CS2040C Semester 1 2020/2021

Data Structures and Algorithms

Tutorial 08 - Graph DS and Traversal

For Week 10

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1 Introduction and Objective

This tutorial marks the last $\frac{1}{3}$ of CS2040/C: Graph. We will discuss various graph data structures and on how to explore them.

The VisuAlgo pages that are used in this tutorial are `https://visualgo.net/en/graphds` and `https://visualgo.net/en/dfsbfs`.

2 Tutorial 08 Questions

Basic Stuffs About Graph DSes

Q1). (Not optional): Tutor will draw **just one random small** graph on the **whiteboard** first and ask students to store that graph in **either** Adjacency Matrix (AM)/Adjacency List (AL)/Edge List (EL) data structure on the **whiteboard**. Then, the tutorial group can compare the answers by drawing the same small graph on `https://visualgo.net/en/graphds`.

Not-So-Basic Stuffs About Graph DSes

Q2a). Draw a Directed Acyclic Graph (DAG) with V vertices and $V \times (V-1)/2$ directed edges.
Q2b). Draw a Bipartite Graph with V vertices (assume that V is even) and $V^2/4$ undirected edges.
Q2c). Draw a Tree with V vertices (and $E = V - 1$ edges) that is not a Bipartite graph.

Q3). Show what is the best (fastest) way to convert a graph currently stored in graph data structure 1 into graph data structure 2.
Q3a). From Adjacency Matrix (AM) to Adjacency List (AL)
Q3b). From AM to Edge List (EL)

Q3c). From AL to AM
Q3d). From AL to EL
Q3e). From EL to AM
Q3f). From EL to AL
For the interest of time, tutor will only pick subset of these for live discussion (the rest are documented in modal answers)

Graph Modeling Exercise Part 1

Q4). The tutor will randomly imagine **one** real life scenario (that can be modeled as a graph problem) and will ask random student to model that scenario into a graph. Students have to describe what the set of vertices represent, what the set of edges represent, are the graphs weighted/directed/connected?, what are the graph (for now, limit to graph traversal) problem being asked?, etc...

DFS/BFS Review

Q5). (Not optional): The tutor will end the tutorial by quickly reviewing DFS and BFS graph traversal algorithms using `https://visualgo.net/en/dfsbfs` starting from the same randomly drawn graph post Q1). discussion. The tutor will ask some students to join the live demonstration. We will discuss harder applications of these two graph traversal algorithms in Tut09.

Hands-on 8

TA will run the second half of this session with a few to do list:

- Very quick review of Steven's `https://github.com/stevenhalim/cpbook-code/blob/master/ch4/traversal/dfs_cc.cpp` and `https://github.com/stevenhalim/cpbook-code/blob/master/ch4/sssp/bfs.cpp`,
- Do a(nother) sample speed run of VisuAlgo online quiz that are applicable so far, e.g., `https://visualgo.net/training?diff=Medium&n=5&tl=0&module=dfsbfs`.
- Then, live solve another chosen Kattis problem involving Graph.

Problem Set 4 (Again)

We will end the tutorial with **high-level** discussion of PS4.
Restrictions are now lifted.
TAs can discuss the **high-level** ideas to get full marks for PS4 A+B, hence it is just an 'implementation issue' from here onwards (until deadline in one or two days time — depending on your Lab session).

WARNING: Plagiarism checker is strongly enforced this time and if anyone is still copy/seek too much help for the much longer ($\approx$ 2 weeks) PS, you can say goodbye to lots of marks for the 2 hours PE.