Exercises Lecture 11
Intelligent System Programming (ISP)

Exercise 1

Formulate the following optimization problem as an LP in standard form:

A bar is composing a party drink of vodka and orange juice. The drink must be between 10 and 20 cl. and have between 15 and 20 volume percent alcohol. The alcohol volume percent of the vodka is 40. The cost of 1 cl. vodka and orange juice is 3 and 1 USD, respectively. 1 cl. of the drink can be sold for an amount of USD corresponding to its volume percent alcohol. What amount of vodka and orange juice in cl. should be in the drink to maximize the profit of one serving of the drink?

(Obs. you do not have to solve the problem)

Exercise 2

As discussed during lecture, an unbounded variable x with a domain from minus infinity to plus infinity can be represented by two non-negative variables y and z using the substitution $x = y - z$. Moreover, a minimization problem *Minimize* e can be represented by the maximization problem *Maximize* $-e$.

Using these techniques and other ideas that you have to come up with yourself, transform the LP problem below to an equivalent LP problem on standard form and explain your transformations.

Minimize $x_1 - x_2$

Subject to

$2x_1 + x_2 = 3$

$2x_2 + x_3 \geq 7$

x_1 unbounded, $x_2 \leq 0, x_3 \geq 0.$

Exercise 3 (Adapted from C83 2.1)

Solve the following problem by the simplex method. Show initial, intermediate, and optimal dictionaries. Recall that you must choose a variable with positive coefficient in the z expression. However, we do not require that you choose the variable with a largest positive coefficient.

Maximize $3x_1 + 2x_2 + 4x_3$

Subject to

$x_1 + x_2 + 2x_3 \leq 4$

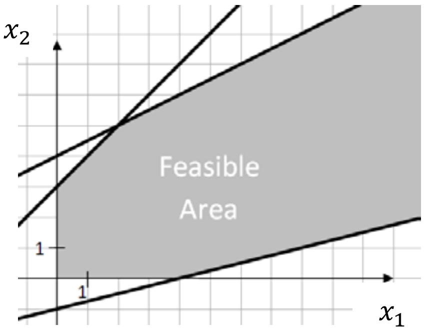
$2x_1 + 3x_3 \leq 5$

$2x_1 + x_2 + 3x_3 \leq 7$

$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0.$

Mandatory assignment

Consider the LP problem of maximizing $-2x_1 + 3x_2$ over the feasible area shown below:



1) Write the LP problem on standard form.
2) Write the LP problem on slack form.
3) By using your answer to 2) as an initial dictionary:
    a. Write the dictionaries computed by the simplex algorithm,
    b. Indicate the corner points associated with each dictionary.
4) What is the optimal solution returned by simplex?
5) Use the figure to answer the following questions:
    a. Is there an optimal solution for maximizing $x_1 - 5x_2$ over the feasible area, and if so where?
    b. Is there an optimal solution for maximizing $3x_1 + x_2$ over the feasible area, and if so where?