COMPUTER SCIENCE TRIPOS Part IA − 2005 − Paper 1

5   Foundations of Computer Science (LCP)

This question has been translated from Standard ML to OCaml

(a) Explain the operation of the Quicksort algorithm. Illustrate your answer by applying it to the list `[8; 3; 6; 12; 2; 9; 20; 1; 5; 0; 7; 13; 4; 11; 10]`.

[6 marks]

(b) Write an OCaml function for finding the median of three integers.   [3 marks]

(c) A variant of Quicksort uses a novel method of choosing the pivot element. Instead of using the head of the list, it uses the median of the first, middle and last elements of the list. Express this algorithm in OCaml. You may assume the existence of the function `length`, but you may not assume that the items being sorted are distinct.   [7 marks]

(d) What is the average-case execution cost, measured in terms of the number of comparisons, for the version of Quicksort described in part (c) above? Justify your answer carefully.   [4 marks]