Homework 1. Due February 1

CS180: Algorithms and Complexity
Winter 2017

GUIDELINES:

- Upload your assignments to Gradescope by 6:59 PM.
- Follow the instructions mentioned on the course webpage for uploading to Gradescope very carefully (including starting each problem on a new page and matching the pages with the assignments); this makes it easy and smooth for everyone. As the guidelines are simple enough, bad uploads will not be graded.
- You may use results proved in class without proofs as long as you state them clearly.
- Most importantly, make sure you adhere to the policies for academic honesty set out on the course webpage. The policies will be enforced strictly. Homework is a stepping stone for exams; keep in mind that reasonable partial credit will be awarded and trying the problems will help you a lot for the exams.

1. Problem 2.8 from [DPV]. [.75 points]
2. Run the BFS algorithm for the following graph with $s = 1$ and $t = 9$: $G = (V, E)$, where $V = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, and $E = \{\{1, 2\}, \{1, 3\}, \{2, 3\}, \{2, 4\}, \{2, 5\}, \{3, 5\}, \{3, 7\}, \{4, 5\}, \{5, 6\}, \{8, 9\}\}$. Your work should the step-by-step evolution of the lists $L_0, L_1, ...$ and of the array $DISCOVERED$ as we did in class (cf. the transcript uploaded in the calendar). [.75 points]
3. Given a graph $G = (V, E)$ in adjacency list representation, give an algorithm that runs in time $O(|V| \cdot |E|)$ to check if G has a 'triangle', i.e., a triple of distinct vertices $\{u, v, w\}$ such that all three edges between them are present in G. [.75 points]
4. Give an algorithm based on BFS that given a graph $G = (V, E)$ (in adjacency list representation) checks whether or not G has a cycle. For full-credit, your algorithm should run in time $O(|V| + |E|)$. Prove that your algorithm works (you can use properties of BFS that we stated in class without further proving them). [.75 points]

ADDITIONAL PROBLEMS. DO NOT turn in answers for the following problems - they are meant for your curiosity and understanding.

1. Problems 3.4, 3.6, 3.9, 3.11 from textbook [KT].
2. Problem 3.16 from Chapter 3 of [DPV].