

ZIMPL

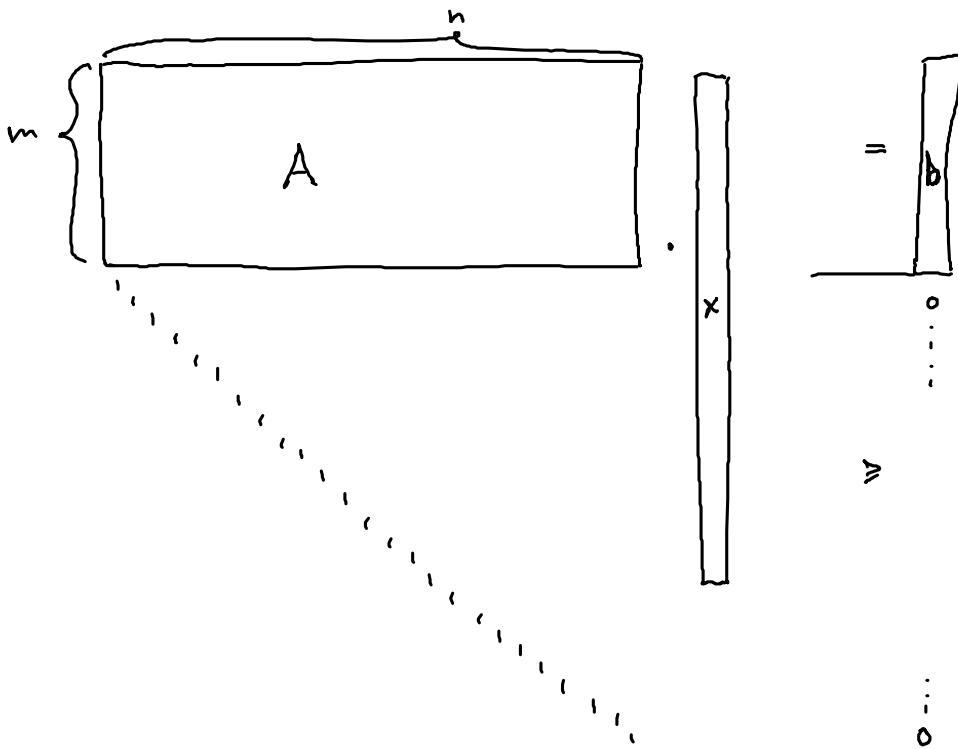
→ see Example

Basic solutions in standard & general form

▶ basic solution $x^* \in \mathbb{R}^n$ such that

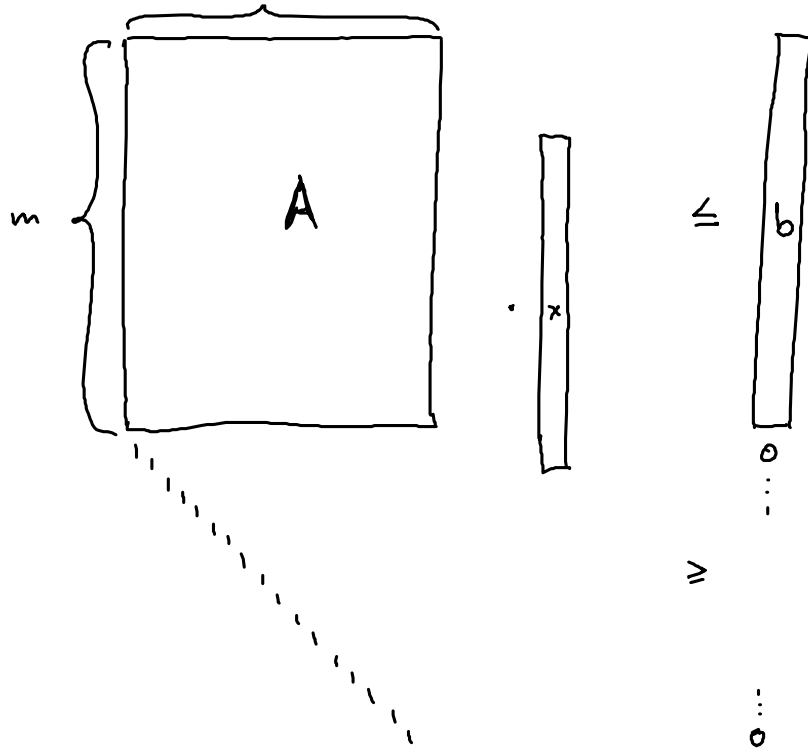
- all equality constraints are active
- at least n lin. indep. constraints are active

▶ LP in standard form: m constraints, n variables (w.l.o.g. $m \leq n$)



at x^* : $\left. \begin{array}{l} m \text{ equality constraints active} \\ n-m \text{ nonneg. constr. active} \end{array} \right\} n \text{ active constr.}$
→ $n - (n-m) = m$ nonneg. constr. remaining
(BASIS!)

▶ LP in general form: m inequalities, n variables



at x^* : n constraints active
(lin. indep. !)

▷ from general to standard form

general form
nonnegativity constr.
"normal" constr.



standard form

nonneg. constr.



equality constr.



plus a slack variable

(↔ nonneg. constr.)

m "normal" constr.



m equalities

n variables

$m+n$ variables

active "normal" constr.



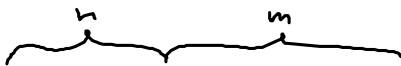
(active equality constr.)

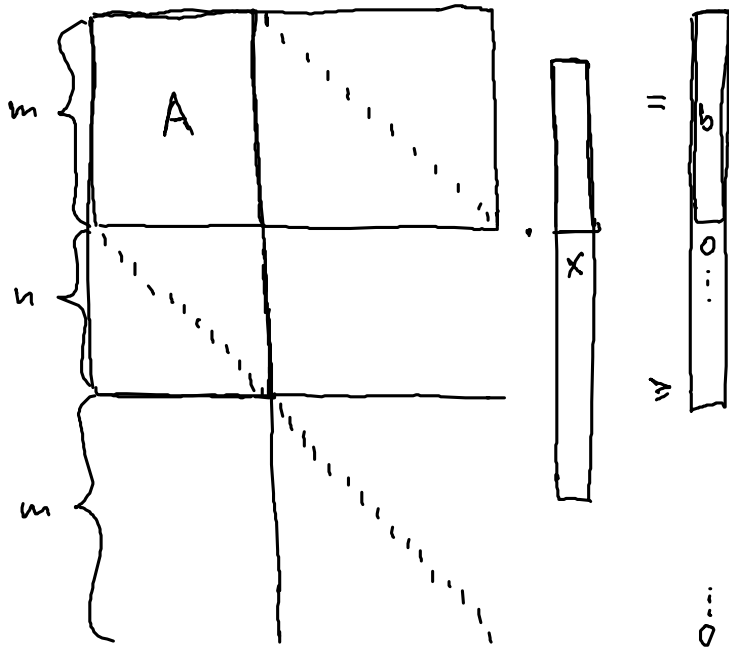
plus active nonneg. constr.

at x^* : n lin. indep. active constr.

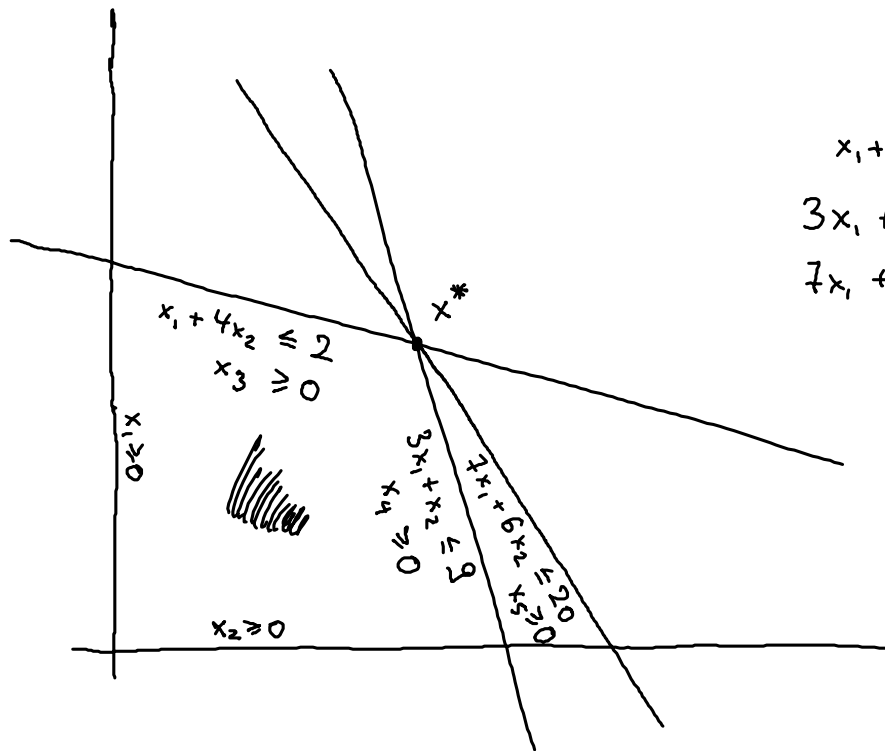


$n+m$ lin. indep. active constr.





► Example



$$\begin{aligned}
 x_1 + 4x_2 + x_3 &= 2 \\
 3x_1 + x_2 + x_4 &= 9 \\
 7x_1 + 6x_2 + x_5 &= 20
 \end{aligned}$$

x^* basic solution

basis: $x_1, x_2, x_3 \rightarrow$ basis matrix: $\begin{pmatrix} 1 & 4 & 1 \\ 3 & 1 & 0 \\ 7 & 6 & 0 \end{pmatrix}$

2 more bases for x^* !