IT5003 Semester 2 2024/2025 Data Structures and Algorithms

Tutorial 07 Graph DS and Traversal For Week 09 (Sat)/10 (Mon)

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1 Introduction and Objective

In this tutorial, we will transition to the last $\frac{1}{3}$ of CS2040/C/S and IT5003: Graph. We will discuss various graph data structures and on how to explore them with basic graph traversal algorithms.

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

2 Tutorial 07 Questions

Basic Stuffs About Graph DSes

Q1). The tutor will draw a <u>two-dimensional depiction</u> of a 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 re-drawing the same small graph on https://visualgo.net/en/graphds, possibly in different 2D depictions of the same graph to reinforce the concept that graph is a set of vertices and edges and can have many possible 2D depictions/embeddings.

Not-So-Basic Stuffs About Graph DSes

Q2). (Choose 2 out of 3) Many of these are already in VisuAlgo online quiz:

- a). Draw a Directed Acyclic Graph (DAG) with V vertices and $V \times (V-1)/2$ directed edges.
- b). Draw a Bipartite Graph with V vertices (assume that V is even) and $V^2/4$ undirected edges.
- c). Draw a Tree with V vertices (and E = V 1 edges) that is not a Bipartite graph.
- All these drawing questions have been integrated in VisuAlgo Online Quiz :).

Q3). (Choose 2 out of 6) Show what is the best (fastest) way to convert a graph currently stored in graph data structure A into graph data structure B.

- a). From Adjacency Matrix (AM) to Adjacency List (AL)
- b). From AM to Edge List (EL)
- c). From AL to AM
- d). From AL to EL
- e). From EL to AM
- f). From EL to AL

For the interest of time, tutor will only pick subset of two of these for live discussion (the rest are documented in modal answers)

DFS Initial Review

Q4). The tutor will then review (the basic form of) DFS graph traversal algorithms using https: //visualgo.net/en/dfsbfs starting from the same randomly drawn graph from 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 the next tutorial.

Hands-on 8

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

- Very quick review of Prof Halim's https://github.com/stevenhalim/cpbook-code/blob/master/ch2/ourown/graph_ds.py, https://github.com/stevenhalim/cpbook-code/blob/master/ch2/ourown/graph_ds.java,
- Very quick review of Prof Halim's https://github.com/stevenhalim/cpbook-code/blob/master/ch4/traversal/dfs_cc.py, https://github.com/stevenhalim/cpbook-code/blob/master/ch4/traversal/dfs_cc.java (BFS will be covered soon),
- Do a sample speed run of VisuAlgo online quiz that are applicable so far (just skip BFS-related questions first), e.g., https://visualgo.net/training?diff=Medium&n=5&tl=5&module=graphds,dfsbfs.
- Then, live solve another chosen Kattis problem involving graph data structure.

Problem Set 5

As there is no more lab session before PS5 is due on Thu, 27 Mar 25, 11.59:59pm (1 second before NUS well-being day of this semester), then TAs can discuss the **high-level** ideas to get full marks for PS5 tasks, hence it is just an 'implementation issue' from here onwards (students may need to understand the discussions on Lec 09 on Wed, 26 March 2025 too).