inform the user of the outcome of submitting/saving their movies.

Using the **ToastController** class this method receives a message as its parameter which is subsequently displayed for 3 seconds at the bottom of the screen.

That covers the breakdown of the code so now let's see the app in action.

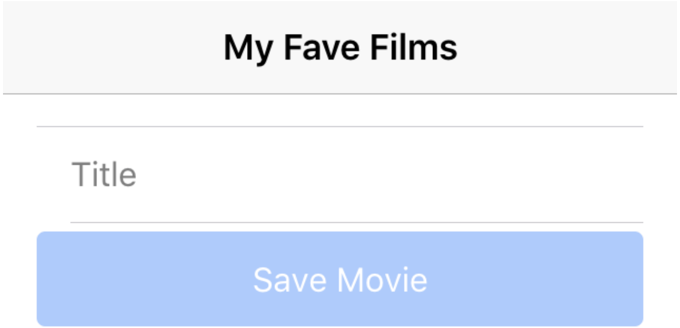
Connect your handheld device to the computer (the following example assumes iOS but you can change this to android if that's the device you're connecting with) and from the Terminal application, while situated in the root of the movieApp project directory, run the following commands (waiting for the first command to complete before running the next one):

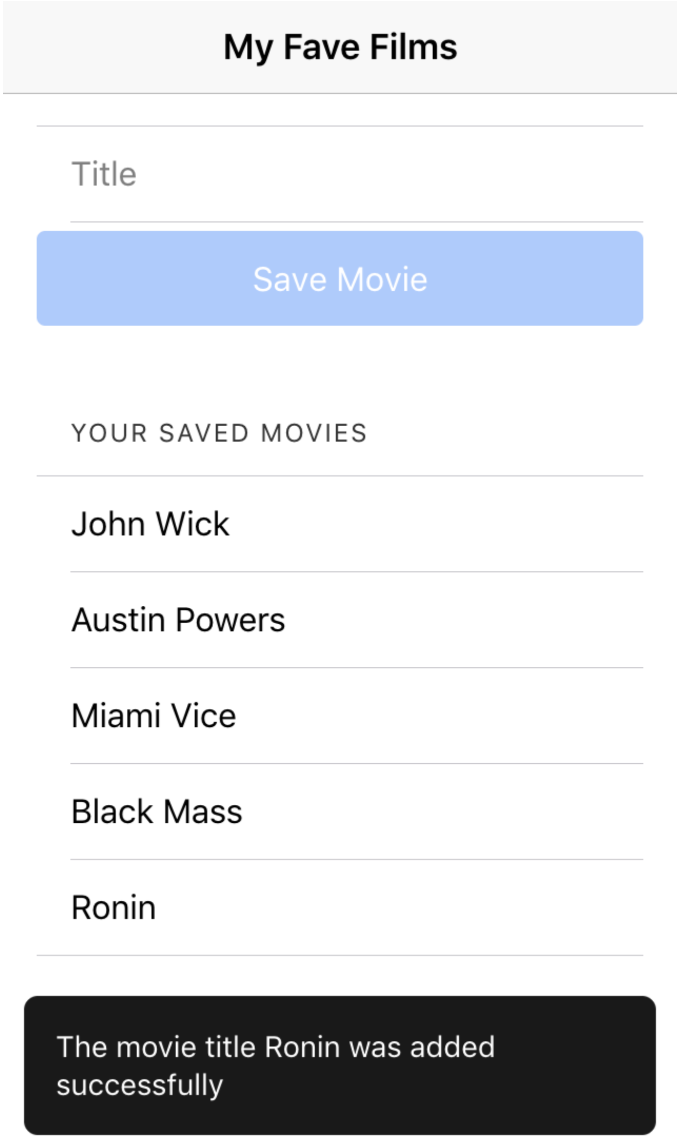
```
ionic prepare ios && ionic build ios
ionic run ios --device
```

If this is the first time you are publishing the app to a handheld device run the *ionic prepare ios && ionic build ios* commands to configure/set up the app for iOS.

If you should experience any errors with this process refer to the chapter titled *Troubleshooting your Ionic app* for potential workarounds/solutions.

Assuming the build/run process ran smoothly the app will be published to the connected device where we should see something resembling the following screens:





YOUR SAVED MOVIES

John Wick

Austin Powers

Miami Vice

Black Mass

Ronin

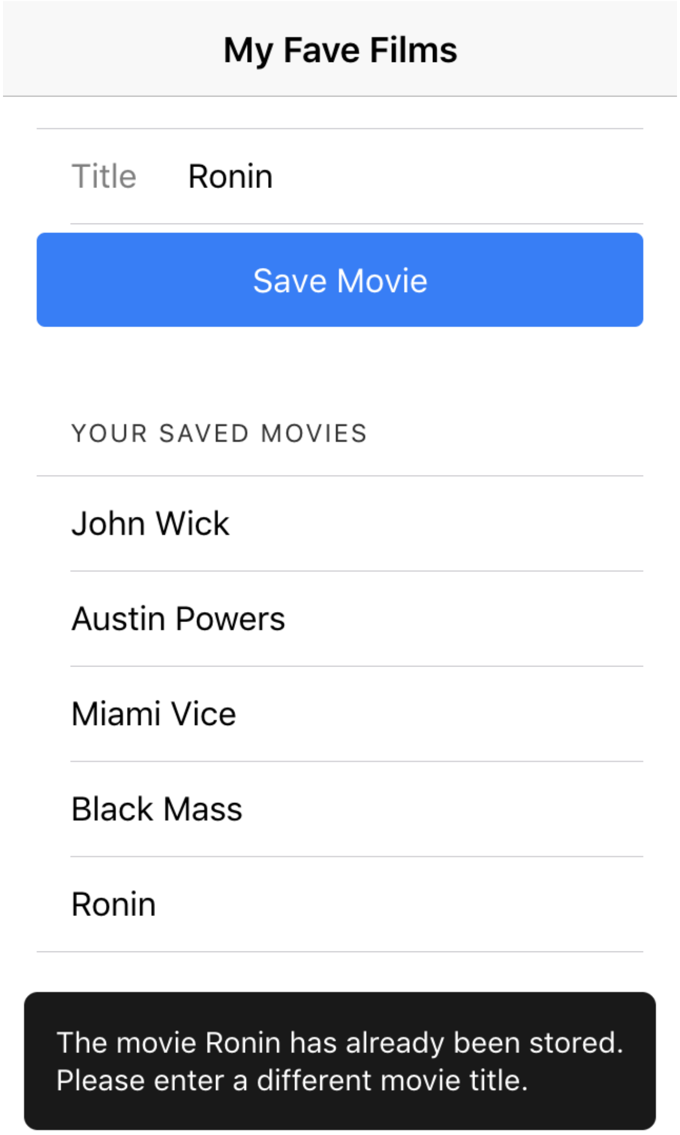
The movie title Ronin was added successfully

The screen capture at the top left of the page depicts the app in its initial state: no saved movies are displayed (as none currently exist) and the screen displays a single input field with a disabled form button.

The screen capture at the top right of the page depicts the app when a movie has been successfully saved to the NativeStorage object.

A notification message is displayed at the bottom of the screen and the saved movie is retrieved from the NativeStorage object and displayed in the Your Saved Movies list under the cleared form.

In the following screen capture we see what happens when we enter the name of a movie that already exists in the NativeStorage object:



The movie Ronin has already been stored. Please enter a different movie title.

There's definitely a lot of room for improvement with what we've built here and, as mentioned earlier, we'll be revisiting this app later on in the case study chapter titled: Your Favourite Movies, where we'll add the following:

- Additional form fields for storing genre and ratings
- Sort movies by title
- Allow the user to edit/remove any previously saved movies
- Filter the display of movies by genre and rating

Now we'll look into the second method of persisting data for Ionic 2 apps using the SQLite database plugin.

The case for SQLite

As useful as the NativeStorage plugin is for data persistence in Cordova/Ionic apps it does come with certain limitations:

- The plugin authors recommend that no more than a few hundred kilobytes of data be stored using the plugin (https://github.com/TheCocoaProject/cordova-plugin-nativestorage#when-to-use-the-plugin)
- More complex data structures/requirements are better handled with a database approach

On this last point, given the complexity of certain apps and their requirements, a database solution is often the preferred approach for structuring and managing data.

With that in mind, and given iOS, Android & Windows Phone support for the SQLite database standard, we're going to explore using the Cordova SQLite Storage plugin to persist data within our apps so let's recreate our last example using this plugin.

From the Terminal, and while in the root of your projects directory, run the following Ionic CLI commands:

```
ionic start moviesSQLiteApp blank --v2
cd moviesSQLiteApp
npm install
ionic platform add android
ionic plugin add cordova-sqlite-storage
ionic g provider database
```

Similar to what we did with the NativeStorage example we:

- Create a new blank Ionic 2 app (this time called moviesSQLiteApp)
- Change into the root directory of the newly created app and install all additional required node modules with the **npm install** command
- Next we install the android platform
- Followed by installing the Cordova SQLite Storage plugin
- Finally, we create a database service to handle API calls to the Cordova SQLite

Storage plugin

Open the **moviesSQLiteApp/src/providers/database/database.ts** service and make the following modifications (displayed in bold):

```
import { Injectable } from '@angular/core';
import {SQLite} from 'ionic-native';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Injectable()
export class DatabaseService {
  public data       : any     =   null;
  public storage    : any     =   null;
  public dbName     : string  =   "movies.db";
  public movies     : any     =   [];

  constructor(public http: Http)
  {
    this.data = null;
  }

  createDatabase()
  {
    this.storage =   new SQLite();
    this.storage.openDatabase({
      name       :      this.dbName,
      location   :      'default' // the location field is required
    })
    .then((data) => {
      console.log("Opened database");
      this.createDatabaseTables();
    }, (err) => {
      console.error('Unable to open database: ', err);
      });
   }



   createDatabaseTables()
   {
      this.createMoviesTable();
   }



   createMoviesTable()
   {
      this.storage.executeSql('CREATE TABLE IF NOT EXISTS movies (id
INTEGER PRIMARY KEY AUTOINCREMENT, movie TEXT)', {})
      .then((data) =>
      {
         console.log("movies table created");
      },
      (error) => {
         console.log("Error: " + JSON.stringify(error.err));
      });
   }



   retrieveMovies()
   {
      return new Promise(resolve =>
      {
         this.storage.executeSql('SELECT * FROM movies', {})
         .then((data) =>
         {
            this.movies      = [];
            if(data.rows.length > 0)
```

```
        {
          var k;
          for(k = 0; k < data.rows.length; k++)
          {
            this.movies.push({
              movie: data.rows.item(k).movie
            });
          }
        }
        resolve(this.movies);
      },
      (error) => {
        console.log("Error: " + JSON.stringify(error.err));
      });
    });
  }


  insertMoviesToTable(movie)
  {
    return new Promise(resolve =>
    {
      let sql = "INSERT INTO movies(movie) VALUES('" + movie + "')";
      this.storage.executeSql(sql, {})
      .then((data) => {
        resolve(true);
      }, (error) => {
        console.log("Error " + JSON.stringify(error.err));
      });
    });
  }
}
```

There's a fair amount of code for our database service so let's break each part down so we have a better understanding of what the script is designed to accomplish.

```
import { Injectable } from '@angular/core';
import {SQLite} from 'ionic-native';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Injectable()
export class DatabaseService {
  public data          : any      =  null;
  public storage       : any      =  null;
  public dbName        : string   =  "movies.db";
  public movies        : any      =  [];


  ...

}
```

We start by importing the SQLite plugin that we installed earlier in this section and, at the top of the Database class, we create a handful of public properties, most notably declaring the name for the app database.

```
createDatabase()
{
  this.storage   =  new SQLite();
  this.storage.openDatabase({
    name      :    this.dbName,
    location  :    'default' // the location field is required
  })
  .then((data) => {
    console.log("Opened database");
    this.createDatabaseTables();
  },
  (err) => {
    console.error('Unable to open database: ', err);
  });
}
```

The **createDatabase** method, as the name suggests, is used to create the app database by triggering the **openDatabase** method of the SQLite plugin.

If the database is successfully created then database tables are generated for the app through calling the **createDatabaseTables** method.

```
createMoviesTable()
{
  this.storage.executeSql('CREATE TABLE IF NOT EXISTS movies (id
INTEGER PRIMARY KEY AUTOINCREMENT, movie TEXT)', {})
  .then((data) =>
  {
    console.log("movies table created");
  },
  (error) => {
    console.log("Error: " + JSON.stringify(error.err));
  });
}
```

The **createDatabaseTables** method calls a single method: **createMoviesTable**.

This generates the database table, if it doesn’t already exist, to store the names of favourite movies for the app using the **executeSql** method of the SQLite plugin.

The **executeSql** method accepts 2 parameters: a SQL query and any additional supplied arguments.

As for data types the SQLite database standard supports the following:

- NULL (Null values)
- INTEGER (signed integer values - look up this article for an explanation on what a signed integer is: http://kias.dyndns.org/comath/13.html)
- TEXT (string values)
- REAL (floating point values)
- BLOB (Blob - Binary Large Object - values I.e. for storing images or files directly within the database table itself)

If you're familiar with databases like MySQL or Oracle you'll probably feel a little limited by the data types available. As you can guess this limitation requires you to be a little more creative with storing certain types of data.

If, for example, you wanted to store a date value in an SQLite table you could choose one of the following data types:

- INTEGER (I.e. in a Unix time format - this would be as the number of seconds since 1970-01-01 00:00:00 UTC)
- TEXT (In this format - "YYYY-MM-DD HH:MM:SS.SSS")
- REAL (I.e. As a Julian day number I.e. 2451557.5)

In this basic example we're setting 2 fields:

- id (set as an INTEGER data type and PRIMARY KEY - which means values must be unique and cannot be null - with the value for the field automatically generated and incremented using AUTOINCREMENT)
- movie (set as a TEXT data type to store the titles for the movies that we will be entering into the database table)

```
retrieveMovies()
{
   return new Promise(resolve =>
   {
      this.storage.executeSql('SELECT * FROM movies', {})
      .then((data) =>
       {
          this.movies       = [];
          if(data.rows.length > 0)
          {
             var k;
             for(k = 0; k < data.rows.length; k++)
             {
                this.movies.push({
                   movie: data.rows.item(k).movie
                });
             }
         }
         resolve(this.movies);
      },
      (error) => {
         console.log("Error:  " + JSON.stringify(error.err));
      });
   });
}
```

We return all movies stored in the database using the **retrieveMovies** method which utilises a Promise to handle the asynchronous nature of the request.

```
insertMoviesToTable(movie)
{
    return new Promise(resolve =>
    {
         let sql = "INSERT INTO movies(movie) VALUES('" + movie + "')";
         this.storage.executeSql(sql, {})
        .then((data) =>
        {
            resolve(true);
```

```
      },
      (error) =>
      {
         console.log("Error: " + JSON.stringify(error.err));
      });
   });
}
```

Finally, we handle adding individual movies to the database table using the **insertMoviesToTable** method which uses a Promise to manage returning the result of the asynchronous database operation.

For more information on SQLite: https://www.sqlite.org/datatype3.html
For more information on the SQLite Cordova Storage plugin, its methods and potential gotchas: https://github.com/litehelpers/Cordova-sqlite-storage

Rendering the template
For the **moviesSQLiteApp/src/pages/home/home.html** template we'll simply use the HTML code from the NativeStorage example.

Replace the current content in this file with the below code instead:

```
<ion-header>
 <ion-navbar>
  <ion-title>
   My Fave Films
  </ion-title>
 </ion-navbar>
</ion-header>

<ion-content padding>
  <form
```

```
    [formGroup]="form"
    (ngSubmit)="saveMovie()">
    <ion-list>
      <ion-item margin-bottom>
        <ion-label>Title</ion-label>
        <ion-input
          type="text"
          formControlName="movieName"
          [(ngModel)]="filmTitle"></ion-input>
          </ion-item>

        <button
          ion-button
          color="primary"
          text-center
          block
          [disabled]="!form.valid">Save Movie</button>

    </ion-list>
  </form>

  <ion-list *ngIf="isData">
    <ion-list-header>
      Your saved movies
    </ion-list-header>
    <ion-item *ngFor="let data of storedData">
      {{ data.movie }}
    </ion-item>
  </ion-list>

</ion-content>
```

Scripting the page logic

With the HTML side covered we can now turn our attention to implementing the logic for our **moviesSQLiteApp/src/pages/home/home.ts** script.

Make the following amendments (highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController, Platform, ToastController } from 'ionic-angular';
import { FormGroup,
         FormControl,
         Validators,
         FormBuilder } from '@angular/forms';
import { DatabaseService } from '../../providers/database';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

   public form          : FormGroup;
   public isData        : boolean       = false;
   public storedData    : any           = null;
   public movies        : any           = [];
   public filmTitle     : any;


   constructor(
      public navCtrl       : NavController,
      public db            : DatabaseService,
      public fb            : FormBuilder,
      public toastCtrl      : ToastController,
      public platform      : Platform
   )
```

```
{
   platform.ready().then(() =>
   {
      setTimeout(() =>
      {
         this.renderMovies();
      }, 750);
   });

   this.form = fb.group({
      "movieName"          : ["", Validators.required]
   });

   this.clearFieldValues();
}


renderMovies()
{
   this.db.retrieveMovies()
   .then(
      (data) =>
      {
         let existingData      = Object.keys(data).length;
         if(existingData !== 0)
         {
            this.storedData     = data;
            this.isData         = true;
         }
         this.resetMovies(this.storedData);
      });
}
```

```
resetMovies(data)
{
  let k;
  this.movies.length = 0;
  for(k in data)
  {
    this.movies.push(data[k].movie);
  }
}


saveMovie()
{
  let movie  : string    =  this.form.controls["movieName"].value,
      i      : number =  0,
      k;

  for(k in this.storedData)
  {
    if(this.storedData[k].movie === movie)
    {
     i++;
    }
  }

  if(i === 0)
  {
    this.movies.push(movie);
    this.storeMovie(movie);
  }
  else
  {
    let msg   =   `The movie ${movie} has already been stored. Please
```

```
enter a different movie title.`;
         this.storageNotification(msg);
      }
   }

   storeMovie(movie)
   {
      this.db.insertMoviesToTable(movie).then(
      (data) =>
      {
         this.storageNotification(data);
         this.renderMovies();
         let msg      = `The movie title ${movie} was added`;
         this.clearFieldValues();
         this.storageNotification(msg);
      },
      (error) =>
      {
         let message  = `Whoops! Something went wrong. The movie title
${movie} was NOT added`;
         this.storageNotification(message);
      });
   }

   clearFieldValues()
   {
      this.filmTitle                  = "";
   }



   storageNotification(message)  : void
   {
      let notification = this.toastCtrl.create({
        message           : message,
        duration          : 3000
      });
      notification.present();
   }

}
```

As this is essentially a reworking of the NativeStorage example all we’re doing here is making modifications to use the Database class instead.

Notice that we wrap the **renderMovies** method within a **setTimeout** function in the class constructor? This is to avoid errors with the method being called before the database is ready - VERY important!

Before we publish our app to a device we need to modify the existing code within the **moviesSQLiteApp/src/app.module.ts** file (amendments highlighted in bold):

```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { Database } from '../providers/database';
import { HomePage } from '../pages/home/home';

@NgModule({
  declarations: [
    MyApp,
    HomePage
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage
  ],
  providers: [{provide: ErrorHandler, useClass: IonicErrorHandler}, Database]
})

export class AppModule {}
```

Here we import our database service and then declare that as a provider within the NgModule metadata.

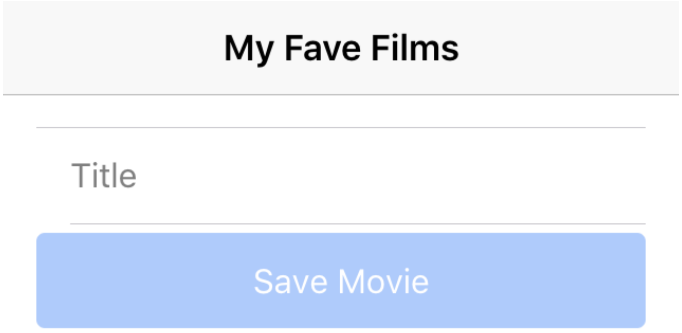
Now connect your mobile device to your computer, navigate to the root of the moviesSQLite project directory in the Terminal application and run the following commands one after the other (substituting iOS with android in the run command if you're using that platform instead):

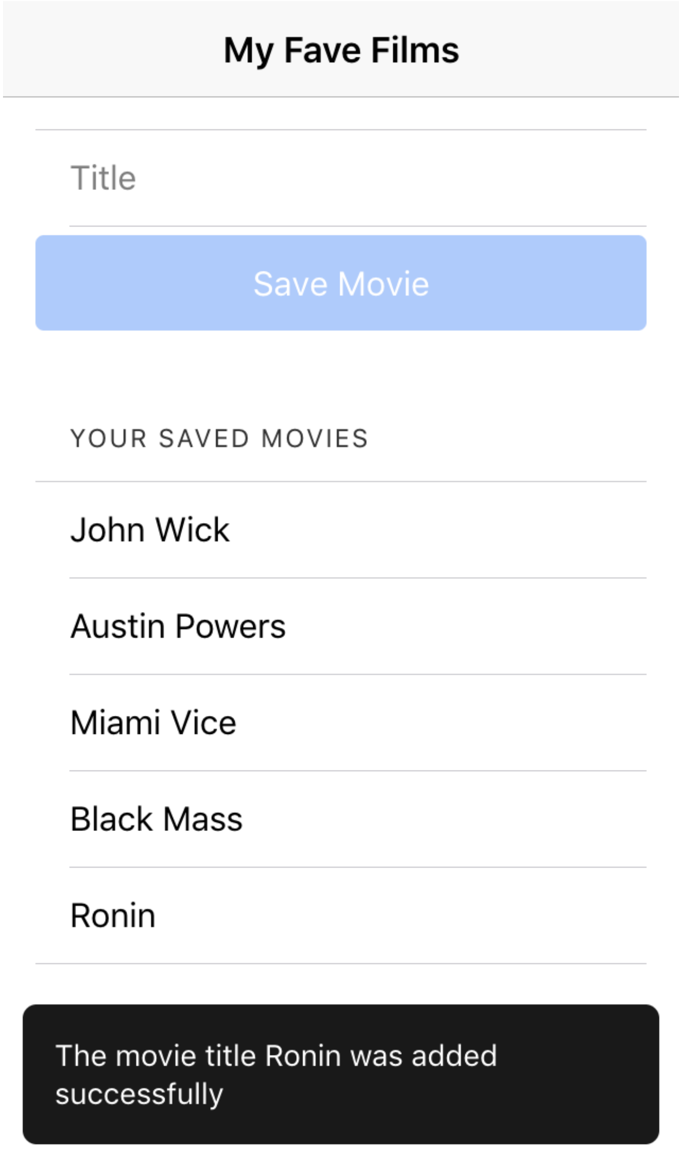
```
ionic prepare ios && ionic build ios
ionic run ios --device
```

Assuming there are no build or run errors (and, if you do experience errors, please read through the chapter titled *Troubleshooting your Ionic app* for common errors and possible workarounds/solutions) you should see the database driven app being published to your device.

Granted the app won't look or feel any different to the NativeStorage example (even though the underlying data persistence strategy is driven via SQLite) but it's always a nice feeling to see your code actually working!

The reworked app should look and behave like the screen captures displayed on the following page:





YOUR SAVED MOVIES

John Wick

Austin Powers

Miami Vice

Black Mass

Ronin

The movie title Ronin was added successfully

If it does then congratulations!

If not, go back through the code featured in this section and double check you haven’t missed or misspelt anything. Failing that inspect the downloadable code for this example (which is listed in the resources at the end of this chapter).

And with that we wrap up our exploration of persisting data using the NativeStorage and Cordova SQLite plugins.

Both approaches have their respective pros and cons but, as a general rule, when it comes to data persistence; the larger and/or more complex the volume of data always go with a database.

In the next chapter we'll be exploring animations and their usage within Ionic 2 apps.

Summary

- When testing Ionic Native/Apache Cordova plugins DON'T use ionic serve as a web browser will NOT be able to run those plugins. DO publish to a connected mobile/tablet device though as this will enable real-world testing compared to that of a simulator.

- When testing your apps on a connected device don't forget to prepare and build your apps before you run them for the first time using the following commands:

```
ionic prepare ios && ionic build ios
```

- To run your app on a mobile device connected to your computer use the following command (substituting android for ios if you're on an Android device)

```
ionic run ios --device
```

- For storing/persisting relatively small amounts of data (no larger than a maximum size of a few hundred kilobytes) opt for NativeStorage

- For persisting larger volumes of data and/or more complex data structures opt for Cordova SQLite instead (or a similar database solution)

Resources

- Cordova SQLite Storage plugin: https://github.com/litehelpers/cordova-sqlite-storage
- Cordova Native Storage plugin: https://github.com/TheCocoaProject/cordova-plugin-nativestorage

All project files for this chapter can be found listed in the download links on page 636.

Animations

Most modern web and mobile applications make use of animation in some form; whether this be a simple sliding carousel, animated modal windows or full blown parallax scrolling.

Used wisely such animation can enhance the user experience, adding a level of interactivity that delights and engages. If implemented poorly though the user experience suffers and app performance can very quickly degrade, particularly on older devices and even modern devices where heavy amounts of animation are being triggered.

This cannot be understated - use technology wisely, particularly when it comes to animations as there's nothing that kills the user experience faster than an app that's so "busy" it becomes unusable.

Ionic, Angular and animation

Ionic already uses animations for events such as page transitions but the underlying Angular 2 framework adds support for developers to craft and implement their own animations using an, at the time of writing, experimental technology known as the Web Animations API.

This technology was designed to unify the different approaches to web based animation (such as taking the logic for CSS animations and transitions out of the stylesheet and moving those into JavaScript where doing so can help reduce the load on the DOM and also allow such animations to be controlled programmatically).

Unfortunately, as this technology is still undergoing development, browser support is limited to the following:

- Chrome (v36+)
- Firefox (v48+)
- Opera (29+)

As you can see the list is pretty short and, as there is NO support for iOS safari, this would make using the technology a serious issue on that platform were it not for a polyfill which helps provide support for that missing functionality.

This polyfill falls back to native implementations of the Web Animations API methods where the browser does not provide support for these.

Be aware that this polyfill only provides support for the following browsers:

- Firefox 27+
- Chrome
- IE10+
- Edge
- iOS Safari 7.1+
- Mac Safari 9+

Realistically this should be more than sufficient for most app development needs.

If not you'll need to think carefully about implementing animations using the Web Animations API & polyfill and possibly opt for a graceful degradation approach on all non-supported platforms instead.

Angular 2 Animations

Let's get acquainted with the Web Animations API (via the Angular 2 framework) by building a new Ionic app (which we'll call animationsApp - project files are available in the resources section for this chapter).

Within this app we'll be looking to create a very simple photo gallery that reveals information about each thumbnail in a sidebar that animates into view after that thumbnail is selected.

In the root of your **apps** directory run the following commands in your Terminal:

```
ionic start animationsApp blank --v2 // Once completed cd into project directory
npm install // Don't forget to install the required node modules!
```

Remember that browser support for the Web Animations API is, at the time of writing, extremely limited so the next thing we'll need to do is download the Web Animations polyfill if we want to support iOS safari (amongst other platforms).

Once the polyfill has been downloaded create a directory titled **js** within the root of the **src/assets** directory for the app and place the polyfill script inside of there.

There's one final step we need to perform before we can jump into coding the animations for our app:

- Create a directory titled **images** inside the root of the **src/assets** directory
- Copy all of the images from the following location in the download files for this chapter: **animationsApp/src/assets/images**
- Paste these images into the **src/assets** directory of your **animationsApp** project

With all of the necessary assets in place we now need to place a link to the recently downloaded polyfill script (highlighted in bold) within the displayed section of the **animationsApp/src/index.html** file:

```
<ion-app></ion-app>
 <script src="assets/js/web-animations.min.js"></script>
 <!-- The polyfills js is generated during the build process -->
 <script src="build/polyfills.js"></script>
 <!-- The bundle js is generated during the build process -->
 <script src="build/main.js"></script>
```

When we run our Ionic build/serve commands the **index.html** file will be copied from the **src/** directory to the **www/** directory, replacing the file of the same name.

The **images** and **js** folders inside the **src/assets** directories will also be copied to the **www** directory.

Now that older supported browsers will be able to implement native fallbacks for the Web Animations API we then open the **animationsApp/src/pages/home/home.ts** file and import the following modules (highlighted in bold):

```
import {
  Component,
  Input,
  trigger,
  state,
  style,
  transition,
  animate } from '@angular/core';
import { NavController } from 'ionic-angular';
```

With the necessary modules imported we can now implement the animation logic directly within the component metadata and build out the class like so (amendments highlighted in bold):

```
@Component({
  selector: 'page-home',
  templateUrl: 'home.html',
  animations: [
    trigger('animatePanel', [
      state('hidden', style({
        right: '-35%'
      })),
      state('displayed', style({
        right: ‘0’
      })),
      transition('hidden => displayed', animate(‘1200ms ease-in-out’)),
      transition('displayed => hidden', animate(‘1200ms ease-in-out’))
    ]),
  ]
})
export class HomePage {

   public panelTitle      : string;
   public panelDesc     : string;
   public panelImage    : string;
   public panelState    : string     = 'hidden';
   public expanded      : boolean  = false;
   public isActive      : boolean  = false;
   public items         : any        = [
   {
      title            : "London Underground",
      description  : "Rarely deserted Tube platform",
      thumbnail     : "assets/images/gallery-thumbnail-1.jpg",
      image          : "assets/images/gallery-1.jpg"
   },
   {
      title            : "Bolsover Castle",
      description  : "A fine piece of English heritage",
      thumbnail     : "assets/images/gallery-thumbnail-2.jpg",
      image          : "assets/images/gallery-2.jpg"
   },
   {
      title            : "Atomium",
      description  : "Brussels architecture and attractions",
      thumbnail     : "assets/images/gallery-thumbnail-3.jpg",
      image          : "assets/images/gallery-3.jpg"
   },
   {
      title            : "Venice",
      description  : "Authentic Venetian experience",
      thumbnail     : "assets/images/gallery-thumbnail-4.jpg",
      image          : "assets/images/gallery-4.jpg"
   },
   {
      title            : "Paris",
      description  : "Louvre Pyramid",
      thumbnail    : "assets/images/gallery-thumbnail-5.jpg",
      image        : "assets/images/gallery-5.jpg"
   },
   {
      title        : "Greenwich",
      description  : "Interesting and unusual sundial",
      thumbnail    : "assets/images/gallery-thumbnail-6.jpg",
      image        : "assets/images/gallery-6.jpg"
   },
   {
      title        : "Piccadilly Circus",
      description  : "Heart of the City",
      thumbnail    : "assets/images/gallery-thumbnail-7.jpg",
      image        : "assets/images/gallery-7.jpg"
   },
   {
      title        : "Erasmusbrug",
      description  : "Rotterdam’s mighty red bridge",
      thumbnail    : "assets/images/gallery-thumbnail-8.jpg",
      image        : "assets/images/gallery-8.jpg"
   },
   {
      title        : "Rotterdam",
      description  : "Dutch parking",
      thumbnail    : "assets/images/gallery-thumbnail-9.jpg",
      image        : "assets/images/gallery-9.jpg"
   },
   {
      title        : "Henry Moore",
      description  : "Fine English sculpture",
      thumbnail    : "assets/images/gallery-thumbnail-10.jpg",
      image        : "assets/images/gallery-10.jpg"
   }];
```

```
   constructor(public navCtrl: NavController)
   {

   }

   togglePanel(item = null)
   {
      this.expanded              = !this.expanded;
      if(this.expanded)
      {
         this.panelState         = 'displayed';
         this.isActive           = true;
      }
      else
      {
         this.panelState         = 'hidden';
         this.isActive           =  false;
      }

      if(item !== null)
      {
         this.panelTitle         = item.title;
         this.panelDesc          = item.description;
         this.panelImage         = item.image;
      }
   }
}
```

At first glance this might appear a little overwhelming but the logic is actually quite straightforward.

We begin by adding an animations array which contains the following elements:

- **trigger** (This defines a property of **animatePanel** which will be attached to a DOM element on the page and act, as the name implies, as an animation trigger)
- **state** (Declares style properties that will be used to animate to and from)
- **transition** (Defines the order in which the declared states will be animated, the duration of that animation and what easing function may be applied)

```
animations: [
  trigger('animatePanel', [
   state('hidden', style({
    right: '-35%'
   })),
   state('displayed', style({
    right: ‘0’
   })),
   transition('hidden => displayed', animate('1200ms ease-in-out')),
   transition('displayed => hidden', animate('1200ms ease-in-out'))
  ]),
 ]
```

We then define a series of properties within the **HomePage** class which will be used to store data for the page (not least of which is referencing the thumbnail and large images that will be rendered to the template) and set up conditional controls for the animation logic.

Finally we create a **togglePanel** method which will be used to control the animation of the sidebar panel for the app and populate this with content.

Now we need to link the custom animation logic to the page template.

Open the **animationsApp/src/pages/home/home.html** file and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Travel Gallery
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
   <div class="background" [class.isActive]="isActive"></div>
   <ul class="gallery">
      <li *ngFor="let item of items" (click)="togglePanel(item)">
         <img src="{{ item.thumbnail }}" alt="{{ item.description }}">
         <p>{{ item.title }}</p>
      </li>
   </ul>

   <section class="panel" [@animatePanel]="panelState">
      <section class="inner">
         <span class="close-panel" (click)="togglePanel()">X Close</span>
         <h1>{{ panelTitle }}</h1>
         <img src="{{ panelImage }}">
         <p>{{ panelDesc }}</p>
      </section>
   </section>

</ion-content>
```

Here we add the following elements:

- A **<div>** tag that will only be displayed when the value for the programmatically assigned class of **isActive** is true
- A list of thumbnail images dynamically generated from the **items** array defined in the component class.

- Each list item implements a click event which triggers the **togglePanel** method passing in the data from the current array iteration as a parameter
- Finally we come to the content sidebar which we assign the animation trigger of **animatePanel** too (this is set to the value of the **panelState** property - which is used to determine whether the panel is displayed or hidden)

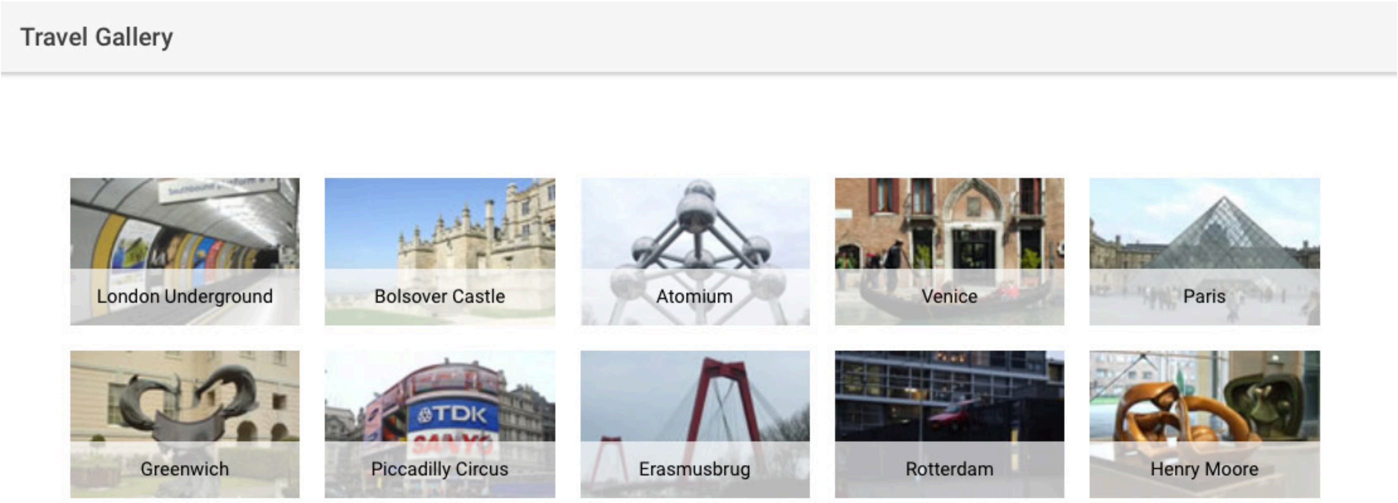
Now all that remains is to add to the **animationsApp/src/pages/home/home.scss** file the following style rules as shown below:

```
.panel {
  background: #1a2580;
  color: #fff;
  position: fixed;
  top: 0;
  right: -35%;
  bottom: 0;
  width: 35%;
  z-index: 9997;
  font-family: Arial, Helvetica, sans-serif;
}

.inner {
   position: absolute;
   top: 75px;
   left: 35px;
   z-index: 9999;
   width: 86%;

   img {
      display: block;
      width: 100%;
   }

   p {
      color: rgb(255, 255, 255);
   }
}

.close-panel {
   font-size: 1em;
   color: rgb(68,68,68);
   cursor:pointer;
}

.background {
   background: rgba(68, 68, 68, 0.7);
   position: fixed;
   z-index: 1000;
   top: 0;
   bottom: 0;
   left: 0;
   width: 100%;
   display: none;
}

.isActive {
   display: block;
}

.isHidden {
   display: none;
}

.gallery {
   width: 75%;
   font-size: 18px;
   line-height: 3;
   font-weight: 400;
```

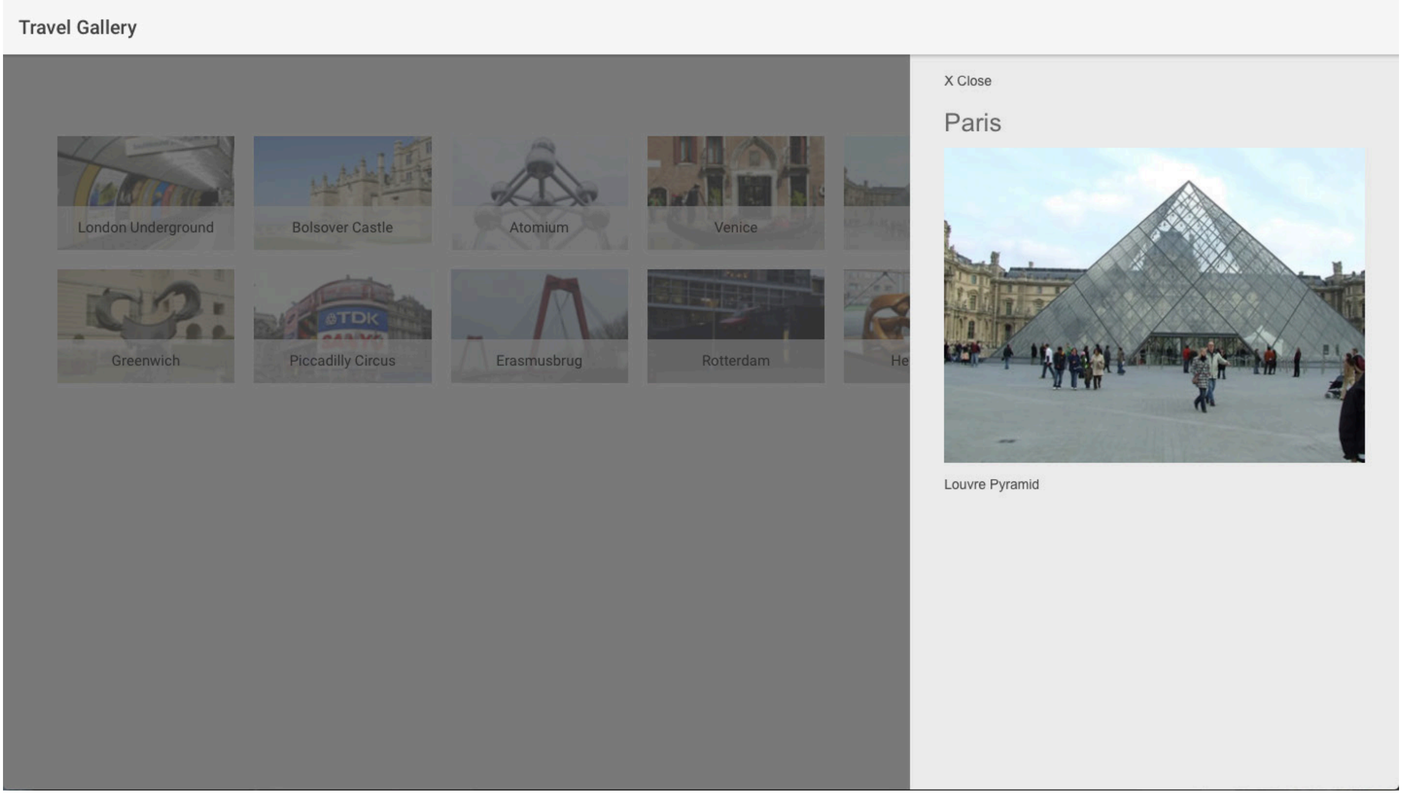
```
    padding-top: 50px;
    list-style: none;
    color: rgb(255, 255, 255);

    li {
      float:left;
      width: 18%;
      margin: 0 20px 20px 0;
      background: rgba(68, 68, 68, 0.35);
      text-align: center;
      cursor: pointer;
      position: relative;

      img {
        display: block;
        width: 100%;
      }

      p {
        position: absolute;
        bottom: 0;
        left: 0;
        width: 100%;
        padding: 0;
        margin: 0;
        background: rgba(255, 255, 255, 0.7);
        font-size: 0.85em;
      }
    }
  }
```

Now that we've completed the necessary coding for the app let's preview this in the browser using the *ionic serve* command from the Terminal.

Initially you should see the following image gallery/layout being displayed:



To see the animation logic working select any thumbnail and watch as the content sidebar transitions into view to display a title, description and larger version of the thumbnail image as shown in the following screen capture:



Even though this is only a basic use of Angular 2 animations this simple example demonstrates how they can be implemented within Ionic 2 apps (thanks to a little help from the addition of the animations polyfill for wider browser support).

In the next chapter we'll look at troubleshooting common bugs, issues & errors in Ionic 2 development.

Summary

- Angular 2 introduces animation capabilities through an experimental technology known as the Web Animations API
- Platform support for the Web Animations API is, at the time of writing, very limited requiring that an additional polyfill be used for wider browser support
- Angular 2 defines animations in terms of a **trigger**, **state** and **transition**
- Angular 2 animation logic is constructed inside of an array that is defined within the @Component metadata for the class
- Heavy use of animations can degrade performance especially on older devices
- Animation may be best avoided on older devices/browsers, depending on support and performance issues

Resources

Web Animations API
Web animations API polyfill
Angular 2 Animations

All project files for this chapter can be found listed in the download links on page 636.

Troubleshooting your Ionic 2 App

Even with the best will in the world there's going to be times when we inevitably run into bugs and issues while developing our Ionic apps.

Over the course of this chapter I'm going to cover common development bugs, potential workarounds/solutions and, where possible, links to further resources.

Problem #1 - The Ionic white screen of death

IMPORTANT - IF you are developing Ionic 2 apps on a Windows platform you MUST install windows and/or android as your platform in your app root directory:

```
ionic platform add android
// and/or
ionic platform add windows
```

If you don't you WILL get the white screen of death when trying to publish the app!

NOTE - The following section has been left for posterity as Ionic 2, since Release Candidate 3, features error reporting functionality that makes the "white screen of death" a thing of the past - see here for more details.

The White Screen of Death is quite possibly one of, if not the most, frustrating bugs that you will ever encounter as an Ionic 2 developer - you publish your app to a testing device but all you see is a blank white page instead of the UI you expected.

The TypeScript compiler might not have thrown up any errors during the Ionic CLI build process and nothing jumps out as erroneous when inspecting the code itself.

The first thing to do here (presuming you're not trying to test any Cordova plugin functionality) is run the app in a web browser using *ionic serve*. You can then use the browser console to see what errors might be thrown up from the transpiled JavaScript - some potential culprits here might include:

- The Root @Component decorator has no **template** or **templateUrl** declaration
- The template value in the Root @Component decorator has no root property on the <ion-nav> element (it should look something like the following snippet)

```
@Component({
  template: '<ion-nav [root]="rootPage"></ion-nav>'
})
```

If you’re working with a fresh Ionic app generated directly through the Ionic CLI then there won’t be a problem with template declarations within the Root @Component decorator.

If this is the case then perform the following checks:

1. Confirm that all plugins you are importing into your classes are definitely installed using the following command in the Terminal application: *ionic plugin ls* - and, if present, that those plugins have been installed correctly (always follow the online instructions for each plugin to be installed as there may be specific configuration options that need to be implemented). If necessary un-install each plugin, test without that plugin and then reinstall that plugin to determine whether or not the problem resides there
2. Similarly, if you are importing custom components/directives/services/pipes then confirm that the paths to these files are correct, that they are loaded correctly into the class and that any requested methods are spelt correctly/actually exist (you would be surprised at how easy it is to call a method that is misspelt or quite simply doesn’t exist!)
3. Ensure that any code that requires plugin method calls is initialised/triggered within the **Platform.ready** method (if the device isn’t ready the code won’t work!)
4. The TypeScript compiler should report any syntax errors in your code - double check that your classes/templates are formatted correctly
5. Prepare and build your app using the Ionic CLI with platform specific commands (I.e. If you’re targeting iOS devices then you would use *ionic prepare ios && ionic build ios*)
6. In more extreme cases remove and reinstall the platform you want to publish to (as this can sometimes correct issues with older versions of the target platform causing bugs/errors)

If the above measures fail to solve the issue then visit the Ionic forums for further help & assistance: https://forum.ionicframework.com

Don’t be too disheartened if you do encounter the Ionic white screen of death as you won’t be the first or last developer to have done so!

Problem #2 - Build failure

This issue can be quite easy or daunting to resolve depending on the cause (or causes) of the build failure.

The Ionic CLI doesn’t always provide the most intuitive or helpful of errors when a build fails and this can sometimes lead to hours spent online trying to find a solution.

Here are the most common causes/fixes that I’ve encountered for build errors.

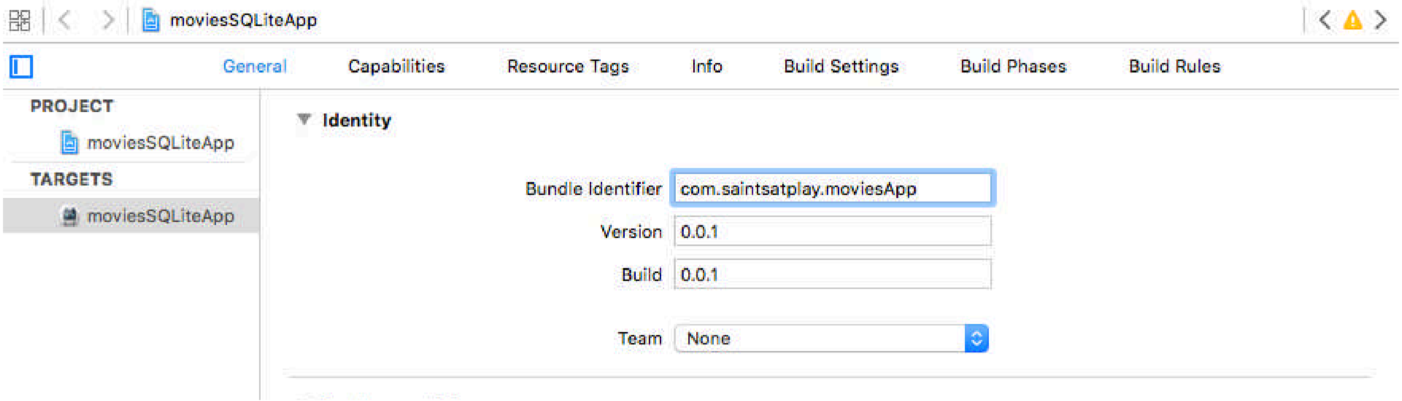
Code signing

If you’re trying to build for an iOS device and receive the following error:

```
Code Sign error: No provisioning profiles found: No non–expired provisioning profiles were found.
```

Thankfully this is relatively simple to fix although there’s a few steps you’ll need to take:

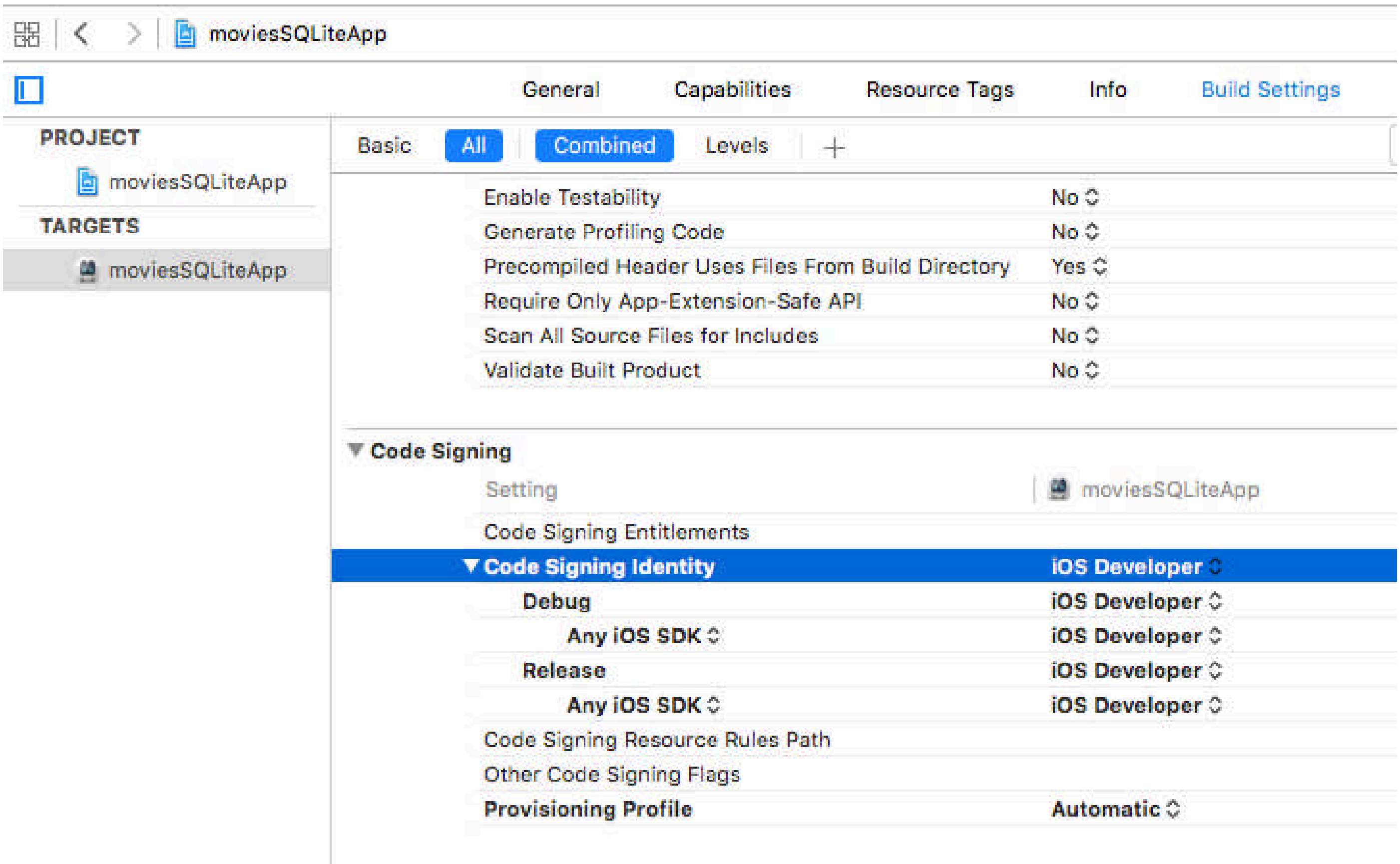
- In the **config.xml** file enter the app bundle identifier, using a reverse domain name style string (I.e. com.saintsatplay.appNameHere), in the widget ID field
- If you don’t already have existing signing certificates installed on your system log into your Apple Developer Account and generate new iOS app development & distribution certificates
- Once you’ve completed generating your certificates download and install them to your Mac OS X Keychain application
- In Apple’s Xcode ensure that the following settings are configured:



Identity

Bundle Identifier: com.saintsatplay.moviesApp
Version: 0.0.1
Build: 0.0.1
Team: None

Ensure that the Apple ID for your developer account is associated with the project by adding or selecting that from the Team menu. Xcode will automatically detect and assign the signing identities and provisioning profiles connected with that Apple ID.



Enable Testability	No
Generate Profiling Code	No
Precompiled Header Uses Files From Build Directory	Yes
Require Only App-Extension-Safe API	No
Scan All Source Files for Includes	No
Validate Built Product	No

Code Signing

Setting	moviesSQLiteApp
Code Signing Entitlements	
▼ Code Signing Identity	iOS Developer
Debug	iOS Developer
Any iOS SDK	iOS Developer
Release	iOS Developer
Any iOS SDK	iOS Developer
Code Signing Resource Rules Path	
Other Code Signing Flags	
Provisioning Profile	Automatic

In your Xcode project editor, select the name of your project under the Targets settings, select the Build Settings tab then scroll down and ensure that the Code Signing Identity field has code signing values selected (Xcode should automatically assign these for you - as shown in the above screen capture).

Following these steps should resolve any issues with code signing when building your app for publishing to an iOS device.

Cannot determine the module for component

There’s nothing more frustrating than running the Ionic CLI Build process only to encounter the following error:

```
[21:34:41]  Error: Cannot determine the module for component NAMEHERE!
[21:34:41]  ngc failed
[21:34:41]  ionic-app-script task: "build"
[21:34:41]  Error: Error
```

The first time you experience this might seem a little mind-boggling because you’ll no doubt have double checked your imported components and found that they’re all there.

What gives?

Thankfully the solution is quick and simple to implement.

In the **src/app/app.module.ts** file ensure that you have performed the following steps:

- Imported the component at the top of the file
- Included the component in the @NgModule **declarations** array
- Included the component in the @NgModule **entryComponents** array

As displayed in the below **app.module.ts** file (highlighted in bold):

```
import { NgModule } from '@angular/core';
import { IonicApp, IonicModule } from 'ionic-angular';
import { MyApp } from './app.component';
import { HomePage } from '../pages/home/home';
import { ComponentA } from '../pages/componentA/componentA';

@NgModule({
  declarations: [
    MyApp,
    HomePage,
    ComponentA
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage,
    ComponentA
  ],
  providers: []
})
export class AppModule {}
```

Cannot find...did you mean the instance member...
The Ionic CLI TypeScript transpiler, will, when encountering an error, print messages such as the following to the Terminal window:

```
transpile update started ...
[18:55:09]  typescript: src/pages/home/home.ts, line: 33
            Cannot find name 'pageWidth'. Did you mean the instance member
'this.pageWidth'?

      L33:  pageWidth                       = platform.width();
```

Unlike some of the errors that are thrown up by the transpiler this one is actually quite helpful - we are actually presented with the solution that we need to implement through a helpful suggestion along with the line where the error occurs.

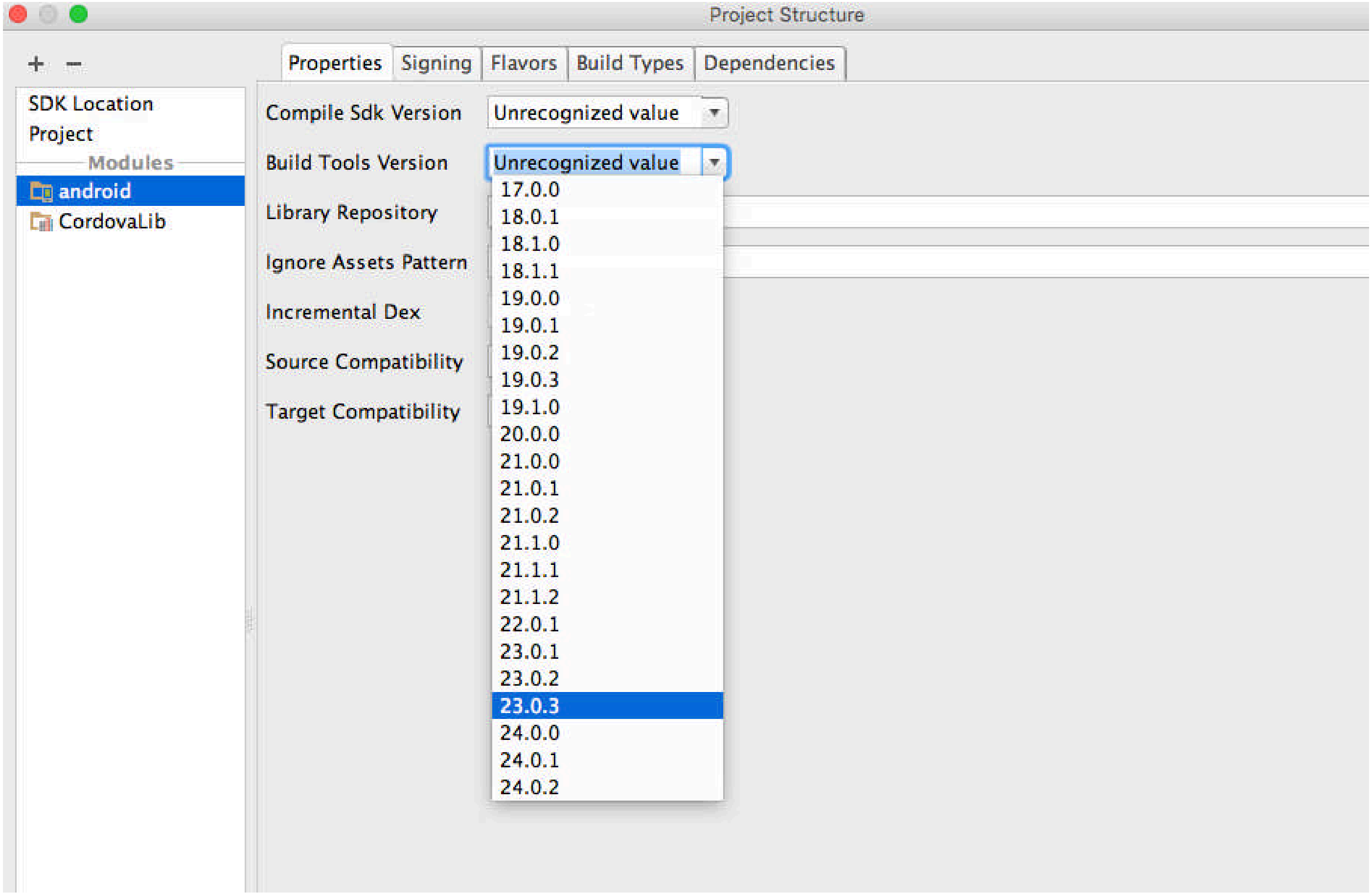
Don’t worry if you encounter errors similar to the above as you make the transition from Ionic 1/JavaScript to Ionic 2/TypeScript - you’ll become a dab hand with the required syntax fairly quickly!

Android transformClasseswithDexforDebug error

If you're trying to run a build process for an Android project through the Ionic CLI and encounter the following error:

```
FAILURE: Build failed with an exception.

* What went wrong:
Execution failed for task ':transformClassesWithDexForDebug'.
```

Open up Android Studio and, if you have updated the Android SDK manager to the latest API's and libraries (which of course, as a good developer, you will have done) set the Build Tools Version to 23.0.3 (as demonstrated in the below screen capture) in your Project Structure settings (File > Project Structure):



Compile Sdk Version: Unrecognized value

Build Tools Version: Unrecognized value

Save these settings return to the Terminal and once you've run the following commands your Android project should build without throwing that error again:

```
ionic prepare android && ionic build android
```

Error code 65

If you're trying to run an iOS build process using the Ionic CLI and are confronted with an error like the following:

```
** BUILD FAILED **

The following build commands failed:
        Ld build/emulator/myApp.app/myApp normal i386

(1 failure)

Error: Error code 65 for command: xcodebuild with args: -xcconfig,/projects/
myApp/platforms/ios/Cordova/build-debug.xcconfig,-project,myApp.xco-
deproj,ARCHS=i386,-target,myApp,-configuration,Debug,-sdk,iphonesimu-
lator,build,VALID_ARCHS=i386,CONFIGURATION_BUILD_DIR=/projects/
myApp/platforms/ios/build/emulator,SHARED_PRECOMPS_DIR=/projects/
myApp/platforms/ios/build/sharedpch
```

The first thing you should do is run the **ionic info** command in your Terminal to check your system's Ionic environment and dependencies.

You may think you've already installed all the software you need but then discover that there's one or more applications that you still require.

The **ionic info** command might output something like the following to the Terminal:

```
Your system information:

Cordova CLI: 6.3.0
Gulp version:  CLI version 1.2.1
Gulp local:   Local version 3.9.1
Ionic Framework Version: 2.0.0-beta.11
Ionic CLI Version: 2.0.0-beta.37
Ionic App Lib Version: 2.0.0-beta.20
```

```
ios-deploy version: Not installed
ios-sim version: Not installed
OS: Mac OS X El Capitan
Node Version: v0.12.0
Xcode version: Xcode 7.3.1 Build version 7D1014

______________________________________________________________________



 Dependency warning - for the CLI to run correctly,
 it is highly recommended to install/upgrade the following:

 Please install your Cordova CLI to version  >=4.2.0 `npm install -g Cordova`
Install ios-sim to deploy iOS applications. npm install -g ios-sim (may require sudo)
 Install ios-deploy to deploy iOS applications to devices.  `npm install -g ios-deploy` (may require sudo)
```

You'll notice from the above output that the ios-deploy and ios-sim applications are not installed.

ios-deploy allows developers to install and debug iPhone apps directly from the command line without Xcode.

ios-sim is a command line application launcher for the iOS simulator.

The Ionic Info output even provides the following installation instructions for these applications:

```
npm install -g ios-sim
npm install -g ios-deploy
```

If you are developing on Mac OS X 10.11 El Capitan you might need to modify the command for installing ios-deploy to the following:

```
npm install -g ios-deploy --unsafe-perm=true
```

Read here for further information on this flag: https://docs.npmjs.com/misc/config#-unsafe-perm.

If installing the previously mentioned software fails to resolve the Error code 65 issue the most reliable solution I have found involves removing and re-adding the ios platform using the following Ionic CLI commands (which you may need to prefix with sudo to overcome possible permission errors):

```
ionic platform rm ios
ionic platform add ios
```

After running these commands my next build process was error free.

Unsupported major.minor version 52.0

This error was encountered while running an android build process using the Ionic CLI.

The solution that I've found works? Upgrade your JDK installation to version 8.

Problem #3 - Plugin methods don't appear to execute

If you're importing Ionic Native/Apache Cordova plugins for use in your app make sure that those plugin methods are triggered within the Platform.ready() method.

Doing so determines that the device is ready, the DOM has fully loaded and calls to Cordova based plugins can access native functionality such as, for example, Geolocation.

Problem #4 - Permission denied error

This can crop up when you're trying to perform an operation in the Ionic CLI and find yourself greeted with a message akin to the following:

```
Error: EACCES, permission denied '/Users/myNameHere/.config/configstore/
insight-cordova.json'
You don’t have access to this file.
```

To solve this simply prefix the command you were trying to run with sudo (a unix utility which grants temporary root like privileges to the user - the word sudo is short for super user do) and then enter your system user password at the prompt.

If you find yourself getting tired of having to keep entering sudo to prefix certain CLI commands you can always change the ownership permissions on your user directory like so (this example pertains to Mac OS X):

```
cd ~    // Change to your home directory

whoami    // Determine your system user name

// Change ownership of your home directory and its contents to your username
sudo chown -R yourName /Users/yourName
```

Problem #5 - Black screen on Ionic Native Google Maps
You’ve installed the Google Maps plugin from Ionic Native (or, more preferably, from the Github repository that it links to) and having followed the installation instructions correctly see a black screen rendering where the Google Map should be displayed.

This appears to be a bug with the current version of Ionic 2 that is caused by a <div> with a class of nav-decor that overlays and hides the Google map from view.

More information on this bug can be accessed via the following forum threads:

- https://github.com/driftyco/ionic/issues/7205
- https://forum.ionicframework.com/t/why-appears-nav-decor-after-pressing-back-button/59791

Other rendering issues with the Google map plugin that other developers have experienced are covered in the following resource: https://github.com/mapsplugin/cordova-plugin-googlemaps/wiki/TroubleShooting:-Blank-Map

Developing from these online resources the current bug fix for this issue involves using CSS to set the background colour to a transparent value for elements with the following classes:

- nav-decor
- _gmaps_cdv_

In the scss file for the component that handles the logic and rendering for the Google Map plugin you can target those classes with the following style rule:

```
._gmaps_cdv_, .nav-decor{
  background-color: transparent !important;
}
```

If you’ve implemented this style rule and the black screen issue still persists double check that you’re using the **isAvailable** method of the GoogleMap plugin API within the Ionic platform ready call like so (highlighted in bold):

```
this.platform.ready().then(() =>
{
   GoogleMap.isAvailable()
   .then((isAvailable: boolean)=>
   {
      if(!isAvailable)
      {
         console.log('GoogleMap plugin is NOT available');
      }
      else
      {
         console.log('GoogleMap plugin is available');
```

```
            // Define necessary logic and execute GoogleMap calls inside here
         }
   });
});
```

Problem 6 - Your key may be invalid for your bundle ID
Here’s another Ionic Native GoogleMap plugin related error.

After trying, and failing, to connect to the Google Maps service the following error is printed to the Xcode console when running your app:

```
Your key may be invalid for your bundle ID: com.company.id
```

There are 2 possible causes of this problem:

- The Google Maps SDK for iOS API is not enabled (double check whether this is the case or not in your Google Developers Console)
- You’ve registered a different bundle ID for your iOS API key in the Google Maps API service to the one that is stored in the **config.xml** file for your published app (simply correct the bundle ID in your **config.xml** file to match that of the iOS API key)

Ensuring that the Google Maps SDK for iOS API is enabled and that the Bundle ID stored in the **config.xml** file matches that entered for the iOS API key will fix this problem.

Apple App Store upload errors

We'll cover submitting an archive to the Apple App Store in the **Submitting your iOS app to the Apple App Store** chapter but here we'll go over some common issues and errors that I've experienced while validating and/or submitting archives to the Apple App Store.

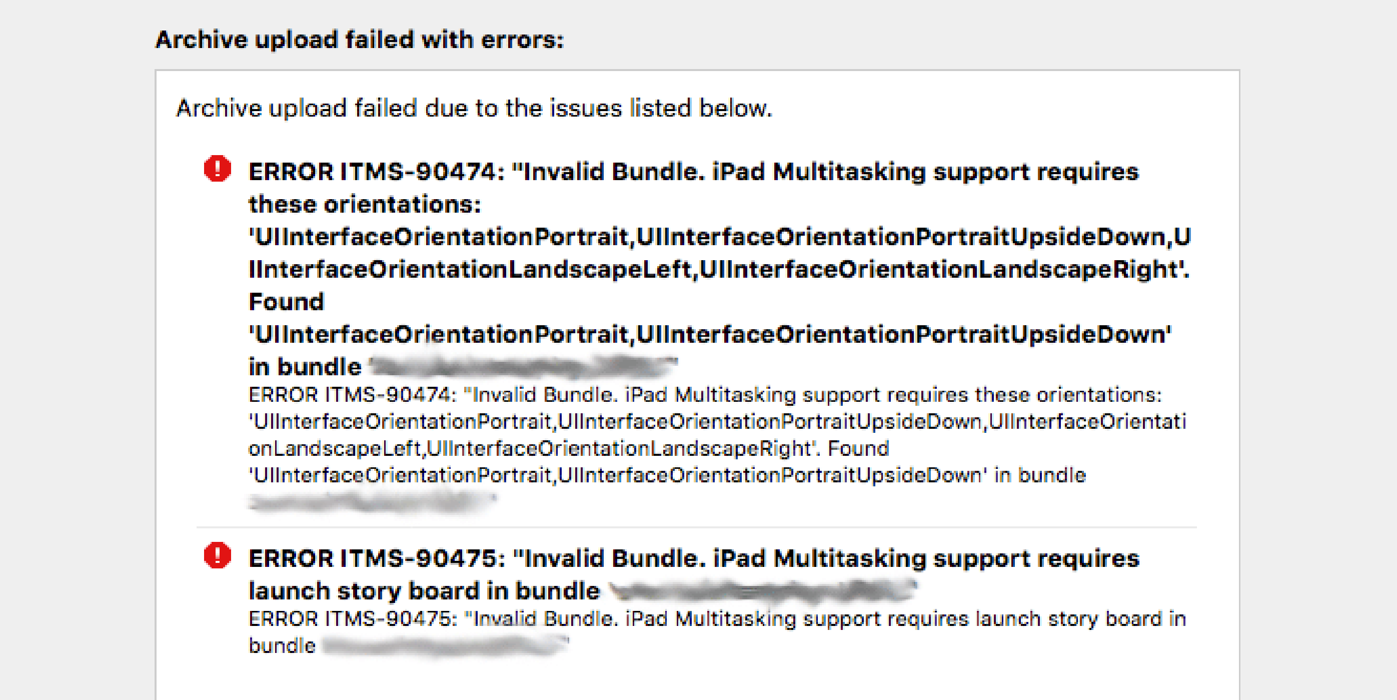
All errors occurred on a system with the following specifications:

- Mac OS X El Capitan (v 10.11.4)
- Xcode 7.3 / Apache Cordova 6.1.1

Whether other developers experience the same issues with a different operating system/software set-up remains to be seen but hopefully the following will help anyone else experiencing the same problem.

iPad Multitasking support requires these orientations

The following error was reported when an archive upload failed:



Archive upload failed with errors:

Archive upload failed due to the issues listed below.

ERROR ITMS-90474: "Invalid Bundle. iPad Multitasking support requires these orientations: 'UIInterfaceOrientationPortrait,UIInterfaceOrientationPortraitUpsideDown,UIInterfaceOrientationLandscapeLeft,UIInterfaceOrientationLandscapeRight'. Found 'UIInterfaceOrientationPortrait,UIInterfaceOrientationPortraitUpsideDown' in bundle [redacted]

ERROR ITMS-90474: "Invalid Bundle. iPad Multitasking support requires these orientations: 'UIInterfaceOrientationPortrait,UIInterfaceOrientationPortraitUpsideDown,UIInterfaceOrientationLandscapeLeft,UIInterfaceOrientationLandscapeRight'. Found 'UIInterfaceOrientationPortrait,UIInterfaceOrientationPortraitUpsideDown' in bundle [redacted]

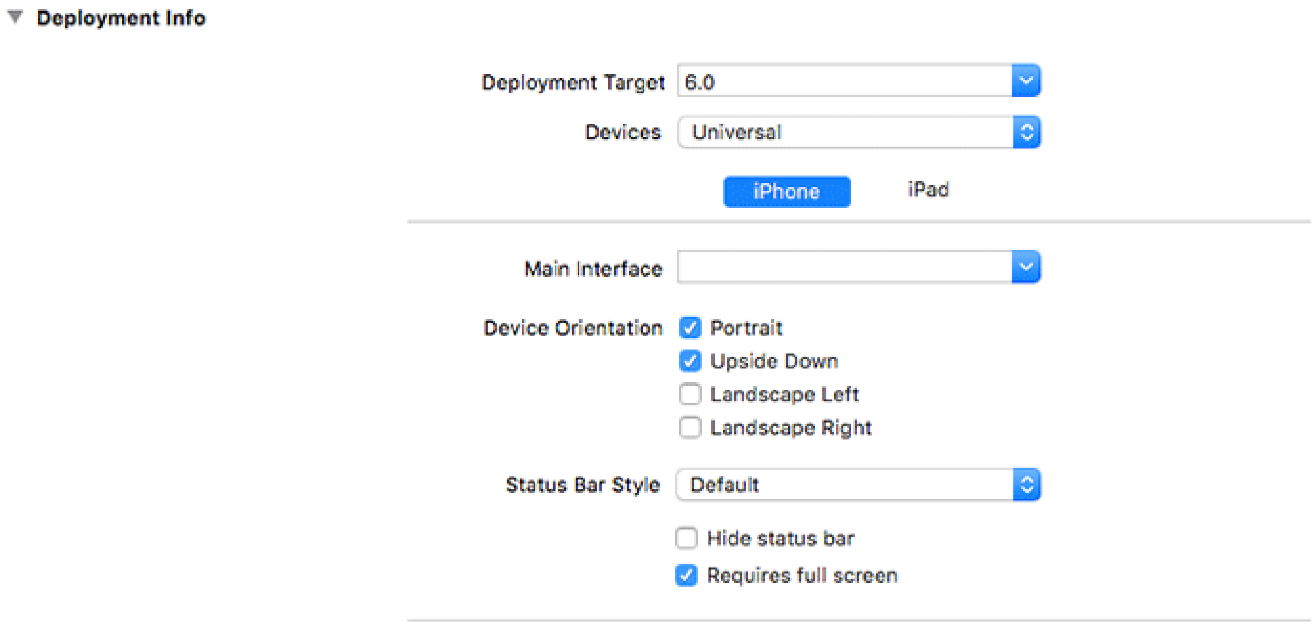
ERROR ITMS-90475: "Invalid Bundle. iPad Multitasking support requires launch story board in bundle [redacted]

ERROR ITMS-90475: "Invalid Bundle. iPad Multitasking support requires launch story board in bundle [redacted]

This one caught me out at first as I had selected the required orientations for the app that I was submitting.

Thankfully the solution was very simple.

This simply involves selecting Xcode’s **Requires full screen** checkbox in the Deployment Info section of the General settings for the project Targets like so:



▼ Deployment Info

Deployment Target: 6.0

Devices: Universal

iPhone | iPad

Main Interface:

Device Orientation:
☑ Portrait
☑ Upside Down
☐ Landscape Left
☐ Landscape Right

Status Bar Style: Default

☐ Hide status bar
☑ Requires full screen

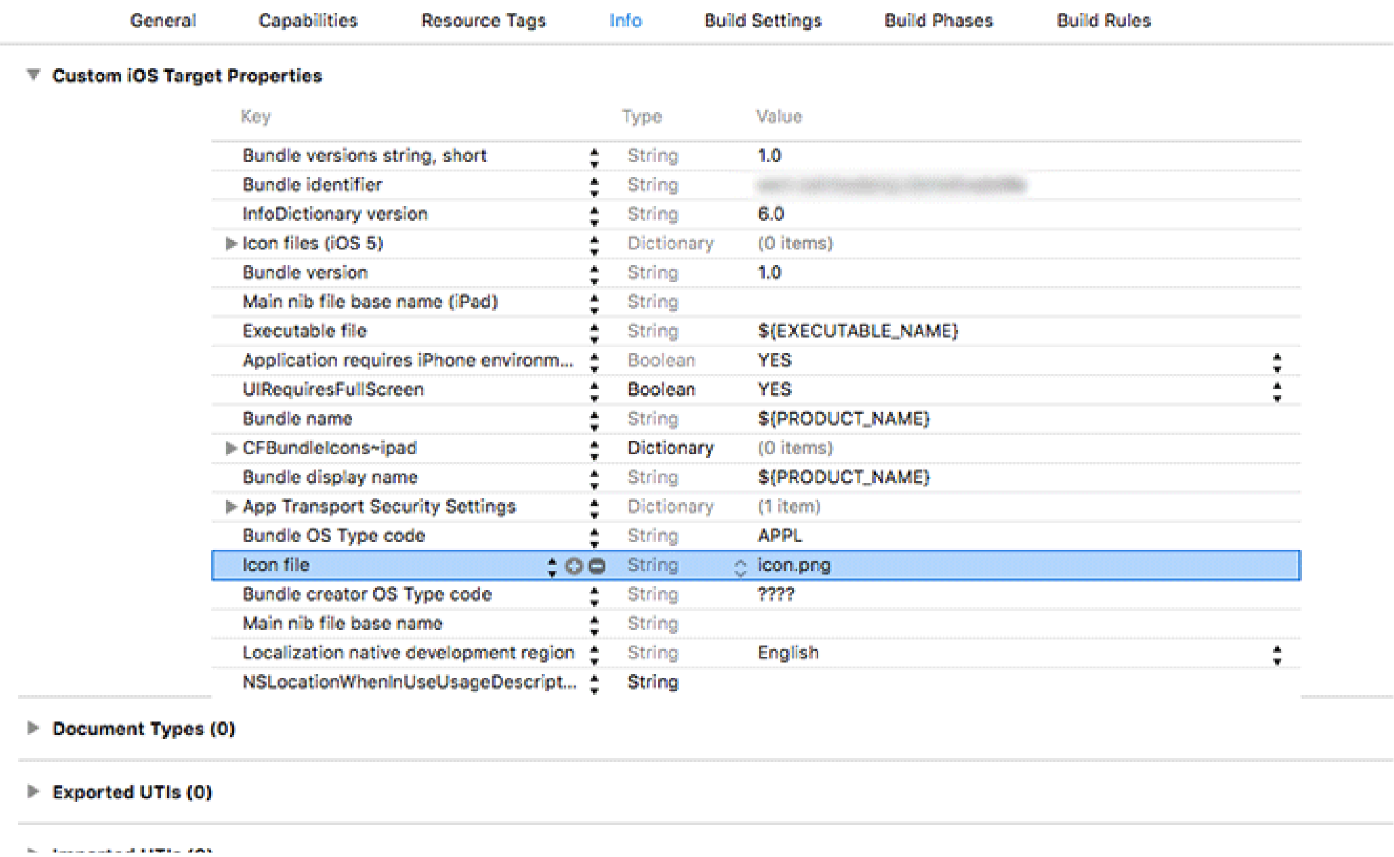
Xcode CFBundleIcons no image found error

If you encounter the following error message while trying to upload your archive:

```
ERROR ITMS-90032:"Invalid Image Path - No image found at the path referenced under key 'CFBundleIcons': icon.png"
```

The problem is that Xcode is trying to reference a launch icon that cannot be found.

To solve this simply delete the highlighted Icon Key listing in Xcode as displayed in the following screen capture:



Custom iOS Target Properties

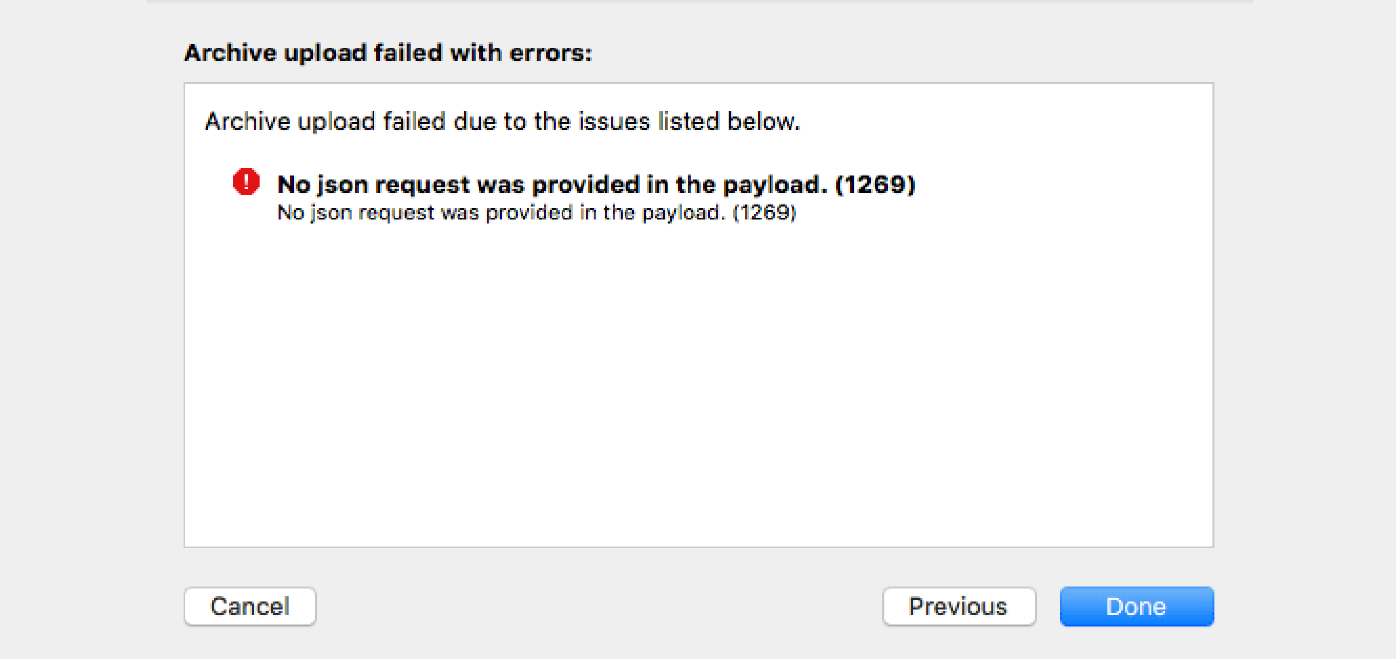
Key	Type	Value
Bundle versions string, short	String	1.0
Bundle identifier	String	[redacted]
InfoDictionary version	String	6.0
▶ Icon files (iOS 5)	Dictionary	(0 items)
Bundle version	String	1.0
Main nib file base name (iPad)	String	
Executable file	String	${EXECUTABLE_NAME}
Application requires iPhone environm...	Boolean	YES
UIRequiresFullScreen	Boolean	YES
Bundle name	String	${PRODUCT_NAME}
▶ CFBundleIcons~ipad	Dictionary	(0 items)
Bundle display name	String	${PRODUCT_NAME}
▶ App Transport Security Settings	Dictionary	(1 item)
Bundle OS Type code	String	APPL
Icon file	String	icon.png
Bundle creator OS Type code	String	????
Main nib file base name	String	
Localization native development region	String	English
NSLocationWhenInUseUsageDescript...	String	

▶ Document Types (0)

▶ Exported UTIs (0)

No JSON request provided in the payload

The following is a very strange and unusual archive upload error:



Archive upload failed with errors:

Archive upload failed due to the issues listed below.

No json request was provided in the payload. (1269)
No json request was provided in the payload. (1269)

The solution?

Simply re-upload the archive.

This solved the error and I’m still none the wiser as to why the archived upload originally failed.

Fixing Xcode issue with Missing iOS Distribution signing identity error

The following occurred during the archive validation process:

```
Failed to locate or generate matching signing assets

Xcode attempted to locate or generate matching signing assets and failed
to do so because of the following issues.

Missing iOS Distribution signing identity for ... Xcode can request one for you.
```

Fixing this requires you follow these steps:

1. Download the [Apple provided certificate]()
2. Install this certificate in your Keychain Access application (double clicking on the downloaded certificate will do this automatically)
3. Within the Keychain Access application navigate to the View menu and select Show Expired Certificates
4. Go to the Keychains section, on the left hand side of the Keychain Access application window
5. In both the login and System links delete the expired Apple Worldwide Developer Relations Certification Authority certificates that are displayed
6. (optional) You can also delete ALL other expired certificates here as well (but be sure to add any replacement/updated certificates where necessary

Now, if you return to Xcode and attempt to validate your archived package, prior to submission to the Apple App store, you should see the previous distribution identity warning message is no longer displayed.

[Apple have released a statement]() explaining, in greater detail, the expiration of the

Worldwide Developer Relations Intermediate Certificate and what developers need to be aware of with regards to this issue.

As the newly installed Apple Worldwide Developer Relations Certification Authority certificate expires on the 7th February 2023 you shouldn’t see this error message for some time to come (all things being well with software updates and Apple mandated changes!)

Debugging
& Profiling Apps

> "Always code as if the guy who ends up maintaining your code will be a violent psychopath who knows where you live"
>
> John F. Woods - post to a comp.lang.c++ newsgroup

In this chapter we're going to look at some tips to help fine-tune the performance of your Ionic 2 app's as well as testing techniques to ensure your application logic is fit for purpose.

Testing is a huge part of software development and there's nothing enjoyable about picking up another developer's work to find bug after bug in what appears to be an impenetrable mess of undocumented, spaghetti like code (particularly when you've got deadlines to meet and a million and one other tasks simultaneously weighing down on you).

It therefore pays when we're developing our apps, regardless of which individual will be responsible for maintaining the codebase, to observe best practice standards for coding, testing & optimising those apps for best results.

When testing our Ionic 2 apps there are a number of approaches we can take:

- Browser debugging
- Unit testing
- UI testing

This chapter will only focus on browser based debugging and profiling techniques using, predominantly, the Console API to test the performance of our code.

Console API

The Console API gives us quite a few methods to choose from, the most commonly used being:

- log
- dir
- dirxml

- profile/profileEnd
- time/timeEnd
- trace

We can then use any single one of these, or a combination of, to determine how well our code is performing; whether there are any bugs in the application logic or optimisations required (such as where code might be performing slowly in the case of iterating through large chunks of data).

Further information on the Console API can be found here.

Most of you are no doubt familiar with using **console.log()** but let's put a handful of different methods to work in a sample application that we're going to build which allows us to retrieve information on selected Apple Store locations in Europe.

At the root of your apps project directory run each of the following commands, one after the other, using the Ionic CLI:

```
ionic start appleStores --v2 blank
cd appleStores
npm install
ionic g provider loadFiles
```

Here we're creating a brand new app named **appleStores**, which, once generated, we change into the project directory to install all the required node modules and dependencies before finally creating a **loadFiles** service

Before making a start on coding the application logic you'll need to take a moment to add the necessary data files for the app:

- Create a directory titled **data** located inside the **appleStores/src/assets** directory
- Copy all of the JS files for the download files for this chapter from the following location: **/Testing-and-profiling-apps/appleStores/src/assets/data/**
- These files will be titled: **apple-store-locations.js** and **european-countries.js**
- Paste both of these copied JS files into your **appleStores/src/assets/data** app project directory

These files, as their names suggest, contain the Apple Store locations and country listings for the following European states:

- Belgium
- France
- Germany
- Netherlands
- United Kingdom

Using Ionic serve our **appleStores** app will output data to the browser console window through the following Console API methods:

- count
- dir
- log
- table
- time
- timeEnd

Nothing terribly fancy or complex here just a handful of console tools to help us understand how the app's code is performing.

Open the **appleStores/src/providers/load-file.ts** provider and let's start the ball rolling with the following amendments (highlighted in bold):

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Injectable()
export class LoadFiles {

  private countries : any          =     [];
  private locations : any          =     [];

```

```
constructor(public http: Http)
{

}



loadCountries()
{
   return new Promise(resolve =>
   {
      this.http.get('assets/data/european-countries.js')
      .map(res => res.json())
      .subscribe(countries =>
      {

         for(var k in countries.countries)
         {
            this.countries.push({
               id:           countries.countries[k].id,
               country:      countries.countries[k].country,
               lat:          countries.countries[k].lat,
               lng:          countries.countries[k].lng,
               zoom:         countries.countries[k].zoom,
               active:       countries.countries[k].active
            });
         }

         resolve(this.countries);
      });
   });
}
```

```
  loadLocations()
  {
    return new Promise(resolve =>
    {
      this.http.get('assets/data/apple-store-locations.js')
      .map(res => res.json())
      .subscribe(locations =>
      {

        for(var k in locations.locations)
        {
          this.locations.push({
            id:            locations.locations[k].id,
            country:       locations.locations[k].country,
            name:          locations.locations[k].name,
            address:       locations.locations[k].address,
            lat:           locations.locations[k].lat,
            lng:           locations.locations[k].lng,
            zoom:          locations.locations[k].zoom,
            active:        locations.locations[k].active
          });

        }
        resolve(this.locations);
      });
    });
  }

}
```

Okay, nothing too drastic or complicated here; just 2 methods: **loadCountries** and **loadLocations** which fetch their respective JSON files and parse that data into objects which are then returned through use of a Promise.

These methods will be called in the **appleStores/src/pages/home/home.ts** file which we'll now make the following amendments too (highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController } from 'ionic-angular';
import { LoadFiles } from '../../providers/load-files';

@Component({
 selector: 'page-home',
 templateUrl: 'home.html'
})
export class HomePage {

  public stores          : any = [];
  public locations       : any;

  constructor(  public navCtrl         : NavController,
                public files           : LoadFiles)
  {
      console.time("Loading Apple Store Locations");
      this.files.loadLocations().then((data) =>
      {

        let i,
           k,
           locations = data;

        console.timeEnd("Loading Apple Store Locations");
        console.time("Loading European Countries");
        this.files.loadCountries().then((data) =>
        {
          let countries = data;
          console.timeEnd("Loading European Countries");
          console.time("Combining Countries & Locations");
          for(i in locations)
          {
            for(k in countries)
            {
              if(countries[k].id === locations[i].country)
              {
                console.log(`Country:${countries[k].country}`);

                this.stores.push(
                {
                  name:              locations[i].name,
                  address:           locations[i].address,
                  country:           countries[k].country,
                  lat:               locations[i].lat,
                  lng:               locations[i].lng,
                  zoom:              locations[i].zoom,
                  active:            locations[i].active
                });

                console.count();
              }
            }
          }
          this.renderDataToTable(this.stores);
          this.renderDataToConsole("Apple Stores & countries", this.
stores);
          console.timeEnd("Combining Countries & Locations");

          this.locations = this.stores;
        });
      });
    }
    // Render object data to tabular data format
    renderDataToTable(stores)
    {
      console.table(stores);
    }


    // Make console logging pretty :)
    renderDataToConsole(name, values)
    {
      console.log(`Begin output for ${name}`);
      console.dir(values);
      console.log(`End output for ${name}`);
    }

}
```

At first glance this might seem like a lot to take in but it’s relatively simple code:

- We begin with importing the **LoadFiles** provider followed by initialising two public properties: **stores** and **locations**
- Within the class constructor a property of **files** is initialised for the **LoadFiles** module
- We then run a **console.time** method to start measuring how long it takes for the **loadLocations** method to return data
- Once the Apple Store locations data has been returned by the **loadLocations** method the timer is then ended (which will output, to the browser console window, the length of time the operation took to complete)
- Straight afterwards a new timer is set to measure the amount of time it takes for data to be returned from the **loadCountries** method
- Once that data has loaded this timer is ended (once again outputting, to the browser console window, the time taken from calling the method to retrieving the data)
- We then create a new timer to measure how long it takes to iterate through a

nested loop that compares keys between the locations and countries data objects
- Within this nested loop we use the **console.log** method to output the name of the country where a match has been found on the keys that are being compared
- We then combine the country name with the Apple Store location, pushing this into the **stores** object, and print to the console window the current loop iteration where a match has been found using the **console.count** method
- After the nested loop the **renderDataToTable** method is called which the **stores** object is passed into. This method uses the supplied **stores** object to generate a table view of its data in the browser console window
- Following from this the **renderDataToConsole** method is called that is passed a custom message and the **stores** object, which it then uses to generate opening and closing log messages around a collapsible tree view of the **stores** object to the browser console
- The last timer that was set is then ended
- Finally, the **stores** object is passed to the locations object which will be used by the home page component's HTML file to output those locations for viewing

That seems like a lot but the logic is fairly simple - we're just testing how long it takes for:

- Each provider method: **loadCountries** and **loadLocations** to retrieve and return data
- A nested loop to iterate through both sets of returned data, find a match between the 2 and then create a hybrid object from selected keys of each of the 2 data sets

Along the way we're just playing with some of the Console API methods!

That covers all of the necessary logic for the appleStores app now we need to open the **appleStores/src/pages/home/home.html** file and implement the necessary mark-up changes for this to work (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      European Apple Stores
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
  <ion-card *ngFor="let location of locations">
    <ion-card-header>
      <ion-item class="heading">
        <ion-icon ios="logo-apple" md="logo-apple" item-left></ion-icon>
        <h2>{{ location.name }}</h2>
      </ion-item>
    </ion-card-header>
    <ion-card-content>
      <h2>{{ location.country }}</h2>
      <div [innerHTML]="location.address"></div>
      <p>Latitude: {{ location.lat }}</p>
      <p>Longitude: {{ location.lng }}</p>
    </ion-card-content>
  </ion-card>
</ion-content>
```

Here we use the **ngFor** directive to loop through the locations data object, which, on each iteration, generates a location listing contained within an **<ion-card>** tag.

There’s nothing here that we aren’t already familiar with from previous examples of working with data in page templates.

Now that the HTML for the component has been covered all that remains is to configure the **appleStores/src/app.module.ts** file with the following amendments (highlighted in bold):

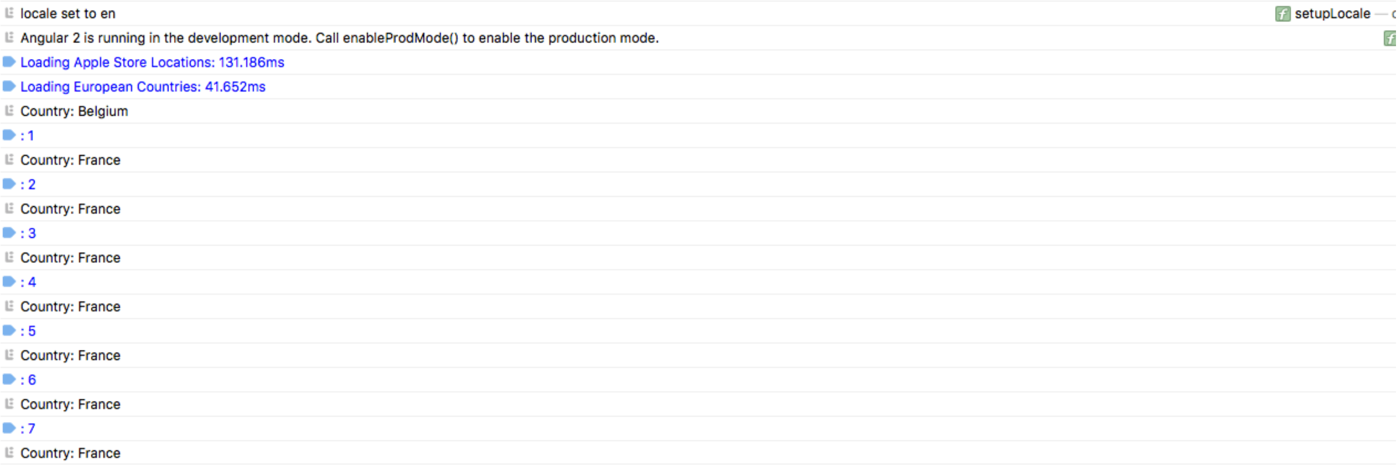
```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { HomePage } from '../pages/home/home';
import { LoadFiles } from '../providers/load-files';

@NgModule({
  declarations: [
    MyApp,
    HomePage
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage
  ],
  providers: [{provide: ErrorHandler, useClass: IonicErrorHandler}, LoadFiles]
})
export class AppModule {}
```

Now that all the necessary code and configuration settings are in place we can run the appleStore app in a desktop browser and see the console logging functionality at work.

Using the Ionic CLI, and at the root of the appleStore project directory (you know the drill by now!), run the following command (feel free to add a lowercase L as a flag to this command if you want to simultaneously preview the app across iOS, Android & Windows Phone platforms):

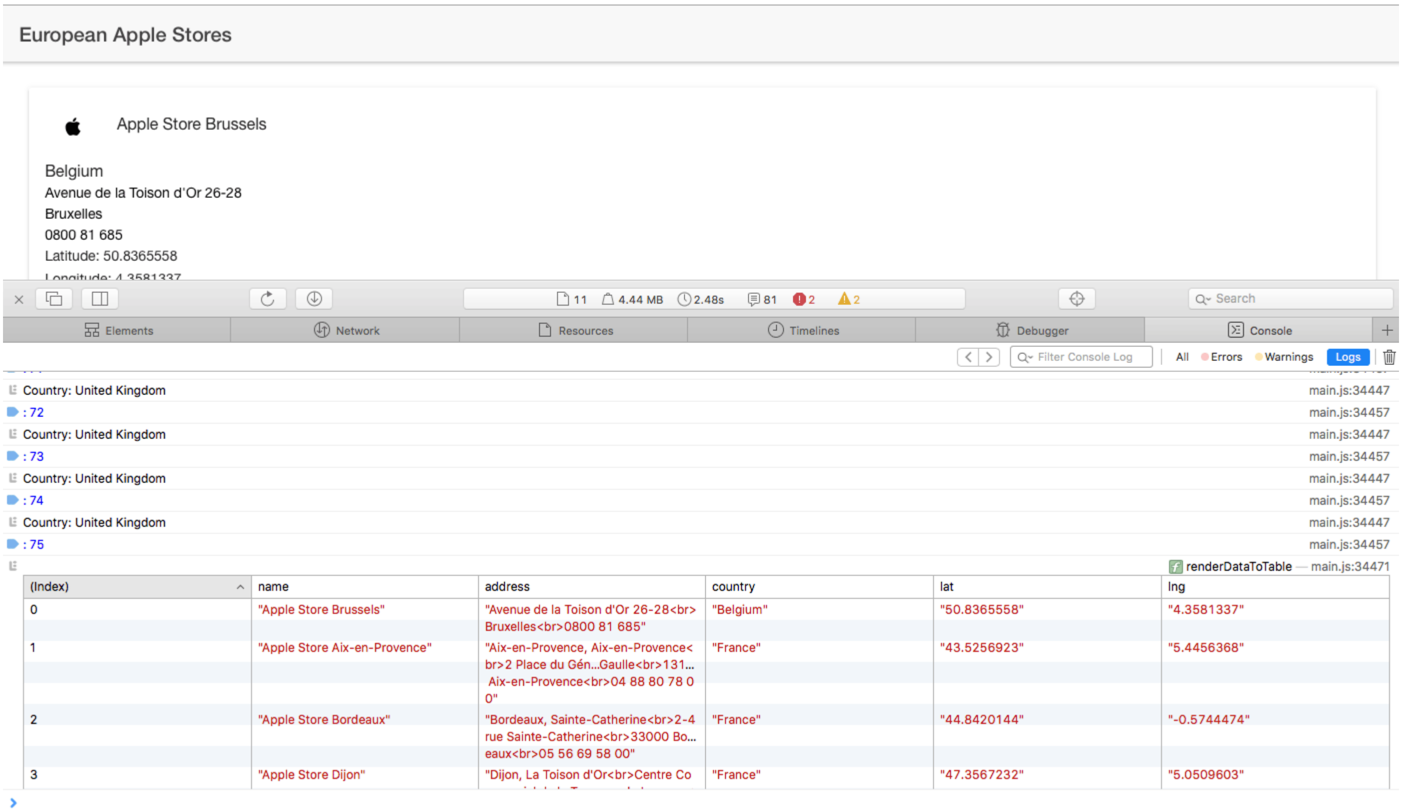
```
ionic serve
```

All things being well you should see various output being printed to the console which includes the times taken for the **loadLocations** and **loadCountries** methods to retrieve data (as well as the matching country and count value for each iteration of the nested loop):



```
locale set to en                                                                      setupLocale — c
Angular 2 is running in the development mode. Call enableProdMode() to enable the production mode.
Loading Apple Store Locations: 131.186ms
Loading European Countries: 41.652ms
Country: Belgium
: 1
Country: France
: 2
Country: France
: 3
Country: France
: 4
Country: France
: 5
Country: France
: 6
Country: France
: 7
Country: France
```

This is then followed by the **stores** object being rendered into tabular data within the browser console window (courtesy of the **console.table** method - which makes visual analysis of data so much nicer and easier):



European Apple Stores

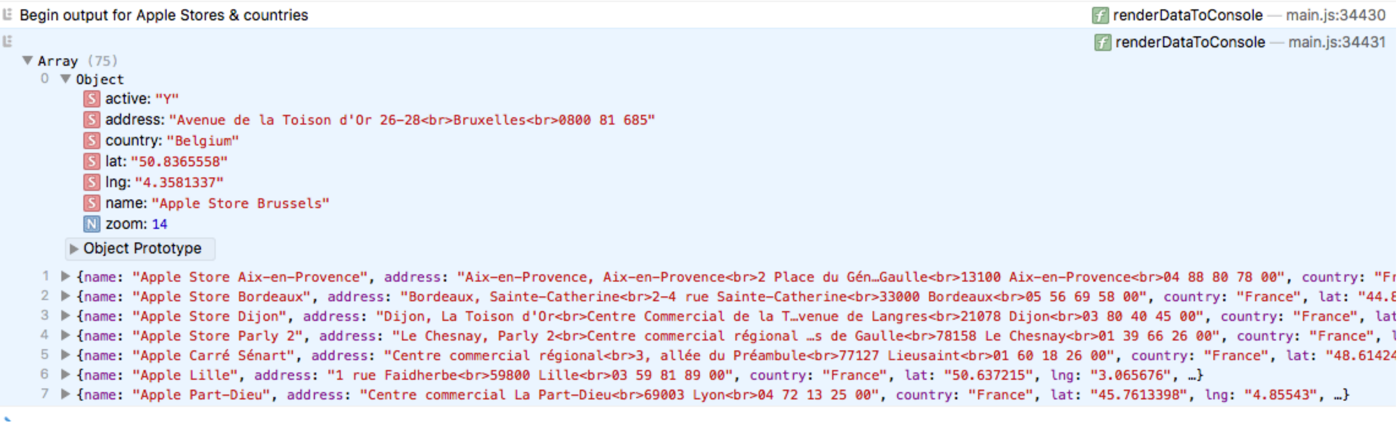
Apple Store Brussels

Belgium
Avenue de la Toison d'Or 26-28
Bruxelles
0800 81 685
Latitude: 50.8365558
Longitude: 4.3581337

```
Country: United Kingdom                                   main.js:34447
: 72                                                      main.js:34457
Country: United Kingdom                                   main.js:34447
: 73                                                      main.js:34457
Country: United Kingdom                                   main.js:34447
: 74                                                      main.js:34457
Country: United Kingdom                                   main.js:34447
: 75                                                      main.js:34457
                                      renderDataToTable — main.js:34471
```

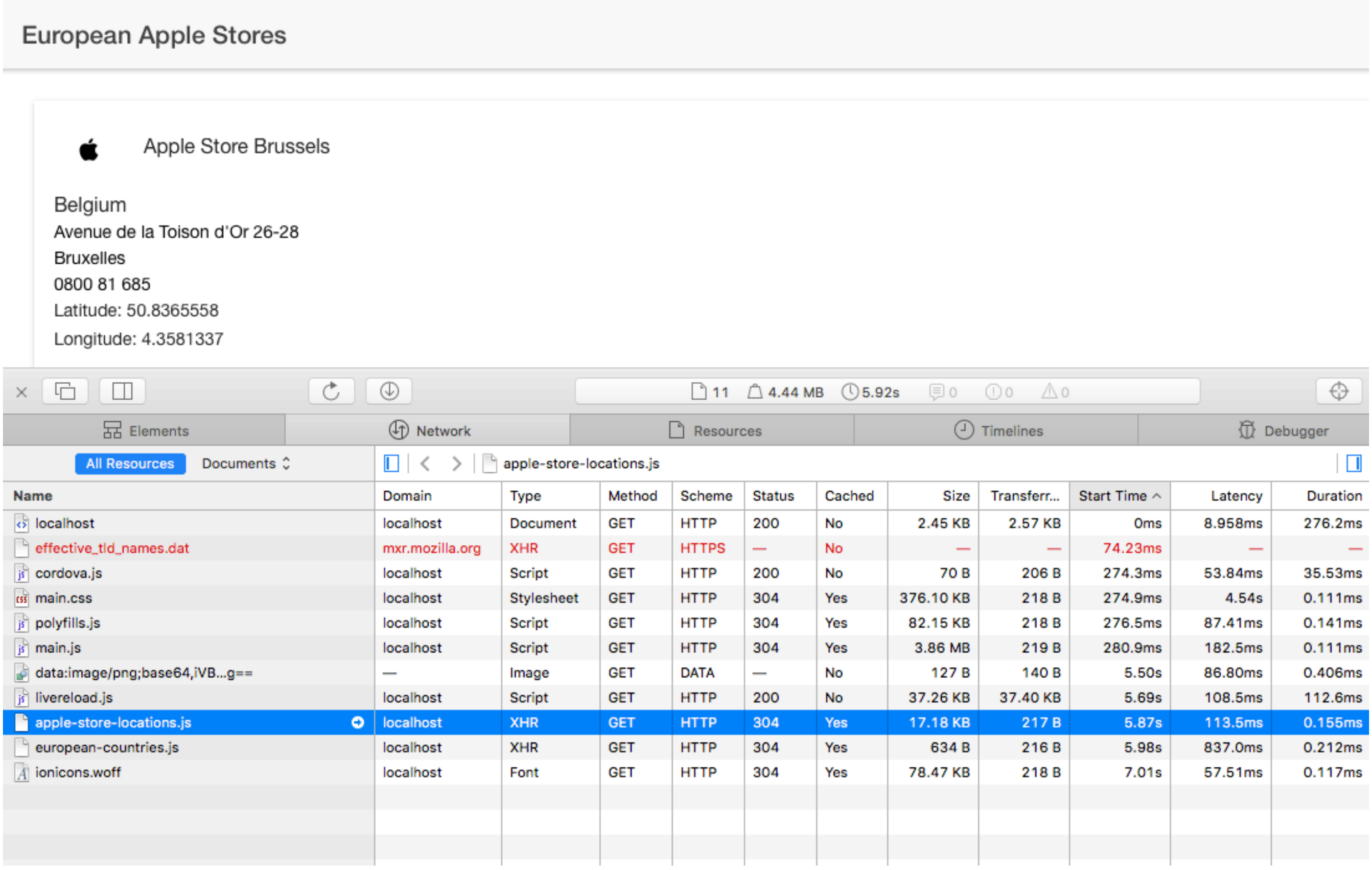
(Index)	name	address	country	lat	lng
0	"Apple Store Brussels"	"Avenue de la Toison d'Or 26-28 Bruxelles 0800 81 685"	"Belgium"	"50.8365558"	"4.3581337"
1	"Apple Store Aix-en-Provence"	"Aix-en-Provence, Aix-en-Provence 2 Place du Gén…Gaulle 131… Aix-en-Provence 04 88 80 78 00"	"France"	"43.5256923"	"5.4456368"
2	"Apple Store Bordeaux"	"Bordeaux, Sainte-Catherine 2-4 rue Sainte-Catherine 33000 Bo…eaux 05 56 69 58 00"	"France"	"44.8420144"	"-0.5744474"
3	"Apple Store Dijon"	"Dijon, La Toison d'Or Centre Co	"France"	"47.3567232"	"5.0509603"

Next up is the **console.dir** method allowing the stores data object to be displayed in a tree-like structure where each item can be opened/collapsed:



```
Begin output for Apple Stores & countries                    renderDataToConsole — main.js:34430
                                                              renderDataToConsole — main.js:34431
▼ Array (75)
  0 ▼ Object
        S active: "Y"
        S address: "Avenue de la Toison d'Or 26-28<br>Bruxelles<br>0800 81 685"
        S country: "Belgium"
        S lat: "50.8365558"
        S lng: "4.3581337"
        S name: "Apple Store Brussels"
        N zoom: 14
      ▶ Object Prototype
  1 ▶ {name: "Apple Store Aix-en-Provence", address: "Aix-en-Provence, Aix-en-Provence<br>2 Place du Gén…Gaulle<br>13100 Aix-en-Provence<br>04 88 80 78 00", country: "Fr
  2 ▶ {name: "Apple Store Bordeaux", address: "Bordeaux, Sainte-Catherine<br>2-4 rue Sainte-Catherine<br>33000 Bordeaux<br>05 56 69 58 00", country: "France", lat: "44.8
  3 ▶ {name: "Apple Store Dijon", address: "Dijon, La Toison d'Or<br>Centre Commercial de la T…venue de Langres<br>21078 Dijon<br>03 80 40 45 00", country: "France", lat
  4 ▶ {name: "Apple Store Parly 2", address: "Le Chesnay, Parly 2<br>Centre commercial régional …s de Gaulle<br>78158 Le Chesnay<br>01 39 66 26 00", country: "France", l
  5 ▶ {name: "Apple Carré Sénart", address: "Centre commercial régional<br>3, allée du Préambule<br>77127 Lieusaint<br>01 60 18 26 00", country: "France", lat: "48.61424
  6 ▶ {name: "Apple Lille", address: "1 rue Faidherbe<br>59800 Lille<br>03 59 81 89 00", country: "France", lat: "50.637215", lng: "3.065676", …}
  7 ▶ {name: "Apple Part-Dieu", address: "Centre commercial La Part-Dieu<br>69003 Lyon<br>04 72 13 25 00", country: "France", lat: "45.7613398", lng: "4.85543", …}
```

While we're using the browser DOM inspector we can also explore the Network tab which allows us to determine any problems with the size of requested files, files not being loaded or similar request/response issues for application assets such as images, JSON files etc.:



European Apple Stores

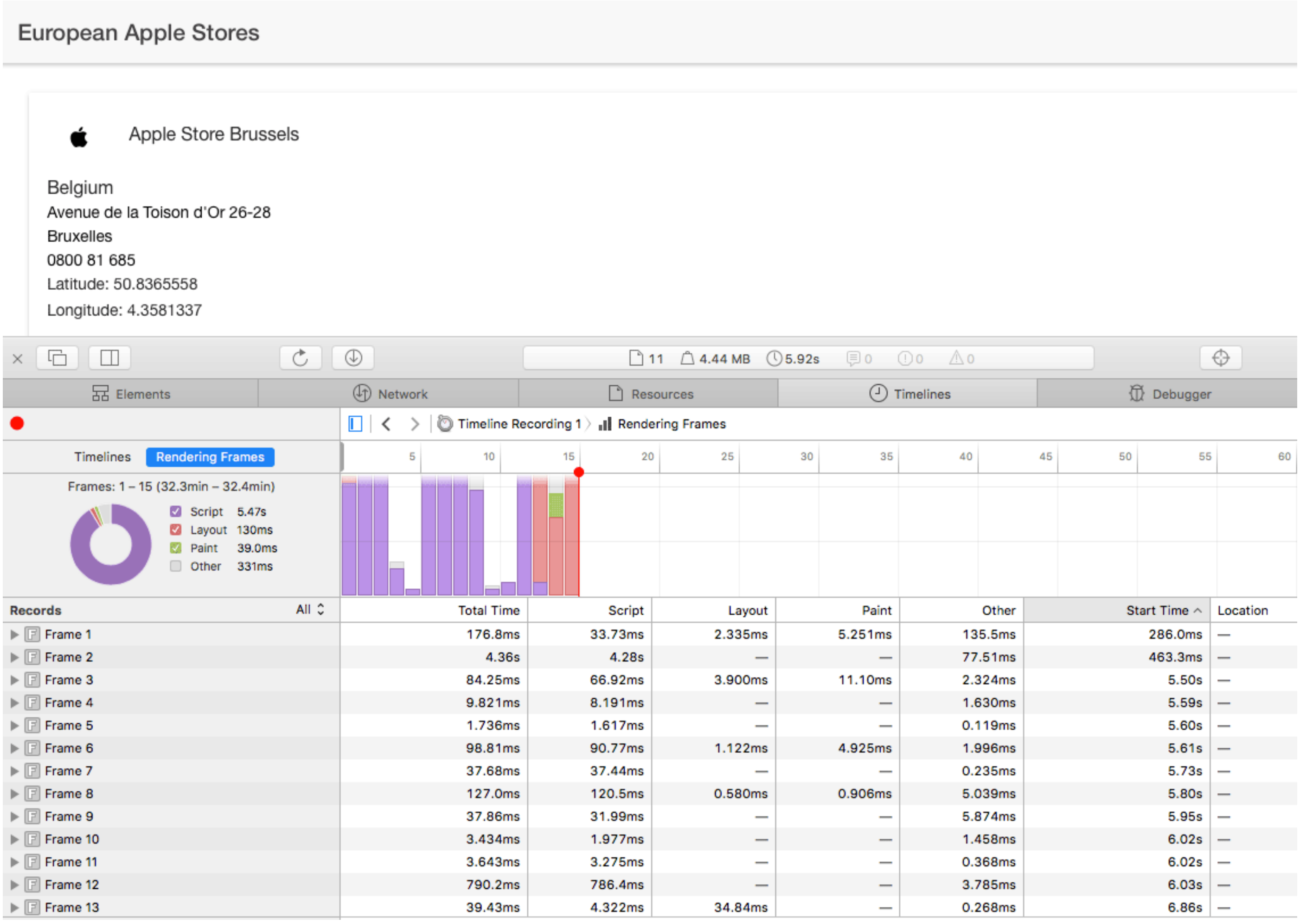
Apple Store Brussels

Belgium
Avenue de la Toison d'Or 26-28
Bruxelles
0800 81 685
Latitude: 50.8365558
Longitude: 4.3581337

Name	Domain	Type	Method	Scheme	Status	Cached	Size	Transferr...	Start Time ^	Latency	Duration
localhost	localhost	Document	GET	HTTP	200	No	2.45 KB	2.57 KB	0ms	8.958ms	276.2ms
effective_tld_names.dat	mxr.mozilla.org	XHR	GET	HTTPS	—	No	—	—	74.23ms	—	—
cordova.js	localhost	Script	GET	HTTP	200	No	70 B	206 B	274.3ms	53.84ms	35.53ms
main.css	localhost	Stylesheet	GET	HTTP	304	Yes	376.10 KB	218 B	274.9ms	4.54s	0.111ms
polyfills.js	localhost	Script	GET	HTTP	304	Yes	82.15 KB	218 B	276.5ms	87.41ms	0.141ms
main.js	localhost	Script	GET	HTTP	304	Yes	3.86 MB	219 B	280.9ms	182.5ms	0.111ms
data:image/png;base64,iVB...g==	—	Image	GET	DATA	—	No	127 B	140 B	5.50s	86.80ms	0.406ms
livereload.js	localhost	Script	GET	HTTP	200	No	37.26 KB	37.40 KB	5.69s	108.5ms	112.6ms
apple-store-locations.js	localhost	XHR	GET	HTTP	304	Yes	17.18 KB	217 B	5.87s	113.5ms	0.155ms
european-countries.js	localhost	XHR	GET	HTTP	304	Yes	634 B	216 B	5.98s	837.0ms	0.212ms
ionicons.woff	localhost	Font	GET	HTTP	304	Yes	78.47 KB	218 B	7.01s	57.51ms	0.117ms

This is useful when trying to determine whether there are any loading issues with the app.

Similarly the Timelines tab in Safari allows us to investigate any potential bottlenecks with processing times for drawing items to the screen:



European Apple Stores

Apple Store Brussels

Belgium
Avenue de la Toison d'Or 26-28
Bruxelles
0800 81 685
Latitude: 50.8365558
Longitude: 4.3581337

Records All	Total Time	Script	Layout	Paint	Other	Start Time	Location
Frame 1	176.8ms	33.73ms	2.335ms	5.251ms	135.5ms	286.0ms	—
Frame 2	4.36s	4.28s	—	—	77.51ms	463.3ms	—
Frame 3	84.25ms	66.92ms	3.900ms	11.10ms	2.324ms	5.50s	—
Frame 4	9.821ms	8.191ms	—	—	1.630ms	5.59s	—
Frame 5	1.736ms	1.617ms	—	—	0.119ms	5.60s	—
Frame 6	98.81ms	90.77ms	1.122ms	4.925ms	1.996ms	5.61s	—
Frame 7	37.68ms	37.44ms	—	—	0.235ms	5.73s	—
Frame 8	127.0ms	120.5ms	0.580ms	0.906ms	5.039ms	5.80s	—
Frame 9	37.86ms	31.99ms	—	—	5.874ms	5.95s	—
Frame 10	3.434ms	1.977ms	—	—	1.458ms	6.02s	—
Frame 11	3.643ms	3.275ms	—	—	0.368ms	6.02s	—
Frame 12	790.2ms	786.4ms	—	—	3.785ms	6.03s	—
Frame 13	39.43ms	4.322ms	34.84ms	—	0.268ms	6.86s	—

App Scripts error reporting

There’s nothing worse as a developer than being greeted with the dreaded “white screen of death” after publishing your Ionic app to a browser, device or simulator.

Sometimes the cause of the problem is obvious, sometimes it isn’t but either way the lack of helpful feedback can often lead to precious time lost in trying to get to grips with the issue.

Since Ionic RC 3 that’s no longer an issue thanks to the improved reporting tools that come bundled with the @ionic/app-scripts library.

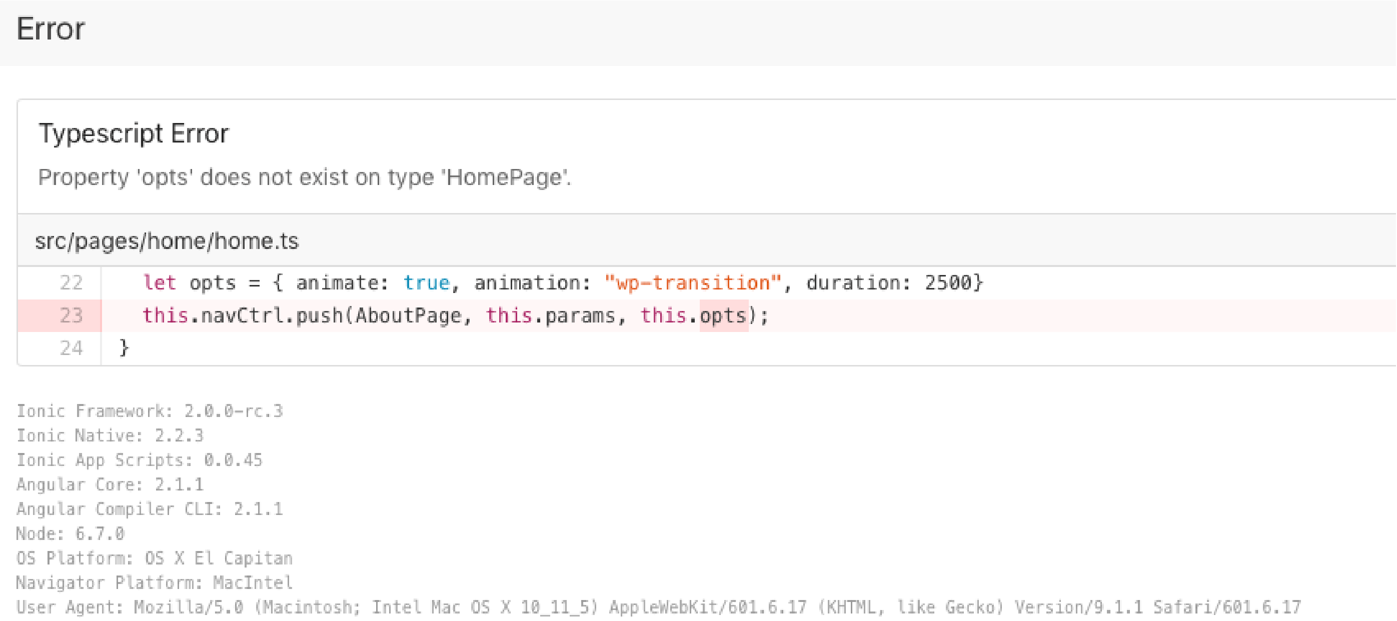
This library provides a variety of different build related scripts that handle processes such as:

- Cleaning files prior to a (or from a previous) build process (I.e. deleting the www directory)
- Linting TypeScript files (requires the **tslint.json** file located at the root of the Ionic 2 project)
- Calling the Angular Ahead-of-Time (AoT) compiler
- Transpiling TypeScript into JavaScript
- Minifying JavaScript
- And a lot more besides the above

Thanks to this library with the latest version of Ionic 2 any compilation errors that are caught during a build process are returned to the screen with the following contextual information:

- A detailed description of the error
- Which file the error can be traced back to
- Which line the error occured on
- Where on the line the error is located (this will be highlighted)
- Information about your environment

As displayed in the following example encountered while running ionic serve :



Error

Typescript Error

Property 'opts' does not exist on type 'HomePage'.

src/pages/home/home.ts

```
    let opts = { animate: true, animation: "wp-transition", duration: 2500}
    this.navCtrl.push(AboutPage, this.params, this.opts);
}
```

```
Ionic Framework: 2.0.0-rc.3
Ionic Native: 2.2.3
Ionic App Scripts: 0.0.45
Angular Core: 2.1.1
Angular Compiler CLI: 2.1.1
Node: 6.7.0
OS Platform: OS X El Capitan
Navigator Platform: MacIntel
User Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_11_5) AppleWebKit/601.6.17 (KHTML, like Gecko) Version/9.1.1 Safari/601.6.17
```

I'm sure you'll agree that this is a huge improvement on a blank screen with no output whatsoever!

Now, with build feedback, we can accurately diagnose the cause of the problem, what we need to do to fix this and where the problem is located.

Simple, but massively helpful.

Additionally the App Scripts error reporting functionality also works with Sass parsing errors as well as TypeScript compilation issues.

FYI - The Ionic team are reportedly developing the App Scripts functionality over the coming weeks and months so the error reporting tool will host even more useful debugging features (this will be interesting to see as anything that cuts down on time spent figuring out bugs and their causes is always a welcome development).

Further Information

https://ionicframework.com/docs/v2/resources/app-scripts/
http://blog.ionic.io/rc3-error-reporting-final-oh-my/
https://www.youtube.com/watch?v=Nu-XuqCXszY

Sourcemaps

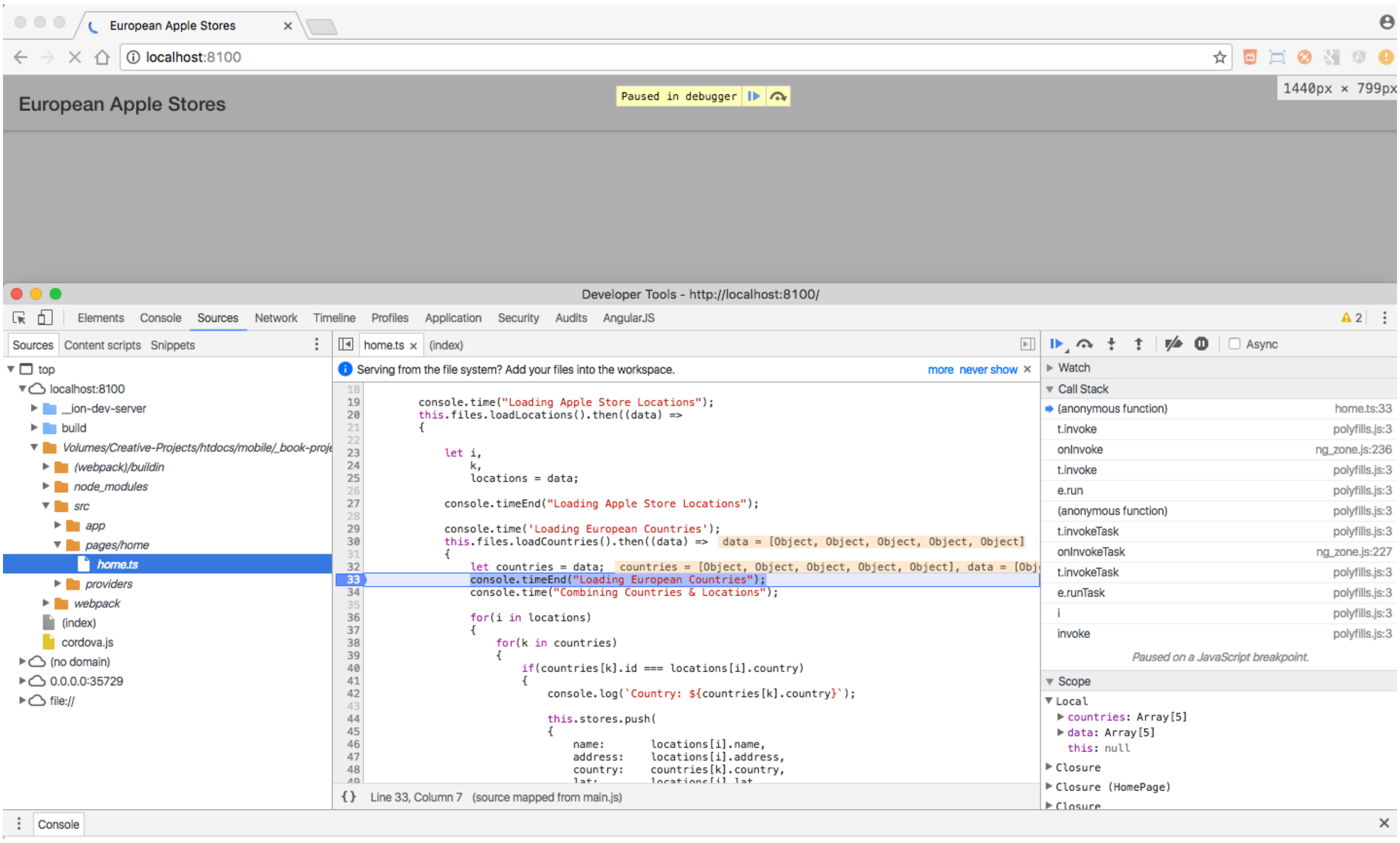
Here's a nice little debugging trick featured in the following YouTube video (credit to Raja Yogan for sharing this with the wider Ionic community).

Using the Google Chrome Inspctor we could actually debug the TypeScript for an Ionic 2 app by making the following small addition to the app's **package.json** file (highlighted in bold):

```
{
  "name": "PROJECT-NAME-HERE",
  "author": "AUTHOR-NAME-HERE",
  "homepage": "URL HERE",
  "private": true,
  "scripts": {
    ...
  },
  "dependencies": {
   ...
  },
  "devDependencies": {
    ...
  },
  "cordovaPlugins": [
   ...
  ],
  "config": {
    "ionic_source_map": "source-map"
  },
  "cordovaPlatforms": [
    "ios",
    {
     ...
    }
  ],
  "description": "PROJECT DESCRIPTION HERE"
}
```

When we run **ionic serve** this addition to the **package.json** file will allow us to view the actual source files for the app.

As you can imagine this is useful as it gives us the ability to set breakpoints in the web browser on key parts of the original code so we can determine if the logic flow is behaving as expected (trying to do this on the transpiled JavaScript would be utterly pointless as we wouldn’t be able to clearly reference the same location in the original TypeScript file - at best, it would be nothing more than an exercise in over-complicating matters).



Serving from the file system? Add your files into the workspace. more never show

```
        console.time("Loading Apple Store Locations");
        this.files.loadLocations().then((data) =>
        {

           let i,
               k,
               locations = data;

           console.timeEnd("Loading Apple Store Locations");

           console.time('Loading European Countries');
           this.files.loadCountries().then((data) =>  data = [Object, Object, Object, Object, Object]
           {
              let countries = data;  countries = [Object, Object, Object, Object, Object], data = [Obj
              console.timeEnd("Loading European Countries");
              console.time("Combining Countries & Locations");

              for(i in locations)
              {
                 for(k in countries)
                 {
                    if(countries[k].id === locations[i].country)
                    {
                       console.log(`Country: ${countries[k].country}`);

                       this.stores.push(
                       {
                          name:       locations[i].name,
                          address:    locations[i].address,
                          country:    countries[k].country,
                          lat:        locations[i].lat,
```

Line 33, Column 7 (source mapped from main.js)

```
(anonymous function)    home.ts:33
t.invoke                polyfills.js:3
onInvoke                ng_zone.js:236
t.invoke                polyfills.js:3
e.run                   polyfills.js:3
(anonymous function)    polyfills.js:3
t.invokeTask            polyfills.js:3
onInvokeTask            ng_zone.js:227
t.invokeTask            polyfills.js:3
e.runTask               polyfills.js:3
i                       polyfills.js:3
invoke                  polyfills.js:3
```

Paused on a JavaScript breakpoint.

```
▼ Local
  ▶ countries: Array[5]
  ▶ data: Array[5]
    this: null
▶ Closure
▶ Closure (HomePage)
▶ Closure
```

Here you can see the expanded debugging folder (which has been added thanks to the configuration option in the **package.json** file) displayed in the left-hand side of the Chrome inspector window with the **home.ts** file selected for use.

Breakpoints have then been added to lines within the **home.ts** file and then, once the page has been reloaded, the debugger pauses at each of these breakpoints.

It's a simple little tweak to the **package.json** file but what a powerful debugging tool that gives us. Thanks to this addition you can now access your TypeScript logic in the same way that you would regular JavaScript.

Summary

Here we conclude our exploration into different browser based debugging and profiling techniques that we can use for app testing.

The error reporting tools introduced in the latest version of Ionic 2, particularly the build feedback functionality, are incredibly useful and will save you no end of time in tracking down development bugs and solving them.

Similarly Raja Yogan’s simple debugging trick, via modifying the **package.json** file, provides a great way to debug TypeScript in the browser using sourcemaps.

You’ll probably find though (if you haven’t done so already) that the console API methods are the most widely used debugging technique in your development arsenal.

Just be sure to clear these out, along with the **package.json** file addition for helping debug through sourcemaps, when it comes time to submit your production ready app to the respective App Store(s).

Resources
Web Console API
Ionic 2 error handling
Debugging your Ionic 2 apps
Ionic 2 App Scripts

All project files for this chapter can be found listed in the download links on page 629.

Documenting your code

Some developers love it, most developers seem to hate it but documenting our code is something that we really should get into the habit of doing regularly.

Nowhere is this more true than when working as part of a team, particularly if we need to hand off our code to another developer. Helping them get up to speed on what we've written with clear, concise and helpful documentation makes everyone's life easier in the long run (especially where project deadlines are concerned!)

If nothing else it also helps us to understand our code should we ever need to come back to that in 6 months time or more so we can remember what we wrote and why.

Over the following pages of this chapter we'll look into how we can document the following code used in our Ionic 2 apps:

- TypeScript
- Sass

We'll be setting up a custom **gulpfile.js** script and using the Sassdoc and Typedoc npm packages to help document the classes and styles from the animationsApp project we worked on in the Animations chapter.

Open the **package.json** file at the root of the animationsApp project directory and add the following to the devDependencies section (amendments highlighted in bold):

```
"devDependencies": {
    "@ionic/app-scripts": "^0.0.23",
    "typescript": "^2.0.3",
    "gulp": "latest",
    "gulp-notify": "latest",
    "gulp-imagemin": "latest",
    "gulp-typedoc": "latest",
    "sassdoc": "latest",
    "typedoc": "latest"
  }
```

Here we're simply stating that we want the latest versions of the listed packages to be installed when we run **npm install**.

In case you didn't know - the devDependencies section of the **package.json** file is used to indicate that the installed packages are to be used for development and are not essential for the application to run.

Now, at the root of the animationsApp project directory, run the **npm install** command from the Terminal to install those devDependencies.

Once the requested npm packages, and all related dependencies, have been successfully installed create a new directory in the root of the animationsApp project named **workflow**.

We'll use the **workflow** directory to run our custom **gulpfile.js** script (which we'll create next) from and store all generated documentation too - this keeps everything neatly packaged in one central location.

In your code editor create the following **gulpfile.js** script and save this to the **workflow** directory you created in the root of your animationsApp project:

```
var paths = {
  docs : {
    src: '../src/pages/home/home.ts',
    dest: '../workflow/docs/'
  },
  Sass : {
    src: '../src/theme/app.mixins.scss',
    dest: '../workflow/sassdoc'
  }
};

var gulp              =     require('gulp'),
    sassdoc           =     require('sassdoc'),
    typedoc          =    require('gulp-typedoc'),
    notify           =    require('gulp-notify');


/* ----- TypeDoc ----- */
gulp.task('TypeDoc', function() {
  return gulp
  .src([paths.docs.src])
  .pipe(typedoc({
    module: "commonjs",
    mode: "file",
    target: "es5",
    includeDeclarations: false,
    excludeExternals: true,
    out: paths.docs.dest,
    name: "AnimationApp",
    ignoreCompilerErrors: true,
    version: true,
  }))
  .pipe(notify({message: 'Documentation published'}));
});


/*----- SassDoc ----- */
gulp.task('SassDoc', function () {
 return gulp.src(paths.Sass.src)
   .pipe(sassdoc())
   .pipe(gulp.dest(paths.Sass.dest))
   .pipe(notify({message: 'Documentation published'}));
});


gulp.task('default', ['SassDoc', 'TypeDoc']);
```

In our custom gulp script we start by defining a paths object which lists the input and output paths for files that we want to run our tasks on, we then import the necessary packages that we require before creating 2 tasks:

- TypeDoc
- SassDoc

Finally we instruct gulp to run both of these as default tasks at the end of the script.

We've supplied quite a few configuration options for our TypeDoc task so let's break these down in a bit more detail so as to understand their function and what we're looking to achieve here:

- **module**
  Specifies the type of module to be used for code generation - available options are: "commonjs", "amd", "system" or "umd"

- **mode**
  Specifies the output mode for the project to be compiled with - available options are: "file" or "modules"

- **target**
  Specifies the ECMAScript target version - available options are: "ES3", "ES5" or "ES6"

- **includeDeclarations**
  Parse d.ts declaration files - available options are true or false

- **excludeExternals**
  Prevents externally resolved TypeScript files from being documented

- **out**
  Specifies the location the documentation should be published to

- **name**

Sets the name of the project that will be displayed in the header of the generated documentation

- **ignoreCompilerErrors**
  Ignores TypeScript compiler errors - available options are true or false

- **version**
  Displays the version number of TypeDoc - available options are true or false

Further information about the configuration options available for the TypeDoc package are listed here:

- Github TypeDoc
- TypeDoc usage guide

Marking up your classes
Currently the options for documenting your classes with TypeDoc are limited to using only the following tags:

- @param <param_name>
- @return

If you're familiar with using a documenting library such as JSDoc or YUIDoc this might feel restricted at first. Surprisingly though this is quite adequate as the TypeDoc plugin actually generates quite detailed documentation on our behalf.

All we need to do is mark up our document correctly supplying information about each property and method, using the necessary tags and the TypeDoc plugin will do the rest of the work for us.

Open the **animationsApp/src/pages/home/home.ts** file and add the following comments (highlighted in bold):

```
...
export class HomePage {

  /**
   * Stores the title to be displayed on the sliding animation panel
   */
  public panelTitle : string;

  /**
   * Stores the description to be displayed on the sliding animation
   * panel
   */
  public panelDesc : string;

  /**
   * Stores the image value to be displayed on the sliding animation
   * panel
   */
  public panelImage : string;

  /**
   * Flag used to determine visibility of animation panel
   */
  public panelState : string    = 'hidden';

  /**
   * Flag used to determine whether animation panel is currently open
   * or not
   */
  public expanded : boolean          = false;

  /**
   * Flag used to determine whether animation panel is active
   */
   public isActive : boolean = false;

   /**
    * Array of gallery locations to be rendered to the HTML template
    */
   public items : any = [
      ...
   ];

   constructor(public navCtrl: NavController)
   {

   }

   /**
    * Determines the state of the sidebar panel
    * @param item Optional object for the gallery location data
    * @return void
    */
   togglePanel(item = null)
   {
      ...
   }

}
```

Now that we've marked up our **HomePage** class the last remaining task is to create the following Sass file - **animationsApp/src/theme/app.mixins.scss** - that we listed as an input source for the SassDoc plugin in our custom **gulpfile.js** script.

Once this file is in place we can start to generate documentation for the app.

Open your code editor and create the **animationsApp/src/theme/app.mixins.scss** file with the following styles and comments (using SassDoc's mark-up syntax - ///):

```
/// Generates CSS3 transitions for all supporting browsers
/// @name transition
/// @access public
/// @param {String}  $args The transition arguments (I.e. property to be
/// affected, duration of transition, type of transition)
/// @author Saints at Play Limited
/// @example
///   @include transition(color .5s ease);
@mixin transition($args...) {
  -webkit-transition: $args;
  -ms-transition: $args;
  transition: $args;
}

/// Generates a border radius effect around all edges of an HTML element
/// @name borderRadiusFull
/// @access public
/// @param {Number I String}   $sizeValue   The radius value (including pixels
/// suffix)
/// @author Saints at Play Limited
/// @example
///   @include borderRadiusFull(5px);
@mixin borderRadiusFull($radii) {
        -webkit-border-radius: $radii;
        border-radius: $radii;
}

/// Generates a border radius effect along the top of an HTML element
/// Supports -webkit prefixes as well as W3C standards compliant syntax
///
/// @name topBorderRadius
/// @access public
/// @param {Number I String}                              $sizeValue
        The radius value (including pixels suffix)
```

```
/// @author Saints at Play Limited
/// @example
///   @include topBorderRadius(5px);
@mixin topBorderRadius($radii){
        -webkit-border-radius:$radii $radii 0 0;
        border-radius:$radii $radii 0 0;
}

/// Generates a border radius effect along the bottom of an HTML element
/// Supports -webkit prefixes as well as W3C standards compliant syntax
/// @name bottomBorderRadius
/// @access public
/// @param {Number | String}                              $sizeValue
        The radius value (including pixels suffix)
/// @author Saints at Play Limited
/// @example
///   @include bottomBorderRadius(5px);
@mixin bottomBorderRadius($radii){
        -webkit-border-radius:0 0 $radii $radii;
        border-radius:0 0 $radii $radii;
}

/// Allows an image to be responsive across desktop, tablet & mobile views
/// @name makeImageResponsive
/// @access public
/// @author Saints at Play Limited
/// @example
///   @include makeImageResponsive();
@mixin makeImageResponsive() {
        display:block;
        width:100%;
        max-width:100%;
}
```

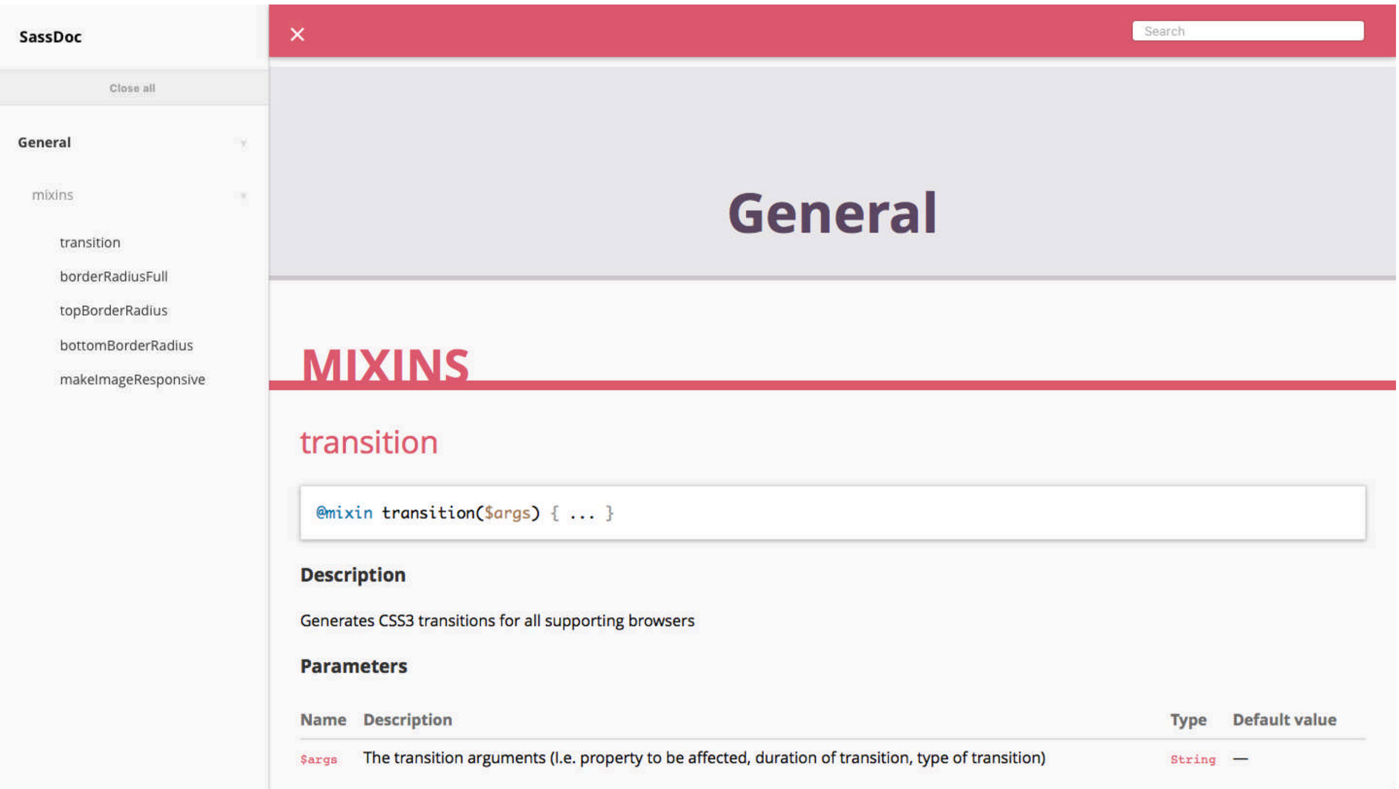
Even though I’m not a big fan of the /// syntax the annotations available for SassDoc are quite impressive (and comparable with those from the YuiDoc/JSDoc libraries) which makes documenting Sass files that much easier to accomplish.

Further information on the available SassDoc markup options can be found in the official documentation.

Now save the **animationsApp/src/theme/app.mixins.scss** file and, using the Terminal application, navigate to the **workflow** directory and run the **gulp** command to execute both the TypeDoc and SassDoc tasks.

While output from the gulp tasks are logged to the console the generated Typescript documentation is subsequently published to the **animationsApp/workflow/docs** directory and the Sass documentation published to the **animationsApp/workflow/sassdoc** directory (both of these directories will be automatically created).

Open the **animationsApp/workflow/sassdoc/index.html** file in your browser and you should be greeted with the following page beautifully documenting all of your Sass mixins:



General

MIXINS

transition

```
@mixin transition($args) { ... }
```

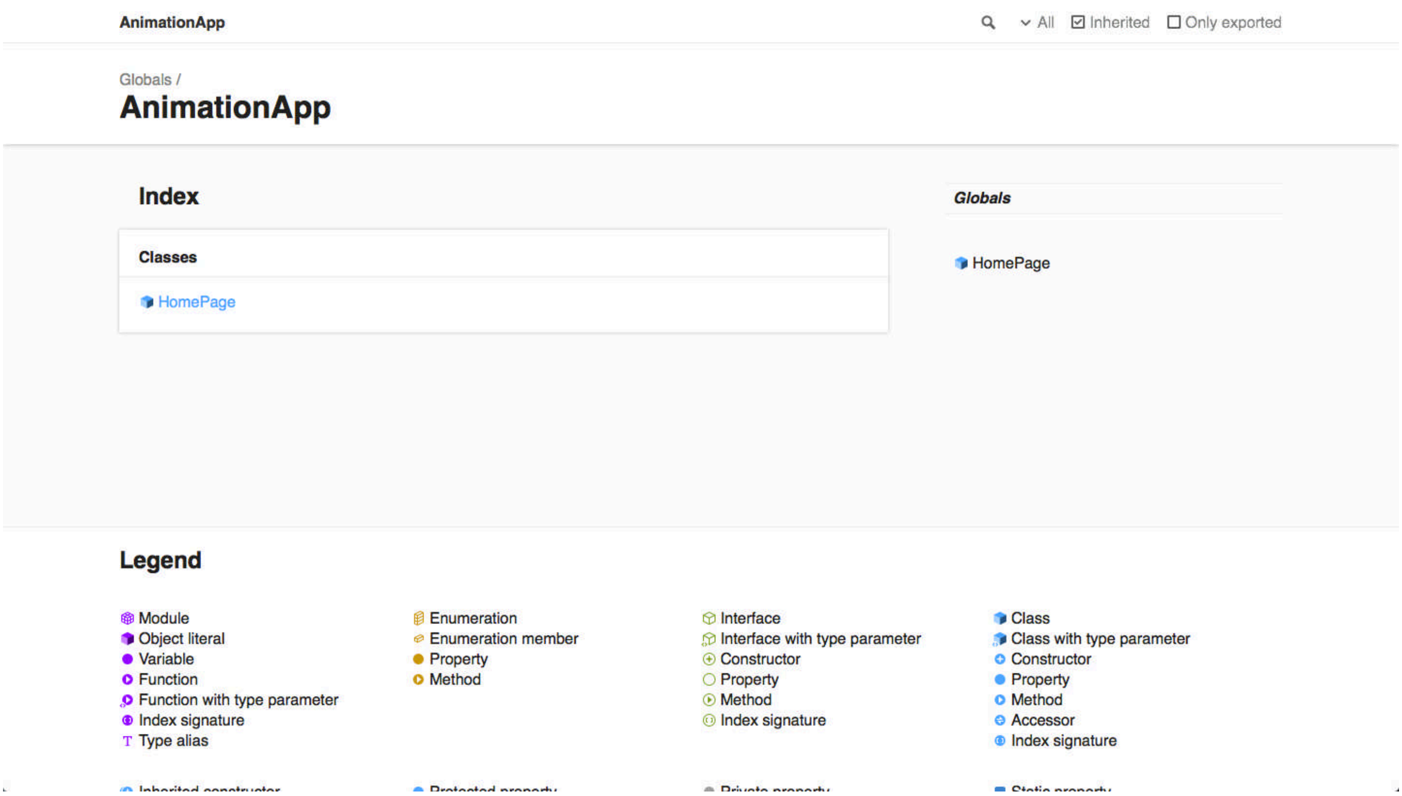
Description

Generates CSS3 transitions for all supporting browsers

Parameters

Name	Description	Type	Default value
$args	The transition arguments (I.e. property to be affected, duration of transition, type of transition)	String	—

Similarly if you open the **animationsApp/ workflow/docs/index.html** file you should see documentation for the HomePage TypeScript class being displayed:


AnimationApp

Globals /

AnimationApp

Index

Classes

HomePage

Globals

HomePage

Legend

Module
Object literal
Variable
Function
Function with type parameter
Index signature
Type alias

Enumeration
Enumeration member
Property
Method

Interface
Interface with type parameter
Constructor
Property
Method
Index signature

Class
Class with type parameter
Constructor
Property
Method
Accessor
Index signature

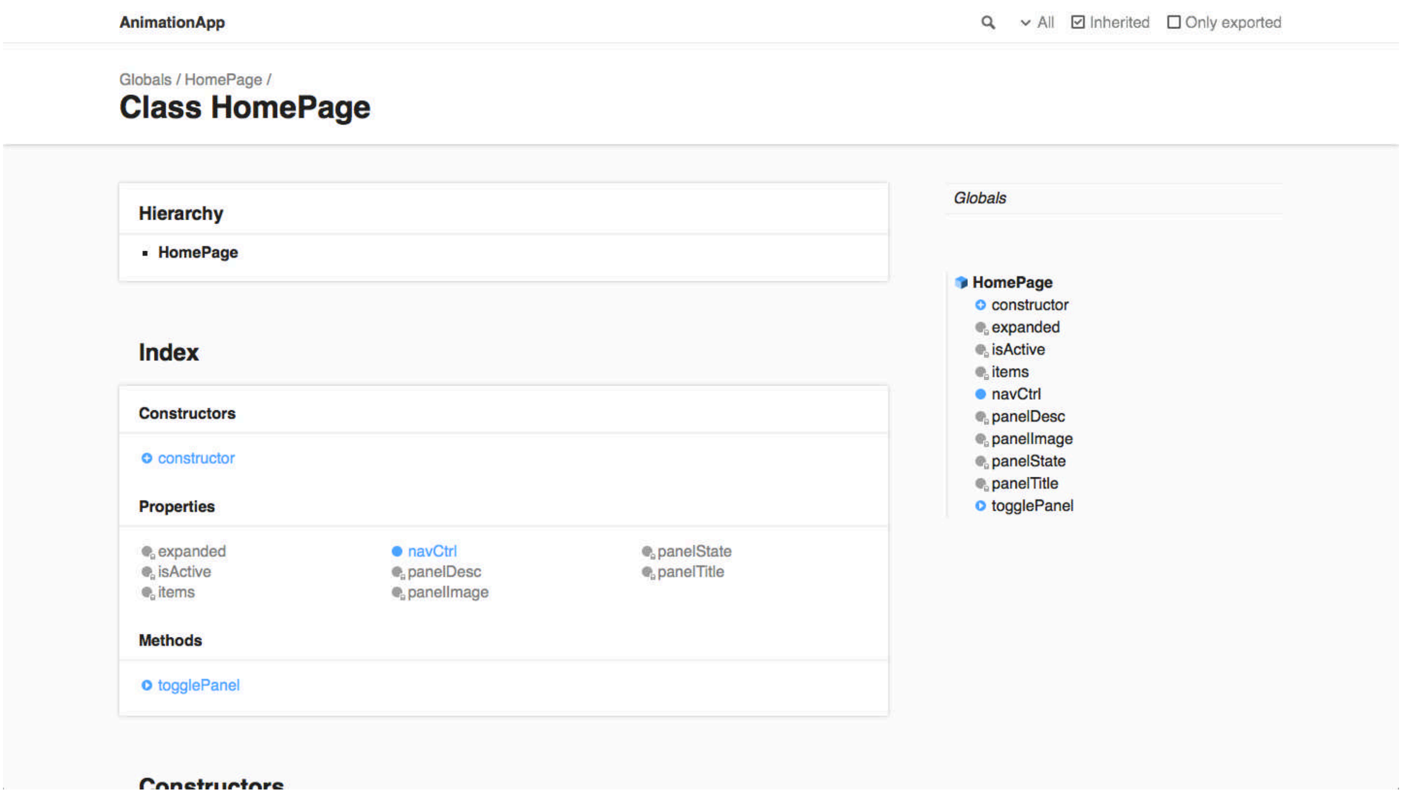
Inherited constructor

Protected property

Private property

Static property

Granted the TypeDoc published documentation is not as pleasing to the eye as the SassDoc documentation but all the class properties & methods are listed along with a legend for the different types of class structural elements.


AnimationApp

Globals / HomePage /

Class HomePage

Hierarchy

- HomePage

Index

Constructors

constructor

Properties

expanded
isActive
items
navCtrl
panelDesc
panelImage
panelState
panelTitle

Methods

togglePanel

Constructors

Globals

HomePage
- constructor
- expanded
- isActive
- items
- navCtrl
- panelDesc
- panelImage
- panelState
- panelTitle
- togglePanel

Summary

Whatever your take on code documentation, whether you're an advocate, reluctant participant or indifferent to the whole issue, TypeDoc and SassDoc are definitely worth spending some time exploring and familiarising yourself with.

If nothing else the ability to quickly and easily share documented code with a development team or provide a user friendly reference guide for developers new to an existing project is pretty handy when deadlines and, dare I say, politics rear their ugly heads (and if you've worked in an agency/corporate environment you'll have some experience of both).

As an aside, we aren't compelled to use gulp in terms of implementing any front-end based workflow in our projects. We could have used another task runner such as Grunt or opted for running tasks via npm command line usage instead.

In the next chapter we'll take a look at preparing apps for release.

Resources

SassDoc annotations
SassDoc gulp plugin
TypeDoc guide
TypeDoc gulp plugin

All project files for this chapter can be found listed in the download links on page 636.

Preparing apps for release

Before you can distribute your app (I.e. through the Apple App Store and/or Google Play Store) you'll need to devote some time towards preparing the following:

- config.xml
- Launch icons
- Splash Screens
- Asset compression
- Code optimisations

Let's take a look at each of these in depth, understand why they're important and what changes we might need to make prior to app distribution.

config.xml

Located at the root of your Ionic 2 app the **config.xml** file contains global and platform specific configuration values used to control different aspects of your app's behaviour.

These behaviours can include splashscreen settings, which URL's the system is allowed to open, Cordova plugins to be restored during app preparation and defining the starting page of the app.

Typically when working with the **config.xml** file you'll find yourself focusing on the following elements:

- **widget id** (a reverse domain name style identifier for your app - this MUST match the bundle ID you use when code signing your app - see next chapter)
- **widget version** (the version number for your app - I.e. 1.0.0)
- **name** (formal name for the app as it's displayed in App Store listings and on the device home screen)
- **description** (metadata about the app that may appear in App Store listings)
- **author** (Contact information for the app developer which includes website and e-mail addresses)

These are located towards the top of the file like so:

```
<widget id="com.saintsatplay.blahdeblah" version="0.0.1" xmlns="http://www.
w3.org/ns/widgets" xmlns:cdv="http://cordova.apache.org/ns/1.0">
  <name>Animator</name>
  <description>Saints at Play demonstration app.</description>
  <author email="info@saintsatplay.com" href="http://www.saintsatplay.com">-
Saints at Play Limited</author>
```

This however is only a small part of what a developer might need to configure in their app’s **config.xml** file (and, to be honest, will probably be all that you ever need to amend in this file).

Additionally Apache Cordova provides the option to configure preferences and elements on a platform by platform basis within the **config.xml** file through use of the <platform> and <preference> tags.

For example, if you wanted to target Android devices:

```
<platform name="android">
  <preference name="KeepRunning" value="false"/>
  <preference name="LoadUrlTimeoutValue" value="10000"/>
  <preference name="InAppBrowserStorageEnabled" value="true"/>
  <preference name="LoadingDialog" value="My Title,My Message"/>
  <preference name="ErrorUrl" value="myErrorPage.html"/>
  <preference name="ShowTitle" value="true"/>
  <preference name="LogLevel" value="VERBOSE"/>
  <preference name="AndroidLaunchMode" value="singleTop"/>
  <preference name="DefaultVolumeStream" value="call" />
  <preference name="OverrideUserAgent" value="Mozilla/5.0 My Browser" />
  <preference name="AppendUserAgent" value="My Browser" />
</platform>
```

Further information on **config.xml** file configuration settings can be found at the online Cordova documentation: https://cordova.apache.org/docs/en/latest/config_ref/

Launch icons and splash screens

One of the most prolonged aspects of preparing your app for distribution across the Apple App and Google Play stores involves configuring the different launch icon and splash screen sizes required for different devices.

Depending on how your app is to be viewed you may also need to configure different splash screens based on orientation too.

As any mobile developer who's had to spend time doing this knows it can be a real chore to get done right - particularly with everything else weighing on your time!

Thankfully the Ionic CLI can help simplify this process with commands to automate the generation of these assets from supplied source files.

At the root of your Ionic 2 app you'll find a directory named **resources**.

Within this directory you'll find **ios** and **android** directories which contain all of the icon and splash screen assets for each platform.

You'll also notice the following files:

- **icon.png**
- **splash.png**

These are the files we need to pay attention to as we'll be replacing these with our own versions which will then be used to generate the required launch icons and splash screens from for each platform.

The icon.png file will be used for the app launch icon and the splash.png file as the app splash screen file.

The files we'll use to replace these with must follow some basic rules which are listed in the table below:

	Launch Icon	Splash Screen
Name (without file suffix)	icon	splash
Dimensions	Minimum - 192 x 192 pixels	2208 x 2208 pixels
Accepted file formats	AI PNG PSD	AI PNG PSD
Image safe zone	10 pixel border around the edge of the file	1200 x 1200 pixels (Must be aligned to the centre of the file)
Considerations	NO rounded corners	Align splash screen design to centre of file to avoid cropping important parts of design on different orientations (within the Image safe zone dimensions)

The following resources are useful in helping guide your own icon & splash screen development:

- Launch Icon photoshop template
- Splash Screen photoshop template
- iOS Human Interface guidelines
- Android Material design guidelines

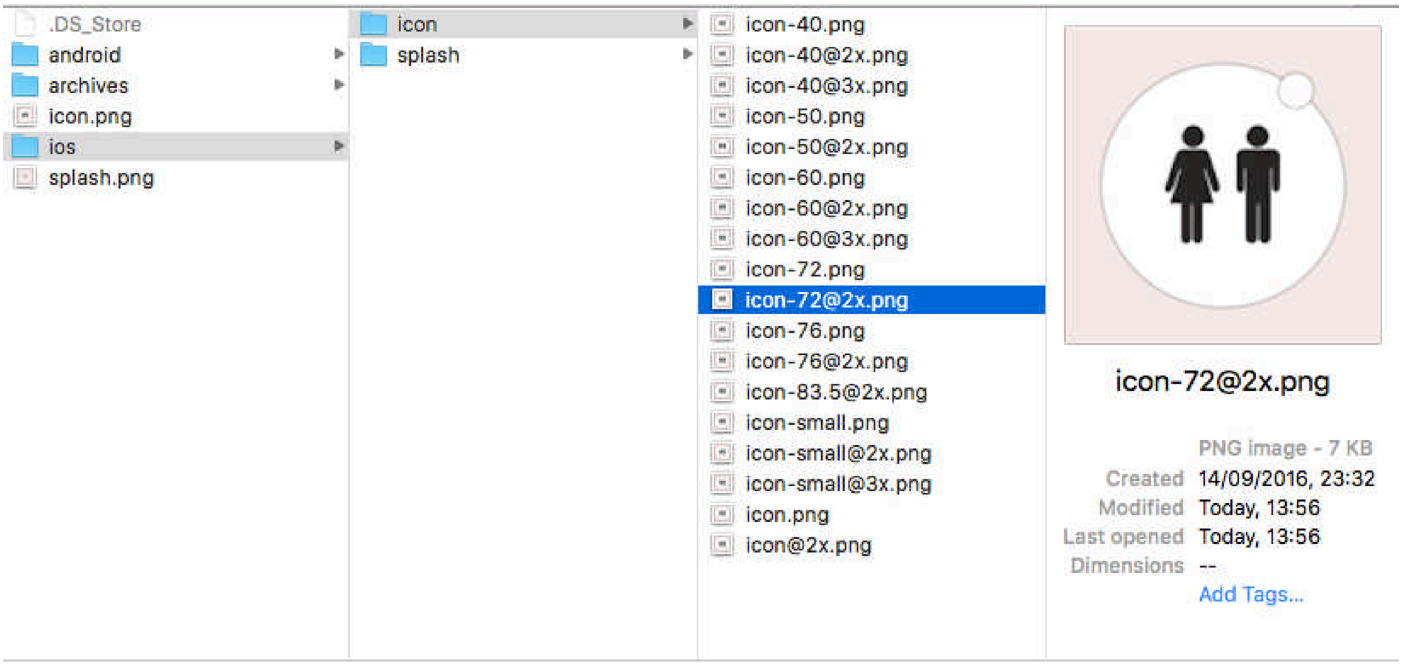
Once you have created your own replacement design for the **icon** and **splash.png** files drop those into the root of the resources directory (replacing the existing files that are there), then within your Terminal (having navigated to the root of your app), run the following command:

```
ionic resources
```

As each file is automatically generated by the Ionic server you'll see the output being printed to the Terminal and, once completed, these icon and splash screen files are able to be accessed in the following directories:

- resources/android/icon
- resources/android/splash
- resources/ios/icon
- resources/ios/splash

Like so:



.DS_Store
android
archives
icon.png
ios
splash.png

icon
splash

icon-40.png
icon-40@2x.png
icon-40@3x.png
icon-50.png
icon-50@2x.png
icon-60.png
icon-60@2x.png
icon-60@3x.png
icon-72.png
icon-72@2x.png
icon-76.png
icon-76@2x.png
icon-83.5@2x.png
icon-small.png
icon-small@2x.png
icon-small@3x.png
icon.png
icon@2x.png

icon-72@2x.png

PNG image - 7 KB
Created 14/09/2016, 23:32
Modified Today, 13:56
Last opened Today, 13:56
Dimensions --

If you only wanted to generate launch icons you could do so with the following flag added to the command:

```
ionic resources --icon
```

Conversely, if it's just splash screen files you want to generate then use the following command instead:

```
ionic resources --splash
```

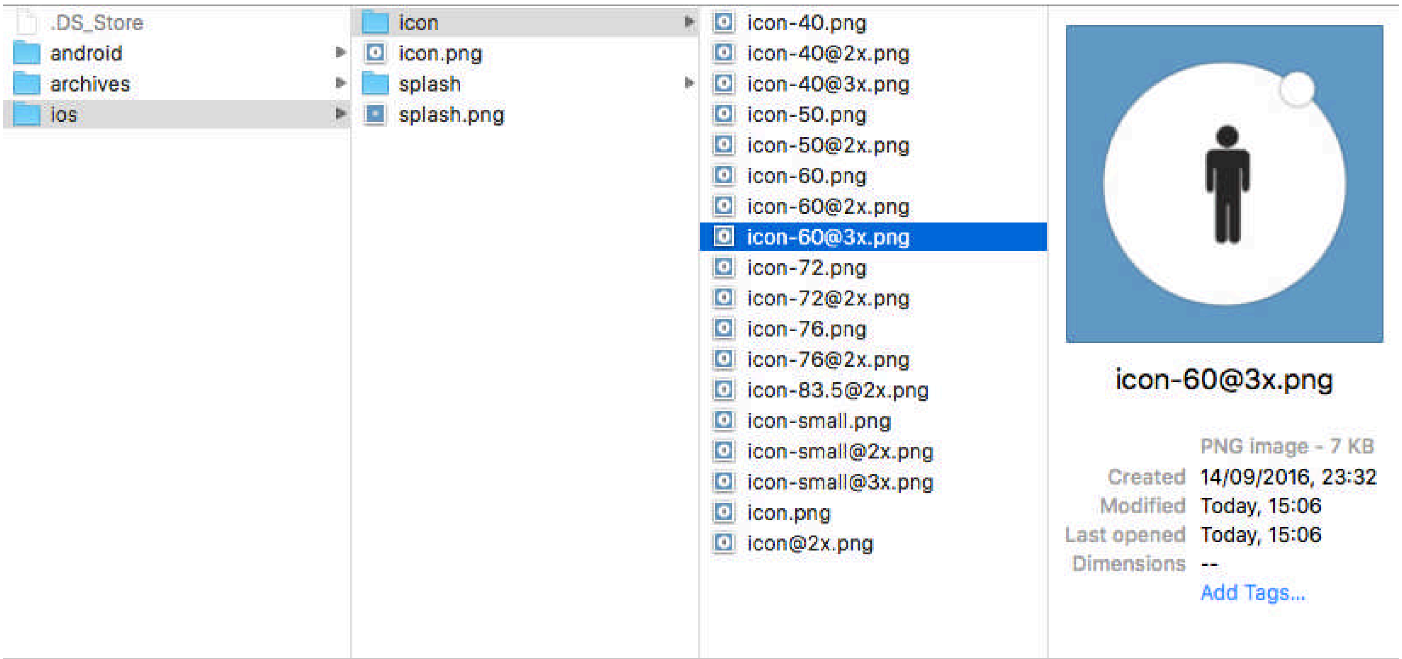
Maybe you want to use different launch icon and splash screen designs for iOS and Android?

Not a problem.

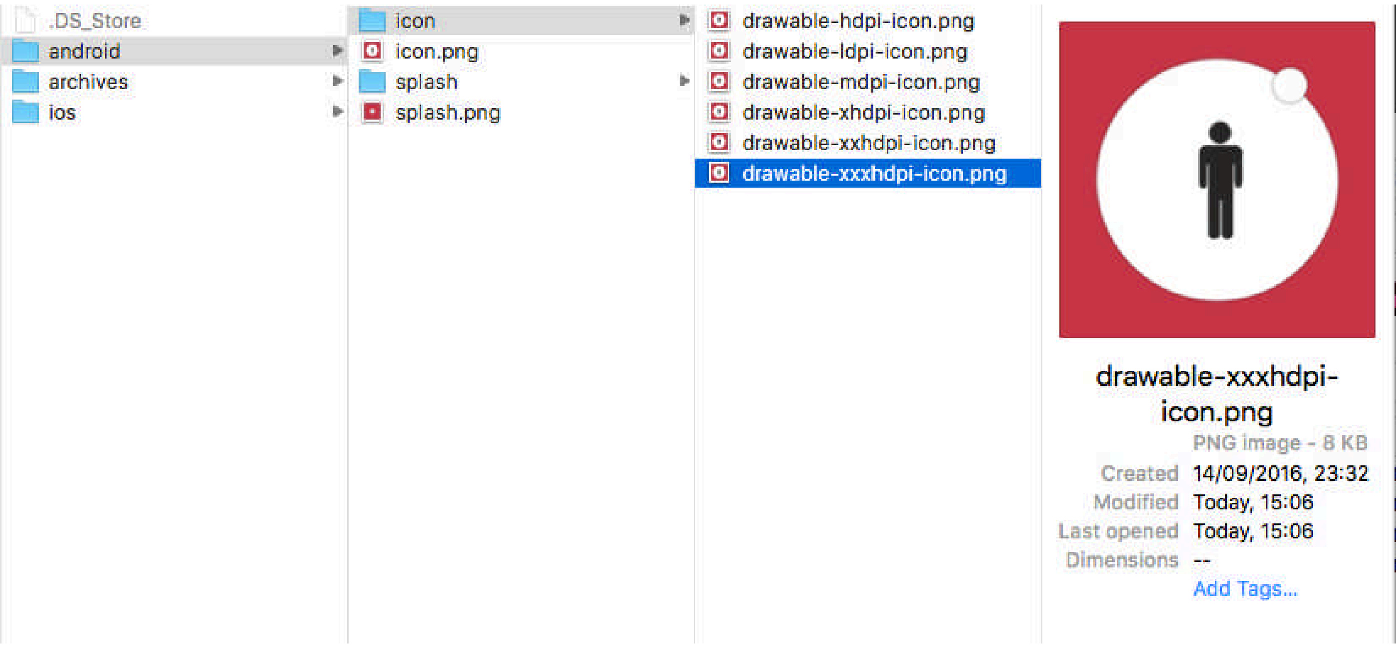
Design your iOS specific **icon.png** and/or **splash.png** files then place these at the root of the **resources/ios** directory.

Similarly place your Android specific **icon.png** and/or **splash.png** files at the root of the **resources/android** directory.

Run the *ionic resources* command to automatically generate the different versions of these files and, once completed, you'll see that each platform uses only the design assigned to it for those icons and/or splash screens:



Created 14/09/2016, 23:32
Modified Today, 15:06
Last opened Today, 15:06
Dimensions --



Created 14/09/2016, 23:32
Modified Today, 15:06
Last opened Today, 15:06
Dimensions --

If you re-open your **config.xml** file after running the *ionic resources* command you'll notice that the generated icon and/or splash screen images for are listed in full for each platform.

You can, if required, add an orientation value to the **config.xml** file to only allow the app to be displayed in a specific orientation, either globally or on a platform basis.

The orientation values are as follows:

- portrait
- landscape
- default (allows the platform to fall back to its own default behaviour)

If this configuration is present in the **config.xml** file and set to portrait or landscape then only those splash screen images for that orientation will be generated when running the *ionic resources* command.

Personally I find the *ionic resources* command to be one of the most under-rated features of the Ionic CLI and it's certainly saved me a lot of time and effort when preparing the launch icons and splash screen images for my apps.

Just design your assets wisely and ionic will take care of the rest!

Asset compression

Reducing the size of assets used within your app will help reduce the overall size of the final build file which means less time spent uploading this to the respective App Stores.

This involves compressing media assets used within your app such as images and videos wherever possible.

To help compress images there are a number of online service we could use such as:

- Compress.io
- TinyPNG
- TinyJPG

Alternatively you can create your own gulp script for handling image compression.

Implementing a Gulp workflow for your Ionic 2 app has the advantage of being able to implement specific task runners, if and where required, such as:

- Optimising SVG files
- Compressing JPEG, GIF & PNG images for smaller file sizes
- Publishing documentation for Sass files
- Publishing documentation for TypeScript files
- Running unit tests
- Generating browser specific prefixes for existing CSS (I.e. adding rules prefixed with -webkit or -moz)
- Minifying published JS/CSS files if required
- Generating responsive videos

The list of potential Gulp tasks could go on ad infinitum and is only limited by what the app would truly benefit from.

When implementing my own custom gulp tasks I create a directory at the root of the Ionic app which I name **workflow** and then place my **gulpfile.js** script inside of this.

For compressing images my custom **gulpfile.js** would look like this:

```
var paths                = {
                              images : {
                                 src   : '../www/src/*',
                                 dest : '../www/images/'
                              }
                         },
   gulp                  =     require('gulp'),
   imagemin              =     require('gulp-imagemin'),
   notify                =     require('gulp-notify');

gulp.task('Images', function() {
      return gulp.src(paths.images.src)
```

```
    .pipe(imagemin({ optimizationLevel: 3, progressive: true, interlaced: true}))
    .pipe(gulp.dest(paths.images.dest))
    .pipe(notify({message: 'Images compressed'}));
});

gulp.task('default', ['Images']);
```

Within the Terminal, at the root of my app directory, I would install the following node modules to be used by my custom gulp script:

```
npm install --save-dev gulp-imagemin
npm install --save-dev gulp-notify
```

Finally I would place the images that I want to optimise within a directory named **src** located in the root of the **www** directory.

I would also place a directory named **images** inside the root of the **www** directory as this is where I am instructing the gulp script to publish my compressed images to.

I would then, using the Terminal, navigate inside the **workflow** directory and run this custom **gulpfile.js** script as follows:

```
gulp
```

This would then copy and compress each individual image from the **src** directory before copying each optimised version to the **images** directory.

Whether you want to implement your own custom gulp workflow set-up for compressing images or rely on web-based tools such as TinyPNG or Compress.Io is entirely up to you.

I personally prefer to implement a custom gulp workflow as this can be extended to include additional workflow tasks where required.

Video optimisation

For optimising video files to be included within your build file I can’t recommend the excellent Miro video converter highly enough.

This cross platform utility provides a number of export formats and can drastically reduce the size of the exported video file without sacrificing any of the quality in the process.

Another free alternative is FFmpeg although some developers might find this a lot more cumbersome as this does require working from the command line.

The world wide web is awash with many different options for compressing and optimising video so find the solution that works best for your particular needs and run with that.

Code optimisations

Within the component classes, services, pipes and directives that you may have created be sure to remove all console logs and similar debugging code.

Make micro-optimisations wherever possible, such as grouping variables under a single var or let pattern and implementing more effective incrementation in for loops:

```
// Single var Pattern
var i,
     technologies = ["Ionic 2", "Angular 2", "Apache Cordova", "TypeScript"],
     total;



// for Loop optimisation
for(i = 0; total = technologies.length; i < total; i+=1)
{
 // Code to be implemented on each loop iteration
}
```

It might seem trivial to make such adjustments in your code, particularly when the performance improvements may only be measured in hundreds of milliseconds at most, but doing so can help reduce the overall load on device resources (particularly when working with large volumes of data).

The recommendations in this chapter may, if you're not familiar with optimising assets and implementing performance enhancements to your code, seem a little overkill in parts but it's a good practice to get into over the long run.

Doing so helps minimise load on system resources, speed up code execution times and reduce build sizes - all of which are worthy goals to be pursued.

When implementing similar tactics for web applications I've seen immediate results with quicker page rendering times, reduced network requests/download speeds and smaller file sizes - all of which help improve the user experience.

In the next chapter I'll take you through code signing your app for iOS & Android.

Resources
All project files for this chapter can be found listed in the download links on page 636.

Code signing
for iOS & Android

Code Signing

Before you can publish your apps to the Apple App and Google Play stores they must be digitally signed with a valid certificate.

This ensures that the app can be "trusted" by end users, as the signing certificate(s) prove the app originates from a known source and hasn't been modified by any party other than the developer.

Code Signing is implemented differently on iOS and Android platforms though.

Over the following pages I'll take you through how to sign an application for both platforms, starting with iOS (which is the most lengthy and complex to implement).

Code signing an iOS application

There are a few steps involved here:

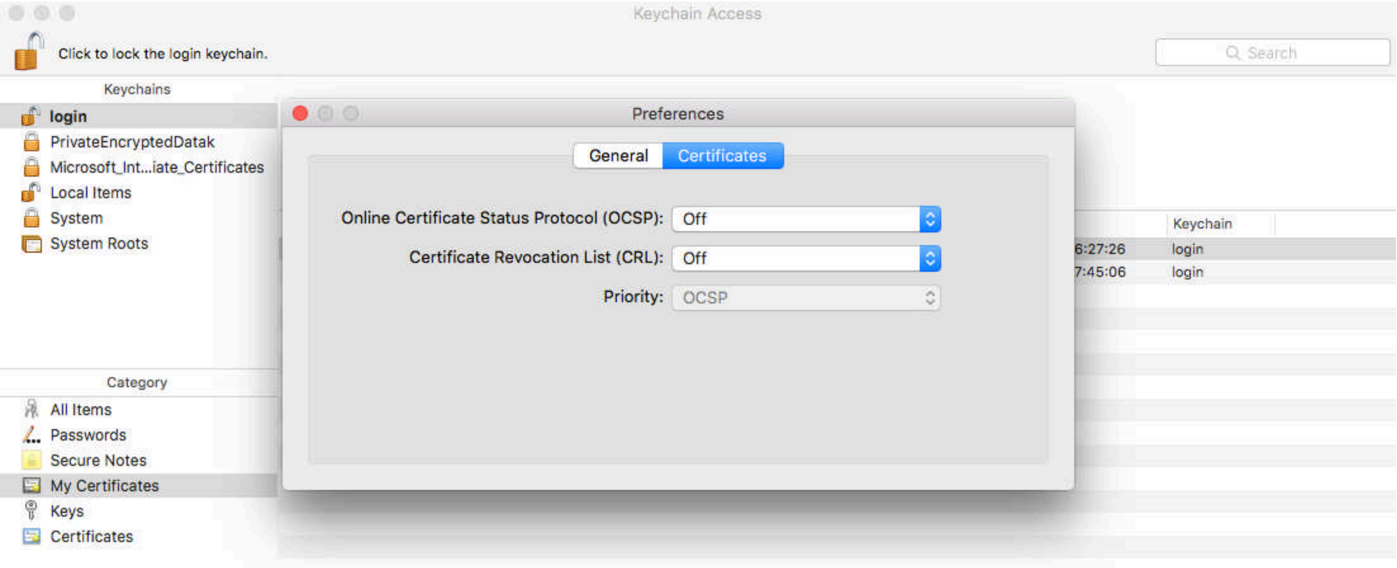
- Creating a Certificate Signing Request (CSR) file
- Generating development & distribution certificates
- Adding Devices/App ID's
- Generating provisioning profiles

We'll start by creating a Certificate Signing Request (CSR) file which will provide encrypted information to be used within the App Store Development and Distribution Certificates that are used to code sign iOS apps.

Open the **Keychain Access** utility on your Mac (located in **Applications/Utilities/**) and from the **Keychain Access** menu select **Preferences**. In the dialog window that appears, select the **Certificates** tab and ensure the following options are set to off:

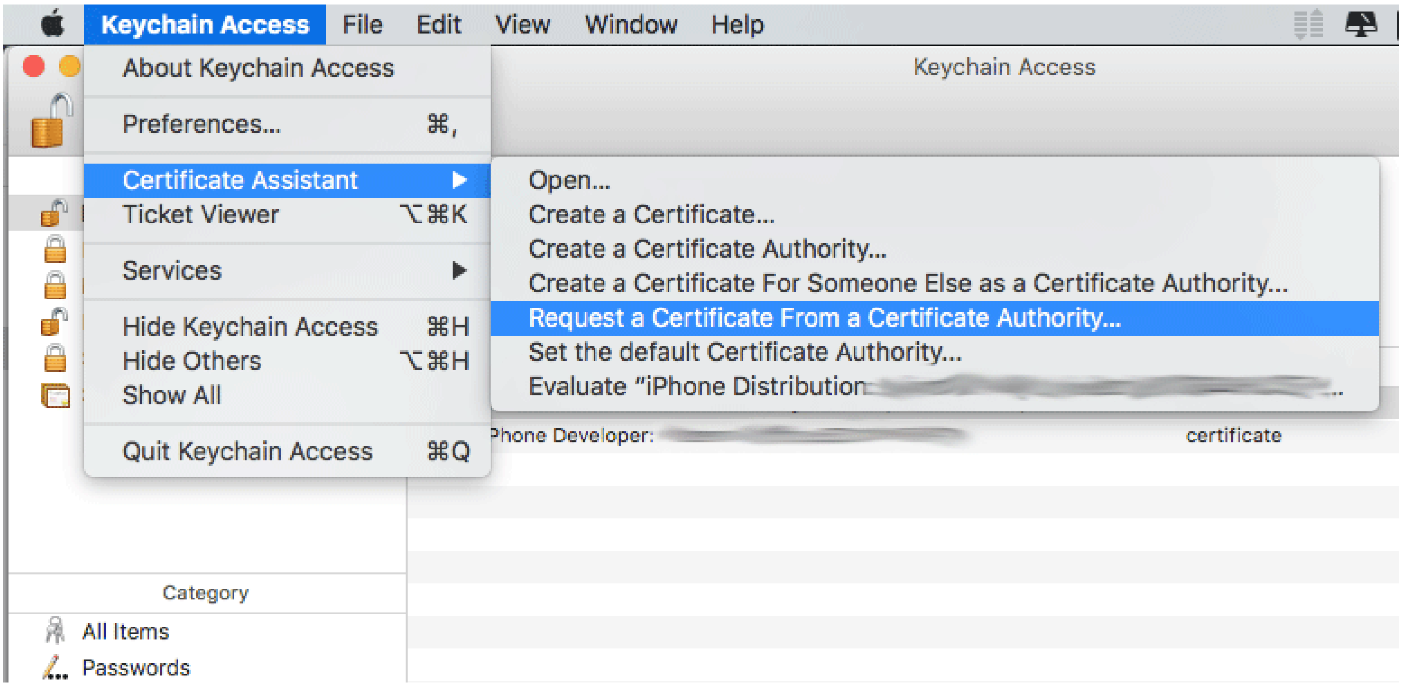
- Online Certificate Status Protocol (OCSP)
- Certificate Revocation List (CRL)

As shown in the following screen capture:



Online Certificate Status Protocol (OCSP): Off
Certificate Revocation List (CRL): Off
Priority: OCSP

Now we need to request a Certificate from a Certificate Authority as demonstrated below:

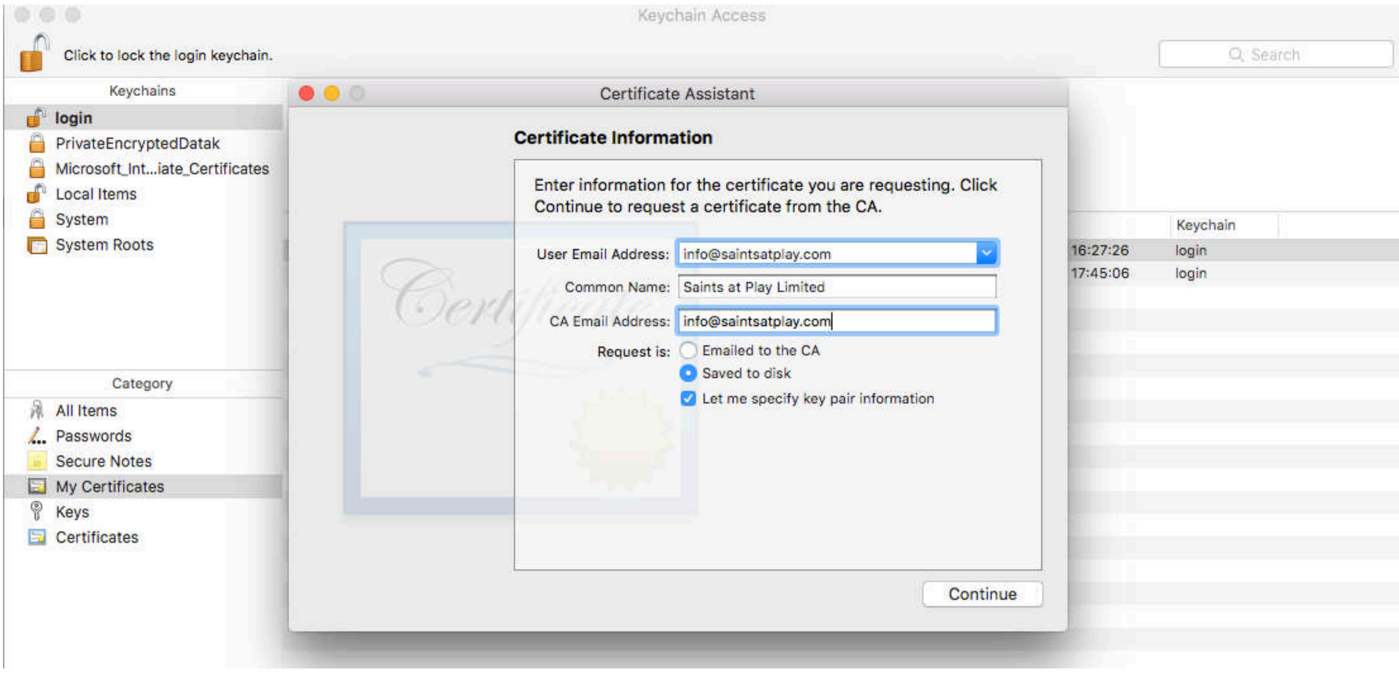


The Certificate Assistant window will subsequently be displayed to help guide you through the process of generating the Certificate Request.

In this window complete the following fields:

- User Email Address
- Common Name
- CA Email Address

Select **Saved to disk** from the radio buttons options and select the checkbox for the **Let me specify key pair information** option:



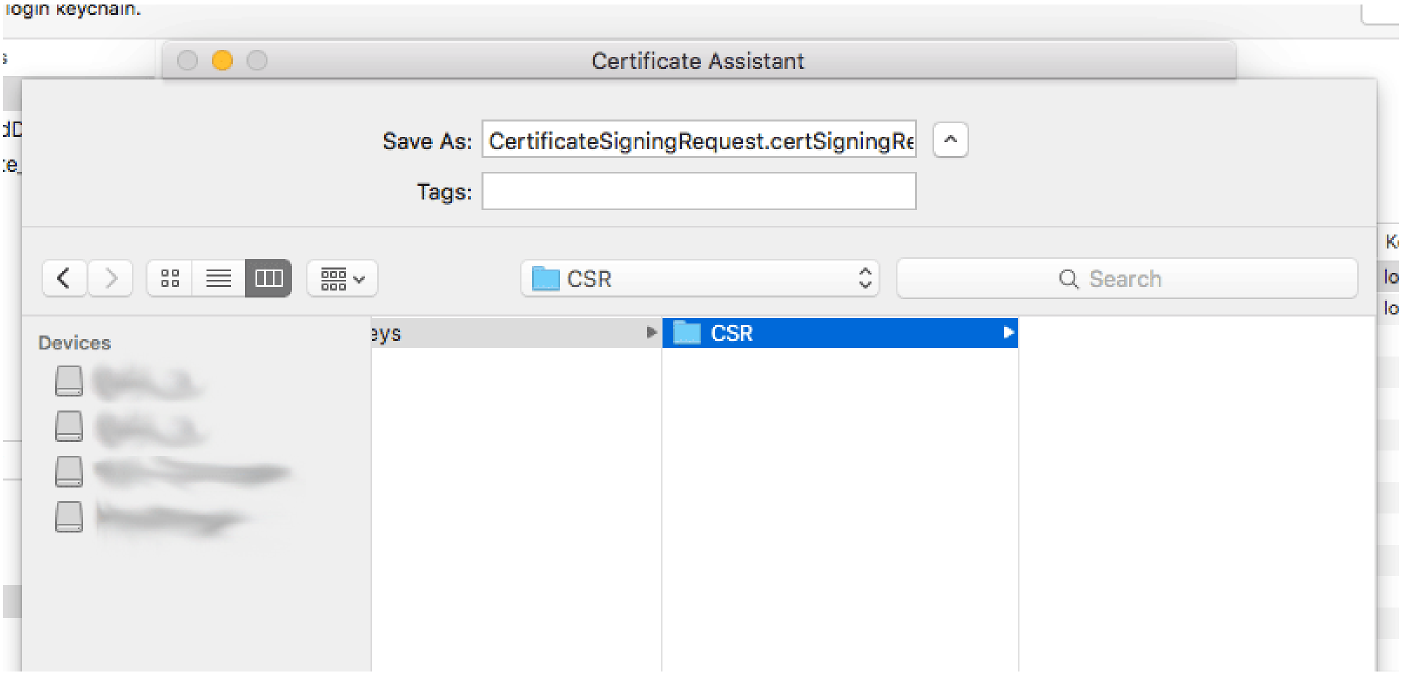
Certificate Assistant

Certificate Information

Enter information for the certificate you are requesting. Click Continue to request a certificate from the CA.

User Email Address: info@saintsatplay.com
Common Name: Saints at Play Limited
CA Email Address: info@saintsatplay.com
Request is: ○ Emailed to the CA
● Saved to disk
☑ Let me specify key pair information

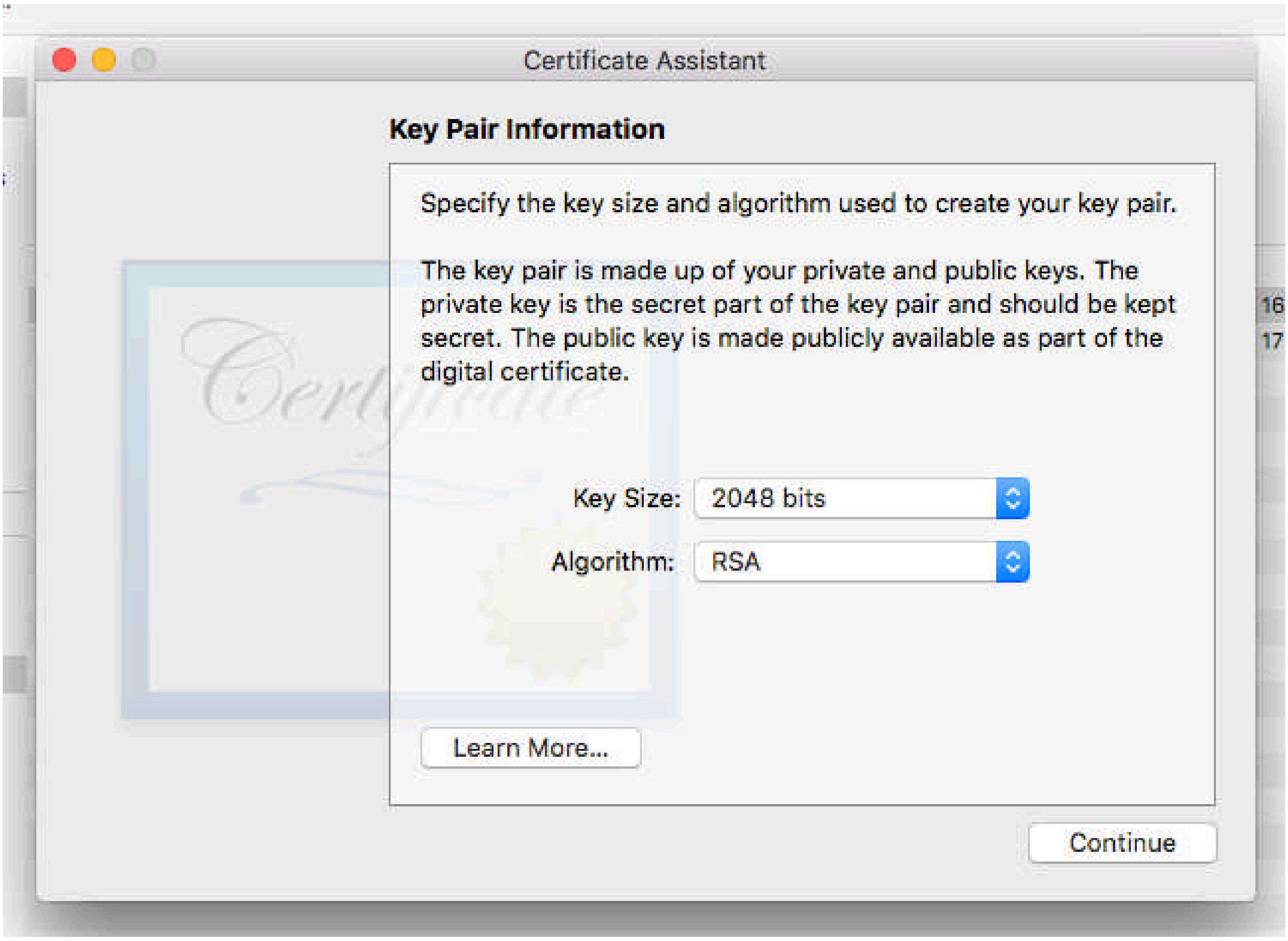
Click Continue and select a location on your computer to save the Certificate Signing Request file to:



Save As: CertificateSigningRequest.certSigningRe
Tags:

Once this has been signed you'll be prompted to select a key size and algorithm for the digital certificate's key pair.

- Your key size should be 2048 bits
- Your algorithm should be RSA


Certificate Assistant

Key Pair Information

Specify the key size and algorithm used to create your key pair.

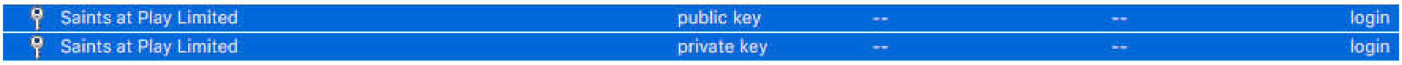
The key pair is made up of your private and public keys. The private key is the secret part of the key pair and should be kept secret. The public key is made publicly available as part of the digital certificate.

Key Size: 2048 bits

Algorithm: RSA

Click Continue and the Certificate Signing Request file will be saved to the location you specified earlier.

With the Keys Category in the sidebar of the **Keychain Access** utility selected you should see the newly generated public/private key pair being displayed like so:



Saints at Play Limited	public key	--	--	login
Saints at Play Limited	private key	--	--	login

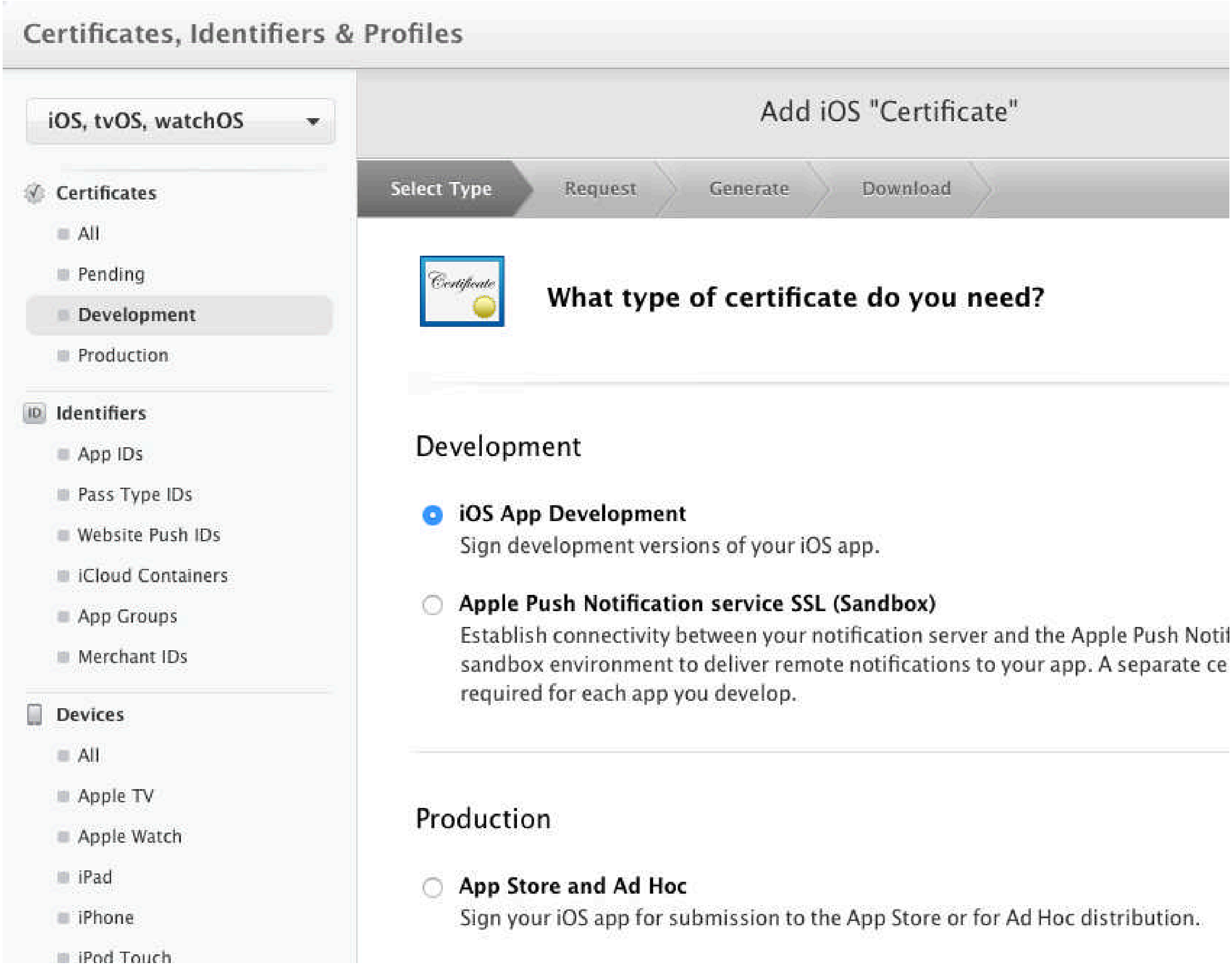
Generating Development and Distribution Certificates

Now that the Certificate Signing Request file has been created and saved to a location on your computer you'll need to log into your Apple Developer account and generate the following certificates:

- **Development** (We want to be able to code sign iOS apps for development)
- **Production** (We want to be able to code sign iOS apps for either submission to the Apple Store or Ad Hoc distribution)

These will allow you to develop and test your app locally on your own devices and then distribute that app, when ready, through either the Apple App Store or Ad Hoc distribution (such as where you want to release the app to a private audience or for testing with a select number of third parties).

From the **Certificates, Identifiers & Profiles** section of your account, create a new Development Certificate and, under the Development section, select the **iOS App Development** option from the displayed radio buttons as shown below:



What type of certificate do you need?

Development

● **iOS App Development**
Sign development versions of your iOS app.

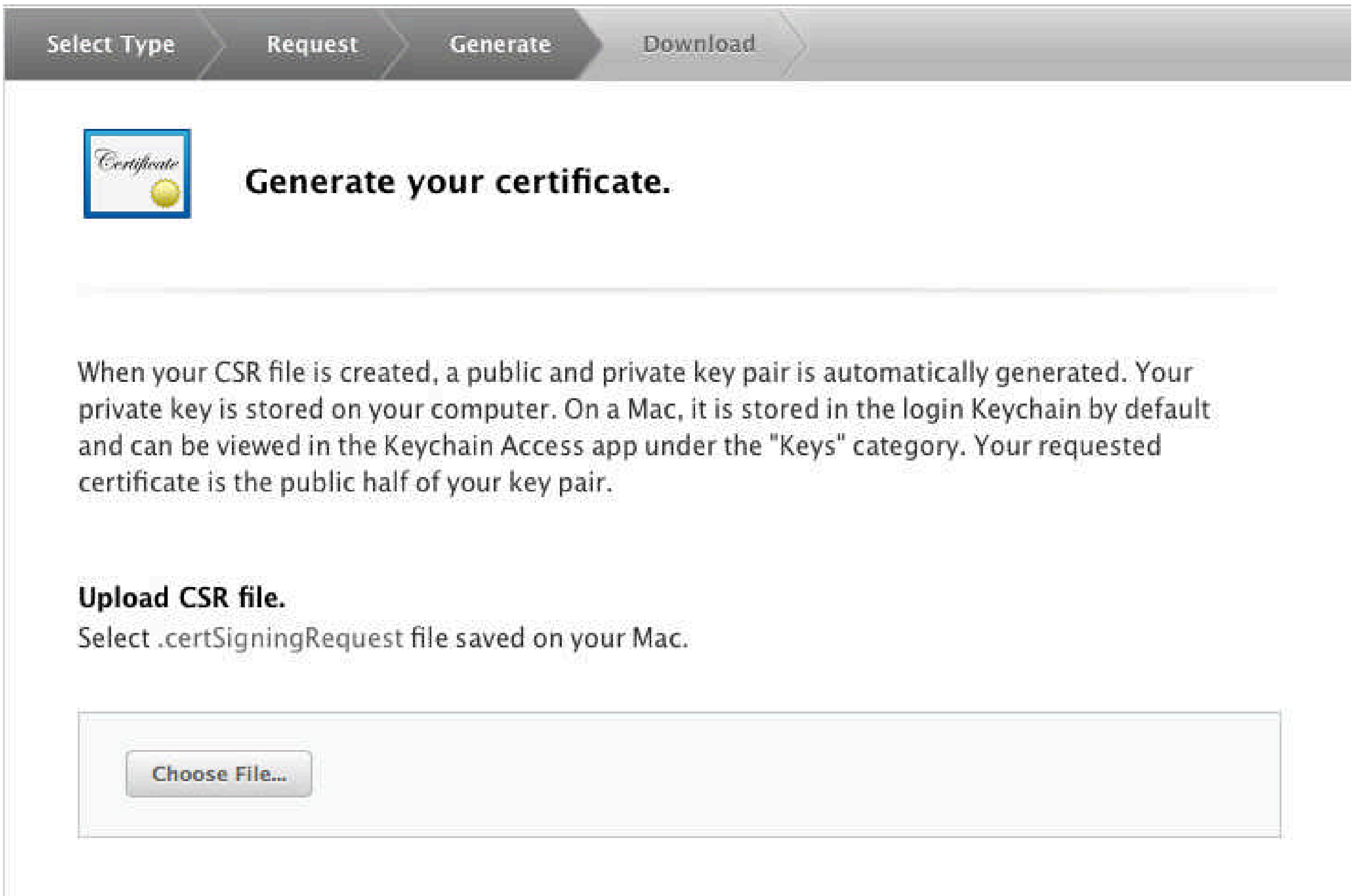
○ **Apple Push Notification service SSL (Sandbox)**
Establish connectivity between your notification server and the Apple Push Notif
sandbox environment to deliver remote notifications to your app. A separate ce
required for each app you develop.

Production

○ **App Store and Ad Hoc**
Sign your iOS app for submission to the App Store or for Ad Hoc distribution.

Scroll to the bottom of the page and click continue where the next screen will prompt you to Create a Certificate Signing Request file.

As this has already been done proceed to the next screen and upload the CSR file that you created earlier.



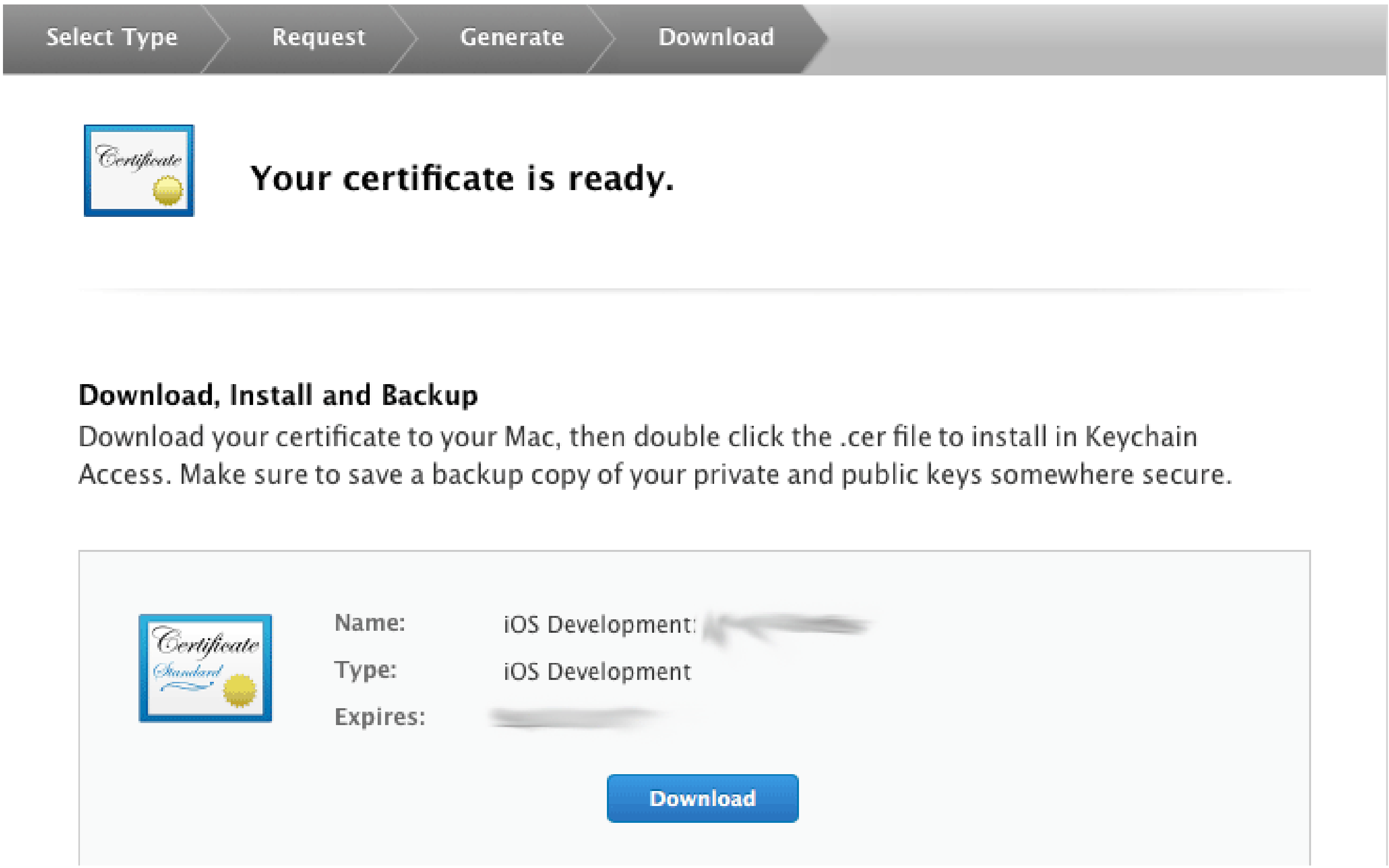
Generate your certificate.

When your CSR file is created, a public and private key pair is automatically generated. Your private key is stored on your computer. On a Mac, it is stored in the login Keychain by default and can be viewed in the Keychain Access app under the "Keys" category. Your requested certificate is the public half of your key pair.

Upload CSR file.

Select .certSigningRequest file saved on your Mac.

On the following screen your generated certificate will be available for download:



Your certificate is ready.

Download, Install and Backup

Download your certificate to your Mac, then double click the .cer file to install in Keychain Access. Make sure to save a backup copy of your private and public keys somewhere secure.

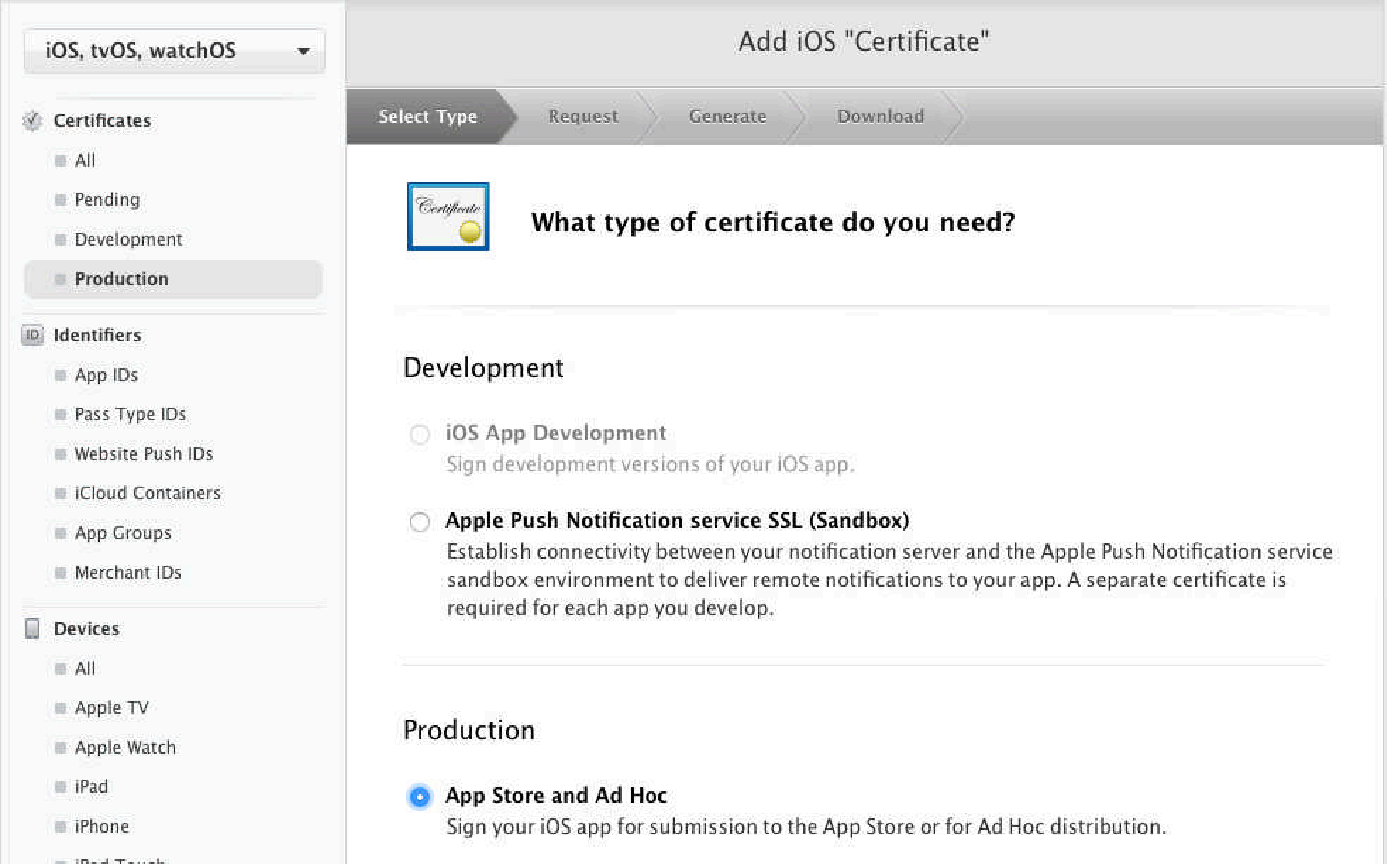
Name: iOS Development: [redacted]

Type: iOS Development

Expires: [redacted]

Download the newly generated Development certificate and store that somewhere safe.

You can repeat the same process for creating a **Production** certificate but be sure to select the **App Store and Ad Hoc Certificate** option from the displayed radio buttons:



What type of certificate do you need?

Development

○ iOS App Development
Sign development versions of your iOS app.

○ Apple Push Notification service SSL (Sandbox)
Establish connectivity between your notification server and the Apple Push Notification service sandbox environment to deliver remote notifications to your app. A separate certificate is required for each app you develop.

Production

● App Store and Ad Hoc
Sign your iOS app for submission to the App Store or for Ad Hoc distribution.

Once completed download the generated **Production** certificate and save to the same location as your **Development** certificate.

Double click on both of these files to install them to your Keychain Access utility.

Okay, so we’re halfway through setting up our environment for Code Signing iOS apps. Now all we need to do is generate the provisioning profiles for our devices.

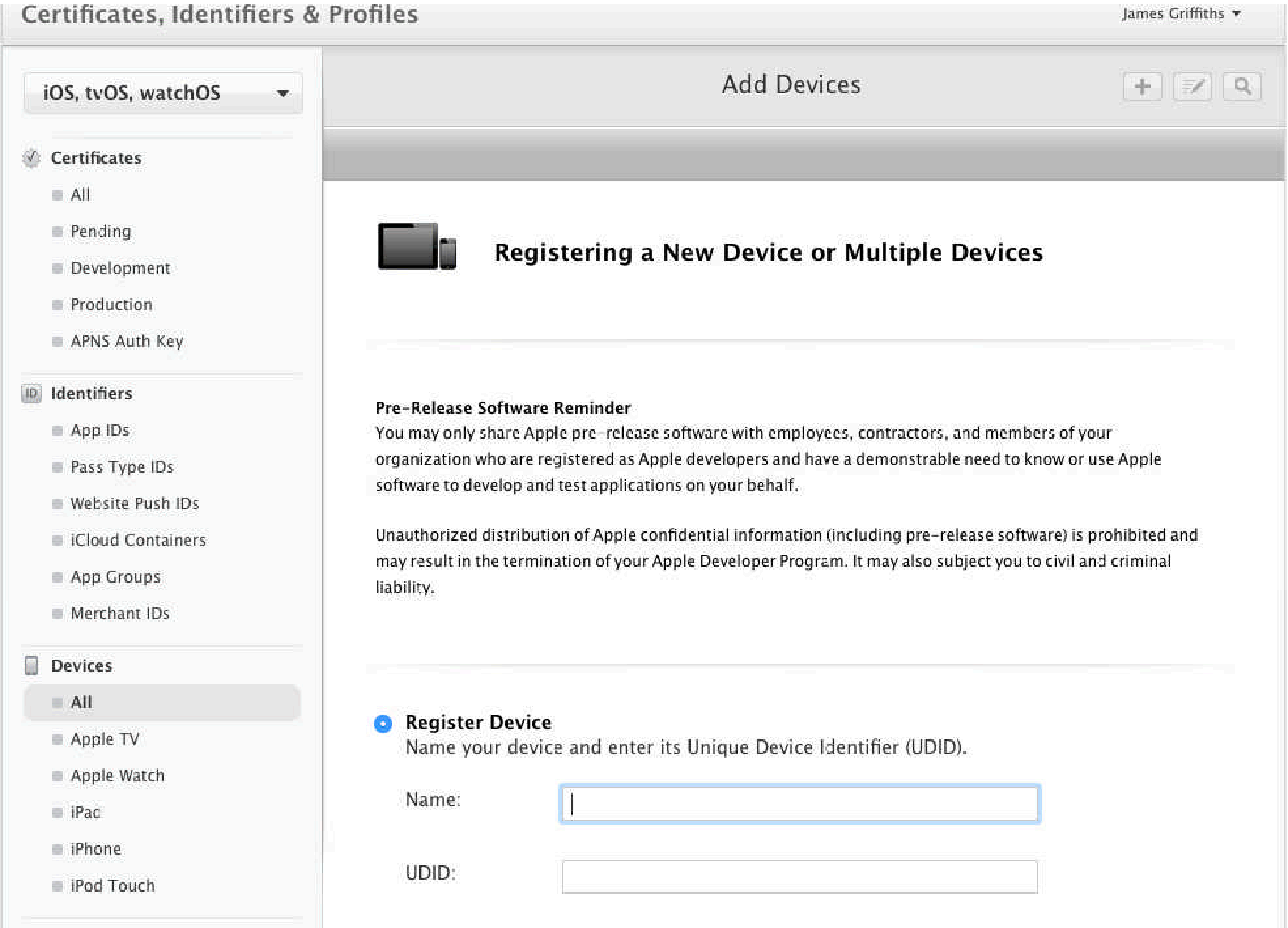
Before we can do this though we’ll need to ensure that iOS devices that we use for development & testing have been added to the Devices section of our Apple Developer account.

Let’s do that now.

In your Apple Developer account navigate to the **Certificates, Identifiers & Profiles** section, select All from under the **Devices** menu link and you can begin adding an iOS device to your account.

Doing so will allow a development provisioning profile (which we’ll generate shortly) to launch your app on a registered device for testing.

Currently Apple allows developers to register a maximum of 100 iOS devices for their accounts. Removing previously registered devices from your account doesn’t decrease the number of devices you have added though.



Registering a New Device or Multiple Devices

Pre-Release Software Reminder
You may only share Apple pre-release software with employees, contractors, and members of your organization who are registered as Apple developers and have a demonstrable need to know or use Apple software to develop and test applications on your behalf.

Unauthorized distribution of Apple confidential information (including pre-release software) is prohibited and may result in the termination of your Apple Developer Program. It may also subject you to civil and criminal liability.

● **Register Device**
Name your device and enter its Unique Device Identifier (UDID).

Name:

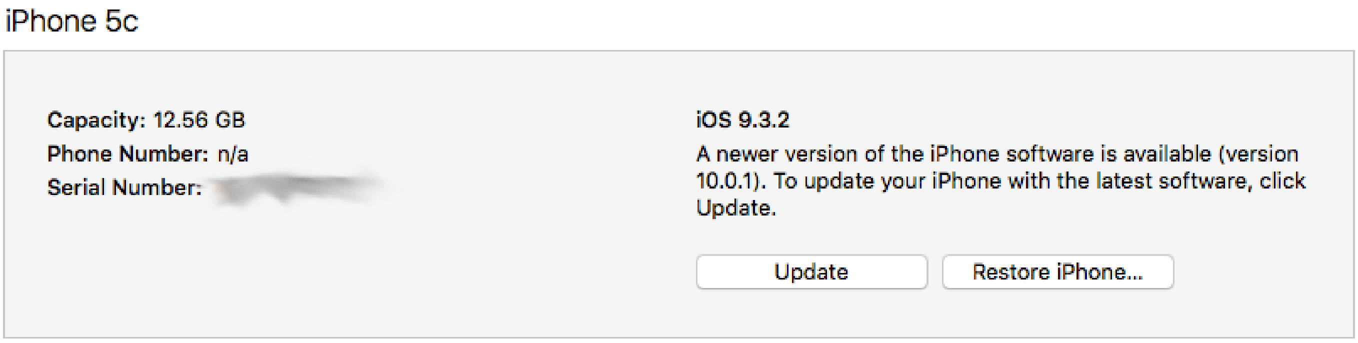
UDID:

When adding an iOS device you need to enter a name to identify that device by and the UDID (Unique Device Identifier) code for the device - which is a sequence of 40 alphanumeric characters.

There are 2 ways in which you can find the UDID for your device:

- iTunes
- Xcode

To find your device UDID in iTunes, connect your iOS device to your Mac and on the Device summary screen click on the Serial Number field:

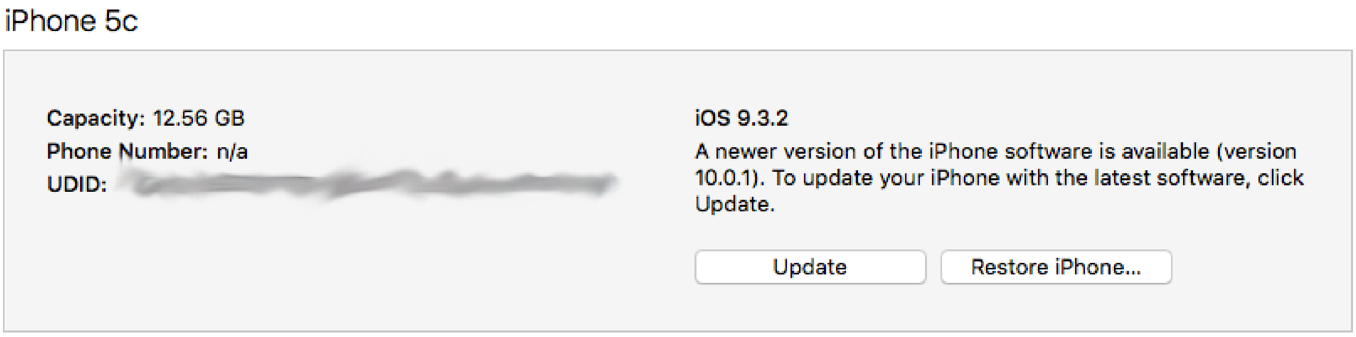


iPhone 5c

Capacity: 12.56 GB
Phone Number: n/a
Serial Number: [redacted]

iOS 9.3.2
A newer version of the iPhone software is available (version 10.0.1). To update your iPhone with the latest software, click Update.

This will then cycle to the UDID field and display the value for your device:



iPhone 5c

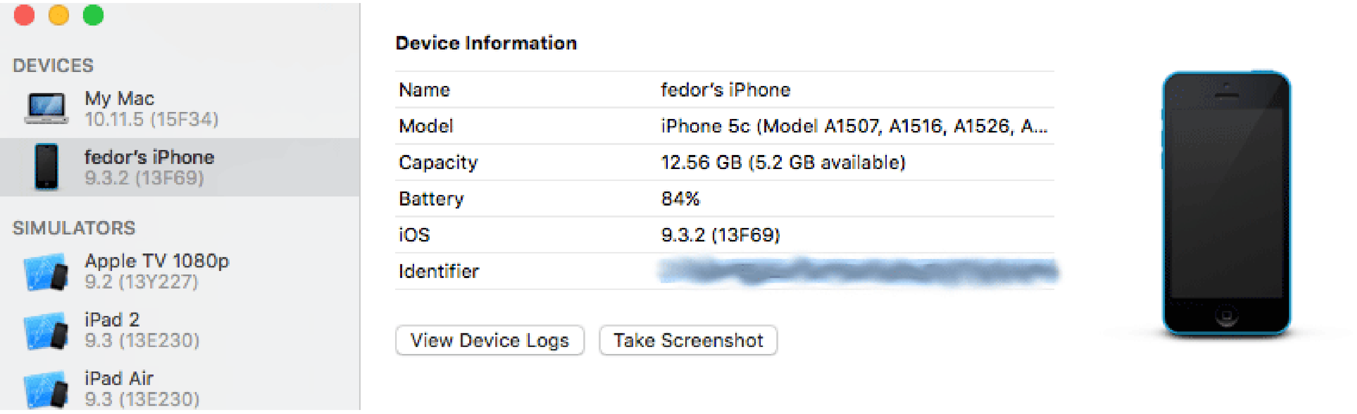
Capacity: 12.56 GB
Phone Number: n/a
UDID: [redacted]

iOS 9.3.2
A newer version of the iPhone software is available (version 10.0.1). To update your iPhone with the latest software, click Update.

Right-click on the displayed value, select Copy from the contextual menu that appears and then paste this copied identifier into the UDID field on the **Add Devices** form in your Apple Developer account (see previous page).

This is the first, and most cumbersome, method of finding your device UDID.

Alternatively, Xcode will automatically display the UDID for a connected iPhone/iPod/iPad, along with other information, in the Devices window (accessible from Window > Devices) as shown in the following screen capture:



DEVICES

My Mac
10.11.5 (15F34)

fedor's iPhone
9.3.2 (13F69)

SIMULATORS

Apple TV 1080p
9.2 (13Y227)

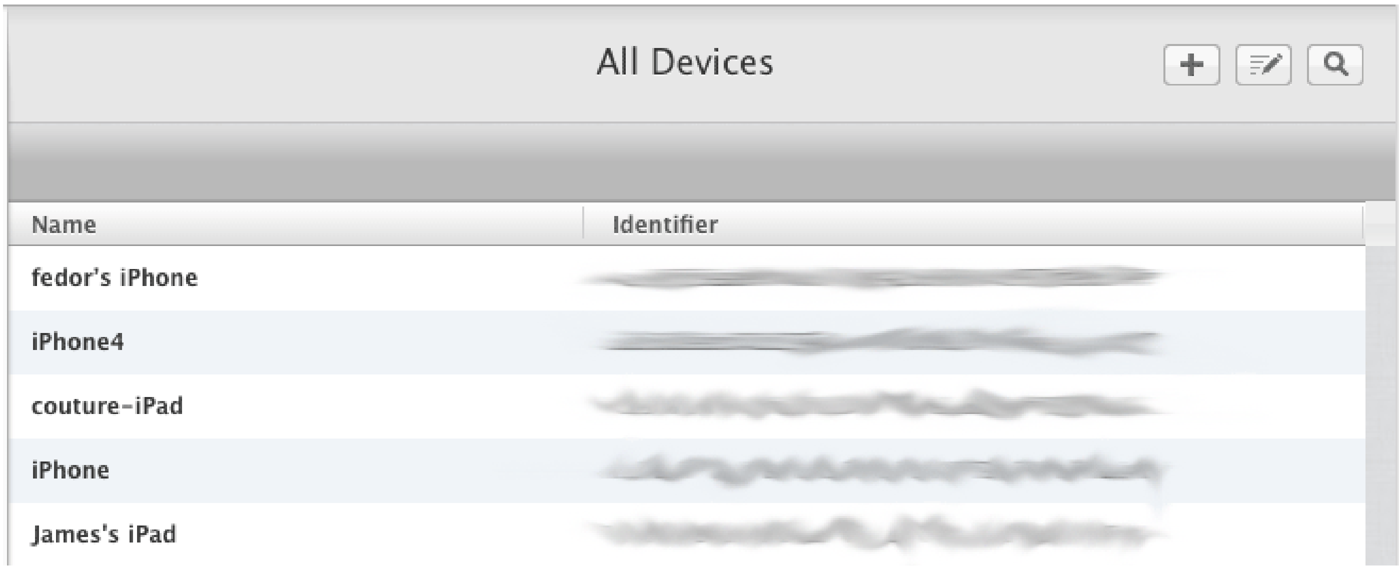
iPad 2
9.3 (13E230)

iPad Air
9.3 (13E230)

Device Information

Name	fedor's iPhone
Model	iPhone 5c (Model A1507, A1516, A1526, A...
Capacity	12.56 GB (5.2 GB available)
Battery	84%
iOS	9.3.2 (13F69)
Identifier	[redacted]

Now that you have the device identifier you can complete adding a device to your Apple Developer account and, once completed, should see all your registered devices being displayed like so:



All Devices

Name	Identifier
fedor's iPhone	[redacted]
iPhone4	[redacted]
couture-iPad	[redacted]
iPhone	[redacted]
James's iPad	[redacted]

In addition to registering your device(s) for developing/testing your iOS apps you'll also need to generate unique App ID's.

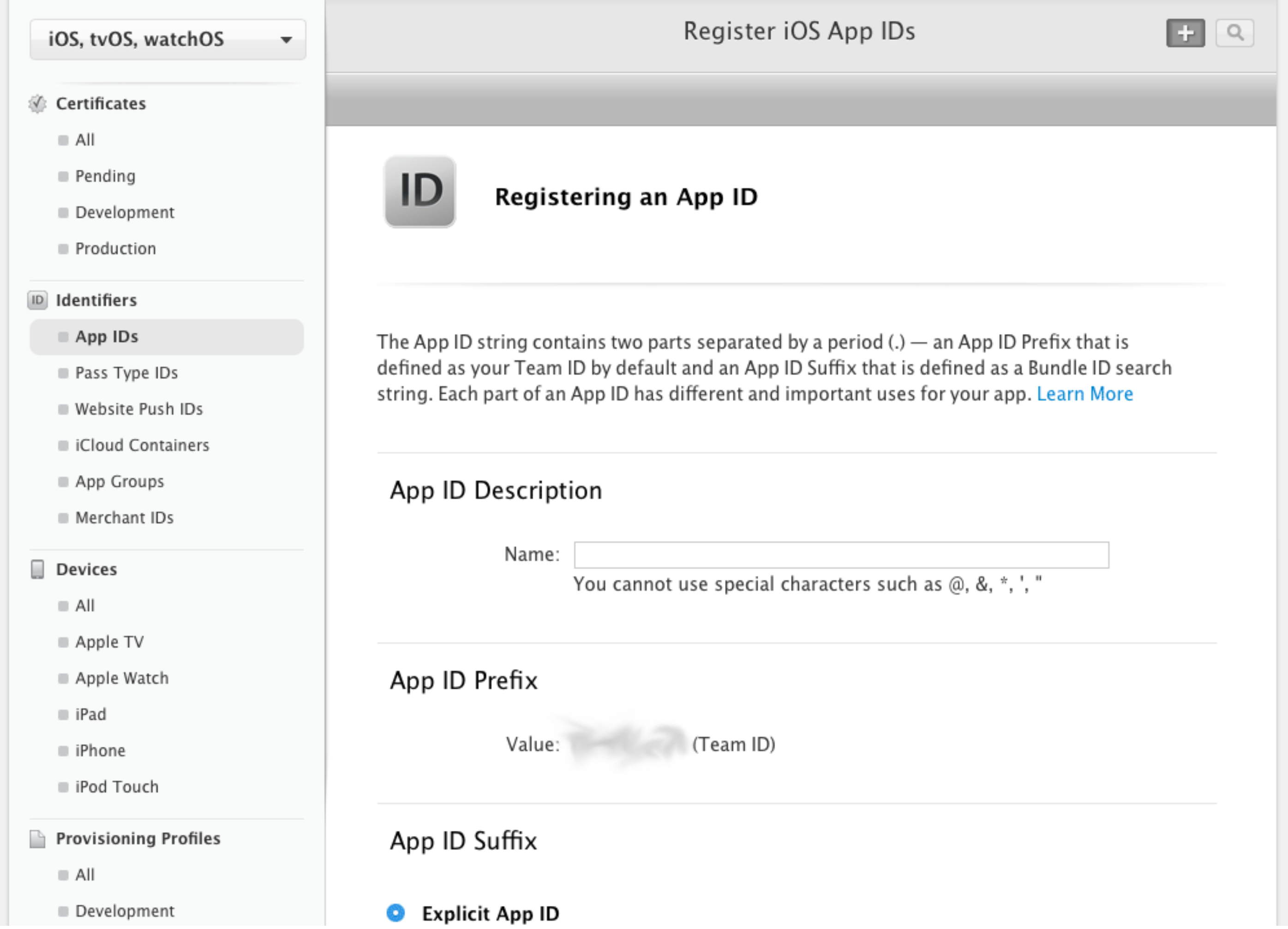
An App ID can be used to identify each App submitted by a developer/development team to the App Store and register the services that the App can use such as Apple Pay, HealthKit or In-App Purchases for example.

App ID's can be created in two ways:

- Wildcards (using asterisks - which match one or more apps)
- Explicit App ID (which matches the bundle ID for a specific app)

Xcode can be used to generate Wildcard App ID's but usually you'll generate an

Explicit App ID from within the **Certificates, Identifiers & Profiles** portal of your Apple Developer account by selecting the **App IDs** link under the **Identifiers** menu section and then clicking on the + icon as demonstrated below:



Registering an App ID

The App ID string contains two parts separated by a period (.) — an App ID Prefix that is defined as your Team ID by default and an App ID Suffix that is defined as a Bundle ID search string. Each part of an App ID has different and important uses for your app. Learn More

App ID Description

Name:

You cannot use special characters such as @, &, *, ', "

App ID Prefix

Value: (Team ID)

App ID Suffix

● Explicit App ID

Explicit App ID’s are written in a reverse domain style notation (using alphanumeric characters with no spaces, asterisks or special characters) such as:

```
com.saintsatplay.nameofAppHere
```

This must match the Widget ID contained within your **config.xml** file.

Once you’ve created your Explicit App ID and saved this to your Apple Developer account you can start creating provisioning profiles for your iOS app.

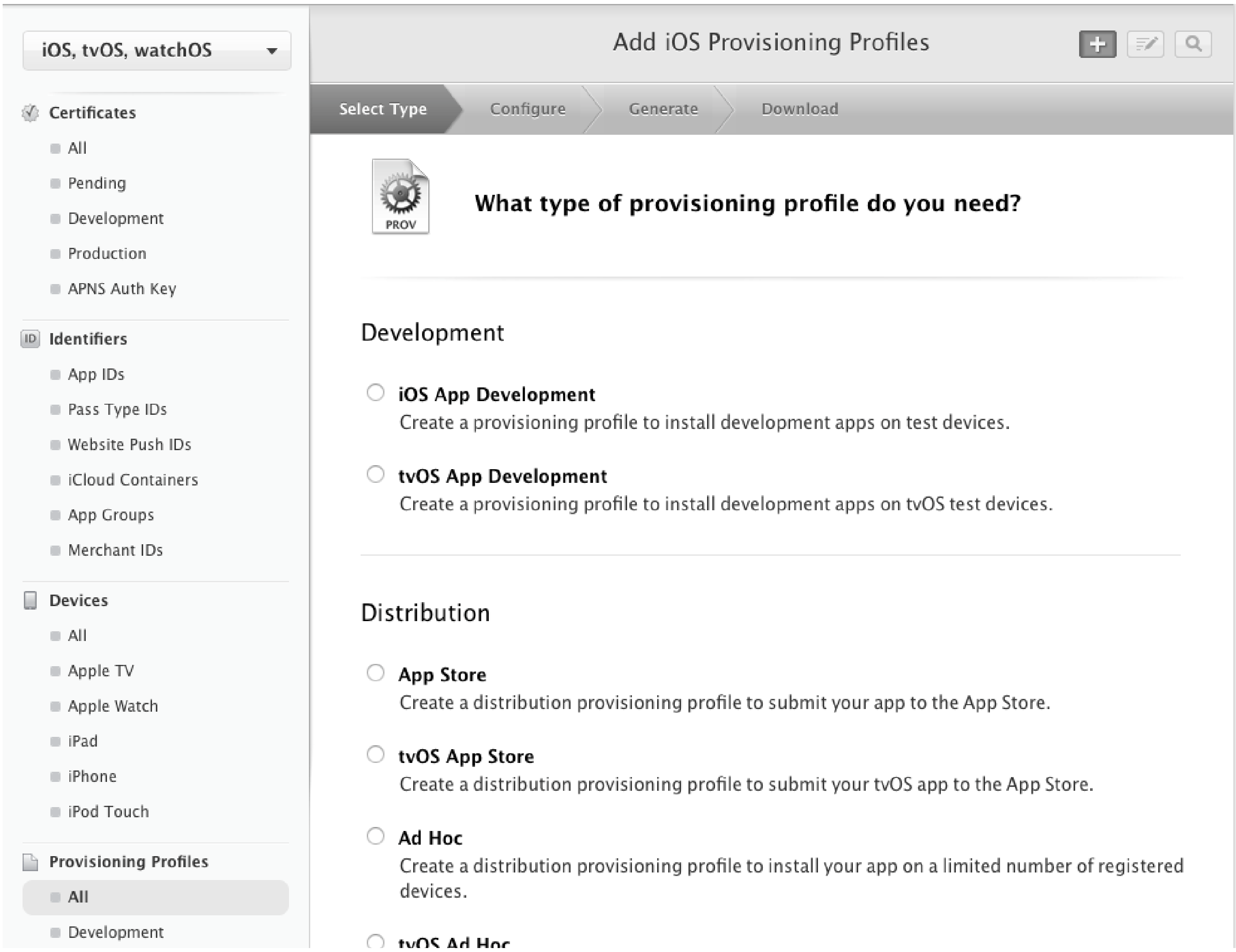
A provisioning profile comes in 2 forms:

- Development (for testing on your authorised devices)

- Distribution (for Apple App Store or Ad-hoc distribution)

These provisioning profiles associate devices with their developers through iOS Certificates and identifiers allowing apps to be authorised for testing/publishing to the Apple App Store.

To generate a Development provisioning profile so you can test your apps navigate to the **Certificates, Identifiers & Profiles** portal of your Apple Developer account, select the **Development** link under the **Provisioning Profiles** section and click on the + icon to see the following form:



Add iOS Provisioning Profiles

What type of provisioning profile do you need?

Development

○ **iOS App Development**
Create a provisioning profile to install development apps on test devices.

○ **tvOS App Development**
Create a provisioning profile to install development apps on tvOS test devices.

Distribution

○ **App Store**
Create a distribution provisioning profile to submit your app to the App Store.

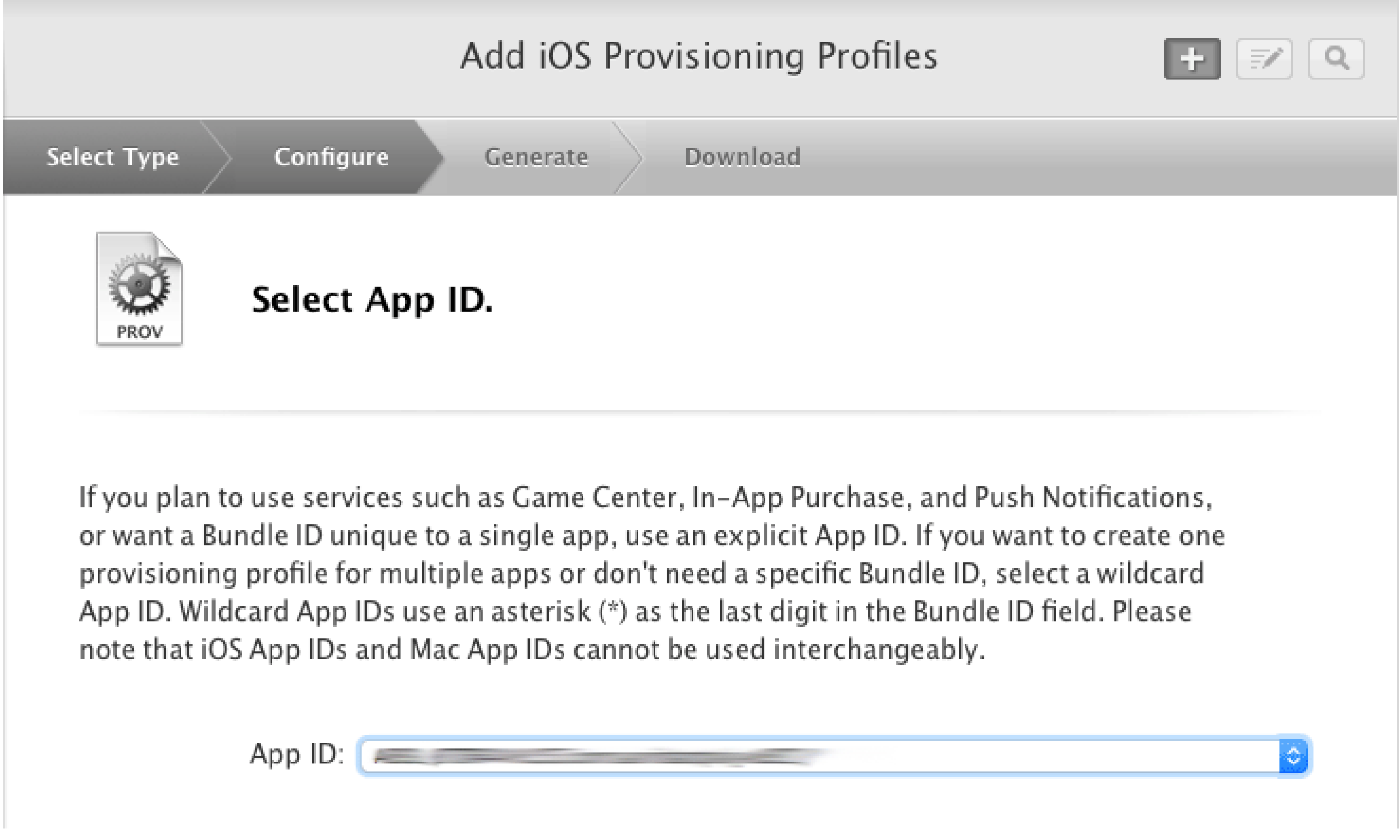
○ **tvOS App Store**
Create a distribution provisioning profile to submit your tvOS app to the App Store.

○ **Ad Hoc**
Create a distribution provisioning profile to install your app on a limited number of registered devices.

○ **tvOS Ad Hoc**

Select **iOS App Development** from the **Development** section towards the top of the form, scroll to the bottom of the screen and press Continue.

Now select the App ID for this development profile:



Add iOS Provisioning Profiles

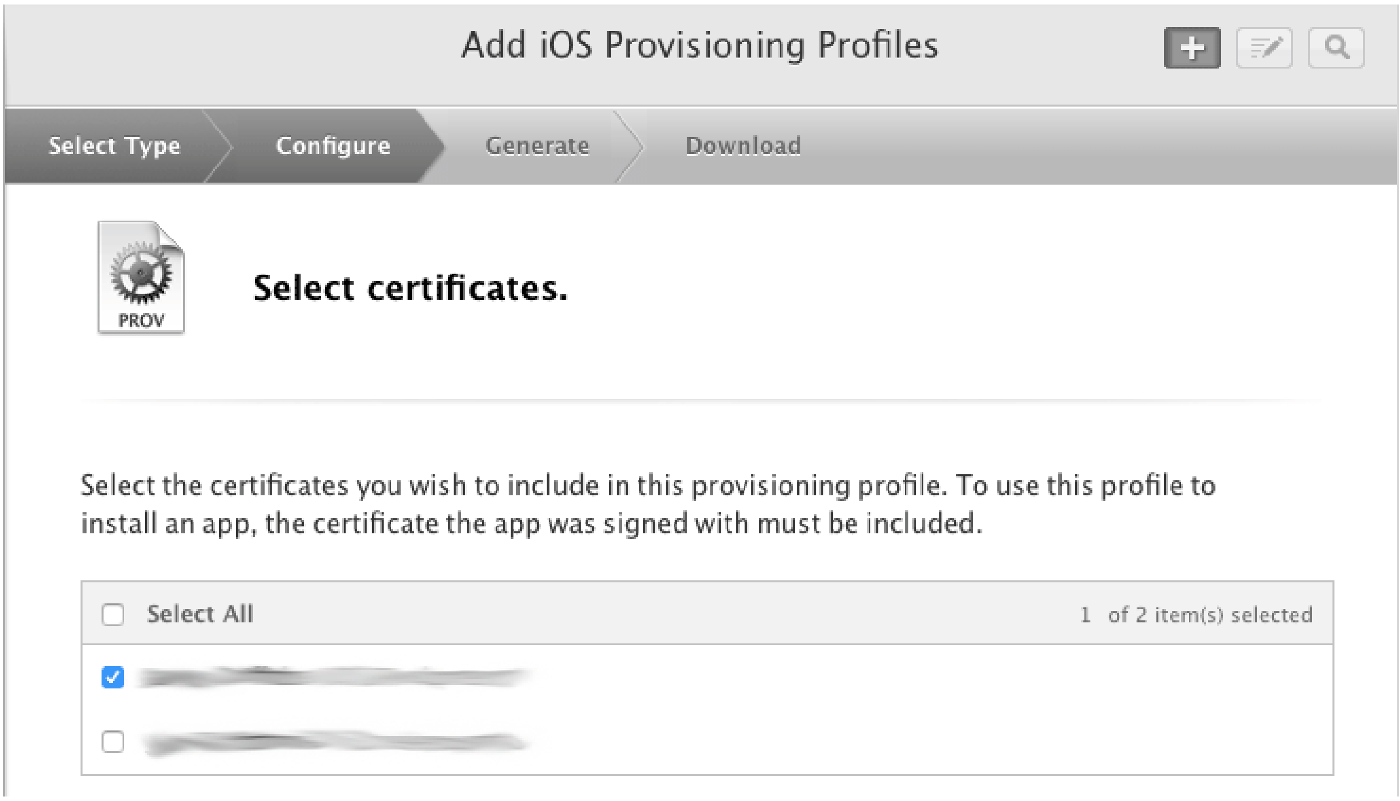
Select App ID.

If you plan to use services such as Game Center, In-App Purchase, and Push Notifications, or want a Bundle ID unique to a single app, use an explicit App ID. If you want to create one provisioning profile for multiple apps or don't need a specific Bundle ID, select a wildcard App ID. Wildcard App IDs use an asterisk (*) as the last digit in the Bundle ID field. Please note that iOS App IDs and Mac App IDs cannot be used interchangeably.

App ID:

Once you have selected the desired App ID from the drop down menu, scroll to the bottom of the page and press Continue.

Now select the Development certificate(s) for this profile:



Add iOS Provisioning Profiles

Select certificates.

Select the certificates you wish to include in this provisioning profile. To use this profile to install an app, the certificate the app was signed with must be included.

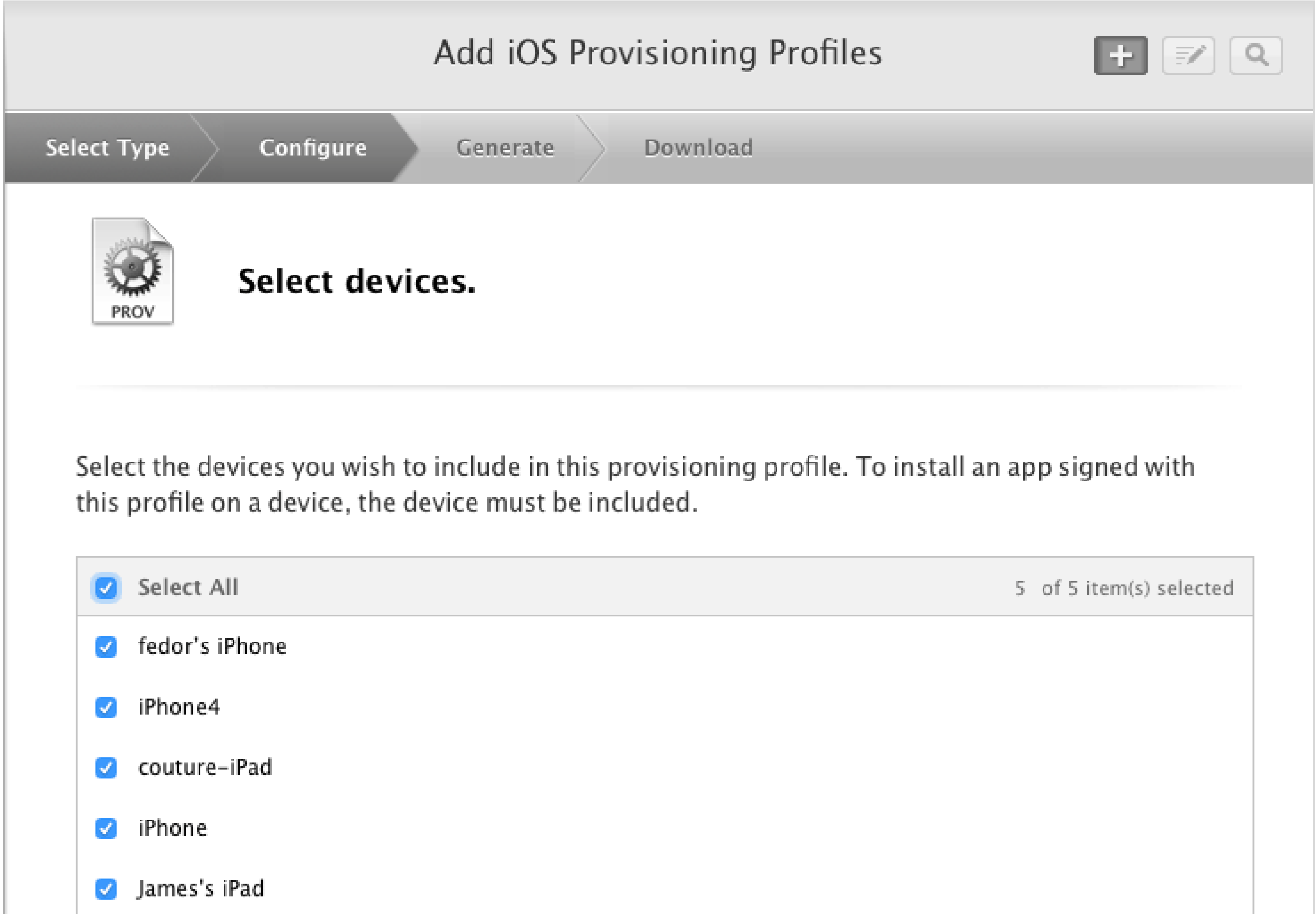
□ Select All 1 of 2 item(s) selected

☑

□

Once selected scroll to the bottom of the page and press Continue.

On the next screen select the devices for this provisioning profile:



Select devices.

Select the devices you wish to include in this provisioning profile. To install an app signed with this profile on a device, the device must be included.

☑ Select All 5 of 5 item(s) selected

☑ fedor's iPhone

☑ iPhone4

☑ couture-iPad

☑ iPhone

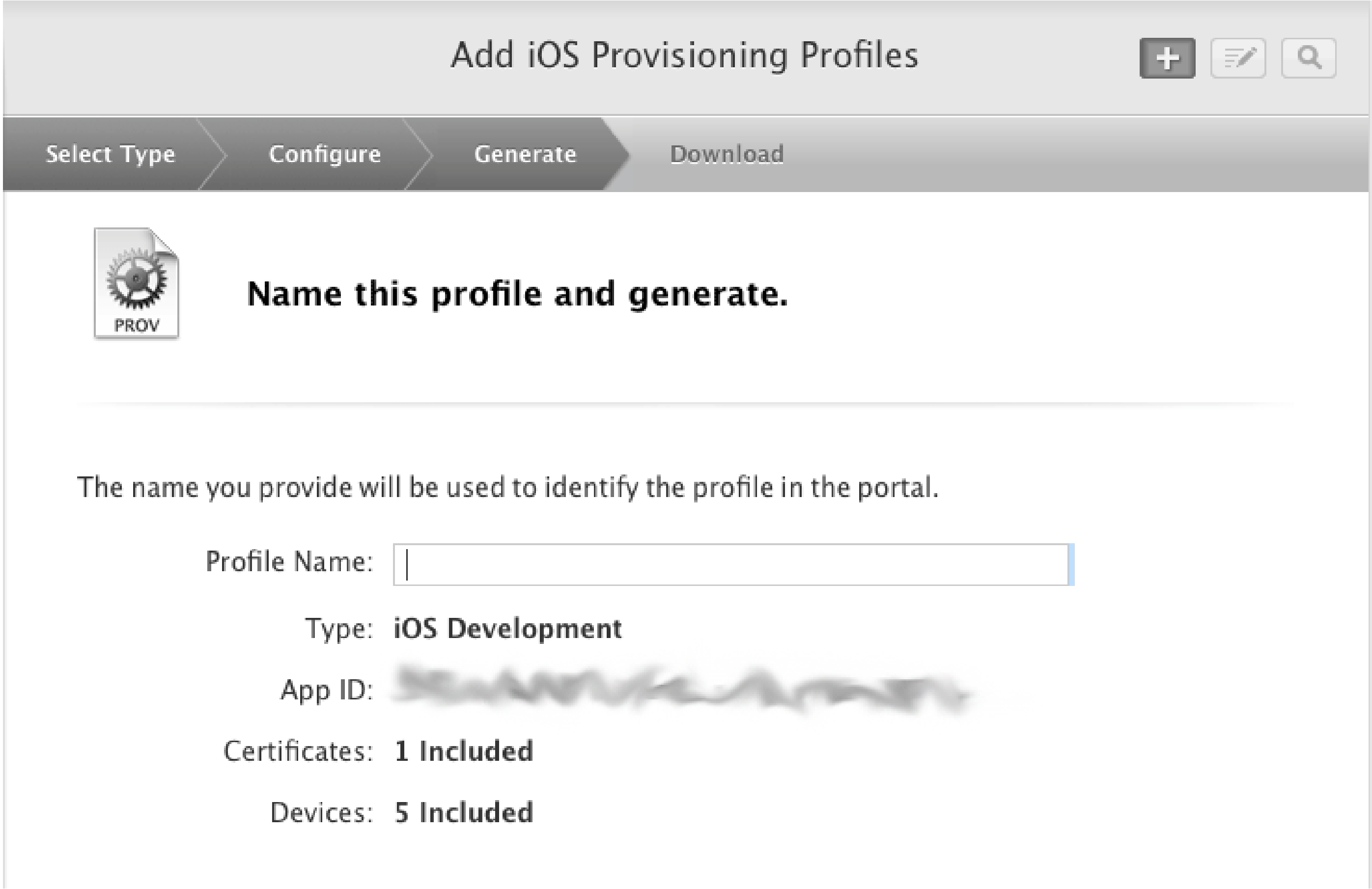
☑ James's iPad

Once selected scroll to the bottom of the page and press Continue.

Now you will be prompted to name the development provisioning profile so that it can be identified in the Provisioning Profiles portal of the **Certificates, Identifiers & Profiles** section of your Apple Developer account.

Choose a name that is both distinctive and easily identifiable (as you may, over the course of your app development career, populate the Provisioning Profiles portal with LOTS of profiles - it’s best to make each one unique!)

As a rule of thumb I always name my profiles depending on the project they are associated with (but you can choose whatever naming convention works best for your particular needs).



Name this profile and generate.

The name you provide will be used to identify the profile in the portal.

Profile Name:

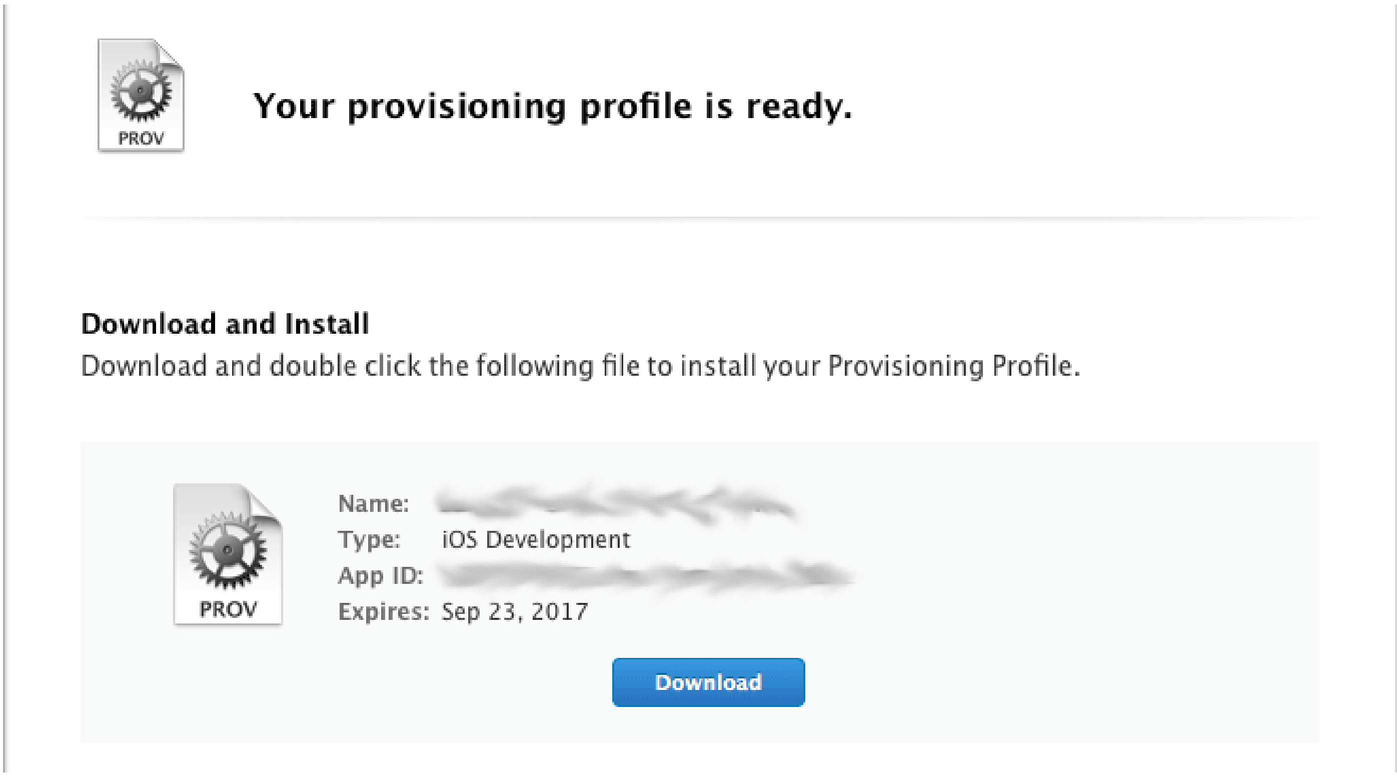
Type: iOS Development

App ID: [redacted]

Certificates: 1 Included

Devices: 5 Included

Once you've entered your uniquely identifiable Profile name click Continue and your Development Provisioning Profile will be generated and ready for download on the final screen:



Your provisioning profile is ready.

Download and Install

Download and double click the following file to install your Provisioning Profile.

Name: [redacted]

Type: iOS Development

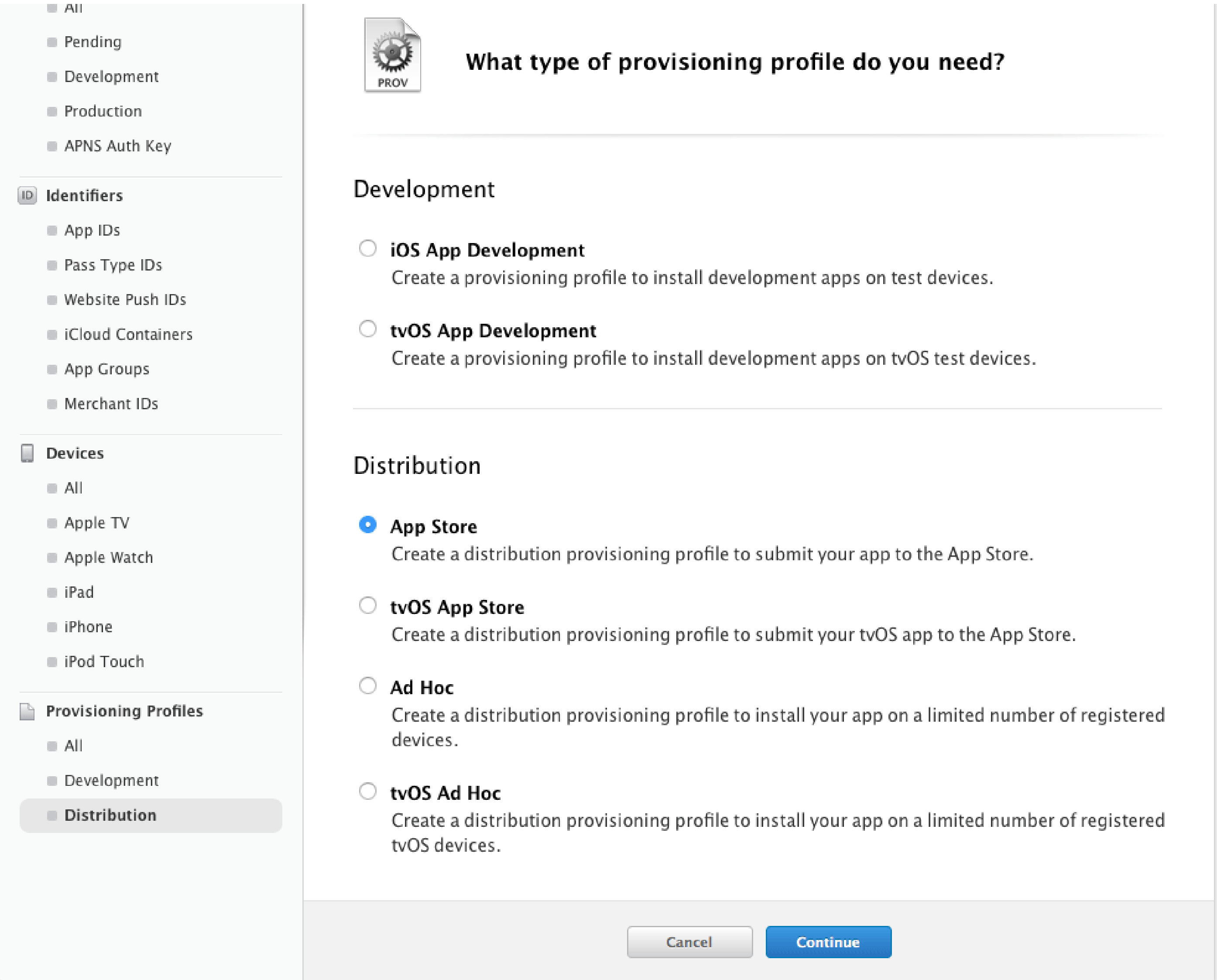
App ID: [redacted]

Expires: Sep 23, 2017

Creating a distribution profile (to allow your app to be submitted to the Apple App Store or via select third parties through Ad Hoc distribution for example) follows a similar process.

Select the **Distribution** link under the **Provisioning Profiles** section in the **Certificates, Identifiers & Profiles** portal of your Apple Developer account and click on the + icon to begin creating a new Distribution profile.

Select App Store from the **Distribution** section, scroll to the bottom of the screen and press Continue:



What type of provisioning profile do you need?

Development

○ **iOS App Development**
Create a provisioning profile to install development apps on test devices.

○ **tvOS App Development**
Create a provisioning profile to install development apps on tvOS test devices.

Distribution

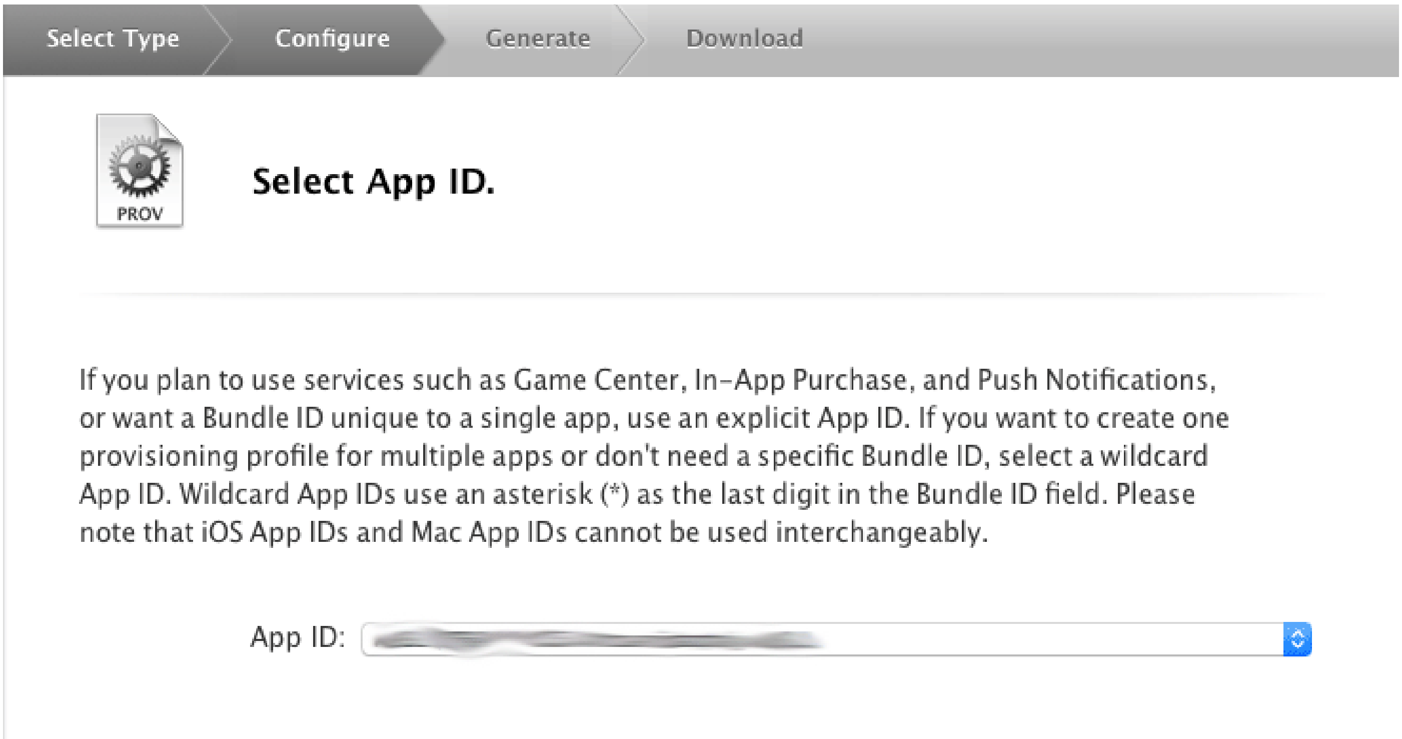
● **App Store**
Create a distribution provisioning profile to submit your app to the App Store.

○ **tvOS App Store**
Create a distribution provisioning profile to submit your tvOS app to the App Store.

○ **Ad Hoc**
Create a distribution provisioning profile to install your app on a limited number of registered devices.

○ **tvOS Ad Hoc**
Create a distribution provisioning profile to install your app on a limited number of registered tvOS devices.

On the following screen select the **App ID** that this Distribution profile will apply to:



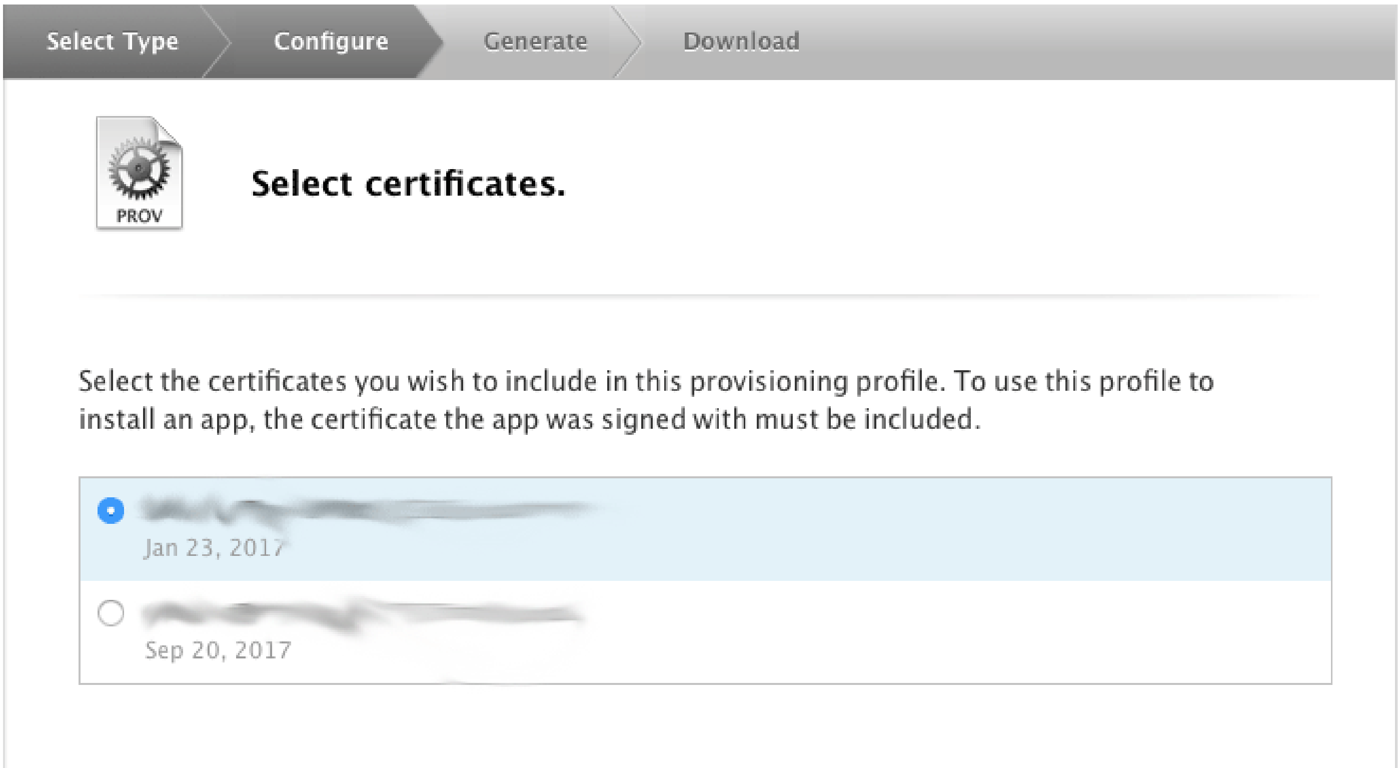
Select App ID.

If you plan to use services such as Game Center, In-App Purchase, and Push Notifications, or want a Bundle ID unique to a single app, use an explicit App ID. If you want to create one provisioning profile for multiple apps or don't need a specific Bundle ID, select a wildcard App ID. Wildcard App IDs use an asterisk (*) as the last digit in the Bundle ID field. Please note that iOS App IDs and Mac App IDs cannot be used interchangeably.

App ID: [redacted]

Once you have selected the desired **App ID** from the drop down menu, scroll to the bottom of the page and press Continue.

Now select the **Distribution** certificate for this profile:



Select certificates.

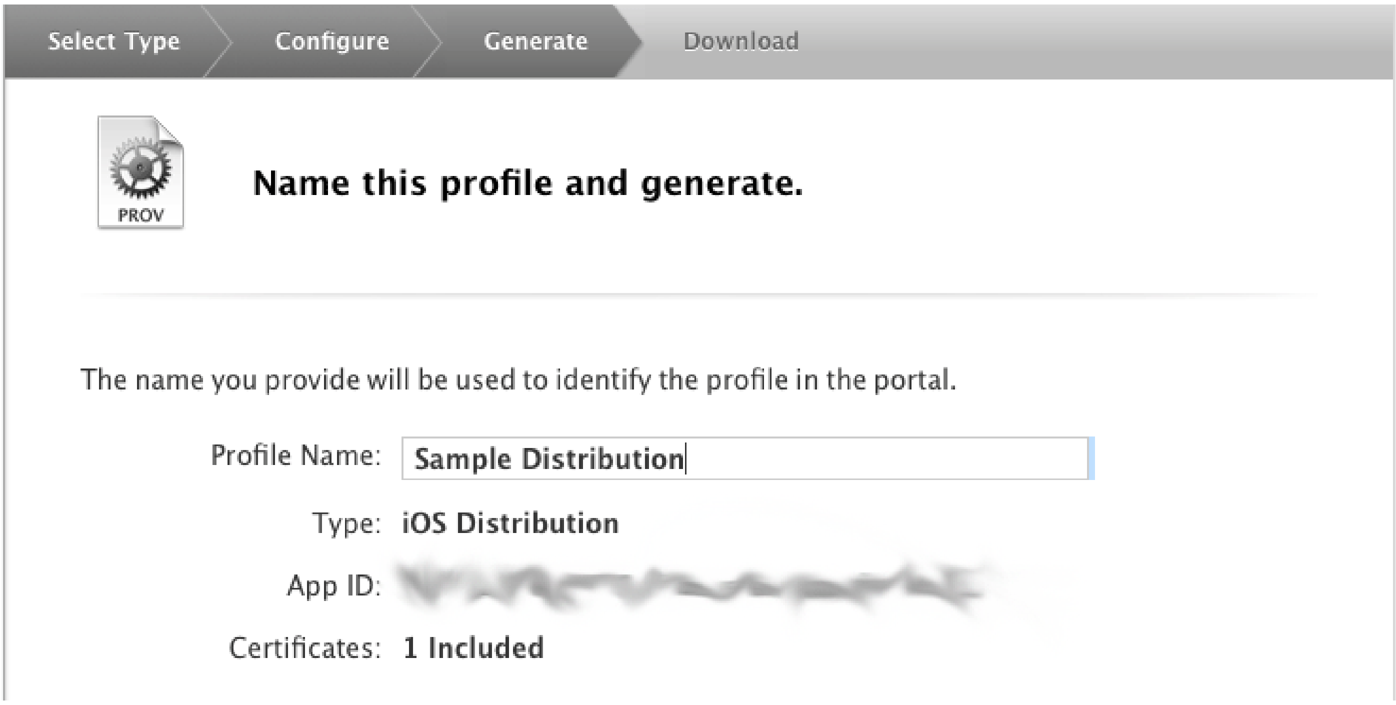
Select the certificates you wish to include in this provisioning profile. To use this profile to install an app, the certificate the app was signed with must be included.

● [redacted]
Jan 23, 2017

○ [redacted]
Sep 20, 2017

On the following screen you'll be prompted to name your **Distribution** profile.

As with generating the Development profile choose a name for your **Distribution** profile that is both distinctive and easily identifiable - as the Provisioning Profiles portal can easily fill with LOTS of profiles over time.



Name this profile and generate.

The name you provide will be used to identify the profile in the portal.

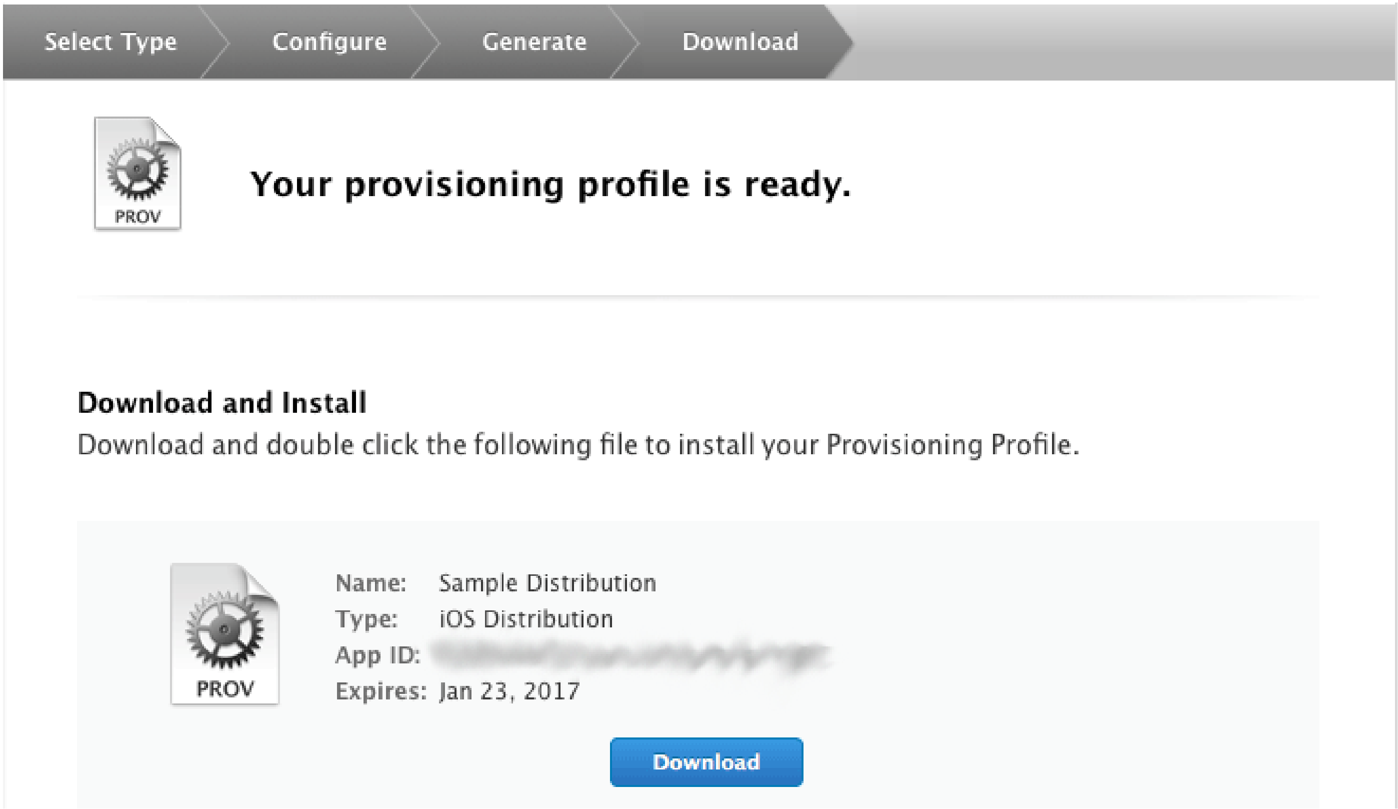
Profile Name: Sample Distribution

Type: iOS Distribution

App ID:

Certificates: 1 Included

On the final screen your generated **Distribution** Profile will be ready to download:



Your provisioning profile is ready.

Download and Install

Download and double click the following file to install your Provisioning Profile.

Name: Sample Distribution

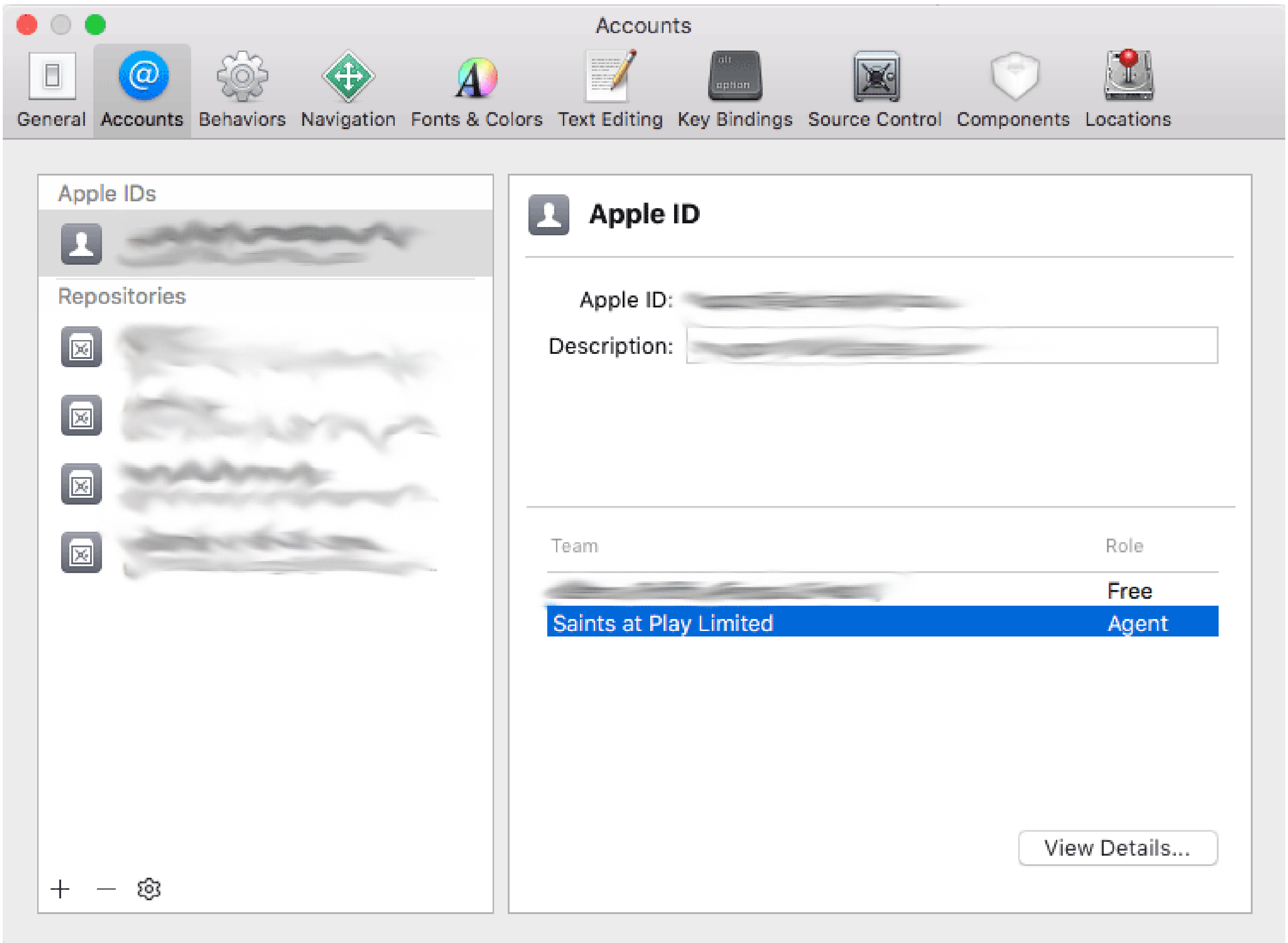
Type: iOS Distribution

App ID:

Expires: Jan 23, 2017

Within Xcode you should now be able to access all of the Signing Certificates and Provisioning Profiles that you have generated in your Apple Developer account.

To do so open the following menu option: **Xcode** > **Preferences**



Apple IDs: [redacted]

Repositories: [redacted]

Apple ID

Apple ID: [redacted]

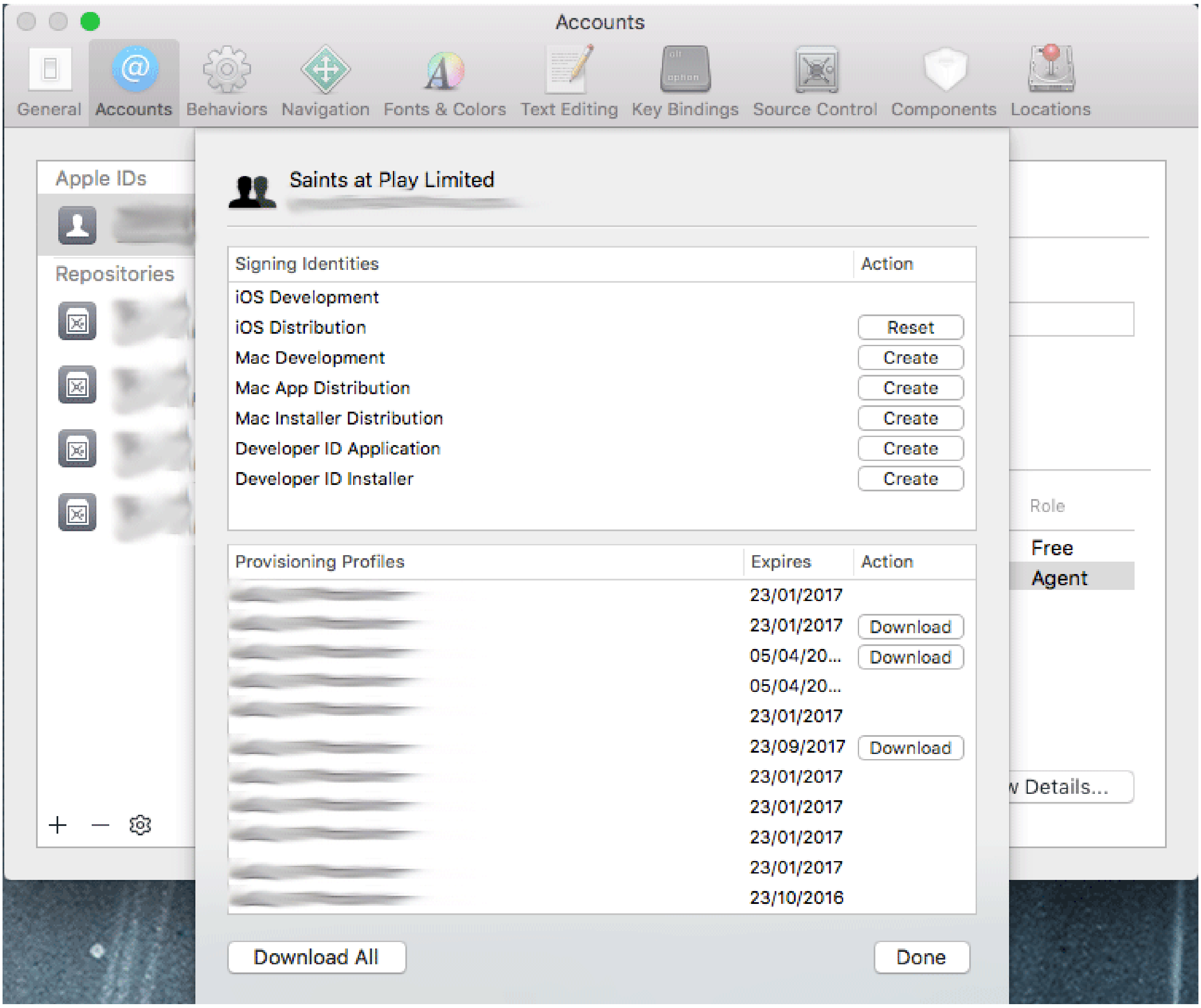
Description: [redacted]

Team	Role
[redacted]	Free
Saints at Play Limited	Agent

From the top of the window that appears select the **Accounts** option.

In the sidebar on the left hand side of this window select your Apple ID from those listed, then click on the relevant Team listing (if you're a single developer you will likely only have the one Team member - yourself!) and press **View Details**.

You should now see all of the Signing Certificates and Provisioning Profiles from your Apple Developer account displayed like so:



Saints at Play Limited

[redacted]

Signing Identities	Action
iOS Development	
iOS Distribution	Reset
Mac Development	Create
Mac App Distribution	Create
Mac Installer Distribution	Create
Developer ID Application	Create
Developer ID Installer	Create

Provisioning Profiles	Expires	Action
[redacted]	23/01/2017	
[redacted]	23/01/2017	Download
[redacted]	05/04/20...	Download
[redacted]	05/04/20...	
[redacted]	23/01/2017	
[redacted]	23/09/2017	Download
[redacted]	23/01/2017	
[redacted]	23/01/2017	
[redacted]	23/01/2017	
[redacted]	23/01/2017	
[redacted]	23/10/2016	

Now that all your Certificates and Profiles are in place you can deploy your iOS apps for testing and distribution directly through Xcode.

As you can see there's quite a lot of steps involved in code signing an iOS app:

- Generating a Certificate Signing Request (CSR) file
- Publishing signing certificates for development and production
- Creating App ID's
- Registering Device UDID's
- Generating provisioning profiles for development and distribution

Code signing an Android app is, in comparison, far quicker and less complicated.

Code signing an Android application

Where iOS requires signing certificates and provisioning profiles for development and distribution Android simply requires an app be signed only when it is ready to be published to the Google Play Store.

Prior to releasing for Google Play you can publish a debug (non-signed) version of the app to your Android device(s) for testing (which, compared to the different iOS configuration and set-up requirements, does make life a lot easier as a developer).

Signing Android applications is quite simple though and involves working from the command line using the Keystore utility (a free software tool - that comes included with your system JDK - which is used to manage cryptographic keys and trusted certificates).

In the Terminal navigate to the root of your app directory and issue the following command (replacing **app-name** with the name of your actual app and **alias_name** with a suitable alias for the keystore file):

```
keytool -genkey -v -keystore app-name-release-key.keystore -alias alias_name
-keyalg RSA -keysize 2048 -validity 10000
```

When the above command is run we will be prompted to create a password for the keystore and then answer a series of questions before the file is finally created.

When this process has been completed the generated keystore file will be saved in the root directory of your app.

IMPORTANT - It would be wise, for future reference, to save the keystore file to another location outside of your project (do NOT lose this keystore file as you won’t be able to make updates to your Android app if you do).

You definitely do NOT want this file to be added, or made available, to version control (as this would present a huge security risk) and nor should it be in the published IPA/APK binaries for your apps that are distributed via the Apple & Google Play App stores or via ad-hoc distribution.

If someone were to reverse-engineer the code for those binaries this means they would gain access to the keystore if it were present in the codebase - not good! Remember, a good developer is a security conscious developer!

If you've tried running the above command and are experiencing problems please refer to the following Android installation guide to make sure that the necessary software is installed on your environment and system paths are correctly configured (this is hugely important so DON'T overlook this): http://cordova.apache.org/docs/en/latest/guide/platforms/android/index.html.

Signing your Android app

You should now have a keystore file residing in the root directory of your project.

In order to sign your Android app you'll firstly need to generate a build file with the following Terminal command:

```
ionic build --release android
```

Once successfully completed this will generate an unsigned APK file, based on the values you entered in your **config.xml** file, located in the following directory:

```
platforms/android/build/outputs/apk/
```

To sign this unsigned APK file you'll need to run the **jarsigner** utility (another tool included with the JDK installation on your system) which generates the necessary digital signature for the APK file based on the information contained within the keystore.

From the Terminal issue the following command:

```
jarsigner -verbose -sigalg SHA1withRSA -digestalg SHA1 -keystore app-name-release-key.keystore nameOfYourApp-release-unsigned.apk alias_name
```

IMPORTANT - Be sure to change the following from the above command to match the values on your own system:

- **app-name-release-key.keystore** (change this to the name of the keystore file that you generated earlier and, if required, prefix with any path to this file)
- **nameOfYourApp-release-unsigned.apk** (change to the path/name of the unsigned APK file)
- **alias_name** (the alias you used when generating the keystore file)

Once you’ve generated the signed APK file the last step will involve optimising this using the zipalign tool (which will have been installed as part of Android Studio):

```
zipalign -v 4 nameOfYourApp-release-unsigned.apk nameOfYourApp.apk
```

As before change the following to match the values of your own project (and don’t forget to prefix with the path to each file):

- **nameOfYourApp-release-unsigned.apk**
- **nameOfYourApp.apk**

Once completed you should find the signed and optimised APK file (nameOfYourApp.apk) located in the *platforms/android/build/outputs/apk/* directory.

Now your android app is signed and ready for submission to the Google Play store!

In the next chapter we’ll look at how to submit iOS apps to the Apple App Store.

Submitting
your iOS app
to the Apple App Store

In this chapter I'll take you through how to submit your own iOS apps to the Apple App Store (this should go without saying but DON'T submit any of the example projects included in or with this book - feel free to use the code how you see fit BUT make sure the apps you submit genuinely are your own - just to avoid legal complications and accusations of plagiarism/theft if nothing else).

Before you can submit your app you'll need to ensure that you have completed the following steps:

- Registered as an Apple Developer
- Registered with the iOS developer program
- Ensured that your app complies with the Apple Store Review Guidelines (if it doesn't the chances of your app being rejected are quite high)
- Have tested your app thoroughly (and fixed any bugs/issues in the process)

Be aware that membership to the iOS Developer program incurs an annual fee of $100. If you don't renew your annual payment your apps will no longer be available on the Apple App Store (unlike Google Play which has a one-off registration fee for membership).

Assuming that the above conditions are met we'll proceed with the following steps:

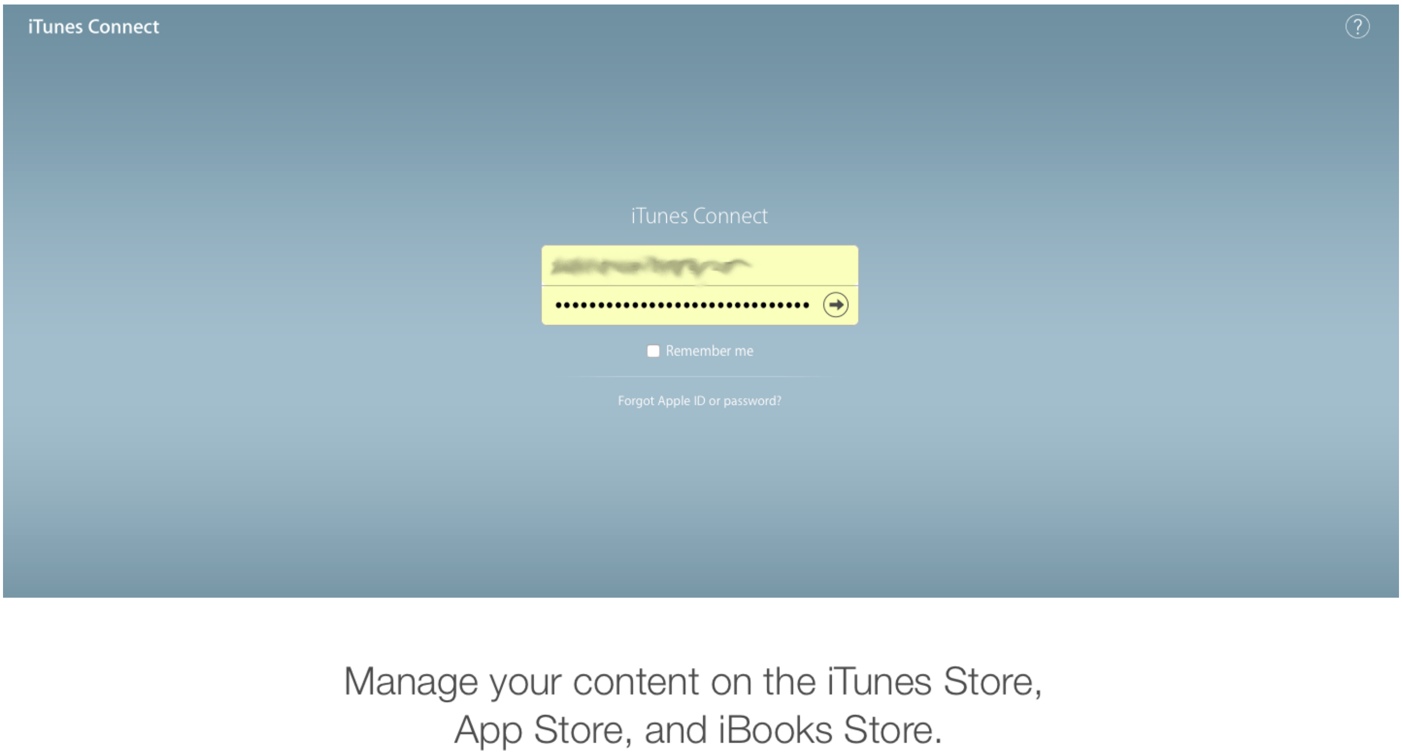
- Create an app listing on the App Store
- Submit an iOS app through Xcode
- Use Apple's TestFlight to test the submitted iOS app
- Publish our app for App Store review

Creating an app listing on the App Store

There's a few hurdles to clear when setting up your App Store listing but they are, thankfully, quite straightforward and simple to work through.

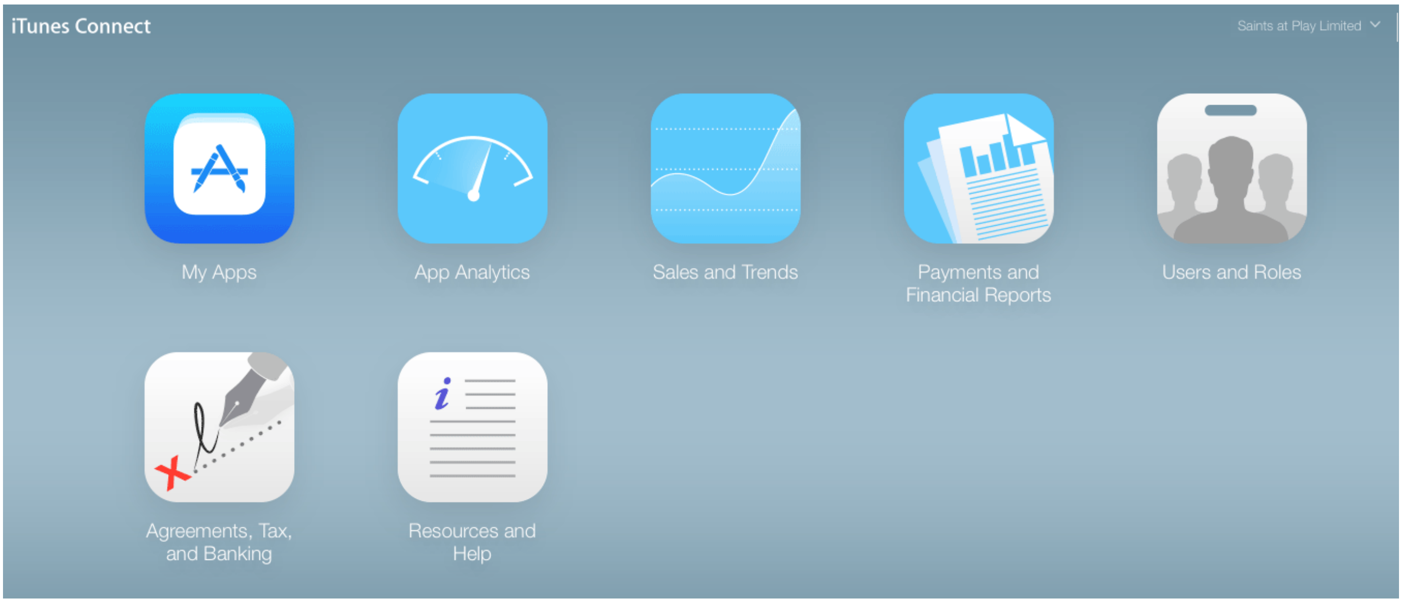
The following screen captures and explanations will document this process visually and help guide you through each step.

In your web browser, navigate to the iTunes Connect portal and log into your developer account:

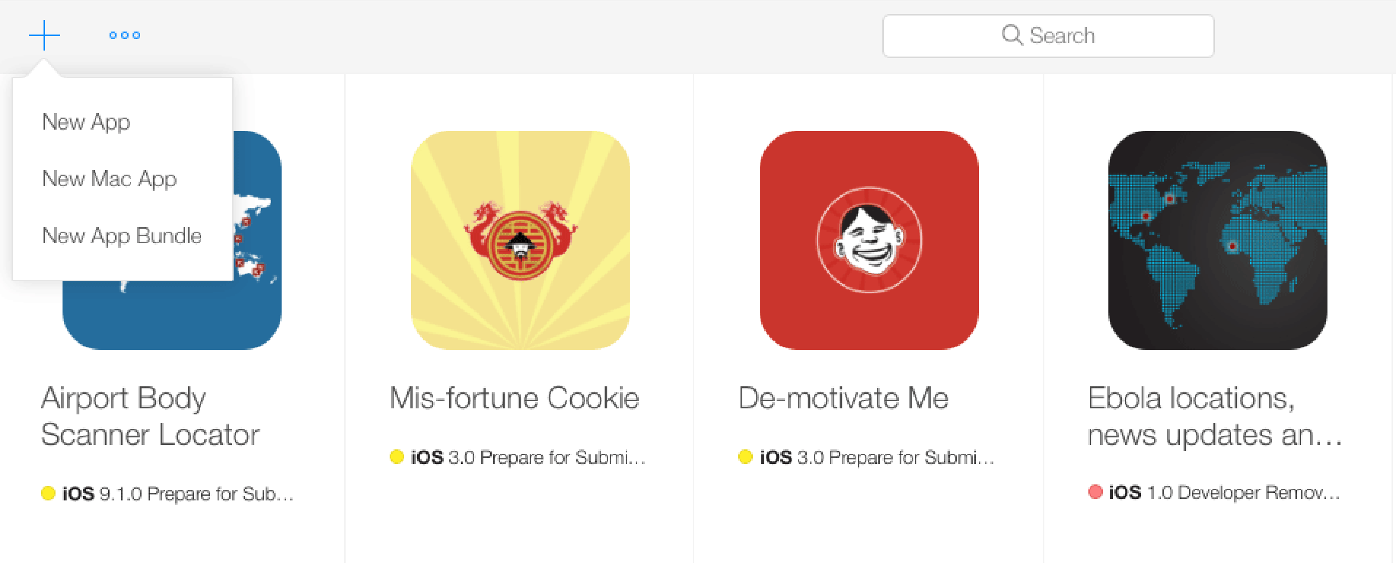


Manage your content on the iTunes Store,
App Store, and iBooks Store.

Once logged in select the My Apps link from the displayed navigation options on the iTunes Connect dashboard page:

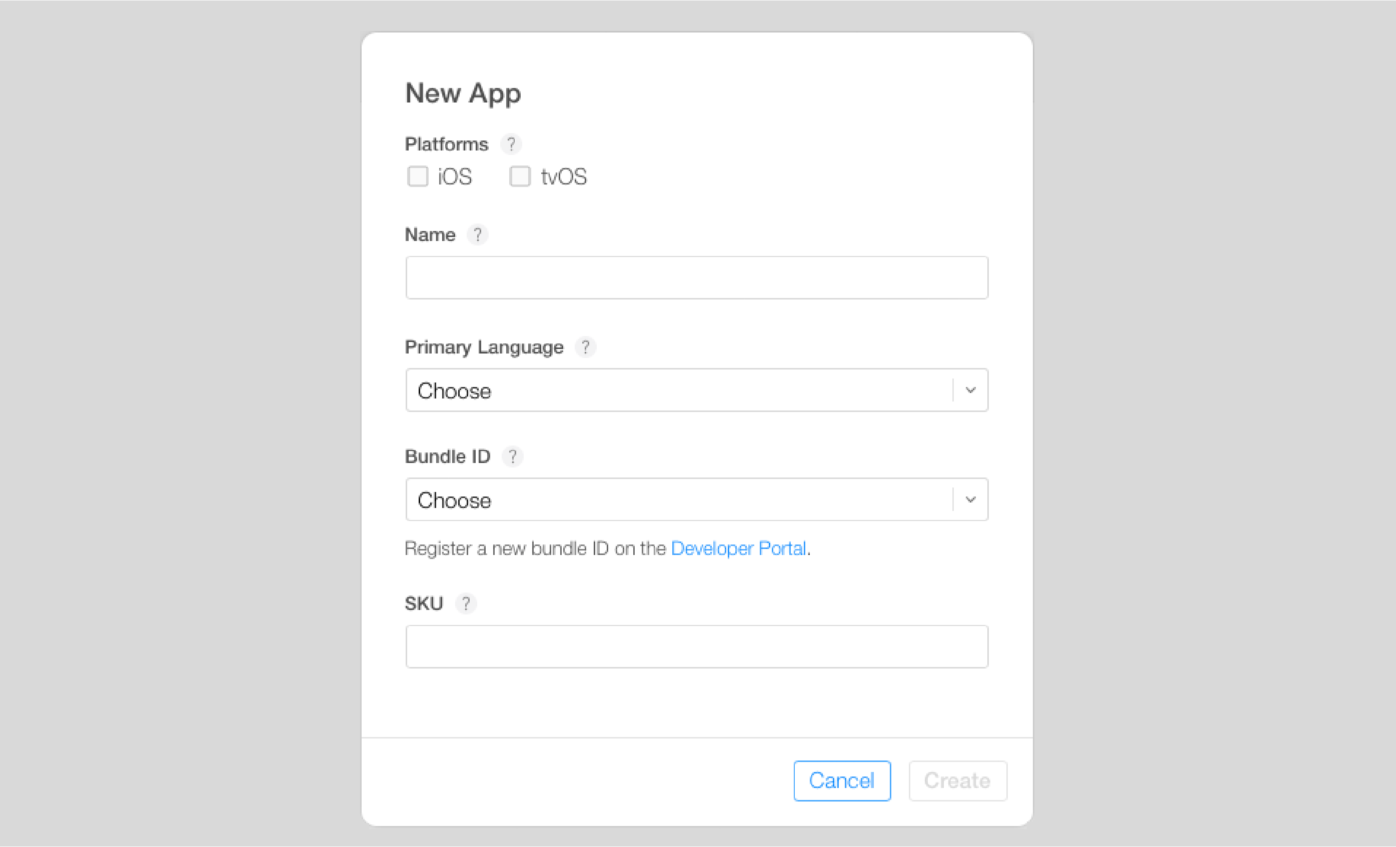


Click on the + icon at the top left of the page, under the iTunes Connect heading, and, from the menu options that are subsequently displayed, select New App:


+
Search
New App
New Mac App
New App Bundle
Airport Body Scanner Locator
iOS 9.1.0 Prepare for Sub…
Mis-fortune Cookie
iOS 3.0 Prepare for Submi…
De-motivate Me
iOS 3.0 Prepare for Submi…
Ebola locations, news updates an…
iOS 1.0 Developer Remov…

A modal window will then be displayed with the following input fields:

- **Platforms** (iOS or tvOS - select iOS)
- **Name** (app name as it will appear on the App Store - maximum of 50 characters)
- **Primary Language**
- **Bundle ID** (select an App ID - that was created in the Developer Portal - from the menu. See next step for details)
- **SKU** (a unique ID for the app that won't be visible on the App Store)


New App

Platforms ?

□ iOS □ tvOS

Name ?

Primary Language ?

Choose

Bundle ID ?

Choose

Register a new bundle ID on the Developer Portal.

SKU ?

Creating App ID's

An App ID can be used to identify each App submitted by a developer/development team to the App Store and register the services that the App can use such as Apple Pay, HealthKit or In-App Purchases for example.

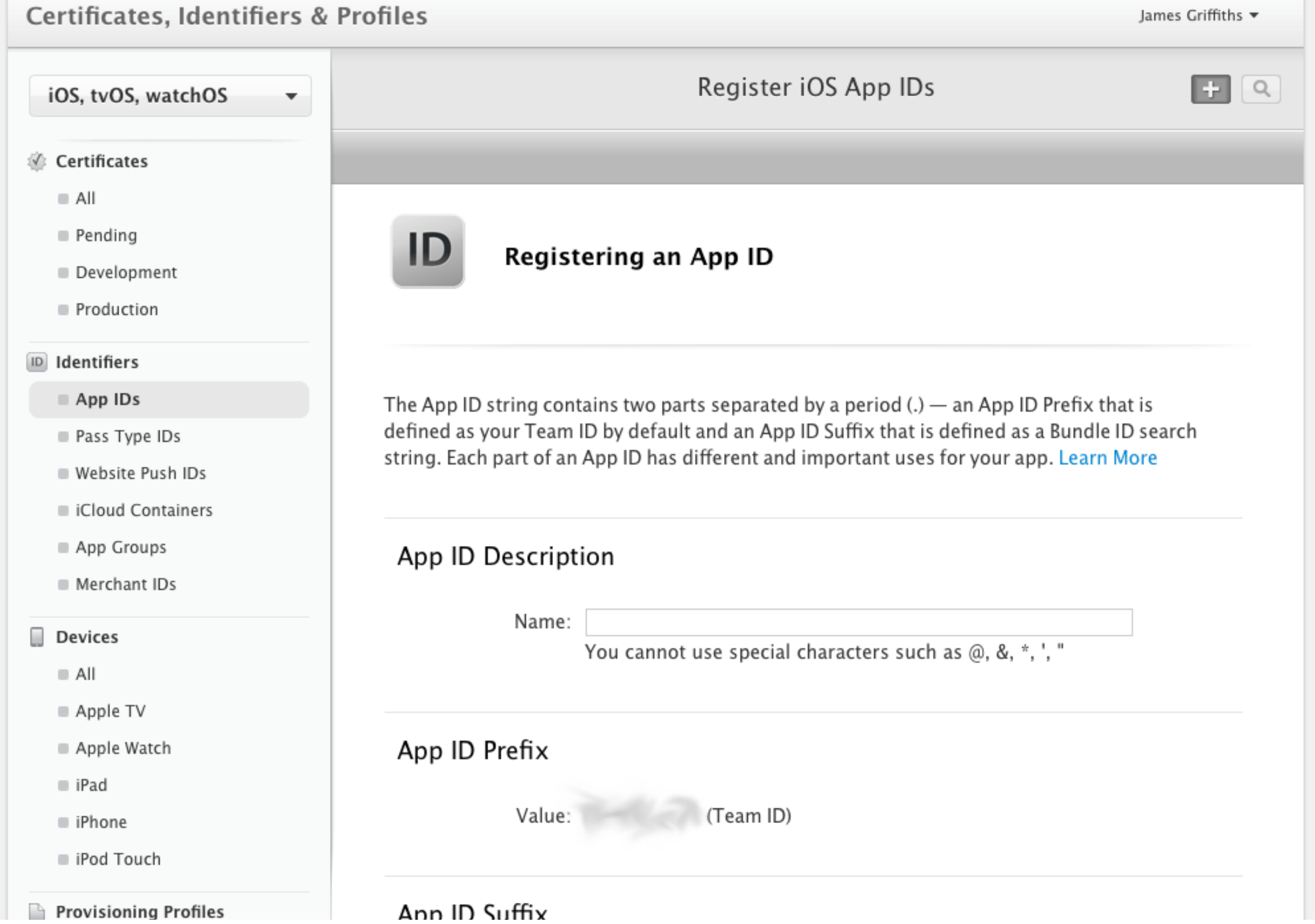
App ID's can be created in two ways:

- Wildcards (using asterisks - which match one or more apps)
- Explicit App ID (which matches the bundle ID for a specific app)

Explicit App ID's are written in a reverse domain style notation (using alphanumeric characters with no spaces, asterisks or special characters) such as:

```
com.saintsatplay.nameofAppHere
```

These can be generated from within Xcode itself or directly through your Apple Developer account - as shown on the following screen:



Registering an App ID

The App ID string contains two parts separated by a period (.) — an App ID Prefix that is defined as your Team ID by default and an App ID Suffix that is defined as a Bundle ID search string. Each part of an App ID has different and important uses for your app. Learn More

App ID Description

Name:

You cannot use special characters such as @, &, *, ', "

App ID Prefix

Value: [redacted] (Team ID)

App ID Suffix

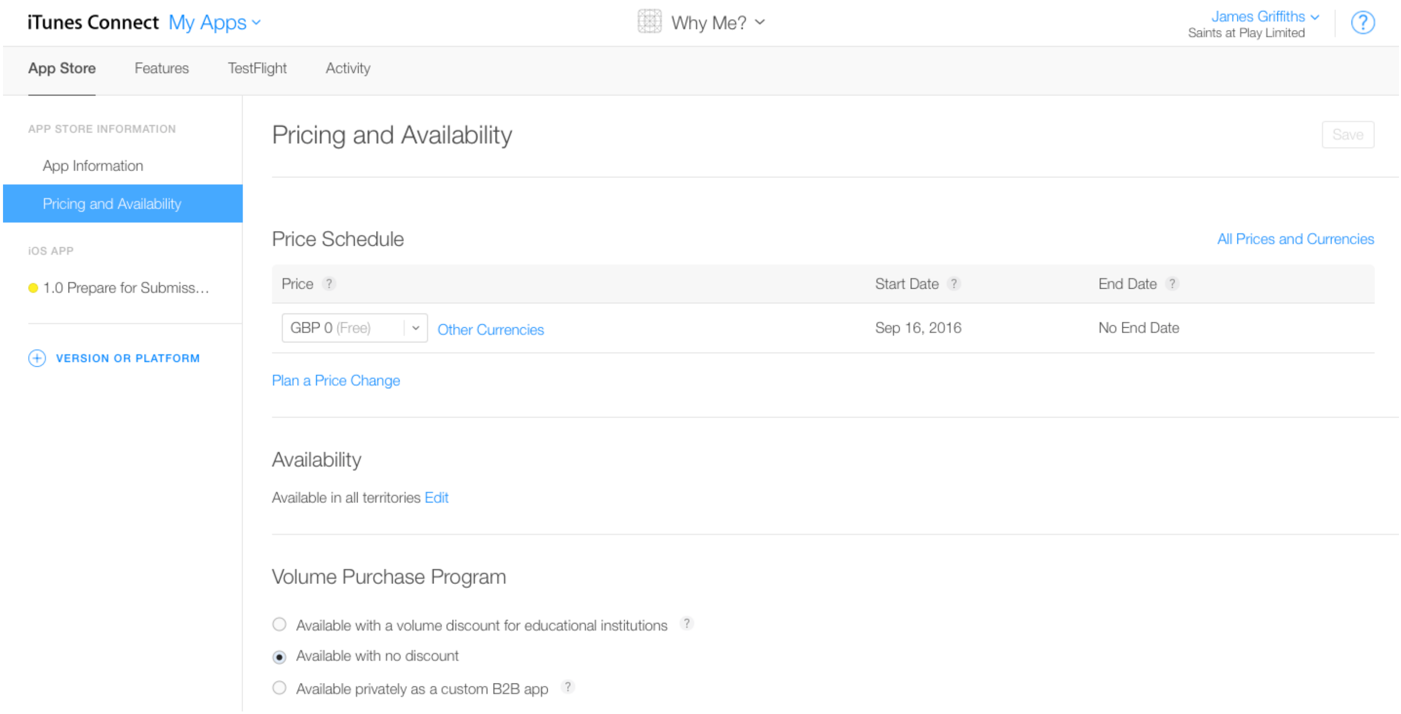
For further information concerning App ID’s view the official Apple documentation.

Going back to your iTunes Connect account, once you’ve entered data into the fields on the New App modal form and clicked on the Create button you will, presuming no errors were encountered, see your new app displayed on the dashboard.

Click on the blank icon for your new app and enter the required data and assets for the following dashboard pages:

- App Information
- Pricing and Availability
- Prepare for Submission

IMPORTANT - If you select a paid tier option from the **Pricing and Availability** screen you’ll be required to accept the Paid Applications contract located in the **Agreements, Tax and Banking** section of your iTunes Connect account:



Pricing and Availability

Price Schedule

Price	Start Date	End Date
GBP 0 (Free) Other Currencies	Sep 16, 2016	No End Date

Availability

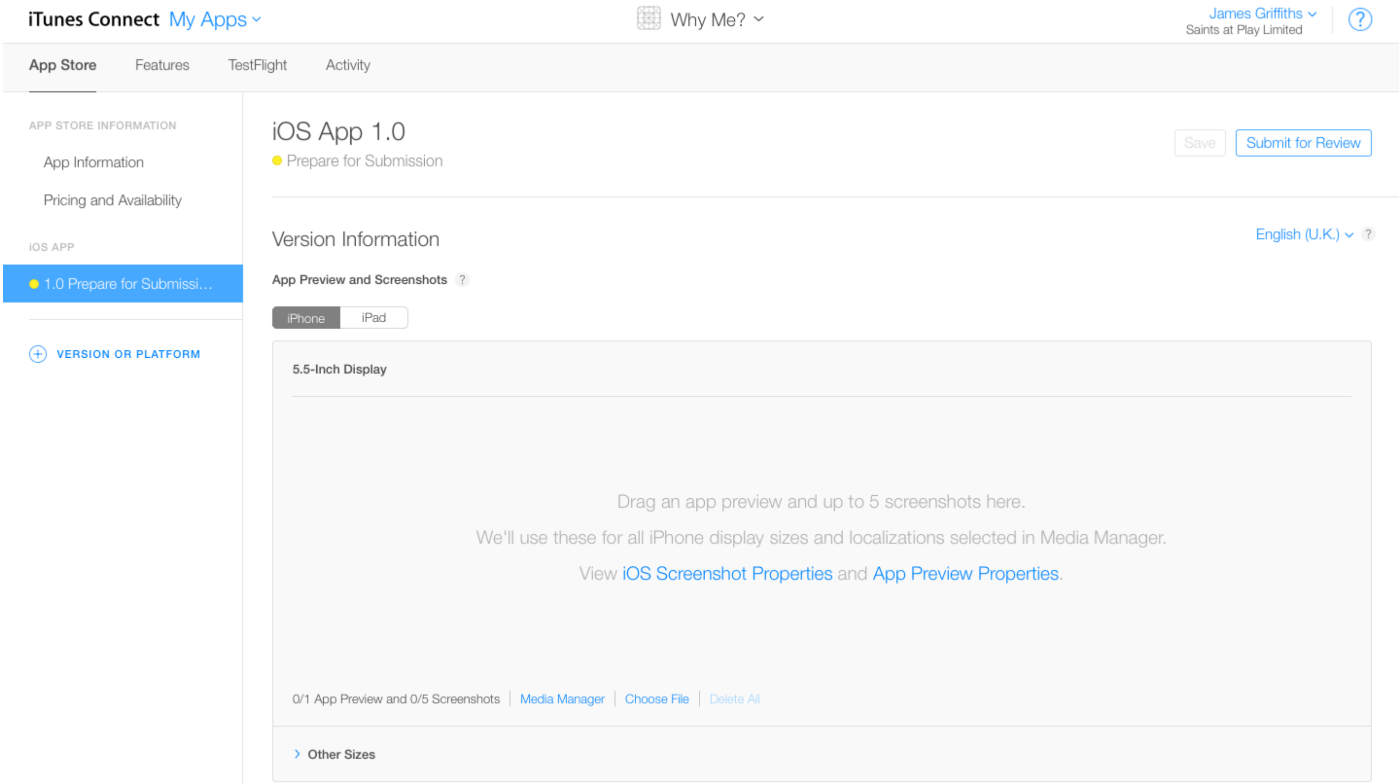
Available in all territories Edit

Volume Purchase Program

○ Available with a volume discount for educational institutions
● Available with no discount
○ Available privately as a custom B2B app

The **Prepare for Submission** screen requires, amongst other content, that you submit screenshots displaying your app on different sized devices (which can be handled through the iTunes Connect Media Manager) and an App Build file (which will be subsequently uploaded using Xcode or the Application Loader software - which we’ll cover in the next section - once this Build file is uploaded you will then be able to select the uploaded file).

Note - It’s worth spending time getting the required screenshots right as these will help potential customers decide if they want to interact with your App Store listing and download your app:



Drag an app preview and up to 5 screenshots here.
We'll use these for all iPhone display sizes and localizations selected in Media Manager.
View iOS Screenshot Properties and App Preview Properties.

Uploading your App

Depending on which operating system you are using there are a few ways in which your iOS app can be uploaded to the Apple App Store.

If you’re using a Mac you can use either of the following applications:

- Xcode
- Application Loader

If you’re using Windows or Linux as your development platform you would have to use an online service such as the following:

- Xcloud
- Mac in Cloud
- Buddy Build

In this section I'll show you how to prepare and upload your app to the Apple App Store using Xcode (this presumes you have set up the necessary certificates and profiles as discussed in the **Code signing for iOS & Android** chapter - if you haven't done this go back now, read through that chapter and ensure you have followed the instructions contained within).

Okay, let's begin.

Open the **config.xml** file for your app (located in the root of your project) and edit the following fields/attributes to your particular requirements:

- **widget ID** (use reverse domain name notation - I.e. com.saintsatplay.nameOfApp - this must match the Bundle ID you set for the app when creating the App Store listing in iTunes Connect)
- **Name** (What your app is called)
- **Description** (A brief summary of the app; what it does, its purpose etc.)
- **Author** (Developer/team name, e-mail address and website address)

If necessary, add or amend any platform specific preferences in this file too (refer back to the **Preparing apps for release** chapter for further details on the available options for this file).

Save this file and now, using your Terminal navigate to the root of your ionic project and run the following Ionic CLI command:

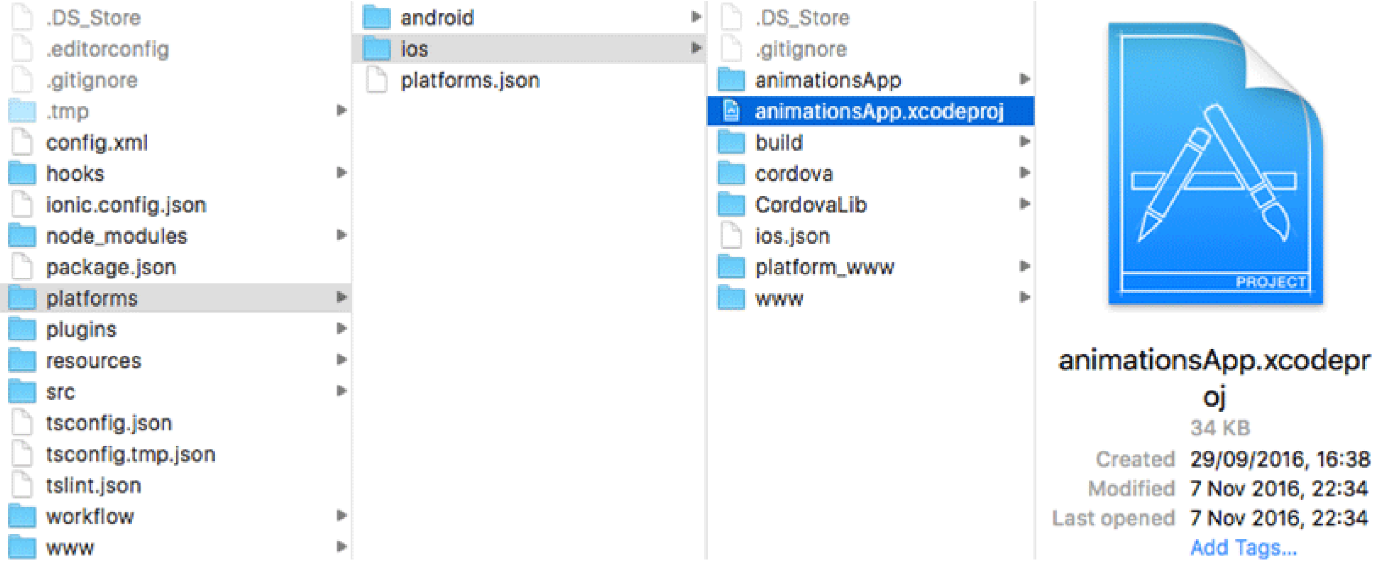
```
ionic build ios
```

This will generate the necessary source code which allow the app to be tested on a mobile emulator or be deployed to a mobile/tablet device for the same purposes.

This will NOT however generate the IPA file which will be needed to submit to the Apple App Store.

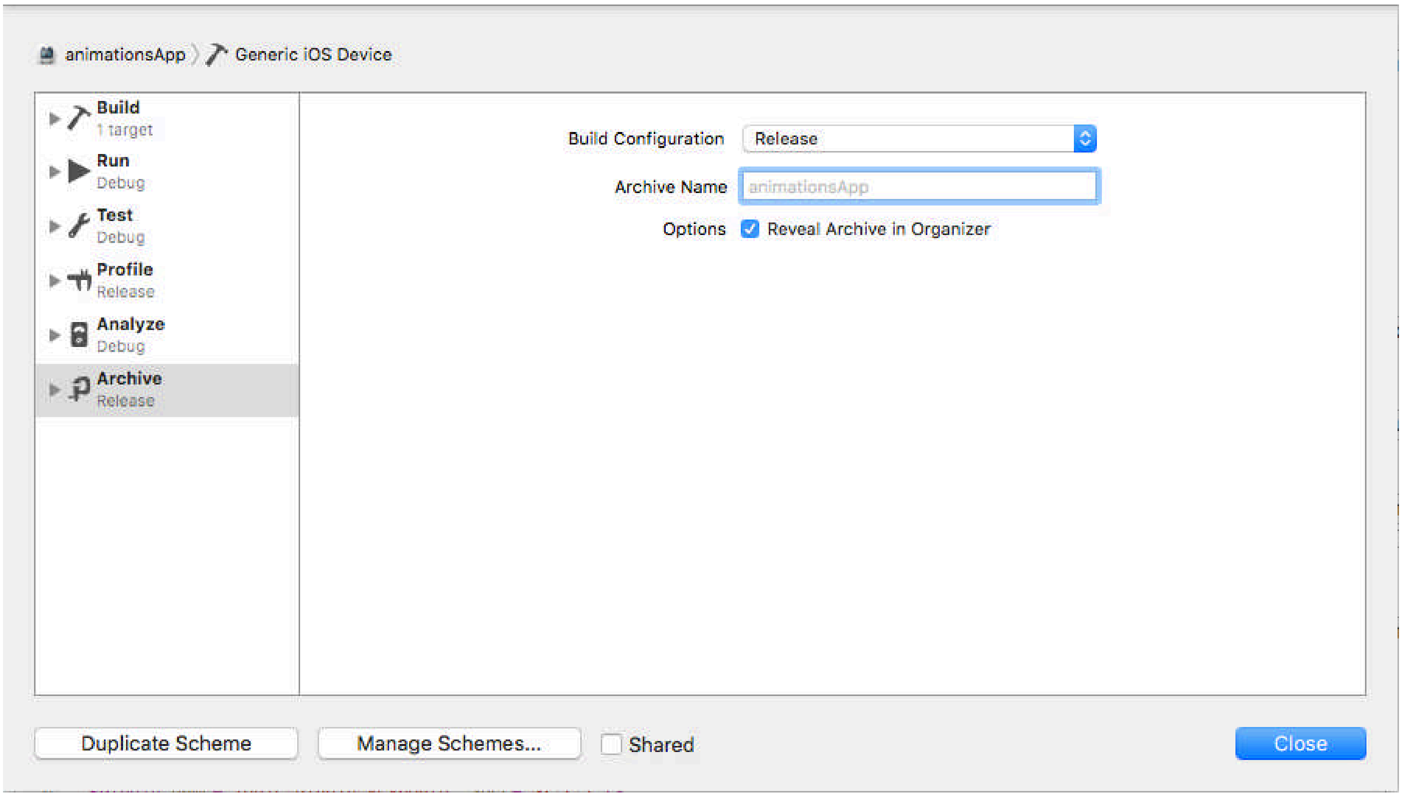
For this we will need to use Xcode.

Navigate to your app's iOS directory and double-click on the Xcode project file to open this within Xcode:



Once your project has been opened in Xcode select Product > Scheme > Edit Scheme from the application menu and, in the window that appears:

- Select the name of the app (from the top left hand side of the window) and iOS Device or Generic iOS Device (do NOT select an emulator)
- Select Archive from the left hand menu
- Select Release from the Build Configuration menu


animationsApp 〉 Generic iOS Device

Build Configuration: Release

Archive Name: animationsApp

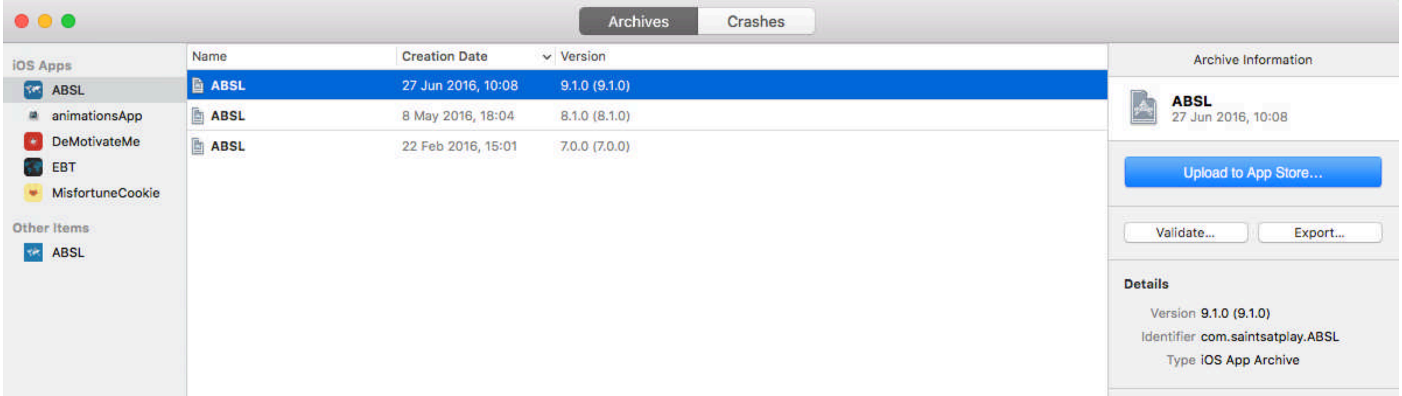
Options: ☑ Reveal Archive in Organizer

Close this window and run the following commands from the application menu:

- Product > Clean
- Product > Archive

The first command will clean the project code of any product files and/or any other intermediate files created during the build process. This ensures the project isn't trying to reference files which may have been removed by the developer - think of it as spring cleaning if nothing else!

The latter command generates the necessary iOS App archive, which if no errors are returned during the archiving process, should be displayed in the Archives tab of the Organizer window like so:



Name	Creation Date	Version
ABSL	27 Jun 2016, 10:08	9.1.0 (9.1.0)
ABSL	8 May 2016, 18:04	8.1.0 (8.1.0)
ABSL	22 Feb 2016, 15:01	7.0.0 (7.0.0)

ABSL
27 Jun 2016, 10:08

Details
Version 9.1.0 (9.1.0)
Identifier com.saintsatplay.ABSL
Type iOS App Archive

You will want to validate your archive before you submit this to the Apple App Store so as to ensure there are no errors with the generated file.

You might think this unnecessary after thoroughly testing your app from the code level to device level with different procedures such as unit tests, profiling, testing across different devices etc. to ensure there are no bugs/performance issues.

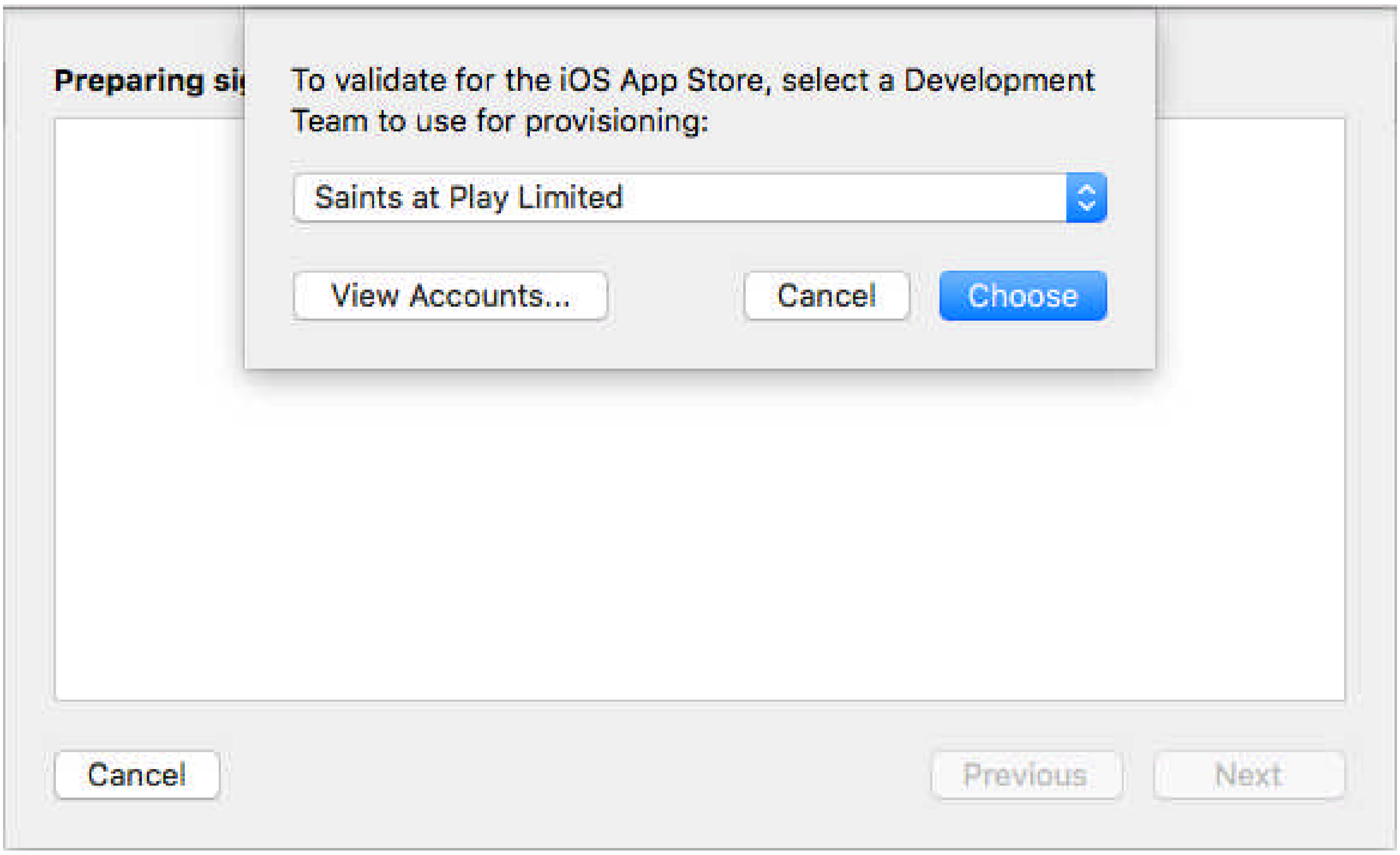
You would be wrong though.

The validation check can still throw up errors and issues (that would get your app rejected by the App Store moderators) that you otherwise may not have been aware of so DO take the time to run this.

Select your app archive and on the right hand side of the window click on the

Validate button (located directly underneath the Upload to App Store... button).

As this process runs you will be prompted to select a development team account for provisioning:



To validate for the iOS App Store, select a Development Team to use for provisioning:

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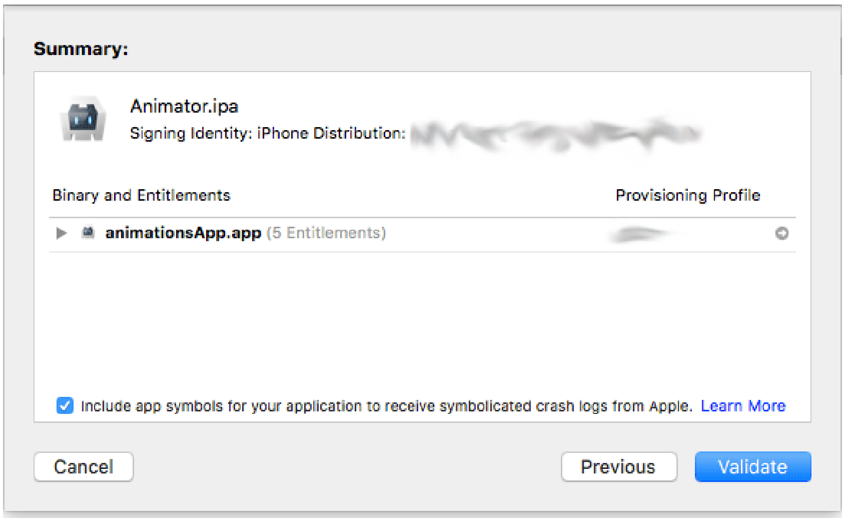
Xcode will automatically attempt to detect the correct profile for you but you can override this if you need to from the options displayed within the prompt itself.

Once you've done this Xcode will prepare the archive for validation and display a summary of the IPA file and its entitlements:



Summary:

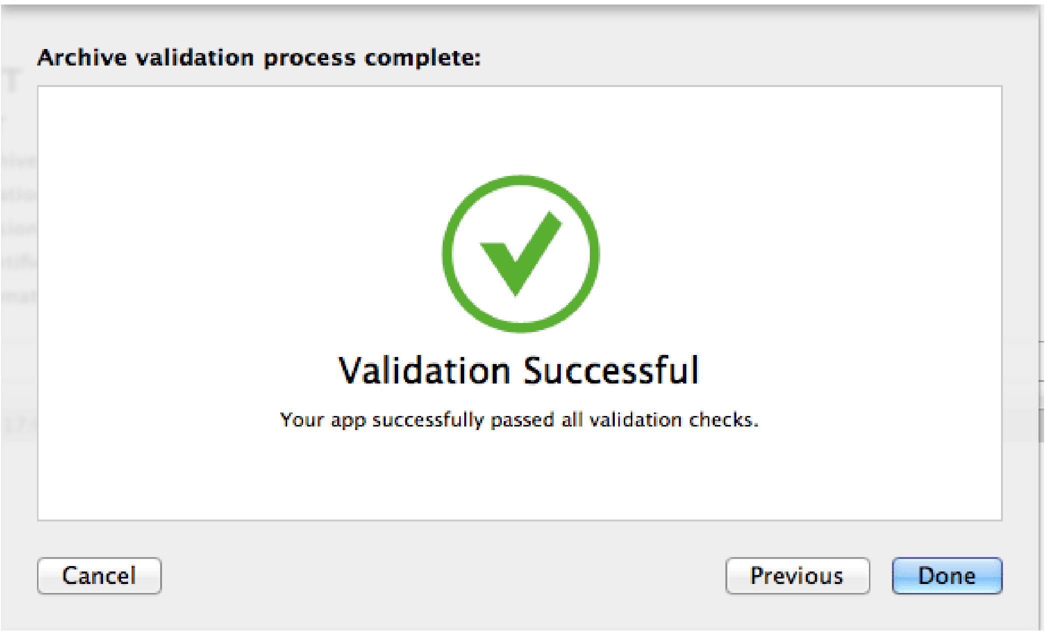
Animator.ipa

Signing Identity: iPhone Distribution: [redacted]

Binary and Entitlements	Provisioning Profile
▶ animationsApp.app (5 Entitlements)	[redacted]

☑ Include app symbols for your application to receive symbolicated crash logs from Apple. Learn More

Click on the Validate button to begin the process of Xcode submitting app data to Apple's Servers for validation and, if the check is successful, you should be greeted with a message like so:



Archive validation process complete:

Validation Successful

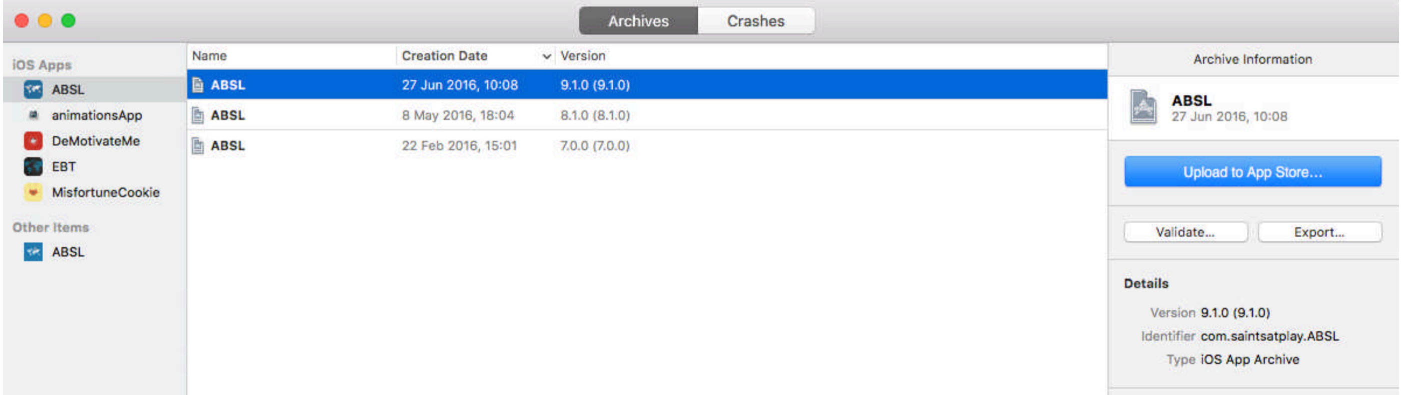
Your app successfully passed all validation checks.

If the validation check should fail ensure that:

- The **config.xml** widget ID matches the Bundle ID for the app (as configured on the App Store listing for the app)
- All required certificates and profiles have been configured and assigned correctly
- There are no unused launch icons for the app

Usually the error message that is returned should be enough to guide you as to the source of the validation failure, follow what this states (even if you have to spend some time googling the answer!) and make the necessary amendments before running the validation check again.

Once the app has been successfully validated you can submit the archive to the Apple App Store using the Upload to Apple App Store button on the right hand side of the Organizer window (as displayed in the following screen capture):



Name	Creation Date	Version
ABSL	27 Jun 2016, 10:08	9.1.0 (9.1.0)
ABSL	8 May 2016, 18:04	8.1.0 (8.1.0)
ABSL	22 Feb 2016, 15:01	7.0.0 (7.0.0)

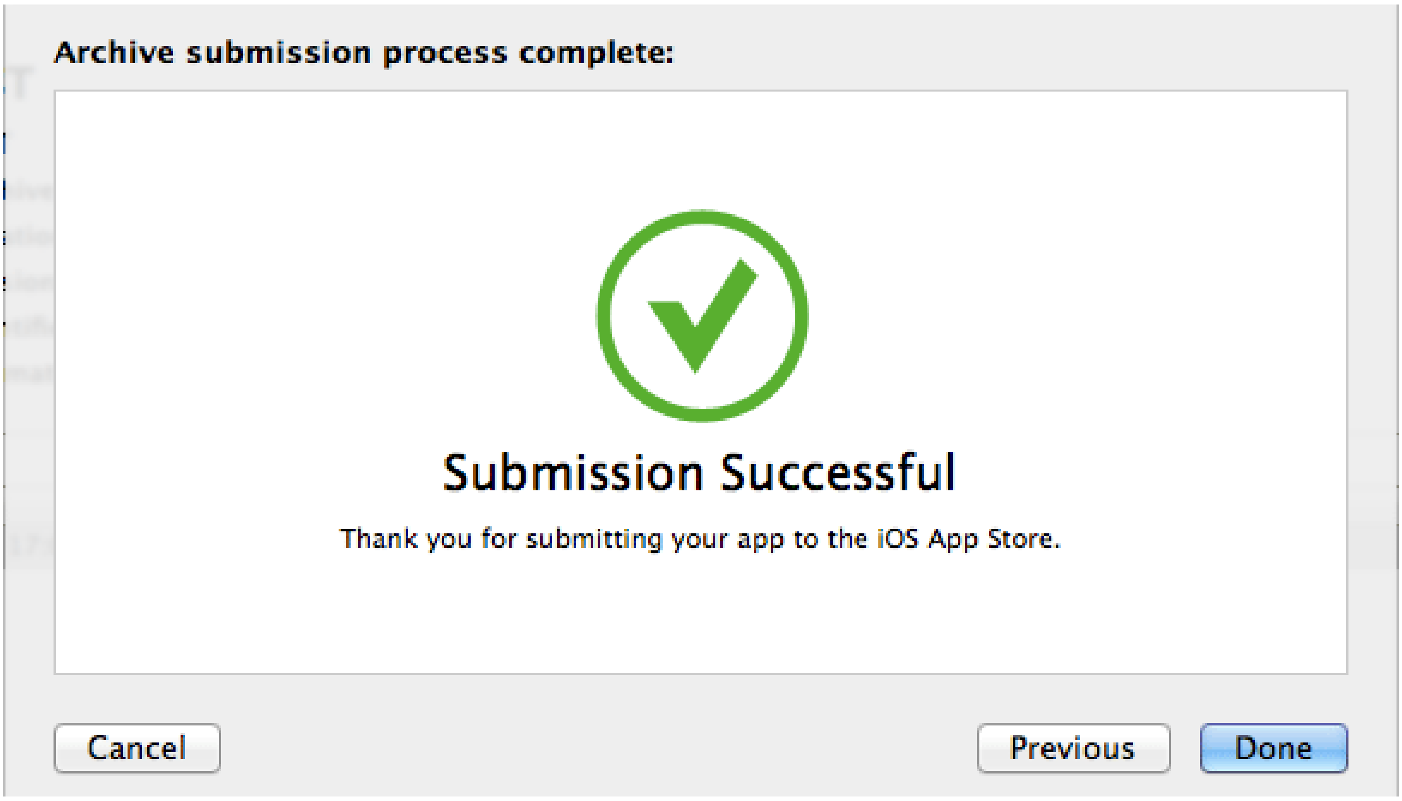
ABSL
27 Jun 2016, 10:08

Details

Version 9.1.0 (9.1.0)
Identifier com.saintsatplay.ABSL
Type iOS App Archive

This will repeat a similar process to that of the validation check where you will be prompted to select the development team account.

The submission process should take a few minutes, depending on the size of your archive, the speed of your network connection and any server latency at Apple's end, and, if all runs smoothly, you should see the following message returned:



Archive submission process complete:

Submission Successful

Thank you for submitting your app to the iOS App Store.

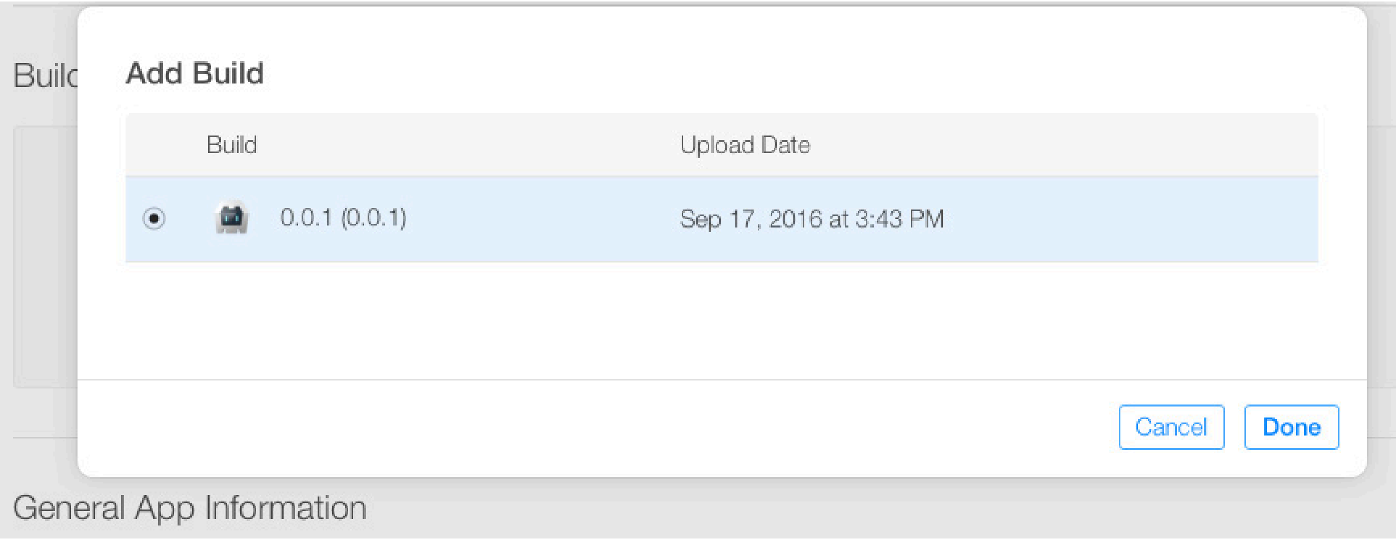
If the submission fails, use the returned error message to guide you in resolving this.

You can also revisit the **Troubleshooting your Ionic App chapter** for possible causes of failed App Store submissions & solutions to this problem.

Now there's one final step remaining before you can submit your app for review.

Assuming that your archive submission was successful you will eventually receive an automated e-mail from Apple informing you that your build has been processed.

Once this has happened log into your iTunes Connect account, navigate to the App Store listing for your recently uploaded archive and select that file from the Build section on the Prepare for Submission screen like so:



Add Build

	Build	Upload Date
●	0.0.1 (0.0.1)	Sep 17, 2016 at 3:43 PM

Save this selection and spend time going back over your listing; double checking all of the supplied assets and content to ensure you are satisfied with everything before you finally submit the app for review.

The review process can take between 2 - 10 days, which can seem frustratingly long (particularly if you're on the latter end of that scale) although in my experiences over recent months, the turnaround time has been 2 - 3 days.

Just be sure that, prior to submission, you have tested your app thoroughly and checked that it complies with the App Store guidelines otherwise the app might be rejected. Then it will be time spent fixing, where possible, the reason(s) for rejection and then waiting for the app to be reviewed again which is not a situation you want to find yourself in!

Submitting your Android App to the Google Play Store

In this chapter I'll take you through how to submit your own Android apps to the Google Play Store (as I stated in the last chapter DON'T submit any of the example projects included in or with this book - feel free to use the code how you see fit BUT make sure the apps you submit genuinely are your own - just to avoid legal complications and accusations of plagiarism/theft if nothing else).

Before you can submit your Android app to the Google Play store you'll need to ensure that you have completed the following steps:

- Registered as a Google Play Developer
- Ensured that your app complies with the Material Design Guidelines and Core App Quality Guidelines
- Have tested your app thoroughly (and fixed any bugs/issues in the process)

Unlike Apple Developer membership the Google Play Developer program incurs a one-off fee of $25 which makes this option a very cost-effective purchase for developers on a limited budget.

Assuming that the above conditions are met we'll proceed with the following steps:

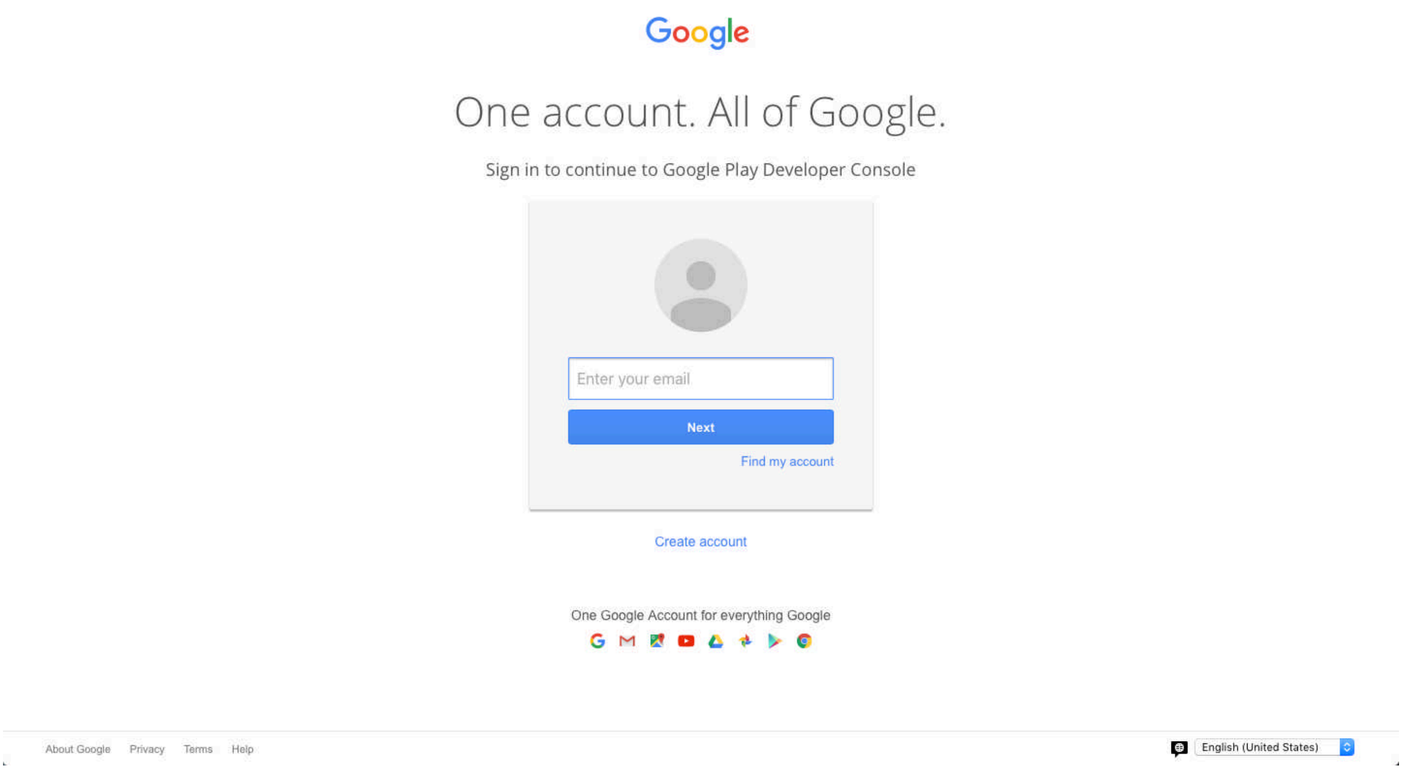
- Create an app listing on the Google Play Store
- Submit our Android App to the Google Play Store
- Publish our app for App Store review

Creating an app listing on the Google Play Store

Similar to creating an app listing on the Apple App Store there's a few hurdles to clear when setting up your Google Play Store listing but they are, thankfully, quite straightforward and simple to accomplish.

The following screen captures and explanations will document this process visually and help guide you through each step.

Log into your Google Play developer account at https://play.google.com/apps/publish/:



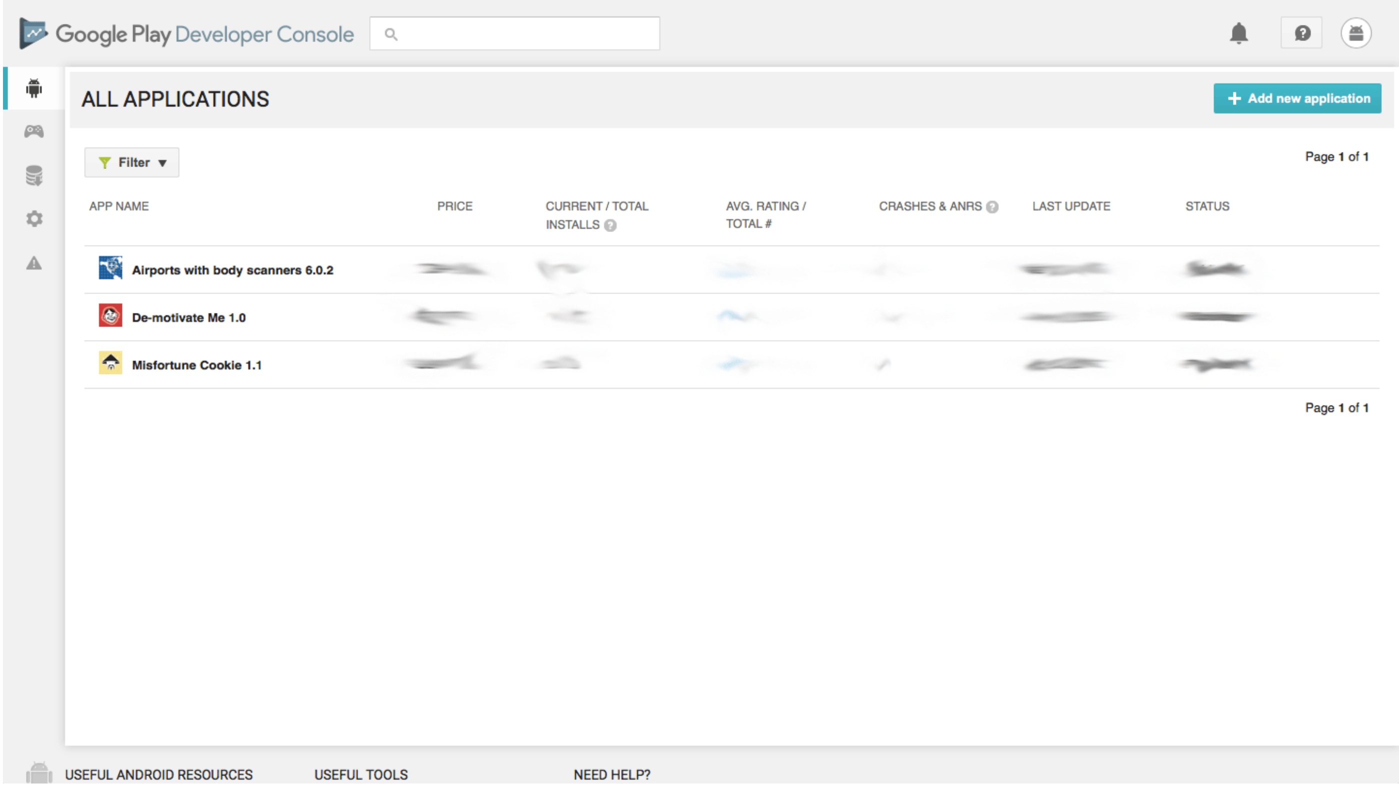
Google

One account. All of Google.

Sign in to continue to Google Play Developer Console

One Google Account for everything Google

Once logged in the Google Play Developer dashboard will be displayed, listing any existing apps you may already have published:



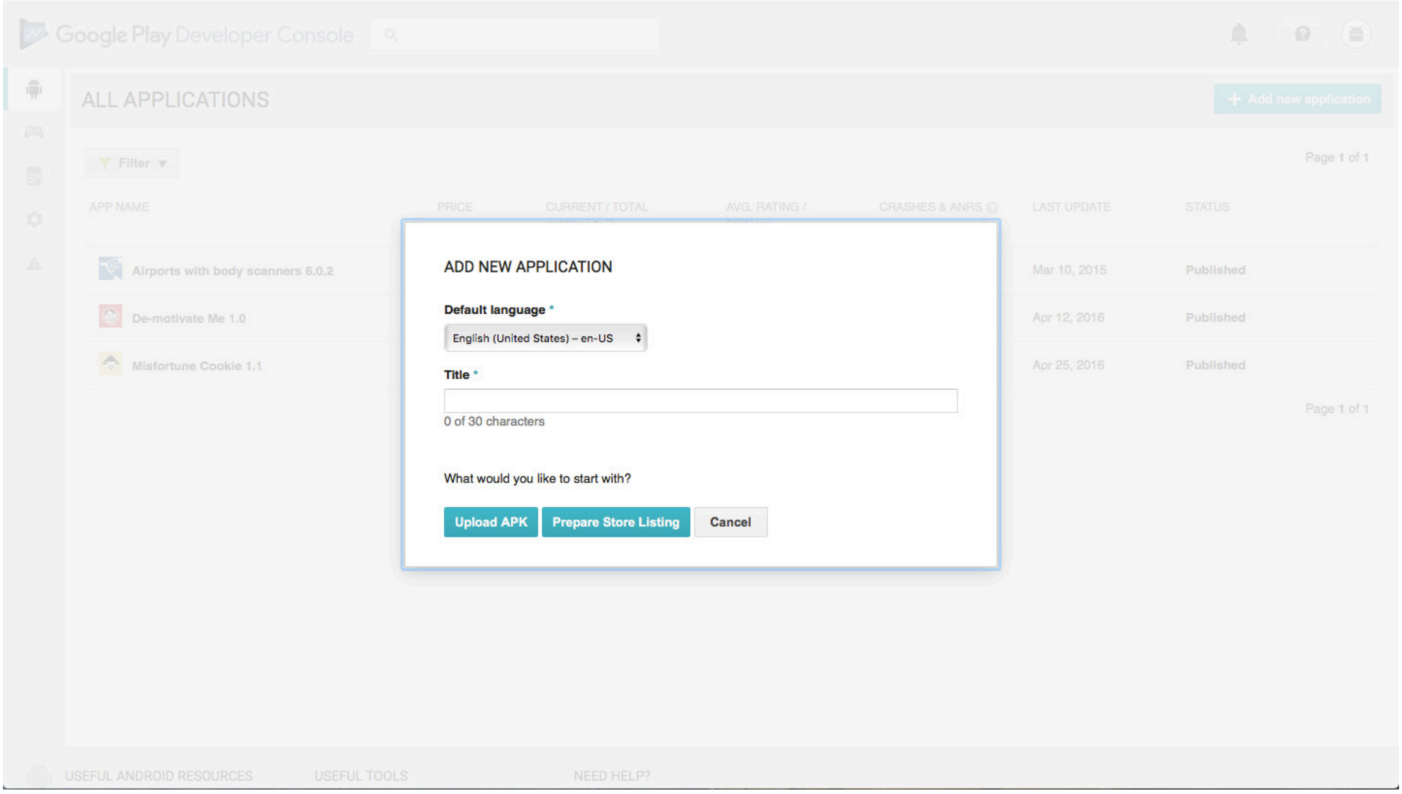
ALL APPLICATIONS

Page 1 of 1

APP NAME	PRICE	CURRENT / TOTAL INSTALLS	AVG. RATING / TOTAL #	CRASHES & ANRS	LAST UPDATE	STATUS
Airports with body scanners 6.0.2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
De-motivate Me 1.0	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Misfortune Cookie 1.1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Page 1 of 1

To add a new Android Application simply click on the Add new application button towards the top right of the dashboard.



APP NAME	PRICE	CURRENT / TOTAL	AVG. RATING /	CRASHES & ANRS	LAST UPDATE	STATUS
Airports with body scanners 6.0.2					Mar 10, 2015	Published
De-motivate Me 1.0					Apr 12, 2016	Published
Misfortune Cookie 1.1					Apr 25, 2016	Published

ADD NEW APPLICATION

Default language *
English (United States) – en-US

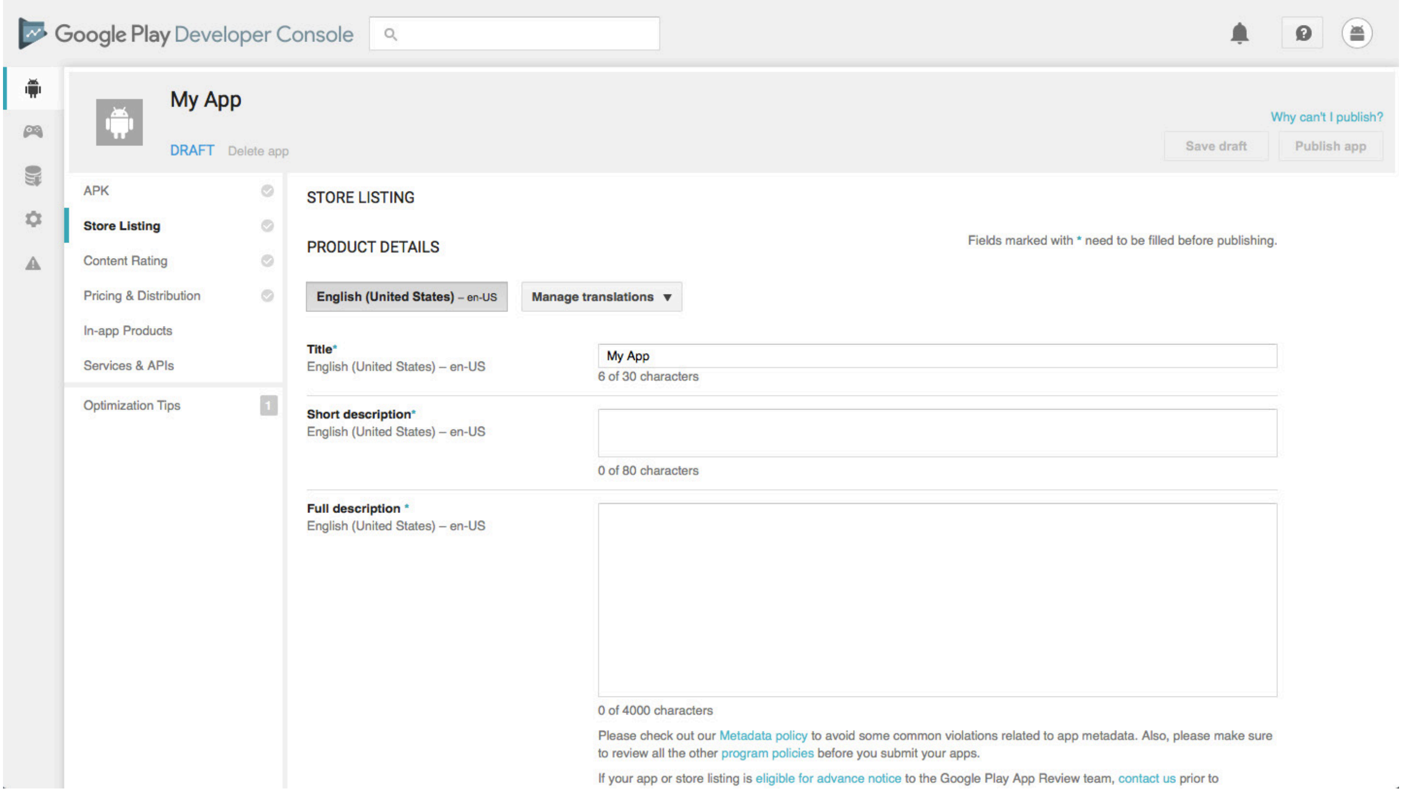
Title *

0 of 30 characters

What would you like to start with?

This presents a modal window which allows you to select the default language and enter a title for the app as well as a choice of uploading an APK file or preparing a Play Store listing.

Preparing a Play Store listing involves entering product details for the App:



STORE LISTING

PRODUCT DETAILS

Fields marked with * need to be filled before publishing.

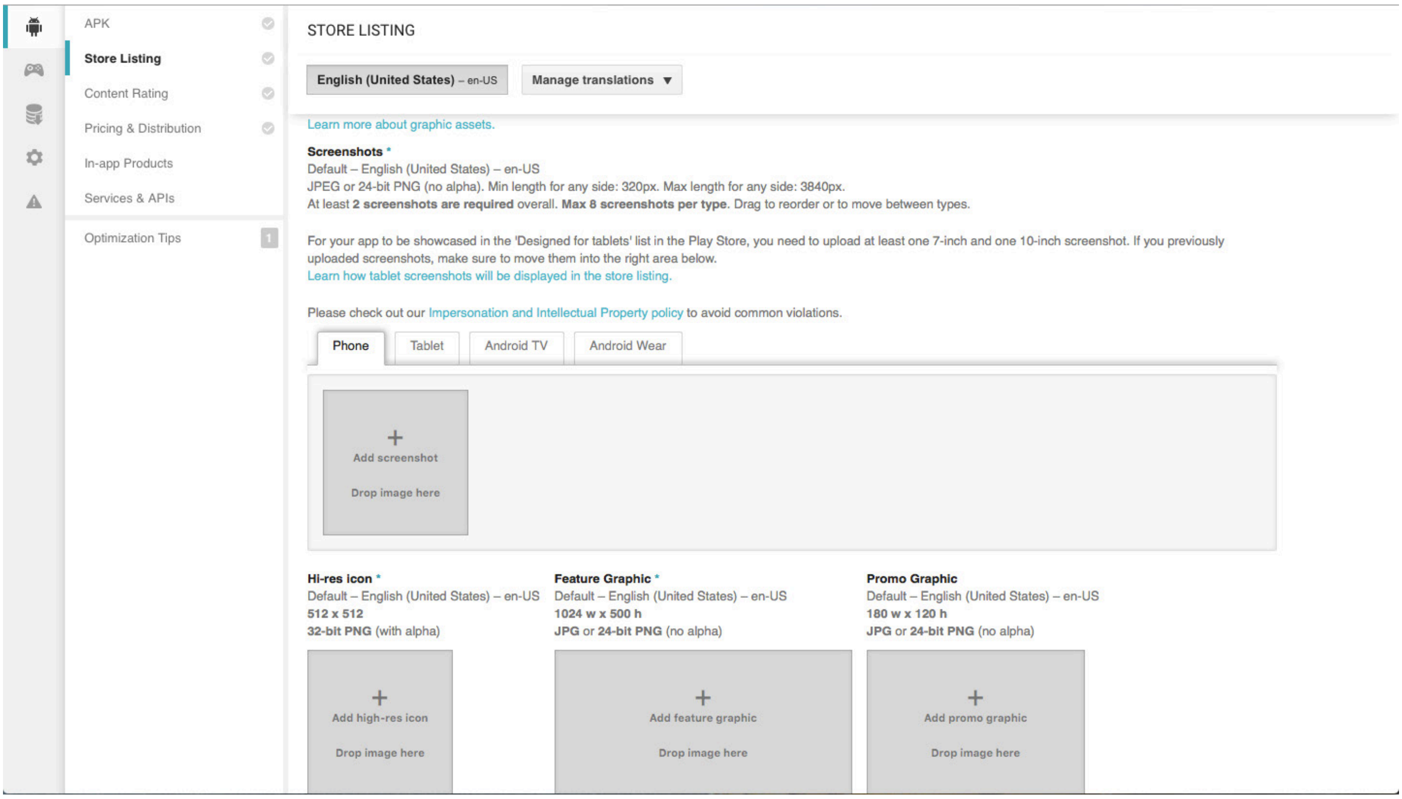
Title*
English (United States) – en-US
My App
6 of 30 characters

Short description*
English (United States) – en-US
0 of 80 characters

Full description *
English (United States) – en-US
0 of 4000 characters

Please check out our Metadata policy to avoid some common violations related to app metadata. Also, please make sure to review all the other program policies before you submit your apps.

If your app or store listing is eligible for advance notice to the Google Play App Review team, contact us prior to



STORE LISTING

Learn more about graphic assets.

Screenshots *
Default – English (United States) – en-US
JPEG or 24-bit PNG (no alpha). Min length for any side: 320px. Max length for any side: 3840px.
At least **2 screenshots are required** overall. **Max 8 screenshots per type**. Drag to reorder or to move between types.

For your app to be showcased in the 'Designed for tablets' list in the Play Store, you need to upload at least one 7-inch and one 10-inch screenshot. If you previously uploaded screenshots, make sure to move them into the right area below.
Learn how tablet screenshots will be displayed in the store listing.

Please check out our Impersonation and Intellectual Property policy to avoid common violations.

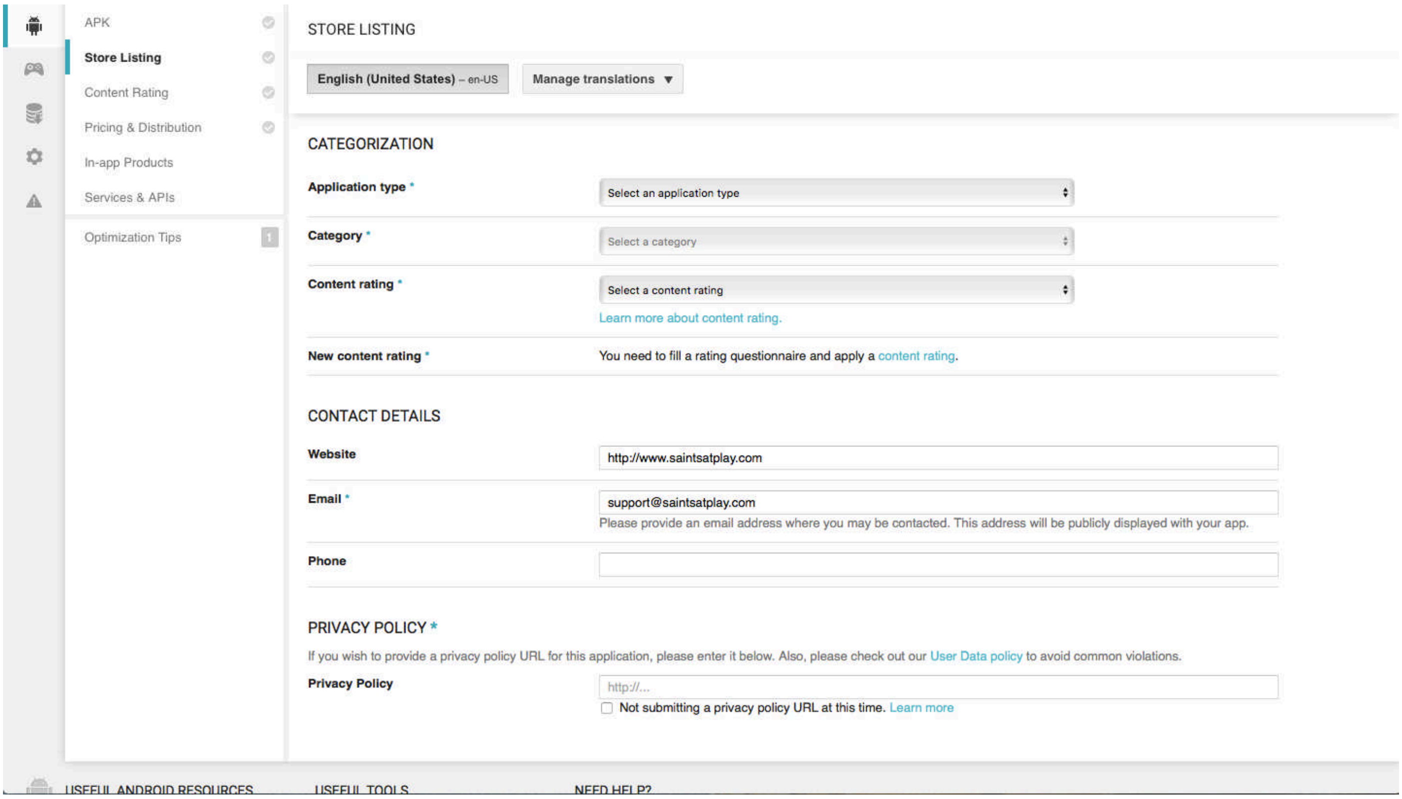
Hi-res icon *
Default – English (United States) – en-US
512 x 512
32-bit PNG (with alpha)

Feature Graphic *
Default – English (United States) – en-US
1024 w x 500 h
JPG or **24-bit PNG** (no alpha)

Promo Graphic
Default – English (United States) – en-US
180 w x 120 h
JPG or **24-bit PNG** (no alpha)

Further down the **Store Listing** page there’s a section for uploading media assets so that potential customers can get a visual impression of the app and its features.

Followed by a section for categorising the app (the sector/industry type, content type etc.) as well as providing contact details:



STORE LISTING

CATEGORIZATION

Application type *	Select an application type
Category *	Select a category
Content rating *	Select a content rating Learn more about content rating.
New content rating *	You need to fill a rating questionnaire and apply a content rating.

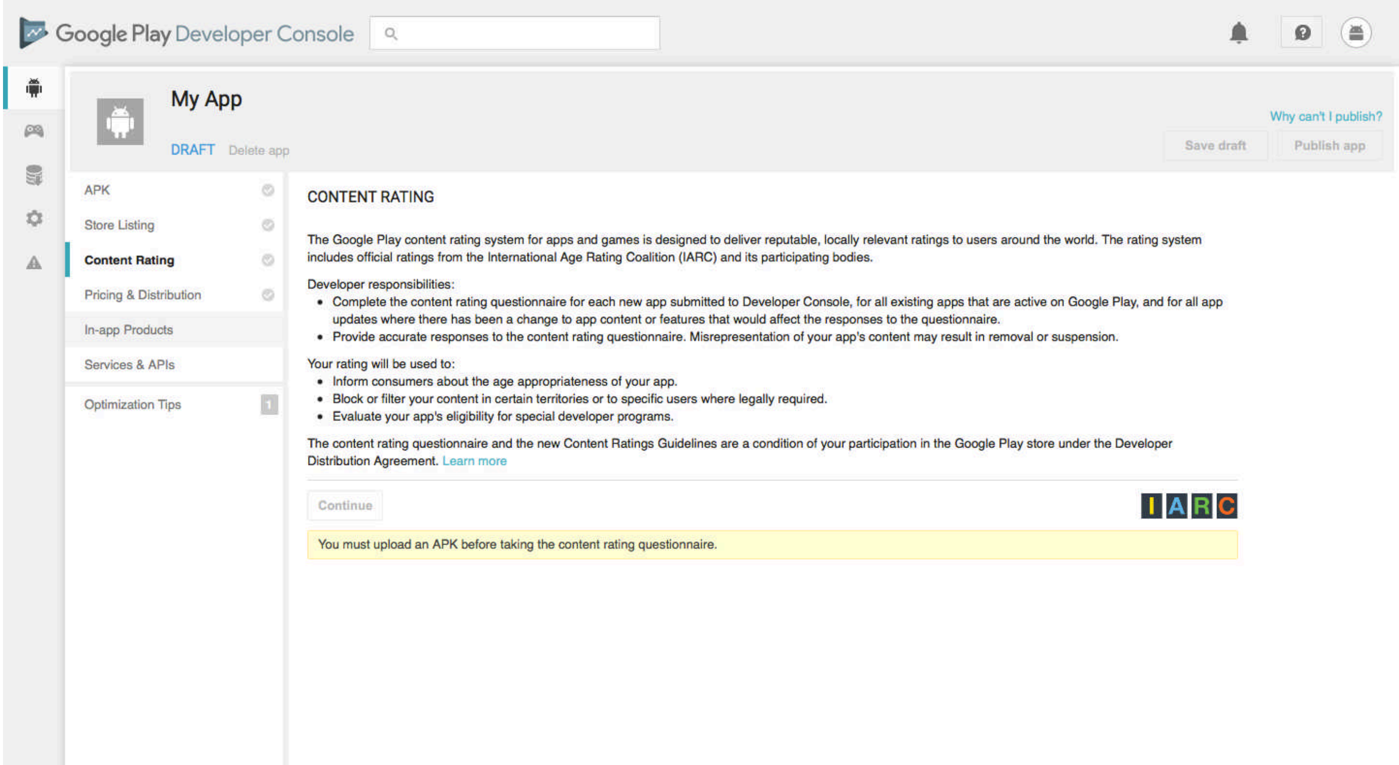
CONTACT DETAILS

Website	http://www.saintsatplay.com
Email *	support@saintsatplay.com Please provide an email address where you may be contacted. This address will be publicly displayed with your app.
Phone	

PRIVACY POLICY *

If you wish to provide a privacy policy URL for this application, please enter it below. Also, please check out our User Data policy to avoid common violations.

Privacy Policy http://...
□ Not submitting a privacy policy URL at this time. Learn more



CONTENT RATING

The Google Play content rating system for apps and games is designed to deliver reputable, locally relevant ratings to users around the world. The rating system includes official ratings from the International Age Rating Coalition (IARC) and its participating bodies.

Developer responsibilities:

- Complete the content rating questionnaire for each new app submitted to Developer Console, for all existing apps that are active on Google Play, and for all app updates where there has been a change to app content or features that would affect the responses to the questionnaire.
- Provide accurate responses to the content rating questionnaire. Misrepresentation of your app's content may result in removal or suspension.

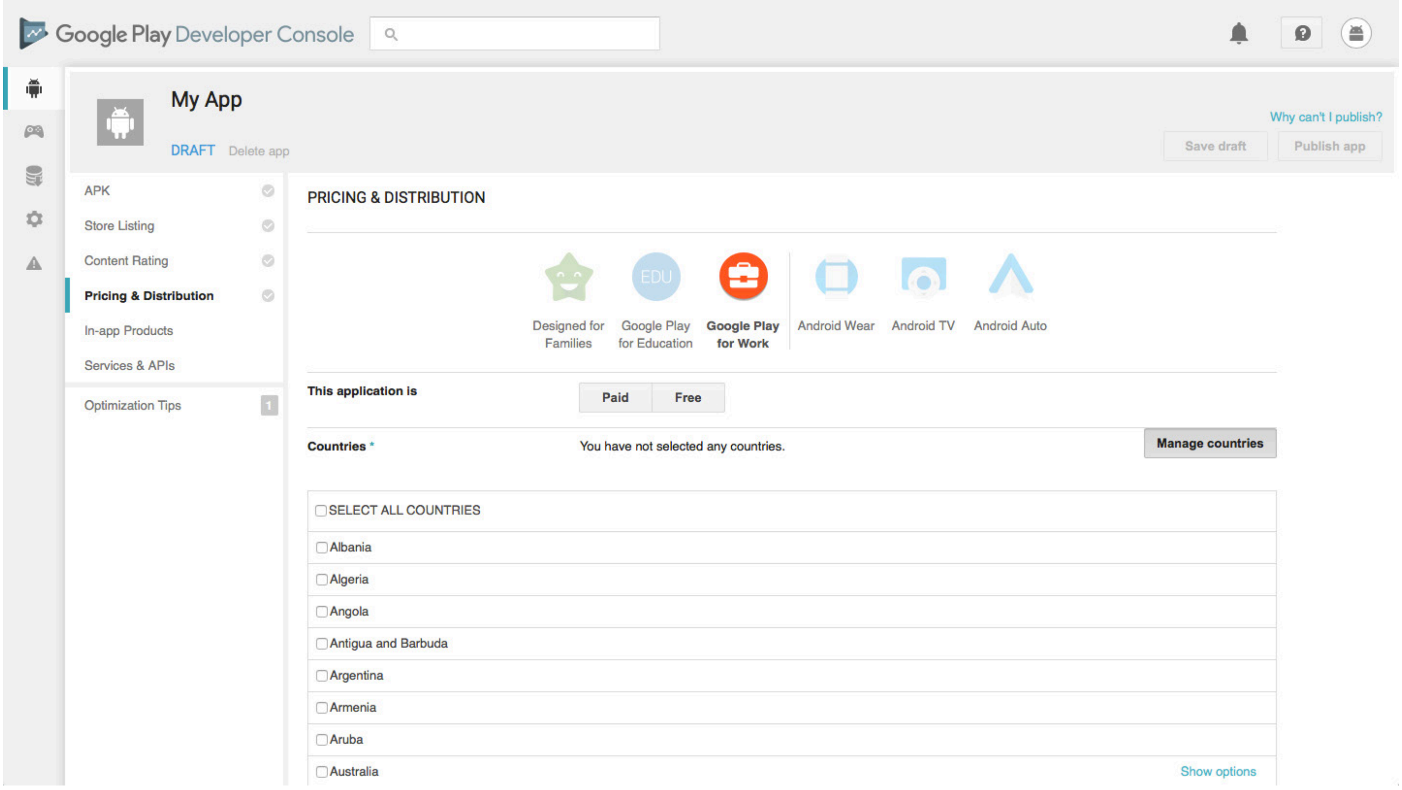
Your rating will be used to:

- Inform consumers about the age appropriateness of your app.
- Block or filter your content in certain territories or to specific users where legally required.
- Evaluate your app's eligibility for special developer programs.

The content rating questionnaire and the new Content Ratings Guidelines are a condition of your participation in the Google Play store under the Developer Distribution Agreement. Learn more

You must upload an APK before taking the content rating questionnaire.

The **Content Rating** screen allows developers to determine the appropriate age/ type of audience for their app.



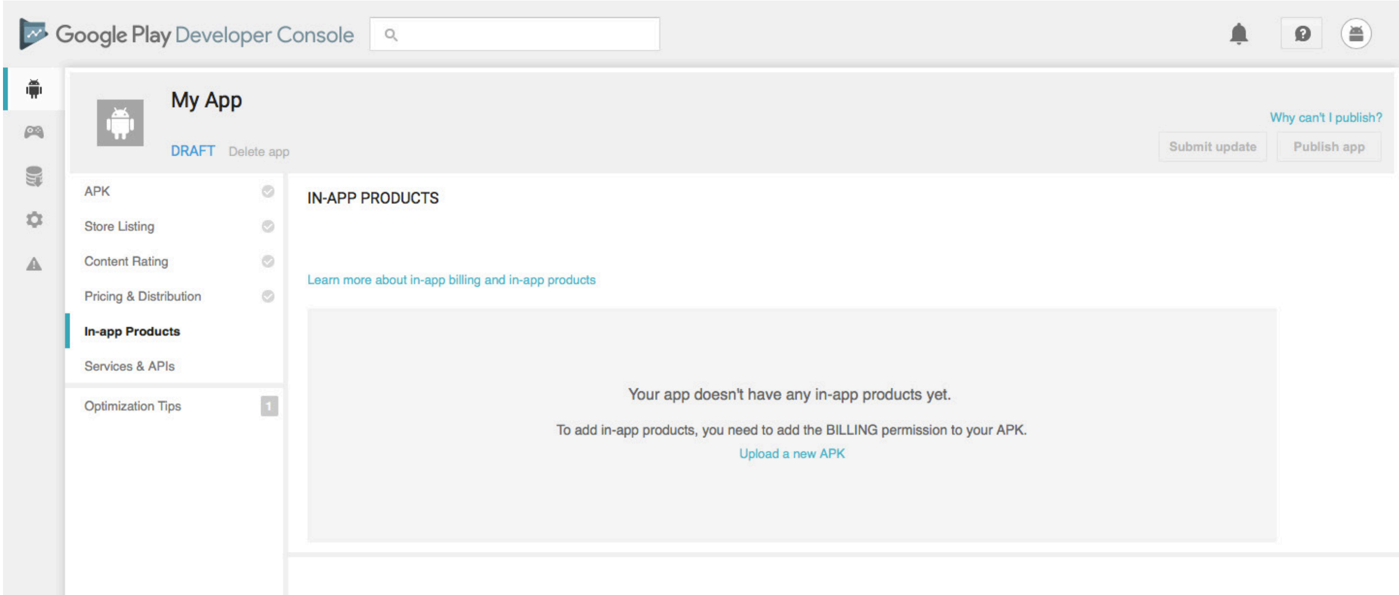
PRICING & DISTRIBUTION

This application is Paid | Free

Countries * You have not selected any countries. Manage countries

□ SELECT ALL COUNTRIES
□ Albania
□ Algeria
□ Angola
□ Antigua and Barbuda
□ Argentina
□ Armenia
□ Aruba
□ Australia Show options

The **Pricing & Distribution** screen is where we can determine whether or not our app is free and what prices our app will be charged for (IF a paid app) based on territory - amongst other options available on this section.



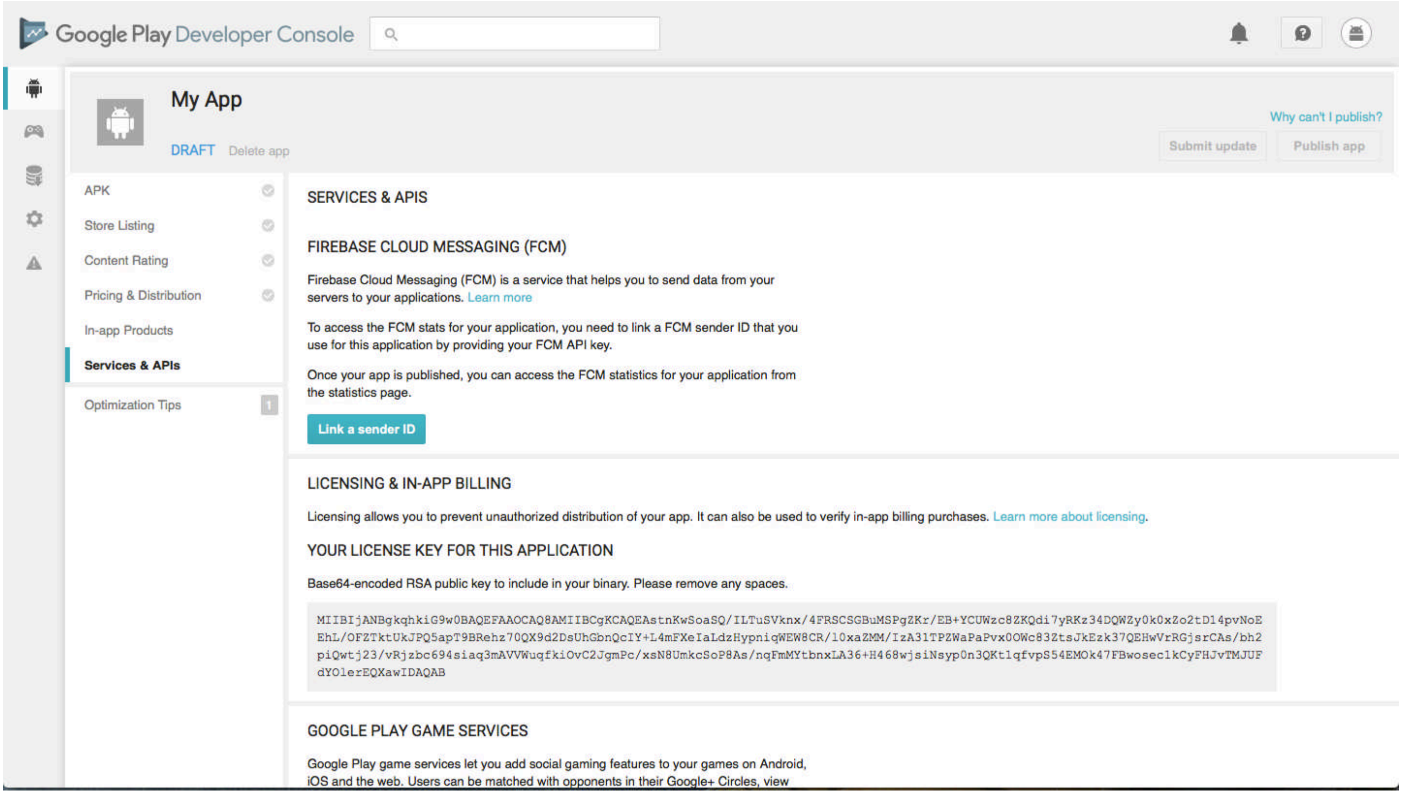
IN-APP PRODUCTS

Learn more about in-app billing and in-app products

Your app doesn't have any in-app products yet.

To add in-app products, you need to add the BILLING permission to your APK.
Upload a new APK

If your app has any In-App Products for providing consumer purchases they can be declared on the **In-App Products** screen.



SERVICES & APIS

FIREBASE CLOUD MESSAGING (FCM)

Firebase Cloud Messaging (FCM) is a service that helps you to send data from your servers to your applications. Learn more

To access the FCM stats for your application, you need to link a FCM sender ID that you use for this application by providing your FCM API key.

Once your app is published, you can access the FCM statistics for your application from the statistics page.

Link a sender ID

LICENSING & IN-APP BILLING

Licensing allows you to prevent unauthorized distribution of your app. It can also be used to verify in-app billing purchases. Learn more about licensing.

YOUR LICENSE KEY FOR THIS APPLICATION

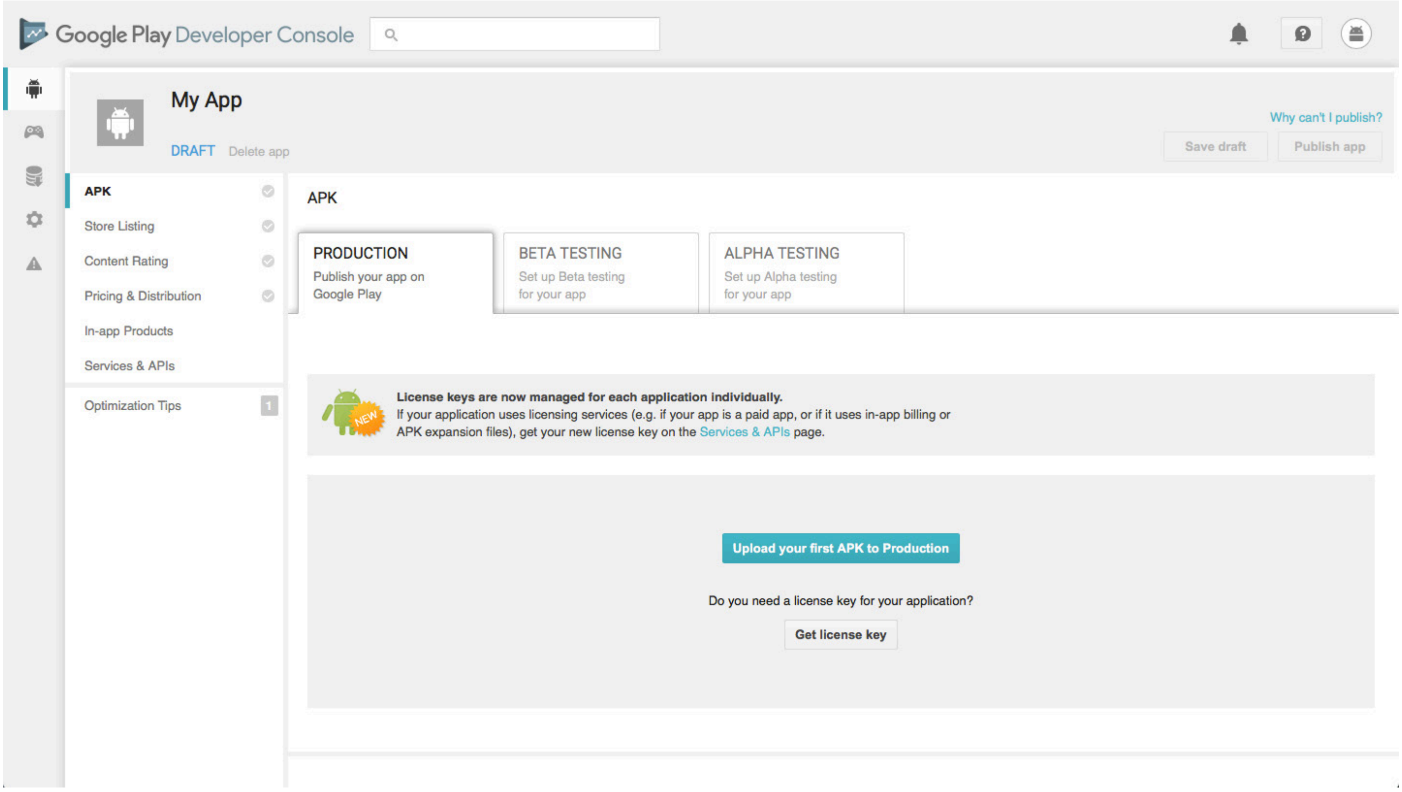
Base64-encoded RSA public key to include in your binary. Please remove any spaces.

```
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAstnKwSoaSQ/ILTuSVknx/4FRSCSGBuMSPgZKr/EB+YCUWzc8ZKQdi7yRKz34DQWZy0k0xZo2tD14pvNoE
EhL/OFZTktUkJPQ5apT9BRehz70QX9d2DsUhGbnQcIY+L4mFXeIaLdzHypniqWEW8CR/10xaZMM/IzA31TPZWaPaPvx0OWc83ZtsJkEzk37QEHwVrRGjsrCAs/bh2
piQwtj23/vRjzbc694siaq3mAVVWuqfkiOvC2JgmPc/xsN8UmkcSoP8As/nqFmMYtbnxLA36+H468wjsiNsyp0n3QKt1qfvpS54EMOk47FBwoseclkCyFHJvTMJUF
dYOlerEQXawIDAQAB
```

GOOGLE PLAY GAME SERVICES

Google Play game services let you add social gaming features to your games on Android, iOS and the web. Users can be matched with opponents in their Google+ Circles, view

The **Services & APIs** screen allows developers to implement licensing keys for their apps (which are used to prevent unauthorised distribution of apps and verify In-App Billing purchases) as well as declaring other services for use in apps.

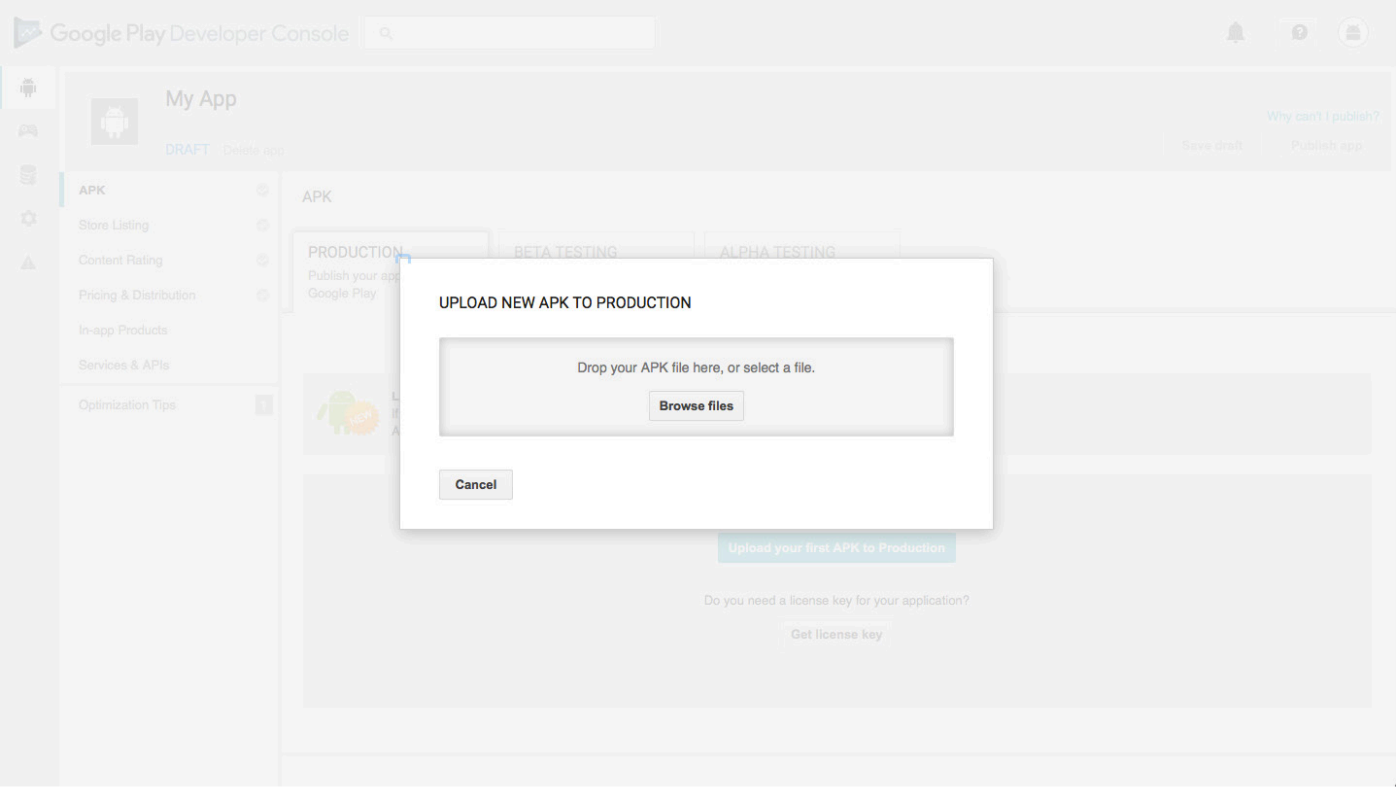


License keys are now managed for each application individually.
If your application uses licensing services (e.g. if your app is a paid app, or if it uses in-app billing or APK expansion files), get your new license key on the Services & APIs page.

Do you need a license key for your application?

The **APK** link from the App dashboard screen allows tested and completed APK files to be uploaded for the **Play Store Listing** for the app.

Additionally APK files can also be uploaded for beta and alpha testing prior to final release of the app.



Drop your APK file here, or select a file.

I personally find creating a Google Play store listing and uploading the Android app APK file less time consuming than I do when setting up an Apple App Store listing and submitting the required IPA file through Xcode.

One other plus of developing for the Google Play Store is that the app moderation process generally takes less than 24 hours to complete and receive notification from.

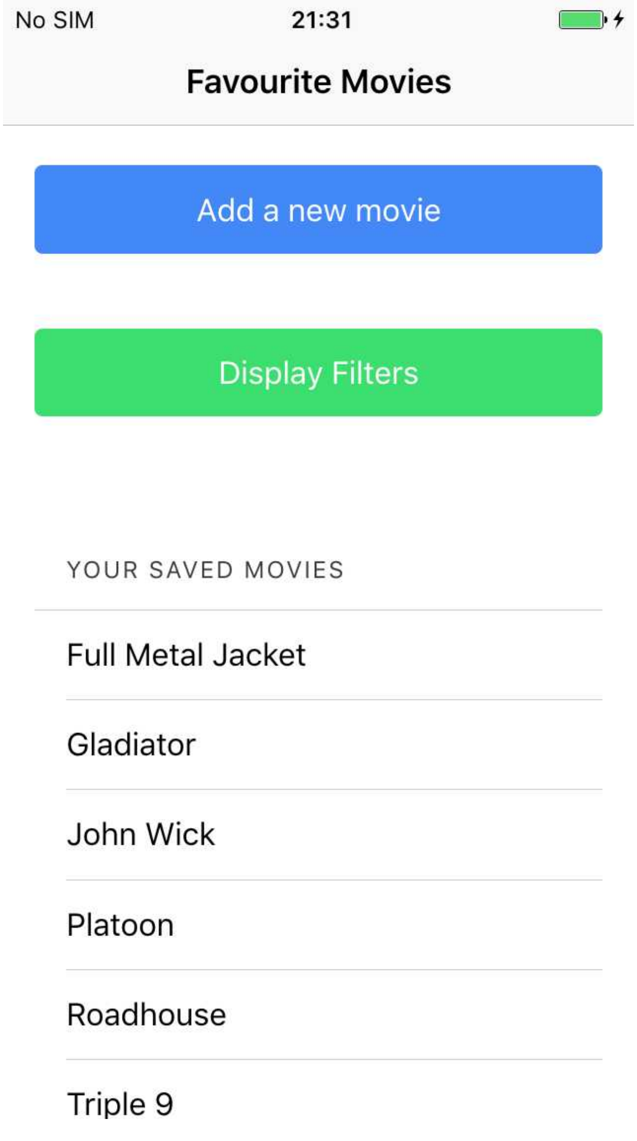
Case Study #1
Movies App

We’ve covered a lot of ground throughout this book; exploring the different aspects of Ionic 2 - from the underlying technologies, tools and principles to working with components, services and plugins - now it’s time to put that learning into practice!

In this case study we’re going to use Ionic 2 to develop an app offering functionality that we explored in the Data Storage chapter - a single page app that will allow us to store and manage our favourite movies.

We’ll implement Ionic’s built-in UI components, services, promises, animations, data validation and last, but not least, the Cordova NativeStorage plugin. With these at our disposal the app will allow us to seamlessly display, add, edit and remove movies through a simple but aesthetically pleasing interface.

The following screens demonstrate what we should see by the end of this chapter:



Favourite Movies

YOUR SAVED MOVIES

Full Metal Jacket

Gladiator

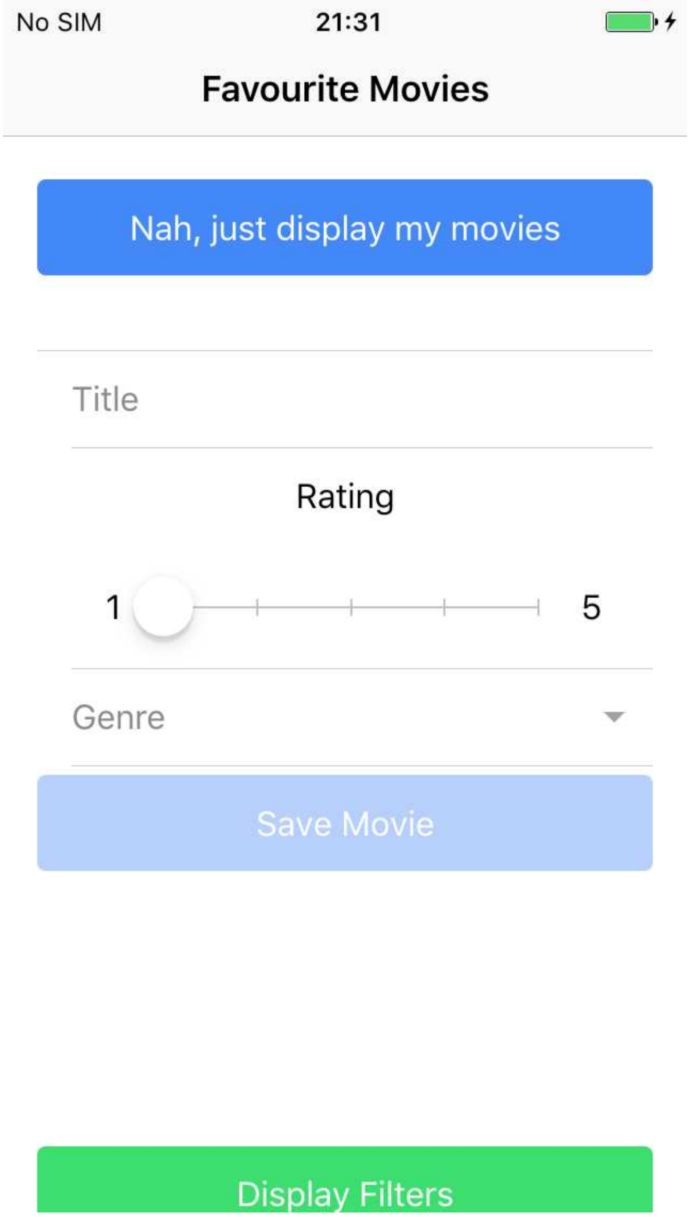
John Wick

Platoon

Roadhouse

Triple 9

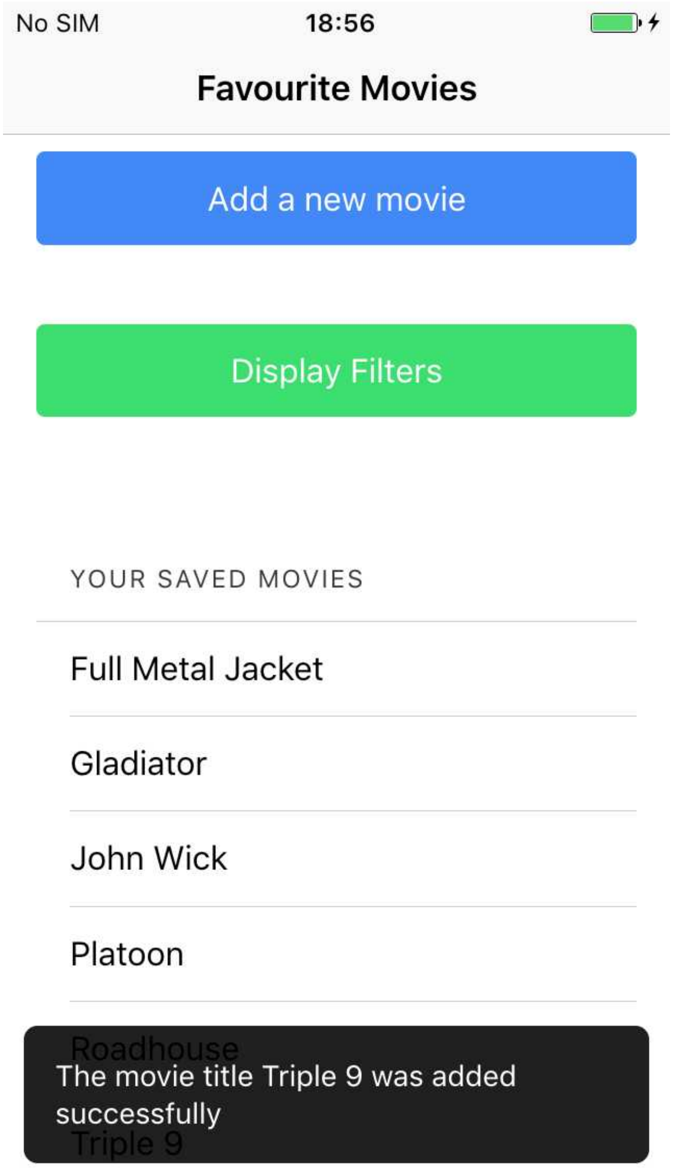
So that’s what the app will look like when displaying your saved movies (make of my choices what you will because you’ll be adding your own favourites as you work through this chapter!)



When the Add a new movie button is activated the above form will transition into view displaying the following UI components:

- <ion-input>
- <ion-range>
- <ion-select>

The Save Movie button will be deactivated until data is entered into the form.

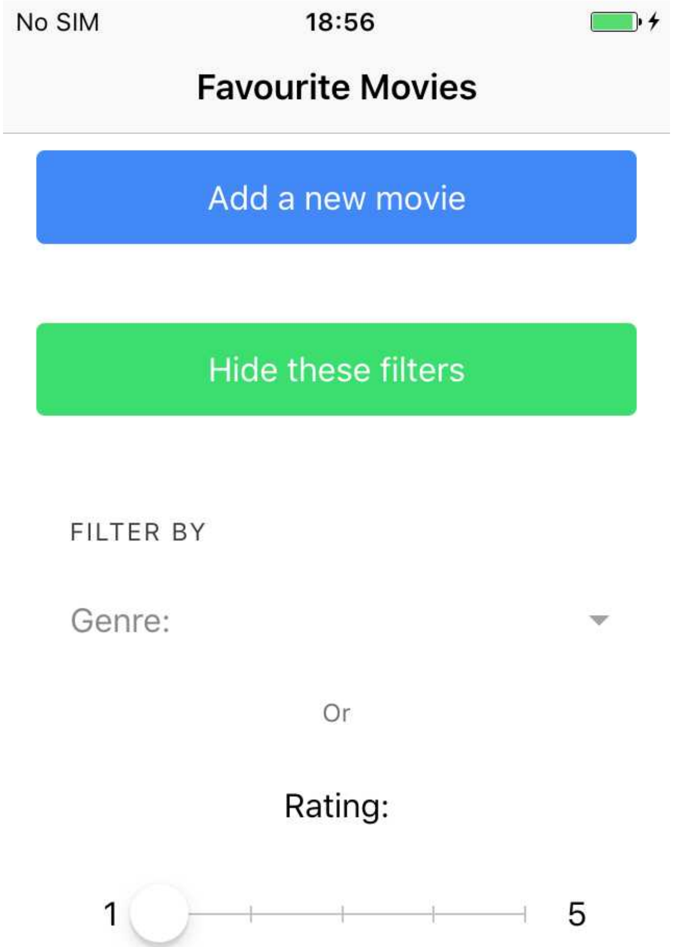


The movie title Triple 9 was added successfully

When a movie has been added to the app a notification message is displayed to the user for 3 seconds at the bottom of the screen.

The movie, upon being added to the NativeStorage object, is immediately displayed in alphabetical order with the list of movies already on the screen.

The form fields where those movie details were entered/selected are cleared of data and the form itself is closed.

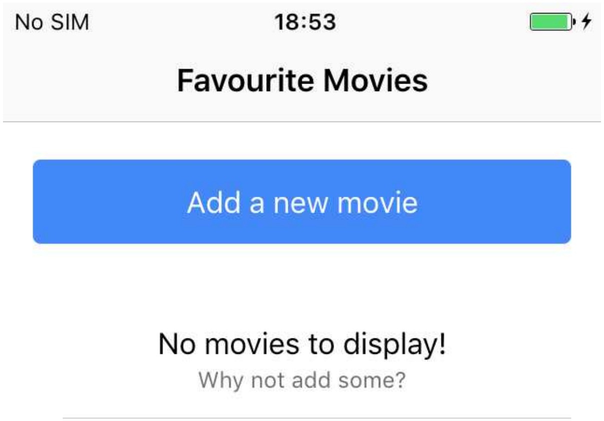


Movies can then be filtered and displayed based on either the type of genre or rating that was previously assigned to those movies.

These filters, once selected, will instantaneously update the movies listed on the page if matches are found.

And if there are no movies to display (as will be the case when we launch the app for the first time)?

Then we are greeted with the following screen:



Favourite Movies

No movies to display!

Why not add some?

That gives a taste of what we'll be developing as we make our way through this chapter.

So, that said, let's get started!

At the root of your apps projects directory run the following commands in the Ionic CLI to generate our new app, install the Cordova NativeStorage plugin and create a storage service:

```
ionic start myMovies blank --v2
cd myMovies
npm install
ionic plugin add cordova-plugin-nativestorage
ionic g provider storage
```

We’ll begin by defining the following storage methods (highlighted in bold) for the **myMovies/src/providers/storage.ts** file:

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import { NativeStorage } from 'ionic-native';
import 'rxjs/add/operator/map';

@Injectable()
export class Storage {
  public storedData : any;

  constructor(public http: Http)
  {
  }

  setItem(itemName, itemValue) : any
  {
    return new Promise(resolve =>
    {
      NativeStorage.setItem(itemName, itemValue)
      .then(
        (data) =>
        {
          resolve(true);
        },
        (error) =>
        {
          console.log("Fail to set storage key value");
        });
    });
  }

  getItems(itemKey)
  {
    return new Promise(resolve =>
    {
      NativeStorage.getItem(itemKey)
      .then(
        (data) =>
        {
          this.storedData = JSON.parse(data);
          resolve(this.storedData);
        },
        (error) =>
        {
          console.log("We don’t get data!");
        })
    });
  }

   removeItem(itemKey)
   {
     return new Promise(resolve =>
{
      NativeStorage.remove(itemKey)
      .then(
        (data) =>
        {
          resolve(true);
        },
        (error) =>
        {
          console.log("Failed to remove item");
      });
    });
  }
}
```

We’ve covered these methods before in the Data Storage chapter so they should be fairly familiar to you (if not, revisit that chapter then come back here!)

Now switch your attention to the **myMovies/src/pages/home/home.html** file and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      My Fave Films
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content padding>
   <form
      [formGroup]="form"
      (ngSubmit)="saveMovie()">
      <ion-list>
         <ion-item margin-bottom>
            <ion-label>Title</ion-label>
            <ion-input
               type="text"
               formControlName="movieName"
               [(ngModel)]="filmTitle"></ion-input>
         </ion-item>

         <button
            ion-button
            color="primary"
            text-center
            block
            [disabled]="!form.valid">Save Movie</button>
    </ion-list>
  </form>

  <ion-list *ngIf="isData">
    <ion-list-header>
      Your saved movies
    </ion-list-header>
    <ion-item *ngFor="let data of storedData">
      {{ data.movie }}
    </ion-item>
  </ion-list>

</ion-content>
```

Again, nothing new here as this is code we're already familiar with from the Data Storage chapter.

We're simply using an **ngIf** directive to iterate through any saved movies and render those to the page using Ionic 2 **<ion-list>** and **<ion-item>** directives.

The final file we need to 'set the stage' for will be the **myMovies/src/pages/home/home.ts** file with the following amendments (highlighted in bold):

```
import { Component } from '@angular/core';
import { NavController, Platform, ToastController } from 'ionic-angular';
import { FormGroup,
         FormControl,
         Validators,
         FormBuilder } from '@angular/forms';
import { Storage } from '../../providers/storage';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
```

```
})
export class HomePage {
    public form                : FormGroup;
    public storageKey          : string          = "MoviesObj";
    public isData              : boolean         = false;
    public storedData          : any             = null;
    public movies              : any             = [];
    public filmTitle           : any;

    constructor(
      public navCtrl           : NavController,
      public storage           : Storage,
      public fb                : FormBuilder,
      public toastCtrl         : ToastController,
      public platform          : Platform
    )
    {
      platform.ready().then(() => {
        setTimeout(() => {
          this.renderMovies();
        }, 750);
      });

      this.form = fb.group({
        "movieName"            : ["", Validators.required]
      });

      this.clearFieldValues();
    }

    renderMovies() : void
    {
      this.storage.getItems(this.storageKey)
```

```
   .then(
      (data) => {
         let existingData      = Object.keys(data).length;
         if(existingData !== 0)
         {
            this.storedData  = data;
            this.isData      = true;
         }
         this.resetMovies(this.storedData);
      }
   );
}

resetMovies(data)
{
   let k;
   this.movies.length = 0;
   for(k in data)
   {
      this.movies.push(
      {
         movie  : data[k].movie
      });
   }
}

saveMovie()
{
   let movie   : string      = this.form.controls["movieName"].value,
       i       : number   = 0,
       k;

   for(k in this.storedData)
```

```
      {
        if(this.storedData[k].movie === movie)
        {
          i++;
        }
      }

      if(i === 0)
      {
        this.movies.push(
        {
          movie   : movie
        });
        this.storeMovie(this.movies, movie);
      }
      else
      {
        let message    =      `The movie ${movie} has already been stored.
Please enter a different movie title.`;
        this.storageNotification(message);
      }
    }

    storeMovie(movies, movie)
    {
      let moviesStored = JSON.stringify(movies);
      this.storage.setItem(this.storageKey, moviesStored).then(
        (data) => {
          this.renderMovies();
          let message = `The movie title ${movie} was added!;
          this.clearFieldValues();
              this.storageNotification(message);
            },
       (error) => {
          let message   = `Whoops! Something went wrong. The movie title
${movie} was NOT added`;
          this.storageNotification(message);
        }
      );
    }

    clearFieldValues()
    {
      this.filmTitle              = "";
    }

    storageNotification(message)  : void
    {
       let notification = this.toastCtrl.create({
          message       : message,
          duration        : 3000
      });
      notification.present();
    }

}
```

With the amendments in place for the **myMovies/src/pages/home/home.html** file we now have the initial stages of our app, based on what we originally developed in the Data Storage chapter.

Now we can start to introduce the following additional features:

- Amend/Remove saved movies
- Add a rating for the film
- Add a genre for the film
- Sliding list component

- Animations for revealing/hiding forms used within the app
- Validation routines for all form fields
- Filter movies by genre & rating
- List movies in ascending alphabetical order

Let’s begin upgrading our app by implementing the rating and genre fields to the add movie form.

In the **myMovies/src/pages/home/home.html** file make the following amendments (highlighted in bold):

```
<form [formGroup]="form" (ngSubmit)="saveMovie()">
  <ion-list>

    <ion-item margin-bottom>
      <ion-label>Title</ion-label>
      <ion-input type="text"
        formControlName="movieName"
        [(ngModel)]="filmTitle">
      </ion-input>
    </ion-item>

    <ion-item margin-bottom>
      <ion-label text-left>Rating</ion-label>
      <ion-range
        formControlName="rating"
        min="1"
        max="5"
        step="1"
        snaps="true"
        color="secondary"
        [(ngModel)]="filmRating">
      <ion-label range-left>1</ion-label>
      <ion-label range-right>5</ion-label>
      </ion-range>
    </ion-item>

    <ion-item margin-bottom>
      <ion-label>Genre</ion-label>
      <ion-select
        formControlName="genre"
        [(ngModel)]="filmGenre">
        <ion-option value="Action">Action</ion-option>
        <ion-option value="Comedy">Comedy</ion-option>
        <ion-option value="Documentary">Documentary</ion-option>
        <ion-option value="Horror">Horror</ion-option>
        <ion-option value="Other">Other</ion-option>
        <ion-option value="Romance">Romance</ion-option>
        <ion-option value="Thriller">Thriller</ion-option>
        <ion-option value="War">War</ion-option>
        <ion-option value="All">All genres!</ion-option>
      </ion-select>
    </ion-item>

    <button
      ion-button
      color="primary"
      text-center
      block
      [disabled]="!form.valid">Save Movie</button>

  </ion-list>
</form>
```

As each of the added form elements implements a particular formControl and model we’ll need to wire this into the logic for the **myMovies/src/pages/home/home.ts** file (amendments highlighted in bold):

```
....
export class HomePage {


   ...
   public filmRating  : any;
   public filmGenre   : any;

   constructor( .. )
   {
     ...
     this.form = fb.group({
       "movieName"     : ["", Validators.required],
       "genre"         : ["", Validators.required],
       "rating"        : ["", Validators.required]
     });

     ...
   }

   ...

}
```

Now that the additional form elements and logic are in place we can next turn our attention towards amending the list that displays our saved movies.

We'll modify this list to include sliding items that reveal buttons to edit and remove the selected movie.

Within the **myMovies/src/pages/home/home.html** file add this functionality by making the following changes (amendments highlighted in bold):

```
<ion-list *ngIf="isData">
  <ion-list-header>
    Your saved movies
  </ion-list-header>
  <ion-item-sliding *ngFor="let data of storedData">
    <ion-item>
      {{ data.movie }}
    </ion-item>
    <ion-item-options side="right">
      <button
              ion-button
              color="primary"
              (click)="amendListing(data)">
        <ion-icon name="create"></ion-icon>
                    Amend
      </button>
      <button
              ion-button
             color="secondary"
             (click)="removeListing(data)">
        <ion-icon name="close"></ion-icon>
        Remove
      </button>
    </ion-item-options>
  </ion-item-sliding>
</ion-list>
```

With the template amended to incorporate a sliding list we now need to add the button event methods - **amendListing** and **removeListing** - to the component class.

In addition to these we'll also need to make the following changes to the existing **myMovies/src/pages/home/home.ts** class logic (amendments highlighted in bold):

```
import { Component, ViewChild } from '@angular/core';
import { Content, ... } from 'ionic-angular';
...
export class HomePage {
  @ViewChild(Content) content: Content;
  ...
  public isEdited        : boolean         = false;
  public isDeleted       : boolean         = false;
  public incr            : number          = 0;

  ...

   resetMovies(data)
  {
    ...
      this.movies.push(
      {
          movie   : data[k].movie,
          genre   : data[k].genre,
          rating  : data[k].rating
      });
    }
  }


  saveMovie()
  {
    let movie  : string     =    this.form.controls["movieName"].value,
        genre  : string     =    this.form.controls["genre"].value,
        rating  : number  =    this.form.controls["rating"].value,
       ...

    this.incr = 0;
    ...
  if(i === 0)
  {
    this.movies.push(
    {
    movie        : movie,
    genre        : genre,
    rating       : rating
  });
  this.storeMovie(this.movies, movie);
  }
  ...
}


scrollToTopOfScreen()
{
  this.content.scrollToTop();
}


amendListing(item) : void
{
  let editedMovie     = item.movie,
      editedGenre     = item.genre,
      editedRating    = item.rating;

  this.scrollToTopOfScreen();
  this.filmTitle      = editedMovie;
  this.filmGenre      = editedGenre;
  this.filmRating     = editedRating;
  this.isEdited       = true;
  this.incr++;
  this.removeListing(item);
```

```
}


removeListing(item) : void
{
  let i : number = 0,
      k;

  for(k = 0; k < this.storedData.length; k++)
  {
    if(this.storedData[k].movie.indexOf(item.movie) !== -1)
    {
      this.storedData.splice(k, 1);
      this.movies.length  = 0;
      this.movies         = this.storedData;
      this.removeItem(this.storageKey);

      if(this.isEdited)
      {
        this.isDeleted = false;
      }
      else
      {
        this.isDeleted    = true;
      }
      this.storeMovie(this.movies, item.movie);
      i++;
    }
  }
}


removeItem(itemKey)
```

```
{
  this.store.removeItem(itemKey)
  .then(
    (data) => {
    },
    (error) => {
      let message = "An error occurred! The item was NOT removed";
      this.storageNotification(message);
    }
  );
}


storeMovie(movies, movie)
{
  ...
  this.store.setItem(this.storageKey, moviesStored).then(
    (data) => {
      this.storedData = null;
      this.renderMovies();
      let message = this.renderNotificationMessage(movie);
      this.storageNotification(message);
    },
    (error) => {
     ...
    }
  );
}


renderNotificationMessage(movie) : string
{
  var message;
```

```
    if(this.isDeleted)
    {
      this.clearFieldValues();
      message      = "Congratulations! The item was successfully removed";
      this.isDeleted = false;
      this.incr = 0;
    }
    else if(this.isEdited)
    {
      if(this.incr === 0)
      {
        this.clearFieldValues();
        message  = `The movie title ${movie} was successfully amended`;
        this.isEdited    = false;
      }
    }
    else
    {
      this.clearFieldValues();
      message          = `The movie title ${movie} was added`;
    }
    return message;
  }


  clearFieldValues()
  {
    this.filmTitle       = "";
    this.filmRating  = "";
    this.filmGenre   = "";
   }
```

That’s quite a lot of code we’ve added to and amended in the **myMovies/src/pages/home/home.ts** file!

Before we cover this new code in depth we need to make some small adjustments (highlighted in bold) to the **myMovies/src/app/app.module.ts** file so we can successfully build and publish the app to a connected device:

```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { Storage } from '../providers/storage';
import { HomePage } from '../pages/home/home';

@NgModule({
  declarations: [
    MyApp,
    HomePage
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage
  ],
  providers: [{provide: ErrorHandler, useClass: IonicErrorHandler}, Storage]
})
export class AppModule {}
```

If we had additional components for the app (instead of just the HomePage module) we would need to import those and then add them within the following sections of the **src/app/app.module.ts** file:

- declarations

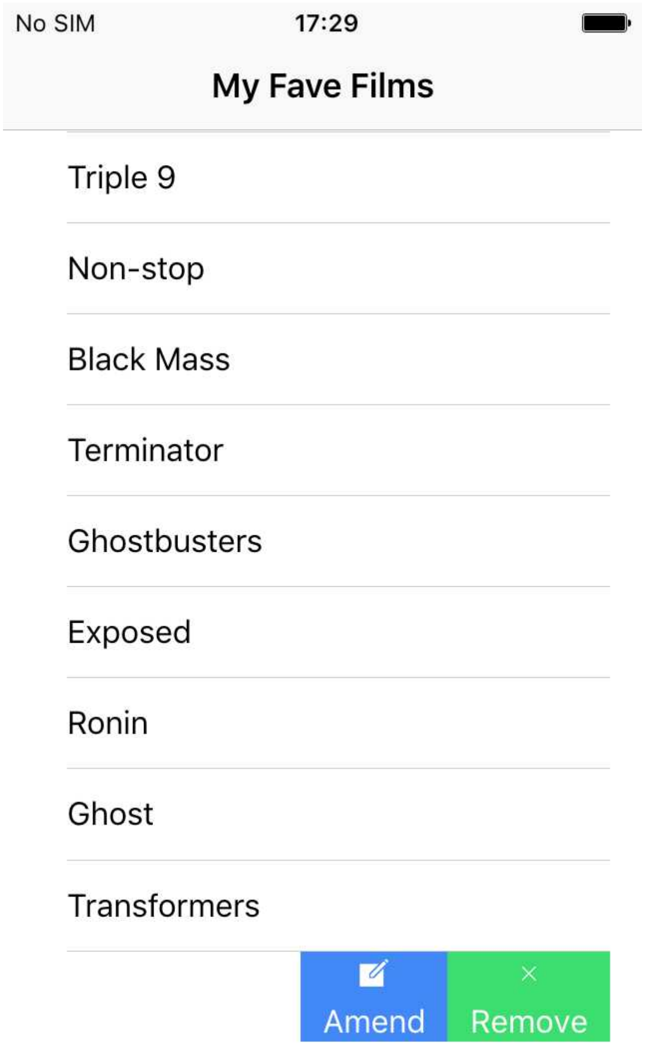
- entryComponents

Now the necessary code for the **myMovies/src/app/app.module.ts** file has been added let's take a break from coding and actually see the app in action on our mobile device.

Connect your handheld device to the computer and through the Terminal application run the following commands:

```
ionic prepare ios && ionic build ios
ionic run ios --device
```

Once published to and running on your device you should the app functionality being displayed as shown in the following screen captures:



No SIM 17:29

My Fave Films

Triple 9

Non-stop

Black Mass

Terminator

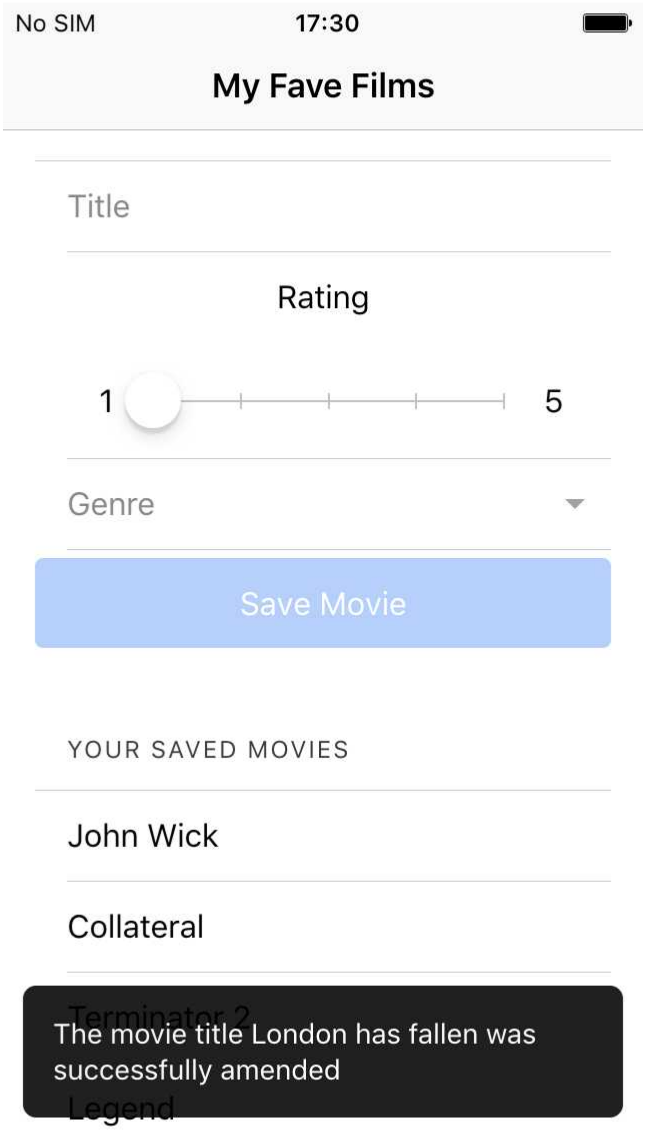
Ghostbusters

Exposed

Ronin

Ghost

Transformers



No SIM 17:30

My Fave Films

YOUR SAVED MOVIES

John Wick

Collateral

Terminator 2

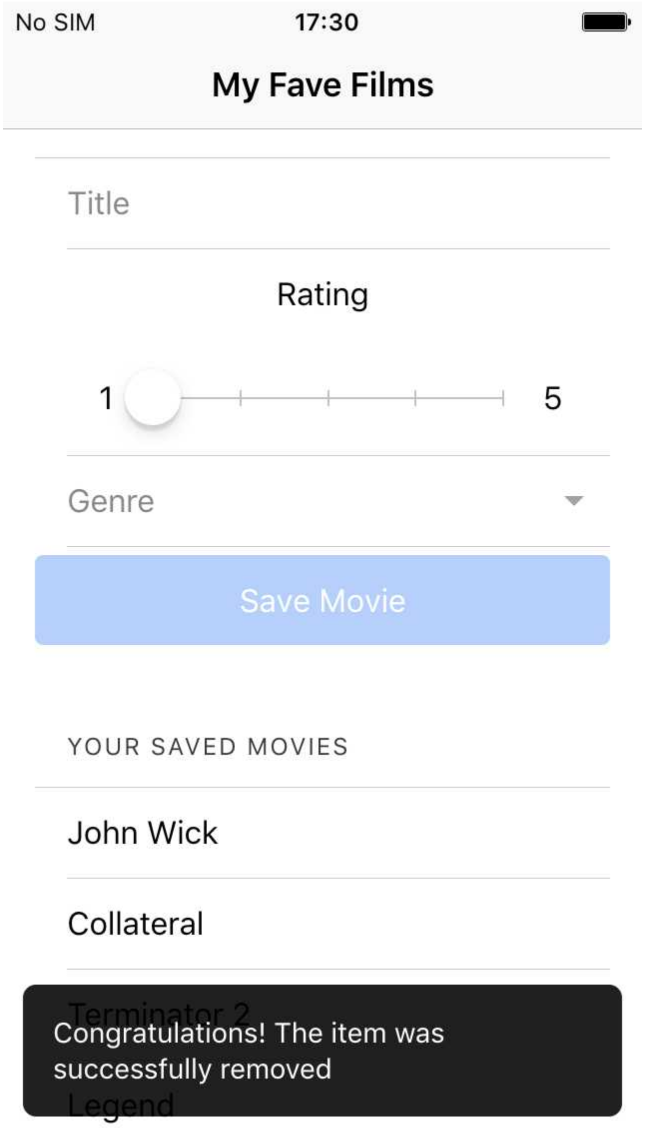
Legend

The movie title London has fallen was successfully amended

Each saved movie can now be slid back to reveal options to amend or remove that particular entry.

When a user selects the Amend movie option the movie will be loaded into the form and, once saved, a notification will be published to the screen informing the user of the fact.

Similarly if a user selects the Remove Movie option a notification will be published to the screen informing the user that the movie has been deleted.



My Fave Films

YOUR SAVED MOVIES

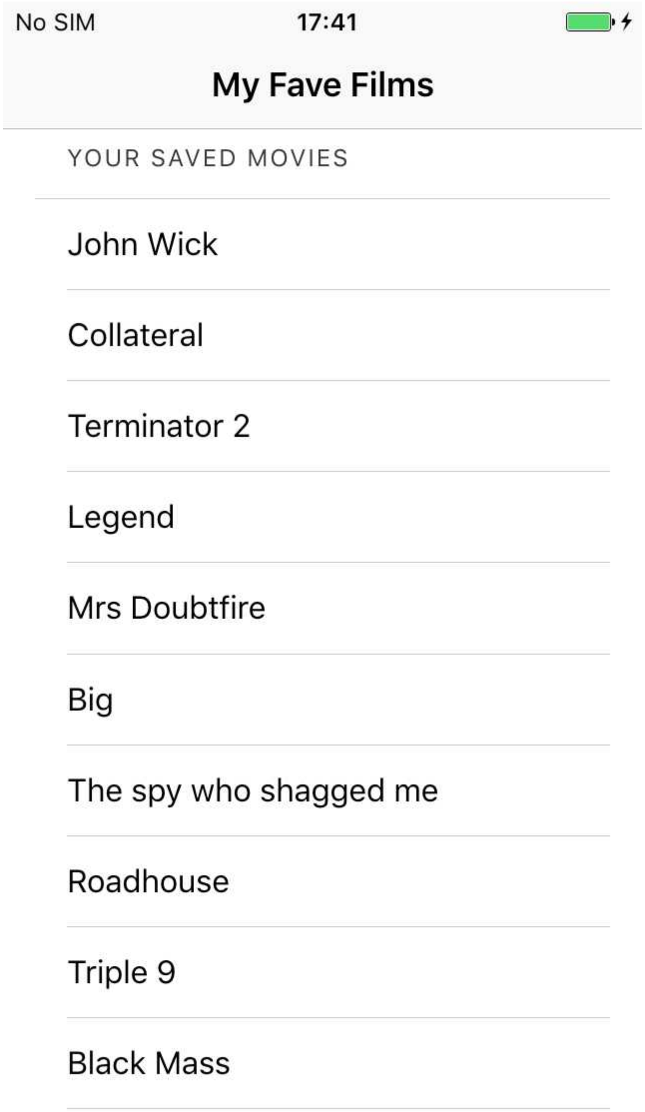
John Wick

Collateral

Terminator 2

Legend

Congratulations! The item was successfully removed



My Fave Films

YOUR SAVED MOVIES

John Wick

Collateral

Terminator 2

Legend

Mrs Doubtfire

Big

The spy who shagged me

Roadhouse

Triple 9

Black Mass

So far so good!

One thing does stand out though - movies are displayed in order of their being added to the list which looks, well, kind of untidy.

Before we begin examining our recent code updates let’s sort the saved movies programmatically so that they are displayed in ascending alphabetical order.

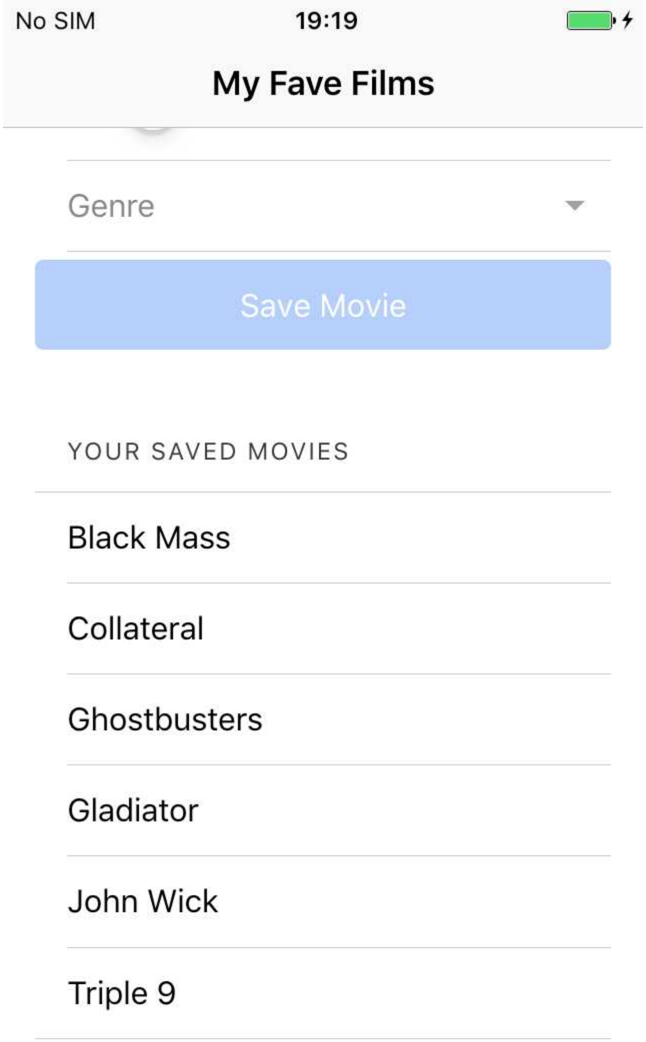
Once again return to the **myMovies/src/pages/home/home.ts** file and make the following amendments (highlighted in bold):

```
...
  renderMovies() : void
  {
    this.store.getItems(this.storageKey)
    .then(
      (data) => {
        let existingData      = Object.keys(data).length;

        if(existingData !== 0)
        {
          this.storedData       = data;
          this.sortMoviesByTitle(this.storedData);
          this.isData           = true;
        }
      }
    );
  }


  sortMoviesByTitle(data)
  {
    data.sort(
      function(a, b)
      {
        var x      = a.movie.toLowerCase(),
            y      = b.movie.toLowerCase();

        return x < y ? -1 : x > y ? 1 : 0;
      }
   );
}


resetMovies(data)
{
   ...
   this.sortMoviesByTitle(this.movies);
}


saveMovie()
{
   for(k in this.storedData)
   {
      ...
      if(i === 0)
      {
         this.movies.push(
         {
            ...
         });
         this.sortMoviesByTitle(this.movies);
         ...
      }
      else
      {
         ...
      }
   }
}
```

With the additional logic to sort our movies in place now would be a good time to rebuild and re-run the application on a connected iOS device using the following CLI commands:

```
ionic build ios
ionic run ios --device
```

Once published, and running on your device, any listed movies should be displayed in ascending alphabetical order as shown in the following screen capture:



YOUR SAVED MOVIES

Black Mass

Collateral

Ghostbusters

Gladiator

John Wick

Triple 9

Lubbly jubbly as Del boy would say (if you're a fan of British sitcom Only Fools and Horses you'll get the reference - if you're not then I really can't help you!)

Now let's break down our recent code amendments for implementing the ability to amend/remove movie listings and display those in ascending alphabetical order so we understand what is going on at each step of the way.

At the top of the **myMovies/src/pages/home/home.ts** file we import the following additional modules (highlighted in bold):

```
import { Component, ViewChild } from '@angular/core';
import { Content,
         NavController,
         Platform,
         ToastController } from 'ionic-angular';
import { FormGroup,
         FormControl,
         Validators,
         FormBuilder } from '@angular/forms';
import { Storage } from '../../providers/storage';
```

The Angular 2 **ViewChild** module will allow the script to access a different component class and its methods.

The Ionic 2 **Content** component provides a scrollable content area for the page HTML template which can be interacted with through the different methods listed in the following online documentation.

The HomePage class begins with implementing the **ViewChild** annotation (which is used to reference the **Content** component) then adds three additional public properties for subsequent use in controlling the amend/remove logic for handling saved movies within the app:

```
export class HomePage {
   @ViewChild(Content) content: Content;


   ...
   public isEdited       : boolean        = false;
   public isDeleted      : boolean        = false;
   public incr           : number         = 0;
```

We then modify the **renderMovies** method to sort the saved movies that are to be displayed on the page in ascending alphabetical order using the **sortMoviesByTitle** method:

```
renderMovies() : void
{
  this.store.getItems(this.storageKey)
  .then(
    (data) => {
      let existingData    = Object.keys(data).length;

      if(existingData !== 0)
      {
        this.storedData = data;
        this.sortMoviesByTitle(this.storedData);
        this.isData       = true;
      }
    });
}
```

The **sortMoviesByTitle** method makes use of the native TypeScript array **sort** method (passing in a function to alphabetically sort the supplied JSON object of saved movies in an ascending order):

```
sortMoviesByTitle(data)
{
  data.sort(function(a, b)
    {
      var x  = a.movie.toLowerCase(),
          y  = b.movie.toLowerCase();

      return x < y ? -1 : x > y ? 1 : 0;
    });
}
```

Within the **saveMovie** method we add some additional logic to reset the **incr** property to zero (for use in conditionally handling notification back to the user when amending an existing movie record) and we also implement the **sortMoviesByTitle** method to ensure that movies are ordered as required prior to being saved back into the existing NativeStorage object:

```
saveMovie()
{
   let movie : string       =      this.form.controls[“movieName”].value,
       genre : string       =      this.form.controls[“genre”].value,
       rating : number      =      this.form.controls[“rating”].value,
       i        : number    =      0,
       k;

   this.incr = 0;
   for(k in this.storedData)
   {
      if(this.storedData[k].movie === movie)
      {
         i++;
      }
   }

   if(i === 0)
   {
      this.movies.push(
      {
         movie         : movie,
         genre         : genre,
         rating        : rating
      });
      this.sortMoviesByTitle(this.movies);
      this.storeMovie(this.movies, movie);
   }
```

```
  else
  {
    let message  =  `The movie ${movie} has already been stored. Please enter a different movie title.`;
    this.storageNotification(message);
  }
}
```

Next we have the **scrollToTopOfScreen** method which, as the name implies, allows the class to programmatically scroll the HTML content to the top of the page.

This will be used, when selecting a saved record for amendment, to scroll to the movie entry form at the top of the page:

```
scrollToTopOfScreen()
{
  this.content.scrollToTop();
}
```

Following this is the **amendListing** method which is called on the click event for the Amend button in the HTML template:

```
amendListing(item) : void
{
  let editedMovie         = item.movie,
      editedGenre         = item.genre,
      editedRating        = item.rating;

  this.scrollToTopOfScreen();
  this.filmTitle          = editedMovie;
  this.filmGenre          = editedGenre;
  this.filmRating         = editedRating;
  this.isEdited           = true;
  this.incr++;
```

```
      this.removeListing(item);
   }
```

This assigns the selected movie name, rating and genre to variables which are then assigned to the associated models used on each form field. This allows the selected movie data to be displayed in the HTML form so that it can then be edited as and where required.

We then set the **isEdited** flag to true and increment the **incr** property by 1 so that we can handle notifying the user later on in the script.

Finally we call the **removeListing** method to remove the selected movie from the NativeStorage object.

```
removeListing(item) : void
{
   let i : number = 0,
        k;

   for(k = 0; k < this.storedData.length; k++)
   {
      if(this.storedData[k].movie.indexOf(item.movie) !== -1)
      {
         this.storedData.splice(k, 1);
         this.movies.length        = 0;
         this.movies               = this.storedData;
         this.removeItem(this.storageKey);

         if(this.isEdited)
         {
            this.isDeleted = false;
         }
         else
         {
            this.isDeleted    = true;
         }
         this.storeMovie(this.movies, item.movie);
         i++;
      }
   }
}
```

The **removeListing** method takes in a single movie object and iterates through the **storedData** array object to see if a match can be found with the supplied movie.

If a match is found the movie is removed from the **storedData** array, the **movies** array is reset and then repopulated with the newly amended **storedData** array items.

The **removeItem** method is called to completely remove the NativeStorage object, we then set the boolean value for the **isDeleted** property based on whether or not we are amending the current movie before finally calling the **storeMovie** method to recreate the NativeStorage object and store the movies data within this.

```
removeItem(itemKey)
{
   this.store.removeItem(itemKey)
   .then(
      (data) => {

      },
      (error) => {
         let message    = "An error occurred! The item was NOT removed";
         this.storageNotification(message);
      }
   );
}
```

The **removeItem** method removes the NativeStorage object that stores all the saved movies and handles how any errors that may occur during this operation are returned to the user.

```
storeMovie(movies, movie)
{
  let moviesStored       = JSON.stringify(movies);
  this.store.setItem(this.storageKey, moviesStored).then(
  (data) => {
    this.storedData      = null;
    this.renderMovies();
    let message          = this.renderNotificationMessage(movie);
    this.storageNotification(message);
  },
  (error) => {
    let message          = `Whoops! Something went wrong. The movie title
${movie} was NOT added`;
    this.storageNotification(message);
  });
}
```

The **storeMovie** method then recreates the NativeStorage object and populates that with the recently amended **movies** array object.

Within the returned promise the **storedData** object is reset before being repopulated through the **renderMovies** method which displays the saved movies on the page.

We then return a notification message to the user to inform them of the outcome of the operation.

The following **renderNotificationMessage** method determines which message to return based on whether we are removing, amending or adding a movie to the NativeStorage object and subsequently clears the HTML form of any entered data:

```
renderNotificationMessage(movie) : string
{
   var message;

   if(this.isDeleted)
   {
      this.clearFieldValues();
      message           = "Congratulations! The item was successfully removed";
      this.isDeleted    = false;
      this.incr         = 0;
   }
   else if(this.isEdited)
      {
      if(this.incr === 0)
      {
         this.clearFieldValues();
         message       = `The movie title ${movie} was successfully amended`;
         this.isEdited = false;
      }
   }
   else
   {
      this.clearFieldValues();
      message        = `The movie title ${movie} was added`;
   }

   return message;
}
```

Finally we reach the last amendment in our code - the **clearFieldValues** method where we simply reset the values for the models used on each form field to empty strings:

```
clearFieldValues()
{
   this.filmTitle      = "";
   this.filmRating  = "";
   this.filmGenre   = "";
}
```

A lot of amendments to go through but we got there in the end - all good stuff!

Now we can implement the next stage of upgrading the functionality for the app with the following features:

- Filter movies by genre
- Filter movies by rating

Open the **myMovies/src/pages/home/home.html** file and make the following amendments (highlighted in bold):

```
<ion-header>
  ...
</ion-header>

<ion-content padding>

   <form
         [formGroup]="form"
         (ngSubmit)="saveMovie()">
      <ion-list>

         ...

      </ion-list>
   </form>
```

```
<ion-item *ngIf="!isData">
   ...
</ion-item>


<ion-list *ngIf="isData" no-lines>
   <ion-list-header>
      Filter By
   </ion-list-header>

  <ion-item side="right">
     <ion-label>Genre:</ion-label>
     <ion-select
      [(ngModel)]="filtered"
      (ionChange)="filterMoviesByGenre($event, filtered)">
        <ion-option value="Action">Action</ion-option>
        <ion-option value="Comedy">Comedy</ion-option>
        <ion-option value="Documentary">Documentary</ion-option>
        <ion-option value="Horror">Horror</ion-option>
        <ion-option value="Other">Other</ion-option>
        <ion-option value="Romance">Romance</ion-option>
        <ion-option value="Thriller">Thriller</ion-option>
        <ion-option value="War">War</ion-option>
        <ion-option value="All">Show me all genres!</ion-option>
     </ion-select>
  </ion-item>

  <ion-item>
     <p text-center>Or</p>
  </ion-item>
```

```
   <ion-item>
     <ion-label text-left>Rating:</ion-label>
     <ion-range
       min="1"
       max="5"
       step="1"
       snaps="true"
       [(ngModel)]="rated"
       (ionChange)="filterMoviesByRating($event, rated)">
        <ion-label range-left>1</ion-label>
        <ion-label range-right>5</ion-label>
     </ion-range>
   </ion-item>

  </ion-list>



  <ion-list *ngIf="isData">
    <ion-list-header>
      Your saved movies
    </ion-list-header>
       ...
  </ion-list>

</ion-content>
```

All we’ve done with the above amendment is simply add 2 Ionic UI components:

- An <ion-select> menu and
- An <ion-range> slider

Which will allow the user to filter the display of saved movies based on their choice of selection.

Now we simply need to amend the component logic to enable this functionality.

Return to the **myMovies/src/pages/home/home.ts** file and make the following amendments (highlighted in bold):

```
...
import { AlertController, ... } from 'ionic-angular';
...

export class HomePage {
   ...
   public filtered    : any;
   public rated       : any;

   constructor(public alertCtrl : AlertController, ...)
   {
      ...
   }

   renderMovies(isFiltered = false, filterType = null, filtered = null) : void
   {
      this.store.getItems(this.storageKey)
      .then(
         (data) => {

            let existingData  = Object.keys(data).length;

            if(isFiltered)
            {
               let k,
                   temp        = [];

               if(data)
               {
```

```
    for(k in data)
    {

      if(filterType === 'genre')
      {
        if(data[k].genre === filtered)
        {

          temp.push({
            movie : data[k].movie,
            genre  : data[k].genre,
            rating  : data[k].rating
          });
        }
      }
      else if(filterType === 'rating')
      {
        if(data[k].rating === filtered)
        {
          temp.push({
            movie  : data[k].movie,
            genre  : data[k].genre,
            rating  : data[k].rating
          });
        }
      }
    }

    this.storedData  = temp.slice(0);
    this.sortMoviesByTitle(this.storedData);
  }
}
else
```

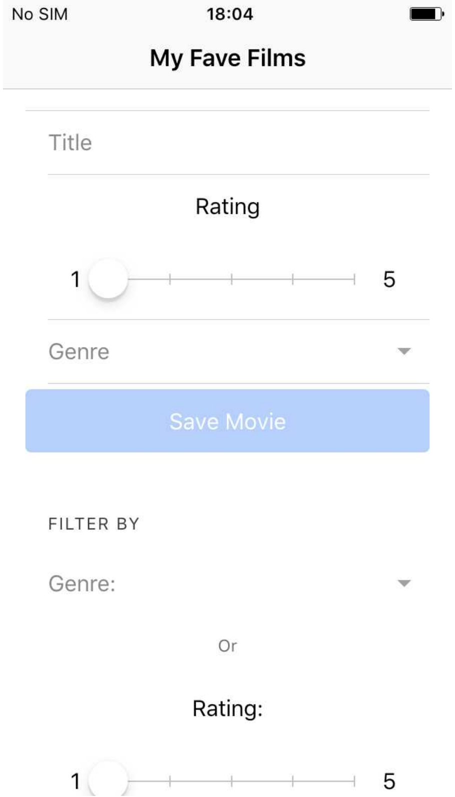
```
        {
          this.storedData = data;
          this.sortMoviesByTitle(this.storedData);
        }

        this.resetMovies(this.storedData);
        if(existingData !== 0)
        {
          this.isData     = true;
        }
        else
        {
          this.isData     = false;
        }
      },
      (error) => {
        let message = "You don't have any movies to display. Why not
add some?";
        this.displayAlert(message);
      });
    }



    displayAlert(message) : void
    {
      let headsUp = this.alertCtrl.create({
        title: 'Heads Up!',
        subTitle: message,
        buttons: ['Got It!']
      });

      headsUp.present();
    }
```

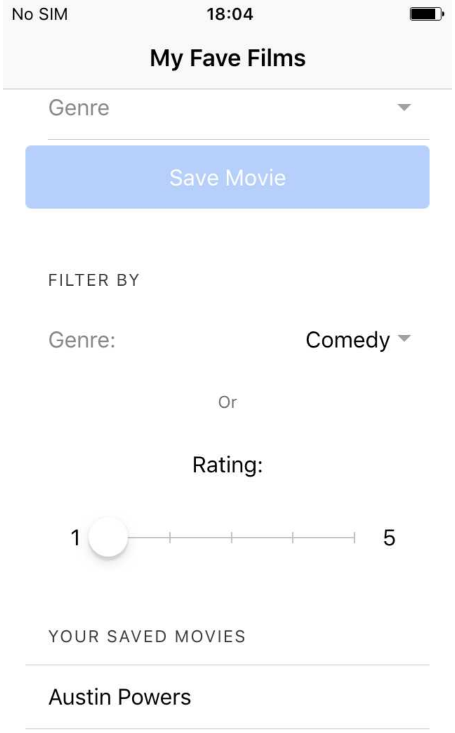
```
filterMoviesByGenre(filtered)
{
   if(filtered !== 'All')
   {
      this.renderMovies(true, 'genre', filtered);
   }
   else
   {
      this.renderMovies();
   }
}


filterMoviesByRating(rated)
{
   this.storedData  = null;
   this.renderMovies(true, 'rating', rated.value);
}


...


clearFieldValues()
{
   ...
   this.rated        = 1;
}
```

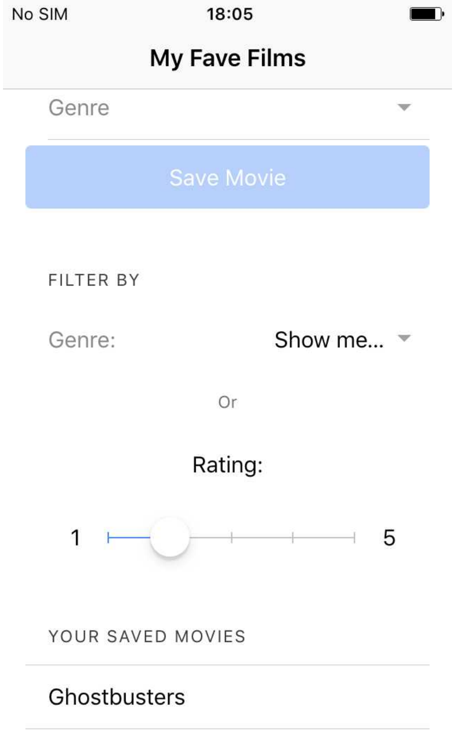
Before we delve into each of the above amendments to our class take a few minutes to rebuild and re-run the application on the handheld device connected to your computer with the following commands:

```
ionic build ios
ionic run ios --device
```

Once published to and running on your device the following UI enhancements and functionality should be displayed as shown in the following screen captures:







As these images demonstrate the genre and rating filters are implemented beneath the movie entry form and, when interacting with these newly added <ion-select> and <ion-range> UI components, we successfully filter the saved movies based on the following criteria:

- Display only those with from the Comedy genre
- Display only those we awarded with a rating of 2

So now we can filter our saved movies by genre or rating which is great but there's one niggle - our recent amendments leave the UI looking too cluttered and "busy".

Our final round of amendments will involve improving the app UI and implementing some Angular 2 animations to help enhance the user experience a little.

Before we get to this though let’s take a look at the amendments we made to the class logic to enable the filtering of our saved movies.

```
...
import { AlertController, ... } from 'ionic-angular';
...

export class HomePage {
   ...
   public filtered  : any;
   public rated     : any;

   constructor(public alertCtrl : AlertController, ...)
   {
      ...
   }
```

We begin with importing the **AlertController** module (subsequently passing that into the class constructor and setting that to a property of **alertCtrl**) which will be used to generate alert messages in the **displayAlert** method.

We also set 2 properties - **filtered** and **rated** - which will be used in the ngModel data binding on the <ion-select> and <ion-range> UI components in the Filter By section on the HTML template. These properties will be used to retrieve selected data and pass those back as parameters within the **filterMoviesByGenre** and **filterMoviesByRating** methods.

Next we amend the **renderMovies** method to accommodate any filtering:

```
renderMovies(isFiltered = false, filterType = null, filtered = null) : void
{
   this.store.getItems(this.storageKey)
      .then(
         (data) => {
```

```
let existingData  = Object.keys(data).length;

if(isFiltered)
{
  let k,
     temp        = [];

  if(data)
  {
    for(k in data)
    {

      if(filterType === 'genre')
      {
        if(data[k].genre === filtered)
        {

          temp.push({
            movie : data[k].movie,
            genre  : data[k].genre,
            rating  : data[k].rating
          });
        }
      }
      else if(filterType === 'rating')
      {
        if(data[k].rating === filtered)
        {
          temp.push({
            movie  : data[k].movie,
            genre  : data[k].genre,
            rating  : data[k].rating
          });
        }
```

```
                  }
                }

                this.storedData  = temp.slice(0);
                this.sortMoviesByTitle(this.storedData);
              }
            }
            else
            {
              this.storedData = data;
              this.sortMoviesByTitle(this.storedData);
            }

            this.resetMovies(this.storedData);
            if(existingData !== 0)
            {
              this.isData     = true;
            }
            else
            {
              this.isData     = false;
            }
          },
          (error) => {
            let message = "You don't have any movies to display. Why not
add some?";
            this.displayAlert(message);
  });
}
```

The **renderMovies** method now accepts 3 optional parameters:

- isFiltered
- filterType

- filtered

These are used to instruct the script, when the **renderMovies** method is triggered, whether or not the user has requested the saved movies to be filtered (**isFiltered**) and, if so, with what type of filter (**filterType**) and the value for that filter (**filtered**).

The method then uses conditional statements to determine, if the saved movies are to be filtered, the type of filter to retrieve only those matching movies on otherwise, if there are no filters, all saved movies are returned for display.

If an error has been encountered with trying to retrieve movies an alert message is triggered using the **displayAlert** method:

```
displayAlert(message) : void
{
   let headsUp = this.alertCtrl.create({
      title: 'Heads Up!',
      subTitle: message,
      buttons: ['Got It!']
   });

   headsUp.present();
}
```

This simply creates a dialog box with a message passed into it for display to the user.

The **filterMoviesByGenre** method is our next addition to the script:

```
filterMoviesByGenre(filtered)
{
   if(filtered !== 'All')
   {
      this.renderMovies(true, 'genre', filtered);
   }
```

```
    else
    {
        this.renderMovies();
    }
}
```

As the name suggests the **filterMoviesByGenre** method triggers the display of saved movies based on the selected genre.

If the user has selected All genres the **renderMovies** method is called without any supplied parameters.

This is followed by our next method - **filterMoviesByRating**:

```
filterMoviesByRating(rated)
{
    this.storedData  =   null;
    this.renderMovies(true, ‘rating’, rated.value);
}
```

This simply captures the selected rating from the <ion-range> slider passing this in as the third parameter for the **renderMovies** method (the first parameter states whether this is an amendment or not and the second value the type of filter - **rating**).

Finally, the remaining amendment is to the **clearFieldValues** method which simply resets the **rated** property value to 1 (this value is then picked up by the ngModel directive on the <ion-slider> UI component for the filter by section:

```
clearFieldValues()
{
    ...
    this.rated          = 1;
}
```

Now we can turn our attention to implementing the final round of amendments for the app - tidying up the UI and adding animations.

Open the **myMovies/src/pages/home/home.html** file and make the following amendments (highlighted in bold):

```
<ion-header>
  ...
</ion-header>

<ion-content padding>

  <div padding-bottom margin-bottom>
    <button
      ion-button
      color="primary"
      text-center
      block
      (click)="toggleForm()">{{ buttonText }}</button>
  </div>

  <div [@panelHeightTrigger]="expandedState">
    <form
      [formGroup]="form"
      (ngSubmit)="saveMovie()"
      *ngIf="expanded">
       ...
    </form>
  </div>

  <ion-list *ngIf="isData" no-lines>
    <div padding-bottom margin-bottom>
      <button
        ion-button
        color="secondary"
        text-center
        block
        (click)="toggleFilters()">{{ filtersText }}</button>
    </div>

    <div [@filtersPanelHeightTrigger]="expandedFiltersState">
      <div *ngIf="expandedFilters">
        <ion-list-header>
          Filter By
        </ion-list-header>

        <ion-item side="right">
          <ion-label>Genre:</ion-label>
          <ion-select
            [(ngModel)]="filtered"
            (ionChange)="filterMoviesByGenre($event, filtered)">
            <ion-option value="Action">Action</ion-option>
            <ion-option value="Comedy">Comedy</ion-option>
            <ion-option value="Documentary">Documentary</ion-option>
            <ion-option value="Horror">Horror</ion-option>
            <ion-option value="Other">Other</ion-option>
            <ion-option value="Romance">Romance</ion-option>
            <ion-option value="Thriller">Thriller</ion-option>
            <ion-option value="War">War</ion-option>
            <ion-option value"All">Show me all genres!</ion-option>
          </ion-select>
        </ion-item>

        <ion-item>
          <p text-center>Or</p>
        </ion-item>
```

```
        <ion-item>
          <ion-label text-left>Rating:</ion-label>
          <ion-range
            min="1"
            max="5"
            step="1"
            snaps="true"
            [(ngModel)]="rated"
            (ionChange)="filterMoviesByRating($event, rated)">
            <ion-label range-left>1</ion-label>
            <ion-label range-right>5</ion-label>
          </ion-range>
        </ion-item>
      </div>
    </div>
  </ion-list>

  ...

</ion-content>
```

For the final HTML adjustment we need to download this JS polyfill (and then add this file to the following app directory: **myMovies/src/assets/js**) so that the Web Animation API used by the underlying Angular 2 framework is able to work on older and non-supporting platforms - particularly iOS!

In the **myMovies/src/index.html** file add the following line (highlighted in bold):

```
<script src="cordova.js"></script>
<script src="assets/js/web-animations.min.js"></script>
<!-- The polyfills js is generated during the build process -->
<script src="build/polyfills.js"></script>
```

And that completes the HTML adjustments for enabling animations within the app!

Let’s go over these in a little more detail so we understand what’s going on.

Within the **myMovies/src/pages/home/home.html** page we start by adding a button to enable the user to show/hide the movie entry form using a function named **toggleForm** (which is triggered on a click event attached to the button):

```
<div padding-bottom margin-bottom>
  <button
    ion-button
    color="primary"
    text-center
    block
    (click)="toggleForm()">{{ buttonText }}</button>
</div>
```

Next we amend the movie entry form to enable animations to be take place by adding a property of **panelHeightTrigger** which will only be fired depending on the value of **expandedState**.

Additionally an **ngIf** directive is attached to the form which is assigned a boolean value of **expanded** (this will be used within the class logic to determine whether or not the form is displayed):

```
<div [@panelHeightTrigger]="expandedState">
  <form
    [formGroup]="form"
    (ngSubmit)="saveMovie()"
    *ngIf="expanded">

     ...

  </form>
</div>
```

Following from this we then add another button to the page template which, using a click event with an attached function named **toggleFilters**, will enable the user to show or hide the filtering based UI components on the page template:

```
<div padding-bottom margin-bottom>
  <button
    ion-button
    color="secondary"
    text-center
    block
    (click)="toggleFilters()">{{ filtersText }}</button>
</div>
```

Next we add a **<div>** wrapper to enable animations to be take place on the Ionic UI components that provide the movie related filters (these components are contained within this **<div>**) by adding a property of **filtersPanelHeightTrigger** which will only be fired depending on the value of **expandedFiltersState**.

Additionally an **ngIf** directive, which uses the **expandedFilters** boolean, is attached to an internal <div> element to determine whether or not the UI components for filtering the saved movies are displayed:

```
<div [@filtersPanelHeightTrigger]="expandedFiltersState">
  <div *ngIf="expandedFilters">
     ...
  </div>
</div>
```

Within this <div> wrapper we have added the following UI components:

- <ion-select>
- <ion-range>

The <ion-select> element offers the user the ability to filter the saved movies by a specific genre and uses the **ionChange** event to trigger the **filterMoviesByGenre** method.

This method captures the event that was fired (in this instance the **ionChange** event) and the genre selected:

```
<ion-select
  [(ngModel)]="filtered"
  (ionChange)="filterMoviesByGenre($event, filtered)">


  ...


</ion-select>
```

The <ion-range> element offers the user the ability to filter the saved movies by a selected rating, using the **ionChange** event to trigger the **filterMoviesByRating** method.

This captures the event that was fired and the selected rating value:

```
<ion-range
  min="1"
  max="5"
  step="1"
  snaps="true"
  [(ngModel)]="rated"
  (ionChange)="filterMoviesByRating($event, rated)">
    <ion-label range-left>1</ion-label>
    <ion-label range-right>5</ion-label>
 </ion-range>
```

That covers the HTML amendments we needed to make for helping to improve the application UI as well as implementing the triggers for the animation functionality.

Now we can move onto scripting the logic for these HTML amendments.

Within the **myMovies/src/pages/home/home.ts** file make the final set of shown amendments (highlighted in bold):

```
import {
  Component,
  trigger,
  state,
  style,
  transition,
  animate,
  ViewChild } from '@angular/core';
...

@Component({
  ...
  animations: [
    trigger('panelHeightTrigger', [
      state('expanded', style({ height: '370px', visibility: 'visible' })),
      state('collapsed', style({ height: '0px', visibility: 'hidden' })),
      transition('collapsed => expanded', animate('1000ms ease-in')),
      transition('expanded => collapsed', animate('1000ms 200ms ease-
out’))
    ]),
    trigger('filtersPanelHeightTrigger', [
      state('expandedState', style({ height: '300px', visibility: 'visible' })),
      state('collapsedState', style({ height: '0px', visibility: 'hidden' })),
      transition('collapsedState => expandedState', animate('1000ms
ease-in')),
      transition('expandedState => collapsedState', animate('1000ms
200ms ease-out'))
    ])
  ]
})
export class HomePage {
```

```
...
public expanded               : boolean  = false;
public expandedState          : string   = "collapsed";
public expandedFilters        : boolean  = false;
public expandedFiltersState   : string   = "collapsedState";
public buttonText             : string   = "Add a new movie";
public filtersText            : string   = "Display Filters";

...

filterMoviesByGenre(filtered)
{
   ...
   this.toggleFilters();
}


filterMoviesByRating(rated)
{
   ...

   setTimeout(
      () => {
         this.toggleFilters();
      }, 750);
}


saveMovie()
{
   let movie : string    =     this.form.controls["movieName"].value,
       genre : string    =     this.form.controls["genre"].value,
       rating : number   =     this.form.controls["rating"].value,
       i        : number =      0,
       k;

   this.toggleForm();
   ...
}


amendListing(item) : void
{
   let editedMovie      = item.movie,
       editedGenre      = item.genre,
       editedRating     = item.rating;

   this.toggleForm();
   ...
}


toggleForm()
{
   this.expanded = !this.expanded;
   if(this.expanded)
   {
      this.buttonText         = "Nah, just display my movies";
      this.expandedState      = 'expanded';
   }
   else
   {
      this.buttonText         = "Add a new movie";
      this.expandedState      = 'collapsed';
   }
}
```

```
toggleFilters()
{
  this.expandedFilters            = !this.expandedFilters;
  if(this.expandedFilters)
  {
    this.filtersText              = "Hide these filters";
    this.expandedFiltersState     = 'expandedState';
  }
  else
  {
    this.filtersText              = "Display Filters";
    this.expandedFiltersState     = 'collapsedState';
  }
}
```

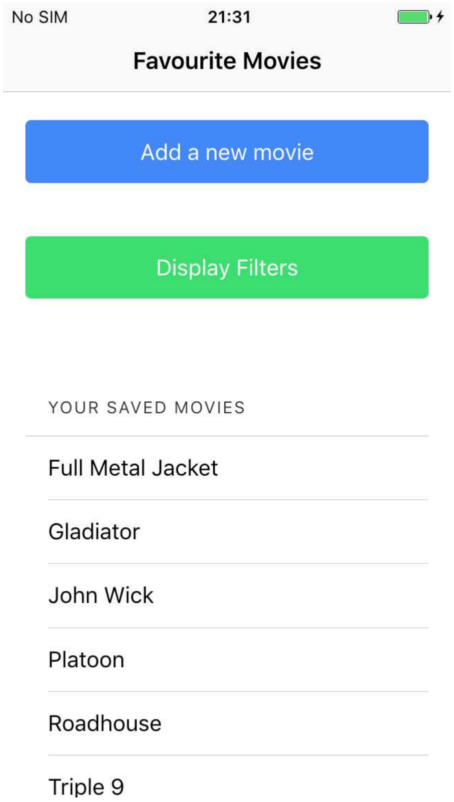
And that completes our final set of amendments!

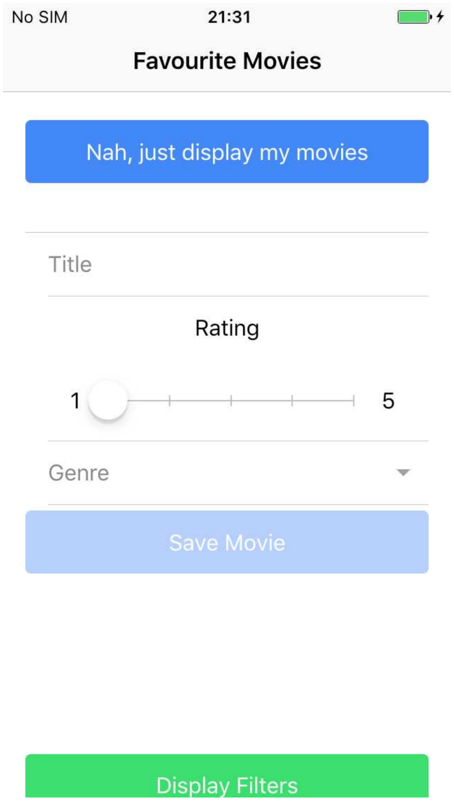
With the above code additions we've implemented a lot of animation oriented logic to enhance the presentation layer for the app.

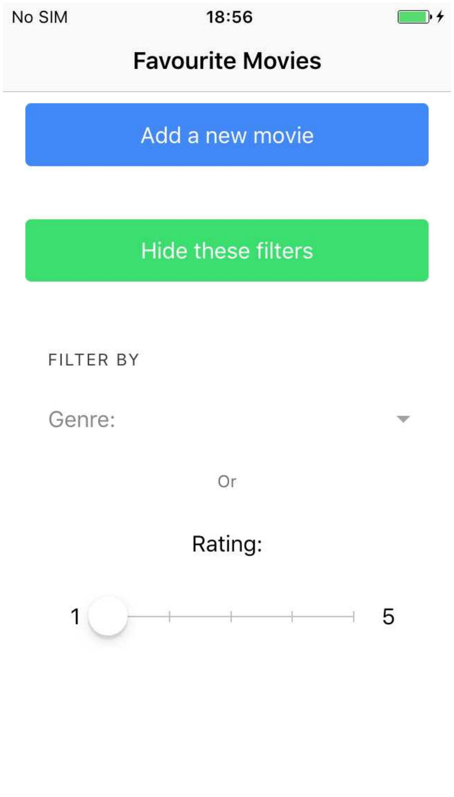
Before reviewing these amendments take a few minutes to rebuild and re-run the application on the handheld device connected to your computer) with the following commands:

```
ionic build ios
ionic run ios --device
```

Once published to and running on your device the application should display the new enhancements to the UI as well as triggering the animation functionality for the form groups on the page as shown in the following screen captures:







If you’re seeing the above then congratulations!

If you’re not then double check your code against that contained within the pages of this chapter and, once resolved, come back to this page.

Assuming all is good and well with your application let’s now spend some time going through the recent additions to the class logic.

We begin by importing animation related modules at the top of the **myMovies/src/pages/home/home.ts** file:

```
import {
   Component,
   trigger,
   state,
   style,
   transition,
   animate,
   ViewChild } from '@angular/core';
```

Following from this we then define 2 sets of animation rules inside an array within the @Component decorator:

- **panelHeightTrigger** (animation logic for the movie entry form)
- **filtersPanelHeightTrigger** (animation logic for the DOM wrapper containing the <ion-select> and <ion-range> movie filters)

These rules consist of the following:

- **trigger** (Defines the properties that will be attached to a DOM element on the page and act, as the name implies, as an animation trigger)
- **state** (Declares the style properties that will be used when animating to and from)
- **transition** (Defines the order in which the declared states will be animated, the duration of that animation and what easing functions may be applied)

All of which is structured like so:

```
@Component({
  ...
  animations: [
    trigger('panelHeightTrigger', [
      state('expanded', style({ height: '370px', visibility: 'visible' })),
      state('collapsed', style({ height: '0px', visibility: 'hidden' })),
      transition('collapsed => expanded', animate('1000ms ease-in')),
      transition('expanded => collapsed', animate('1000ms 200ms ease-
out'))
    ]),
    trigger('filtersPanelHeightTrigger', [
      state('expandedState', style({ height: '300px', visibility: 'visible' })),
      state('collapsedState', style({ height: '0px', visibility: 'hidden' })),
      transition('collapsedState => expandedState', animate('1000ms
ease-in')),
      transition('expandedState => collapsedState', animate('1000ms
200ms ease-out'))
```

```
    ])
  ]
})
```

We then, within the body of the HomePage class, add some additional properties for use with the animation logic:

```
public expanded                : boolean  = false;
public expandedState           : string   = "collapsed";
public expandedFilters         : boolean  = false;
public expandedFiltersState    : string   = "collapsedState";
public buttonText              : string   = "Add a new movie";
public filtersText             : string   = "Display Filters";
```

The **filterMoviesByGenre** method is subsequently amended to include a call to trigger the **toggleFilters** method so that the **<ion-select>** and **<ion-range>** UI components are hidden once the user has selected a genre to filter the display of saved movies:

```
filterMoviesByGenre(filtered)
{
  ...
  this.toggleFilters();
}
```

Related to this the **filterMoviesByRating** method also includes a call to trigger the **toggleFilters** method, wrapping that within a setTimeout call to avoid UI conflicts with closing the filters area while also rendering filtered movie results to the screen:

```
filterMoviesByRating(rated)
{
  ...

  setTimeout(
      () => {
        this.toggleFilters();
      }, 750);
   }
```

We then add the **toggleForm** method to both the **saveMovie** and **amendListing** methods so that the movie entry form is hidden once the user has submitted their movie to be saved to the NativeStorage object:

```
saveMovie()
{
   let movie : string       =      this.form.controls["movieName"].value,
       genre : string       =      this.form.controls["genre"].value,
       rating : number      =      this.form.controls["rating"].value,
       i        : number    =      0,
       k;

   this.toggleForm();
   ...
}



amendListing(item) : void
{
   let editedMovie        = item.movie,
       editedGenre        = item.genre,
       editedRating       = item.rating;

   this.toggleForm();
   ...
}
```

Finally, we added the following methods:

- **toggleForm** (Control display of movie entry form)
- **toggleFilters** (Control display of <ion-select> and <ion-range> filters)

Which use conditional logic to set button texts and the state of the movie entry form and the <ion-select> and <ion-range> filters:

```
toggleForm()
 {
   this.expanded                 = !this.expanded;
   if(this.expanded)
   {
     this.buttonText             = "Nah, just display my movies";
     this.expandedState          = "expanded";
   }
   else
   {
     this.buttonText             = "Add a new movie";
     this.expandedState          = "collapsed";
   }
 }


 toggleFilters()
 {
   this.expandedFilters          = !this.expandedFilters;
   if(this.expandedFilters)
   {
     this.filtersText            = "Hide these filters";
     this.expandedFiltersState   = "expandedState";
   }
   else
   {
     this.filtersText            = "Display Filters";
     this.expandedFiltersState   = "collapsedState";
```

```
    }
  }
```

Finishing touches

Before we can consider the app completed there's one final addition we need to make - implementing the necessary launch icon and splash screen images for the iOS and Android directories in the **/myMovies/resources** directory.

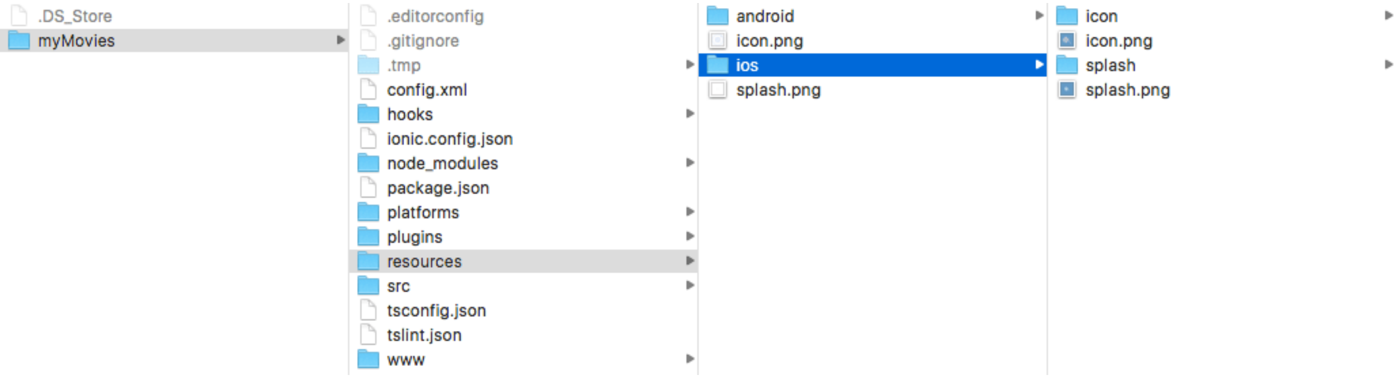
Without these our app will use the default Apache Cordova images which seems a little lazy after all the work we've put in during this case study.

Before proceeding though you'll need to download the files for this case study from the following link: http://tinyurl.com/jxc5wcn (if you haven't done so already).

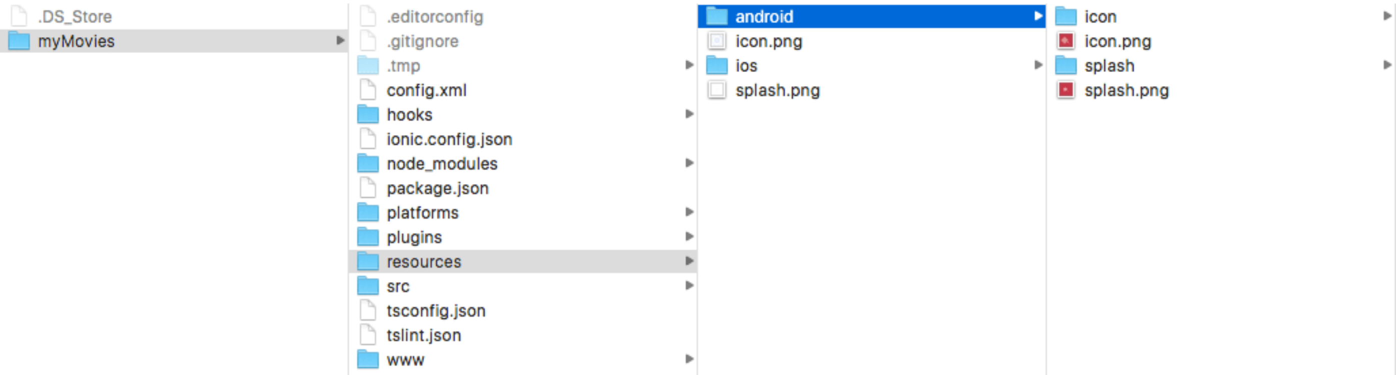
Having done this copy both the **icon.png** and **splash.png** files from the following locations in the downloaded project files directory:

- **myMovies/resources/android**
- **myMovies/resources/ios**

And then paste these into the matching directories in your own myMovies project, beginning with the iOS launch and splash images:



Followed by those for Android:



.DS_Store
myMovies

.editorconfig
.gitignore
.tmp
config.xml
hooks
ionic.config.json
node_modules
package.json
platforms
plugins
resources
src
tsconfig.json
tslint.json
www

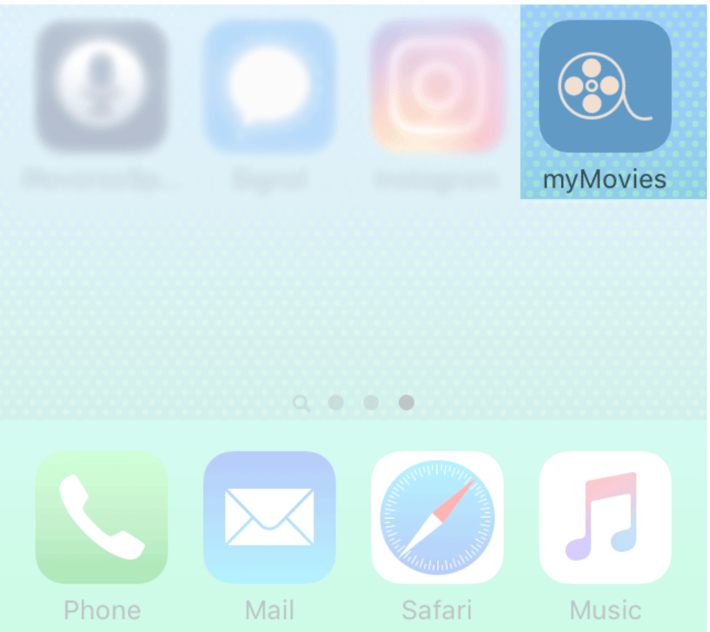
android
icon.png
ios
splash.png

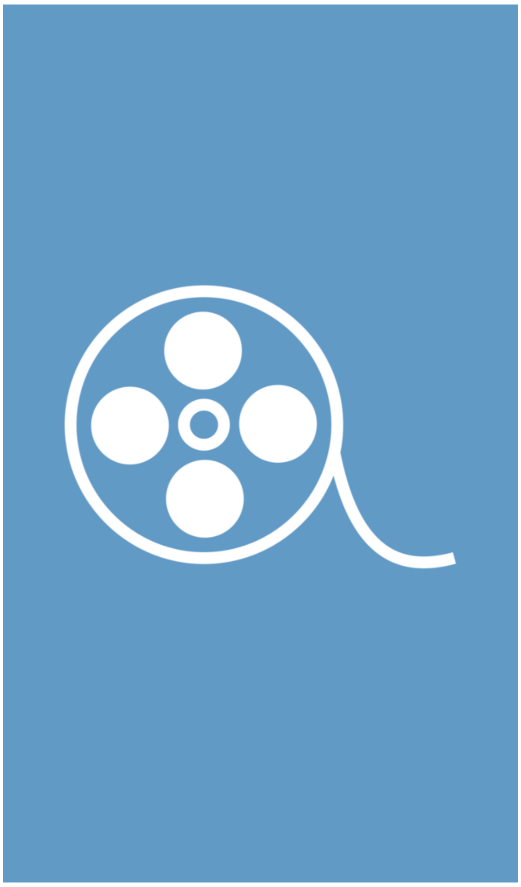
icon
icon.png
splash
splash.png

With our respective launch icon and splash screen templates in place for iOS and Android we can now generate the images to be used for these platforms using the following Ionic CLI command (as always - ensure you are at the root of the myMovies project directory before running such commands):

```
ionic resources
```

Once the command has finished processing you should see the different launch icon and splash screen sizes being generated from the supplied template images which, when our app is published to a mobile device, should give us something like the following:





And that, as they say, is a wrap!

In the case study we’ve built a single page Ionic 2 app using Native Storage and the Web Animations API that allows us to:

- Add, amend and remove movie entries
- Implemented Angular 2’s FormBuilder service & form validation logic
- Check for duplicate movie entries (and reject them from being entered)
- Display movies in ascending alphabetical order
- Filter movies by genre and rating
- Display data entry forms and components when and where necessary with just the right amount of animation (not too much, not too little!)

Feel free to experiment with building on top of what we’ve accomplished here with adding extra features such as inserting a movie image for each listing, more refined movie validation logic or maybe even enabling both filters to work together instead of
independently.

Hopefully you’ve found this case study useful in learning more about working with Ionic 2 and some of its features (which you can then carry over for use in your own projects).

In the next case study we’ll look at implementing features including SQLite data storage, In-App Purchases and further Ionic 2 UI components.

Resources
All project files for this chapter can be found listed in the download links on page 636.

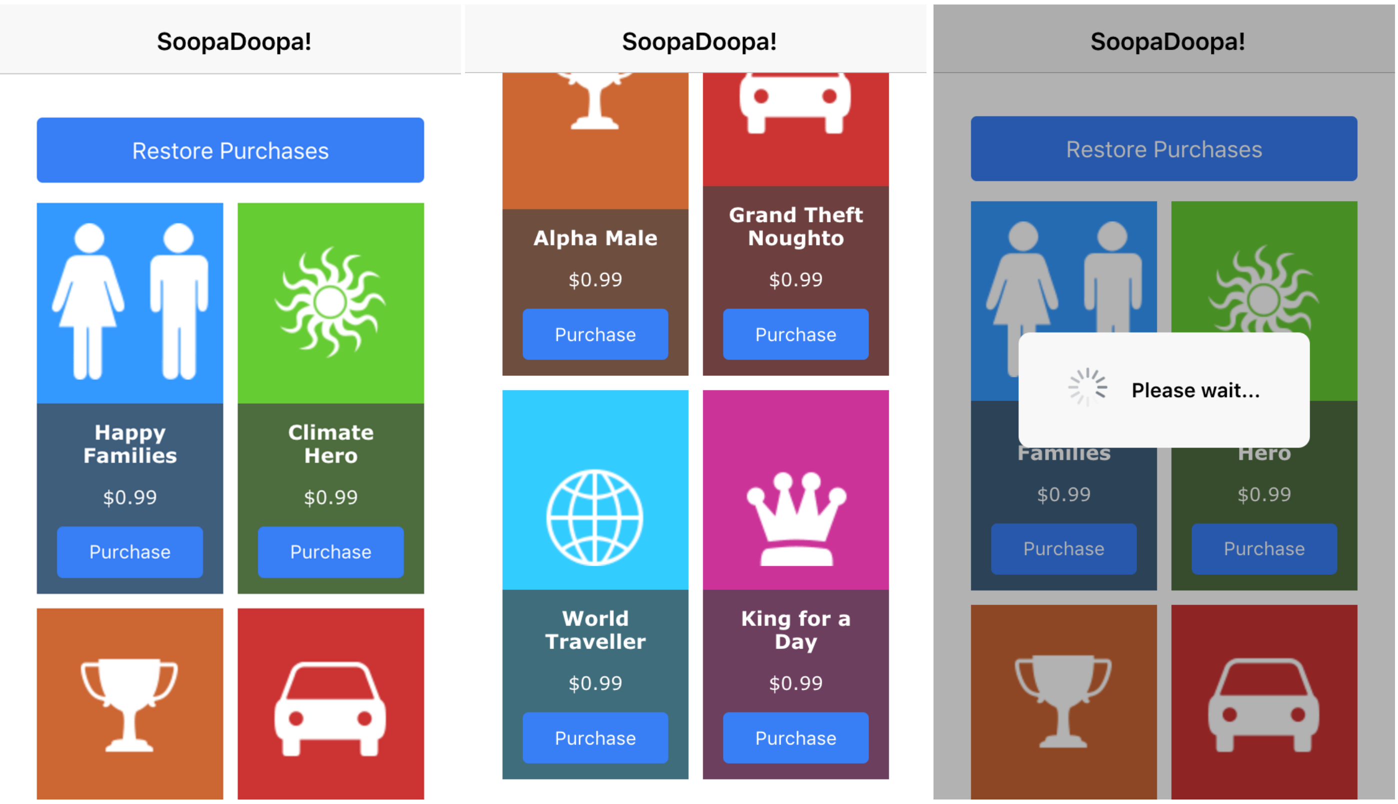
Case Study #2
SoopaDoopaGames
App

In this case study we're going to use Ionic 2 to develop a sample application that allows users to purchase and unlock pre-existing content that would otherwise be inaccessible (in this context we'll be unlocking fictional games but the choice of content could really be anything at all such as downloadable files, video media etc.).

Features and functionality that will be used include:

- The Ionic Grid component
- In-App Purchasing functionality
- Storing data using the Cordova SQLite plugin

And, by the end of this chapter, your app should resemble the following:



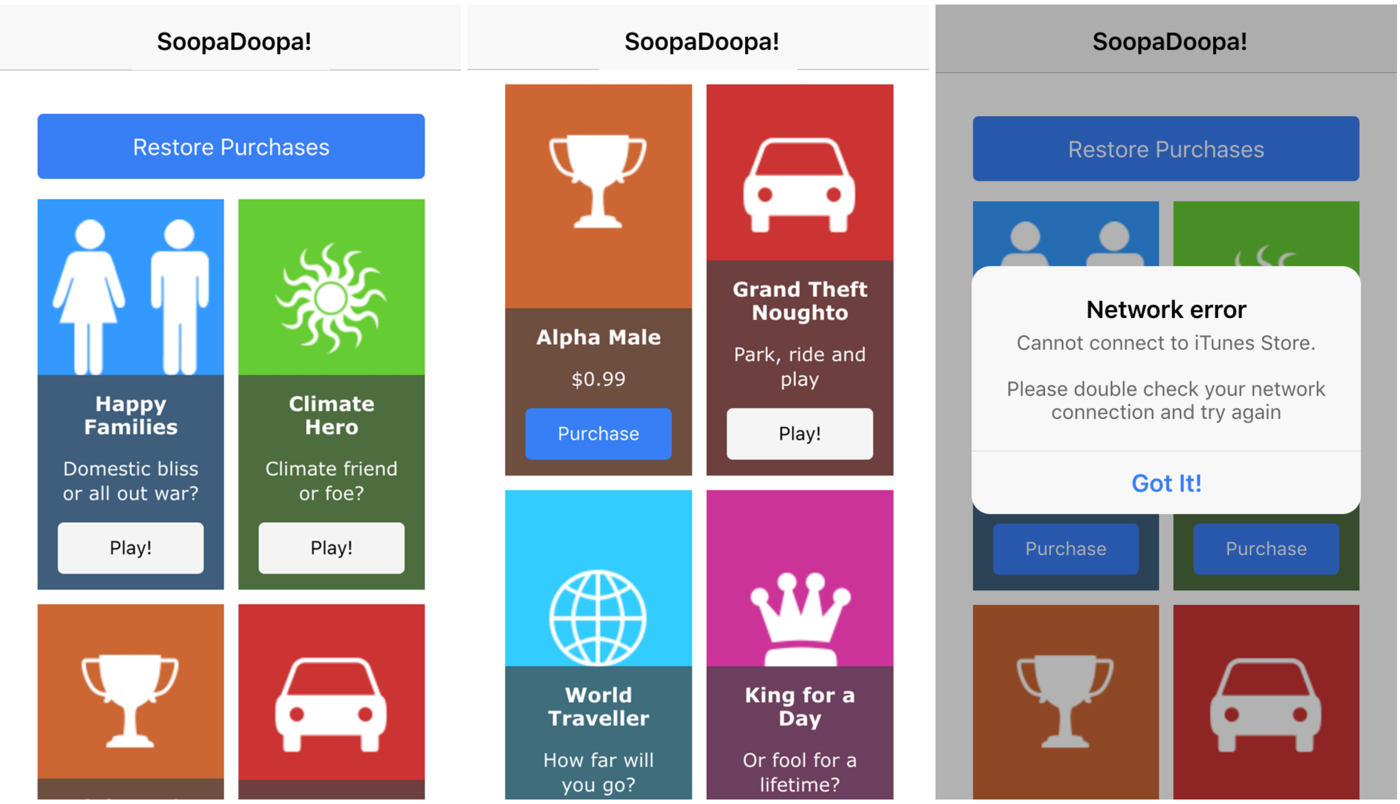
The very first time the app is loaded the following 6 "games" are displayed with Purchase buttons enabled:

- Happy Families
- Climate Hero
- Alpha Male
- Grand Theft Noughto
- World Traveller

- King for a Day

Every time the App is loaded a network check is run to determine whether the purchasable products are able to be verified with the Apple App & Google Play stores.

When a “game” has been successfully purchased the UI is updated to display a caption and a Play! button for that game:



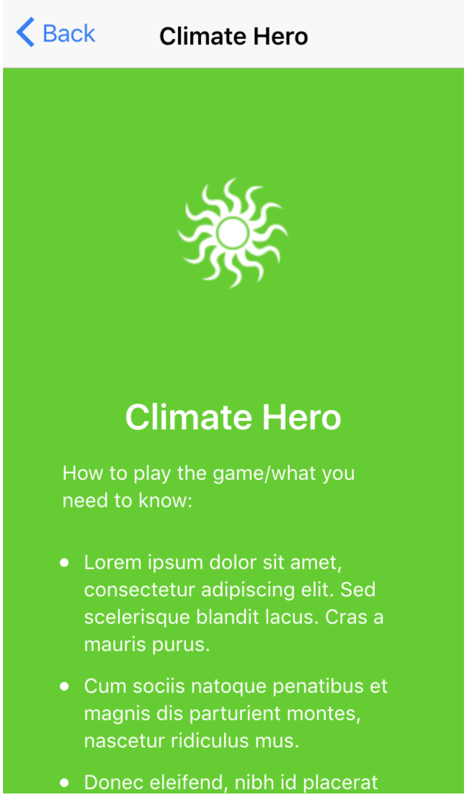
Network error
Cannot connect to iTunes Store.

Please double check your network connection and try again

As previously mentioned, if, for some reason, when launched the app cannot connect with the respective online store an alert window is displayed informing the user of the fact and provides a suggestion for further investigation.

When the user closes this alert window the app then tries to re-initiate the request to contact the respective app store to verify that the listed “games” are available for purchase.

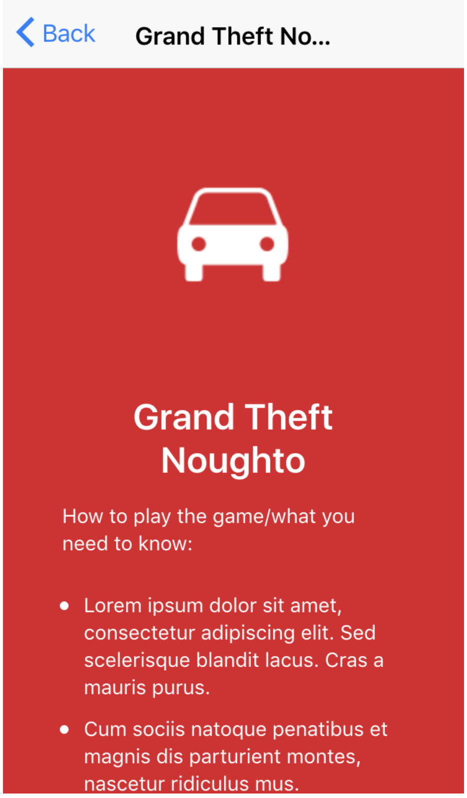
Assuming that the user has successfully purchased their selected “game” they will be able to then access that as shown in the following screen captures for all “games”:



Climate Hero

How to play the game/what you need to know:

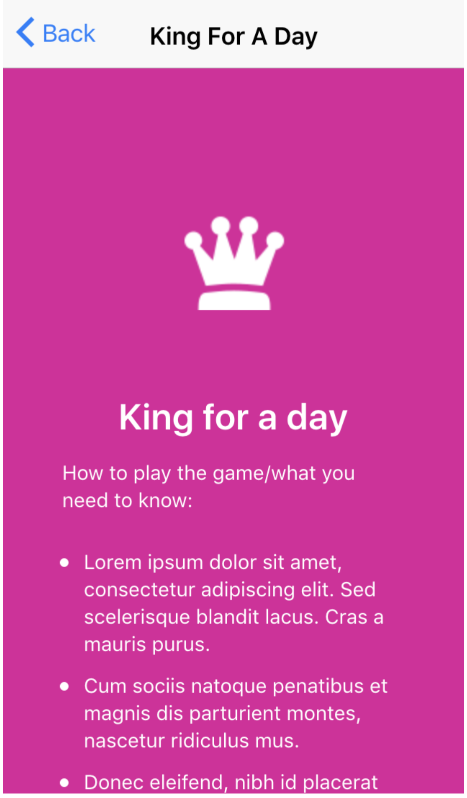
- Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed scelerisque blandit lacus. Cras a mauris purus.
- Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.
- Donec eleifend, nibh id placerat



Grand Theft Noughto

How to play the game/what you need to know:

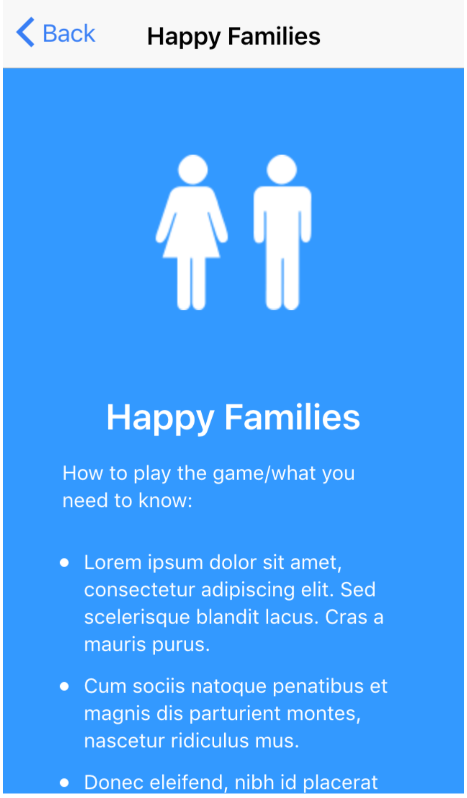
- Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed scelerisque blandit lacus. Cras a mauris purus.
- Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.



King for a day

How to play the game/what you need to know:

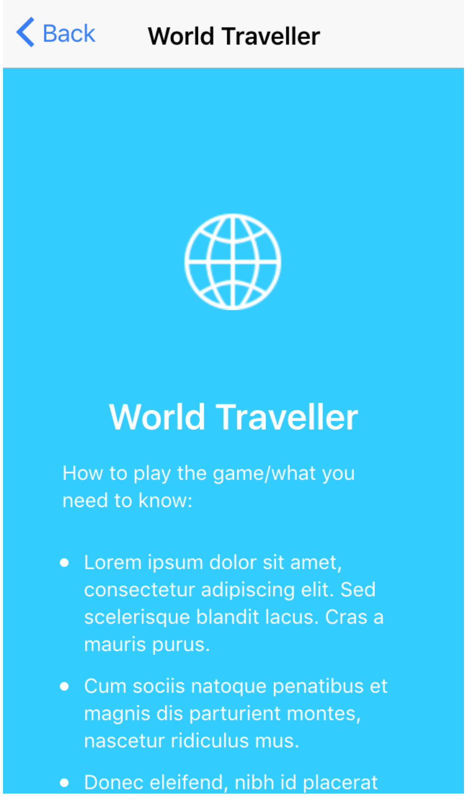
- Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed scelerisque blandit lacus. Cras a mauris purus.
- Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.
- Donec eleifend, nibh id placerat



Happy Families

How to play the game/what you need to know:

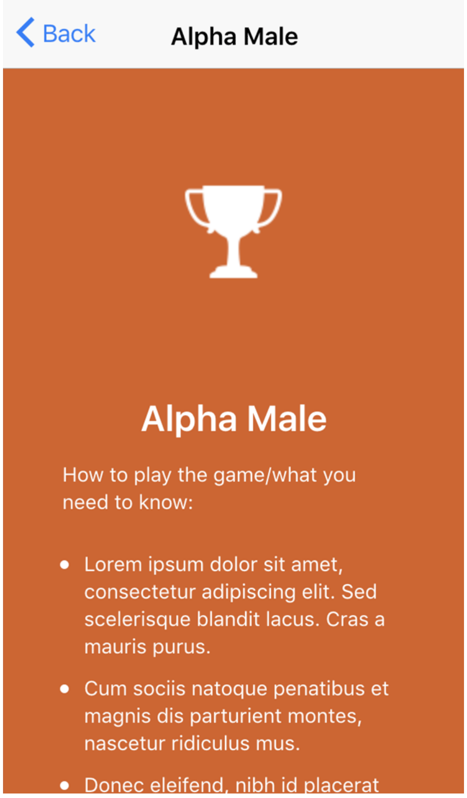
- Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed scelerisque blandit lacus. Cras a mauris purus.
- Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.
- Donec eleifend, nibh id placerat



World Traveller

How to play the game/what you need to know:

- Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed scelerisque blandit lacus. Cras a mauris purus.
- Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.
- Donec eleifend, nibh id placerat



Alpha Male

How to play the game/what you need to know:

- Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed scelerisque blandit lacus. Cras a mauris purus.
- Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.
- Donec eleifend, nibh id placerat

As you can see each “game” is pretty much a variation on the same theme - the only differences being those of the title, choice of image and page background colour for each respective “game”.

So that covers what you’ll be developing in this Case Study and should expect to see by the end of the chapter.

So, without further ado, let’s make a start on building the app!

At the root of your apps projects directory run the following commands (waiting for each successive command to successfully complete running of course!) in the Ionic CLI to generate the new app, install the required plugins and create the necessary pages:

```
ionic start SoopaDoopaGames blank --v2
cd SoopaDoopaGames
npm install
ionic plugin add cordova-plugin-inapppurchase
ionic plugin add cordova-sqlite-storage
ionic g provider database
ionic g provider utilities
ionic g page alphaMale
ionic g page climateHero
ionic g page grandTheftNoughto
ionic g page happyFamilies
ionic g page kingForADay
ionic g page worldTraveller
```

Breaking this down we create a blank Ionic 2 app (don’t forget that --v2 flag!) named SoopaDoopaGames which, once generated by the CLI, we then change into and run the **npm install** command to make all required dependencies and modules available for the app to subsequently use.

Following on from this we then install the following plugins:

- cordova-plugin-inapppurchase
- cordova-sqlite-storage

Once completed we generate the following 2 services (also referred to as providers/injectables - depending on who you ask there are many terms used to describe the same item!):

- **Database** (provides methods to interact with the underlying SQLite database through the cordova-sqlite-storage plugin API)
- **Utilities** (provides helper methods for the app)

Finally we generate the pages (or, more accurately, the web components that will contain the TypeScript, Sass and HTML for the page) for each “game”:

- alphaMale
- climateHero
- grandTheftNoughto
- happyFamilies
- kingForADay
- worldTraveller

That forms the basic foundation for our app which, over the following pages, we are going to spend time plugging the necessary logic, styles and UI elements into place for.

Let’s begin by setting up the **SoopaDoopaGames/src/app/app.module.ts** file with the necessary imports and configurations (amendments highlighted in bold):

```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { HomePage } from '../pages/home/home';
import { AlphaMale } from '../pages/alpha-male/alpha-male';
import { ClimateHero } from '../pages/climate-hero/climate-hero';
import { GrandTheftNoughto } from '../pages/grand-theft-noughto/grand-theft-noughto';
import { HappyFamilies } from '../pages/happy-families/happy-families';
import { KingForADay } from '../pages/king-for-a-day/king-for-a-day';
import { WorldTraveller } from '../pages/world-traveller/world-traveller';
import { Database } from '../providers/database';
import { Utilities } from '../providers/utilities';
```

```
@NgModule({
  declarations: [
    MyApp,
    HomePage,
    AlphaMale,
    ClimateHero,
    GrandTheftNoughto,
    HappyFamilies,
    KingForADay,
    WorldTraveller
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage,
    AlphaMale,
    ClimateHero,
    GrandTheftNoughto,
    HappyFamilies,
    KingForADay,
    WorldTraveller
  ],
  providers: [{provide: ErrorHandler, useClass: IonicErrorHandler}, Database, Utilities]
})
export class AppModule {}
```

Here we are simply declaring the components and providers that will be imported and used within the app. This is an important step so be sure to get the paths to the components/providers correct as well as the spelling of the modules to be imported.

Now we can turn our attention to implementing the logic for the following providers:

- Database
- Utilities

Let’s make a start with scripting the logic for the **Utilities** provider as this will contain only a single method.

Open the **SoopaDoopaGames/src/providers/utilities.ts** file and make the amendments displayed below (highlighted in bold):

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Injectable()
export class Utilities {

   constructor(public http: Http)
   {
      console.log('Hello Utilities Provider');
   }

   prefixWithZeros =   function(num)
   {
      var num           =   num;
      if(num < 10)
      {
         num            =   '0' + num;
      }
      return num;
   }

}
```

The **prefixWithZeros** method simply takes a number, determines if it’s less than 10 and, if so, prepends a zero to the number and then returns that back to the script where the method will be called.

We’re going to use this method to prepend single date values with zeros where necessary.

For example:

```
// The prefixWithZeros method transforms this
1-1-2016

// Into this
01-01-2016
```

This formats our date values so they’re easier to read and understand when saving (to the SQLite database) the “games” that have been purchased through the In-App Purchases plugin API (unfortunately there’s no DATE type in SQLite as there is in MySQL or other database vendors as this format would be perfect for these converted date values).

That completes all of the logic required for our **Utilities** provider so now we can turn our attention towards implementing the necessary methods for the app database provider.

Open the **SoopaDoopaGames/src/providers/database.ts** file and make the amendments displayed below (highlighted in bold):

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import {SQLite} from 'ionic-native';
import 'rxjs/add/operator/map';
import { Utilities } from '../providers/utilities';

@Injectable()
```

```
export class Database {
  public data            : any       =  null;
  public storage         : any       =  null;
  public dbName          : string    =  "Soopadoopagames.db";
  public purchases       : any       =  [];


  constructor(
    public http      : Http,
    public UTIL  : Utilities
  )
  {
    this.data = null;
  }


  createDatabase()
  {
    this.storage =   new SQLite();
    this.storage.openDatabase({
      name        :   this.dbName,
      location    :   'default' // the location field is required
    })
    .then((data) =>
    {
      console.log("Opened database");
      this.createDatabaseTables();
    },
    (err) =>
    {
      console.error('Unable to open database: ', err);
    });
  }
```

```
   createDatabaseTables()
   {
      this.createPurchasesTable();
   }


   createPurchasesTable()
   {
      this.storage.executeSql('CREATE TABLE IF NOT EXISTS appPurchases (id INTEGER PRIMARY KEY AUTOINCREMENT, productID TEXT, isPurchased TEXT NOT NULL, date TEXT NOT NULL, timestamp INTEGER NOT NULL)', {})
      .then((data) =>
      {
         console.log("TABLE CREATED: " + JSON.stringify(data));
      },
      (error) =>
      {
         console.log("Error: " + JSON.stringify(error.err));
         console.dir(error);
      });
   }


   retrievePurchases()
   {
      return new Promise(resolve =>
      {
         this.storage.executeSql("SELECT * FROM appPurchases", {})
         .then((data) =>
         {
            this.purchases                    = [];
            if(data.rows.length > 0)
```

```
        {
          var k;
          for(k = 0; k < data.rows.length; k++)
          {
            this.purchases.push({
              productId  : data.rows.item(k).productID
            });
          }
        }
        resolve(this.purchases);
      },
      (error) =>
      {
        console.log("Error: " + JSON.stringify(error));
      });
    });
  }


  doesPurchaseExistInTable(productID)
  {
    this.storage.executeSql("SELECT * FROM appPurchases WHERE
productID = '" + productID + "'", {})
    .then((data) =>
     {
      let isPurchased =  'Y',
         currDate       =   new Date(),
         year      =   currDate.getFullYear(),
         month   =   this.UTIL.prefixWithZeros(currDate.getMonth()),
         day       =   this.UTIL.prefixWithZeros(currDate.getDay()),
         hour      =   this.UTIL.prefixWithZeros(currDate.getHours()),
         mins      =   this.UTIL.prefixWithZeros(currDate.getMinutes()),
         secs      =   this.UTIL.prefixWithZeros(currDate.getSeconds()),
         dateIs    =   year + '-' + month + '-' + day + ' ' + hour + ':' + mins + ':'
```

```
+ secs,
          timestampIs       =   Math.floor(Date.now()/1000);

      if(data.rows.length === 0)
      {
        this.insertPurchasesToTable(productID, isPurchased, dateIs,
timestampIs);
      }
      else
      {
        console.log('Record exists for ' + productID);
      }
    },
    (error) =>
    {
      console.log("Error determining if purchase exists in appPurchases
table: " + JSON.stringify(error));
    });
  }



  insertPurchasesToTable(productID, isPurchased, date, timestamp)
  {
    let sql = "INSERT INTO appPurchases(productID, isPurchased, date,
timestamp) VALUES('" + productID + "', '" + isPurchased + "', '" + date +
"', " + timestamp + ")";
    this.storage.executeSql(sql, {})
    .then((data) =>
    {
      console.log(`INSERTED RECORD for product ID: ${productID}`);
    },
    (error) =>
    {
        console.log("Error inserting " + productID + ": " + JSON.stringify(error.err));
      });
   }
}
```

There’s quite a bit going on here so let’s break the provider down section by section.

We firstly import the Utilities module so we can subsequently access and use the **prefixWithZeros** method:

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import {SQLite} from 'ionic-native';
import 'rxjs/add/operator/map';
import { Utilities } from '../providers/utilities';
```

We then define public properties at the top of the Database class which are used for various purposes such as defining the name of the database object as well as storing/managing data throughout the class:

```
public data             : any       =   null;
public storage          : any       =   null;
public dbName           : string    =   "soopadoopagames.db";
public purchases        : any       =   [];
```

Next we create the **createDatabase** method which, as the name implies, is used to generate the SQLite database - via the SQLite plugin API:

```
createDatabase()
{
  this.storage    =   new SQLite();
  this.storage.openDatabase({
     name           :   this.dbName,
     location      :   'default' // the location field is required
  })
  .then((data) =>
  {
     console.log("Opened database");
     this.createDatabaseTables();
  },
  (err) =>
  {
     console.error('Unable to open database: ', err);
  });
}
```

This also executes the **createDatabaseTables()** method which is simply a wrapper for executing a single method - **createPurchasesTable()**:

```
createDatabaseTables()
{
   this.createPurchasesTable();
}
```

The **createPurchasesTable()** method is used to generate the SQLite database table for storing a record of each In-App product purchased by the user.

This table will be used by the app to determine whether or not a game has been purchased.

If a record for that game purchase is found the app UI is updated to display a link to the game page. If a record isn’t found the app UI simply displays a Purchase button for that game:

```
createPurchasesTable()
{
   this.storage.executeSql('CREATE TABLE IF NOT EXISTS appPurchases
(id INTEGER PRIMARY KEY AUTOINCREMENT, productID TEXT, isPurchased TEXT NOT NULL, date TEXT NOT NULL, timestamp INTEGER NOT NULL)', {})
  .then((data) =>
   {
     console.log("TABLE CREATED: " + JSON.stringify(data));
   },
   (error) =>
   {
     console.log("Error: " + JSON.stringify(error.err));
     console.dir(error);
   });
}
```

Here the table fields are structured to store the following data:

- **productID** (the game product ID I.e. 'com.saintsatplay.happyFamilies')
- **isPurchased** (stores a value to show whether the product has been purchased)
- **date** (date of the purchase)
- **timestamp** (timestamp format for the date of the purchase)

The next database method **retrievePurchases** is, as the name implies, used to return all records stored in the **appPurchases** SQLite table:

```
retrievePurchases()
{
  return new Promise(resolve =>
  {
    this.storage.executeSql("SELECT * FROM appPurchases", {})
    .then((data) =>
    {
      this.purchases                  = [];
       if(data.rows.length > 0)
```

```
         {
            var k;
            for(k = 0; k < data.rows.length; k++)
            {
               this.purchases.push({
               productId  : data.rows.item(k).productID
            });
         }
      }
         resolve(this.purchases);
      },
      (error) =>
      {
         console.log("Error: " + JSON.stringify(error));
      });
   });
}
```

Our next, and final, method for the Database service - **insertPurchasesToTable** - handles adding purchased products to the SQLite table:

```
insertPurchasesToTable(productID, isPurchased, date, timestamp)
{
   let sql = "INSERT INTO appPurchases(productID, isPurchased, date, 
timestamp) VALUES('" + productID + "', '" + isPurchased + "', '" + date + 
"', " + timestamp + ")";
   this.storage.executeSql(sql, {})
   .then((data) =>
   {
      console.log(`INSERTED RECORD for product ID: ${productID}`);
   },
   (error) =>
   {
      console.log("Error inserting " + productID + ": " + JSON.stringify(error.err));
   });
}
```

Sass/Page styles
Now we can turn our attention to defining the styling for the app.

Open the **SoopaDoopaGames/src/theme/variables.scss** file and add the following shared variables (highlighted in bold):

```
// Shared Variables
// --------------------------------------------------
// To customize the look and feel of this app, you can override
// the Sass variables found in Ionic's source scss files.
// To view all the possible Ionic variables, see:
// http://ionicframework.com/docs/v2/theming/overriding-ionic-variables/
$text-color:                    #000;
$background-color:              #fff;
$happy-families:                #3399ff;
$climate-hero:                  #66cc33;
$alpha-male:                    #cc6633;
$grand-theft-noughto:           #cc3333;
$world-traveller:               #33ccff;
$king-for-a-day:                #cc3399;
```

These additional Sass variables are named based on the “game” they will apply to and are used in both the “game” link panels on the home page and the individual pages for each “game”.

We’re now going to create a brand new Sass file which we’ll save under the name of **shared.scss** within the following directory: **SoopaDoopaGames/src/theme**.

This file will contain the following style rules that will be used across the pages for each “game”:

```
.page {

    img {
        display: block;
        margin: 50px auto 0 auto;
    }

    h1 {
        margin-top: 50px;
        font-size: 1.8em;
        font-weight: bold;
        color: #fff;
        text-align: center;
    }

    p,
    li {
        font-size: 1em;
        color: #fff;
        line-height: 1.4em;
        text-align: left;
        padding-bottom: 10px;
    }

    ul {
        padding: 0 0 50px 15px;
        margin: 0;
    }
}
```

Don’t forget to save this file in the following location: **SoopaDoopaGames/src/theme/shared.scss**.

Within the **SoopaDoopaGames/src/theme/variables.scss** file place an import rule for this shared Sass file like so (highlighted in bold):

```
// Ionic Variables and Theming. For more info, please see:
// http://ionicframework.com/docs/v2/theming/
@import "ionic.globals";
@import "shared";
```

The final set up for the app styling involves making edits to the following files:

- **src/pages/home/home.scss**
- **src/pages/alpha-male/alpha-male.scss**
- **src/pages/climate-hero/climate-hero.scss**
- **src/pages/grand-theft-noughto/grand-theft-noughto.scss**
- **src/pages/happy-families/happy-families.scss**
- **src/pages/king-for-a-day/king-for-a-day.scss**
- **src/pages/world-traveller/world-traveller.scss**

We’ll go through each one of these in turn (all amendments highlighted in bold).

home.scss

This will simply declare the styles that are to be used within the Ionic Grid UI component where each “game” link will be displayed:

```
page-home {

  .box {
    position: relative;
    height: 270px;

    img {
      padding: 1em 0 1em 0;
      display: block;
      margin: auto;
    }
  }

  .description {
    position: absolute;
    width: 100%;
    bottom: 0;
    padding: 1em 1em 0.5em 1em;
    background-color: rgba(68, 68, 68, 0.7);

    h1 {
      font-size: 1em;
      font-weight: bold;
      font-family: Verdana;
      text-align: center;
      color: rgba(255, 255, 255, 1);
    }

    p {
      font-size: 0.9em;
      font-family: Verdana;
      text-align: center;
      color: rgba(255, 255, 255, 1);
    }

    button {
      font-size: 0.9em;
    }
  }

  .happy-families {
    background-color: $happy-families;
  }

  .climate-hero {
    background-color: $climate-hero;
  }

  .alpha-male {
    background-color: $alpha-male;
  }

  .grand-theft-noughto {
    background-color: $grand-theft-noughto;
  }

  .world-traveller {
    background-color: $world-traveller;
  }

  .king-for-a-day {
    background-color: $king-for-a-day;
  }

}
```

alpha-male.scss
Here we simply define the background colour for the **alpha-male.html** page:

```
page-alpha-male {
  .alpha-male {
    background-color: $alpha-male;
  }
}
```

climate-hero.scss

And in the **climate-hero.html** page we define the background colour too:

```
page-climate-hero {
  .climate-hero {
    background-color: $climate-hero;
  }
}
```

grand-theft-noughto.scss

Similarly we define the background colour for the **grand-theft-noughto.html** page:

```
page-grand-theft-noughto {
  .grand-theft-noughto {
    background-color: $grand-theft-noughto;
  }
}
```

happy-families.scss

The background colour for the **happy-families.html** page is defined next:

```
page-happy-families {
  .happy-families {
    background-color: $happy-families;
  }
}
```

king-for-a-day.scss

The **king-for-a-day.html** page background colour is also defined:

```
page-king-for-a-day {
  .king-for-a-day {
    background-color: $king-for-a-day;
  }
}
```

world-traveller.scss
Finally the **world-traveller.html** page background colour is the last to be defined:

```
page-world-traveller {
  .world-traveller {
    background-color: $world-traveller;
  }
}
```

And with that final edit we've concluded the coding for all custom style rules that will be used within the app.

HTML
As we begin coding the HTML for the individual page components we'll start to see how these styles are implemented - starting with the **SoopaDoopaGames/src/pages/home/home.html** template (amendments highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      SooperDooperGames!
    </ion-title>
  </ion-navbar>
</ion-header>
```

```
<ion-content padding>

  <ion-grid>

    <ion-row>
      <ion-col>

        <button
          ion-button
          text-center
          block
          color="primary"
          (click)="restoreProductListings()">
            Restore Purchases
        </button>

      </ion-col>
    </ion-row>

    <ion-row>
      <ion-col width-50>
        <section class="box happy-families">
          <img src="assets/images/happy-families.png" alt="Happy fami-
lies">
          <div class="description">
            <h1>Happy Families</h1>
            <div *ngIf="!happyFamilies">
              <p>$0.99</p>
              <button
                ion-button
                text-center
                block
                color="primary"
                (click)="purchaseProduct('com.saintsatplay.happyfami-
lies')">
                  Purchase
              </button>
            </div>


            <div *ngIf="happyFamilies">
              <p>Domestic bliss or all out war?</p>
              <button
                ion-button
                text-center
                block
                color="light"
                (click)="playGame('HappyFamilies')">
                  Play!
              </button>
            </div>

          </div>
        </section>
      </ion-col>


      <ion-col width-50>
        <section class="box climate-hero">
          <img src="assets/images/climate-hero.png" alt="Climate Hero">
          <div class="description">
            <h1>Climate Hero</h1>
            <div *ngIf="!climateHero">
              <p>$0.99</p>
              <button
                ion-button
                text-center
                block
                color="primary"
                (click)="purchaseProduct('com.saintsatplay.climatehero')">
                  Purchase
              </button>
            </div>


            <div *ngIf="climateHero">
              <p>Climate friend or foe?</p>
              <button
                ion-button
                text-center
                block
                color="light"
                (click)="playGame('ClimateHero')">
                  Play!
              </button>
            </div>

          </div>
        </section>
      </ion-col>
    </ion-row>


    <ion-row>
      <ion-col width-50>
        <section class="box alpha-male">
          <img src="assets/images/alpha-male.png" alt="Alpha Male">
          <div class="description">
            <h1>Alpha Male</h1>
            <div *ngIf="!alphaMale">
              <p>$0.99</p>
              <button
```

```
                ion-button
                text-center
                block
                color="primary"
                (click)="purchaseProduct('com.saintsatplay.alphamale')">
                  Purchase
              </button>
            </div>


            <div *ngIf="alphaMale">
              <p>Tough enough to cut it at the top?</p>
              <button
                ion-button
                text-center
                block
                color="light"
                (click)="playGame('AlphaMale')">
                  Play!
              </button>
            </div>

          </div>
        </section>
      </ion-col>


      <ion-col width-50>
        <section class="box grand-theft-noughto">
          <img src="assets/images/grand-theft-noughto.png" alt="Grand
Theft Noughto">
          <div class="description">
            <h1>Grand Theft Noughto</h1>
            <div *ngIf="!grandTheftNoughto">
```

```
              <p>$0.99</p>
              <button
                ion-button
                text-center
                block
                color="primary"
                (click)="purchaseProduct('com.saintsatplay.grandtheft-
noughto')">
                  Purchase
              </button>
            </div>


            <div *ngIf="grandTheftNoughto">
              <p>Park, ride and play</p>
              <button
                ion-button
                text-center
                block
                color="light"
                (click)="playGame('GrandTheftNoughto')">
                  Play!
              </button>
            </div>

          </div>
        </section>
      </ion-col>
    </ion-row>


    <ion-row>
      <ion-col width-50>
        <section class="box world-traveller">
```

```
          <img src="assets/images/world-traveller.png" alt="World Traveller">
          <div class="description">
            <h1>World Traveller</h1>
            <div *ngIf="!worldTraveller">
              <p>$0.99</p>
              <button
                ion-button
                text-center
                block
                color="primary"
                (click)="purchaseProduct('com.saintsatplay.worldtraveller')">
                  Purchase
              </button>
            </div>


            <div *ngIf="worldTraveller">
              <p>How far will you go?</p>
              <button
                ion-button
                text-center
                block
                color="light"
                (click)="playGame('WorldTraveller')">
                  Play!
              </button>
            </div>

          </div>
        </section>
      </ion-col>
      <ion-col width-50>
        <section class="box king-for-a-day">
          <img src="assets/images/king-for-a-day.png" alt="King for a
day">
          <div class="description">
            <h1>King for a Day</h1>
            <div *ngIf="!kingForADay">
              <p>$0.99</p>
              <button
                ion-button
                text-center
                block
                color="primary"
                (click)="purchaseProduct('com.saintsatplay.kingfora-
day')">
                  Purchase
              </button>
            </div>


            <div *ngIf="kingForADay">
              <p>Or fool for a lifetime?</p>
              <button
                ion-button
                text-center
                block
                color="light"
                (click)="playGame('KingForADay')">
                  Play!
              </button>
            </div>

          </div>
        </section>
      </ion-col>

    </ion-row>
  </ion-grid>

</ion-content>
```

Here we’ve implemented the Ionic Grid component to layout the page UI using a combination of the <ion-row> and <ion-col> tags.

There’s a lot going on here but the layout essentially follows the same pattern with each <ion-col> displaying the same HTML tag structure albeit with different “game” content for each <ion-col>:

```
<ion-col width-50>
  <section class="box king-for-a-day">
    <img src="assets/images/king-for-a-day.png" alt="King for a day">
    <div class="description">
      <h1>King for a Day</h1>

      <div *ngIf="!kingForADay">
        <p>$0.99</p>
        <button
          ion-button
          text-center
          block
          color="primary"
          (click)="purchaseProduct('com.saintsatplay.kingforaday')">
            Purchase
        </button>
      </div>
      <div *ngIf="kingForADay">
        <p>Or fool for a lifetime?</p>
        <button
          ion-button
          text-center
          block
          color="light"
          (click)="playGame('KingForADay')">
            Play!
        </button>
      </div>

    </div>
  </section>
</ion-col>
```

As the content for each <ion-col> follows the same structure we implement the same rules across each column:

- Set the column width to 50% of the grid width
- Assign the CSS class name to the <section> tag that is relevant to the “game“ being displayed (in the above example this is: **king-for-a-day**)
- Display the price along with a Purchase button for the “game” if the ngIf condition evaluates to false
- Otherwise display a description and a link to play the “game” if the ngIf condition evaluates to true

Each column displays the title, image and description specific to each “game” and where the game has yet to be purchased a Purchase button is displayed with a click event that calls the **purchaseProduct** method.

This **purchaseProduct** method supplies the product ID for the “game” which matches those stored in the In-App Purchase product listings of each respective App Store.

If a “game” has been purchased by the user a link to the page where that “game” resides is displayed in the form of a Play! button.

This Play! button implements a click event which calls the **playGame** method to initiate the navigation process.

The value passed into the **playGame** method is the component class name for the page that we are navigating to.

At the top of the page, above the rows/columns where the games are displayed, we’ve implemented a single button component with a click event calling a method of **restoreProductListings**:

```
<button
  ion-button
  text-center
  block
  color="primary"
  (click)="restoreProductListings()">
  Restore Purchases
</button>
```

The **restoreProductListings** method allows the user to be able to manually restore any previous product purchases for the app.

Even though we’ll be implementing the SQLite database functionality to store and retrieve purchases for the app the Apple App Store guidelines recommend that an app making use of In-App Purchase functionality must provide the user with the means to restore their purchases.

If such functionality is not implemented with In-App Purchase based apps then the app will more than likely be rejected by the App Store moderators.

The **restoreProductListings** method/feature helps us meet this particular App Store criteria while also providing a nice UX feature for the end-user.

That covers all of the necessary HTML for the home page component template.

Now we’ll turn our attention to the individual page HTML templates for each “game”.

The HTML structure and content will essentially be the same across each page, save for some minor differences with images and names, so there will be a lot of repetition in the following examples.

Open the **SoopaDoopaGames/src/pages/alpha-male/alpha-male.html** template and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>Alpha Male</ion-title>
  </ion-navbar>
</ion-header>


<ion-content>

  <ion-grid class="page alpha-male">
    <ion-row>
      <ion-col>
        <img src="assets/images/alpha-male.png" alt="Alpha Male">
      </ion-col>
    </ion-row>

    <ion-row>
      <ion-col width-10></ion-col>
      <ion-col width-80>
        <h1>Alpha Male</h1>
        <p>How to play the game/what you need to know:</p>
        <ul>
          <li>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</li>
          <li>Curabitur non nisl sit amet arcu tempus imperdiet.</li>
          <li>In quis efficitur felis, vel cursus ex.</li>
          <li>Donec quis nisl et ex porttitor maximus sed in nisl.</li>
          <li>Cras et odio vitae purus aliquam viverra.</li>
          <li>In hac habitasse platea dictumst.</li>
        </ul>

        <button
          ion-button
          text-center
          block
          color="light">
            Got it - let’s go!
        </button>
      </ion-col>

      <ion-col width-10></ion-col>
    </ion-row>
  </ion-grid>

</ion-content>
```

Once again we implement the Ionic Grid component for the page layout, separating the content area into 3 columns this time and aligning the actual content with the vertical centre of the screen by assigning a 10% width to the columns on either side.

The main page content consists of the “game” image, name, rules for playing (which are just lines of lorem ipsum generated at the surprisingly useful lipsum.com website) and a dummy button to initiate the “game” (yes...it’s only there for show!)

There will be NO class logic for each of these “game” pages as they are simply template placeholders to demonstrate what we would see after purchasing that “game” from the app home screen.

Climate Hero

Now open the **SoopaDoopaGames/src/pages/climate-hero/climate-hero.html** template and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>Climate Hero</ion-title>
  </ion-navbar>
</ion-header>



<ion-content>

   <ion-grid class="page climate-hero">
      <ion-row>
         <ion-col>
            <img src="assets/images/climate-hero.png" alt="Climate
Hero">
         </ion-col>
      </ion-row>

      <ion-row>
         <ion-col width-10></ion-col>
         <ion-col width-80>
            <h1>Climate Hero</h1>
            <p>How to play the game/what you need to know:</p>
            <ul>
               <li>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</li>
               <li>Curabitur non nisl sit amet arcu tempus imperdiet.</li>
               <li>In quis efficitur felis, vel cursus ex.</li>
               <li>Donec quis nisl et ex porttitor maximus sed in nisl.</li>
               <li>Cras et odio vitae purus aliquam viverra.</li>
               <li>In hac habitasse platea dictumst.</li>
            </ul>
```

```
        <button
          ion-button
          text-center
          block
          color="light">
            Got it - let’s go!
        </button>
      </ion-col>

      <ion-col width-10></ion-col>
    </ion-row>
  </ion-grid>

</ion-content>
```

Once again the template structure and majority of the content is identical save for:

- <ion-title> value of Climate Hero
- <ion-grid> class name of climate-hero
- image source file of climate-hero.png
- <h1> value of Climate Hero.

This pattern is repeated over ALL of the “game” specific pages where the values for the above are based on the name of the “game” for each page.

Grand Theft Noughto

Now, make similar amendments (highlighted in bold), to the **SoopaDoopaGames/src/pages/grand-theft-noughto/grand-theft-noughto.html** template (taking care to substitute the necessary game values where required):

```
<ion-header>
  <ion-navbar>
```

```
    <ion-title>Grand Theft Noughto</ion-title>
  </ion-navbar>
</ion-header>
<ion-content>

  <ion-grid class="page grand-theft-noughto">
    <ion-row>
      <ion-col>
        <img src="assets/images/grand-theft-noughto.png" alt="Grand
Theft Noughto">
      </ion-col>
    </ion-row>

    <ion-row>
      <ion-col width-10></ion-col>
      <ion-col width-80>
        <h1>Grand Theft Noughto</h1>
        <p>How to play the game/what you need to know:</p>
        <ul>
          <li>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</li>
          <li>Curabitur non nisl sit amet arcu tempus imperdiet.</li>
          <li>In quis efficitur felis, vel cursus ex.</li>
          <li>Donec quis nisl et ex porttitor maximus sed in nisl.</li>
          <li>Cras et odio vitae purus aliquam viverra.</li>
          <li>In hac habitasse platea dictumst.</li>
        </ul>

        <button
          ion-button
          text-center
          block
          color="light">
            Got it - let's go!
        </button>
      </ion-col>

      <ion-col width-10></ion-col>
    </ion-row>
  </ion-grid>

</ion-content>
```

Happy Families

Now make similar amendments (highlighted in bold) for the **SoopaDoopaGames/src/pages/happy-families/happy-families.html** template:

```
<ion-header>
  <ion-navbar>
    <ion-title>Happy Families</ion-title>
  </ion-navbar>
</ion-header>
<ion-content>

  <ion-grid class="page happy-families">
    <ion-row>
      <ion-col>
        <img src="assets/images/happy-families.png" alt="Happy Families">
      </ion-col>
    </ion-row>

    <ion-row>
      <ion-col width-10></ion-col>
      <ion-col width-80>
        <h1>Happy Families</h1>
        <p>How to play the game/what you need to know:</p>
        <ul>
          <li>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</li>
          <li>Curabitur non nisl sit amet arcu tempus imperdiet.</li>
          <li>In quis efficitur felis, vel cursus ex.</li>
          <li>Donec quis nisl et ex porttitor maximus sed in nisl.</li>
          <li>Cras et odio vitae purus aliquam viverra.</li>
          <li>In hac habitasse platea dictumst.</li>
        </ul>

        <button
          ion-button
          text-center
          block
          color="light">
            Got it - let’s go!
        </button>
      </ion-col>

      <ion-col width-10></ion-col>
    </ion-row>
  </ion-grid>

</ion-content>
```

King for a Day

Make the following amendments (highlighted in bold) for the **SoopaDoopaGames/src/pages/king-for-a-day/king-for-a-day.html** template:

```
<ion-header>
  <ion-navbar>
    <ion-title>King for a Day</ion-title>
  </ion-navbar>
```

```
</ion-header>


<ion-content>

  <ion-grid class="page king-for-a-day">
    <ion-row>
      <ion-col>
        <img src="assets/images/king-for-a-day.png" alt="King for a
Day">
      </ion-col>
    </ion-row>

    <ion-row>
      <ion-col width-10></ion-col>
      <ion-col width-80>
        <h1>King for a Day</h1>
        <p>How to play the game/what you need to know:</p>
        <ul>
          <li>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</li>
          <li>Curabitur non nisl sit amet arcu tempus imperdiet.</li>
          <li>In quis efficitur felis, vel cursus ex.</li>
          <li>Donec quis nisl et ex porttitor maximus sed in nisl.</li>
          <li>Cras et odio vitae purus aliquam viverra.</li>
          <li>In hac habitasse platea dictumst.</li>
        </ul>

        <button
          ion-button
          text-center
          block
          color="light">
            Got it - let’s go!
        </button>
      </ion-col>

      <ion-col width-10></ion-col>
    </ion-row>
  </ion-grid>

</ion-content>
```

World Traveller
Once you’ve saved this file make the final set of amendments (highlighted in bold) to the **SoopaDoopaGames/src/pages/world-traveller/world-traveller.html** template:

```
<ion-header>
  <ion-navbar>
    <ion-title>World Traveller</ion-title>
  </ion-navbar>
</ion-header>



<ion-content>

  <ion-grid class="page world-traveller">
    <ion-row>
      <ion-col>
        <img src="assets/images/ world-traveller.png" alt="World Traveller">
      </ion-col>
    </ion-row>

    <ion-row>
      <ion-col width-10></ion-col>
      <ion-col width-80>
        <h1>World Traveller</h1>
        <p>How to play the game/what you need to know:</p>
        <ul>
          <li>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</li>
          <li>Curabitur non nisl sit amet arcu tempus imperdiet.</li>
          <li>In quis efficitur felis, vel cursus ex.</li>
          <li>Donec quis nisl et ex porttitor maximus sed in nisl.</li>
          <li>Cras et odio vitae purus aliquam viverra.</li>
          <li>In hac habitasse platea dictumst.</li>
        </ul>

        <button
          ion-button
          text-center
          block
          color="light">
            Got it - let’s go!
        </button>
      </ion-col>

      <ion-col width-10></ion-col>
    </ion-row>
  </ion-grid>

</ion-content>
```

There’s definitely a lot of repetition over these page templates but you’ll be glad to know that’s the last of the HTML amendments for the app!

With the templates, styles and services in place we can now move onto scripting the logic to tie all of this together.

Open the **SoopaDoopaGames/src/pages/home/home.ts** file and implement the following amendments (highlighted in bold):

```
import { Component } from '@angular/core';
import { AlertController,
         LoadingController,
         NavController,
         Platform } from 'ionic-angular';
import { InAppPurchase } from 'ionic-native';
import { AlphaMale } from '../../pages/alpha-male/alpha-male';
import { ClimateHero } from '../../pages/climate-hero/climate-hero';
import { GrandTheftNoughto } from '../../pages/grand-theft-noughto/
grand-theft-noughto';
import { HappyFamilies } from '../../pages/happy-families/happy-families';
import { KingForADay } from '../../pages/king-for-a-day/king-for-a-day';
import { WorldTraveller } from '../../pages/world-traveller/world-traveller';
import { Database } from '../../providers/database';

@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {

  public happyFamilies        : boolean  = false;
  public climateHero          : boolean  = false;
  public alphaMale            : boolean  = false;
  public grandTheftNoughto    : boolean  = false;
  public worldTraveller       : boolean  = false;
  public kingForADay          : boolean  = false;
  public goTo;
  private loader;
  public products  = [
                     'com.saintsatplay.happyfamilies',
                     'com.saintsatplay.climatehero',
                          'com.saintsatplay.alphamale',
                          'com.saintsatplay.grandtheftnoughto',
                          'com.saintsatplay.worldtraveller',
                          'com.saintsatplay.kingforaday'
                         ];


constructor( public alertCtrl     : AlertController,
             public DB            : Database,
             public loadingCtrl   : LoadingController,
             public navCtrl       : NavController,
             public platform      : Platform)
{

  this.platform.ready().then(() =>
  {
    DB.createDatabase();
    this.initiateProductCheckAndParsing();
  });

}


initiateProductCheckAndParsing()
{
  this.platform.ready().then(() =>
  {
    this.displayPreloader();

    InAppPurchase
    .getProducts(this.products)
    .then((products) =>
    {
        this.DB.retrievePurchases()
        .then((data) =>
        {
          this.hidePreloader();
          this.determineProductsToEnable(data);
        })
        .catch(function(err)
        {
          this.hidePreloader();
          this.displayAlert('Retrieving Saved purchases', err);
        });
      })
      .catch((err) =>
      {
        this.hidePreloader();
        this.displayNetworkErrorMessage('Network error', err.errorMessage + '.<br><br>Please double check your network connection and try again');
      });

    });
  }



  determineProductsToEnable(data)
  {
    this.platform.ready().then(() =>
    {
      let k;
      for(k in data)
      {
        this.DB.doesPurchaseExistInTable(data[k].productId);
        if(data[k].productId === "com.saintsatplay.happyfamilies")
      {
        this.happyFamilies          = true;
      }

      if(data[k].productId === "com.saintsatplay.climatehero")
      {
        this.climateHero      = true;
      }

      if(data[k].productId === "com.saintsatplay.alphamale")
      {
        this.alphaMale        = true;
      }

      if(data[k].productId === "com.saintsatplay.grandtheftnoughto")
      {
        this.grandTheftNoughto      = true;
      }

      if(data[k].productId === "com.saintsatplay.worldtraveller")
      {
       this.worldTraveller    = true;
      }

      if(data[k].productId === "com.saintsatplay.kingforaday")
      {
        this.kingForADay  = true;
      }
    }
  });
};
```

```
displayPreloader()
{
  this.loader = this.loadingCtrl.create({
    content: "Please wait..."
  });
  this.loader.present();
};


hidePreloader()
{
  this.loader.dismissAll();
}


playGame(page)
{
  switch(page)
  {
    case "AlphaMale":
      this.goTo = AlphaMale;
    break;

    case "ClimateHero":
      this.goTo = ClimateHero;
    break;

    case "HappyFamilies":
      this.goTo = HappyFamilies;
    break;

    case "GrandTheftNoughto":
      this.goTo = GrandTheftNoughto;
    break;
    case "WorldTraveller":
      this.goTo = WorldTraveller;
    break;

    case "KingForADay":
      this.goTo = KingForADay;
    break;

  }
  this.navCtrl.push(this.goTo);
}


purchaseProduct(product)
{
  this.platform.ready().then(() =>
  {
    var productID          =      product,
        purchasedItem      =      [{"productId" : productID}];

    this.displayPreloader();

    InAppPurchase
    .buy(productID)
    .then((data) =>
    {
      this.hidePreloader();
      this.determineProductsToEnable(purchasedItem);
    })
    .catch((err) =>
    {
      this.hidePreloader();
      });
   });
}


restoreProductListings()
{
   this.platform.ready().then(() =>
   {
      this.displayPreloader();
      InAppPurchase
      .restorePurchases()
      .then((data) =>
      {
         this.hidePreloader();
         this.determineProductsToEnable(data);
      })
      .catch((err) =>
      {
         console.log(err);
      });
   });
}


displayAlert(title, message) : void
{
   let headsUp = this.alertCtrl.create({
      title: title,
      subTitle: message,
      buttons: ['Got It!']
   });
   headsUp.present();
   }



   displayNetworkErrorMessage(title, message) : void
   {
      let headsUp = this.alertCtrl.create({
         title: title,
         subTitle: message,
         buttons: [
         {
            text        : 'Got It!',
            handler   : () =>
            {
               this.initiateProductCheckAndParsing();
            }
         }]
      });
      headsUp.present();
   }

}
```

With these amendments to the **src/pages/home/home.ts** file we've managed to tie together the following functionality:

- Implemented the ability to performIn-App purchases
- Stored records of all purchased products within SQLite data storage
- Provided UI friendly error handling
- Implemented navigation based on the purchased product
- Offered users the ability to restore purchased products

Thanks to leveraging the installed Cordova plugin API's, Ionic 2 UI components and our custom services we've managed to script all that functionality in the space of just one class.

For roughly 248 lines of code that’s quite an impressive feat!

As in the previous case study let’s spend some time going through the different sections of the script and familiarising ourselves with exactly what is going at each stage of the code.

At the top of the script we import additional required modules which consist of:

- The **AlertController** and **LoadingController** Ionic 2 UI components
- The excellent **InAppPurchase** Cordova plugin for handling all the app product purchase requirements
- The different page components for the app
- Finally the custom **Database** service

Which completes all the modules that we need to import for the app:

```
import { Component } from '@angular/core';
import { AlertController,
         LoadingController,
         NavController,
         Platform } from 'ionic-angular';
import { InAppPurchase } from 'ionic-native';
import { AlphaMale } from '../../pages/alpha-male/alpha-male’;
import { ClimateHero } from '../../pages/climate-hero/climate-hero’;
import { GrandTheftNoughto } from '../../pages/grand-theft-noughto/
grand-theft-noughto';
import { HappyFamilies } from '../../pages/happy-families/happy-families';
import { KingForADay } from '../../pages/king-for-a-day/king-for-a-day';
import { WorldTraveller } from '../../pages/world-traveller/world-traveller';
import { Database } from '../../providers/database';
```

Towards the top of the **HomePage** class we define some boolean properties that will be used to control the initial display of the purchase options for each “game” option on the home page HTML template, followed by properties to help with subsequent navigation to other pages, loading of messages and finally an array to store the product ID’s associated with the App Stores and the “games” available for purchase:

```
public happyFamilies            : boolean  = false;
public climateHero              : boolean  = false;
public alphaMale                : boolean  = false;
public grandTheftNoughto        : boolean  = false;
public worldTraveller           : boolean  = false;
public kingForADay              : boolean  = false;
public goTo;
private loader;
public products  = [
                       'com.saintsatplay.happyfamilies',
                       'com.saintsatplay.climatehero',
                       'com.saintsatplay.alphamale',
                       'com.saintsatplay.grandtheftnoughto',
                       'com.saintsatplay.worldtraveller',
                       'com.saintsatplay.kingforaday'
                      ];
```

We then pass selected modules as parameters into the class constructor, assigning each one to a specific public property before triggering both the **createDatabase** and **initiateProductCheckAndParsing** methods within a **platform.ready()** call so that the device is ready for all plugin related tasks to be executed:

```
constructor( public alertCtrl      : AlertController,
             public DB             : Database,
             public loadingCtrl    : LoadingController,
             public navCtrl        : NavController,
             public platform       : Platform)
  {

     this.platform.ready().then(() =>
     {
       DB.createDatabase();
```

```
         this.initiateProductCheckAndParsing();
      });

   }
```

The **initiateProductCheckAndParsing()** method handles the initial contact with the App store, using the Cordova **InAppPurchase** plugin's **getProducts()** method, to determine if the products are available for purchase within the app.

Using a Promise based API the **InAppPurchase** plugin, where App Store contact was successful, returns saved purchases via the **DB.retrievePurchases()** method.

If there are any saved records returned from the SQLite database then the **determineProductsToEnable()** method is called which is used to update the HTML template content to allow the user to play each purchased "game".

If the initial App Store check was unable to be implemented, for whatever reasons, the **displayNetworkErrorMessage()** method is called which handles informing the user and providing the functionality to re-initiate the App Store check:

```
initiateProductCheckAndParsing()
{
   this.platform.ready().then(() =>
   {
      this.displayPreloader();

      InAppPurchase
      .getProducts(this.products)
      .then((products) =>
      {
         this.DB.retrievePurchases()
         .then((data) =>
         {
            this.hidePreloader();
```

```
        this.determineProductsToEnable(data);
      })
      .catch(function(err)
      {
        this.hidePreloader();
        this.displayAlert('Retrieving Saved purchases', err);
      });
    })
    .catch((err) =>
    {
      this.hidePreloader();
      this.displayNetworkErrorMessage('Network error', err.errorMessage + '.<br><br>Please double check your network connection and try again');
    });

  });
}
```

The **determineProductsToEnable()** method simply takes the data object returned from the earlier call to the initial **InAppPurchase.getProducts** and then the **DB.retrieveProducts()** methods.

This data object is iterated through to determine if any matches are found for the productId value and, if there are, the boolean properties for controlling the display of purchase buttons are updated to hide them in the page HTML template and show the links to each purchased game instead.

A call to the **DB.doesPurchaseExistInTable()** method is also called to determine whether a purchased product can be added to the SQLite database table:

```
determineProductsToEnable(data)
{
  this.platform.ready().then(() =>
{
  let k;
  for(k in data)
  {
    this.DB.doesPurchaseExistInTable(data[k].productId);
    if(data[k].productId === "com.saintsatplay.happyfamilies")
    {
      this.happyFamilies        = true;
    }

    if(data[k].productId === "com.saintsatplay.climatehero")
    {
      this.climateHero          = true;
    }

    if(data[k].productId === "com.saintsatplay.alphamale")
    {
      this.alphaMale            = true;
    }

    if(data[k].productId === "com.saintsatplay.grandtheftnoughto")
    {
      this.grandTheftNoughto    = true;
    }

    if(data[k].productId === "com.saintsatplay.worldtraveller")
    {
     this.worldTraveller        = true;
    }

    if(data[k].productId === "com.saintsatplay.kingforaday")
    {
      this.kingForADay          = true;
    }
```

```
      }
   });
};
```

We then define methods to handle informing the user that a background task is taking place (such as communicating with the App Store or retrieving saved records from the app’s SQLite database).

These implement specific methods provided through the Ionic **LoadingController** component API:

```
displayPreloader()
{
   this.loader = this.loadingCtrl.create({
      content: "Please wait.."
   });
   this.loader.present();
};



hidePreloader()
{
   this.loader.dismissAll();
}
```

Following from this we handle the page navigation for the purchased “game” that the user has selected to play through the **playGame()** method:

```
playGame(page)
{
   switch(page)
   {
      case "AlphaMale":
```

```
      this.goTo = AlphaMale;
    break;

    case "ClimateHero":
      this.goTo = ClimateHero;
    break;

    case "HappyFamilies":
      this.goTo = HappyFamilies;
    break;

    case "GrandTheftNoughto":
      this.goTo = GrandTheftNoughto;
    break;

    case "WorldTraveller":
      this.goTo = WorldTraveller;
    break;

    case "KingForADay":
      this.goTo = KingForADay;
    break;

  }
  this.navCtrl.push(this.goTo);
}
```

Purchasing “game” products displayed on the home page HTML template is handled with the **purchaseProduct()** method.

This method takes the supplied **productId** value for the game, attempts to initiate a purchase request with the App Store and, if successfully completed, subsequently adds the purchased product to the app’s SQLite database enabling the “game” to be accessed by the user:

```
purchaseProduct(product)
{
  this.platform.ready().then(() =>
  {
    var productID            =     product,
        purchasedItem        =     [{"productId" : productID}];

    this.displayPreloader();

    InAppPurchase
    .buy(productID)
    .then((data) =>
    {
      this.hidePreloader();
      this.determineProductsToEnable(purchasedItem);
    })
    .catch((err) =>
    {
      this.hidePreloader();
    });
  });
}
```

The **restoreProductListings** method allows the user to retrieve data about all the products they have purchased for the app from the App Store and, if the network request was successful, switch those products on in the page template in addition to determining whether each purchased product needs to be added to the app SQLite database:

```
restoreProductListings()
{
  this.platform.ready().then(() =>
  {
    this.displayPreloader();
    InAppPurchase
    .restorePurchases()
    .then((data) =>
    {
      this.hidePreloader();
      this.determineProductsToEnable(data);
    })
    .catch((err) =>
    {
      console.log(err);
    });
  });
}
```

The **displayAlert()** method simply handles informing the user of an error that may have occurred using the Ionic **AlertController** Component and methods available through its API:

```
displayAlert(title, message) : void
{
  let headsUp = this.alertCtrl.create({
    title: title,
    subTitle: message,
    buttons: ['Got It!']
  });
  headsUp.present();
}
```

Finally the **displayNetworkErrorMessage()** method handles error situations where attempts to connect with and run tasks through the App Store have failed.

The user is informed of the nature of the error and is able to re-initiate the App Store request through calling the **initiateProductCheckAndParsing()** method upon closing the alert window thrown up by the **displayNetworkErrorMessage()** method:

```
displayNetworkErrorMessage(title, message) : void
{
  let headsUp = this.alertCtrl.create({
    title: title,
    subTitle: message,
    buttons: [
    {
      text          : 'Got It!',
      handler       : () =>
      {
        this.initiateProductCheckAndParsing();
      }
    }]
  });
  headsUp.present();
}
```

With the app logic, styling and HTML structure implemented, along with the necessary configurations for the **SoopaDoopaGames/src/app/app.module.ts** file, we are now left with the following 3 tasks for the front-end development of our app:

- Editing the **config.xml** file to include the necessary widget ID
- Adding the images to be used on the home page and “game” pages
- Adding the Google Play Billing Key to the **www/manifest.json** file

The first 2 tasks we can solve shortly whereas the last task will be dealt with when setting up the Google Play In-App Products and submitting an APK file.

Adding Images for the App

The necessary images for the app can be added as follows:

- Create a directory titled **images** inside the root of the **src/assets** directory
- Copy all of the images for the download files for this case study from the following download directory: **/SooperDooperGames/src/assets/images/**
- Paste these copied images into the following directory of your own soopaDoopaGames app: **SooperDooperGames/src/assets/images**

config.xml

Open the **config.xml** file for your app (located in the root of your project) and edit the following fields/attributes to your particular requirements:

- widget ID (use reverse domain name notation - I.e. com.saintsatplay.nameOfApp - this must match the Bundle ID you set for the app when creating the App Store listing in iTunes Connect - which we'll do shortly!)
- Name (What your app is called)
- Description (A brief summary of the app; what it does, its purpose etc.)
- Author (Developer/team name, e-mail address and website address)

The above fields/attributes are configured within the **config.xml** file as follows (highlighted in bold):

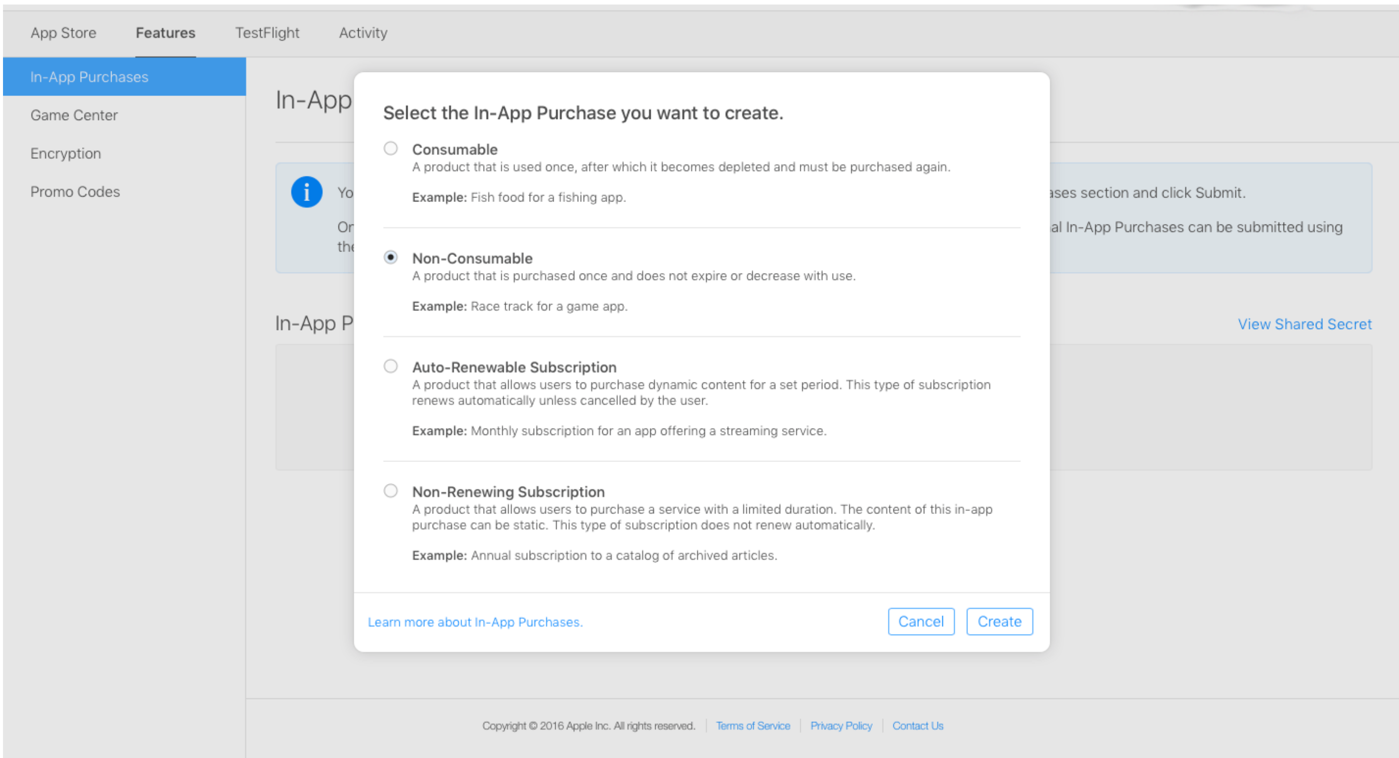
```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<widget
      id="com.saintsatplay.sooperdoopergames"
      version="0.0.1"
      xmlns="http://www.w3.org/ns/widgets"
      xmlns:cdv="http://cordova.apache.org/ns/1.0">
  <name>Soopa Doopa Games</name>
  <description>An awesome Ionic/Cordova app.</description>
  <author
      email="support@saintsatplay.com"
      href="http://www.saintsatplay.com/">
            Saints at Play Limited
  </author>
```

Now that the coding for the app is more or less completed (with the exception of the In-App Product Billing Key for the **www/manifest.json** file which we'll add later on when setting up the Google Play listing and APK file) we can start configuring the In-App Purchasable products for the Apple App Store and Google Play Store.

Creating In-App Purchases on the Apple App Store

Log into your iOS developer account on the iTunes Connect portal and create a new iOS App.

Proceed to the **Features** screen for the newly created app, from the side menu select the In-App Purchases link then click on the + icon to add a new In-App Purchase and select **Non-Consumable** from the available options in the modal window that appears:


App Store
Features
TestFlight
Activity
In-App Purchases
Game Center
Encryption
Promo Codes
In-App
Yo
On
the
ases section and click Submit.
al In-App Purchases can be submitted using
In-App P
View Shared Secret
Learn more about In-App Purchases.
Cancel
Create
Copyright © 2016 Apple Inc. All rights reserved. | Terms of Service | Privacy Policy | Contact Us

Select the In-App Purchase you want to create.

○ Consumable
A product that is used once, after which it becomes depleted and must be purchased again.

Example: Fish food for a fishing app.

● Non-Consumable
A product that is purchased once and does not expire or decrease with use.

Example: Race track for a game app.

○ Auto-Renewable Subscription
A product that allows users to purchase dynamic content for a set period. This type of subscription renews automatically unless cancelled by the user.

Example: Monthly subscription for an app offering a streaming service.

○ Non-Renewing Subscription
A product that allows users to purchase a service with a limited duration. The content of this in-app purchase can be static. This type of subscription does not renew automatically.

Example: Annual subscription to a catalog of archived articles.

Choosing **Non-Consumable** allows us to create a product that the user can only purchase once from within the app.

Once this option has been selected click the **Create** button at the bottom right hand side of the modal window.

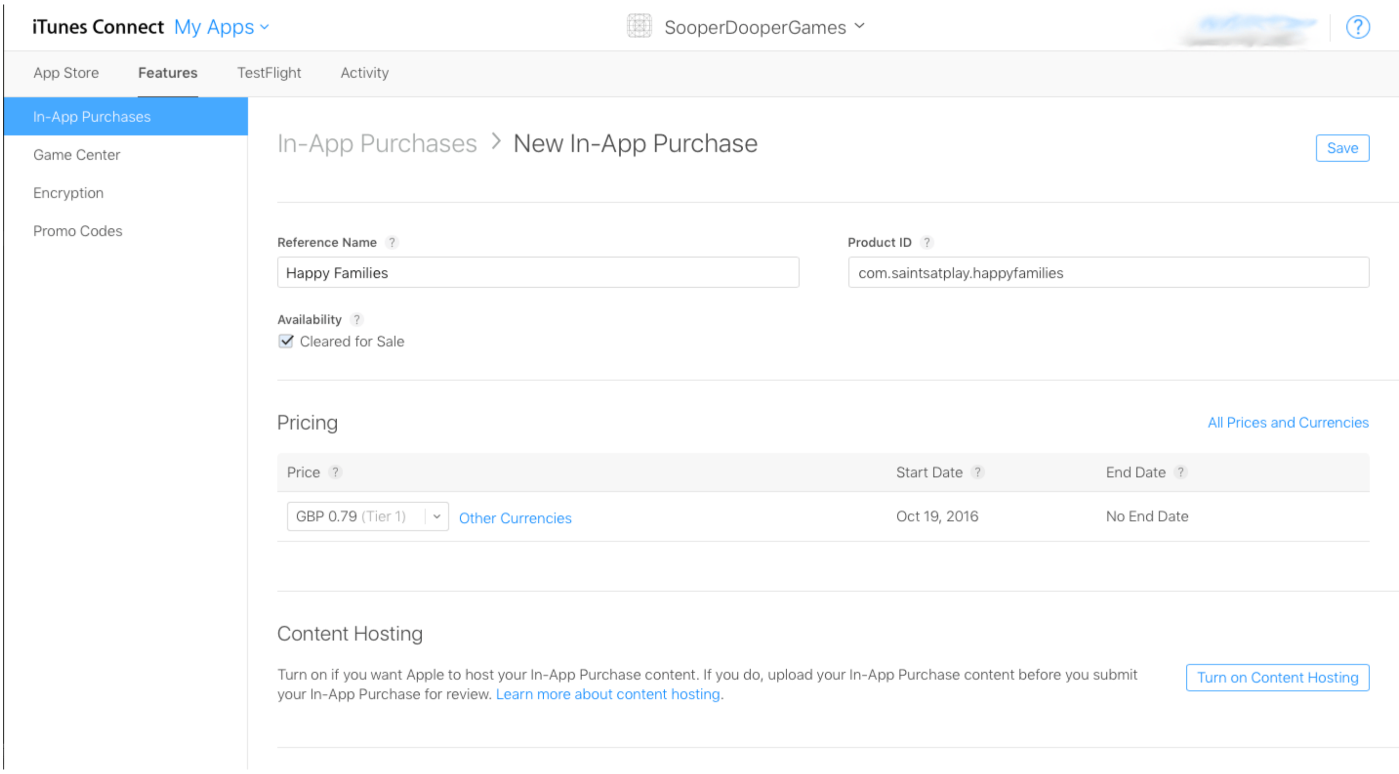
The New In-App Purchase screen will then open presenting the following fields for data entry/selection:

- **Reference Name** (Required - Product name which is displayed only in the Sales & Trends reports on iTunes Connect - maximum of 64 characters)
- **Product ID** (Required - the alphanumeric string that identifies the product such as com.saintsatplay.happyfamilies or com.saintsatplay.climatehero)
- **Availability** (Optional - Whether or not the In-App Purchase is available on the Apple App Store - checked by default)
- **Pricing** (Required - Choice of applicable price for the product ranging from Free through to different pricing tiers)
- **Display Name** (Required - Name of the In-App Purchase which is displayed on the App Store)
- **Description** (Optional - Information about the In-App Purchase product that will be used for review purposes and may, depending on the type of In-App Purchase, be visible to customers on the App Store)
- **Screenshot** (Required for review by the App Store moderator)
- **Review Notes** (Additional information about the In-App Purchase product that may be useful to the App Store moderator I.e. test account details for accessing the product etc.)

Through this screen you'll need to create and enter details for In-App Purchases connected with the following products:

- **com.saintsatplay.alphamale**
- **com.saintsatplay.climatehero**
- **com.saintsatplay.grandtheftnoughto**
- **com.saintsatplay.happyfamilies**
- **com.saintsatplay.kingforaday**
- **com.saintsatplay.worldtraveller**

The following screen capture displays the **com.saintsatplay.happyfamilies** In-App Purchase entry:



In-App Purchases > New In-App Purchase

Reference Name ?: Happy Families

Product ID ?: com.saintsatplay.happyfamilies

Availability ?

☑ Cleared for Sale

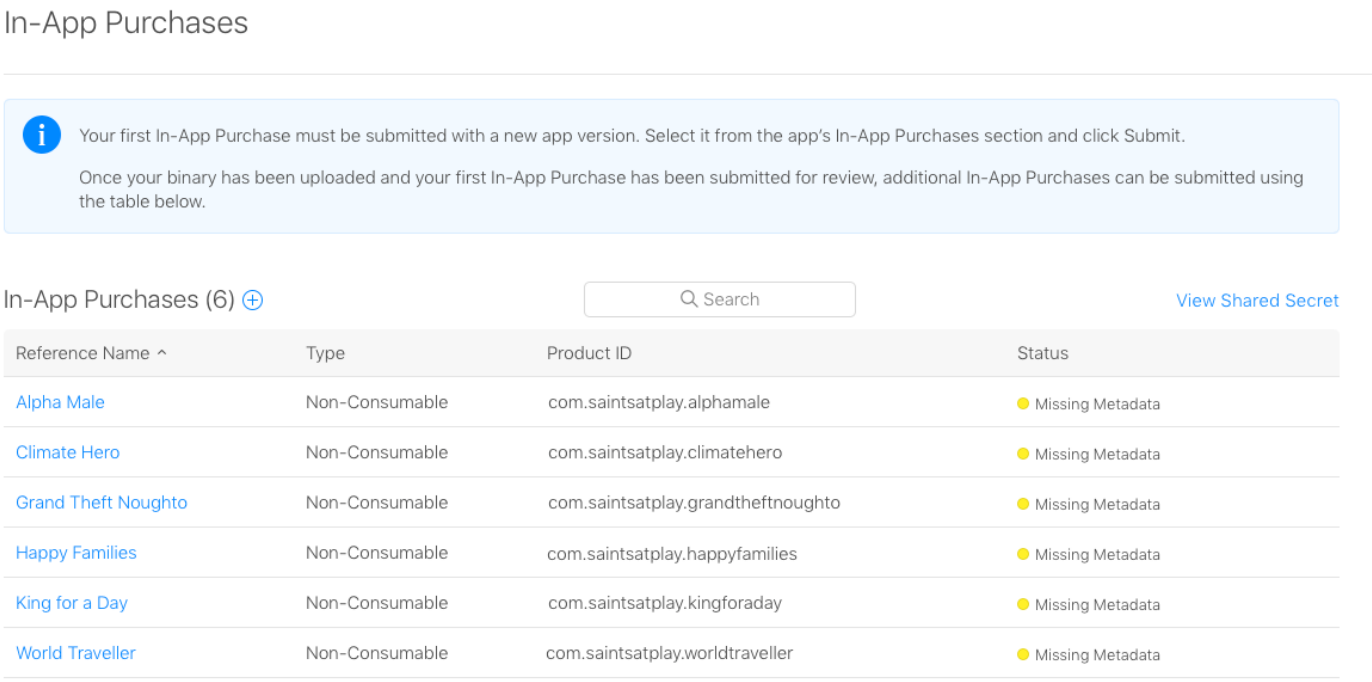
Pricing

Price ?	Start Date ?	End Date ?
GBP 0.79 (Tier 1)	Oct 19, 2016	No End Date

Content Hosting

Turn on if you want Apple to host your In-App Purchase content. If you do, upload your In-App Purchase content before you submit your In-App Purchase for review. Learn more about content hosting.

Once you’ve entered all of the necessary In-App Purchase product entries you’ll see these displayed on the landing screen for the In-App Purchases section of the newly created **SooperDooperGames** app like so:



In-App Purchases

Your first In-App Purchase must be submitted with a new app version. Select it from the app’s In-App Purchases section and click Submit.

Once your binary has been uploaded and your first In-App Purchase has been submitted for review, additional In-App Purchases can be submitted using the table below.

In-App Purchases (6)

Reference Name ^	Type	Product ID	Status
Alpha Male	Non-Consumable	com.saintsatplay.alphamale	● Missing Metadata
Climate Hero	Non-Consumable	com.saintsatplay.climatehero	● Missing Metadata
Grand Theft Noughto	Non-Consumable	com.saintsatplay.grandtheftnoughto	● Missing Metadata
Happy Families	Non-Consumable	com.saintsatplay.happyfamilies	● Missing Metadata
King for a Day	Non-Consumable	com.saintsatplay.kingforaday	● Missing Metadata
World Traveller	Non-Consumable	com.saintsatplay.worldtraveller	● Missing Metadata

As you can see the process of setting up In-App Purchases on the Apple App Store is a little time consuming but relatively straightforward.

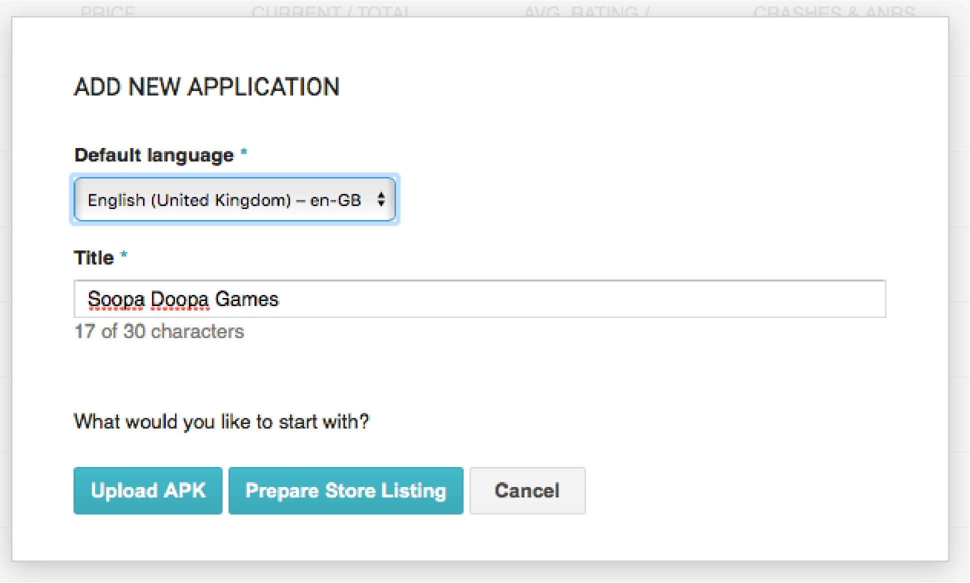
One (possible) last step regarding the Apple set-up for the app...

Unless you're using a wildcard App ID (which can be generated by Xcode) you'll need to create an App ID matching the one that was entered in your **config.xml** file (in the widget ID field) through the **Certificates, Identifiers & Profiles** portal of your Apple Developer account.

Creating In-app Products on the Google Play Store

Google Play implements In-app Products in a way that they can only be tested AFTER an APK file has been uploaded for beta/alpha testing (prior to that being production ready and published for sale on the Play Store).

To understand how this works log in to your Google Play Developer account and Add a New Application:



ADD NEW APPLICATION

Default language *

English (United Kingdom) – en-GB

Title *

Soopa Doopa Games

17 of 30 characters

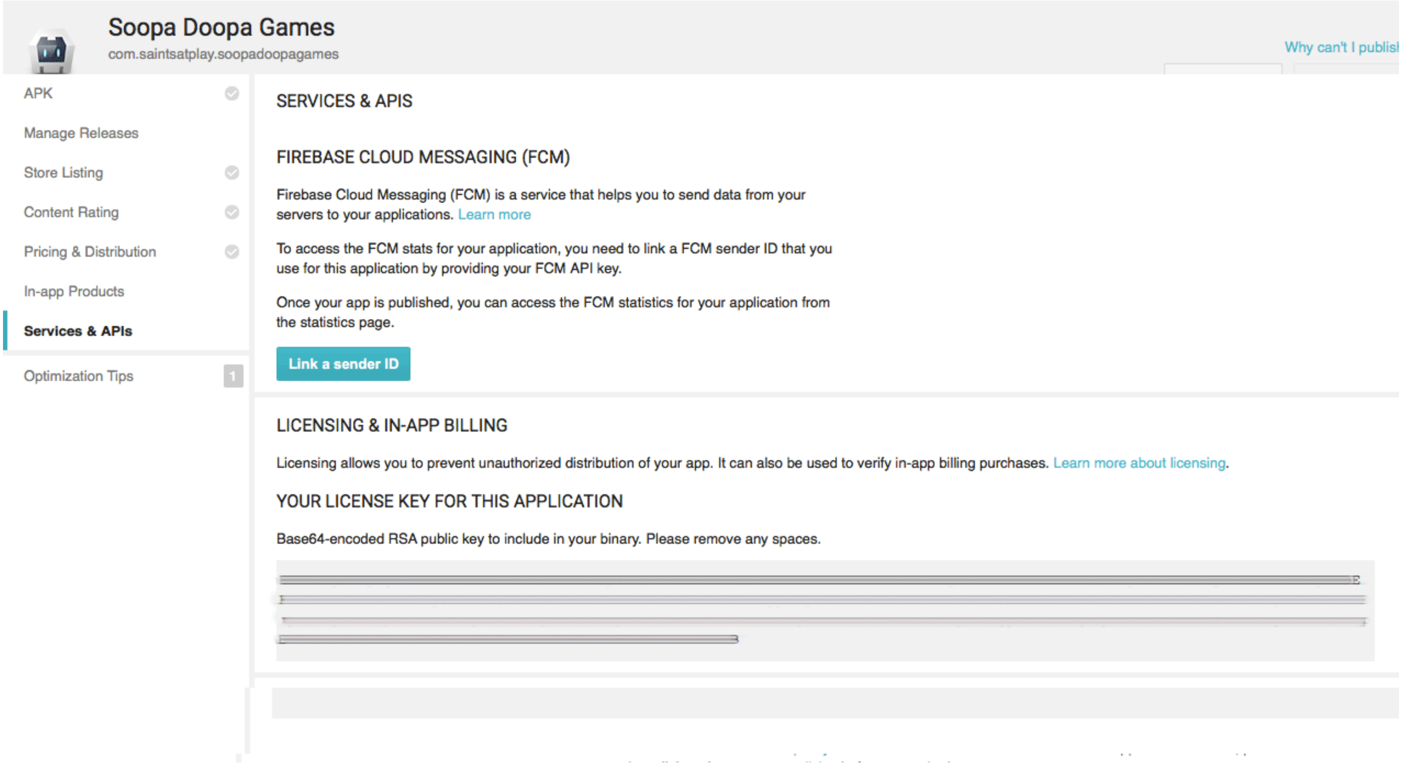
What would you like to start with?

In the modal window that appears be sure to:

- Select the default language for your application
- Enter the title for your application (in this example - Soopa Doopa Games)
- Select Prepare Store Listing from the buttons at the bottom of the window

We could **Upload an APK** file but we first of all need to add the License Key for the application to the **www/manifest.json** file so that we can enable In-app Products to be able to be purchased through Google Play.

Navigate to the **Services & APIs** screen, scroll down to the **Licensing & In-App Billing** section and select & copy the displayed license key:



SERVICES & APIS

FIREBASE CLOUD MESSAGING (FCM)

Firebase Cloud Messaging (FCM) is a service that helps you to send data from your servers to your applications. Learn more

To access the FCM stats for your application, you need to link a FCM sender ID that you use for this application by providing your FCM API key.

Once your app is published, you can access the FCM statistics for your application from the statistics page.

LICENSING & IN-APP BILLING

Licensing allows you to prevent unauthorized distribution of your app. It can also be used to verify in-app billing purchases. Learn more about licensing.

YOUR LICENSE KEY FOR THIS APPLICATION

Base64-encoded RSA public key to include in your binary. Please remove any spaces.

[redacted]

Now in your application's **www/manifest.json** file enter this license key as the following key/value pairing (highlighted in bold):

```
{
  "name": "My Ionic App",
  "short_name": "My Ionic App",
  "start_url": "index.html",
  "display": "standalone",
  "icons": [{
    "src": "icon.png",
    "sizes": "512x512",
    "type": "image/png"
  }],
  "play_store_key":"COPIED_KEY_VALUE_IS_PASTED_HERE"
}
```

With the Play Store license key in place we can now build our android app and then code sign the APK file ready for upload.

Using the Ionic CLI run the following build command to generate an unsigned APK file:

```
ionic build --release android
```

Once successfully completed you'll need to generate a **keystore** file which, as you'll remember from the *Code signing for iOS & Android* chapter, is used to generate a digital signature when signing the APK file using the **jarsigner** tool:

```
keytool -genkey -v -keystore SoopaDoopaGames-release-key.keystore -alias
SoopaDoopaGames -keyalg RSA -keysize 2048 -validity 10000
```

Enter a password for the keystore file (store this somewhere safe as, if you lose this, you won't be able to run the keystore file in the future!), answer the command line tool prompts and you should have a generated keystore file within the space of a minute or so.

Once this is the case you can sign the previously generated APK file by running the following command:

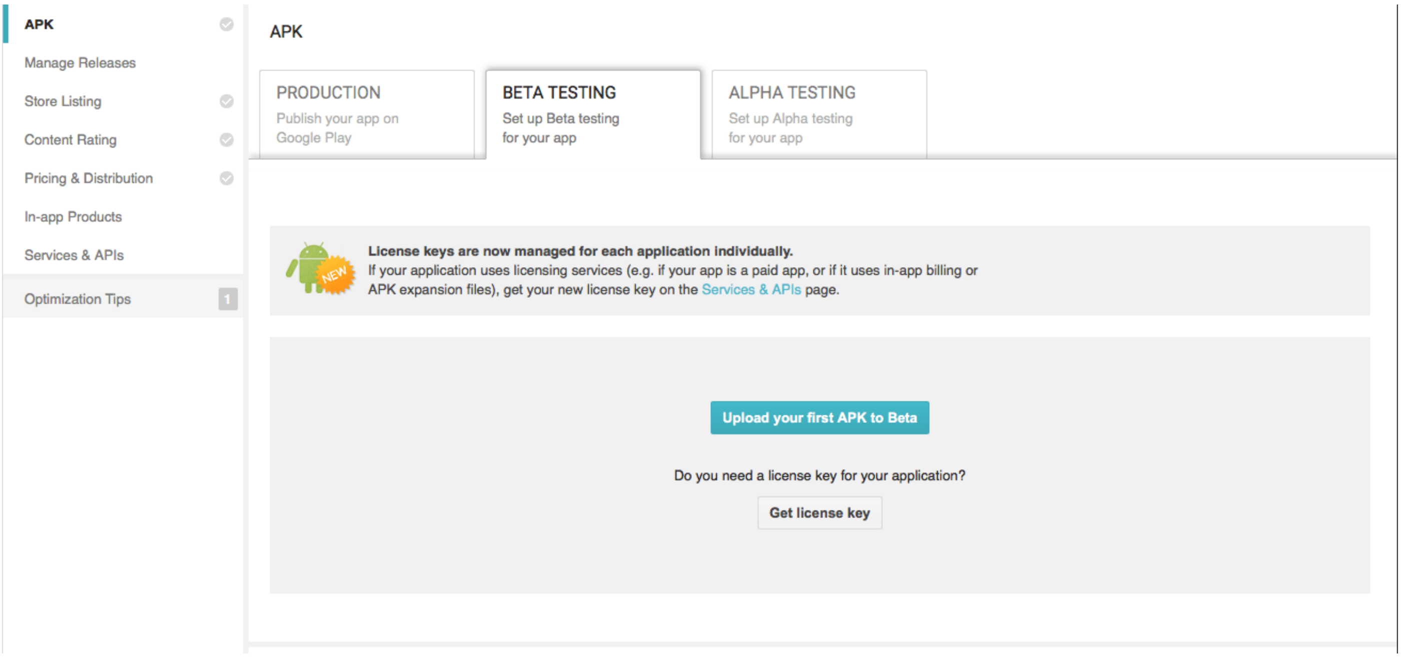
```
jarsigner -verbose -sigalg SHA1withRSA -digestalg SHA1 -keystore SoopaDoopaGames-release-key.keystore platforms/android/build/outputs/apk/android-release-unsigned.apk SoopaDoopaGames
```

Once the APK has been signed we need to run the **zipalign** tool using the following command to optimise the APK file:

```
zipalign -v 4 platforms/android/build/outputs/apk/android-release-unsigned.apk
platforms/android/build/outputs/apk/SoopaDoopaGames.apk
```

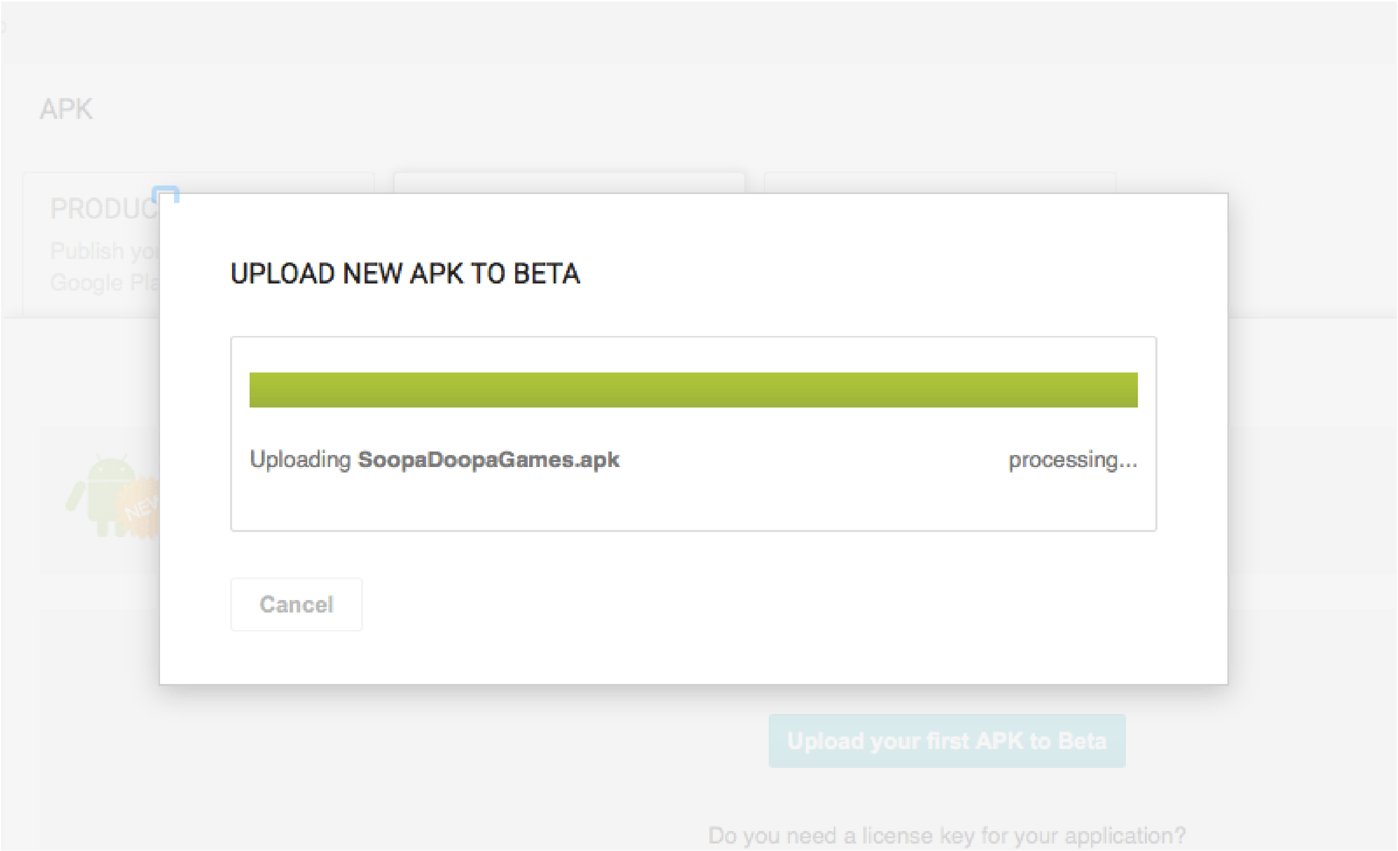
Now that the APK file for the app has been generated, signed and optimised it's ready for upload to the Google Play Store.

Returning to your Google Play Developer account go to the APK screen of the Soopa Doopa Games Application, select the Beta Testing tab and upload the signed APK file:



License keys are now managed for each application individually.
If your application uses licensing services (e.g. if your app is a paid app, or if it uses in-app billing or APK expansion files), get your new license key on the Services & APIs page.

Do you need a license key for your application?



UPLOAD NEW APK TO BETA

Uploading **SoopaDoopaGames.apk** processing...

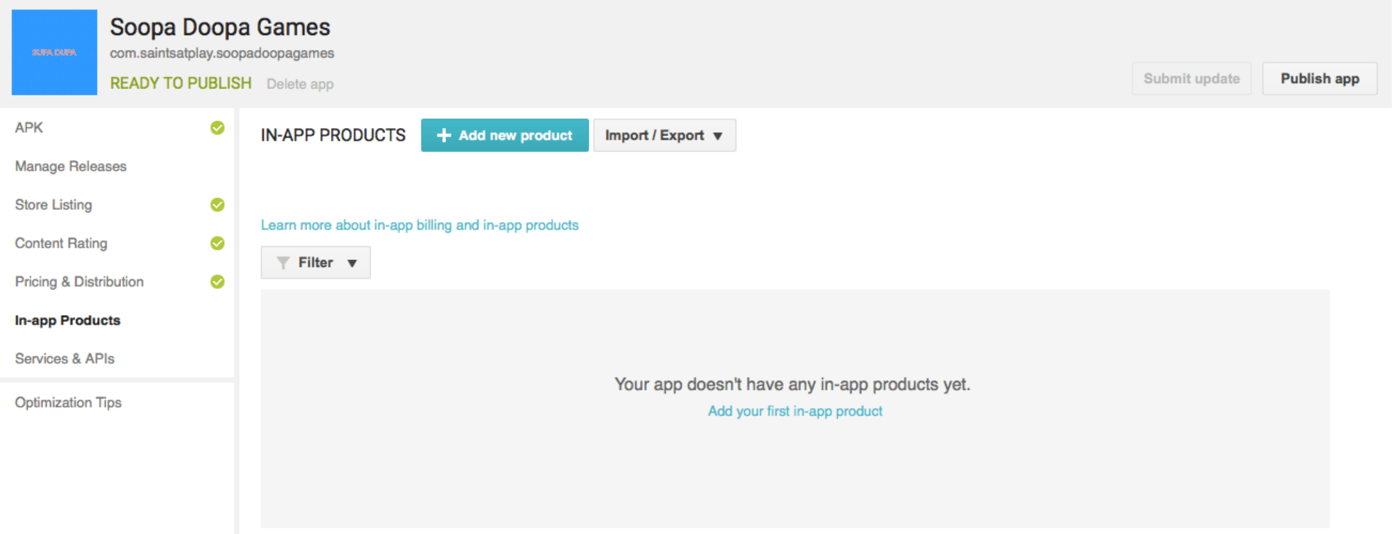
Do you need a license key for your application?

Once the APK file has completed uploading to the Beta Testing tab you can begin completing the rest of the Soopa Doopa Games application content sections.

We won't go through all the screen here as we covered those in the *Submitting your Android App to the Google Play Store* chapter but we will concentrate on the In-app Products screen.

As we have entered the license key for the app we can start adding our In-app Products to this section.

Click on the **Add new product** button:



Soopa Doopa Games
com.saintsatplay.soopadoopagames
READY TO PUBLISH Delete app

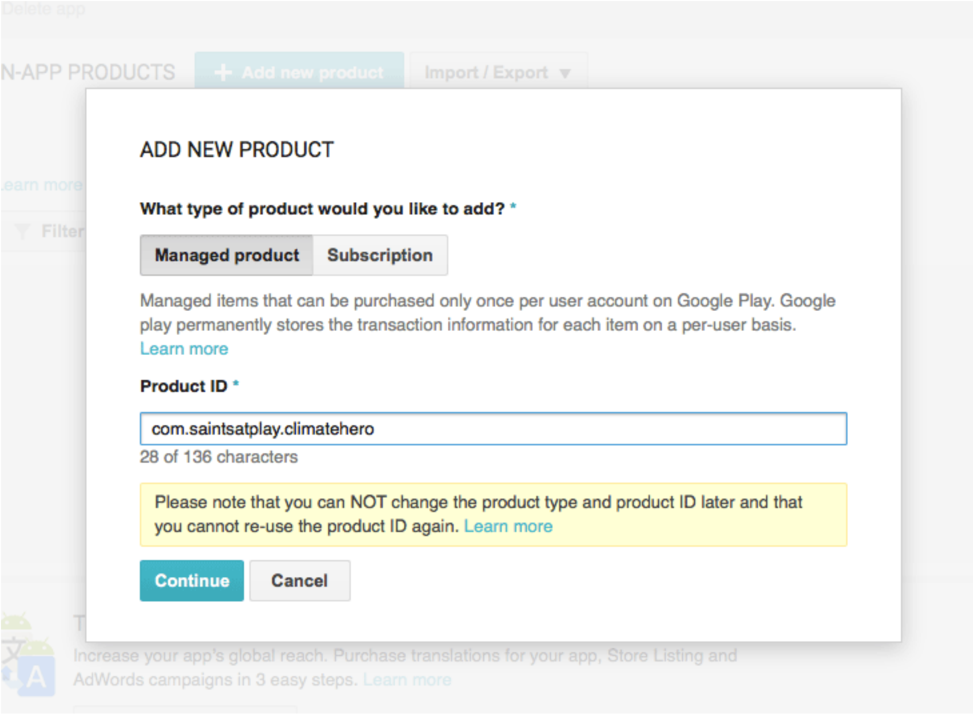
Learn more about in-app billing and in-app products

Your app doesn't have any in-app products yet.
Add your first in-app product

A modal window will appear offering two product types to select from:

- **Managed product** (I.e. a consumable or non-consumable product item)
- **Subscription** (I.e. a recurring billable item such as a monthly magazine)

Select **Managed product** from the product type options and enter the product ID for the product you want to create in the **Product ID** field:



ADD NEW PRODUCT

What type of product would you like to add? *

Managed items that can be purchased only once per user account on Google Play. Google play permanently stores the transaction information for each item on a per-user basis. Learn more

Product ID *

com.saintsatplay.climatehero

28 of 136 characters

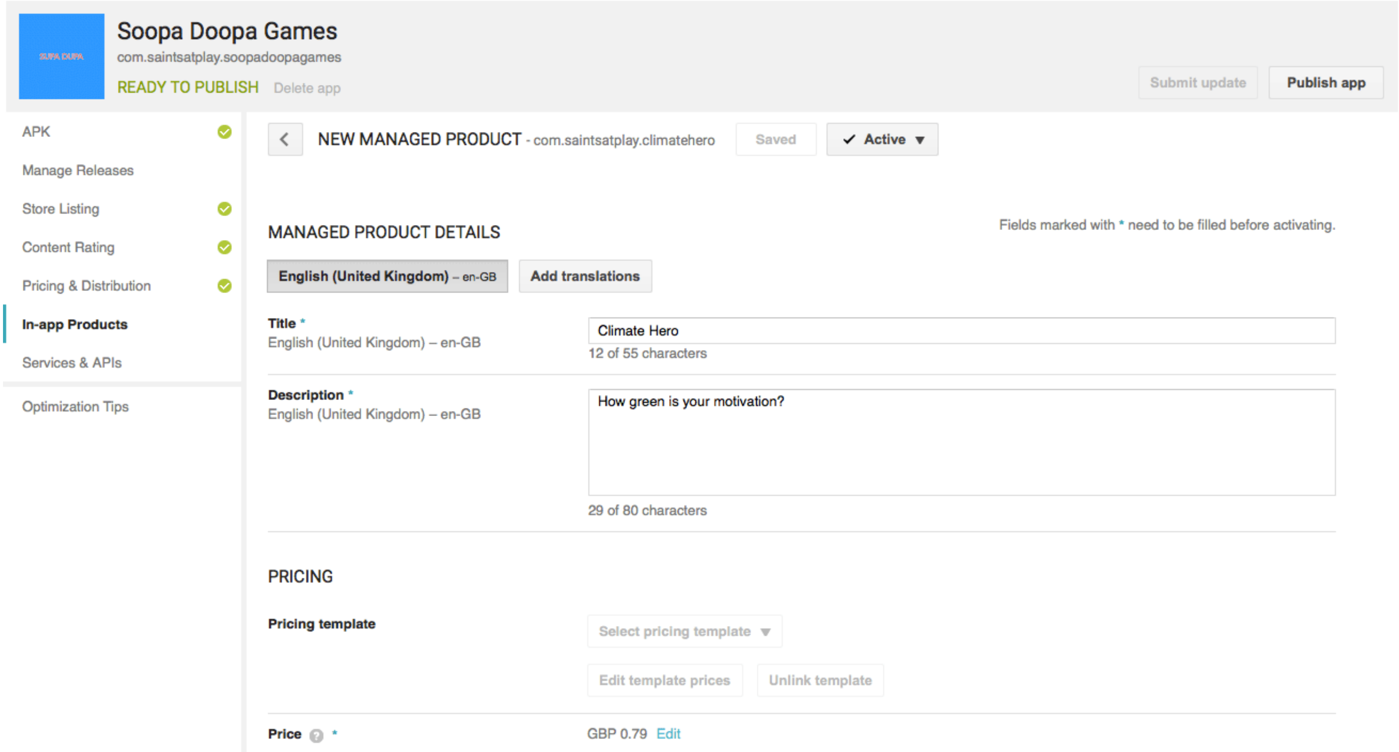
Please note that you can NOT change the product type and product ID later and that you cannot re-use the product ID again. Learn more

Increase your app's global reach. Purchase translations for your app, Store Listing and AdWords campaigns in 3 easy steps. Learn more

The following product ID’s will need to be individually added as In-app Products for the Soopa Doopa Games app:

- **com.saintsatplay.alphamale**
- **com.saintsatplay.climatehero**
- **com.saintsatplay.grandtheftnoughto**
- **com.saintsatplay.happyfamilies**
- **com.saintsatplay.kingforaday**
- **com.saintsatplay.worldtraveller**

As we’re creating the **com.saintsatplay.climatehero** In-app Product we’ll be prompted to complete entering details for this product after clicking on the Continue button:



NEW MANAGED PRODUCT - com.saintsatplay.climatehero

MANAGED PRODUCT DETAILS

Fields marked with * need to be filled before activating.

Title *
English (United Kingdom) – en-GB
Climate Hero
12 of 55 characters

Description *
English (United Kingdom) – en-GB
How green is your motivation?
29 of 80 characters

PRICING

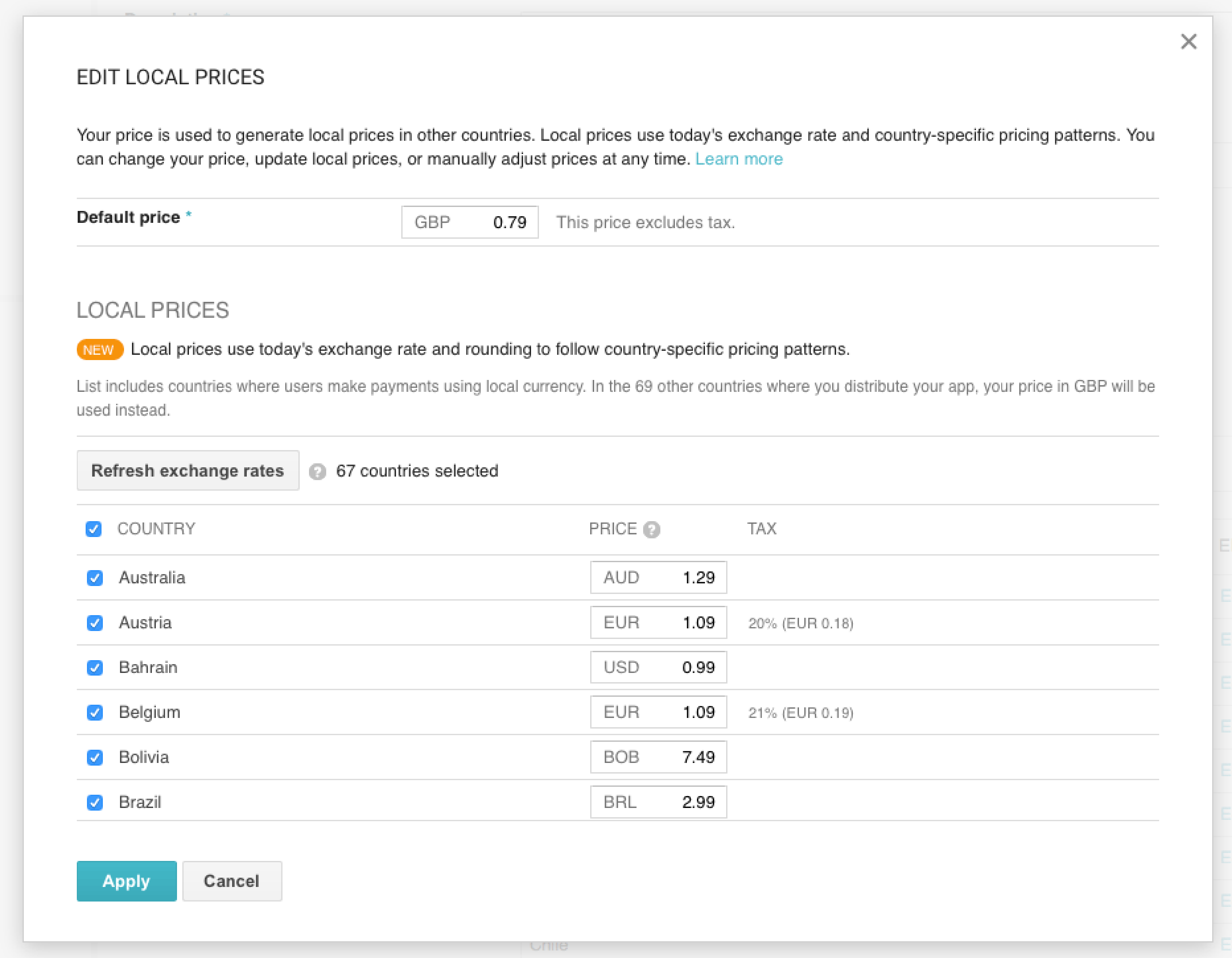
Pricing template

Price *
GBP 0.79 Edit

These details, which will be displayed on the customer facing purchase prompt in the app, include:

- Title
- Description
- Price

When determining a price for the In-app Product (if it is not free) you can also select the countries where the In-app product will be displayed in the local currency for that country:



EDIT LOCAL PRICES

Your price is used to generate local prices in other countries. Local prices use today's exchange rate and country-specific pricing patterns. You can change your price, update local prices, or manually adjust prices at any time. Learn more

Default price * GBP 0.79 This price excludes tax.

LOCAL PRICES

NEW Local prices use today's exchange rate and rounding to follow country-specific pricing patterns.

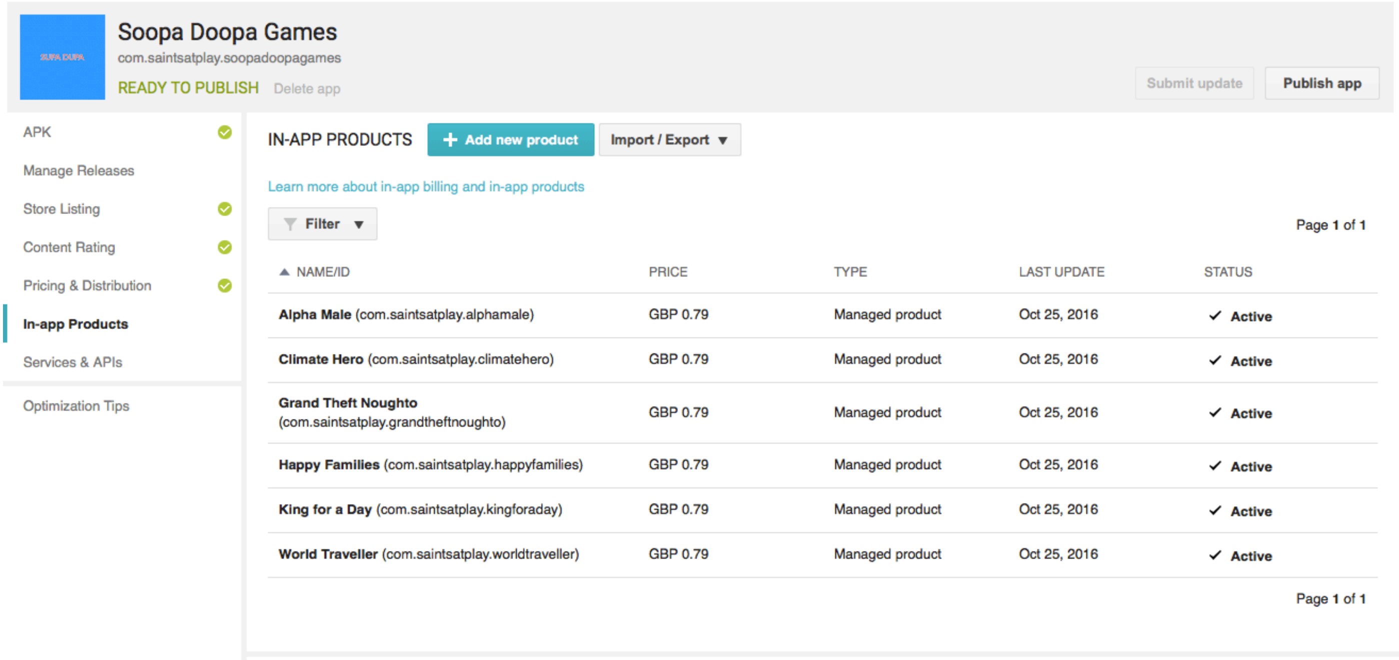
List includes countries where users make payments using local currency. In the 69 other countries where you distribute your app, your price in GBP will be used instead.

Refresh exchange rates 67 countries selected

☑ COUNTRY	PRICE		TAX
☑ Australia	AUD	1.29	
☑ Austria	EUR	1.09	20% (EUR 0.18)
☑ Bahrain	USD	0.99	
☑ Belgium	EUR	1.09	21% (EUR 0.19)
☑ Bolivia	BOB	7.49	
☑ Brazil	BRL	2.99	

Once any fees have been applied you can either save your In-app Product details using the Save button at the top of the form or choose Active from the drop down menu next to this button (which will automatically save your In-app Product and make this publicly available once the app is published to the Google Play store).

After creating the separate In-app Products (whose product ID's match exactly those listed at the top of the previous page) you'll see these displayed on the landing screen for the In-app Products section like so:



Soopa Doopa Games
com.saintsatplay.soopadoopagames
READY TO PUBLISH Delete app

IN-APP PRODUCTS

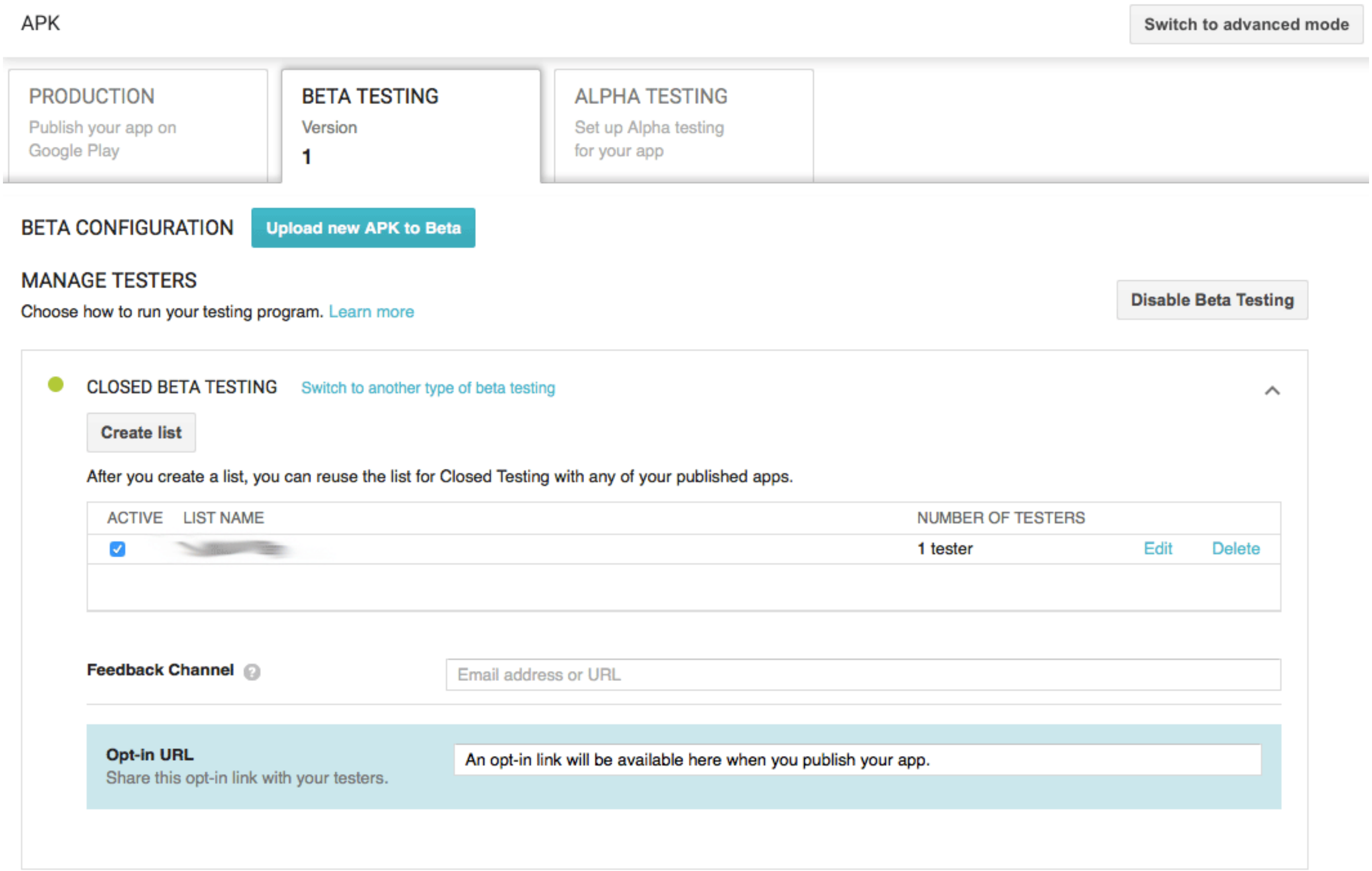
Learn more about in-app billing and in-app products

Page 1 of 1

NAME/ID	PRICE	TYPE	LAST UPDATE	STATUS
Alpha Male (com.saintsatplay.alphamale)	GBP 0.79	Managed product	Oct 25, 2016	✓ Active
Climate Hero (com.saintsatplay.climatehero)	GBP 0.79	Managed product	Oct 25, 2016	✓ Active
Grand Theft Noughto (com.saintsatplay.grandtheftnoughto)	GBP 0.79	Managed product	Oct 25, 2016	✓ Active
Happy Families (com.saintsatplay.happyfamilies)	GBP 0.79	Managed product	Oct 25, 2016	✓ Active
King for a Day (com.saintsatplay.kingforaday)	GBP 0.79	Managed product	Oct 25, 2016	✓ Active
World Traveller (com.saintsatplay.worldtraveller)	GBP 0.79	Managed product	Oct 25, 2016	✓ Active

Page 1 of 1

There is one final step to be taken before we can publish the app and that is to **Set up Closed Beta Testing** which allows the app to be installed by selected testers (we can enter their email addresses on screen) who can then make test purchases of the activated In-app Products:



APK

BETA CONFIGURATION

MANAGE TESTERS

Choose how to run your testing program. Learn more

● CLOSED BETA TESTING

After you create a list, you can reuse the list for Closed Testing with any of your published apps.

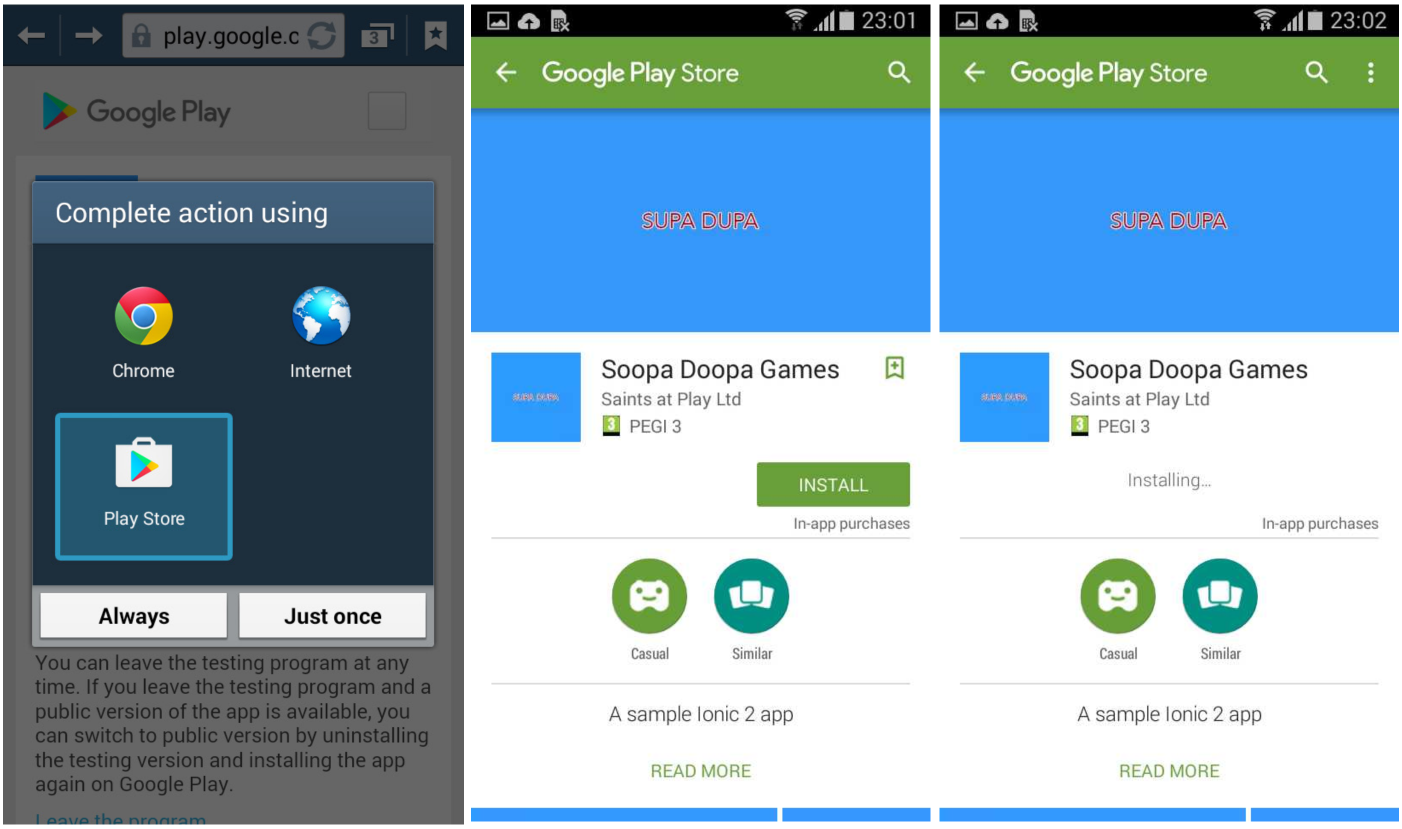
ACTIVE	LIST NAME	NUMBER OF TESTERS
☑	[redacted]	1 tester

Feedback Channel: Email address or URL

Opt-in URL
Share this opt-in link with your testers.
An opt-in link will be available here when you publish your app.

Once published and approved by the Google Play moderators an opt-in URL for the app will be displayed within the Closed Beta Testing section of the APK screen which can then be shared with testers.

This opt-in URL contains a “closed” Google Play Store link which testers can visit to download, install and beta test the app from:



You can leave the testing program at any time. If you leave the testing program and a public version of the app is available, you can switch to public version by uninstalling the testing version and installing the app again on Google Play.

Leave the program

A sample Ionic 2 app

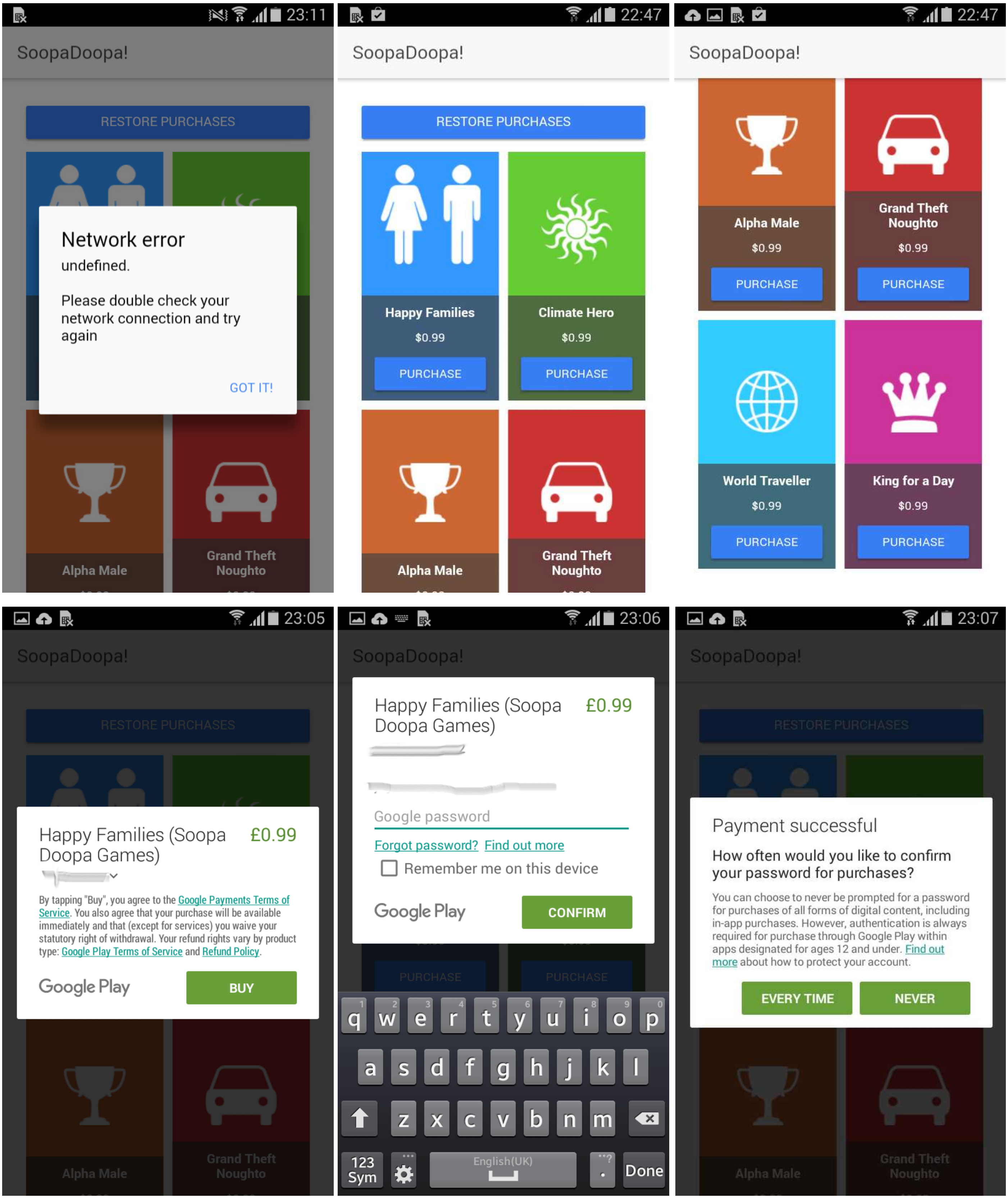
A sample Ionic 2 app

An important point to note here - The tester installing the beta app cannot be the publisher of the app as the In-app Product functionality won’t allow purchases to be made for products in the app if this is the case.

If you, as the developer, want to test your beta apps then you’ll need to use a secondary Google account - NOT the one associated with your Google Play Developer account (and, if you don’t currently have a second Google account, creating one is pretty quick and easy to do).

Simply log into that secondary account on your Android device and you should be good to go with installing beta versions of your app for testing.

Once installed you should be able to test your In-App Product purchases like so:



23:11

SoopaDoopa!

RESTORE PURCHASES

Network error

undefined.

Please double check your network connection and try again

GOT IT!

Alpha Male

Grand Theft Noughto

22:47

SoopaDoopa!

RESTORE PURCHASES

Happy Families

$0.99

PURCHASE

Climate Hero

$0.99

PURCHASE

Alpha Male

Grand Theft Noughto

22:47

SoopaDoopa!

Alpha Male

$0.99

PURCHASE

Grand Theft Noughto

$0.99

PURCHASE

World Traveller

$0.99

PURCHASE

King for a Day

$0.99

PURCHASE

23:05

SoopaDoopa!

RESTORE PURCHASES

Happy Families (Soopa Doopa Games) £0.99

By tapping "Buy", you agree to the Google Payments Terms of Service. You also agree that your purchase will be available immediately and that (except for services) you waive your statutory right of withdrawal. Your refund rights vary by product type: Google Play Terms of Service and Refund Policy.

Google Play

BUY

Alpha Male

Grand Theft Noughto

23:06

SoopaDoopa!

Happy Families (Soopa Doopa Games) £0.99

Google password

Forgot password? Find out more

□ Remember me on this device

Google Play

CONFIRM

PURCHASE

PURCHASE

23:07

SoopaDoopa!

RESTORE PURCHASES

Payment successful

How often would you like to confirm your password for purchases?

You can choose to never be prompted for a password for purchases of all forms of digital content, including in-app purchases. However, authentication is always required for purchase through Google Play within apps designated for ages 12 and under. Find out more about how to protect your account.

EVERY TIME

NEVER

Alpha Male

Grand Theft Noughto

As you can see implementing In-app Purchases (or In-app Products as they are referred to on Google Play) is a little more involved on the Android platform than they are on iOS.

There's quite a few hoops to jump through and, in my personal opinion, it's not as intuitive or as user friendly as the iOS experience.

Thanks to Alex Disler's excellent Cordova In-App Purchase plugin though we can implement In-App purchases/products across both platforms through a simplified and easy-to-use API which makes life as a developer so much easier...and that can never be a bad thing!

Finishing touches

Before we can consider the app completed there's one final addition we need to make - implementing the necessary launch icon and splash screen images for the iOS and Android directories in the **/SoopaDoopaGames/resources** directory.

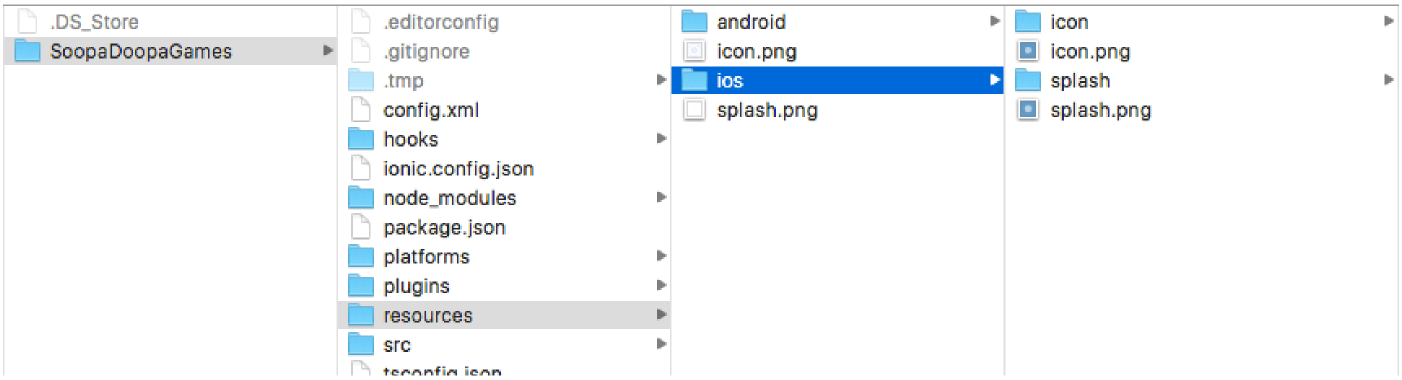
Without these our app will use the default Apache Cordova images which seems a little lazy after all the work we've put in during this case study.

Before proceeding though you'll need to download the files for this case study from the following link: http://tinyurl.com/gwnamma (if you haven't done so already).

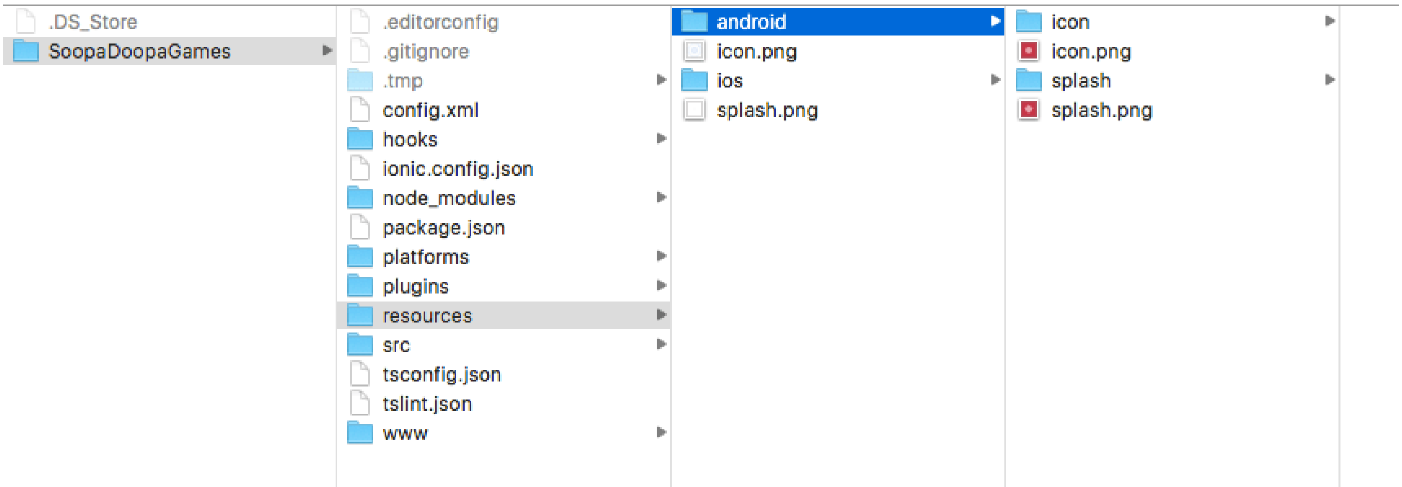
Having done this copy both the **icon.png** and **splash.png** files from the following locations in the downloaded project files directory:

- **SoopaDoopaGames/resources/android**
- **SoopaDoopaGames/resources/ios**

And then paste these into the matching directories in your own SoopaDoopaGames project, beginning with the iOS launch and splash images:



Followed by those for Android:



.DS_Store
SoopaDoopaGames

.editorconfig
.gitignore
.tmp
config.xml
hooks
ionic.config.json
node_modules
package.json
platforms
plugins
resources
src
tsconfig.json
tslint.json
www

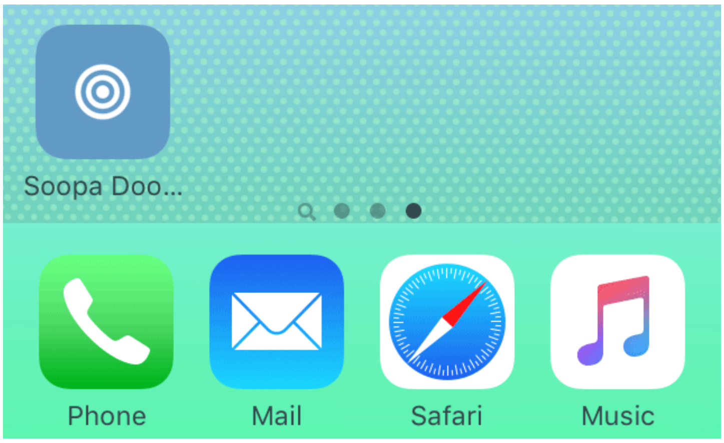
android
icon.png
ios
splash.png

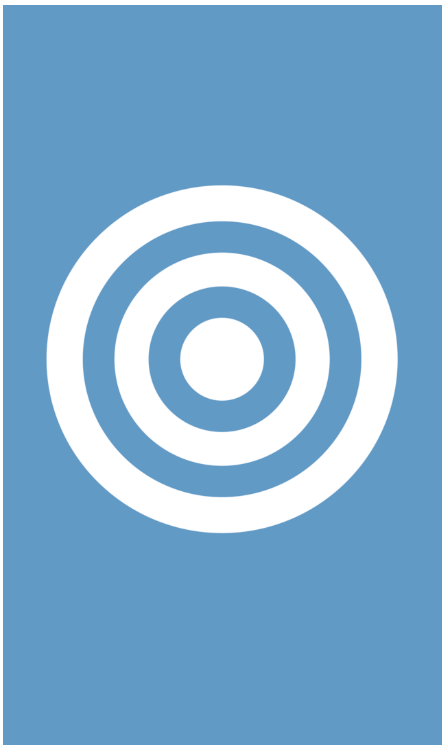
icon
icon.png
splash
splash.png

With our respective launch icon and splash screen templates in place for iOS and Android we can now generate the images to be used for these platforms using the following Ionic CLI command (as always - ensure you are at the root of the SoopaDoopaGames project directory before running such commands):

```
ionic resources
```

Once the command has finished processing you should see the different launch icon and splash screen sizes being generated from the supplied template images which, when our app is published to a mobile device, should give us something like the following:





Summary

Congratulations on reaching the end of the SoopaDoopaGames Case Study!

Over the course of this chapter you've managed to build a product based app for iOS & Android (while navigating and overcoming certain keys differences between the platforms) that successfully implements the following features:

- In-App Purchase functionality allowing the user to buy and restore products
- The ability to store purchased products in the app's SQLite database
- Render page layouts using the Ionic 2 Grid component

In addition to integrating Ionic/Cordova plugins, custom services and page UI Components you've also spent time creating and configuring the necessary In-App Purchase products on both the Apple App and Google Play Stores.

Through doing this you've learnt that the Apple App Store allows you to create your In-App Purchases and test those BEFORE submitting your app for release while the Google Play Store requires that your In-App Products are created and only able to be tested AFTER submitting a pre-production APK file.

I personally prefer Apple's approach!

Hopefully you can take away new techniques and knowledge from this case study and develop those further in your own Ionic 2 projects.

Maybe you could further develop the case study itself? What about improving and extending network detection capabilities so that if the network connection is suddenly lost the app informs the user of this event and responds accordingly? Maybe you could look into adding further In-App Purchase products that are, this time, consumable instead (that is, once depleted they can be repurchased again and again)? Or maybe even have a go at creating re-billable subscriptions?

Whatever your choices there's a lot of scope for further development and I'd love to receive feedback from readers on what they've been able to take away and use from this particular case study.

Resources

Cordova SQLite Storage
The excellent Cordova In-App Purchase plugin by Alex Disler
Ionic Grid component

All project files for this chapter can be found listed in the download links on page 636.

Case Study #3
AppyMapper
App

In our third and final case study we're going to develop a Google Maps single page application, called appyMapper, that allows users to find Apple store locations across the United Kingdom, France, Germany, Belgium and the Netherlands.

The app will incorporate the following features and functionality:

- Locate all available Apple store locations within a pre-selected distance from the user's current geographic location
- Filter stores by specific countries
- Reload all stores
- Ionic Form components
- Ionic Native GoogleMaps and Cordova SQLite plugins

With these in mind let's make a start by creating a new project at the root of your apps directory, installing the required plugins and creating the pipes and services for the app using the following commands (you will of course know by now to wait patiently for each listed command to successfully complete executing before running the next one!):

```
ionic start appyMapper blank --v2
cd appyMapper
npm install
ionic platform add android
ionic plugin add cordova-plugin-geolocation
ionic plugin add cordova-sqlite-storage
ionic g provider database
ionic g provider files
ionic g provider distances
ionic g pipe sanitiser
```

We'll also be installing the Cordova Google Maps plugin that we spent some time exploring and familiarising ourselves with during the *Plugins* chapter.

This will require setting up the following additional keys in your Google Developers Console account:

- Android API Key
- iOS API Key

If you need to, revisit the *Plugins* chapter for a step-by-step guide on how this is achieved but, before you do, let's quickly open and amend the **appyMapper/config.xml** file to include the following changes (highlighted in bold):

```
<widget
  id="com.saintsatplay.appyMapper"
  version="0.0.1"
  xmlns="http://www.w3.org/ns/widgets"
  xmlns:cdv="http://cordova.apache.org/ns/1.0">
```

With the App ID now in place feel free to set up the Android & iOS API keys for the appyMapper project and then come back to this page once completed!

Now that the necessary platform API keys have been created it's time to proceed with installing the Cordova GoogleMaps plugin.

In your Terminal, and at the root of the appyMapper project directory, enter the following command (substituting YOUR_APP_KEY_VALUE_HERE for the recently generated iOS and Android key values that you will need to copy from your Google Developers Console account - BUT do make sure you enter the iOS key value for iOS and the Android key value for Android otherwise the Google maps functionality won't work!):

```
Cordova plugin add https://github.com/phonegap-googlemaps-plugin/cordova-plugin-googlemaps --variable API_KEY_FOR_ANDROID="YOUR_APP_KEY_VALUE_HERE" --variable API_KEY_FOR_IOS="YOUR_APP_KEY_VALUE_HERE"
```

Remember, from the Plugins chapter, that the installation process might take a little while so sit back, relax and get ready to start diving into some coding shortly!

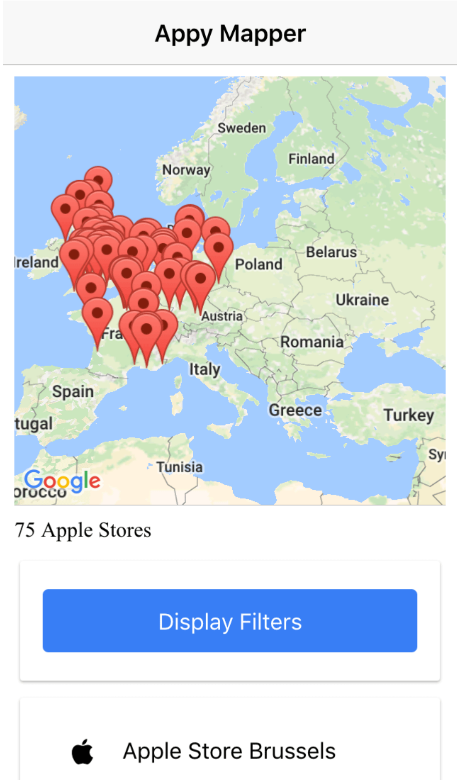
appyMapper

With all the necessary files and plugins in place for the app now would be a good time to review what we are going to be building in this case study.

The app will consist of a single page with:

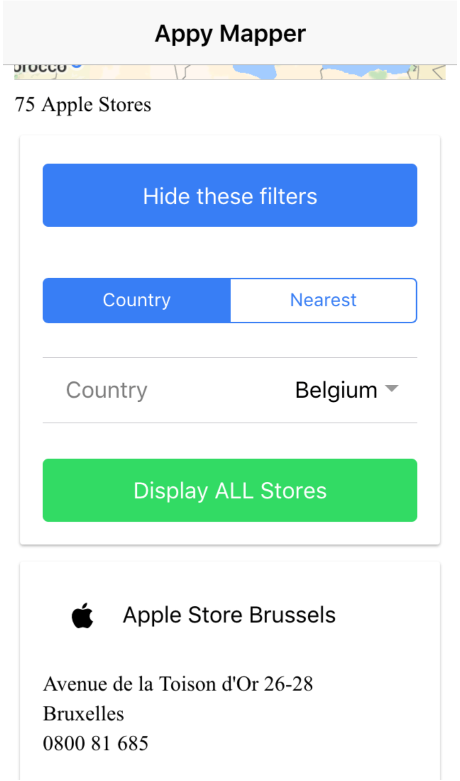
- A Google Map displaying all Apple Store locations
- A filters section where the user can display those store locations based solely on country or those nearest to their current geographical location
- A list of each store, with accompanying address/contact details, will be displayed underneath the map

By the end of the case study you should be able to see a fully functional app as shown in the following screen captures:


Appy Mapper

75 Apple Stores

Apple Store Brussels

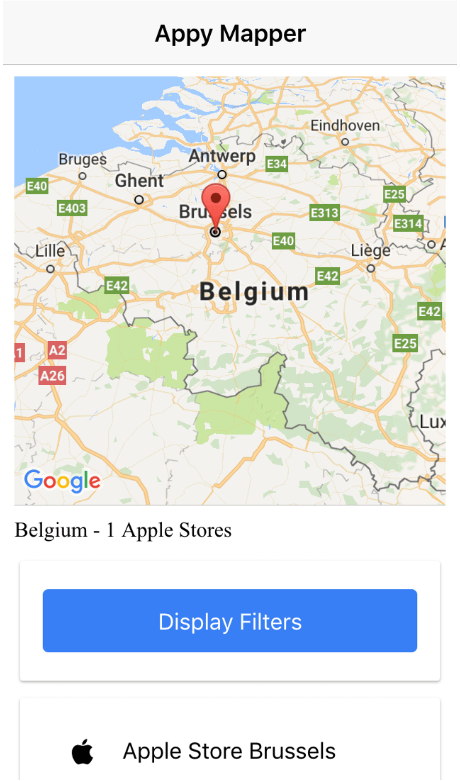

Appy Mapper

75 Apple Stores

Country Belgium

Apple Store Brussels

Avenue de la Toison d'Or 26-28
Bruxelles
0800 81 685


Appy Mapper

Belgium - 1 Apple Stores

Apple Store Brussels

The first screen capture demonstrates the initially loaded state of the application with all of the Apple Store locations displayed for the following countries:

- Belgium
- France
- Germany

- Netherlands
- United Kingdom

The second screen capture demonstrates the types of filters we’ll be building into the application allowing us to display Apple Store locations by:

- Country
- Nearest to current location by a specified range
- All store locations

Finally, the third screen capture displays the locations of Apple Stores for the country selection of Belgium with the Google Map zooming in to fit the borders of that country.

With the preview of what we’ll be building covered let’s make a start on the actual development!

A good place to start would be with our newly created providers:

- **appyMapper/src/providers/files.ts**
- **appyMapper/src/providers/database.ts**
- **appyMapper/src/providers/distances.ts**

These form the backbone for the logic of the appyMapper application so what better place to start coding?

files.ts

The **appyMapper/src/providers/files.ts** file contains the functionality to load the following JSON files for the app:

- **appyMapper/src/assets/data/countries.js**
- **appyMapper/src/assets/data/locations.js**

These will be used to subsequently populate the app’s SQLite database with the

European countries and Apple Store locations that our app will use as data sources.

Within the **appyMapper/src/providers/files.ts** file make the following amendments (highlighted in bold):

```
...

@Injectable()
export class Files {

  private countries : any        =    [];
  private locations : any        =    [];

  constructor(public http: Http)
  {

  }



  loadCountries()
  {
    this.http.get('assets/data/countries.js')
    .map(res => res.json())
    .subscribe(countries =>
    {
      for(var k in countries.countries)
      {

        this.countries.push({
          id:         countries.countries[k].id,
          country:    countries.countries[k].country,
          lat:        countries.countries[k].lat,
          lng:        countries.countries[k].lng,
          zoom:       countries.countries[k].zoom,
          active:     countries.countries[k].active
        });

      }
    });
  }


  getCountriesFromJSON()
  {
    return this.countries;
  }


  loadLocations()
  {
    this.http.get('assets/data/locations.js')
    .map(res => res.json())
    .subscribe(locations =>
    {
      for(var k in locations.locations)
      {
        this.locations.push({
          id:           locations.locations[k].id,
          country:      locations.locations[k].country,
          name:         locations.locations[k].name,
          address:      locations.locations[k].address,
          lat:          locations.locations[k].lat,
          lng:          locations.locations[k].lng,
          zoom:         locations.locations[k].zoom,
          active:       locations.locations[k].active
        });
      }
    });
```

```
   }



   getLocationsFromJSON()
   {
      return this.locations;
   }

}
```

This is a fairly simple provider which, through the **loadCountries()** method, loads the list of European countries that the appyMapper will use that the different Apple Store locations belong to.

Once the JSON country data has been loaded this is then stored in a dedicated **countries** object which is able to be accessed by other TypeScript classes in the appyMapper application through the **getCountriesFromJSON()** method.

Similarly the **loadLocations()** method is used to load the JSON data for all the Apple Store locations that are associated with the European countries loaded through the **loadCountries()** method.

The locations object which stores all of the loaded JSON data for the Apple Stores is then able to be accessed through other TypeScript classes in the appyMapper application through the **getLocationsFromJSON()** method.

That's all that needs to be stated about the **Files** service - it's pretty simple and fairly straightforward to understand.

Before we go any further though now would be a good time to actually add the following files to the app:

- **countries.js**
- **locations.js**

Without those we have no data to work with so they're kind of important!

Both of these files can be found in the downloadable assets for this case study in the following directory: **/appyMapper/src/assets/data**.

You will need to copy both of these files to a directory named **data** that will need to be created within the following project location on your machine: **appyMapper/src/assets**.

If you're not too sure about the location simply look at the structure of the completed appyMapper project available in the downloadable assets directory: **Projects Files/Case Studies/AppyMapper/** and use that as a guide to compare to your own app structure.

I'm deliberately not listing the contents for those files here as the **locations.js** JSON data alone runs to 73 entries - believe me when I say that would be a lot of pages you'd be copying and pasting from!

Also adding that here would unnecessarily add to the size of this Case Study chapter and that would detract from the material that we need to cover through these pages...so get copying those files if you haven't already done so!

Once those JSON files have been copied to this location you're good to go!

database.ts

The engine driving the app is, as you've probably guessed by now, the SQLite database which is used to store and retrieve the JSON data originally loaded into the app using methods contained within the **Files** service.

The **appyMapper/src/providers/database.ts** file as you might expect will contain the functionality to interact with the SQLite database for the app, which will include:

- Creating the appyMapper database
- Creating the tables for storing country and locations JSON data

- Storing the locations and country data
- Retrieving locations and country data

These requirements should be fairly familiar by now with similar functionality that we’ve covered in both the Plugins chapter and the SoopaDoopaGames case study.

So let’s see what this functionality looks like by implementing the following code to the **appyMapper/src/providers/database.ts** script (amendments highlighted in bold):

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import { SQLite } from 'ionic-native';
import 'rxjs/add/operator/map';
import { Files } from '../providers/files';


@Injectable()
export class Database {

  public data          : any       =   null;
  public storage       : any       =   null;
  public dbName        : string    =   "appyMapper.db";
  public locations     : any       =   [];
  public countries     : any       =   [];


  constructor(
    public http      : Http,
    public files     : Files
   )
   {
     this.data = null;
   }
```

```
    createDatabase()
    {
        this.storage =   new SQLite();
        this.storage.openDatabase({
            name        :       this.dbName,
            location    :       'default' // the location field is required
        })
        .then((data) =>
        {
            console.log("Opened database");
            this.createDatabaseTables();
        },
        (err) =>
        {
            console.error('Unable to open database: ', err);
        });
    }


    createDatabaseTables()
    {
        this.createCountriesTable();
        this.createStorelocationsTable();
    }


    createCountriesTable()
    {
        this.storage.executeSql('CREATE TABLE IF NOT EXISTS countries (id
INTEGER PRIMARY KEY AUTOINCREMENT, country TEXT NOT NULL, lat
TEXT NOT NULL, lng TEXT NOT NULL, zoom INTEGER NOT NULL, active
TEXT NOT NULL)', {})
        .then((data) =>
        {
```

```
      console.log("countries TABLE CREATED : " + JSON.stringify(data));
    },
    (error) =>
    {
      console.log("Error: " + JSON.stringify(error.err));
      console.dir(error);
    });
  }



  createStorelocationsTable()
  {
    this.storage.executeSql('CREATE TABLE IF NOT EXISTS storeLocations (id INTEGER PRIMARY KEY AUTOINCREMENT, country INTEGER NOT NULL, name TEXT NOT NULL, address TEXT NOT NULL, lat TEXT NOT NULL, lng TEXT NOT NULL, zoom INTEGER NOT NULL, active TEXT NOT NULL)', {})
    .then((data) =>
    {
      console.log("storeLocations TABLE CREATED: " + JSON.stringify(data));
    },
    (error) =>
    {
      console.log("Error: " + JSON.stringify(error.err));
      console.dir(error);
    });
  }



  retrieveStorelocations()
  {
    return new Promise(resolve =>
    {
      this.storage.executeSql("SELECT * FROM storeLocations WHERE 
active='Y'", {})
    .then((data) =>
    {
      this.locations                   = [];
      if(data.rows.length > 0)
      {
        let k;
        for(k = 0; k < data.rows.length; k++)
        {
          this.locations.push({
            country            : data.rows.item(k).country,
            name               : data.rows.item(k).name,
            address            : data.rows.item(k).address,
            lat                : data.rows.item(k).lat,
            lng                : data.rows.item(k).lng,
            zoom               : data.rows.item(k).zoom
          });
        }
      }
      else
      {
        var numLocations          =   this.files.getLocationsFromJSON(),
            isFavourite           =   "N",
            k;

        for(k = 0; k < numLocations.length; k++)
        {
          this.locations.push({
            country            : numLocations[k].country,
            name               : numLocations[k].name,
            address            : numLocations[k].address,
            lat                : numLocations[k].lat,
            lng                : numLocations[k].lng,
            zoom                  : numLocations[k].zoom,
            active                : numLocations[k].active
          });
        }
        this.insertStoreLocationsToTable(numLocations, isFavourite);
      }
      resolve(this.locations);
      },
      (error) =>
      {
        console.log("Error retrieving locations from retrieveStoreLocations: " + JSON.stringify(error));
      });
    });
  }


  insertStoreLocationsToTable(val, isFavourite)
  {
    var i,
        sql  =  'INSERT INTO storeLocations(country, name, address, lat, lng, zoom, active) VALUES';

    for(i = 0; i < val.length; i++)
    {
      sql =   sql + '("' + val[i].country + '", "' + val[i].name + '", "' + val[i].address + '", "' + val[i].lat + '", "' + val[i].lng + '", ' + val[i].zoom + , "' + val[i].active + '")';



      if(i < (val.length - 1))
      {
        sql        =   sql + ',';
      }
    }
    this.storage.executeSql(sql, {})
    .then((data) =>
    {
      //console.log("storeLocations TABLE INSERTED RECORDS");
    },
    (error) =>
    {
      console.log(“ERROR -> “ + JSON.stringify(error.err));
    });
  }



  retrieveCountries()
  {
    return new Promise(resolve =>
    {
      this.storage.executeSql("SELECT * FROM countries WHERE active='Y'", {})
      .then((data) =>
       {
        this.countries = [];
        if(data.rows.length > 0)
        {
          let k;

          for(k = 0; k < data.rows.length; k++)
          {
            this.countries.push({
              id         : data.rows.item(k).id,
              country    : data.rows.item(k).country,
              lat        : data.rows.item(k).lat,
              lng        : data.rows.item(k).lng,
              zoom       : data.rows.item(k).zoom,
              active      : data.rows.item(k).active
            });
          }
        }
        else
        {
          //console.log("No data found in countries table");
          let numCountries      =   this.files.getCountriesFromJSON(),
              k;

          for(k = 0; k < numCountries.length; k++)
          {
            if(numCountries[k].isActive !== "N")
            {
               this.countries.push({
                 id               :   numCountries[k].id,
                 country          :   numCountries[k].country,
                 lat              :   numCountries[k].lat,
                 lng              :   numCountries[k].lng,
                 zoom             :   numCountries[k].zoom,
                 active           :   numCountries[k].active
               });
             }
           }
           this.insertCountriesToTable(numCountries);
         }
         resolve(this.countries);
       },
       (error) =>
       {
         console.log("Error retrieving countries from retrieveCountries: "
+ JSON.stringify(error));
       });
    });
```

```
   }



   insertCountriesToTable(val)
   {
      var i,
            sql = 'INSERT INTO countries(country, lat, lng, zoom, active) VALUES';

      for(i = 0; i < val.length; i++)
      {
         sql =   sql + '("' + val[i].country + '", "' + val[i].lat + '", "' + val[i].lng +
'", ' + val[i].zoom + ', "' + val[i].active + '")';

         if(i < (val.length - 1))
         {
            sql        =   sql + ',';
         }
      }

      this.storage.executeSql(sql, {})
      .then((data) =>
      {
         //console.log("countries TABLE INSERTED RECORDS");
      },
      (error) =>
      {
         console.log("ERROR: " + JSON.stringify(error.err));
      });
   }

}
```

After previous chapters and code examples the **Database** provider should make sense but let’s break each section of the above script down in more detail so we truly understand what their purpose is.

We begin with importing the SQLite plugin from Ionic Native and the **Files** service (which will be subsequently used to load the necessary JSON files for the app) followed by defining some properties to be used by the **Database** provider and then initialise a public property named **files** within the class constructor:

```
...
import { SQLite } from 'ionic-native';
...
import { Files } from '../providers/files';



@Injectable()
export class Database {

  public data          : any      =  null;
  public storage       : any      =  null;
  public dbName        : string   =  "appyMapper.db";
  public locations     : any      =  [];
  public countries     : any      =  [];



  constructor(
    public http      : Http,
    public files     : Files
   )
   {
     this.data = null;
   }
```

The **createDatabase** method, which follows after the constructor declaration, is used, as the name implies, to create the database for the application.

If the database is successfully created the **createDatabaseTables** method is then called to set up the necessary tables for subsequently storing the list of European countries and Apple Store locations:

```
createDatabase()
{
  this.storage    =   new SQLite();
  this.storage.openDatabase({
    name          :       this.dbName,
    location      :       'default' // the location field is required
  })
  .then((data) =>
  {
    console.log("Opened database");
    this.createDatabaseTables();
  },
  (err) =>
  {
    console.error('Unable to open database: ', err);
  });
}


createDatabaseTables()
{
  this.createCountriesTable();
  this.createStorelocationsTable();
}
```

The Database provider then goes on to generate the **createCountriesTable** and **createStorelocationsTable** methods - each of which declare field definitions that match up to those of the keys in the respective JSON files that were imported through the Files service.

Structuring the fields in this way allows for straightforward one-to-one insertion of data from each JSON file to its respective database table when parsing the files a little later on in the script:

```
createCountriesTable()
{
  this.storage.executeSql('CREATE TABLE IF NOT EXISTS countries (id
INTEGER PRIMARY KEY AUTOINCREMENT, country TEXT NOT NULL, lat
TEXT NOT NULL, lng TEXT NOT NULL, zoom INTEGER NOT NULL, active
TEXT NOT NULL)' {})
  .then((data) =>
  {
    console.log("countries TABLE CREATED : " + JSON.stringify(data));
  },
  (error) =>
  {
    console.log("Error: " + JSON.stringify(error.err));
    console.dir(error);
  });
}


createStorelocationsTable()
{
  this.storage.executeSql('CREATE TABLE IF NOT EXISTS storeLocations
(id INTEGER PRIMARY KEY AUTOINCREMENT, country INTEGER NOT
NULL, name TEXT NOT NULL, address TEXT NOT NULL, lat TEXT NOT
NULL, lng TEXT NOT NULL, zoom INTEGER NOT NULL, active TEXT NOT
NULL)', {})
  .then((data) =>
  {
    console.log("storeLocations TABLE CREATED: " + JSON.stringify(da-
ta));
  },
  (error) =>
  {
    console.log("Error: " + JSON.stringify(error.err));
    console.dir(error);
  });
}
```

Now we create the **retrieveStoreLocations** method to return data for all of the Apple Store locations that we have imported into the app.

This method determines whether we load the Apple Store locations from the database or from the JSON object created through the **loadLocations** method of the **Files** service.

If no data is found in the **storeLocations** table the JSON object is returned instead with its data also being used to populate the **storeLocations** table:

```
retrieveStorelocations()
{
  return new Promise(resolve =>
  {
    this.storage.executeSql("SELECT * FROM storeLocations WHERE
active='Y'", {})
  .then((data) =>
  {
    this.locations                      = [];
    if(data.rows.length > 0)
    {
      let k;
      for(k = 0; k < data.rows.length; k++)
      {
        this.locations.push({
```

```
      country         : data.rows.item(k).country,
      name            : data.rows.item(k).name,
      address         : data.rows.item(k).address,
      lat             : data.rows.item(k).lat,
      lng             : data.rows.item(k).lng,
      zoom            : data.rows.item(k).zoom
    });
  }
}
else
{
  var numLocations     =   this.files.getLocationsFromJSON(),
      isFavourite      =   "N",
      k;

  for(k = 0; k < numLocations.length; k++)
  {
    this.locations.push({
      country         : numLocations[k].country,
      name            : numLocations[k].name,
      address         : numLocations[k].address,
      lat             : numLocations[k].lat,
      lng             : numLocations[k].lng,
      zoom            : numLocations[k].zoom,
      active          : numLocations[k].active
    });
  }
  this.insertStoreLocationsToTable(numLocations, isFavourite);
}
resolve(this.locations);
},
(error) =>
{
        console.log("Error retrieving locations from retrieveStoreLocations:
" + JSON.stringify(error));
      });
   });
}
```

The **insertStoreLocationsToTable** method follows immediately afterwards and handles the bulk inserts of all Apple Store locations to the **storeLocations** table:

```
insertStoreLocationsToTable(val, isFavourite)
{
   var i,
        sql  =  'INSERT INTO storeLocations(country, name, address, lat,
lng, zoom, active) VALUES';

   for(i = 0; i < val.length; i++)
   {
      sql =   sql + '("' + val[i].country + '", "' + val[i].name + '", "' + val[i].ad-
dress + '", "' + val[i].lat + '", "' + val[i].lng + '", ' + val[i].zoom + ', "' + val[i].
active + '")';



      if(i < (val.length - 1))
      {
         sql        =   sql + ',';
      }
   }
   this.storage.executeSql(sql, {})
   .then((data) =>
   {
      //console.log("storeLocations TABLE INSERTED RECORDS");
   },
   (error) =>
   {
      console.log("Error: " + JSON.stringify(error.err));
   });
}
```

Following from this the **retrieveCountries** method is used to return data for all of the European countries that we have imported into the app.

Similar to the **retrieveStoreLocations** method this determines whether we load the records of countries from the database or from the JSON object created through the **loadCountries** method of the **Files** service.

If no data is found in the **countries** table the JSON object is returned instead with its data also being used to populate the **countries** table:

```
retrieveCountries()
{
   return new Promise(resolve =>
   {
      this.storage.executeSql("SELECT * FROM countries WHERE ac-
tive='Y'", {})
      .then((data) =>
      {
         this.countries = [];
         if(data.rows.length > 0)
         {
            let k;

            for(k = 0; k < data.rows.length; k++)
            {
               this.countries.push({
                  id            : data.rows.item(k).id,
                  country       : data.rows.item(k).country,
                  lat           : data.rows.item(k).lat,
                  lng           : data.rows.item(k).lng,
                  zoom        : data.rows.item(k).zoom,
                  active      : data.rows.item(k).active
               });
            }
         }
         else
         {
            //console.log("No data found in countries table");
            let numCountries     =   this.files.getCountriesFromJSON(),
                k;

            for(k = 0; k < numCountries.length; k++)
            {
               if(numCountries[k].isActive !== "N")
               {
                  this.countries.push({
                     id          :   numCountries[k].id,
                     country     :   numCountries[k].country,
                     lat         :   numCountries[k].lat,
                     lng         :   numCountries[k].lng,
                     zoom        :   numCountries[k].zoom,
                     active      :   numCountries[k].active
                  });
               }
            }
            this.insertCountriesToTable(numCountries);
         }
         resolve(this.countries);
      },
      (error) =>
      {
         console.log("Error retrieving countries from retrieveCountries: " +
JSON.stringify(error));
```

```
      });
   });
}
```

Finally we complete our Database provider with the **insertCountriesToTable** method which like the **insertStoreLocationsToTable** method handles the bulk inserts of all imported European countries to the **countries** table:

```
insertCountriesToTable(val)
{
   var i,
         sql = 'INSERT INTO countries(country, lat, lng, zoom, active) VAL-
UES';

   for(i = 0; i < val.length; i++)
   {
      sql =   sql + '("' + val[i].country + '", "' + val[i].lat + '", "' + val[i].lng + '",
' + val[i].zoom + ', "' + val[i].active + '")';
      if(i < (val.length - 1))
      {
         sql         =   sql + ',';
      }
   }

   this.storage.executeSql(sql, {})
   .then((data) =>
   {
      //console.log("countries TABLE INSERTED RECORDS");
   },
   (error) =>
   {
      console.log("ERROR: " + JSON.stringify(error.err));
   });
}
```

distances.ts

Our third and final provider, the **appyMapper/src/providers/distances.ts** file, handles the required logic for calculating the nearest Apple Store to a user's location - this does assume that the user is one of the following countries OR very close to:

- Belgium
- France
- Germany
- Netherlands
- United Kingdom

If the user happens to be somewhere completely different then the logic will not be able to find an Apple Store (or Stores) nearest to their current location due to the data set being used!

With that said let's look at the logic used to calculate the nearest store(s) based on range/location (amendments highlighted in bold):

```
import { Injectable } from '@angular/core';
import { Http } from '@angular/http';
import 'rxjs/add/operator/map';

@Injectable()
export class Distances {

  constructor(public http: Http)
  {

  }


  convertDegreesToRadians(degree)
  {
    return degree * (Math.PI / 180);
  }



  calculateDistanceInKilometres(latitudeOne, longitudeOne, latitudeTwo, longitudeTwo)
  {
     let radiusOfEarth          = 6371, // Radius of the earth in km
         degreesLat             = this.convertDegreesToRadians(latitudeTwo - latitudeOne),
         degreesLon             = this.convertDegreesToRadians(longitudeTwo - longitudeOne),
         calculationOne         = Math.sin(degreesLat/2) * Math.sin(degreesLat/2),
         calculationTwo         = Math.cos(this.convertDegreesToRadians(latitudeOne)) * Math.cos(this.convertDegreesToRadians(latitudeTwo)),
         calculationThree       = Math.sin(degreesLon/2) * Math.sin(degreesLon/2),
         sumTotal               = calculationOne + calculationTwo * calculationThree,
         finalSum               = 2 * Math.atan2(Math.sqrt(sumTotal), Math.sqrt(1-sumTotal)),
         actualDistance         = radiusOfEarth * finalSum;

        return actualDistance;
  }

}
```

Even though there are only 2 methods in the provider this is easily the most complex logic required for the nearest store to current location functionality.

The first of these methods - **convertDegreesToRadians** - is used to convert a latitude or longitude coordinate value into a radian to be able to be used to help calculate distances within the **calculateDistanceInKilometres** method:

```
convertDegreesToRadians(degree)
{
   return degree * (Math.PI / 180);
}
```

So why do we need to convert map coordinates to radians instead of being able to directly use the latitude and longitude values?

It all boils down to the math and the numbers required to be able to calculate the distances between different coordinate sets.

This online resource explains in further detail.

The second and final method - **calculateDistanceInKilometres** - accepts the following 4 parameters:

- **latitudeOne** (The user's current latitude)
- **longitudeOne** (The user's current longitude)
- **latitudeTwo** (A latitude coordinate for an Apple Store location)
- **longitudeTwo** (A longitude coordinate for an Apple Store location)

These are then used in a quite complicated mathematical formula within the method - which I'm not even going to try and explain in depth (as, to be honest, I don't fully understand every aspect of the logic myself!) - that involves the use of trigonometric functions to calculate distances between the location coordinates (which have been converted from degrees into radians) while taking into account the curvature of the earth (based on the radius of the planet in kilometres).

Once calculated the distance is then returned by the method:

```
calculateDistanceInKilometres(latitudeOne, longitudeOne, latitudeTwo,
longitudeTwo)
{
   let radiusOfEarth     = 6371, // Radius of the earth in km
```

```
  degreesLat          = this.convertDegreesToRadians(latitudeTwo - latitudeOne),
  degreesLon          = this.convertDegreesToRadians(longitudeTwo - longitudeOne),
  calculationOne      = Math.sin(degreesLat/2) * Math.sin(degreesLat/2),
  calculationTwo      = Math.cos(this.convertDegreesToRadians(latitudeOne)) * Math.cos(this.convertDegreesToRadians(latitudeTwo)),
  calculationThree    = Math.sin(degreesLon/2) * Math.sin(degreesLon/2),
  sumTotal            = calculationOne + calculationTwo * calculationThree,
  finalSum            = 2 * Math.atan2(Math.sqrt(sumTotal), Math.sqrt(1-sumTotal)),
  actualDistance      = radiusOfEarth * finalSum;

  return actualDistance;
}
```

The trigonometry/math for this particular method was derived from something called the Haversine formula which is covered in great detail through this particular online resource.

It’s worth reading this online resource just to get a handle on the logic behind the formula but, unless you’re quite mathematically inclined, don’t expect to find it the easiest of material to spend time trying to digest!

That covers the necessary provider logic for our app but before we progress onto using these in our home page component we need to make them available for use within the app through the following modifications (highlighted in bold) to the **appyMapper/src/app/app.module.ts** file:

```
import { NgModule, ErrorHandler } from '@angular/core';
import { IonicApp, IonicModule, IonicErrorHandler } from 'ionic-angular';
import { MyApp } from './app.component';
import { Database } from '../providers/database';
import { Distances } from '../providers/distances';
import { Files } from '../providers/files';
import { Sanitiser } from '../pipes/sanitiser';
import { HomePage } from '../pages/home/home';

@NgModule({
  declarations: [
    MyApp,
    HomePage,
    Sanitiser
  ],
  imports: [
    IonicModule.forRoot(MyApp)
  ],
  bootstrap: [IonicApp],
  entryComponents: [
    MyApp,
    HomePage
  ],
  providers: [{provide: ErrorHandler, useClass: IonicErrorHandler}, Database,
Distances, Files, Sanitiser]
})
export class AppModule {}
```

The eagle-eyed amongst you may have noticed the addition of a certain pipe in the above code named **Sanitiser**.

This will be used to ‘sanitise’ and trust any HTML tags contained within the parsed locations data that was inserted into the **storeLocations** table from the locations JSON file.

Before we go any further open the **appyMapper/src/pipes/sanitiser.ts** file and implement the following logic to assist with making the HTML input for the store locations data ‘trustworthy’ (amendments highlighted in bold):

```
import { Injectable, Pipe, PipeTransform } from '@angular/core';
import {DomSanitizer, SafeHtml } from '@angular/platform-browser';

@Pipe({
  name: 'sanitiser'
})
@Injectable()
export class Sanitiser implements PipeTransform
{

    constructor(public _sanitise: DomSanitizer)
    {

    }



   transform(v: string)
   {
      return this._sanitise.bypassSecurityTrustHtml(v);
   }

}
```

This is a fairly simple and straightforward script that imports and uses Angular 2's **DomSanitizer** and **SafeHtml** modules to bypass security and trust the string that contains the HTML value which is supplied in the **transform** method.

As we are loading and working with locally imported location data that we know can be trusted use of this pipe won't cause any security issues or concerns.

If, however, we were working with third-party, remote data that was being imported into the app (such as a social media feed) it would be wise, in such a context, to take a much stricter data handling policy.

After all, it’s better to be safe than sorry for the sake of expediency!

With our pipe now completed, saved and, along with the app providers, added to the **appyMapper/src/app/app.module.ts** file we can begin to turn our attention to scripting and bringing together all of the different application logic within our **appyMapper/src/pages/home/home.ts** file (amendments highlighted in bold):

```
import { Component, ViewChild } from '@angular/core';
import { Content,
         NavController,
         Platform,
         ToastController } from 'ionic-angular';
import { Geolocation,
         GoogleMap,
         GoogleMapsAnimation,
         GoogleMapsEvent,
         GoogleMapsLatLng } from 'ionic-native';
import { Database } from '../../providers/database';
import { Distances } from '../../providers/distances';
import { Sanitiser } from '../../pipes/sanitiser';


@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
   @ViewChild(Content) content: Content;

   private coords          : any           = {};
   private europe          : any           = {};
   private map             : GoogleMap;
   private location        : any;
   public allStores        : any;
   public locations              : any;
   public locationsPresent  : any         = false;
   public countries              : any;
   public markers                : any         = [];
   public byCountry              : any;
   public byNearest              : any;
   public displayFilters         : boolean  = false;
   public filtersText            : string      = "Display Filters";
   public summary                : string;


   constructor(public navCtrl              : NavController,
                   public platform           : Platform,
                   public DB                  : Database,
                   public DIST                : Distances,
                   public toastCtrl          : ToastController)
   {

     this.platform.ready().then(() =>
     {

       GoogleMap.isAvailable()
       .then((isAvailable: boolean)=>
       {
         if(!isAvailable)
         {
           console.log('GoogleMap plugin is NOT available');
         }
         else
         {
           console.log('GoogleMap plugin is available');
           Geolocation.getCurrentPosition().then((resp) =>
           {
               this.coords = {
                 lat   : resp.coords.latitude,
                 lng  : resp.coords.longitude
               };

               this.europe = {
                 lat   : '50.537421',
                 lng  : '15.114438'
               };

               this.location = new GoogleMapsLatLng(this.europe.lat, this.
   europe.lng);
               this.map = new GoogleMap('map', {
                 'backgroundColor': 'white',
                 'controls' : {
                   'compass': true,
                   'indoorPicker': true,
                   'zoom': true
                 },
                 'camera': {
                   'latLng': this.location,
                   'tilt': 90,
                   'zoom': 3,
                   'bearing': 0
                 },
                 'gestures': {
                   'scroll': true,
                   'tilt': true,
                   'rotate': true,
                   'zoom': true
                 }
               });
```

```
               this.map.on(GoogleMapsEvent.MAP_READY).subscribe(() =>
               {
                  DB.retrieveStorelocations().then((data) =>
                  {
                     this.allStores   = data;
                     this.locations  = data;
                     this.renderLocations(this.map, this.locations, null, null);
                     this.summary = `${this.locations.length} Apple Stores`;
                  });

                  DB.retrieveCountries().then((data) =>
                  {
                     this.countries = data;
                  });
               });
            })
            .catch((error) =>
            {
               console.dir(error);
            });
         }
      });
   });
}


renderLocations(map, locations, lat = null, lng = null, zoom = null)
{
   let k;

   if(lat !== null && lng !== null && zoom !== null)
   {
      let LOCATIONS = new GoogleMapsLatLng(lat, lng);
```

```
  map.animateCamera({
    'target': LOCATIONS,
    'tilt': 90,
    'zoom': zoom,
    'bearing': 0,
    'duration': 1500
  },
  function()
  {
    console.log("The animation is done");
  });
}

if(locations.length !== 0)
{
  for(k in locations)
  {
    let markerOptions = {
      ‘position’   : new GoogleMapsLatLng( locations[k].lat,
                                             locations[k].lng),
      'title'       : locations[k].name,
      animation : GoogleMapsAnimation.DROP,
      'styles'            : {
        'text-align'     : 'right',
        'color'            : 'grey'
      }
    };
    map.addMarker(markerOptions, this.onMarkerAdded);
  };
  this.locationsPresent = true;
  this.locations             = locations;
}
else
```

```
    {
      let message = "No stores were found for your selected search criteria. Please try a different search.";
      this.storeNotification(message);
      this.locationsPresent =        false;
    }
  }


  renderAllStoreLocations()
  {
    this.scrollToTopOfScreen();
    this.removeMapMarkers();
    this.locations                         = this.allStores;
    let zoom                               = 3;

    this.renderLocations(this.map,
                          this.locations,
                          this.europe.lat, this.europe.lng, zoom);
    this.displayLocationFilters();
    this.summary = `${this.locations.length} Apple Stores`;
  }


  renderLocationsByCountry(id)
  {
    let j,
       k,
       stores     = [],
       country,
       lat,
       lng,
       zoom,
     num        = Number(id);
  for(k in this.countries)
  {
    if(num === this.countries[k].id)
    {
      country   = this.countries[k].country;
      lat       = this.countries[k].lat;
      lng       = this.countries[k].lng;
      zoom      = this.countries[k].zoom;
    }
  }

  for(j in this.allStores)
  {
    if(num === this.allStores[j].country)
    {
      stores.push({
        id            : this.allStores[j].id,
        country       : this.allStores[j].country,
        name          : this.allStores[j].name,
        address       : this.allStores[j].address,
        lat           : this.allStores[j].lat,
        lng           : this.allStores[j].lng,
        zoom          : this.allStores[j].zoom,
        isFavourite   : this.allStores[j].isFavourite
      });
    }
  }
  this.renderLocations(this.map, stores, lat, lng, zoom);
  this.summary = `${country} - ${this.locations.length} Apple Stores`;
}
```

```
onMarkerAdded(marker)
{
  this.markers.push(marker);
}


removeMapMarkers()
{
  this.markers.length = 0;
  this.map.clear();
}


filterLocationsByCountry(byCountry)
{
  this.removeMapMarkers();
  this.scrollToTopOfScreen();
  this.renderLocationsByCountry(byCountry);
  this.displayLocationFilters();
}


filterLocationsByNearest(byNearest)
{
  this.removeMapMarkers();
  this.scrollToTopOfScreen();
  this.determineNearestLocations(byNearest);
  this.displayLocationFilters();
}


determineNearestLocations(range)
{
```

```
let j,
currentGeoLat          =     this.coords.lat,
currentGeoLng          =     this.coords.lng,
stores                 =     [],
rangeToSearch          =     Number(range),
zoom                   =     4;

for(j in this.allStores)
{
  var storeLat         =     this.allStores[j].lat,
      storeLng         =     this.allStores[j].lng,
      distance         =     this.DIST.calculateDistanceInKilometres(
                                   currentGeoLat,
                                   currentGeoLng,
                                   storeLat,
                                   storeLng);

  if(distance <= rangeToSearch)
  {
    stores.push({
      id            : this.allStores[j].id,
      country       : this.allStores[j].country,
      name          : this.allStores[j].name,
      address       : this.allStores[j].address,
      lat           : this.allStores[j].lat,
      lng           : this.allStores[j].lng,
      zoom          : this.allStores[j].zoom,
      isFavourite   : this.allStores[j].isFavourite,
      distance    : distance
    });
  }
}
```

```
    this.renderLocations(this.map,
                         stores,
                         currentGeoLat,
                         currentGeoLng,
                         zoom);
    this.summary = `${stores.length} Apple Stores found within ${rangeToSearch} Km of your location`;
  }



  scrollTheScreen()
  {
    this.content.scrollTo(0, 300, 750);
  }



  scrollToTopOfScreen()
  {
    this.content.scrollTo(0, 0, 750);
  }

  storeNotification(message)  : void
  {
    let notification = this.toastCtrl.create({
      message          : message,
      duration         : 3000
    });
    notification.present();
  }



  displayLocationFilters()
  {
    this.scrollTheScreen();
    this.displayFilters                  = !this.displayFilters;
    if(this.displayFilters)
    {
      this.filtersText                  = "Hide these filters";
    }
    else
    {
      this.filtersText                 = "Display Filters";
    }
  }

}
```

As you can see with the **appyMapper/src/pages/home/home.ts** script there's quite a lot going on! As we did with the providers let's go over each section in more detail so we have a complete understanding of what the script is designed to do.

As with all TypeScript classes we begin by importing the necessary modules for our application logic, in particular, the **GoogleMap** related modules and our custom providers and pipes.

We then use the **ViewChild** annotation, within the **HomePage** class, to configure the script to be able to access the Ionic 2 **Content** component and its methods.

Following from this a range of private and public properties are then defined that will be used to work with data, Ionic native plugins and Ionic 2 UI components:

```
import { Component, ViewChild } from '@angular/core';
import { Content,
         NavController,
         Platform,
         ToastController } from 'ionic-angular';
import { Geolocation,
         GoogleMap,
         GoogleMapsAnimation,
         GoogleMapsEvent,
         GoogleMapsLatLng } from 'ionic-native';
import { Database } from '../../providers/database';
import { Distances } from '../../providers/distances';
import { Sanitiser } from '../../pipes/sanitiser';


@Component({
  selector: 'page-home',
  templateUrl: 'home.html'
})
export class HomePage {
   @ViewChild(Content) content: Content;

   private coords           : any         = {};
   private europe           : any         = {};
   private map              : GoogleMap;
   private location         : any;
   public allStores         : any;
   public locations         : any;
   public locationsPresent  : any         = false;
   public countries         : any;
   public markers           : any         = [];
   public byCountry         : any;
   public byNearest         : any;
   public displayFilters    : boolean     = false;
   public filtersText       : string      = "Display Filters";
   public summary           : string;
```

We then pass the names of selected modules into the class constructor using these to initialise properties for our database and distances providers, as well as the Ionic 2 **ToastController** component.

Within the constructor we then implement the **platform.ready** method to ensure that calls to the **GoogleMap** plugin methods are able to be executed once the platform has loaded and is able to be accessed.

The **GoogleMap** plugin performs a conditional check using the **isAvailable** method to determine whether the plugin is able to be accessed or not.

If the **GoogleMap** plugin is able to be accessed then the user’s current geolocation position is captured, coordinates for the European continent are defined and supplied to create a new GoogleMap instance and, once the GoogleMap has been successfully initialised and is ready for use, the **DB.retrieveStorelocations()** and **DB.retrieveCountries** methods are called to return the required data to power the app with:

```
this.platform.ready().then(() =>
{

   GoogleMap.isAvailable()
   .then((isAvailable: boolean)=>
   {
      if(!isAvailable)
      {
         console.log('GoogleMap plugin is NOT available');
      }
      else
      {
         console.log('GoogleMap plugin is available');
         Geolocation.getCurrentPosition().then((resp) =>
         {
            this.coords = {
               lat      : resp.coords.latitude,
               lng      : resp.coords.longitude
            };

            this.europe = {
```

```
    lat        : '50.537421',
    lng        : '15.114438'
  };

  this.location = new GoogleMapsLatLng(this.europe.lat,
                                             this.europe.lng);
  this.map = new GoogleMap('map', {
    'backgroundColor': 'white',
    'controls' : {
    'compass': true,
    'indoorPicker': true,
    'zoom': true
  },
  'camera': {
    'latLng': this.location,
    'tilt': 90,
    'zoom': 3,
    'bearing': 0
  },
  'gestures': {
    'scroll': true,
    'tilt': true,
    'rotate': true,
    'zoom': true
  }
});

this.map.on(GoogleMapsEvent.MAP_READY).subscribe(() =>
{
  DB.retrieveStorelocations().then((data) =>
  {
    this.allStores   = data;
    this.locations  = data;
    this.renderLocations(this.map, this.locations, null, null);
```

```
          this.summary = `${this.locations.length} Apple Stores`;
        });

        DB.retrieveCountries().then((data) =>
        {
          this.countries = data;
        });
      });
    })
    .catch((error) =>
    {
      console.dir(error);
    });
    }
  });
});
```

The **renderLocations** method is used to render map markers to the **GoogleMap** instance that display the locations for the Apple Stores retrieved from the supplied data set.

A conditional check is performed within the method to determine whether or not map latitude, longitude and zoom supplied parameters have been provided.

If they have the **GoogleMap** instance is positioned to the supplied coordinate values (which will be the case when the user filters locations by country or nearest stores to their current geographical location).

If no store locations were supplied to the method the user is informed of the fact through the **storeNotification** method and a boolean value of false is set for the **locationsPresent** property which is used to hide any previous store listings from being displayed on the HTML template underneath the **GoogleMap** instance:

```
renderLocations(map, locations, lat = null, lng = null, zoom = null)
{
   let k;

   if(lat !== null && lng !== null && zoom !== null)
   {
      let LOCATIONS = new GoogleMapsLatLng(lat, lng);
      map.animateCamera({
         'target': LOCATIONS,
         'tilt': 90,
         'zoom': zoom,
         'bearing': 0,
         'duration': 1500
      },
      function()
      {
         console.log("The animation is done");
      });
   }

   if(locations.length !== 0)
   {
      for(k in locations)
      {
         let markerOptions = {
            'position'    : new GoogleMapsLatLng( locations[k].lat,
                                                  locations[k].lng),
            'title'       : locations[k].name,
            animation     : GoogleMapsAnimation.DROP,
            'styles'      : {
               'text-align' : 'right',
               'color'      : 'grey'
            }
      };
      map.addMarker(markerOptions, this.onMarkerAdded);
    };
    this.locationsPresent   = true;
    this.locations          = locations;
  }
  else
  {
    let message = "No stores were found for your selected search criteria.
Please try a different search.";
    this.storeNotification(message);
    this.locationsPresent   =      false;
  }
}
```

The **renderAllStoreLocations** method, as the name implies, is used to render all Apple Store locations from the loaded data set.

This method would only be triggered once a user has pressed the **Display ALL Stores** button situated in the location filters section of the HTML template.

Once pressed the method scrolls the page back towards the top of the screen to ensure the map is displayed to the user, removes all current map markers, calls the **renderLocations** method (supplying latitude, longitude and zoom values as method parameters), hides the display of the location filters and updates the text beneath the **GoogleMap** instance on the page:

```
renderAllStoreLocations()
{
  this.scrollToTopOfScreen();
  this.removeMapMarkers();
  this.locations                  = this.allStores;
  let zoom                        = 3;
```

```
   this.renderLocations(this.map,
   this.locations,
   this.europe.lat, this.europe.lng, zoom);
   this.displayLocationFilters();
   this.summary = `${this.locations.length} Apple Stores`;
}
```

Following from this the **renderLocationsByCountry** method defines the logic for filtering Apple Store locations based on the supplied country ID value.

As countries matching the supplied ID are found these are pushed into an array which, upon completion, are passed to the **renderLocations** method, along with the necessary country specific latitude, longitude and zoom values, to show only Apple Store locations for that country on the **GoogleMap** instance:

```
renderLocationsByCountry(id)
{
   let j,
       k,
       stores       = [],
       country,
       lat,
       lng,
       zoom,
       num   = Number(id);
   for(k in this.countries)
   {
      if(num === this.countries[k].id)
      {
         country      = this.countries[k].country;
         lat          = this.countries[k].lat;
         lng          = this.countries[k].lng;
         zoom         = this.countries[k].zoom;
      }
```

```
  }

  for(j in this.allStores)
  {
    if(num === this.allStores[j].country)
    {
      stores.push({
        id                : this.allStores[j].id,
        country           : this.allStores[j].country,
        name              : this.allStores[j].name,
        address           : this.allStores[j].address,
        lat               : this.allStores[j].lat,
        lng               : this.allStores[j].lng,
        zoom              : this.allStores[j].zoom,
        isFavourite       : this.allStores[j].isFavourite
      });
    }
  }
  this.renderLocations(this.map, stores, lat, lng, zoom);
  this.summary = `${country} - ${this.locations.length} Apple Stores`;
}
```

Methods to handle the addition and removal of map markers are defined shortly afterwards:

```
onMarkerAdded(marker)
{
  this.markers.push(marker);
}

removeMapMarkers()
{
  this.markers.length = 0;
```

```
   this.map.clear();
}
```

The **filterLocationsByCountry** method is defined next which is used to clear the map of currently displayed Apple Store locations, scrolls the page back to the top of the screen, passes the supplied country value to the **renderLocationsByCountry** method and subsequently handles hiding the display of the locations filters on the HTML template through the **displayLocationFilters** method:

```
filterLocationsByCountry(byCountry)
{
   this.removeMapMarkers();
   this.scrollToTopOfScreen();
   this.renderLocationsByCountry(byCountry);
   this.displayLocationFilters();
}
```

Similarly the **filterLocationsByNearest** method performs exactly the same function with one major difference: store locations are filtered by those nearest to the user's current geographical location using the **determineNearestLocations** which accepts a single parameter - the range in kilometres that the user wants to search within.

```
filterLocationsByNearest(byNearest)
{
   this.removeMapMarkers();
   this.scrollToTopOfScreen();
   this.determineNearestLocations(byNearest);
   this.displayLocationFilters();
}
```

The **determineNearestLocations** method handles the logic for filtering through all of the imported European Apple Store locations to determine, using the **Distances** provider's **calculateDistanceInKilometres** method, which Apple stores fall within the range specified by the user based on their supplied geographical location.

Stores that meet the search criteria are pushed into a **stores** object which, once all matching locations have been found, is then supplied as one of the parameters for the **renderLocations** method (along with the user’s current geolocation coordinates), to display those store locations on both the **GoogleMap** instance and in the store listings underneath the map:

```
determineNearestLocations(range)
{
  let j,
      currentGeoLat          =     this.coords.lat,
      currentGeoLng          =     this.coords.lng,
      stores                 =     [],
      rangeToSearch          =     Number(range),
      zoom                   =     4;

  for(j in this.allStores)
  {
    var storeLat             =     this.allStores[j].lat,
         storeLng            =     this.allStores[j].lng,
         distance            =     this.DIST.calculateDistanceInKilometres(
                                           currentGeoLat,
                                           currentGeoLng,
                                           storeLat,
                                           storeLng);

    if(distance <= rangeToSearch)
    {
      stores.push({
        id        : this.allStores[j].id,
        country   : this.allStores[j].country,
        name      : this.allStores[j].name,
        address   : this.allStores[j].address,
        lat       : this.allStores[j].lat,
        lng       : this.allStores[j].lng,
        zoom           : this.allStores[j].zoom,
        isFavourite    : this.allStores[j].isFavourite,
        distance       : distance
      });
    }
  }

  this.renderLocations(this.map,
                       stores,
                       currentGeoLat,
                       currentGeoLng,
                       zoom);
  this.summary = `${stores.length} Apple Stores found within ${rangeTo-
Search} Km of your location`;
}
```

Following this methods for scrolling the page to specific positions on the screen are defined:

```
scrollTheScreen()
{
  this.content.scrollTo(0, 300, 750);
}



scrollToTopOfScreen()
{
  this.content.scrollTo(0, 0, 750);
}
```

Along with the **storeNotification** method which provides the user with a supplied message, to be displayed at the bottom of the screen for a maximum of 3 seconds, using the Ionic 2 **ToastController** component:

```
storeNotification(message)  : void
{
  let notification = this.toastCtrl.create({
      message           : message,
      duration          : 3000
  });
  notification.present();
}
```

Finally the **displayLocationFilters**, as the name suggests, handles the display of the location filters in the HTML template along with the text for the button handling the display/non-display of those filters:

```
displayLocationFilters()
{
  this.scrollTheScreen();
  this.displayFilters           = !this.displayFilters;
  if(this.displayFilters)
  {
    this.filtersText            = "Hide these filters";
  }
  else
  {
    this.filtersText            = "Display Filters";
  }
}
```

So that pretty much concludes the logic driving the app functionality.

Hopefully you get a good idea of how this is used to implement features such as filtering Apple Store locations by country or those nearest to a user's current geolocation coordinates - now let's take a look at the HTML used in the home page component's template.

HTML

Open the **appyMapper/src/pages/home/home.html** template and make the following amendments (highlighted in bold):

```
<ion-header>
  <ion-navbar>
    <ion-title>
      Appy Mapper
    </ion-title>
  </ion-navbar>
</ion-header>

<ion-content>

   <div id="map"></div>
   <span class="map-information">{{ summary }}</span>

   <ion-card>

      <ion-card-header>
         <button
            ion-button
            color="primary"
            text-align
            block
            (click)="displayLocationFilters()">{{ filtersText }}</button>
      </ion-card-header>

      <div *ngIf="displayFilters" padding>
         <ion-segment [(ngModel)]="filters">
         <ion-segment-button value="country">
            Country
         </ion-segment-button>
         <ion-segment-button value="byNearest">
  Nearest
</ion-segment-button>
</ion-segment>

<div class="filters" [ngSwitch]="filters">

  <ion-list>
    <ion-item *ngSwitchCase="'country'">
      <ion-label>Country</ion-label>
      <ion-select
        [(ngModel)]="byCountry"
        (ionChange)="filterLocationsByCountry(byCountry)">
        <ion-option>Select a country...</ion-option>
        <ion-option
          *ngFor="let country of countries"
          value="{{ country.id }}">{{ country.country }}</ion-option>
      </ion-select>
    </ion-item>


    <ion-item *ngSwitchCase="'byNearest'">
      <ion-label>Nearest store to me:</ion-label>
      <ion-select
        [(ngModel)]="byNearest"
        (ionChange)="filterLocationsByNearest(byNearest)">
        <ion-option value="50">50 Miles</ion-option>
        <ion-option value="100">100 Miles</ion-option>
        <ion-option value="250">250 Miles</ion-option>
        <ion-option value="500">500 Miles</ion-option>
        <ion-option value="1000">1000 Miles</ion-option>
      </ion-select>
    </ion-item>
  </ion-list>
</div>
```

```
  <button class="reset"
    ion-button
    color="secondary"
    text-align
    block
    (click)="renderAllStoreLocations()">Display ALL Stores</button>
  </div>

</ion-card>

<div *ngIf="locationsPresent">

  <ion-card *ngFor="let location of locations">
    <ion-card-header>
      <ion-item class="heading">
        <ion-icon ios="logo-apple"
          md="logo-apple"
          item-left></ion-icon>
        <h2>{{ location.name }}</h2>
      </ion-item>
    </ion-card-header>
    <ion-card-content>
      <div
        class="location-address"
        [innerHTML]="location.address | sanitiser"></div>
    </ion-card-content>
  </ion-card>

  <button
    ion-button
    color="secondary"
    text-align
    block
```

```
        (click)="scrollToTopOfScreen()">Back to Top</button>
     </div>

</ion-content>
```

That’s a lot of HTML so let’s break this down section-by-section.

Firstly we define the HTML area for the map and the location summary displayed underneath the map:

```
<div id="map"></div>
<span class="map-information">{{ summary }}</span>
```

We then create the button to operate displaying/hiding the filters for the Apple Store Locations using the **displayLocationFilters** click event:

```
<ion-card-header>
  <button
    ion-button
    color="primary"
    text-align
    block
    (click)="displayLocationFilters()">{{ filtersText }}</button>
</ion-card-header>
```

The filters, consisting of by European country and by stores nearest to the user’s current geolocation, are operated through buttons situated within **<ion-segment>** components.

Each filter is displayed using an **ngSwitch** directive which uses the value from the button within the **<ion-segment>** to determine what is/isn’t activated on the page.

When a selection is made with either filter the attached **ionChange** event triggers a function call which accepts the selected value retrieved from the ngModel for that particular filter.

The final filter, used to display All Apple Store locations through the attached click event calling the **renderAllStoreLocations** method, is situated underneath all other filters in its own block level button.

The buttons to operate the filters, along with the filters themselves, are contained within an **ngIf** directive whose value determines whether or not they are displayed on the page:

```
<div *ngIf="displayFilters" padding>
  <ion-segment [(ngModel)]="filters">
    <ion-segment-button value="country">
      Country
    </ion-segment-button>
    <ion-segment-button value="byNearest">
      Nearest
    </ion-segment-button>
  </ion-segment>

  <div class="filters" [ngSwitch]="filters">

    <ion-list>
      <ion-item *ngSwitchCase="'country'">
        <ion-label>Country</ion-label>
        <ion-select
          [(ngModel)]="byCountry"
          (ionChange)="filterLocationsByCountry(byCountry)">
          <ion-option>Select a country...</ion-option>
          <ion-option
            *ngFor="let country of countries"
            value="{{ country.id }}">{{ country.country }}</ion-option>
        </ion-select>
      </ion-item>

      <ion-item *ngSwitchCase="'byNearest'">
```

```
        <ion-label>Nearest store to me:</ion-label>
        <ion-select
          [(ngModel)]="byNearest"
          (ionChange)="filterLocationsByNearest(byNearest)">
          <ion-option value="50">50 Miles</ion-option>
          <ion-option value="100">100 Miles</ion-option>
          <ion-option value="250">250 Miles</ion-option>
          <ion-option value="500">500 Miles</ion-option>
          <ion-option value="1000">1000 Miles</ion-option>
        </ion-select>
      </ion-item>
    </ion-list>
  </div>

  <button class="reset"
    ion-button
    color="secondary"
    text-align
    block
    (click)="renderAllStoreLocations()">Display ALL Stores</button>

</div>
```

Underneath the filters the final section of the page HTML is used to display a list of the locations displayed on the GoogleMap instance followed by a block level button to allow the user to scroll back to the top of the screen by triggering the attached click event for the **scrollToTopOfScreen** method.

Notice in the **ngFor** loop, where the location details are being iterated through and rendered into **<ion-card>** components, the use of the **sanitiser** class appended as a pipe to the value of the innerHTML property for the location address?

This is where the pipe that we created earlier for sanitising HTML output is finally used!

All of the locations output being rendered into **<ion-card>** components is wrapped within an **ngIf** directive that relies on the value of the **locationsPresent** property to determine whether or not to display the rendered locations.

This conditional directive is useful where a nearest location search has retrieved no store locations yet the content area still displays those store locations that were rendered to the page prior to the nearest locations filter being activated:

```
<div *ngIf="locationsPresent">

  <ion-card *ngFor="let location of locations">
    <ion-card-header>
      <ion-item class="heading">
        <ion-icon ios="logo-apple"
          md="logo-apple"
          item-left></ion-icon>
        <h2>{{ location.name }}</h2>
      </ion-item>
    </ion-card-header>
    <ion-card-content>
      <div
        class="location-address"
        [innerHTML]="location.address | sanitiser"></div>
    </ion-card-content>
  </ion-card>

  <button
    ion-button
    color="secondary"
    text-align
    block
    (click)="scrollToTopOfScreen()">Back to Top</button>

</div>
```

CSS

The final area we need to cover will be the styling for the appyMapper project.

Thankfully this is a relatively small task consisting of a handful of lines added solely to the **appyMapper/src/pages/home/home.scss** file (amendments highlighted in bold):

```
page-home {

  #map {
    height: 60%;
    width: 95%;
    margin: 2.5%;
  }

  .map-information {
    display: block;
    font-size: 1.1em;
    padding-bottom: 0 0 1.5em 0;
    margin: 0 0 0 2.5%;
  }

  .filters,
  .reset {
    margin: 25px 0 0 0;
  }

  .heading {
    font-weight: bold;
  }

  .location-address {
    padding: 0 0 1em 0;
    line-height: 1.4em;
    font-size: 1.1em;
  }
}

ion-app.gmapscdv_ .nav-decor,
._gmaps_cdv_,
.nav-decor{
  background-color: rgba(0, 0, 0, 0) !important;
}
```

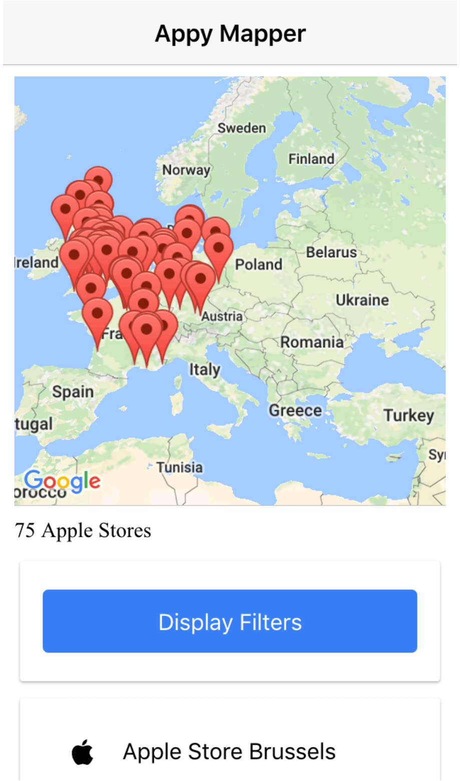
There’s nothing complicated or involved here, just some straightforward custom style rules for assisting with rendering certain aspects of the app UI as well as the addition of a familiar looking style rule from the Plugins chapter which helps overcome any potential issues with the Google Map not rendering properly.

With the styling now implemented let’s take a few moments to celebrate our hard work by building, running and finally previewing the completed app!

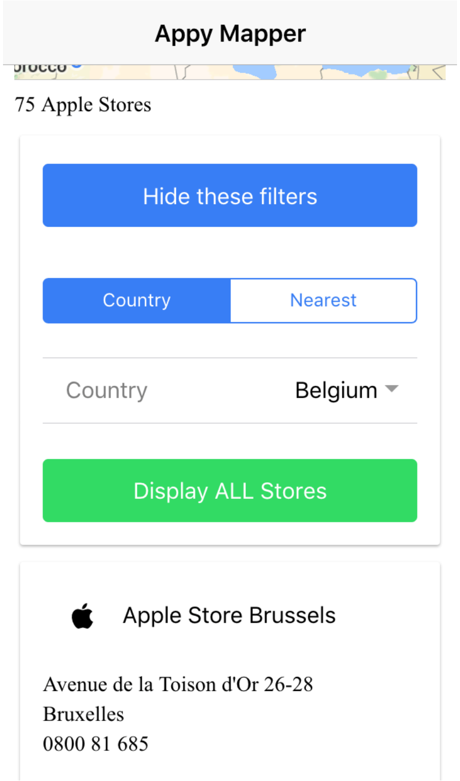
Connect your handheld device to the computer and using the Ionic CLI run the following commands (substituting android for iOS if you happen to be developing for that platform) - you know the drill by now!

```
ionic prepare ios && ionic build ios
ionic run ios --device
```

All things being well (and always assuming no mistakes were made with the coding!) you should be greeted by a fully functioning app allowing you to play with and explore the different features that it offers as demonstrated in the screen captures on the following page:



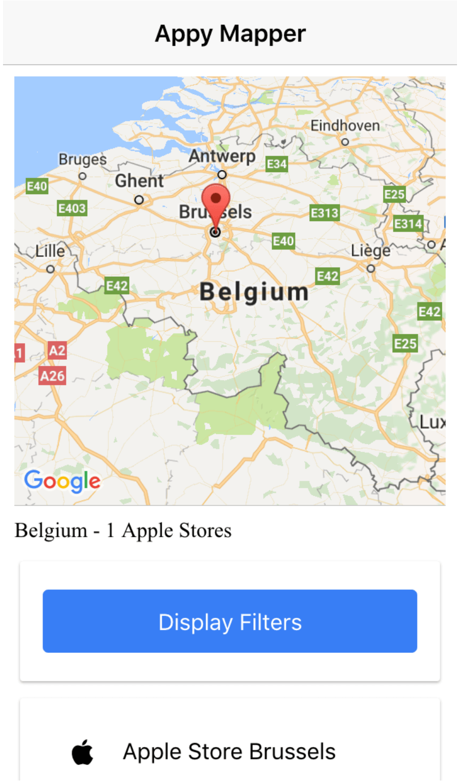
75 Apple Stores



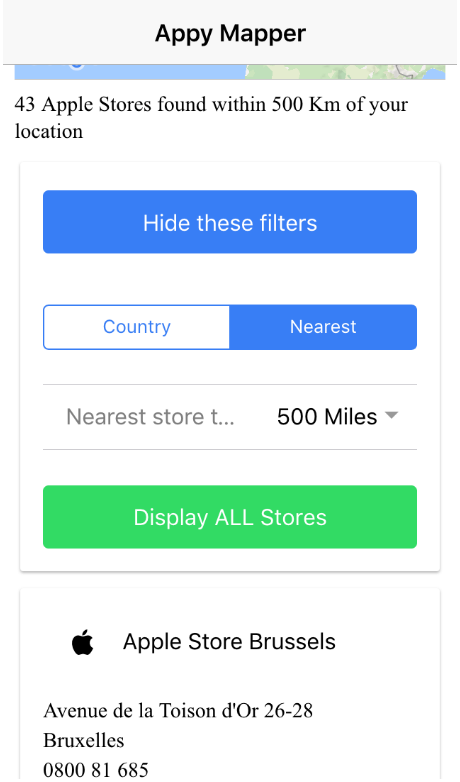
75 Apple Stores

Country Belgium

Avenue de la Toison d'Or 26-28
Bruxelles
0800 81 685



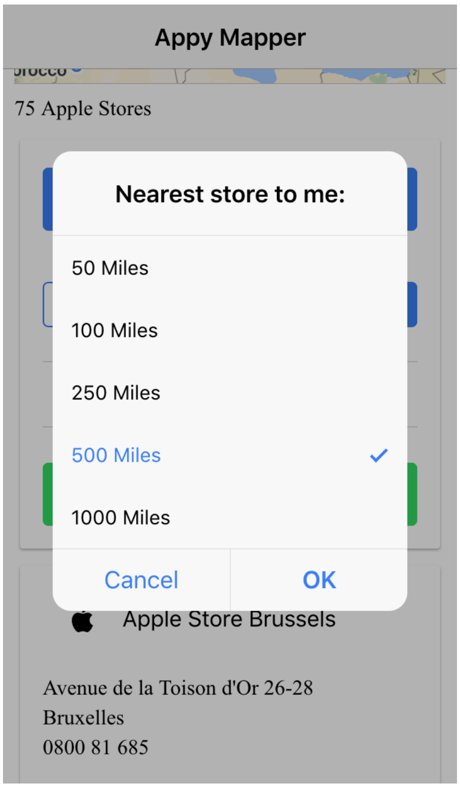
Belgium - 1 Apple Stores



43 Apple Stores found within 500 Km of your location

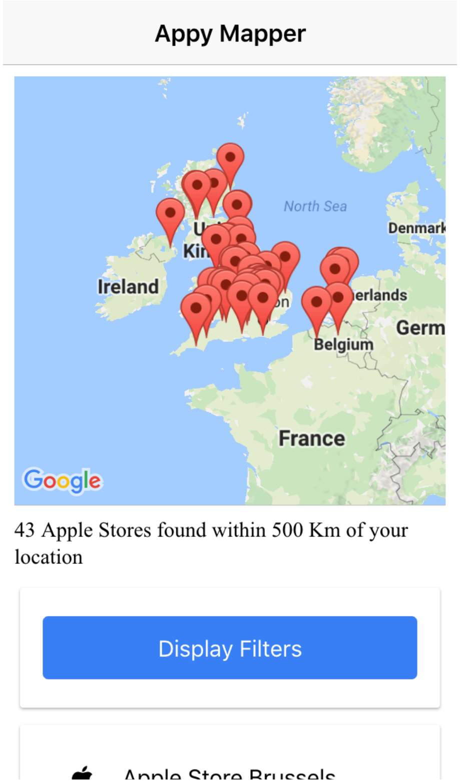
Nearest store t... 500 Miles

Avenue de la Toison d'Or 26-28
Bruxelles
0800 81 685



75 Apple Stores

Avenue de la Toison d'Or 26-28
Bruxelles
0800 81 685



43 Apple Stores found within 500 Km of your location

If you’re able to interact with the app and see the above screens (okay - your results may differ for the Nearest store to me functionality!) then congratulations!

Now for the last remaining step in completing our third and final case study.

Finishing touches

As in previous case studies there's one final addition we need to make before we can consider the app completed - implementing the necessary launch icon and splash screen images for the iOS and Android directories located in the following directory: **/appyMapper/resources**.

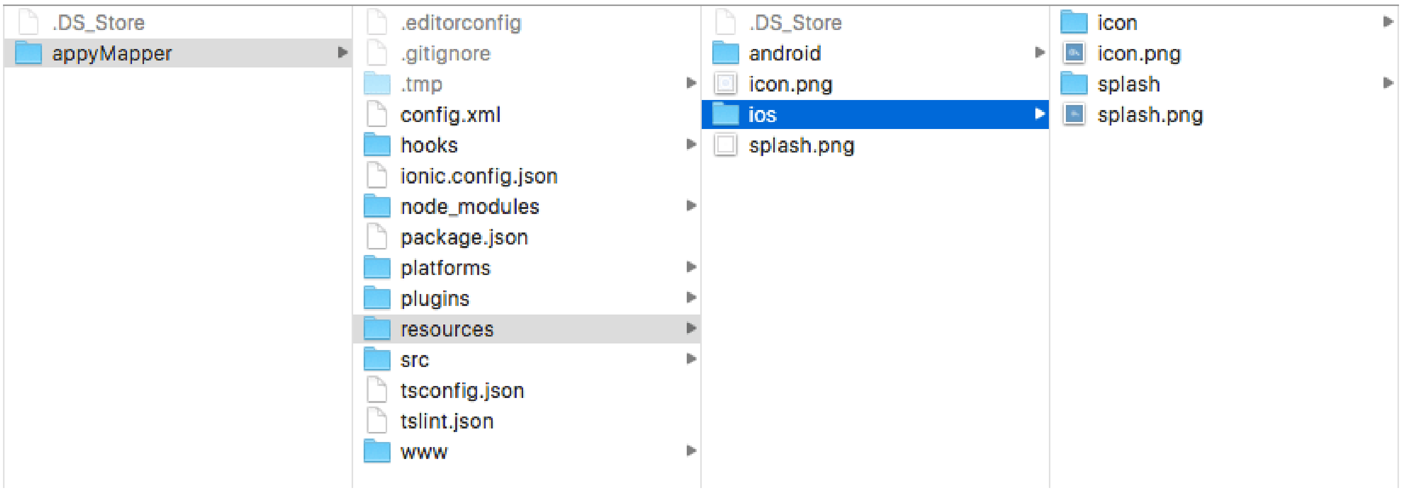
Without these our app will use the default Apache Cordova images which seems a little lazy after all the work we've put in during this case study.

Before proceeding though you'll need to download the files for this case study from the following link: http://tinyurl.com/j3yjqbo (if you haven't done so already).

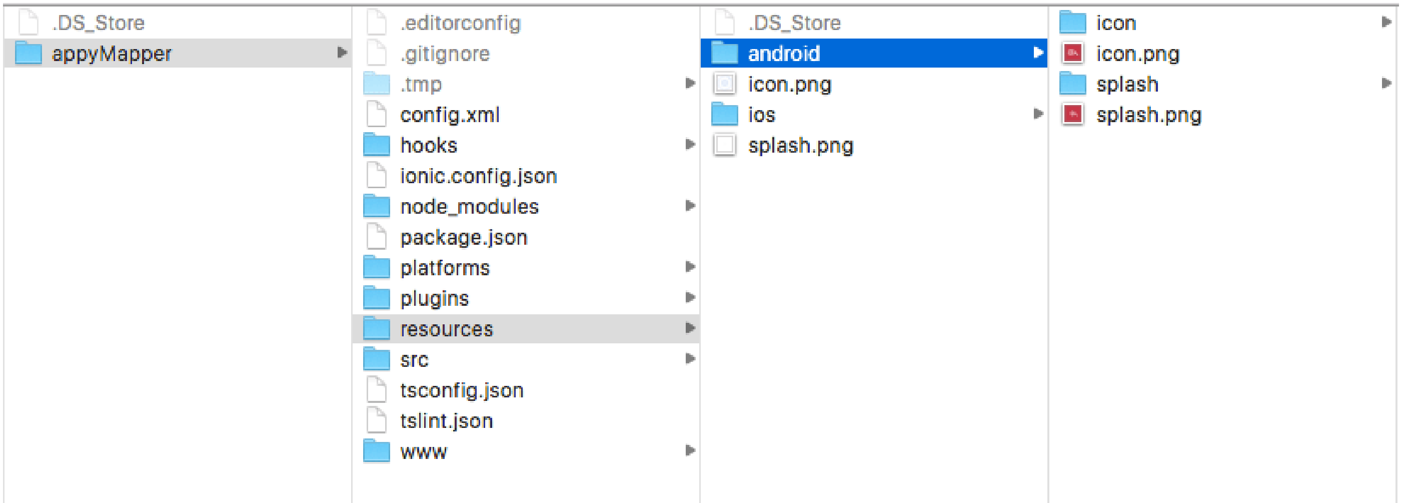
Having done this copy both the **icon.png** and **splash.png** files from the following locations in the downloaded project files directory:

- **appyMapper/resources/android**
- **appyMapper/resources/ios**

And then paste these into the matching directories in your own appyMapper project, beginning with the iOS launch and splash images:



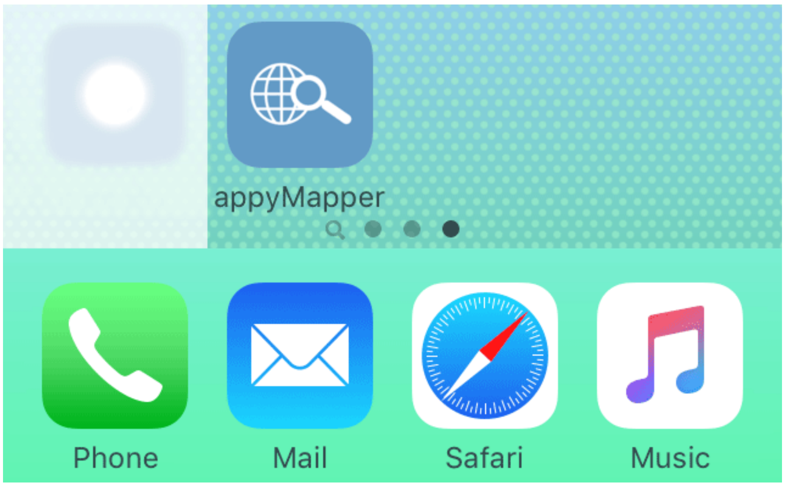
We then do the same for the android sub-directory:

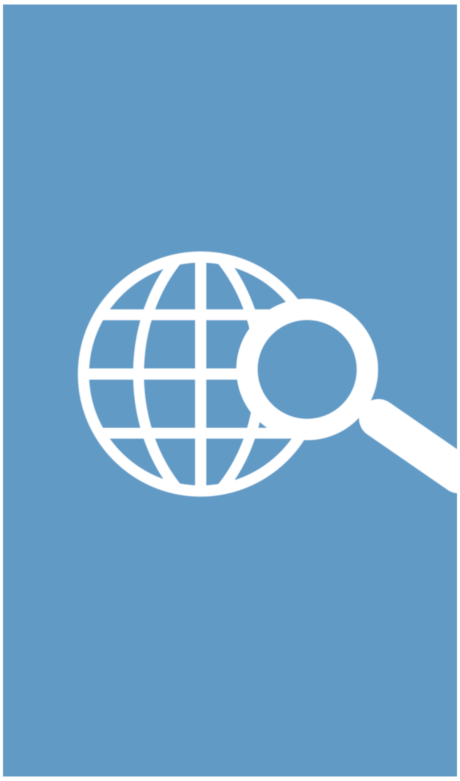


With our respective launch icon and splash screen templates in place for iOS and Android we can now generate the images to be used for these platforms using the following Ionic CLI command (as always - ensure you are at the root of the appyMapper project directory before running such commands):

```
ionic resources
```

Once the command has finished processing you should see the different launch icon and splash screen sizes being generated from the supplied template images which, when our app is published to a mobile device, should give us something like the following:





And, with that, you've successfully completed the third and final case study for this book!

Give yourself a round of applause for all the time, effort and hard work you've put in to get to this stage.

Not only does this concludes the third and final case study but also the material for Mastering Ionic 2.

There's been a lot to take in and I hope you've had fun consolidating your learning with working on these case studies and find something useful to take into your own projects.

Resources
All project files for this chapter can be found listed in the download links on page 636.

In closing...

Once again thanks for making the decision to purchase Mastering Ionic 2.

You've covered a lot of topics throughout this book including, but not limited to: core technologies, classes & decorators, components, templates, theming, plugins, code signing and submitting your iOS & Android apps to their respective App Stores.

That's a lot of material to get through and I hope that you've managed to learn some new and useful concepts and techniques along the way that will help inform your app development going forwards.

Let me know if there's anything that you felt wasn't covered in the book and/or could be improved upon - especially if there are any errors in the spelling and/or code samples (even the most diligent of eyes don't always catch a mistake!)

I'd love to know what readers think of the book so please feel free to share your thoughts, comments, suggestions and any feedback that you may have through the following e-mail address: support@masteringionic2.com.

Alternatively you can visit masteringionic2.com to sign up to the mailing list for book updates (which I would strongly encourage you to do just to ensure the book's content is kept up to date - please note that I don't spam or share your details with others....I promise!) as well as access to blog articles and related Ionic 2 resources.

Happy coding and....I look forward to hearing from you shortly!

Finding himself drawn to the web design industry shortly after the dot com bubble collapse James Griffiths has been designing/developing websites for over 14 years and mobile/tablet apps for 5 years for a range of clients including Virgin Media, Shelter, Evans Cycles, EDF Energy, Rated People & the British Science Association.

His business website: Saints at Play provides a range of digital products & services as well as sharing hundreds of freely available articles on web/mobile development technologies and processes.

When not working on websites/apps, writing e-books and researching web based technologies James enjoys spending time reading, studying history, making sculpture, listening to podcasts and trying to spend as much time in nature as possible.

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Code samples

Project code featured throughout the pages of this book is able to be downloaded, in the form of zip files, on a chapter by chapter basis, as indicated in the table below:

Animations	http://tinyurl.com/gs5m99e
Data Storage	http://tinyurl.com/hatfzvf
Documenting your code	http://tinyurl.com/zepjcey
Forms & Data Input	http://tinyurl.com/jxo3t8k
Navigation	http://tinyurl.com/h3wjv8p
Plugins	http://tinyurl.com/jf8bf2y
Preparing Apps for release	http://tinyurl.com/jz9pjjq
Templates	http://tinyurl.com/j34mueb
Testing & Profiling Apps	http://tinyurl.com/hpz7j7a
Case Study #1	http://tinyurl.com/jxc5wcn

Case Study #2	http://tinyurl.com/gwnamma
Case Study #3	http://tinyurl.com/j3yjqbo