Preface

Deep machine learning is an emergent area in the field of computational intelligence (CI) research that is concerned with the analysis and design of learning algorithms, representations of data, at multiple levels of abstraction. Deep learning is a technique for implementing machine learning that provides an effective solution for parallel computing environment in bi-engineering problems. It encompasses artificial intelligence (AI), artificial neural network, reasoning, natural language processing that will be helpful to human intelligence and decision making process. The heterogeneous parallel computing architectures have been significant for real-time bio-engineering applications that needed a design of a high-level operating system for matching the processing tasks to the appropriate machine learning paradigm in a mixed-machine parallel system. This effort is exerted to investigate the feasibility of a deep machine learning technique for implementing a high-level operating system for heterogeneous parallel computers.

The new frontier research era and convergence of deep machine learning and parallel computing with reference to bio-engineering has three main streams needing to be addressed in the current scenario: bioinformatics, medical imaging, and sustainable engineering. This book is integrating machine learning, cognitive neural computing, parallel computing paradigms, advanced data analytics and optimization opportunities to bring more compute to the bio-engineering problems and challenges. Further, it is important to make a note that convergence of parallel computing architectures, deep machine learning and its intelligence techniques has not been adequately investigated from the perspective of bioengineering research streams (bioinformatics, medical imaging, and sustainable engineering) and its related research issues. Obviously, these challenges also create immense opportunities for researchers.

The book will present novel, in-depth and fundamental research contributions either from a methodological or application perspective in understanding the fusion of deep machine learning paradigms and their capabilities in solving a diverse range of problems in bio-engineering and its real-world applications. The overall objective of the book is to illustrate the state-of-the-art and recent developments in the new theories and applications of deep learning approaches applied to parallel computing environment in bioengineering systems. Presently, there are many noteworthy issues (health informatics, bio-image informatics energy efficiency, etc.) that need to be addressed in the context of deep machine learning, parallel computing and bioengineering. For the aforementioned reasons, this book focuses on addressing a comprehensive nature of cognitive neural computing, parallel computing and on emphasizing its character in human intelligence and learning systems, complex analysis tasks mimicking human cognition and learning behavior, prediction and control of bio-engineering systems. This book intends to give an overview of state-of-the-art of issues and solution guidelines in the new era of deep machine learning paradigm and its recent trends of techniques for bioengineering.

ORGANIZATION OF THE BOOK

The volume is organized into 15 chapters. A brief description of each chapter is given as follows:

Chapter 1 illustrates the parallel processing basic concepts with examples in order to highlight the significance of parallel deep learning. The types of parallelization technique are addressed, and the relation between computational intelligence and parallel deep learning, the challenges in combining them together (parallel computing, graphics processing unit and new hardware for deep learning in computational intelligence research) and benefits are discussed in this chapter.

Chapter 2 presents the big data analytics with regards to the Hadoop Big Data framework for storing and processing big data, described in the context of bioinformatics. The authors have highlighted the importance of the machine learning approach for performing predictive and prescriptive analytics. Thus, machine and deep learning approaches currently being used in the context of big data analytics in the Hadoop framework have also been presented, as well as the current uses of such techniques and tools in bioinformatics are illustrated in this chapter.

Chapter 3 deals with the survey of image fusion algorithms based on deep convolutional neural network, and the results obtained by these methods are interpreted and discussed. The chapter authors have addressed the significance in combining the outcomes of different modalities to utilize the complementary information from each modality to form a better image. With image fusion, the multi-sensor data with complementary information about the particular region are comparatively analyzed in this chapter.

Chapter 4 illustrates the necessity of integrating machine and deep learning methodology with the diagnosis of brain tumor, and recent segmentation and classification techniques on magnetic resonance images (MRI) are reviewed. This chapter addressed the current trends in the grading of brain tumor with a focus on gliomas which include astrocytoma. The current state-of-the-art, software packages, evaluation and validation metrics used in different approaches are discussed, along with integration into the clinical environment.

Chapter 5 provides the essentials of deep learning methods with convolutional neural networks and analyzes their achievements in medical image analysis such as deep feature representation, detection, segmentation, classification, and prediction. This chapter reviews the different deep learning convolution neural network methods. The features, benefits, and applications of convolutional neural network methods are also discussed in this chapter.

Chapter 6 investigated how deep learning could be applied to the classification of images on the CIFAR-10 database. The chapter authors have specified deep learning technologies that are becoming more accessible for corporations and individuals and give better results than the convolution neuron network. In this chapter, deep convolutional neural networks are used for classification and GPU technology is used for parallel processing.

Chapter 7 discusses the basic deep learning network models and outlines some of the applications in health informatics. In this chapter, biomedical data can be efficiently processed by deep learning networks, which in turn increase the predictive power for many specific applications in the health informatics domain. Thus, this chapter highlights that deep learning algorithms can provide better outcomes and prediction in health informatics with the integration of advanced parallel processors.

Chapter 8 illustrates the role of deep learning and semi-supervised and transfer learning algorithms for medical imaging. The chapter authors have used classification of supervised, semi-supervised and unsupervised learning algorithms for real time medical imaging data sets and justified their profound impact on the medical field.

Chapter 9 describes the role of machine learning algorithms on both linear and nonlinear data in addressing regression and classification problems. The results obtained in this chapter are applicable to address the real time problems like classification and regression. The chapter results state that support vector machine (SVM) performs better than all other classification algorithms and the neural network (NN) approach gives the lowest mean squared error (MSE) in the regression problem.

The main objective of Chapter 10 is to consolidate the benefits of the classifications using singular value decomposition (SVD-QR) and limited memory subspace optimization SVD (LMSVD-QR) calculations for preprocessing of profound learning in multilayer neural systems. This chapter has indicated why singular value decomposition (SVD)-QR calculation is required for preprocessing of profound learning for vast scale information input.

Chapter 11 presents the challenges in storing and processing big data using Hadoop and Spark. The authors have highlighted the new analytical platforms such as Hadoop, Spark, along with MapReduce programming. The objective of this chapter is to make the readers understand the challenges in storing and processing big data and how to use different big data frameworks effectively to store and process big data.

Chapter 12 presents a novel mixed-integer linear programming (MILP) model to consider a location routing problem (LRP) for multiple perishable products with vehicles having multiple trips, intermediate depots, and soft time windows. To cope with the solution complexity of the problem, an efficient biography based optimization algorithm (BBO) is investigated in this chapter.

Chapter 13 gives a brief overview of evolutionary procedures, systolic arrays and methods to transform an iterative algorithm into architecture. Significance of parameters derived from GTDM is mentioned, and the parameters involved in selecting the best of addressed algorithms are clearly justified. The chapter authors have revealed that ant colony optimization performed the best among the selected evolutionary algorithms in addressing a systolic array mapping of grey tone distribution matrix (GTDM) computation.

The ultimate aim of Chapter 14 is to design a complete combinatorial model for the results from various screening experiments involving multimodal deep learning technique that projects into better solution of

autism identification. This chapter mainly focuses on the emotional sequence identification of children who are autism spectrum disorder (ASD) positive and ASD negative (i.e., normal TD).

Chapter 15 gives parallel machine learning and deep learning approaches for bioinformatics. The authors have outlined the deep learning and other deep-based representative learning algorithms which have been applied successfully in image understanding, speech recognition, and text classification, etc.

AUDIENCE

The overall objective of the book is to illustrate the state-of-the-art and recent developments in the new theories and applications of deep learning approaches applied to parallel computing environment in bioengineering systems. The book aims to present concepts and technologies that are successfully used in the implementation of today's intelligent data-centric critical systems and multimedia cloud big data, having a good chance to be used in future computing systems. The book will constitute teaching material for organizing the course titled Computational Intelligence for New Computing Environments, hence suitable for university level courses as well as research scholars.

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