CS415, Human Computer Interactive Systems

Course Description: This course is an introduction to human computer interaction, graphical user interfaces, interactive systems and devices, use of user interface builder tools, methods and general interaction methods ranging from command line interfaces to more advanced methods of interaction in two and three dimensions. The course assumes proficient C/C++ programming skills.

Goals: The purpose of this course is to introduce students to tools, methods, and theory of human computer interaction. The course familiarizes students with 2D and 3D interaction interfaces that are found in a wide range of applications from scientific visualization, to avionics and intelligent transportation, to more commonly found mobile and tablet 2D user interfaces and command lines. The student will learn how to use libraries and tools to build user interfaces, graphic visualization and image processing applications commonly found in interactive systems using C/C++ as well as scripting languages for rapid prototyping of interactive applications.

Textbook: Human-Computer Interaction, 3rd Edition, (ISBN-10 0130461091, ISBN-13 9780130461094), <u>Amazon</u>, <u>Companion Materials</u>

<u>Weekly Syllabus [Please Consult Canvas for all Assignment Due Dates]</u>

Week-1 [8/28, 8/30]: Introduction, Discussion of Lab Platforms (Intel NUC and Embedded Jetson)

> **Read: HCI, Part-1, Chapters 1 & 2**
>
> **Lecture: Human Senses Used in Computing (Visual Tri-stimulus, Audio, Tactile, Proprioception, Vestibular, Chronoception), not all from the basic 5 senses (see, touch, smell, taste, hear)**
>
> **Activity-1: Log into Intel NUC, verify and tailor your account, change your password from default (choose 2 or 3 of your favorite systems, each is independently setup)**
>
> **Demonstration: OpenCV Machine Vision & Driver Assistant / Self-driving**
>
> **Start Assignment #1**

Week-2 [9/4, 9/6]:

> **Read: HCI, Part-1, Chapter 3**
>
> **Lecture: Historical Computer Interaction Devices, Interactive Systems, Ergonomics**
>
> **Lecture: Human Perception Related to HCI**
>
> **<u>Minute Paper-1</u>: What Causes Humans to Miss the Obvious in Visual Scenes? (see examples on p.21 of our text)**
>
> **Activity Follow-Up: Issues with Lab system**

Week-3 [9/11, 9/13]:

    Read: HCI, Part-1, Chapter 4

    Lecture: Interactive System Architectures – Time Share, Server CLI, PC Mouse/Bitmap, Mobile, Cloud, Embedded

    Activity-2: Modeling with state machines and state-transition tables

    Start Assignment #2

Week-4 [9/18, 9/20]:

    Read: HCI, Part-2, Chapter 5

    Lecture: Beyond WIMP (3D) and HCI Design Process, Introduction

    <u>Minute Paper-2</u>: GUI Builders, Libraries, and Code-Generation – What are Issues with GUI development?

    Activity Follow-Up: Issues with Jetson Lab, grahpics, use during Assignment #2?

    QUIZ - Part-1 on Foundations (Chapters 1-4), Discuss Quiz Solutions

Week-5 [9/25, 9/27]:

    Read: HCI, Part-2, Chapter 6

    Lecture: HCI Development – Interaction, Visualization and Graphics

    <u>Minute Paper-3</u>: What new Interactive Devices may revolutionize HCI?

    Activity-3: Run OpenCV and Jetson example code as requested in class

    Start Assignment #3

Week-6 [10/2, 10/4]:

    Read: HCI, Part-2, Chapter 7 & 8

    Lecture: Interactive System Design Rules and Implementation

    Lecture: Adherence to Design Rules, Guidelines, Best Practices, Standards

    Activity-4: OpenCV, VHLL and Qt Designer GUI Builders

    <u>Minute Paper-4</u>: Features that Create User Confusion? What are some of the worst GUIs you've used?

Week-7 [10/9]:

    Read: HCI, Part-2, Chapter 9

    Lecture: Interactive System Evaluation Techniques

    QUIZ - Part-2 on HCI Design Process

    10/11 - FALL BREAK

Week 8 – EXAM #1 (10/16, 10/18) – Chapters 1-9

    REVIEW – 10/16

    10/18 - <u>**EXAM-1 – Knowledge, Concepts, Design and Implementation**</u>

Week-9 [10/23, 10/25]:

    Return Exam #1 and Review Solutions in Class

    Read or Watch: Examples of Intelligent Transportation Systems

    <u>Minute Paper-5</u>: Evolution from driving assistants to self-driving cars

    Lecture: Intelligent Transportation Systems

    Start Assignment #4

Week-10 [10/30, 11/1]:

    Read: HCI, Part-2, Chapter 10

    Lecture: Universal Design

    <u>Guest Lecture, Video or Group HCI Walkthrough – DoT and Ford Motor Videos on Driving Assistants</u>

Week-11 [11/6, 11/8]:

    Read: HCI, Chapter 12

    <u>Guest Lecture, Video or Group HCI Walkthrough – Project Proposal Ideas</u>

    <u>Minute Paper-6</u>: Cognitive Models – Nature of HCI and relationship to Artificial Intelligence

Lecture: HCI Cognitive Models, Introduction

Start Assignment #5

Week-12 [11/13, 11/15]:

Read: HCI, Chapter 20

<u>Guest Lecture, Video or Group HCI Walkthrough - Project Proposals</u>

Lecture: Augmented Reality, Introduction

<u>Minute Paper-7</u>: Augmented Reality, What is It, and what's it Good for?

Activity-5: AR/VR and IoT presentations. Discuss ubiquitous computing

Week-13 [11/20]:

Read or Watch Examples: Advanced Avionics and/or UAS Command and Control

<u>Group HCI Walkthrough - Status from each group (**Teams-2017**)</u>

Lecture: Avionics HCI

Start Assignment #6

Week-14 [11/27, 11/29]: Chapters 10, 12, 20, In-class Notes

Lecture: Avionics HCI Continued

Activity-6: Watch videos on UAS command and control. Discussion of advanced avionics and semi-autonomous systems shared control.

<u>Minute Paper-8</u>: Time Constrained Decision Support - What are Key Features?

Q&A on Final Exam Presentation and Projects

EXAM #2 REVIEW

Week-15 [12/4, 12/6]: EXAM #2 — Chapters 10, 12, 20, In-class Notes

<u>*EXAM-2, Knowledge, Concepts, Design and Implementation*</u>

*Week 16 — **FINAL EXAMS** - **Final Exam and Design Presentation by Team (20+ Minutes Each)***

STEM, Room 123B, 8:00-10:00 Thursday, 12/13

Student Learning Outcomes:

1. Describe human computer interaction application and system analysis and design processes. (1, 6, 3)
   o Week-#3-6, Assignment #3

2. Describe the purpose of HCI systems and applications. (6, 3, 7)
   o Week-#1-6, Assignment #1-3

3. Define HCI. (3, 7)
   o Week-#1-2, Assignment #1

4. Understand the analysis of requirements. (1, 2, 3)
   o Week-#3-6, Assignment #2

5. Develop and specify conceptual models and mock-ups of User Interfaces. (1, 2)
   o Week-#7-14, Assignment #4-6

6. Develop and document use cases for HCI applications. (6, 3)
   o Week-#5-6, Assignment #3

7. Understand HCI 2D and 3D methods of visualization and interaction. (1, 6)
   o Week-#6-14, Assignment #4-6

8. Design and document HCI designs. (1, 6, 3, 7)
   o Week-#6-14, Assignment #4-6

9. Develop and document HCI mock-ups and prototypes suitable for usability experimental evaluation. (6)
   o Week-#6-14, Assignment #4-6

10. **Develop and document HCI applications for interaction using CLI (Command Line Interface) or WIMP (Windows, Icons, Menus, and Pointers) as well as contemporary and emergent interaction (mobile, AR/VR/MR, AI & NLP). Mock-ups and prototypes much include experimental design to assess usability of HCI applications with consideration for universal and ubiquitous design guidelines, principles, and standards (2)**
    o Week-#9, Assignment #5, Assignment #6

11. Understand the use of design patterns in HCI. (4, 7)
    o Week-#6, Assignment #3

12. Define and document characteristics of system behavior in HCI based upon universal and ubiquitous design guidelines, principles and standards. (2, 6, 7, 5)
    o Week-#6-14, Assignment #6, Final HCI design presentation

Access To Learning: *ERAU is committed to the success of all students. It is University policy to provide reasonable accommodations to students with disabilities who qualify for services. If you would like to*

discuss and/or request accommodations, please contact Disability Support Services located in Hazy Library (first floor, end of hall), or call 928/777-6750 or 928/777-6749, or email the director at: marcee.keller@erau.edu

Civil Rights Equity and Title IX

ERAU seeks to provide an environment that is free of bias, discrimination, and harassment. If you have been the victim of harassment, discrimination or sexual misconduct, we encourage you to report this. If you inform me of an issue of harassment, discrimination, or sexual misconduct I will keep the information as private as I can, but I am required to bring it to the attention of the institution's Title IX Coordinator. If you would like to talk to the Title IX Coordinator (Dr. Liz Higgins Frost) directly, she can be reached at Building 49, Dean of Students Office, 928-777-3747, froste@erau.edu. For more information, please refer to the Nondiscrimination/Title IX webpage at https://prescott.erau.edu/title-ix/

ABET Student Outcomes (Expectations of student knowledge and skills attained by graduation)

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. **An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors**
3. An ability to communicate effectively with a range of audiences
4. **An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. **An ability to acquire and apply new knowledge as needed, using appropriate learning strategies**

ABET Program Educational Objectives (Expectations of our alumni working within industry)

The objectives of the Computer, Electrical, and Software Engineering Programs are to produce engineers who:
- Demonstrate achievements in their chosen profession
- Contribute to the development of the profession
- Engage in professional growth
- Contribute to the welfare of society through service

Examples of activities which demonstrate each of these objectives include:

Demonstrate achievements in their chosen profession

Project Leadership
Technical Leadership
Received professional recognition
Strong early-career performance

Contribute to the development of the profession
Educational improvement within profession
Product development or improvement
Presentation, publications, patents

Engage in professional growth
Membership in technical societies
Obtaining additional education
Achieved career advancement

Contribute to the welfare of society through service
Participation in activities outside the professional area