2018-9-11

$$\min_x f(x) \quad \text{s.t.} \quad g(x) \le 0, \quad h(x) = 0$$

objectives

price

quality, luxe,

performance, speed.

fuel consumption

space

safety

multi-criteria

constraints

$8000 \le \text{price} \le 50000$ €

max. speed $\geq$ 175 km/h

fuel consumption $\le$ 2 l/100km

space = 6 seats.

$\text{space} - 6 = 0$

$8000 - \text{price} \le 0$

$$\underbrace{\begin{bmatrix} \text{price} - 50000 \\ 8000 - \text{price} \\ 175 - \text{speed} \\ \text{fuel} - 2 \end{bmatrix}}_{g} \le \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$c^T x = \sum_{i=1}^{n} c_i x_i$$

x, c : column vectors

✓ $x \geq 0$

$y \in \mathbb{R}^n$

$\hookrightarrow y^+, y^-$

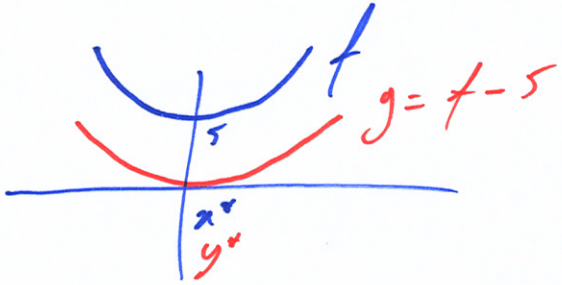
$y = y^+ - y^-$

$y^+, y^- \geq 0$

$$y = \begin{bmatrix} 5 \\ -4 \\ 3 \\ -2 \\ 0 \end{bmatrix}$$

$$y^+ = \begin{bmatrix} 5 \\ 0 \\ 3 \\ 0 \\ 0 \end{bmatrix} \quad y^- = \begin{bmatrix} 0 \\ 4 \\ 0 \\ 2 \\ 0 \end{bmatrix}$$

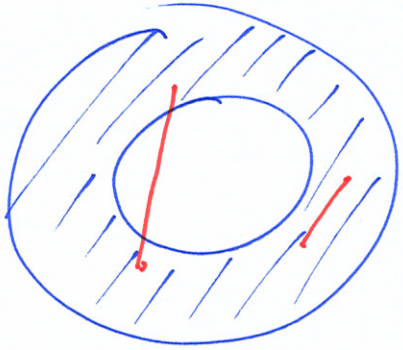
• $\min_{x_1, x_2, x_3} \; 5x_1 + 3x_2 + 6x_3 \cancel{+8}$



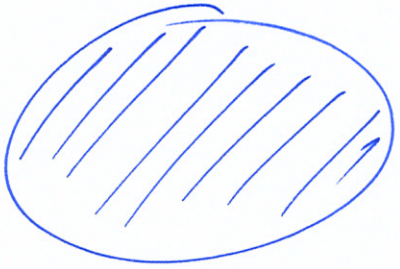
$$\min_x f(x) = x^*$$
$$\parallel$$
$$\min_y g(y) = y^*$$

Convex

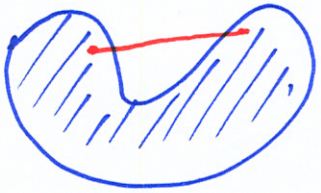
not convex



convex



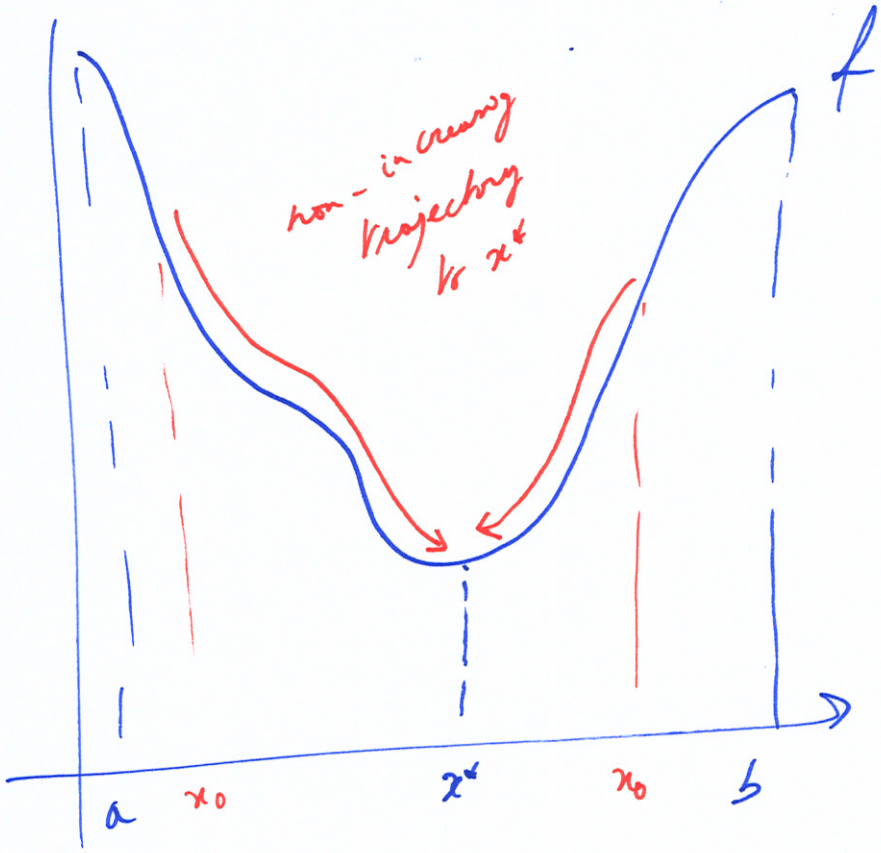
nonconvex



not convex

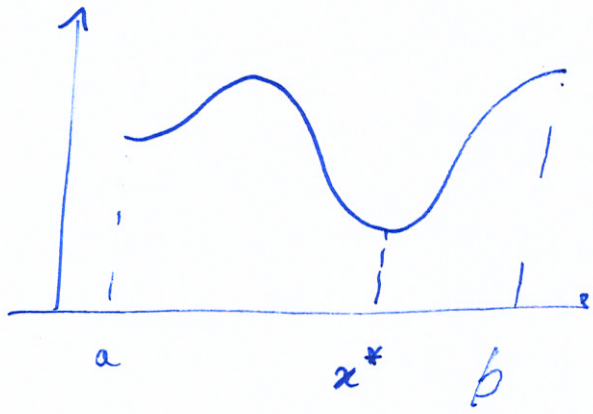
not convex
(4 lines)

unimodal

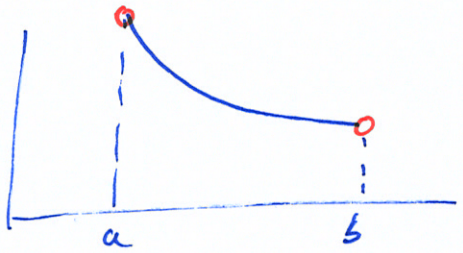


$\mathrm{dom}(f) = [a, b]$ is convex

not unimodal



not unimodal



$\mathrm{dom}(f) = (a, b)$

$x^* \notin \mathrm{dom}(f)$