

OLLSCOIL NA hÉIREANN  
THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

SUMMER EXAMINATIONS 1999  
SECOND YEAR COMPUTER SCIENCE

Computer Science [CS201]

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Time Allowed: **Three Hours**

**Answer only 5 questions**

1. What is a computer operating system? Describe the structure of the UNIX operating system.

What are the main functions of the UNIX shell? Give some simple examples of UNIX shell commands to carry out the following sequence of operations.

You have 4 files called *test.1*, *test.2*, *test.3* and *test.4* stored in the directory */scratch*. Copy these files into a directory called */scratch/new\_one*. Finally delete all the original files.

2. What is a race condition? What measures can be taken to overcome them.

A printer queue with a number of slots is accessible by a number of processes. Write some code (C or pseudo code) to show how these processes should access the queue without any part of the queue being over-written.

3. Describe the main threats to the security of a distributed system.

A Bank wants to ensure that its computer systems are secure. At the same time it wants to enable its customers to access the details of their bank account at all times via the Internet. What measures could be taken to ensure that bank-customer confidentiality is maintained under this system?

4. Write short notes on the following using examples where appropriate

- i) Client-Server Computing
- ii) Atomic Operations
- iii) UNIX pipes
- iv) Parent and child processes; the fork() command.

5. (a) Explain the purpose and illustrate the use of the Maple commands: (i) `coeff`, (ii) `Int`, (iii) `op`, (iv) `assume`.
- (b) Explain the differences between and illustrate the meaning in Maple of (i) expression sequences (ii) sets and (iii) lists.
- (c) Explain the use of the `local`, `global` and `option remember` statements in a Maple procedure. The Hermite polynomial  $H_n(x)$  can be defined by the recursion formula

$$H_{n+1}(x) = xH_n(x) - nH_{n-1}(x)$$

where  $H_0(x) = 1$  and  $H_1(x) = x$ . Write an **efficient** Maple procedure which computes  $H_{20}(x)$  in its simplest form.

6. (i) Algorithm  $A$  below is supposed to compute  $p = mn$  when  $m$  and  $n$  are integers.
- (a) Show that  $z + xy$  is a loop invariant.
  - (b) Show that the algorithm is correct if  $n \geq 0$ .
  - (c) Modify the algorithm to make it correct for all integers  $n$ .
- (ii) Show that the statement “5 divides  $x$ ” is a loop invariant for Algorithm  $B$  below. Find the values of  $m \geq 1$  for which the algorithm terminates, and describe the partial function  $f : N \rightarrow N$  it computes.

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      A
x ← m; y ← n; z ← 0
while  y ≠ 0 do
      z ← z + x
      y ← y - 1
p ← z

```

```

    B
x ← m
while x > 1 do
    if x even
        then x ←  $\frac{x}{2}$ 
        else x ← x + 5
k ← x

```

7. (i) Illustrate the sorting algorithms (a) Bubble sort (b) Tree sort by using each of them to sort the sequence of numbers  
3, 5, 8, 1, 2, 6, 4, 7  
in increasing order.
- (ii) Show that each of the above algorithms has complexity  $O(n^2)$ .
- (iii) Show that Tree sort has average complexity  $O(n \log n)$ .