Preface

The amount of data collected today from various applications all over the world across a wide variety of fields is expected to double for every 2 years. It has no utility unless these data/records are analyzed to get useful information. The development of powerful computers is a boon to implement these techniques leading to automated systems. The transformation of data into knowledge is by no means an easy task for high-performance large-scale data processing. Moreover, these data may involve uncertainty in many different forms. Many different models like fuzzy sets, rough sets, soft sets, neural networks, their generalizations, and hybrid models obtained by combining two or more of these models have been found to be fruitful in representing data. These models are also very much fruitful for analysis. More often than not, machine learning (ML) is reduced to include only the important characteristics that are necessary from a particular study point of view or depending upon the application area. So, reduction techniques have been developed. Often the data collected have missing values. These tuples having missing values are supposed to be eliminated from the dataset before analysis. More importantly, these new challenges may comprise, sometimes even deteriorate, the performance, efficiency, and scalability of the dedicated data-intensive computing systems. This brings up many research issues in the industry and research community in forms of capturing and accessing data effectively. In addition, fast processing while achieving high performance and high throughput, and storing it efficiently for future use is another issue.

Further, programming for ML is an important challenging issue. Expressing data access requirements of applications and designing programming language abstractions to exploit parallelism are an immediate need. While these are a few examples of issues, our intention in this book is to offer concepts of computational intelligence for ML and in healthcare informatics in a precise and clear manner to the research community, that is, the conceptual basis required to achieve in-depth knowledge in the field of computer science and information technology. Application of ML in healthcare is an emerging research issue that is related to the digital transformations in the healthcare paradigm. Today's world is wired differently compared to the past few years where almost everything can be made ubiquitously. Extreme connectivity enables more universal, global, and close-to-instant communication. These new technological models based on these emerging topics are mainly focused on collecting and connecting health-related data from all available sources, extracting meaningful information from that data, and providing that information to other players. Extreme automation, on the other hand, can be coupled with extreme connectivity or even with extreme environment, allowing computing systems to control and manage physical processes and respond in evermore "human" ways in highly connected normal environment or a challenging extreme environment.

It will help those researchers who have interest in this field to keep insight into different concepts and their importance for applications in real life. This has been

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done to make this book more flexible and to stimulate further interest in topics. All these motivated us toward computational intelligence for ML and healthcare informatics. This book is organized into 15 chapters. Chapter 1 is a review of bone tissue engineering for the application of AI (artificial intelligence) in cellular adhesion prediction. The chapter shows that most of the AI tools used were the artificial neural network in their different types, followed by cellular automata and multiagent systems. The intended use varies, but it is mainly related to understanding the variables involved and adjusting a model that provides insight and allows for a better and more informed design process of the scaffold. Health informatics primarily deals with the methodologies that help to acquire, store, and use information in health and medicine. Chapter 2 deals with the various types of ML techniques, approaches, challenges, and their future scope in healthcare informatics. Further, these techniques can also be used to make a model for quick and precise healthcare discovery. Chapter 3 reported a new method by combining the Stockwell transform as morphological features and heart rate variability as dynamic features. This final feature vector is applied as input to artificial bee colony-optimized twin support vector machines for automated recognition of heartbeats in 16 classes. The developed method can be utilized to monitor long-term heartbeat recordings and analyze the nonstationary behavior of heartbeats. The validation of the developed method is performed on the Physionet data while its evaluation is done under patient-specific scheme. An improved accuracy of 88.22% is achieved by the methodology under patient-specific scheme.

Chapter 4 discusses the stringing together of three major techniques: automatic speech recognition, automated translation by machine, and conversion of text into spoken utterance, that is, text to speech for seamless communication in healthcare services. Besides this, the technological developments and implementation of the challenges at each step are identified and briefly discussed. The performance of the S2S system is evaluated in the healthcare domain. Chapter 5 focuses on recent advancement of ML and deep learning in the field of healthcare system.

Chapter 6 explains the classification techniques in ML – supervised, unsupervised, and semisupervised – and how effectively these techniques are used in psychological disorder prediction. The accuracy levels of each technique have been reported. The recent advancements in ML techniques for predicting disorders have been explained, and also the challenges being faced while predicting psychological disorders have been studied and explained in this chapter. Chapter 7 focuses on the automatic analysis of cardiovascular diseases using empirical mode decomposition (EMD) and support vector machines. This chapter employs Hilbert–Huang transform for feature selection (FS), which is demonstrated as an effective technique capable of providing frequency spectrum that varies with time. As a result, the output coefficients are used to extract different features such as weighted mean frequency, skewness, central moment, and many more processed from the intrinsic mode functions extricated by utilizing the EMD calculation. The validation of proposed methodology

is performed on the Physionet data to identify six categories of heartbeats. The methodology reported a higher accuracy of 99.18% in comparison with previous methodologies reported. The methodology can be utilized as a solution for computerized diagnosis of cardiac diseases to serve the cardiac healthcare. Chapter 8 talks about different architectures of near-data processing (NDP), which is compatible for ML methods and the way in which NDP architectures are mentioned.

Chapter 9 discusses on the classification of various image fusion algorithms and their performance evaluation metrics. Authors have also surveyed on various type of images (single sensor and multimodal) that can be fused together and their corresponding image fusion methods. As argued in this chapter, various application areas of image fusion are explored. Strength and weakness of different image fusion methods have been discussed with examples. Image fusion results may be verified using quantitative and qualitative metric parameters. Further, various quantitative performance metric has also been discussed in this chapter. Chapter 10 provides a literature study of the health recommender systems (HRS) domain in general, which includes the literature, innovations, purpose, and methods of HRS, along with the new concept of HRS being used for medication purposes. Chapter 11 describes two case studies on dense convolutional neural network approach for medical diagnosis. From the study, it is found that the approach results are better than all the state-of-the-art approaches in this field, giving us higher accuracy. In future, authors aim to apply this approach to various types of medical images. If the desired result is achieved, it can change our way of approaching medical reports.

Time to time, survey and data have clearly revealed the hesitation and reluctance of patients to undergo robotic-assisted surgeries. While there exist many factors that determine the automation of human effort in industries, authors analyze few specific ones that lay common in that field. The analysis further proves that robots do provide various advantages in the industries. Today, robotic surgery is a major topic of research. Chapter 12 shows how impact of sentiment analysis tools can improve patients' life in critical diseases. The study shows various types of tools used in each case and different media sources, and examines its impact and improvement in diseases such as obesity, diabetes, cardiovascular disease, hypertension, schizophrenia, Alzheimer's disease, and cancer using sentiment analysis and its impact on one's life. Sentiment analysis helps in designing strategies to improve the understanding and behavior of patients.

Chapter 13 provides a multilevel image border for object segmentation. The suggested algorithm is evaluated on standard image sets using FA, DE, and particle swarm optimization, and the results are compared with entropy approaches for Shannon or fuzzy. The suggested approach shows better efficiency in objective factor than the state-of-the-art approaches, structural similarity index, PSNR, and standard derivation. ML is an application of AI, which deals with the capability of a computer to learn from the given data to gain knowledge in making predictions and decisions based on its experience. Chapter 14 shows ML can be used in healthcare.

Chapter 15 is a recent survey of evolutionary computation (EC)-based FS techniques whose objective is mainly to improve the accuracy of the ML algorithm in minimized computation time. The idea is to bring forth the main strengths of EC as a naturally inspired optimization technique for FS in the ML process. The modeling of biological and natural intelligence that has made progressive advancements in the recent decade motivates the author to review state-of-the-art FS techniques to add more to the area of computational intelligence.

This book is intended to be used as a reference for undergraduate and postgraduate students in the disciplines of computer science, electronics and telecommunication, information security, and electrical engineering.

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