2714. Find Shortest Path with K Hops Premium

Hard Topics Hint

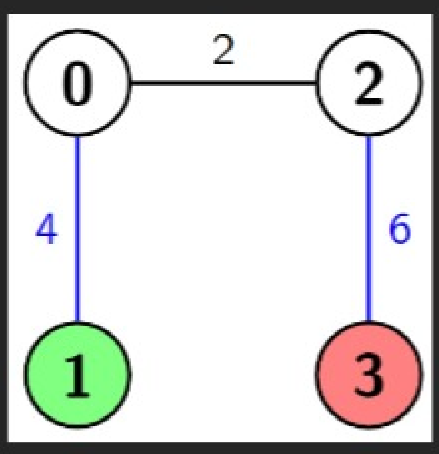
You are given a positive integer `n` which is the number of nodes of a **0-indexed undirected weighted connected** graph and a **0-indexed 2D array** `edges` where `edges[i] = [u_i, v_i, w_i]` indicates that there is an edge between nodes u_i and v_i with weight w_i.

You are also given two nodes `s` and `d`, and a positive integer `k`, your task is to find the **shortest** path from `s` to `d`, but you can hop over **at most** `k` edges. In other words, make the weight of **at most** `k` edges `0` and then find the **shortest** path from `s` to `d`.

Return *the length of the **shortest** path from* `s` *to* `d` *with the given condition.*

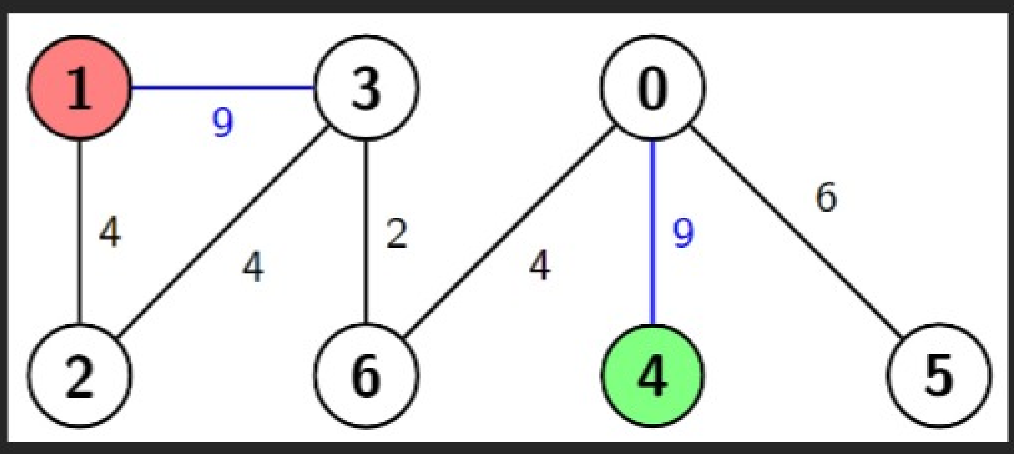
Example 1:

> **Input:** `n = 4, edges = [[0,1,4],[0,2,2],[2,3,6]], s = 1, d = 3, k = 2`
> **Output:** `2`
> **Explanation:** `In this example there is only one path from node 1 (the green node) to node 3 (the red node), which is (1->0->2->3) and the length of it is 4 + 2 + 6 = 12. Now we can make weight of two edges 0, we make weight of the blue edges 0, then we have 0 + 2 + 0 = 2. It can be shown that 2 is the minimum length of a path we can achieve with the given condition.`



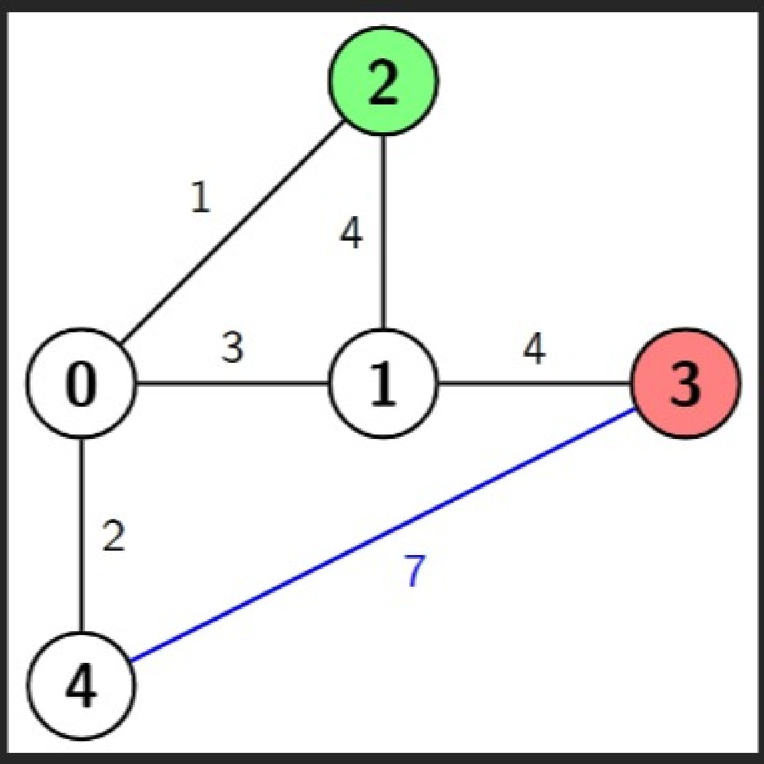
Example 2:

> **Input:** `n = 7, edges = [[3,1,9],[3,2,4],[4,0,9],[0,5,6],[3,6,2],[6,0,4],[1,2,4]], s = 4, d = 1, k = 2`
> **Output:** `6`
> **Explanation:** `In this example there are 2 paths from node 4 (the green node) to node 1 (the red node), which are (4->0->6->3->2->1) and (4->0->6->3->1). The first one has the length 9 + 4 + 2 + 4 + 4 = 23, and the second one has the length 9 + 4 + 2 + 9 = 24. Now if we make weight of the blue edges 0, we get the shortest path with the length 0 + 4 + 2 + 0 = 6. It can be shown that 6 is the minimum length of a path we can achieve with the given condition.`



Example 3:

> **Input:** `n = 5, edges = [[0,4,2],[0,1,3],[0,2,1],[2,1,4],[1,3,4],[3,4,7]], s = 2, d = 3, k = 1`
> **Output:** `3`
> **Explanation:** `In this example there are 4 paths from node 2 (the green node) to node 3 (the red node), which are (2->1->3), (2->0->1->3), (2->1->0->4->3) and (2->0->4->3). The first two have the length 4 + 4 = 1 + 3 + 4 = 8, the third one has the length 4 + 3 + 2 + 7 = 16 and the last one has the length 1 + 2 + 7 = 10. Now if we make weight of the blue edge 0, we get the shortest path with the length 1 + 2 + 0 = 3. It can be shown that 3 is the minimum length of a path we can achieve with the given condition.`



Constraints:

- `2 <= n <= 500`
- $n - 1 <= edges.length <= min(10^4, n * (n - 1) / 2)$
- `edges[i].length = 3`
- `0 <= edges[i][0], edges[i][1] <= n - 1`
- $1 <= edges[i][2] <= 10^6$
- `0 <= s, d, k <= n - 1`
- `s != d`
- The input is generated such that the graph is **connected** and has **no repeated edges** or **self-loops**

Seen this question in a real interview before? 1/5

Yes No

Accepted 1.1K | Submissions 1.8K | Acceptance Rate 61.3%

Topics

Graph Heap (Priority Queue) Shortest Path

Hint 1

Let's construct a new graph and run Dijkstra on it to get the answer to the problem.

Hint 2

We define the new graph as follows: Each node of this graph is a pair (v, c) where v is a node from the given graph and c is any number between 0 and k (inclusive).

Hint 3

Try to make edges of the defined graph in such a way that if we run Dijkstra on the node (s, 0), then the shortest path to node (d, k) would be the final answer.

Hint 4

Edge type one: If the edge (v, u, w) belongs to the initial graph, we put an edge with the weight of w between nodes (v, c) and (u, c) for any c between 0 and k (inclusive) in the new graph.

Hint 5

Edge type two: If the edge (v, u, w) belongs to the initial graph, we put an edge with the weight of 0 between nodes (v, c) and (u, c + 1), also between (u, c) and (v, c + 1) for any c between 0 and k - 1 (inclusive) in the new graph.

Hint 6

For the matter of time complexity, note that you **don't need** to literally construct the described graph.

Discussion (1)