

CSCI 1411: Fundamentals of Computing

Lab 9

Due Date: **8:30 AM October 20, 2020**

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Goals:

- Learn modular programming
- Learn test driven development methodology

Development Environment: IDLE

Skills: modular programming, testing

Deliverables:

1. This lab handout with 6 screen shots.
2. Your Python code. Name the file using the following format:
YourlastnameFirstnameLab09.cpp
Example: If your name is Jamal Jones then you will name the file as follows:
JonesJamalLab09.cpp
3. Two output files (output1.txt and output2.txt)

How to take a **screen shot**:

- For a Windows 10: Use Snipping Tool to copy and CTRL + V to paste screen shot.
- For Mac: Shift + Command + 4 to copy and CTRL + V to paste screen shot.

In this lab we will write a program, which will perform the following tasks:

1. Read a set of integers from an input file.
2. Calculate sum, mean and standard deviation of the given set of integers.
3. Write the result in an output file.

The modular programming and test driven development methodology works as follows:

1. Write some code.
2. Test the code.
3. Write some more code and test the new code.
4. Keep on doing step 3 until you are done with your program.

We will complete the development process in 6 steps. In steps 1 to 5 we will write functions. Each function will perform one single task. We will also test our functions as we write code for each one of them. In step 6 we will write `main` function, which will use the functions developed in steps 1 to 5 to accomplish the tasks stated above for our program. There are two data files provided with this lab: `data1.txt` and `data2.txt`. We will use `data1.txt` file for testing. We will use `data2.txt` for the final testing of our code. Numbers in the input file are separated with a new line character. This mean there is one integer number on each line.

Note: Each of the function must be documented with a block of comments. An example block is provided for the function developed in Step 1.

Step 1 (4 Points)

In this step we will write a function (`read_data`) to read data from an input file. It will receive the name of the input file as a parameter and will return a list of numbers. It will complete the task using as follows:

- Open the file for reading
- Initialize an empty list
- Use a definite loop to read each line of the file
 - Convert the line into integer
 - Add the integer to the list
- Close the file
- Return the list

A block of comments before the start of the function will be used to document our function. An example of such a block is as follows:

```
#####  
# Function Name: read_data  
# Description: Reads a set of numbers from an input file.  
# Parameter: file_name - name of the input file  
# Returns list of numbers  
#####  
def read_data (file_name):  
    # Code for the function  
  
    return list_of_numbers
```

Make sure you have similar block of comments before each of the functions that we will develop in this lab. Once you are done with writing the code for the function you can test it as follows:

- Load your program into shell by selecting “Run Module” from Run menu.
- Type `read_data('data1.txt')` in shell to run the function.
- It will return a list of numbers as follows:
[1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
- If it returns a list of `strings` instead of `ints` that mean that you are missing a step in the read process.
- If there are any errors then make sure you fix those errors and run the function again.
- **Once you are satisfied with the result of your step 1, take a screen shot and paste it below.**
- Note: You must complete this step before starting on step 2.

Paste your screen shot below this line

```
===== RESTART: C:/Users/kerry/Desktop/GipKerryLab09.py =====  
>>> read_data("data1.txt")  
[1, 2, 3, 4, 5, 6, 7, 8, 9, 10]  
>>>
```

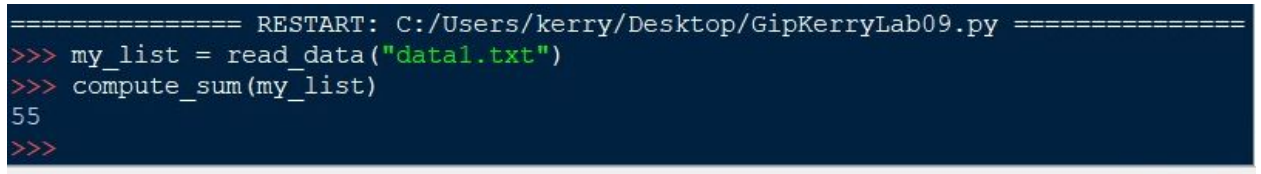
Step 2 (4 Points)

In this step we will write a function (`compute_sum`) to calculate the sum of the numbers in a list. It will receive a list of integer numbers as parameter and will return the sum of the numbers in the given list. It will use a definite loop to add the numbers in the given list.

Once you are done with writing the code for the function you can test it as follows:

- Load your program into shell by selecting “Run Module” from Run menu.
- Type:
`my_list = read_data('data1.txt')`
`compute_sum (my_list)`
- It will return 55
- If there are any errors then make sure you fix those errors and run the function again.
- Once you are satisfied with the result of your step 2, take a screen shot and paste it below.
- Note: You must complete this step before starting on step 3.

Paste your screen shot below this line



```
===== RESTART: C:/Users/kerry/Desktop/GipKerryLab09.py =====  
>>> my_list = read_data("data1.txt")  
>>> compute_sum(my_list)  
55  
>>>
```

Step 3 (4 Points)

In this step we will write a function (`compute_mean`) to calculate the mean of the numbers in a list. It will receive a list of integer numbers as parameter and will return the mean of the numbers in the given list. It will complete the task as follows:

- Use `compute_sum` function to calculate sum of the numbers in the list
- Calculate the size of the list
- Divide sum of the numbers by the size of the list to compute the mean.
- Return the mean of the numbers in the list.

Once you are done with writing the code for the function you can test it as follows:

- Load your program into shell by selecting “Run Module” from Run menu.
- Type:
`my_list = read_data('data1.txt')`
`compute_mean (my_list)`
- It will return 5.5
- If there are any errors then make sure you fix those errors and run the function again.
- Once you are satisfied with the result of your step 3, take a screen shot and paste it below.

- Note: You must complete this step before starting on step 4.

Paste your screen shot below this line

```
===== RESTART: C:/Users/kerry/Desktop/GipKerryLab09.py =====
>>> my_list = read_data("data1.txt")
>>> compute_mean(my_list)
5.5
>>>
```

Step 4 (5 Points)

In this step we will write a function (`compute_sd`) to calculate the standard deviation of the numbers in a list. It will receive a list of integer numbers as parameter and will return the standard deviation of the numbers in the given list. It will complete the task as follows:

- Use `compute_mean` function to calculate mean of the numbers in the list
- Initialize `sum` to 0
- Use definite loop (`for num in list_of_numbers`)
 - Calculate deviation by subtracting mean from the num
 - Calculate the square of the deviation
 - Add the square of the deviation to `sum`
- Calculate the `size` of the list
- Divide `sum` by the **`size-1`** to compute the result.
- Take the square root of the `result` to compute the standard deviation.
- Return the standard deviation of the numbers in the list.

Once you are done with writing the code for the function you can test it as follows:

- Load your program into shell by selecting “Run Module” from Run menu.
- Type:

```
my_list = read_data('data1.txt')
compute_sd (my_list)
```
- It will return 3.0276503540974917
- If there are any errors then make sure you fix those errors and run the function again.
- Once you are satisfied with the result of your step 4, take a screen shot and paste it below.
- Note: You must complete this step before starting on step 5.

Paste your screen shot below this line

```
===== RESTART: C:/Users/kerry/Desktop/GipKerryLab09.py =====
>>> my_list = read_data("data1.txt")
>>> compute_std(my_list)
3.0276503540974917
>>>
```

Step 5 (4 Points)

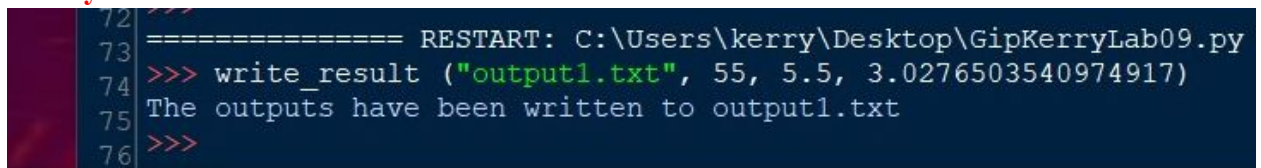
In this step we will write a function (`write_result`) to write the sum, mean, and standard deviation of the given list of numbers to an output file. It will receive name of the output file, sum, means and standard deviation as parameters. It will complete the task as follows:

- Open file for writing
- Write the result (sum, mean, and standard deviation – one per line) with appropriate labels into the file. Make sure you format the numbers to two decimal places.
- Close the file when done.

Once you are done with writing the code for the function you can test it as follows:

- Load your program into shell by selecting “Run Module” from Run menu.
- Type:
`write_result ("output1.txt", 55, 5.5, 3.0276503540974917)`
- The output file will be as follows:
Sum is: 55.00
Mean is: 5.50
Standard Deviation is: 3.03
- If there are any errors then make sure you fix those errors and run the function again.
- Once you are satisfied with the result of your step 5, take a screen shot and paste it below.
- Note: You must complete this step before starting on step 6.

Paste your screen shot below this line



```
72 >>>
73 ===== RESTART: C:\Users\kerry\Desktop\GipKerryLab09.py
74 >>> write_result ("output1.txt", 55, 5.5, 3.0276503540974917)
75 The outputs have been written to output1.txt
76 >>>
```

output1.txt - Notepad

File Edit Format View Help

The sum is: 55.00
The mean is: 5.50
The std deviation is: 3.03

Step 6 (4 Points)

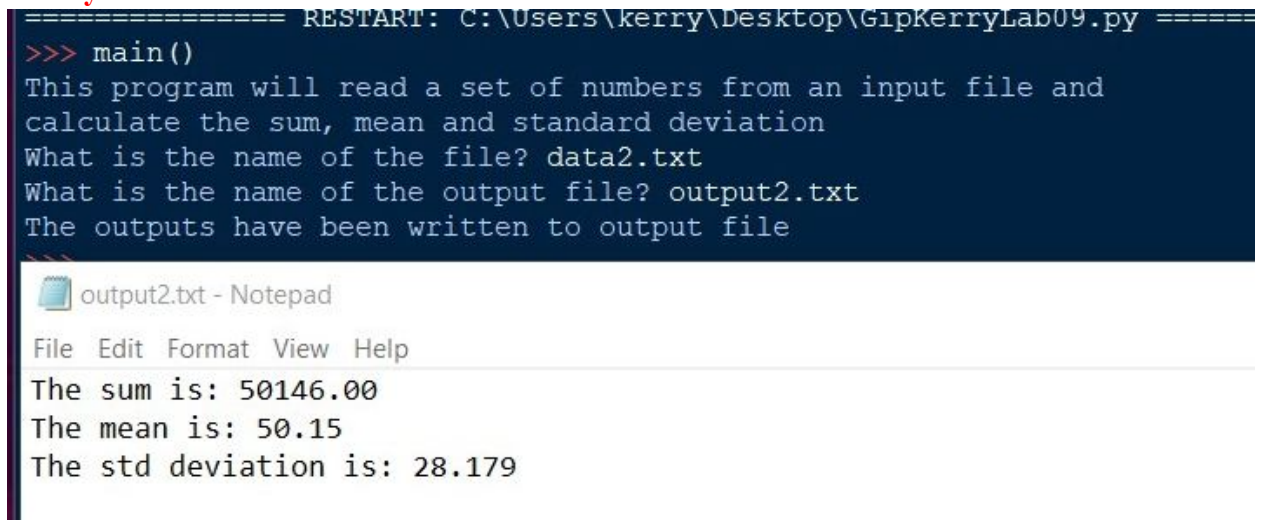
In this step we will write `main` function which will use the functions developed in steps 1 to 5 to read the data from an input file, calculate sum, mean & standard deviation, and write the result to an output file. It will complete the task as follows:

- Ask user for the name of the input file.
- Ask user for the name of the output file.
- Use `read_data` function to read the file.
- Use the `compute_sum` function to compute the sum of the numbers.
- Use `compute_mean` function to compute the mean of the numbers.
- Use `compute_sd` function to compute the standard deviation of the numbers.
- Use `write_result` function to write the result in an output file.

Once you are done with writing the code for the function you can test it as follows:

- Load your program into shell by selecting “Run Module” from Run menu.
- Type:
`main ()`
- It will ask for the name of the input file. Type `data2.txt`.
- It will ask for the name of the output file. Type `output2.txt`.
- The output file will be as follows:
Sum is: 50146.00
Mean is: 50.15
Standard Deviation is: 28.18
- If there are any errors then make sure you fix those errors and run the function again.
- Once you are satisfied with the result of your step 6, take a screen shot and paste it below.

Paste your screen shot below this line



```
===== RESTART: C:\Users\kerry\Desktop\GipKerryLab09.py =====  
>>> main()  
This program will read a set of numbers from an input file and  
calculate the sum, mean and standard deviation  
What is the name of the file? data2.txt  
What is the name of the output file? output2.txt  
The outputs have been written to output file  
=====
```

output2.txt - Notepad

File Edit Format View Help

The sum is: 50146.00
The mean is: 50.15
The std deviation is: 28.179

- Upload this lab handout with required screen shots and the following files:
 - `output1.txt`

- output2.txt
- Your Python code