

## CSE 3512-Algorithm Design and Analysis Sessional

### Mid Term Assignment

Submission Due: 31<sup>st</sup> August, 2023

#### Problem 1

There are  $n$  cities and there are roads in between some of the cities. Somehow all the roads are damaged simultaneously. We have to repair the roads to connect the cities again. There is a fixed cost to repair a particular road. Find out the minimum cost to connect all the cities by repairing roads. Input is in matrix(city) form, if  $city[i][j] = 0$  then there is not any road between city  $i$  and city  $j$ , if  $city[i][j] = a > 0$  then the cost to rebuild the path between city  $i$  and city  $j$  is  $a$ . Find out the minimum cost to connect all the cities. Which roads (edges) need to be repaired to connect all the cities with minimum repair cost.

Input:

```
{ {0, 1, 2, 3, 4},  
  {1, 0, 5, 0, 7},  
  {2, 5, 0, 6, 0},  
  {3, 0, 6, 0, 0},  
  {4, 7, 0, 0, 0} };
```

#### Problem 2

Mohammad is visiting the country Wonderland. Wonderland has  $n$  cities and  $m$  bi-directional roads. There are  $k$  types of tokens. Token  $i$  costs  $c_i$ . The costs of the tokens are such that for all  $2 \leq i \leq k$ ,  $c_i \geq 2c_{i-1}$ . For each road, you need to have a particular set of tokens, if you want to travel it. Note that you don't have to give the tokens, you just need to show them. Thus, one token can be used at any number of roads, where it is required. Mohammad wants to select a set of tokens, such that using them, he can go from any city to any other city. You have to help him minimize the total cost of tokens he buys.

Input:

- The first line contains three space separated integers,  $n$   $m$  and  $k$ .
- The second line contains  $k$  space separated integers, where the  $i^{th}$  integer denotes the price of  $i^{th}$  token, i.e.  $c_i$ .
- $i^{th}$  of the next  $m$  lines contains three integers  $u_i, v_i, l_i$ , where  $l_i$  is the number of tokens required by the  $i^{th}$  road, followed by  $l_i$  indices denoting the tokens required. This road connects cities  $u_i$  and  $v_i$ .

Sample Input	Sample Output
3 3 4 1 2 5 10 1 2 2 1 2 1 3 1 4 2 3 1 3	8

**Explanation**

The best way for Mohammad is to buy the first three tokens. Using these tokens, he can use the roads 1 and 3, and using the roads he can go from any city to any other city. The minimum cost is therefore 8

**Problem 3**

- a) Implement Huffman encoding to compress a message. Save the compressed message in a text file *secretmessage.txt*.
- b) Implement Huffman decoding to decipher a compressed message. Your code should be able to decode your encoded message from *secretmessage.txt* file.