CS 101 Fall 2021 - Quiz 6-A

11/22/2021 - 25 Minutes **Name:** **ID number:**

Remember that your work is graded on the quality of your writing and explanation as well as the validity.

Problem 1 Notes of discussion (1 pts):

I promise that I will complete this QUIZ independently, and will not use any electronic products or paper-based materials during the QUIZ, nor will I communicate with other students during this QUIZ.

True or False: I have read the notes and understood them.

1

Problem 2 True or False(5×1pts):

The following questions are True or False questions, you should judge whether each statement is true or false and write the answer(T/F) in the box below.

Note: You should write those answers in the box below.

Question 2.1	Question 2.2	Question 2.3	Question 2.4	Question 2.5
T	T	F	T	T

2.1 The time complexity of graph traversal on a connected graph is $\Theta(E)$ where E is the number of edges.

2.2 BFS can be used to give a path to any node in the graph which has the smallest number of edges.

2.3 Adjacency matrix is better than adjacency list when inserting a new vertex.

2.4 We can use DFS to determine whether a graph is bipartite.

2.5 A directed graph with n vertices has at least n edges to ensure the whole graph is strongly connected.

Problem 3 Disjoint Set(3 pts):

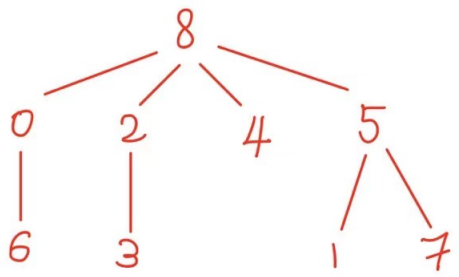
Consider a disjoint set with both path compression and union-by-size optimization. When two trees have the same height, the set specified first in the union will be the root of the merged set. The following operations are done:

union(2,3);union(1,2);union(5,7);union(8,4);union(7,2);

find(1);union(0,6);union(4,6);union(6,3);find(2);

Please write down the result for each *find* operation appeared in the above operations, and draw the disjoint set tree after all operations above is finished.

5, 8



CS 101 Fall 2021 - Quiz 6-A

11/22/2021 - 25 Minutes **Name:** **ID number:**

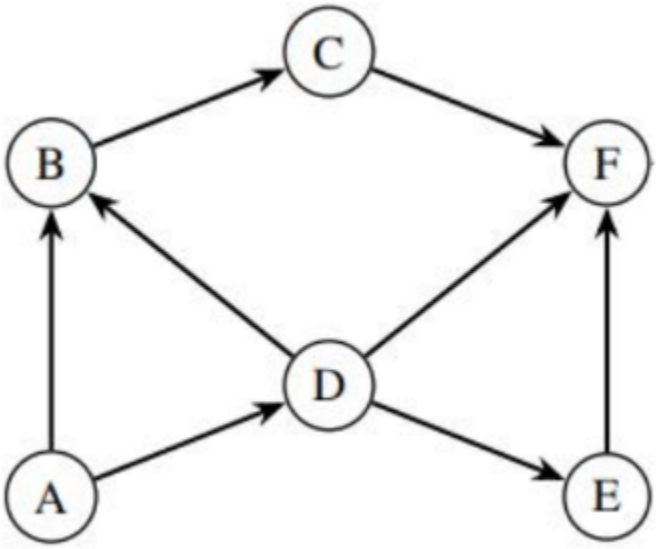
Problem 3 Graph Algorithms(3+3 pts):

(1) Design an algorithm to solve the problem below efficiently and give a worst case runtime bound in Θ notation in terms of V and E.

Problem: determine whether there is a path between from node s to node t in a directed graph.

Run DFS or BFS starting from s. After that, check whether t is visited. Time: $\Theta(|V| + |E|)$

(2) Run DFS on the following graph starting with vertex A. Please write down the result. Whenever there is a choice of which node to visit next, follow the alphabetical order.



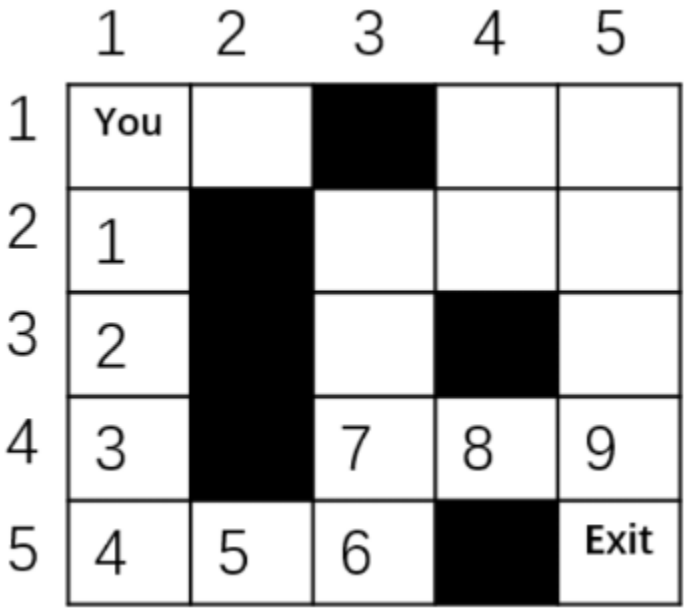
A B C F D E

CS 101 Fall 2021 - Quiz 6-A

11/22/2021 - 25 Minutes **Name:** **ID number:**

Problem 4 Maze(5 pts):

There is a maze stored in a $m \times n$ matrix A. If there is an obstacle at point (i, j), $A[i][j] = 1$; otherwise $A[i][j] = 0$. You're at point (1, 1), and you want to go to (m, n).



Please design an algorithm to find out the shortest path from (1, 1) to (m, n). Briefly explain your algorithm using natural language. For the provided example, the result is 10.

The input matrix can be seen as a undirected graph, each point (i, j) as a vertex, and there are edges between each point with value 0 and each of its neighbor with value 0. Use BFS to search this graph starting at point (1, 1). For each node appeared in the fringe, record its parent. When we reach point (m,n), stop, then we can calculate the shortest path by the recorded parent.