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Preface

During the last decades, there has been a significant increase in the level of interest regarding the use of computational intelligent systems in the fields of biomedicine and healthcare provision. As the production and collection of digital health-related data continue to expand (the field known as electronic healthcare) and new technologies enable the rapid processing of large data volumes (the field known as big data), healthcare organizations are asking medical personnel and nurses to interact increasingly with computer systems to perform their duties. Furthermore, health data computational analysis is used for developing expert systems and machine learning algorithms to serve as diagnostic tools or to monitor therapeutic procedures or even to create new therapies. At the organization level, health data analysis is used to drive the strategic decisions of managers and stakeholders, while assisting policy makers in public health policies. In this context, the fields of computational analysis and artificial intelligence in medicine attract a lot of researchers working in the AI domain.

This book is a part of a series devoted to this emerging field of computational intelligence (CI) in health care, attempting to provide surveys and practical examples of artificial intelligent applications in the areas of human–machine interface (HMI) and affective computing, machine learning, big health data and visualization analytics, computer vision and medical image analysis. The volume also addresses new and emerging topics in CI for electronic healthcare such as the utilization of social media (SM) and the introduction of new intelligent paradigms in the critical areas of security and privacy. A summary of the contributions per chapter follows.

Chapter "Human–Machine Interfaces for Motor Rehabilitation" seeks to describe the principles of modern non-invasive human-machine interface (HMI) systems and to present current trends regarding the methods used to capture physiological and non-physiological motor-related data in order to control external devices within a rehabilitation framework. Furthermore, in regard to classification and parameter complexity, computational intelligence tools, machine learning approaches and simulation testing are presented. The relevant applications are discussed within a taxonomy based on the nature of the motor-related source data,

while methodological aspects and future challenges concerning the design of HMI systems for rehabilitation purposes are also included.

Awareness of the emotion in human–computer interaction is a challenging task when building human-centred computing systems. Emotion is a complex state of mind that is affected by external events, physiological changes and, generally, human relationships. Researchers suggest various methods of measuring human emotions through the analysis of physiological signals, facial expressions, voice, etc. Chapter "Passive Emotion Recognition Using Smartphone Sensing Data" presents a system for recognizing the emotions of a smartphone user through the collection and analysis of data generated from different types of sensors on the device. Data collection is carried out by an application installed on the participants' smartphone provided that the smartphone remains in their pocket throughout the experiments. The collected data is processed and utilized to train different classifiers (decision trees, naïve Bayes and *k*-nearest neighbours). The described system applied to a smartphone demonstrates the feasibility of an emotion recognition approach through a user-friendly scenario for users' activity recognition.

Chapter "Intelligent and Immersive Visual Analytics of Health Data" deals with the massive amounts of health data have been created together with the advent of computer technologies and next-generation sequencing technologies. Analytical techniques can significantly aid in the processing, integration and interpretation of the complex data. Visual analytics field has been rapidly evolving together with the advancement in automated analysis methods such as data mining, machine learning, and statistics, visualization and immersive technologies. Although automated analysis processes greatly support the decision-making, conservative domains such as medicine, banking and insurance need trusts on machine learning models. Explainable artificial intelligence could open the black boxes of the machine learning models to improve the trusts for decision-makers. Immersive technologies allow the users to engage naturally with the blended reality in where they can look at the information in different angles in addition to traditional screens. This chapter reviews and discusses the intelligent visualization, artificial intelligence and immersive technologies in the health domain. This chapter illustrates also the ideas with various case studies in genomic data visual analytics.

The chapter "Interactive Process Indicators for Obesity Modelling Using Process Mining" belongs in the same area of big data analytics. World Health Organization defines overweight and obesity as abnormal or excessive fat accumulation that represents a risk to health. Obesity and overweight are associated with increased risk of comorbidities and social problems that negative impact on the quality of life. Due to the complexity of the problems, it is necessary to classify obesity based on a set of factors rather than a simple increase in body weight. The objectives of this work were, to examine BMI and data available from comorbidities associated to obesity, from a dynamic perspective thanks to the use of process mining tools, in order to obtain patterns of patients' behaviours. On the other hand, the goal and contextualized interactive Key Process Indicators (iKPIs) in the field of obesity and related conditions to support health professionals to interact with the process. Modelling iKPIs has enhanced views, which will help the professionals to better

perception of these processes. Professionals will monitor patient's progress iteratively and will interact with the system to fine-tune interventions and treatments. The developed strategy can support both the characterization of general process-based KPI and the analysis of individual and personalized aspects of the processes going from general to individual. This method was applied to real data extracted from a tertiary hospital in Spain.

Chapter "Recent Machine Learning Approaches for Single-Cell RNA-seq Data Analysis" involves the processing of DNA sequencing, which has become an extremely popular assay with researchers claiming that in the distant future, the DNA sequencing impact will be equal to the microscope impact. Single-cell RNA-seq (scRNA-seq) is an emerging DNA sequencing technology with promising capabilities, but with major computational challenges due to the large-scaled generated data. Given the fact that sequencing costs are constantly decreasing, the volume and complexity of the data generated by these technologies will be constantly increasing. Towards this direction, major computational challenges are posed at the cell level, in particular, when focusing on the ultra-high dimensionality aspect of the scRNA-seq data. The main challenges are related to three pillars of machine learning (ML) analysis, classification, clustering and visualization methods. Although there has been remarkable progress in ML methods for single-cell RNA-seq data analysis, numerous questions are still unresolved. This review records the state-of-the-art classification, clustering and visualization methods tailored for single-cell transcriptomics data.

Chapter "A Review on State-of-the-Art Computer-Based Approaches for the Early Recognition of Malignant Melanoma" reviews the state-of-the-art techniques used in the development of computational intelligent systems for the detection of skin cancer and especially melanoma, which continues to be a rare form of skin cancer but causes the majority of skin cancer-related deaths. The most common technique for detection of melanoma is dermoscopy (or dermatoscopy or epiluminescence microscopy ELM), which performs the examination through an optical system (magnifying glass) with a light source (polarized light), allowing an in-depth visualization of features used for the diagnosis. Over the past decades, the efforts have been made to create computer-based systems able to analyse such dermoscopy images, assisting the early detection of skin cancer, while also allowing repeatability of results. One major issue of image dermoscopy is the inability to detect early melanoma or cases that lack optical features. To deal with that issue researchers have focused lately on molecular techniques. Aim of this chapter is to present the state-of-the-art concerning the detection methods of malignant melanoma and describe the contributions made in this area of research.

Chapter "Cardiovascular Disease Stratification Based on Ultrasound Images of the Carotid Artery" deals with the identification of cardiovascular disease (CVD) through ultrasound scans of the arteries and, more specific, the common carotid artery (CCA). Measurement of the intima–media thickness (IMT) of the CCA is an established indicator of CVD. Several reports have indicated differences of the IMT of CCA and related then with various risk factors as well as their

association with the risk of stroke. This chapter presents the work presented in this direction. The presented CVD stratification system is based on image normalization, speckle reduction filtering and active contour segmentation, for segmenting the CCA, performing IMT measurements and providing the differences between the left and right sides. The results are based on a group of 1104 longitudinal-section ultrasound images acquired from 568 men and 536 women out of which 125 had cardiovascular symptoms (CVD). The main findings can be summarized as follows: (1) there was no significant difference between the CCA left side IMT and the right side IMT; (2) there were statistically significant differences for the IMT measurements between the normal group and the CVD group for both the left and the right sides; and (3) there was an increasing linear relationship of the left and right IMT measurements with age for the normal group.

Chapter "Forecasting and Prevention Mechanisms Using Social Media in Health Care" involves the utilization of social media (SM), which is establishing a new era of tools with multi-usage capabilities. Governments, businesses, organizations, as well as individuals, are engaging in, implementing their promotions, sharing opinions and propagating decisions on SM. We need filters, validators and a way of weighting expressed opinions in order to regulate this continuous data stream. This chapter presents trends and attempts by the research community regarding: (a) the influence of SM on attitudes towards a specific domain, related to public health and safety (e.g. diseases, vaccines, mental health), (b) frameworks and tools for monitoring their evolution and (c) techniques for suggesting useful interventions for nudging public sentiment towards best practices. Based on the state of the art, authors in this chapter discuss and assess whether SM can be used as means of prejudice or esteem regarding online opinions on health care. We group the state of the art in the following categories: virus-illness outbreaks, antivaccination, mental health, social trends and food and environment. Furthermore, we give more weight to virus-illness outbreaks and the antivaccination issues/trends in order to examine disease outbreak prevention methodologies and vaccination/antivaccination incentives, while discussing their performance. The goal is to consolidate the state of the art and give well-supported directions for future work. To sum up, this chapter discusses the aforementioned concepts and related biases, elaborating on forecasting and prevention attempts using SM data.

Finally, chapter "Security and Privacy Issues for Intelligent Cloud-Based Health Systems", which concludes this the volume, deals with intelligent security and privacy in the healthcare IT sector. New technological advances such as cloud computing provide benefits and have changed the way we store, access and exchange information. Especially, in the healthcare IT sector, cloud-based systems offer great potential, from many perspectives, including improved medical diagnosis, accurate and faster prediction and cost-effective management treatment. In an attempt to assist cloud providers and healthcare organizations to secure their cloud-based environment and to adopt the appropriate measures for data protection, this chapter presents an overview of the security and privacy requirements of cloud-based healthcare systems. Specifically, this chapter starts with the presentation of the reported threats in cloud-based health systems, continues with the

identified objectives and assets and concludes with measures for the mitigation of the identified threats. Due to the fact that migration into cloud-based healthcare systems, in most cases, implies that data subjects lose control of their data, and many scientists have raised their worries about this. It is therefore needed to reconsider security, privacy and trust requirements, in the context of cloud computing. This chapter makes concrete recommendations for improving the protection level of cloud-based health organizations, cloud providers, hospitals and patients.

The included in this book chapters, while of course not comprehensive in addressing all the possible aspects of the aforementioned areas, are indicative of the explosive nature of interdisciplinary research going on in this area. All three editors, we are indebted to the authors who have contributed chapters on their respective fields of expertise and worked hard in order of deadlines to be met and for the overall book to be meaningful and coherent.

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