Preface

Computational Intelligence is the synergy of ingredients of Soft Computing methodologies and the elements of Machine Intelligence. In the course of imparting “intelligence” into a machine (which essentially is a computational system), in order that it behaves in an intelligent manner as a human being does, it becomes imperative to “train” the machine in a meaningful manner. Needless to say, the task for achieving this goal requires the real life techniques to deal with situations those are imprecise, uncertain, and/or vague. An intelligent machine may behave effectively only when it itself is capable of learning from real life input and carrying out adequate analysis and processing subsequently so that the response it makes out of that input looks relevant and meaningful. One must naturally appreciate at the outset that the synergy between different soft computing methods and machine intelligence is not only strongly intermingled but conceptually inseparable too. Ideally an intelligent system is expected to offer a low cost as well as robust solution having close resemblance to human like decision making out of a real life situation that is typically shrouded with ambiguity and/or partial truth.

An intelligent machine inherits the boon of intelligence by virtue of the various methodologies offered by Soft Computing paradigm encompassing fuzzy and rough set theory, artificial neurocomputing, evolutionary computation, as well as approximate reasoning. At times situation demands in reality where any of the individual techniques enlisted above does not provide any comprehensible solution but an effective symbiosis of more than one of the above techniques offers a formidable solution. This gives rise to the advent of several hybrid methodologies. Of late, there is enormous growth of research exploration of injecting elements of intelligence using efficient hybrid techniques. All these initiatives indicate that the individual soft computing techniques do not behave in conflicting manner rather behaves complimentarily to one another. In fact, recent reporting reveals the inherent strength of such hybridization of computation methods.

Of late, Computational Intelligence has projected enormous promise in respect of various application areas. By virtue of the fact that it is able to deal with various real life possibilities, it has become important to assemble various applications emanating from different walks of life. Our comprehensive study reveals that there is a specific shortfall of any ensemble of Computational Intelligence applications. Naturally, that this has motivated us to go for such an initiative.

This edition comprises as many as thirty chapters.

1. In chapter 1, the authors have tried to extend the concept of type-2 fuzzy logic by accommodating hybridization in it and have shown how effectively they could apply it in an interesting problem of ascertaining the qualitative attribute of oral presentation of a number of students.

2. The second chapter deals with an interesting application of soft computing technique for analysis of time series data pertaining to chaos theory and fractals.
3. Complex network functionality is achieved by simple network cells that minimize the needed chip area for hardware implementation. Functionality of this network is demonstrated by the authors in chapter three by automatic character recognition with various input deformations like random noise infection, rotation, scaling, and shifting. In that sense this technique is a robust technique.

4. We come across yet another image processing application in course of chapter four. In that chapter the analysis and subsequent understanding is achieved through the process of cooperative fusion of data obtained on application of information theory and region merging available in literature.

5. The fifth chapter is intended to propose a self supervised image segmentation method by a multi-objective genetic algorithm based optimized MUSIG (OptiMUSIG) activation function with a multilayer self organizing neural network architecture to segment multilevel gray scale intensity images. The parallel extension of this function called Parallel optimized MUSIG (ParaOptiMUSIG) has also been proposed by the authors for segmenting true color images. Three commonly used criteria play the role of objective functions yielding very formidable results.

6. The problem of image segmentation and/or extraction has remained a challenging mission for long. There have been several techniques employed to arrive at a good solution to this effect. Chapter six is yet another method aimed at this. The novelty of the article in this chapter is that the strength of fuzzy rule base has been explored and exploited to meet the end offering convincingly encouraging result.

7. Application of the rich ingredients offered by graph theory has been successfully exploited to meet the task of digital image segmentation problem. The use of graph theoretic platform for this purpose as available in chapter seven is indeed a praiseworthy effort in this context.

8. Chapter eight pertains to an interesting problem. The endeavor is to develop a system intelligent enough to be able to detect violation of stop line in the road traffic movement system in an online manner. There are a few existing reporting on the said problem available in the literature. The present initiative by the authors can be viewed as aimed at offering an improved solution specifically applicable in Indian context.

9. The task of detection of video shot boundaries to discern subsequences consisting of different video contexts is specifically useful in video surveillance, target tracking etc. There are some reporting in the literature to this end including very recent unsupervised techniques like fuzzy entropy content based method. In chapter nine, the authors have taken recourse to the probabilistic fuzzy entropy measure for this purpose and offered an extensive comparison of several methods.

10. Chapter ten is dedicated to another image processing application. In this chapter, the authors propose a hierarchical multilevel image thresholding method induced by image histogram based tree structure. This thresholding is used for edge information extraction based on the maximum fuzzy entropy principle. Incidentally, in each level of the tree structure, the image is segmented by three-level thresholding based on the principle of maximum fuzzy entropy.

11. The application field of chapter eleven is digital image processing. The problem of pixel classification is tackled by a novel median filtering approach which is adaptive in nature. Authors have shown that this adaptive nature is the real strength of the underlying approach. Moreover, it behaves in unsupervised manner in respect of its implementation.

12. Chapter twelve focuses on rough set based clustering algorithms and also offers efficiency comparison among all the fuzzy set based and rough set based clustering algorithms.
13. The contribution of chapter thirteen is interesting for extra-technical reason also, where authors have tried to trace how different genetic schemes as part of soft computing solution mechanisms emerged for the classification rule mining issue.

14. Authors of chapter fourteen have identified the problem of database anonymization problem and its future scope. In this chapter, the technique of effective tackling of one or more sensitive attributes in respect of I-diversity has been highlighted.

15. The work in course of chapter fifteen proposes a data masking technique for protecting sensitive business data in data warehouses which is capable of balancing security strength with database performance on one hand and offers solution on the other hand providing apparent randomness in the generation and distribution of the masked values, while introducing small storage space and query execution time overheads.

16. Parameter sweep experiments (PSE) which involve many independent jobs, need to develop effective scheduling strategies to allocate jobs to machines and reduce the associated processing times. In chapter sixteen, authors conducted a survey of different scheduling algorithms based on Swarm Intelligence (SI), and more precisely Ant Colony Optimization (ACO), which is the most popular SI technique, to solve the problem of job scheduling, a known NP-complete problem, with PSEs on different distributed computing environments.

17. Selection of feature subset has always remained a challenging issue for particularly for the image processing community. The thorny part of the problem is the balanced variant of number of important features in respect of a particular image context. In course of the seventeenth chapter, the benefits of particle swarm technique have been considered for the sake of this optimization which has been found to offer quite encouraging findings.

18. In chapter eighteen, the authors proposed an extended probabilistic neural network (ePNN) technique towards solving the text classification problem and justify its supremacy by comparing it against two other competitive counterparts available in the literature, namely Incremental Probabilistic Neural Network (IPNN) and Evolving Fuzzy Neural Network (EFuNN).

19. The scope of the nineteenth chapter is the parameterization of the uncertainties induced by the permanent magnet synchronous generator. To tackle this, the authors have taken recourse to fuzzy modeling of the control parameters and fault diagnosis thereof. Such a technique has yielded convincing results.

20. The twentieth chapter deals with an interesting problem. Here the authors propose a modular design tool specifically for design of self-actuating flapping wing Micro Aerial Vehicles (MAV), supposedly the generation next to the one that we are normally accustomed in such problems where present day design so far facilitate the flapping motion of their wings by means of a mounted actuating mechanism, driven, for example, by a piezoelectric crystal.

21. The twenty first chapter proposes a fuzzy-controlled energy conservation technique (FET) that identifies the busy and idle nodes to canalize some traffic of busy nodes through the idle ones ensuring thereby fair load distribution in the network on one hand and maintenance of network connectivity by reducing the death rate (complete exhaustion of nodes) on the other.

22. Data of human faces are obtained from different sensors which need fusion before an inference is drawn regarding the proper identification. The issue gathers further importance in case this inference is used for the purpose of ensuring security. The authors of chapter twenty two have suggested a novel algorithm towards this end.
23. Of late, Multi Agent System (MAS) has shown several application domains. Chapter twenty three is devoted to indicate the use of MAS in the field of health care and medical diagnosis. The authors have tried to justify the effective use of MAS for this purpose especially keeping the modernization aspect at the top. A comprehensive comparative study is the strong point of this chapter.

24. The problem of digital watermarking has been attempted through various methods as per the literature reporting. The twenty fourth chapter indicates the effective use of a biometric technique for achieving the task of watermarking. In that sense, this is a novel endeavor.

25. In the article in chapter twenty five, the authors have considered the process of phenol removal along with the underlying technical characteristics/parameters. Accordingly, they have framed a corresponding parameter graph. The primary contribution of this chapter is realization of a quantum inspired variant of backpropagation network with that end in view.

26. The problem in chapter twenty six is the pathological issues pertaining to precision agriculture. Undoubtedly, the underlying application is very interesting where the fruits of Computational Intelligence has been successfully utilized and reported.

27. The twenty-seventh chapter is dedicated to a very important problem pertaining to the oncogene expression data analysis for which the authors resorted to the underlying inherent power enjoyed by rough set theory in the field of Computational Intelligence. This type of reporting would inspire the research in the field of bioinformatics.

28. Chapter twenty eight aims at arriving at a comprehensive solution based on associative memory principles, for regulating the parameters primarily responsible for cold catching so that the room ambience can be made self-adjustable. Authors have shown that this may also be useful for medical diagnosis in some specific situations.

29. Chapter twenty nine is aimed at infusing intelligence in the web based applications.

30. Reporting of loss of human lives is often encountered when people get inside manholes for various reasons. Now since the chemical composition of the manhole gas mixture contains some components that may become fatal in case present in higher proportion for any reason. The authors in the last chapter have used various methods avail in computational intelligence and compared their relative performance.

The book is intended to be a reference to the researchers and professionals. The spectrum of application areas where the concepts of computational intelligence could be put into use effectively has been elaborated, which in our opinion, would help the researchers, especially the new entrants in research programme to appreciate the strength of the ingredients of computational intelligence for real life applications of various types. It can also be considered as a text for teaching graduate courses in subjects like soft computing, pattern recognition, machine intelligence, and computational intelligence.

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