Goal

The fourth part of the project consists in implementing two approximation algorithms of an optimal cycle(route).

Procedures

1. Implement the two algorithms seen in the laboratory (RSL and HK)

2.test and compare these algorithms, as well as the variants that you deem appropriate in order to obtain the best approximations that you can on our instances of symmetric TSP

3. follow other instructions given in the laboratory presentation.

Fourth part of this laboratory

1. implement the Rosenkrantz, Stearns and Lewis algorithm;

2. implement the Held and Karp (HK) climb algorithm;

3. the algorithm contains several parameters:

3.1 Kruskal vs. Prim;

3.2 the choice of the privileged vertex (the root);

3.3 the choice of the step length t (HK);

3.4 the choice of the stop criterion (HK).

4. by playing on these parameters, identify the best possible routes on the problems of the symmetrical TSP (you can use different parameters on different problems);

5. graphically illustrate the routes identified and express the relative error with an optimal route 1 for each of the two algorithms;

6. I need to be able to reproduce your results by passing an instance of the TSP as an argument to a main program.

Tours

The problem of the tour, or the Hamiltonian cycle, is a classic graph problem posed by Hamilton in 1859.

Given an undirected graph, find a cycle that passes through each vertex once and only once.

Necessary condition of existence: the graph must be biconnected. This condition is not sufficient.

There is no known effective algorithm to solve this problem.

Our problem is more complicated: to find a minimum tour.

Let us remain optimistic.

Minimum approximate tours

Finding a minimal tour is difficult without using sophisticated heuristics.

However, one can sometimes find good approximate minimum rounds in

using the tools developed in the previous laboratories.

We examine two algorithms:

1. the Rosenkrantz, Stearns and Lewis algorithm (simple);
2. Held and Karp's algorithm (more difficult).

We assume our graph is complete.

Rosenkrantz, Stearns and Lewis algorithm

Condition: c (u; w) c (u; v) + c (v; w).

1. Choose a node which will play the role of root;
2. calculate a minimal spanning tree using this root;
3. Order the vertices of the graph following a preorder path of the tree of minimum recovery (i.e., in the order of the visit);
4. this order determines a tour in the starting graph.

Theorem

The algorithm of Rosenkrantz, Stearns and Lewis provides a tour of which the weight is less than twice the weight of an optimal tour.

Held and Karp algorithm

(see handwritten notes)

Références

1. The Traveling-Salesman Problem and Minimum Spanning Trees (Held et Karp) : introduction, sections 1 et 4 (attention, l'algorithme de la section 4 n'est pas celui qu'on demande d'implémenter mais aide à la compréhension) ;
2. The Traveling-Salesman Problem and Minimum Spanning Trees: Part II (Held et Karp) : introduction, sections 1, 2 et 4 ;
3. An Effective Implementation of the Lin-Kernighan Traveling Salesman Heuristic (Helsgaun) : section 4:1 (l'algorithme de Held et Karp se trouve à la page 25).