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COMPARING THE TECHNOLOGIES USED FOR THE APPLICATION OF ARTIFICIAL NEURAL NETWORKS

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ABSTRACT: *In the past few years, artificial neural networks (ANNs) have become a practice wherever it is necessary to solve problems of forecasting, classification, or control. ANNs are intuitively attractive because they are based on a primitive biological model of nervous systems. In the future, the development of such neurobiological models may lead to the creation of truly thinking computers. The areas of application of neural networks are very diverse - these are text and speech recognition, semantic search, expert systems, and decision support systems, prediction of stock prices, security systems, text analysis, etc. Based on the wide application of artificial neural networks, the application of numerous and diverse technologies can be inferred. In this research paper, a comparative approach towards the above-mentioned technologies will be undertaken in order to identify the optimal technology for each problem area in accordance with their respective advantages and disadvantages.*

KEYWORDS: artificial neural networks, applications, modules

INTRODUCTION

Artificial Neural Network (ANN) is a computational method that integrates the concepts of the human biological brain to computers for machine learning. The main purpose is to enable computers to adapt and learn the exact behaviour of human beings. As such, machine learning facilitates the continued processing of information that leads to the capacity to solve complex problems and equations that are beyond human ability (Goncalves et al., 2013). The training and implementation of ANN involve the same principle associated with the human brain. Training activities can be categorized into two major groups: supervised and unsupervised. Each group's efficacy depends on the volume of utilized neurons. Like axons and dendrites within brain neuron cells, ANN consists of inputs and outputs known as processing components that train and validate data (Abiodun et al., 2018). There are numerous technologies for artificial neural network applications, which primarily concentrate on data mining, simulation, and projections. These applications are used in diverse fields such as medicine, economics, weather prediction, and other contemporary industries. Since a majority of these ANN technologies are compatible with the widely used Windows operating system (OS), the compared neural networks software falls under this category (Abiodun et al., 2018). Comparison of applied technologies for artificial neural networks is founded on stand-alone and application software, which either run independently or through external environments, with varying functionalities, benefits, and drawbacks.

Stand Alone Artificial Neural Networks

Stand-alone neural networks refer to software that can be directly installed on a given OS, independently from other applications.

Commercial Applications

Selected ANN applications for analysis are "Neurosolutions, SPSS Modeler, and NeuroIntellingence," which all utilize the commercial license for processing activities (Křenek et al., 2014). IBM SPSS application is mainly used for predictive analysis and data mining. The software is available across various commercial licenses with different functionalities. Significant advantages of the SPSS Modeler are associated with its increased concentration on data mining and prediction, which significantly enhances data processing. Further, it operates within the stream environment, which contains multiple nodes. These nodes make it easier to operate the SPSS modeler since it utilizes the 'drag and drop' process (Aghbashlo, Hosseinpour & Mujumdar, 2015). Evident cons of the SPSS modeler include limited functionality, relatively expensive, and similarities with Excel. Regardless, SPSS Modeler is an efficient statistical tool for complex predictive analysis.

On the other hand, Neurosolutions is also a commercial licensed ANN application. Unlike the SPSS Modeler, this application can be incorporated into a different platform such as Excel. Mainly, Neurosolutions is applied for sports projection; sales predictions; medical analysis; and cluster assessment. The Neurosolutions editor is an icon-centric Windows package that is very user-friendly. The icon-centric design and modular interface are founded on cutting-edge algorithms and intelligent wizards designated for highly accurate and accessible outputs. A specialized tool known as the 'Express Builder' allows the neural network design in a single step (Aghbashlo, Hosseinpour & Mujumdar, 2015). Tutorial instructions and commands are available for the user when utilizing any model for analyzing and validating data. Nevertheless, identified disadvantages of the ANN software are associated with the limited storage capacities and lack of the exportation or saving feature.

The final commercial ANN application is referred to as NeuroIntelligence, which mainly helps in data classification, pattern development, and predictive modelling across diverse fields. Compared to the SPSS modeler and Neurosolutions, this neural network application is based on the standard dialogs initiated by standard Windows software (Imanuel, 2021). Additionally, the application's environment is equivalent to table processor. To facilitate neural network design, the application integrates a dataset that is capable of setting attributes for data outputs. More advantages of the software are attributed to the random automated algorithms that are easily applicable for data testing and processing. Its ease of use allows constant optimization of ANN architecture that visualizes the conformance rate of all datasets during the assessment stage (Imanuel, 2021). The platform also enables developers to integrate large datasets of up to several gigabytes. Unlike the other two commercial ANN applications, NeuroIntelligence's neural net mechanisms have no identified functional limitations, making it a high-performance and faster solution for neural network training and validation.

Open-Source Applications

In this section, typical open-source neural network applications are compared, including *Neuroph Studio, Weka, Neuro Designer,* and *FANN.* These open-source ANN applications are distributed with their licenses or source code being available for improvement by programmers. Neuroph Studio is Java-based neural network software that allows the development, training, and saving of neural designs. It can be used for stock market forecast, image recognition, and data normalization. The software consists of Java library source codes and a user-friendly graphical user interface (GUI) network editor to quickly develop Java ANN components. The software is licensed using Appache 2.0, which can be integrated under GPL license to sustain flexible modifications (Křenek et al., 2014). In addition to its simplicity, Neuroph Studio applies the 'drag and drop' technique when incorporating input functions, layers, and nodes. The user can easily save the project using separate files for advanced assessment and data training. Identified drawbacks of the software include less security due to frequent modifications, lack of coding standards, and the implementation of a joint license environment. Neuroph Studio remains an effective platform for creating and training neural designs.

Similar to Neuroph Studio, Weka is a Java-based neural network application that operates under GPL licensing. Its functionality involves data classification and machine learning algorithms that are either directly applied to a dataset or a different Java code. Major tools associated with Weka software encompass regression, cluster, pre-processing, and visualization aspects (Negassi et al., 2020). For instance, multilayer perceptrons (MLP) and related neural network functions contain visualization and pre-processing options, capable of filtering massive amounts of data for improved classification, processing, and clustering (Křenek et al., 2014). Additionally, the ANN application allows advanced editing of input data in a particular and required format by developers. The only identified drawback of Weka neural network application is its complex usability, which necessitates a level of necessary knowledge. Overall, Weka serves as an advanced open-source platform for machine learning and data mining.

Contrary to the two discussed open-source neural networks software platforms, Neuro Designer is a desktop software that applies ANN for data mining. Major advantages of the application involve its user-friendly feature, enhanced analytics, and pattern recognition abilities. Developers widely integrate Neuro Designer in the identification of data interactions and predicting trends based on actual data. Nevertheless, the ANN application has relatively limited functionality regardless of its compatibility with multiple programming languages. Primarily, the neural network design entails only two hidden layers and a few activation functions (Křenek et al., 2014). The user cannot export or open programs using external datasets, which significantly hinders the flexibility of the open-source environment. With respect to these drawbacks, Neuro Designer is not highly recommended for data mining since it comprises limited functions, layers, and bias.

Compared to Neural Designer, FANN (*Fast artificial neural network*) integrates multiple layers for neural network design (Křenek et al., 2014). Consequently, FANN differs from the discussed open-source applications, in which it is not entirely a stand-

alone ANN and necessitates other GUI for optimal functionality. Through numerous activation functions, FANN is compatible with around twenty programming languages, including Matlab, C++, Python, C, and Java (Negassi et al., 2020). The identified disadvantage of this application entails relatively low-security features due to its open-source library. Nevertheless, FANN utilizes available data and complex interactions to create and train neural architecture. Additional benefits encompass its diverse integration across different systems such as Linux, iOS, and Windows, making it a fundamental choice for developers. Thus, as a well-documented ANN application, FANN effectively designs neural networks using diverse programming tools.

Application Modules

This group of neural network applications executes on other software or environment. The comparison of various application add-ons for neural networks is based on commercial modules designed to function in different environments; and open-source modules, which encompass popular programming languages.

Commercial Modules

The majority of commercial add-ons encompass statistical tools that are integrated into different programs. StatSoft's SANN (*Statistica Automated Neural Networks*) is an advanced tool for data normalization, missing data imputation, regression, scaling, and other series problems that necessitate network learning algorithms (Křenek et al., 2014). This application runs on Statistica software. Main advantages of SANN include an appropriately detailed assessment of datasets during both processing stages. The inclusion of pre-built ANN topologies and an efficient design wizard allow the development of networks of any size depending on the need and reasonability.

A similar commercial add-on is the NNT (*Neural Network Toolbox*), which runs on Matlab and Mathematica as a powerful deep learning tool for developing, training, and simulating networks such as clustering, nominal values, and time series challenges. Both SANN and NNT assist novice developers in solving complex numerical computation problems for engineering and mathematical fields (Goncalves et al., 2013). NNT is highly flexible and allows enhanced data visualization, making it a resourceful tool for data processing.

Another similar commercial add-on is the *NeuroXL* software integrated with MS Excel and two modules (Clusterizer and Predictor) (Křenek et al., 2014). As a predictive analysis tool, the software is highly beneficial due to its ease of use and mass distribution. For the three discussed commercial add-ons, the main disadvantage is the need to purchase and implement two licenses for the neural network tool and the software environment.

Open-Source Modules

Common open-source add-ons for neural network design are the Python and Java programming languages. *Python* is popular open-source programming that is widely used across most Linux OS distributions. It is an object-oriented machine learning technique founded on scripting. As such, the main disadvantages of Python include difficulty in usability, limited sources of reliable codes, and huge memory consumption

(Abiodun et al., 2018). Nevertheless, major Python modules such as Feed-Forward ANN solution and PyBrain comprise high computing speed, processing topologies of neural networks, and capacity to export programs in useable and compatible formats. Consequently, *Java* is a widely-used programming language, capable of creating desktop applications, big data processing, and related embedded characteristics. Compared to Python language, Java executes much quickly but takes more time to develop (Abiodun et al., 2018). Java language is also object-oriented but preferred for shorter programs due to its complex nature. Similarly, the major disadvantages associated with Java are the lack of user-friendly scripting, huge memory and processing requirements, and no backup feature (Negassi et al., 2020). Nevertheless, Java neural network tools such as Simbrain assist developers and novice users solve probabilistic challenges using learning networks.

CONCLUSION

There are numerous artificial neural networks utilized to design and validate machine learning components across diverse fields. The discussed array of technologies is primarily categorized based on licensing and execution environment for various projects and purposes. Comparison of applied technologies for ANN is founded on stand-alone and application software, which encompasses commercial and open-source modules with varying functionalities, benefits, and drawbacks. Identified neural network tools and software are summarized in Table 1 below, in accordance with their advantages and disadvantages.

Table 1. Summary of various technologies for the application of ANNs

No	Name of the Software	Advantages	Disadvantages
1	SPSS Modeler	. used for data mining, predictive analysis, and data processing. . works on Windows, OS X . contains multiple nodes . ease of use due to the 'drag and drop' technique	. limited functionality . relatively expensive . similarities with excel
2	Neurosolutions	. founded on intelligent wizards and algorithms . increased accuracy and user-friendly . availability of user tutorial	. limited storage capacities . incapable of exporting programs

3	NeuroIntelligence	. used across diverse fields for data classification, pattern development, and predictive analysis . easily applicable . random automated algorithms . works with large datasets of up to several gigabytes	. no identified limitation
4	Neuroph Studio	. comprise of java library source codes . user-friendly GUI ANN editor . numerous storage format files	. less security . lack of coding standards . need for a joint licensing environment
5	Weka	. contain data visualization and pre-processing functions . capable of filtering massive amounts of data . allow advanced editing of input data in a particular format	. complex usability
6	Neuro Designer	. user-friendly feature . enhanced analytics . pattern recognition abilities	. relatively limited functionality . user cannot export or open programs using external datasets . less layers and activation functions
7	FANN	. compatibility with around twenty programming languages . integrates multiple layers for	. relatively low-security features due to its open-source library

		neural network design . diverse integration across different systems	
8	SANN	. appropriately detailed assessment of datasets . development of networks of any size depending on the need and reasonability	. need to purchase and implement two licenses for the neural network tool and the software environment
9	NNT	. ability to solve complex numerical computation problems . highly flexible	. need to purchase and implement two licenses for the neural network tool and the software environment
10	NeuroXL	. powerful deep learning tool for clustering and time series solutions . ease of use . mass distribution	. need to purchase and implement two licenses for the neural network tool and the software environment
11	Python	. object-oriented machine learning technique . high computing speed . capacity to export programs in useable and compatible formats	. difficulty in usability . limited sources of reliable codes . huge memory consumption
12	Java	. Java executes much quickly . big data processing abilities . capable of solving probabilistic challenges using learning networks	. takes more time to develop . lack of user-friendly scripting . huge memory and processing requirements

REFERENCES

Abiodun, O., Jantan, A., Omolara, A., Dada, K., Mohamed, N., & Arshad, H. (2018). State-of-the-art in artificial neural network applications: A survey. *Heliyon*, *4*(11), e00938. DOI: 10.1016/j.heliyon.2018.e00938

Aghbashlo, M., Hosseinpour, S., & Mujumdar, A. (2015). Application of Artificial Neural Networks (ANNs) in Drying Technology: A Comprehensive Review. *Drying Technology*, *33*(12), 1397-1462. DOI: 10.1080/07373937.2015.1036288

Goncalves, V., Maria, K., & da Silv, A. (2013). Applications of Artificial Neural Networks in Chemical Problems. *Artificial Neural Networks - Architectures And Applications*, 203-223. DOI: 10.5772/51275

Imanuel. (2021). Top 27 Artificial Neural Network Software in 2021 - Reviews, Features, Pricing, Comparison - PAT RESEARCH: B2B Reviews, Buying Guides & Best Practices. Retrieved 22 April 2021, from https://www.predictiveanalyticstoday.com/top-artificial-neural-network-software/

Křenek, J., Kuca, K., Krejcar, O., & Maresova, P. (2014). Artificial Neural Networks Tools for Computerised Data Modeling and Processing. *CINTI2014*. Retrieved from https://www.researchgate.net/publication/268995502_Artificial_Neural_Network_Tools_for_Computerised_Data_Modeling_and_Processing

Negassi, M., Suarez-Ibarrola, R., Hein, S., Miernik, A., & Reiterer, A. (2020). Application of artificial neural networks for automated analysis of cystoscopic images: a review of the current status and future prospects. *World Journal Of Urology*, *38*(10), 2349-2358. DOI: 10.1007/s00345-019-03059-0