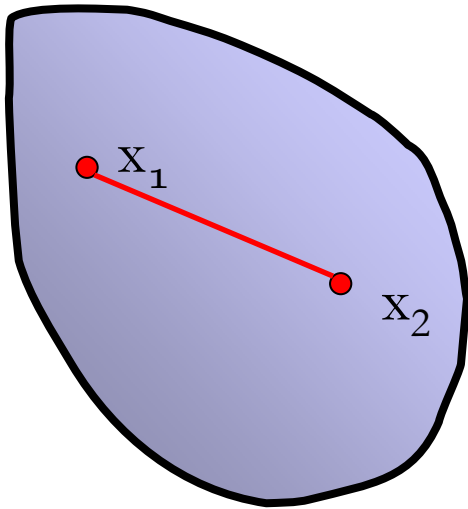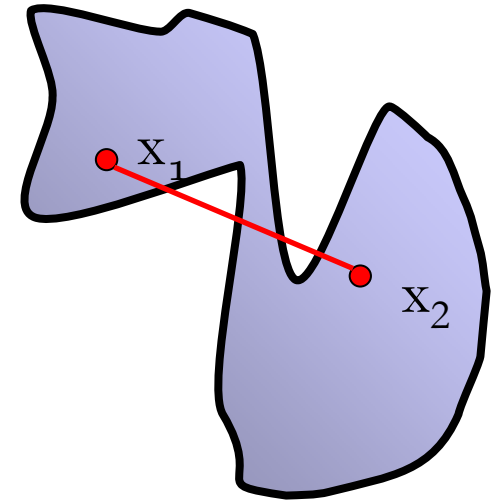# Convex Sets

Convex
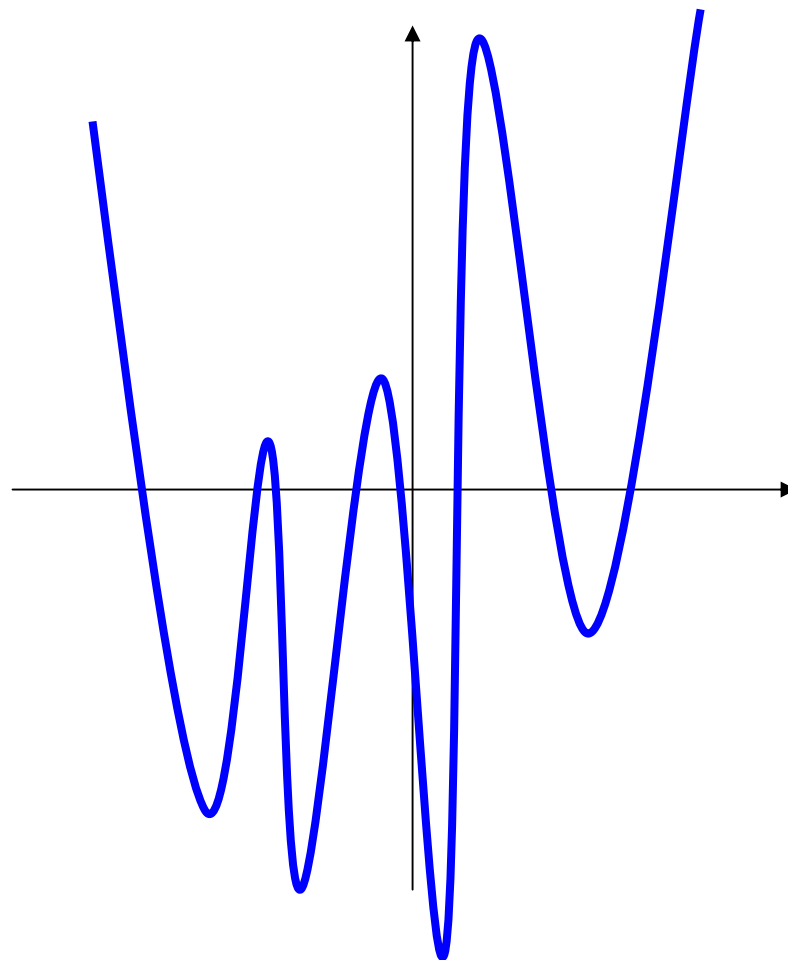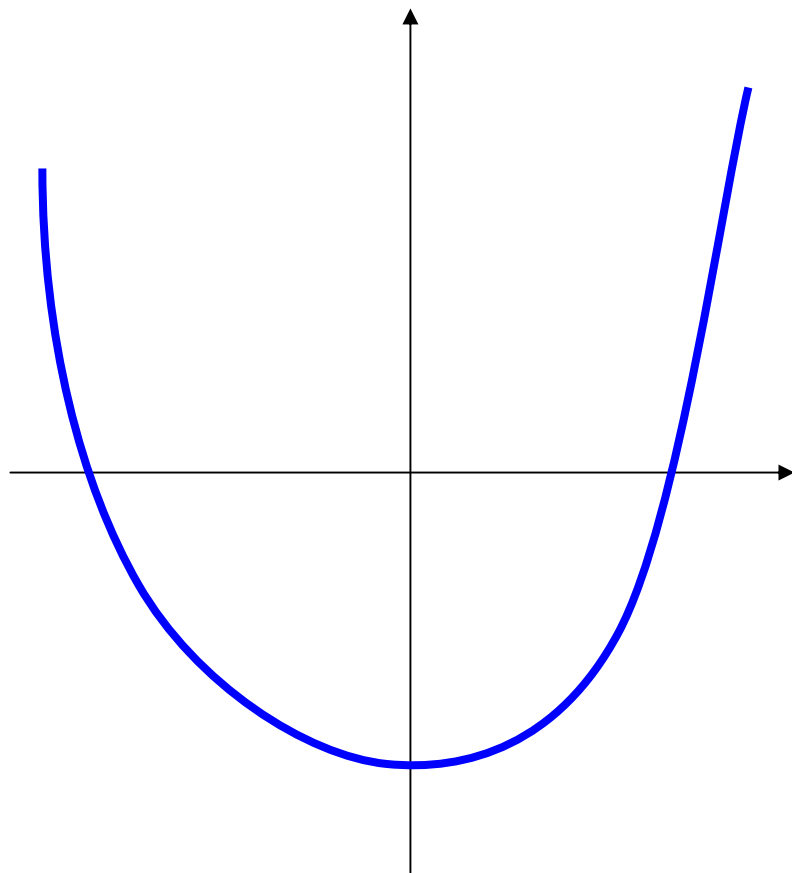
Non-convex

Convex Functions

Convex

Non-convex

Hahn-Banach Theorem

If a set is convex and x outside the set then there exists a hyperplane separating x and the set.

It follows that this set is the intersection of all half-spaces containing it
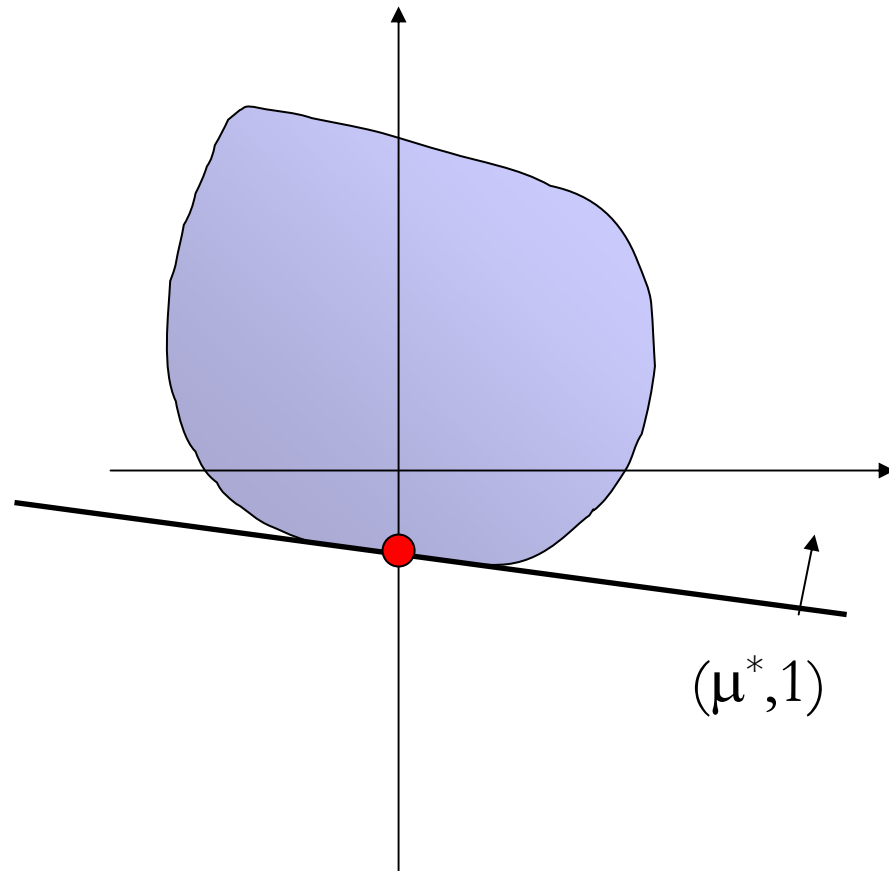
x

Lagrangian Duality

- General Problem

  minimize $\quad f(\mathbf{x})$
  subject to $\quad g_i(\mathbf{x}) \leq 0$

- Dual Program

  $$\max_{\mu \geq 0} \min_{\mathbf{x}} f(\mathbf{x}) + \sum_{i=1}^{K} \mu_i g_i(\mathbf{x})$$

- Search over half spaces

$(\mu^*, 1)$

Non-convex optimization

duality gap