1998 Paper 3 Question 6

Data Structures and Algorithms

What is a *priority queue*? Explain the data structure known as a *heap* and describe how a heap can be implemented using a simple linear block of memory. Assuming that a heap implemented in this way stores N items, describe how it can be viewed as an almost-balanced binary tree. What difference can there be between the greatest and least lengths of paths from the root of the tree to a leaf? [5 marks]

Describe, and estimate the costs of, procedures to

(a) find the parent and offspring of a given node; [2 marks]

(b) insert a new item into an existing heap; [2 marks]

(c) delete the topmost item from a non-empty heap; [2 marks]

(d) starting from an array holding N items in arbitrary order, rearrange those items so that they form a heap, taking time less than that which would be needed if the items were just inserted into the heap one after the other. [4 marks]

A *stable* sorting method is one where items whose keys compare as equal will appear in the output in the same order that they appeared in the input list. Would a heap sort based on the algorithms you have documented be stable? Justify your answer. [5 marks]