

OLLSCOIL NA hÉIREANN
The National University of Ireland

NATIONAL UNIVERSITY OF IRELAND, GALWAY

SUMMER EXAMINATIONS 2000

MASTERS OF INFORMATION TECHNOLOGY
MASTERS IN ENGINEERING SCIENCE

ALGORITHMS (CT510)

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Ms. J. Griffith

Answer any *THREE* questions
All questions carry equal marks

Time allowed: **TWO** hours

- Q. 1**
- i) Describe the stack and queue data structures, discussing a representation of each of the data structures.
 - ii) Given stack and queue data structures describe algorithms, and give pseudocode, for insertion and deletion of an item.
 - iii) Describe the Binary Search Tree data structure. Discuss a representation of a Binary Search Tree and, using this representation, outline the steps involved in insertion and deletion algorithms. Your answer should include pseudocode.
- Q. 2**
- i) What is meant by a well-defined recursive procedure? Outline a recursive algorithm to find the n^{th} term in the sequence:

$$0, 1, 1, 2, 3, 5, 8, 13, 21, \dots$$
 i.e. fibonacci series where: $F_0 = 0$; $F_1 = 1$ and $F_n = F_{n-1} + F_{n-2}$
 - ii) Outline a recursive and non-recursive algorithm to search for an item in an array where the elements in the array are sorted in non-decreasing order. Comment on the efficiency of the algorithms you develop.
 - iii) Develop an algorithm which searches for an item in a binary search tree. Discuss the efficiency of the algorithm you develop and comment on how searching time may be affected if the tree is unbalanced.

- Q. 3**
- i) What is meant by hashing? With the aid of examples describe the following hashing functions:
 - folding method.
 - midsquare method.
 - ii) Why is a collision resolution technique required when using a hashing algorithm? Describe the operation of the following collision resolution techniques and comment on their efficiency:
 - linear probing.
 - double hashing.
 - chaining.
 - iii) Outline the main steps in an algorithm for search and insertion using any hash function with a collision resolution technique of your choice.
- Q. 4**
- i) Distinguish between lossless and lossy compression. Outline metrics which can be used to measure the efficiency of both lossless and lossy compression algorithms.
 - ii) With the aid of examples distinguish between *run-length encoding* compression techniques and *prefix encoding* compression techniques.
 - iii) Describe Huffman's algorithm for compression and use the algorithm to build a Huffman tree given the following characters and the associated frequency of their occurrence in a file. List the resulting code for each letter:

a	b	c	d	e	f	g	h
7	4	10	5	2	11	15	3

- Q. 5**
- i) Outline, including pseudocode, the steps involved in the count sort algorithm.
 - ii) Describe what is meant by a *divide and conquer* approach to sorting. Outline the steps involved in any divide and conquer sorting algorithm. Include pseudocode in your answer.
 - iii) Compare the following sorting algorithms by describing their advantages and disadvantages:
 - quick sort.
 - insertion sort.
 - selection sort.
 - count sort.