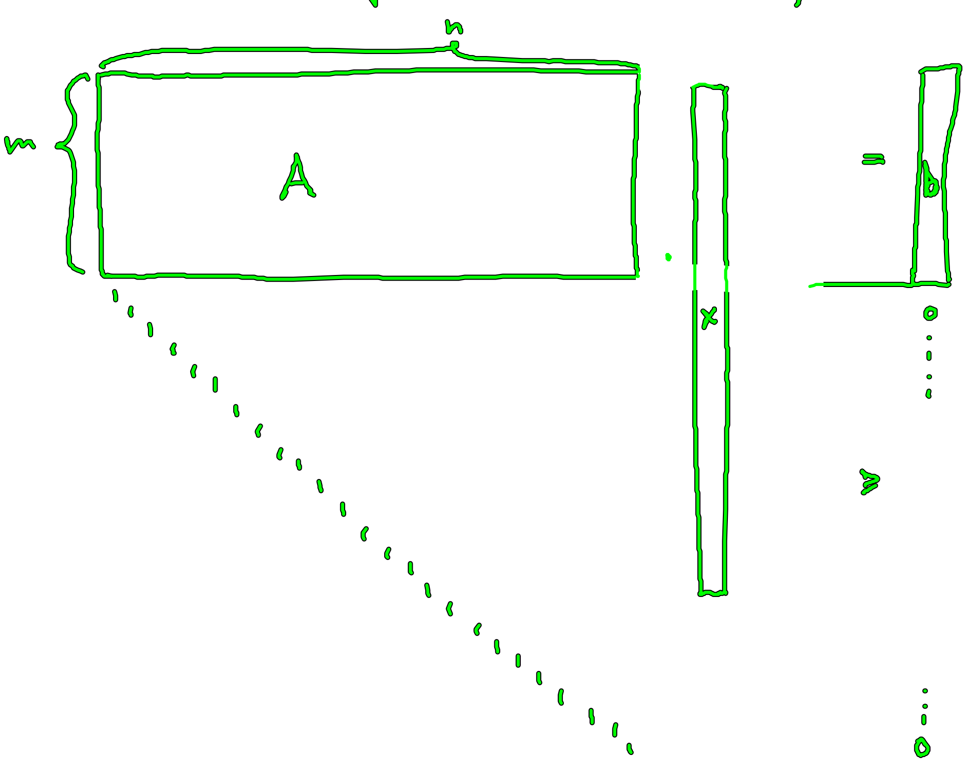
ZIMPL

→ 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. $m \leq n$)



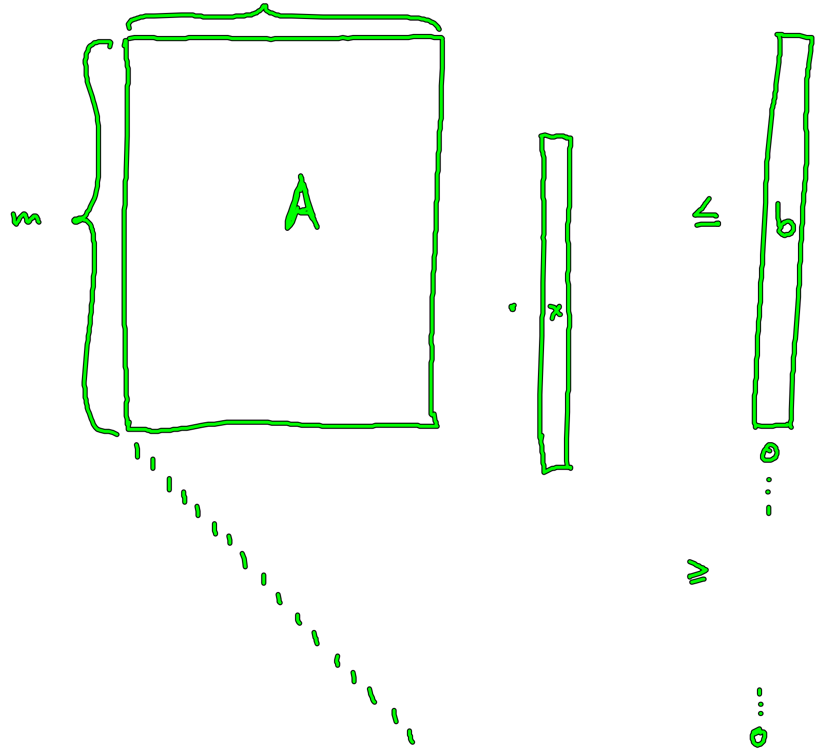
at x^*: m equality constraints active, $n-m$ noneg. constr. active $\Big\}$ n active constr.

→ $n-(n-m) = m$ noneg. constr. remaining

(BASIS!)

- LP in general form: m inequalities, n variables

n

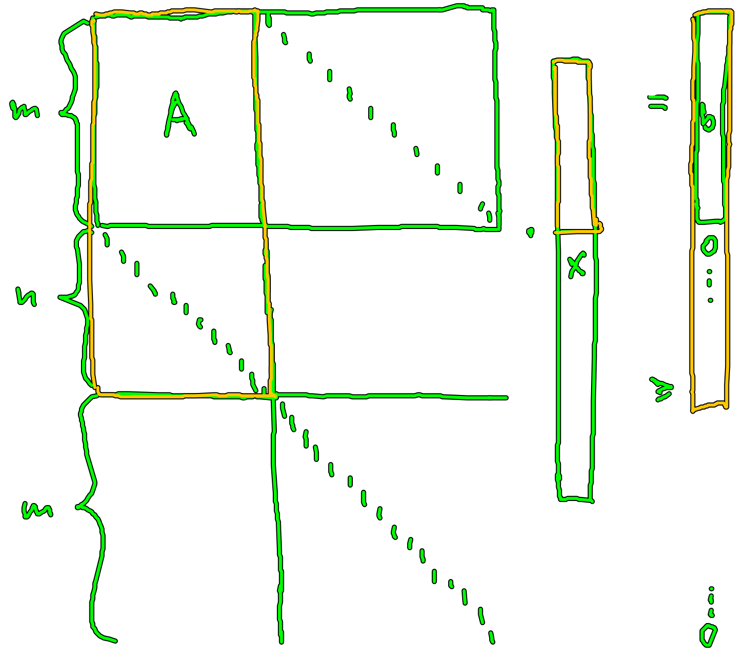


at x^*: n constraints active
(lin. indep.!)

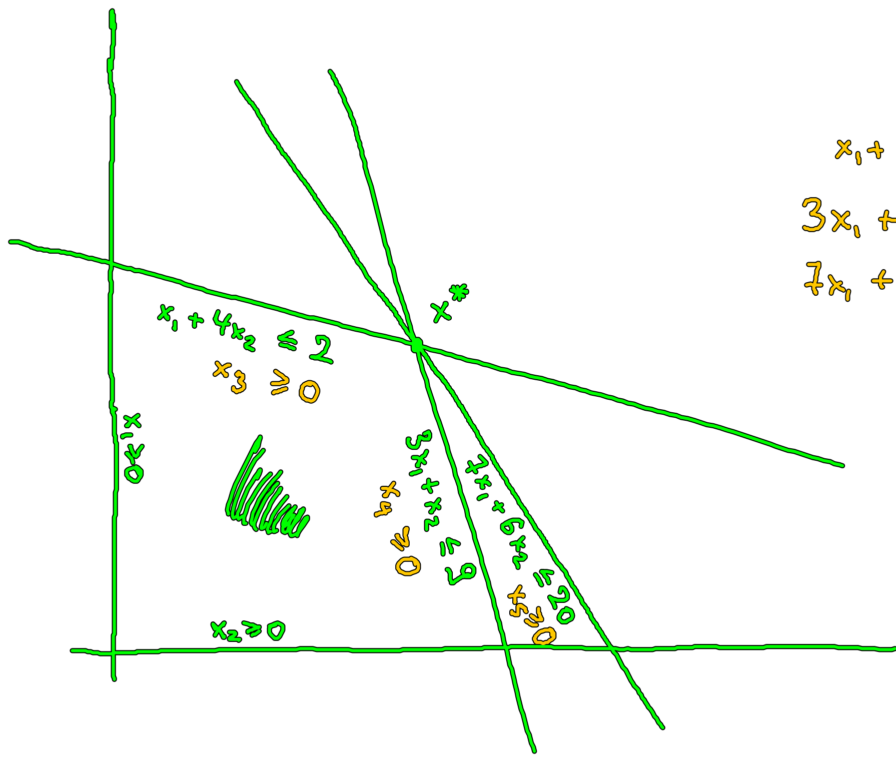
▷ from general to standard form

general form	$\longrightarrow$	standard form
nonnegativity constr.	$\longrightarrow$	nonneg. constr.
"normal" constr.	$\longrightarrow$	equality constr. plus a slack variable ($\leftrightarrow$ nonneg. constr.)
m "normal" constr.	$\longrightarrow$	m equalities
n variables		m+n variables
active "normal" constr.	$\longrightarrow$	(active equality constr.) plus active nonneg. constr.
at x^*: n lin. indep. active constr.	$\longrightarrow$	n+m lin. indep. active constr.

$\underbrace{\hphantom{xxxxxxxxxxxxxxxxxxxx}}_{}$ n m



▸ 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 ⟶ basis matrix: $\begin{pmatrix} 1 & 4 & 1 \\ 3 & 1 & 0 \\ 7 & 6 & 0 \end{pmatrix}$

2 more bases for x^* !