Contents

PART I Approximate Reasoning and Fuzzy Logic	
THE SEMANTICS OF FUZZY "IF THEN" RULES	3
Didier Dubois and Henri Prade (France)	
1 INTRODUCTION	3
2 QUALITATIVE DESCRIPTION OF NUMERICAL FUNCTIONS	4
3 THE UNCERTAINTY OF A FUZZY EVENT 3.1 Certainty qualification	6
3.2 Possibility qualification	8
4 FUZZY "IF THEN" RULES	10
5 MULTIPLE RULES	12
6 CONCLUDING REMARKS	14
ON THE LOGICAL BASIS OF APPROXIMATE REASONING	17
Vilém Novák (Czechoslovakia)	
1 WHY FUZZY LOGIC	17
2 TRANSLATION RULES OF APPROXIMATE REASONING	19
2.1 General definition	19
2.2 Definition of special functions 3 RULES OF INFERENCE OF APPROXIMATE REASONING	20
3.1 General definition	22
3.2 Modus ponens	24
4 CONCLUSION	26
FUZZY LOGIC WITH LINGUISTIC QUANTIFIERS IN INDUCTIVE LEARNING	29
Janusz Kacprzyk and Cezary Iwański (Poland)	
1 INTRODUCTION	29
2 LINGUISTICALLY QUANTIFIED PROPOSITIONS	31
3 INDUCTIVE LEARNING UNDER IMPRECISION AND ERRORS	32
4 CONCLUDING REMARKS	37
FUZZY LOCAL INFERENCE IN FUZZY KNOWLEDGE BASES	39
Hans Bandemer (Germany)	
1 KNOWLEDGE BASE	39
2 LOCAL PROBLEMS	40

3 MAIN IDEA AND SUGGESTIONS	40
4 LOCAL INFERENCE	45
5 SOME REMARKS ON APPLICATIONS	46
FUZZY RELATIONAL PRODUCTS IN KNOWLEDGE	
ENGINEERING	51
Ladislav J. Kohout and Wyllis Bandler (USA)	
1 INTRODUCTION	52
2 MATHEMATICAL THEORY	52
2.1 Triangle and Square Types of Relational Products	53
2.2 Forming New Relations by Products	55
2.3 Local Properties of Crisp and Fuzzy Relations	55
3 METHODOLOGY AND SEMANTICS	57
4 FAST FUZZY RELATIONAL ALGORITHMS	60
5 APPLICATIONS	60
EXPERT SYSTEM SHELL SAK BASED ON COMPLETE MANY-VAL LOGIC AND ITS APPLICATION IN TERRITORIAL PLANNING	LUED 67
Petr Berka, Jan Ferjenčík and Jiří Ivánek (Czechoslovakia)	0.
1 DESCRIPTION OF THE SYSTEM	67
1.1 Knowledge representation	68
1.2 Inference mechanism and reasoning with uncertainty	69
2 CASE STUDY: EXPERT SYSTEM IN TERRITORIAL PLANNING	70
2.1 The structure and functionality of the system	71 72
2.2 Supporting computational models	72
2.3 The course of consultation with the system 2.4 Knowledge base testing	73
2.4 Knowledge base testing	13
MULTIMODEL REPRESENTATION AND MANAGEMENT	
OF UNCERTAINTY	75
George J. Klir (USA)	
1 INTRODUCTION	75
2 NOTATION AND TERMINOLOGY	77
3 MEASURES OF UNCERTAINTY	78
4 BASIC PRINCIPLES OF MANAGING UNCERTAINTY	80
5 COMPLEMENTARITY OF UNCERTAINTY MODELS	82
6 CONCLUSIONS	84

PART II Decision-Making

TRIANGULAR NORMS AND SOME APPLICATIONS TO MEAS AND GAME THEORY	SURE 89
Dan Butnariu (Israel) and Erich P. Klement (Austria)	CANTELLE
1 INTRODUCTION	89
2 TRIANGULAR NORMS	90
3 T-TRIBES	93
4 T-MEASURES	97
5 GAMES WITH FUZZY COALITIONS	102
LINEAR DEPENDENCE OF FUZZY VECTORS	107
Milan Mareš (Czechoslovakia)	
1 FUZZY QUANTITY	107
2 ALGEBRAIC OPERATIONS	108
3 TWO CONCEPTS OF FUZZY VECTORS	109
4 VECTOR OF NORMAL FUZZY QUANTITIES	109
5 LINEAR COMBINATION	112
6 EQUATIONS AND EQUIVALENTIONS	113
7 CONCLUSIVE REMARKS	114
LP PROBLEMS WITH INEXACT AND INTERACTIVE COEFFICIENTS	117
	111
Jaroslav Ramík (Czechoslovakia)	
1 PRELIMINARIES	117
2 VARIABLE RIGHT-HAND SIDES	123
3 VARIABLE COEFFICIENTS OF MATRIX A 4 ALGORITHM	124 126
4 ADGORITHM	120
A CONCEPT OF OPTIMALITY FOR FUZZIFIED LINEAR	
PROGRAMMING BASED ON PENALTY FUNCTION	133
Margit Kovács (Hungary)	
1 INTRODUCTION	133
2 PRELIMINARIES: BASIC DEFINITIONS AND THEOREMS	134
3 DESCRIPTION OF THE FUZZIFIED LINEAR PROGRAMMING	10000
PROBLEM	136
4 CONCLUSION	138

THE POSSIBILITIES OF FUZZY DIALOGUE IN INTERACTIVE	
VECTOR OPTIMIZATION	141
Martin Černý (Czechoslovakia)	
1 INTRODUCTION	141
2 FUZZY SUBSTITUTION RATES	143
3 FUZZY ACHIEVEMENT LEVELS – THE CASE OF STEM METHOD	144
ON THE NATURE OF INTRANSITIVITY IN HUMAN PREFEREN	NTIAL
JUDGMENTS	147
Kazuo Nakamura (Japan)	
1 INTRODUCTION	147
2 FUZZY PREFERENCES AND TRANSITIVITY	149
3 EMPIRICAL CONSIDERATION OF INTRANSITIVITIES OF FUZZY	
PREFERENCES	150
4 MODELING OF SYSTEMATIC INTRANSITIVITY MECHANISM	
OF FUZZY PREFERENCES	152
5 EXPERIMENTAL INVESTIGATION 6 CONCLUSIONS	156 159
AGGREGATION OF STRICT PREFERENCE RELATIONS IN MCI	DM 163
	103
Janos C. Fodor (Hungary) and Marc Roubens (Belgium)	
1 INTRODUCTION	164
2 BASIC OPERATIONS ON THE UNIT INTERVAL	165
3 AXIOMATICS OF (P, I, J)	166
4 BUILDING STRICT PREFERENCES IN MCDM PROBLEMS	168
CLUSTERING IN BANACH SPACES	173
James C. Bezdek (USA)	
1 INTRODUCTION	173
2 THE c-MEANS MODELS	174
3 THE c-MEANS ALGORITHMS	176
3.1 Explicit half-step for U with fixed prototypes P^* and any $\{D_{kj}^*\}$	177
4 A NUMERICAL EXAMPLE	180
5 CONCLUSIONS	189

PART III Applications in Physics

ON THE STRUCTURE OF FUZZY OBSERVABLES	187
Anna Kolesárová (Czechoslovakia)	
1 INTRODUCTION	187
2 THE STRUCTURE OF FUZZY σ -HOMOMORPHISMS	190
3 THE REPRESENTATION OF FUZZY OBSERVABLES BY RANDOM	
VARIABLES	191
4 RANDOM VARIABLES AND FUZZY OBSERVABLES OF FUZZY	100
QUANTUM SPACES 5 THE BACKWARD REPRESENTATION OF FUZZY OBSERVABLES	193
OF FUZZY QUANTUM POSETS	196
OF FOZZI QUANTOM FOSEIS	190
GENERAL FUZZY OBSERVABLES	199
Radko Mesiar (Czechoslovakia)	
1 INTRODUCTION	199
2 GENERAL FUZZY OBSERVABLES	200
3 ⊥-FUZZY OBSERVABLES	203
ON A FUZZY APPROACH TO QUANTUM MECHANICS	207
Beloslav Riečan (Czechoslovakia)	
1 INTRODUCTION	207
2 DEFINITIONS	208
3 REPRESENTATION OF OBSERVABLES	210
4 STATES	212
INDEX	218