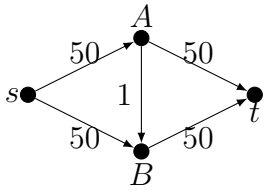
1. **(10 points)** Demonstrate that, with sufficiently poorly-chosen flow-augmentations, the following graph might take as many as 100 iterations of the Ford-Fulkerson algorithm to find a maximum flow. Also show that, with well-chosen flow augmentations, a maximum flow can be found with only two iterations.



2. **(10 points)** Find a digraph and a flow thereon which could not be improved by qqnaïve flow expansion (i.e. simply attempting to add flow along some path), but which has value only one-third (or less) of the maximum possible flow.

3. **(10 points)** 6 people (A, B, C, D, E, and F) are to be assigned to 4 committees (W, X, Y, and Z). Each person can serve on no more than 2 committees, and each committee should have 3 people on it. Below is a table indicating which people are eligible to serve on which committees:

	W	X	Y	Z
A	√	√	√	√
B	√		√	
C	√		√	
D		√	√	√
E		√	√	
F			√	√

   (a) **(5 points)** Produce a digraph with capacities whose flows would represent committee assignments.

   (b) **(5 points)** Find a maximum flow on your digraph. What does this flow's value tell you about your committee assignment?

4. **(10 points)** You are building circular bracelets with 6 beads on them; you have beads in red, yellow, and green. You want to have at least one bead of each color on every bracelet, and two bracelets are considered to be identical if one can be produced by flipping or rotating the other. How many different bracelets are possible?

5. **(5 point bonus)** The faces of a cube are to be painted red, blue, and green; each color can be used as many times as desired or not at all. Two cube-paintings are considered to be identical if one is a rotation of the other. How many different ways are there to paint the cubes? Do not brute-force this problem!

Life is an even-numbered problem. —Educational folk wisdom

 due April 9, 2012