CS 312: Algorithms **Fall 2018**

Homework 5

Your Name: _____

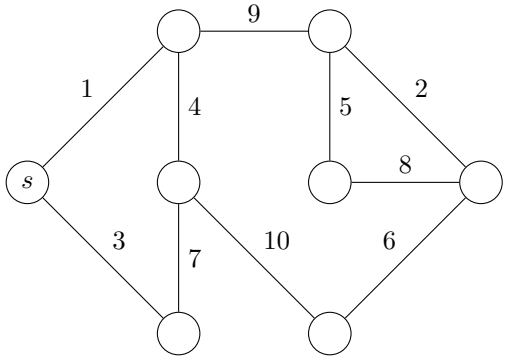
Collaborators and sources: _____

Instructions. You may work in groups, but you must write solutions yourself. List collaborators on your submission.

If you are asked to design an algorithm, please provide: (a) either pseudocode or a precise English description of the algorithm, (b) an explanation of the intuition for the algorithm, (c) a proof of correctness, (d) the running time of your algorithm and (e) justification for your running time analysis.

Submission instructions. This assignment is due by noon on Thursday, March 22 in Gradescope (as a pdf file). Please review the course policies on the course home page about Gradescope submissions.

1. **Minimum Spanning Trees (10 points)** Consider the following graph with distinct edge costs.



   (a) (5 points) List the costs of the edges in the order they are added by Kruskal's algorithm

   (b) (5 points) List the costs of the edges in the order they are added Prim's algorithm using s as the start node.

2. **Chapter 4, Exercise 2 (10 points)**. You may use the following fact (from Exercise 8): if G has distinct edge costs, then the minimum spanning tree is unique.

   NOTE: *Before doing the next two problems, read about the Cycle Property starting on the lower half of page 147 in the book. You will need to use the Cycle Property in both problems.*

3. **K&T Chapter 4, Exercise 9 (10 points)**

4. **K&T Chapter 4, Exercise 10. (10 points)** You may assume that edge costs are distinct in this exercise.

   - (5 points) Complete part (a)
   - (5 points) (Slight modification of part (b) from the book). Suppose T is no longer the minimum-cost spanning tree. Give a linear-time algorithm (time $O(|E|)$) to find a spanning tree with smaller cost. Justify why your algorithm is correct.

5. **(0 points).** How long did it take you to complete this assignment?