CS2010 Semester 1 2012/2013

Data Structures and Algorithms II

Tutorial 07 - Shortest Path 2

For Week 09 (15 October - 19 October 2012)

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1 Introduction and Objective

This is the last tutorial for the second part of CS2010 (Graph). After this, we will switch to the last topic of CS2010 (DP).

We will continue discussing the SSSP problem, especially the graph modeling aspects. We will revisit Dijkstra's algorithm, both the original and the modified implementation variant. Finally, we will discuss PS5 Subtask 1-2-3-4 that highlight special cases that can be solved more efficiently using another algorithm than the generic one.

Note: Use `http://www.comp.nus.edu.sg/~stevenha/visualization/sssp.html` to *verify* the answers of some questions in this tutorial. However during written tests, you have to be able to do this by yourself.

2 Tutorial 07 Questions

Shortest Path application

Q1. What is the best algorithm to detect "the issue" in the following SSSP problem given the directed graph below and a source (highlighted as a black node)?

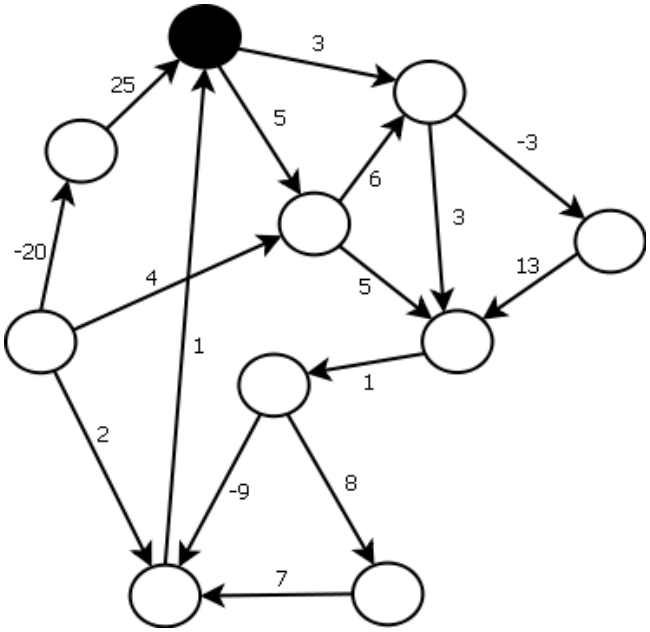


Figure 1:

1. Bellman Ford's
2. Original Dijkstra's
3. Modified Dijkstra's
4. BFS
5. DFS
6. None of the above

Q2. Run the modified Dijkstra's algorithm (as shown in Lecture 08) on the graph below using vertex A as the source. Show the PQ in each step of the algorithm and also give the final shortest path spanning tree.

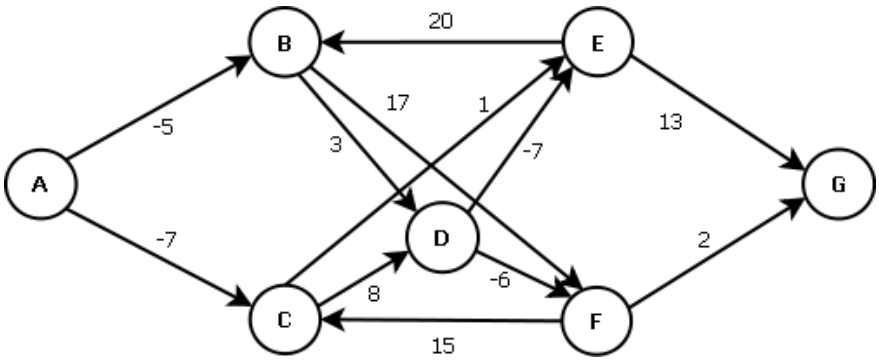
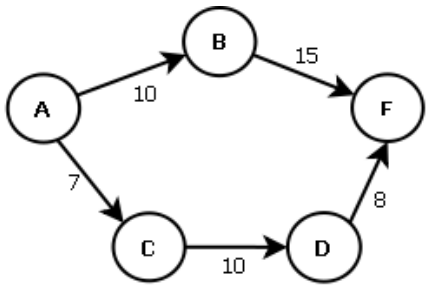


Figure 2:

Q3. A salesman frequently needs to drive from one city to another to promote his products. Since time is of the essence, he will want the shortest route to get from one city to another. However in every city he passes he will have to pay a **toll fee** (assuming toll fee is the same for every city). Therefore, given two different routes of the same distance to get from city A to city B, he will prefer the one which passes through fewer cities. An example is shown



To get from A to E, route A,B,E is preferred over route A,C,D,E even though both have the same cost 25, since A,B,E goes through fewer cities.

Figure 3:

Propose the best algorithm using what you have learnt so far, so that the salesman will choose a route from any source city A to any destination city B such that it has the shortest distance and also passes through the fewest cities. What is the running time for your algorithm?

Q4. A travel agent has access to a database which lists for all airports around the world, their flight schedule. The flight schedule consists of the flight plans of all airplanes coming into and leaving a given airport. Specifically, the flight plan for each airplane is as follows

1. plane number
2. destination airport
3. departure time from airport
4. arrival time at destination airport

Help the travel agent develop a software which will determine a flight route for her clients, such that given a source airport **SA** and starting time **ST** (departure time of a flight must be >= ST), it will produce the flight route giving the earliest arrival time at the destination airport **DA**.

*you can assume that smallest unit of time is in minutes.

Problem Set 5 – A Very Quick Discussion

Q5. Discussion of PS5 Subtask 1-2-3-4 :O...