CS2040C Semester 2 2018/2019

Data Structures and Algorithms

Tutorial 10 - Shortest Paths

For Week 12

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1 Introduction and Objective

In this tutorial, we will discuss the last 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). Note that timing of this tutorial can be a bit off as Steven is not present in Singapore on Week 11...

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.

Also note that Friday of Week 12 will mark the end Friday tutorial groups as there won't be any Friday tutorial group on Week 13 (Good Friday). Therefore, for all Friday tutorial groups, we shall take a class photo.

Standard Stuffs

During your self-study via VisuAlgo e-Lecture and in real life class discussions, you were presented with these SSSP algorithms: Bellman Ford's algorithm (for general case, but also the slowest), BFS (only for unweighted graph), and the original version of Dijkstra's algorithm (as defined by Dijkstra himself and implemented using C++ STL set/Java TreeSet – a 'special' Priority Queue ADT that is still C++ STL/Java API-based that can be used to update/decrease key efficiently). This part is examinable.

Later on Lecture 13a, we will discuss the modified version of Dijkstra's algorithm (as commonly used in Competitive Programming world), SSSP on Tree, and SSSP on DAG (pre-cursor to DP), etc. This part is somehow not examinable.

First (maybe not optional due to the fact that this topic has only been discussed on Lecture 12a/12b), the tutor will (re-)demonstrate the executions of those 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 – will be there in Final Exam but usually not going to be the hardest question) are as follows:

1. `https://www.comp.nus.edu.sg/~stevenha/cs2040c/tests/CS2010-2015-16-S1-WQ2-medium.pdf`, Question C.1, Graph Traversal

2. `https://www.comp.nus.edu.sg/~stevenha/cs2040c/tests/CS2010-2013-14-S1-final.pdf`, Question 4.1, Facebook Privacy Setting

Class Photo (Friday Tutorial Groups on Week 12)

Only for Friday Tutorial Groups on Week 12: Let's take a class photo with your tutor as momento (and post the photos in our Facebook Group).

All the best for your final assessment of this module and of your other modules.