

CS 300

Data Structures

Homework 4

Assigned: Dec 13, 2019, Due: Dec 23, 2019 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.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 (20 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) partition sizes are 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 graph given in Figure 1. Use vertex *E* as your start vertex.

Question 3 (15 points)

Trace the operation of Prim's minimum spanning tree algorithm for the graph in Figure 2. Use vertex *E* as your start vertex.

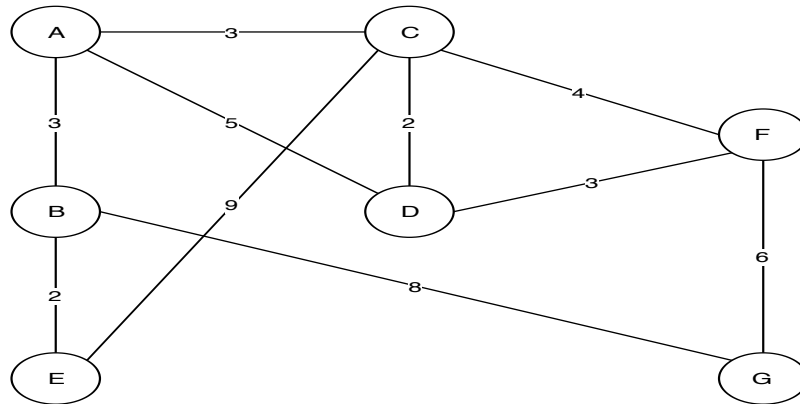


Figure 1: An undirected weighted graph.

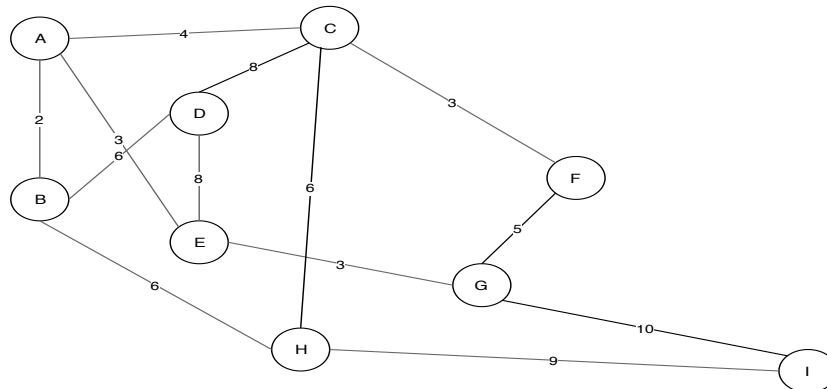


Figure 2: An undirected weighted graph.

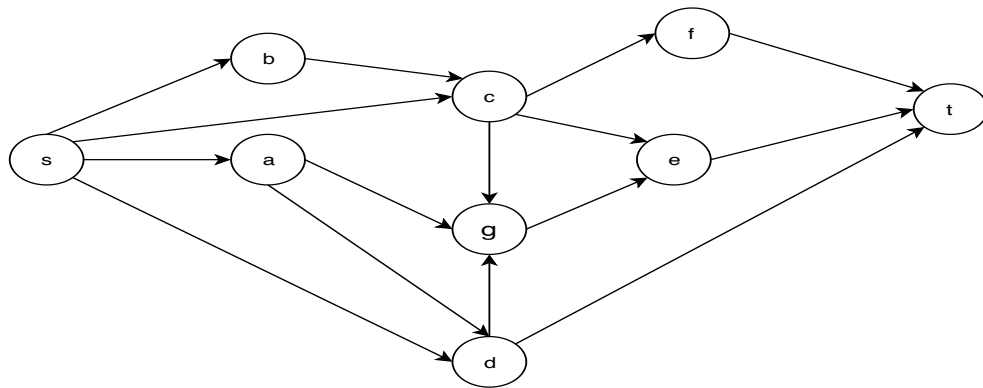
Figure 3: Graph used in Question 6

Question 4 (15 points)

Trace the operation of Kruskal's minimum spanning tree algorithm for the graph in Figure 2.

Question 5 (15 points)

Find shortest *unweighted* path from G to all other vertices for the graph in Figure 2. Use breadth-first search algorithm in your answer. Do NOT forget to show the trace.



Question 6 (15 points)

Find a topological ordering of the graph in Figure 3.