Exam Neural Networks (Theory Part)
August 30, 2005

Please do not use any notes, books, slides, etc.

1. **Perceptron/Adaline**

   - (5 points) Describe the stopping criterion of the perceptron learning algorithm.
   - (10 points) For what class of problems is the perceptron learning algorithm guaranteed to stop?
   - (10 points) Consider the following sets C_1 and C_{-1} consisting of examples of the two classes with class label 1 and -1, respectively:

     $$C_1 = \{(1,1), (0.5,1), (1.5,1), (-1,-1)\}$$

     $$C_{-1} = \{(1,-1), (0.5,-1), (1.5,-1), (-1,1)\}$$

     Plot the points in the 2-dimensional input space. Does the perceptron algorithm applied to the two sets terminates? Justify your answer.

2. **Learning/Feed-Forward Neural Networks (FFNNs)**

   - (5 points) Explain the differences between supervised and unsupervised learning learning.
   - (20 points) Describe architecture and learning algorithm of the FFNN with one hidden layer.

3. **Radial Basis Function Networks**

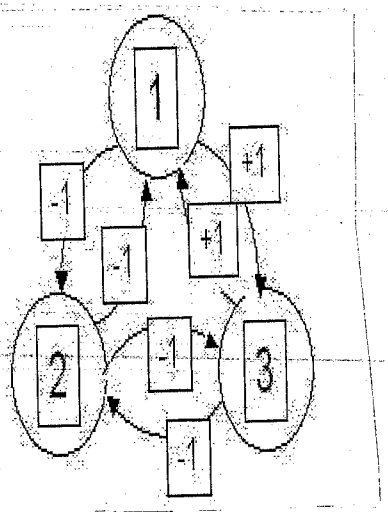
   - (15 points) Describe architecture and weights of a RBF net that correctly classifies the following dataset for the XOR problem: $C_1 = \{(1,-1), (-1,1)\}$, $C_{-1} = \{(1,1), (-1,-1)\}$.

4. **Self Organizing Map (SOM)/Competitive learning**

   - (15 points) Describe in detail SOM: for what learning tasks it is used, what is its architecture and learning algorithm.

5. Hopfield Networks

- (10 points) Consider the discrete Hopfield network given in the picture below:



  - Is (-1,1,-1) a stable state?
  - Into which state is the state (-1,-1,1) mapped?

6. Support Vector Machines (SVM)

- (2 points) What is the VC dimension?
- (8 points) Describe the support vector classifier with linear kernel.