

Exam questions: TKO 3108 Algorithm Design

(answers in english)

29-October-2018

(1) (8p) *Binary search trees:*

(a)(4p) Describe what is a balanced binary search tree and, given a key, how to find an item in the tree. 2

(b)(4p) How to insert a new element into the tree so that it retains both the ordered and balanced properties.

(2) (8p) Given a graph $G = (V, E)$, when is G a *Bipartite Graph* (give a definition) and how to test for *bipartiteness* (give an algorithm)? u

(3) (8p) Given a directed graph $G = (V, E)$, give an algorithm that constructs a *topological ordering* of the graph. What is the condition for a topological ordering to exist in G ? √ 8

(4) (8p) *Minimum Spanning Trees:*

(a)(2p) What is a *minimum spanning tree* in a graph $G = (V, E)$ with costs c_e on the edges.

(b)(3p) Give one algorithm that outputs a minimum spanning tree (hint: Kruskal's, Prim's or Reverse Delete).

(c)(3p) Prove that the algorithm outputs a spanning tree of minimum total cost.

(5) (8p) *Sorting:* Given an array of n numbers, give an algorithm that sorts these numbers in increasing order and runs in $O(n \log n)$ time. Prove that the asymptotic running time of the algorithm is $O(n \log n)$.