1 Conditions for Shortest Path Algorithms

Suppose that we want to find the shortest path between two nodes in the following graph. Which algorithms can we use?

- BFS
- Dijkstra
- Bellman-Ford
- All of the above
- BFS and Dijkstra
- Dijkstra and Bellman-Ford

We have a graph with negative edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No

We have an undirected graph with positive edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No

We have a directed graph with positive edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No

What is the minimum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

2 Dijkstra Forensics

Suppose we use Dijkstra on the node graph with nodes A, B, C, D, E, F that has negative to 0 edge weights, starting from the node A. Is the middle of the algorithm our computer crashes. We look through the memory dump, and see that the state of the heap looks as follows when the crash happened:

\[ H = \{(0, 0, 0), (1, 4, 4), (2, 2, 0), (3, 0, 2)\} \]

Additionally from the memory dump we see that the current node when the crash happened was node C.

What is the maximum possible length of the shortest path from node A to node E?

- 2
- 4
- 6
- 8
- Does not exist

Stanford Oval, which of the following locations will become the current node first?

- Times Square in New York
- The Hollister Sign
- Times Square in New York Tresidder Union
- Harvard Yard
- All of the above

What is the maximum possible length of the shortest path from node A to node F?

- 4
- 6
- 8
- 10
- Does not exist

If we run the Dijkstra algorithm on the graph of U.S. streets/roads/highways/etc., starting from the starting node, which of the following cost functions will become the current node first?

- Time Square in New York
- The Hollister Sign
- Times Square in New York Tresidder Union
- Harvard Yard
- All of the above

3 Runtime

Suppose that we implement Dijkstra with a red-black tree. What is the asymptotically smallest upper bound on runtime in terms of \( n \) (the number of nodes), and \( m \) (the number of edges)?

- \( O(m \log n) \)
- \( O(n \log m) \)
- \( O(n \log n) \)
- \( O(m \log m) \)
- \( O(n \log m) \)

What if we implement Dijkstra with a Fibonacci heap? What is the asymptotically smallest upper bound on runtime in terms of \( n \) (the number of nodes), and \( m \) (the number of edges)?

- \( O(m + \log n) \)
- \( O(n + \log m) \)
- \( O(n \log m) \)
- \( O(m \log m) \)
- \( O(n \log n) \)

We have a directed graph with positive edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No

What is the maximum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

What is the minimum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

What is the maximum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

What is the minimum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

We have a directed graph with positive edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No

What is the maximum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

What is the minimum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

We have a directed graph with positive edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No

What is the maximum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

What is the minimum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

We have a directed graph with positive edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No

What is the maximum possible length of the shortest path from node A to node E?

- 4
- 6
- 8
- 10
- Does not exist

What is the minimum possible length of the shortest path from node A to node E?

- 4
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- 8
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We have a directed graph with positive edge weights. Can we use Dijkstra to find shortest paths?

- Yes
- No