

## ECE 175 Homework Assignment 5

**Due Date:** by 11.59 pm on October 5, 2021

**Submission Instructions:** Submit only .c files in the designated Assignment Dropbox on D2L.

**Conventions:** Name your C programs as *hw<sub>x</sub>py.c*

where *x* corresponds to the homework number and *y* corresponds to the problem number. For example, the C program for homework 5, problem 1 should be named as *hw5p1.c*

**Write comments in your programs.** Programs with no comments will receive PARTIAL credits.

For each program, the following info should at least be included at the top of the C file:

Author and Date created:

Brief description of the program:

- input(s) and output(s):
- an algorithm (or description/relationship between inputs and outputs)

**Problem 1 (35 points):** Water bill calculation

Given the chart below (same chart that you used for problem 2 of homework 2),

<b>Fixed Cost:</b>		
	Residential – fixed cost	\$13.50
	Government – fixed cost	\$ 3.75
	Business – fixed cost	\$17.25
User	Water Usage (w) In cubic feet (cf)	Cost per cubic foot
Residential	For the first 400 cf, $w \leq 400$	0.04
	For the next 300 cf, $400 < w \leq 700$	0.062
	For additional cf above 700 $w > 700$	0.12
Government		0.035
Business		0.0553
Tax rate is 8.7%		

write a **C program** that

- read from the text file called "water\_usage.txt" (this file is on D2L)
- for each line (consisting of a user type and water usage in cubic feet) in the given text file, find the total cost (including tax) and display the table of information (including the calculated cost) as shown in the **sample code execution**.

**Your C program must use the following user defined function:**

```
double water_billcalculation(char user_type, int water_use);
```

//the function accepts user type and water usage in cubic feet and returns the cost with tax

To read one line from the text file, the statement below can be used.

```
fscanf(your_file_pointername, "%c%d ", &var_youuseforUserType, &var_youusefor_cubicfeet);
```

Note: there is a space after %d – used to tell fscanf to ignore a newline character at the end of that line.

### Sample code execution:

Given part of "water\_usage.txt" (more test cases are given in the text file)

g 5000  
B 1250  
M 50  
r 120  
R 450  
G 1750  
b 274  
A 10

If your program works correctly, below is part of what your code should display

Type	Water usage	Cost including tax(\$)
g	5000	194.30
B	1250	93.89
M	Wrong user type	
r	120	19.89
R	450	35.44
G	1750	70.66
b	274	35.22
A	Wrong user type	

Observation: the user type can now be either lowercase or UPPERCASE. If the type is not Residential, Business or Government, it should display "Wrong user type".

### Problem 2 (35 points) Three-dimensional vector calculation

Given a vector  $\mathbf{V} = \langle V_x, V_y, V_z \rangle$ , its magnitude is calculated as

$$|\mathbf{V}| = \sqrt{V_x^2 + V_y^2 + V_z^2}$$

Given two vectors  $\mathbf{V1} = \langle V_{x1}, V_{y1}, V_{z1} \rangle$  and  $\mathbf{V2} = \langle V_{x2}, V_{y2}, V_{z2} \rangle$ , the dot product is

$$\mathbf{V1} \cdot \mathbf{V2} = \mathbf{V1} \text{ dot } \mathbf{V2} = V_{x1} * V_{x2} + V_{y1} * V_{y2} + V_{z1} * V_{z2}$$

the angle (in degrees) between the two vectors is

$$\theta = \cos^{-1} \left( \frac{\mathbf{V1} \cdot \mathbf{V2}}{|\mathbf{V1}| * |\mathbf{V2}|} \right) * \frac{180}{\pi}$$

Use 3.14159 for  $\pi$ .

Write an interactive C program that

- display options for vector calculation that a user can choose
- ask a user for an option (M/m for finding the magnitude, D/d for finding the dot product and angle between the two vectors)
- ask a user for one vector or two vectors (depending on the option)
- find and display the calculation
- ask whether a user wants to continue (N/n for no).

**Your C program must include at least the following user defined functions:**

```
//find_magnitude accepts three input arguments and returns the vector magnitude
double find_magnitude(double Vx, double Vy, double Vz);

// find_dotprod_angledeg accepts two vectors and outputs the dot product and angle in
degrees between two vectors
void find_dotprod_angledeg(double Vx1, double Vy1, double Vz1, double Vx2,
double Vy2, double Vz2, double *dotprod, double *angle_deg);
```

### Sample code execution 1: Bold entered by a user

```
3-D Vector calculation
Enter M or m to find the magnitude
Enter D or d to find the dot product and angle in degrees
Enter your choice: A
wrong option entered
Do you want to continue (N/n for no)? w
```

```
3-D Vector calculation
Enter M or m to find the magnitude
Enter D or d to find the dot product and angle in degrees
Enter your choice: M
Enter Vx Vy Vz (separated by spaces): 1 2 3.3
magnitude of <1.00, 2.00, 3.30> is 3.9862
Do you want to continue (N/n for no)? y
```

```
3-D Vector calculation
Enter M or m to find the magnitude
Enter D or d to find the dot product and angle in degrees
Enter your choice: D
Enter Vx1 Vy1 Vz1 (separated by spaces): 1 2 3.3
Enter Vx2 Vy2 Vz2 (separated by spaces): 7.1 14.2 23.43
<1.00, 2.00, 3.30> dot <7.10, 14.20, 23.43> is 112.8190
angle between these 2 vectors is 0.0000 degrees
Do you want to continue (N/n for no)? A
```

```
3-D Vector calculation
Enter M or m to find the magnitude
Enter D or d to find the dot product and angle in degrees
Enter your choice: m
Enter Vx Vy Vz (separated by spaces): 7.1 14.2 23.43
magnitude of <7.10, 14.20, 23.43> is 28.3022
Do you want to continue (N/n for no)? N
good bye
```

**Sample code execution 2: Bold entered by a user**

3-D Vector calculation

Enter M or m to find the magnitude

Enter D or d to find the dot product and angle in degrees

Enter your choice: **d**

Enter Vx1 Vy1 Vz1 (separated by spaces): **1 2 3.3**

Enter Vx2 Vy2 Vz2 (separated by spaces): **11 7.7 -8**

<1.00, 2.00, 3.30> dot <11.00, 7.70, -8.00> is 0.0000

angle between these 2 vectors is 90.0001 degrees

Do you want to continue (N/n for no)? **T**

3-D Vector calculation

Enter M or m to find the magnitude

Enter D or d to find the dot product and angle in degrees

Enter your choice: **m**

Enter Vx Vy Vz (separated by spaces): **3 4 5**

magnitude of <3.00, 4.00, 5.00> is 7.0711

Do you want to continue (N/n for no)? **g**

3-D Vector calculation

Enter M or m to find the magnitude

Enter D or d to find the dot product and angle in degrees

Enter your choice: **D**

Enter Vx1 Vy1 Vz1 (separated by spaces): **3 4 5**

Enter Vx2 Vy2 Vz2 (separated by spaces): **-5.4 1.5 6**

<3.00, 4.00, 5.00> dot <-5.40, 1.50, 6.00> is 19.8000

angle between these 2 vectors is 70.0592 degrees

Do you want to continue (N/n for no)? **n**

good bye

**Lab 5 (30 points):** complete this assignment when you attend the lab session after HW 5 is due.