CS525 Closed-Book Midterm Exam

Tuesday, March 23, 1993
11:00 a.m.-12:55 p.m., Room 3335 Sterling

Remarks:

(i) If a problem has no solution or an infinite number of solutions, you must clearly state so and justify your claim.

(ii) Each problem can be solved in 4 tableaus or less including the initial tableau.

1. (10 points) Solve:

$$\begin{array}{rcrcrcr} x_1 & + & 2x_2 & - & x_3 & = & 1 \\ x_1 & + & x_2 & & & = & 2 \\ & & 2x_2 & - & x_3 & = & -1 \\ -x_1 & & & + & x_3 & = & -1 \end{array}$$

2. (10 points)

$$\begin{array}{ll} \text{maximize} & x_1 - x_2 - x_3 \\ \text{subject to} & \begin{array}{rcrcrcr} x_1 & - & 2x_2 & + & x_3 & \leq & 1 \\ x_1 & - & x_2 & + & 2x_3 & \leq & -1 \\ x_1 & - & x_2 & & & \leq & -2 \\ x_1 & , & x_2 & , & x_3 & \geq & 0 \end{array} \end{array}$$

3. (10 points)

$$\begin{array}{ll} \text{maximize} & 2x_1 + x_2 - 2x_3 \\ \text{subject to} & \begin{array}{rcrcrcr} x_1 & - & x_2 & + & 2x_3 & \leq & 1 \\ 2x_1 & + & 3x_2 & + & x_3 & \leq & -2 \\ -3x_1 & - & x_2 & + & x_3 & = & 1 \\ x_1 & , & & & x_3 & \geq & 0 \\ & & x_2 & \multicolumn{4}{l}{: \text{unrestricted}} \end{array} \end{array}$$

4. (10 points) **Without** solving the following linear program, obtain a **lower** bound to its minimum value:

$$\begin{array}{ll} \text{minimize} & 9x_1 - x_2 - x_3 \\ \text{subject to} & \begin{array}{rcrcrcr} -x_1 & + & x_2 & - & x_3 & \geq & 1 \\ x_1 & - & 3x_2 & + & x_3 & \geq & -11 \\ 5x_1 & - & x_2 & - & x_3 & \geq & 2 \\ x_1 & , & x_2 & , & x_3 & \geq & 0 \end{array} \end{array}$$

What is the minimum value? Justify your answer. (No credit will be given for this problem if you merely solve it by the simplex method.)