The Comparison and Application of Different Traveling Salesman Problem Algorithms

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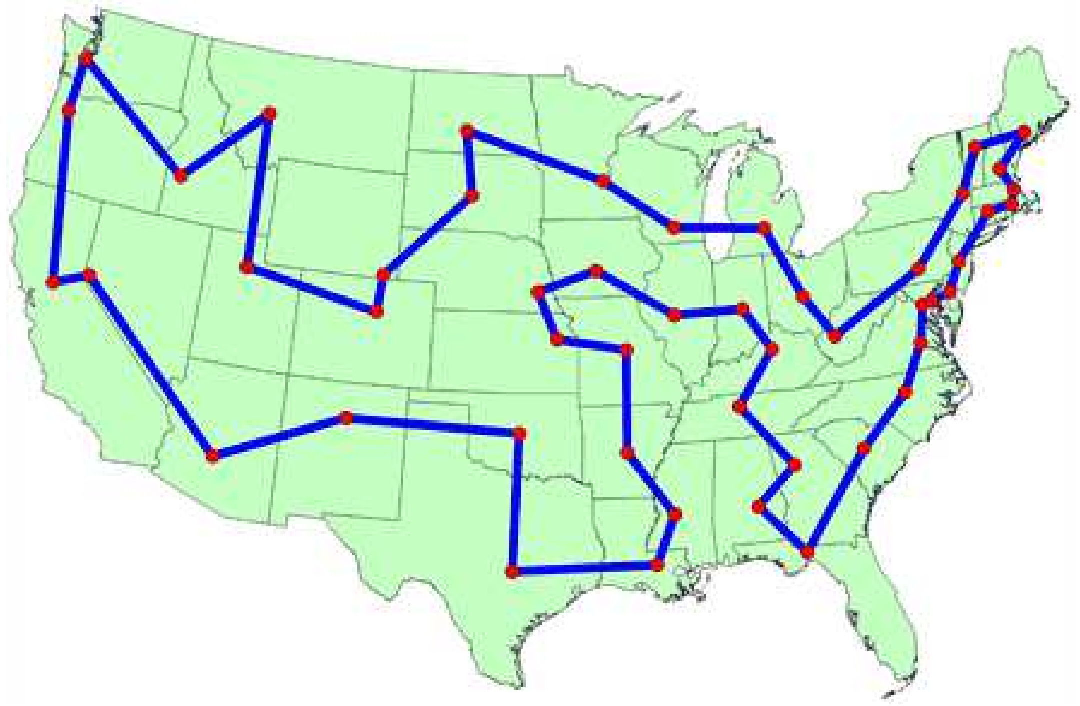
Introduction to Dr. Carlsson's Lab

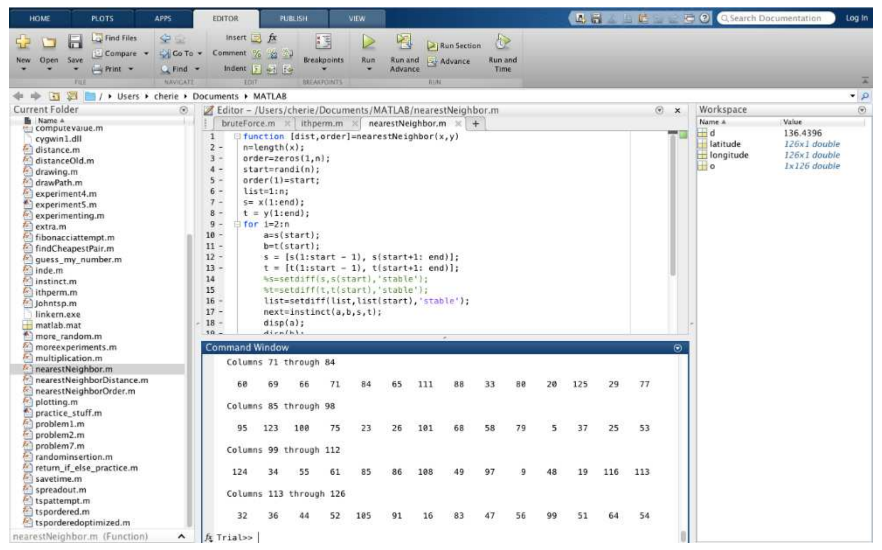
In Prof. Carlsson's research of optimizing delivery times, the Traveling Salesman Problem presents a salesman who is given a list of locations to visit. He must visit each destination once. The goal of the problem is to find the optimal route that would take the least amount of time. TSP is classified as NP-Hard (Non-deterministic Polynomial acceptable problems) for its computational complexity.



An example of a cross-country TSP tour

Skills Learned

- MatLAB coding
- Graph Theory
- TSP problem formulation and algorithms
- Operation of DJI Spark Drone
- Operation of remote controlled car
- Logic and calculus strengthened through complex problems



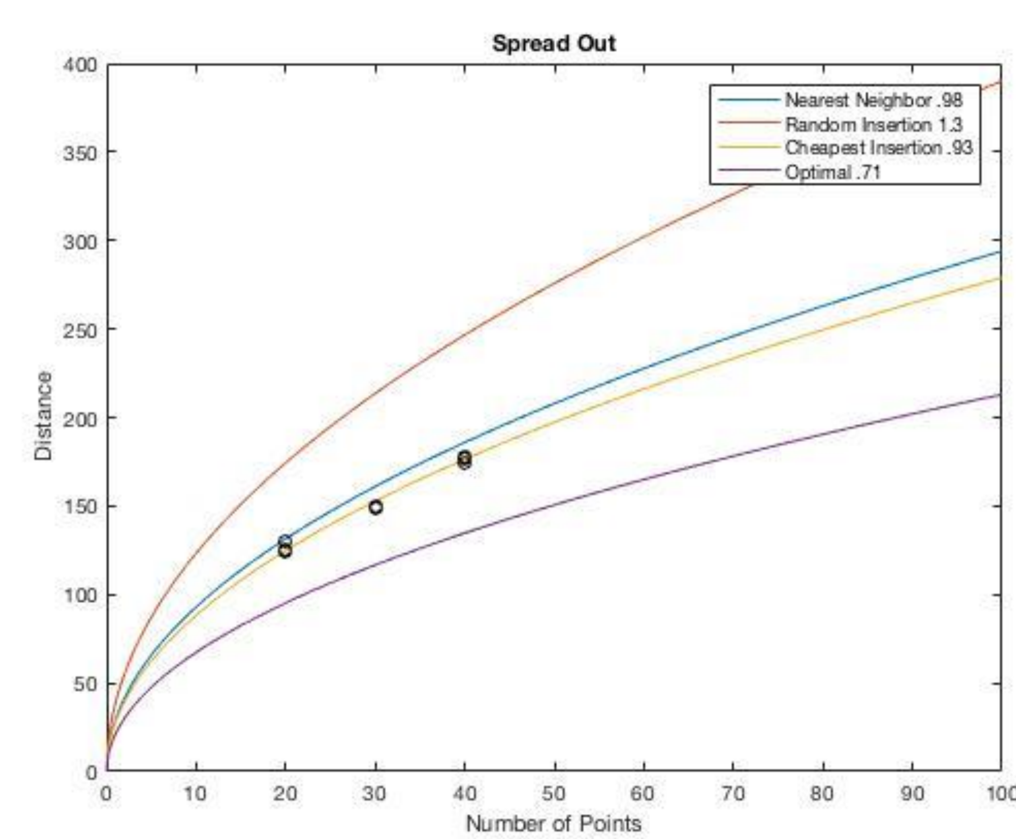
Screenshot of MatLAB code I wrote

Research Objective

The goal of Professor Carlsson's research was to further the understanding of the effectiveness of different methods for solving TSP problems. This takes into account the efficiency of drone delivery (ex: Amazon Prime) versus man-operated deliver (ex: FedEx) and explored what happens when the two are combined in what is referred to as a horsefly scenario. (Horsefly delivery is when a person is driving a truck that has drones on it. The drones complete the actual delivery to the customer, and the driver minimizes time the drone would have to spend in air.)

Projects and Experiment

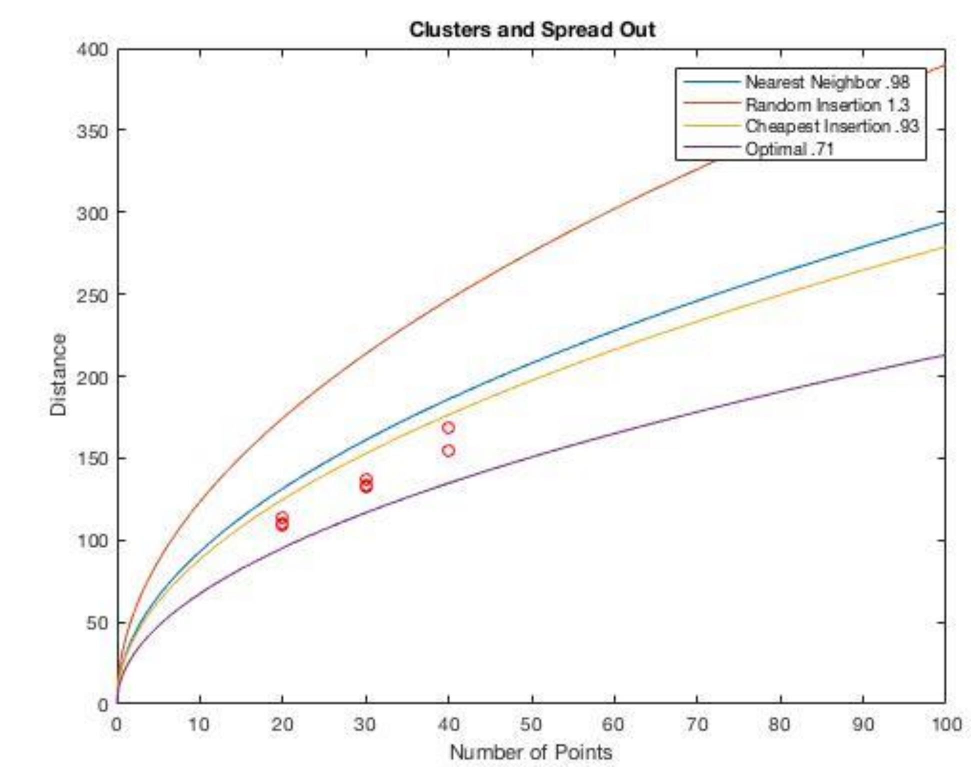
Within a 30x30ft area, we randomly placed 20, 30, and 40 flags. In three trial runs, we created individual TSP tours that we then measured the distance of. We ran the same experiment with clusters of five flags integrated with the randomly spread out flags. We then plotted these data points against the algorithms we previously learned and coded (Nearest Neighbor, Cheapest Insertion, Random Insertion, and the Optimal TSP).



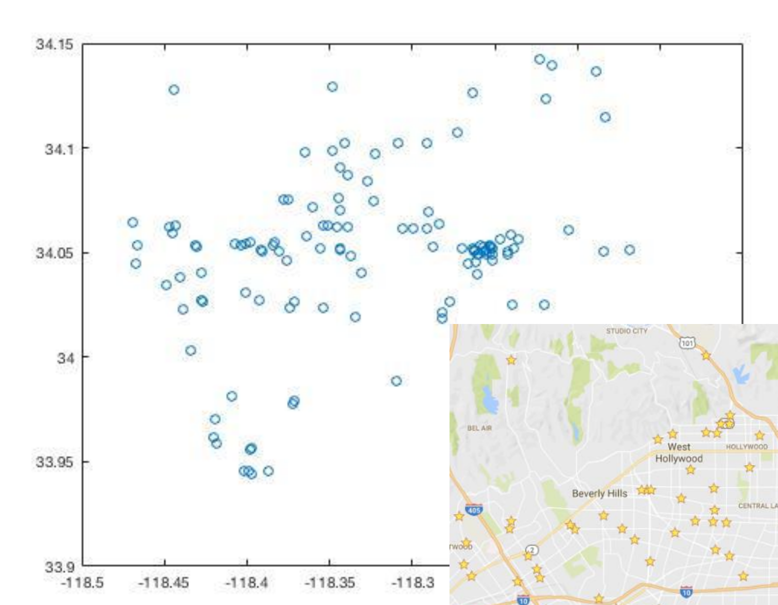
Data points and lines I graphed on MatLAB

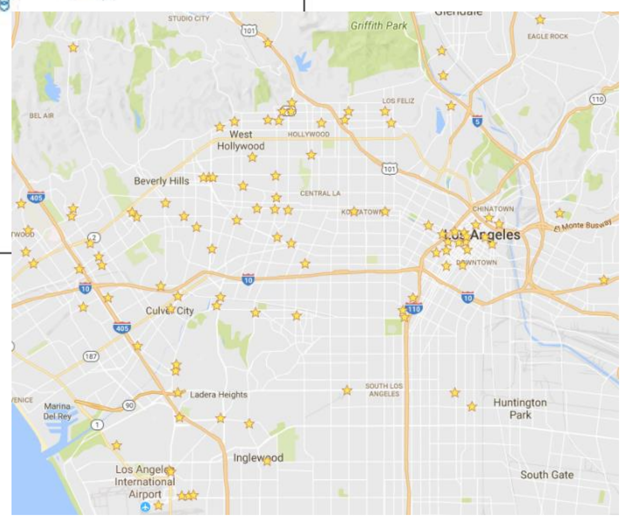
Project and Experiment Cont.

Data points and lines I graphed on MatLAB



For my own personal project, I identified all of the Starbucks Coffee locations in Los Angeles. I plotted these points and ran the multiple theorems we coded to compare their efficiencies. I compared Nearest Neighbor, Cheapest Insertion, and Random Insertion. Not only did this produce different graphs and tours, it also provided different overall distances and costs. The point of this was to consider the different routes a delivery truck might have to take to restock the different locations from their Los Angeles warehouses. It also calls to question where it would be most efficient to place those warehouses. This map, similar to our previous experiment, had many spread-out points as well as some clusters.

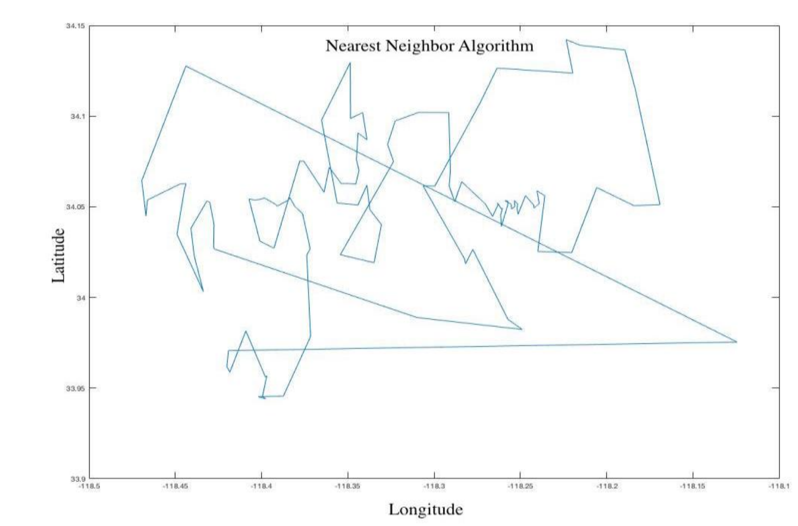




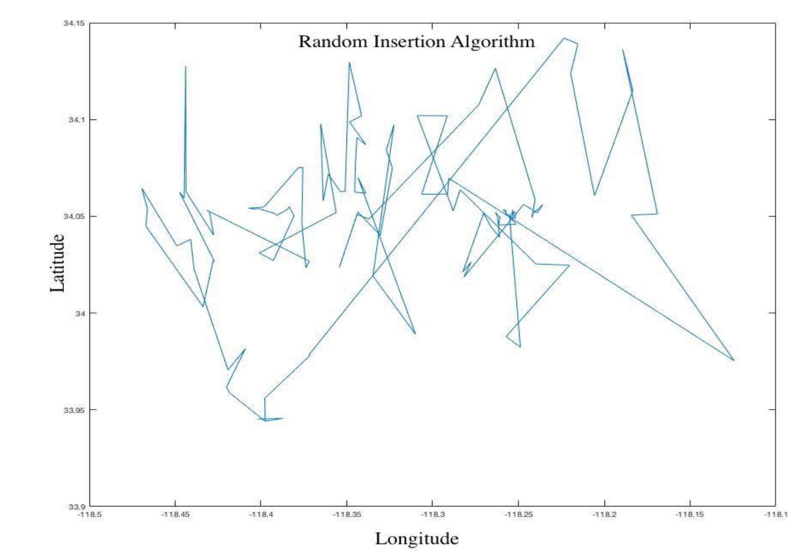
Starbucks locations I graphed on MatLAB and Google Maps

Project and Experiment Cont.

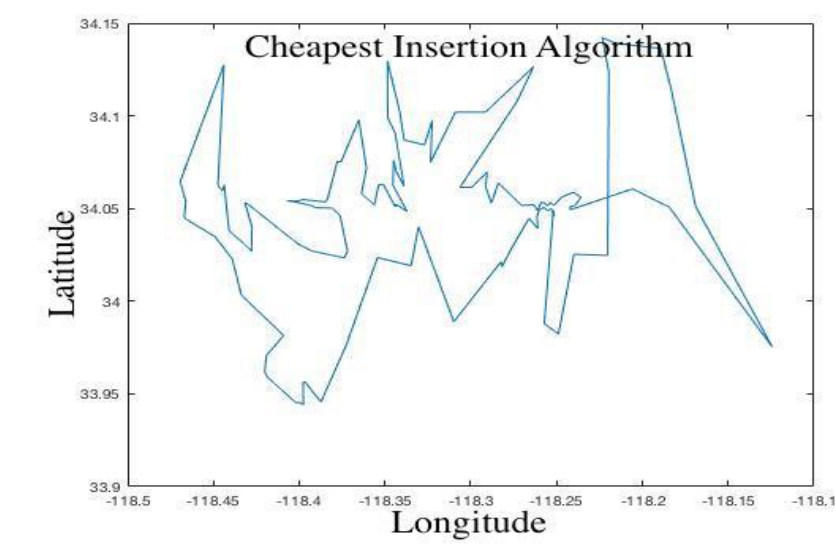
Nearest Neighbor, Distance=141.1133 miles



Random Insertion, Distance=137.09 miles



Cheapest Insertion, Distance=95.18 miles



Acknowledgements

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