

Linear SVM

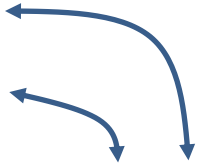
Classifier: $f(\mathbf{x}) = \mathbf{w}^T \mathbf{x} + b$

Parameters: \mathbf{w} , b

Training Data: $T = \{(\mathbf{x}_i, \mathbf{y}_i)\}$, $i=1, \dots, |T|$. \mathbf{x}_i is a feature vector; $\mathbf{y}_i \in \{-1, 1\}$

$f(X) \geq 0 \Rightarrow X$ is in category θ_1

$f(X) < 0 \Rightarrow X$ is in category θ_2



Goal 1: Correct labeling on training data:

If $\mathbf{y}_i = 1 \rightarrow \mathbf{w}^T \mathbf{x}_i + b \geq 1$

If $\mathbf{y}_i = -1 \rightarrow \mathbf{w}^T \mathbf{x}_i + b \leq -1$



Constraint

$$\forall i, \mathbf{y}_i (\mathbf{w}^T \mathbf{x}_i + b) \geq 1$$

Objective

$$\text{Minimize } \Phi(\mathbf{w}) = \mathbf{w}^T \mathbf{w}$$

Goal 2: Maximize margin

Large margin \Leftrightarrow Small $\mathbf{w}^T \mathbf{w}$

The optimization problem is quadratic programming with linear constraints