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AN ASSESSMENT OF NEURAL NETWORK ALGORITHMS THAT COULD AID SME SURVIVAL

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Abstract: Artificial Neural Networks (ANNs) have been used in a wide variety of application sectors from credit card fraud detection to transportation. Over the last two decades many algorithms have been applied in the areas of classification, association, prediction and filtering of data. Such systems would allow managers of smaller businesses to determine the significance of large volumes of data quickly and just as importantly data can be classified and ordered based on the importance of the data to a predefined task for smaller businesses. Mantagno et al (2002) proposed using neural networks for identifying organisational improvement strategies. Even though Mantagno's research focused on large organisations we believe it is imperative that smaller businesses adopt a similar approach as it could well be the deciding factor between business decline and business survival. Choy et al (2003) supports this approach in arguing that there has to be a technological searching strategy to support businesses and effective management. Although it is now possible to find many neural network models being incorporated into business applications it is still uncommon in the smaller business sector. This paper is a review of neural network algorithms applicable to SMEs.

1. Introduction

A small business is essentially made up of between ten to ninety nine members of staff (10-99) whereas a medium enterprise is made up of one hundred to approximately five hundred members of staff (100-499) (Duarte, 2004). Small and Medium enterprises continue to envision a future with limitless growth and staff continuity. Unfortunately, not all SMEs can withstand competition. To ensure that such competition is being kept at bay the need for technology usage is now at the forefront of most businesses (Walcott and Williams, 2006).

SMEs need to identify core business practices and be readily available to evaluate such practices in order to maintain profitability and in essence

continue to survive. For larger businesses there may be specialists that are continually involved in ensuring that the health of such firms is continually evaluated and validated in order to meet company objectives. In SMEs though, it may often be impossible to do so, as there may be no one capable of undertaking such tasks or they may be financial barriers that make such evaluations impossible. Neural networks are one of many tools that are being touted as innovative mechanisms that can ascertain problems from the data which might be available to SMEs. Therefore suggesting that the technology associated to neural networks must be considered applicable to the business needs of smaller businesses. As a result of this, key questions that will need further examination are, how can

such networks help the smaller business sector? Why not some other forms of technology as opposed to this one?

In order for small businesses to maintain any area of business performance, technology may have to be created or adapted for such businesses to attain specific objectives such as the questions raised in the previous paragraph.

2. Challenges of SMEs

The need for technological advancement is overwhelming; therefore businesses must be prepared to embark on information technology usage. Smaller businesses often do not have information technologists amongst their staff. This in effect makes adoption or implementation of technology difficult, as time and expertise will have to be administered for ensuring that the right type of technology is being suggested for the business practices of a particular SME (Lawson et al, 2006).

Major challenges faced by SMEs include but not limited to the following: large volumes of data, limited staff, and customer demands cannot be met and products and services cannot be identified easily. Smaller businesses tend to have large volumes of data and limited members of staff. Therefore an effective and efficient use of information technology may increase productivity of such organisation's business practices, which will ensure that operational targets are to be met, achieving customer satisfaction and a decrease in staff workload. A diminishing of staff workload will ensure that there is a more structured approach for achieving growth of such businesses. This implies that staff is better placed to deduce new business ventures

that can be aligned to business continuity (Lohrke et al, 2006).

The problems faced by smaller firms often tend to revolve around meeting the demands of customers and erasing the competition in an area of operation. To this effect small businesses are hindered, as they need to know the potentiality of embarking on new products and services as this will be an essential requirement if such a small business is to be considered vibrant in terms of meeting the needs of customers (Morgan et al, 2005 and Quayle, 2002).

The suggestions of the preceding paragraph does infer that if an SME cannot identify products and services then the advent of technology usage must be used as a driver for ensuring that a feasible market is worthy for the business to diverse into. This has to be considered a core challenge because now the smaller firm will also need to identify the types of customers currently interested in any products or services that will be relevant in that newer area of operation. To this effect, if this new region of potential business growth is to be capitalised on then it does mean that the business may also need to physically relocate. However, this does suggest that any technology to be embarked upon will have to be examined and as a result the business needs to become fully conversant in the underlying principles of the technology to be adapted or implemented (see section 2.1 below).

For smaller businesses to truly comprehend the significance of embarking on technology they must be willing to critique the technology. Therefore, pros and cons of the technology to be adapted must be examined critically in that such approaches need to ensure that the core business goals are being met. However, there has to be a sustained benefit in the

form of a deduction of technological relevance, any system must be able to ensure that operational targets can be achieved in a timely manner, any system being used to address competition issues must be precise and such technology must be cost effective for the chosen small firm. The need for understanding the aims and objectives of the technology to be implemented or adapted must be fully

appreciated if such technology is to benefit a smaller firm (see section 2.1 below).

3. Overview of Artificial Neural Networks

Artificial Neural Networks (ANNs) consist of input nodes (or neurons), hidden nodes and output nodes. Weighted connections formed from nodes work together in order to interpret meaning from data inputted to the network.

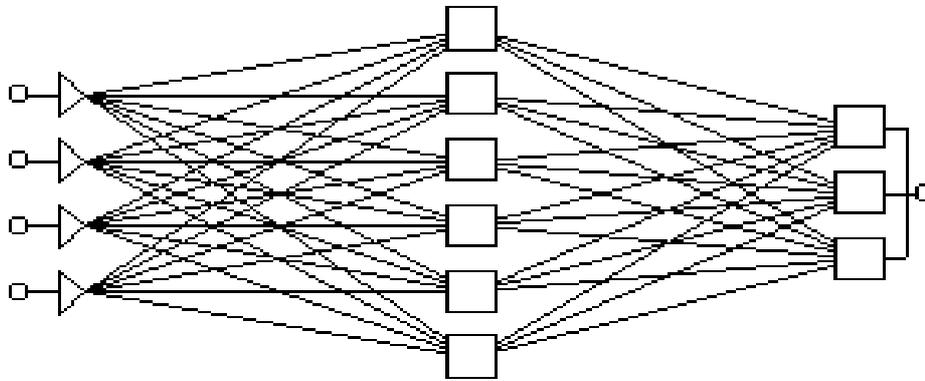


Fig.1 shows a feed forwarded network (StatSoft, 2003).

Each type of network created (and associated algorithm) may conform to a different learning technique. However, there are three distinct types of learning paradigms and they are supervised, unsupervised and reinforcement learning (Palmer-Brown et al, 2003). Supervising learning is an approach that allows for a network to be given a set of examples. These examples are known as training data. Each set of training data may consist of pairs of input objects (vectors) and a desired output. Unsupervised learning is a method used in neural networks that allows for a model to fit observations. This means that there is no structure forced on the learning but rather the network identifies similarities in data and as such

creates patterns and groupings purely on the information at its disposal.

Learning known as reinforcement refers to a class of problems which is based on the assumption that an agent examines its environment. Therefore, each agent in turn determines its current state and takes actions accordingly. As a result of this the environment will provide a reward (either positive or negative). Reinforcement learning is similar to supervised learning on the basis that the desired output is often known or at least controlled by the designer of the network. However, in actuality this type of learning functions essentially between both supervised and unsupervised modes of operation. There are no correct inputs or outputs but rather

reinforcement learning will allow a neural network to achieve a balance between data exploration and knowledge exploitation (Williams and Howe, 2002). Consequently, reinforcement assists in analysing unknown data but also in assessing knowledge that has been extracted from data initially.

3.1 Types of Neural Networks

Neural Networks normally take two forms. They are either feed forward or feed back networks. However, they are networks that possess capabilities of both such as a snap-drift algorithm (Lee et al, 2004) and recurrent networks such as those used for natural language processing (Palmer-Brown et al, 2002)

Feedback Networks can have too much iteration and may result in the learning and training process becoming greatly enhanced. For feed forward networks learning and training will be quicker as this takes place in only one direction hence cutting down on iterations highlighted in feedback types of neural networks.

The design process associated with feed forwarded networks is rather simplistic and often easier to comprehend as opposed to fed back types of networks, which are larger in terms of architecture and will result in greater complexity in the design process.

The type of neural network to be implemented (or adapted) will depend on the nature of the business and the types of data that the business currently possesses. Therefore, a business considering neural network use should in fact become aware of the business applications of such systems as it gives the organisation the opportunity to deduce if there are current models or algorithms that can be adapted

especially if such systems have been used in similar areas already. The choice of implementation can be considered if there needs to be a neural system to address specific issues that are only relevant to your specific business practices.

4. Business Applications of Neural Networks

Over the last two decades, ANNs have been continually used for solving problems in the business sector. The nature of neural networks allows them to model systems considered to be non-linear. This makes it possible for such systems to analyse data sets inputted very quickly. To this effect these types of networks have been used as modelling tools across a variety of business areas such as banking, finance, insurance marketing, operations management and the retail sector (Smith and Gupta, 2000).

The usage of neural networks for purposes of acquiring competition is not a new approach. However, neural networks are considered new to small businesses because many do not yet understand the opportunities that such tools can bring to their organisations. Irrespective of this present scenario there are some smaller businesses that have been able to exploit neural networks so far. Turkeyilmaz et al (2006) uses such networks to strengthen the management of quality in the Turkish SME textile sector. Methodology development in the SME sector has also been greatly aided by using neural networks to build and examine metamodels by way of incorporating the goals and cultures of the business as input data for analysis by the network (Lawson et al, 2006).

Smaller businesses tend not to have any improvement strategies (Fernandez et al,

2006 and Mantagno et al, 2002). However, neural networks would provide such firms with an approach for deducing organisational performance. Therefore, a neural network would be able to determine the productivity in each department of the business and used for staff performance monitoring. Neural Networks could also be used for acquiring (data mining and information retrieval) business intelligence on competitors. Effective data usage will ensure that a business is essentially meeting the demands of customers and also identifying areas of weakness that need to be addressed before the competition taps into the area which could lead to financial loss.

4.1 Benefits of Using Neural Networks in Business Applications

The ability of a business to plan, control and evaluate is crucial to its existence in the changing world of business. Therefore the choice of technology should reflect the goals of the business through a thorough identification of its core business practices.

Neural networks can provide huge benefits but only if the business understands the core purposes of the technique. The fundamental characteristic of neural networks implies that they are adaptive systems. This means that an organisation relying on such systems to analyse business data do not have to continually inform the network how to interpret or act on the data inputted into such a system. The system will learn how to manipulate or interpret information from the data given to the system over a certain time period. Classification allows for neural networks to determine similarities in data. Therefore an SME operating in the textile industry could use neural networks to

determine the types of products customers are more interested in buying by examining its sales across its areas of operation then determining what types of products are most popular based on the attributes discovered from the types of textiles sold and the customers requiring such products in a specified region.

The ability to perform optimisation (Sargent, 2001 and Tu, 1996) makes neural networks a valid business tool for many SMEs. Their problems are often linked with how the business operates and if ANNs are fed data on the ability and inability of a business to deliver goods to its customers continuously over a certain time period then the neural network will identify favourable solutions for meeting customer requirements based on the data inputted into the system. Neural Networks can also be used to predict how businesses are to progress. This effectively allows small firms to determine if the current area of operation is feasible and if it suggests not, then the SME may be alerted to prioritise. Priority seeking opportunities will allow smaller firms to identify new areas of operation that SMEs might not be aware of. The technology of neural networks allows such systems to also determine relations between data. If a small firm spent too much money advertising a product in a new region of operation then the system might be able to determine how to minimize cost by advertising that newer product with an existing brand that has key similarities with the new product an identified by the neural network.

4.2 Issues that may prevent SME adapting Neural Networks

Every technology to be developed has had some type of problem and neural networks are no different.

Neural Networks cannot solve all problems (Li, 1994 and Tu, 1996): It is a good idea to ensure that proper planning and research is undertaken before deciding to use such networks. This will ensure that potential users can determine when such networks are applicable. Therefore, eradicating the possibility of attempting to solve a problem that some other system may better serve (e.g. a standard statistical tool or even a standard calculator may better serve calculating the wages of a small organisation as opposed to neural network software being deployed)

Neural Networks do not possess explanation facilities (Williams and Howe, 2002; Tu, 1996) but they can incorporate enhancements that provide transparency needed to interpret information collected from the network (RoadKnight et al, 1997). This makes it easier for the system designer to construct guidelines (or rule extraction) in order to demonstrate how the neural network analyses data in order to make decisions (Roadknight et al, 2003).

There are no specific methodologies for SMEs. However, there are methodologies created for each type of algorithm which suggests that potential adoption of neural networks will be an easier process as the problems facing particular SMEs may suggest a particular algorithm.

ANNs are often considered unpredictable but this can be both an advantage and a disadvantage. If a small firm has too much data at its disposal the use of a neural network may determine patterns of association in the data that can create new areas of operation for that small firm. This suggests that the patterns discovered may not have been seen by members of that firm and as a direct result in such a case neural networks would be of added value

to that organisation. SMEs need technology that is specific to each small firms needs therefore for neural network implementation to become a valid tool in these firms the unpredictable nature of ANNs means that there will have to be clearer guidelines for interpreting analysed data, such as those developed by Roadknight (Roadknight et al, 2003).

5. Conclusions and Further Work

This paper has highlighted some types of neural networks that can be used to aid data analysis for small businesses. For neural networks to aid SME development they will have to match the organizational objectives. Small businesses need help in extracting knowledge from data. This is one area in which such organisations are continually having problems (Walcott and Williams, 2006) suggesting that small firms will need to identify tools such as neural networks that can be used to deduce patterns in data that may otherwise have remained obscure.

The listing of all networks is beyond the scope of this paper but the principles of most neural networks are similar. They can be used to plan or forecast the activities of a business. The choice of a network will depend on the current needs of a business and whoever is advising such an organisation, and should take into account the nature of the data that needs to be analysed. ANNs possess many advantages that potentially outweigh current limitations and they may hold the answer to sustainability for smaller businesses.

Sustainability is a concept that every business strives for but for smaller businesses it is often tedious and unachievable purely because of ill-advised decision-making and poor planning.

Neural Networks are proven techniques that can make sense out of data that can otherwise become burdensome to managers (bearing in mind that a SME owner/manager may well be the only person making many decisions).

In order to truly assess how neural networks can aid SMEs then it does appear necessary to conduct interviews (or surveys). This will pinpoint problems facing these types of organisations but it will also ensure that the current data can be inputted into a neural network of choice. That data can also be examined against traditional approaches used by such companies in order to determine how efficient neural networks truly are for specific SME problems. Assuming that the latter can be achieved this will give clearer insights into how such techniques can be adapted across a wider spectrum.

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