

BSc EXAMINATIONS 2002

**DATA STRUCTURES**

Thursday 13 June, 2002

6.00 pm – 7.30 pm

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**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. Write brief descriptions of the following data structures. Explain what functions they can serve, and how they might be implemented. Give an example of an application where each might be used.
  - (a) stack [4 marks]
  - (b) binary search tree [8 marks]
  - (c) priority queue [8 marks]

2. (a) Explain the internal structure of a simple singly linked list. [5 marks]
- (b) A *sorted* list is a list of data items, which are *comparable* with respect to order, and which are arranged in order of *increasing size*: for example

[3, 7, 7, 13, 15, 16, 21]

Describe how to implement a `SortedList` class whose methods guarantee that every list in the class is always properly sorted, whatever class methods are applied to it. In particular, indicate using Java or pseudo-code how to implement the following three methods:

```
/* Inserts an item at its correct place in the list */
public void insert (Comparable item);
```

```
/* Tests whether or not an item is present in the list */
public boolean contains (Comparable item);
```

```
/* Removes all occurrences of an item from the list */
public void remove (Comparable item);
```

Your algorithms should exploit the fact that the lists to which these methods apply are *sorted*. For example, in testing whether 9 is contained in the list shown above, it is not necessary to look beyond the first four elements of the list. [15 marks]

3. (a) Explain the function of a hash table and the reasons why it may be a good method for storing data. [6 marks]
- (b) What is a hash function and what properties should it ideally have? What is meant by a collision in a hash table? [4 marks]
- (c) Suppose that the integers

17, 45, 27, 56, 10, 76, 85, 21

are to be stored in a hash table with 10 positions, using the division modulo 10 method of hashing. The items are to be inserted in the order shown. Show where they will be stored, assuming open addressing with linear probing for collision resolution. [4 marks]

- (d) What other probing methods might be used for collision resolution? What benefits might one method have over another? [6 marks]