December 2, 2021 ▪ Arrays / Data Structure / Queue

Rotten Oranges : Min time to rot all oranges : BFS

Problem Statement: You will be given an **m x n** grid, where each cell has the following values :

1. 2 – represents a rotten orange
2. 1 – represents a Fresh orange
3. 0 – represents an Empty Cell

Every minute, if a Fresh Orange is adjacent to a Rotten Orange in 4-direction (upward, downwards, right, and left) it becomes Rotten.

Return the minimum number of minutes required such that none of the cells has a Fresh Orange. If it's not possible, return **-1.**

Examples:

```
Example 1:

Input: grid - [ [2,1,1] , [0,1,1] , [1,0,1] ]

Output: -1
```

Minute - 0

2	1	1
0	1	1
1	0	1

Minute - 1

2	2	1
0	1	1
1	0	1

Minute - 2

2	2	2
0	2	1
1	0	1

Minute - 3

2	2	2
0	2	2
1	0	1

Minute - 4

2	2	2
0	2	2
1	0	2

Example 2:

Input: grid – [[2,1,1] , [1,1,0] , [0,1,1]]

Output: 4

Explanation:

Minute - 0

2	1	1
1	1	0
0	1	1

Minute - 1

2	2	1
2	1	0
0	1	1

Minute - 2

2	2	2
2	2	0
0	1	1

Minute - 3

2	2	2
2	2	0
0	2	1

Minute - 4

2	2	2
2	2	0
0	2	2

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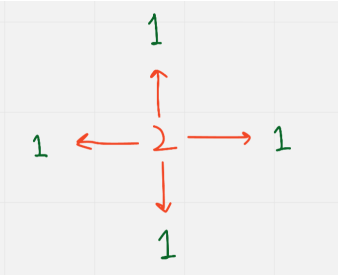
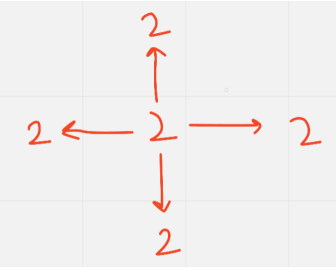
Intuition:

The idea is that for each rotten orange, we will find how many fresh oranges there are in its 4 directions. If we find any fresh orange we will make it into a rotten orange. One rotten orange can rotten up to 4 fresh oranges present in its 4 directions. For this problem, we will be using the BFS (Breadth-First Search) technique.





Approach:

-> First of all we will create a Queue data structure to store coordinate of Rotten Oranges

We will also have variables as:

1. **Total_oranges** – It will store total number of oranges in the grid (Rotten + Fresh)
2. **Count** – It will store the total number of oranges rotten by us .
3. **Total_time** – total time taken to rotten.

-> After this, we will traverse the whole grid and count the total number of oranges in the grid and store it in Total_oranges. Then we will also push the rotten oranges in the Queue data structure as well.

-> Now while our queue is not empty, we will pick up each Rotten Orange and check in all its 4 directions whether a Fresh orange is present or not. If it is present

-> Also we will keep track of the count of rotten oranges we are getting.

-> If we rotten some oranges, then obviously our queue will not be empty. In that case, we will increase our total time. This goes on until our queue becomes empty.

-> After it becomes empty, We will check whether the total number of oranges initially is equal to the current count of oranges. If yes, we will return the **total time taken**, else will return **-1** because some fresh oranges are still left and can't be made rotten.

Code:

C++ Code

```
#include<bits/stdc++.h>
using namespace std;
    int orangesRotting(vector<vector<int>>& g
        if(grid.empty()) return 0;
        int m = grid.size(), n = grid[0].size
        queue<pair<int, int>> rotten;
        for(int i = 0; i < m; ++i){
            for(int j = 0; j < n; ++j){
                if(grid[i][j] != 0) tot++;
                if(grid[i][j] == 2) rotten.pu
            }
        }

        int dx[4] = {0, 0, 1, -1};
        int dy[4] = {1, -1, 0, 0};

        while(!rotten.empty()){
            int k = rotten.size();
            cnt += k;
            while(k--){
                int x = rotten.front().first,
                rotten.pop();
                for(int i = 0; i < 4; ++i){
                    int nx = x + dx[i], ny =
                    if(nx < 0 || ny < 0 || nx
```

```
        }

        return tot == cnt ? days : -1;
    }

    int main()
    {
        vector<vector<int>> v{ {2,1,1} , {1,1
        int rotting = orangesRotting(v);
        cout<<"Minimum Number of Minutes Requ

    }
```

Output:

Minimum Number of Minutes Required 4

Time Complexity: O (n x n) x 4

Reason: Worst-case – We will be making each fresh orange rotten in the grid and for each rotten orange will check in 4 directions

Space Complexity: O (n x n)

Reason: worst-case – If all oranges are Rotten, we will end up pushing all rotten oranges into the Queue data structure

Java Code

```
import java.util.*;
class TUF{
public static int orangesRotting(int[][] gric
        if(grid == null || grid.length == 0)
        int rows = grid.length;
        int cols = grid[0].length;
        Queue<int[]> queue = new LinkedList<>
        int count_fresh = 0;
        //Put the position of all rotten oran
        //count the number of fresh oranges
        for(int i = 0 ; i < rows ; i++) {
            for(int j = 0 ; j < cols ; j++) {
```

```
                }
            }
        }

        if(count_fresh == 0) return 0;
        int countMin = 0, cnt = 0;
        int dx[] = {0, 0, 1, -1};
        int dy[] = {1, -1, 0, 0};

        //bfs starting from initially rotten
        while(!queue.isEmpty()) {
            int size = queue.size();
            cnt += size;
            for(int i = 0 ; i < size ; i++) {
                int[] point = queue.poll();
                for(int j = 0;j<4;j++) {
                    int x = point[0] + dx[j];
                    int y = point[1] + dy[j];

                    if(x < 0 || y < 0 || x >=
                    grid[x][y] == 2) continue

                    grid[x][y] = 2;
                    queue.offer(new int[]{x ,
                }
            }
            if(queue.size() != 0) {
                countMin++;
            }
        }
        return count_fresh == cnt ? countMin
    }
    public static void main(String args[])
    {
        int arr[][]={ {2,1,1} , {1,1,0} , {0,
        int rotting = orangesRotting(arr);
        System.out.println("Minimum Number of
    }
}
```

Output:

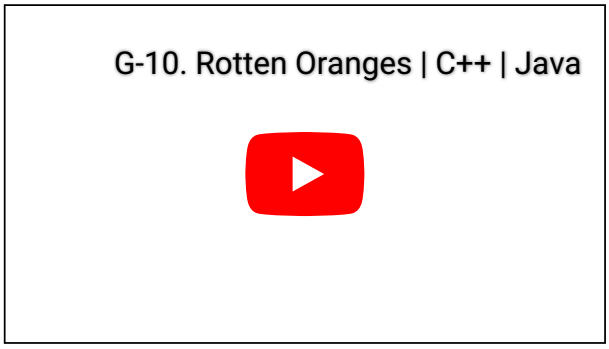
Minimum Number of Minutes Required 4

Time Complexity: O (n x n) x 4

Space Complexity: O (n x n)

Reason: worst-case – If all oranges are Rotten, we will end up pushing all rotten oranges into the Queue data structure

> Special thanks to **Shreyas Vishwakarma** for contributing to this article on takeUforward. If you also wish to share your knowledge with the takeUforward fam, please check out this article



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