

Assignment 1

Travelling Salesman Problem

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Abstract

We have to provide the best tour visiting all cities with cost of time. TSP is used as a benchmark for many optimization methods

1 Problem Statement

Given a set of cities (coordinates) and distances between them, find your best(shortest) tour (visiting all cities exactly once and returning to the origin city) in a given amount of time.

2 Applied Algorithm

2.1 Algorithm 1 (Interim Submission) - OPT-2

We used 2-opt local search algorithm to optimize our route. It takes any two nodes and reverse the path in between those two nodes so that it creates a new sub route. Then calculate the cost of that new route and compare it with previous route cost. If that cost is less than previous cost then it will update that sub route and cost. Hence the cost is optimized using 2-opt method.

2.2 Algorithm 1(Final Submission)- Simulated Annealing with Opt -2

In our final approach we are optimizing majorly using Simulated Annealing algorithm. Initially we had assume route from 1 to N where N is no. of cities and calculated its cost. Now we pick any two random number from 1 to N. Now the opt-2 method is applied and cost is calculate of the route. On the other hand we had calculated probability(P) as:

$$P = \frac{1}{1 + \exp \frac{-\Delta(E)}{T}}$$

where

$\Delta(E)$ = Difference in cost of two random points.

T = Temperature(initialized to a large value).

Now we calculate random probability(Q) in between 0 to 1. Then we compared it with calculated probability (P).

If $P \geq Q$ **than** change the route to new route and change the value of temperature(T) to $0.99999 * T$

If $P \geq Q$ and $Cost_{newroute} > Cost_{oldRoute}$ **than** update the new route with best route and change the value of temperature(T) to $0.99999 * T$

3 Functions in Code

- Printing - It will print the final route on terminal.
- cost - It will return the cost of a route.
- opt2 - It will return the route after each time swapping of nodes.

4 Results

The cost for different tours is as :

File Name	Cost calculated using Algorithm 1	Cost calculated using Algorithm 2
euc 100	1606.85	1561.2
euc 250	2698.90	2458.73
euc 500	3847.95	3522.81
noneuc 100	5282.99	5230.43
noneuc 250	12862.78	12842.7
noneuc 500	25412.87	25366.8

5 Conclusion

- The non-euclidean distance between any two cities is always greater than or equal to euclidean distance. Hence the cost of route is coming high in non euclidean files as compare to euclidean files with same number of cities.
- The cost using Simulated Annealing with Opt-2 algorithm is lesser than only Opt-2 algorithm..
- For a tour with larger number of cities Algorithm 1 is giving at a faster rate compared to Algorithm 2 since Algorithm 2 is just a upgraded version of Algorithm 1 so it is taking some extra time.