

The Impact of Machine Learning in Business Applications/Processes

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Abstract—The following literature review delves into the impact of Machine Learning and its future in business applications/processes. The history and future of machine learning and similar technologies are presented within this review. The machine learning aspect refers to the artificial intelligence (AI) in computing. The literature review looks at the work that examined the future of technology and its importance it has on the industry.

1 Introduction

The idea of Machine Learning and AI first originated from Alan Turing. He was an English Mathematician who published a paper in 1950 titled "Computing Machinery and Intelligence". In this paper, Turing poses a question "Can machines think?". This question is simple, but complex. It proposes if a machine can exhibit thought, indistinguishable from a human. In Turing's paper, he discusses "The Imitation Game" which is later coined as the Turing Test. The Turing Test tests the ability to exhibit intelligent behaviour. The test proposes that a human evaluator would judge natural language conversations between a human and a machine designed to generate human-like responses. The object of the test was for the interrogator (human) to determine if he/she was either talking to a person or machine. This was decided by the interrogator posing questions in which the subject had to answer.[1]

In 1959, Arthur Samuel, coined the term "Machine Learning" while studying the area of computing and artificial intelligence. He was an American pioneer in Machine Learning and this is evident from his paper "Some studies in machine learning using the game of checkers". This paper investigates in detail, two machine learning procedures using the game of checkers. It validates the theory that a computer can in fact be programmed to learn how to play a game of checkers more efficiently than a human. When given set rules of the game, the machine can learn within a relatively short period of time.[2]

Joachim Herbst and Dimitris Karagiannis in their paper, put forth their theory that integration of machine learning in work-flow models which enable a more inductive approach in comparison to the current work-flow management systems. They postulated the application of two different algorithms based on hidden Markov models. The preliminary algorithm is bottom-up and specific-to-general, whereas, the secondary algorithm applied a top-down general-to-specific strategy. A thorough evaluation of six scenarios was carried out and the two algorithms were implemented in a research prototype. ADONIS, the business process management system, was induced with a combination of both work-flow models.[3]

In today's world, business process decisions which leverage machine learning technologies are being optimised by a significant number of applications built by IBM. These business applications designed and developed by IBM are also used for their own internal use and their clients. The necessity for scalability, automation and robustness is now of preliminary concern as machine learning applications are being embedded increasingly in operational IT environments. The necessity for real-time and on-line machine learning methods are driven by applications exhibiting the high-volume in a low-latency streaming environment.[4]

As proven, the rise of machine learning is becoming more and more evident in the future of business applications processes.

2 Business with Deep Machine Learning

In an article published by PR Newswire in October 2017, methods were presented helping companies attract new clients, thereby, increasing revenue and enhancing brand awareness. This was done using deep machine learning.[5] This is changing the way companies do business online. These methods include:

2.1 Informed Product Suggestions

This improves conversion and units per transaction. Deep machine learning removes the lack of personalised services by providing relevant product suggestions. This is based on user behaviour such as user interests and certain items the user searches for. This drives unit growth potential similar to how a salesperson who asks open-ended questions to uncover consumer needs for appropriate solutions.[5]

2.2 Improved Customer Service

Customer service is improved to drive customer retention. Deep machine learning achieves this by the use of service chat-bots to assist users. The machine quickly learns common questions based on product and service issues, along with

the success of re-directs. Relevant solutions are found as machines learn to "understand" the user and their issues better.[5] This enhances the user experience as the machine finds relevant solutions more efficiently.

2.3 Improved Search Function

Deep machine learning improves search functionality by learning from the users context and returning relevant information. Online behaviours and interests are analysed, along with phrasing habits, to create relevant search results. This provides accurate search results which lead to improved retention, conversion, social proof, repeat business and overall revenue growth.[5] For example, Google provides tools for search engine optimisation, which demonstrates the use of improved search functionality.[6]

2.4 Predictive Pricing

The issue is that retailers have always struggled to balance competitive pricing with margin driven pricing. E-commerce businesses use predictive market-right pricing which proves to be more profitable. This, in turn, attracts more consumers to the site via adverts. These deep machine learning algorithms provide online retailers with predictive analysis about pricing trends, product rates, and online consumer purchasing behaviours to assist in traffic driving and conversion.[5]

2.5 E-commerce Ad Segmentation

Ad segmentation is used to improve inbound traffic. Consumer behaviours and preferences are analysed by deep machine learning methods by gathering historical searches to social media platforms. This improves targeting and ad segmentation which drives traffic to e-commerce sites.[5] Customised marketing is impacted based on individual consumer online personalities.

2.6 Inventory Forecasting

Inventory forecasting is used to improve multiple factors for retailers, such as improved margins, conversion and unit movement. Deep learning removes the issues of either not being able to accommodate user demand due to insufficient inventory, or having an excess of inventory. Both of these issues diminish profitability. This is done by inventory volume prediction which is based on analysing the industry trends. Wasteful spending is minimised, along with the need for profit-spending markdowns. Retailers benefit from deep machine learning by having the appropriate items available when the consumer wants them.[5]

3 Neural Networks in Business

Neural networks are computing systems that are vaguely inspired by the biological neural networks that are comprised of animal brains. The neural network is a framework used in machine learning algorithms which process data inputs. These networks learn to perform tasks by being given a set of examples to train from. Neural networks are built from a collection of nodes, each node is given a certain input and distributes a certain output to other nodes. The output is determined by a set function that happens inside of the node.[7] Neural networks have been used on a variety of tasks, including speech recognition, computer vision, social network filtering, machine translation, medical diagnosis, and playing board and video games.[8]

Artificial neural systems have been widely utilised in numerous real-world business applications.

"In a related real-world application, Air Canada uses neural networks for airport scheduling, reducing delays from flight re-scheduling, cutting fuel and other direct costs, and shortening the idle time of the aircraft" [9]

This is in direct relation to customer demand. It is an effect of planning accuracy on the business operations. In P.J.G Lisboa and A. Vellido research [9], the study found that by using a neural network for optimal resource allocation, the company Kodak have reduced the cost of production by \$3 million per year.

Looking at the history of neural network technology in industrial and commercial communications, studies show that these technologies are on the rise and becoming more prominent in business, using different variations of algorithms.[10] As the need for certain tasks such as quality control in manufacturing, or credit card fraud detection become more vital to businesses, the more reliability will be placed on these neural network technologies.

From the recent past, some studies have stated that *"Neural network architectures will probably never be able to compete with conventional techniques at performing precise and well-defined numerical operations"*[10], but the rise of technology in this sector has been overlooked making these statements appear to be untrue. This is proven by looking at the technological advancements in the present moment. One source suggests that due to the exponential growth of big data, physicians are under pressure to innovate faster than ever.[11] The issue is that processing big data requires a large amount of time and sophisticated analytic tools. However, the rise of artificial intelligence using neural networks, physicians can use this powerful technology for assistance, shortening processing times.

4 Forecast of A.I. & Machine Learning

"Artificial Intelligence is not only shaping the tools and platforms we use, but the way our job roles are evolving"[12]

The impact of artificial intelligence and machine learning is evolving rapidly, making a business era that is more exciting. This technology is allowing for small businesses to thrive. For small business owners, some may have found it difficult to manage the administrative duties a business needs to run, but introducing artificial intelligence can aid in performing these duties. This technology can perform these tedious tasks, while at the same time without being intrusive into the business. It allows for the small business owner to be able to be submersed into running the business and be more interactive with the team of workers. Keeping this connection is crucial for businesses.[12]

Some sources suggest that in the near future, every business and work force on the globe will be replaced by artificial intelligent machines.[13] This has already been the case in some scenarios. For example, the need for travel agencies are no longer needed. Various professions will be effected by the growth of this technology, may this be a positive or negative effect. These changes will mainly impact the 'knowledge' workers in business, along with the workforce who deals with the customer-facing functions. In 2015, the World Economic Forum (WEF) made a prediction that a 'Fourth Industrial Revolution' will occur, due to major advancements in Artificial Intelligence, machine learning, along with other technologies.[13] The WEF made an estimation of 7.1 million jobs will be lost due to the innovations, and that two-thirds of these jobs will be "*concentrated in the Office and Administrative job family.*" This source suggests that the solution to this, is to up-skill the workforce to retain those appointments. Combining these technologies with up-skilled workers will avoid any gloom scenarios.

Due to the importance of Artificial Intelligence in many fields, it has made significant growth and progress. Along with neural networks, deep learning and machine learning, Artificial intelligence is being used to solve more complex problems in businesses everyday. Such problems include the likes of finance, social commerce, predictive analytics, macroeconomic measurement and forecasting, and business intelligence and analytics.[14] Business models will change for the good, as artificial intelligence has been a huge breakthrough in the technology sector. Many companies have acquired artificial intelligence into their business systems, to obtain a competitive advantage in providing new products and services, while immensely improving productivity. These technological advancements will aid business firms to make most rational decisions, solve difficult problems and improve their overall performance.

Machine learning has made a substantial amount of progress over the last decade, with a huge number of applications in many different domains. Studies suggest that finance benefits the most from machine learning, in particular

bankruptcy prediction and credit scoring.[15] The financial statement fraud risk have been assessed by Song et al., (2014), and have put forward a hybrid assessment method combining the rule-based system with machine learning [16]. They have optimised the traditional machine learning method and lowered the error rates, via the data from Chinese firms.

5 Conclusion

For now, and the future, it is clear that much more domains are going to be affected by machine learning and artificial intelligence. The impact this technology is having on the business sector must not be overlooked. It must be utilised to its full potential to achieve cohesion in our business sector.[17] These business's and companies need to be ready to implement these strides in innovation. On the other hand, these technological developments may in fact lead to vast unemployment of the low-skilled workforce. As seen from recent developments, some business's have already begun to migrate towards the change that these technologies are having on the business sector.[18] Manufacturing firms and non-manufacturing firms have a positive attitude towards using artificial intelligence and machine learning. The reason for this is that it impacts this sector favourably in relation to computing and handling big data, which in return improves productivity performance. This is imperative to enhance the potential growth rate of advanced economics and finance. This is the result of applying this technology with the up-skilled level of a firm's employees.[19]

As a summary, the current impacts and changes of machine learning and artificial intelligence on the economics and business sectors are at the relatively early stages of development.[18] Further research will have to be done to determine the full impact on machine learning in business applications and processes.

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