The Subway Challenge is an open record put out by the Guinness World Records Company. The goal of the challenge is to visit all 472 stations on the New York City Subway System in the shortest amount of time. We transformed the New York Subway System into a representation that a computer can solve. We then ran a couple different solvers on our representation: Nearest Neighbor Search and Ant Colony Optimizer. Through trial and error, we found multiple tours that beat the world record.

Introduction

- Subway Challenge: Open record put out by the Guinness World Records Company
- Goal: Visit all 472 stations on the New York City Subway system in the shortest amount of time.
- similarities to other problems in Computer Science/Optimization
  + Traveling Salesperson Problem (TSP)
  + Famous problem with a variety of applications
  + What is the fastest way to visit a set of cities and return home?
  + Time Dependent Traveling Salesperson Problem (TDTSP)
  + Variation of TSP
  + Asks the same question
  + Adds that the cost to go between cities changes over time
- Differences
  + Cannot visit all other stations from another station immediately, restricted to Subway lines
  + Does not have to be a single cycle that passes through all stations exactly once
  + Additional parameters such as starting station and starting time of day affect traveling times

Methods

- Code was written in C++ and Python
- Transformed subway data from MTA to Time Expanded Graph
  + Edges appear and disappear over time
  + Traveling times on an edge can vary with time
- Added edges between stations that were in 2 miles of each other (running distance)
- Ran two types of solvers on the graph
  + Nearest Neighbor Algorithm
  + Greedy Algorithm
  + Adds nearest station to tour
  + Ant Colony Optimizer
  + Based on ants foraging for food
  + Ants create random tours to food at first
  + Develop faster tours based on previous iterations
  + Generated best results so far

Abstract

The Subway Challenge is an open record put out by the Guinness World Records Company. The goal of the challenge is to visit all 472 stations on the New York City Subway System in the shortest amount of time. We transformed the New York Subway System into a representation that a computer can solve. We then ran a couple different solvers on our representation: Nearest Neighbor Search and Ant Colony Optimizer. Through trial and error, we found multiple tours that beat the world record.

Results

- Current World Record
  + Far Rockaway - Mott Av
  + Starting Time: 2:00 AM
  + Total Time: 22H:15M*
- Nearest Neighbor
  + Carnarise - Rockaway Pkwy
  + Starting Time: 9:40 AM
  + Total Time: 24H:12M
- Ant Colony
  + Pelham Bay Park
  + Starting Time: 2:20 AM
  + Total Time: 22H:10M

Table 1: Best Results of Methods

Next Steps

- Go to NYC and execute the tour!
- Investigate alternative methods of formulating the problem
  + Set TSP (generalization of TSP)
  + Railway Traveling Salesperson Problem (different formulation)
- Use different solvers
  + ILP Formulation
  + Genetic Algorithm
  + Lin–Kernighan Heuristic/Concorde (classic TSP solvers)

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Further Questions? Reach out to me on Twitter: @KuleenSasse