

OLLSCOIL NA hÉIREANN
THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II EXAMINATIONS 2000

**HIGHER DIPLOMA IN APPLIED SCIENCE (SOFTWARE
DESIGN & DEVELOPMENT) & 2nd ELECTRICAL AND
COMPUTER ENGINEERING**

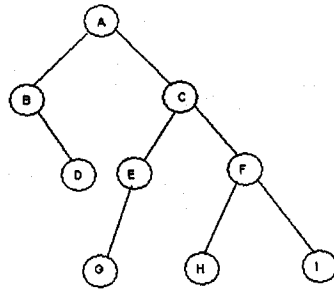
CT853 – ALGORITHMS & LOGICAL METHODS

Professor D. Bell
Dr. G. Lyons
Mr. F. Smith

Time allowed: 2 hours
Answer 4 questions. All questions carry equal marks

1. (a) Describe the advantages and disadvantages of implementing a list in each of these ways (give examples of situations where each approach would be useful):
 - (i) Arrays
 - (ii) Singly linked lists
 - (iii) Doubly linked lists
- (b) What is meant by an abstract data structure? Why can it be useful to use abstract data structures when writing and designing programs?
- (c) In linked representations, what are the advantages and disadvantages in using a Freelist?
2. (a) Write SAL code to reverse the elements in a Queue Q:queuetype using only a Stack S:stacktype and a single variable X:element.
- (b) Write SAL code to check that a sequence of brackets ('(', ')', '[', and ']') is properly nested (e.g. each left bracket is matched by the correct right bracket) using the stack data type. Assume that the ADT stack can hold single characters.

3. (a) Show the order in which the nodes are visited in the this tree



for preorder, postorder and inorder traversals.

- (b) Describe what is meant by a complete binary tree and a full binary tree.
- (c) Describe Huffman Coding Trees, explaining the limitations of the approach.
- (d) Build a Huffman Coding Tree for the following set of letter frequencies, and give the Huffman codes for each of the letters :

Letter	Frequency
A	77
B	17
C	32
D	42
W	22
X	4
Y	23
Z	2

4. (a) Perform a quicksort on the following data to sort the data into ascending order, showing all intermediate steps:

75 9 54 85 83 40 79 74 52 60

- (b) What is the difference between a binary search tree and a heap? Which representation would be best for implementing them?
- (c) Explain how heaps can be used to sort the elements in an array.
- (d) Describe the bubblesort algorithm. Is the algorithm efficient?
5. (a) Describe the binary search algorithm, highlighting the efficiency of the algorithm.
- (b) Using binary search, look for 15 in the following array, showing the portion of the array being searched at each step:

2 6 8 12 16 20 22 25 30 34 37 40 42 46 50

- (c) Is it possible to implement a binary search using a linked list representation? Give examples of any features of linked list that would particularly improve or reduce the efficiency of the algorithm.
6. (a) What is a hash function? What properties are required of such a function?
- (b) Give a hash function that would be suitable for inserting random integers between 0 and 100 into a table of sixteen slots. Would the hash function you have written be suitable if the values to be inserted were now the ages of University Students?
- (c) What is the difference between Open Hashing and Closed Hashing?
- (d) Discuss two different Collision Resolution Methods, comparing their advantages and disadvantages.

CT853 - ADT Information page

Stack data type operators:

```
declare createstack ( in-out stack : stacktype ; ) : empty;  
declare destroystack ( in-out stack : stacktype ; ) : empty;  
declare push ( in-out stack : stacktype ; in elem : integer ; ) : empty;  
declare pop ( in-out stack : stacktype ; ) : integer;  
declare topvalue ( in stack : stacktype ; ) : integer;  
declare emptystack ( in stack : stacktype ; ) : boolean;
```

Queue data type operators:

```
declare createqueue ( in-out queue : queue type ; ) : empty;  
declare destroyqueue ( in-out queue : queue type ; ) : empty;  
declare enqueue ( in-out queue : queue type ; in elem : integer ; ) : empty;  
declare dequeue ( in-out queue : queue type ; ) : integer;  
declare frontvalue ( in queue : queue type ; ) : integer;  
declare isemptyqueue ( in queue : queue type ; ) : boolean;
```