Classifier: SVM vs Logistic Regression

Learning Type: Supervised, Task: Classification, Algorithm: SVM and Logistic Regression

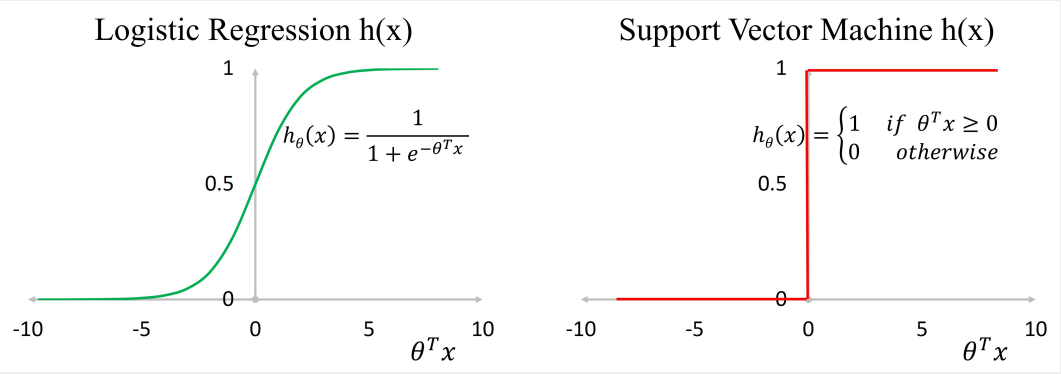
Model $h(x)$:

Logistic Regression (sigmoid):

$h_\theta(x)_{LR} = \frac{1}{1+e^{-\theta^T x}} = \frac{e^{\theta^T x}}{e^{\theta^T x}+1}$

Support Vector Machine:

$$h_\theta(x)_{SVM} = \begin{cases} 1 & \text{if } \theta^T x >= 0 \\ 0 & \text{otherwise} \end{cases}$$

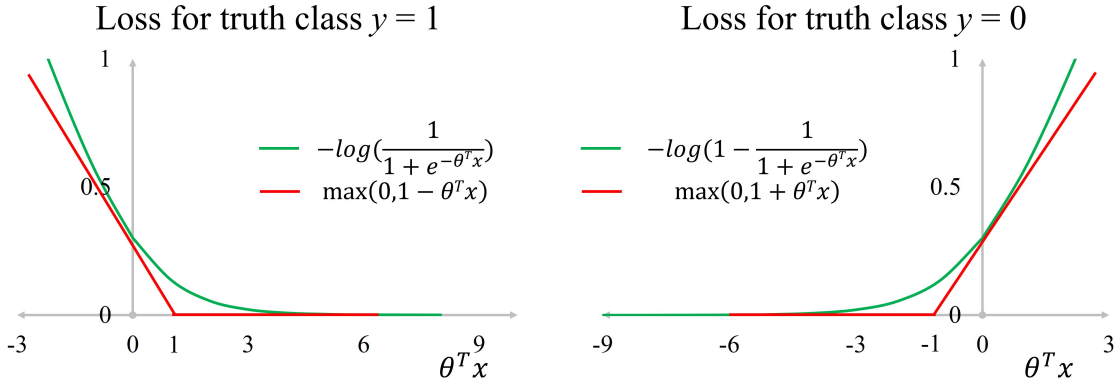


Evaluation Criteria: Cost Function

Cross Entropy or Log Loss for LR: $J(\theta) = -\frac{1}{m}\left[\sum_{i=1}^{m} y^{(i)} \log h_\theta\left(x^{(i)}\right) + \left(1-y^{(i)}\right) \log\left(1-h_\theta\left(x^{(i)}\right)\right)\right] + \frac{\lambda}{2m}\sum_{j=1}^{n}\theta_j^2$

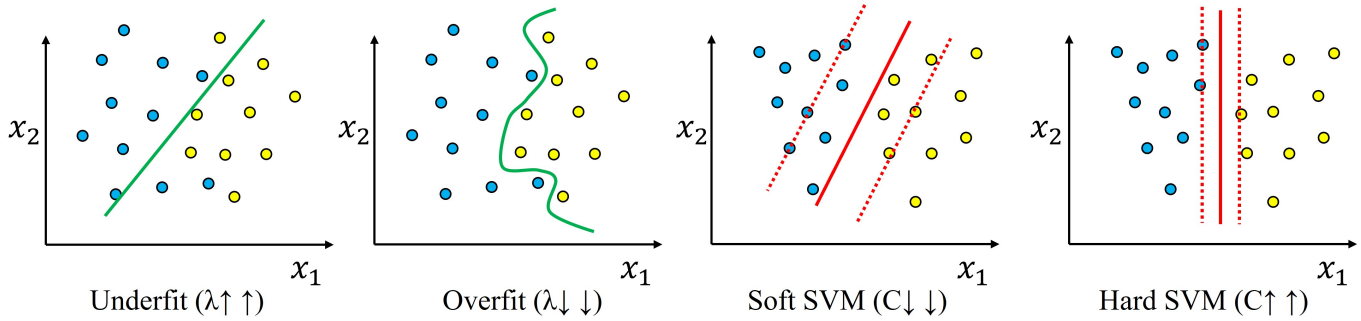
Hinge Loss for SVM: $J(\theta) = C[\sum_{i=1}^{m} y^{(i)} \max\left(0, 1-\theta^T x\right) + \left(1-y^{(i)}\right) \max\left(0, 1+\theta^T x\right)] + \frac{1}{2}\sum_{j=1}^{n}\theta_j^2$

where m = no. of examples; n = no. of features; X = dataset and θ = model weights



More Details about SVM and Logistic Regression

	Logistic Regression	Support Vector Machine
Regularization	$\lambda\uparrow$ Overfitting $\downarrow$	C $\uparrow$ Overfitting $\uparrow$ $C = \frac{1}{\lambda}$
MultiClass	One-vs-all	One-vs-all
NonLinear Dataset	Nonlinear transformation of $\theta^T x$	Kernel function to convert X to higher dimension and use linear hyperplane
Class Margin	Effect with λ	C $\uparrow$ Loss $\uparrow$ Margin $\downarrow$ Hard SVM C $\downarrow$ Loss $\downarrow$ Margin $\uparrow$ Soft SVM



For any mistake/query: alishafique3@gmail.com For references and updates: Website, Github