**Algorithm Engineering**

**09 February 2015**

**Exercise [rank 4+4]**

Construct a perfect hash table for the set of keys {1, 4, 6, 8, 2, 9, 11, 16, 18}, by assuming a first-level table of size 5 and by defining hash functions of the form

h(x) = a \* x + b mod m, where m is an integer (possibly not prime, in order to manage the functions of the second level).

Prove that the space taken by a perfect hash table is linear in the number of keys.

**Exercise [points 4+4]** Given the array A = [5, 2, 4, 8, 3, 1, 9, 6], build the RMQ data structure but **ONLY** for RMQ-queries which are either aligned to blocks or overlap block boundaries (hence, no the queries internal into blocks). Finally, show how it is answered the query RMQ[1,6], where indices in A start from 0.

**Exercise [rank 3+3]**

Given the undirected and weighted graph G={(A,B, 4), (A,F, 5), (A,E, 6), (B,C, 6), (B,F, 8), (C,D, 7), (C,F, 5)}.

* Compute the MST via the Kruskal’s algorithm
* Compute the MST via the Prim’s algorithm

Show all steps of each algorithm e the content of the used data structures.

**Exercise [points 2+3+3]** Given the string S=ababca, construct its suffix array and then show how it is executed the search and listing of the occurrences of the pattern P=ab. Show also the time and space complexity of the proposed solution.