2008 Paper 11 Question 7

Data Structures and Algorithms

Quicksort can be described as a recursive in-place sorting algorithm that performs a `partition()` operation on the given array and then invokes itself twice on two distinct subranges of the array.

(a) Describe the purpose, I/O parameters and effect of the `partition()` procedure and explain what the *pivot* is. Pseudocode is not required. [3 marks]

(b) Give pseudocode for the `quicksort()` procedure that would call the `partition()` procedure you described in (a). Prove that your `quicksort()` will always terminate. [3 marks]

(c) Analyse the worst-case behaviour of Quicksort and discuss possible ways of improving it. [4 marks]

(d) Some researchers have suggested choosing the pivot from a randomly chosen location in the input array. Discuss the advantages and disadvantages of such a solution. How does it affect the worst-case and average-case behaviour? [5 marks]

(e) Define the median of an array of n numbers. Then explain clearly how to implement a `median()` procedure that would use the `partition()` procedure you described in part (a). (You may, if you wish, illustrate your answer with pseudocode.) Briefly analyse the complexity of this procedure. [5 marks]