Indian Institute of Technology, Guwahati

Department of Computer Science and Engineering

Data Structure Lab (CS210)

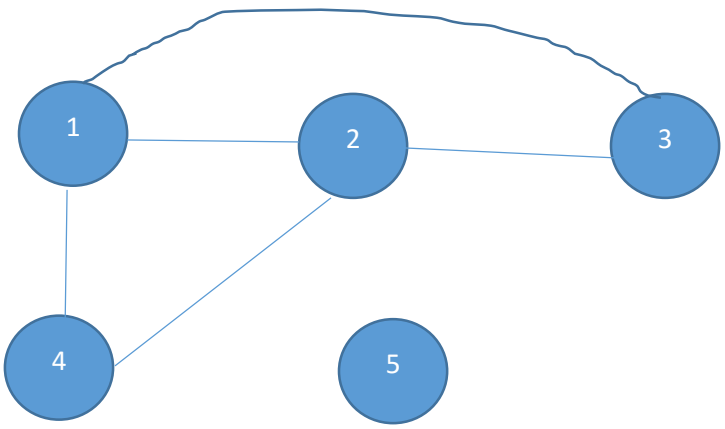
Assignment: 5

Date: 8st September, 2016. **Total Marks: 30 (lab assignments) + 30 (offline assignments)**

Deadline of Offline Assignment Submission: 18th September, 2016.

Lab Assignments:

1. Let G = (V, E) be an **undirected** graph. You are required to find out the connected components of G. Also if the graph has a cycle, you are required to print one such cycle. For this, read the number of nodes n, the number of edges e and then read in the list of edges from a file. Print the number of connected components and also print each connected component as a set of nodes. You are also required to list a cycle if it exists. Otherwise print that there are no cycles. You should test your program carefully on various kinds of inputs and present the test results. Use adjacency list to store this graph**.** **(15 + 15 = 30)**
Marks Distributions: Finding connected components and print them: 15, Finding cycles and print cycles: 15)
Note: The below data is based on the following graph. You need to identify two cycles as shown above.



Input Format:

<no of nodes n > <no of edges e> next e lines for e edges of the form	Example: 5 6 1, 2

<u, v>	3, 1 4, 2 2, 3 1, 4

Output:

The number of connected components: 2

Connected components 1: 1 2 3 4

Connected components 2: 5

The number of cycles: 2

Cycle 1: 1 3 2 1

Cycle 2: 1 4 2 1

Offline Assignments:

2. Let G = (V,E) be **a <u>directed</u>** graph. For every pair of nodes (i,j) determine if there is a path from i to j. You are to read the number of nodes n, the number of edges e and then read in the list of edges. Print the result in a matrix form. You should test your program carefully on various kinds of inputs, especially in the presence of cycles. You may use adjacency list or adjacency matrix to store this graph. **(15)**

3. Let G = (V,E) be a **<u>directed</u>** graph. The graph is represented as adjacency list. You need to mark all the edges as one of the four types: tree edge, back edge, forward edge and cross edge. You are to read the number of nodes n, the number of edges e and then read in the list of edges. Print the types of each edges. **(15)**

4. **<u>(OPTIONAL: No Marks will be given)</u>** In support of the Bharat bandh, some engineers got even Internet bots to stop. One such bot was a web crawler. But the good news is that before it was stopped, it had already collected some data about the linkage of the web pages, which is provided to you as input. But this data needs to be processed more.
   You are tasked to find all groups among these web pages; A **group** is such that, from a web page in that group we can reach any other page of that group.
   For simplicity, a number represents a web page. The first line of Input contains the total number of web pages, following input lines contain linkage from a page to the other. Each output line represents a group (ordering of pages in a group does not matter). **(10)**

Input:

```
12
0 1
1 2
1 3
1 4
2 5
4 1
4 5
5 2
5 7
4 6
6 7
6 9
7 10
8 6
9 8
10 11
11 9
```

Output:

```
0
1 4
3
2 5
7 6 8 9 11 10
```