



Travelling Salesman Problem (TSP)

Background

- The travelling salesman problem(TSP) asks the following question: "Given a list of locations and the distance between each respective location, what is the shortest possible route that visits each location?". Our team decided to use 4 algorithms to tackle the problem: Nearest neighbour, Brute force, 2-Opt and Branch-and-Bound.

Abstract

- The TSP is a problem that asks for the most efficient trajectory possible given a set of points and distances that must all be visited. Our team has implemented 4 algorithms in our application that is able to provide users with a visual representation on how the algorithms traverse through the nodes to find the optimal route. Additionally, the application is also able display the time taken and results. Based on our observation, the 4 algorithms take different duration from start to the end.

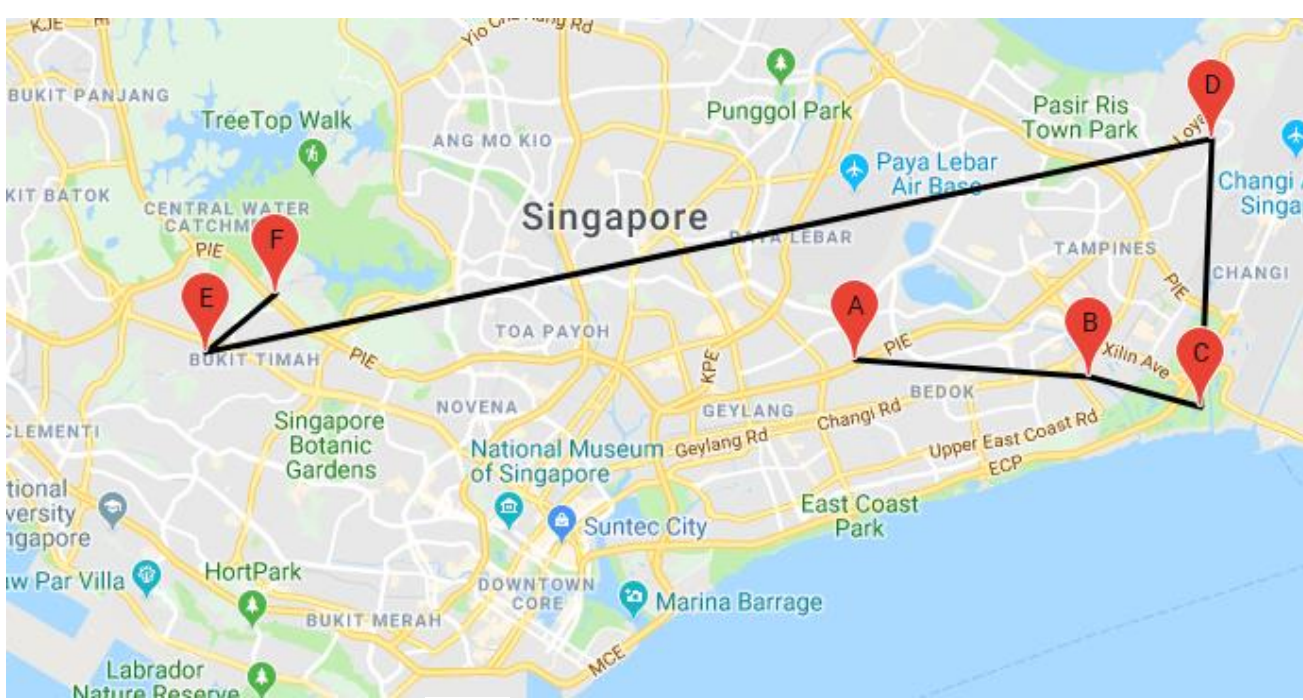
Algorithms

- Nearest Neighbour.** An algorithm that selects the nearest unvisited location as its next move until all locations are visited.
- Brute Force.** An algorithm that attempts all possible permutations and selects the best solution.
- 2-Opt.** An algorithm that takes a route that crosses over itself and reorder it so that it does not intersect. It will compare every possible valid combination of the swapping mechanism to obtain an optimal solution.
- Branch-And-Bound.** An algorithm that consists of a systematic enumeration of candidate solutions by means of state space search. the set of candidate solutions is thought of as forming a rooted tree with the full set at the root. The algorithm explores branches of this tree, which represent subsets of the solution set. Before enumerating the candidate solutions of a branch, the branch is checked against upper estimated bounds on the optimal solution and is discarded if it cannot produce a better solution than the best one found so far by the algorithm.

Application

Visual Representation

	Address/Name
1	602 Bedok Reservoir Rd, Block 602, ...
2	75 St John's Cres, Singapore 508149
3	10 Changi Coast Walk, Singapore 4...
4	51 Lily Ave, Singapore 277784
5	97 Bedok Ria Cres, Singapore 489913
6	Sime Rd, Singapore



Two-Opt

Total Nodes: 6
Total Time: 0.43484s
Total Distance: 35.16 Km
Total Permutation: 4

Preview Speed: Default Normal

Two Opt

Brute Force

Total Nodes: 6
Total Time: 1.01129s
Total Distance: 35.16 Km
Total Permutation: 4

Preview Speed: Default Normal

Nearest Neighbour

Brute Force

Total Nodes: 6
Total Time: 19.39014s
Total Distance: 35.16 Km
Total Permutation: 24

Preview Speed: Default Normal

Brute Force

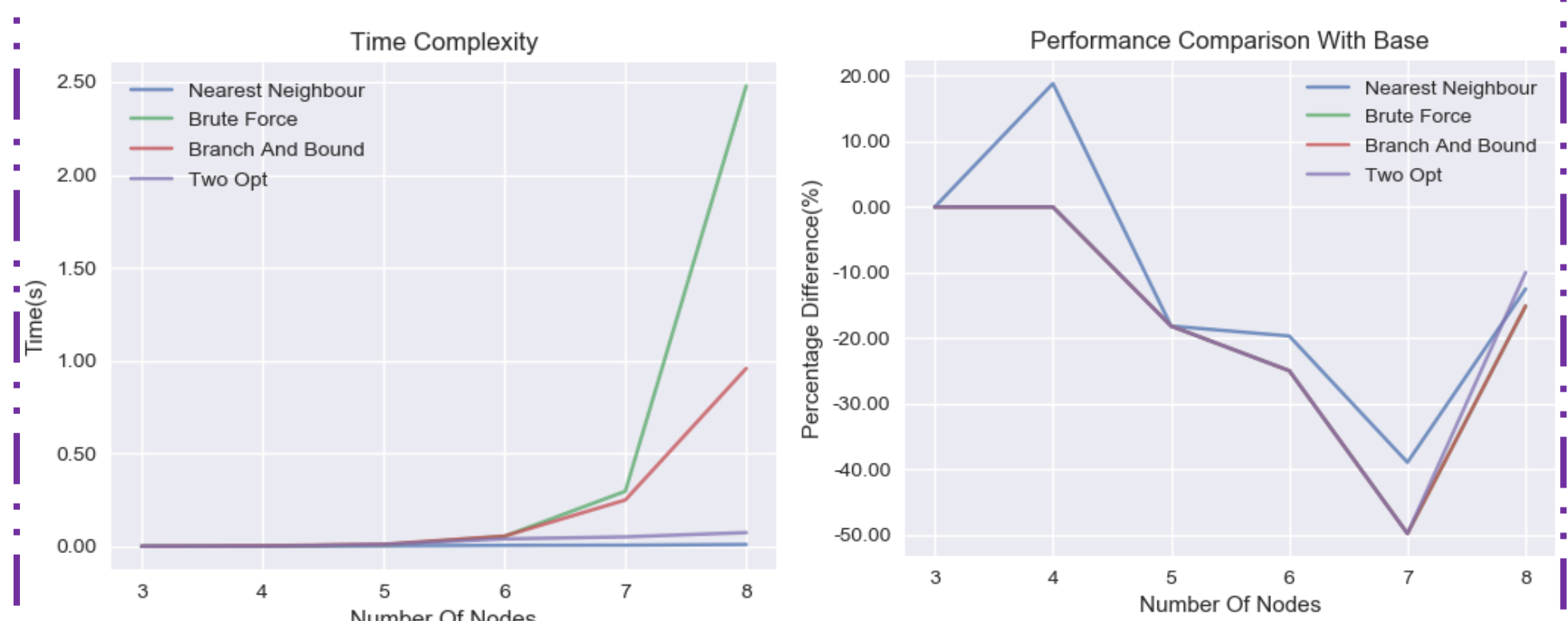
Branch And Bound

Total Nodes: 6
Total Time: 23.0334s
Total Distance: 35.16 Km
Total Permutation: 24

Preview Speed: Default Normal

Branch And Bound

Time Complexity



Algorithm	Worst Case	Avg Case	Best Case
Nearest Neighbour	$O(n)$	$O(n)$	$O(n)$
Brute Force	$O(n!)$	$O(n!)$	$O(n!)$
Branch And Bound	$O(n!)$	$O(n)$	$O(1)$
Two Opt	$O(n^2)$	$O(n^2)$	$O(n^2)$