

CONTENTS

PREFACE	xi
1 COMPUTERS AND INTELLIGENCE	1
1.1 What is a Computer?	1
1.2 Symbols and Decisions	3
1.3 What is Intelligence?	4
1.4 Some Techniques of Artificial Intelligence	6
1.5 Summary	8
1.6 Exercises	8
2 GAME PLAYING AND MACHINES	10
2.1 Decision Models	10
2.2 Game Trees	12
2.3 Games	17
2.4 Last One Loses: G-1A	21
2.5 The G-1A Cup Machine	21
2.6 Theory of G-1A	22
2.7 Summary	24
2.8 Exercises	24

3	REASON, LOGIC, AND MATHEMATICS	26
3.1	Logic	26
3.2	Deduction	27
3.3	Boolean Algebra of Classes	28
3.4	Propositional Calculus	32
3.5	Induction	36
3.6	Abstraction	38
3.7	Logic Revisited	39
3.8	Exercises	39
4	COMPUTERS AND AUTOMATA	42
4.1	Automata	42
4.2	Turing Machines	44
4.3	Computable Functions	49
4.4	Characteristic Functions	50
4.5	Predicates and the Predicate Calculus	51
4.6	The Halting Problem	55
4.7	Universal Turing Machines	55
4.8	Stochastic Automata	56
4.9	Information Theory	60
4.10	Summary	62
4.11	Exercises	62
5	ADAPTATION, LEARNING, SELF REPAIR, AND SELF-ORGANIZATION	65
5.1	Adaptation, Learning and Self-Repair	66
5.2	Some Formalization	70
5.3	A Summary	71
5.4	Self-Organization	72
5.5	Some System Models	74
5.6	Homeostat	77
5.7	Gilstrap's Multinomial Forward Transfer Element	79
5.8	Adaptation and Learning in Stochastic Automata	83
5.9	Search Techniques	86
5.10	Unimodal Search	87

5.11	Random Search	91
5.12	Summary	92
5.13	Exercises	92
6	ADAPTIVE, LEARNING, AND SELF-ORGANIZING CONTROLLERS	96
6.1	State Variable Approach	97
6.2	Adaptive Control Systems	102
6.3	Parameter Adaptive Control Systems	103
6.4	Learning Control	108
6.5	Self-Organizing Controllers	111
6.6	Hierarchical Multilevel Systems	117
6.7	Summary	119
6.8	Exercises	119
7	CYBERNETIC TECHNIQUES IN COMMUNICATIONS SYSTEMS	122
7.1	Communications Systems	123
7.2	The Channel	125
7.3	Channel Equalization	126
7.4	The Decision Process	131
7.5	Communications Networks	134
7.6	Network Specification	135
7.7	Summary	144
7.8	Exercises	145
8	RELIABILITY AND REPAIR	148
8.1	Reliability of Systems	149
8.2	Modular Redundancy	153
8.3	Quadded Logic	158
8.4	The Sequential Prime Implicant Form	163
8.5	Architecture of Reliable Computers	167
8.6	Summary	171
8.7	Exercises	171

9	NEURONS AND NEURAL MODELS	174
9.1	Physiology of the Neuron	175
9.2	Information Coding in Nerve Pulses	180
9.3	Models	182
9.4	Threshold Logic	187
9.5	Summary	195
9.6	Exercises	196
10	THRESHOLD LOGIC	199
10.1	Number of Linearly Separable Functions	199
10.2	Relative Coefficient Values of Single Logical Elements	205
10.3	Synthesis of Single-Level Threshold Logic Elements	208
10.4	Synthesis of Nonlinearly Separable Functions	212
10.5	Adaptive Elements and Networks	218
10.6	Summary	221
10.7	Exercises	222
11	PATTERN RECOGNITION	224
11.1	What is Pattern Recognition	224
11.2	Input Systems	226
11.3	Feature Extraction	229
11.4	Transformations in Feature Extraction	234
11.5	The Discrimination and Response Selection Problems (Classification)	240
11.6	Decision Surfaces and Discriminant Functions	240
11.7	Nonlinear Discriminants	246
11.8	Quadric Discriminant Functions	248
11.9	Summary	250
11.10	Exercises	250
	INDEX	253

