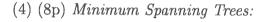
## Exam questions: TKO 3108 Algorithm Design

(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.
  - (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)?
- (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?



- (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  $O(n \log n)$ .



