6 Algorithms I (FMS)

(a) Imagine that the search procedure that looks for a key in a binary search tree is instrumented to print out the sequence of the keys of the nodes it visits.

(i) For each of the following sequences, say whether or not it could have been printed by that procedure, justifying any negative answers.

A) 903, 478, 551, 598, 560, 557, 555.
B) 825, 302, 811, 340, 812, 345, 363.
C) 788, 359, 875, 283, 118, 941, 466.

(ii) Give a clear and simple description of a linear algorithm that, given an arbitrary sequence of integers, says whether or not it could have been printed by the search procedure referred to above. [Note: Pseudocode optional, clarity necessary] [5 marks]

(b) Compare the binary search tree and the binary min-heap. [Note: For simplicity ignore the payloads, assume that keys are integers and assume that there are no duplicate keys.]

(i) Give a necessary and sufficient criterion to decide whether a given binary tree is a binary search tree. [3 marks]

(ii) Give a necessary and sufficient criterion to decide whether a given binary tree is a binary min-heap. [3 marks]

(iii) Choose either the binary search tree or the binary min-heap, then give clear and concise pseudocode to output the keys of that type of tree in sorted order in linear time. Justify why your answer gives the intended results. [3 marks]

(iv) For the other type of tree not chosen in part (b)(iii), is it also possible to output the sorted keys in linear time? Justify your answer. [3 marks]