IC152: Assignment 7
Matrices and Probability

You must keep filenames as mentioned in the assignment since the assignments will be auto evaluated via a script. There are 5 problems.

Problem 1: Matrices

a. Write a python script to generate two random matrices and create text files MatA.txt and MatB.txt to save two different matrices.
   i. Take the number of rows and number of columns as command line arguments: r1 c1 r2 c2. r1 and c1 are rows and columns of the first matrix, r2 and c2 of second.
   ii. Each line of the files should have space separated row elements, and line number should represent row number. So, the format of the files will be (a(i,j) means value at ith row and jth column):

rows, columns
a(1,1) a(1,2) a(1,3) . . . a(1,c)
a(2,1) a(2,2) a(2,3) . . . a(2,c)
.
.
.
a(r,1) a(r,2) a(r,3) . . . a(r,c)

For example: a 2 × 3 matrix can be saved as:-
2 3
1 4 9

4 6 7

Save the python filename as problem1a.py.

b. Create two files using previous code (try different inputs for this question). Take two input files via command line arguments, perform matrix operations. Using numpy, perform addition and multiplication of the two matrices and save them in files with name “addOp.txt” and “multOp.txt” in same format as in previous part (a). Give an appropriate error message if the matrices are not compatible and handle corner cases.
Save the python filename as problem1b.py.

Problem 2: Write a Python script to solve system of Linear Equations Ax=B, where A is a N X N matrix with N <=3 and B is N X 1, as follows (use gaussian elimination or numpy.linalg library):

Take input matrices A and B from the user in the form of files, with their names as two command line arguments similar to inputs in problem 1b.

a. Check for the nature of the solution (No solution, Unique solution, Infinite solutions). Save the nature of the solution in the first line of file “problem2aOp.txt”. Save the python filename as problem2a.py.
b. Solve the System of Linear Equations with Numpy. In case of unique solutions or infinite solutions, save one of the valid solutions in “problem2bOp.txt” in the same format as of problem 1a. Save the python filename as problem2b.py.

Problem 3: Statistical Regularity and Central Limit Theorem

a. Consider an experiment where you pick up a ball at random out of four balls having numbers 0, 1, 2, and 3. Simulate the experiment of 50 trials using a random package (random.randint(0,3)) and plot the relative frequency of each observed value vs number of trials. Then repeat the experiment 500 times. Then repeat the experiment 5000 times and 50000 times. Save the three plots as problem3a_50.png, problem3a_500.png, problem3a_5000.png, and problem3a_50000.png. Share your observations with the lab TAs or lab Instructor.
   Save the python filename as problem3a.py.
b. Central Limit Theorem states that the distribution of sample means approximate the normal distribution as sample size gets larger. Plot the histograms of sample means (observed values) of 5 trials in the previous experiment, by repeating it 50000 times and verify. Save the plot as problem3b_5_50000.png.

   Run the code with 50 trials instead of 5 in each repetition of 50000. Save the plot as problem3b_50_50000.png.

   Share your observations with the lab TAs or lab Instructor.
   Save the python filename as problem3b.py.

Create the folder having your python files and inputs/outputs, with name having your roll number followed by "_assignment7" (don't use inverted commas in folder name), compress the folder with .zip extension and submit it on moodle.

Important: If you copy the assignment or any of its parts from others or share with others, our plagiarism softwares will catch it and you will be awarded 0 marks for the whole assignment or F grade for the course.