

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
Atleast one unit away from margin

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

Constraint = $y_i (\omega x_i + b) \geq 1 - \xi_i$

$\xi_i = 0$ → point outside margin

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

$\xi_i > 1$ → 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

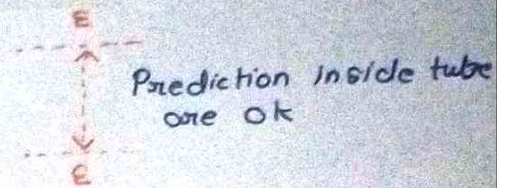
Support Vector Regression

Fit a function that stays within 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



$$\text{Constraints} = \begin{cases} y_i - (w x_i + b) \leq \epsilon + \xi_i \\ (w x_i + b) - y_i \leq \epsilon + \xi_i^* \end{cases}$$
$$\text{Cost} = \frac{1}{2} \|w\|^2 + c \sum (\xi_i + \xi_i^*)$$

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