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Using Open-Source Software for Business, Urban, and Other Applications of Deep Neural Networks, Machine Learning, and Data Analytics Tools

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ABSTRACT

This article provides an overview with examples of what neural networks (NN), machine learning (ML), and artificial intelligence (AI) and data analytics are and their applications in business, urban, and biomedical situations. The characteristics of 29 types of neural networks are provided including their distinctive graphical illustrations. A survey of current open-source software (OSS) for neural networks, neural network software available for free trial download for limited time use, open-source software (OSS) for machine learning (ML), and open-source software (OSS) for data analytics tools are provided. Characteristics of artificial intelligence (AI) technologies for machine learning available as open source are discussed. Illustrations of applications of neural networks, machine learning, and artificial intelligence are presented as used in the daily operations of a large international-based software company for optimal configuration of their helix data capacity system.

KEYWORDS

Artificial Intelligence (AI), Data Analytics, Deep Neural Networks (DNN), Machine Learning (ML), Multi-Factor Prediction, Neural Networks (NN), Open-Source Software (OSS)

INTRODUCTION

In a constantly evolving world, modern society also has to change, and through complex Artificial Intelligence (AI), and Artificial Neural Network (ANN) Algorithms are helping not only biochemistry to solve issues like modeling bio-processes, algorithms and methods to promote the design and synthesis of bio-compounds but also to assist with medical diagnosis, drug discovery, gene identification, and protein structure prediction such as those discussed in Sino et al. (2020).

Other applications as discussed in this article include those for business such as for prediction of credit card churn, prediction of spending of mall customers based on factors such as gender, customer identification, and annual income; and for urban applications such as prediction of the number of automobile accidents by hour of the day during different weather conditions; and prediction of Uber

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traffic and reasons for the delay. Other business applications discussed in the article include the applications of Neural Networks for cognitive routing of chatbot systems of a large software company and the use of machine learning for the optimal configuration of their Helix Data Capacity system.

The basic Neural Network layout involves the interconnection of nodes by arcs is as discussed below, and also later with the diversification of the many types of possible variants as shown in Figure 2 such as Neural Turing Machine (NTM) that includes memory cells, Hopfield Network (HN) that includes back-fed input cells, and Echo State Network (ESN) that includes recurrent cells.

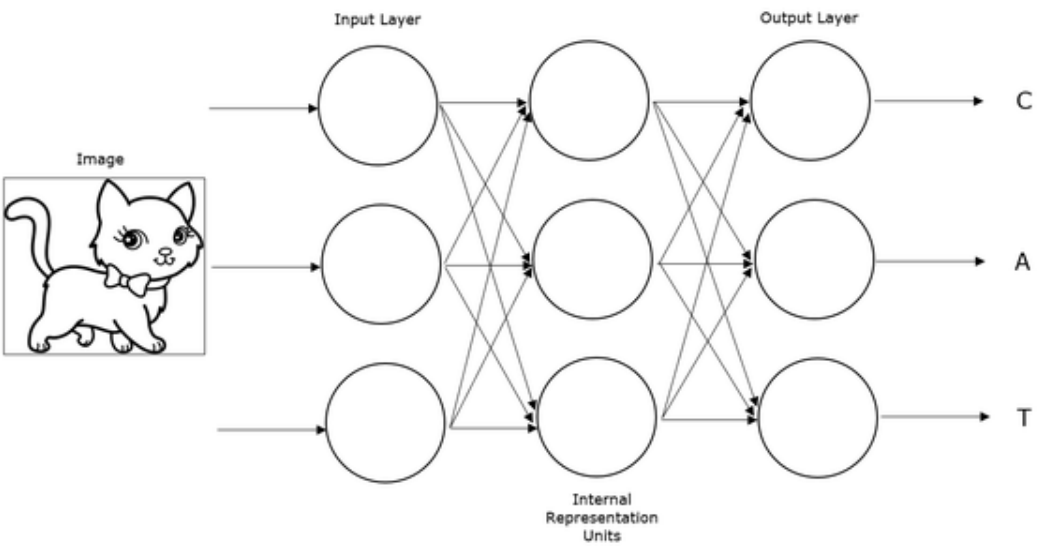
The research objectives of this paper include the provision of the availability of free and open-source software for (1.) Neural Networks that perform operations such as training, validating, and querying neural networks, and simulation of hierarchical, multilayered Artificial Neural Networks (ANN); (2.) Machine Learning includes features such as numerical computation using data flow graphs, and tensors that can develop dynamic graphs to accelerate the machine learning process; (3.) Artificial Intelligence (AI) that have features such as a diverse assemblage of cognitive algorithms, and (4.) Data Analytics has features such as rapid distributed large-scale data processing, and a platform that can create data visualizations and reports that can be embedded into web or client applications.

Neural Networks (NN)

A Neural Network (NN) is a network consisting of arcs and nodes or circuits of neurons. An Artificial Neural Network (ANN) is composed of artificial neurons or nodes. (Hopfield, 1982). A Neural Network (NN) can be either a biological neural network, made up of real biological neurons, or an Artificial Neural Network, for solving Artificial Intelligence (AI) problems. (Purves et al., 2012)

Figure 1 shows a basic Neural Network with an input layer, processing layer, and output layer of nodes. The connections of the biological neuron are modeled as weights. A positive weight reflects an excitatory connection, while negative values mean inhibitory connections. All inputs are modified by weight and summed. This activity is referred to as a linear combination. An activation function controls the amplitude of the output. For example, an acceptable range of output is usually between 0 and 1, or it could be −1 and 1. (Sharma, 2021)

Figure 1. Feed-forward neural network used for image classification task with machine learning



Statistical Model Selection for Seasonal Big Time Series Data

Brian Guangshi Wuand Dorin Drignei (2023). *Encyclopedia of Data Science and Machine Learning (pp. 3043-3056).*

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