Total number of printed pages–8

53 (IT 501) DAAL

2018

DESIGN AND ANALYSIS OF ALGORITHM

Paper : IT 501

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

GROUP–A

1. Choose the correct alternative : ***(any ten)*** $1 \times 10 = 10$

   (i) *O*-notation provides an asymptotic

   (a) upper bound

   (b) lower bound

   (c) tight bound

   (d) light bound

(ii) Time complexity for recurrent relation $T(n) = 2T\left(n/2\right) + n$ is

(a) $O(\log n)$

(b) $O(n \log n)$

(c) $O(n)$

(d) $O(n^2)$

(iii) Tight bound for building a max heap algorithm will be

(a) $O(\log n)$

(b) $O(n^2)$

(c) $O(n \log n)$

(d) $O(n)$

(iv) Complexity of merge sort is

(a) $O(n \log n)$

(b) $O(2^n)$

(c) $O(n^n)$

(d) $O(\log n)$

(v) In the following C function, let $n \geq m$

```
int gcd (n, m)
{ if (n % m = = 0) return m;
  return gcd (m, n % m);
}
```

How many recursive calls are made by this function ?

(a) $\Theta(\log_2 n)$

(b) $\Omega(n)$

(c) $\Theta(\log_2 \log_2 n)$

(d) $\Theta(\sqrt{n})$

(vi) The Floyd-Warshall algorithm fall all-pair shortest paths computation is based on

(a) Greedy paradigm

(b) Divide & Conquer

(c) Dynamic Programming

(d) Backtracking

(vii) A sorting technique is called stable if

(a) it takes $O(nlogn)$ time

(b) it maintains the relative order of occurrence of non-distinct elements

(c) it uses divide & conquer paradigm

(d) it takes $O(n)$ space

(viii) To implement Dijkstra's shortest path algorithm on unweighted graphs so that it runs in linear time, then data structure to be used is

(a) Queue

(b) Stack

(c) Heap

(d) B-Tree

(ix) What is the time complexity of Bellman-Ford single-source shortest path algorithm on a complete graph of n vertices

(a) $O(n^2 log\ n)$

(b) $O(n^2)$

(c) $O(n^3)$

(d) $O(n^3 log_2 n)$

(x) Kruskal's algorithm is based on

(a) Greedy method

(b) Divide and Conquer method

(c) Dynamic Programming

(d) Backtracking

(xi) BFS has running time of a graph $G(V, E)$ using adjacency is

(a) $O(|V|)$

(b) $O(|E|)$

(c) $O(|E log V|)$

(d) $O(|V|+|E|)$

(xii) A problem in NP is NP-complete if

(a) it can be reduced to 3-SAT problem in polynomial time

(b) the 3-SAT problem can be reduced to it in polynomial time

(c) it can be reduced to any other problem in NP in polynomial time

(d) some problem in NP can be reduced to it in polynomial time

Group–B

Answer ***any five*** *questions.*

2. *(a)* Define an algorithm. What are the various properties of an algorithm? 6

   (b) What are the various fundamental techniques used to design an algorithm efficiently? 6

   (c) Define asymptotic notation (O, Θ, Ω). 6

3. *(a)* Illustrate the partition operation in the context of the Quicksort algorithm on the array: 10

   A = < 13, 19, 9, 5, 12, 8, 7, 4, 11, 2, 6, 21 >

   (b) Prove that the average case time-complexity of Quicksort is $O(n \log n)$. 8

4. *(a)* What is Heap? 4

   (b) Illustrate the operation of Build-Max-Heap (*A*, 8) on the array

   A = < 4, 1, 3, 2, 16, 9, 10, 14, 8, 7 > 7

   (c) Write the algorithm of Heapsort. 7

5. *(a)* Show how the merge sort algorithm will sort the following array in increasing order: 8

   70, 80, 40, 50, 60, 12, 35, 95, 10

   (b) Write complete merge sort algorithm. 10

6. *(a)* Prove that if 6

   $$f(n) = a_m n^m + a_{m-1} n^{n-1} + \ldots\ldots + a_1 n + a_0$$

   then $f(n) = 0(n^m)$

   (b) Solve the following recurrence relation using recursive tree 6

   $$T(n) = T(n/3) + T(2n/3) + n$$

   (c) Solve the following recurrence relation using substitution method: 6

   $$T(n) = 2T(\sqrt{n}) + 1, T(1) = 1$$

7. *(a)* Find the minimum number of operation required for the following matrix chain multiplication using dynamic programming 12

   $A(10 \times 20) * B(20 \times 50) * C(50 \times 1) * D(1 \times 100)$

(b) Trace the steps to solve the 4-Queens problem by backtracking method. For each step draw the 4×4 matrix showing the positions of queens in it. Show where you apply backtracking. 6

8. (a) Find the optimal solution (using Greedy Algorithm) for the fractional knapsack problem given below : 4

$I = \{I1, I2, I3\}$

$W = \{18, 15, 10\}$

$V = \{25, 24, 15\}$

$m = 20$

(b) Show the steps of Kruskal's and Prim's algorithm to find a minimum spanning tree of the graph shown in the *Figure* 1. 14

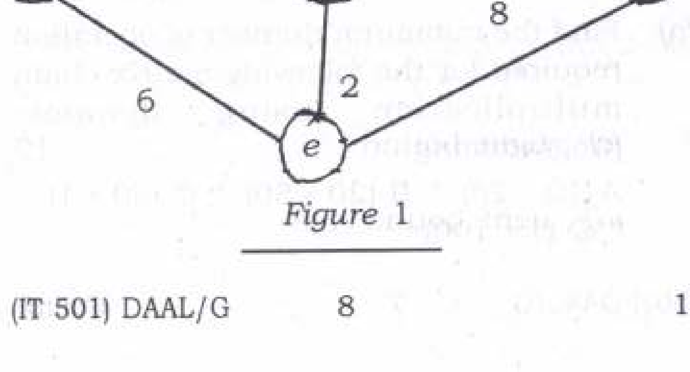

Figure 1