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Project: Traveling Salesman Approximation

Motivation: P=NP is arguably the primary outstanding challenge that exists in computer science. A wide variety of real-world problems reduce down to what is essentially the infamous traveling salesman problem. The issue is that the brute force method, which is guaranteed to identify the optimal solution, runs in O(n!) time. For all intents and purposes, this makes the brute force algorithm unusable. But this isn’t the end of the story. Several approximations exist that relax the requirement for guaranteed accuracy in exchange for a usable runtime. We intend to compare and contrast several approximation algorithms for the traveling salesman problem.

Features: Unfortunately, we don’t anticipate being able to confirm that the problem is solved, which in our case involves finding the optimal solution, for large input sizes. For very small input sizes, we will be able to run a brute force algorithm and compare its results against the output of our approximation algorithms. For large inputs, we will be able to plot the distance of the generated route as the algorithm iterates and visualize that it approaches a lower limit. Here is an example of the results from an early version of a genetic approach:

A picture containing text, plot, line, diagram

Description automatically generated

Data: We intend to use the coordinates of the 200 highest population Florida cities. There are (n-1)! different possible solutions which comes to ~4x10372. In comparison, the number of atoms in the universe is currently estimated to be between 1078 and 1082.

Tools: The project is being written in python and the visualization is planned to be created using pygame.

Visuals: This is an early attempt at the menu for the project: A map of the state of florida

Description automatically generated with medium confidence

Strategy: The algorithms that we currently plan to explore are a greedy algorithm, 2-Opt, 3-Opt, a genetic algorithm, and the brute force method (for comparison). Data is planned to be presented in two ways. First, we intend to display a graph showing the total distances of the routes that the approximations generate during each iteration. We also intend to visually display these routes on the map shown in the picture above to allow the user to visualize the route as it approaches an optimal result.

Responsibility and roles: