THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

COMP5511 Artificial Intelligence Concepts
- Project 1 -

Important Notes

1. *Write your report using your preferred word editor (maximum 15 pages). On top of the first page, provide your name and matriculation number.*
2. *Students can modify the Matlab file provided or use other programming language to solve the problem given. All modifications should be justified and explained clearly in the report.*
3. *Students are encouraged to experiment with the various parameters, for example, the crossover and mutation rates, the population size and the number of generations, and discuss the effects of changing these parameters. Provide your reasoning leading to the final answer.*
4. *The solution and report should be the results of each individual work.*
5. *The report together with the codes should be submitted in a zip file (MatricNumber.zip) to LEARN@PolyU (https://learn.polyu.edu.hk/ultra/course) under "COMP5511-> Assessments->Project 1" before the due date of **11:59PM on 8 November 2021 (Monday)**. No late submission will be accepted.*

References

(1) http://comopt.ifi.uni-heidelberg.de/software/TSPLIB95/
(2) http://myweb.uiowa.edu/bthoa/TSPTWBenchmarkDataSets.htm
(3) Solving Large-Scale TSP Using Adaptive Clustering Method. Computational Intelligence and Design, 2009. ISCID '09.

Project Description

The Traveling Salesman Problem (TSP) is a classical combinatorial problem which is deceptively simple. This problem is about a salesman who spends his time visiting *n* cities cyclically. In one tour, he must visit each city just once and should finish up where he started. Since each city is situated in different locations, the distance between every city will be different. The objective is to find the shortest round-trip route that visits each city once and then returns to the starting city.

Many TSPs are symmetric, i.e., for any two cities A and B, the distance from A to B is the same as that from B to A. A two-city TSP is trivial as there is only one possible tour. However the number of possible tours will increase exponentially as the number of cities grows. Hence, the number of solutions becomes intractably large for large *n* making an exhaustive search impractical.

Implement a genetic algorithm to solve the 10-city symmetric TSP. The coordinates for the 10 cities are given as follows:

City	X-coordinate	Y-coordinate
1	0.3642	0.7770
2	0.7185	0.8312
3	0.0986	0.5891
4	0.2954	0.9606
5	0.5951	0.4647
6	0.6697	0.7657
7	0.4353	0.1709
8	0.2131	0.8349
9	0.3479	0.6984
10	0.4516	0.0488

Discussion and analysis:

As stated earlier, increasing the number of cities will exponentially increase the possible number of solutions and the complexity of the problem. Students are required to introduce more cities to the given problem. The X-coordinate and Y-coordinate of the additional cities should be limited to [0, 1]. The various cases should be simulated and a discussion based on the results obtained should be given.

For the problem considered, there are no restrictions on the start and end point. Students are encouraged to discuss if the start and the end city are given. This means that the salesman must visit each city just once, but instead of finishing at where he started, his last location should be the given end city. Students are also encouraged to discuss on the effect of a non-symmetrical TSP problem. Simulation results could be used to support the discussion and analysis.

Extension:

(1) Asymmetric traveling salesman problem (ATSP)
The TSP problem is considered as an asymmetric one, i.e., for any two cities A and B, the distance from A to B is different from that from B to A.

(2) Sequential ordering problem (SOP)
Sequence constraint is required in real world problem. The salesman is asked to visit certain cities in a required sequence. A particular city has to be visited before some other cities.

(3) Time window is considered in the problem. The salesman is required to visit certain cities within certain time window. A data set with 100 cities is given ('TSPTW_dataset.txt').

(4) For large-scale data, the cities can be divided into several regions (decided by students), the salesman must finish visiting all the cities within the region before traveling to any other city in other regions. Using clustering technique can decompose the large-scale data into several small-scale data sets by its relativity. The dataset with 50 points is provided ('Cluster_dataset.txt').