

CS 372/469 – Spring 2022

Lab 2

Due: 03/18/2022 11:59 pm

For each of the following questions, write a successful running code in any programming language that you prefer. Your code should run without any errors for any *valid* input.

All problems are borrowed from Leetcode or GeeksForGeeks or TechieDelight.

### Question 1 (30 points):

Given a *directed graph (nodes and edges)* and a *starting node*, return the Depth First Traversal of the graph from that node.

Source (Open at your own risk – solution is also on this page):

<https://www.geeksforgeeks.org/depth-first-search-or-dfs-for-a-graph/>

Input and Output Example (from the above source):

**Input:**  $n = 4, e = 6$

0 -> 1, 0 -> 2, 1 -> 2, 2 -> 0, 2 -> 3, 3 -> 3

**Output:** DFS from vertex 1 : 1 2 0 3

**Input:**  $n = 4, e = 6$

2 -> 0, 0 -> 2, 1 -> 2, 0 -> 1, 3 -> 3, 1 -> 3

**Output:** DFS from vertex 2 : 2 0 1 3

Your code should be able to traverse the above input format (e.g. 2 -> 0, 0 -> 2, 1 -> 2, 0 -> 1, 3 -> 3, 1 -> 3) **from a given text file** and create edges in your data structure.

Your algorithm must have a time complexity of  $O(V + E)$

## Question 2 (35 points):

Given a *directed graph*, return Yes if the graph contains a cycle and No if it does not.

Source (Open at your own risk – solution is also on this page):

<https://www.geeksforgeeks.org/detect-cycle-undirected-graph/>

Input and Output Example (modified from the above source):

**Input:**  $n = 3, e = 3$

$0 \rightarrow 1, 0 \rightarrow 2, 1 \rightarrow 2$

**Output:** No

**Input:**  $n = 3, e = 3$

$0 \rightarrow 1, 2 \rightarrow 0, 1 \rightarrow 2$

**Output:** Yes

Your code should be able to traverse the above input format (e.g.  $2 \rightarrow 0, 0 \rightarrow 2, 1 \rightarrow 2, 0 \rightarrow 1, 3 \rightarrow 3, 1 \rightarrow 3$ ) **from a given text file** and create edges in your data structure.

Your algorithm must have a time complexity of  $O(V + E)$

## Question 3 (35 points):

Given a boolean 2D matrix, find the number of islands. A group of connected 1s forms an island.

Source (Open at your own risk – solution is also on this page):

<https://www.geeksforgeeks.org/find-number-of-islands/>

Input and Output Example (from the above source):

Input : 1, 1, 0, 0, 0,  
          0, 1, 0, 0, 1,  
          1, 0, 0, 1, 1,  
          0, 0, 0, 0, 0,  
          1, 0, 1, 0, 1

Output : 5

Explanation (from the above source):

```
{ {1, 1, 0, 0, 0},  
  {0, 1, 0, 0, 1},  
  {1, 0, 0, 1, 1},  
  {0, 0, 0, 0, 0},  
  {1, 0, 1, 1, 0} }
```



<https://media.geeksforgeeks.org/wp-content/uploads/20190704154734/FindNumberOfIslands.png>

Your code should be able to traverse the above input format from a given text file.

Your algorithm must have a time complexity of  $O(\text{numRows} \times \text{numColumns})$

**Submission Instructions:** Put all your solutions in a properly commented file named *lab2\_lastname\_firstname.EXTENSION*, where EXTENSION = the appropriate extension for the programming language that you chose.