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INTRODUCTION

The innovations of new technologies such as Artificial Intelligence (AI) and Deep learning (DL) are changing the industries rules of competition all over the world. With the potential value and advantage of competiveness will leads AI to be much important technological development [1].

1.1 THE EMERGING OF ARTIFICIAL INTELLIGENCE

The emergence of artificial intelligence (AI) has been a transformative and rapidly evolving phenomenon with profound implications across various industries and aspects of society. Here are some key points in the timeline of the emergence of artificial intelligence:

a. Early Foundations (Mid-20th Century):

The concept of artificial intelligence dates back to ancient history, but the formalization of the field began in the mid-20th century.

Alan Turing's work laid the theoretical groundwork for AI, and his Turing Test (1950) proposed a way to determine a machine's ability to exhibit intelligent behavior indistinguishable from that of a human.

b. Dartmouth Conference (1956):

In 1956, the phrase "artificial intelligence" was coined at the Dartmouth Conference. The symposium established the birth of artificial intelligence as a distinct field of research.

c. Early AI Applications (1950s-1960s):

Symbolic thinking and problem solving were the emphasis of early AI research. During this time, systems such as the General Problem Solver (GPS) were developed.

d. AI Winter (1970s-1980s):

Despite initial optimism, AI progress slowed over the 1970s and 1980s, resulting in the "AI winter." Unmet expectations and technical obstacles reduced funding and interest.

e. Rise of Expert Systems (1980s):

During the AI winter, expert systems, which used rule-based reasoning to address specific issues, rose to popularity. While they were successful in some areas, their capacity to adjust to new situations was limited.

f. Machine Learning Renaissance (1990s-2000s):

Advances in machine learning, particularly neural networks, sparked the rebirth of interest in AI. Backpropagation and other approaches aided in pattern recognition and data processing advancements.

g. Big Data and Computing Power (2010s):

Large datasets, improved processing power, and algorithm enhancements all contributed to substantial advances in machine learning and AI applications.

h. Deep Learning and Neural Networks (2010s):

Deep learning, a subclass of machine learning based on multi-layer neural networks, has emerged as the dominating approach. Deep learning algorithms enabled breakthroughs in picture and speech recognition, as well as natural language processing.

i. AI in Everyday Life (2010s-Present):

AI technology have permeated many facets of daily life, from virtual assistants and recommendation systems to picture recognition and self-driving cars.

j. Ethical and Societal Considerations (ongoing):

The rise of AI has sparked debates regarding ethical problems, algorithm bias, privacy concerns, and the possible impact on jobs and society. These challenges must be addressed for responsible AI development and deployment.

k. Continued Advancements and Research (ongoing):

AI research in fields such as reinforcement learning, explainable AI, and the confluence of AI with other technologies such as robotics and the Internet of Things (IoT) is ongoing.

AI is still evolving, and its impact on society is likely to rise as researchers and developers investigate new possibilities and address issues related with its widespread implementation. Figure 1. depicts the AI Development Generation.

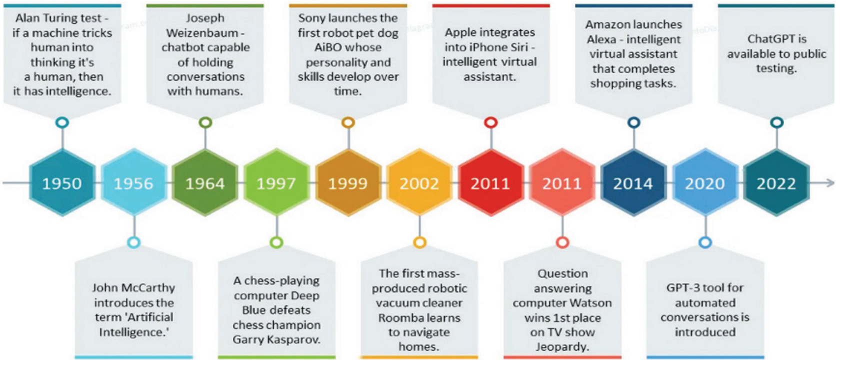

Figure 1.1. Generation of AI Development [84].

1.2 THE EMERGING OF DEEP LEARNING

Deep learning is a critical stage in the growth of artificial intelligence (AI), defined by major advances in machine learning. Here is a timeline of major events in the evolution and emergence of deep learning:

a. **Origins in Neural Networks (1940s–1950s):**

The notion of neural networks, which underpins deep learning, may be traced back to the 1940s work of Warren McCulloch and Walter Pitts. They presented a mathematical model of synthetic neurons.

b. **Perceptrons and Early Neural Networks (1950s–1960s):**

One of the first neural network models was Frank Rosenblatt's perceptron, which was developed in the late 1950s. However, due to limitations in perceptrons, such as their inability to handle non-linearly separable data, interest in neural networks declined over the 1960s and 1970s.

c. **Connectionism and Backpropagation (1980s):**

In the 1980s, the connectionist approach gained popularity, and the backpropagation algorithm, a method for training neural networks, was devised. Despite these advancements, research was hampered by the computer resources available at the time.

d. **First AI Winter and Neural Network Resurgence (1990s–2000s):**

The first AI winter, which occurred in the 1970s and 1980s, had an impact on neural network development. However, with the development of more powerful computers and the awareness that deeper architectures might address difficult issues, interest was reignited in the 1990s.

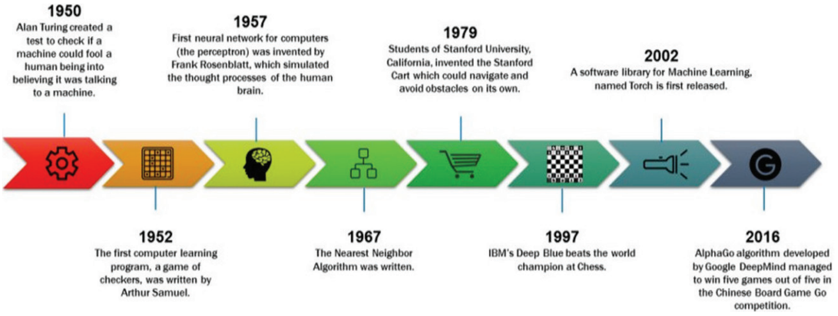

Figure 1.2. Evaluation of Deep Learning [85].

e. Deep Learning Renaissance (2010s):

The phrase "deep learning" became popular in the 2010s, owing to a renewed emphasis on developing deep neural networks. The availability of massive datasets, improved methods, and powerful graphics processing units (GPUs) for parallel processing enabled breakthroughs.

f. ImageNet and Convolutional Neural Networks (CNNs):

AlexNet, a deep convolutional neural network, won the ImageNet Large Scale Visual Recognition Challenge in 2012, showcasing deep learning's effectiveness in image categorization. CNNs have become a mainstay in computer vision applications.

g. Natural Language Processing and Recurrent Neural Networks (RNNs):

Recurrent Neural Networks (RNNs) have gained popularity in natural language processing jobs due to their ability to model sequential data. Long Short-Term Memory (LSTM) networks, an RNN version, enhanced the management of long-range dependencies.

h. Transfer Learning and Pre-trained Models:

Transfer learning, in which models pre-trained on vast datasets may be fine-tuned for specific tasks, became a dominating paradigm. This method was found to be useful in a variety of disciplines, including computer vision and natural language processing.

i. Generative Models and GANs (Generative Adversarial Networks):

For creating realistic synthetic data, generative models, notably GANs, have gained popularity. GANs can be used for picture synthesis, style transfer, and other creative tasks.

j. Ongoing Developments and Interdisciplinary Applications:

Deep learning research is continuing in areas such as reinforcement learning, unsupervised learning, and the merging of deep learning with other AI techniques. Interdisciplinary uses include healthcare, finance, and self-driving cars.

The emergence of deep learning has revolutionized AI applications, enabling machines to learn complex representations and patterns directly from data. The field continues to evolve, with researchers exploring new architectures, training methods, and applications for deep neural networks.

This section provides an overview of Deep Learning (DL), starting with a brief introduction to DL and distinguishing it from Machine Learning (ML) (Figure 1.3). We explore the inspiration behind DL, drawing from information processing patterns observed in the human brain. Unlike traditional rule-based approaches, DL operates without human-designed rules, relying instead on extensive datasets to map input to specific labels. The architectural foundation of DL involves multiple layers of algorithms, known as artificial neural networks (ANNs). Each layer in these networks offers a distinct interpretation of the input data provided to them, contributing to the overall functionality of deep learning systems.

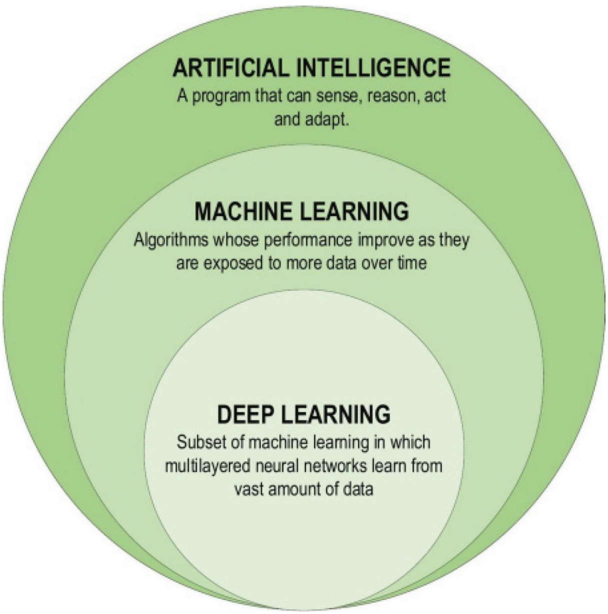

Figure 1.3. Deep Learning is subset of Machine Learning while Machine Learning is part of AI [86].

Personalized pricing in business model innovation refers to the practice of tailoring product or service prices based on individual customer characteristics, behaviors, or preferences. This approach represents a departure from traditional fixed pricing models and allows businesses to optimize revenue, enhance customer satisfaction, and respond dynamically to market conditions.

Deep learning plays a crucial role in the case of personalized pricing within the realm of business model innovation. Here's how deep learning is applied in this context:

1.3 DATA ANALYSIS AND CUSTOMER PROFILING

Role of Deep Learning: Deep learning algorithms are employed to analyze vast datasets containing customer information, transaction history, browsing behavior, and other relevant data points.

Outcome: Deep learning helps in creating sophisticated customer profiles, capturing nuanced patterns and preferences that may not be apparent through traditional methods. This enables a more comprehensive understanding of individual customers.

1.4 PREDICTIVE ANALYTICS

Role of Deep Learning: Deep learning models, such as neural networks, are used for predictive analytics. These models can predict future customer behavior based on historical data, identifying potential buying patterns, preferences, and the likelihood of responding to personalized pricing.

Outcome: Businesses can anticipate customer needs and tailor pricing strategies in advance, optimizing their approach for maximum effectiveness.

Real-time Dynamic Pricing:

1.5 ROLE OF DEEP LEARNING

Deep learning enables real-time analysis of incoming data streams. This is particularly important in dynamic pricing scenarios where prices need to be adjusted on the fly based on current market conditions and customer behavior.

Outcome: The ability to process real-time data allows businesses to implement dynamic pricing strategies, responding quickly to changes in demand, competitor pricing, and other influencing factors.

1.6 SEGMENTATION AND TARGETING

Role of Deep Learning: Deep learning models assist in customer segmentation by identifying patterns and similarities among diverse customer groups. This segmentation helps in tailoring pricing strategies to the specific needs of each segment.

Outcome: Businesses can target different customer segments with personalized pricing models, ensuring that each group receives offers that align with their preferences and behaviors.

1.7 PREFERENCE LEARNING

Role of Deep Learning: Deep learning models, including neural networks, are adept at learning complex patterns and non-linear relationships. They can capture subtle variations in customer preferences and behaviors.

Outcome: By understanding individual preferences at a granular level, businesses can customize pricing structures to align with what each customer values most, whether it be discounts, bundled offers, or other incentives.

1.8 FEEDBACK LOOP AND CONTINUOUS IMPROVEMENT

Role of Deep Learning: Deep learning models can be integrated into a feedback loop system. Customer responses to personalized pricing can be fed back into the models, allowing for continuous learning and refinement.

Outcome: Over time, the deep learning models improve their accuracy, adapting to evolving customer preferences and market dynamics, and enhancing the effectiveness of personalized pricing strategies.

In summary, the application of deep learning in personalized pricing for business model innovation empowers companies to analyze vast and complex datasets, predict customer behavior, implement real-time dynamic pricing, segment customers effectively, learn individual preferences, and continuously improve pricing strategies. This integration of deep learning technologies enhances the agility and precision with which businesses can tailor their pricing models to the unique needs of each customer.

These new technologies drives the companies experiences digital transformation [2],[3]. Digital transformation is the process to replace the traditional approach by creating new business approaches [3]. To maintain the business model with digitalization can quickly discover the errors, remedies and future improvement of the products [4]. Hence, e-Maintenance or digital maintenance is the recent research attention for recent years [5]. Digital maintenance is the area of providing the digital support for operations and maintenance decision through advanced technologies [6]. This is not only provide technical support but also provide functioning of external factors and its working methods of entire organization that are changed from traditional maintenance [5]. Pricing function with decision making has been changed from clerical task to team activity of cross functional drives planned value [7]. Developing the major pricing functionalities that can give positive impact to overall firm performance [8].

Liozu and hinterhuber [9] developed a model with price setting capabilities using robust internal process, pricing tools and training. This process incorporates the data mining techniques for analytics [10] and data asymmetries for behavioral discrimination [11]. There is a knowledge gap on these new technologies in business world and need a strong understanding on the impact of these technologies will influences the future business model innovations (BMI). However, business industry should agree a common business model language [12–16]. BMI concepts are the debate of how companies preserve their market position [17,18]. This literature focuses on BMI with the focus on how pressure companies can engage their BMI with these technologies [19]. Research studies argue that process of BMI is affected by its environment [20]. Therefore, this research paper focuses on the impact of BMI with the emerging technologies introduction for the improvement of BMI [21,22].

Innovations on business model with new techniques provides the successful firm performance [23–25] of all area business operations includes supply chain management [26], commerce [27], risk modelling [28], preventive maintenance [29] and manufacturing [30]. Predictive models are the core component of successful business analytics. Digital technologies with AI and DL are now increasing the interest on wide range of businesses. AI are the intelligent system that can perform task without programmed need [31] which will automate the decision making process through human like reasoning. Global executive study and research report on AI [32] says that 90% of respondents provide opportunities to the company because of AI. Moreover, 40% of respondents says that major investments doesn't not result in business gains. With advances in recent AI leads specific predictive model called deep learning [33] which is not specific to machine learning, it refers deep neural network that will hanging the traditional neural network with hundreds of layers and millions of neurons with complex structure [34].The focus on deep learning is why because have following reasons [35]:

- Computational power: Because of executing the linear algebra through graphical processing units for neural networks, computational capabilities are increased. For example, Google DeepMind to find best human players in the game using neural network method optimized with deep neural network which used 176 GPUs for 40 days [36].

- Data: To avoid Overfitting, large datasets are trained by deep neural networks. With increasing amount of data, DNN performance is gradually increases compared to machine learning approaches. DNN can be used with big data that are having millions of data points [36].
- Optimization algorithms: Parameters in DNN are optimized with several optimization algorithms [37] to improve the performance. The optimization process is further enhanced with common optimization methods such as Adam, Adagrad, RMSprop and variants fo stochastic gradient descent. The common issue called Overfitting on training data is handled by the integration of regularization method and optimization procedure such as weight decay, dropout to improve the generalizability.

However, our research paper discusses about the existing literature with deep learning utilization in our discipline. The objectives of this paper is as follows:

(1) Review research literature on AI and deep learning for BMI from an operational point of view
(2) Motivate why the researchers from BMI utilized AI and DL and review about the use cases, benefits and requirements
(3) Discusses about the feedback mechanisms and algorithms for price setting and price changing decisions.
(4) Investigate about the real time case studies with the improvement operational performance over traditional ML and DL
(5) Provide guidelines for researchers, practitioners who want to add value to their business analytics with AI and DL techniques.
(6) Described about the various AI and DL methods for business analytics.

Remaining section of this paper is as follows: Section 2 discussed about the literature review findings, Section 3 discussed about the mathematical background from AI to DL methods for business analytics. Section 4 discussed about the case studies and qualitative models and Section 5 concludes the survey.