CX4230 - Computer Simulation

Project 2C - Campus Evaluation Results

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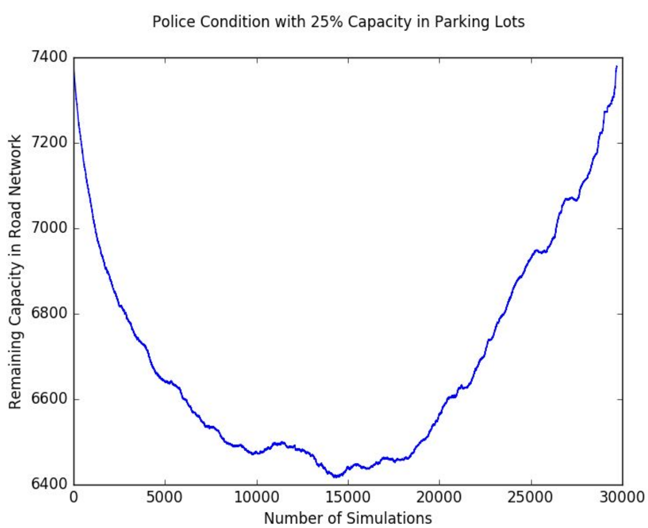
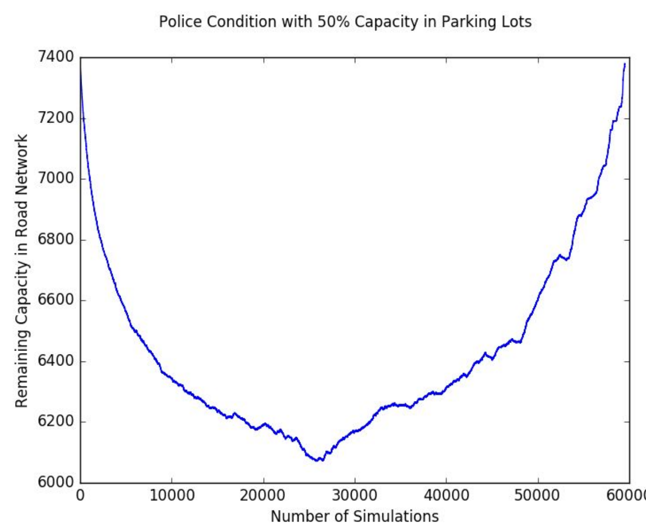
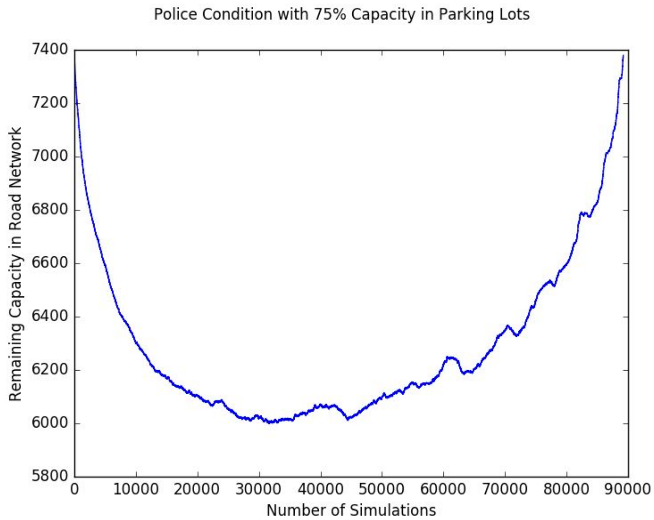
For the Campus Evaluation project, several experiments were run to simulate three overall conditions, including the police direct driving condition at every intersection, no westward driving condition, and a random driving condition. Additionally, car size was varied among the three sizes, including 7-ft, 15-ft, 30-ft, to see if size really made a difference. Also, several graphs were created showing car driving paths under a few different simulations, including police condition with a few cars from each parking lot, no westward condition with one car from one parking lot, and random condition with one car from one parking lot. One thing to note is that the capacity of the entire map is approximately 7,391 cars for a 15-ft car size.

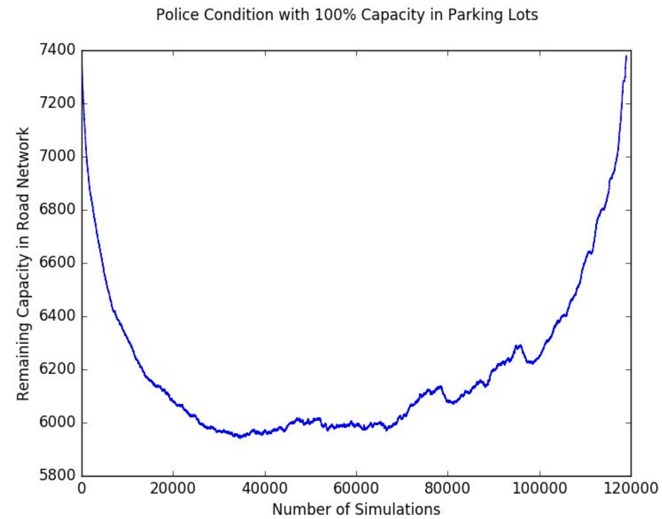
<u>Police Direct Driving Condition:</u>

The below four charts represent the police direct driving condition at every intersection with a range of capacities for all parking lots from 25% to 100% full. As the parking lot capacity is increased, simulations are increased and the remaining capacity left in the road network is lowered as well to a point. The remaining capacity on the network is lowered down to 5,900 remaining capacity and runs out to a maximum number of simulations of 120,000.



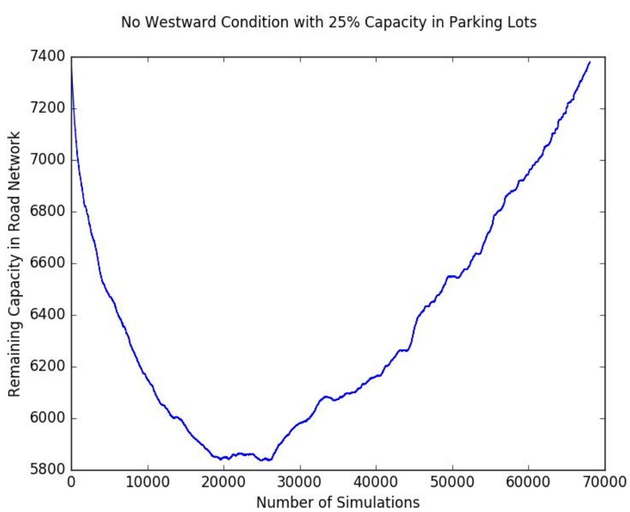


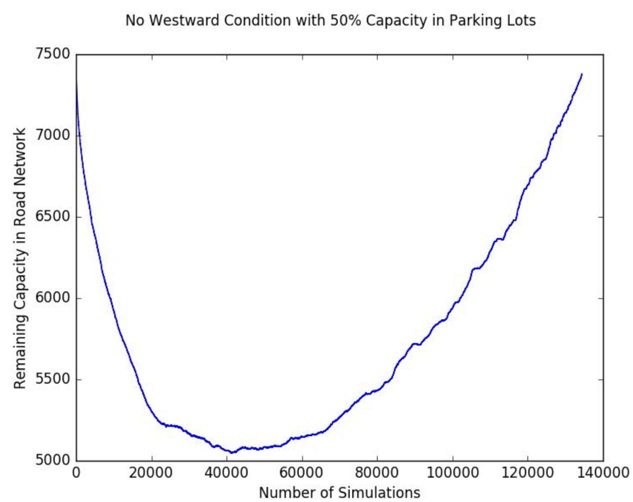


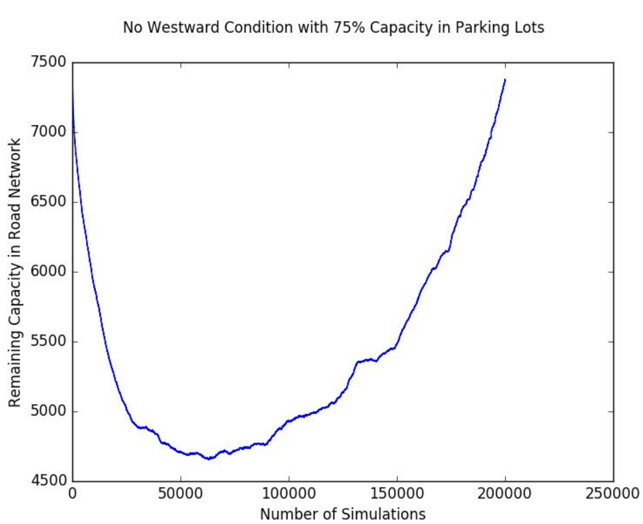


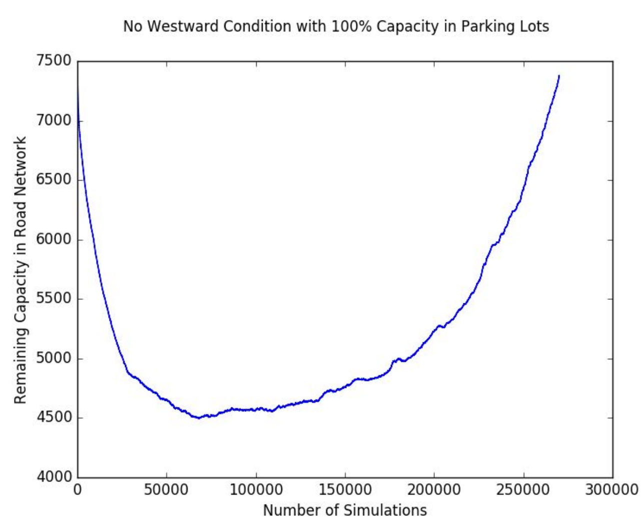
<u>No Westward Driving Condition:</u>

The below four charts represent the no westward driving condition at every intersection with a range of capacities for all parking lots from 25% to 100% full. As the parking lot capacity is increased, simulations are increased and the remaining capacity left in the road network is lowered. This model goes down to a minimum of a remaining capacity of 4,500 cars on the road network. The model also runs out to a maximum of 275,000 simulations.



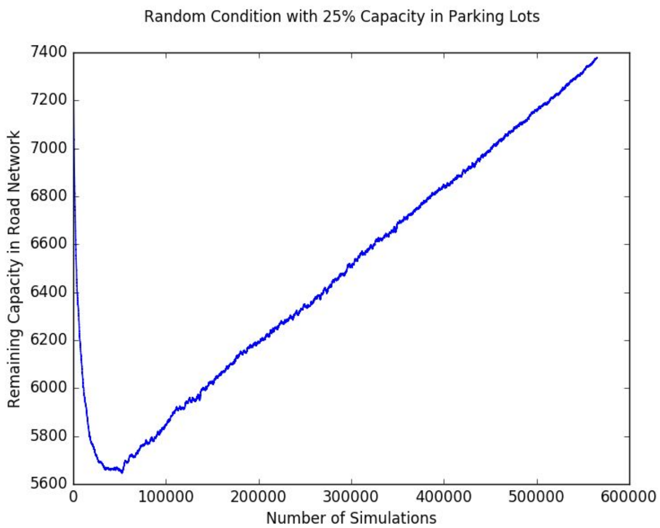


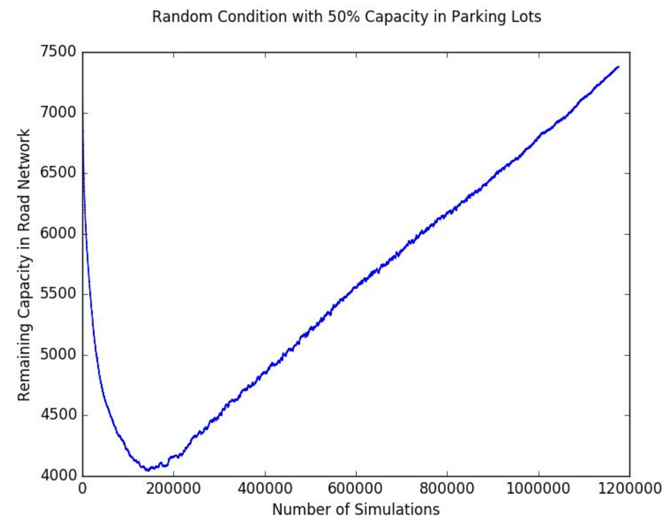


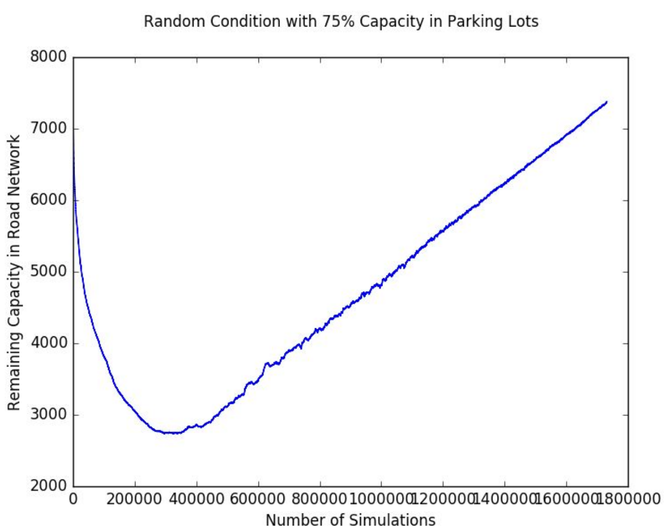


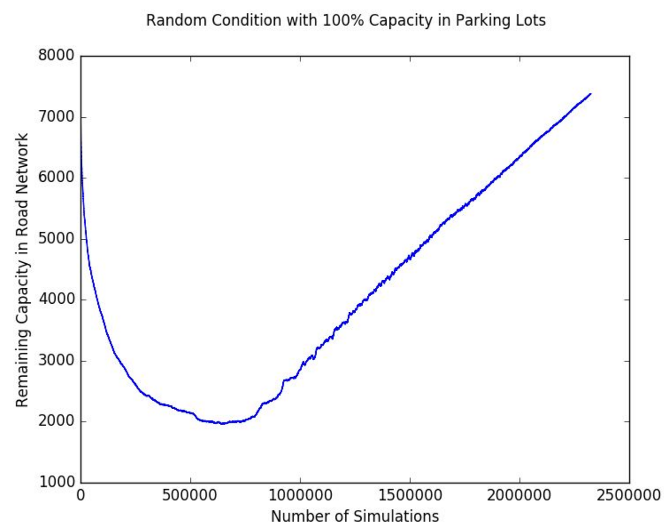
Random Driving Condition:

The below four charts represent the random driving condition at every intersection with a range of capacities for all parking lots from 25% to 100% full. As the parking lot capacity is increased, simulations are increased and the remaining capacity left in the road network is lowered. This model goes down to a minimum of a remaining capacity of 2,000 cars on the road network. The model also runs out to a maximum of 2,250,000 simulations.







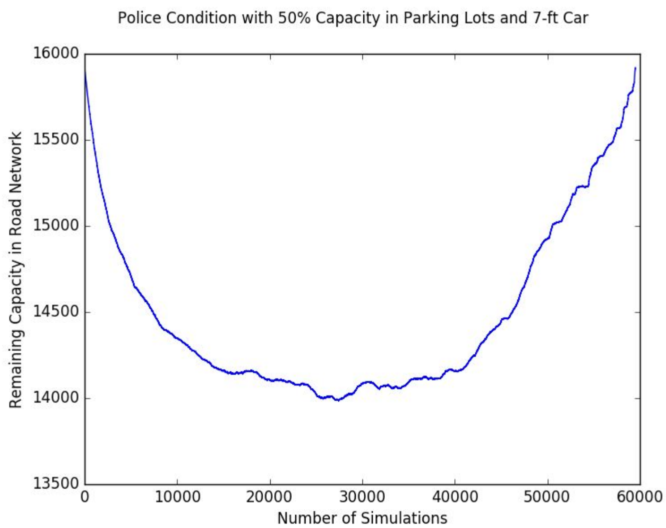


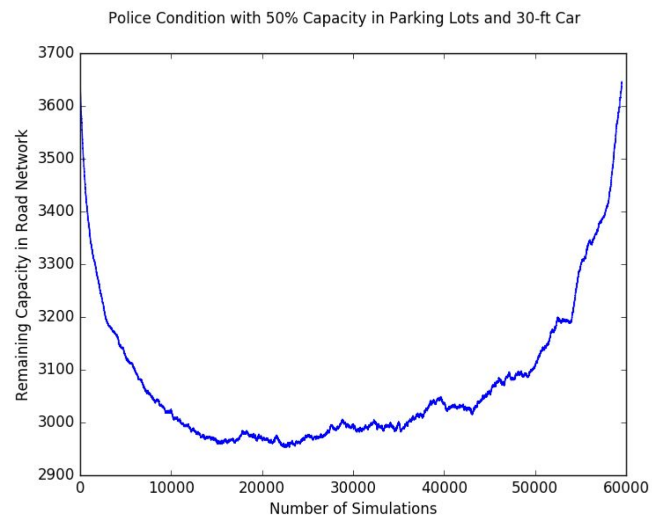
Analysis of Driving Conditions:

For an effective evacuation plan, the police direct driving option or a no westward movement driving option would simulate more of a real life situation. The police option is roughly two to three times more effective at getting traffic out of campus than a no westward driving option. This brings out how important it is to keep people informed of what's going on. Granted this map was closed off and forced cars to drive around forever until exiting eastward via the three exits, it still represents a chaotic situation that could partially insue without proper direction of cars or informing where the disaster is on campus. The random option is approximately 19 times worse than the police option and 8 times worse than the no westward driving condition.

Different Size Cars Police Direct Driving Condition:

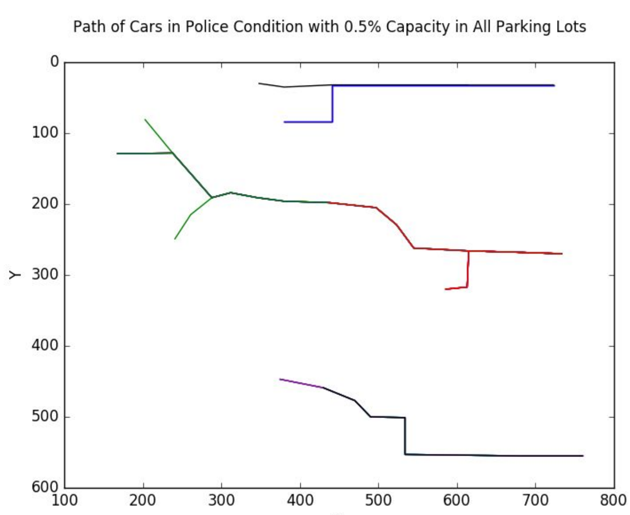
Two scenarios were looked at with all parking lots 50% full via the police direct driving condition and having the car sizes be 7-ft (motorcycle) and 30-ft (GT bus), instead of the standard 15-ft length that was used in the above driving conditions. In the 7-ft car size scenario, the capacity of the roads goes up because of the size of car goes down, but the same number of simulations is required as the 15-ft car size scenario because of the remaining capacity in the roads and car size are proportional to each other. As either one goes up, the other one goes down and vice versa. So effectively cars get through the system the same number of simulations. The same thing happens in the 30-ft car scenario.

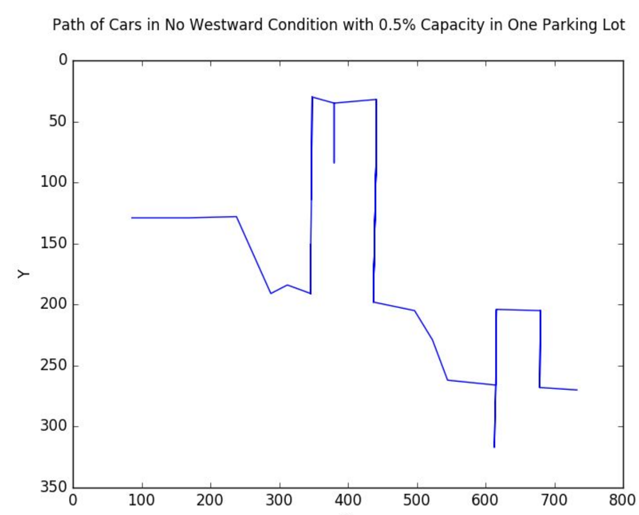


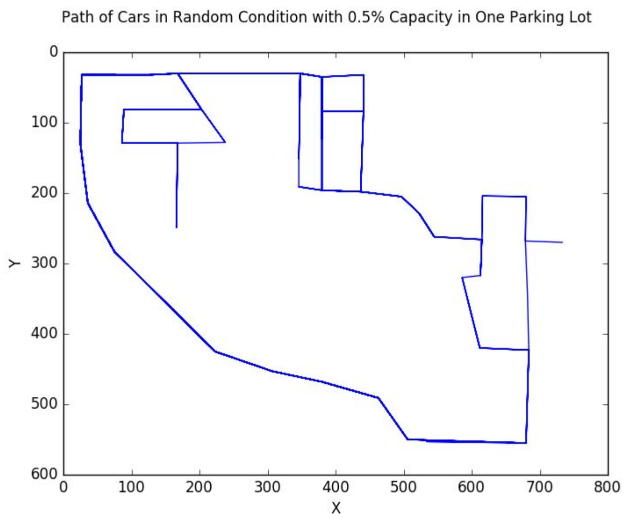


Driving Paths:

Three scenarios were run for giving examples of the car driving path. The first scenario was under the Police Direct Driving condition at 0.5% capacity in all parking lots. This scenario produced generally three main travel paths which makes sense at low capacity numbers as the roads should never back-up and cause cars to drive other paths. The second scenario involved a No Westward Driving condition at 0.5% capacity in one parking lot. The path was a progressive movement eastward, but was still a little chaotic, but could represent a real driver in a tense situation exiting campus under an evacuation moment. The third scenario involved a Random Driving condition at 0.5% capacity in one parking lot. The path was total chaos and represents why the administration should highly look at the Police Direct Driving or No Westward Driving conditions as the most realistic and best simulations for figuring out an evacuation plan.







Test for numpy's random number generator:

When conducted the chi-square test to check if the numpy's random number generator is random for exponential numbers, the following result was produced for one test run:

CHI_SQUARE TEST: Power_divergenceResult(statistic=38.787615503174479, pvalue=0.85195035039316724)

According to the result of the Chi-Square test, we fail to reject the null hypothesis that numpy's random number generator generates exponential random numbers with only 5% confidence. Since the p-value of 0.851950350393 for the chi-square is greater than an alpha of .05, we fail to reject the null hypothesis and prove that numpy's random number generator is random!

Please take a look at the graphs and notice how, when plotting the random exponential values (which is what we used), we notice that the distribution follows the exponential distributions. Thus, proving that numpy's random number generator for exponential values is random.