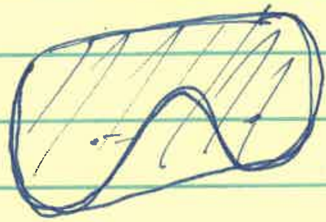


$$\mathrm{conv}(C) = \left\{ \sum_{i=1}^{k} \theta_i x_i \;:\; x_1 \ldots x_k \in C,\; \theta_i \geq 0,\; \sum \theta_i = 1 \right\}$$

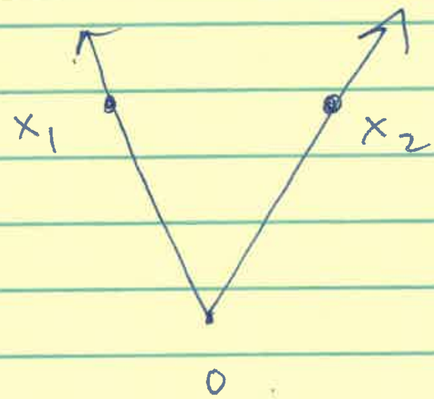
$$a_i^T x \leq b_i$$

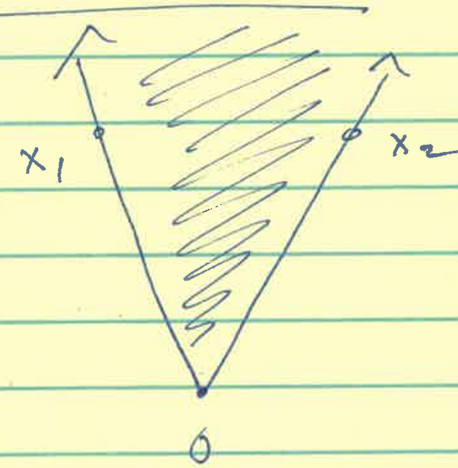
$$i = 1, \ldots m$$

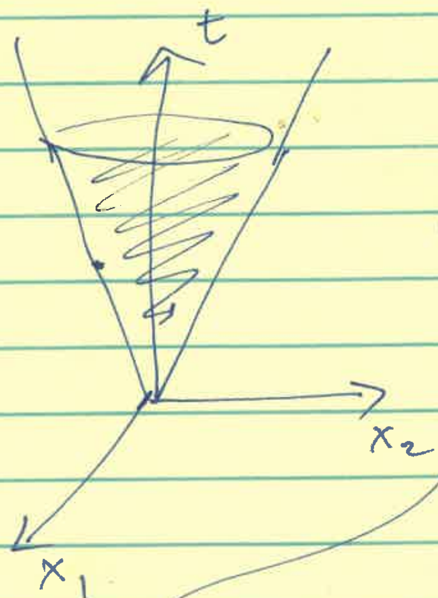
$$Ax \leq b$$

$$Cx \leq d$$

$$-Cx \leq -d$$







$$\{ (x,t) \in \mathbb{R}^3 : \|x\|_2 \leq t \}$$

$$X \succeq 0$$

means

smallest eigenvalue of X

$$\lambda_{\min}(X) \geq 0.$$

$$\iff$$

$$a^T X a \geq 0 \text{ for all } a$$

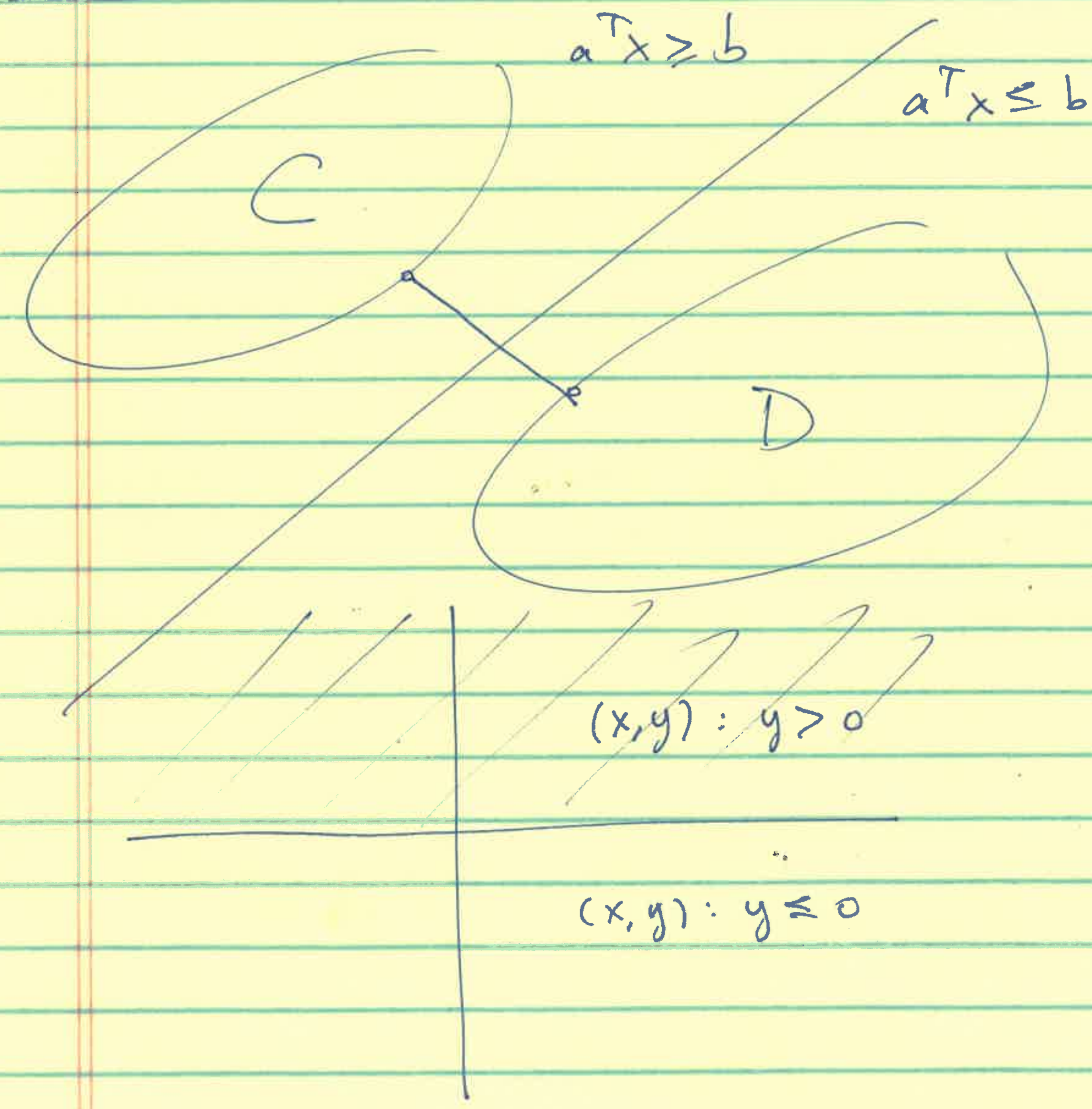
$$A \succeq B \text{ means } A - B \succeq 0$$

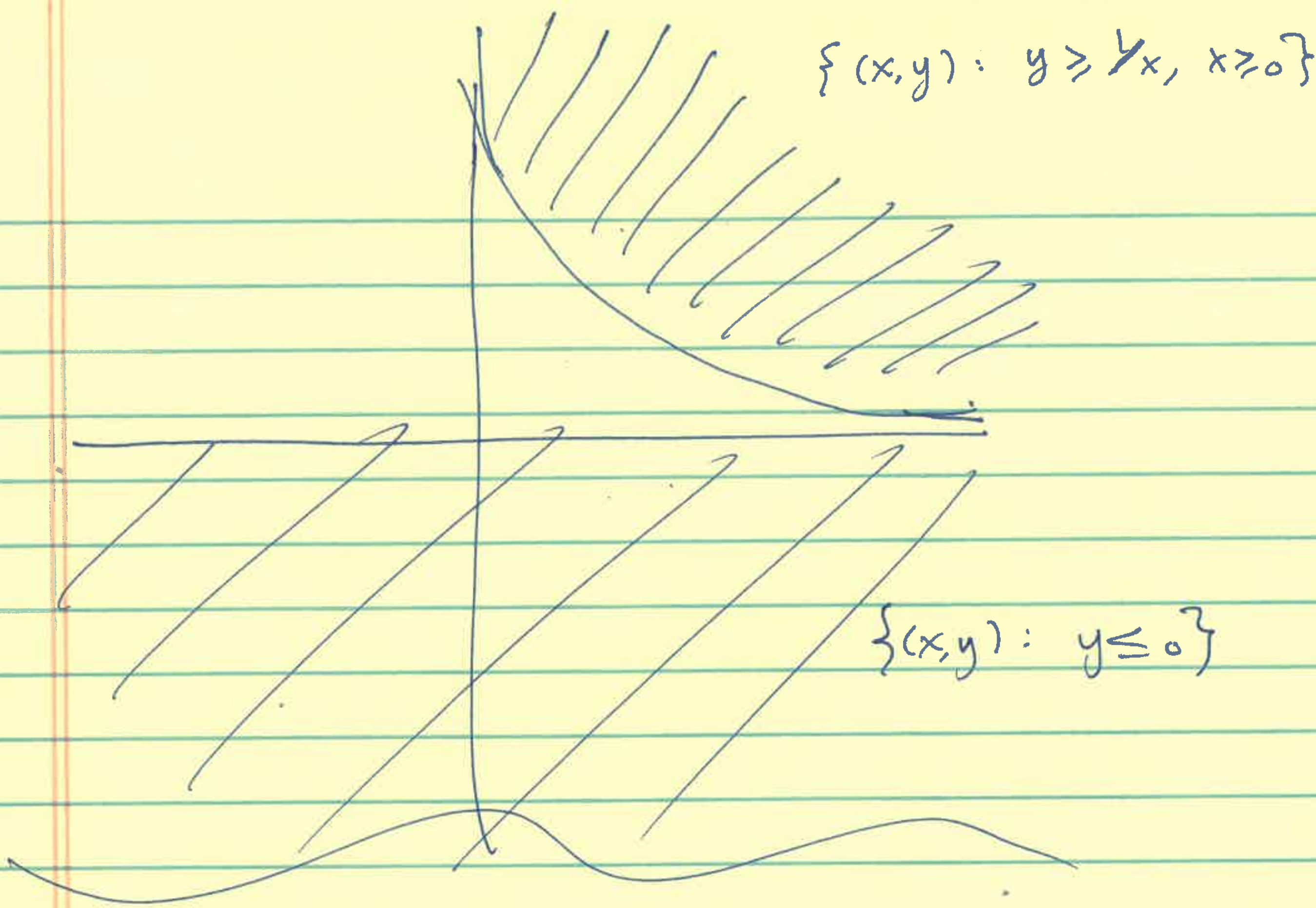
$$S_+^n = \{X : X \succeq 0\}$$

$X, Y \in S_+^n$.

$t_1 X + t_2 Y \succeq 0$? ✓

$$a^T(t_1 X + t_2 Y)a$$
$$= t_1 (a^T X a) + t_2 (a^T Y a)$$
$$\geq 0.$$





$$x_1 A_1 + \dots + x_k A_k \preceq B$$

means $\quad B - x_1 A_1 - \dots x_k A_k \succeq 0.$

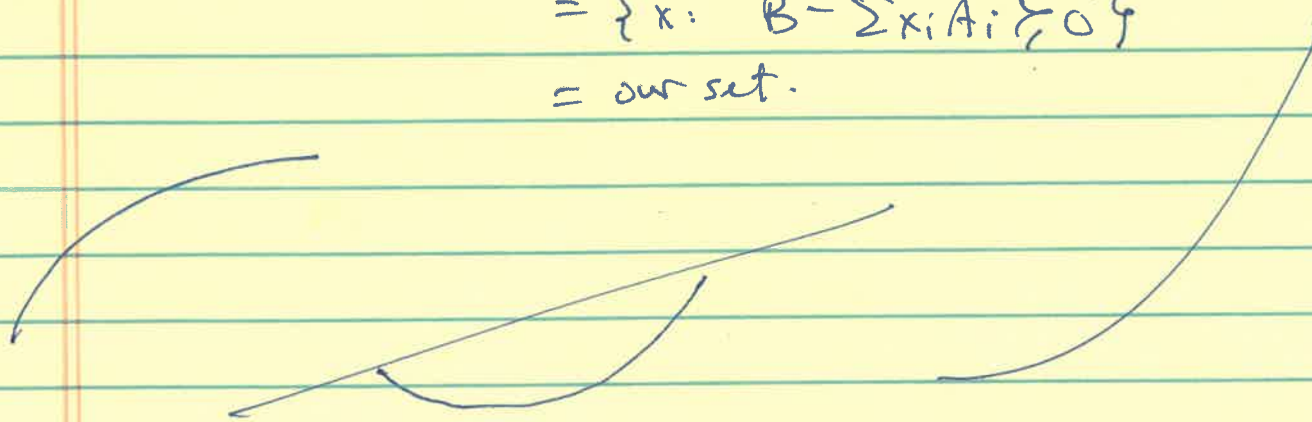
$S^n_+ = \{Y : Y \succeq 0\}$ is convex.

$f(x) = B - \sum x_i A_i$

$f^{-1}(S^n_+) = \{x : f(x) \in S^n_+\}$

$= \{x : B - \sum x_i A_i \succeq 0\}$

$=$ our set.



$$b^T A^T A b \geq 0$$

why? $\quad \overset{\shortparallel}{z^T z} = \sum z_i^2$

where $\quad z = Ab$

$p = 1, 2, \infty \quad$ common cases

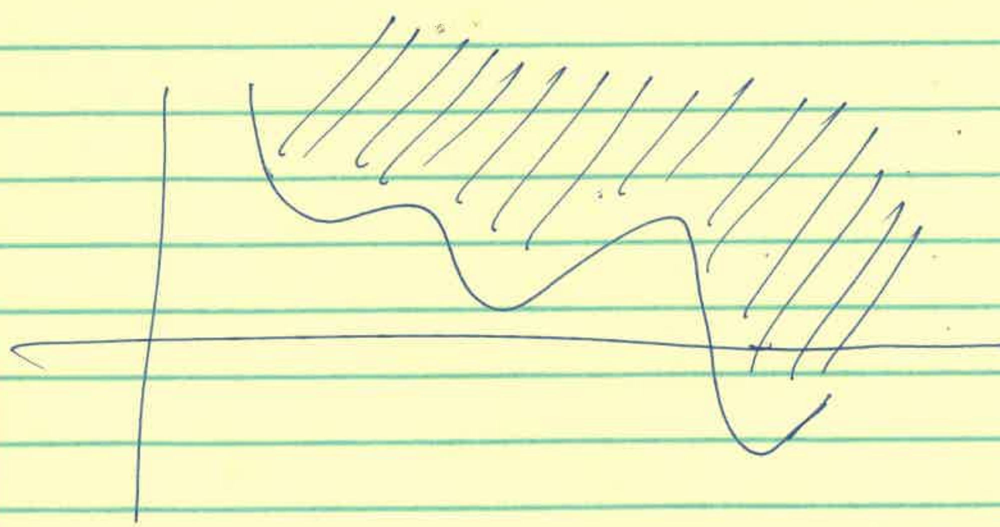
$p = 0 \quad \ell_0$ "norm"

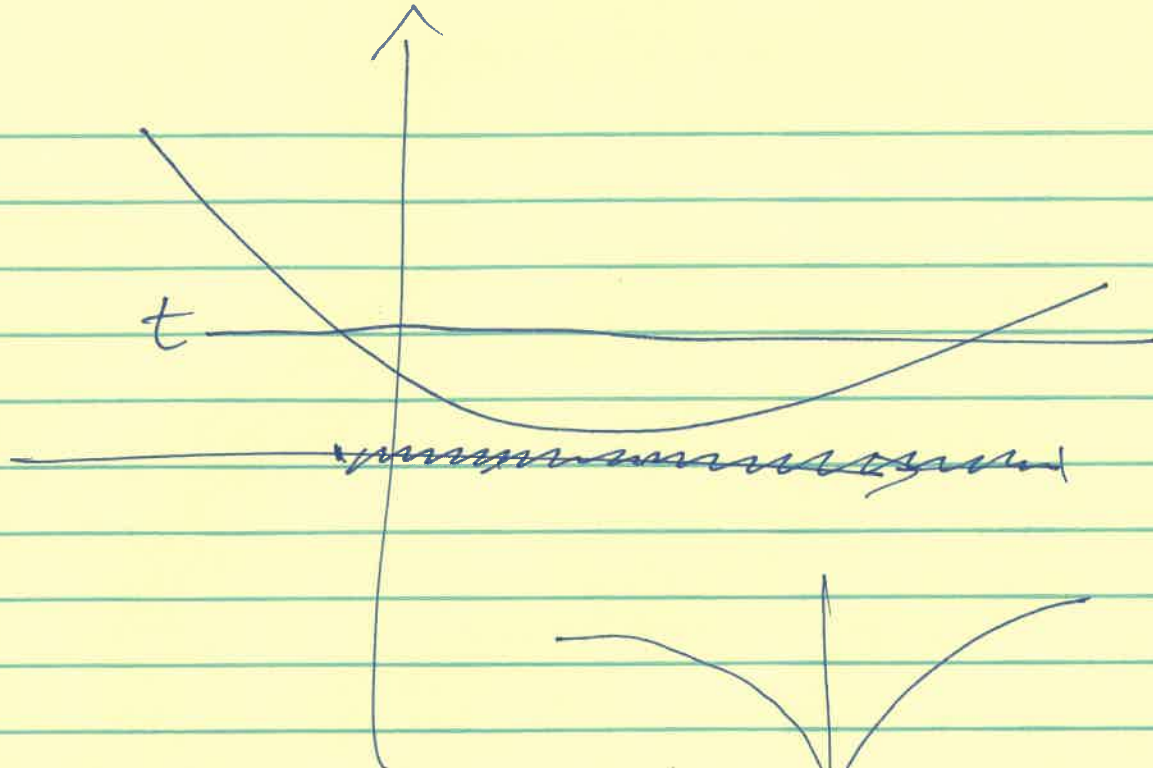
$\|x\|_0 = \sum 1\{x_i \neq 0\}$ NOT convex.

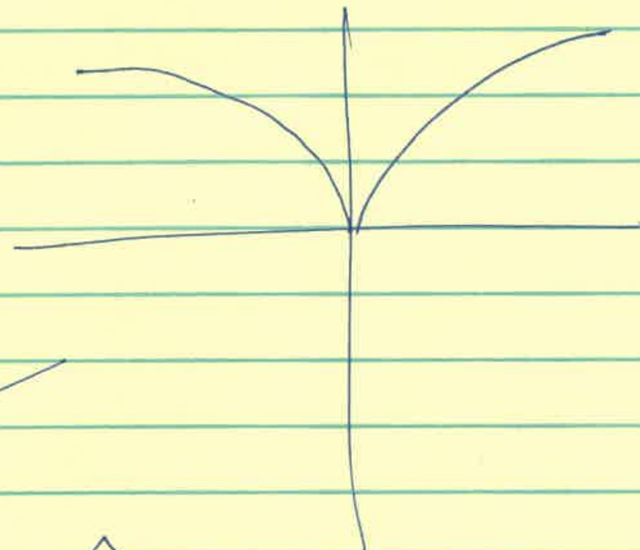
$f(x) = I_C(x) \qquad \mathrm{dom}(f) = C$ is convex ✓

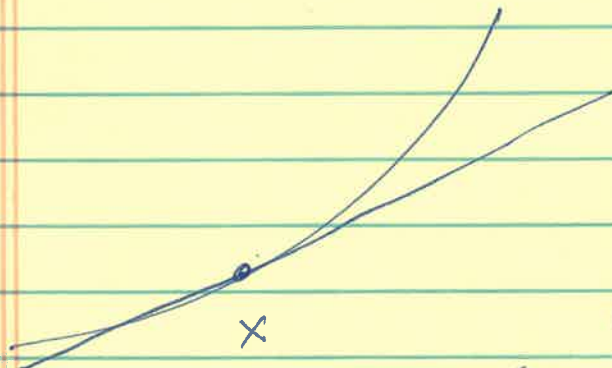
$x, y \in \mathrm{dom}(f)$

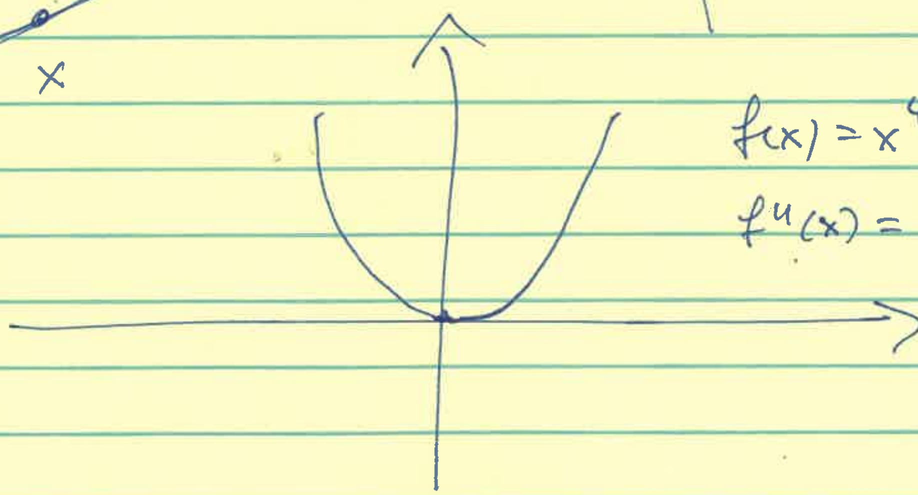
$$\underbrace{f(tx + (1-t)y)}_{=0} \leq t\,\underbrace{f(x)}_{=0} + (1-t)\,\underbrace{f(y)}_{=0}$$











$f(x) = x^4.$

$f''(x) = 4 \cdot 3 \cdot x^2$