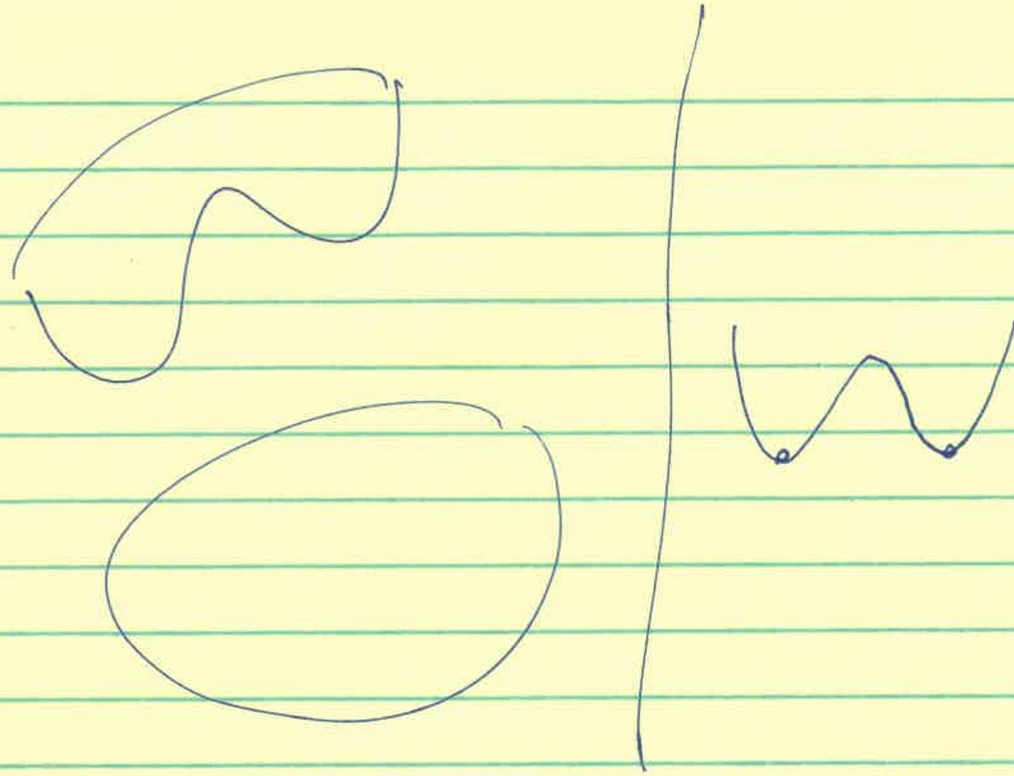


Two convex sets, one open, one closed

$\exists$ separating hyperplane $\Longrightarrow$ disjoint

Set closed, nonempty interior, $\exists$ supporting hyperplane at every bdry point $\Longrightarrow$ convex.

$$f(x) = h(g(x))$$
$$f'(x) = h'(g(x)) \cdot g'(x)$$
$$f''(x) = h''(g(x)) \cdot (g'(x))^2 + h'(g(x)) \cdot g''(x)$$

$$h(x) = 0$$
$$\Longleftrightarrow \begin{cases} h(x) \le 0 \\ -h(x) \le 0 \end{cases}$$

$f(x) = e^{-x} \longleftarrow$

$\min f(x)$

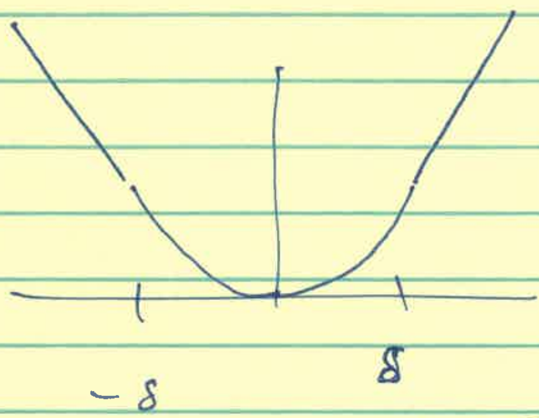
$g(\beta) = \|\beta\|_1 - s$

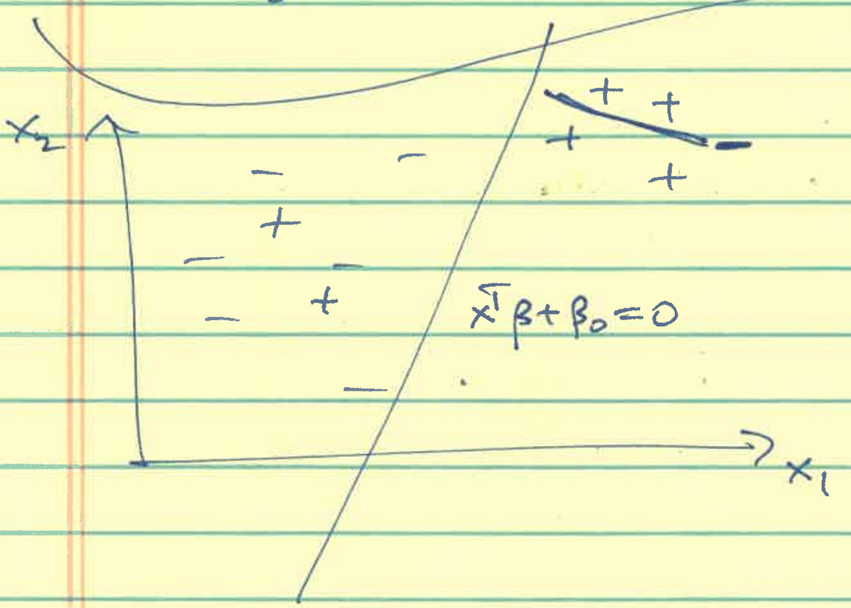
$$f(\beta) = \|y - X\beta\|_2^2 = \beta^T X^T X \beta - 2y^T X\beta + y^T y.$$

$$\nabla^2 f(\beta) = 2X^T X.$$

strictly pos def $\iff$ $X^T X$ invertible

$\iff$ X has linearly independent columns





$\|\beta\|_2^2$

(β, β_0, ξ)

$(\tilde{\beta}, \tilde{\beta}_0, \tilde{\xi})$

and $\underline{\beta \neq \tilde{\beta}}$

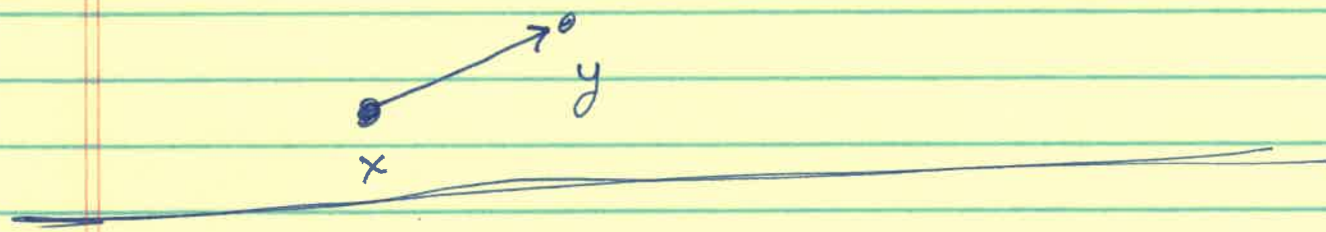
$\nabla f(x)^T (y-x) \geq 0$ all $y \in \mathbb{R}^n$

$\Rightarrow \nabla f(x)^T a \geq 0.$ all $a \in \mathbb{R}^n$

$\Rightarrow \nabla f(x)^T a = 0.$ all $a \in \mathbb{R}^n$

$\Rightarrow \nabla f(x) = 0.$

$\nabla f(x)^T (y-x) \geq 0$ all $y \in C.$



$\max_\theta$ likelihood (θ) $\leftarrow$

$\Leftrightarrow \max_\theta$ log likelihood (θ) $\leftarrow$

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pick some x_0 s.t. $Ax_0 = b.$

M have columns that span null (A)

$\{x : Ax = b\} = \{x_0 + My : y\}$