

## Table of Contents

<b>PREFACE</b>	<b>xi</b>
<b>1 INTRODUCTION</b>	<b>1</b>
1.1 AI, Logic and Legal Reasoning: Some General Remarks . . .	1
1.1.1 An Overview . . . . .	1
1.1.2 Artificial Intelligence . . . . .	2
1.1.3 Computable Aspects of Legal Reasoning . . . . .	5
1.1.4 The Role of Logic . . . . .	6
1.2 The Focus of Research . . . . .	7
1.3 Logic and AI . . . . .	8
1.3.1 The Declarative vs. Procedural Debate . . . . .	8
1.3.2 Logics and Programming Systems . . . . .	9
1.3.3 Logic and Reasoning . . . . .	11
1.4 Points of Departure . . . . .	12
1.5 The Structure of this Book . . . . .	13
<b>2 THE ROLE OF LOGIC IN LEGAL REASONING</b>	<b>15</b>
2.1 Three Misunderstandings about Logic . . . . .	16
2.1.1 'To Formalize is to Define Completely' . . . . .	16
2.1.2 'Formalization Leaves No Room for Interpretation' .	17
2.1.3 'Logic Excludes Nondeductive Modes of Reasoning' .	18
2.2 The 'Deductivist Fallacy' . . . . .	18
2.2.1 'Naive Deductivism' . . . . .	19
2.2.2 The Criticism . . . . .	20
2.2.3 The Misunderstanding . . . . .	23
2.2.4 The Merits of the Criticism . . . . .	25
2.3 Noninferential Reasoning with Logical Tools . . . . .	26
2.4 Rule-based and Case-based Reasoning . . . . .	30
2.5 Summary . . . . .	31
<b>3 THE NEED FOR NEW LOGICAL TOOLS</b>	<b>33</b>
3.1 The Separation of Rules and Exceptions in Legislation . . .	34
3.1.1 Terminology . . . . .	35
3.1.2 Examples . . . . .	36

3.1.3	Formalizations in Standard Logic . . . . .	37
3.1.4	Nonstandard Methods . . . . .	41
3.2	Defeasibility of Legal Rules . . . . .	47
3.3	Open Texture . . . . .	49
3.3.1	Classification Problems . . . . .	50
3.3.2	Defeasibility of Legal Concepts . . . . .	52
3.3.3	Vagueness . . . . .	54
3.4	Which Nonstandard Techniques are Needed? . . . . .	55
3.4.1	Reasoning with Inconsistent Information . . . . .	55
3.4.2	Nonmonotonic Reasoning . . . . .	56
3.5	AI-and-law Programs with Nonstandard Features . . . . .	61
3.5.1	The Law as Logic Programs . . . . .	61
3.5.2	TAXMAN II . . . . .	61
3.5.3	Gardner's Program . . . . .	62
3.5.4	CABARET . . . . .	63
<b>4</b>	<b>LOGICS FOR NONMONOTONIC REASONING</b>	<b>67</b>
4.1	Nonmonotonic Logics . . . . .	68
4.1.1	Consistency-based Approaches . . . . .	68
4.1.2	Autoepistemic Logic . . . . .	73
4.1.3	Minimization . . . . .	76
4.1.4	Conditional Approaches . . . . .	87
4.1.5	Inconsistency Handling . . . . .	89
4.2	General Issues . . . . .	93
4.2.1	Preferential Entailment . . . . .	93
4.2.2	Properties of Consequence Notions . . . . .	94
4.2.3	Connections . . . . .	96
4.2.4	Truth Maintenance Systems . . . . .	97
4.3	Objections to Nonmonotonic Logics . . . . .	97
4.3.1	'Logic is Monotonic' . . . . .	97
4.3.2	Intractability . . . . .	99
<b>5</b>	<b>REPRESENTING EXPLICIT EXCEPTIONS</b>	<b>101</b>
5.1	Introduction . . . . .	102
5.1.1	Methods of Representing Rules and Exceptions . . . . .	102
5.1.2	Kinds of Exceptions . . . . .	102
5.1.3	Requirements for Representing Rules and Exceptions . . . . .	103
5.2	Default Logic . . . . .	105
5.2.1	Specific Exception Clauses . . . . .	106
5.2.2	General Exception Clauses . . . . .	107
5.2.3	Evaluation . . . . .	111
5.3	Circumscription . . . . .	112

5.4	Poole's Framework for Default Reasoning . . . . .	117
5.5	Logic-programming's Negation as Failure . . . . .	120
5.5.1	Specific Exception Clauses . . . . .	121
5.5.2	General Exception Clauses . . . . .	122
5.5.3	Logic Programs with Classical Negation . . . . .	125
5.5.4	Summary . . . . .	129
5.6	Evaluation . . . . .	129
5.6.1	A Formalization Methodology . . . . .	130
5.6.2	Directionality of Defaults . . . . .	134
5.6.3	Contrapositive Inferences . . . . .	135
5.6.4	Assessment of the Exception Clause Approach . . .	136
<b>6</b>	<b>PREFERRING THE MOST SPECIFIC ARGUMENT</b>	<b>141</b>
6.1	Introduction . . . . .	141
6.2	Poole: Preferring the Most Specific Explanation . . . . .	143
6.3	Problems . . . . .	148
6.3.1	Some Possible Facts are Irrelevant . . . . .	148
6.3.2	Multiple Conflicts Ignored . . . . .	149
6.3.3	Defaults Cannot be Represented in Standard Logic .	150
6.4	A System for Constructing and Comparing Arguments . . .	151
6.4.1	General Remarks . . . . .	151
6.4.2	The Underlying Logical Language . . . . .	152
6.4.3	Arguments . . . . .	154
6.4.4	Conflicts Between Arguments . . . . .	156
6.4.5	Comparing Arguments . . . . .	158
6.4.6	Informal Summary . . . . .	163
6.5	The Assessment of Arguments . . . . .	163
6.5.1	The General Idea . . . . .	163
6.5.2	The Dialogue Game Defined . . . . .	166
6.5.3	Illustrations . . . . .	170
6.6	Combining Priorities and Exception Clauses . . . . .	172
6.6.1	Extending the System . . . . .	172
6.6.2	Illustrations . . . . .	175
6.7	Evaluation . . . . .	177
<b>7</b>	<b>REASONING WITH INCONSISTENT INFORMATION</b>	<b>179</b>
7.1	Introduction . . . . .	179
7.2	Existing Formalizations of Inconsistency Tolerant Reasoning	180
7.2.1	Alchourrón & Makinson (1981) . . . . .	181
7.2.2	Belief Revision Approaches . . . . .	183
7.2.3	Brewka's Preferred-subtheories Approach . . . . .	187
7.3	Diagnosis . . . . .	188

7.4	Hierarchical Defeat . . . . .	191
7.5	General Features of the System . . . . .	193
7.5.1	Properties of the Consequence Notion . . . . .	193
7.5.2	Sceptical and Credulous Reasoning . . . . .	195
7.5.3	Floating Conclusions . . . . .	196
7.5.4	Accrual of Arguments . . . . .	198
7.6	Conclusion . . . . .	200
<b>8</b>	<b>REASONING ABOUT PRIORITY RELATIONS</b>	<b>203</b>
8.1	Introduction . . . . .	203
8.2	Legal Issues . . . . .	204
8.2.1	Legal Collision Rules . . . . .	204
8.2.2	Requirements for a Formal Analysis . . . . .	205
8.3	Extending the Definitions . . . . .	206
8.4	A Formalization Methodology . . . . .	210
8.5	Examples . . . . .	212
8.6	An Alternative Method . . . . .	217
<b>9</b>	<b>SYSTEMS FOR DEFEASIBLE ARGUMENTATION</b>	<b>219</b>
9.1	Argumentation Systems . . . . .	219
9.2	Some Argumentation Systems . . . . .	221
9.2.1	The Bondarenko-Dung-Kowalski-Toni Approach . . . . .	221
9.2.2	Pollock . . . . .	226
9.2.3	Lin and Shoham . . . . .	229
9.2.4	Vreeswijk's Abstract Argumentation Systems . . . . .	230
9.2.5	Nute's Defeasible Logic . . . . .	232
9.2.6	Simari and Loui . . . . .	235
9.2.7	Geffner and Pearl's Conditional Entailment . . . . .	235
9.2.8	General Comparison . . . . .	237
9.3	Other Relevant Research . . . . .	238
9.3.1	Brewka's Later Work . . . . .	238
9.3.2	Reason-based Logic . . . . .	240
<b>10</b>	<b>USING THE ARGUMENTATION SYSTEM</b>	<b>249</b>
10.1	A Comparison of the Methods for Representing Exceptions . . . . .	249
10.2	Implementational Concerns . . . . .	253
10.3	Applications . . . . .	255
10.3.1	Toulmin on the Structure of Arguments . . . . .	255
10.3.2	The System as a Tool in Reasoning . . . . .	256
10.4	A Logical Analysis of Some Implemented Systems . . . . .	258
10.4.1	Gardner's Program . . . . .	258
10.4.2	CABARET . . . . .	261
10.4.3	Applications of Logic Metaprogramming . . . . .	262

# TABLE OF CONTENTS

ix

10.4.4	Freeman and Farley's DART System . . . . .	263
10.4.5	The Pleadings Game . . . . .	264
10.5	Four Layers in Legal Argumentation . . . . .	270
<b>11</b>	<b>CONCLUSION</b>	<b>275</b>
11.1	Summary . . . . .	275
11.2	Main Results . . . . .	276
11.3	Implications for Other Issues . . . . .	281
11.4	Suggestions for Further Research . . . . .	284
<b>A</b>	<b>NOTATIONS, ORDERINGS AND GLOSSARY</b>	<b>287</b>
A1	General Symbols and Notations . . . . .	287
A2	Ordering Relations . . . . .	288
A3	Notions of the Argumentation System of Chapters 6–8 . . .	289
A4	Glossary . . . . .	289
	<b>REFERENCES</b>	<b>293</b>
	<b>INDEX</b>	<b>303</b>