Indian Institute of technology, Guwahati
Department of Computer Science and Engineering
Data Structure Lab: (CS210)
Offline Assignment: 5

Date: 4th September 2017 **Total Marks: 30**
Deadline: 10PM, 10th September 2017. (Hard Deadline)

1. Write the binary search version of the insertion sort. In binary search version, binary search will be used to find the proper position of x[k] in the sorted file of x[0], x[1], …, x[k-1]. **[10]**

   Input Format:
   First line containing the integer **N**, the number of elements in array.
   Second line containing N space separated integers denoting elements of array.
   Output Format:
   First line containing total number of comparisons in binary search.
   Second line containing sorted array.

   Test 1:
   Input:
   9
   37 23 0 17 12 72 31 46 100
   Output:
   19
   0 12 17 23 31 37 46 72 100

   Test 2:
   Input:
   15
   109 28 30 34 56 78 112 46 21 10 84 66 98 14 59
   Output:
   43
   10 14 21 28 30 34 46 56 59 66 78 84 98 109 112

2. Let S be a sequence of n elements. An inversion in S is a pair of elements x and y such that x appears before y in S but x > y. Write an algorithm running in O (n log n) for determining the number of inversions in S. **[10]**

   Input Format:
   First line containing the integer **N**, the number of elements in array.
   Second line containing N space separated integers denoting elements of array.

Output Format:
Single line containing number of inversions.

Test 1:
Input:
15
109 28 30 34 56 78 112 46 21 10 84 66 98 14 59
Output:
52

Test 2:
Input:
20
119 19 91 31 49 72 63 23 80 42 32 48 70 64 35 81 16 24 40 56
Output:
108

3. [**Make it to Work**] There is a company having **E** employees working in town **T** that you work for. The employees live in **N** towns in that area. Some of the employees drive **P** passengers. When P==1 then it means the driver can only transport themselves to work. You want to ensure that everyone will be able to make it to work and you would like to minimize the number of cars on the road. **[10]**

Requirements to calculate the number of cars on the road:
- Every employee can get to town **T**
- An employee can travel in a car belonging to an employee between towns
- Employees can only take rides from other employees that live in same town
- The minimum number of cars is used

Find whether it is possible for everyone to make it to work, and if it is, how many cars will end up driving to the office.

Input Format
First line containing the integer **N**, the number of towns in your area and the integer T, the town where the office is located.
Second line containing the integer **E**, the number of employees.
Following **E** lines, one for each employee, each containing:
 o An integer **H** >= 1, the home town of the employee, followed by
 o An integer **P** >= 0, the number of passengers they can drive. If the employee is not licensed to drive the number will be 0.

Constraints
$1 \leq T \leq N$
$1 \leq H \leq N$
$0 \leq P \leq 6$

Output Format
One line containing EITHER The string IMPOSSIBLE, if there are not enough drivers for everyone to commute; OR
N space-separated integers, one for each town from 1 to **N**, which indicate the number of vehicles commuting from the town.

Test 1:

Input:

5 1

3

2 4

2 0

3 0

Output:

IMPOSSIBLE

Test 2:

Input:

5 3

5

1 2

1 0

4 2

4 4

4 0

Output:

1 0 0 1 0