Statistical Methods for Machine Learning
Assignment 2: Basic Learning Algorithms

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1 Neural Networks

1. How to represent the neural network in MATLAB? One method could be $M \times M$ matrix (where M is the number of neurons). Call it **NN**. Then we number the neurons from $1, \ldots, M$ and $\mathbf{NN}(i; j) = w_{i,j}$

Implement a multi-layer neural network with linear output neuron and a single hidden layer with non-linear neuron. All neurons should have bias (offset) parameters.

To find the derivative of the activation function:

$$\sigma(u) = \frac{|u|}{1 + |u|}$$

we apply the quotient rule for differantiation:

$$\frac{d}{du}\frac{f(x)}{g(x)} = \frac{g(x)f'(x) - g'(x)f(x)}{[g(x)]^2}$$

where, in our case $f(u) = |u|$ and $g(u) = 1 + |u|$.

$$\frac{d}{du}\left(\frac{|u|}{1 + |u|}\right) = \frac{(1 + |u|) \cdot 1 - (0 + 1)|u|}{(1 + |u|)^2} \tag{1}$$

$$= \frac{1 + |u| - |u|}{(1 + |u|)^2} \tag{2}$$

$$= \frac{1}{(1 + |u|)^2} \tag{3}$$

Implement backpropagation to compute gradient of error with respect to the network parameters.

2 Support Vector Machines

2.1 Model Selection

Description (we normalized the data, then used the builtin function of libsvm, tried these values for gamma: [])

Result: best parameters are:

Applied to the testdata, this gives the following results:

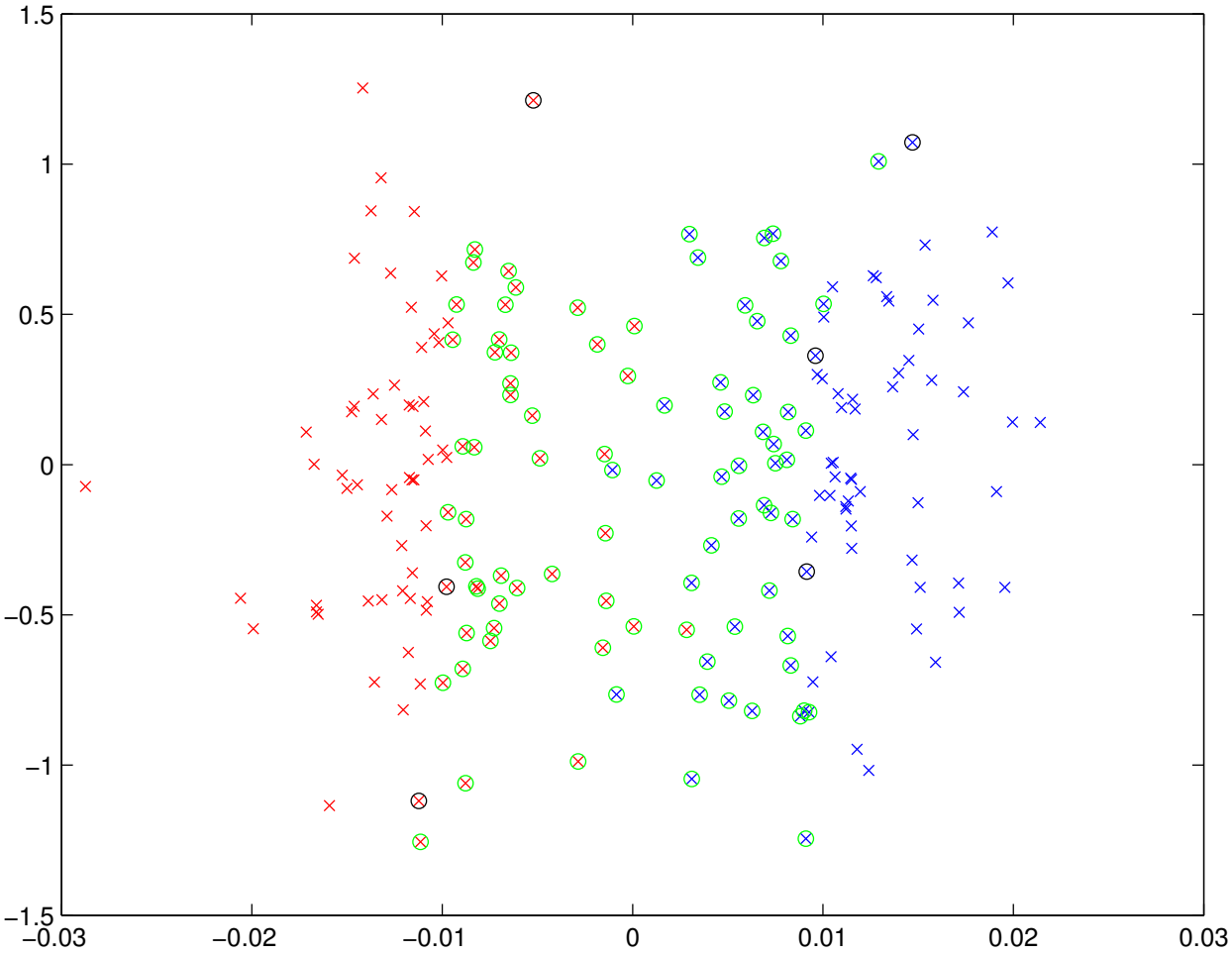

Figure 1: `knollC-train200` trained SVM model. Bounded support vectors are circled in green and free support vectors are circled in black.