NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI-15
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
II YEAR B.TECH , CYCLE TEST 2
CSPE43 ADVANCED DATA STRUCTURES AND ALGORITHMS

DATE: 23-04-2021 **Duration: 1 Hr 30 Mins** **Max Marks: 25**

1. **Answer ALL Questions**
2. **Each question carries 2 marks, except Q3 (which is 3 marks).**
3. **Submit your answer in https://forms.gle/E6GzPjGZxe2w8Y5U7**

1. **The prefix sum array is given below for an array A of size 4 X 5. What is the actual element in A[3,3]? (Row and Column indices are started from 0).**

$$\begin{pmatrix} 1 & 3 & 10 & 19 & 26 \\ 5 & 12 & 27 & 39 & 51 \\ 8 & 17 & 43 & 59 & 77 \\ 14 & 23 & 56 & 84 & 107 \end{pmatrix}$$

(a) 3
(b) 12
(c) 4
(d) 16

2. **Assume that the sparse table algorithm is used to address the min query in the given Array[0,..,n-1] = { 10,6,5,-7,9,-8,2,4,20}. From the constructed sparse table, find out**
(i) the values in locations (2,2), (5,2) and (7,1)
(ii) the locations that are looked up to solve the query min(3,8)?

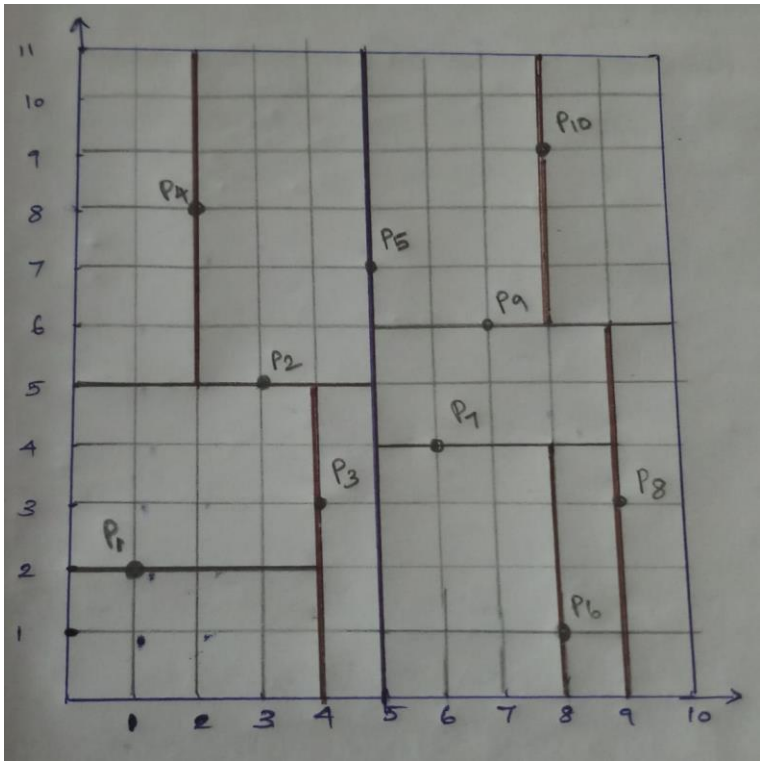
(a) (i) 5,5,7 (ii) (3,2), (5,2)
(b) (i) -8,-8, 4 (ii) (3,2), (5,1)
(c) (i) 3,5,7 (ii) (3,3), (5,2)
(d) (i) 5,6,7 (ii) (3,3), (6,1)

3. **Segment Tree (ST) with lazy propagation is constructed to address sum query for the given array A[0,9]= {1,3,5,7,9,11,13,15,17,19}. Assume that the following operations are applied in the order :**
   - **(i) Range update (4,9) by 5**
   - **(ii) Range update (4,9) by 3**
   - **(iii) Range update (4,5) by 1**
   - **(iv) Query sum (4,8).**

   What are the values that are stored in the segment tree of locations ST[5], ST[12] and ST[13] after applying (ii), (iii) and (iv)?

   (a) {24,23,17}, { 41,23,17} and {41,23,25}
   (b) {39,15,17}, {64,23,17} and {64,23,25}
   (c) {63,23,25}, {64,23,25} and {64,23,25}
   (d) {40,15,25}, {41,23,23} and {41,23,25}

4. **The following data points in the graph are used to construct unbalanced 2D tree. What are the nodes in level 2? (Assume that root has level 0).**



(a) P3, P4,P10
(b) P3,P4,P7,P8
(c) P3,P4,P8,P10
(d) P1,P7,P6

5. **For the given matrices A1(4*5), A2(5*3), A3(3*2), A4(2*7) and A5(7*2), an optimal parenthesization is determined using dynamic programming. What are the entries in the S matrix of 5^{th} column ?**

   (a) 2 1 4 3 0
   (b) 1 2 4 3 0
   (c) 1 4 2 3 0
   (d) 1 2 3 4 0

6. **For the given data, what is the cost of the Optimal Binary Search Tree?**

D		1	2	3	4	5	6	7
P_D		0.04	0.06	0.08	0.12	0.1	0.12	0.14
Q_D	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05

   (a) 3.12
   (b) 3.21
   (c) 3.02
   (d) None of the Above

7. **What is the chromatic number of the graph represented by the following adjacency matrix?**

$$\begin{matrix} 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \end{matrix}$$

   (a) 2
   (b) 3
   (c) 4
   (d) 5

8. **Five objects with weights W(4,6,3,4,2) are required to be put into the knapsack of maximum capacity 12. The profit of these 5 items are (10,15,6,8,4). FIFO branch and bound technique is used to find the maximum profit. In which level of the state space tree, the maximum number of nodes are killed? (single node is in level 0).**

   (a) Level 3
   (b) Level 4
   (c) Level 2
   (d) Level 5

9. **The text string (12111211111122111121) and the pattern (1112) are given. Assume that the preprocessing step is done. Using KMP algorithm, the pattern is matched with the text string. How many times both the variables i and j are moved ahead by one character?**

   (a) 14
   (b) 16
   (c) 17
   (d) 15

10. **Using Rabin-Karp Algorithm, the pattern P (CDDC) is matched with the text string S (ABDCDCCDDCCDCDDCABEFG). The hash function is $(3*d^3 + 4*d^2 + 4*d^1 + 3*d^0)$ %q, where d is 10 and q is 13. Consider the corresponding rolling hash function for calculating hash values for substrings in S. How many spurious hits are occurred in the entire matching process?**

    (a) 1
    (b) 2
    (c) 3
    (d) 0

11. Consider the following data points: (9,6),(5,5),(1,4), (3,3), (5,2),(3,1),(7,0), (0, 3), (1, 1), (2, 2), (4, 4), (0, 0), (1, 2), (3, 5) and (3, 3). How many data points will be in the convex hull?

(a) 6
(b) 8
(c) 7
(d) 9

12. Consider the following two problems on undirected graphs:

A: Anticlique Decision Problem (Anticlique: Set of vertices in a graph and in that no two vertices are adjacent)

B: Finding the longest path in a graph

Which one of the following is TRUE?

(a) A is NP-Complete and B is NP-Hard
(b) Both are NP-Hard
(c) Both are NP-Complete
(d) A is NP and B is P