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TUTORIAL #1

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(Tuition fee includes both notes and refreshments during coffee break)

FUZZY NEURAL COMPUTING SYSTEMS:
THEORY AND APPLICATIONS

Madan M. Gupta[1], Noriyasu Homma[2], and Zeng-Guang Hou[3]

Contents:

Summary

Fuzzy neural networks (FNNs), being the product of both fuzzy logic and neural networks are the computational machines with some unique capabilities of dealing with both the numerical data and the linguistic knowledge information. In this tutorial, some basic methodology, morphology, learning and adaptation algorithms of FNNs are discussed extensively. First, elements of fuzzy sets and systems are briefly reviewed in order to provide some necessary mathematical preliminaries for developing FNNs. Also, some basic results of conventional multilayer feedforward neural networks (MFNNs) with a well-known backpropagation (BP) learning algorithm are provided as a basis for FNNs. Several fuzzy logic operations for various types of fuzzy neurons (FNs) which have fuzzy inputs and fuzzy weights are then introduced. Analogous to the backpropagation (BP) learning algorithm for multilayered feedforward neural networks (MFNNs), the concept and formulations of fuzzy backpropagation (FBP) learning algorithms for FNNs are then developed. Moreover, the capabilities and limitations of FNNs consisting of many interconnected FNs are also discussed. The universal approximation capabilities of fuzzy basis function networks (FBFNs) which are represented as a modified version of Gaussian radial basis function networks (GRBFNs) are also addressed. The material presented in this tutorial provides not only an overview of the existing results but also presents some state-of-the-art new achievements and open problems in the field of fuzzy neural computing.

Key words*: Fuzzy logic; Neural networks; Fuzzy-neural systems; Learning; Universal approximation.*

References:

1. Fuzzy Neural Computing Systems: Theory and Applications, 80 pages notes (will be supplied).

2. Madan M. Gupta, Liang Jin, and Noriyasu Homma [2003], *Static and Dynamic Neural Networks: From Fundamentals to Advanced Theory,* Wiley-IEEE Press, ISBN: 0-471-21948-7.

Dr. Madan M. Gupta (publication list, book list, research compendium, faculty page, lab page) is a Professor Emeritus in the Department of Mechanical Engineering and Director of the Intelligent Systems Research Laboratory at University of Saskatchewan. Dr. Gupta's current research interests are in the areas of neuro-vision systems, neuro-control systems, integration of fuzzy-neural systems, neuronal morphology of biological vision systems, intelligent and cognitive robotic systems, cognitive information, new paradigms in information processing, and chaos in neural systems. He is also developing architectures of computational neural networks and computational fuzzy neural networks for application to advanced robotics, aerospace, and industrial systems.

Dr. Gupta authored or coauthored over 800 published research papers. He recently coauthored the seminal book *Static and Dynamic Neural Networks: From Fundamentals to Advanced Theory.* Dr. Gupta previously coauthored *Introduction to Fuzzy Arithmetic: Theory and Applications,* the first book on fuzzy arithmetic, and *Fuzzy Mathematical Models in Engineering and Management Science.* Both of these books had Japanese translations. Also, Dr. Gupta edited 19 books in the fields of adaptive control systems, fuzzy computing, neurocomputing, neuro-vision systems, and neuro-control systems (book list).

Dr. Gupta was elected fellow of the Institute of Electrical and Electronics Engineers (IEEE) for his contributions to the theory of fuzzy sets and adaptive control systems and for the advancement of the diagnosis of cardiovascular disease. He was elected fellow of the International Society for Optical Engineering (SPIE) for his contributions to the field of neuro-control and neuro-fuzzy systems. He was elected fellow of the International Fuzzy Systems Association (IFSA) for his contributions to fuzzy-neural systems. In 1991, Dr. Gupta was co-recipient of the Institute of Electrical Engineering Kelvin Premium. In 1998, Dr. Gupta received the Kaufmann Prize Gold Medal for Research in the field of fuzzy logic. He has been elected as a visiting professor and a special advisor in the area of high technology to the European Centre for Peace and Development (ECPD), University for Peace, which was established by the United Nations.

Dr. Gupta received B.E. (Hons.) and M.E. degrees in electronics-communications engineering from the Birla Engineering College (now the Birla Institute of Technology & Science), Pilani, India in 1961 and 1962, respectively. He received his Ph.D. degree from the University of Warwick, United Kingdom in 1967 in adaptive control systems. In 1998, for his extensive contributions in neuro-control, neuro-vision, and fuzzy-neural systems, Dr. Gupta received an earned doctor of science (D.Sc.) degree from the University of Saskatchewan.

[1] Dr. Madan M. Gupta, Professor & Director
Intelligent Systems Research Laboratory
College of Engineering, University of Saskatchewan
57 Campus Drive, Saskatoon, SK, Canada S7N 5A9
Phone: (306) 966-5451 (Office), (306) 933-0663 (Home), Fax: (306) 966-5427
Email: Madan.Gupta@usask.ca

Dr. Noriyasu Homma received a BA, MA, and PhD in electrical and communication engineering from Tohoku University, Japan, in 1990, 1992, and 1995, respectively.

From 1995 to 1998, he was a lecturer at the Tohoku University, Japan. He is currently an associate professor of the Faculty of Medicine at the Tohoku University. From 2000 to 2001, he was a visiting professor at the Intelligent Systems Research Laboratory, University of Saskatchewan, Canada. His current research interests include neural networks, complex and chaotic systems, soft-computing, cognitive sciences, and actual brain functions. He has published over 70 papers, and co-authored 1 book and 3 chapters in 3 research books in these fields.

[2] Dr. Noriyasu Homma, Associate Professor
Faculty of Medicine, Tohoku University
2-1 Seiryo-machi, Aoba-ku, Sendai, Japan 980-8575
Phone: +81 (22) 717-7940,   Fax: +81 (22) 717-7944
Email: homma@abe.ecei.tohoku.ac.jp

Dr. Zeng-Guang Hou received the B.E. and M.E. degrees in electrical engineering from Yanshan University (former North-East Heavy Machinery Institute), Qinhuangdao, China, in 1991 and 1993, respectively. He received the Ph.D. degree in electrical engineering from Beijing Institute of Technology, Beijing, China, in 1997.

From 1997 to 1999, he was a Postdoctoral Research Fellow at the Institute of Systems Science, Chinese Academy of Sciences, Beijing, China. From 1999 to 2004, Associate Professor at the Institute of Automation, Chinese Academy of Sciences, Beijing, China, where now he serves as a Full Professor. From September 2003 to October 2004, he was with the Intelligent Systems Research Laboratory, University of Saskatchewan, Canada, as a Visiting Professor. His current research interests include neural networks, fuzzy logic, SVM, optimization algorithms, intelligent control and robotics. He has published over 50 papers in these fields.

[3] Dr. Zeng-Guang Hou, Professor
Institute of Automation, The Chinese Academy of Sciences
P. O. Box 2728, Beijing, P.R. CHINA 100080
Phone: +86 (10) 8261-4501,   Fax: +86 (10) 6255-5383
Email: zengguang.hou@mail.ia.ac.cn