

Contents

Part I Domain of Rule-Based Systems

1	Rules as a Knowledge Representation Paradigm	3
1.1	Rules in AI	3
1.2	Selected Knowledge Representation Methods	5
1.3	Expert Systems and Rules	9
1.4	Formal Calculi for Rules	12
1.5	Introduction to Attributive Logics	19
1.6	Rule Languages and Formalization	21
1.7	Summary	22
	References	23
2	Knowledge Engineering with Rules	27
2.1	Knowledge Acquisition and Rule Base Modeling	28
2.2	Automated Inference with Rules	33
2.3	Structure of Rule Bases	35
2.4	Knowledge Base Analysis	37
2.5	Rule Interchange and Interoperability	39
2.6	Architectures for Integration	42
2.7	Summary	44
	References	45
3	Selected Applications of Rules	49
3.1	Business Rules Approach	49
3.2	Rules in Business Process Management	54
3.3	Rules on the Semantic Web	58
3.4	Rules in Context-Aware Systems	61
3.5	Rules in Software Engineering	66
3.6	Rules as Programming Paradigm	69
3.7	Summary	72
	References	73

Part II Formal Models for Rules

4	Formalism for Description of Decision Rules	85
4.1	Attributive Logic with Set Values over Finite Domains	85
4.2	Inference in ALSV(FD) Formulae	90
4.3	Formulation of XTT2 Rules	92
4.4	Structure of XTT2 Rule Base	95
4.5	Inference Control in Structured Rule Bases	100
4.6	Formalized Detection of Anomalies in Rules	103
4.7	Summary	106
	References	107
5	Formalized Integration of Rules and Processes	109
5.1	Formal Description of BPMN Process Model	110
5.2	General Business Logic Model	117
5.3	SKE-Based BPMN Process Model	124
5.4	Description of Example Using the Model	126
5.5	Summary	130
	References	130
6	Prototyping Structure of Rule Bases	133
6.1	Main Concepts of ARD+	134
6.2	ARD+ Method Formalization	134
6.3	Prototyping Structure of the Rule Base	142
6.4	Design of Business Processes with Business Rules	144
6.5	Summary	152
	References	152
7	Handling Uncertainty in Rules	155
7.1	Uncertainty in Mobile Systems	156
7.2	Improving Uncertainty Handling	159
7.3	Modified Certainty Factors Algebra for XTT2 Rules	162
7.4	Certainty Factors on Table Level	166
7.5	Time-Parametrised Operators for XTT2	168
7.6	Probabilistic Interpretation of XTT2 Models	170
7.7	Summary	176
	References	176
8	Formalizing Interoperability in Rule Bases	179
8.1	Formalized Approach to Rule Interoperability	180
8.2	Data Types, Objects and Attributes	182
8.3	Taxonomy of Formulae and Operators	192
8.4	Rule Level	199
8.5	Modules and Structure	202

8.6	Complete Knowledge Base	206
8.7	Summary	208
	References	208

Part III Practical Studies in Semantic Knowledge Engineering

9	Semantic Knowledge Engineering Approach	211
9.1	Introduction to the Approach	212
9.2	Design Process for Rule-Based Systems	215
9.3	Architecture of Rule-Centric Applications	218
9.4	Overview of the HADEs+ Tool Framework	221
9.5	Visual Design of a Modularized Rule Base	224
9.6	HMR Rule Language	227
9.7	HEART and HEARTDROID Rule Engines	230
9.8	Rule Analysis with HALVA	236
9.9	Summary	240
	References	242
10	Rule Interoperability with Expert System Shells	245
10.1	Semantically Equivalent Features of Rule Languages	245
10.2	Analysis of the CLIPS Rule Language	247
10.3	Analysis of the DROOLS Rule Language	249
10.4	Formalization of Selected Features of Rule Languages	252
10.5	Rule Translation Using a Case Study	260
10.6	Translation of Module Structure	266
10.7	Summary	273
	References	274
11	Visual Software Modeling with Rules	275
11.1	Integration of Rules with UML Design	276
11.2	Representation of ARD+ and XTT2 with UML Diagrams	277
11.3	Selected Model Translations	284
11.4	Evaluation Using a Case Study	291
11.5	Summary	295
	References	296
12	Using Rules to Support Software Testing	299
12.1	Software Unit Testing with Rules	299
12.2	Decision Table-Based Testing	300
12.3	Framework for Test Unit Generation	303
12.4	Evaluation of the Testing Approach	308
12.5	Summary	311
	References	312

13	Integrating Business Process Models with Rules	313
13.1	Motivation and Challenges	314
13.2	Design and Execution Using the Integrated Approach	315
13.3	Model-Based Perspective	321
13.4	Complexity Assessment	324
13.5	Practical Application of the Model	326
13.6	Evaluation of the Example	329
13.7	Summary	334
	References	335
14	Rule-Based Systems and Semantic Web	339
14.1	Integrating SKE with the Semantic Web	339
14.2	DAAL Rule Language	342
14.3	Hybrid Reasoning with PELLET-HEART	347
14.4	DAAL in Practice	348
14.5	Summary	353
	References	353
15	Collaborative Knowledge Engineering with Wikis	355
15.1	Semantic Knowledge Engineering in LOKI	356
15.2	Case Study Implementation in LOKI	363
15.3	Collaborative Rule Authoring with SBVR	369
15.4	Collaborative Modeling of BPMN Models	373
15.5	Summary	377
	References	377
16	Designing Robot Control Logic with Rules	381
16.1	Robot Prototyping with Mindstorms NXT	381
16.2	PLNXT Library	384
16.3	Rule-based Control with XTT2 and HEART	388
16.4	Examples of Control Algorithms	390
16.5	Summary	400
	References	400
17	Rules in Mobile Context-Aware Systems	403
17.1	Challenges for Context-Aware Systems on Mobile Platforms	404
17.2	Overview of the KNOWME Architecture	406
17.3	Knowledge Modeling in KNOWME	410
17.4	KNOWME Toolset	415
17.5	Feedback Loop in System Development	421
17.6	Evaluation Studies	423
17.7	Summary	428
	References	429
	Concluding Remarks	431
	Index	433

Modeling with Rules Using Semantic Knowledge
Engineering

Nalepa, G.J.

2018, XXVI, 435 p. 130 illus., 35 illus. in color.,
Hardcover

ISBN: 978-3-319-66654-9