2006 Paper 1 Question 11

Algorithms

(a) What is the time complexity of binary search on a list of N items? [1 mark]

(b) Binary search requires list items to be in sorted order. What is the best possible worst-case time complexity achievable by a comparison-based sorting algorithm? Credit will be given for a clear explanation of your answer, but there is no need to provide a formal mathematical analysis or proof. [7 marks]

(c) A researcher proposes a ternary search algorithm which repeatedly compares the search key with the two list items that most accurately trisect the remaining sorted search space.

(i) Derive asymptotic expressions for the number of list items queried by binary search and by ternary search in the worst case. Explain your derivations in terms of worst-case executions of the search algorithms. [6 marks]

(ii) Approximately how many extra list items are queried by a ternary search compared with an equivalent binary search, in the worst case? Express your answer as a numeric percentage. If required, you may assume that the list being searched is very large and that $\log_2(3) \approx 1.6$. [6 marks]