

# ECE 175: Computer Programming for Engineering Applications

## Homework Assignment 2

**Due Date: Tuesday September 12, 2017 by 11:59 PM, via D2L**

**Conventions:** Name your C programs as *hw $x$ py.c*

where  $x$  corresponds to the homework number and  $y$  corresponds to the problem number.

For example, the C program for homework 2, problem 1 should be named as *hw2p1.c*.

**Write comments to your programs.** Programs with no comments will receive PARTIAL credit. For each program that you turn in, at least the following information should be included at the top of the C file:

- Author:
- Date created:
- Brief description of the program:
  - input(s):
  - output(s):
  - brief description or relationship between inputs and outputs

**Submission Instructions:** Submit your .c files in D2L “Assignments” Dropbox and Zylab.

**Problem 1 (30 points):** Write a C program that calculates the water bill according to the chart below. The program should let a user enter the user type and the water usage amount and then displays the total cost (including tax). See sample code execution.

<b>Fixed cost:</b>		
Residential – fixed cost		\$9.00
Business – fixed cost		\$14.00
User	Water Usage (w) (in cubic feet (cf))	Cost (\$) per cubic feet
Residential	for the first 700 cf, $w \leq 700$	0.018
	for the next 800 cf $700 < w \leq 1500$	0.032
	for additional cf above 1500 $w > 1500$	0.08
Business		0.0288

The **tax rate** is 6.1%

Red is entered by a user

### Sample Code Execution #1

Enter User Type (R for Residential, B for Business): **E**

Enter water usage in cubic feet: **58**

**Wrong User Type**

Not valid user type,  
Your code should display the  
message

### Sample Code Execution #2

Enter User Type (R for Residential, B for Business): **R**

Enter water usage in cubic feet: **58.5**

Total cost including tax is \$10.67

**=> Note: the cost before tax is  $9.00 + 58.5 \times 0.018 = \$10.053$  -> with tax of 6.1%, cost is \$10.67**

### Sample Code Execution #3

Enter User Type (R for Residential, B for Business): **R**

Enter water usage in cubic feet: **1523**

Total cost including tax is \$52.03

=> **Note: Since 1523 > 1500,**

(the first 700 cf costs 0.018 per cf, the next 800 cf costs 0.032 per cf, 0.08 after 1500 cf)

**the cost before tax is  $9.00 + 0.018*700 + 0.032*800 + 0.08*23 = \$49.04$**

**-> with tax of 6.1%, cost is \$52.03**

### Sample Code Execution #4

Enter User Type (R for Residential, B for Business): **B**

Enter water usage in cubic feet: **1891.4**

Total cost including tax is \$72.65

=> **Note: the cost before tax is  $14.00 + 1891.4*0.0288 = \$ 68.4723$**

**-> with tax of 6.1%, cost is \$72.65**

**Test cases:** (User Type, Water usage) = (E, 58), (R, 58.5), (R, 1523), (B, 1891.4), (P, 523)

**Problem 2 (40 points):** Finding statistics of data set: Average, Standard Deviation and Maximum

#### 1) Average

Given a list of n data values/points:  $m_1, m_2, \dots, m_n$ , the average value is defined as

$$average = \overline{m}_n = \frac{m_1 + m_2 + \dots + m_n}{n}$$

For example,

with 2 data values:  $average = \frac{m_1 + m_2}{2}$

with 3 data values:  $average = \frac{m_1 + m_2 + m_3}{3}$

We want to find the average value of incoming data without having to store all previous data values in memory. This can be done by

- 1) Find accumulated sum of all data values
- 2) Once all n data values are entered (for this problem, n is 8)  
average = accumulated sum / total number of data points

#### b) Standard Deviation

Once a user enters all numbers, the value of standard deviation can also be calculated as

$$standard\ deviation = \sqrt{\frac{sum\_squares}{n} - average^2} = \sqrt{\frac{sum\_squares}{n} - \overline{m}_n^2}$$

Note:  $sum\_squares = (m_1)^2 + (m_2)^2 + \dots + (m_n)^2$ .

**Hint:** After each value is entered, your program should find the accumulated sum of each value squared.

#### c) Maximum

Once a user enters all numbers, maximum data point can be determined.

**Hint:** After each value is entered, your program should decide whether the entered value is a maximum of all entered value thus far. If it is, update the variable used to keep the maximum value.

Write a C program that:

- (i) Prompts the user for measurement value (one value at a time)
- (ii) Displays the accumulated sum for all data entered thus far.
- (iii) Displays the accumulated sum of each data squared for all data entered thus far.
- (iv) After 8 values are entered, display average, standard deviation and maximum

**Sample code Execution #1:** Red text indicates information entered by the user

Enter data value: -68.47

Accumulated sum of 1 values is -68.47

Accumulated sum of squares of 1 values is 4688.14

Enter data value: 91.42

Accumulated sum of 2 values is 22.95

Accumulated sum of squares of 2 values is 13045.76

Enter data value: 94.11

Accumulated sum of 3 values is 117.06

Accumulated sum of squares of 3 values is 21902.45

Enter data value: -71.66

Accumulated sum of 4 values is 45.40

Accumulated sum of squares of 4 values is 27037.60

Enter data value: 60.04

Accumulated sum of 5 values is 105.44

Accumulated sum of squares of 5 values is 30642.41

Enter data value: -2.9

Accumulated sum of 6 values is 102.54

Accumulated sum of squares of 6 values is 30650.82

Enter data value: -60.12

Accumulated sum of 7 values is 42.42

Accumulated sum of squares of 7 values is 34265.23

Enter data value: 58.44

Accumulated sum of 8 values is 100.86

Accumulated sum of squares of 8 values is 37680.46

**Average of 8 values is 12.61**

**Standard deviation is 67.462**

**Maximum of 8 values is 94.110**

**Sample Code Execution #2:** Red text indicates information entered by the user

Enter data value: -9.36  
Accumulated sum of 1 values is -9.36  
Accumulated sum of squares of 1 values is 87.61

Enter data value: 12.3  
Accumulated sum of 2 values is 2.94  
Accumulated sum of squares of 2 values is 238.90

Enter data value: -4.16  
Accumulated sum of 3 values is -1.22  
Accumulated sum of squares of 3 values is 256.21

Enter data value: -9  
Accumulated sum of 4 values is -10.22  
Accumulated sum of squares of 4 values is 337.21

Enter data value: -10.25  
Accumulated sum of 5 values is -20.47  
Accumulated sum of squares of 5 values is 442.27

Enter data value: -15.8  
Accumulated sum of 6 values is -36.27  
Accumulated sum of squares of 6 values is 691.91

Enter data value: 15.6  
Accumulated sum of 7 values is -20.67  
Accumulated sum of squares of 7 values is 935.27

Enter data value: -20  
Accumulated sum of 8 values is -40.67  
Accumulated sum of squares of 8 values is 1335.27

**Average of 8 values is -5.08**  
**Standard deviation is 11.877**  
**Maximum of 8 values is 15.600**

**Lab 2 assignment (30 points):** You will complete lab 2 assignment when you attend your lab session.