$$\min_{\substack{u_0,\dots,u_{N-1}\\ x_0,\dots,x_N}} \sum_{k=0}^{N-1} u_k^2$$

$$\text{s.t.} \quad x_0 = \bar{x}_0,$$
$$x_{k+1} = F_h(x_k, u_k), \quad k = 0, \dots, N-1$$
$$x_N = \bar{x}_N$$

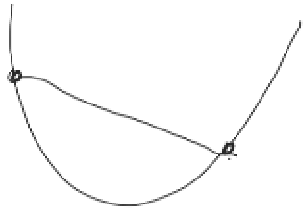
$$\tilde{x}_{k+1}(U) = F_h(\tilde{x}_k(U), u_k)$$

$$\tilde{x}_0(U) = \bar{x}_0$$

$$\boxed{\min_{u_0,\dots,u_{N-1}} \sum_{k=0}^{N-1} U_k^2 \quad \text{s.t.} \quad \tilde{x}_N(U) = \bar{x}_N}$$

$$\min_{x \in \mathbb{R}^n} f(x)$$
$$\text{s.t.} \quad c_i(x) = 0, \quad i \in \mathcal{E}$$
$$c_i(x) \geq 0, \quad i \in \mathcal{I}$$

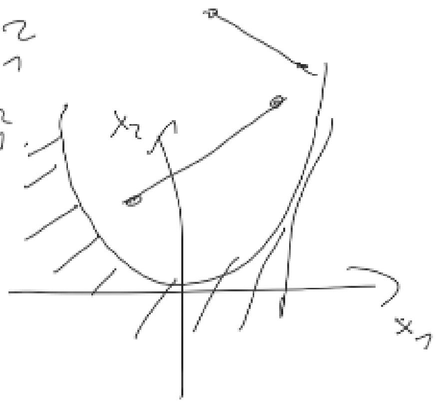
$$\left.\begin{array}{l} f(x) \text{ convex} \\ c_i(x)\ \ i \in \mathcal{E} \ \text{ affin} \\ c_i(x)\ \ i \in \mathcal{I} \ \text{ concave} \end{array}\right\} \Rightarrow \text{NLP convex}$$



x^2 $\quad$ $5 \cdot x^2 + 1$

$x_2 = x_1^2$

$x \in \mathbb{R}^2$ $\quad$ $x_2 \geq x_1^2$.



$f(x) = Ax + b$

$A \in \mathbb{R}^{m \times n}, \; x \in \mathbb{R}^n, \; b \in \mathbb{R}^m$

$f: \mathbb{R}^n \to \mathbb{R}^m$

$Ax + b = 0$

$c_1(x) = x_2 - x_1^2 \quad (\geq 0)$

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