

OLLSCOIL NA hÉIREANN GAILLIMH
NATIONAL UNIVERSITY OF IRELAND GALWAY

SUMMER EXAMINATIONS 2000

First University Examination in Information Technology

ALGORITHMS AND INFORMATION SYSTEMS (CT102)

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Time allowed: *three* hours.
Attempt *five* questions.

1. Using each of the following methods, write down (step by step) the position of each letter in the string "zagreb" when sorted using
 - (a) mergesort
 - (b) insertion sort
 - (c) quicksort
2. Explain the difference between "top down" and "bottom up" approaches to writing algorithms. Illustrate this by writing two different algorithms which calculate the factorial $n! = n(n-1)(n-2) \dots 3 \cdot 2 \cdot 1$ of a positive integer n .
3.
 - (a) Explain the difference between linear (sequential) and binary search.
 - (b) Construct a Binary Search Tree for the data 9, 3, 4, 12, 1, 13. Using the Binary Tree Search Algorithm, calculate the number of comparisons we must make to find the data item 12, and the maximum number of comparisons needed to find any data item.
4. Four businesses b_1, b_2, b_3, b_4 making yearly profit/loss of -2, 10, -5, and 6 million euro (respectively) are being sold off. They lie next to one another on a certain street, and we wish to purchase any number of them (from 0 to 4) to maximize our yearly profit. Subject to the condition that businesses purchased must be next to one another
 - (a) Write a brute force algorithm that determines which businesses we should purchase.
 - (b) By inspection determine which businesses we should purchase and the total resulting yearly profit.

5. Explain what is meant by an Abstract Data Type (ADT). Define the *List* ADT and hence write an algorithm to swap two elements of a *List*.
6.
 - (a) Explain the difference between the *Stack* and *Queue* Abstract Data Types (ADT).
 - (b) Using the *Stack* ADT, write pseudocode to determine if a given piece of text has balanced round brackets (i.e. the same number of open brackets '(' as closed brackets ')')
7. Explain three of the following terms:
 - (a) Database.
 - (b) The 3-schema architecture: Conceptual, Internal and External.
 - (c) Logical and Physical Data Independence.
 - (d) Entity-Relationship Diagrams.
8. Describe the components of an Expert System. Explain the difference between Bottom-Up (Forward Chaining) and Top-Down (Backward Chaining) Inference, giving an example of each.