Exam questions: TKO_3109 Advanced Algorithms

(answers in english)

16-January-2017

IMPORTANT: answer 4 out of the following 5 questions.

(1) (10p) In the *Subset Sum* problem we are given a set of n non-negative numbers $\{w_1, w_2, ..., w_n\}$, and a bound W. The goal is to select a subset S of these numbers so that $\sum_{i \in S} w_i \leq W$ and $\sum_{i \in S} w_i$ is maximized. Write a *dynamic programming* algorithm that solves this problem.

(2) (10p) Given a graph $G = (V, E)$ with edge costs c_e associated with each edge $e \in E$. The edge costs are allowed to be negative; but we assume that there are no negative cycles in the graph. Give a *dynamic programming* algorithm that finds the length of the shortest path from any node to a target node $t \in V$. How to recover an actual shortest path from the resulting table?

(3) (10p) Describe the *Maximum Flow Problem* and outline the Ford-Fulkerson algorithm for finding the maximum flow in the network (no need for proofs).

(4) (10p) *Bipartite Matching Problem*: given a graph $G = (V, E)$ where nodes are partitioned into two sets X and Y, so that all edges $e \in E$ have one end in X and one in Y. A matching M is a subset of edges ($M \subseteq E$) such that each node appears in at most one edge in M. Find the largest possible matching in G using network flows.

(5) (10p) *NP-Completeness:* Show that the *Hamiltonian Cycle* problem is NP-Complete.