Preface

Another Volume on artificial intelligence…neural networks…fuzzy logic…evolutionary computation! There are hundreds of books, volumes and doctoral theses that help us to update our knowledge of computational intelligence and intelligent systems. We have already seen so many varieties. What makes this volume different from the others?

When the computers first appeared in the early fifties, we admired it as an artificial brain, and we thought that we were successful in creating a low level decision making cognitive machine. Researchers coined the term artificial intelligence and waited for many potential applications to evolve. In the 60's, computers failed to pass the Turing test due to the low processing speed of the computers. Last few decades have seen a new era of artificial intelligence focusing on emulating humans, either in their behaviour or in their neurophysiology. Rather than viewing humans as the premier example of intelligence, a broader and potentially more beneficial perspective views this species simply as a product of evolution, a process that generally produces organisms of increasing intellect. Recognizing the connection between evolution and intelligence makes it possible to overcome the limitations of conventional artificial intelligence techniques, and indeed to evolve such systems and create machine intelligence.

Computational intelligence is a well-established paradigm, where new theories with a sound biological understanding have been evolving. The current experimental systems have many of the characteristics of biological computers (brains in other words) and are beginning to be built to perform a variety of tasks that are difficult or impossible to do with conventional computers. In a nutshell, which becomes quite apparent in the light of the current research pursuits, the area is heterogeneous as being dwelled on such technologies as neurocomputing, fuzzy systems, artificial life, intelligent agents, probabilistic reasoning, evolutionary computation and so on.

This volume is a rare collection of 12 chapters compiling the latest state-of-the-art research in the area of intelligent systems and computational intelligence authored by the world leading well-established experts in the field. Each Chapter focus on different aspects of intelligent systems and is complete by itself. The Chapters present the latest theoretical developments as well as practical applications of these latest technologies. The Volume is organized as follows:

Chapter 1 introduces the different intelligent system paradigms involving neural networks, fuzzy systems, evolutionary algorithms and probabilistic reasoning techniques. Some of the generic architectures for implementing hybrid systems are presented emphasizing the advantages and disadvantages of each model. The design aspects of some of the hybrid architectures like evolutionary neural networks, evolutionary fuzzy systems, neuro-fuzzy systems, evolutionary-neuro-fuzzy systems etc. are presented in detail with brief discussions on implementation issues and perspectives.

Chapter 2 deals with the autonomy of unmanned robotics systems in an attempt at filling the gap between reactive behavioural and deliberative decision systems, while keeping a close eye on the dynamic management of all the resources available to the robot. Two main characteristics of the developed robotic system is its own ability to control its own autonomy, and on the other hand the capacity to evolve and to learn.

Chapter 3 explores the application of intuitionistic fuzzy sets for intelligent medical diagnosis. Intuitionistic fuzzy sets are a generalized version of conventional fuzzy sets with an additional degree of freedom. By employing intuitionistic fuzzy sets in databases, we can express a hesitation concerning examined objects. This chapter begins with an introduction to intuitionistic fuzzy sets followed by detailed presentation of the authors new approach of applying the technique to a medical diagnosis problem.

Chapter 4 presents the inclusion based approximate reasoning, which outperforms the traditional scheme based on the compositional rule of inference in terms of both complexity and of logical soundness. In terms of semantics, it also offers a better solution to the implementation of analogical reasoning than similarity measures are able to do. In addition to the classical inference strategies, authors have discussed in depth the inclusion-based approach. The method was generalized to cover a collection of parallel rules, as is typically the case in realistic applications. The authors have also reviewed some aggregation procedures and checked their suitability in the light of criteria such as coherency, consistency and speed.

Chapter 5 is concerned with a fuzzy approach to deal the popular job-shop scheduling problem, which is considered as a difficult problem, both theoretically and practically (because of its industrial importance). The theoretical problems stem from the search for optimal schedules subject to a limited number of constraints while the complexity of practical problems is due to the number and variety of constraints that are not rigid in a practical scenario. Considering the practical importance, this chapter presents imprecise processing times as triangular fuzzy numbers and then constructed a job-scheduling model to solve the problem.

Chapter 6 presents the representation of expert knowledge by fuzzy logic by an optimal combination of granularity and higher order approaches. Conventional fuzzy logic has been successful in several practical applications, but in several aspects, the resulting computer representation is somewhat different from the original expert meaning. Granularity and higher order approaches have been used to incorporate expert knowledge in fuzzy inference systems and has been tried in some applications. The idea of combining the two approaches is very natural, but so far, it had led to the few successful practical applications. This chapter provides results aimed at finding a better (ideal optimal) way of combining those approaches.

Chapter 7 explores the training of artificial neural networks using genetic programming. Genetic programming is used to discover new supervised learning algorithms for neural networks. Genetic programming discovers an optimal combination of the generalized Delta rule and the Hebbian learning rule to train neural networks. The combined training approach performed much better than the

standard backpropagation technique in terms of speed, stability and greater feature extraction capabilities.

Chapter 8 tackles the modelling and identification of nonlinear time-varying systems using neuro-fuzzy approaches. Among the different nonlinear identification techniques, methods based on neuro-fuzzy models are gradually becoming established not only in the academia but also in industrial applications. The tools for building neuro-fuzzy models are based on combinations of algorithms from the fields of neural networks, pattern recognition and regression analysis. The rule-based character of neuro-fuzzy models allows for the analysis and interpretation of the results.

Chapter 9 presents an evolutionary algorithm based approach for two dimensional bin packing which is yet another difficult problem because of its practical significance. A new genetic algorithm (with a novel penalty function) is proposed for packing rectangular cargos of different sizes into a given area in a two dimensional framework. The proposed method is then compared with other heuristic methods. Empirical results indicate that the proposed method is superior in terms of packing efficiency and solution time.

Chapter 10 explores the performance of sequential and distributed evolutionary algorithms for combinatorial optimization problems. Performance of three sequential (generational, steady state and cellular genetic algorithm) and three parallel evolutionary algorithms on seven hard problem instances are studied. The intrinsic search features of each class of algorithms proved to be powerful enough to solve a given problem instance. It is interesting to note that some of the sequential and almost every parallel algorithm, yielded fast and accurate results, although they sampled only a tiny fraction of the search space.

Chapter 11 presents a novel approach where an intelligent agent constraint satisfaction is met using neural networks for an interesting real world application. An intelligent distribution agent and particularly its constraint satisfaction module take up the challenge to automate the process. Indeterminate subjective component makes the optimization of the constraint satisfaction a very sophisticated task. The authors present neural network learning paradigms and support vector machine to optimise the performance of the module.

Chapter 12 discusses how an embodied emotional agent could improve the training system intelligence. The authors present how to generate nonverbal output through an embodied agent, based on user's actions in an intelligent training system. An overview of the agents environment, role of the agent and its international architecture are presented in detail. It is interesting to learn how the system inputs are used to modify the emotional model of the agent.

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