6

NEURAL NETWORK METHODS

> The error of youth is to believe that intelligence is a substitute for experience, while the error of age is to believe experience is a substitute for intelligence.
>
> Ernest Hemingway

This chapter describes data-analytic methods developed in the field of artificial neural networks (ANNs). Neural network methods have been inspired by biological learning, and they use very specialized terminology. However, most neural network applications are concerned with predictive learning. So these methods can be described under predictive learning framework.

Section 6.1 describes motivation and a brief history of neural network learning. Section 6.2 describes basic gradient-descent style algorithms for estimating parameters (or weights) of a neural network model. Sections 6.3 and 6.4 describe two popular supervised learning methods: multilayer perceptrons (MLPs) and radial basis function (RBF) networks. These methods can be used, with minor modifications, for both regression and classification problems. Section 6.5 describes methods for unsupervised learning aka clustering and vector quantization. Section 6.6 describes Self-Organizing Maps (SOM) method for clustering and dimensionality reduction.

Discussion of neural networks in this chapter includes:

- original (biological) motivation for these methods;
- neural network terminology;
- interpretation of these methods under common predictive learning framework;
- important practical issues related to learning algorithms and complexity control.

The development of nonlinear adaptive methods in the fields of statistics, machine learning and neural networks has proceeded rather independently in 1980's and early 1990's. Hence, many neural network algorithms have their statistical counterparts, as discussed in this chapter.

Neural network methods use a particular nonlinear parameterization called 'neural network'. Mathematically, parameterization of MLP and RBF neural networks represents a linear combination of adaptive basis functions, similar to nonlinear statistical methods. So the material in Chapter 2 on the predictive methodology and in Chapter 5 on nonlinear statistical methods can be helpful for understanding this chapter.

Predictive Learning
By Vladimir Cherkassky