

CS 5040: Data Structures and Algorithms

Spring 2021

Assignment #1 – Recursion

Develop Java program for each of the following problems. Please **name the programs as indicated** and add proper **program headers** and **output labels** as shown below.

Use only concepts and programming constructs/syntax we discussed in class.

Program name (= Class name) must be same as the java filename.

At first, **design** your strategy of this problem with **recursive thinking**, then write code.

Programming #1 (10 points)

Write your Java program named **StarPatternYourName** as follows. The main method prompts the user to enter a number of rows. Then passes the input string to method printStars(...) to **recursively** print the pyramid stars. You can use recursive helper method if you need it.

Please carefully think about the number of spaces and stars. There is a space between stars.

Format the outputs as follows. Not only for 20, your program should run correctly with the other integers.

Enter Number of Rows : 20

[illegible]

Programming #2 (10 points)

Write your Java program named **VowelsYourName** as follows. The main method prompts the user to enter a string. The main method then passes the input string to method `countVowels(...)` to **recursively** count and then return number of vowels (a, e, i, o, u) in the passed string. Again, method `countVowels(...)` is a recursive method.

Format the outputs as follows. Test data shows values for illustration, user may enter values one per line. Test strings does not show input prompts. User will input it.

Test data:

```
Entered string: This is a test input
Number of vowels:      6
```

```
Entered string: Hello world
Number of vowels:      3
```

```
Entered string: My list of Objects
Number of vowels:      4
```

Document your code, use proper prompts for input, format outputs as shown above, use sound coding practices we learned thus far, do not hard code inputs, allow program re-runs, and test your code thoroughly.

Programming #3 (10 points)

Write a java program (name it **AverageGradeYourName**) as follows: The main method prompts the user to enter number of students in a class (class size is integer value), then prompts the user to enter the grades (between 0 and 100) into an array of type integer. The entered class size determines the array size. Next, the main method passes the filled array to method `findAverage(...)` to **recursively** determine and return the class average as a double value. Again, method `findAverage(...)` is a recursive method.

Format the outputs as follows. Shown input values are just for illustration, user may enter values one per line. Test data does not show input prompts.

Test data:

```
Class size:      3
Entered grades: 100 100 100
Class average:    100.00
```

```
Class size:      7
Entered grades: 50 75 80 80 40 35 85
Class average:    63.57
```

```
Class size:      8
Entered grades: 0 100 25 90 55 30 90 35
Class average:    53.13
```

Document your code, use proper prompts for input, format outputs as shown above, use sound coding practices we learned thus far, do not hard code inputs, allow program re-runs, and test your code thoroughly.

(Spoiler Alert) On the last page, there is a strategy to get average recursively.
Please think yourself first, and check it if you have no idea!

Submission:

Before submitting your programs, make sure you review the assignment submission requirements and grading guidelines on the course webpage. The grading guidelines explain some of the common errors found in programming assignments.

1. The assignment is due no later than **11:59 PM** on the due day posted in D2L.
2. Please compile and run your java files (only the .java files) right before you upload to the assignment submission folder in D2L.



$$\text{Mean}(\{1,2,3,4,5\}) = \frac{\text{Mean}(\{1,2,3,4\}) * 4 + 5}{5}$$



$$\text{Mean}(\{1,2,3,4\}) = \frac{\text{Mean}(\{1,2,3\}) * 3 + 4}{4}$$



$$\text{Mean}(\{1,2,3\}) = \frac{\text{Mean}(\{1,2\}) * 2 + 3}{3}$$



$$\text{Mean}(\{1,2\}) = \frac{\text{Mean}(\{1\}) * 1 + 2}{2}$$

Size Of Array
Element of Array