

Contents

Foreword by Douglas R. Hofstadter	xi
Preface	xix
Introduction	1
<i>Perspective</i>	6
<i>Background</i>	7
<i>Premises</i>	13
<i>Symbols</i>	14
Chapter 1	
Mathematical Foundations	15
<i>The Space $\{0, 1\}^n$</i>	15
<i>Concepts Related to the Space $\{0, 1\}^n$</i>	15
<i>Some Properties of the Space $\{0, 1\}^n$</i>	18
<i>Memory Items as Points of the Space $\{0, 1\}^n$</i>	23
<i>Sets, Sequences or Lists, and Multisets</i>	26
Chapter 2	
Background Material from Computers	29
<i>The Random-Access Memory of a Computer</i>	30
<i>Content-Addressable Memories</i>	33
Chapter 3	
Background Material from Idealized Neurons	35
<i>The Neuron</i>	35
<i>Formal Neurons</i>	35
<i>Modeling with Neurons: The Perceptron</i>	37
<i>A Critical Look at Perceptron-Convergence Learning</i>	39
Chapter 4	
Neurons as Address Decoders	43
<i>Input Coefficients and the Address of a Neuron</i>	43

<i>The Threshold and the Response Region of a Neuron</i>	44
<i>Unequal Weights and Weighted Distance</i>	46
Chapter 5	
<i>Search of Memory for the Best Match</i>	49
<i>The Problem of the Best Match</i>	49
<i>The Best-Match Machine</i>	50
<i>A Note on Serial and Parallel Computing</i>	52
Chapter 6	
<i>Sparse Memory</i>	53
<i>Concepts Related to Sparse Memory</i>	54
<i>The Nearest-Neighbor Method in Sparse Memory</i>	56
Chapter 7	
<i>Distributed Storage</i>	61
<i>Concepts Related to Distributed Storage</i>	62
<i>The Feasibility of Distributed Storage: Finding the Best Match</i>	65
<i>Further Concepts and Properties of Distributed Storage</i>	71
<i>Interpretations</i>	76
Chapter 8	
<i>Storage and Retrieval of Sequences: Predicting</i>	79
<i>General Data Storage</i>	79
<i>Storage of Sequences</i>	80
<i>Convergence to the Stored Sequence</i>	82
<i>Second- and Higher-Order Prediction: k-fold Prediction</i>	83
<i>Interpretations</i>	86
Chapter 9	
<i>Constructing Distributed Memory</i>	87
<i>An Important Detail of Architecture</i>	90
<i>Cerebellar Cortex as a Random-Access Memory</i>	90
Chapter 10	
<i>The Organization of an Autonomous Learning System</i>	97
<i>Memory for Patterns and Pattern Sequences</i>	97
<i>Modeling the World</i>	99
<i>Storing the World Model in Sparse Distributed Memory</i>	100
<i>Including Action in the World Model</i>	103
<i>Learning to Act</i>	106
<i>Learning in Social Settings</i>	110

<i>Application to the Frame Problem of Robotics</i>	112
<i>The Encoding Problem</i>	116
<i>Summary and Conclusions</i>	118
Appendix A	
<i>The Distribution of the Third Side of a Triangle</i>	121
Appendix B	
<i>The Intersection of Two Circles</i>	125
Appendix C	
<i>The Fidelity of Sparse Distributed Memory</i>	135
Appendix D	
<i>The Distance between Two Read Chains</i>	139
Appendix E	
<i>Commonly Used Symbols</i>	143
<i>Bibliography</i>	147
<i>Index</i>	151