Advances in computational intelligence (UKCI 2012)

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This special issue of Soft Computing contains a selection of extended versions of papers presented during the 12th UK Workshop on Computational Intelligence (UKCI 2012) held at Heriot-Watt University (Edinburgh, UK) on 5–7 September, 2012.

UKCI is an annual conference which provides a stimulating forum for the academic community to share ideas on theoretical and practical aspects of computational intelligence techniques and is designed to encourage a lively atmosphere for discussing the research findings and future problems, making new contacts and forging collaborations. Over the past eleven editions of UKCI, the list of topics has evolved alongside the field of Computational Intelligence. The current topics of the conference cover all aspects of computational intelligence, neural networks, learning, fuzzy logic, fuzzy systems, machine learning, biologically-inspired computing, artificial immune systems, multi-agent systems, games, data mining, web intelligence, computational intelligence and self-awareness and various applications of computational intelligence.

Based on the reviewers' recommendations, a number of authors were invited by the conference chairs to submit the extension of their papers to this special issue. Following a rigorous review process adhering to the standards of Soft Computing journal, 13 substantially extended papers have been carefully chosen to be included in this issue. These

papers can be generally divided into three sections: Fuzzy Systems, Optimization and Decision Making section.

Soft Computing and Computational Intelligence emerged at the same time around 1993. They both relied on component fields that were much older: fuzzy logic, neural networks and evolutionary algorithms. Lotfi Zadeh was the driving force behind Soft Computing but, just as with fuzzy logic, the field has expanded well beyond its original scope. Computational Intelligence was more loosely defined from the outset, but has been unified as a field because of the efforts of many researchers involved with different IEEE conferences and Transactions. This shows how both areas, Computational Intelligence and Soft Computing, have now become a melting pot for original research with much practical potential.

As noted above, the papers in this issue were derived from a Computational Intelligence workshop and we are proud to introduce readers of Soft Computing to this selection of 13 papers. Each paper has a unique and novel approach to an important problem. We invite the readers not only to download the papers, but to correspond with the authors, build on the results presented, and cite the papers!

In the first paper in the fuzzy systems section, Bernardo, Hagra and Tsang present a Genetic Type-2 Fuzzy Logic System for the modeling and prediction of financial applications. The proposed system is capable of generating summarized models from pre-specified number of linguistic rules, which enables a better understanding and interpretability of the generated financial model even by a lay user. System evaluation carried out on two real datasets (spotting arbitrage opportunities in the London International Financial Futures Exchange market and credit approval dataset) has shown that the proposed system outperforms several white- and black-box models.

In the second paper, Bilgin, Hagra, Malibari, Alhaddad and Alghazzawi identify the step-by-step formation of per-

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ceptual judgments to be incorporated in the mapping of the reasoning of human brain into computer processes. Such approach falls within a fast growing body of papers on the paradigm of Computing With Words which tackles the problem of human intelligence by taking the human mind as a role model. The authors employ general type-2 fuzzy logic to successfully model human perceptions based on experience in dynamical fashion and verify this approach on a real case scenario.

In the third paper of this section, Martin, Abd Rahim and Majidian suggest that some ways of fuzzy grouping of unstructured and semi-structured data can lead to additional knowledge that can be extracted from this vast previously unexploited resource. They argue that fuzzy formal concept analysis effectively allows identification of the hierarchical structure arising from similarities in attribute values but may lead to concept lattices whose structure varies over time. This leads to the need for a good measure of the distance between concept lattices. The authors propose such a measure and verify their methodology via a few examples.

The second section of this special issue contains papers related to the topic of optimization. In the first paper, Caraffini, Neri, Passow and Iacca propose a simple novel algorithm for continuous optimization, Re-sampled Inheritance Search. The proposed algorithm combines a stochastic sample mechanism and a deterministic local search to produce a computationally effective method with low memory requirements. The authors report good and robust performance of this simple combination of inheritance and exploitative search on a variety of problems and further validate their method on the control system tuning for yaw operations on a helicopter robot.

The second paper deals with an emergent technology of the wireless sensor networks which is currently permeating a wide range of domains on varying environments. To achieve consistent operation of such networks, constant optimization/adaptation to current conditions is required. However, the common restriction on the online optimization of such networks is due to hardware limitations. Iacca investigates the possibility to perform an online, distributed optimization process within a wireless sensor network. The proposed approach, called Distributed Optimization for WSN, is an island model infrastructure in which each node of the network executes a simple, computationally cheap optimization algorithm, and shares promising solutions with its neighbours. Extensive analysis shows superiority of the proposed approach in terms of performance, memory and energy consumption.

The third paper deals with solving timetabling problems by means of an iterative hyper-heuristic approach. This approach aims to build low cost methods which are general and can be reused on unseen problems with no additional human expert intervention. The proposed iterative hyper-

heuristic operates on the space formed by a fixed set of low level heuristics which, in turn, operate directly on the space of problem solutions. In this study, Kalender, Kheiri, Özcan and Burke combine a simulated annealing move acceptance method with a learning heuristic selection method and a set of low level constraint oriented heuristics. The authors report a reasonable performance of their method across several real-world and benchmark domains.

In the forth paper, Kong, Ouyang and Piao proposed a new adaptive grouping differential evolution algorithm for constrained optimization problems where constraints are handled by prediction according to the Lipschitz condition. This eliminates the need of the actual calculation of the constraints which drastically reduces the computational load at the same time, however, preserving with high probability the solutions feasibility. The proposed methodology has a further advantage of the increased diversity of the population due to the strategy of grouping the population according to the mutation strategy and adopting the mutation factor and crossover probability associated with the evolutionary process according to the information of the entire population.

In the fifth paper, Pessin, Sales, Dias, Klaser, Wolf, Osorio and Vargas focus on the application of Swarm Intelligence to a problem of garbage and recycling collection using a swarm of interacting cooperative robots behaving as cognitive entities. Using two versions of Particle Swarm algorithms and Ant Colony Optimization approach, the authors propose an efficient solution of the problem.

Finally, the last paper in this section deals with solving dynamic environment problems by means of the hybridization of population based incremental learning algorithm and selection hyper-heuristic. In this paper, Uludağ, Kiraz, Uyar and zcan propose to incorporate the offline learning in the framework during the training and online learning—during the search process for a given problem instance. Through evaluation over a range of problems created by a benchmark generator, the authors demonstrate the performance of the proposed methodology for several heuristic selection methods.

The last section of this special issue contains four papers that deal with learning, games and data-mining. Al Shami, Lofti and Coleman investigate the use of Fuzzy Proximity Knowledge Mining technique to build the qualitative taxonomy which is subsequently used by Fuzzy c-means to form the new non-biased synthetic composite indicators. The proposed methodology is then compared with a wide selection of classical tools for aggregation of synthetic indicators.

The second paper of this section proposes a Stackelberg game approach to maximize the profit of the electricity retailer and minimize the payment bills of his customers. In this approach, Meng and Zeng model interactions between the retailer and his electricity customers as a 1-leader, N-follower Stackelberg game. In this setup, the

electricity retailer determines the price according to the smart energy pricing scheme to optimally adjust the real-time pricing with the aim to maximize his profit. This optimization is carried out by a genetic algorithm. Meanwhile, the customers automatically adjust their electricity consumption through a scheduling system with the aim to minimize their electricity bills. This minimization is based on the analytical solution to the linear programming problem. Simulation results show that the proposed approach can be beneficial for both the customers and the retailer.

The third paper of this section deals with extracting adverse drug reaction signals from the electronic healthcare database THIN. In their paper, Reps, Garibaldi, Aickelin, Soria, Gibson and Hubbard present the results of applying four existing electronic database signal detecting algorithms for a selection of drugs from different drug families. Their results suggest that further work is needed for this data extraction problem.

Finally, in the last paper of this special issue, Su, Shang and Shen join the debate over the ways of measuring the quality

of publications in academic journals by means of the ISI Impact Factor, in an unbiased fashion. To eliminate the bias, the authors propose the use of ensemble of multiple indicators and suggest a methodology of constructing such indicators based on the fused-links between academic journals. Results of their systematic experimental evaluations demonstrate in such setup, simple algorithms like K-Nearest Neighbours and K-means provide good performance and highly interpretable indicators.

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