

Support Vector Machine

Support vector classifier

Separate 2 classes with widest possible margin, while allowing some mistake

Decision rule

$$\hat{y} = \text{sign}(\omega \cdot x + b)$$

Hard margin: Every point should be on correct side of boundary
At least one unit away from margin

Soft margin: Introduces slack variable ξ_i → how much data point breaks SVM

$$\text{Constraint: } y_i (\omega \cdot x_i + b) \geq 1 - \xi_i \quad \text{Rule}$$

$\xi_i = 0 \rightarrow$ point outside margin

$0 < \xi_i < 1 \rightarrow$ inside the margin but still correctly classified

$\xi_i > 1 \rightarrow$ point misclassified

slack how much you forgive mistake

$$\text{Cost func: } \min \frac{\|\omega\|^2}{2} + C \sum \xi_i$$

I want to put wide margin but will pay penalty if rule break

Constraints are rule data point is supposed to satisfy

Only point which violates rule are in cost

If $\xi_i = 0$ no cost

$\xi_i > 0$ cost

Point inside margin or misclassified

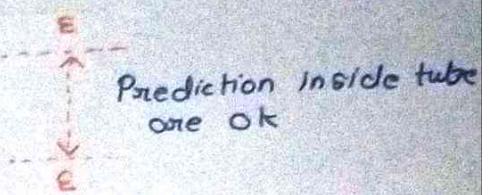
Support Vector Regressor

Fit a function that stays with a tube of size ϵ around data while keeping function as flat as possible

here also we have slack variable

$\xi_i \rightarrow$ above tube

$\xi_i^* \rightarrow$ below tube



$$\text{Constraints} = \begin{cases} y_i - (\omega_{x_i} + b) \leq \epsilon + \xi_i \\ (\omega_{x_i} + b) - y_i \leq \epsilon + \xi_i^* \end{cases}$$

$$\text{Cost} = \frac{1}{2} \|\omega\|^2 + C \sum (\xi_i + \xi_i^*)$$

Any point that break constraint are penalize
i.e. \rightarrow any point outside tube