Assignment 7/8

Problem 1:

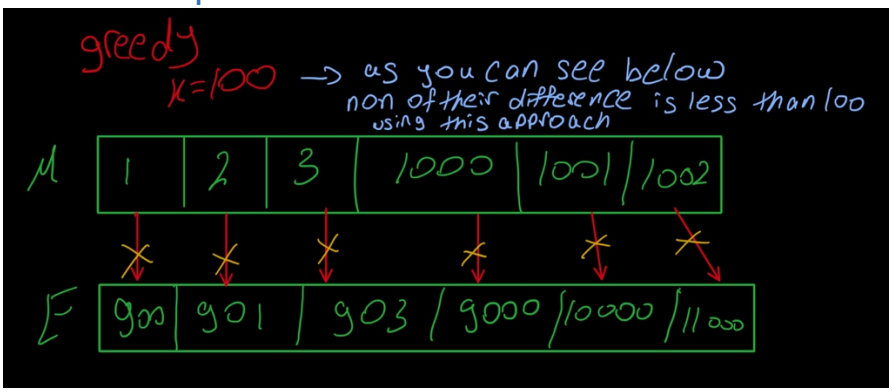
My algorithm:
I decided to use Dynamic programing
Complexity -> O(n^2)

Problem 2:

This problem is like either the Halloween problem or the shortest path problem in a 1 D, I have 2 approaches to solve this problem

First approach is greedy algorithm:

- As we have both ethical and malicious in one array
- So, we have to separate them in two different arrays
- Second, assume that the zones are in ascending order in the x axis, so sort both arrays (ethical and malicious) according to the zone number
- Then loop over the two arrays and assigning i^{th} ethical to the i^{th} malicious hacker if their difference is less than K
- Complexity can be [O (n logn+n) =O(n)]
  This approach won't be the most optimal way: see the below example

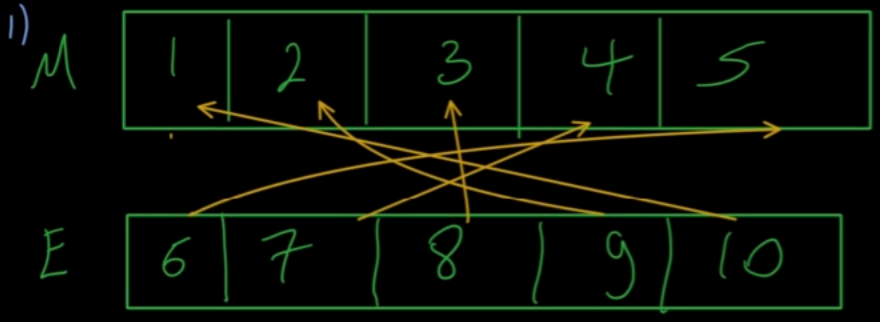


Second approach is greedy algorithm:

- also divide E and M in two different arrays
- then, also sort both of them
- now check the closest M to i^{th} **E**
- then mark this M visited
- repeat this to assign all the ethical hacker to M
- and then put the result of the number of matches in a variable
- did we get the optimal thing now, not yet?
- we need to repeat all of these comparisons (closest M to every E), but re-sort the E array descending and re-initialize everything, and repeat all of previous algorithm and put the result in another variable and compare both variable and check which is bigger and return it
- Complexity here -> O(n^2 +nlogn) ->O(n^2)
  see the below example

second approach, K=4

1)



6 (shortest path for it is) 5

	diff	
7 -> 4	1	✓
8 -> 3	3	✓
9 -> 2	5	✓
10 -> 1	7	✗
	9	✗

matches = 3

---

2) resort E again
then we will begin with 10

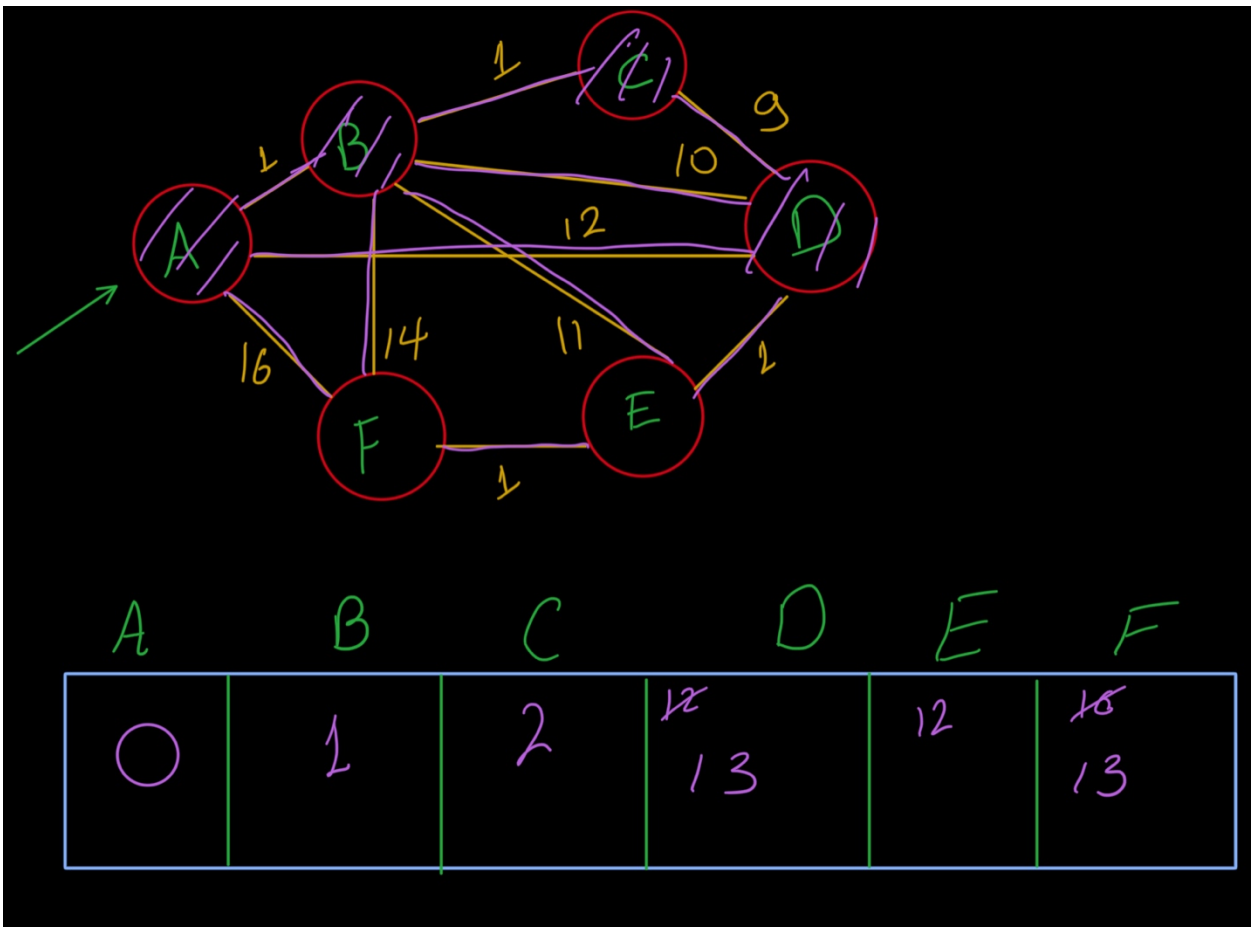
	diff	
10 -> 5	5	✓
9 -> 4	5	✓
8 -> 3	5	✓
7 -> 2	5	✓
6 -> 1	5	✓

matches = 5

3) Compare 5, 2 **return 5**

Problem 3:

a)



b) Getpath(X s, X e) function in the dikstra.cpp

Problem 4:

The problem is optimal merge algorithm, where I used priority queue, where the it pops always the smallest two numbers and then push the sum of them

Complexity -> pushing and popping from the priority queue (logn)
so pushing and popping n time make the complexity ->O(nlogn)

Problem 5:

Implementation: Covid.cpp which also contains a detailed comments and description for the code

Complexity -> O(n)

Problem 6:

When dividing a tree into many trees across many processors, every processor will take probably logn to compute the MST, and in the process of merging them again it will merge n spanning trees into one tree, which is O(logn) complexity

Kruskal's algorithm: when using min heaps its complexity can be O(nlogn)

So, there is no difference in the complexity, so it is not better nor worst

Problem 7:

Please check the small pdf for this Question where there is a detailed algorithm and pseudo code

```
#include <iostream>

using namespace std;

void count(int Grid[][5], int rows, int cols){
    int count=0;
    for(int i=0;i<rows;i++)
     for(int j=0;j<cols;j++)
         if(Grid[i-1][j+1]!=1&&Grid[i][j-1]!=1&&Grid[i-
1][j]!=1&&Grid[i][j]==1)
          {
             //  cout<<Grid[i][j-1]<<" "<<Grid[i-1][j]<<" "<<i<<" "<<j<<" ";
              count++;
              cout<<endl;
          }
    cout<<count;
}
```

```
int main()
{

// int Grid[5][8] =
//      { 0, 0, 0, 0, 0, 0, 0, 0,
//        0, 1, 1, 1, 1, 0, 0, 0,
//        0, 1, 0, 1, 0, 0, 1, 0,
//        0, 1, 1, 1, 1, 0, 1, 0,
//        0, 0, 0, 0, 0, 0, 0, 0, };

//i ignored the blue X here in my grid but it is supposed to be 1's and i
dont loop over them
         int Grid[3][5] =
                {0,0,0,0,0,
                 0,0,0,1,0,
                  0,1,1,0,0 };
        count(Grid,3,4);
    return 0;
}
```