53

RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

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

Second Year – Semester I Examination – April/May 2016

ICT2301 - Design and Analysis of Algorithms

Answer any five questions
Time allowed: Three hours

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1) i. List three features of a good algorithm. (03 Marks)

ii. Compare and contrast time complexity and space complexity of algorithms. (03 Marks)

iii. Formally define asymptotically upper bound and asymptotically lower bound. (04 Marks)

iv. "A devised algorithm should be a polynomial time algorithm". Explain why using examples. (04 Marks)

v. Analyse the following algorithms. (06 Marks)

a. *test(positive integer n)*

```
1 if n=0 then
2   return 1
3 else
4   return test(n-1)+test(n-2)
```

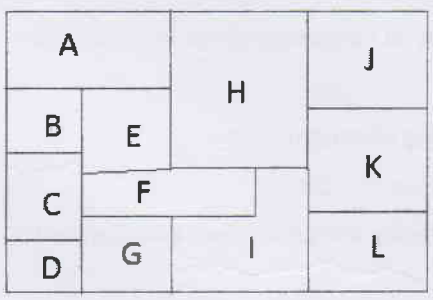
b. *MinDistance(A[0..n−1])*

```
1 dmin←∞
2 for i ←0 to n−1 do
3       for j ←0 to n−1do
4    if i≠ j and |A[i]−A[j]|<dmin
5            dmin←|A[i]−A[j]|
6 return dmin
```

2) i. Explain the Backtracking algorithmic technique using appropriate examples. (04 Marks)

ii. For what type of problems you can apply the Backtracking technique. (04 Marks)

iii. Consider the following map (12 Marks)



a. Explain how you can use the graph-coloring problem to color the map so that no two neighboring regions are colored the same.

b. Use your answer to part (i) to color the map with the smallest number of colors.

3) i. The recurrence relation for the running time of an algorithm is given by $T(n) = \begin{cases} 1; when\ n = 1 \\ T\left(\frac{n}{2}\right) + \log n \end{cases}$ Solve this by repeated substitution. (05 Marks)

ii. Analyse the following algorithms; (06 Marks)

a) Alpha(positive integer n)

```
1. for i←n down to 1 do
2. for j←i-1 to n do
3.     for k←1 to j do
4.         Some statements requiring O(1) time
```

b) Beta(positive integer n, positive integer k)

```
1. if k=0
2.     return n
3. if k is even
4.     return Beta(n-1,k/2)*n
5. else
6.     return Beta(n-1, k/2)*n*n
```

iii. Obtain a recurrence relation for the running time of the following algorithm. (04 Marks)

```
Lambda(integer n)
1. if n<=1
2.         return 1
3. else
4.         return Lambda(n-1)+ Lambda(2/2)
```

iv. Rewrite the above algorithm using the "Dynamic" technique. (05 Marks)

4) i. Compare and contrast "Recursive" and "Dynamic" algorithms. For what kind of problems these are applicable? (06 Marks)

ii. What is a state space tree? (03 Marks)

iii. The sum of subset problem is defined as: "Given n positive integers $w_1, \ldots w_n$ and a positive integer S, find all subsets of $w_1, \ldots w_n$ that sum to S". Suppose the given integers are 1, 2, 3,5 and 6. Draw a state space tree that represents all subsets of given integers that sum to 6. (05 Marks)

iv. What is a promising node in a state space tree? (02 Marks)

v. Redraw the state space tree you drew in (iii.) above by removing all the non-promising nodes. (04 Marks)

5) i. What is meant by the Stability of a sorting algorithm? (05 Marks)

ii. Compare and contrast Merge sort and Insertion sort. (04 Marks)

iii. Depict sorting of the list 7, 9, 3, 10, 2, 6 using Merge sort and Insertion sort algorithms. (06 Marks)

iv. Explain the binary search algorithm using examples. (05 Marks)

6) i. What are the strengths and weaknesses of Brute-Force algorithms? (03 Marks)

ii. Suppose that you have a bag of size 7.If the following list of items are available:

Item (i)	Size (w)	Value 24 (v)
01	4	11
02	3	7
03	5	12
04	2	8
05	2	6

a) Find the value of the bag if you use Greedy strategy to collect items into the bag. (02 Marks)

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

c) Illustrate the way of collecting items into the bag if Brute-Force strategy is used. (05 Marks)

d) Find the running time of the algorithm you used in above (c). (04 Marks)

e) Suggest a better technique to select items such that you have a bag with the maximum value. (04 Marks)

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