CONTENTS

	Preface to the Fourth Edition	xı
Chapter 1	Truth-Functional Logic	1
1.1	"Not," "And"	2
1.2	"Or"	3
1.3	Is This Argument Valid?	4
1.4	A Bad Argument	4
1.5	Soundness	5
1.6	"If"	6
1.7	Denial, Conjunction, Disjunction	6
1.8	Conditionals	8
1.9	Counterfactual Conditionals	9
1.10	Biconditionals and Logical Equivalence	10
1.11	Rules of Valuation	10
1.12	Oddities of "If"	11
1.13	Rules of Formation	13
1.14	Consistency and the Science of Refutation	14
1.15	Tautologies	15
1.16	Context Dependency	15
1.17	Formal Validity	17
1.18	Problems	18
Chapter 2	Truth Trees	21
2.1	A Closed Tree	22
2.2	An Open Finished Tree	24
2.3	Double Denial	24
2.4	Flowchart for " \neg " and " \rightarrow " with Examples	25
2.5	Rules of Inference, with Flowchart	27

. 1

1

VIII CONTENTS

2.6	Problems	29
2.7	Adequacy of the Tree Test	31
2.8	Decidability	32
2.9	Soundness	33
2.10	Completeness	34

Chapter 3 Generality

35

59

3.1	Universal Instantiation ("UI")	37
3.2	Existential Instantiation ("EI")	38
3.3	UI Again—Closure	39
3.4	Examples	40
3.5	Rules of Formation	41
3.6	The Complete Method, with Flowchart	44
3.7	Logical Structure	46
3.8	Problems	48
3.9	Interpretations	49
3.10	-	51
3.11	II	52
	"Some S's Are P"	54
3.13	Decidability	55
3.14	Completeness	55
3.15	-	56
	"Some S's Are P": Solution	57
		51

Chapter 4 Multiple Generality

4.1 Example 59 4.2 Example 60 4.3 Logic into English 61 4.4 Linkage 62 4.5 **Rules of Formation** 63 4.6 English into Logical Notation 64 Example: Alma's Narcissism Inflames the Baron 4.7 65 4.8 Example: Alma Inflamed by Her Own Narcissism 66 4.9 Amor Vincit Omnia 66 4.10 Problems 67 4.11 Infinite Counterexamples 68 4.12 More Problems 70 4.13 Undecidability 70 4.14 Soundness 70 4.15 Completeness 71 4.16 Translation Drill 72 4.17 Exercises 74

Chapter 5	Identity	75
5.1	Rules of Inference for Identity	76
5.2	Saying of What Is Not That It Is Not	78
5.3	Definite Descriptions	79
5.4	Number	80
5.5	Problems	81
5.6	· · · · · · · · · · · · · · · · · · ·	81
	Soundness	81
	Completeness	82
5.9 5.10	Examples of Modified Interpretations Problems	83 84
Chapter 6	Functions	85
6.1	Rule of Formation	86
6.2	Rule of Interpretation	87
6.3	EI and UI Revised	88
6.4	Regulating UI, with Flowchart	89
	Adequacy	90
6.6	Problems	93
6.7	Mathematical Reasoning and Groups	93
	Problems	95
• • •	Robinson Arithmetic	96
6.10	Problems	97
Chapter 7	Uncomputability	99
7.1	How to Program a Register Machine	100
7.2	Problems	102
7.3	Register Machine Tree Tests	102
7.4	The Church-Turing Thesis	105
7.5	Unsolvability of the Halting Problem	106
7.6	Problems	109
7.7	Programs in Logical Notation	110
7.8	Problems	112
Chapter 8	Undecidability	113
8.1	The Decision Problem	114
8.2	A Routine Test for Halting	115
8.3	The Argument Is Valid iff the Program Halts	116
8.4	Focusing the Undecidability Result	119
8.5	A Solvable Case of the Decision Problem	121
8.6	Undecidability without Function Symbols	121
8.7	Undecidability of Two-Place Predicate Logic	122
8.8	Problems	123

Chapter 9	Incompleteness	125
9.1	Second-Order Logic	125
9.2	Problems	128
9.3	Logical Types	128
9.4	Russell's Paradox	130
9.5	Second-Order Formation and Valuation Rules	131
9.6	Mathematical Induction	132
9.7	Isomorphism, Categoricity, Completeness	134
9.8	Incompleteness of Validity Tests for	
	Second-Order Logic	135
9.9	Problems	138
9.10	Some History	139
Supplement A	Truth-Functional Equivalence	141
A.1	Venn Diagrams	141
A.2	Laws of Equivalence	143
A.3	Normal Form	144
A.4	Expressive Completeness	147
A.5	Simplification	147
A.6	Logic Circuits	148
A .7	Problems	150
Supplement B	Variant Methods	151
B .1	Looking for Finite Models	152
B.2	Finding Finite Models	153
B.3	Adequacy of the Method	154
B.4	The Cut Rule	155
B.5	Speedy Closure with Cut	156
B.6	Slow Closure without Cut	157
B .7	Problems	158
	Solutions	161
	Index	171