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Problem Set 2

due: May 1, 2018

Exercise 1 — 3 points

Find an example of a complete undirected graph K_n, $n \geq 3$, together with a cost function $c : E(K_n) \to \mathbb{R}_{\geq 0}$ such that the optimal Traveling Salesman tour visiting each vertex at least once is not a Hamiltonian circuit.

Exercise 2 — 4 points

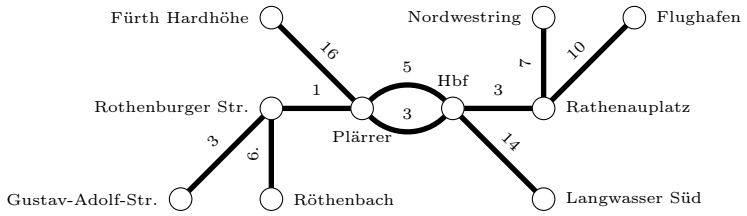
Let $G = (V, E)$ be an undirected graph with a cost function $c : E \to \mathbb{R}_{\geq 0}$. Reduce the following problem to TSP: Find a – not necessarily closed – walk of minimum cost w.r.t. c in G such that each vertex is visited at least once.

Exercise 3 — 3 points

Let $G = (V, E)$ be an undirected graph with a weight function $w : E \to \mathbb{R}$. Write the minimum-weight perfect matching problem on (G, w) as an integer program.

Exercise 4 — 10 points

Let G be the following weighted undirected graph (U-Bahn Nürnberg, data is online):



(a) Compute the complete graph K_{10} and the length function $\ell : E(K_{10}) \to \mathbb{R}_{\geq 0}$ satisfying

$$\ell(\{v, w\}) = \text{(weighted) length of shortest path in } G \text{ from } v \text{ to } w$$

for all unordered pairs $\{v, w\}$ of distinct vertices in G.

(b) Write a TSPLIB file and use concorde to solve the TSP on (K_{10}, ℓ).

- TSPLIB file format (use `EDGE_WEIGHT_FORMAT: FULL_MATRIX`, separate the entries by whitespaces, and the rows by line breaks):
  `http://plato.asu.edu/tsplib.pdf`
- concorde:
  `http://www.math.uwaterloo.ca/tsp/concorde/index.html` (download)
  `https://neos-server.org/neos/solvers/co:concorde/TSP.html` (online)

(c) Write down the shortest Traveling Salesman tour visiting each vertex in G at least once. What is its length?

If you solve (a) by programming, then send the code. Please submit also the TSPLIB file.