Problem 3608: Minimum Time for K Connected Components

Problem Information

Difficulty: Medium
Acceptance Rate: 44.92%
Paid Only: No
Tags: Binary Search, Union Find, Graph, Sorting

Problem Description

You are given an integer `n` and an undirected graph with `n` nodes labeled from 0 to `n - 1`. This is represented by a 2D array `edges`, where `edges[i] = [ui, vi, timei]` indicates an undirected edge between nodes `ui` and `vi` that can be removed at `timei`.

You are also given an integer `k`.

Initially, the graph may be connected or disconnected. Your task is to find the **minimum** time `t` such that after removing all edges with `time <= t`, the graph contains **at least** `k` connected components.

Return the **minimum** time `t`.

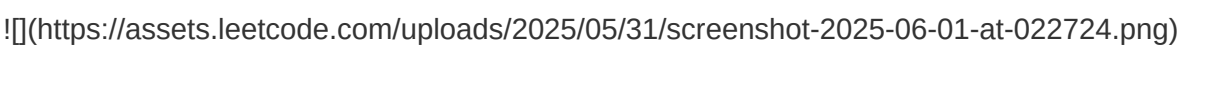
A **connected component** is a subgraph of a graph in which there exists a path between any two vertices, and no vertex of the subgraph shares an edge with a vertex outside of the subgraph.

Example 1:

Input: n = 2, edges = [[0,1,3]], k = 2

Output: 3

Explanation:



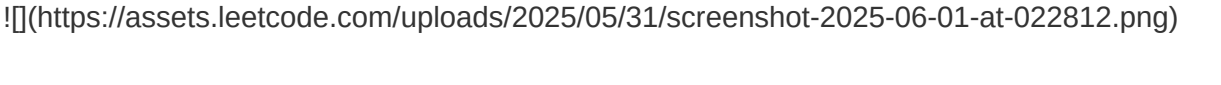
* Initially, there is one connected component `{0, 1}`. * At `time = 1` or `2`, the graph remains unchanged. * At `time = 3`, edge `[0, 1]` is removed, resulting in `k = 2` connected components `{0}`, `{1}`. Thus, the answer is 3.

Example 2:

Input: n = 3, edges = [[0,1,2],[1,2,4]], k = 3

Output: 4

Explanation:



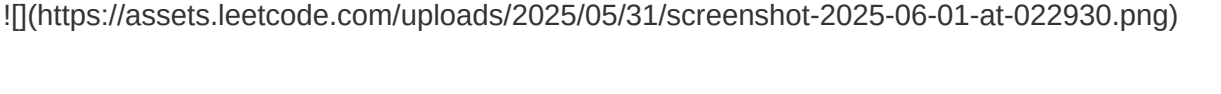
* Initially, there is one connected component `{0, 1, 2}`. * At `time = 2`, edge `[0, 1]` is removed, resulting in two connected components `{0}`, `{1, 2}`. * At `time = 4`, edge `[1, 2]` is removed, resulting in `k = 3` connected components `{0}`, `{1}`, `{2}`. Thus, the answer is 4.

Example 3:

Input: n = 3, edges = [[0,2,5]], k = 2

Output: 0

Explanation:



* Since there are already `k = 2` disconnected components `{1}`, `{0, 2}`, no edge removal is needed. Thus, the answer is 0.

Constraints:

* `1 <= n <= 105` * `0 <= edges.length <= 105` * `edges[i] = [ui, vi, timei]` * `0 <= ui, vi < n` * `ui != vi` * `1 <= timei <= 109` * `1 <= k <= n` * There are no duplicate edges.

Code Snippets

C++:

```
class Solution {
public:
int minTime(int n, vector<vector<int>>& edges, int k) {

}
};
```

Java:

```
class Solution {
public int minTime(int n, int[][] edges, int k) {

}
}
```

Python3:

```
class Solution:
def minTime(self, n: int, edges: List[List[int]], k: int) -> int:
```