

DATA STRUCTURES

Tuesday 14th June 2005

9:30am – 11.00am

Data Structures

3 Questions

Candidates should answer ONLY TWO questions. The time allowed is ONE AND A HALF hours. Each question is worth 20 marks.

1. Give a brief explanation of each one of the following data structures. Describe the basic methods it should provide and how it can be implemented. Give an example of an application where each might be used.
 - (a) stack [4 marks]
 - (b) search tree [8 marks]
 - (c) hash table [8 marks]

2. (a) Write a Java interface for a **SortedList**. The data held in the list should be of type **Comparable**. The idea is that the data should be held in some linear structure in increasing order, for efficient access. Your interface should include all the basic methods that a client might need. [6 marks]
- (b) Explain how to implement a **SortedList** using either an array or a singly linked list. The implementation must ensure that the result of any operation on the list leaves it in correctly sorted order. You should discuss in detail at least the methods for
 - (i) determining whether or not a given data item is present in the list;
 - (ii) inserting a new item into the list in its correct place.

[10 marks]

- (c) Comment on the advantages and disadvantages of using one of the implementations (array or list) rather than the other. [4 marks]

3. (a) What is a priority queue, and what methods should it provide? [4 marks]

(b) What is a binary heap, and why can it be considered to be an efficient implementation of a priority queue? [6 marks]

(c) Demonstrate your understanding of the standard operations of insertion into, and removal from, a binary heap, in relation to the following example. The heap h is initially empty.

(i) The following operations are now executed in the order listed:

```
h.insert (2) ;  
h.insert (3) ;  
h.insert (4) ;  
h.insert (1) ;  
h.insert (9) ;
```

What does the heap now look like? [5 marks]

(ii) The following operations are now executed:

```
h.remove () ;  
h.remove () ;
```

What does the heap now look like? [5 marks]

In both cases, you should explain your conclusions with reference to the standard insertion and removal algorithms for binary heaps.

End of paper