

OLLSCOIL NA hÉIREANN GAILLIMH
NATIONAL UNIVERSITY OF IRELAND GALWAY

SUMMER EXAMINATIONS 2001

First University Examination in Information Technology

ALGORITHMS AND INFORMATION SYSTEMS (CT102)

Professor D. Bell
Professor G. Lyons
Dr. M. Mc Gettrick

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

1. Using each of the following methods, write down (step by step) the position of each digit in the number 691723 when sorted (with lower digits to the left) using
 - (a) bubble sort
 - (b) merge sort
 - (c) selection sort

2. (a) Explain exactly what is meant by saying an algorithm has complexity $O(f(n))$ ("Big Oh" notation).
 (b) If merge sort has complexity $O(n \log_2 n)$ and bubble sort has complexity $O(n^2)$, which is a more efficient algorithm?
 (c) Explain why selection sort is also $O(n^2)$.

3. (a) Calculate $f(5)$ where f is the recursive function defined by the following pseudocode.


```
f(i)
  IF (i<2) THEN
    f ← 1
  ELSE
    f ← f(i-1) + f(i-2)
```

 - (b) How many times was the function f called in the calculation of $f(5)$?
 - (c) Given two positive integers x, y with $y \geq x$, write an algorithm using either iteration or recursion to calculate how many times x goes into y and the integer remainder (i.e. find q and r where $y = qx + r$ and $r < x$).

4. (a) Write the pseudocode for a recursive function $H(i, x, y, z)$ to be used in solving the Towers of Hanoi problem, where there are i discs on peg x that have to be moved to peg y , with z as spare.
- (b) Rewrite the following pseudocode using FOR instead of WHILE.
- ```
c ← 0
WHILE (c < n) DO
 BEGIN
 c ← c + 1
 OUTPUT c
END
```
5. (a) In a certain country only coins of size 3 cents and 4 cents are available. We want to make up an amount  $n$  using the minimum number of coins. State if the **greedy strategy** provides a solution to this problem, and if so give the solution, for the two cases
- (i)  $n = 9$
- (ii)  $n = 11$
- (b) For the Abstract Data Type (Ordered) List  $L(i)$ , with index  $i$  and operations **retrieve**, **insert**, **delete** simplify each of the following:
- (i) **retrieve**(**insert**( $L, i, x$ ),  $i$ )
- (ii) **retrieve**(**delete**( $L, i-1$ ),  $i$ )
- (iii) **delete**(**insert**( $L, i, x$ ),  $i$ )
6. For two of the following, define the ADT in question and illustrate with examples two operations that can be performed on it: (a) stack, (b) queue, (c) table.
7. (a) Give four advantages of using Databases instead of File Processing Systems.
- (b) Explain the term *schema* and describe the components of the three-level (database) architecture.
8. In different countries, records are kept on the car colours that are most popular. For countries  $C_1$  to  $C_4$  the most popular colours are given below.

$C_1$  : {blue, red, black, brown}  
 $C_2$  : {red, yellow, brown}  
 $C_3$  : {black, white, red}  
 $C_4$  : {red, green, black, brown}

Calculate the support and the confidence of each of the following Association Rules, and state which are valid if we set our threshold at 70%.

- (a) {brown, red}  $\rightarrow$  {blue}
- (b) {green}  $\rightarrow$  {red}
- (c) {red}  $\rightarrow$  {black}