REPORT ON COIL 2000 SYMPOSIUM ON COMPUTATIONAL INTELLIGENCE AND LEARNING

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The COIL Symposium is intended to give new inspirations for computational intelligence and machine learning researchers by providing a forum to share ideas and experience about the application of different soft-computing techniques. The basic idea behind this motivation is that each problem-solving technique has its own strengths and weaknesses, as well there are common features when these tools are used.

According to this aim, the symposium concentrated mainly on the application of hybrid techniques in data mining, where fuzzy, neural, genetic and/or machine learning techniques are used and combined during a data-driven procedure. The combination of these tools is not a totally new idea, but because most of us are specialised to the usage and development of only one of these soft-computing tools, there is a need to catalyse this fertilisation process, e.g. with the organisation of such symposiums.

In order to tackle the problems and advantages of these hybrid tools, the organisers tried to propose a new framework that a problem solver can use during the application of these techniques. Although, the proposed "problem solving process" is developed in data-mining mind, it can be easily seen that the resulted scheme is only a special case of system modelling or even a general problem solving procedure [1], and every expert has such a meta-learning scheme in her/his mind. However, it is a nice and useful intention to collect the tool-specific knowledge and promote its usage during the problem solving procedure. The COIL Symposium was able to give such an overview about these properties of computational intelligence tools for the attendants.

Beside this tool-specific knowledge, there are information that should be also used by soft computing researchers: the problem specific knowledge. Hence, it was extremely interesting to hear at the debate when one of the organisers of COIL stated that by using soft-computing tools it is possible to model the word without any physical knowledge. The source of this self-confidence in black-box models could be the huge amount of application examples presented also in this symposium. These case studies have proven that soft-computing is useful tool when standard engineering knowledge brakes down. These tools are aimed to provide solutions for ill-defined when the available prior information is not enough, so there is a need for a data-driven learning and adaptation procedure and/or to the use of heuristic knowledge formed by linguistic terms. However, back to Polya and to the proposed "problem solving process", at the beginning of the problem solving procedure it has to be identified what is known *a priori,* because all the available knowledge have to be used. According to this heuristic rule, the "do not estimate that you already know" rule of thumb become widely used in the field of systems engineering, e.g. the identification of grey-box models [2] become a useful tool when process relevant and measurement-based information is also available. Even, at the early 90's, by the combination first-principle models with black-box neural-networks hybrid modelling schemes were developed [3]. These hybrid solutions that use also engineering based knowledge perform better than standard data-driven tools, e.g. [4].

These success stories could show to the COIL participants that not only soft-computing tools have to be combined with each other, like neural networks and fuzzy systems into neuro-fuzzy models, but also the available information used by these tools. This means, the available "crisp" scientific and engineering knowledge has to be also used, and when it is possible in hybrid solutions first-principle models should be also combined. This scheme resulted in an iterative problem solving process, when during the modelling procedure all of the extracted information is used by a tool that is most proper to handle the available information.

This iterative scheme could motivate future work on the transformation of the information between different soft-computing models. For instance, rule-extraction from neural networks [5], identification of decision trees with the use of fuzzy models [6] or initialisation of radial basis functions by decision trees [7], etc. This kind of research could be also co-ordinated by COIL.

[1] G. Polya, "How to Solve It", 2nd ed., Princeton University Press, 1957, ISBN 0-691-08097-6.

[2] Johansen T.A., Identification of Nonlinear Systems Using Empirical Data and *A priori* Knowledge - An optimisation approach, Automatica, 32, 337-356, 1996

[3] Psichogios D.C. and Ungar L.H., A Hybrid Neural Network-First Principles Approach to Process Modelling, AIChE Journal, 38(10), 1499-1511, 1992

[4] J. Abonyi, R. Babuska, H. Verbruggen, F. Szeifert, "Incorporating Prior Knowledge in Fuzzy Model Identification", Int. Journal of Systems Science, 31(5), 657-667, 200

[5] R. Setiono and W.K. Leow, On mapping decision trees and neural networks, Knowledge Based Systems, 13, 95--99, 1999

[6] W. Pedrycz and Z.A. Sosnowski, Designing Decision Trees with the Use of Fuzzy Granulation, IEEE Trans. SMC-B, 30, 151--159, 2000,

[7] M. Kubat Decision Trees Can Initialize Radial-Basis-Function Networks, IEEE Trans. NN, 9, 813--821, 1998