

Homework 10: Heuristic Algorithms

Due: Friday, April 24 at 11:59 pm on Canvas

Concepts: optimization, NP-hardness, heuristic algorithms

The traveling salesman problem is one of the most well-known NP-complete problems. Recall that in this problem you are given n cities labeled $\{1, 2, \dots, n\}$ and a distance matrix C that gives the pairwise distances between all cities. We assume that this matrix is symmetric such that $C[i, j] = C[j, i]$. In this homework assignment, you will implement two heuristic algorithms for this problem and compare the results on three given TSP instances from the TSPLIB¹. The four TSP instances can be found on Canvas under Files - Assignments - TSP, and there is starting code in hw10.py under Files-Assignments.

NOTE: You are **not** required to write corresponding test functions for your implemented algorithms below, but you should make sure you feel confident in the output. There will be a **course assistant check-off** for this assignment.

1. (8 points) Implement a greedy heuristic algorithm for the traveling salesman problem. We discussed a few options during class, but you are also free to invent your own. Be sure to specify your algorithm below in a couple of sentences and explain why it is a greedy approach.
2. (8 points) Implement a local search heuristic algorithm for the traveling salesman problem. We discussed a few options during class, but you are also free to invent your own. Be sure to specify your algorithm below in a couple of sentences and explain why it is a local search approach. To find an initial solution, your algorithm should run the greedy algorithm you implemented above.
3. (6 points) Compare the results of your algorithms by recording the runtimes and optimality gaps. Depending on your chosen algorithm, you should also consider different starting conditions that may affect the performance. Record your results in a table below. Then, in a few sentences, comment what you observe. Do the results match what you expected?

The optimal values for each problem instance can be found here <http://comopt.ifl.uni-heidelberg.de/software/TSPLIB95/STSP.html>.

¹<http://comopt.ifl.uni-heidelberg.de/software/TSPLIB95/index.html>