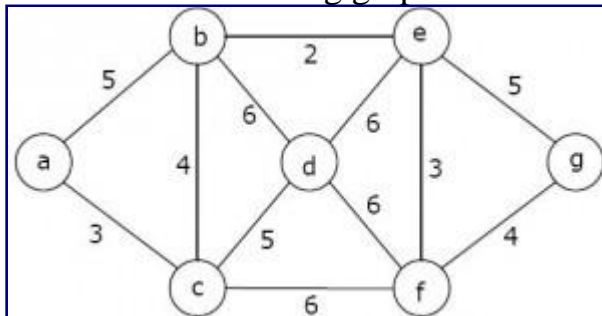


1. To implement Dijkstra's shortest path algorithm on unweighted graphs so that it runs in linear time, the data structure to be used is:

- (A) Priority Queue
- (B) Stack
- (C) Heap
- (D) B-Tree

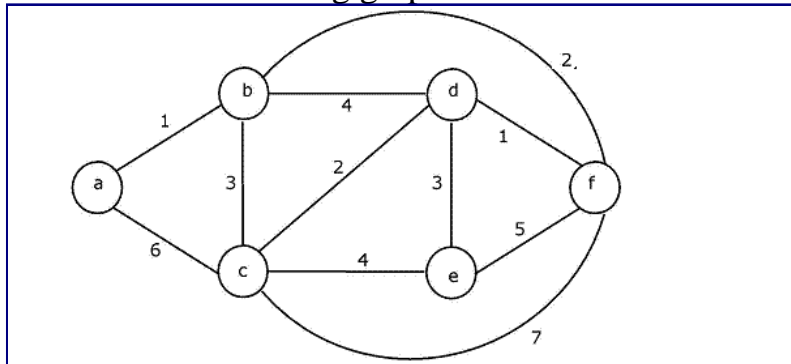
2. Consider the following graph:



Which one of the following is NOT the sequence of edges added to the minimum spanning tree using Kruskal's algorithm?

- (A) (b,e)(e,f)(a,c)(b,c)(f,g)(c,d)
- (B) (b,e)(e,f)(a,c)(f,g)(b,c)(c,d)
- (C) (b,e)(a,c)(e,f)(b,c)(f,g)(c,d)
- (D) (b,e)(e,f)(b,c)(a,c)(f,g)(c,d)

3. Consider the following graph:



Which one of the following cannot be the sequence of edges added, in that order, to a minimum spanning tree using Kruskal's algorithm?

- (A) (a—b),(d—f),(b—f),(d—c),(d—e)
- (B) (a—b),(d—f),(d—c),(b—f),(d—e)
- (C) (d—f),(a—b),(d—c),(b—f),(d—e)
- (D) (d—f),(a—b),(b—f),(d—e),(d—c)

4. 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)  $\Theta(n^4)$

5. Let  $G$  be an undirected graph. Consider a depth-first traversal of  $G$ , and let  $T$  be the resulting depth-first search tree. Let  $u$  be a vertex in  $G$  and let  $v$  be the first new (unvisited) vertex visited after visiting  $u$  in the traversal. Which of the following statements is always true?

- (A)  $\{u, v\}$  must be an edge in  $G$ , and  $u$  is a descendant of  $v$  in  $T$
- (B)  $\{u, v\}$  must be an edge in  $G$ , and  $v$  is a descendant of  $u$  in  $T$
- (C) If  $\{u, v\}$  is not an edge in  $G$  then  $u$  is a leaf in  $T$
- (D) If  $\{u, v\}$  is not an edge in  $G$  then  $u$  and  $v$  must have the same parent in  $T$

6. What are the appropriate data structures for following algorithms?

- (1) Breadth First Search
- (2) Depth First Search
- (3) Prim's Minimum Spanning Tree
- (4) Kruskal's Minimum Spanning Tree

- (A)
  - 1) Stack
  - 2) Linear Queue
  - 3) Priority Queue
  - 4) Union Find

- (B)
  - 1) Linear Queue
  - 2) Stack
  - 3) Priority Queue
  - 4) Union Find

- (C)
  - 1) Stack
  - 2) Linear Queue
  - 3) Union Find
  - 4) Priority Queue

- (D)
  - 1) Priority Queue
  - 2) Linear Queue
  - 3) Stack
  - 4) Union Find

7. Which is the correct order of the following algorithms with respect to their time Complexity in the best case ?
- (A) Merge sort > Quick sort > Insertion sort > selection sort
  - (B) insertion sort < Quick sort < Merge sort < selection sort
  - (C) Merge sort > selection sort > quick sort > insertion sort
  - (D) Merge sort > Quick sort > selection sort > insertion sort
8. You have to sort 1 GB of data with only 100 MB of available main memory. Which sorting technique will be most appropriate?
- (A) Heap sort
  - (B) Merge sort
  - (C) Quick sort
  - (D) Insertion sort
9. Assume that a merge sort algorithm in the worst case takes 30 seconds for an input of size 64. Which of the following most closely approximates the maximum input size of a problem that can be solved in 6 minutes?
- (A) 256
  - (B) 512
  - (C) 1024
  - (D) 2048

**Answer: (B)**

**Explanation:**

Time complexity of merge sort is  $\Theta(n \log n)$   $c \cdot 64 \log 64$  is 30

$c \cdot 64 \cdot 6$  is 30

$c$  is  $5/64$

For time 6 minutes

$$5/64 \cdot n \log n = 6 \cdot 60$$

$$n \log n = 72 \cdot 64 = 512 \cdot 9$$

$$n = 512.$$

10. Consider a situation where swap operation is very costly. Which of the following sorting algorithms should be preferred so that the number of swap operations are minimized in general?
- (A) Heap Sort
  - (B) Selection Sort
  - (C) Insertion Sort
  - (D) Merge Sort
11. Where in a max-heap can the smallest element reside, assuming all elements are distinct? Include both the location in the array and the location in the implicit tree structure.

12. The sequence 20,15,18,7,9,5,12,3,6,2 is a max-heap. True or False. Explain.

13. .... sorting algorithm is frequently used when n is small where n is total number of elements.

- A. Heap
- B. Insertion
- C. Bubble
- D. Quick

14. Which of the following sorting algorithm is of divide and conquer type?

- A. Bubble sort
- B. Insertion sort
- C. Merge sort
- D. Selection sort

15. Topological sort can be implemented by?

- a) Using Depth First Search
- b) Using Breadth First Search
- c) Using Depth and Breadth First Search
- d) Using level ordered search

16. Topological sort can be applied to which of the following graphs?

- a) Undirected Cyclic Graphs
- b) Directed Cyclic Graphs
- c) Undirected Acyclic Graphs
- d) Directed Acyclic Graphs

17. Which of the following is not an application of Depth First Search?

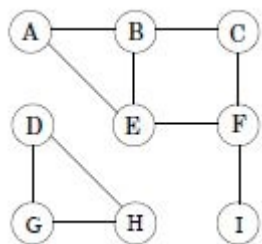
- a) For generating topological sort of a graph
- b) For generating Strongly Connected Components of a directed graph
- c) Detecting cycles in the graph
- d) Peer to Peer Networks

18. Regarding implementation of Depth First Search using stacks, what is the maximum distance between two nodes present in the stack? (considering each edge length 1)

- a) Can be anything
- b) 0
- c) At most 1
- d) Insufficient Information

19. Can DFS algorithm be used to check the bipartite-ness of a graph? If yes, how?

20. Perform a depth-first search on the following graph; whenever there's a choice of vertices, pick the one that is alphabetically first. Classify each edge as a tree edge or back edge, and give the pre and post number of each vertex.



21. Which of the following is false?

- (A) Heap sort is in-place Algorithm
- (B) Heap sort is a stable sort
- (C) Heap sort is a comparison-based algorithm
- (D) Time complexity of Heap sort is  $O(n \log n)$  Average case

22. A \_\_\_\_\_ is a special Tree-based data structure in which the tree is a complete binary tree.?

- A. Graph
- B. Heap
- C. List
- D. Stack

23. Which one of the following array elements represents a binary min heap?

- A. 12 10 8 25 14 17
- B. 8 10 12 25 14 17
- C. 25 17 14 12 10 8
- D. 14 17 25 10 12 8

24. Given an array of element 5, 7, 9, 1, 3, 10, 8, 4. Which of the following is the correct sequences of elements after inserting all the elements in a min-heap?

- A. 1,3,4,5,7,8,9,10
- B. 1,4,3,9,8,5,7,10
- C. 1,3,4,5,8,7,9,10
- D. 1,3,7,4,8,5,9,10

25. Which one of the following array elements represents a binary min heap?

- A. 12 10 8 25 14 17
- B. 8 10 12 25 14 17
- C. 25 17 14 12 10 8
- D. 14 17 25 10 12 8

