EE-527: Machine Learning Laboratory **Due Date : 16 Jan 2023**

Assignment 1: Python Basics

1. Print 'Hello World!'.
2. User input two numbers a and b. Perform the following algebraic operations c = a+b, d= a-b, e= a*b, f=a/b and g=a%b and print their results.
3. Print the factorial of a positive number 'a' given as a user input.
4. Write a function to print all prime numbers in an interval [a,b]. Interval is to be obtained as a user input.
5. User input two numbers a and b. Print their lowest common multiple (LCM).
6. Create a list of length n = 15. Sort in descending order and print the sorted list as well as the sorted indices. Use bubble sort algorithm.
7. Repeat the previous program for sorting in ascending order. Use numpy array instead of list.
8. Print a matrix $M \in \mathbf{R}^{m \times n}$ having random values in the given range [-2, 5]. m and n are to be given as a user input.
9. Program to multiply two random matrices $M1 \in \mathbf{R}^{m \times n}, M2 \in \mathbf{R}^{n \times p}$ (Don't use built-in functions). Compare the result obtained with the built-in function.
10. File operations :write
    - Generate a set of n=100 random points $\mathbf{X} = \{\mathbf{x}_i\}, i = 1, \ldots n, \mathbf{x}_i \in \mathbf{R}^{10}$
    - Write the points to a csv (https://en.wikipedia.org/wiki/Comma-separated_values) file
11. File operations:read
    - Read the csv (https://en.wikipedia.org/wiki/Comma-separated_values) file generated in the previous program to a matrix. Each column of the matrix should represent a vector
    - Compute the following: $\mathbf{C} = \frac{1}{n} \sum_{i=1}^{n} (\mathbf{x}_i - \mu)(\mathbf{x}_i - \mu)^T$, where $\mu = \frac{1}{n} \sum_{i=1}^{n} \mathbf{x}_i, i = 1, \ldots n, \mathbf{x}_i = [x_{i1}, \ldots x_{i10}]^T$ is a column vector
12. Define a class for a complex number $a + jb$. Define memeber functions to do basic operations conjugate, absolute value, addition, subtraction, multiplication, division and angle. Define two complex numbers $c1, c2$ and print the results of the following operations $c1 + c2, c1 - c2, c1 * c2, c1/c2$, $|c1|, |c2|, \angle c1, \angle c2$.
13. Plot the function $y = 3x + 2$ with $x \in [-10, 10]$.

14. Scatter plot
    - Generate a set of $n = 100$ points, $\mathbf{X} = \{\mathbf{x}_i\}, i = 1, \ldots n, \mathbf{x}_i \in \mathbf{R}^2$ within an ellipse $\frac{(x-\mu_x)^2}{a^2} + \frac{(y-\mu_y)^2}{b^2}$ centered at $[\mu_x, \mu_y] = [5, -5]$ and has a major axis $2a = 10$ and minor axis $2b = 5$
    - Scatter plot all the points.