

IT5003 Mar-May 2024
Data Structures and Algorithms

Tutorial+Lab 07
Graph Traversal and Shortest Paths (Part 1)

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1 Introduction and Objective

In this penultimate lab session, we will quickly review graph traversal topics (DFS/BFS and the standard graph traversal applications) and start discussing the last topic for this module: Single-Source Shortest Paths (SSSP) problem that has just been introduced recently (only the unweighted version first). We will continue talking about the ‘graph modeling’ soft skill, i.e., ability to model a seemingly random (non-explicit-graph) problem into a graph problem.

SSSP problem is quite easily found in many real life applications and it is the source of many interesting Computer Science problems, as you can see in this session. Again, we recommend that you put some thoughts on them before discussing the potential solutions with your tutor.

We use <https://visualgo.net/en/dfsdfs> and <https://visualgo.net/en/sssp> (limited to BFS first) during our discussion in this session.

During the hands-on session, we will spend some time discussing one of the hardest Graph Traversal topic discussed in IT5003: topological sorting (using either DFS or BFS modification), <https://visualgo.net/en/dfsdfs?slide=7-10> to 7-11 (toposort).

2 Questions

Graph Traversal Open QnA

We continue with QnA on graph traversal algorithms: basic DFS + basic BFS.

Unweighted SSSP Open QnA

During your self-study via VisuAlgo e-Lecture and in real life class discussions, you were presented with these SSSP algorithms: BFS (only for unweighted graph) — already discussed by this tutorial

and Modified Dijkstra's algorithm (for non-negative weighted graph) — will be discussed next week. We skipped negative weight cases in IT5003 (moved to optional topics in the last recitation r8)

To start this review, the tutor will (re-)demonstrate the executions of BFS algorithms on a small (un)directed unweighted graph using <https://visualgo.net/en/sssp> from a certain source vertex s . The tutor will re-explain why BFS can still be used for this variant. The tutor may invite some students to do this live demonstration using different source vertex s and/or using different graph.

Graph Modeling Exercise, via Past Paper Discussion

There are a few graph questions in past final assessment papers. Let's discuss one of them (considering that SSSP will be asked in Final Assessment – but usually not going to be the hardest question).

Read <https://www.comp.nus.edu.sg/~stevenha/cs2040/tests/CS2010-2013-14-S1-final.pdf>, Question 4.1, Facebook Privacy Setting. Is this an unweighted SSSP problem solvable with BFS?

Hands-on 7

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

- PS6 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&t1=0&module=dfsbfbs>.
PS: Skip parts that are skipped for this sem's IT5003.
- Then, live solve another chosen Kattis problem involving Graph Traversal (toposort).

Problem Set 7

We will end the tutorial with high level discussion of PS7 A+B.