CS2040C Semester 1 2021/2022

Data Structures and Algorithms

Tutorial+Lab 10

Shortest Paths

For Week 12

Document is last modified on: October 26, 2021

1 Introduction and Objective

In this tutorial, we will discuss the last examinable topic for this module: Single-Source Shortest Paths (SSSP) problem and continue talking about the 'graph modeling' soft skill, i.e., ability to model a seemingly random (non-explicit-graph) problem into a graph problem (specifically the SSSP problem for this tutorial).

We will use `https://visualgo.net/en/sssp` during our discussion in this tutorial.

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 tutorial. Again, we recommend that you put some thoughts on them before discussing the potential solutions with your tutor.

Standard Stuffs

During your self-study via VisuAlgo e-Lecture and in class discussions on Wednesday of Week 11, you were presented with these SSSP algorithms: Bellman-Ford algorithm (for general case, but also the slowest) and BFS (only for unweighted graph).

Due to the timing of the PE on Thursday of Week 11 and PH (Deepavali) on Thursday of Week 12, we will only discuss the Dijkstra's algorithm later on Wednesday of Week 12 (and thus will only be discussed in the last tutorial 11 instead).

First, the tutor will (re-)demonstrate the executions of Bellman-Ford and/or BFS algorithms on a small directed weighted graph using `https://visualgo.net/en/sssp` from a certain source vertex s. The tutor will re-explain when a certain algorithm can be used and when the same algorithm cannot be used. The tutor may invite some students to do this live demonstration using different source vertex s and/or using different graph.

Graph Modeling Exercises, via Past Paper Discussions

There are a few graph questions in recent final assessment papers. Let's discuss two of them (considering that SSSP – our typical last topic of CS2040/C/S – will be there in the Final Assessment – but usually (but not always) not going to be the hardest question) are as follows:

1. `https://www.comp.nus.edu.sg/~stevenha/cs2040c/tests/CS2010-2013-14-S1-final.pdf`, Question 4.1, Facebook Privacy Setting
2. `https://www.comp.nus.edu.sg/~stevenha/cs2040c/tests/CS2040-2017-18-S4-final.pdf`, Question C.1, SSSP in a Special "SLL" (code the solution in C++ instead)

Hands-on 10

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

- Speedrun the last two components of VisuAlgo Online Quiz:
  `https://visualgo.net/training?diff=Medium&n=5&tl=0&module=dfsbfs,sssp`
  PS: Skipping Dijkstra's or other SSSP specific questions that are not yet covered.
- Share any last minute tips for VA OQ preparation based on TA's experiences
- Hands-on, PE upsolve (and if time permitting, one more task about SSSP)

Problem Set 5

We will end the tutorial with **high-level** discussion of PS5.
Now approaching the second week (with 3 days extension until the end of Lab/Tutorial of Week 13).
We can now discuss more ideas of PS5 A+B (not necessarily until the final subtask).