SUPPORT VECTOR MACHINE TECHNIQUES

Project Idea

A. Using a RFB NN

1. Develop a regular RBFNN program.

2. We assume there are two classes here, but the idea can be extended to a few more. Now add the following features. Find the two feature vectors, one from each class, that are closest to each other from the two classes. Then find the next two feature vectors that are closest from each class. Now we have two such pairs.

3. Let $\mathbf{x}$ and $\mathbf{y}$ be the first pair, and $\mathbf{x}'$ and $\mathbf{y}'$ be the second pair, where $\mathbf{x}$ and $\mathbf{x}'$ are in Class 1 and $\mathbf{y}$ and $\mathbf{y}'$ are in Class 2. Now find the points

$$\mathbf{x}^* = 0.75\mathbf{x} + 0.25\mathbf{y} \qquad \mathbf{y}^* = 0.25\mathbf{x} + 0.75\mathbf{y}$$

$$\mathbf{x}^{**} = 0.75\mathbf{x}' + 0.25\mathbf{y}' \qquad \mathbf{y}^{**} = 0.25\mathbf{x}' + 0.75\mathbf{y}'$$

4. Center a Gaussian with $\sigma = 0.25\|\mathbf{x} - \mathbf{y}\|$ on each of $\mathbf{x}^*$ and $\mathbf{y}^*$ and also center a Gaussian on each of $\mathbf{x}^{**}$ and $\mathbf{y}^{**}$ with $\sigma = 0.25\|\mathbf{x}' - \mathbf{y}'\|$. Add these Gaussian to the set of RBFs.

5. A simplification is to center a Gaussian RBF on each of $\mathbf{x}$, $\mathbf{y}$, $\mathbf{x}'$ and $\mathbf{y}'$ and use as σ's half the distance between the pairs.

B. Using Hyperplanes

1. Find the two pairs of feature vectors from the different classes. Then pass a hyperplane between $\mathbf{x}$ and $\mathbf{x}'$ and another one between $\mathbf{y}$ and $\mathbf{y}'$.Use these hyperplanes to separate the two classes.

2. This is linear separation. For quadratic separation, find three pairs of closest vectors from the different classes and pass a quadratic equation through the midpoints between each pair. Such a quadratic would be of the form $av(1)^2 + bv(1)v(2) + ... + zv(N)^2 + \text{constant}$, where the vectors are $\mathbf{v}^{(1)}$ and $\mathbf{v}^{(2)}$. The format will be seen by experimenting with a quadratic equation (hypersurface) in 2 dimensions, which has the form, for variables x and y, of

$$ax^2 + bxy + cy^2 + d$$

where a, b, c and d are coefficients