CS 101 - Algorithms & Programming I

Fall 2022 - Lab 2

Due: Week of October 10, 2022

*Remember the **honor code** for your programming assignments.*
*For all labs, your solutions must conform to the CS101 style **guidelines**!*
All data and results should be stored in variables (or constants where appropriate) with meaningful names.

The objective of this lab is to write basic Java programs that take inputs from the user and generate respective outputs on the console/terminal. The outputs are expected to have a certain formatting to achieve user friendliness. As always, this process will include program design & debugging. Remember that analyzing your problems and designing them on a piece of paper *before* starting implementation/coding is always a best practice.

0. Setup Workspace

Start VSC and open the previously created folder named `labs`. Now, under the `labs` folder, create a new folder named `lab2`.

In this lab, you are to have three Java classes/files (under `labs/lab2` folder) as described below.

1. Ellipse Properties

Create a new/empty file of your own under the `lab2` folder named `Lab02_Q1.java` with a class with the same name that takes two **double** inputs from the user to calculate the area and the circumference of an ellipse. The user inputs are shown with blue color below.

Sample Run

```
Enter length of the semi major axis of the ellipse: 24.1
Enter length of the semi minor axis: 12.3

The area of the ellipse is                :         931.262
The circumference of the ellipse is ~     :         120.213
```

The area of an ellipse is $A = \pi \cdot a \cdot b$, where a and b denote the semi major and semi minor axes of the ellipse. The circumference of the ellipse is a lot more difficult to calculate but an approximation will suffice for the purposes of this exercise: $C \simeq 2\pi \cdot \sqrt{\frac{a^2+b^2}{2}}$. Take π as 3.14159265359.

2. Maintenance Cost of a Car

Create a new/empty file of your own under the `lab2` folder named `Lab02_Q2.java` with a class with the same name. This time your program will take the breakdown of the cost of building a house and will calculate and display the values as a table as exemplified below. According to a June 2020 Home Values report from Zillow,[1] average construction cost for a house in the U.S. is $237,760. The breakdown of these costs are as follows:

- Site Work – $15,903
- Foundations – $25,671
- Framing – $41,123

[1] https://www.zillow.com/home-values/

- Exterior – $33,066
- Utility – $32,746
- Interior Finishes – $67,939
- Outdoor – $16,591
- Unexpected Costs – the rest

The percentages shown indicate the percent of the cost of each construction item. First define appropriate constants to represent the cost of each item in an average house. Changing the value of these **constants** in your code should update the results. Then, calculate the percentages of each item based on these constants. These percentages should also be constants.

Now assuming the user enters the cost of a specific house that may or may not be higher or lower than the cost of an average house, calculate the cost of each item appropriately and output the results as a table. Here we assume the breakdown of the cost to various items is the same percentage wise. Finally, present the results as a table formatted properly as in the example (percentage are integers and amounts are fractional numbers) **without** repeatedly using the space character in the output. Once again, you should not do any calculations yourself but rather have your program do it!

Sample Run

```
Enter the cost of building a house in USD: 300000

************************************************
*****     House Cost Distribution Table     *****
************************************************
* Site Work            %6          20066.03    *
* Foundations          %10         32391.07    *
* Framing              %17         51888.04    *
* Exterior             %13         41721.90    *
* Utility              %13         41318.14    *
* Interior Finishes    %28         85723.84    *
* Outdoor              %6          20934.14    *
* Unexpected Costs     %1           5956.85    *
* TOTAL                          300000.00    *
************************************************
```

3. Strings Incorporated

Create a new/empty file of your own under the `lab2` folder named `Lab02_Q3.java` with a class with the same name. This time your program will take a title as an input from the user and display each one of the following in a separate line. A sample run is given below where the input is highlighted with yellow color. Note that, the entered title has 3 spaces at the beginning and 4 spaces at the end. You can use the **Lang** package's **String** class and its methods. For details about the String class and possible methods to use, see: https://docs.oracle.com/en/java/javase/11/docs/api/java.base/java/lang/String.html.

a) Print number of characters in the string

b) Convert all characters to lowercase and print

c) Remove all leading and trailing white spaces from the string and print

d) Print the character at index 4

e) Print the part of the title from 3rd character to 5th character (both included)

f) Print the index of first occurrence of character 'e'

g) Print the index of last occurrence of character 'e'

Sample Run

```
Enter the title:    Pride & Prejudice
--------------------------------------
Number of characters:24
All lowercase:"   pride & prejudice    "
Remove leading and trailing blank characters:"Pride & Prejudice"
Character at index position 4:'r'
Title from 3rd character to 5th character (both included):" Pr"
First occurrence of character 'P':3
Last occurrence of character 'P':11
```