



RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. in Information Technology
Second Year - Semester I Examination – July/August 2023

ICT 2301 – DESIGN AND ANALYSIS OF ALGORITHMS

Time: Three (03) hours

- Answer **ALL** questions.

1. a) Explain why the step count method is not recommended for calculating the complexity of algorithms. (03 marks)
- b) In asymptotic analysis, what are the three cases you have to consider? Explain them using your own examples. (06 marks)
- c) Compare and contrast *time complexity* and *space complexity* of algorithms. (04 marks)
- d) Explain why *Super Polynomial Time Algorithms* are not recommended. (03 marks)
- e) Analyse the following algorithms and find the time complexities;
 - a. *fibonacci*(positive integer n)

```
1 if  $n=0$  or  $n=1$  then
2   return 1
3 else
4   return  $\text{fibonacci}(n-1) + \text{fibonacci}(n-2)$ 
```
 - b. *MinDistance*($A[0..n-1]$)

```
1  $dmin \leftarrow \infty$ 
2 for  $i \leftarrow 0$  to  $n-1$  do
3   for  $j \leftarrow 0$  to  $n-1$  do
4     if  $i \neq j$  and  $|A[i] - A[j]| < dmin$ 
5        $dmin \leftarrow |A[i] - A[j]|$ 
6 return  $dmin$ 
```

 (04 marks)

2. a) The recurrence relation for the running time of an algorithm is given as;

$$T(n) = \begin{cases} C_1, & \text{if } n = 1 \\ 2T\left(\frac{n}{2}\right) + C_2n, & \text{if } n > 1 \end{cases}$$

Solve the recurrence relation and find the running time as a function of n . (04 marks)

- b) Explain the *Brute-force* approach in algorithm designing. (04 marks)
- c) What are the advantages and disadvantages of *Brute-force* algorithm? (04 marks)
- d) The percentages of appearing each character in a text message are given below.

Symbol	A	B	C	D	E	F	G	H
Frequency	16%	8%	11%	13%	21	9%	10%	12%

- i. Construct a *Huffman tree* that helps to encode and compress the original message.
 ii. Calculate the compression ratio of the encoded message.

(08 marks)

3. a) Compare and contrast *Recursive* and *Dynamic* algorithms (04 marks)
- b) For what kind of problems, can you build *dynamic* algorithms? (04 marks)
- c) The table below shows the amount payable and the profit that can be earned for an item in a product list. If you only have 100 rupees in hand, select a set of items that maximize the total profit using;
- Brute-force approach
 - Greedy approach
 - Dynamic approach

Note that you are not allowed to select more than one item from a single product. For each of the above approach, find the time complexity.

Product	1	2	3	4
Cost	20	20	40	60
Profit	30	70	20	90

(12 marks)

4. a) Explain why sorting is important in computer programming. You may use your own examples. (03 marks)
- b) Compare and contrast *Quick sort* and *Heap sort*. (04 marks)
- c) Show that the following is a *Heap* structure.

0	1	2	3	4	5	6	7	8	9
14	8	10	6	9	5	7	3	1	4

(05 marks)

d) Illustrate how to sort the contents of the structure given in question 4. c) above using *Heap-Sort* algorithm.

(04 marks)

e) Explain the *Binary search* algorithm using an example.

(04 marks)

5. a) What is a *Minimum Cost Spanning Tree* (MST)?

(03 marks)

b) Find the *Minimum (Cost?) Spanning Tree* using of following weighted graph using;

- Prim's algorithm and
- Kruskal's algorithm

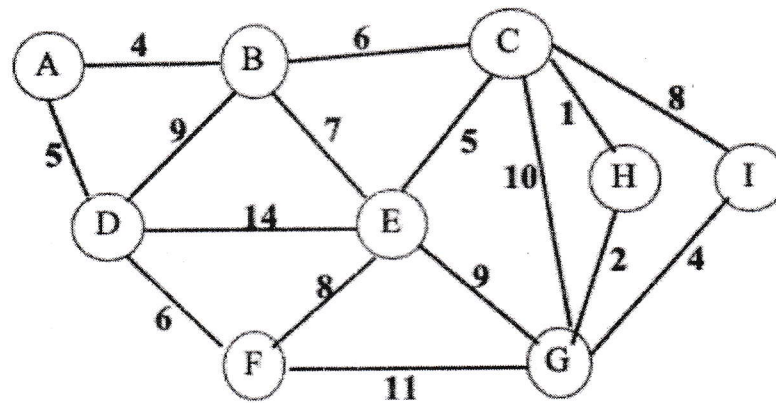


Figure 1

(08 marks)

c) Find the shortest path from node A to node I of the graph given in *Figure 1* above. Indicate the steps clearly.

(04 marks)

d) "*Backtracking* is a methodical way of trying out various sequences of decisions, until you find one that 'works'".

- To solve what kind of problems, you can use Backtracking strategy.
- Draw the Depth First Search (DFS) tree rooted at node A of the graph given in Figure 1 above.

(05 marks)

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