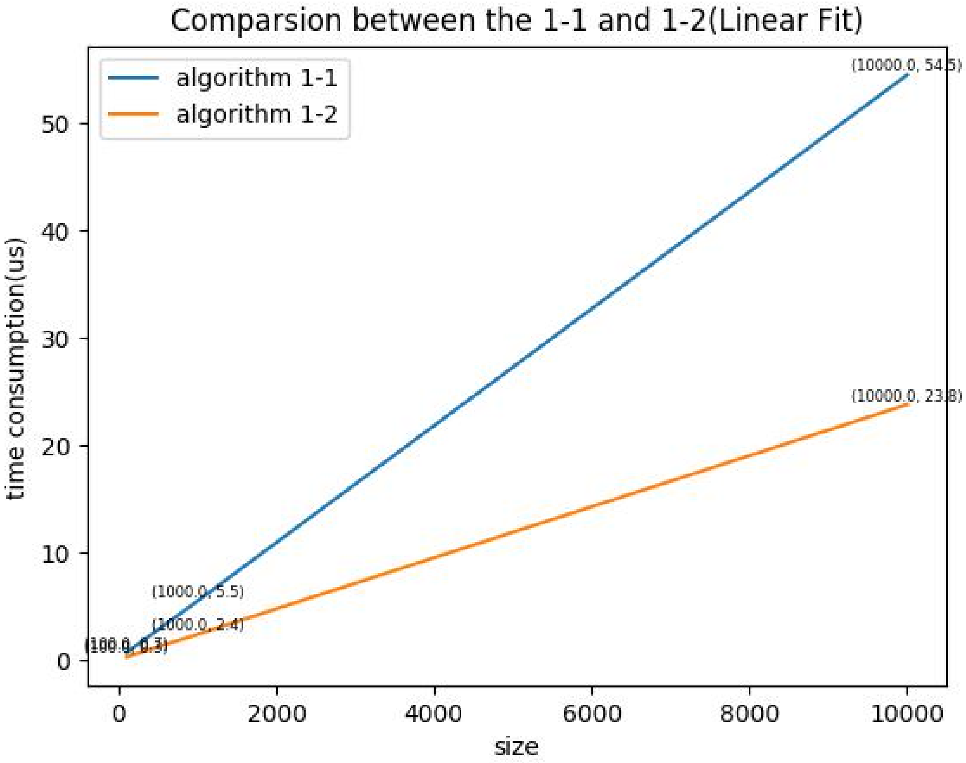
数据结构第一周实验报告

一、实现代码 1-1 和代码 1-2，并生成数据检测

令数组的大小分别为 100,1000,10000，分别测试代码 1-1 和代码 1-2，并得到运行的时间数据，每个 size 均运行了 10 次并取平均值，python 绘图，编译环境 GCC 5.4.0



使用 numpy 库拟合得到的结果分别是

$$y1 = 0.005438\ x + 0.1111$$

$$y2 = 0.002375\ x + 0.04444$$

1. 从图中和拟合结果可以看出，代码 1-1 拟合曲线的斜率大致为代码 1-2 拟合曲线的 2 倍，并且与数组的大小呈线性关系，这符合时间复杂度的分析

   代码 1-1，时间复杂度 O(2N) = O(N)

   代码 1-2，时间复杂度 O(N)

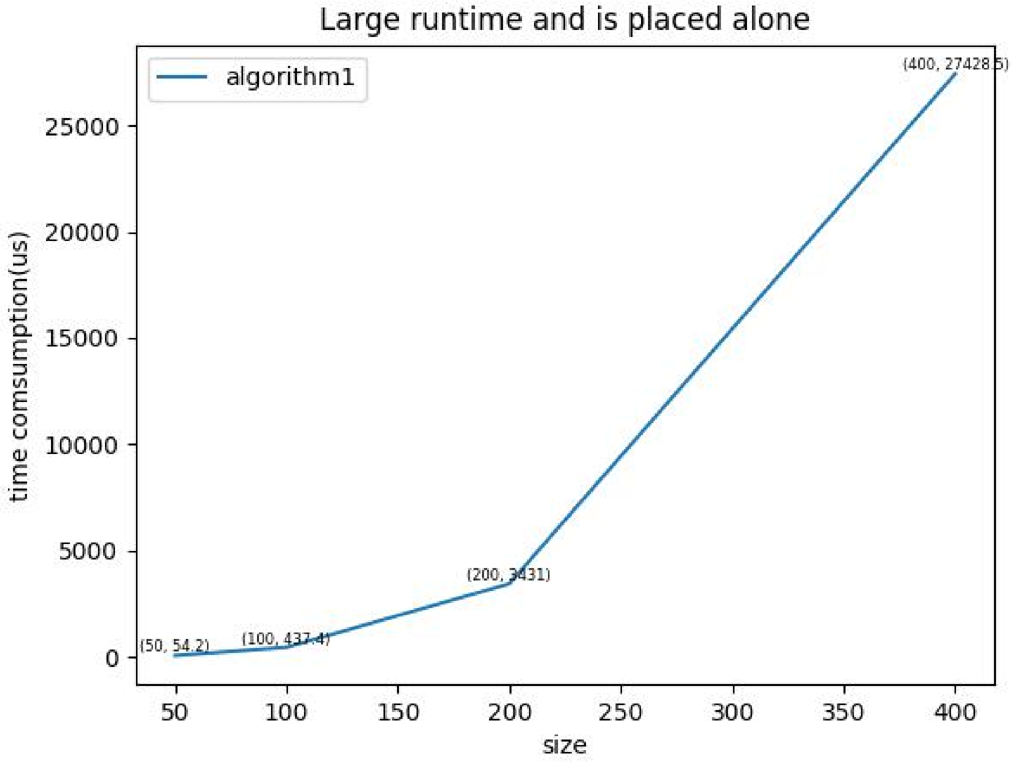
2. 从图中可以看出，当数组的 size 越小，两个算法耗费的时间越接近，随着 size 的增加，算法二的优势越明显

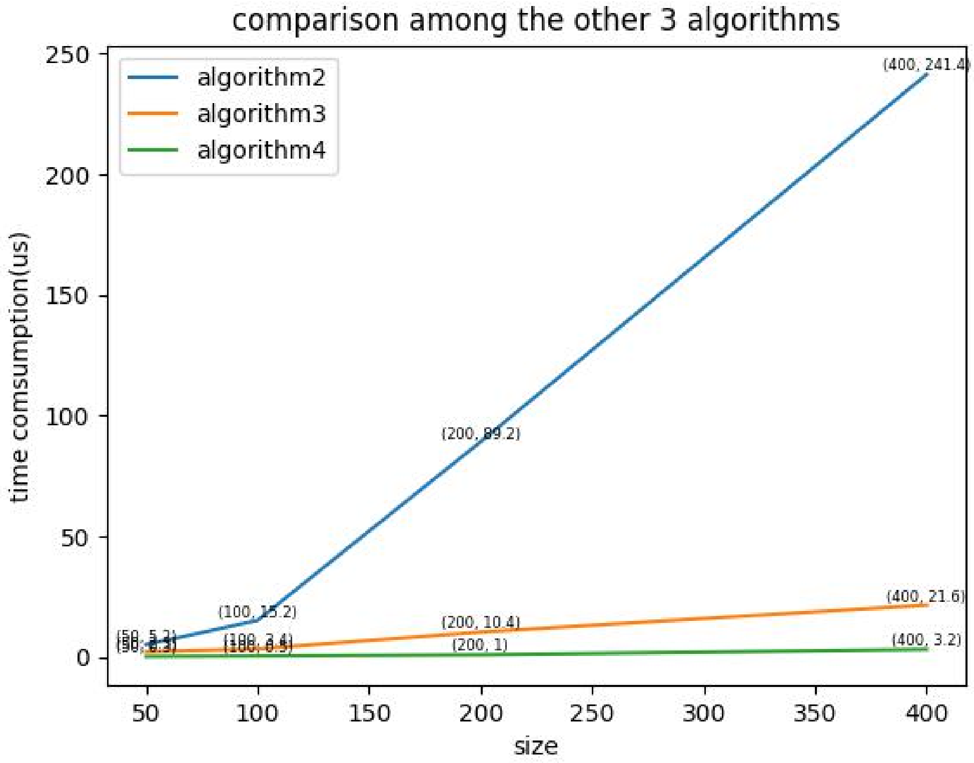
二、求最大子序列的四种算法

考虑到 size 过大时运行时间过长，这里取 size 为 50,100,200,400,分别测试四种算法，并得到运行的时间。由于算法一运行的时间远高于其它三种算法，故为了便于观察将算法一的图像单独列出。这里以表格形式给出了运行时间，折线图以及拟合图像

运行时间(us)/数组大小	50	100	200	400
算法 1	54.2	434.7	3431	27428
算法 2	5.2	15.2	89.2	241.4

算法 3	2.3	3.4	10.4	21.6
算法 4	0.3	0.5	1	3.2

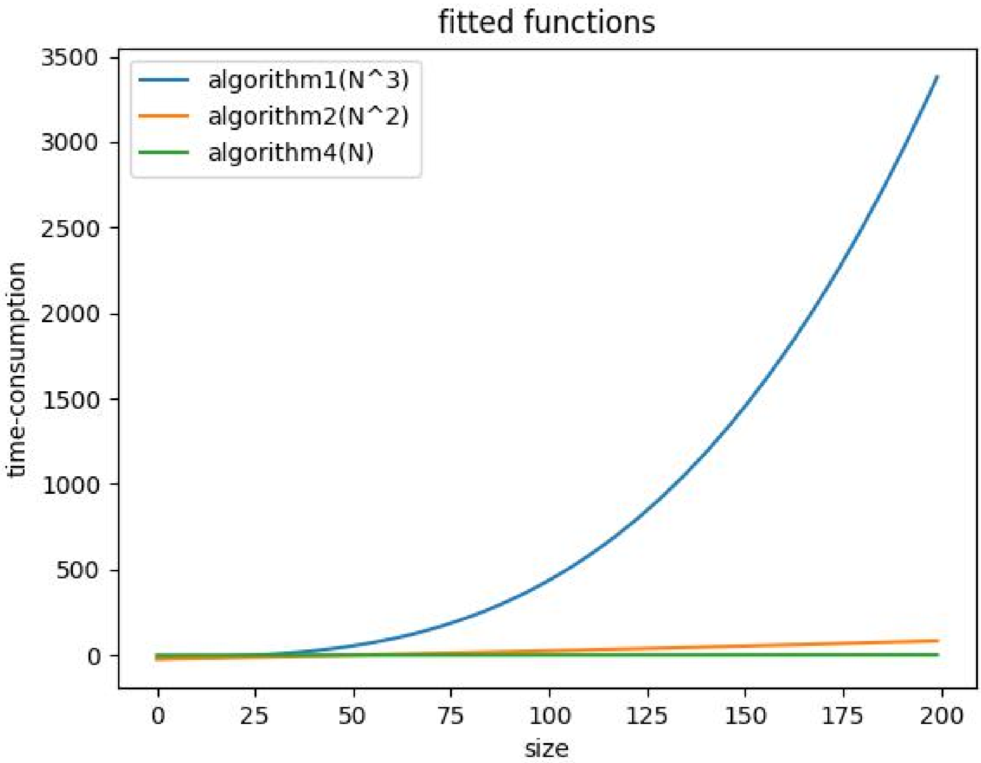




y1 = 0.0004334 x^3 - 0.003212 x^2 + 0.5612 x - 20

Y2 = 0.0006394 x^2+ 0.4047 x - 22.1

Y4 = 0.008452 x - 0.3348



（由于样本点较少且运行时间相差较大，故拟合效果不是很好，但足以反映相对彼此的运行快慢）

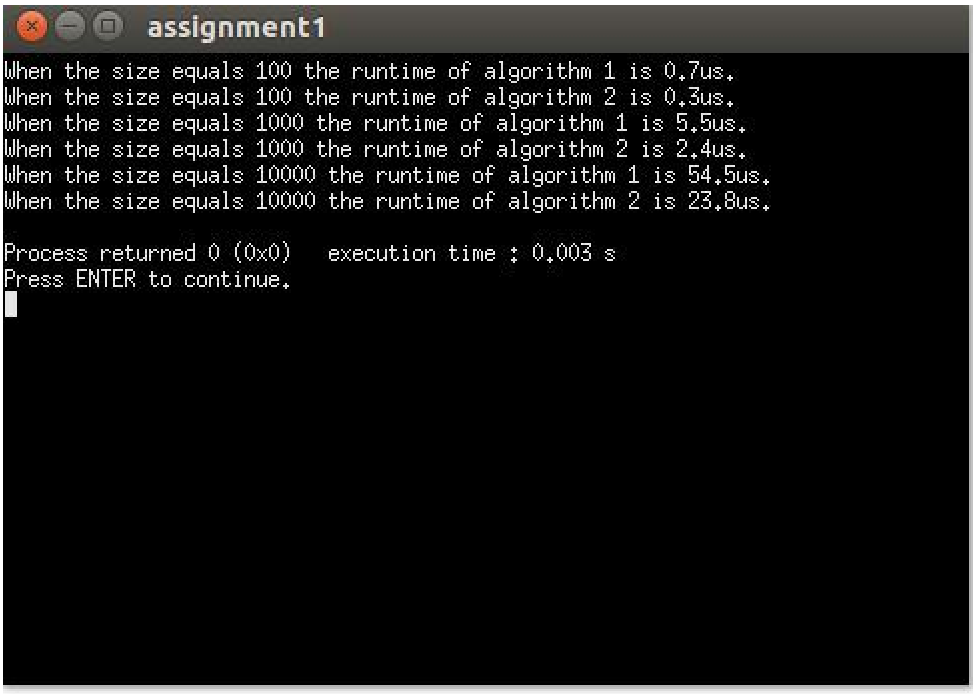
三、完成书上习题

见源代码

求素数的算法在最坏的情况下，时间复杂度为 O(√n)

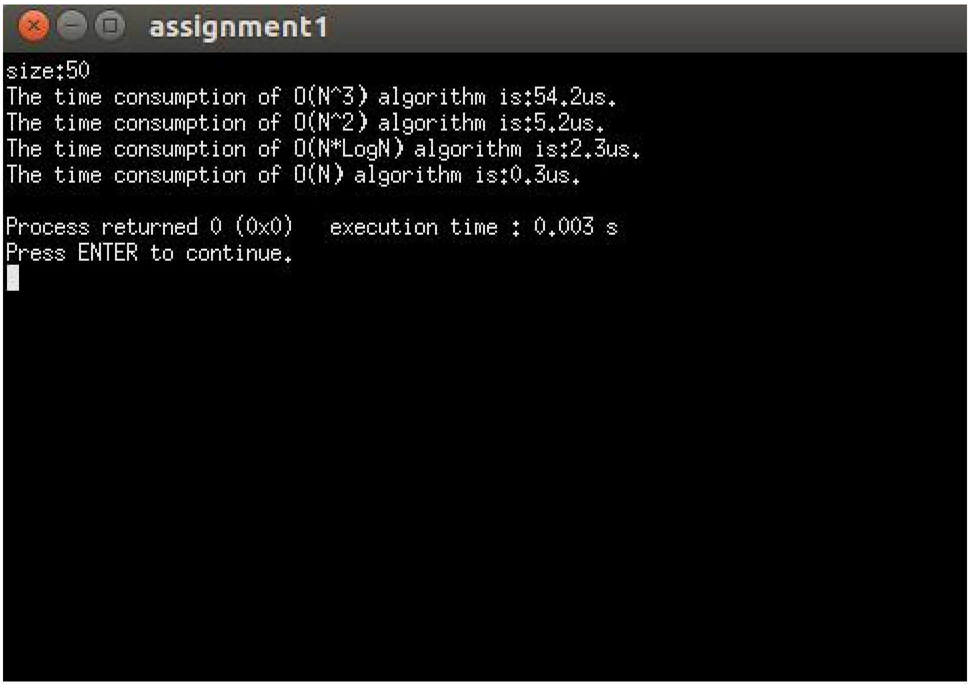
附图：

1-1 与 1-2 的比较

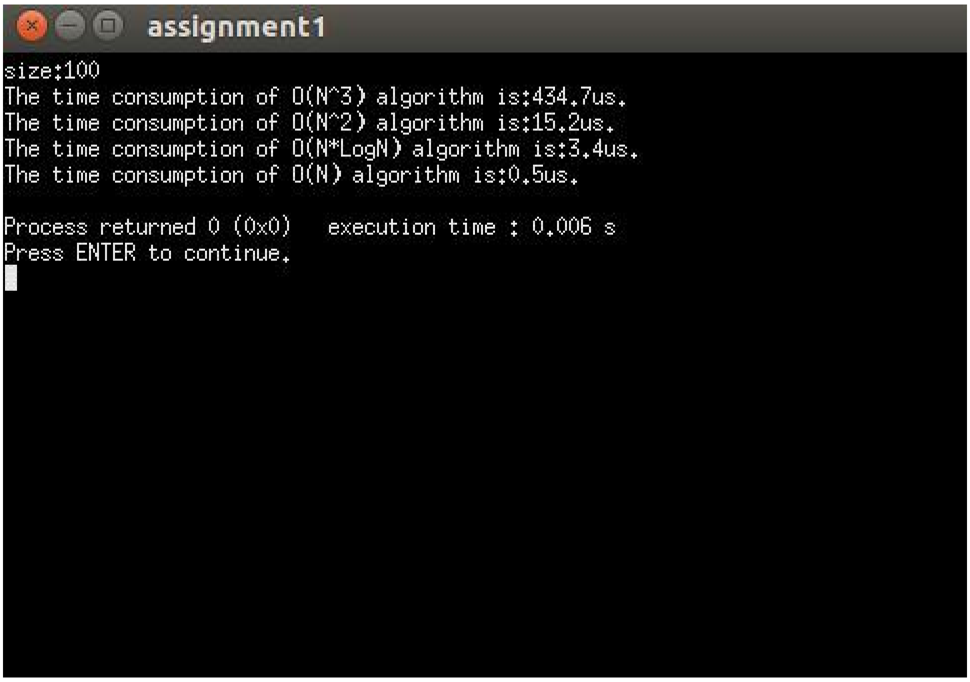


```
When the size equals 100 the runtime of algorithm 1 is 0.7us.
When the size equals 100 the runtime of algorithm 2 is 0.3us.
When the size equals 1000 the runtime of algorithm 1 is 5.5us.
When the size equals 1000 the runtime of algorithm 2 is 2.4us.
When the size equals 10000 the runtime of algorithm 1 is 54.5us.
When the size equals 10000 the runtime of algorithm 2 is 23.8us.

Process returned 0 (0x0)   execution time : 0.003 s
Press ENTER to continue.
```

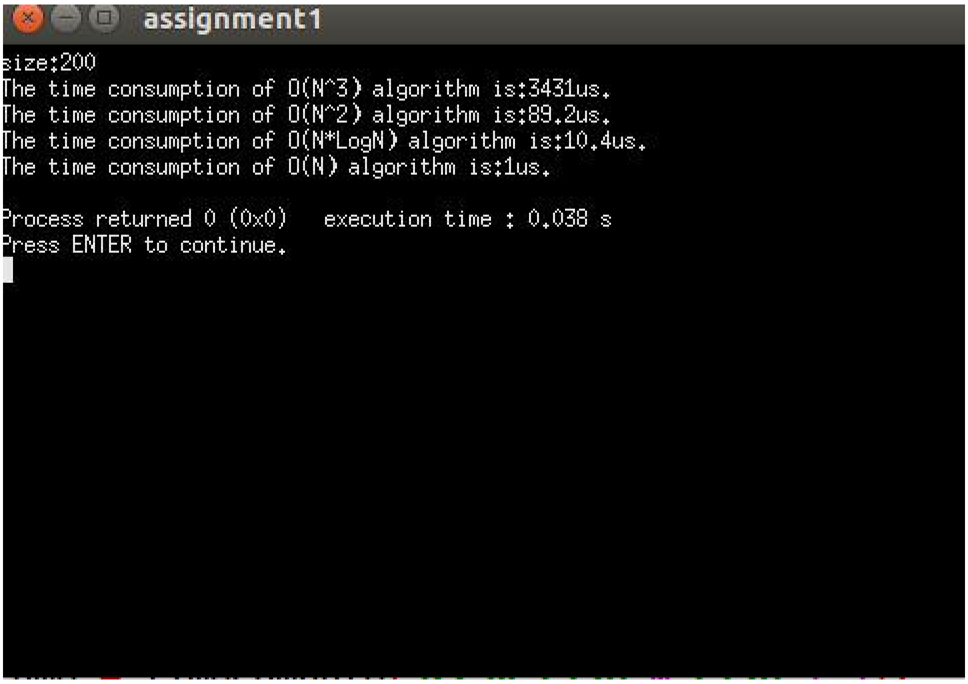
4 种算法在 4 个不同 size 下的运行时间



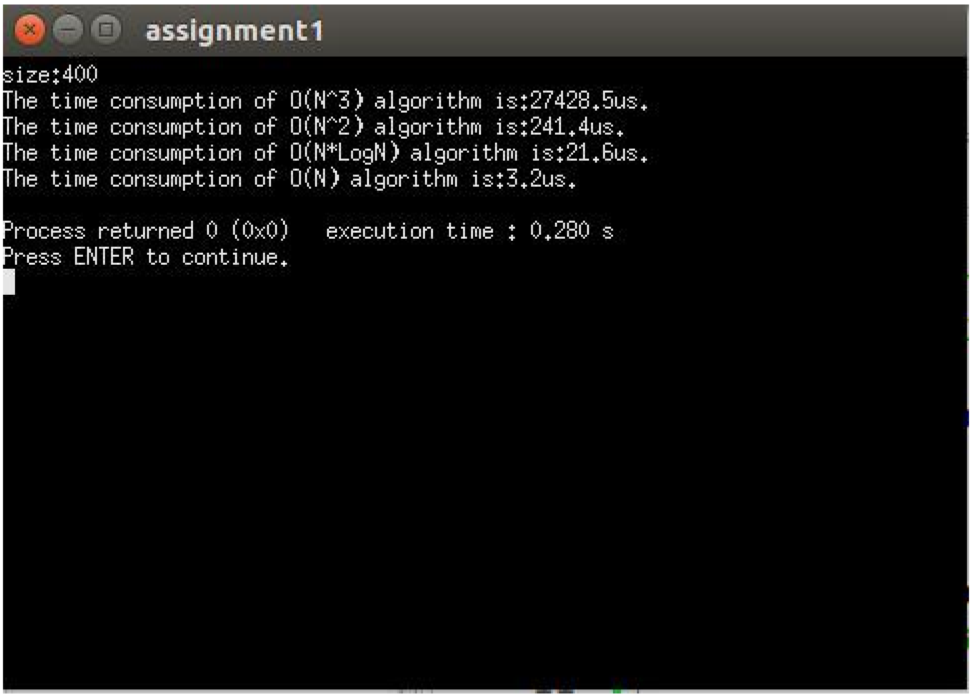
```
size:50
The time consumption of O(N^3) algorithm is:54.2us.
The time consumption of O(N^2) algorithm is:5.2us.
The time consumption of O(N*LogN) algorithm is:2.3us.
The time consumption of O(N) algorithm is:0.3us.

Process returned 0 (0x0)   execution time : 0.003 s
Press ENTER to continue.
```



```
size:100
The time consumption of O(N^3) algorithm is:434.7us.
The time consumption of O(N^2) algorithm is:15.2us.
The time consumption of O(N*LogN) algorithm is:3.4us.
The time consumption of O(N) algorithm is:0.5us.

Process returned 0 (0x0)   execution time : 0.006 s
Press ENTER to continue.
```

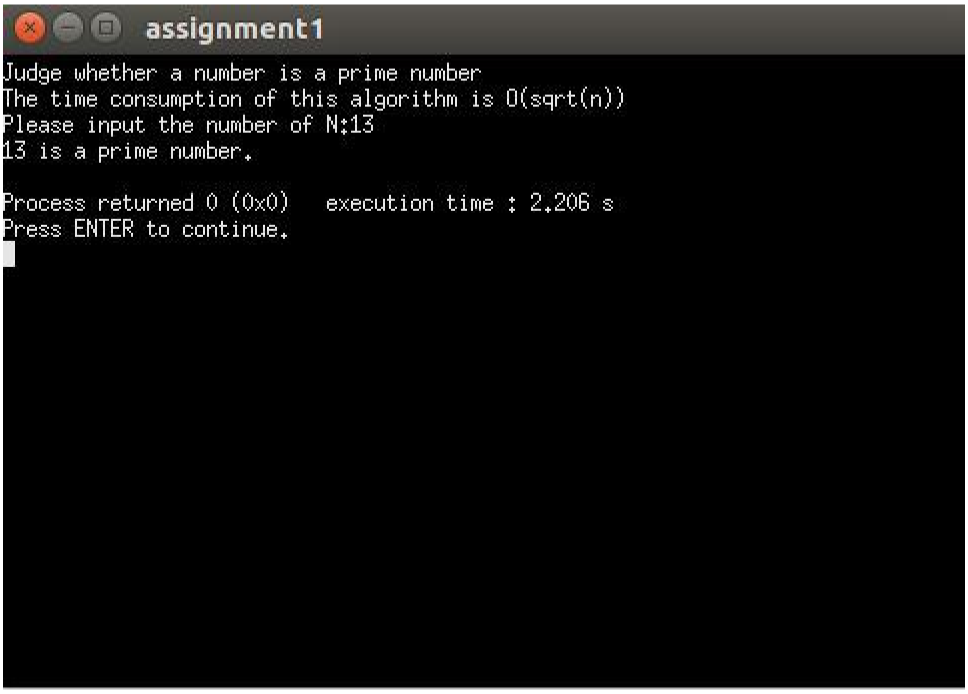


```
size:200
The time consumption of O(N^3) algorithm is:3431us.
The time consumption of O(N^2) algorithm is:89.2us.
The time consumption of O(N*LogN) algorithm is:10.4us.
The time consumption of O(N) algorithm is:1us.

Process returned 0 (0x0)   execution time : 0.038 s
Press ENTER to continue.
```



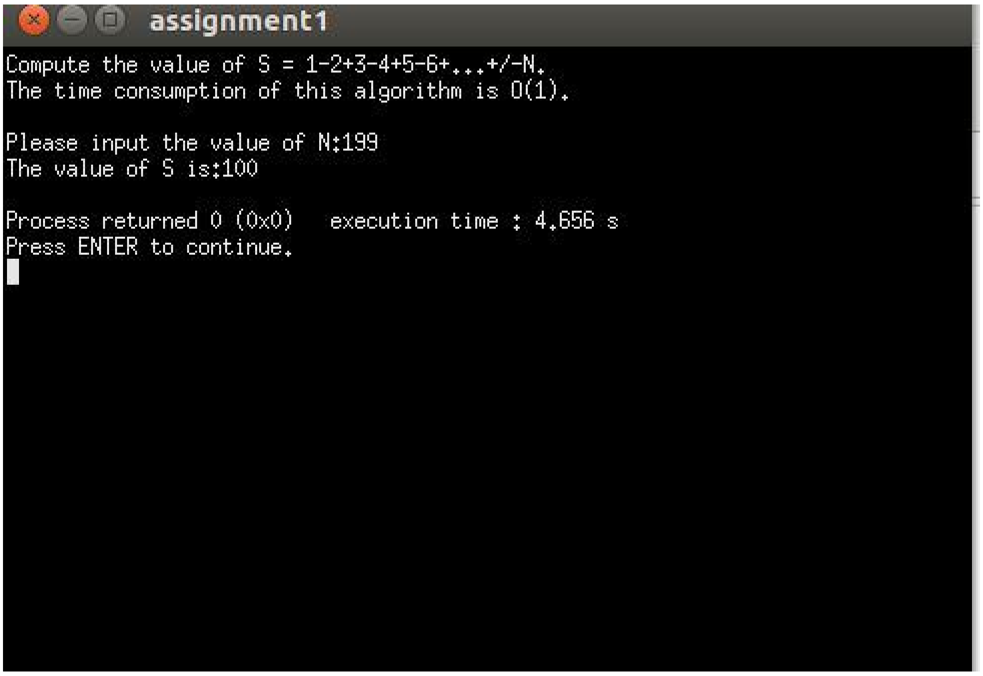
```
size:400
The time consumption of O(N^3) algorithm is:27428.5us.
The time consumption of O(N^2) algorithm is:241.4us.
The time consumption of O(N*LogN) algorithm is:21.6us.
The time consumption of O(N) algorithm is:3.2us.

Process returned 0 (0x0)   execution time : 0.280 s
Press ENTER to continue.
```

课本习题第一题



```
Judge whether a number is a prime number
The time consumption of this algorithm is O(sqrt(n))
Please input the number of N:13
13 is a prime number.

Process returned 0 (0x0)   execution time : 2.206 s
Press ENTER to continue.
```

课本习题第二题



```
Compute the value of S = 1-2+3-4+5-6+...+/-N.
The time consumption of this algorithm is O(1).

Please input the value of N:199
The value of S is:100

Process returned 0 (0x0)   execution time : 4.656 s
Press ENTER to continue.
```