

2000 Paper 1 Question 5

Foundations of Computer Science

State the time complexity of the *lookup* and *update* operations for each of the following:

- (a) association lists
- (b) binary search trees
- (c) functional arrays (implemented as binary trees)

Use O -notation and include both the average-case and worst-case complexity.

[6 marks]

You are provided with the ML code for binary search trees, including the *lookup* and *update* operations. Use these operations to code a sorting function that works by repeatedly inserting elements of a list into a binary search tree, then converting the final binary search tree back into a list.

[4 marks]

Consider the following methods of sorting a list:

- (a) Locate the smallest element of the input. The output is this element followed by the result of recursively sorting the remaining elements.
- (b) Take the first 16 elements of the input and sort them using special hardware. Sort the remaining elements recursively. The output is the result of merging the two sorted lists.
- (c) Take the first 20% of the input elements. Sort them and the remaining 80% recursively. The output is the result of merging the two sorted lists.

For each of these methods, state with justification the worst-case complexity in terms of the number of comparisons.

[10 marks]