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Artificial Intelligence and Neural Networks: Editor's Introduction to the Special Issue

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Artificial Intelligence (AI) and Neural Networks (NN) have had a tempestuous relation through time. They were born as twin disciplines in the fourties with the common aim of automating intelligence. Their roots, though, were quite different: AI steemed from Computer Science and Cognitive Psychology, while the fathers of NN were biologists and mathematicians.

Pursuing a common goal with different tools lead to their rivalry, which ended up with the massive adoption of AI in the early sixties, to the detriment of NN. The view of intelligence as sequential symbol processing, enforced by the success and spread of digital computers, prevailed for the next two decades over the competing view advocating that the brain-like substrate was determinant, and that perception and adaptation were at least as important for intelligence as logical reasoning.

The eighties saw the resurgence of NN impelled by both their success in applications and the technology advances which made possible their VLSI implementation. Then, several authorized voices were raised saying that the two views shouldn't be regarded as competitors but as complementary, NN being more adequate for the massively-parallel tasks of perception and control of action, while AI remained the right option for automating logical inference and symbolic learning.

This opened up a new research area, that of integrating both types of components into a single system. But it has not been until quite recently that this integration has become a reality.

The major AI conference worldwide, namely the International Joint Conference on Artificial Intelligence (IJCAI), has come to reflect this reality. In its seventeenth edition held in Seattle, Washington, on August 4-10, 2001, there were 33 submissions related to NN out of a total of 796 submissions and, of the 196 papers finally accepted for presentation, 10 had NN as a keyword.

On the other hand, the International Journal on Computational Intelligence and Applications (IJCIA) started its publication this year with a clear integration will, as stated in its "aims and scope". Thus, it offered the right place to publish extended versions of those papers presented at IJCAI-2001 best serving this aim.

This is how this special issue came to light.

In the first paper in the issue, entitled "Combining regression estimators: GA-based selective neural network ensemble", Z-H. Zhou, J-X. Wu, W. Tang and Z-Q. Chen use a genetic algorithm to select, among a set of networks trained for the same task, those that, when ensembled, give rise to the best generalization performance. It is remarkable that this strategy performs better than well-established ensembling approaches, such as averaging all and enumerating, at a much lower computational cost.

Next, the paper "Neural logic network learning using genetic programming" by H.W-K. Chia and C-L. Tan also genetically evolves a population of networks, but this time the processing units are logic operators instead of neurons. The resulting structures, called *Neurolets*, can be viewed as hybrids of neural networks and expert systems, from which it is easy to extract understandable logic rules, as well as to introduce a priori knowledge from experts.

The extraction of rules from trained networks is also addressed by K. Mcgarry, S. Wermter and J. Macintyre in their paper "The extraction and comparison of knowledge from local function networks". Two types of rules are extracted from Radial Basis Function (RBF) networks: those stemming from hidden unit to class assignments, and those based on input-output mappings. The performance of the set of extracted rules is validated against that of the original network.

The paper by B.W. Wah and M. Qian, entitled "Violation-guided neural-network learning for constrained formulations in time-series predictions" makes a fundamental contribution to the neural learning field by incorporating recent results on discrete constrained optimization by the authors themselves. Thus, the integration here is between optimization theory and NN. Time-series prediction is used as a test-bench, and the new algorithm compares favourably to the winner of the Santa Fe competition.

Optimization is also the object of the paper "A general updating rule for discrete Hopfield-type neural network with time-delay and the corresponding search algorithm" by D.S. Yeung, S. Qiu, E.C.C. Tsang and X. Wang, but from a different standpoint. While in the previous paper it was used to speed up network learning, here the network itself is an optimizing device (specifically, a Hopfield-type network with delay) and the goal is to find an updating rule that ensures quick convergence. A general such rule is proposed, which subsumes previously available rules for this type of network.

The paper by F. Linaker and H. Jacobsson on "Learning delayed response tasks through unsupervised event extraction" proposes a four-layered architecture for handling tasks where the triggering stimulation cue comes arbitrarily earlier than the instant when the response has to be produced. A vector quantization network and a recurrent network conform two of the layers, and a robotics application of the whole system is presented.

An image processing application is described in the following paper entitled "Learning iterative image reconstruction in the neural abstraction pyramid" by S.

Behnke, which also makes use of recurrent networks. Images are represented at multiple scales and the reconstruction is performed iteratively. Interesting results are obtained for different types of image degradation, both in standstill and dynamic images.

The last paper, entitled "NORN predictor - Stock prediction using a neural oscillatory-based recurrent network" by R.S.T. Lee and J.N.K. Liu, is devoted to an increasingly widespread application, namely financial prediction. An oscillatory neural network is coupled to a RBF network, and both are integrated with statistical procedures to conform a hybrid system that achieves challenging results when applied to real data on the evolution of the major Hong Kong stocks along the last decade.

I wouldn't like to close this introduction without thanking Prof. Antonio Braga for suggesting the idea of this special issue, as well as providing all the help needed for its successful completion. Likewise, I like to thank all the authors for their efficiency in responding to my call for extended papers and their readiness to incorporate the suggestions of the reviewers. Finally, I acknowledge the support of the IJCAI organization and specially of the Program Chair of IJCAI-2001, Prof. Bernhard Nebel, who invited me to join the Program Committee, the first step that triggered this initiative.

I hope the readers of this special issue will enjoy it.

Barcelona, November 23, 2001.