Data Structure
Chapter 5: Graphs

GATE CS PYQ

Solved By

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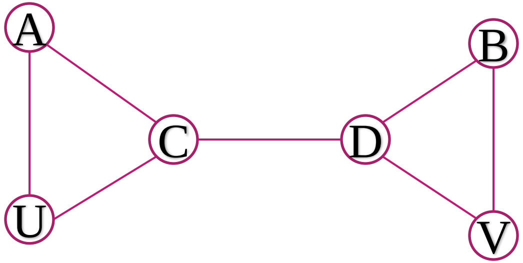
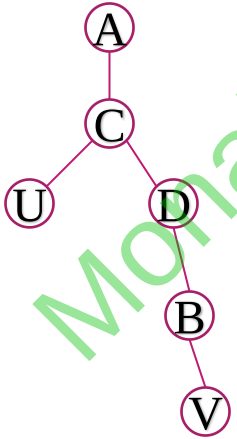
- GATE 2006,Q48:Let T be a depth first search tree in an undirected graph G. Vertices u and v are leaves of this tree T. The degrees of both u and v in G are at least 2. Which one of the following statements is true?
- **(A)** There must exist a vertex w adjacent to both u and v in G
  (B) There must exist a vertex w whose removal disconnects u and v in G
  (C) There must exist a cycle in G containing u and v
  (D) There must exist a cycle in G containing u and all its neighbors in G.

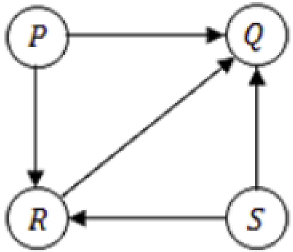




- Ans : **(D)**

- GATE 2014,Set-1,Q11:Let G be a graph with n vertices and m edges. What is the tightest upper bound on the running time of Depth First Search on G, when G is represented as an adjacency matrix?
- **(A)** O(n) **(B)** O(m+n) **(C)** $O(n^2)$ **(D)** O(mn)
- DFS visits each vertex once and as it visits each vertex, we need to find all of its adjacent to figure out where to search next.
- Finding all its adjacent in an adjacency matrix requires O(n) time, so overall the running time will be $O(n^2)$.
- Ans : **(C)** $O(n^2)$

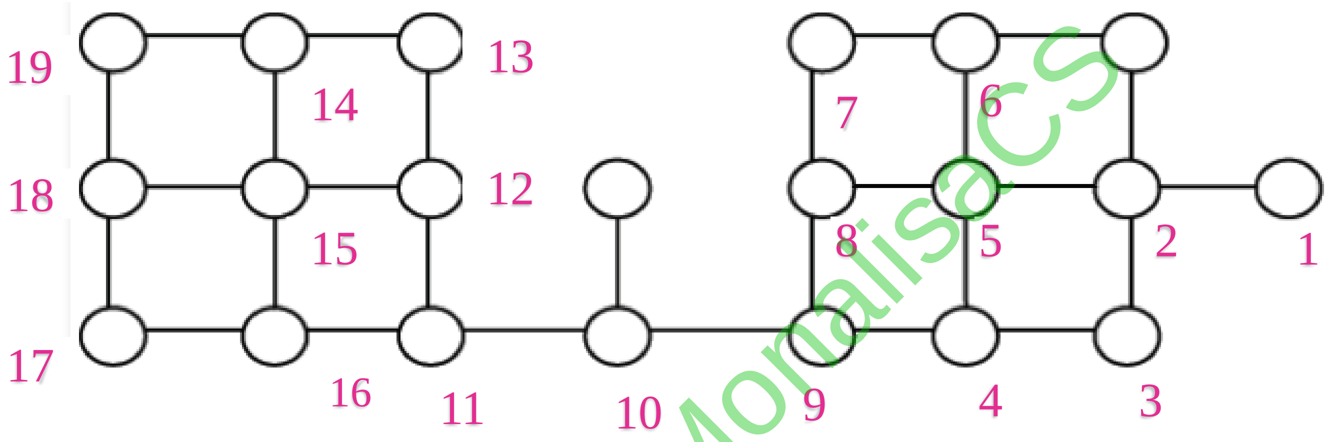
- GATE 2014,Set-1,Q13:Consider the directed graph given below. Which one of the following is TRUE?



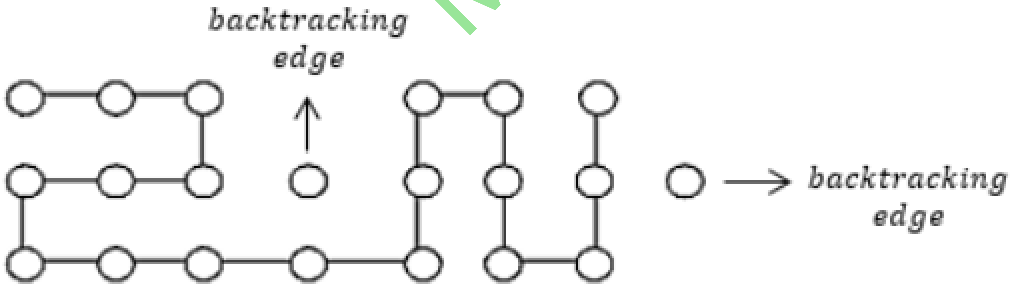
- (A) The graph doesn't have any topological ordering
- (B) Both PQRS and SRPQ are topological ordering
- (C) Both PSRQ and SPRQ are topological ordering
- (D) PSRQ is the only topological ordering
- There are no cycles in the graph, so topological orderings exist.
- We can consider P & S as starting vertex, followed by R & Q.
- Hence, PSRQ & SPRQ are the topological orderings.
- Ans :(C) Both PSRQ and SPRQ are topological ordering

- GATE 2014,Set-2,Q14 :Consider the tree arcs of a BFS traversal from a source node W in an unweighted, connected, undirected graph. The tree T formed by the tree arcs is a data structure for computing.
- **(A)** the shortest path between every pair of vertices.
- **(B)** the shortest path from W to every vertex in the graph.
- **(C)** the shortest paths from W to only those nodes that are leaves of T.
- **(D)** the longest path in the graph
- One of the application of BFS algorithm is to find the shortest path
- In the given question the BFS algorithm starts from the source vertex W and we can find the shortest path from W to every vertex of the graph.
- Ans: **(B)** the shortest path from W to every vertex in the graph.

- GATE 2014,Set-3,Q13 :Suppose depth first search is executed on the graph below starting at some unknown vertex. Assume that a recursive call to visit a vertex is made only after first checking that the vertex has not been visited earlier. Then the maximum possible recursion depth (including the initial call) is __________.



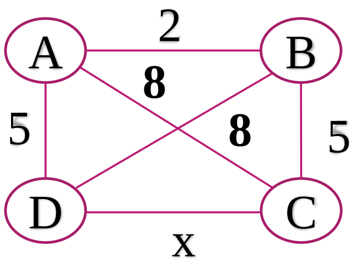
- Ans :19



- GATE 2016,Set-1,Q38:Consider the weighted undirected graph with 4 vertices, where the weight of edge {i, j} is given by the entry W_{ij} in the matrix W

$$W=\begin{bmatrix} 0 & 2 & 8 & 5 \\ 2 & 0 & 5 & 8 \\ 8 & 5 & 0 & x \\ 5 & 8 & x & 0 \end{bmatrix}$$

- The largest possible integer value of x, for which at least one shortest path between some pair of vertices will contain the edge with weight x is ________.

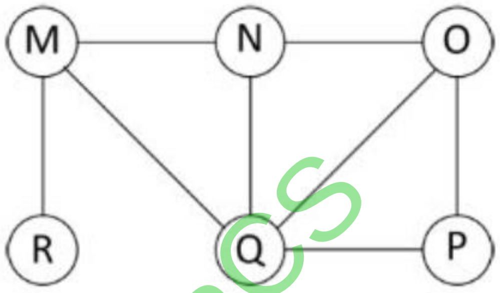


- The shortest path from C to D is of weight 12 (C-B-A-D)
- So largest possible value for x is 12
- Ans :12

- GATE 2016,Set-2,Q11:Breadth First Search (BFS) is started on a binary tree beginning from the root vertex. There is a vertex t at a distance four from the root. If t is the n-th vertex in this BFS traversal, then the maximum possible value of n is ____.
- Max number of nodes = $2^{(h+1)} - 1 = 2^{(4+1)} - 1 = 32-1=31$
- At distance four, last node is 31.
- Ans :31

- GATE 2016,Set-2,Q41:In an adjacency list representation of an undirected simple graph G = (V,E), each edge (u,v) has two adjacency list entries: [v] in the adjacency list of u, and [u] in the adjacency list of v. These are called twins of each other. A twin pointer is a pointer from an adjacency list entry to its twin. If |E| = m and |V| = n, and the memory size is not a constraint, what is the time complexity of the most efficient algorithm to set the twin pointer in each entry in each adjacency list?
- **(A)** $\Theta(n^2)$ **(B)** $\Theta(m+n)$ **(C)** $\Theta(m^2)$ **(D)** $\Theta(n^4)$
- First find twins of each node.
- You can do this using **level order traversal (i.e., BFS)** once.
- Time complexity of BFS is $\Theta(m+n)$.
- And you have to use linked list for representation.
- Final, time complexity is $\Theta(m + n)$ to set twin pointer.
- Ans : **(B)** $\Theta(m+n)$

- GATE 2017,Set-2,Q15:The Breath First Search(BFS) algorithm has been implemented using queue data structure. Which one of the following is a possible order of visiting the nodes in the gra



- **(A)** MNOPQR **(B)** NQMPOR
  (C) QMNROP **(D)** POQNMR
- (a) MNOPQR – MNO is not the proper order R ,Q must come in between.
- (b) NQMPOR – QMP is not the order Q is the adjacent of N.
- (C) QMNROP – R is not the adjacent of Q, so QMNR is false.
- (D) POQNMR – is the correct sequence. Hence Option (D).
- Ans: **(D)** POQNMR

- GATE 2018,Q30:Let G be a simple undirected graph. Let T_D be a depth first search tree of G. Let T_B be a breadth first search tree of G. Consider the following statements.
- (I) No edge of G is a cross edge with respect to T_D.
  (A cross edge in G is between two nodes neither of which is an ancestor of the other in T_D.)
- (II) For every edge (u,v) of G, if u is at depth i and v is at depth j in T_B, then $|i-j| = 1$.
- Which of the statements above must necessarily be true?
- (A) I only (B) II only (C) Both I and II (D) Neither I nor II
- I. Undirected graph do not have cross edges in DFS. But can have cross edges in directed graph. Hence True.
- II. Just draw a triangle ABC. Source is A. Vertex B and C are at same level at distance 1.
- There is an edge between B and C too. So here $|i - j| = |1 - 1| = 0$. Hence, False.
- Ans: (A) I only