

Programme Code: TU856, TU858

Module Code: CMPU1001

TECHNOLOGICAL UNIVERSITY DUBLIN

Grangegorman

TU856 – BSc. (Honours) in Computer Science

**TU858 – BSc. (Honours) in Computer Science
(International)**

Year 1

SEMESTER 2 EXAMINATIONS 2023/24

CMPU1001 - Algorithm Design and Problem Solving

Internal Examiner(s):

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Instructions To Candidates:

Answer QUESTION 1 and ANY TWO questions of the remaining three available.

Question 1 carries 40 marks while all further questions each carry 30 marks

Exam Duration:

TWO HOURS

1. (a) i. “Recursion is a technique used in the Divide and Conquer paradigm.”
What does this mean? Explain using examples. (3 marks)
- ii. You have been asked how you would compare the performance of two algorithms.

Assuming both algorithms achieve the same outcome and are correct, outline a technique to evaluate both algorithms. (4 marks)
- (b) i. What is the Tower of Hanoi puzzle? (3 marks)
- ii. Write an algorithm which solves the Tower of Hanoi. (8 marks)
- iii. Show, using a stack trace, how your algorithm works for 3 disks. (12 marks)
- iv. What is the complexity of the Tower of Hanoi puzzle? (2 marks)
- (c) i. What is the name of the algorithm below :-
- ```

for i = 0 to i < N-1 do
 min = A[i]
 for j = i to j < N do
 if A[j] < A[min] then
 min = A[j]
 End if
 End for
 temp = A[j]
 A[min] = A[i]
 A[i] = temp
End for

```
- (2 marks)
- ii. There are a number of errors in the algorithm, list them and suggest the correct instructions. (6 marks)

2. (a) i. The mergesort is an algorithm which recursively merges two sorted halves of a list. Show how the merge works on two sorted halves of the list below :-

[ 3,6,7,8] [ 3,4,5,6]

(5 marks)

- ii. Write the merge algorithm for sorting two sorted arrays.

(7 marks)

- (b) Using a sort trace, show how the merge sort acts on the following list to sort it:-

[ 8,7,6,5,4,3,2,1 ]

(6 marks)

- (c) How would you improve the Mergesort? Using pseudocode, show how your algorithm would work and explain the performance improvement in terms of Big-O.

(12 marks)

3. (a) i. What is an Abstract Data Type (ADT).

(3 marks)

- ii. Describe the following three ADT's, using examples to illustrate your answer :-

- *Stack*
- *Queue*
- *Binary Search Tree*

(9 marks)

- (b) i. Describe two implementations of a list and explain the advantages and disadvantages of each.

(4 marks)

- ii. Show using pseudocode how you would insert into an ordered List.

(7 marks)

- iii. Show using pseudocode how you would delete from an ordered List.

(7 marks)

**4. (a)** i. Draw a Binary Search Tree from the following data :-

[ 9,4,3,18,2,11,10,9,12,15 ]

(4 marks)

ii. Show how the tree can be traversed using 3 different named methods.

(6 marks)

**(b)** Describe the Eight-Puzzle.

(5 marks)

Choosing a suitable way to represent the data, demonstrate the first 6 states of the puzzle.

(5 marks)

**(c)** The Breadth First Search (BFS) is a strategy for locating a node in a tree. Write out an iterative algorithm to implement BFS in pseudocode.

(10 marks)