

# Primal Problem

$$\min_{w \in \mathbb{R}^d} \left[ P(\mathbf{w}) := \frac{\lambda}{2} ||w||^2 + \frac{1}{N} \sum_{i=1}^N f_i(\mathbf{w}^\top \mathbf{x}_i) \right] \geq$$

Support Vector Machine

Regularized linear and logistic regression

Ordinal regression

$f^*(y) = \sup_{x \in \text{dom } f} (y^\top x - f(x))$  is the conjugate of  $f$

# Dual Problem

$$\max_{\alpha \in \mathbb{R}^N} \left[ D(\alpha) := -\frac{\lambda}{2} ||A\alpha||^2 - \frac{1}{N} \sum_{i=1}^N f_i^*(-\alpha_i) \right]$$

$A_i := \frac{1}{\lambda n} \mathbf{x}_i$

- Stopping criteria given by duality gap
- Good performance in practice



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