

ECE 175: Computer Programming for Engineering Applications

Homework Assignment 4

Due Date: Tuesday September 26, 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 4, problem 1 should be named as *hw4p1.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 and 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 (35 points): Write a C program that prints either

- 1) a school of fish on the screen by prompting the user for the number of fish to print out OR
- 2) mice on the screen by prompting the user for the number of mice to print out

Your program should

- **Use nested loop (0 point if nested loop is not used)**
- **Work for any numbers of fish or mice entered by a user.**

Note:

- a) Observe the slight difference in the print structure when an odd vs. even number is entered.
- b) Observe the difference between the print structure of the school of fish and of mice in a maze.

EIGHT examples of code execution are given below : **Red text entered by the user**

```
This program prints
1) a school of fish or
2) mice in a maze.
Enter your option (1 or 2): 1
How many fish are in the school? 5
```

```
><(((('>
    ><(((('>
        ><(((('>
            ><(((('>
                ><(((('>
```

```
This program prints
1) a school of fish or
2) mice in a maze.
Enter your option (1 or 2): 1
How many fish are in the school? 6
```

```
><(((('>
    ><(((('>
        ><(((('>
            ><(((('>
                ><(((('>
                    ><(((('>
```

```
This program prints
1) a school of fish or
2) mice in a maze.
Enter your option (1 or 2): 2
How many mice in the maze? 5
```

```
    ----{,_, ">
    ----{,_, ">
    ----{,_, ">
    ----{,_, ">
    ----{,_, ">
```

```
This program prints
1) a school of fish or
2) mice in a maze.
Enter your option (1 or 2): 2
How many mice in the maze? 6
```

```
    ----{,_, ">
    ----{,_, ">
    ----{,_, ">
    ----{,_, ">
    ----{,_, ">
    ----{,_, ">
```

How many fish are in the school? 9

How many fish are in the school? 10

How many mice in the maze? 9

How many mice in the maze? 10

[illegible]

Problem 2 (35 points): Van Der Waals equation

As the temperature and the volume of the gas changes, the gas pressure changes. The *Van Der Waals* equation given below is often used for to find pressure of any given gas type:

$$P = \frac{R T}{\left(\frac{V}{n}\right) - b} - \frac{a}{\left(\frac{V}{n}\right)^2}$$

where P is the pressure (atm)
 V is the volume in liters (L)
 R is gas constant, $R = 0.08206$ L-atm/mol-K.
 T is the *absolute* temperature in Kelvin (K)
 n is the quantity of gas (in mols)

a and b depend on the type of gas. Some values are given in **Table 1** below

| Gas Type | Gas | a (L ² -atm/mol ²) | b(L/mol) |
|----------|---------------------------------|-------------------------------------------|----------|
| 1 | Helium, He | 0.0341 | 0.0237 |
| 2 | Hydrogen, H ₂ | 0.244 | 0.0266 |
| 3 | Oxygen, O ₂ | 1.36 | 0.0318 |
| 4 | Chlorine, Cl ₂ | 6.49 | 0.0562 |
| 5 | Carbon dioxide, CO ₂ | 3.59 | 0.0427 |

Implement an *interactive C program* to let the user enter required information and display, in tabular format, values of volume (Liter (L)) and Pressure (atm) at a given temperature. **See sample code execution.**

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

- `print_list` function is to display the information given in **Table 1** above.
`void print_list(void);`
- `pressure_cal` function returns the value gas pressure given all input values shown below.
`gas_type` value is between 1 and 5 – to be used to choose correct values of a and b .
`double pressure_cal(int gas_type, double T, double V, double n);`

See sample code execution on the next page

Lab 4 assignment (30 points): You will complete lab 4 assignment when you attend your lab session.

Sample code execution: Red entered by a user

| Number | Gas Type |
|--------|----------------|
| 1 | Helium |
| 2 | Hydrogen |
| 3 | Oxygen |
| 4 | Chlorine |
| 5 | Carbon dioxide |

Enter Gas number (1,2,3,4 or 5)>> **10**
Enter Gas number (1,2,3,4 or 5)>> **8**
Enter Gas number (1,2,3,4 or 5)>> **5**
Enter Quantity of gas (in moles) >> **0.02**
Enter temperature (in Kelvin)>> **300**
Enter initial volume (in liters)>> **0.4**
Enter final volume (in liters)>> **0.6**
Enter volume increment (in liters)>> **0.05**

} Continue asking is the user does not enter a number between 1 and 5

| Volume (liters) | Pressure(atm) |
|-----------------|---------------|
| 0.400 | 1.2246 |
| 0.450 | 1.0891 |
| 0.500 | 0.9807 |
| 0.550 | 0.8918 |
| 0.600 | 0.8178 |

Do you want to continue (y or n)? **y**

| Number | Gas Type |
|--------|----------------|
| 1 | Helium |
| 2 | Hydrogen |
| 3 | Oxygen |
| 4 | Chlorine |
| 5 | Carbon dioxide |

Enter Gas number (1,2,3,4 or 5)>> **1**
Enter Quantity of gas (in moles) >> **1.0**
Enter temperature (in Kelvin)>> **273.15**
Enter initial volume (in liters)>> **20.4**
Enter final volume (in liters)>> **23.0**
Enter volume increment (in liters)>> **0.2**

| Volume (liters) | Pressure(atm) |
|-----------------|---------------|
| 20.400 | 1.1000 |
| 20.600 | 1.0893 |
| 20.800 | 1.0788 |
| 21.000 | 1.0685 |
| 21.200 | 1.0584 |
| 21.400 | 1.0485 |
| 21.600 | 1.0388 |
| 21.800 | 1.0292 |
| 22.000 | 1.0199 |
| 22.200 | 1.0107 |
| 22.400 | 1.0016 |
| 22.600 | 0.9928 |
| 22.800 | 0.9841 |
| 23.000 | 0.9755 |

Do you want to continue (y or n)? **n**