PROGRAMMING TASK

In this part, you must implement your own graph data structure by taking inspiration from your textbook and use it to help to solve problem. You are not allowed to use any external library or .jar file. Any solutions without using graph data structure are not evaluated!

Question 1(25 points):

You are a flight operations manager in a flight company and there are N cities and M undirected flight routes you need to organize in the country. Each city has an airport and each airport can work as layover. The airport will be in two states, loading and running. In loading state, luggage is loaded into the planes. In the running state, planes will leave the airport for the next city. All the airports will switch their states from loading to running and vice versa after every T minutes. At an airport, if its state is loading, you have to wait for it to switch its state to running. At the beginning, all the airports are in running state. The time taken to travel through any flight route is C minutes. Find the lexicographically smallest path which will take the minimum amount of time (in minutes) required to move from city X to city Y.

In the input, the first line contains 4 space separated integers, N, M, T and C. N denotes the number of cities we have, M denotes the number of connections between the N cities, T denotes the time required by airports to change their states and C denotes that the time for travelling one city to another. Next M lines contains two space separated integers each, U and V denoting that there is a bidirectional road between city U and city V. Next line contains two space separated integers, X the city we start to travel and Y the city we want to reach at the end.

In the first line it is given that we have 5 cities and 5 bidirectional roads between them. For this case, time required the airports to change their state is 3 minutes and travel through any flight route is 5 minutes. The next lines gives the connections between the cities and the last line gives which city is the starting point and which city is the end point for this case.

Sample Input:

```
5 5 3 5
1 2
1 3
2 4
1 4
2 5
1 5
```

In the output, the first line print an integer K, denoting the number of city you need to go through to reach city Y from the city X. In next line, print K space separated integers denoting the path which will take the minimum amount of time (in minutes) required by to move from city X to city Y. In the last line, print the total time through the path from city X to city Y. There can be multiple paths. Print the lexicographically smallest one and then the total time for each path at the end.

The output for the above inputs as follows. Please check your program with this input as well as the others that you will create. Please note that we may use other inputs when grading your assignments.

Sample Output:

```
3
1 2 5
11
```

Question 2(25 points):

You are a tour guide in a coastal city and you need to organize a ship tour for your guests. There are N islands around the city and M <u>undirected</u> paths between the islands. The ship tour you will organize should start from island X and include island Y and return the beginning point at the end of the tour.

In the input, the first line contains 2 space separated integers, N, M. N denotes the number of islands we have, M denotes the number of connections between the N islands. Next M lines contains two space separated integers each, U and V denoting that there is a bidirectional road between island U and island V. Next line contains two space separated integers, X the island we start tour and Y the island tour should include.

In the first line it is given that we have 6 islands and 6 bidirectional paths between them. The next lines gives the connections between the islands and the last line gives which island is the starting point and which island should be included to the tour for this case.

Sample Input:

```
6 6
1 2
1 3
2 4
3 4
3 5
5 6
1 4
```

In the output, print K space separated integers denoting the path which the tour starts from island X and includes island Y. There can be multiple paths. Print the lexicographically smallest one.

The output for the above inputs as follows. Please check your program with this input as well as the others that you will create. Please note that we may use other inputs when grading your assignments.

Sample Output:

```
1 2 3 4
```