Neural networks for classsification and identification

Credits: 5 Semester 1 Compulsory: No			
Format	Lectures 25h	Tutorials 15h	Private study 50 h
Lecturers: B. Daya (ECN)			

Objectives:
The goal of the class is to present neural networks as tools for pattern classification, function approximation, and system modeling and prediction. Neural methodology will be thus treated as a step in development of dynamic systems. Neural networks are presented as static or dynamic systems whose main distinctive properties are modularity and adaptability. They are presented in the context of classification, function approximation, dynamical system modeling, and other applications.

Contents:
Classification abilities are discussed for contemporary versions of Rosenblatt's perceptron, support vector machines, and multi-layer perceptrons. They are complemented with elements of learning theory and probably approximately correct estimators. Approximation properties of neural networks are outlined for multilayer perceptrons and for radial basis function networks, and connected to linear regression models. In particular, approximation quality and generalization problems are discussed. Back-propagation is derived as an effective way to calculate gradients in large systems. Theoretical abilities of function approximation properties of multi-layer perceptrons and radial basis function networks are also analyzed. Dynamic neural networks are outlined in the context of dynamical system modeling, contents-addressable memories, and combinatorial system optimization. Neural ARMA models will be derived as a generalization of ARMA models, and their properties will be analyzed. Stability of dynamic networks is discussed in the context of system optimization and contents-addressable memories.

Practical Work: Exercises on the application of the neural networks

Abilities: The students will be able to:

Understand the commonly used neural network architectures and learning algorithms.
Distinguish classes of problems to which neural networks offer solutions superior to other methods.
Design a neural network to solve a practical problem.
Gain a practical experience on how to apply neural network methods to classification problems.
Approximate diverse functions by neural networks.
Set-up a dynamical neural model.

Assessment: 30% continuous assessment, 70% from end of semester examination.

Recommended texts:

G.C.Bekey, K.Y.Goldberg, *Neural Networks in Robotics*, Kluwer 1993
R. Callan, *The Essence of Neural Networks*, Pearson Education (Academic), 1998

Further readings: will be provided by lecturer