Exam questions: TKO 3108 Algorithm Design

(answers in english)

25.11.2019

(1) (8p) The *Heap* data structure has the property that for every element v, if the parent of v is w then $key(w) < key(v)$.

(a)(3p) Describe how the heap data structure is stored in an array.

(b)(5p) Write an algorithm that adds a new item into the heap (so that the heap property is kept).

(2) (8p) Given a graph $G = (V, E)$, describe the two methods (matrix and adjacency list) of representing G in the computer memory. Discuss what are the advantages and disadvantages of these methods.

(3) (8p) *Stable matching:* Define the *stable matching problem* and give an algorithm that outputs a stable matching. What is the running time of the algorithm?

(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) *Counting inversions*: Given an array of numbers in arbitrary order, count the number of inversions using an algorithm. A pair is an inversion if the larger number occurs before the smaller one in the array. What is the running time of the algorithm?