

G5029

THE UNIVERSITY OF SUSSEX

INFORMATICS

BSc Examinations 2004 – Year 1

Data Structures

Tuesday 15 June 2004

9.30 am – 11.00 am

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Data Structures

3 Questions

*Candidates should answer ONLY TWO questions.*

*Time allowed is ONE AND A HALF hours.*

*Each question is worth 20 marks*

## DATA STRUCTURES

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) queue [4 marks]
  - (b) linked list [8 marks]
  - (c) binary heap [8 marks]
  
2.
  - (a) What is a binary search tree, and what can it be used for? [5 marks]
  - (b) Discuss the importance of *balance* for a binary search tree. [5 marks]
  - (c) Display all the binary search trees that result after inserting the values 1, 2, 3 and 4, in various permutations, into an initially empty tree. There are 24 different permutations. How many different trees are there? [5 marks]
  - (d) Describe the *inorder* traversal of a binary search tree. How would you implement *inorder* traversal, specifically as a procedure which outputs the data items in a binary search tree in their correct order (for example, it prints them to a file or the screen)? [5 marks]
  
3.
  - (a) Explain the general purpose of a hash table. [4 marks]
  - (b) Suppose that English words are to be inserted into a hash table of length 10. Comment on the merits and demerits of the following hash functions:
    - (i) the hash function returns the remainder when the length of the word is divided by 10; [2 marks]
    - (ii) the hash function returns the remainder when the Unicode (ASCII) value of the first character is divided by 10; [2 marks]
    - (iii) the hash function raises the Unicode value of the first character to the power one thousand, and returns the remainder when the result is divided by 10. [2 marks]
  - (c) Suppose that open-addressing is used for hash table insertion. Explain what is meant by *probing* and why it may be necessary. [5 marks]
  - (d) Suppose the hash table is of length 10 and uses open-addressing, and that the hash function to be used is the one described in (b)(i). The words  
Rough winds do shake the darling buds of May  
are to be inserted into the hash table in the order in which they occur in the phrase. Show where the words will finally be stored, using one or more probing methods. [5 marks]