Goals

The main scientific goal of the workshop is to introduce recent developments in mathematical techniques applied to complex engineering problems. In particular, the workshop will focus on different aspects of the area called soft computing, including fuzzy and conexionist systems, evolutionary computation, artificial life and complex systems.

Harnessing complexity is an important aspect of today problem solving. Complexity may be due to the presence of uncertain information or because the regularities of a system, we are trying to understand, cannot be briefly described. We will discuss recent developments in dealing with complexity, by means of introducing the methods and their sound mathematical foundations, as well as through the work of some difficult problems.

Audience

The target audience will be about thirty worldwide students, with a good mathematical background and an engineering bias. These students are supposed to be engaged in a post-graduation course, like a Ph.D..

Justification

There is an increase of interest in the area of soft computing and complexity theory as they give new solutions to old and poorly solved or understood problems. This field is one of the most active worldwide in information science; new architectures and learning algorithms are being developed; new solutions are being proposed that challenge more traditional ones. We start seeing the first efforts to understand the field as a whole, and, as a consequence, it is possible today to describe coherently the area. This is particularly important for young researchers working in engineering problems, because they still have, in general, some lack of knowledge about these new ways to deal with them. The strong mathematical basis of the school is also an important aspect, that will show to the students the importance of rigour that these new mathematic techniques provide. Today is clear that soft computing and complexity theory are in the intersection of advanced mathematics and engineering applications.

In Portugal, there exist already several groups, spread around the country, working in soft computing and complexity. Their work is internationally recognised and we expect that the school will be an important opportunity for some of youngest Portuguese researchers not only to improve their expertise but also to make contact with some colleagues from other countries, fostering that way the possibility of future international cooperation.

Broad structure

The school will be organised around three main activities: lectures, given by well known international experts, teamwork by the attendees, to solve a particular problem proposed by the lecturers and, finally, short presentations by the students about their own work and interests.

	Day	Lectures
1	Morning	1A (Georg Dorffner)
		1B (R. Babuska)
	Afternoon	1C (Carlos Fonseca)
		2A (Félix Costa)
2	Morning	2B (R. Babuska)
		2C (Juergen Schimdhuber)
	Afternoon	Workshop
3	Morning	Workshop
		Teams Formation
	Aferternoon	Team work
4	Morning	Team work
	Aferternoon	Team work
5	Morning	Team work
	Aferternoon	Presentation and Discussion of results

Each Lecture will last for one and a half hour. There will be a small break between the lectures. Each team will have a lecturer assigned to it to provide some help if needed. The results of each group will be in the form of a written document, that will be the possible basis for a paper to be submitted to an international conference.

Lecturers

Robert BABUSKA
Delft University of Technology
Holland

Neuro-Fuzzy Modelling.

Clustering in its several forms will be studied for structure learning from data in fuzzy systems. Parameter optimisation through neural networks, composing neuro-fuzzy systems will be reviewed and experimented.

Intelligent Control.

The main recently developed techniques for advanced Intelligent Control will be studied and experimented. On-line learning techniques, the problems of dimensionality, will be discussed.

Georg DORFFNER
Department of Medical Cybernetics and Artificial Intelligence
University of Vienna
Austria

Neural Computation and Applications in Time Series and Signal Processing.

The main architectures for neural computation will be reviewed. The particular architectures for time series prediction and signal processing will be studied.

José FÉLIX COSTA
Department of Mathematics
Technical University of Lisbon
Portugal

Analog Computation.

There will be short introduction to the new promising area of analog computation. Some mathematical results, about the power of this approach, will be presented as well as the implications for the theory of computation.

Carlos FONSECA

University of Algarve
Portugal

Multi-criteria Genetic Optimisation.

Genetic optimisation will be reviewed in its general formulation. The particular case of multi-criteria will then be developed and discussed.

Juergen SCHMIDHUBER

IDSIA- Instituto Dalle Molle di Studi
sull'Intelligenza Artificiale
Switzerland

Universal learning algorithms based on the theory of universal induction and Kolmogorov complexity, with applications.

Optimal Ordered Problem Solver; *Theory of Universal Learning Machines*, recent Results of an Ongoing Research Project; *The Speed Prior*, a new simplicity measure for near-optimal computable predictions (based on the fastest way of describing objects, not the shortest); *Generalized Algorithmic Information, Generalized Algorithmic Probability, and Super Omegas*.

Recurrent Neural Networks.

RNNs are artificial neural networks with adaptive feedback connections. From training examples they can learn to map input sequences to output sequences. They can implement almost arbitrary sequential behavior. RNNs are biologically more plausible and computationally more powerful than other adaptive models such as Hidden Markov Models (no continuous internal states), feedforward networks and Support Vector Machines (no internal states at all)

Organising Committee

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Location and Contact Address

All the lectures will be held in the Mathematics Department of the University of Coimbra.
For any information, please contact:

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Registration Fees

The registration fee is 150€ (180€ after 19 April 2003) the registration should be made by filling in the registration form available on the Web site.

The registration fees covers: Lectures notes, Coffee-breaks, School Dinner.

Important Dates

Early Registration Deadline:
19 Apr 2003
Students Short Papers Submissions Deadline:
19 Apr 2003

Advanced School and Workshop on Soft Computing and Complex Systems

Coimbra, 23–27 June 2003

Department of Mathematics
University of Coimbra
COIMBRA – PORTUGAL

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