1 Conditions for Shortest Path Algorithms

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

- Dijkstra
- Bellman-Ford
- Neither

Which one is correct?

Correct

2 Dijkstra Forensics

Suppose we use Dijkstra’s algorithm with edge weights 0, 1, 2, 3, 4, 5, 6, and 7, starting from the node A as the middle of the algorithm to our computer. We look through the memory dump and see that the state of the heap is as follows when the crash happened:

- Key: 0, Object: A
- Key: 1, Object: B
- Key: 5, Object: E
- Key: 7, Object: C

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 B?
- What is the minimum possible length of the shortest path from node A to node B?
- What is the maximum possible length of the shortest path from node A to node C?
- What is the minimum possible length of the shortest path from node A to node C?
- What is the maximum possible length of the shortest path from node A to node D?
- What is the minimum possible length of the shortest path from node A to node D?
- What is the maximum possible length of the shortest path from node A to node E?
- What is the minimum possible length of the shortest path from node A to node E?
- What is the maximum possible length of the shortest path from node A to node F?
- What is the minimum possible length of the shortest path from node A to node F?

If we run the Dijkstra algorithm on the graph of U.S. streets (roads, highways, etc), starting from the Stanford Oval, which of the following locations will become the current node first?

- Tresidder Union
- The Hollywood Sign
- Times Square in New York
- The Stanford Oval

What if we implement Dijkstra with using a Fibonacci heap? What is the asymptotically smallest upper bound on the runtime of the above code assuming that both the insert and decrease-key operations on H take O(\text{log}(\text{heap size})) time? Assume that n = 1, ≤ m ≤ 2n (in particular log n = \text{O}(\log m)).

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

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

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

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

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

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

What if we implement Dijkstra with using 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(n \log m)
- O(m \log n)
- O(n \log n)
- O(m \log m)

What if we implement Dijkstra with using 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(n \log n)
- O(m \log n)
- O(n \log m)
- O(m \log m)

What if we implement Dijkstra with using a binary 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(n \log m)
- O(m \log n)
- O(n \log n)
- O(m \log m)

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
- B
- C
- D

What is the minimum possible length of the shortest path from node

- A
- B
- C
- D

If we run Dijkstra on some graph with nodes A, B, C, D, E, F

- What is the maximum possible length of the shortest path from node A to node B?
- What is the minimum possible length of the shortest path from node A to node B?
- What is the maximum possible length of the shortest path from node A to node C?
- What is the minimum possible length of the shortest path from node A to node C?
- What is the maximum possible length of the shortest path from node A to node D?
- What is the minimum possible length of the shortest path from node A to node D?
- What is the maximum possible length of the shortest path from node A to node E?
- What is the minimum possible length of the shortest path from node A to node E?
- What is the maximum possible length of the shortest path from node A to node F?
- What is the minimum possible length of the shortest path from node A to node F?