

CS 300

Data Structures

Homework 5

Assigned: 26 Dec. 2012, Due: 4 Jan. 2013 at 11:55pm

- NO SUBMISSIONS OUTSIDE SUCOURSE WILL BE ACCEPTED.
- **SOLUTIONS HAVE TO BE YOUR OWN. NO COLLABORATION OR COOPERATION AMONG STUDENTS IS PERMITTED.**
- Please provide only the requested information and nothing more. The solution papers should be typeset using Word, ScientificWorkplace, LATEX, etc., and any figures should be drawn using some kind of a drawing tool such as PowerPoint, Visio, etc. **HOWEVER YOUR SOLUTIONS SHOULD BE SUBMITTED IN ONLY .pdf FORMAT. NO HAND-WRITTEN SOLUTIONS WILL BE ACCEPTED.** Make sure what is submitted can be properly printed, otherwise they will not be considered.
- You should name your homework as XXXXX-NameLastname-hw5.pdf where XXXXX is your student number (possibly with a leading 0). Make sure you do NOT use any Turkish characters in the file/folder name.
- **Late submissions will be penalized 10% of the full grade per late day (or portion of a late day). Submissions that are late by more than 1 day will not get any credits.**

Question 1 (15 points)

Prove that the **average** running time of *quickselect* algorithm (given in Figure 7.16 in the second edition of your textbook) is $O(N)$. For simplicity, assume that 1) pivots are chosen randomly, 2) each of the sizes for a partition is equally likely, and 3) no cutoff size is used. Note that this proof is quite similar to that of average running time of Quicksort algorithm.

Question 2 (20 points)

Trace the operation of Dijkstra's *weighted* shortest path algorithm for the following graph. Use vertex E as your start vertex.

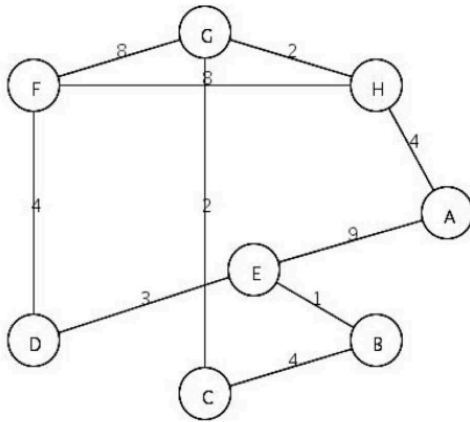


Figure 1: An undirected weighted graph.

Question 3 (10 points)

Trace the operation of Prim's minimum spanning tree algorithm for the graph in Figure 1. Use vertex E as your start vertex.

Question 4 (10 points)

Trace the operation of Kruskal's minimum spanning tree algorithm for the graph in Figure 1.

Question 5 (15 points)

Find shortest *unweighted* path from G to all other vertices for the graph in Figure 1. Use breadth-first search algorithm in your answer. Do NOT forget to show the trace.

Question 6 (20 points)

Assuming that for a given vertex arcs are considered "left-to-right" as drawn in Figure 1 and as discussed in the class,

- Show the depth-first search tree for the graph in Figure 1 by listing the tree arcs included in the tree. Use vertex G as your start vertex.
- Give the post-order numbers for all the nodes.
- Give the pre-order numbers for all the nodes.

d) List the cross arcs, forward arcs, and backward arcs (if any).

Question 7 (10 points)

Find a topological ordering for the graph in Figure 2.

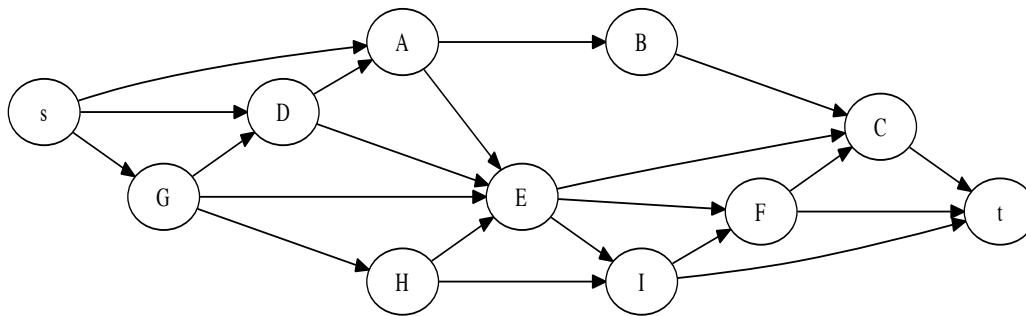


Figure 2: Graph used in Question 7