

Preface

In recent years, deep learning has emerged as the leading technology for accomplishing a broad range of artificial intelligence (AI) tasks and serves as the “brain” behind the world’s smartest AI systems. Deep learning algorithms enable computer systems to improve their performance with experience and data. They attain great power and flexibility by representing more abstract representations of data computed in terms of less abstract ones. The age we are living in involves a large amount of data and by employing machine learning algorithms data can be turned into knowledge. In recent years many powerful algorithms have been developed for matching patterns in data and making predictions about future events. The major advantage of deep learning is to process big data for better analysis and self-adaptive algorithms to handle more data. Deep learning methods with multiple levels of representation learn from raw to higher abstract-level representations at each level of the system. Previously, it was a common requirement to have a domain expert to develop a specific model for a particular application; however, recent advancements in representation learning algorithms (deep learning techniques) allow one to automatically learn the pattern and representation of the given data for the development of such a model. Deep learning is the state-of-the-art approach across many domains, including object recognition and identification, text understanding and translation, question answering, and more. In addition, it is expected to play a key role in many new areas deemed almost impossible before, such as fully autonomous driving. This book will portray certain practical applications of deep learning in building a smart world. Deep learning, a function of AI, works similarly to the human brain for decision making with data processing and data patterns. Deep learning includes a subset of machine learning for processing the unsupervised data with artificial neural network functions. The development of deep learning in engineering applications has made a great impact on the digital era for decision making. Deep learning approaches, such as neural networks, deep belief networks, recurrent neural networks, convolutional neural networks, deep autoencoders, and deep generative networks, have emerged as powerful computational models. These models have shown significant success in dealing with massive amounts of data for large numbers of applications due to their capability to extract complex hidden features and learn efficient

representation in unsupervised settings. Deep learning-based algorithms have demonstrated great performance in a variety of application domains, including e-commerce, agriculture, social computing, computer vision, image processing, natural language processing, speech recognition, video analysis, biomedical and health informatics, etc.

This book will cover the introduction, development, and applications of both classical and modern deep learning models, which represent the current state of the art of various domains. The prime focus of this book will be on theory, algorithms, and their implementation targeted at real-world problems. It will deal with different applications to give the practitioner a flavor of how deep learning architectures are designed and introduced into different types of problems. More particularly, this volume comprises 12 well-versed contributed chapters devoted to reporting the latest findings on deep learning methods.

In Chapter 1, recent advances in the increasing usage of biometric systems using deep learning are presented. It basically focuses on theory, developments in the domain of biometric systems, and social implications and challenges in existing systems. It also highlights the need for customers and deep learning algorithms as an alternative to solve state-of-the-art biometric systems. Future insights and recommendations are summarized to conclude the chapter.

The role of deep learning in this analysis of data and its significance in the financial market is highlighted in Chapter 2. Applications of deep learning in the financial market include fraud detection and loan underwriting applications that have significantly contributed to making financial institutions more transparent and efficient. Apart from directly improving efficiency in these fields, deep learning methods have also been instrumental in improving the fields of data mining and big data. They have identified the different components of data (i.e., multimedia data) in the data mining process. The chapter provides some recent advances and future directions for the development of new applications in the financial market.

In Chapter 3, a convolutional neural network-based deep learning framework for classifying erythrocytes and leukocytes is presented. A novel architecture is presented for white cell subtypes in digital images that fits the criteria for reliability and efficiency of blood cell detection, making the methodology more accessible to diverse populations. The proposed method is developed in Python. Experiments are conducted using a dataset of digital images of human blood smear fields comprising nonpathological leukocytes. The results reported are promising and demonstrate high reliability.

Chapter 4 proposes a deep learning framework to predict information popularity on Twitter, measured through the retweet feature of the tool and algorithmically created features. The hypothesis involved is that retweeting behavior can be an outcome of a writer's practice of semantics and grasp of the language. Depending on the understanding of humans regarding any sentence through knowledge, word features are created. A long short-term memory framework is employed to grasp the capability of storing previous learnings for use when needed. The experiments are conducted to classify a tweet into a class of tweets with high potential for being retweeted, and tweets with a low possibility of being retweeted.

Chapter 5 presents insights into recent advancements in the field of healthcare technology by employing Internet of Things (IoT) technology and deep learning tools. IoT has tremendously transformed and revolutionized present healthcare services by allowing remote, continuous, and safe monitoring of a patient's health condition. The chapter focuses on such technologies, their adoption, and applicability in the healthcare sector, which can be productized and adopted at a larger scale targeted at the mass market.

In Chapter 6, an overview of deep learning in the domain of big data and image and signal processing in the modern digital age is presented. It focuses particularly on the significance and applications of deep learning for analyzing complex, rich, and multidimensional data. It also addresses evolutionary and fundamental concepts, as well as integration into new technologies, approaching its success, and categorizing and synthesizing the potential of both technologies.

Chapter 7 presents a deep learning framework for the detection and classification of adenocarcinoma cell nuclei. The challenges involved in examining microscopic pictures in the identification of cancerous diseases are highlighted. The chapter presents an approach, i.e., region convolutional neural network, for localizing cell nuclei. The region convolutional neural network estimates the probability of a pixel belonging to a core of the cell nuclei, and pixels with maximum probability indicate the location of the nucleus. Experiments validated on the adenocarcinoma dataset reported better results.

In Chapter 8, a deep learning model for disease prediction is envisaged. The architecture developed can be helpful to many medical experts as well as researchers to discover important insights from healthcare data and provide better medical facilities to patients. To demonstrate the effectiveness of the proposed method, the deep learning architecture is validated on

electronic health records to perform disease prediction. The experimental results reported better performance for state-of-the-art methodologies.

Chapter 9 unfolds the brief history of deep learning followed by the emergence of artificial neural networks. It also explains the algorithms of deep learning and how artificial neural networks are combating security attacks. Furthermore, it describes the recent trends and models that have been developed to mitigate the effects of security attacks based on deep learning along with future scope. The impact of deep learning in cyber security has not yet reached its maximum but is on its way to creating possible new vectors for the mitigation of modern-day threats.

Chapter 10 focuses on decision trees in the data mining stream. A novel decision trees-based stream mining approach called Efficient Classification and Regression Tree (E-CART), which is a combination of the Classification and Regression Trees for Data Stream decision tree approach with the Efficient-Concept-adapting Very Fast Decision Tree (E-CVFDT) learning system, is presented. The proposed E-CART approach mines the streams on the basis of its type of concept drift. A sliding window concept is used to hold the sample of examples and the size of the window is specified by the user. Experiments are performed considering three types of drifts: accidental, gradual, and instantaneous concept drifts. The results reported using the proposed approach are compared to CVFDT and E-CVFDT.

Chapter 11 explores a model based on deep convolutional neural networks to automatically identify dementia using magnetic resonance imaging scans at early stages. Dementia is a disorder signified by a decrease in memory and as well as a decline in other cognitive skills like language and vision, and is a widespread problem in older people. The pretrained model, Inception-V3, is retrained for that purpose. The experiments are validated on the Brain MRI DataSet, namely OASIS-1, where a higher accuracy is reported on the testing dataset.

In the final Chapter 12, the primary aim is to propose a method for the classification of hand symbols. There are different stages that serve this purpose. Initially, preprocessing is applied to the hand symbols to remove the noise associated with the images. Preprocessing includes the smoothening, sharpening, and enhancement of edges of an image. The preprocessing step is followed by the segmentation stage. In this stage, a specific region or an area of interest is extracted from a hand image using thresholding. Furthermore, different features are extracted such as color features, geometric features, and Zernike moment features. These features for a hand image are applied to a set of different classifiers such as support

vector machine (SVM), K-nearest neighbor, decision tree, and native Bayes in which the SVM classifier achieves a higher accuracy.

This volume is intended to be used as a reference by undergraduate, postgraduate, and research students/scholars in the domain of computer science, electronics and telecommunication, information science, and electrical engineering as part of their curriculum.

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