

Artificial Neural Networks and some applications

Nong Van Ha

Abstract: This thesis explores the theoretical foundations and practical applications of Artificial Neural Networks (ANNs). Beginning with an overview of biological inspiration, the study formalizes the mathematical model of a single neuron and progresses to multi-layer perceptrons, focusing on the backpropagation algorithm for supervised learning. The core of the research investigates three distinct application domains to demonstrate the versatility of ANNs. First, the study implements a feedforward network for pattern recognition, specifically handwritten digit classification, achieving high accuracy on benchmark datasets. Second, it examines the use of recurrent neural networks for time-series prediction in financial markets, analyzing their ability to model non-linear temporal dependencies. Finally, the thesis applies a self-organizing map for clustering and dimensionality reduction in high-dimensional data visualization. The results confirm that ANNs are powerful tools for solving complex, non-linear problems across diverse fields. The thesis concludes by discussing current limitations, such as computational cost and overfitting, and suggests future directions involving deep learning architectures.

Keywords: Neural networks, applications, artificial intelligence, deep learning