

Contents

1	Introduction.....	1
1.1	Motivation and Outline.....	1
1.2	Symbol and Abbreviation Conventions.....	4
2	Fuzzy Conceptual Graphs.....	5
2.1	Overview	5
2.2	Conceptual Graphs.....	6
2.3	Functional Relation Types and Conjunctive Types	11
2.4	Extended Conceptual Graphs.....	14
2.5	Fuzzy Sets and Fuzzy Logics.....	18
2.6	Fuzzy Types.....	26
2.7	Fuzzy Conceptual Graphs.....	36
2.8	Summary.....	44
3	Annotated Fuzzy Logic Programming.....	47
3.1	Overview	47
3.2	AFLP Syntax	49
3.3	AFLP Model-Theoretic Semantics	52
3.4	AFLP Fixpoint Semantics.....	56
3.5	AFLP Reductants and Constraints	59
3.6	AFLP Procedural Semantics.....	63
3.7	Order-Sorted AFLPs.....	66
3.8	Generalized and Specialized AFLPs.....	71
3.9	Summary.....	78
4	Fuzzy Conceptual Graph Programming.....	79
4.1	Overview	79
4.2	FCGP Syntax	80
4.3	FCGP Model-Theoretic Semantics	84
4.4	FCGP Fixpoint Semantics	88
4.5	General Issues of CG Unification and Resolution	91
4.6	FCG Unification and FCGP Reductants	96
4.7	FCGP Procedural Semantics.....	99
4.8	Summary.....	103

5	Modelling and Computing with Generally Quantified Statements.....	105
5.1	Overview	105
5.2	Fuzzy Arithmetic	107
5.3	Fuzzy Conditional Probability	111
5.4	Universally Quantified Conceptual Graphs	112
5.5	Generally Quantified Conceptual Graphs	117
5.6	Computing with Linguistic Quantifiers	120
5.7	Summary.....	124
6	Approximate Knowledge Retrieval.....	127
6.1	Overview	127
6.2	Matching Measures for Entity Types, Names, and Attributes	128
6.3	Storing and Querying Knowledge Graphs	134
6.4	Approximate Knowledge Graph Matching.....	138
6.5	Knowledge Management in VN-KIM	141
6.6	Summary.....	144
7	Natural Language Query Understanding.....	145
7.1	Overview	145
7.2	Ontology-Based Information Retrieval.....	146
7.3	Nested Query Conceptual Graphs.....	151
7.4	Ontology-Based Query Understanding.....	154
7.5	Evaluation Experiments.....	161
7.6	VN-KIM Search.....	163
7.7	Summary.....	166
	Appendices	167
A.1	Proofs for Chapter 2.....	167
A.2	Proofs for Chapter 3.....	174
A.3	Proofs for Chapter 4.....	181
A.4	Proofs for Chapter 5.....	185
	References	193