CS & IT ENGINEERING

Algorithms

1500 series

Lecture No.- 04

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Recap of Previous Lecture

Topic ALGORITHMS 03

Topics to be Covered

Topic D and C

Topic Greedy Method

#Q. Which of the following represents the order of the edges while construction of MST using Prim's algorithm.

18 19 20 ✗

A (C, A) (C , F) (A, G) (G, F) (F, E) (E, D) (D, C) (G, H) (I, J)

B (F, E) (C, A) (C, F) (C, D) (A, G) (I, J) (F, I) (A, B) (D, E)

19 17 19 18 20 23 16 31 32

C (D, E) (E, F) (F, C) (C, A) (A, G) (F, I) (I, J) (G, H) (A, B)

D None of these.

#Q. Consider the following statements.

S1 : In a connected graph G with distinct weighted edges, different spanning trees of G will have different total weights. F

S2 : In a connected graph G with weighted edges, if edge e has a weight smaller than any other edge in G, then e must be included in every minimal spanning tree of G. F

– least cost Edge

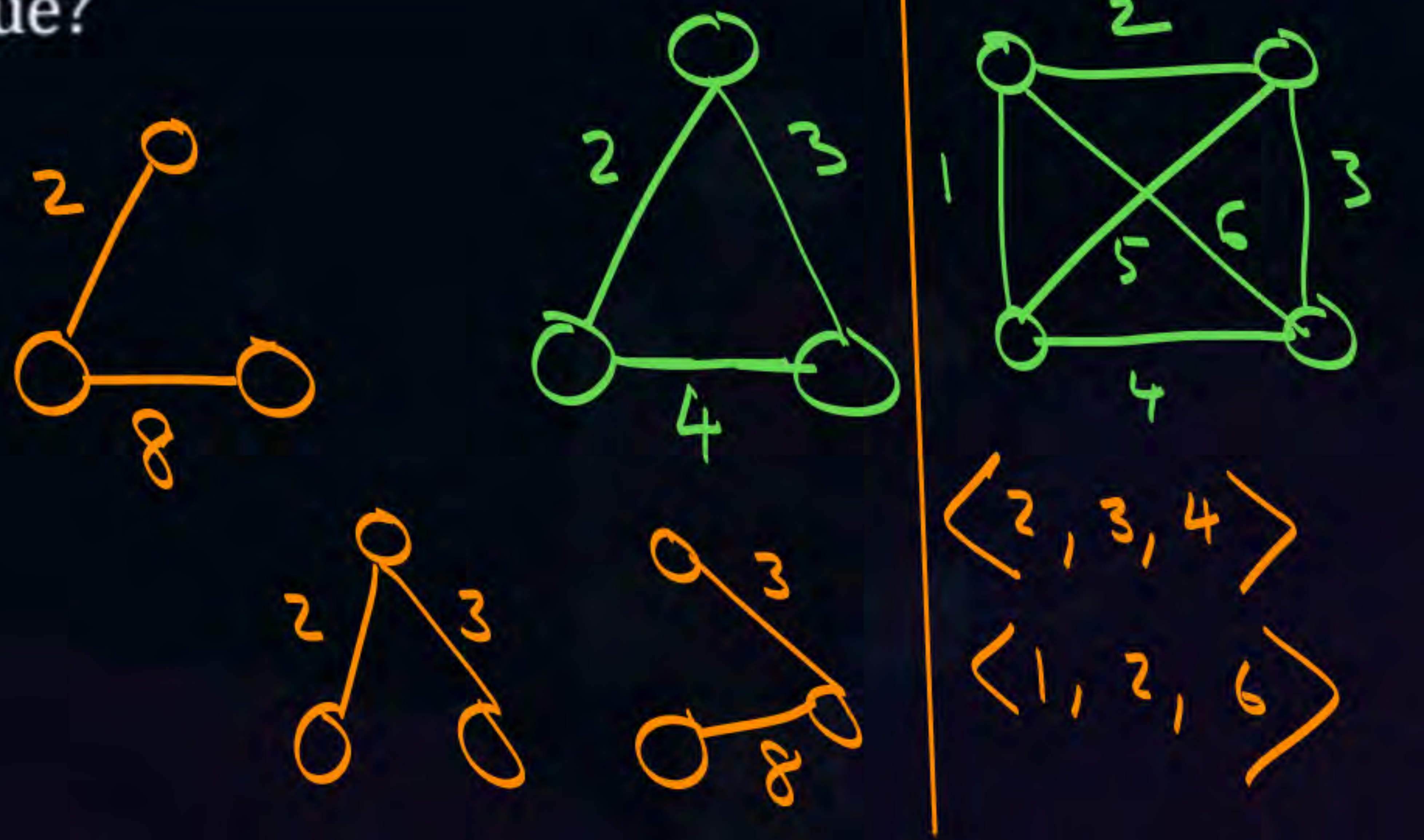
Which of the above statement is/are true?

A. Only S_1

B. Only S_2

C. Both S_1 and S_2

D. Neither S_1 nor S_2



#Q. Which of the following algorithm design techniques can be used for solving the problem of 0/1 Knapsack? <MSQ>

<A+C>

A. Backtracking

B. Greedy method

C. Dynamic Programming

D. Divide & conquer

#Q. Which of the following problems can be solved by Dynamic Programming

Backtracking

A N-Queens

B 0/1 Knapsack

C Sum of Subsets

D Optimal Binary Search Tree

#Q. What is the number of element comparisons needed to sort n elements using Radix sort (Non-Comparison based)

A 0

B n

C nlogn

D n^2

#Q. Let the numbers 794, 332, 561, 342, 200, 607 and 893 be sorted using RADIX SORT. What will be the sixth number in the sequence of numbers after sorting the second digit?

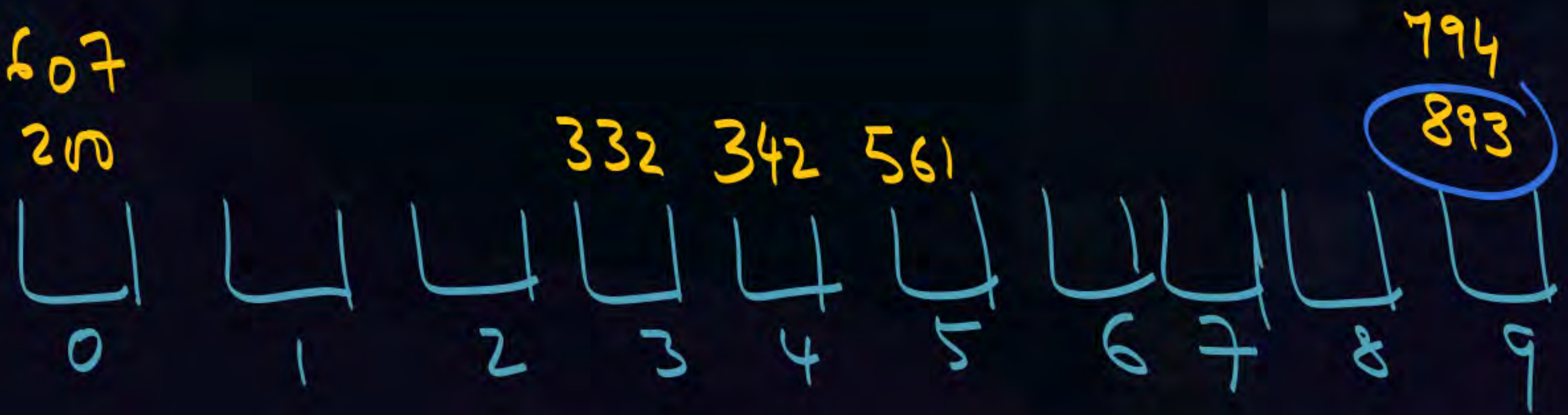
<u>Pass 1</u> : 200 ; 561 ; 332 ; 342 ; 893 ; 794 ; 607

A 561

B 794

C 893

D 332



#Q. Which algorithm can be used to sort n elements in the range [1.....n^k] k >0, in linear time

A Radix sort

B Selection sort

C Address calculation sort

D Merge sort

#Q. Consider the following array with 9 elements

a[9] = {25, 20, 15, 35, 30, 16, 11, 7, 105}

Count the total number of swaps done, if insertion sort is applied on the above array ___21___.

15	20	25	35

: 1+2+

#Q. Which of the following algorithms may use Heap data structures in its implementation

<MSQ>

<A+B+C>

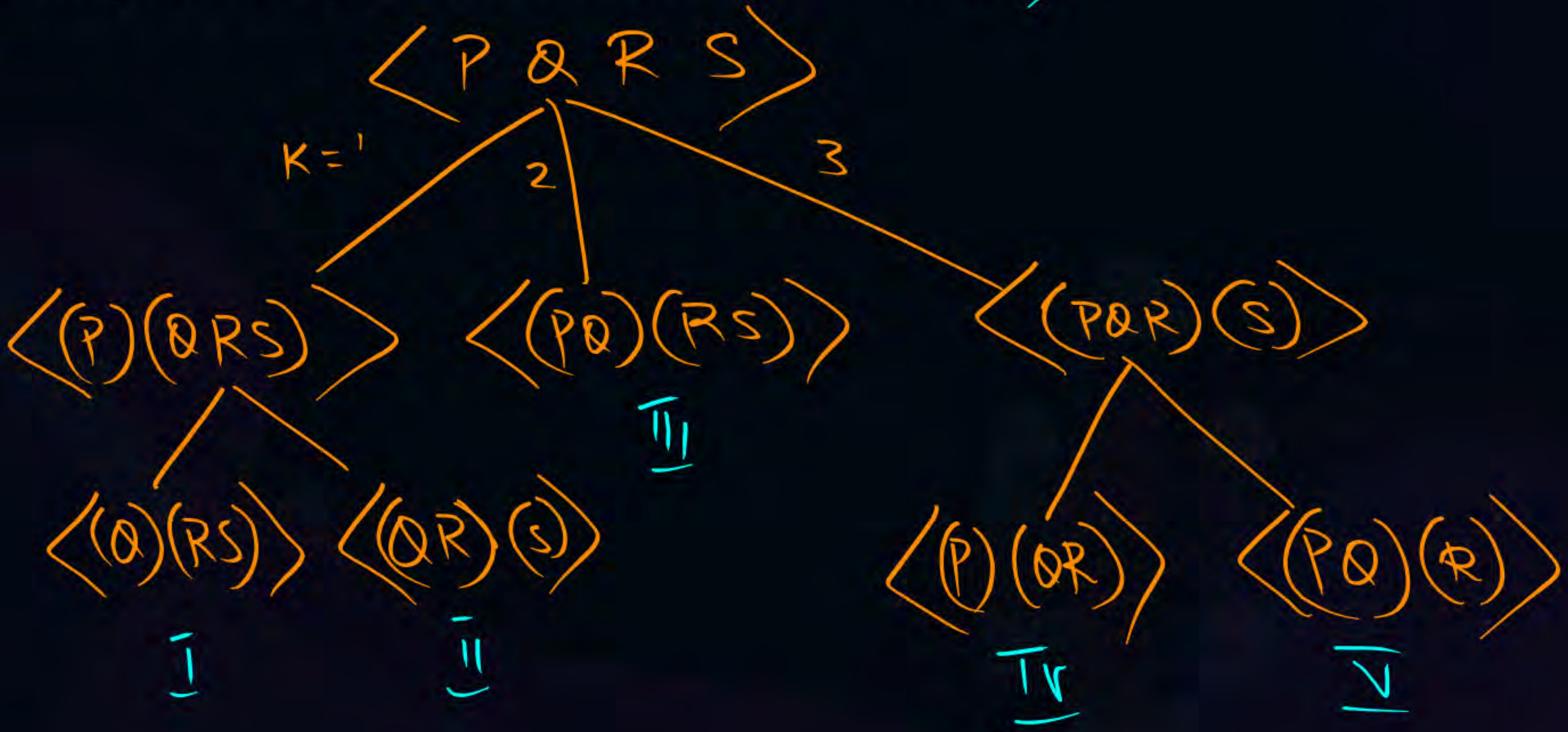
A. Prim's algorithm

B. Kruskal's algorithm

C. Shortest Job First

D. Round Robin

#Q. Let P, Q, R and S be four matrices of dimensions 20×15, 15×25, 25×20 and 20×5 respectively. The total optimal number of multiplication using the best parenthesization is 5875 (?).



Next 2 Questions refer to the following information.

The All Pairs Shortest Path Problem can be specified as follows.

Input:

Directed graph G(V, E), where V = {1, 2,..., n}

Cost C(i, j) $\in R^{+} \cup \{\infty\}$ for all i, j $\in$ V, where C(i, j) = ∞ if and only if (i, j) $\notin$ E

Definition:

D(i, j) is the length of the shortest path from i to j for all i, j $\in$ V.

If there is no path from i to j, then D(i, j) = ∞.

If i = j, then D(i, j) = 0.

$$A^{k}(i,j) = \min\left\{A^{k-1}(i,j),\ A^{k-1}(i,k) + A^{k-1}(k,j)\right\}$$

Problem:

Find D(i, j) for all i, j $\in$ V.

The Floyd-Warshall algorithm gives a dynamic programming solution to the problem by defining an array A(k, i, j) for $0 \le k \le n$ and i, j $\in$ V by the following condition.

A(k, i, j) is the length of a shortest path from i to j such that all intermediate nodes on the path are in {1, 2,...,k} (where no intermediate nodes are allowed if k = 0).

Then D(i, j) = A(n, i, j).

The algorithm computes A(k, i, j) using a recurrence on k. where the initial step is given as follows.

A(0, i, j) = C(i, j) for all i, j $\in$ V such that I $\neq$ j

A(0, i, i) = 0 for all i $\in$ V

#Q. Which of the following is the general step in the recurrence, where $1 \le k \le n$?

A. $A(k,i,j) = \min\limits_{l<k}\{A(l,i,k\} + A(l,k,j)\}$

B. $A(k,i,j) = \min\limits_{l<k}\{A(k-1,i,l) + A(k-1,l,j)\}$

C. $A(k,i,j) = \min\{A(k-1,i,j), A(k-1,i,k) + A(k-1,k,j)\}$

D. $A(k,i,j) = \min\{C(i,j), A(k,i,k) + A(k,k,j)\}$

E. $A(k,i,j) = \min\{\underline{C(i,j)}, A(k-1,i,k) + A(k-1,k,j)\}$

#Q. Which is the running time of the Floyd-Warshall's Algorithm?

A $\Theta(n)$

B $\Theta(n^2)$

C $\Theta(n^3)$

D $\Theta(n^3 \log n)$

E $\Theta(n^4)$

#Q. The Transitive Closure of a binary relation on a set of 'n' elements can be found by which of the following algorithm-

A. Kadane's Algorithm

B. Belady's Algorithm

C. Dijkstra's Algorithm

D. Floyd-Warshall's Algorithm

#Q. Considering the brute force approach in which we explore all possible ways of multiplying a given set of 'n' matrices, what is the time complexity of the matrix chain multiplication implementation?

Exponential (Catalan No)

$\frac{1}{(n+1)} {}^{2n}C_n$

$\Omega(2^n)$

A Linear

B Cubic polynomial

C Quadratic polynomial

D Exponential

#Q. Which of the following is incorrect?

A. Floyd-Warshall is based on Dynamic Programming.

B. Kruskal is based on Greedy approach.

C. Sum of Subsets problem is solved by Dynamic Programming

D. None of these.

#Q. Consider the following graph: MSQ

C+D

Which of the following is/are correct BFS traversing order?

A. G E H F D A B C

B. H E A F G D B C

C. F G H E D A B C

D. C A B H D F E G

#Q. Consider the following directed graph.

Which of the following is a Topological sort of the nodes of the graph?

A. 5, 7, 10, 13, 14, 17, 20, 30

B. 10, 5, 13, 14, 7, 30, 17, 20

C. 10, 5, 13, 17, 20, 14, 7, 30

D. 10, 5, 20, 13, 17, 30, 14, 7

E. 10, 20, 5, 17, 13, 14, 7, 30

#Q. Which of the following data structure is used in topological sort on directed graph?

D.F.S
<Stack>

- A Heap
- B Linked list
- C Array
- D Stack

#Q. What is the time complexity to find the maximum element in a min heap of n-elements?

Max-Heap (using Heapify)

A $\theta(\log n)$

B $\theta(1)$

C $\theta(n)$

D $\theta(n \log n)$

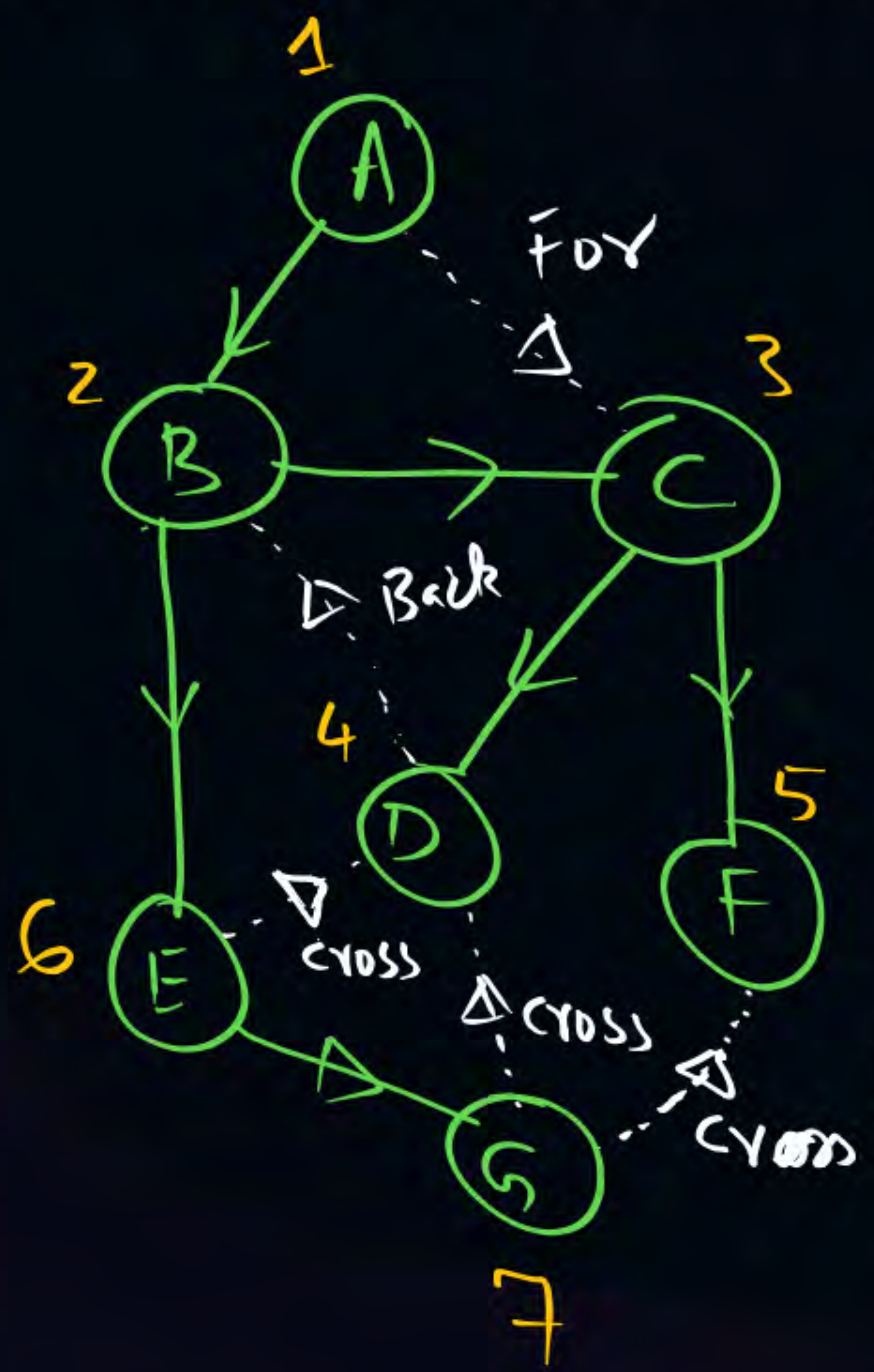
#Q. Consider the given graph. If DFS algorithm runs from vertex A and adjacency are chosen based on lexicographic order of vertex labels. Then the number of possible tree edges a, back edges b, cross edges f and forward edges g are:

A) $a = 6, b = 2, g = 3, f = 4$

B) $a = 6, b = 1, f = 1, g = 4$

C) $a = 6, b = 1, f = 3, g = 1$

D) $a = 3, f = 2, g = 1, b = 2$



#Q. Number of Topological Sort Sequences possible from the given Graph is ___8___.

$2 \times 2 \times 2 = 8$

#Q. Which of the following option(s) is/are correct? ⟨MSQ⟩

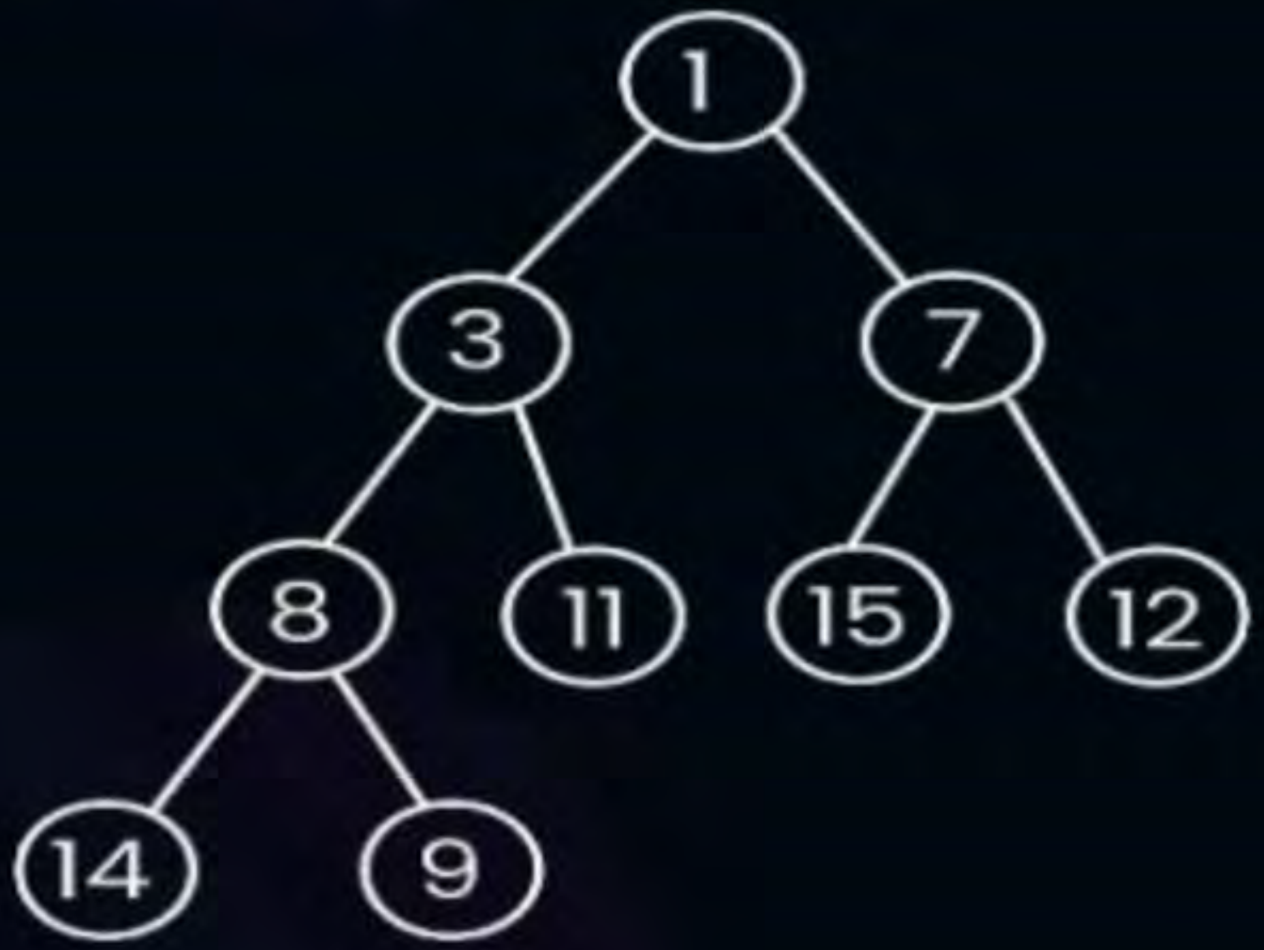
A. Time complexity of Breadth first search and Depth first search are same as O(V+E) in case of adjacency list.

B. Time complexity of Breadth first traversal and Depth first traversal are same as O(V+E) in case of adjacency list.

C. Space complexity of Breadth first search and Depth first search are same as O(V).

D. Time complexity of ~~Breadth~~ Depth first search and Breadth First traversal are same as $O(v^2)$ in case of adjacency matrix.

#Q. Consider the given min heap:



What will be the result from doing 2 delete min. operations on the above given min. heap?

A

B

C

D

#Q. Consider a max heap-

85, 83, 80, 75, 76, 48, 15, 32, 68, 18

A list of operations are performed-

Del(max), insert(87) delete(18), insert(82), inset(81), delete(max)

What is the content of the max heap after these operations?

A) 83, 75, 80, 68, 32, 76, 81, 48, 15, 82.

B) 83, 82, 80, 75, 81, 48, 15, 68, 32, 76.

C) 83, 82, 80, 81, 76, 48, 15, 32, 68, 75

D) 83, 82, 80 75, 81, 48, 15, 32, 68, 76

#Q. Given a directed weighted graph having n-vertices and n edges (edge weight may be negative) . The time complexity of the most efficient algorithm to determine whether there are paths of large weights is-

A $O(n \log n)$

B $O(n\sqrt{n})$

C $O(2^n)$

D $O(n^3)$

#Q. Which of the following is not implied by P = NP? Cook's Theorem

A. 3 SAT can be solved in polynomial time

B. Factoring can be solved in polynomial time

C. Halting problem can be solved in polynomial time

D. TSP can be solved in polynomial time

#Q. Consider the following possible data structure for a set of n distinct integers.

I. A min-heap

II. An array of length n sorted in increasing order

III. A balanced binary search tree

For which of these data structure is the number of steps needed to find and remove the 7^{th} largest element in $O(\log n)$ in the worst case?

A I only

B II only

C I and II

D I and III

E II and III

#Q. The Character ‘p’ to ‘u’ have the set of frequencies based on the given table:

Character	Frequency
p	10
q	20
r	24
s	11
t	4
u	18

Which of the following is/are correct based on Huffman code?

A. For character sequence “t p t u q” corresponding hexadecimal code is “E F E 1”.

B. For character sequence “t p p q u” corresponding hexadecimal code is “E F F 1”.

C. For bit stream “10101100100” sequence of the character is “r r s q u”.

D. For bit stream “10101100001” sequence of character is “r r s u q”.

2 mins Summary

Topic One D and C

Topic Two Greedy Method

Topic Three

Topic Four

Topic Five

THANK - YOU