MCA 129

Roll No. 2 9

MCA
Even Semester
Minor Test 2018-19
Subject: Algorithms Design and Analysis

Time: 2 Hours **Max. Marks: 30**

Note: Attempt all questions.

Q.1. Attempt any three of the followings Q. 1(a) is compulsory.

a. Define algorithm, control abstraction and stable sorting. Write procedure for control abstraction of greedy approach. 04

b. Discuss time and space complexity of an algorithm and its importance. 03

c. (i) Consider the following instance of the knapsack problem: n = 3, m = 20, (p_1, p_2, p_3) = (25, 24, 15), $(w_1, w_1, w1)$ = (18, 15, 10), using greedy approach show the few feasible solutions and write the optimal solution. 03

(ii) Show the process for finding the optimal binary merge pattern for the following five files A (with 15 records), B (with 25 records), C (with 20 records), A (with 10 records), and E (with 30 records). What is the total number of record movements needed by this merge pattern?

d. Write BUCKET_SORT algorithm and illustrate the operation of BUCKET_SORT on the array A = <.79, .13, .16, .64, .39, .20, .89, .53, 71, .42>. 03

Q.2. Attempt any three of the followings Q. 2(a) is compulsory.

a. Explain tree vertex splitting problem with help of example. 04

b. Explain the master method for solving the recurrence relations 03

c. What will be order of algorithm, if the computational time is given by the recurrence relation as given below, where n is a power of 2, i.e. $n = 2^k$ (solve recurrence relation without using master method): 03

$$T(n) = \begin{cases} a & ; n = 1, a \text{ a constant} \\ 2T(n/2) + cn & ; n>1, c \text{ a constant} \end{cases}$$

d. Write merge sort algorithm and discuss its complexity. Is it stable sorting or not? Justify your answer. 03

Q.3. Attempt any three of the followings Q. 3(a) is compulsory.

a. Write greedy-activity-selector algorithm. Let 11 activities are given s = {p, q, r, s, t, u, v, w, x, y, z} the start and finished time for proposed activities are (1, 6), (3, 7), (4, 8), (5, 9), (3, 10), (7, 11), (10, 13), (8,15), (8, 15), (2, 16), and (13, 17). Compute a schedule where the largest number of activities takes place. 04

b. Write algorithm for greedy –frictional –knapsack problem and comments on its complexity. 03

c. Sort the following list of elements using merge sort: 70, 80, 40, 50, 60, 11, 35, 85, 2 03

d. Write bellman ford algorithm and comment on its time complexity. 03

Minor(18-19)

MCA

(SEM IV) EVEN SEMESTER

MAJOR EXAMINATION 2018 – 2019

SUBJECT: ALGORITHMS DESIGN AND ANALYSIS

Time: 3 Hrs

Max. Marks: 50

Note : *Attempt all questions. Each question carries equal marks.*

1 Attempt any **five**parts of the following: **(5x2=10)**

(a) Write quicksort algorithms using divide and conquer approach and argue on its time complexity in best case, average case and worst case.

(b) Explain the various asymptotic notations used in algorithms analysis.

(c) Consider the merge sort algorithm for sorting a set of n points.

i) Draw the recursion tree for this algorithm for n = 15

ii) How many levels are there in the recursion tree?

iii) How many comparisons are at each of the levels in the worst case?

What is the total number of comparisons needed?

(d) Use the master method to give tight asymptotic bounds for the following recurrences:

i) $T(n) = 4T(n/2)+n$

ii) $T(n) = 4T(n/2)+n^2$

iii) $T(n) = 4T(n/2)+n^3$

(e) Discuss knapsack problem with help of example.

(f) Trace the Kurskal's algorithm on the graph given in fig. 1 to find the MST. Show the partially constructed MST at each stage.

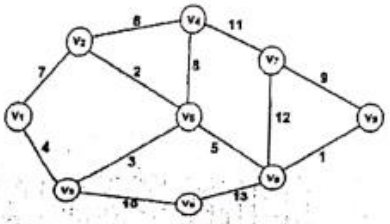

Fig. 1

(g) How many calls to the following fib(n) will be made for n = 8.

```
int fib (int n){
  if(n<2) return n;
  else return(fib(n-1)+fib(n-2));
```

2 Attempt any **two** parts of the following: **(5x2=10)**

(a) Write algorithm for Matrix-Chain-Order. Using dynamic programming algorithm to find out the minimum number of scalar multiplications required for the following chain of

matrices A1, A2, A3, A4, where the dimensions of the matrices are (5x1), (1x7), (7x3) and (3x3) respectively.

(b) Write all pair shortest path algorithm and analyse its complexity. Is this problem can be solved with single source shortest path algorithm? Justify your answer.

(c) Explain the concept of algorithm design using amortized analysis with help of suitable example.

major(18-19)

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(b). Define knapsack problem. Consider the following instance of the knapsack problem: n = 3, m = 20, $(p_1, p_2, p_3) = (25, 24, 15)$, $(w_1, w_1, w_1) = (18, 15, 10)$, show the few feasible solutions and finally write the optimal solution.

(c) Determine the frequency counts for all statements in the following c program segments:-

i)
```
i= 0;
while(i <= n) do
{
  x :=x+1;
  i:=i+1;
}
```

ii)
```
sum = 0;
for(i=0; i<=m; i++)
for(j=0; j <= n; j++){
 c[i, j]  = 0;
for(i=0; i<=m; i++)
for(k=0; k< =p;  k++){
c[i, j]= c[i, j] + a[i, k]*b[k, j];
 } }
```

(d) Sort the following list of elements in increasing order using quick sort technique and argue on its time complexity in best case, average case and worst case. L= {60, 65, 70, 75, 80,55,50, 45,40}.

(e) Write merge sort algorithms using divide and conquer approach argue on its time complexity in best case, average case and worst case.

(f) Write dijkstra's algorithm and comment on its time complexity. Using this algorithm to solve the following instance of the single source shortest-paths problem with vertex a as the source as shown in figure 1.

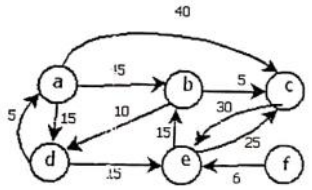

Fig. 1

(g) Discuss briefly the five essential attributes of an algorithm. Why we bother to analyze algorithms.

2 Attempt any **two** parts of the following: **(5x2=10)**

(a) Write algorithm of forward approach for finding the shortest path in multistage graph and argue on time complexity. Consider the multistage graph as given in figure 2: calculate the minimum cost path from source (s) to destination (t) using forward approach algorithm and explain how minimum cost path decided at each stage.

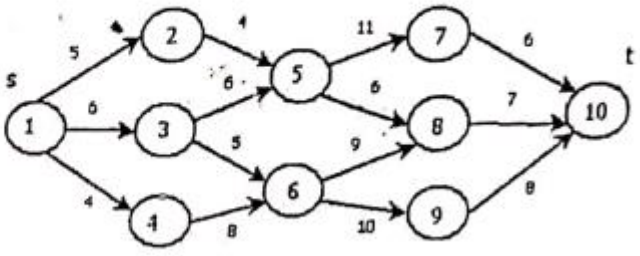

Fig. 2

MINOR(17-18)

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MCA

Even Semester

Minor Test 2017-18

Subject: Algorithms Design and Analysis

Time: 2 Hours **Max. Marks: 30**

Note: Attempt all questions.

Q.1. Attempt any three of the followings Q. 1(a) is compulsory.

a. Define algorithm, in-place sorting, and control abstraction. Write procedure for control abstraction of divide and conquer method. 04

b. Explain different types of asymptotic notations. 03

c. (i) Consider the following instance of the knapsack problem: n = 3, m = 20, $(p_1, p_2, p_3) = (25, 24, 15)$, $(w_1, w_2, w_3) = (18, 15, 10)$, using greedy approach show the few feasible solutions and write the optimal solution. 03

(ii) Show the process for finding the optimal binary merge pattern for the following five files A (with 10 records), B (with 20 records), C (with 15 records), A (with 5 records), and E (with 25records). What is the total number of record movements needed for this merge-pattern?

d. Write procedure for control abstraction of greedy approach. 03

Q.2. Attempt any three of the followings Q. 2(a) is compulsory.

a. Write an algorithm to find maximum and minimum elements of given n positive numbers using divide and conquer approach and analyze its time complexity by writhing and solving the corresponding its recurrence relations. 04

b. What is meant by time complexity and space complexity? Discuss its importance. 03

c. What will be order of algorithm, if the computational time is given by the recurrence relation as given below, where n is a power of 2, i.e. $n = 2^k$ (solve recurrence relation without using master method): 03

$$T(n) = \begin{cases} T(n/2) + T(n/2) + 2 & ; n > 2 \\ 1 & ; n = 2 \\ 0 & ; n = 1 \end{cases}$$

d. Write procedure of partitioning elements in Quicksort algorithm. Is it stable sorting or not? Justify your answer. 03

Q.3. Attempt any three of the followings Q. 3(a) is compulsory.

a. Consider the merge sort algorithm for sorting a set of n points.
Define the following terms:
1) Draw the recursion tree for this algorithm for n = 13
2) How many levels are there in the recursion tree?
3) How many comparisons are at each of the levels in the worst case?
What is the total number of comparisons needed? 04

b. Write greedy-activity-selector algorithm. Let 11 activities are given s = {p, q, r, s, t, u, v, w, x, y, z} the start and finished time for proposed activities are (1, 4), (3, 5), (4, 6), (5, 7), (3, 8), (7, 9), (10, 11), (8, 12), (8, 13), (2, 14), and (13, 15). Compute a schedule where the largest number of activities takes place. 04

c. Apply Prim's algorithm and Kruskal algorithm to the graph as given in fig. 1 to obtain minimum spanning trees by showing partially constructed of MST at each stage. Do both algorithms always generate same output Justify your answer. By which algorithms we get forest of tree at intermediate stage. 03

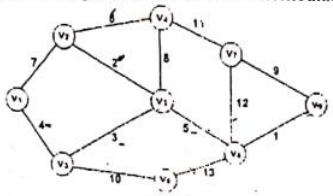

Fig.1

d. Write algorithm for greedy –frictional –knapsack problem. Also comments on its complexity. 03