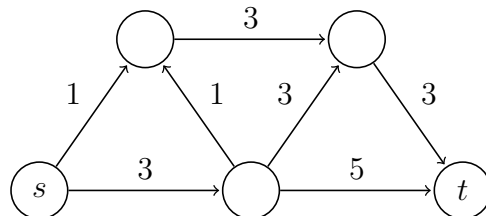# Problem Set 5

CS 331

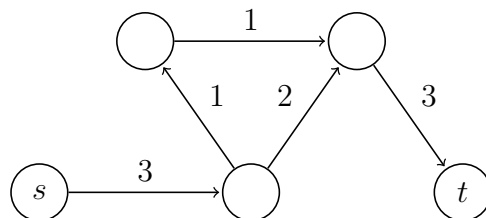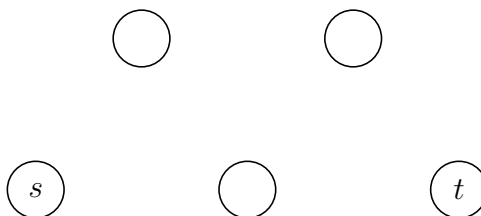### Due Tuesday, November 7

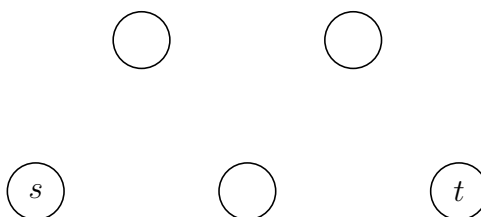1. Consider running network flow on the graph with the following capacities:
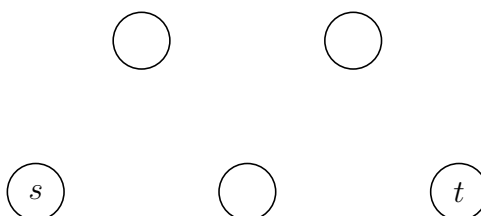

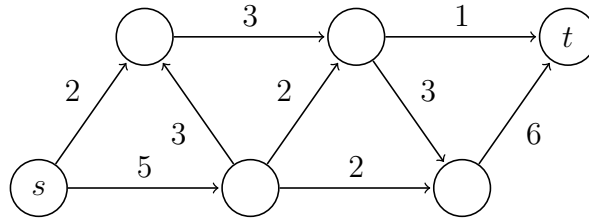
We currently have flow

(a) Draw the residual graph.

(b) Draw the shortest augmenting path.

(c) Draw the residual graph in the next round.

2. (a) Similar to problem 1, draw out every step of the Ford-Fulkerson max flow algorithm when run on the following graph, when choosing the maximum capacity augmenting path in each iteration:

   (b) What is the corresponding cut?

3. Given a weighted, undirected graph with positive edge weights, a source s, and a sink t, find the shortest path from s to t and back to s that uses each edge at most once. Aim for $O(m + n \log n)$ time. **Hint:** after finding the shortest $s \to t$ path, find the shortest $s \to t$ path on a "residual graph" that is similar to the one used in the Ford-Fulkerson algorithm.