Artificial Neural Networks and Their Applications in Business

Trevor J. Bihl
Air Force Institute of Technology, USA

William A. Young
Ohio University, USA

Gary R. Weckman
Ohio University, USA

INTRODUCTION

Perspectives of Chapter

Knowledge discovery in datasets (KDD), the process of finding non-obvious patterns or trends in datasets primarily to assist in understanding complicated systems (Mannila, 1996), leveraging computational pattern recognition methods to predict, describe, classify, group, and categorization data (Jain, Duin, & Mao, 2000). The nonlinearity of ANNs lend to modeling complex data structures; however, this also results in ANNs being complex and opaque to many users (Weckman, et al., 2009). While ANNs see application in business applications, some hesitation and misconceptions appear due to the 'black-box' nature of ANNs (Dewdney, 1997); hence traditional statistical-based models are far more used in practice. Although some interpretability aspects exist when applying ANNs (de Marchi, Gelpi, & Grynaviski, 2004), it should be noted that the interpretability of ANNs is subjective relative to other commonly used tools.

Objectives of Chapter

ANNs methods are interconnected networks of nodes, which are trained on patterns in data through statistical learning methods (Jain, Duin, & Mao, 2000). Although ANNs are computation-ally complex, inherently ANNs are statistical in nature and epistemologically similar in function to Bayesian (Beck, King, & Zeng, 2004) and likelihood methods (Verikas & Bacauskiene, 2002). Various software packages are now available for practitioners, including NeuroDimensions (2005), Matlab (2010), JMP (Sall, Lehman, Stephens, & Creighton, 2012), and R (2008). The objective of this chapter is to provide readers with a general background of ANNs, their business applications, and developing quality ANN models. The target audience is intended to be readers who may not be familiar with this form of mathematical modeling practice but may want to pursue it for their business need.

In Young, Bihl, and Weckman (2014), the authors provided a brief overview of ANNs and their applications in business. Herein, the authors have revised this discussion and included new material on ANN architectures and an example end-to-end analysis of business data using ANNs with the JMP13 Pro platform.

Biological Inspiration of ANNs

ANNs are computational machine learning models that are neurologically inspired with the intent of representing complex non-linear input and output relationships. The earliest known development of the ANN model was in the 1940s (McCulloch &

Figure 1. Biological Neuron (Young, Holland, & Weckman, 2008)
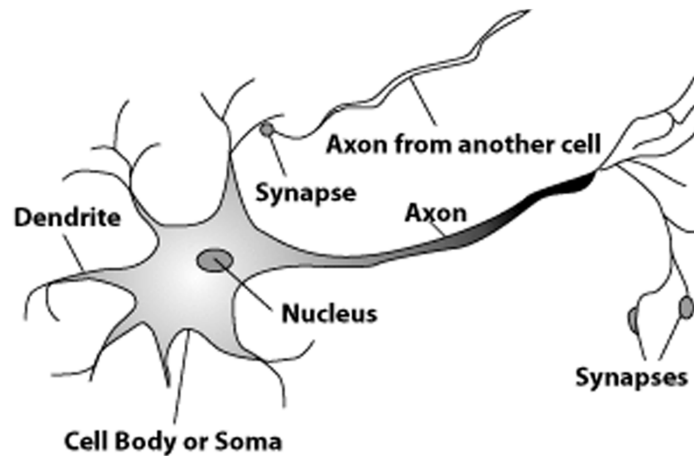
Pitts, 1943), with the fundamental building block of the ANN model being the neuron. Figure 1 displays a basic sketch of the biological neural network model (Neuralpower, 2007).

Computational ANNs extend biological neuron models by considering multiple interconnected nodes termed "neurons" which employ statistical methods to learn patterns between inputs and outputs (Jain, Duin, & Mao, 2000). Through organizational and iterative principles, connection weights between neurons, inputs and outputs are computed to learn a nonlinear input-output relationship (Jain, Duin, & Mao, 2000).

BACKGROUND: ANN PROPERTIES

Underlying Artificial Neuron Operations

Perceptrons, aka "nodes", computationally inspired models of biological neurons, employ mathematical and statistical methods to determine a mapping between independent inputs (X_1, X_2, X_3, and X_m) and a dependent variable (Y). In operation, as represented in Figure 2 and with an example linear activation function, perceptron connection weights (W_1, W_2, W_3, and W_m) and

Figure 2. Artificial Neuron, adapted from (Young, Holland, & Weckman, 2008; Li, Artificial neural networks and their business applications, 1994)
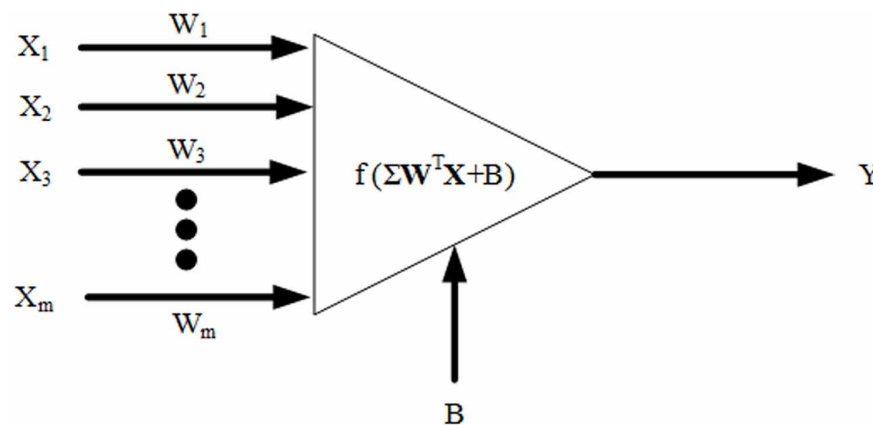
Related Content

GPU Based Modified HYPR Technique: A Promising Method for Low Dose Imaging
Shrinivas D. Desaiand Linganagouda Kulkarni (2015). *International Journal of Rough Sets and Data Analysis (pp. 42-57).*
www.irma-international.org/article/gpu-based-modified-hypr-technique/133532

Data Recognition for Multi-Source Heterogeneous Experimental Detection in Cloud Edge Collaboratives
Yang Yubo, Meng Jing, Duan Xiaomeng, Bai Jingfenand Jin Yang (2023). *International Journal of Information Technologies and Systems Approach (pp. 1-19).*
www.irma-international.org/article/data-recognition-for-multi-source-heterogeneous-experimental-detection-in-cloud-edge-collaboratives/330986

Overview of Dooyeweerd's Philosophy
Andrew Basden (2008). *Philosophical Frameworks for Understanding Information Systems (pp. 32-61).*
www.irma-international.org/chapter/overview-dooyeweerd-philosophy/28080

Adaptive Hypermedia in Education
Vehbi Turel (2018). *Encyclopedia of Information Science and Technology, Fourth Edition (pp. 2357-2368).*
www.irma-international.org/chapter/adaptive-hypermedia-in-education/183949

Immersing People in Scientific Knowledge and Technological Innovation Through Disney's Use of Installation Art
Jonathan Lillieand Michelle Jones-Lillie (2018). *Encyclopedia of Information Science and Technology, Fourth Edition (pp. 4692-4703).*
www.irma-international.org/chapter/immersing-people-in-scientific-knowledge-and-technological-innovation-through-disneys-use-of-installation-art/184175