CSCI 3104: Algorithms
Homework 8

Due at **11:00am on Wednesday, November 18, 2015**. Submit your solutions electronically at moodle (name file as **LastName_FirstName_HW8.pdf**) or submit in paper before class. Make sure to include your name and student ID. Digital submission should also include the Honor Code Pledge (`http://honorcode.colorado.edu/about-honor-code`), and paper submission should include your signature indicating adherence to the Honor Code Pledge.

1. The Canine Products company offers two dog foods, Frisky Pup and Husky Hound, that are made from a blend of cereal and meat. A package of Frisky Pup requires 1 pound of cereal and 1.5 pounds of meat, and sells for $7. A package of Husky Hound uses 2 pounds of cereal and 1 pound of meat, and sells for $6. Raw cereal costs $1 per pound and raw meat costs $2 per pound. It also costs $1.40 to package the Frisky Pup and $0.60 to package the Husky Hound. A total of 240,000 pounds of cereal and 180,000 pounds of meat are available each month. The only production bottleneck is that the factory can only package 110,000 bags of Frisky Pup per month. Needless to say, management would like to maximize profit.

   (a) Formulate the problem as a linear program in two variables.

   (b) Graph the feasible region, give the coordinates of every vertex, and circle the vertex maximizing profit. What is the maximum profit possible?

2. A salad is any combination of the following ingredients: (1) tomato, (2) lettuce, (3) spinach, (4) carrot, and (5) oil. Each salad must contain: (A) at least 15 grams of protein, (B) at least 2 and at most 6 grams of fat, (C) at least 4 grams of carbohydrates, (D) at most 100 milligrams of sodium. Furthermore, (E) you do not want your salad to be more than 50% greens by mass. The nutritional contents of these ingredients (per 100 grams) are

ingredient	energy (kcal)	protein (grams)	fat (grams)	carbohydrate (grams)	sodium (milligrams)
tomato	21	0.85	0.33	4.65	9.00
lettuce	17	1.63	0.20	2.37	8.00
spinach	370	12.79	1.58	73.68	7.00
carrot	345	8.38	1.39	80.70	506.40
oil	883	0.00	100.00	0.00	0.00

   Find a linear programming applet on the Web and use it to make the salad with the fewest calories under the nutritional constraints. Describe your linear programming formulation and the optimal solution (the quantity of each ingredient and the value). Cite the Web resources that you used and include a screenshot of results generated by the Web applet.

3. Given the following network with edge capacities as shown,

   (a) Starting with zero flow, find an augmenting path from S to T.

   (b) What is the maximum flow that can be increased along this path?

   (c) Draw the corresponding residue network after increasing that flow along the path.

   (d) Find a solution for the max flow and Find a cut in this network to certify that flow is maximum.