Intelligent Systems: Reasoning and Recognition

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Support Vector Machines with Radial Basis Functions

A radial basis function (RBF) is a real-valued function whose value depends only on the distance from the origin. The Gaussian function

$$f(\|\vec{x}-\vec{c}\|) = e^{-\frac{\|\vec{x}-\vec{c}\|^2}{2}}$$

is a popular Radial Basis Function, and is often used as a kernel for support vector machines. When used in this way, each center point, $\vec{c}$, is one of the support vectors.

We can use a sum of N radial basis functions to define a discriminant function, where the support vectors are drawn from the M training samples. This gives a discriminant function

$$g(\vec{X},\vec{w}) = \sum_{m=1}^{M} a_m y_m f(\| \vec{X} - \vec{X}_m \|) + w_0,$$

The training samples $\vec{X}_m$ for which $a_m \neq 0$ are the support vectors.

Suppose that you have two classes and a training data composed of 10 samples, $\{\vec{X}_m\}\{y_m\}$ and that an SVM learning algorithm has provided the weights $\{a_m\}$ as shown below, with $b=0$.

a) Write out the polynomial for the discriminant function $g(\vec{X},\vec{w})$

b) Is the training data separable with this discriminant function?

m	y	x_1	x_2	a_m
1	1	1	1	0
2	1	1	3	0
3	1	2	2	1
4	1	3	1	0
5	1	3	3	0
6	-1	1	5	0
7	-1	3	5	1
8	-1	5	1	0
9	-1	5	3	1
10	-1	5	5	0