

Quiz-4
Data Structures

Set A

18th April

Time Allowed: **60** minutes

INSTRUCTIONS

1. This paper contains **Multiple choice questions** .

2. Marking Scheme

Marking scheme format : (correct, unattempted, incorrect)

MCQs (+4, 0, -1)

True/False(+4, 0, -2)

Fill-ups(+4, 0, 0)

3. Answers have to be written in the space provided besides the question .

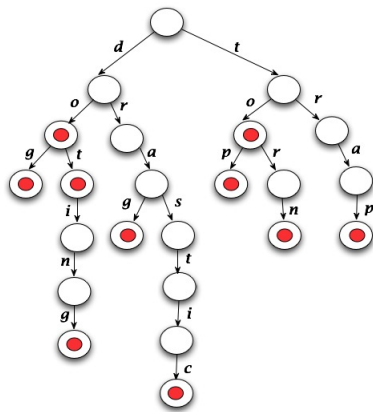
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1. If all possible strings of length at most k ($k > 0$) having only lowercase English alphabet are inserted in a Trie, what is the total number of nodes in the Trie ?

Ans : _____

- Lets denote the ending node of strings "drag" and "drastic" by A and B respectively. Which of the following strings when inserted in this Trie end on the node represented by $LCA(A, B)$?



Ans : _____

Ans : _____

Ans : _____

$u \neq v$) exist such that $LCA(u, v) == A$?

Ans : _____

7. Consider a tree, and its two nodes A and B , at depths d1 and d2 respectively (depth of root node == 0). Let $LCA(A, B) = L$ and $depth(L) = d3$. Let $S = \{ LCA(u, B) \mid u \text{ is an ancestor of } A \}$. Assume a node is also an ancestor of itself. What is the cardinality of S ?

- (a) $d3 + 1$
- (b) $d1 + d2 - d3 + 1$
- (c) $d1 + 1$
- (d) $d2 + 1$

8. Consider the following pseudo-code of a function F that takes two arguments : nodes u, v that belong to a tree.

```
F(u, v):
    Initialize : l = 0, r = depth(v)
    while l <= r :
        d = ( l + r ) / 2
        A = d-th ancestor of v
        if A is an ancestor of u :
            return A
        else :
            l = mid + 1
    return u
```

Mark all the correct options:

- (a) F returns $LCA(u, v)$ in some cases.
- (b) F returns $LCA(u, v)$ in all cases.
- (c) F returns some ancestor of $LCA(u, v)$ in all cases.
- (d) F returns ancestor of u in all cases.

9. If the first k nodes on the path from Root to node u are same as the first k nodes on the path from Root to node v , in a given Tree, the k -th node in any of these paths (from root to u or v) is always the LCA of u and v . State True / False

Ans : _____

10. Given a tree, and two nodes u and v belonging to it. Any node A present in the path from u to v which satisfies the property, that both u and v are present in the subtree of A is LCA of u and v . State True / False.

Ans : _____

11. Consider a tree having N nodes and $N - 1$ edges ($N \geq 2$). Let us define a function $F(u, v, R)$ which returns the $LCA(u, v)$ when the tree is rooted at R . Given two nodes A and B ($A \neq B$), now consider the set $S = \{ F(A, B, R) \mid R \text{ is any node in the tree} \}$. What is the cardinality of S ?

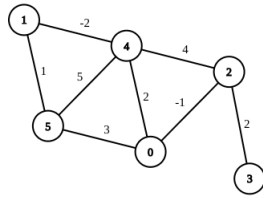
- (a) N
- (b) 1
- (c) $N/2$
- (d) $\text{distance}(A, B) + 1$

12. Given a rooted tree, consider nodes A, B, C, D . Let $E = LCA(A, B)$ and $F = LCA(C, D)$ and $G = LCA(E, F)$. Assume nodes A, B, C, D, E, F, G are all distinct.

Mark all correct options :

- (a) $LCA(A, C) == G$
- (b) $LCA(B, D) == G$
- (c) $LCA(A, C) == E$
- (d) $LCA(A, G) == G$

13. Consider the following graph :



Mark all the correct statements for the given graph :

- (a) Dijkstra's Algorithm can be used to find the single source shortest path from source vertex 0.
 - (b) Bellman Ford Algorithm can be used to find the single source shortest path from source vertex 0.
 - (c) Floyd Warshall Algorithm can be used to find all pair shortest path.
 - (d) None of these.
14. For a directed graph having V vertices and having no negative cycles, if instead of running the outer loop of Bellman Ford Algorithm for $V - 1$ iterations, it is run for V iterations, the distances computed by the algorithm may be wrong. State True / False.

Ans : _____

15. DAG-BELLMAN-FORD(V , E , s):
1. TOPOLOGICALLYSORT(V , E)
 2. INITIALIZE(V , E)
 3. for i in $1..|V|-1$:
 4. for each vertex u in V taken in topological order :
 5. for each edge originating at u : (u, v) in E :
 6. RELAX(u , v)
 7. if no edge was relaxed :
 8. break

For an input graph which is a DAG, to the above function, how many times does the loop in line number 3 run ?

Mark all the correct options :

- (a) 1

- (b) 2
 (c) $|V| - 1$
 (d) Can't say, depends on the input graph.
16. Consider a connected undirected graph $G(V, E)$ having all edge weights greater than 0. Dijkstra's algorithm is applied from source vertex s . Let $d[i]$ store the shortest distance from s to vertex i . Let $E' = \{ (u, v) \mid d[u] == d[v] + w(u, v) \text{ or } d[v] == d[u] + w(u, v) \}$, such that (u, v) denotes the edge joining vertices u and v , and $w(u, v)$ denote the edge weight of edge (u, v) . Graph represented by $G'(V, E')$ will always form a tree. State True / False.
 Ans : _____

17. What is the worst case space complexity of Bellman Ford algorithm on an input Graph $G(V, E)$?
- (a) $\theta(|V|)$
 (b) $\theta(|V| + |E|)$
 (c) $O(|V|)$
 (d) $O(|V| + |E|)$

Note : We consider only the auxiliary space used for calculating the space complexity of an algorithm.

18. On applying Floyd Warshall Algorithm on a directed Graph $G(V, E)$, it is found that $distance(u, u) < 0$ for some vertex $u \in V$. Mark all the correct options :
- (a) G has at least one edge with negative edge weight.
 (b) G has a negative cycle.
 (c) All edges going out of u have negative edge weights.
 (d) There exists an edge going out of u having negative edge weight.
19. Consider a connected undirected weighted graph $G(V, E)$ with distinct edge weights, such that $|V|, |E| > 3$. Let S_1, S_2 be two non-empty mutually exclusive subsets of V , such that $S_1 \cup S_2 == V$.
 Let $E' = \{ (u, v) \mid (u, v) \in E \text{ and } ((u \in S_1 \text{ and } v \in S_2) \text{ or } (u \in S_2 \text{ and } v \in S_1)) \}$
 The claim that edge $e = (u, v)$ such that $e \in E'$ and $weight(e)$ is minimum, will belong to the Minimum Spanning Tree of G . State True / False.
 Ans : _____

20. Given an undirected graph $G(V, E)$, if you start the DFS from a node $n \in V$, what is the worst complexity of the algorithm ?

Mark all the correct options :

- (a) $O(|V|)$
- (b) $O(|V| + |E|)$
- (c) $O(|V| * |E|)$
- (d) $O(|E|)$