PROCEEDINGS

8TH INTERNATIONAL CONFERENCE ON HYBRID INTELLIGENT SYSTEMS

Edited by

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Francisco Herrera, University of Granada, *Spain*
Ajith Abraham, Norwegian University of Science and Technology, *Norway*
Mario Köppen, Kyushu Institute of Technology, *Japan*
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Welcome from HIS 2008 General Chairs

Welcome to Barcelona and to the 8th International Conference on *Hybrid Intelligent Systems* (HIS 2008), held at the Technical University of Catalonia (Spain), September 10-12th, 2008.

Hybridization of intelligent systems is a promising research field of modern artificial/computational intelligence concerned with the development of the next generation of intelligent systems. A fundamental stimulus to the investigations of Hybrid Intelligent Systems (HIS) is the awareness in the academic communities that combined approaches will be necessary if the remaining tough problems in Artificial and computational intelligence are to be solved. Recently, Hybrid Intelligent Systems are getting popular due to their capabilities in handling several real world complexities involving imprecision, uncertainty and vagueness.

HIS 2008 builds on the success of last year's HIS 2007 edition held during September 17-19, 2007, Kaiserslautern - Germany. HIS 2008 is the Eighth International conference that brings together researchers, developers, practitioners, and users of soft computing, computational intelligence, agents, logic programming, and several other intelligent computing techniques.

HIS 2008 focused on the following themes:

- Hybrid Intelligent Systems: Architectures and Applications
- Soft Computing for Image and Signal Processing
- Intelligent Internet Modeling, Communication and Networking
- Intelligent Data mining
- Computational Biology and Bioinformatics
- Intelligent Business Information Systems
- Soft Computing for Control and Automation
- Multi Agent Systems and Applications
- Special topics

HIS 2008 is technically co-sponsored by IEEE Systems, Man & Cybernetics Society, European Neural Network Society, International Fuzzy Systems Association and European Society for Fuzzy Logic and Technology.

Many people have collaborated and worked hard to produce a successful HIS-2008 conference. First and foremost, we would like to thank all the authors for submitting their papers to the conference, for their presentations and discussions during the conference. Our thanks to Program Committee members and reviewers, who carried out the most difficult work by carefully evaluating the submitted papers. We would like to give special thanks to the PC Chairs Francisco Herrera (University of Granada, Spain), Enrique Alba (University of Málaga, Spain) and Andreas Koenig (University of Kaiserslautern, Germany) for their work and great efforts in preparing an interesting technical programme.

HIS 2008 has marked an important shift in the number of submissions received and in attracting a larger audience of researchers. In this edition, in conjunction with HIS 2008 we have 5 Workshops and 3 Special Sessions that complemented HIS 2008 program with contributions for specific topics. We

would like to thank the Workshop & Special Sessions Chair Dr. José Manuel Benítez (University of Granada, Spain) for his excellent work in selecting and coordinating the workshops and special sessions.

In this edition of HIS 2008 we had 5 plenary talks. We would like to thank José Luis Balcázar (Technical University of Catalonia, Barcelona, Spain), Stefano Cagnoni (Università degli Studi di Parma, Italy), Andries Engelbrecht (University of Pretoria South Africa), Imre Rudas (Budapest Tech, Hungary) and Albert Y. Zomaya (The University of Sydney, Australia) for providing very interesting plenary talks and support to HIS2008. We would like to thank the excellent work and efforts of Josep Piqué and Ana Majó (22@ Barcelona Innovation District), Ricard Jiménez (ASCAMM Foundation), Angel Alejandro Juan (Open University of Catalonia) and Santi Caballé (Open University of Catalonia), in the organization of the Industrial Track.

We would like to thank Leonor Frías, Pau Fernández, Josefina López and all the Local Organizing Committee members as well as the Administration Staff of Technical University of Catalonia for their support and help in local arrangements of the conference. The support of Generalitat de Catalunya (Comissionat per a Universitats i Recerca) is also acknowledged.

Our special thanks to Ms. Lisa O'Conner of IEEE Computer Society Press for all the support and help related to the production of this important scientific work. HIS2008 conference used EasyChair Conference system; Andrei Voronkov's support is much appreciated.

We look forward to seeing you in Barcelona, Spain, during HIS 2008.

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Fatos Xhafa, Technical University of Catalonia, *Spain*
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Mario Köppen, Kyushu Institute of Technology, *Japan*

Welcome from the HIS 2008 Program Chairs

First of all, we are so delighted to welcome all the participants of the 8th International Conference on Hybrid Intelligent System (HIS2008). The conference aims to presents the latest development in theories and applications of hybrid intelligent systems, soft computing and computational intelligence, emphasizing the hybridization of the basic techniques concerning with the development of the next generation of intelligent systems.

HIS2008 received 269 submissions. Each paper was reviewed by at least 3 reviewers in a standard peer-review process. Papers belonged to three categories: regular papers of 6 pages (from main conference and Workshop/Special sessions), short papers of 4 pages and poster papers of 2 pages. The acceptance rate of the regular papers of the main conference was 46% (77 papers accepted out of 165 submissions). Finally, 14 papers were accepted as short papers and 3 as poster papers. The final program consists of 5 plenary talks, 25 ordinary sessions consisting of 77 regular papers, 5 workshops consisting of 54 papers, 3 special sessions consisting of 16 papers, and a poster session consisting of 14 short papers (presented as posters) and 3 posters.

The themes of the contributions and scientific sessions range from theories to applications, reflecting a wide spectrum of coverage of the hybrid intelligent systems and computational intelligence areas.

Many people have given their best efforts to make this conference a successful event. We would like to thanks all authors for their submissions, session and workshop organizers, and last but not least the reviewers for their continued interest, energy, and support.

We heartily wish all HIS 2008 participants enjoy attending conference sessions and activities, meeting friends and colleagues and having pleasant stays in Barcelona

Francisco Herrera, Andreas König, Enrique Alba (Program Chairs)
September 2008, Barcelona

Welcome from the HIS 2008 Workshops and Special Session Chair

HIS International Conference series have become an international prestigious meeting point for experts in Hybrid Intelligent Systems, who gather to share experiences and exchange knowledge. The Workshops and Special Sessions have become an essential ingredient of these successful events.

They are focused on interesting subjects and draw the attention of active researchers and practitioners in the corresponding fields, who submit contributions describing bleeding-edge applications or new foundations for combination of the basic intelligent components.

At HIS 2008 we are pleased to count on with five workshops and three special sessions, all of them of the highest level. Their topics cover a wide spectrum of the basic research and a host of applications of hybrid intelligent systems.

All the contributions submitted to the special sessions have gone under a thorough peer-review process, in which each paper have been evaluated by three to four experts, with an average of 2.7 reviewers per paper. The overall acceptance rate is 72%, yielding a total of 70 accepted papers.

The success of these workshops and special sessions is the final and deserved fruit of the hard work and effort of many people. To begin with I would like to deliver my gratitude to authors, who provide the basic matter. Next, to guarantee the quality of papers, a fine evaluation has to be performed. The members of the program committee for these special sessions have earned a special thank because of their generosity evaluating a good share of papers, when we all know they all are really busy. Finally, I have intentionally left for the end, a quintessential role: the organizers. They all know that setting up a special sessions means a lot of fun, but also a good deal of hard work and exchanging an "infinity" of e-mail messages. I have been fortunate enough to count on with their continuous support, encourage, collaboration and patience. I am deeply indebted to all you.

Now the work is done and ready to be presented at the Conference. I do wish you all to enjoy, and gain a lot of inspiring ideas!

José Manuel Benítez (Special Session Chair)
September 2008, Barcelona

Welcome from the HIS 2008 Industrial Track Chairs

It is our great pleasure to welcome you in Barcelona for the International Industrial & Exhibition Track on Open Innovation. This track is held in conjunction with the 8th International Conference on Hybrid Intelligent Systems (HIS2008) that will take place on September 10th, 2008, Barcelona, Spain.

The objective of this track is to improve the communication between the research community and industry with the objective to shorten the gap between the two communities. The aim is to benefit from HIS2008 as a joint forum for both academic and industry research communities. HIS2008 will thus serve as a platform, where research and industry can mutually benefit. Hybrid Intelligent Systems' areas are gaining more attention as important research topics of R+D of many industries world-wide. Industries using techniques from Soft computing, AI and Multi-agents have increased their benefits and effectiveness in supporting the development of innovative products.

Hybrid Intelligent Technologies are within reach of any size of company. They are the spark that put in motion many innovative start-ups. They are also the complement allowing small and medium enterprises to become more competitive in an always changing globalized economy. Big companies are obliged to take profit of them if they want to ensure a suitable usage of their vast and dispersed resources of knowledge. So, the Industrial Track of HIS 2008 aims also at demonstrating that size does not matter when using hybrid intelligent systems.

A further innovation of this track is to establish and develop the willingness to build an open innovation model between the Academia, Research and Technology Institutes, Administration and Industry as the main actors performing an important role in this joint forum.

The concept of this track is to support and deepen the communication between the research community and industry, by the better understanding of the current research, on the Hybrid Intelligent Systems, and the industrial needs. In addition, in view of increasing importance of international cooperation among competition authorities while the economy is getting globalised, HIS 2008 track has been working on strengthening this relationship and also actively engaging in the works in multilateral frameworks in general.

Therefore scientists and researchers are encouraged to attend the open platform of communication of HIS industrial track, in order to:
- Meet and network with companies of their specialty.
- Discuss their interests and needs with business people and key decision makers.
- Participate and exchange their views with eminent professionals during the networking cocktail.
- Acquire knowledge, discover new directions and develop their career.
- Detect the industrial opportunity for research transfer.

We wish you a very fruitful Industrial Track!

Josep Piqué, Ricard Jiménez, Ana Majó, Angel Alejandro Juan, Santi Caballé (Industrial Track Chairs), September 2008, Barcelona

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Hybrid Intelligent Systems for Data Reduction in Data Mining

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Hybrid Metaheuristics and their Applications

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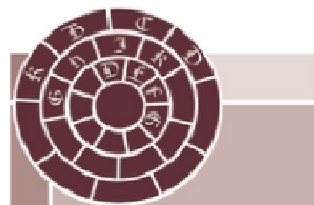IEEE Systems, Man & Cybernetics Society

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Plenary Keynotes

The Logics of Association Rule Mining

José Luis Balcázar
Universitat Politècnica de Catalunya, Spain

Abstract

Association rules are exact or approximate implications found empirically on relational data. The logic of exact implications has been studied deeply in several disciplines. The study of the logic of partial, or approximate, implications is also advanced, but not to a similar extent at all. Nowadays, the Data Mining field provides ample room for case studies focusing on the goal of extracting implications from data. This contribution belongs to a large research program contemplating the need of further, deeper scientific knowledge about the combinatorics of partial implications. Existing, important progress on various mathematical problems of direct practical relevance for the task of mining associations from data is, currently, somewhat hindered by the lack of deep knowledge about these combinatorics. We propose here an approach based on the most classical, elementary notions of Mathematical Logic: the propositional logic domain, with its traditional semantics in terms of Boolean algebra and entailment, and with its traditional approaches to syntactic calculi for deductive inference.

The intuition of entailment can be formulated in a number of ways, but their algorithmic difficulties range from exponential time (co-NP-completeness) up to sheer undecidability. Even purportedly simple cases such as the propositional domains still present formidable difficulties for a number of algorithmic problems. Modeling rationality asks, in fact, for even further expressiveness, but this leads to extremely inefficient algorithmics. There is an intuitively natural choice of a logic of about as much expressivity as possible under the constraint of fast deduction algorithms: Horn logic. Association Rules constitute a very close relative, whose logical, combinatorial, and algorithmic properties are still not fully understood. They can be interpreted as an answer to the following question: how can Propositional Horn Logic, limited in expressiveness but enjoying very efficient entailment tests, help us in the analysis of existing phenomena, given through either interaction with some unknown or only partially known system, or plainly as a static dataset with information gathered about the phenomenon. Many important tasks fall into such a category: scientific discovery from large masses of data gathered by instruments or sensors, decision making in economically crucial environments such as production sectors or forecast in stock market investments and gambling, or processing of information related to human communication like ontologies or social networks.

We will describe some recent advances in the topic of inference of implications from data, first, in the active learning setting, where we will explain an important conceptual advance that allows us to simplify the proof of the well-known AFP algorithm and reach a profound understanding of the properties that make it work. Then, we will focus on three problems of inference from static data: the lack of scientific guidance to set to appropriate values the free parameters, such as intensity of implication, inherent to all such data mining algorithms; the problem of constructing a principled approach to process of structured data where the interdependences go beyond the case of plain relational models; and the question of how to react in the case of huge sets of output rules, which is, in practice, almost always.
We will describe our Logic-based approach to these problems, and explain in detail how a semantic notion of entailment encompasses the existing notions of redundancy in Association Rules, how it can be characterized by a syntactic deductive calculus, and how these progresses allow us to construct axiomatizations of partial association rules that can be proved to be of absolutely minimum size with respect to the corresponding notion of redundancy.

CIlib: A Component-based Framework for Plug-and-Simulate Hybrid Computational Intelligence Systems

Andries Engelbrecht
University of Pretoria
South Africa

Abstract

Research in Computational Intelligence (CI) has produced a huge collection of algorithms, grouped into the main CI paradigms. These CI algorithms are increasingly being used to create hybrid intelligent systems, where different algorithms from different CI paradigms are combined to form a new model. Implementation of a hybrid system requires that the underlying CI algorithms be implemented. While most hybrid systems have specialized implementations focusing only on specific CI algorithms, the development process usually requires different variations of a CI technique to be implemented and tested in order to find the best combination of CI algorithms for the hybrid system. This process usually demands a re-implementation of existing algorithms, and sometimes even rewrites of the hybrid system skeleton. In addition to the CI components of a hybrid system, a communications protocol for information (or state) exchange among CI components needs to be defined and implemented. Here it may also become necessary to implement and test different communications protocols. When a final hybrid system has been produced, this system has to be thoroughly evaluated and benchmarked against other models.

The development and evaluation of a hybrid system can then become a tedious and time consuming process. Furthermore, re-implementation of existing CI algorithms may lead to code bugs and wastes time. Trying to implement a new generic hybrid system framework for each new research study can become a nightmare.

This plenary talk will introduce a new, open source component-based framework which

- provides a generic framework to implement any CI algorithm, or variation of that algorithm,
- facilitates the process of implementing a generic hybrid system, where any of the CI algorithms (components) can be used within the hybrid system,
- provides a generic framework for implementing any communications protocol,
- allows easy implementation of the problem to be solved,
- provides an XML interface to easily glue components together to form the hybrid system, and
- provides a simulator to manage the process of running a specified number of simulations on all specified benchmark problems.

The talk will discuss this library, called CIlib, in detail and will show that it provides an environment for plug-and-simulate hybrid systems, and doing so with minimal development effort.

Hybrid Intelligent Methods for Solving Mobility Management Problems

Albert Y. Zomaya
School of Information Technologies, University of Sydney
NSW 2006, Australia
a.zomaya@usyd.edu.au

Abstract

In order to support a wide range of data transfer and user applications, mobility management becomes a crucial factor when designing infrastructure for wireless mobile networks. Mobility management requests are often initiated either by a mobile terminal movement (crossing a cell boundary) or by deterioration in the quality of a received signal on a currently allocated channel. Due to the anticipated increase in the usage of the wireless services in the future, the next generation of mobile networks should be able to support a huge number of users and their bandwidth requirements.

The talk will address some of the key algorithmic and computational challenges associated with the mobility management problem. The talk will present several scenarios for static and dynamic mobility management instances incorporating a combination of metaheuristics. The studies show that hybrid approaches are more capable at producing efficient solutions. From a practical standpoint, these approaches have the potential to lead to massive savings in the number of network signal transactions made to locate users. Several hybrid approaches are used with a number of test networks to show their advantages to the currently implemented GSM standards. The results provide new insights into the mobility management problem.