

## Programming Assignment – A

Submit your assignment as a report. You need to do the following for each of the problems to get full points.

- 1) Describe the workings of your code and challenges that you encountered during your program development. [ 3 points ]
  - 2) Program listing with line numbers. [ 10 points ]
  - 3) Create at least 5 test cases and report their output. [ 7 points]
- 

### 1. Quadratic Equation [20 points]

Write a Java code that calculates the roots  $p$  and  $q$  of a quadratic equation  $ax^2 + bx + c = 0$ , where  $a, b$  and  $c$  are real numbers. Using different cases validate the following equations:

$$p + q = -\frac{b}{a},$$

and

$$pq = \frac{c}{a}.$$

### 2. Needle in a Haystack [20 points]

You are given a small string called **needle** and a long string called **haystack**.

- (1) Write a Java program that will find the number of occurrences of a needle in the haystack. If there is no needle you return 0. Make your search case insensitive. You **cannot** use string library method called contains().
- (2) Show the computation **time** (use System.currentTimeMillis()) for different needles and different haystacks.

#### Example:

Haystack = The western American city of San Francisco, California suffered a huge earthquake on April 18th, 1906. More than three thousand people are known to have died. The true number of dead will never be known. Two hundred fifty thousand people lost their homes. Just a few hours after the terrible earthquake, a magazine named Collier's sent a telegraph message to the famous American writer Jack London. They asked Mr. London to go to San Francisco and report about what he saw.

Needle = "earthquake" and Ans: 2

Needle = "San Francisco" and Ans: 2

### 3. Random Matrix [20 points]

You will create a general NxM matrix where N = number of rows and M = number columns that are specified by the user. Write a generic class of matrix that accepts user-defined N and M as input parameters and generates a random matrix. Each cell of the matrix is a random number.

**Example 1:** Consider a 2x2 matrix:  $A = \begin{pmatrix} 23 & 54 \\ 98 & 97 \end{pmatrix}$  where  $A[i][j]$  is a random number between (0,99).

**Example 2:** Consider a 3x3 matrix  $A = \begin{pmatrix} 54 & 43 & 76 \\ 12 & 98 & 34 \\ 38 & 43 & 62 \end{pmatrix}$  where  $A[i][j]$  is a random number between (0,99).

Thus generate a random matrix **A**. Similarly you can generate matrices of other dimensions by specifying user values N and M. Perform your operations on these matrices.

**Note:** Your input data should come from a file, and each file should have two rows as shown below:

---

```
columns =3
rows=3
```

---

Design and write Java codes that solves the following:

- Matrix Addition (2x2, 3x5)
- Matrix Multiplication (2x2, 3x5)

Show your results with at least two examples of each.

#### 4. Find Sorted Indexes [20 points]

Implement a Java method that sorts your list/array and returns the sorted array and the original positions of the unsorted array.

**Example:**

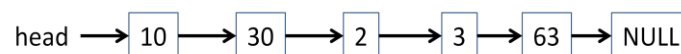
```
Unsorted Array = {10, 30, 2, 3, 63}
Sorted Array = {2, 3, 10, 30, 63}
Sorted Indexes = [2,3,0,1,4]
```

#### 5. Linked List in Java [20 points]

Write a Java method called reverseLinkedList that will take a Linked list and return a reversed linked list.

*LinkedList reverseLinkedList ( LinkedList head );*

**Example:** Create a list from a set of numbers in the following order {10, 30, 2, 3, 63} as shown below.



Take this list and reverse it. Reversed list will be as follows.

