CS/DSA 4413 Algorithm Analysis,

Take Home Exam, Due on NOV 21, 2019

1. a) Write a program to generate N-pairs (u_i, v_i), $1 \le i \le N$ uniformly distributed in the range [0, 1). Plot these N pairs on a unit square where the i^{th} point has coordinates (u_i, v_i), $1 \le i \le N$ and $N = 10^3$.

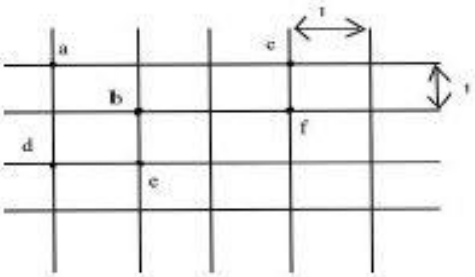
   b) Using the Monte Carlo method used in the class, estimate the value of $\pi/4$ using N pairs of samples: $N = 10^3, 10^4, 10^5, 10^6$. Plot the estimates vs N.

2. Derive a recurrence for the number P(n) of ways of parenthesizing an expression with n atoms. Compute and plot P(n) vs n for $2 \le n \le 20$.

3. Derive a recurrence for the average number L(n), of rounds needed to elect a leader in a city with n people. Compute and plot L(n) vs n.

4. Derive a recurrence for the average case complexity of Quick-Sort. Solve the resulting recurrence.

5.



- Consider a set of six cities named a through f laid out on a uniform grid of grid length being unit in both X and Y directions.
- Compute the pair-wise distances between (6 x 5)/2 = 15 distinct pairs of cities and build the 6 x 6 symmetric, weight matrix.
- Compute the MST and its cost using the two methods discussed in the class.
- Compute all pair shortest paths between these six cities.

Remarks

1. Each question carry 10-points.
2. You need to write a program to solve all problems except problem 4.
3. Need to plot all the results using the computer.
4. Attach a copy of your program with a time-stamp of when you ran the program.
5. An example: Distance between a and f:

$$d(a, f) = (1^2+3^2)^{1/2} = \sqrt{10}$$