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Tutorial03.ipynb

STATS5099: Data Mining

Support vector machines

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This week's content

Three types of support vector machines (SVMs):

(1) Hard-margin (linear) SVM

(2) Soft-margin (linear) SVM

(3) Nonlinearkernel SVM

Overview of SVM

The goal of SVM is to find a hyperplane that separates the two classes with the largest margin.

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- Hyperplane: in a p-dimensional space, a hyperplane is defined by

$$\{x \in \mathbb{R}^p : \mathbf{w}^\top \mathbf{x} + b = 0\},$$

where $\mathbf{w}$ is a set of p coefficients and b is a scalar

- $2D$ → a line; $3D$ → plane
- SVM classification rule:

$$\hat{y}_{new} = \text{sign}(\mathbf{w}^\top \mathbf{x}_{new} + b)$$

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- Margin: minimal distance from the observations to the hyperplane (assuming the separating hyperplane exists)
- In general, a larger margin indicates better generalization to test data

Margin

Margin

Margin

Margin

Margin

Optimization problem

Optimization problem

Optimization problem

Soft-margin SVM

Soft-margin SVM

Nonlinear SVM

Nonlinear SVM

Nonlinear SVM

Nonlinear SVM: kernel trick

Nonlinear SVM: kernel trick

Nonlinear SVM: kernel trick

Nonlinear SVM: kernel trick

Summary