

CS2010 Semester 1 2012/2013
Data Structures and Algorithms II

Tutorial 10 - APSP & DP3

For Week 12 (05 November - 09 November 2012)

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1 Introduction and Objective

This is the last official tutorial session for CS2010 in this semester. On Week 13, we do not have Tuesday classes (Deepavali) and Steven will be in Hat Yai on Wednesday for ACM ICPC. Therefore, Week 13 tutorial classes will be made 'optional' (personal arrangement with Ket Fah and Yan Han) and thus Week 12 (Tutorial 10) is the last official tutorial.

We will discuss, Floyd Warshall's algorithm, the All-Pairs Shortest Paths problem, and discuss two questions from past exam papers.

2 Tutorial 10 Questions

Q1. In the pseudo-code for Floyd Warshall's algorithm, there are 3 nested loops:

```
for (int k = 0; k < V; k++)
    for (int i = 0; i < V; i++)
        for (int j = 0; j < V; j++)
            D[i][j] = Math.min(D[i][j], D[i][k] + D[k][j]);
```

Does the following modified code still work if the order in which variable *i* is processed is changed?

```
for (int k = 0; k < V; k++)
    for (int i = V-1; i >= 0; i++) // i is processed from V-1 to 0
        for (int j = 0; j < V; j++)
            D[i][j] = Math.min(D[i][j], D[i][k] + D[k][j]);
```

Do some simple experiment with “FloydWarshallDemo.java” to answer this question.

Once you have the answer, explain why do you see such answer!

Q2. Consider the following modification of the shortest-paths problem. Edges in the graph are colored red and blue. A path is valid if it starts with a red edge, and then alternates colors; that is, it goes red, blue, red, blue ... All edge weights are positive, e.g.

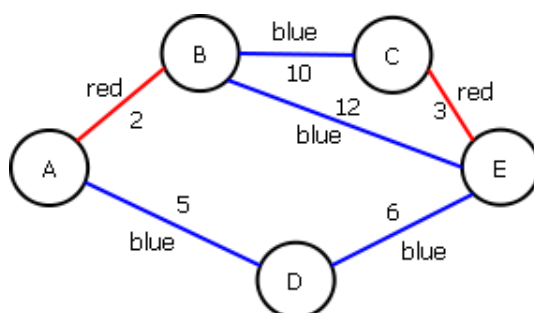


Figure 1:

Suppose the source is vertex A and we want to know what the **shortest alternating color path** to vertex E. The path A,B,C,E is a valid path with cost 15, while A,D,E is not a valid path although it is shorter (11). The path A,B,E is also a valid path with cost 14. This is even shorter than A,B,C,E, so the best answer is A,B,E → 14.

Assume that the input is given as a weighted Adjacency List where positive value on a certain edge implies that it is a red edge and negative value on a certain edge implies that it is a blue edge (you will have to negate this value, the usage of +/- is just to differentiate red/blue edge). Now, given a source vertex *S* and a target vertex *T*, what is the shortest alternating color path from *S* to *T*? *S* is guaranteed to be different from *T*. Analyze the time complexity of your algorithm!

CS2020 Final Exam S2 2010/2011)

Go to NUS Digital Library, download CS2020 Final Exam from S2, 2010/2011, and attempt the k-Reliable Shortest Path problem.

Problem Set 8 (CS2010 Final Exam S1 2011/2012)

Discussion of PS8 Subtask 1-2, especially part 3.