
Preface

Computational Intelligence (CI) has emerged as a rapid growing field over the last decade. CI techniques, e.g., artificial neural networks, genetic algorithms, fuzzy theory, evolution computing, machine learning, and many others, are powerful tools for intelligent information processing, decision making and knowledge management in organizations ranging from manufacturing firms to medical and healthcare institutions. Some of the recent examples of applying CI techniques include case-based reasoning in medical diagnosis and clinical decision support, customer relationship management through data mining, fault detection and quality improvement using artificial neural networks, design rationale assessment through semantic modeling of design documents, and so on.

The editors of this book have been working on data and text mining, machine learning, information retrieval, digital libraries and related research fields. Some of them have conducted CI research to address problems in industrial application scenarios, e.g., product design and manufacturing process control, for a few years. They are fully aware of the demand for advanced tools to support daily routine tasks like process monitoring as well as to support decision making in strategic planning. Therefore, it is timely to have a book that presents the latest advances in CI topics with a strong focus on industrial applications. This book aims to report and demonstrate how industrial organizations can gain a competitive advantage by applying different CI techniques. The industrial organizations here refer to a wide range of enterprises, bodies from design studios and manufacturing firms to hospitals and non-profit organizations.

The book includes 17 chapters selected from more than 30 submissions based on a thorough and strict peer review process. The 17 chapters accepted were contributed by international researchers from 14 countries and regions. They present a snapshot of the cutting-edge research in CI and the state-of-the-art industrial CI applications. These 17 chapters are broadly grouped into two main sections, namely, Section I: Theory and Foundation, and Section II: Industrial Applications.

In the Theory and Foundation section, Das et al. give a comprehensive overview of particle swarm optimization (PSO) and differential evolution (DE) algorithms. This chapter describes several schemes to control the convergence behaviors of PSO and DE by carefully selecting and tuning their parameters. Furthermore, the authors have explored the possibility of a hybrid approach by combining PSO and DE with other soft computing algorithms which leads to a powerful global search algorithm. Its application in various engineering domains has been highlighted.

The chapter by Maamar et al. covers Web services and their integration with context and policies, a topic not discussed much in CI. In their framework, a three-level approach to compose Web services has been proposed, i.e., component, composite and resource level. In their work, context is defined as the information about the environment within each level, i.e., context of Web service, context of composite Web service and context of resource, and jumping from one level to another requires policy activation, either engagement policies or deployment policies.

Qiu focuses on privacy protection when delegating data mining tasks in industrial systems, one of the prevailing topics in the area. Qiu introduces a Bloom filter-based approach for privacy preserving in association rule mining. His findings show that the privacy security level and analysis precision are positively correlated using the Bloom filter. To increase the privacy security level, more data storage is needed. The additional storage required is in a linear relation with respect to the privacy level or the analysis precision. Further research on other data mining tasks and testing in a distributed database environment are suggested.

Tsivtsivadze et al. present a comprehensive overview of various kernels for text analysis, including bag-of-words kernel, string kernel, gappy string kernel, convolution kernel, and graph kernel. What intrigues us is its unique feature of incorporating prior domain knowledge into kernels for text analysis. An evaluation using different features, e.g., grammatical bigram, word and part-of-speech tag, link type, link length, and random walk features from graph feature representation, shows the importance and contribution of grammatical bigram and link bigram and their merits in embedding prior domain knowledge in feature representation.

Wang et al. report their work on the discovery of frequent patterns from long sequences which may contain many events. Different from the existing approaches in sequential pattern mining that simply count the occurrence of patterns in disjoint sequences, Wang et al.'s work adopts the concept of maximum cardinality to describe the number of pattern occurrences in an individual sequence. The advantages of their approach include not requiring sliding window sizes and efficient implementation with sound precision.

Lin's work on gauging image and video quality in industrial applications highlights an important area which receives little attention in CI. Based on a unified framework and its computational modules, three perceptual visual quality metrics and an embedded just-noticeable difference estimator have

been proposed. More applications of perceptual models in industrial scenarios are expected to further stress the importance of Lin's study.

Finally, after a nice review on model construction, Stein presents an interesting methodology regarding model construction for knowledge intensive engineering tasks. Based on the observation that domain experts and knowledge engineers often develop a new and appropriate model by modifying some existing ones, Stein proposes a means of horizontal modeling construction. A few real-world case studies are provided to demonstrate its practical value.

In Sect. II, we emphasize the state-of-the-art application of CI techniques in various industrial scenarios. We start with a few chapters focusing on medical and healthcare areas. Almeida et al. adopt case based reasoning and genetic algorithm in the implementation of a virtual medical office for medical diagnosis and knowledge transfer and management purpose. In their case study, promising results are achieved.

Chan et al. address the important issue of using data mining approach in clinical decision support. They highlight the complicated reality that a clinical decision is often drawn by synthesizing knowledge from multiple disciplines while information needed is presented in a number of different formats, e.g., magnetic resonance images, somatosensory evoked potentials and radiographs. Hence, Chan et al. propose the DICOM model to form a synergy platform which aims to extract and present relevant features from multiple disciplinary knowledge sources for medical knowledge discovery and clinical decision support purposes. An example is given subsequently.

Caldwell et al. tackle the problem of promoter prediction using neural network for promoter prediction (NNPP) algorithm. They have raised a point that DNA sequence information, which is released through DNA sequence quantitative measurements instead of DNA sequence pattern information, can significantly improve the precision of computational promoter prediction. Their extended algorithms based on three coding region lengths, e.g., TLS-TSC length, TSS-TLS length, and TSC-TTS length, have shown their merits. Future research directions have been outlined.

Das et al. investigate the anomaly detection problem using two successful negative selection algorithms, i.e., the self-organizing RNS algorithm and the V-detector algorithm. For the latter, both a single-stage and a multi-stage proliferating V-detector algorithm are studied to create such vectors.

Braga et al. report their study using a number of pattern classification algorithms, e.g., multi-layer perceptron, RBF neural network, support vector machines, and decision tree, to automatically monitor the dressing procedure in the grinding process of an industrial CNC machine. They also examine the robustness and effectiveness of different algorithms when the controlled noise is purposely introduced in simulation.

Clifton et al. provide a nice survey of the existing methods for detecting novelty or something abnormal in the industrial environment. Using an SVM core, novelty classifiers are set up in a way that their output is calibrated into probabilities, resulting in a probabilistic novelty threshold being specified

automatically. This is in contrast to the existing distance-based methods where heuristics are needed and the models are manually constructed. Their validation and experiments are conducted based on real-world jet-engine data.

Khosravi et al. explore another important problem – predicting the origin of power sags in distributed substations using a multiway principal component analysis (MPCA), and an extension of the classic principal component analysis (PCA). In their study, MPCA classifiers are able to achieve better performance in differentiating high-voltage and medium-voltage sags compared to other possibilities, e.g., multi-layer perceptron, RBF neural network, and decision tree.

Cheong and Tan report their study of using a multi-objective multi-colony ant algorithm (MOMCAA) in solving the berth allocation problem, an important topic in logistics and supply chain management. In their work, berth allocation problem has been taken as an optimization of complete shipping schedules with minimum service time and delay for the departure of ships, subject to a number of temporal and spatial constraints, and hence a multi-objective and multi-modal combinational optimization problem. The proposed MOMCAA framework possesses several features, such as using ant groups in searching for each candidate group, concurrent optimization, flexibility and expandability of incorporating other meta-heuristics, e.g., genetic algorithm and simulated annealing, etc.

Yu's chapter focuses on the application of neural network on dynamic system identification and adaptive control. Two examples are given, i.e., rotorcraft acoustic data modeling and DC voltage controller.

Hamniche et al. describe their work of query rewriting for semantic multimedia data retrieval, a domain knowledge based approach to retrieve multimedia data formatted according to MPEG-7 standard. The basic idea is to add a semantic layer on top of the MPEG-7 metadata layer. To fulfill the retrieval task, users' queries are pre-processed, rewritten and translated into the XQuery queries using the mapping rules and a set of XQuery functions defined over the MPEG-7 descriptions.

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