Examples

Regression (least squares) + regularization
Classification (SVMs)
Preference ordering (lasso, ridge)

Linear systems
\[ b = Ax \quad \text{or} \quad y = X \theta \]
\[ \text{target, model features} \]

Resource allocation
Clustering (k-means)
PCA

Non-examples
Hierarchical clustering
Density-based clustering
Tree-based models: \[ \frac{1}{2} \]
Boosting \[ \frac{1}{2} \]
Monte-Carlo
Cross-validation & Bootstrap

\[ E = \frac{1}{2} \sum \left( \hat{y}(x, \hat{\theta}), (y, \hat{\theta}) \right)^2 + \alpha \text{norm} (\hat{\theta}) \]

\[ |i_{x} - i_{y}| = 1 \quad \text{or} \quad |i_{x} - i_{y}| = 1 \]
\[ h_i(x) = \beta_i \cdot x + i \sqrt{3} \]

\[ \text{dom}(f) = \{ x : f(x) \text{ is defined and finite} \} \]

\[ h_j(x) = a_j^T x + b_j \quad \text{affine} \]

\[ h_j(x) = 0 \iff a_j^T x + b_j = 0 \]

\[ -h_j(x) \leq 0 \]
Suppose not. Assume there is some feasible $z$ such that
\[ f(z) < f(x) \]

Then $\|z - x\|_2 > r$

Let $y = tz + (1-t)x \quad t \in [0,1]$

$y \in D$ since $y$ satisfy constraints

\[ h_j(y) = a_j^T (tz + (1-t)x) + b_j = 0 \]

\[ g_i(y) \leq tg_i(z) + (1-t)g_i(x) \leq 0 \]

Take $t$ small enough so that $y \in B$

$t > 0$

\[ f(y) \leq tf(z) + (1-t)f(x) \]

< $f(x)$

$\times$ contradiction