

COMPUTER SCIENCE TRIPOS Part IA – 2012 – Paper 1

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.
- [3 marks]
- (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]