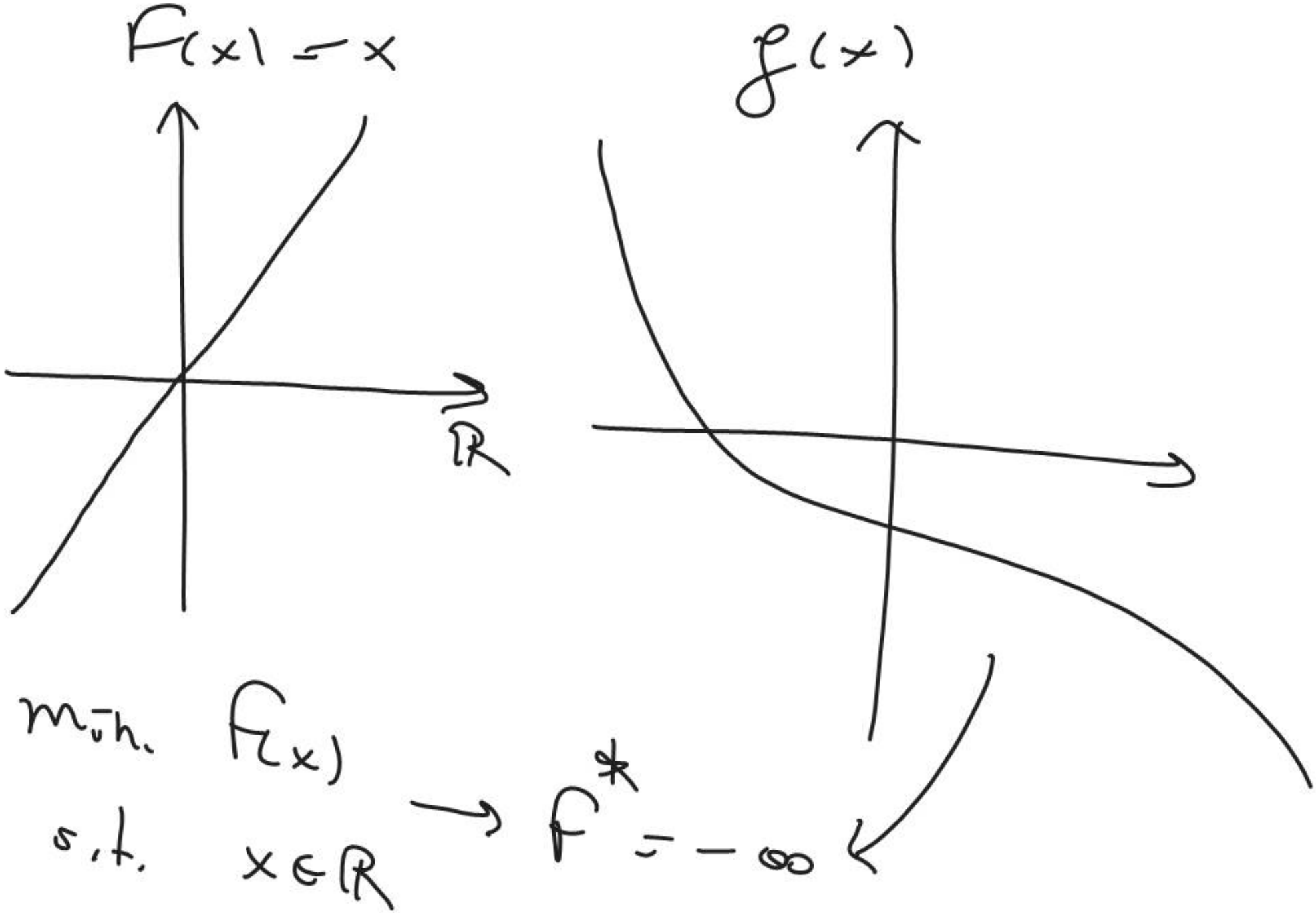
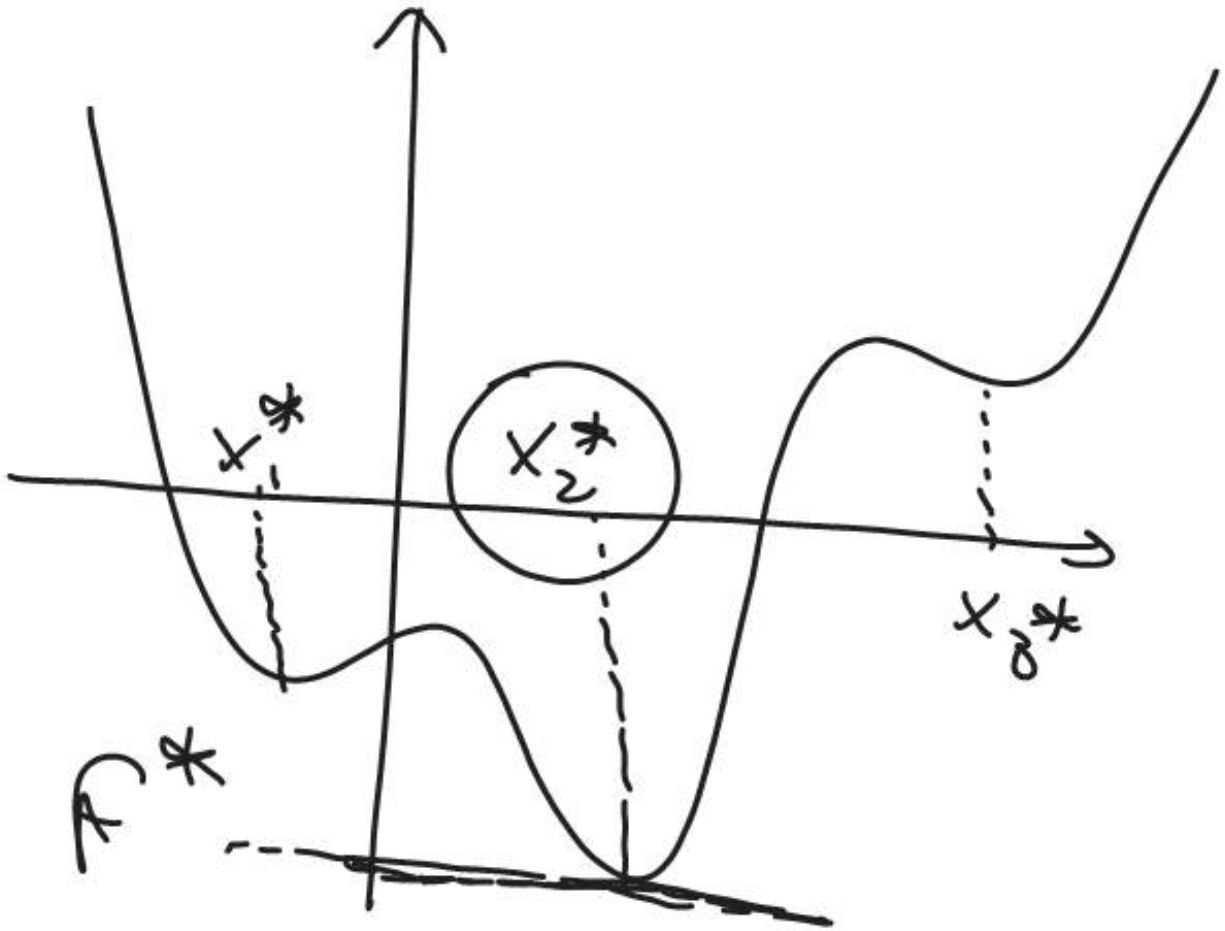
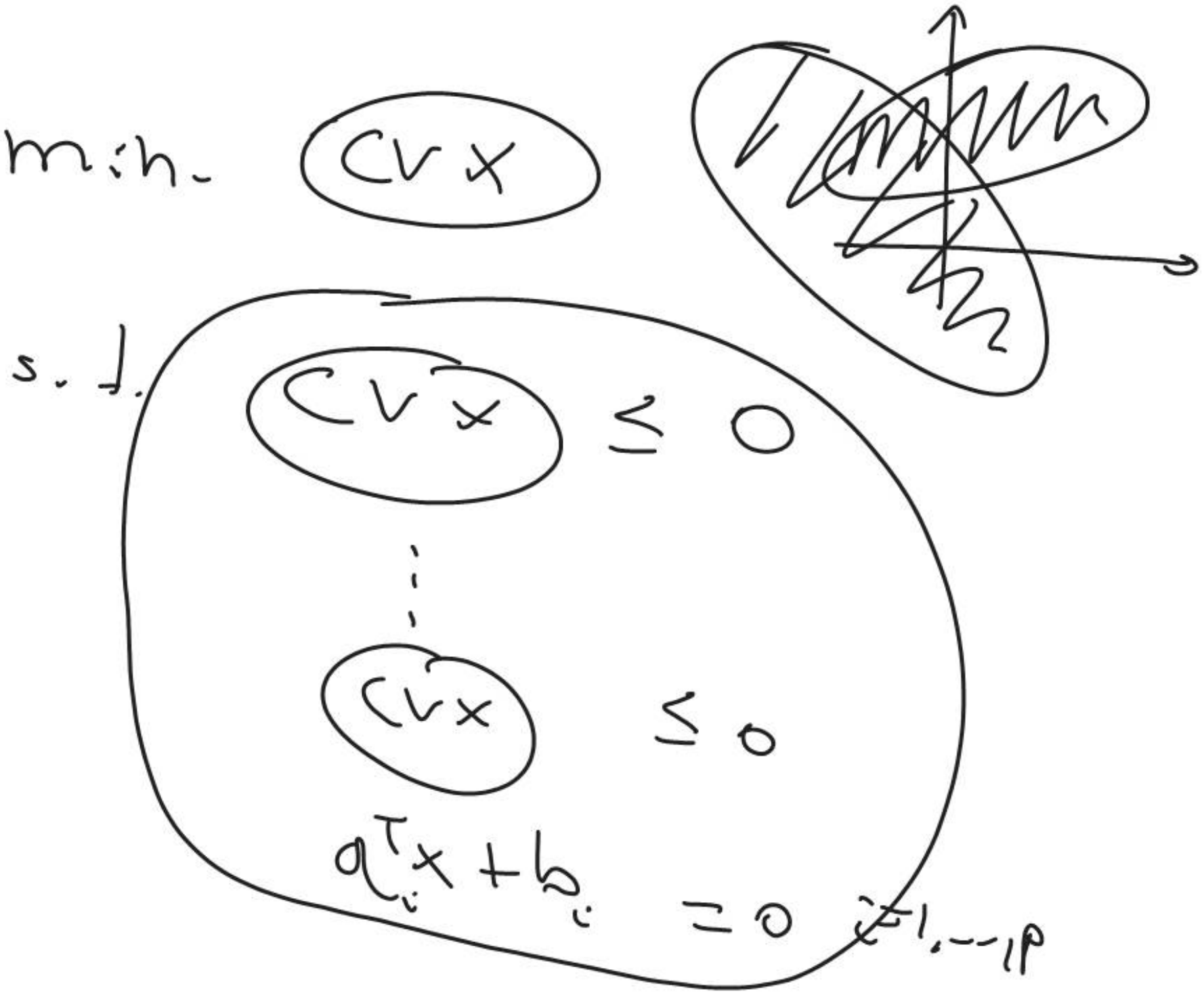


$$\min. \; f(x) \quad \text{s.t.} \quad x \in \mathbb{R} \;\rightarrow\; f^* = -\infty$$

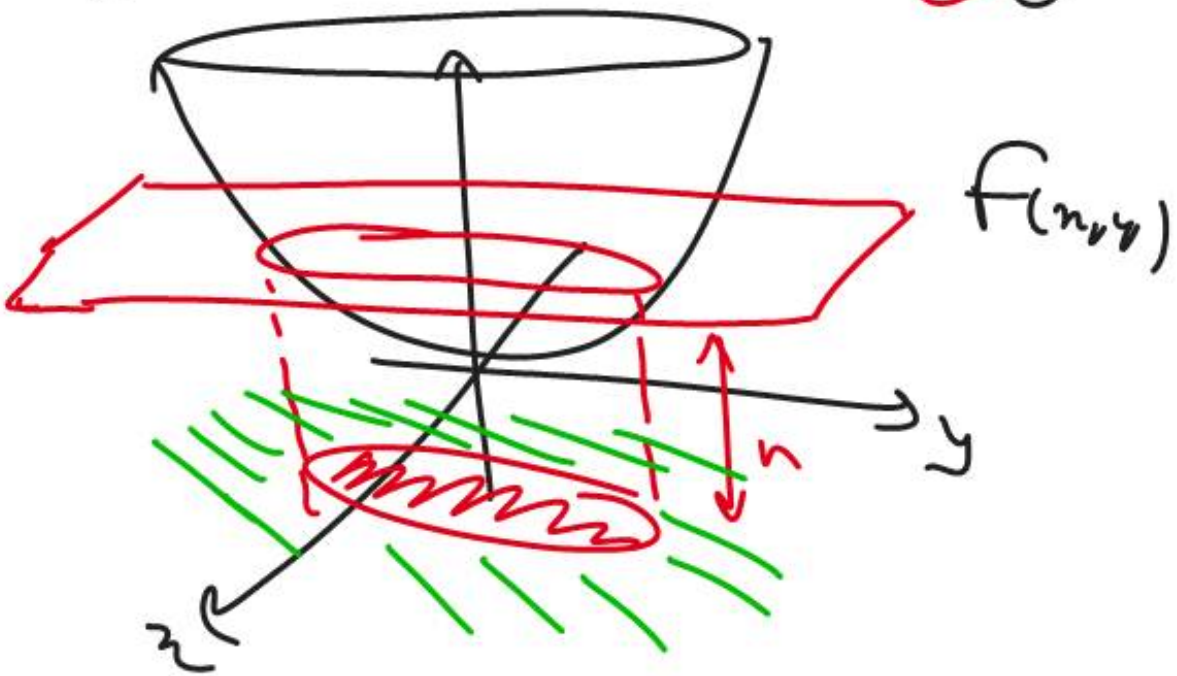

x_1^*
x_2^*
x_3^*
f^*


min.
cvx
s.t.
cvx ≤ 0
cvx ≤ 0
$a_i^T x + b_i = 0$ $i = 1, \dots, p$

f : cvx

$\Downarrow$

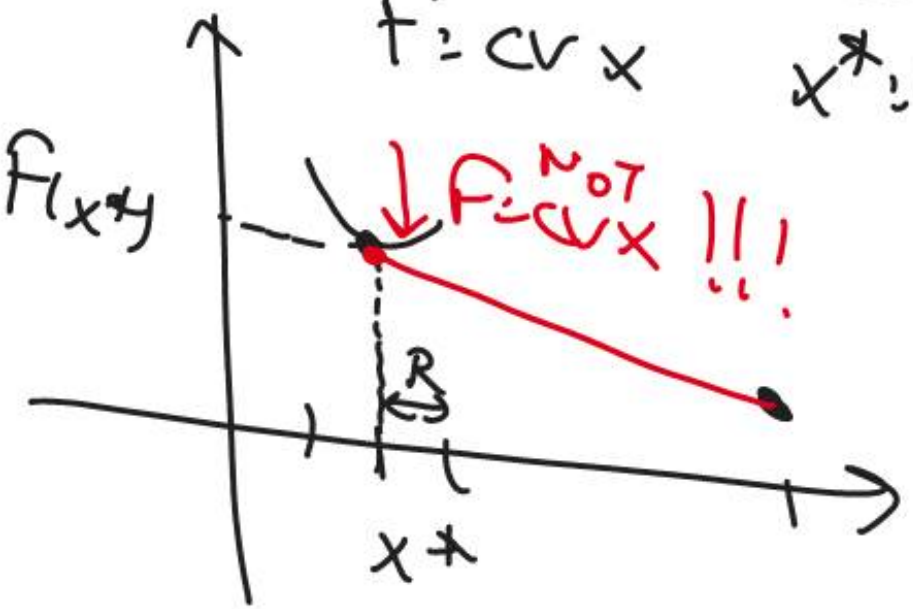
$\{x \in \mathbb{R}^n : f(x) \geq r\}$: cvx



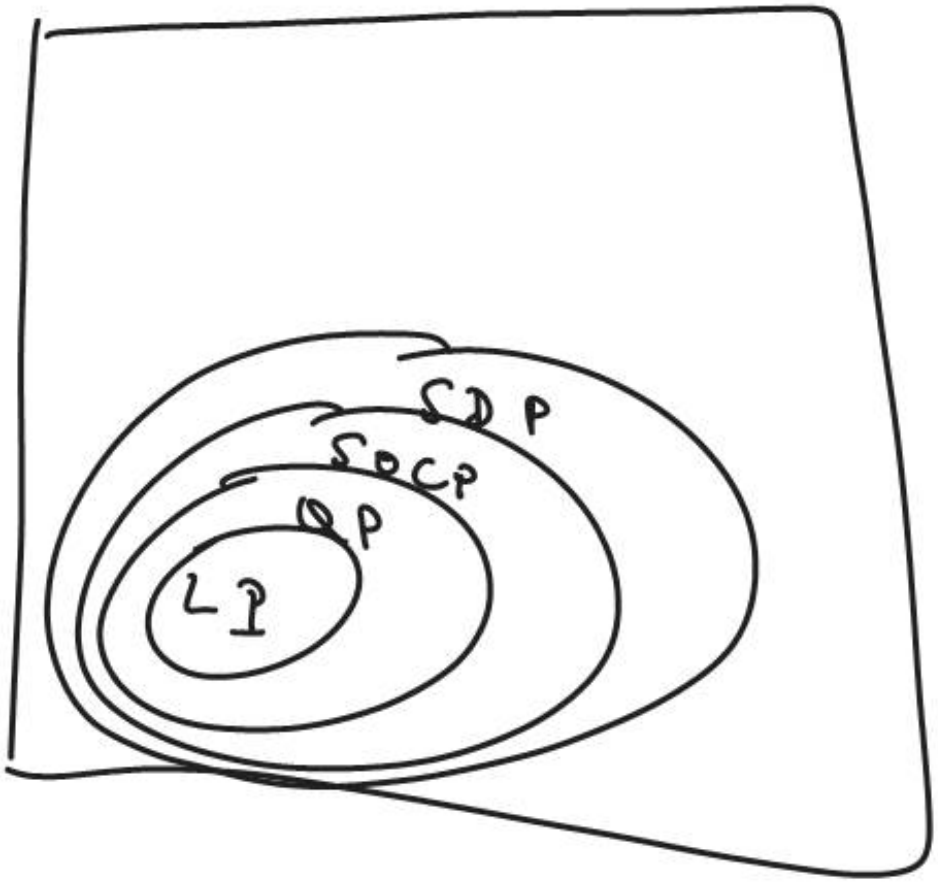
cvx

$f(x) \geq r$

$-f(x) \leq -r$



x^*: local solution, but not global



LP

$$\min. \quad c^T x + d$$

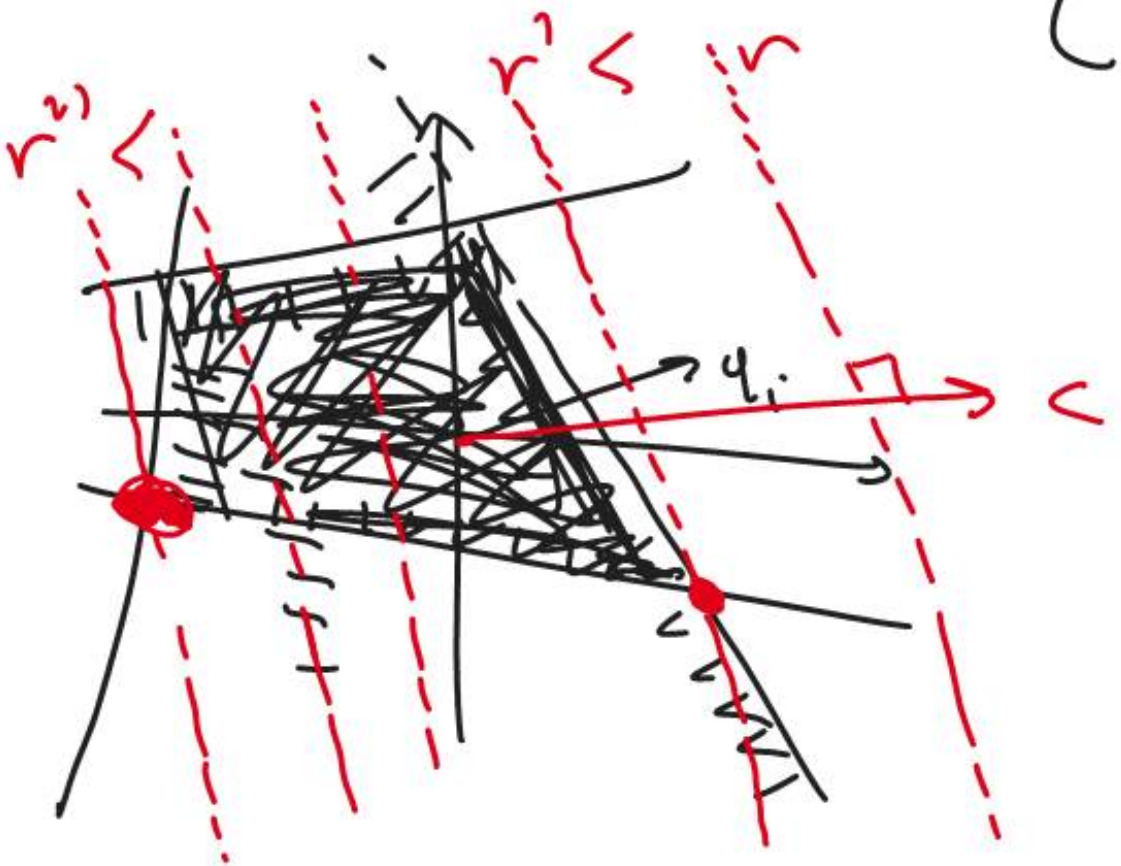
$$s.t. \quad \underline{q_i^T x + b_i \le 0} \quad i = 1, \ldots, m$$

$$c_i^T x + d_i = 0 \quad i = 1, \ldots, p$$

$\min. \quad c^T x$

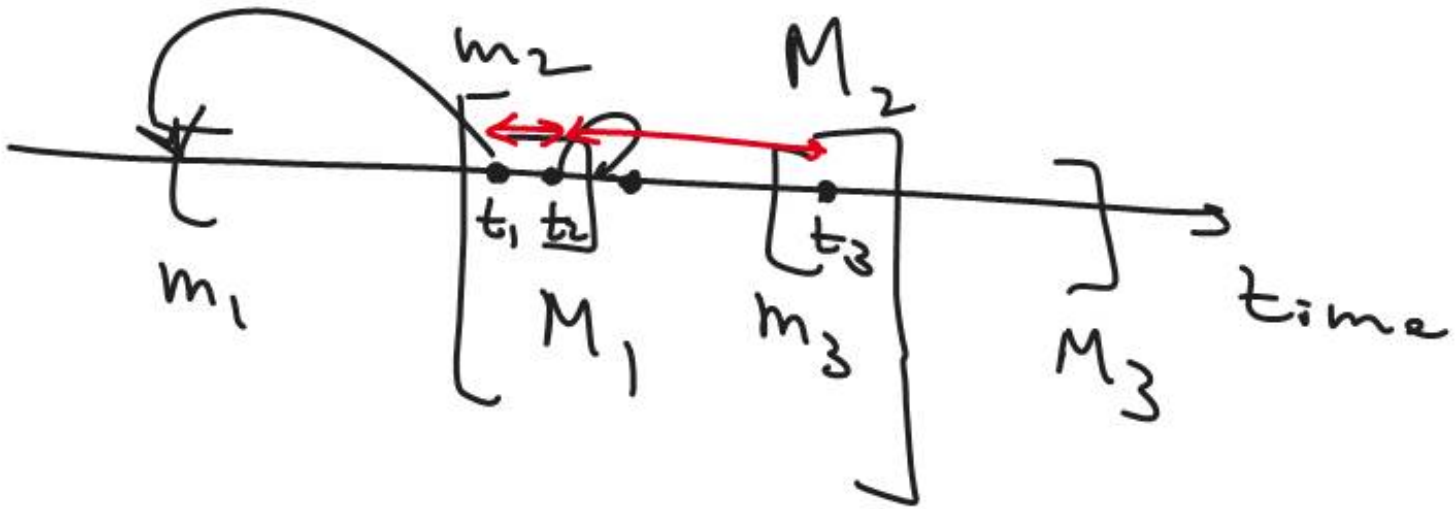
$s.t. \quad Ax \le b \iff$

$\begin{cases} \vdots \\ q_i^T x \le b_i \\ \vdots \end{cases}$



$x : c^T x = r$

- must land in order $i = 1, 2, \ldots, n$
- $t_i \in [m_i, M_i]$



$\max f(t_1, \dots, t_n)$

s.t. $t_i \le t_{i+1}$ $\quad i = 1, \dots, n-1$

$m_i \le t_i \le M_i$ $\quad i = 1, \dots, n$

?

$q_i^T x \le b_i$

$x = \begin{bmatrix} t_1 \\ t_2 \\ \vdots \\ t_n \end{bmatrix}$

$q_i = \begin{bmatrix} 0 \\ \vdots \\ 0 \\ 1 \\ -1 \\ 0 \\ \vdots \\ 0 \end{bmatrix}$

$b_i = 0$

$\max. \quad f(t) \qquad t = (t_1, \ldots, t_w)$

$s.t. \quad At \leq b$ (t)

$\max. \quad s$ (s, t)

$s.t. \quad s \leq f(t)$

$At \leq b$

max. s

s.t. $s \le f(t) = \min\{t_2 - t_1, \dots, t_n - t_{n-1}\}$

$At \le b$

$a = \min\{b_i\}$ $\Leftrightarrow$ $a \le \min\{b_1, b_2, \dots b_m\}$ $\Leftrightarrow$ $a \le b_1, \dots, a \le b_m$

$a = b_i$ and $a \le b_j$ $\forall j = 2, \dots m$

OR

$a = b_2$ and $a \le b_j$ $\forall j \ne 2$

---

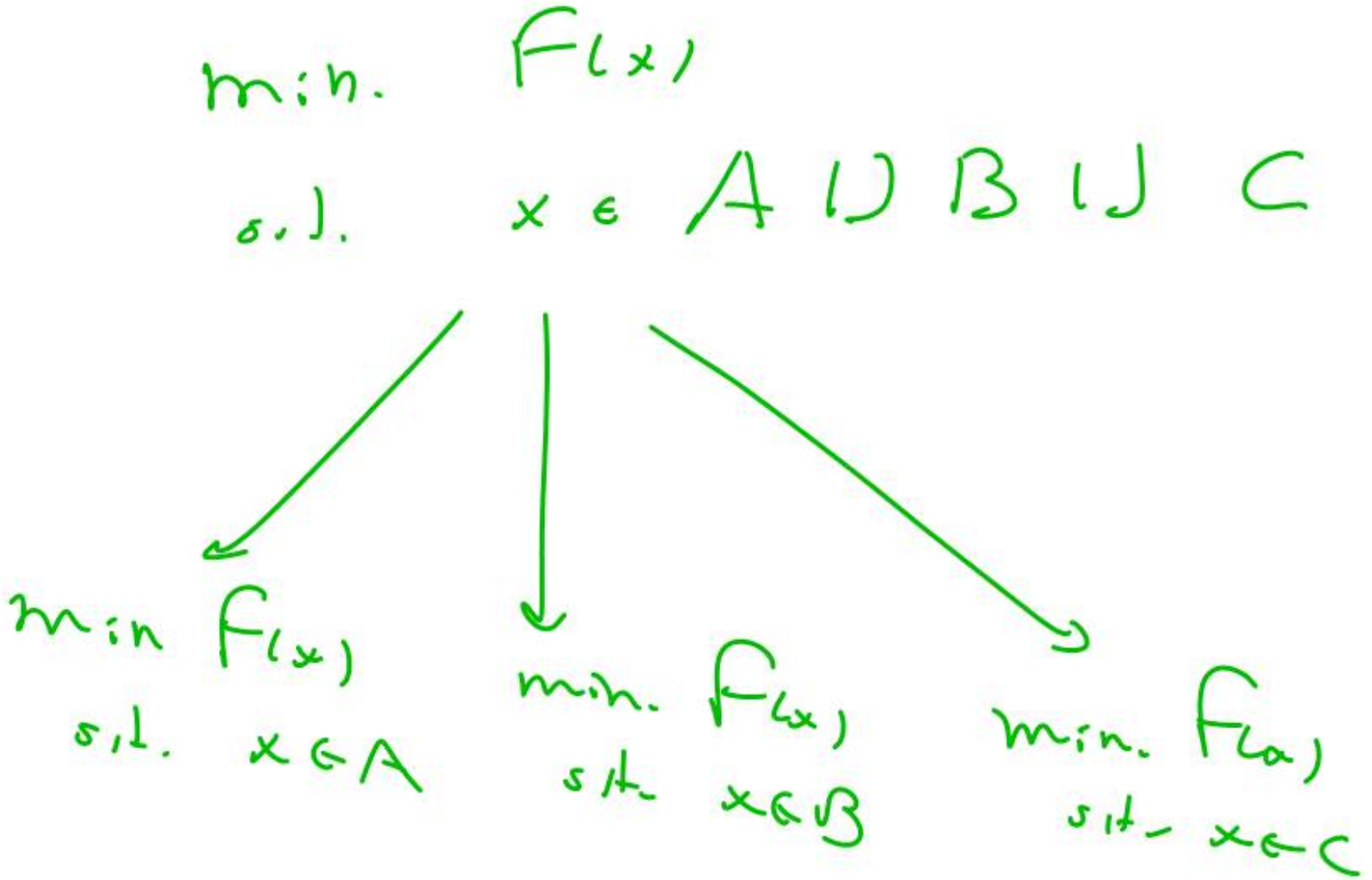
max $-s$

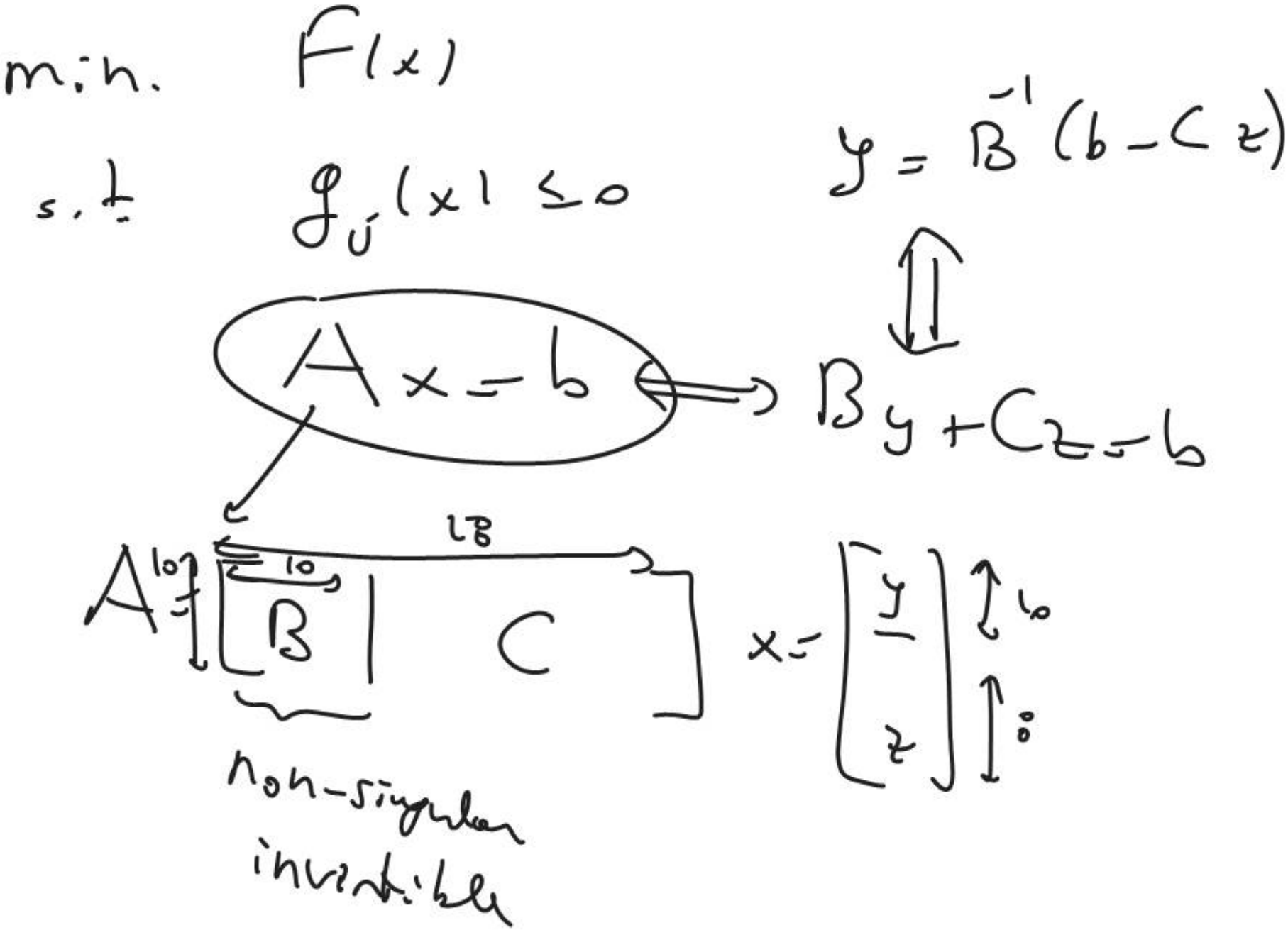
s.t. $s \le t_2 - t_1$

$\vdots$

$s \le t_n - t_{n-1}$

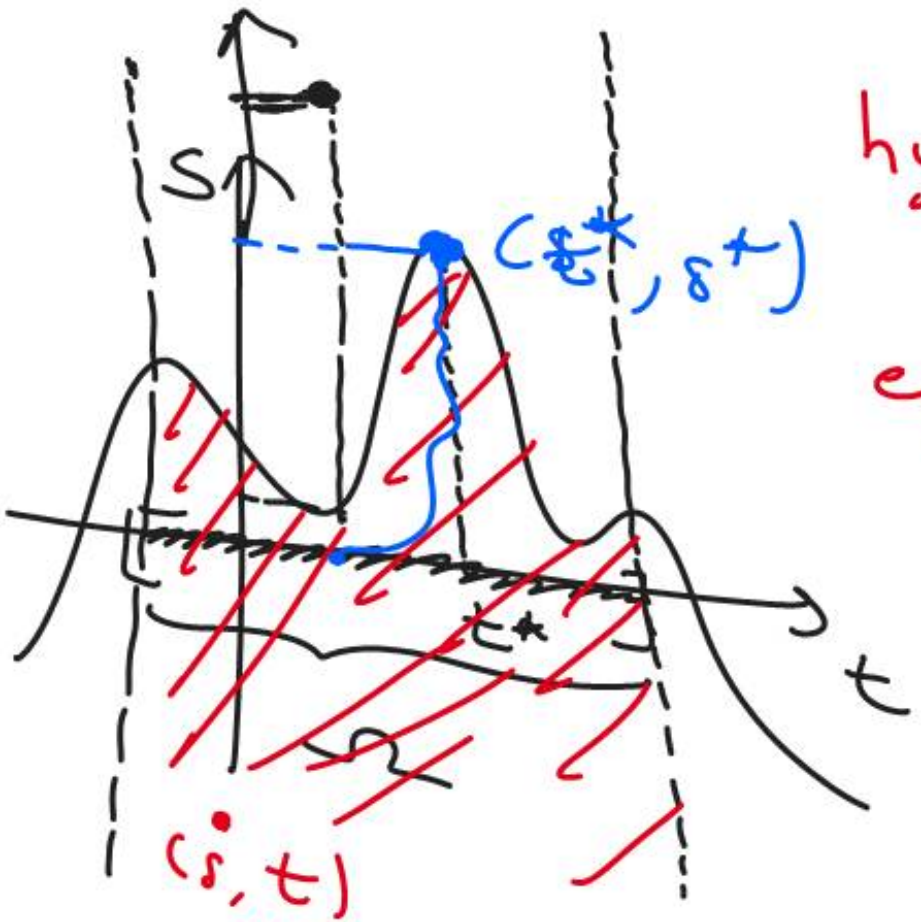
$At \le b$


min. F(x)
s.t. x ∈ A ∪ B ∪ C
min F(x)
s.t. x∈A
min. F(x)
s.t. x∈B
min. F(x)
s.t. x∈C


min. F(x)
s.t. $g_i(x) \le 0$
$y = B^{-1}(b - Cz)$
$Ax = b$
$By + Cz = b$
lB
lo
lo
B
C
non-singular
invertible
$x = \begin{bmatrix} y \\ z \end{bmatrix}$
lo
lo

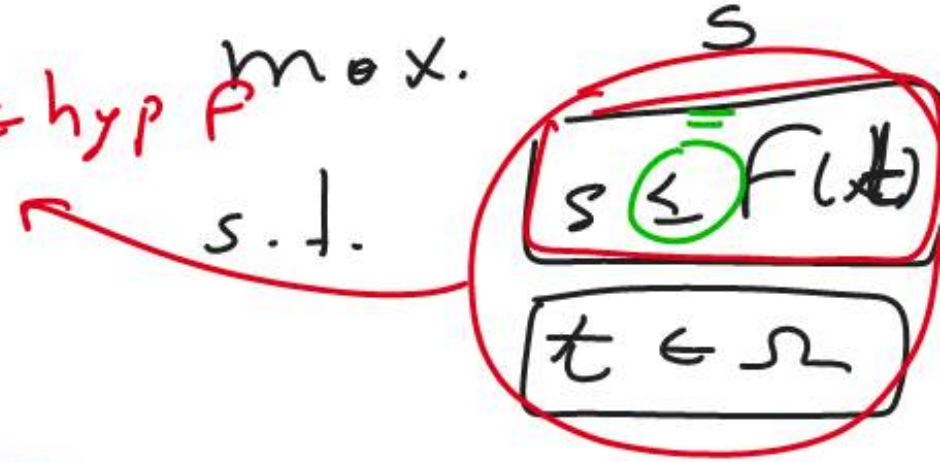
$\max. \quad f(t)$

$s.t. \quad t \in \Omega$



$\max. \quad (t,s) \in \text{hyp } f$

$s.t. \quad t \in \Omega$

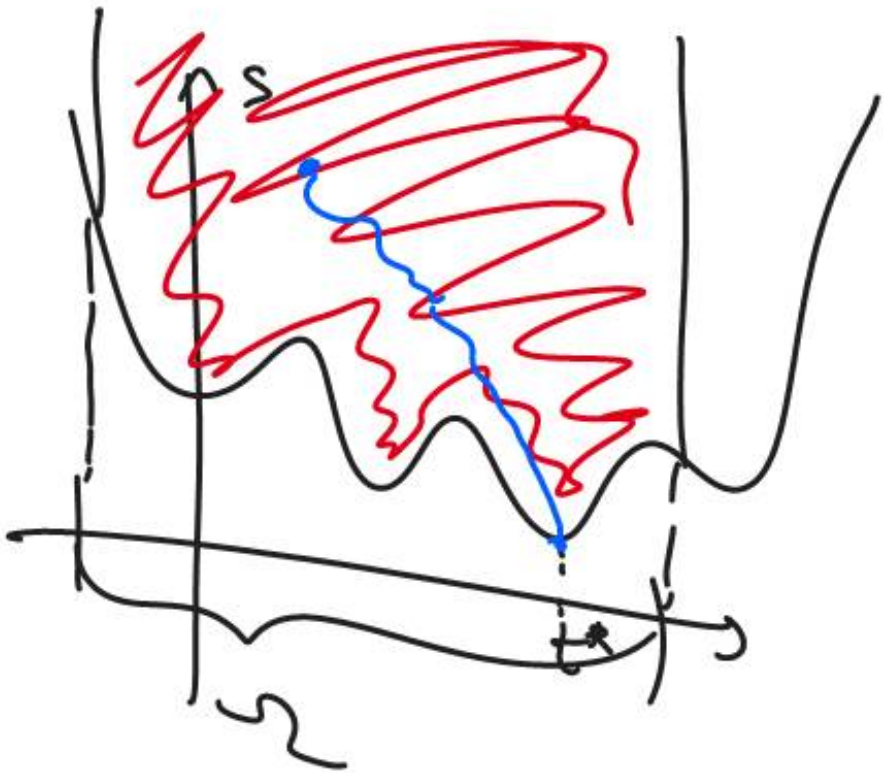


$$\text{hyp } f = \{(t,s) : s \leq f(t)\}$$

$$\text{epi } f = \{(t,s) : f(t) \leq s\}$$

min. $F(t)$

s.t. $t \in \Omega$



min. s

s.t. $F(t) \leq s$

$t \in \Omega$

$(t, s) \in \text{epi } f$