The 1997 IEEE International Conference on Neural Networks

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A MESSAGE FROM THE GENERAL CHAIR

The 1997 International Conference on Neural Networks (ICNN 97) is organized this year under the guidance and sponsorship of the IEEE Neural Networks Council (NNC) to bring together researchers , practitioners, managers, and policy-makers interested in biological and computational neural networks. This is a special year, because the International Neural Network Society (INNS) decided to participate in the organization of the ICNN 97 as a Technical Sponsor. The collaboration of these two major organizations and the combined talents of IEEE and INNS members make the ICNN 97 unique among the meetings that are directly or indirectly related to neural networks. With neural networks gaining recognition as building blocks of complex systems and the new millenium approaching, we thought the most appropriate motto for the ICNN 97 would be:

Hybrid Neural Systems for the 21st Century.

The idea of organizing the ICNN 97 in Houston came up two years ago in a conversation I had in Orlando with the current President of the IEEE NNC Jim Bezdek, the the Vice President of the Council responsible for meetings. The NNC approved my proposal and several members of the Council offered their valuable advice and suggestions, including Antti Koivo, Bob Marks, and Pierre Bonissone. The Council also decided to award a number of grants to cover the travel and accomodation expenses of student authors. I would like to thank Karen Haines for strongly supporting our proposal for student travel support and securing the funds that will certainly contribute to the development of the next generation of researchers in the field. Walter Karplus, the former President of the NNC, made it clear in Washington last year that the emphasis of the IEEE NNC is on quality. Quality was also the center of my discussions with George Lendaris, which led to the INNS involvement in the organization of the ICNN 97.

The quality of a technical meeting is the responsibility of the Technical Committee Members. The Technical Committee carried out a daunting task this year, given that they had to organize the review and revision of almost 750 papers under strict time constraints. I am especially grateful to the Co-Chairs of the Technical Committee Jim Keller, Raghu Krishnapuram, and Dan Levine for their monumental efforts to organize the review of the papers and put together the final program of the Conference. My sincere thanks also goes to the Area Chairs and the numerous colleagues who agreed to serve as reviewers. Thanks to the combined efforts of all these colleagues, we were confident to reject almost 35% of the papers submitted to the regular program of the ICNN 97. I hope that this trend will continue and future Conferences will become even more selective. In addition to the regular sessions, there are several special sessions dealing with emerging trends and directions in neural network research. I would like to thank Jacek Zurada for undertaking the review of proposals for special sessions and carrying out the review of the papers included in special sessions in collaboration with the Chairs of the Special Sessions and the Technical Committee Co-Chairs. Jacek Zurada also helped with the organization of the plenary sessions. Thanks to his efforts and Dan Levine's help, we invited twelve plenary speakers among the authorities in the field. I would also like to thank Asim Roy, Dan Levine and John Taylor for organizing three panel discussions and igniting many interesting debates. After a careful review, we planned six tutorials that gave the opportunity to the participants to learn more from experts in cutting-edge areas of neural network. My thanks go to John Yen who organized the review of the proposals for tutorials. I would also like to thank Mary Lou Padgett for agreeing to serve as the Publicity Chair for the ICNN 97. Thanks to her continuing efforts, our Web page was always updated and informative. More than that, Mary Lou helped me and the Technical Committee Co-Chairs in times of despair with an amazing dedication and discipline. I would also like to thank Joydeep Ghosh for serving as the Chair of the Exhibits Committee and Sankar K. Pal for serving as the International Liaison Chair. Ben Jansen was responsible for the finances of the meeting. Thanks to his careful bookkeeping and persistent predictions of a financial disaster, I was able to control my temptations to spend more money. I would also like to thank Heidar Malki for organizing the tours and helping advertise the ICNN 97 locally. My sincere thanks go to the student volunteers for helping during the meeting with the many details that sometime make the difference between a successful and a disastrous conference. Finally, I would like to thank Steve Marlin and his staff at Meeting Management for helping us organize the ICNN 97. In particular, I would like to acknowledge Carol Nichols and Barbara Klemm for their efforts during the past two years.

A conference does not materialize until the participants are coming together to exchange ideas, present their approaches and talk about their accomplishments and hopes. I would like to express my sincere thanks to all of you who helped with your attendance to make the ICNN 97 part of neural networks history. I sincerely hope that you will find the ICNN 97 a rewarding and memorable experience.

Nicolaos B. Karayiannis General Chair, ICNN 97

A Message from the Technical Program Chairs

It is an honor to serve as the program chairs for the International Conference on Neural Networks (ICNN '97) to be held at the Westin Galleria Hotel, Houston, USA, during June 8-12, 1997. We have tried our best to maintain the reputation of this meeting as the leading international forum for scientists and practitioners in the area of neural networks. With the participation of the International Neural Network Society (INNS), this conference will regain its original flavor of the IJCNN, and the resoponsibility for the conference will alternate between IEEE and INNS starting 1998.

We received approximately 655 submissions in 13 areas. The papers were logged in at the University of Missouri, and the authors were sent an acknowledgment via e-mail. For each area, we picked two persons as area chairs (in two cases three). The area chairs were responsible for collecting three reviews for each paper. The same review form was used for all areas. In addition, each area chair was asked to supply a recommendation on each paper.

The members of the organizing committee (with some exceptions) met in Houton early January and made the final decisions on the papers based on the reviews and area chair recommendations. A total of 310 papers were accepted for oral presentation and 132 papers were accepted for poster presentation. About 18 of these papers were withdrawn later for various reasons.

The reviewing process was somewhat stricter than in the preceding years. We believe that the area chairs did their best to select objective reviewers and summarizing the reviewers for us. However, the review and decision process is never perfect. Moreover, due to time and space constraints, we were not able to accommodate all good papers. We apologize for any resulting disappointment. There were nine invited-paper (special) sessions and three panels organized by Prof. Jacek Zurada. The special session papers (which totaled 62) were reviewed separately. Fiftynine of them appear in the proceedings. Nine student papers were selected based on reviewer comments and ratings. These papers were revewed by us as well as some members of the organizing committee to determine the best student paper award.

We would like to thank the area chairs without whose timely help it would have been impossible to assemble this program. We would also like to thank our graduate students, Olfa Nasraoui and Hichem Frigui for their help with creating the data base of the submissions. We gratefully acknowledge Prof. Mary Lou Padgett's help with the web site.

Jim Keller, Raghu Krishnapuram and Dan Levine

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Modeling the Creative Process
Organizer: **Dan Levine**
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Brain Imaging and Modeling
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PLENARY TALKS

PL1: NEURAL NETS AND AI: TIME FOR A SYNTHESIS

David Waltz, NEC Research Institute

ABSTRACT

Throughout its history, neural net research has been heavily impacted by AI, nearly always negatively. Neural net research and applications are finally thriving as an enterprise largely divorced from AI, though with the upsurge of interest in learning in AI, there are communities of researchers who feel affinities with both fields. But in a broader perspective, AI and neural nets could learn a great deal from each other: AI is unlikely to succeed in its central goals if researchers ignore learning and insist on hand construction of programs grounded in logical primitives; and neural nets are unlikely to add much to our overall understanding of intelligence, or to break out of their role as useful application tools if researchers ignore representational issues and constrain each system to begin as "tabula rasa". Moreover, while both fields have developed useful insights and applications, both AI and neural net researchers will need to look at larger architectural issues if we are ever to build systems that are intelligent in any sense comparable with human or animal intelligence.

PL2: ADAPTIVE APPROXIMATION NETWORKS FOR STABLE LEARNING AND CONTROL

Jean-Jacques E. Slotine
Nonlinear Systems Laboratory, MIT

ABSTRACT

Real-time estimation and adaptive control using "neural" networks presents specific challenges and opportunities. Intuitively, because the estimated model is used in closed-loop {\it at the same time as it is being built}, the main difficulty is to guarantee and quantify the overall stability and convergence of the three concurrent processes of structural adaption (basis function selection), coefficient (weight) adaption, and actual control or estimation. The main opportunity is that learning performance is specified in terms of task convergence rather than global function approximation, so that stable real-time algorithms and representations can be derived that, in a sense, are just complex enough to get the job done. Specifically, we study an algorithm for stable real-time estimation and control using on-line construction of a multi-resolution dynamic model. We illustrate the discussion experimentally on robotic catching and throwing tasks.

PL3: A GEOMETRIC APPROACH TO EDGE DETECTION

Jim Bezdek
University of West Florida

ABSTRACT

This paper describes edge detection as a composition of four steps: conditioning, feature extraction, blending and scaling. We examine the role of geometry in determining good features for edge detection and in setting parameters for functions to blend the features. Our main results: (I) statistical features such as the range and standard deviation of window intensities can be as effective as more traditional features such as estimates of digital gradients; (ii) blending functions that are roughly concave near the origin of feature space can provide visually better edge images than the traditional choices such as the city-block and Euclidean norms; (iii) geometric considerations can be used to specify the parameters of generalized logistic functions and Takagi-Sugeno input/output systems that yield a rich variety of edge images; and (iv) understanding the geometry of the feature extraction and blending functions is the key to using models based on computational learning algorithms such as neural networks and fuzzy systems for edge detection. Edge images derived from a digitized mammogram are given to illustrate various facets of our approach.

PL4: EXPLORATION OF VERY LARGE DATABASES BY SELF-ORGANIZING MAPS

Teuvo Kohonen
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ABSTRACT

Exploratory data analysis, or "data mining", is a new area in neural-network research. The main problem thereby is the vast dimensionality. Neurocomputers have a high computing speed but their local memory capacities are still rather limited for those

tasks. Due to the latter restriction, for really big problems such as organization of very large text collections, one therefore still has to use general-purpose computers but effective shortcuts to computations are then badly needed, The talk first discusses data mining from a general point of view. The talk then concentrates on a case example, an architecture and several computational solutions in which two cascaded Self-Organizing Maps of very high dimensionality are used to cluster documents according to their semantic contents. This architecture facilitates the retrieval of documents that are semantically most similar or relevant to a piece of given text. Using this system, one can also specify a personalized mailbox into which such documents are automatically directed that belong to some defined semantic cluster. In the summer of 1996, the size of the document map was 49,152 (forty-nine thousand and 152) nodes or locations, and the total number of documents mapped onto these nodes was 306,350 (three hundred six thousand and 350). Semantically most similar documents were mapped onto the same node and when moving to other nodes on the map, the topic area gradually changed.

PL6: RESEARCH AND APPLICATION ASPECTS IN SOFT COMPUTING: HISTORY AND RECENT TRENDS IN JAPAN

Kaoru Hirota
Tokyo Institute of Technology, JAPAN

ABSTRACT

Research and application aspects in the field of soft computing mainly in Japan have been surveyed. In the middle of the 1980's, the fuzzy technology became a central issue for mainly process control and the year 1990 became a so-called "fuzzy-home-electronics year". These technologies are mainly based on if-then rule based fuzzy inference with instrumentation (i.e. sensor and actuator) engineering. Then, the neural network technology was merged in fuzzy technology in 1991 and again many consumer products were sent to the real market in Japan. Such neuro-fuzzy technologies are classified into 9 categories. In 1993, chaos technologies were also taken part in research and development of such high-tech issues. Very recently, other technologies such as chaos, genetic algorithms and artificial life are also investigated by company engineers in Japan. These kinds of practical, technological aspects in Japan are discussed and the future trends are also indicated by giving many examples.

PL7: STRUCTURE AND DYNAMICS OF NETWORK MEMORY

Joaquin Fuster, M.D., Ph.D.
Brain Research Institute, University of California, Los Angeles

Memory and knowledge are represented in widely distributed and hierarchically organized networks of interconnected neocortical neurons. These networks transcend cytoarchitecturally defined areas and modules. Perceptual memory is organized in networks of postrolandic cortex, motor (action) memory in prerolandic cortex. The prefrontal cortex is the highest hierarchical level of motor memory. The retrieval of memory — or knowledge — in recall and recognition, as well as its recall in "working memory", consist in the associative activation of pre-established neuronal networks. Probably an essential mechanism of active memory is the sustained re-entry of neural impulses within a network.

PL8: TOWARDS NEURALLY PLAUSIBLE BAYESIAN NETWORKS

Geoffrey Hinton
University of Toronto, CANADA

Bayesian networks have been one of the major advances in statistics and artificial intelligence over the last decade. Multilayer logistics Bayes nets which compute posterior distributions over hidden states using Gibbs sampling are considerably more efficient than Boltzmann machines at unsupervised learning (Neal, 1992). However, they are implausible as biological models because to handle "explaining away" effects properly, a unit in one layer needs to know not only the state of a unit in the layer below but also that unit's total top-down input. Seung has recently shown how explaining away can be handled in a biologically plausible way using lateral connections, provided the generative model is linear. We extend Seung's trick to multilayer non-linear generative models and show that these models are very effective in extracting sparse distributed representations with easily interpreted hidden units. This talk describes joint work with Z. Ghahramani.

PL9: THE DEEP AND SURFACE STRUCTURE OF MEMORY

Karl H. Pribram
Stanford University

James P. and Anna King
Commonwealth of Virginia

ABSTRACT:
Memory loss due to brain injury ordinarily encompasses a category of processing: prosopagnosia (inability to recognize faces); tactile agnosia; aphasia (inability to speak) and so forth. But the category can be narrowly restricted — for instance, to living versus non-living items or unfamiliar perspectives on familiar objects. Furthermore, whenever we wish to recall something or other, we find it useful to employ a very specific trigger that provides entry into the retrieval structure. Still, specific memories (engrams) are rarely "lost" due to brain injury. This has given rise to the view that ultimately, storage of experience in the brain is distributed. What kind of brain process can account for both the specificity of memory and distribution? I will conceive of the organization of memory storage to resemble somewhat the organization proposed by Chomsky (1965) for language: Memory has a deep and a surface structure. The deep structure of memory is distributed in the connection web of brain tissue; its surface structure is encompassed in specific circuits which are dispositions toward patterned propagation of signals performed genetically and/or on the basis of experience. Retrieval entails a process whereby brain circuitry addresses the distributed store. Smolensky (1986) has captured the formal essence of the process that characterizes the retrieval process, the surface structure of memory: "The dyanmical system [embodied in the function of a circuit] towards a point attractor [a trigger] whose position is the state space [the distributed store] is the memory. You naturally get dynamics of the system so that its attractors are located where the memories are supposed to be..." (pp. 194-281). In short, the process of re-membering operates on a dis-membered store by initiating a temporary dominant focus of exitation in the dendritic net. Smolensky's suggestion is made more plausible if the "location" of attractors is content determined; that is, if the process is essentially content addressable — by a similarity matching procedure — rather than location addressable.

PL10: TOWARD A MODEL OF MIND AS A LAISSEZ-FAIRE ECONOMY OF IDIOTS

Eric Baum
NEC Research Institute

PL11: FROM NEUROCONTROL TO BRAIN-LIKE INTELLIGENCE

Paul Werbos
National Science Foundation

ABSTRACT
Formally, the ENTIRE brain is a neurocontroller — a learning-based system of neural nets designed to output actions or decisions to achieve results over time. But what kind of neurocontroller is it and how do we replicate its capabilities? In 1981, I published a first-order theory of the brain as a neurocontroller, in a design combining reinforcement learning, expectations and backpropagation. As of 1995, applied neurocontrol has "climbed up the ladder" of designs high enough to implement that theory and demonstrate its superior capabilities on simulated control problems; a physical demonstration is well underway and a couple of stability theorems have been proved. This talk will review this progress and then describe a more complete theory of brain-like intelligence — "three brains in one" — which addresses issues such as generalized spatial navigation, planning, discrete choice and the role of the basal ganglia, with a few related simulation results.

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Conference Proceedings Overview

TABLE OF CONTENTS

Volume I

PLENARY

APPLICATIONS