

Table of contents

Preface	9
Acknowledgements	11
Notation	13
List of non-monotonic logics discussed in the book	19
1 ELEMENTS OF MONOTONIC LOGICS	21
1.1 Basic notions	21
1.2 Classical propositional logic	26
1.2.1 Language of propositional logic	27
1.2.2. Semantics of propositional logic	28
1.2.3 Propositional theories	31
1.2.4 Propositional logic as a deduction system	33
1.3 Classical first-order logic	36
1.3.1 Language of first-order logic	36
1.3.2 Semantics of first-order logic	38
1.3.3 First-order theories	43
1.3.4 First-order logic as a deduction system	45
1.3.5 Many-sorted first-order logic	46
1.4 Resolution method	49
1.4.1 Clausal form	50
1.4.2 Resolution rule	53
1.4.3 Linear resolution	58
1.5 Classical second-order logic	60
1.5.1 Language of second-order logic	61
1.5.2 Semantics of second-order logic	62
1.5.3 Second-order theories	64

1.5.4	Deduction systems for second-order logic	64
1.5.5	Predicate and function expressions	65
1.6	Modal logic	69
1.6.1	Modal propositional logic	69
1.6.2	Modal first-order logic	73
2	FOUNDATIONS OF NON-MONOTONIC REASONING	77
2.1	Non-monotonic reasoning	77
2.2	Non-monotonic inference and reasoning about action	82
2.3	Typology of non-monotonic reasoning	84
3	APPROACHES TO NON-MONOTONIC REASONING	88
3.1	Computational approaches to non-monotonic reasoning	88
3.1.1	MICRO-PLANNER	88
3.1.2	Network- and frame-based systems	90
3.1.3	Systems employing meta-level reasoning facilities	94
3.1.4	Truth Maintenance systems	97
3.2	Formal approaches to non-monotonic reasoning	102
3.2.1	Sandewall's formalism	102
3.2.2	Modal non-monotonic logics	103
3.2.3	Default logic	103
3.2.4	Circumscription	104
3.2.5	Reasoning under the closed world assumption	105
3.2.6	Poole's approach to non-monotonic reasoning	105
3.2.7	Model-theoretic approach to non-monotonic reasoning	106
3.3	Objections to non-monotonic formalisms	107
4	MODAL NON-MONOTONIC LOGICS	111
4.1	Modal non-monotonic logic of McDermott and Doyle	112
4.2	Modal non-monotonic logics of McDermott	116
4.3	Autoepistemic logic	122
4.3.1	Preliminaries	122
4.3.2	Semantic considerations	123
4.3.3	Syntactic characterization of AE extensions	126
4.3.4	Possible-world semantics for autoepistemic logic	133
4.3.5	Reduction theorem	139
4.3.6	Minimal, strongly grounded and superstrongly grounded AE extensions	141
4.3.7	A comparison of autoepistemic logic to non-monotonic logics of McDermott and Doyle	145
4.3.8	Conclusions	148
4.4	Other bases for modal non-monotonic logic	149
4.4.1	Intuitionistic basis for modal non-monotonic logic	149
4.4.2	3-valued basis for modal non-monotonic logic	154
5	DEFAULT LOGIC	159
5.1	Preliminaries	160
5.2	Open defaults and their instances	164
5.3	Closed default theories	168
5.4	Normal default theories	173

5.5	Representational issues	179
5.6	Semi-normal default theories	184
5.7	Semantic characterization of extensions	187
5.8	Proof theory for closed normal default theories	192
5.9	A comparison between default logic and autoepistemic logic	199
5.10	Alternative formalization of default logic	202
5.11	Basic properties of the new formalization	205
5.12	Semantic characterization of m-extensions	219
5.13	Proof theory for alternative default logic	224
6	CIRCUMSCRIPTION	226
6.1	Introduction	226
6.2	Abnormality formalism	228
6.3	Predicate circumscription	230
6.3.1	Preliminaries	230
6.3.2	Semantics for predicate circumscription	233
6.3.3	Consistency of predicate circumscription	238
6.3.4	Expressive power of predicate circumscription	239
6.4	Formula circumscription	241
6.5	Second-order circumscription	245
6.5.1	Preliminaries	245
6.5.2	Satisfiability of second-order circumscription	248
6.5.3	Reducing second-order circumscription to first-order logic	249
6.5.4	Expressive power of second-order circumscription	252
6.5.5	Prioritized second-order circumscription	254
6.6	Non-recursive circumscription	260
6.7	Domain circumscription	262
6.8	Pointwise circumscription	267
6.8.1	The basic case	267
6.8.2	Minimizing several predicates	269
6.8.3	General pointwise circumscription	271
6.9	Conclusions	277
7	APPROACHES TO CLOSED WORLD ASSUMPTION	281
7.1	Introduction	281
7.2	Naive CWA	282
7.3	Generalized CWA	288
7.4	Careful CWA	292
7.5	Extended CWA	297
7.6	Theory completion	300
	Bibliography	309
	Index	319