Assignment 1

CSC 226

Theoretical Part

Question 1 (*Searching, lower bounds*)**.** Argue convincingly: The problem of searching for the k^{th} smallest element when given a sequence of n pairwise comparable elements has the following lower bound: $\Omega(n)$

Question 2 (*Linear Selection*)**.** If we would vary the pivot determination in the linear selection algorithm studied in class such that we break the given sequence S in short sequences of size 3 instead of size 5 and then continue the algorithm as described, the running time is not linear anymore. Why? When writing up your answer, argue convincingly!

Question 3 (*MST, graph properties*)**.** In class, we studied the cycle and cut properties when determining minimum spanning trees for a given edge weighted graph. In both proofs we assumed that every edge in the given graph is of distinct weight.

a) Argue correctness of the cycle property for the case that edges in the graph can be of identical weight.

b) Argue correctness of the cut property for the case that edges in the graph can be of identical weight.

Question 4 (*MST algorithm*)**.** Borůvka's algorithm assumes that all edges in the given graph are of distinct weight. Assume you are given a graph that does not satisfy this property but you are determined to apply Borůvka's algorithm to find a minimum spanning tree.

a) What problem can the algorithm run into? Give an example of a graph where Borůvka's algorithm as presented in class may fail.

b) Expand Borůvka's algorithm to overcome the difficulty. Describe your algorithm in pseudocode.