POSSESION OF MOBILES IN EXAMS IS UFM PRACTICE.

NAME _____ Enrollment No. _____

Jaypee Institute of Information Technology , Noida
Supplementry Examination , Even 2019
B.Tech 4th Semester

Course Title: Algorithms and Problem Solving **Maximum Time : 2 hr**
Course Code: 15B11CI411 **Maximum Marks : 75**

Q1[15][CO3] In the art gallery guarding problem we are given a line *L* that represents a long (straight) hallway in an art gallery. We are also given a set *X = (x1; x2; : : : ; xn)* of real numbers that represent locations where paintings are hung in the hallway. Suppose that a single guard can protect all the paintings within distance at most 1 of his or her position (on both sides). Design an algorithm for finding a placement of the guards that uses the minimum number of guards to guard all the paintings with positions in *X*.

Q2[15][CO2] RB Tree is one of the balanced binary search trees. Perform following operations: Insert (50, 20, 10, 29, 23, 45, 86, 75, 89, 5, 7, 2, 8, 18, 27, 32, 41, 22) followed by Delete (86, 22, 76 (answer should be not found), 18, 2) followed by Insert (86, 22, 76, 18, 2).

Q3[15][CO4] A contiguous subsequence of a list S is a subsequence made up of consecutive elements of S. For instance, if S is 5; 15; -30; 10; -5; 40; 10; then 15; -30; 10 is a contiguous subsequence but 5; 15; 40 is not. Given a list of numbers, write a linear-time algorithm for the finding the contiguous subsequence of maximum sum.

Q4[15][CO1] Find the recurrence for the function One. Further, solve the obtained recurrence.
Function: One(int *a, int n)

```
{
    int *b, *c, i, x = 0, y = 0;
    allocate memory to b to store n / 3 elements; allocate memory to c to store 2 * n / 3 elements
    for(i = 0; i < n; i++)
        if i < n / 3 { b[x++] = a[i]; }
        else { c[y++] = a[i]; }
    if x > 1 { One(b, x); }
    if y > 1 { One(c, y); }
}
```

Q5[15][CO4] Minimum Spanning Tree (MST) is a well known problem for weighted graph G = {V, E}, where it is needed to compute the minimum weighted acyclic network of all the V vertices. Suppose that you have already computed the Minimum Spanning Tree, T = {V, E' = V – 1} of a given graph, G = {V, E}. Let us consider following scenarios:

(a) Weight of an edge E1 ϵ E of the given graph G is modified (increased or decreased). Let us call the modified graph as Gmod.

(b) An edge E1 ϵ E is removed / deleted from the given graph G. Let us call the modified graph as Gmod.

(c) A new edge Enew is inserted between two vertices, V and V into the given graph G. Let us call the modified graph as Gmod.

In each of the above scenario, the pre computed MST (T) for the graph G, might not be the MST for the graph G'. Without re-computing from scratch, propose efficient strategies in each of the above scenario, either find new MST, Tmod (if needed) or report that the pre computed MST, T is also the MST for Gmod.

POSSESION OF MOBILES IN EXAMS IS UFM PRACTICE.

NAME _____ Enrollment No. _____

Jaypee Institute of Information Technology, Noida
T2 Examination, Even 2019
B. Tech. 4th Semester

Course Title: Algorithms and Problem Solving
Course Code: 15B11CI411

Maximum Time: 1 hr
Maximum Marks: 20

Note: Calculators are allowed.

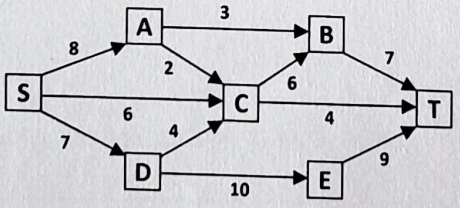
Q1 [3+3+1+1 = 8 Marks] Being an editor of a newspaper, your job is to put such news articles (NA) on the front page of the newspaper which attracts maximum readers. To accommodate maximum NA on the front page, it is usual practice to break the NA into two parts and print one part/partition (P1) at the front page and second part/partition (P2) at other page. However, breaking of the news article may reduce the attraction of the readers. Instead of random size of the partitions, let us fix the size of the partitions for each NA as follows: (a) P1 = 100% and P2 = 0%, (b) P1 = 75% and P2 = 25%, (c) P1 = 50% and P2 = 50% and (d) P1 = 25% and P2 = 75%. As an example, Table 1 presents the details like, NA id, count of characters in the NA, count of attracted readers if P1 = 100%, 75%, 50%, and 25%.

Table 1

NA id	Characters Count	Count of Readers, if			
		P1=100%	P1=75%	P1=50%	P1=25%
1	100	1000	700	600	500
2	200	1500	1200	1100	1000
3	300	6000	5000	2500	2000
4	200	2500	2400	2300	2200
5	400	9000	8500	8000	5000
6	200	1800	1000	800	600

Considering that maximum C characters can be placed at the front page of the newspaper, **propose (a)** Backtrack and **(b)** Greedy (efficient) based algorithms (**Need to write pseudo-code**) to place/print the NAs on the front page which attracts maximum number of readers. Considering C as 1000, **find the count of attracted readers** using proposed Backtrack and Greedy approaches **for the example given in Table 1**.

Q2. [2+2 = 4 Marks] In the following flow network, find out the maximum flow between source, S and Tank/Destination, T using **(a)** Ford Fulkerson and **(b)** Edmonds-Karp Ford Fulkerson algorithms.



Q3. [2+2 = 4 Marks] Fibonacci Heap is one of the data structures used to reduce the computational time in many problems. Explore the suitability of the Fibonacci Heap data structure for computing the **(a)** shortest path between single source to all destinations in a weighted graph using Dijkstra's algorithm, and **(b)** minimum spanning tree in a weighted graph using Prim's algorithm.

Q4. [2+2 = 4 Marks] A message, T (of 1000 characters) is made up entirely of characters from the set X = {K, L, M, N, and O}. The probabilities of each character in T are as follows: K (0.35), L (0.15), M (0.17), N (0.15), and O (0.17). Calculate the expected length of encoded message in bits, if T is encoded using **(a)** Huffman coding and **(b)** Shannon-Fanon coding.

POSSESION OF MOBILES IN EXAM IS UFM PRACTICE.

Name _____ **Enrollment No.**_____

Jaypee Institute of Information Technology, Noida
T1 Examination, Even 2020
B.Tech, IV Sem

Course Title: Algorithms and Problem Solving **Maximum Time: 1 hr**
Course Code: 15B11CI411 **Maximum Marks : 20**

CO 1	Analyze the complexity of different algorithms using asymptotic analysis.
CO 2	Select an appropriate data structure and apply related operations for a given problem.
CO 3	Apply algorithmic principles for solving a given problem:
CO 4	Identify, formulate and design an efficient solution to a given problem using appropriate data structure and algorithm design technique.

Q1[CO3][5 Marks] Given a matrix M[N][N] in which elements are arranged in sorted ordered ring as shown in Fig 1. Propose O (log N) algorithm to search a given element K in this matrix M [N][N].

4	5	6	7	8	10
44	46	48	50	55	13
39	73	76	79	57	15
37	70	111	88	60	16
35	69	68	67	65	18
33	29	27	25	24	22

Fig.1.

Event	Start time	End time
Busking	20	505
Euphonium	10	45
Robo Race	5	10
Chaupal	30	80
Rangmanch	40	90
Vanity	57	105
Oracle Quest	3	100
Knuth Cup	4	500
Code Greed	42	720

Fig.2.

Q2. [CO2][4 Marks] You are event head of JIIT fest "Impressions" and want to store the start time and end time of different events in an interval tree (implemented using **RB-Tree**). The event times are represented in form of minutes only (there are 60 x 24 i.e. 1440 minutes in a day), e.g. 10 represent 00:10, 523 represent 08:43, and 790 represent 13:10. Table in Fig 2 provides you the details of events in impressions.

a) Show step wise insertion of above events in given order (one by one.) in the interval tree.

b) Two events namely Busking and Vanity are cancelled at a later stage. Delete them from the constructed Interval Tree in mentioned order. Show all the steps.

Q3. [CO1][4 Marks] Below table represents a recursive Algorithm Tic(), which recursively calls itself as well as another recursive algorithm Toc(). Analyze Time complexity of Algorithm Tic().

```
Algo: Tic(A[1..n])
{
  if(n>1)
   {
     Toc(A);
     return(max(Tic(A[1..n/4]), Tic(A[n/2..3n/4), Tic(A[3n/4..n]));
}
```

```
Algo: Toc(A[1..n])
{ if(n>1)
  { for(i : 1 to n)
       { A[i] *= i;}
    Toc(A[n/4..3n/4]);
    Toc(A[n/2..n]);
  } }
```

Q4.[CO1,CO2] [2+2+3=7 Marks] Given an input array of N elements, Inp[] and corresponding 1-D array representation of segment tree for minimum range queries, SegTree[]. ∞ is the dummy value to make segment tree complete at leaf level.

Inp[ ] = {7,-5,15,30,1,-7,4,}
SegTree[ ] = {-7,-5,-7,-5,15,-7,4,7,-5,15,30,1,-7,4,∞}

a) A new element -17 is inserted in Input Array. Update SegTree[] for this newly inserted element **without recreating it.**

b) Now discuss the possibility of inserting 19 in SegTree[] generated in Part a) , **without recreating it.**

c) A given element K is deleted from Input Array Inp[]. Propose an efficient Algorithm to update corresponding segment tree SegTree[]. Also analyze the time complexity of your proposed algorithm.

POSSESION OF MOBILES IN EXAMS IS UFM PRACTICE.

NAME _____ **Enrollment No.** _____

Jaypee Institute of Information Technology , Noida
End Term Examination , Even 2019
B.Tech 4th Semester

Course Title: Algorithms and Problem Solving **Maximum Time: 2 hrs**
Course Code: 15B11CI411 **Maximum Marks: 35**

Q1. [2 Marks] Categories the following under the classes: P/NP-Hard/NP-Complete. Justify your categorization.

(a) Vertex Cover (b) M coloring (c) Binary search

Q2. [2 + 3 = 5 Marks] We have many options to multiply a chain of matrices because matrix multiplication is associative. In other words, no matter how we parenthesize the product, the result will be the same. However, the order in which we parenthesize the product affects the number of simple arithmetic operations (multiplications) needed to compute the product (i.e. the computed resultant matrix after multiplying the chain of matrices). It is desired to solve the problem of matrix chain multiplication using dynamic programming (DP).

(a) Give the DP based recurrence to decide the order of multiplication so that minimum number of multiplications are needed to multiply the chain of matrices.
(b) For the following chain of matrices find the minimum number of multiplications needed to multiply the given chain of matrices: Matrix 1 (rows = 4, columns = 3), Matrix 2 (rows = 3, columns = 5), Matrix 3 (rows = 5, columns = 1), Matrix 4 (rows = 1, columns = 8), and Matrix 5 (rows = 8, columns = 2)

Q3. [1 + 2 + 2 = 5 Marks] It is desired to search numerous patterns (P1, P2, etc.) in a text (T). We may store the text, T into a suffix tree (ST) or into a suffix array (SA) and search the ST or SA for the desired pattern.

(a) In context of space complexity and time complexity, justify your selection (ST or SA) to store the text, T.
(b) Search the patterns, P1 (aabcb), P2 (abb) and P2 (abaa) in the text, T (aabaabcb), if T is stored in a suffix tree, ST.
(c) Create a suffix array, SA for the text, T given in part (b) and search T for the patterns given in part (b).

Q4.[2 + 2 = 4 Marks] Map (M) of a large geographical region is stored in a graph, G, where each node in G represents a place in M and implicitly contains the longitude and latitude of that place. Weighted edges between two nodes in G represent the road connectivity between corresponding places in M, where weight of the edge represents the length of the road. It is desired to find out the shortest distance between

(a) A given source, S and a given destination, D in G
(b) A given destination, D and remaining node (s) as source (s) in G
Out of the two algorithms (Dijkstra's algorithm and A* algorithm) for shortest path computation, justify, your selection of algorithm (s) to solve above queries.

Q5.[3 + 2 = 5 Marks] You have been given n ropes of different lengths with the objective to connect all the n ropes into one rope. The cost to connect any two ropes (Ri and Rj) and make it single rope (Rc) is equal to sum of their (Ri and Rj) lengths.

(a) Using efficient data structure (s), propose an efficient scheme to connect the ropes with minimum cost.
(b) For the given 8 ropes of lengths, 4, 6, 3, 8, 2, 7, 5, and 3, compute the minimum cost required to connect all 8 ropes to make a single rope of length 38.

Q6.[3 Marks] Consider the problem of moving a knight (in one move, a knight can move to maximum 8 different places in a chessboard) on a 3x4 chessboard (Figure 1), with start and goal states labeled as S and G. The letter in each grid of the given chessboard is its name and the subscript digit is the heuristic value (i.e. how far the goal node is from the current grid). Let us consider that the actual cost to make one move of the knight is 1, i.e. all transitions have cost 1. Starting with S, what will be the sequence of visited grids to reach to the grid G, if movement of the knight is decided using A* algorithm. For uniformity, grids are selected in alphabetical order when the algorithm finds a tie.

S_3	H_1	D_1	K_1
I_1	J_2	A_2	E_2
C_1	B_2	G_0	F_3

Figure 1

Q7.[5 Marks] You have been given two integer arrays, A and B. It is desired to find the length of the longest common increasing subsequence between A and B, e.g. for A = {3, 4, 9, 1} and B = {5, 3, 8, 9, 2, 1} the longest common increasing subsequence is {3, 9}. Propose an efficient dynamic programming based scheme to solve above problem.

Q8.[3 Marks] One by one perform following operations (I – insert, EM – extract min) in min Binomial heap: I(8), I(7), I(9), I(6), I(12), I(5), EM, EM, EM, I(3), I(4), I(6), I(13), EM.

Q9.[3 Marks] It is desired to find following two patterns (P1, P2) in any given text, T
P1 = aaabba
P2 = aabba
Propose an efficient strategy in which the text, T is scanned only once for occurrence of both patterns (P1, P2) in T.

POSSESION OF MOBILES IN EXAM IS UFM PRACTICE.

Name _____ _____ **Enrollment No.**____ _____

Jaypee Institute of Information Technology, Noida

T2 Examination, ODD 2018
B.Tech VII Semester

Course Title: Graph Algorithms and Applications **Maximum Time: 1 Hr.**
Course Code: 17B1NCI748 **Maximum Marks: 20**

Q1. There are many hubs (technical and cultural) at JIIT, say N umber of hubs, *e.g.* Programming Hub, CICE, µCR (microcontroller and robotics hub), Parola (literary hub), etc. Each student of JIIT (say, there are M number of students, where, M > N) is having weighted skills of the expectations/pre-requisites of some of the hubs, *e.g.* as given in Table 1, student A has 90% skill set of the Programming hub (PH), 40% skill set of µCR, and 50% skill set of Parola.

Table 1

Hubs → Student ↓	PH	µCR	Parola
S1	90	80	30
S2	75	35	70
S3	92	88	71
S4	60	80	85

Table 1 contd..

Hubs → Student ↓	PH	µCR	Parola
S5	85	80	75
S6	82	90	60
S7	65	70	66
S8	89	84	82

Table 2

Hubs	Count of students to be accommodated
PH	2
µCR	3
Parola	2

Perform following:

(a) **[4+2 = 6 Marks]**Based on student's skill sets, it is desired to form groups so that each student must be the part of at most one of the hubs. Further, each hub can accommodate K number of students (where K is variable for each hub). As shown in Table 2, two students are required to be accommodated in Programming hub, whereas three students are required to be accommodated in µCR and so on. Propose an efficient algorithm to accommodate students in different hubs so that combined skill set of all the accommodated students is maximum. Based on your proposed algorithm, find out the maximum combined skill set achieved with the data given in Table 1 and Table 2.

(b) [4+2 = 6 Marks]Based on student's skill sets, it is desired to accommodate all students in minimum number of hubs so that combined skill set of all the accommodated students in minimum number of hubs is maximum.Propose an efficient algorithm. Based on your proposed algorithm, find out the maximum combined skill set achieved with the data given in Table 1.

Q2. [4 Marks] Propose your approach to find whether any given graph can be embedded in a plane or not? If not, then propose your approach to find out the minimum number of jumps required to embed the graph in a plane. Show the performance of your approaches using an example graph.

Q3. [4 Marks] You have been given a flow network having directed edges, maximum capacity of each channel/edge, and occupied capacities of each channel/edge to produce maximum flow (say TF is the maximum possible flow) between source and destination vertices. Due to some reason one of the channels (say between vertices V1 and V2 which are neither source nor destination vertices) becomes faulty and hence incapable to provide any flow between V1 and V2. The faulty channel may responsible to reduce the total flow (TF) between source and destination vertices. Propose efficient approaches to maintain the total flow as TF between source and destination vertices by (a) increasing the capacities of least number of channels, and (b) increasing the least combined capacities of the channels.

POSSESION OF MOBILES IN EXAM IS UFM PRACTICE.

Name _____ _____ **Enrollment No.** ___ _____

Jaypee Institute of Information Technology, Noida

T1 Examination, Odd 2018
B.Tech VII Semester

Course Title: Graph Algorithms and Applications
Course Code: 17B1NCI748

Maximum Time: 1 Hr.
Maximum Marks: 20 Marks

Q1. [6 + 2 = 8 Marks] Minimum spanning tree (MST) in a weighted graph, G is the smallest network of all the nodes of the graph, G. You have been given the list of all the weighted edges forming the MST in a given graph, G along with the graph, G. Let us consider following updates in the weights of the graph, G: weights of all the edges forming the MST, M are increased by 2, whereas weights of remaining edges in the graph, G are increased by 1. After this update, M may not be the MST of the updated graph, G'. Without starting from the scratch, propose an efficient strategy to find out the MST in the updated graph, G'. Elaborate the steps of your strategy using suitable example.

Q2. [2 + 2 + 5 = 9 Marks] A reliable network (represented by graphs) never consist articulation points and bridges. Find out all the articulation points and bridges in the graph given in Fig. 1. Also propose an efficient strategy to find out minimum number of edges required to make a network stable (i.e. neither articulation point nor any bridges are present in the network). Use your scheme to make the network given in Fig. 1 as reliable network.

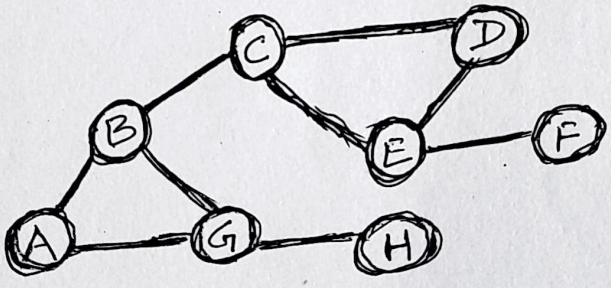


fig. 1.

Q3. [3 Marks] You have been given a weighted graph, G and two vertices V1 and V2 in the graph, G. It is desired to identify a third vertex, V3 in the given graph, G so that summation of the distances between V1 to V2 and V2 to V3 is minimum compared to any other third vertex, Vi in the graph, G. For given two vertices, V1 and V2 in G, propose an efficient strategy to find out the third vertex, V3.