

FUZZY EXPERT ADVISORY FOR E-COUNSELLING

A project submitted to the Graduate School in partial fulfillment of the requirements
for the degree Master of Science (Intelligent System)
Universiti Utara Malaysia

By:
Taniza Binti Tajuddin

© Taniza Binti Tajuddin, 2004
All rights reserved.



JABATAN HAL EHWAL AKADEMIK
(Department of Academic Affairs)
Universiti Utara Malaysia

PERAKUAN KERJA KERTAS PROJEK
(Certificate of Project Paper)

Saya, yang bertandatangan, memperakukan bahawa
(I, the undersigned, certify that)

TANIZA BINTI TAJUDDIN

calon untuk Ijazah
(candidate for the degree of) **MSc. (Intelligent System)**

telah mengemukakan kertas projek yang bertajuk
(has presented his/her project paper of the following title)

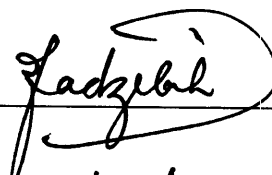
FUZZY EXPERT ADVISORY FOR E-COUNSELLING

seperti yang tercatat di muka surat tajuk dan kulit kertas projek
(as it appears on the title page and front cover of project paper)

bahawa kertas projek tersebut boleh diterima dari segi bentuk serta kandungan
dan meliputi bidang ilmu dengan memuaskan.
(that the project paper acceptable in form and content, and that a satisfactory
knowledge of the filed is covered by the project paper).

Nama Penyelia Utama
(Name of Main Supervisor): **ASSOC. PROF. FADZILAH SIRAJ**

Tandatangan
(Signature)

: 

Tarikh
(Date)

: 23/10/2004

PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirement for a postgraduate degree from Universiti Utara Malaysia, I agree that the University Library may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purposes may be granted by my supervisor or, in her absence, by the dean of the Graduate School. It is also understood that due recognition shall be given to me and Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or make other use of materials in this thesis, in whole part, should be addressed to:

**Dean of Graduate School
Universiti Utara Malaysia
06010 UUM Sintok
Kedah Darul Aman
Malaysia**

ABSTRAK

Logik Kabur dan Sistem Pakar di rekabentuk untuk meniru proses membuat keputusan dalam sistem bermodul, menetapkan nilai berdasarkan syarat dan menggunakan kawalan logik kabur untuk menerangkan sistem yang ketidakpastian, dan menggunakan pengaruh sistem pakar untuk mewakili dan mengawal pengetahuan (Medeiros et al., 1998). Kertas kerja ini membentangkan pembangunan Logik Kabur dan Sistem Pakar penasihat untuk Sistem e-Kaunseling. Model penasihat dalam kaunseling ini menggunakan sistem bermodul yang digunakan untuk proses ujian psikologi bagi Tingkahlaku Kendiri terhadap Akademik (TKA). Sistem ini dibangunkan dengan menggunakan pendekatan struktur berhirarki. Sistem ini telah dibangunkan dengan menggunakan bahasa aplikasi berasaskan web iaitu Halaman Pelayan Aktif Microsoft (ASP) iaitu tapak pelayan penulisan web. Sistem ini mengandungi lima modul, iaitu Inisiatif Pelajar bagi TKA faktor pertama, Perhatian Sosial bagi TKA faktor kedua, Kejayaan/Kegagalan bagi TKA faktor ketiga, Daya Tarikan Sosial bagi TKA faktor keempat, dan Keyakinan Diri bagi TKA faktor kelima. Ujian TKA ini mengandungi enam belas item, dikategorikan kepada lima (5) faktor utama TKA. Input yang dimasukkan ke dalam sistem akan dikaburkan (fuzzified) dan di proses melalui Memori Kesatuan Kabur (FAM) yang dibangunkan untuk mengendalikan syarat-syarat kabur berdasarkan kepada kelima-lima faktor kajian kes ke atas TKA. Pengkaburan Semula (Defuzzification) yang dikenali sebagai kawasan berpusat digunakan untuk membuat anggaran kepada faktor TKA dan menentukan tahap-tahap sendiri terhadap akademik seseorang pelajar samada ia berada pada tahap rendah, pertengahan atau tinggi. Tambahan pula, penasihat yang menggunakan Logik Kabur dan Sistem Pakar menyediakan penerangan dan juga menerangkan bagaimana sesuatu diagnosis dicapai bagi sesuatu kes. Keputusan-keputusan menunjukkan sistem prototaip Logik Kabur dan Sistem Pakar yang dibentangkan dalam kertas kerja ini telah menghasilkan keputusan yang boleh percaya dan tepat setelah beberapa pengujian kes telah dilakukan. Pencapaian keseluruhan bagi sistem ini telah berjaya diuji dan menghasilkan keputusan yang sama dengan keputusan pakar, justeru mencapai matlamat. Sistem ini telah disahkan oleh kaunselor-kaunselor dan keputusan-keputusan yang dihasilkan oleh sistem bertepatan dengan skala yang ditetapkan dan sub skor dalam TKA.

ABSTRACT

Fuzzy Expert is designed to mimic the human decision process of the modular system, maintains the value of based rules and using fuzzy logic control to describe uncertainty systems, and utilizes the predominance of using expert systems to denote and control knowledge (Medeiros et al., 1998). This paper presents the development of Fuzzy Expert Advisory for e-Counselling. The advisory model in counselling using a modular system for the psychology testing process for Behavioural Academic Self-Esteem (BASE) is used to test the prototype developed in this study. The system was constructed using hierarchical structural approach. The system was developed using web-based application language that is Microsoft's Active Server Pages (ASP) the server-side web scripting. The system comprises of five modules, namely Student Initiative of BASE Factor 1, Social Attention of BASE Factor 2, Success / Failure of BASE Factor 3, Social Attraction of BASE Factor 4, and Self-Confidence of BASE Factor 5. BASE test consists of sixteen items, categorized into the five main BASE factors. The input to the system was first fuzzified and Fuzzy Associative Memory (FAM) table were constructed to handle the fuzzy rules of the five factors of BASE case study. The defuzzification known as Centre of Area (COA) is used to estimate the BASE factor and determine the levels of academic self-esteem such as low self-esteem, moderate self-esteem, and high self-esteem. In addition, fuzzy expert advisory provides explanation and also explain how a diagnosis is reached for a particular case. The results showed that the fuzzy expert prototype system presented in this paper provided a reliable and accurate outcome after several test cases have been performed. Overall performance of this system was successfully tested and produced the results that were equal to an expert's judgment, thus accomplishing the set goals. The system has been verified by the counsellors and the results produced by the system conform to the BASE factor rating scale and sub-scores.

ACKNOWLEDGEMENTS

I would like to express my thanks and gratitude to Allah, the Compassionate, Most Gracious, and the Most Merciful who has granted me the ability and will power to start and complete this project. I pray to His greatness to inspire and to enable me to continue the work for the benefits of my country, specifically for the educational institutions.

I would also like to express my gratitude to my supervisor, Associate Professor, Fadzilah Siraj, Head of Artificial Intelligent, Computer Science Department, Faculty of Information Technology at the Northern University of Malaysia for her valuable time, contribution and effort at the end providing guidance and constructive suggestions. Thanks also for the understanding and support throughout the completion of this project. I would like to thank to the domain expert, En. Muhammad Salleh b Ahmad, Pengarah, Pusat Kaunseling, Tn Hj Shahrin Hj. Ahmad, and Puan Faezah Binti Nayan, Pusat Kaunseling dan Kerjaya, from Universiti Utara Malaysia for their helps and contributions. I like to express my thanks to staffs at Mixac, especially Miss Ana and Miss Aida for their valuable assistance.

I am indebted to my husband, Ahmad Takiuddin Bin Shuaib for his numerous pieces of advice, encouragement and different kinds of support. To my late sister, Zaliza Binti Tajuddin who already passed away, thanks for your kindness and may Allah bless you forever and ever. My heartfelt thanks to my sons and daughters, Muhammad Aiman, Adilah, Muhammad Adnin, Aliyah, Ahmad Luqman, Muhammad Asyraf and Muhammad Imran, for their tremendous patience and continuous support. Finally, my heartfelt thanks to my parents, for their understanding, support and kindness. Without their support this thesis would have never been realised. I would like to express my thanks to each and every family member, and my relatives for their support.

TABLE OF CONTENTS

PERMISSION TO USE	i
ABSTRAK	ii
ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	x
1.0 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statements	5
1.3 Objectives	6
1.4 Significance of the Study	6
1.5 Project Scope	7
1.6 Thesis Overview	8
2.0 LITERATURE REVIEW	9
2.1 Introduction.....	9
2.2 Fuzzy Logic	11
2.3 Expert System	15
2.4 Fuzzy Expert System	19
2.5 E-Counseling	22
2.5.1 Introduction.....	22
2.5.2 Psychology and Psychological Testing.....	25
2.5.3 Self-Esteem.....	30
2.5.4 BASE.....	34

3.0	SYSTEM DESIGN AND DEVELOPMENT	38
3.1	Introduction.....	38
3.2	System Development.....	41
3.2.1	Problem Assessment	42
3.2.2	Knowledge Acquisition and Analysis	42
3.2.3	Literature References on Psychology and Counseling	44
3.2.4	Expert Interviews.....	45
3.2.5	Acquisition via the Internet	45
3.2.6	Knowledge Analysis.....	46
3.3	Design and Implementation	49
3.3.1	Knowledge Representation	49
3.3.2	Fuzzy Logic and Expert System	50
3.3.3	Fuzzy Expert Advisory for e-Counselling.....	56
3.4	Testing	96
3.5	Documentation	96
3.6	Integration and Maintenance of the System	96
4.0	RESULTS AND DISCUSSION	97
4.1	Introduction	97
4.2	Experimental Results	98
4.2.1	BASE Factor 1: Student Initiative.....	99
4.2.2	BASE Factor 2: Social Attention.....	106
4.2.3	BASE Factor 3: Success/Failure.....	112
4.2.4	BASE Factor 4: Social Attention.....	114
4.2.5	BASE Factor 5: Self-Confidence.....	117
4.3	Expert System Explanation	122
5.0	CONCLUSION	125

REFERENCES 128

APPENDIX A: USER MANUAL 137

APPENDIX B: COGNITIVE MAP 149

APPENDIX C: INFERENCE NETWORK 150

APPENDIX D: DATA DESCRIPTION TABLE 151

LIST OF TABLES

TABLE NO	TITLE	PAGE
2.1	Examples of Psychological Tests and Descriptions	28
2.2	Apart of Questions of Cognitive Distortion Scale Test	29
2.3	Measures of Self-Esteem	32
2.4	Modified Version of BASE Rating Scale	35
3.1	Questions and its Behaviours	59
3.2	Fuzzy Input Variables and Linguistic Variable of Student Initiative	60
3.3	Fuzzy Input Variables and Linguistic Variable of Social Attention	60
3.4	Fuzzy Input Variables and Linguistic Variable of Success/Failure	61
3.5	Fuzzy Input Variables and Linguistic Variable of Social Attraction	61
3.6	Fuzzy Input Variables and Linguistic Variable of Self-Confidence	62
3.7	Label and Ranges of Student Initiative	64
3.8	Label and Ranges of Social Attention	64
3.9	Label and Ranges of Success/Failure	65
3.10	Label and Ranges of Social Attraction	65
3.11	Label and Ranges of Self-Confidence	66
3.12	Fuzzy Output Variables and Linguistic Variables for System Output	71
3.13	Hierarchical FAM of Student Initiative (Phase 1)	79
3.14	Hierarchical FAM of Student Initiative (Phase 2)	80
3.15	Hierarchical FAM of Student Initiative (Phase 3)	81
3.16	Hierarchical FAM of Student Initiative (Phase 4)	81

3.17	Hierarchical FAM of Student Initiative (Phase 5)	82
3.18	Hierarchical FAM of Social Attention (Phase 1)	83
3.19	Hierarchical FAM of Social Attention (Phase 2)	83
3.20	FAM of Success / Failure	84
3.21	Hierarchical FAM of Social Attraction (Phase 1)	85
3.22	Hierarchical FAM of Social Attraction (Phase 2)	85
3.23	FAM of Self-Confidence	86
3.24	Fuzzy Operators	87
3.25	Confidence Value Computation of FAM for Social Attention (Phase 1)	87
3.26	Confidence Value Computation of FAM for Social Attention (Phase 2)	88
3.27	Confidence Value Computation of FAM for Success/Failure	89
3.28	Confidence Value Computation of FAM for Social Attraction (Phase 1)	89
3.29	Confidence Value Computation of FAM for Social Attraction (Phase 2)	90
3.30	Confidence Value Computation of FAM for Self- Confidence	90
4.1	FAM of First Inference for Student Initiative	101
4.2	FAM of Second Inference for Student Initiative	102

LIST OF FIGURES

FIGURE NO	TITLE	PAGE
2.1	Membership Functions of the Linguistic Variable “Width”	12
3.1	Design of Fuzzy Expert Advisory for e-Counselling	40
3.2	Knowledge Engineering Methodology	41
3.3	Flowchart of Fuzzy Expert Advisory for e-Counselling	48
3.4	Fuzzy Logic System Design Methodology	51
3.5	Components of Fuzzy Logic	52
3.6	Two Continuous Membership Functions	53
3.7	Components of Expert System	55
3.8	Fuzzy Expert Advisory for e-Counselling System Components	56
3.9	Membership Function for Questions of Student Initiative	66
3.10	Membership Function for Questions of Social Attention and Social Attraction	67
3.11	Membership Function for Output 21 and Output 41 of Social Attention and Social Attraction	67
3.12	Membership Function Graph Zone	68
3.13	Fuzzy Membership Function for Output of Student Initiative	72
3.14	Fuzzy Membership Function for Output Social Attention and Social Attraction	72
3.15	Fuzzy Membership Function for Output of Success/Failure and Self-Confidence	73
3.16	Fuzzification Algorithm	74
3.17	Student Initiative - Hierarchical Inference Structure	76
3.18	Social Attention - Hierarchical Inference Structure	77
3.19	Success/Failure - Single Inference Structure	77
3.20	Social Attraction - Hierarchical Inference Structure	78
3.21	Self -Confidence - Single Inference Structure	78
3.22	Confidence Value Computation Algorithm	88

3.23	Defuzzification Algorithm	92
3.24	Macromedia Dreamweaver MX Design Tool	93
3.25	Fuzzy Expert Advisory for e-Counselling User Interface	95
4.1	Fuzzification Phase Result of Experiment 1	100
4.2	FAM of Inference (Phase 1 to 3) of Experiment 1	103
4.3	FAM of Inference (Phase 4 to 5) of Experiment 1	104
4.4	Final Inference Result of Experiment 1	105
4.5	Fuzzification Phase Result of Experiment 2	107
4.6	FAM of First and Second Inference of Experiment 2	108
4.7	Final Inference Result of Experiment 2	109
4.8	Fuzzification Phase Result of Experiment 3	110
4.9	FAM of First and Second Inference of Experiment 3	111
4.10	Final Inference Result of Experiment 3	112
4.11	Fuzzification Phase Result of Experiment 4	113
4.12	FAM of Experiment 4	113
4.13	Final Inference Result of Experiment 4	114
4.14	Fuzzification Phase Result of Experiment 5	115
4.15	FAM of First and Second Inference of Experiment 5	116
4.16	Final Inference Result of Experiment 5	117
4.17	Fuzzification Phase Result of Experiment 6	118
4.18	FAM of Experiment 6	119
4.19	Final Inference Result of Experiment 6	120
4.20	Final Output of Inference Results	121
4.21	Result on Explanation and How	122
4.22	Guide to Answer Question Screen	124

CHAPTER 1

INTRODUCTION

This section presents the background of the project that focuses on the hybrid approach using fuzzy logic and expert system. The main idea of the study is to develop the prototype system using the integration of both approaches in e-counselling domain. The section also presents the problem statement, objectives, significance and scopes of the project.

1.1 Background

Fuzzy logic deals with the kind of uncertainty that is inherently human in nature. Fuzzy logic is a computational paradigm that provides a mathematical tool for representing and manipulating information in a way that resembles human communication and reasoning processes (Yager *et al.*, 1994). The concept of the fuzzy set was first introduced by Zadeh (1965). Fuzzy logic offers a better way of representing reality with a statement is true to various degrees, ranging from completely true through half-truth to completely false. The fuzzy system is a popular computing framework based on the concepts of fuzzy set theory, fuzzy if then rules and fuzzy reasoning.

An expert system is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise (Turban, 2001). An expert

The contents of
the thesis is for
internal user
only

REFERENCES

- Abood, D. A., & Conway, T. L. (1992). Health value and self-esteem as predictors of wellness behavior. *Health Values*, 16, 20-26.
- Acquire (2004). Applications: Employment Counselling Systems. Acquire Intelligence Inc. url: <http://www.aiinc.ca>
- Alastair, A. (1998), A Model for Fuzzy Personal Construct Psychology, in Fuzzy Systems Design (Studies in Fuzziness and Soft Computing), ed. By Reznik L., Dimitrov V. and Kacprzyk J., Springer-Verlag, pp. 153-170.
- Athanasios, Tsakonas, A. and Dounias, G. (2002). Hybrid Computational Intelligence Schemes in Complex Domains: An Extended Review, pp. 494-512.
- Baumeister, R.F., Campbell, J.D., Kreuger, J.I. and Vohs, K.D. (2003). Does high self-esteem cause better performance, interpersonal success, happiness or healthier lifestyles? *Psychological Science in the Public Interest*, 4(1), pp.1-44.
- BBC. (2004). Science and Nature: Human Body and Mind. URL: <http://www.bbc.co.uk/sn/>
- Beebe, J., Wang and Tang, J. (2001). Injection Painting Optimization With Fuzzy Logic Expert System. Proceedings of the 2001 Particle Accelerator Conference, Chicago.
<http://accelconf.web.cern.ch/AccelConf/p01/PAPERS/TPPH005.PDF>
- Bishop, Peter. *Fifth Generation Computers Concepts, Implementations & Uses*, 1986, Chichester, England: Ellis Horwood Ltd.
- Blascovich, J., and Tomaka, J. (1991). Measures of self-esteem. In J. P. Robinson, P. R. Shaver, & L. S. Wrightsman (Eds.) *Measures of personality and social psychological attitudes, Volume I*. San Diego, CA: Academic Press.
- Booker and Parkinson (Eds), *Fuzzy Logic and Probability Applications*,
- Borba, M., Borba, C., and Reasoner, R (2001). Effectiveness of Implementing the Esteem Builders Program School-wide on Elementary Students' Behaviour and Academic Self-concept. Pilot Study Results.
- Brule, James F. (1986). Artificial Intelligence: Theory, Logic and Application, Blue Ridge Summit, PA: TAB Books.

- Champanand, A. J. (2002). Artificial Intelligence. AI Depot. url: <http://ai-depot.com>
- Charles, E. and Kahn, Jr., M.D. (1993). Artificial Intelligence in Radiology: Decision Support Systems. American Association of Physicists in Medicine; Medical Physics Monograph no. 22.
- Coopersmith, S. and Gilberts, R. (1979). Behavioural Academic Self-Esteem (BASE). A Rating Scale. Consulting Psychologists Press, Inc.
- Druzdel, M. J. (1996). Decision Support Systems in Genetic Counseling. In *Technology Studies*, Vol. 3(2), pp.263-267.
- Durkin, J. (1994) *Expert Systems Design and Development*. Macmillan.
- Dutta, and Soumitra. (1993). Fuzzy Logic Applications: Technological and Strategic Issues. *IEEE Transactions on Engineering Management*, Vol. 40, No. 3, pp. 237-254.
- Eberhart, R. Simpson, P. and Dobbins, R. (1996). "Computational Intelligence PC Tools", AP Professional.
- Edwards, Alex and Connell, N.A.D. (1989). *Expert Systems in Accounting*, Herfordshire, UK: Prentice Hall International (UK) Ltd.
- Engelmore, R. S. and Feigenbaum, E. (1993). Expert Systems and Artificial Intelligence. <http://www.wtec.org/loyola/librarian.htm>
- Expert Counseling System.
url: <http://www.aiinc.ca/services/applications/counsel/ecs.shtml>
- Fischhoff, B. (1985). Decision Making in Complex Systems. In Proceedings of the NATO Advanced Study, Institute on Decision Support in Process Environments, San Miniato, Berlin, Germany, Springer-Verlag.
- Gerald L. and Spiller, P. (1998). Electronic Shopping. *Communications of the ACM*, Vol. 41, No. 7.
- Grammenou, V., Panayiotopoulos, T., Mantas, I. and Saroglou, G. (2001). Strategy for antibiotic use against nosocomial pneumonia via the use of a Medical Expert System. *4th International Conference "Neural Networks and Expert Systems in Medicine and Healthcare"*. Milos Island, Greece.

- Hansen, B. K., (1997). SIGMAR: A fuzzy expert system for critiquing marine forecasts. *AI Applications*, Vol. 11, No. 1, pp. 59-68.
- Hany I. Fahmy and Christos Douligeris. (199)Applications of Hybrid Fuzzy Expert
- Haugland, S. W. (2002). Computers in the Early Childhood Classroom.Earlychildhood.com - The Professional Resource For Teachers And Parents.
- Haugland, S.W. (1992). The effects of computer software on preschool children's developmental gains. *Journal of Computing in Childhood Education*. Vol. 3(1), pp. 15-30.
- Hayo, M.G., Werf, V. D., and Zimmer, C. (1997). An Indicator of Pesticide Environmental Impact based on a Fuzzy Expert System.
- Holden, E. J., Owens, R. and Roy, G.(1999a). Adaptive Fuzzy Expert System for Sign Recognition. <http://citeseer.ist.psu.edu/holden99adaptive.html>
- Holden, E. J., Owens, R., and Roy, G. G. (1999b). An Adaptive Fuzzy Expert System for 3D Hand Motion Understanding.
- Holden, E. J., Roy, G. and Owens, R. (1996). Hand movement classification using an adaptive fuzzy expert system. *International Journal of Expert Systems*, Vol. 9(4), pp. 465-480.
- Horstkotte, E. (2000). Fuzzy Expert Systems. Togai InfraLogic, Inc. <http://www.siteterrific.com>
- J. P. (2002). Using the Internet to Enhance Testing in Counseling. url: www.career.fsu.edu/techcenter/
- James, and Rye, N. (2002). EdotCounsellor. Online Counsellors. <http://www.edotcounsellor.com>
- Janet B Parks, Jianwei Sun (1992). ExSport II : An Artificial Intteligence Sport Management Career Guidance System. <http://personal.bgsu.edu/~jparks/ExSport>
- Jiajun, Y., Guodong, X., Xibin, C. and Xingrui, M. (2000). A Fuzzy Expert System Architecture Implementing Onboard Planning and Scheduling for Autonomous Small Satellite

- Jim Warren, Gleb Beliakov and Berend van der Zwaag (2000). Fuzzy logic in clinical practice decision support systems. *Proceedings of the 33rd Hawaii International Conference on System Sciences - 2000*
- Johnson, B. W., Redfield D. L., Miller, R. L., and Simpson, R. E. (1983). Coopersmith Self-Esteem Inventory (SEI): A Construct Validation Study. *Educational Psychological Measurement, Vol. 43*, pp. 907-913.
- Johnson, B. W., Redfield, D. L., Miller, R. L. and Simpson, R. E. (1983). The Coopersmith Self-Esteem Inventory: A Construct Validation Study, *Educational and Psychological Measurement, Vol. 43*, pp. 907-913.
- Johnson, B. W., Redfield, D. L., Miller, R. L., and Simpson, R. E. (1983). The Coopersmith Self-Esteem Inventory: A Construct Validation Study. *Educational and Psychological Measurement, Vol. 43*, pp. 907-913.
- Juuso, and Esko K. (1999). Intelligent Systems Design with Linguistic Equations, 9th Workshop Fuzzy Control, Dortmund, Germany, pp. 177–196.
- Kandel, A., (1991) Fuzzy Expert Systems. CRC Press, Boca Raton.
- Karady, G. (2001). Fuzzy Logic.
- King, K.H. and Marsolan, N.F. (1988). An Expert Adaptive Fuzzy Logic Control System on a Thermal Process Unit. *Proceedings of the ISA 88 International Conference and Exhibit*, Houston, Texas, October 16-21, 1988 (Research Triangle Park, North Carolina: Instrument Society of America), pp.67-74.
- Lam, S. Y., Petri, K. L. and Smith, A. E. (1997). A Hierarchical System of Neural Networks and Fuzzy Logic: Prediction and Optimization for Ceramic Casting. *IEEE Transactions on Neural Networks*, Special Issue on Hybrid Models.
- Lam, S. Y., Petri, K. L. and Smith, A. E. (1999). Prediction and Optimization of a Ceramic Casting Process Using A Hierarchical Hybrid System of Neural Networks and Fuzzy Logic. *IEEE Transactions on Design and Manufacturing*.
- Liebowitz, Jay, *Introduction to Expert Systems*, 1988, Santa Cruz, CA: Mitchell Publishing, Inc.
- Luger, G. F. (2002). Artificial Intelligence: Structures and Strategies for Complex Problem Solving. Fourth Edition. Addison Wesley Publishing Co.
- Marcos, M. (2004). An Analysis of the Fuzzy Expert Systems Architecture for Multispectral Image Classification Using Mathematical Morphology

Operators. *International Journal of Computational Cognition*, Volume 2, Number 2, pp. 35-69.

Medeiros, D.J., Watson, E.F., Carson, J.S. and Manivannan., M.S. (1998). An Expert Systems Approach to Simulating the Human Decision Maker. *Proceedings of the 1998 Winter Simulation Conference*.

Mehrabian, A. (2000). Beyond IQ: Broad-based measurement of individual success potential or "emotional intelligence." *Genetic, Social, and General Psychology Monographs*, 126, 133-239.

Mehrabian, A. (2003). Self-Esteem Test and Optimism-Pessimism Tests & Software

Meier, Willi, Weber, R. and Zimmermann, H. (1994). Fuzzy Sets and Systems. *Fuzzy Data Analysis-Methods and Industrial Applications*, Vol. 61, pp. 19-28.

Meyer, M. A., Butterfield, K. B., Murray, W. S., Smith, R. E., and Booker, J. M. (2000). Guidelines For Eliciting Expert Judgment As Probabilities or Fuzzy Logic

Morales A, Creus, A. and Carvajal, J.P. (1998). A WWW-Based Expert System Advisor for the Diagnostic of Network Communication Problems. *Proceedings of ADMI 98*, Houston, TX .

Morsy, M. A. (1992). Expert Systems vs. Database Systems. *Workshop on Social Monitoring Systems Assuit Governorate*.

Negnevitsky, M. (2002). Pearson Education.
url: <http://www.neiu.edu/~mosztain/cs335/lecture11.ppt>

Nikolarazi, M. and Kefalas, P. (2000). Design and Development of a Web-Counseling Centre for the Parent of the Deaf Children. In *Proceedings of the International Conference on Computers Helping People with Special Needs (ICCHP 2000)*, Karlsruhe, Germany, July 2000

Norman, D.A., *The Psychology of Every Day Things*. 1988: Basic Books, New York.

Oliveras, C. S. (2002). *Systems, Advisory Systems and Safety*.

Pervin, L. A. (1993). *Personality: Theory and research*. NY: John Wiley and Sons.

Psychology, (2004). The World's Largest Online Library. Questia Media America, Inc. <http://www.questia.com>

- Reasoner, R. (2004). The True Meaning of Self-Esteem. National Association for Self-Esteem (NASE).
- Rekkedal, T. (1991). The Personal Tutor/Counsellor in Distance Education. Presented at the ZIFF-Ringkolloquium, FernUniversität, Germany.
- Reyes, C. A. and Sipper, M. (1999). A fuzzy-genetic approach to breast cancer diagnosis Artificial Intelligence in Medicine, Vol. 17, pp. 131–155.
- Rich, E. and Knight, K. (1991). Artificial Intelligence. (2 ed.) New York: McGraw-Hill, Inc.
- Richmond R. L. (2004). Psychological Testing.
url:<http://www.guidetopsychology.com>.
- Rosch, E., and Mervis, C. (1975). Family Resemblances: Studies in the Internal Structure of Categories. Cognitive Psychology, pp. 573.
- Roscher, G. (1996). REAL-TIME ANALYSIS OF THE EEG IN COMMUNICATIVE SITUATIONS: A NEW APPROACH BY INNOVATIVE INFORMATION TECHNOLOGY. Paper presented at *Measuring Behavior '96, International Workshop on Methods and Techniques in Behavioral Research*.
- Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.
- Rosenberg, M., & Pearlman, L. I. (1978). Social class and self-esteem among children and adults. *American Journal of Sociology*, 84, 53-77.
- Russell, S. J. and Norvig, P. (1999). Artificial Intelligence: A Modern Approach. Prentice Hall.
- Saini, H.S., Kamal, Raj and Sharma, A.N. (2000). Web Based Fuzzy Expert System for Integrated Pest Management in Soybean, International Journal of Information Technology, Vol.8, No.1.
- Sampson J. P. (2002). Using the Internet to Enhance Testing in Counseling.
url: www.career.fsu.edu/techcenter/
- Sazonov, E.S., Klinkhachorn, P., Gangarao, H. V. S. and Halabe, U. B. (2002). Fuzzy Logic Expert System for Automated Damage Detection from Changes in Strain Energy Mode Shapes. *Nondestructive Testing and Evaluation*, Vol. 18 (1), pp. 1–20.

- Sciamnna, C. N. *et al.*, (1997). An Expert System for Counseling Patients to Stop Smoking. *Applied Artificial Intelligence*, Vol. 5, pp. 267-280.
- Sciamnna, C. N. *et al.*, (1997). An Expert System for Counseling Patients to Stop Smoking.
- Semerçi, C. (2000). Fuzzy logic theory in education. *Atatürk University IX. National Education Sciences Congress*.
- Semerçi, C., Yildirim, A. and Bektas, C. (2003). Fuzzy Logic Theory in Distance Education. *IJCI Proceedings of Intl. XII. Turkish Symposium on Artificial Intelligence and Neural Networks*, Vol.1, No .1.
- Shepell, W. (2004). WS E-Counseling.
<http://www.warrenshepell.com/ecounseling.asp>
- Sidek Mohd Noah (1998). Pengujian Dalam Psikologi dan Kaunseling. Untuk Pelajar Psikologi dan Kaunseling.
- Spiegel, R. and Nenh, Y. P. (2004). An expert system supporting diagnosis in clinical psychology. *Human Perspectives in the Internet Society: Culture, Psychology and Gender*. WIT Press, www.witpress.com.
- Steimann, F. (1997). Fuzzy set theory in medicine. *Artificial Intelligence in Medicine*, Vol. 11, pp. 1–7. <http://citeseer.nj.nec.com/steimann97fuzzy.html>
- Sundance L. A. (2002). Fuzzy Logic in Expert Systems.
- Tait, A. and Sewart, D. (1983): International workshop on counselling in distance education.
- Taner, M., Aksoy, Y. and Arroyo, A. A. (1991). An Expert System for Academic Counseling. *Applied Artificial Intelligence*, Vol. 5, pp. 267-280.
- Tonn, B. and MacGregor, D. (1986). Psychology of developing and designing expert systems. *AAAI '86: 5th national conference on artificial intelligence*; 11 Aug 1986; Philadelphia, PA, USA
- Tsoukalas, Lefteri, H. and Robert E. (1997). Fuzzy and neural approaches in engineering. John Wiley and Sons, Inc.
- Turban, E. and Aronson, J.E. (2001). *Decision Support Systems and Intelligent Systems*, 6th Edition, Prentice Hall, Inc.

- Twenge, J.M. & Campbell, W.K. (2001). Age and birth cohort differences in self-esteem: A cross-temporal meta-analysis. *Personality and Social Psychology Review*, 5(4), 321-344.
url: <http://www.aiinc.ca/services/applications/counsel/ecs.shtml>
- Vasileva, T., Trajkovic, V. and Davcev, D. (2000). A prototype for knowledge evaluation in a distance learning system. *Proceedings of the IASTED International Conference Internet and Multimedia Systems and Applications*. November 19-23, Las Vegas, Nevada.
<http://odl-skopje.etf.ukim.edu.mk/trudovi-pdf/IMSA2000.pdf>
- Wagner EH, Curry SJ, McBride C, et al., A. (1995). Randomized Trial of Self-Help Materials, Personalized Feedback, and Telephone **Counseling** with Nonvolunteer Smokers. *Journal of Consulting and Clinical Psychology*, Vol. 63, pp. 1005-1014.
- Walter, C. (1988). "Elements of Legal Language" Chapter Three in C Walter (ed.), *Computer Power and Legal Language* (Quorum: London).
- Waterman, Donald A. (1986), *A Guide to Expert Systems*, Reading, MA: Addison-Wesley.
- Watt, G. (1998). *Supporting Employability: Guides to Good Practice in Employment Counselling and Guidance*. Publications of the European Communities, European Foundation for the Improvement of Living and Working Conditions.
- White, T. and Bieszczad, A. (1992). *The Expert Advisor: An Expert System for Real Time Network Monitoring*. Canadian Conference on Artificial Intelligence, Vancouver, 1992.
- Xexeo, G. (2000). *Fuzzy Logic*.
- Yager, R. R. (2000). Target on E-commerce marketing using Fuzzy intelligent agents. *IEEE Intelligent System*.
- Yager, R. R., and Zadeh, L. A. (1994). *Fuzzy Sets, Neural Networks, and Soft Computing*. New York: Van Nostrand Reinhold.
- Yang, S. (2004). On Fuzzy Relation and Fuzzy Quotient Groups. *International Journal of Computational Cognition*, Vol. 2, No. 2, pp. 71-79.
- Zadeh, L. A. (1965). *Fuzzy Set In Information and Control*, Vol. 8, New York, Academic Press, pp. 338-353.

Zadeh, L. A. (1996). Fuzzy logic = Computing with words, IEEE Transactions on Fuzzy System, Vol. 4(2), pp. 103-111.

Zadeh, L.A. (1975). The concept of a linguistic variable and its application to approximate reasoning, Parts 1 and 2, Inf. Sci. 8, pp. 199–249, 301–357.