GOMORY-CHVATAL CUTTING PLANE

Part 1: Setting up the problem.

ILP in Standard Form

A, b, c are all assumed to be integers.

Conversion to standard from

- Recap from LP formulations lectures:
 - Equality constraints into two inequalities.
 - Rewrite in case $x_i \ge 0$ is missing:

$$x_i \mapsto x_i^+ - x_i^-$$

Convert ≥ to ≤ by negating both sides.

• How do we make sure A, b, c are integers?

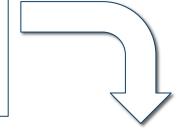
Reasonable assumption: original problem coefficients are rationals.

Integer Coefficients.

Scale

 $\max 2x_1 +0.3x_2 -0.1x_3$ $0.1x_1 \quad -2x_2 \quad -x_3 \quad \leq \quad 0.25$ s.t. $0.5x_1 \quad -2.6x_2 \quad +1.3x_3 \quad \leq \quad 0.15$ $x_2, \qquad x_3 \geq$ x_1 , constraints $x_1, \qquad x_2, \qquad x_3 \in \mathbb{Z}$ Objective $2x_1 +0.3x_2 -0.1x_3$ $\times 10$ max $0.1x_1 \quad -2x_2 \quad -x_3 \leq 0.25$ $\times 20$ s.t. $0.5x_1 -2.6x_2 +1.3x_3 \leq 0.15 \times 100$ $x_2, \qquad x_3 \geq 0$ x_1 , $x_2,$ $x_4 \in$ x_1 ,

Conversion to Integer Coefficients.



Divide result by 10

Adding Slack Variables

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\begin{array}{cccc} \max & \mathbf{c}^{\intercal} \mathbf{x} \\ \text{s.t.} & A\mathbf{x} & \leq \mathbf{b} \\ & \mathbf{x} & \geq \mathbf{0} \\ & \mathbf{x} & \in \mathbb{Z} \end{array}
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Summary

- We assume problem is in LP standard form.
 - Assume coefficients are rational.
- ILP standard form: coefficients (A,b,c) are integers.
 - Scale the original rational problem.
 - Make sure that result is divided by scale factor for objective.
- Advantage of ILP standard form:
 - Slack variables are naturally integers.
 - No need for separate treatment of decision and slack variables.