American University of Armenia, CSE
CS110 Intro to CS Sections A, D
Fall 2021

Homework Assignment 5 (100 pts.)

Deadline: Thu. Dec. 7th, 2021 9:00 AM (Before class)

- Please upload your submissions as zip files containing js **or** py files to Moodle
- Include links and references to the resources you have used with your answers
- Instances of academic dishonesty will result in the forfeiture of your entire submission.

1. (15 pts) Write a function that calculates and returns the Euclidean distance between two n-dimensional points, p1 and p2. These points are arrays of coordinates (e.g. `p1 = [x1,y1,z1]` and `p2 = [x2,y2,z2]`). Assume they always come in correct and matching lengths.

```
calculateDistance (p1, p2)
```

2. (15 pts) Write a function that returns 2 if its parameter M is a square matrix, 1 if M is rectangular but not square, 0 if M is a ragged two-dimensional array. Return -1 if m is not a 2D array.

```
determineMatrixType (m)
```

3. (15 pts) Write a function that returns the transpose of a given matrix. This function should first verify that the argument is a rectangular matrix using the function from p2 and return null otherwise. The result must be stored in a new matrix and the original argument matrix must be left intact.

```
Input:                  Output:

1   2   3   4           1   5   9
5   6   7   8           2   6   10
9   10  11  12          3   7   11
                        4   8   12
```

The transpose of a matrix is a matrix that has been “flipped over” its diagonal. The rows become columns and the columns become rows.

4. (15 pts) Create a function that has a parameter N, with N being an odd number and returns an N × N matrix filled with numbers, arranged in a spiral pattern.

```
Example. 3

9   2   3
8   1   4
7   6   5
```

```
Example. 5

25  11  11  12  13
24  9   2   3   14
23  8   1   4   15
22  7   6   5   16
21  20  19  18  17
```

5.a. (15 pts) Create a pair of functions for saving and loading matrices to and from text files. The first function, `saveMatrixToFile(matrix, path)`, writes the contents of the argument matrix into a file located at the given path.

5.b. (15 pts) The second, `loadMatrixFromFile(path)` function, returns a matrix filled with the contents of a file that has been created using the function from p5.a. Ensure that they remain compatible with each other.

5.c. (10 pts) Write a demo program that illustrates the use of these functions, e.g. creates a matrix, saves it inside a file, loads that same matrix from that file and performs integer operations on its values after determining the shape. See bonus.

BONUS (15 pts). Create a dedicated library package for your save and load functions and use that library for the demo program in 5.c.

BONUS (15 pts). Upload your library to a git repository and include the link in your submission in addition to your files. GitHub and BitBucket are popular choices and are free to use.