CS 5150/6150: Assignment 4
Due: Oct 21, 2011

This assignment has 7 questions, for a total of 100 points and 0 bonus points. Unless otherwise specified, complete and reasoned arguments will be expected for all answers.

Question 1: Tracing a flow . . . . **[30]**

The figure depicts a flow network with source s, sink t, and all edges labelled with their capacities. Run the ``fat pipes'' and ``short pipes'' algorithm on this flow network.

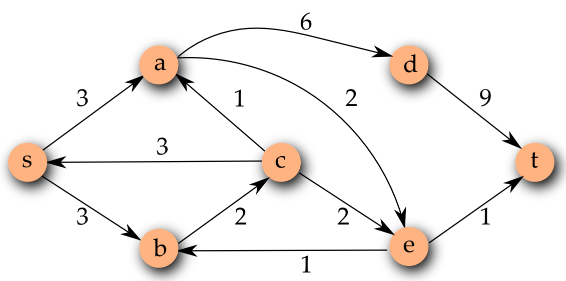

Figure 1: A flow network

You will illustrate the algorithms by using a table, with one column for each edge. In each pair of rows, the first row will contain the flow and capacity along each edge, and the next row will describe the augmenting path and the flow pushed through it. Below is an example for vanilla Ford-Fulkerson.

Ford-Fulkerson

sa	*sb*	*cs*	*bc*	*ca*	*ae*	*ce*	*eb*	*ad*	*dt*	*et*
0/3	0/3	0/3	0/2	0/1	0/2	0/2	0/1	0/6	0/9	0/1
$s-b-c-a-e-t$: flow = 1										
0/3	1/3	0/3	1/2	1/1	1/2	0/2	0/1	0/6	0/9	1/1
and so on...										

Thus, your answer should consist of two tables (one for fat pipes, and one for short pipes) illustrating the augmenting paths and the resulting flow.

In the questions that follow, the goal in each case is to solve the problem using some kind of flow construction. A valid answer will specify how the input flow network is constructed, what problem is solved, and how the solution is used to obtain the desired answer. For full marks, you must explain the procedure, and prove that it yields the desired answer. Unlike in other assignments we will not be concerned with running time in these questions, since you will merely invoke a standard algorithm from one of the flow variants we've studied in class. Of course, the transformation should run in polynomial time.
In what follows, **[23]** refers to `http://compgeom.cs.uiuc.edu/~jeffe/teaching/algorithms/notes/23-maxflowapps.pdf` and **[24]** refers to `http://compgeom.cs.uiuc.edu/~jeffe/teaching/algorithms/notes/24-maxflowext.pdf`

Question 2: Cycle covers .... **[10]**

Solve Question 3 from **[23]**.

Question 3: Disconnecting a railroad .... **[10]**

Solve Question 5 from **[23]**. Remember that the goal to find a minimum set of *vertices* whose removal separate the two stations.

Question 4: Visibility .... **[10]**

This is question 6 from Chapter 7 of Algorithm Design, by Kleinberg and Tardos.

You're given the floor plan of a 1-room house, in the form of line segments (x, y)--(x', y') that specify each wall of the room. You're also given n light fixtures and n switch locations (each of which is specified by a pair of coordinate (x, y). Your goal is to assign switches to fixtures so that each light fixture is visible from its assigned switch (i.e is not blocked by any wall). Assume that you're given a constant-time procedure that takes two line segments and determines whether they intersect.

Remember that the room might be arbitrarily shaped.

Question 5: Targeted Ad Placement .... **[10]**

Solve Question 9 from **[23]**

Question 6: Nested Boxes .... **[10]**

Solve Question 3 from **[24]**

Question 7: Covering Marked Cells .... **[20]**

Solve all parts of Question 2 from **[24]**. The breakdown by part is 5 + 5 + 10.