

Semester II Examinations, 2002/2003

Exam Code(s) 1MS1, 1SD1

Exam(s) MS1 M.Sc.Degree
SD1 H.Dip.(Software Design And Development)

Module Code(s) CT853

Module(s) Algorithmics & Logical Methods

Paper No. 1
Repeat Paper _____ Special Paper _____

External Examiner(s) Professor D. Bell

Internal Examiner(s) Professor G. Lyons

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Instructions

Answer 3 questions.
All questions will be marked equally.

Duration 2hrs

No. of Answer Books 1

Requirements

Handout _____

MCQ _____

Statistical Tables _____

Graph Paper _____

Log Graph Paper _____

Other Material _____

No. of Pages _____

Department(s) _____

1. (a) Using each of the following methods, write down (step by step) the position of each letter in the word “korea” when sorted alphabetically using
 - (i) selection sort
 - (ii) merge sort
 (b) State (in “Big Oh” notation) the complexities of the algorithms in part (a). On a super-computer, it takes 2 seconds to perform a merge sort on one billion ($1,000,000,000 = 10^9$) items. Estimate how long (in seconds) it would take using merge sort on the same computer to sort 10 billion items ($10,000,000,000 = 10^{10}$).

2. (a) Explain the Divide and Conquer approach to algorithm design. Give an example (using pseudocode) of a Divide and Conquer algorithm to calculate x^n , where n is a positive integer.
 (b) In cryptography we often need to multiply two large integers. Using a Divide and Conquer strategy, the *Karatsuba* algorithm gives us an efficient way to do this. Describe the algorithm, explain why it is more efficient than “standard” multiplication, and give (in “Big Oh” notation) its complexity.

3. A container truck has total (weight) capacity 5 KiloTonnes. In a port, there are four loads it can collect, each with a different weight and value:

Load:	A	B	C	D
Weight(Kilotonnes):	2	1	4	3
Value(Millions of Euro):	5	3	7	6

The objective is to decide which loads to take to maximize the Value, while not surpassing the 5 KiloTonne limit.

- (a) Using a Greedy approach to this problem, what solution is obtained if the Greedy approach is based on
 - (i) maximizing value?
 - (ii) minimizing weight?
 - (iii) maximizing the (value/weight) ratio?
- (b) Describe (by composing a table of intermediate values) how Dynamic Programming can be used to solve this problem, and state the solution obtained.

4. (a) Use truth tables to determine whether each of the following well formed formulae (wff) are tautologies, contradictions, or neither.

(i) $A \vee [(\neg B \wedge \neg A) \vee B]$

(ii) $(A \wedge \neg A) \rightarrow (B \wedge \neg B)$

(iii) $[A \vee (B \rightarrow C)] \wedge (\neg C \vee B)$

- (b) Given the predicates

$H(x)$: "x is a hard language" (Universe $U \equiv$ set of all languages, $x \in U$)

$I(y)$: "y is an Irish person " (Universe $V \equiv$ set of all people, $y \in V$)

$S(p,q)$: "p Speaks (language) q" ($p \in V, q \in U$)

write statements in First Order Predicate Calculus to express each of the following:

- (i) Joe speaks Japanese.
(ii) Irish French speakers (i.e. Irish people who speak French) do not speak Korean or other hard languages.
(iii) Easy languages are spoken by everybody.
(iv) No Irish person speaks all the hard languages.