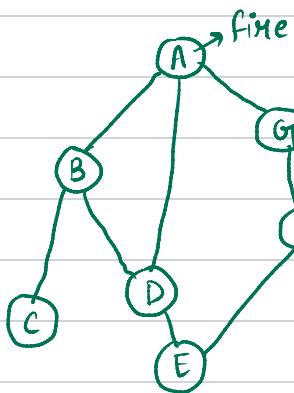


DOUBT SESSION

Ques: Burn them all

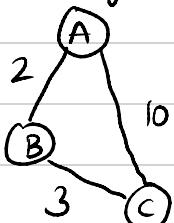
You have given an undirected graph of N vertices and M edges. Edge weight d on edge between nodes u and v represents that u and v are connected by a thread of length d units. You set node A on to the fire. It takes the fire 1 unit of time to travel 1 unit of distance via threads. Let T be the minimum time in which all the threads will be burned out. Your task is to find $10T$. We can prove that $10T$ will always be an integer number. See the sample test cases for more explanation.



There is a fire in node A. Now let's say we have to calculate min time for fire to spread to all nodes.

This problem boils down to calculating the min distance of all nodes from A and then its max will be the answer. So, for all nodes, we just had to run Dijkstra once to get min distance.

But in this problem, instead of nodes, it's saying to burn all the edges. Ex:



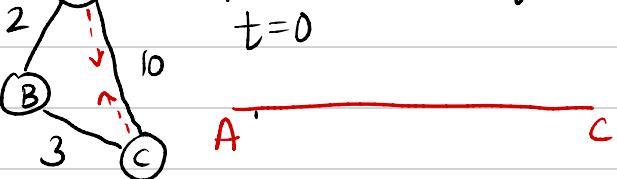
For nodes, the answer would have been 5.

But, we see that shortest path won't cover the $A \rightarrow C$ path. We need all the edges to burn. So min time for $A \rightarrow C$:

Observe that $A \rightarrow C$ from the path $(A \rightarrow B, B \rightarrow C)$ would take 5. And then, it will start

its traversal towards A ($C \rightarrow A$) and A will also start traversing to C from its right edge.

$t=0$ Suppose we start from

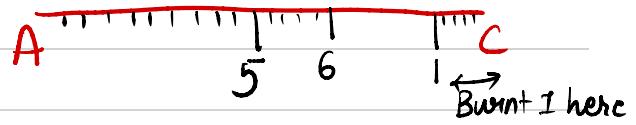


- $t=5$ (already burnt till 5)



- $t > 5$ (will also start burning this edge from node C)

$$\bullet t = 6$$



- $t=7$ (length=9 is already burnt)



- $t=7.5$ (length=10)



So in total for the edge $(A \rightarrow C)$ straight burn, it will take 7.5s to burn.

Ques 2. Subsequences summing to sevens

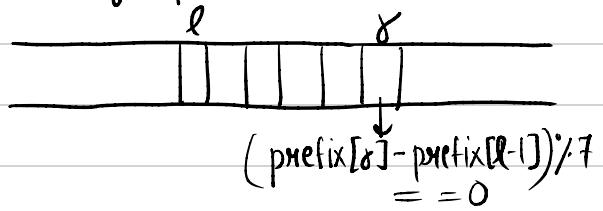
<https://usaco.org/index.php?page=viewproblem2&cpid=595>

Farmer John's N cows are standing in a row, as they have a tendency to do from time to time. Each cow is labeled with a distinct integer ID number so FJ can tell them apart. FJ would like to take a photo of a contiguous group of cows but, due to a traumatic childhood incident involving the numbers 1...6, he only wants to take a picture of a group of cows if their IDs add up to a multiple of 7.

Please help FJ determine the size of the largest group he can photograph.

This problem boils down to finding largest subarray with $\text{Sum} \% 7 == 0$.

Generally, prefix sum is used.



Take prefix sum

At each step, maintain a map in which we can add the following:

map<int, int>

$$\text{prefix_sum}[i] \% 7 = \text{index}$$

So, if we are at r , we have to find min index such that the condition is followed (the mod one)

Use map to find ans.

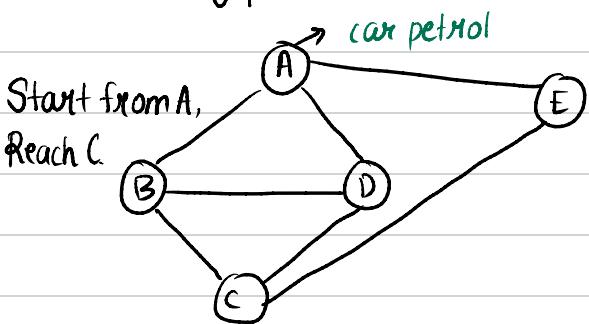
Ques 3. Budget Travelling

You want to visit the country of Wonderland. There are N cities in the country. Not all cities are connected by roads, but you know which cities are connected. You landed in city A , and you want to visit city B . You already booked your car, but it doesn't have any petrol. The capacity of the tank of the car is C . You know the per liter cost of petrol in each city, and you also have the map of the country (i.e., you know the length of the road between two cities).

To travel one unit of distance, you need one liter of petrol.

Your task is to find the minimum cost to travel from city A to city B .

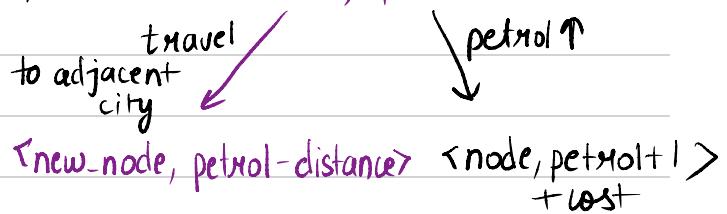
Use of Dijkstra and have to maintain additional state, i.e., amount of petrol



For every node, you have 2 options:

1. Enough petrol to reach next city
2. Fill petrol

So, my state for every node will be <node, petrol>



Ques 4. Number of Zig-Zag Arr |

<https://leetcode.com/problems/number-of-zigzag-arrays-i/>

You are given three integers n , l , and r .

A ZigZag array of length n is defined as follows:

- Each element lies in the range $[l, r]$.
- No two adjacent elements are equal.
- No three consecutive elements form a strictly increasing or strictly decreasing sequence.

Return the total number of valid ZigZag arrays.

Since the answer may be large, return it modulo $10^9 + 7$.

A sequence is said to be strictly increasing if each element is strictly greater than its previous one (if exists).

A sequence is said to be strictly decreasing if each element is strictly smaller than its previous one (if exists).



Maintain :

- index i
- last element taken prev
- previous to previous val prev_prev_val

$\langle i \rangle$

$\langle i, \text{prev}, \text{prev_prev_val} \rangle$

$i+1$

($l \dots r$)

info needed to
Select:

$i+1 \leftarrow l \dots r$

Use prev &
 prev_prev_val to
check if we are
forming any strictly
increasing/decreasing
sequence to select
from $l \dots r$

T.C $\Rightarrow O(N^4)$

Optimisation :

- Instead of maintaining prev_prev_val just maintain a boolean whether this prev_prev_val is less than prev or greater than.

$\langle i, \text{prev}, \text{bool} \rangle$

- With above info, we know the range of value that we can take. Then, we can simply use prefix sum instead of iterating over $l \dots r$.

$\Rightarrow O(N^2)$

