Homework 3

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, Oct 4 in Gradescope (as a pdf file). Please review the course policies on the course home page about Gradescope submissions.

1. **(5 points) Gradescope submission.**

   - The solutions are either typed or written neatly (with ample white-space and no scratching out, etc.).
   - The submission is a pdf.
   - The **Gradescope scanning recommendations** (see their website, which will recommend specific scanning apps) are followed to ensure the scan is high quality.
   - The pages are marked correctly during the gradescope submission.

2. **(5 points) K&T Chapter 3 Exercise 1.** *(Work independently; we will cover topological sorting on Monday, so leave this problem until then.)*

3. **(10 points) BFS and DFS Trees**. *(Work independently.)* Let G be a connected graph with the property that both BFS and DFS starting from some node v return the same tree. Complete the proof below to argue that G itself must be a tree. In the proof, use *only the facts about non-tree edges in BFS and DFS trees that we proved in class: i.e., fact (3.4) on page 81 and fact (3.7) on page 85 of Kleinberg and Tardos.*.

   Proof: Let T be the tree returned by both BFS and DFS. We will show that G is equal to T. Suppose for the sake of contradiction that G has a non-tree edge, that is, an edge (x, y) that does not belong to T.

   By (3.7), we know that (x, y) ...

   By (3.4), we know that (x, y) ...

4. **(10 points) K&T Chapter 3 Exercise 4.** Hint: try to modify BFS

5. **(10 points) K&T Chapter 3 Exercise 9**

6. **(0 points).** How long did it take you to complete this assignment?