RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Information and Communication Technology

Second Year – Semester I Examination – June/July 2018

ICT2301-Design and Analysis of Algorithms

Time allowed: <u>Three</u> (03)hours

This paper contains five questions in three pages
Answer all questions

1.

i. Time complexity and space complexity are two important ways of characterizing the effectiveness of an algorithm. Explain how to determine which of these two is most important for an algorithm.

(05 Marks)

ii. What is asymptotic analysis of an algorithm?

(03 Marks)

iii. Define asymptotic upper bound and asymptotic lower bound.

(04 Marks)

iv. What are the reasons to avoid super-polynomial time algorithms? Explain using examples.

(04 Marks)

v. Find the best big O function for each of the following.
   a. $n(n+1)/2$
   b. $n^2 + n \log(n) + 5n$
   c. $\log(n) + \log(n^2)$
   d. $1 + 2 + ... + n$

(04 Marks)

2.

i. Discuss the advantages and disadvantages of recursive algorithms. (04 Marks)

ii. Explain how to remove a recursion using an example (03 Marks)

iii. If the time complexity of an algorithm is given by following recurrence relation, find running time of the algorithm;

$$T(n) = \begin{cases} 1; when\ n = 1 \\ T\left(\frac{n}{2}\right) + n; when\ n > 1 \end{cases}$$

(05 Marks)

iv. Following algorithms compute the GCD of two integers a, and b. find time complexities of them in both best case and worst case.

```
function gcd1(INTEGER a, b)
    1. while a ≠ b
    2.     if a > b
    3.         a ← a − b
    4.     else
    5.         b ← b − a
    6. return a
```

```
function gcd2(INTEGER a, b)
    1. if b = 0
    2.     return a
    3. else
    4.     return gcd2(b, a mod b)
```

(08 Marks)

3.

i. Compare and contrast Greedy and Dynamic algorithms. (04 Marks)

ii. Assume that there is a knapsack with max weight capacity 5 and set of items. The following table shows the set of items with values.

Item (i)	1	2	3	4
Value (v)	12	10	3	6
Weight (w)	4	2	2	1

a) Illustrate selecting items into the knapsack using brute-force method. (04 Marks)

b) What is/are the drawback(s) of above method? (02 Marks)

c) Illustrate selecting the best set of items into the knapsack using dynamic approach by filling the following table.

(05 Marks)

V[i,w]	w=0	1	2	3	4	5
i=0	0	0	0	0	0	0
1	0					
2	0					
3	0					
4	0					

iii. Write down the algorithm you used in ii. c) above and find its time complexity. (05 Marks)

4.
   i. Backtracking is a methodical way of trying out various sequences of decisions, until you find one that "works". List the characteristics of problems for which you can apply the Backtracking strategy. **(03 Marks)**

   ii. Define the term "State Space Tree" **(03 Marks)**

   iii. Find the minimum number of colors you require to color the following map such that no two neighboring regions share the same color.
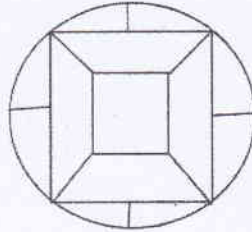
      Explain the algorithm you used to color the map. **(06 Marks)**

   iv. Suppose there is a list of marks for 100 students. You should insert these marks into a structure, such that the structure facilitates extracting the minimum or maximum mark easily.

      a) Suggest a suitable structure for this purpose.
      b) Write the insertion algorithm you suggest to use and find its time complexity
      c) Write an algorithm to extract the maximum and find its time complexity **(08 Marks)**

5.
   i. What is meant by the stability of a sorting algorithm? Explain using examples. **(04 Marks)**

   ii. Illustrate sorting of the list, 5,2,8,7,3,1,4 using Quick sort algorithm by selecting the number in the middle as the pivot element. **(04 Marks)**

   iii. Define the following terms with respect to graphs giving an example for each.

      a) Circuit
      b) Cycle
      c) Hamiltonian Cycle **(05 Marks)**

   iv. Compare and contrast Depth First Search and Breadth First Search in a graph. **(03 Marks)**

   v. Illustrate the DFS algorithm with a suitable example. **(04 Marks)**

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