IDC101-Introduction to computers (Python programming)

Lab tasks – **Session 09** January 16-17 2023

- Name your Colab sheet as rollNo-WS-No.ipynb (for example, if you are making colab sheet for WS9 then it should be named as: rollNo-WS-09.ipynb)

Learn to use:

- Importing matplotlib.pyplot and plotting simple scatter and line plots.
  Example:

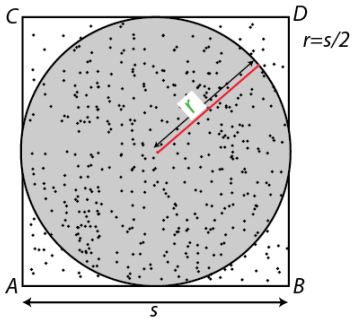
```
import matplotlib.pyplot as plt
import math
X = range(-10,10)
Y = []
for i in X:
      Y.append(X**2)
plt.plot(X,Y) ## explore option to change line color and its
thickness
plt.xlabel('Value of x')
plt.ylabel('Value of y')
plt.show()
```

Finish all previous python Lab tasks

Q1. Estimating the value of $\boldsymbol{\pi}$ using Monte Carlo simulation. Consider a square of unit length and inscribe a circle within square where diameter (*d*) of circle is equal to side (*s*) of square (see figure). Put a point (x,y) randomly in such a diagram and find the ratio of number of points within a circle to number of points generated in the square. The value of $\boldsymbol{\pi}$ is calculated by:

a. Use random module for generating random numbers between two numbers.
b. Generate coordinate (x,y) using random number generator where x and y are within limits of square (within A,B,C,D) coordinates.
c. A point is defined to be in circle if
   $x^2+y^2 \leq r^2$
d. Get value of $\boldsymbol{\pi}$ using equation

$$\pi = 4 * \frac{number\ of\ points\ in\ the\ circle}{number\ of\ points\ in\ the\ square}$$



Write a function to estimate value of pi by varying the number of random number generated (N).

Q2. Simulate random walk in 1-D. Assume the starting position is at x=0, one can randomly choose to take steps either (-1,0,1) in the x-dimension. After N=100 steps, calculate how far is one from starting position. Repeat this P number of times (P=1000) and find average distance from the starting positions. Try to plot the random walk positions with steps for 100 steps. Plot end points after 1000 walks.

Q3. Evaluate the function given in **eq-1** at x=4.625 using rounding the number to 3-decimal places. Determine the fractional relative error (eq-2) using truncating and rounding off method (round-up). The true value (exact value) can be calculated using calculator. You should truncate/round-off at each powers of x.

$$f(x) = 4.25x^3 - 5.7x^2 + 4.2x + 2.0 \qquad \text{eq-1}$$

Relative error = ((Approximate value – True value)/True value) eq-2

Q4. In absence of true (exact) value, the approximations are made iteratively. Here, the error is approximated as the change in the approximate error from one iteration to the next given by **E**=f(i+1)-f(i). The relative approximate error is given by: **E**/f(i)*100. The initial value of f(i) at 0 is given as f(0) =1. Find the approximate value of $\boldsymbol{e^x}$ given by eq-3.

$$\boldsymbol{e^x} = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \cdots. \qquad \text{eq-3}$$

Calculate value of e^1, $e^{0.1}$, $e^{0.25}$ till 10^{th} term and report the relative approximate error.