CS 525 - Fall 2015 - Homework 3*

assigned 9/13/15 — due 9/23/15

1. Given simple examples of linear systems $Ax = b$ (where A is an $m \times n$ matrix, for some m, n) with the following properties. You simply need to come up with appropriate values of A and b in each case, and explain why they work. If it is not possible to find a system with the desired properties, explain why not.

   (a) The system is overdetermined (that is, $m > n$) yet has a unique solution.

   (b) The system is overdetermined yet has infinitely many solutions.

   (c) The system is underdetermined (that is, $m < n$) yet has no solutions.

   (d) The system is underdetermined and has a unique solution.

2. Let
$$G = \begin{bmatrix} -1 & 1 & -3 & 2 \\ 4 & 2 & -1 & -3 \\ 5 & 1 & 2 & -5 \end{bmatrix}.$$
   By using the Jordan exchange code `ljx.m`, find out how many linearly independent rows G has. Find out how many linearly independent columns G has. (You can do the latter by working with the transpose of G.) In both cases, if there are linear dependencies, write them out explicitly.

3. Reformulate the following optimization problems as linear programs in standard form, that is, all variables are nonnegative variables and

*Hard copy to be submitted **in class** on the due date. Hand in a printout of your code, a diary file of the output, and your written formulation of the problem. No late homework accepted.

all general constraints are $\geq$ constraints. (If a linear programming formulation is not possible, say so.)

(a) max $p^T x$ subject to $Cx \leq d$, $x \leq 0$.

(b) min $\|Ax - b\|_\infty$ (x free).

(c) min $\min(p^T x, c^T x + 1)$ subject to $x \geq 0$.

(Here A and C represent matrices while p, c, b, and d represent vectors of appropriate dimension.)

4. Do Exercise 2-4-6. (The data for this problem can be loaded using `load ex2-4-6`.)

5. Do Exercise 2-4-7. (The data for this problem can be loaded using `load ex2-4-7`.)