

CS367 Lab 5

This lab consists of two parts. For **each** part you will create and submit a directory containing a complete C program consisting of **4** files:

1. A source code file containing the definitions of all functions other than **main**.
2. A header file containing the prototypes for all functions defined in file **1** above along with the definition of any constants specified. Note that you may add additional constants as you deem helpful.
3. A source code file containing the definition of your **main** function.
4. A text file containing:
 - a. the commands you used to build your executable (note that individual source files must be compiled separately, as indicated below)
 - b. the output (i.e., everything that occurred at the command line) from running the program with the indicated inputs

Your submitted directories should contain no other files. Separately **tar** and **gzip** the directory for each Part and submit the two gzipped files via **Moodle**.

Remember to put the required header comments in all source code and header files.

Part A. Write a C program that calculates and outputs the volume and surface area of a sphere. Your program should consist of the following:

1. Define a constant for π with a value of **3.1415926** using a preprocessor directive. All functions should make use of this constant for π .
2. Write a function that takes as an argument the radius of a sphere and calculates and returns the volume of a sphere with that radius. The volume v of a sphere is given by:

$$v = 4 / 3 * \pi * r^3$$

3. Write a function that takes as an argument the radius of a sphere and calculates and returns the surface area of a sphere with that radius. The surface area s of a sphere is given by:

$$s = 4 * \pi * r^2$$

4. Write a function that takes no arguments and gets and returns a positive radius value input by the user. Give the user as many chances as necessary to enter a valid positive number.

5. Write a **main** function that does the following in the indicated order, using the functions you defined above:

- a. Get a positive radius value from the user.
- b. Calculate the volume of the sphere.
- c. Calculate the surface area of the sphere.
- d. Output the radius, volume, and surface area in a sentence with 4 digits to the right of the decimal place for all values.

Compile each source code file separately (i.e., using a different command line for each compilation) and then link them together to create an executable. Include with your submission the commands you used to build your executable and the output from running your program with the following inputs (see submission instructions at the top of this assignment):

abc
corrected to -5.5
corrected to def
corrected to -3
corrected to 5.5

Part B. For this part you will write a program that prints a part of an ascii lookup table as per Lab 4 Part D, but for this lab you will allow the user to enter the range of character values they want output, and you will write the program using multiple functions. Your program should consist of the following:

1. Use preprocessor directives to define constants for the minimum and maximum printable ascii character values, which are **32** and **126** respectively.
2. Write a function that takes as arguments a minimum and maximum allowable integer value, and gets and returns a value in that range (inclusive) input by the user. Give the user as many chances as necessary to enter a valid value. Make sure to give the user informative prompts and error feedback.
3. Write a function that takes a single integer value argument and prints-out, on a single line, the specified numeric value followed by the corresponding ascii character. Each character should be bracketed by $\langle \rangle$'s. Use conversion modifiers as necessary to ensure that the columns are aligned; the first column of numbers should be left-justified (see the example output below).

4. Write a function that takes a minimum and maximum value and outputs a table of values/characters for all ascii values within the specified range (inclusive) by making calls to your function (3). For example, if the specified limits are **98** and **101**, this function should print-out:

```
98  <b>
99  <c>
100 <d>
101 <e>
```

5. Write a main function that does the following in the indicated order, using the functions you defined above:

a. Have the user input a desired minimum numerical value in the range of printable ascii character values.

b. Have the user input a desired maximum numerical value in the range of printable ascii character values. The input maximum value must be at least as big as the minimum value input in (a).

c. Output a table of values/characters for all ascii values within the user-specified range (inclusive).

Compile each source code file separately (i.e., using a different command line for each compilation) and then link them together to create an executable. Include with your submission the commands you used to build your executable and the outputs from running your program twice with the following inputs (see submission instructions at the top of this assignment):

Run 1: **95** (minimum) and **103** (maximum).

Run 2:

minimum: **31**

corrected to: **128**

corrected to: **abc**

corrected to: **40**

maximum: **def**

corrected to: **35**

corrected to: **abc**

corrected to: **55**