Application of Deep Learning for Society

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Abstract : Deep learning has transformed the ways societies solve complex issues across many areas. The paper covers deep learning's usage and its influence on society's advancement. It examines the way deep learning (DL) models are used throughout businesses and affect society. The study examines the results of several deep learning models in important social domains at a time when Artificial Intelligence (AI) and DL are being employed to handle complicated problems. Several industries put deep learning algorithms to the test, including building, financial data analysis, and social networking. The study synthesizes information and discusses the practicalities of deep learning in varied societies.

Keywords: Deep Learning, Society, Machine Learning, Healthcare, Finance.

1. Introduction

Deep learning is one type of machine learning aimed at emulating how the human brain works so that computers can learn and make decisions without the involvement of a human being [1]. It involves the use of neural networks consisting of interconnected artificial neurons arranged in layers [2]. Image and audio recognition, natural language processing, and even gaming are just a few of the many activities that benefit greatly from these networks' ability to effortlessly learn and extract complicated patterns and representations from massive volumes of data [3]. Numerous industries have been revolutionized by deep learning due to their ability to solve issues that were previously considered too complex for traditional methods. To solve complex problems, deep learning models' ability to automatically discover hierarchical features from data has been essential in driving AI advancements [4]. Figure 1 shows the contrast between machine learning and deep learning [5].

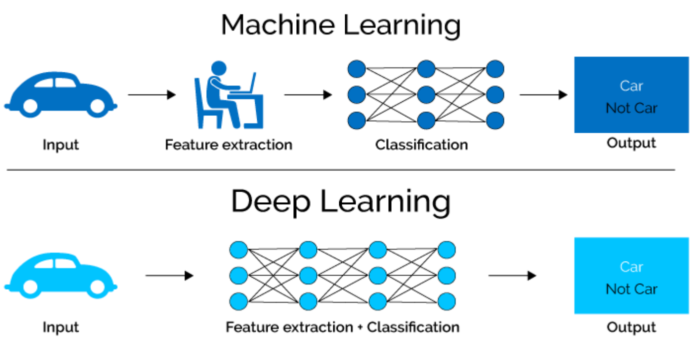

Figure 1: Comparing Deep Learning and Machine Learning

Deep learning originated with artificial neural networks (ANNs) inspired by the human brain in the 1940s and 1950s [6]. The development process was slow because of limitations in terms of computing and data. Over several decades, the field has been both enthusiastic and critical. Reintroducing and popularizing backpropagation for neural network training in the 1980s was a milestone [7]. Deep network training was computationally intensive, limiting adoption. Deep learning history is shown in Figure 2 [8].

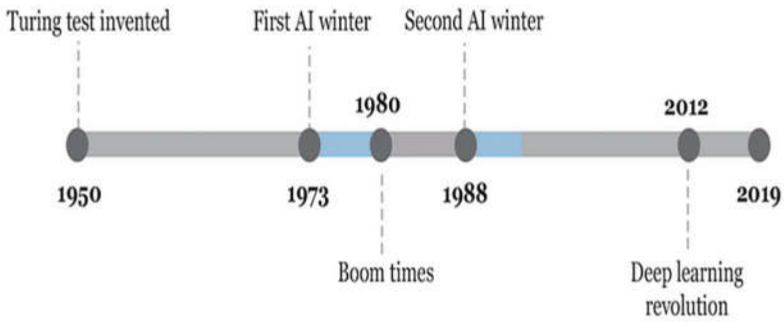

Figure 2: History of Deep Learning

The 2010s were an important decade because of the convergence of three critical factors: increased access to massive datasets, lightning-fast graphics processing units (GPUs) that simplified calculations, and innovations in neural network topologies [9]. Several fields started seeing exceptional success with deep learning approaches, especially convolutional neural networks (CNNs) for picture identification and recurrent neural networks (RNNs) for sequential data [10].

AlexNet demonstrated the promise of deep learning for picture categorization when it succeeded in the 2012 ImageNet Large Scale Visual Recognition Challenge. The field experienced a boom of attention and investment following achievement [11]. Building on earlier work, more complex structures like ResNet from Microsoft and Inception from Google significantly enhanced the effectiveness and efficiency of deep learning models. The development proceeded with the emergence of attention mechanisms, as seen in the Transformer architecture [12], and RNNs for applications such as natural language processing.

Deep learning uses neural network concepts from the human brain [13]. Artificial neural networks can learn complicated patterns from big datasets through training. They have neuronal layers [14]. Backpropagation is the fundamental principle of deep learning. It adjusts network settings by comparing predictions to results. Through iterative learning, the model's performance may be improved forever [15]. Use optimization, regularization, and activation functions to improve deep learning models' efficiency and generalizability [16]. As the subject has expanded, CNNs for image-related tasks and RNNs for sequential data have proved vital. Deep learning's success in many domains is due to its basic principles and methods, which allow machines to autonomously identify complex data patterns.

2. Impact on Various Industries

Deep learning, a type of machine learning, has transformed corporate operations and complicated problem-solving across sectors. These industries have been greatly impacted by deep learning:

1. **Healthcare**: Advanced diagnostics and imaging models quickly and accurately diagnose illnesses by analyzing medical images including X-rays, MRIs, and CT scans [17]. Deep learning also accelerates drug research by discovering novel drug targets and predicting therapeutic outcomes [18].

2. **Finance:** Deep learning models are important in finance. It analyzes large amounts of financial data to improve fraud detection, credit scoring, and risk assessment [19]. In Algorithmic Trading, these models can quickly assess market trends and make smart trading choices by understanding complex patterns and data sets [20].

3. **Retail:** Deep learning enhances several business processes. It powers recommendation systems that propose tailored products, improving the purchasing experience [21]. Deep learning algorithms improve logistics, inventory management, and demand forecasting, optimizing the supply chain. These advances demonstrate how deep learning transforms corporate operations and client relations [22].

4. **Automotive:** Autonomous vehicles manage sensor data, detect objects, and make real-time decisions for self-driving automobiles [23]. Deep learning also helps forecast and avoid equipment breakdowns, reducing industrial downtime [24].

5. **Technology:** Deep learning is crucial to several technologies. It improves voice assistants, chatbots, and language translation services in Natural language processing (NLP) [25]. Deep learning algorithms increase the accuracy and adaptability of Image and Speech Recognition technology, enabling their broad use [26].

3. Related Work

The studies presented in Application of Deep Learning for Society are critically examined in this part. The important writings of several authors are also taken into account.

1. Khanna et al., (2023) [27] introduced a deep learning-enabled healthcare condition diagnostic model using biological ECG data. The loTDL-HDD model uses DL models to identify CVDs in biological ECG data. The recommended loTDL-HDD model uses BiLSTM feature extraction to retrieve significant ECG feature vectors. The artificial flora optimization (AFO) hyperparameter optimizer improves the BiLSTM methodology. The author evaluated the loTDL-HDD model using biological ECG data in different ways. The trials indicated that the loTDL-HDD model was most accurate at 93.452%.

2. Venkateswarlu et al., (2022) [28] proposed a new OALOFS technique (the OALOFS-MLC model) which selects the best subset of features for improved classification. The classification process is also done using the deep random vector functional links network (DRVFLN) model. Nonetheless, the PIOFS system, ACOFS technique, GWOFS methodology, and PSOFS model had a low performance as they secured 95.23%, 90.81%, 89.31%, and 79.42% respectively while the OALOFS-MLC algorithm achieved an accuracy score of 98.75%.

3. Aslam et al., (2021) [29] presented a deep learning ensemble-based network for news article authentication on a LIAR dataset. To grow the dataset two deep learning models were necessary. All characteristics that were taught by the Bi-LSTM-GRU-dense model, excluding the “statement” feature, were employed in the dense deep learning model. According to experimental data, suggested research with only statement features gave an accuracy of 0.898, recall of 0.916, precision of 0.913, and F-score of 0.914. The proposed models have better performance than previous studies in detecting fake news on the LIAR dataset.

4. Tuli et al., (2020) [30] integrated ensemble deep learning with Edge computing devices and utilized it for autonomous heart disease analysis; this was done through the introduction of Health Fog. As part of its fog-based healthcare service, Health Fog uses Internet of Things (IoT) sensors to categorize cardiac patient data according to request. Compared to earlier systems that did not use ensemble deep learning, the ensemble significantly improves prediction accuracy for 5 edge nodes, increasing it by 16%.

5. Barra et al., (2020) [31] utilized a network of convolutional neural networks (CNNs) that have been trained using pictures of Gramian angular fields (GAFs) and produced from time series linked to the future of the Standard & Poor's 500 index; the objective is to forecast the direction of the US market. In a period where the buy-and-hold (B&H) strategy has superior returns, the approach achieves better results. The outcomes are presented in both quantitative and qualitative formats.

6. Ali et al., (2020) [32] suggested a smart healthcare system that uses ensemble deep learning and feature

fusion to forecast the occurrence of cardiac disease. The author compares the proposed method with other traditional classifiers that involve feature fusion, feature selection, and weightings using cardiac disorder data. The suggested one has an improved accuracy of 98.5% concerning existing techniques. The discovery showed how the technique outperformed all other currently used approaches in predicting the onset of heart diseases.

7. Nguyen et al., (2020) [33] introduced a deep learning model for the application of neural networks in hyperspectral landslide detection. Creating a design involves two steps. It used a deep belief network to extract the spectral-spatial characteristics of landslides. Finally, use a logistic regression classifier by plugging in input features and constraints to confirm the occurrence of landslides. A better framework than conventional approaches to hyperspectral image classification was demonstrated in the study. The preferred way detected landslides with a 97.91% accuracy rate, while the linear support vector machine offered 94.36%, spectral information divergence gave 84.50%, and spectral angle match was 86.44%.

8. Dong et al., (2019) [34] suggested that FL-SegNet can be applied to identify multiple faults at pixel level with a single-stage network. It was a merged segment-based architecture and focal loss function. Test results revealed that for multiple damage detection and segnet, FL-SegNet outperformed the two-streaming technique. Two steam techniques outperformed SegNet MPA: 69.54% and MIOU: 64.98%.

4. Comparison Analysis

Table 1 displays the relative accuracy of several deep learning methods applied to different sectors. The finance sector uses DRVFLN, the most precise approach, which has an accuracy rate of 98.75%. In addition, LSTM is a noteworthy approach, with 97.91% of financial data, respectively. Among the methods used for social media, Bi-LSTM-GRU has the lowest accuracy rate at 89.80%.

Table 1: Comparative Analysis (Source: Author's compilation based on literature review)

Author	**Technique**	**Industry**	**Accuracy**
Khanna et al., (2023) [27]	loTDL-HDD	Healthcare	93.45 %
Venkateswarlu et al., (2022) [28]	DRVFLN	Finance	98.75 %
Aslam et al., (2021) [29]	Bi-LSTM-GRU	Social Media	89.80 %
Nguyen et al., (2020) [33]	LSTM	Finance	97.91%

5. Conclusion

The study examined the results of several deep learning models in important social domains at a time when Artificial Intelligence (AI) and DL are being employed to handle complicated problems. The deep random vector functional links network (DRVFLN) approach is the most accurate for structure construction, at 98.75%. The research highlights Long Short-term Memory (LSTM) for financial data analysis with 97.91% accuracy rates and Internet of Things and Deep Learning enabled Health Disease Diagnosis (loTDL-HDD) for health data analysis with 93.45%, respectively. The research does provide insights into social media issues, as the bidirectional long short-term memory Gated Recurrent Unit (Bi-LSTM-GRU) model has an accuracy rate of 89.80%.

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