

Lecture 13- Shortest Paths

1. Which algorithm is the most efficient for finding single source shortest paths in a Directed Acyclic Graph?

- A) Dijkstra's algorithm
- B) Bellman-Ford
- C) BFS (Breadth-First Search)
- D) Topological Sort

Answer: D) Topological Sort

Explanation: Topological Sort has complexity $O(V+E)$, which is the most efficient algorithm among the three

2. What data structures are used in BFS to track the shortest distance (SD) and previous node (PN)?

- A) Stack and Queue
- B) Priority Queue and Hash Map
- C) Two maps: one for SD and one for PN
- D) Adjacency List and Array

Answer: C) Two maps: one for SD and one for PN

3. Dijkstra's Algorithm is NOT suitable for graphs with:

- A) Non-negative edge weights
- B) Directed edges
- C) Negative edge weights
- D) Undirected edges

Answer: C) Negative edge weights

4. What is the time complexity of Dijkstra's Algorithm using a binary min-heap?

- A) $O(V + E)$
- B) $O((V + E) \log V)$
- C) $O(V^2)$
- D) $O(E \log V)$

Answer: B) $O((V + E) \log V)$

5. During edge relaxation, if a shorter path to node v is found through node u , what happens?

- A) $SD[v]$ and $PN[v]$ are updated
- B) $SD[u]$ is reset to infinity
- C) $PN[u]$ is set to v
- D) The edge $u \rightarrow v$ is removed

Answer: A) $SD[v]$ and $PN[v]$ are updated

6. In Dijkstra's algorithm, how is the priority queue used to select the next node to visit?

- A) The node with the largest known distance is chosen first.
- B) The node with the smallest Shortest Distance (SD) is chosen first.
- C) Nodes are processed in alphabetical order.
- D) Nodes are selected based on the number of edges.

Answer: B) The node with the smallest Shortest Distance (SD) is chosen first.

7. In the Shortest Path Tree (SPT), what does the PN map store?

- A) The shortest distance from the source
- B) The previous node in the shortest path
- C) The weight of edges
- D) The next node to visit

Answer: B) The previous node in the shortest path

8. What is the first step in Dijkstra's Algorithm?

- A) Relax all edges
- B) Initialize SD for the source node to 0 and others to ∞
- C) Mark all nodes as known
- D) Sort edges by weight

Answer: B) Initialize SD for the source node to 0 and others to ∞

9. Which algorithm processes nodes in topological order for shortest paths?

- A) BFS
- B) Dijkstra's Algorithm
- C) Bellman-Ford Algorithm
- D) Topological Sort-based algorithm

Answer: D) Topological Sort-based algorithm

10. In BFS, nodes are visited in order of:

- A) Increasing edge weights
- B) Decreasing distance from the source
- C) Increasing distance from the source
- D) Alphabetical order

Answer: C) Increasing distance from the source

11. After running Dijkstra's Algorithm, how is the shortest path reconstructed?

- A) Using the adjacency list

- B) Following backpointers in the PN map
 - C) Sorting the SD map
 - D) Reversing the visit order
- Answer:** B) Following backpointers in the PN map
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12. What is a key advantage of using Topological Sort for shortest paths in a DAG?

- A) Handles negative weights
- B) Runs in linear time
- C) Works for cyclic graphs
- D) Uses a priority queue

Answer: B) Runs in linear time

13. During the edge relaxation step in Dijkstra's algorithm, which condition must be met to update the shortest distance (SD) to node v ?

- A) $SD[v] < SD[u] + w(u,v)$
- B) $SD[v] > SD[u] + w(u,v)$
- C) $SD[u] < SD[v] + w(u,v)$
- D) $SD[v] == SD[u] + w(u,v)$

Answer: B) $SD[v] > SD[u] + w(u,v)$

14. True or false: Given a graph where all edges have positive weights, the shortest paths produced by Dijkstra and Bellman Ford algorithm may be different but path weight would always be same.

Answer: True

Explanation: Dijkstra and Bellman-Ford both work fine for a graph with all positive weights, but they are different algorithms and may pick different edges for shortest paths.