IT5003 Mar-May 2024

Data Structures and Algorithms

Tutorial+Lab 06
Graph DS and Traversal

Document is last modified on: January 6, 2024

1 Introduction and Objective

This tutorial marks the last $\frac{3}{8}$ of IT5003: Graph. We will discuss various graph data structures and on how to explore them.

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

2 Questions

Basic Stuffs About Graph DSes

Q1). (Short opening exercise): Tutor will draw a *two-dimensional depiction* of **a random small** graph on the **whiteboard** (or shared screen for online class...) first and ask students to store that graph in **either** Adjacency Matrix (AM)/Adjacency List (AL)/Edge List (EL) data structure on the **whiteboard** (or shared screen for online class...). 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). Draw certain (special) graphs with certain constraints:
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.

Q3). Show what is the best (fastest) way to convert a graph currently stored in a graph data structure 1 into another 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 start with Q3f (the most common input type for graph-related problems in Kattis) and then perhaps pick at most one other to save time (the rest are shown in the modal answers below but not discussed in details)
The reason for doing graph DS conversion is usually because on its original form, we cannot do certain things efficiently (e.g., in AM|AL, we cannot easily sort the edges), so, we convert the current graph DS into an another graph DS so we can do what we want to do, efficiently.

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?, should we explicitly store the graph?, etc...

Simple DFS Review

Q5). (Fresh from the oven): Next, we will review DFS graph traversal algorithms using `https://visualgo.net/en/dfsbfs` that has just been introduced recently... starting from the same randomly drawn graph post Q1). discussion. The tutor will ask some students to join the live demonstration.

Hands-on 6

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

- PS5 Quick Debrief,
- Do a 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=graphds`.
  PS: Skip parts that are skipped for this sem's IT5003.
- Then, live solve another chosen Kattis problem involving Graph Data Structure.

Problem Set 6

We will end the tutorial with high level discussion of PS6 A+B.