Istanbul Medipol University
School of Engineering and
Natural Sciences
Computer Engineering

Spring 2022 – Assignment #2
Introduction to Programming
Assignment Date: 14.05.2022
Due Date: 21.05.2022

Programming Assignment #2

(Use a jupyter notebook to solve the following NumPy exercises)

Question I (60 pts):

Q1.1. (8 pts) Write a NumPy program to get the following array by using loops

Output:

```
array([[ 1,  2,  3,  4,  5,  6,  7,  8,  9],
       [ 2,  4,  6,  8, 10, 12, 14, 16, 18],
       [ 3,  6,  9, 12, 15, 18, 21, 24, 27],
       [ 4,  8, 12, 16, 20, 24, 28, 32, 36],
       [ 5, 10, 15, 20, 25, 30, 35, 40, 45],
       [ 6, 12, 18, 24, 30, 36, 42, 48, 54],
       [ 7, 14, 21, 28, 35, 42, 49, 56, 63],
       [ 8, 16, 24, 32, 40, 48, 56, 64, 72],
       [ 9, 18, 27, 36, 45, 54, 63, 72, 81]])
```

Q1.2. (8 pts) Write a NumPy program to generate a 4-by-4 array filled with *random* integers between 5 and 35.

Sample output (your output should be different):

```
[[12 16 10 15]
 [ 9 25 27 22]
 [30 25 11 15]
 [ 8 32 20 26]]
```

Q1.3. (8 pts) Write a NumPy program to fill a 2-by-3 array with ones, a 3-by-3 array with zeros and a 2-by-5 array with 7s.

Outputs:

```
array([[1., 1., 1.],
       [1., 1., 1.]])
```

```
array([[0., 0., 0.],
       [0., 0., 0.],
       [0., 0., 0.]])
```

```
array([[7, 7, 7, 7, 7],
       [7, 7, 7, 7, 7]])
```

Q1.4. (8 pts) Create a 3-by-3 array containing the even integers from 2 through 18. Create a second 3-by-3 array containing the integers from 9 down to 1, then perform an elementwise multiplication of the first array by the second.

Outputs:

```
array([[ 2,  4,  6],
       [ 8, 10, 12],
       [14, 16, 18]])
```

```
array([[9, 8, 7],
       [6, 5, 4],
       [3, 2, 1]])

array([[18, 32, 42],
       [48, 50, 48],
       [42, 32, 18]])
```

Q1.5. (18 pts) Create an array containing the values 1–15, reshape it into a 3-by-5 array, then use indexing and slicing techniques to perform each of the following operations:

Input Array:
array([[1, 2, 3, 4, 5],
[6, 7, 8, 9, 10],
[11, 12, 13, 14, 15]])

a. Select row 2.
Output:
array([11, 12, 13, 14, 15])

b. Select column 4.
Output:
array([5, 10, 15])

c. Select the first two columns of rows 0 and 1.
Output:
array([[1, 2],
[6, 7],
[11, 12]])

d. Select columns 2–4.
Output:
array([[3, 4, 5],
[8, 9, 10],
[13, 14, 15]])

e. Select the element that is in row 1 and column 4.
Output:
10

f. Select all elements from rows 1 and 2 that are in columns 0, 2 and 4.
Output:
array([[6, 8, 10],
[11, 13, 15]])

Q1.6. (10 pts) Write a NumPy program to calculate the maximum, minimum, mean and standard deviation of values of the following matrix along the second axis.

Original array:
[[10 10 90 90]
[40 40 60 60]
[55 55 65 65]
[10 30 60 90]]

The maximum and the minimum values of the array along the second axis:
[10 40 55 10] [90 60 65 90] [50. 50. 60. 47.5]

The standard deviation of the array along the second axis:
[40. 10. 5. 30.31088913]

Question II (40 pts):
In this question, you are going to write a program that computes matrix operations using NumPy. The program reads values of matrices A, B, and C stored in a file called inputs.txt. This file should be placed under current directory where you have the program. The first line before each matrix contains the number of rows and the number of columns as shown below.

<Input>
4 4
55 55 55 56
66 66 66 67
77 77 77 78
88 88 88 89
4 4
1 2 3 4
2 2 2 2
3 3 3 3
4 4 4 4
4 4
11 12 13 14
22 24 24 25
33 34 35 36
44 45 46 47
<End Input>

As a first step, the program reads data for matrices A, B and C from inputs.txt file and write them into console. A fourth matrix D is generated randomly.

The program will calculate S = (A+B) * Transpose(C) + D) – A and find the maximum element in S. Complete the code given above so that it will produce an output like as follows:

<Output>
```
Reading data from inputs.txt file in current directory

 **** Matrix A ****
   55    55    55    56
   66    20    12    67
   77    15    25    78
   88    12    13    89

 **** Matrix B ****
    1     2     3     4
    2     2     2     2
    3     3     3     3
    4     4     4     4

 **** Matrix C ****
   50    12    75    14
   55    24    24    25
   33    34    35    36
   44    45    46    47

 **** Matrix D ****
   19    46    14    61
```

```
  54    81    91    34
  46    60    95    40
  52    74    95    31

 *** Computing S = (A+B) * Transpose(C) + D) - A ***

 **** MatriX T1 = (A+B) ****
  56    57    58    60
  68    22    14    69
  80    18    28    81
  92    16    17    93

 **** Matrix T2 = Transpose(C) ****
  50    55    33    44
  12    24    34    45
  75    24    35    46
  14    25    36    47

 **** Matrix T3 =(A+B) * transpose(C) ****
 8674  7340  7976 10517
 5680  6329  5966  7869
 7450  7529  7148  9425
 7369  8177  7523  9921

**** Matrix T4 =(A+B) * transpose(C)+ D ****
 8693  7386  7990 10578
 5734  6410  6057  7903
 7496  7589  7243  9465
 7421  8251  7618  9952

**** Matrix S =(A+B) * transpose(C) + D - A ****
 8638  7331  7935 10522
 5668  6390  6045  7836
 7419  7574  7218  9387
 7333  8239  7605  9863

Maximum Element in S = 10522
```

<End Output>

Submit your program code as .ipynb file (like COE-64160099-KAYA-A2.ipynb), python .py file (like COE-64160099-KAYA-A2.py) and html (like 64160099-KAYA-A2.html) file. Put all files inside of a ZIP file (64160099-KAYA-A2.zip)

To obtain .py file, select

- *File / (Export Notebook As.. / Export Notebook to Executacle Script* (if you are using Jupyter lab)
- *File / Download as / Python (.py)* (if you are using jupyter)

after completing your solution using Jupyter notebooks.

To obtain .html file, select

- *File / (Export Notebook As.. / Export Notebook to HTML* (if you are using Jupyter lab)
- *File / Download as / HTML (.html)* (if you are using jupyter)

after completing your solution using Jupyter notebooks.

The first cell of the notebook should contain information about you as follows:

[1]:
```
##############################################################################
#  Name:         Ali Cokcalışır
#  Student ID:   6321211
#  Department:   Computer Engineering
#
#  Assignment ID: A2
##############################################################################
```

[2]:
```
import numpy as np
```