Practical-03: Arrays and Methods - Part I

Due 25 Aug by 22:00 **Points** 100 **Available** after 11 Aug at 0:00

Submission

Note: all class work must be submitted to your SVN repository. For this practice, you shall use:

```
https://version-control.adelaide.edu.au/svn/axxxxxxx/2019/s2/fcs/week-03/practical-03
```

This assignment has 2 parts. The first part focuses on arrays and methods. The second part focused on using Java to deal with some simple problems.

Problem 01: Arrays & For Loops

In this problem, you are asked to create methods in the class BaseOperations.

```
printArray
You are asked to create a function that performs the printing of a given array;

Signatures:
void printArray(int [] array);
void printArray(String [] array);
void printArray(Float [] array);


Reversing an array

You are asked to create a function that changes the order of the elements of a given array in reverse order;

Signature

int [] reverseArray(int [] array)
String [] reverseArray(String [] array)
float [] reverseArray(float [] array)

Test Case:
array = {1,2,3,4}

printArray(array)
[1,2,3,4]

array = reverseArray(array)
printArray(array)
[4,3,2,1]
```

Problem 02 - Prime Number

In this problem, you are required to ask for user input of a number. Your program should check whether the number is prime or not.

```
Test case:

----------
Please, insert a number: 2
Your number is prime
----------

----------
Please, insert a number: 10
Your number is not prime
----------



Requirements:

* Handle exceptions;
* Handle wrong inputs, such as Strings;
```

Problem 03 - Comparison

In this problem, you are required to ask two number for your user. Write a Program to read the number and to display the largest value between:

```
Test case:

----------
Please, insert a number (1): 2
Please, insert a number (1): 3
The bigger number is 3;
----------

----------
Please, insert a number: 10
Please, insert a number: -55
The bigger number is 10
----------



Requirements:

* Handle exceptions;
* Handle wrong inputs, such as Strings;
```

Problem 04 - Mathematical Operations

A complex number is a number that can be expressed in the form a + bi, where a and b are real numbers, and i is a solution of the equation x2 = −1. Because no real number satisfies this equation, i is called an imaginary number. For the complex number a + bi, a is called the real part, and b is called the imaginary part. Despite the historical nomenclature "imaginary", complex numbers are regarded in the mathematical sciences as just as "real" as the real numbers and are fundamental in many aspects of the scientific description of the natural world. Write a Program to perform the following arithmetic operations of a complex number using a structure.

```
Signature

class name: ComplexCalculator
```

```
4
5   Requirements:
6
7   (a). Addition of the two complex numbers (add)
8
9   (b). Subtraction of the two complex numbers (sub)
10
11  (c). Multiplication of the two complex numbers (multiplication)
12
13  (d). Division of the two complex numbers. (division)
```

Problem 05 - Matrix Determinant

Background: In linear algebra, the determinant is a scalar value that can be computed from the elements of a square matrix and encodes certain properties of the linear transformation described by the matrix. The determinant of a matrix A is denoted det(A), det A, or |A|. Geometrically, it can be viewed as the volume scaling factor of the linear transformation described by the matrix. This is also the signed volume of the n-dimensional parallelepiped spanned by the column or row vectors of the matrix. The determinant is positive or negative according to whether the linear mapping preserves or reverses the orientation of n-space. (This background is not assessable but useful to know in computer science.)

$$|A| = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc.$$

or

$$\begin{aligned} |A| = \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix} &= a \begin{vmatrix} \square & \square & \square \\ \square & e & f \\ \square & h & i \end{vmatrix} - b \begin{vmatrix} \square & \square & \square \\ d & \square & f \\ g & \square & i \end{vmatrix} + c \begin{vmatrix} \square & \square & \square \\ d & e & \square \\ g & h & \square \end{vmatrix} \\ &= a \begin{vmatrix} e & f \\ h & i \end{vmatrix} - b \begin{vmatrix} d & f \\ g & i \end{vmatrix} + c \begin{vmatrix} d & e \\ g & h \end{vmatrix} \\ &= aei + bfg + cdh - ceg - bdi - afh. \end{aligned}$$

In this problem, you are asked to define a multi-dimensional array and perform a matrix determinant operation. Note that due to the complexity of this operation you are required to develop only matrices 2x2 and 3x3. To calculate a determinant you can use the following steps. But you can use any correct method you choose.

- Set the matrix (must be square).
- Reduce this matrix to row echelon form using elementary row operations so that all the elements below diagonal are zero.
- Multiply the main diagonal elements of the matrix - determinant is calculated.

Here is an example of how your program should behave:

```
1  Welcome to Matrix Determinant Calculator!
2  Would you like to calculate the determinant of a new matrix?
3  1. Yes, 2. No
4
5  Option: 1
```

```
What is the dimension of the matrix?
Input: 3x3
```

```
Great! Let's calculate this determinant then.
Please insert all the values for your matrix.

New matrix [1][1]: 12
New matrix [1][2]: 151
New matrix [1][3]: 12

...

New matrix [3][1]: 1
New matrix [3][2]: 22
New matrix [3][3]: 22
```

```
The determinant of your matrix is:

|  12, 151, 12 |
|    1,     1,   1 |
|    1,   22, 22 |

Determinant: -2919
```

Good luck!

Basic Marking Scheme		
Criteria	**Ratings**	**Pts**
Compilation In order to achieve full marks - your code must compile and run;		20.0 pts
Basic Functionality Your code (1) perform all the functions correctly, (2) use latest concepts learned in class, (3) has a clear, creative and sophisticated way of solving the problem.		40.0 pts
Functionality Extension Your code (1) perform all the functions correctly, (2) use latest concepts learned in class, (3) has a clear, creative and sophisticated way of solving the problem, and (4) you propose novel ways to solve the problems - or extra functionalities.		10.0 pts
Code Formatting Your code (1) has the right proportion of comments and place line and block comments correctly, (2) follow correct indentation every new indentation level, (3) has good variable naming, (4) has clear organization between tabs and is easy to read.		30.0 pts
		Total points: 100.0