# Contents



### Preface x1

### CHAPTER ONE

## Logic 1

I

1.1 Historical Background

1.2	Representing Knowledge in Logic	11
1.3	Varieties of Logic	18
1.4	Names, Types, and Measures	29
1.5	Unity Amidst Diversity	39
	CHAPTER TWO	
	Ontology 51	
2.1	Ontological Categories	51
2.2	Philosophical Background	55
2.3	Top-Level Categories	67
2.4	Describing Physical Entities	78
2.5	Defining Abstractions	89
2.6	Sets, Collections, Types, and Categories	97
2.7	Space and Time	109

#### CHAPTER THREE

	Knowledge Representations 13	2
3.1	Knowledge Engineering	132
3.2	Representing Structure in Frames	143
3.3	Rules and Data	156
3.4	Object-Oriented Systems	169
3.5	Natural Language Semantics	1-8
3.6	Levels of Representation	186
	CHAPTER FOUR	
	Processes 206	
4.1	Times, Events, and Situations	206
4.2	Classification of Processes	213
4.3	Procedures, Processes, and Histories	217
4.4	Concurrent Processes	223
4.5	Computation	232
4.6	Constraint Satisfaction	239
<b>4.</b> 7	Change	245
	CHAPTER FIVE	
	Purposes, Contexts, and Agents	265
5.1	Purpose	265
5.2	Syntax of Contexts	274
5.3	Semantics of Contexts	284
5.4	First-Order Reasoning in Contexts	297
5.5	Modal Reasoning in Contexts	307

CONTENTS	<b>₹</b> \$	IX
CONTENTS	<b>₹</b> \$	IX

5.6	Encapsulating Objects in Contexts	321		
5.7	Agents	330		
	CHAPTER SIX			
	Knowledge Soup 348			
6.1	Vagueness, Uncertainty, Randomness, and Ignorance	348		
6.2	Limitations of Logic	356		
6.3	Fuzzy Logic	364		
6.4	Nonmonotonic Logic	373		
6.5	Theories, Models, and the World	383		
6.6	Semiotics	394		
CHAPTER SEVEN				
	CHAPTER SEVEN			
		408		
7.1		<b>408</b>		
	Knowledge Acquisition and Sharing			
7.2	Knowledge Acquisition and Sharing Sharing Ontologies	408		
7.2 7.3	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema	408 417		
7.2 7.3 7.4	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema Accommodating Multiple Paradigms	408 417 427		
<ul><li>7.2</li><li>7.3</li><li>7.4</li><li>7.5</li></ul>	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema Accommodating Multiple Paradigms Relating Different Knowledge Representations	408 417 427 438		
<ul><li>7.2</li><li>7.3</li><li>7.4</li><li>7.5</li></ul>	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema Accommodating Multiple Paradigms Relating Different Knowledge Representations Language Patterns	408 417 427 438 445		
<ul><li>7.2</li><li>7.3</li><li>7.4</li><li>7.5</li></ul>	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema Accommodating Multiple Paradigms Relating Different Knowledge Representations Language Patterns	408 417 427 438 445		
<ul><li>7.2</li><li>7.3</li><li>7.4</li><li>7.5</li></ul>	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema Accommodating Multiple Paradigms Relating Different Knowledge Representations Language Patterns Tools for Knowledge Acquisition	408 417 427 438 445		
7.2 7.3 7.4 7.5 7.6	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema Accommodating Multiple Paradigms Relating Different Knowledge Representations Language Patterns Tools for Knowledge Acquisition	408 417 427 438 445		
7.2 7.3 7.4 7.5 7.6	Knowledge Acquisition and Sharing Sharing Ontologies Conceptual Schema Accommodating Multiple Paradigms Relating Different Knowledge Representations Language Patterns Tools for Knowledge Acquisition  APPENDIX A Summary of Notations 467	408 417 427 438 445 452		

### APPENDIX B

Sample Ontology 492	
B.1 Principles of Ontology 49	2
B.2 Top-Level Categories 497	7
B.3 Role and Relation Types 500	2
B.4 Thematic Roles 500	6
B.5 Placement of the Thematic Roles 510	Э
APPENDIX C	
Extended Example 513	
C.1 Hotel Reservation System 513	3
C.2 Library Database 51	5
C.3 ACE Vocabulary 518	8
C.4 Translating ACE to Logic 518	8
Answers to Selected Exercises 522	
Bibliography 549	
Name Index 574	
Subject Index 579	

Special Symbols

594