# CS:5350 Homework 7, Spring 2016

## Due in class on Thu, Mar 31

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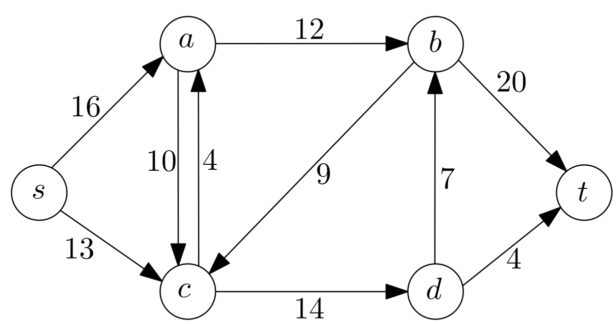
**Collaboration:** You are welcome to form groups of size 2 and work on your homeworks in groups. Of course, you are not required to work in groups. Every group should make one submission and names of both group members should appear on the submission and both students in a group will receive the same score. Other than the TA and the professor, you can only discuss homework problems with your group partner. Collaboration can be positive because talking to someone else about these problems can help to clarify your ideas and you will also (hopefully) get to hear about different ways of thinking about the problem. On the other hand, collaboration can be negative if one member of the group rides on work being done by the other member – please avoid this situation. If your solutions are (even partly) based on material other than what has been posted on the course website, you should clearly acknowledge your outside sources.
**Late submissions:** No late submissions are permitted. You will receive no points for your submission if your submission is not turned in at the beginning of class on the due date.
**Evaluation:** Your submissions will be evaluated on correctness *and* clarity. Correctness is of course crucial, but how clearly you communicate your ideas is also quite important.

1. Consider the directed graph $G$ given below, with source $s$ and target $t$ identified.




   (a) Let $f$ be a flow in $G$ defined by $f(s,a) = 12$, $f(a,b) = 12$, $f(b,t) = 12$ and $f(u,v) = 0$ for all other edges $u \to v$ in $G$. Draw the residual graph $G_f$.

   (b) Identify an augmenting path in $G_f$ that would be picked by the Edmonds-Karp "fat pipe" heuristic.

   (c) Identify an augmenting path in $G_f$ that would be picked by the Edmonds-Karp "short pipe" heuristic.

   (d) Show a maximum flow in $G_f$. Certify that this flow indeed has maximum value by showing a cut in $G_f$ with capacity equal to the value of the flow.

2. Problem 12(a), Pages 12-13 from Prof. Erickson's notes.

3. Problem 13, Page 13 from Prof. Erickson's notes.

4. The *edge connectivity* of an undirected graph is the minimum number $k$ of edges that must be removed to disconnect the graph. For example, the edge connectivity of a tree is 1 and the edge connectivity of a cycle is 2. Show how the edge connectivity of an undirected graph $G = (V,E)$ can be determined by running a maximum-flow algorithm on at most $|V|$ flow networks, each having $O(|V|)$ vertices and $O(|E|)$ edges.

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