DSSC 221 – Probability and Statistics
Lab 3

The problem, which being stuck behind vehicles waiting to take a left turn, provides a good setting for combinatorics problems.

1. Suppose there are 10 cars waiting at an intersection in a single line, and 4 of them are left turners. The vehicles are equally likely to be in any order. Use *Python* to calculate the probability that:
    a. The first four vehicles are all left turners.
    b. None of the first four vehicles are left turners.
    c. No non-left-turning vehicle has more than two left turners in front of it.

2. Verify your calculations in (1) using a small Python *simulation*.
    a. Create a vector of 10 random numbers. Imagine 1 stands for the first vehicle in line at the intersection, 2 stands for the 2nd vehicle, etc. (Hint: Use 'rand' function of numpy)
    b. Use b) to randomly choose which of the 10 vehicles are left turners. For example the left-turners could be the vehicles whose associated random numbers are the smallest. (Hint: Use 'sort' function of numpy)
    c. For this set of left turners, determine whether each of the events identified in Problem 1 is correct, record the results in three binary variables, one for each of the three events.
    d. Repeat the above steps 10,000 times and estimate the probabilities for the three events (in Problem 1) from your results.

3. **Challenge Question (Extra pts.)** - Revise the codes developed in 1 and 2 so that they can handle any number *n* of total vehicles and any number of left turners, *l*, up to *n*. Save the python function as simulation.py. Show solutions for
    a. n=15,l=6
    b. n=20,l=8
    c. n=50,l=20

4. Define the random variable *X* to be the largest number of left-turners in front of any non-left turner. They need not be directly in front, just somewhere between the non-left-turner and the front.