

CS2040C Semester 1 2018/19  
Data Structures and Algorithms

## **Tutorial 10 - DFS/BFS applications, PS5**

For Week 12 (Week Starting 05 November 2018)

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### **1 Introduction and Objective**

Now that we have stored our graphs in one (or more) graph data structure(s), we want to run various algorithms on it.

In this tutorial, we will focus on two graph traversal algorithms: Depth-First Search (DFS) and Breadth-First Search (BFS) and concentrate on what they can do on top of just traversing the underlying graph.

### **2 Tutorial 10 Questions**

#### **Review Harder Topics**

Q1. Tutor will spend some time (depending on the requests) to review any remaining harder topics about graph traversal that may not be clear even after the flipped classroom on Week 5a+5b. In recent years, these are the usually harder topics for students:

1. <https://visualgo.net/en/dfsbfbs?slide=7-1> to 7-3 (about back edge/detecting cycle in the graph; we will focus on this first). To test your understanding, draw a graph such that back-edge checking will be erroneous if two states (unvisited/visited) were used instead of three states (unvisited/explored/visited).
2. <https://visualgo.net/en/dfsbfbs?slide=7-6> to 7-9 (should be clearer this time, but check your understanding about the  $O(V \times (V + E))$  versus just  $O(V + E)$  analysis again)

#### **DFS/BFS Applications**

Q2. Please look at <https://open.kattis.com/problems/countingstars> and try to solve it with either DFS or BFS.

Q3. Please look at <https://www.comp.nus.edu.sg/~stevenha/cs2040c/tests/CS2010-2013-14-S1-final.pdf>, Question 4.1, Facebook Privacy Setting and try to solve it.

### Problem Set 5

Q4. For PS5A, the given graph is in the form of a tree. Note that  $V = 1000$  and  $Q = 100\,000$ . To help you think of a solution, answer the following questions:

1. What is the time complexity if one DFS/BFS/Bellman Ford/Dijkstra's algorithm is performed for each query? Will it run in time?
2. A Single Source Shortest Path algorithm from one vertex will compute the shortest path from one starting vertex to **only one other vertex**. True/False?
3. How many simple paths are there between two vertices of a tree?

This marks the end of Tutorial 10. Tutor can continue to discuss about PS5 if time permits.