TABLE OF CONTENTS

	Pref	ace	xix
1	Overview: Artificial Neural Networks and Neural Computing		1
	1.1	What is Neural Computing? 1.1.1 Computing Architectures / 1.1.2 Chapter Overview / 1.1.3 Definition of Artificial Neural Network / 1.1.4 Fundamental Neural Network Concepts / 1.1.5 Introductory Terminology and Notational Conventions	1
	1.2	Neural Computing Applications 1.2.1 Characteristics of Problems Suitable for ANNs / 1.2.2 Sample ANN Applications	6
	1.3	A Brief Overview of Neural Computing 1.3.1 Background / 1.3.2 What Are the Relevant Computational Properties of the Human Brain? / 1.3.3 Neural Approaches to Computation / 1.3.4 Advantages and Disadvantages of ANNs	7
	1.4	Engineering Approaches to Neural Computing 1.4.1 Initial Questions / 1.4.2 Neural Engineering Procedures: Replacing Design with Training / 1.4.3 Procedures for ANN System Engineering	10
	1.5	ANNs: The Mappings Viewpoint 1.5.1 The Basic Perceptual System and Stimulus-Response Approaches / 1.5.2 Network Inputs and Outputs / 1.5.3 Vector Representations for S-R Characteristics / 1.5.4 Parameters, Weights, and Constraints	12
	1.6	ANNs: The Structure Viewpoint 1.6.1 ANN Functions / 1.6.2 Neural Network Structure / 1.6.3 Network Topologies and Characterization / 1.6.4 Interconnection Complexity and Problem Scale / 1.6.5 Feedback Interconnections and Network Stability / 1.6.6 Combinations of Nets and Variable Topologies	17
	1.7	ANN Learning Approaches 1.7.1 Training Sets and Test Sets / 1.7.2 Generalization / 1.7.3 Learning Curves / 1.7.4 Error Measures and Error Trajectories	2:
	1.8	Relationship of ANNs to Other Technologies	2

	1.	9 Historical Efforts 1.9.1 Perceptron and Earlier / 1.9.2 Post-Perceptron / 1.9.3 The Third Generation of ANNs / 1.9.4 Future Directions and Open Issues	27
	1.1		30
	1.11		
		References	32
-			32
2	Ma	thematical Fundamentals for ANN Study	20
	2.1	Vector and Matrix Fundamentals	36
		2.1.1 Elementary Matrices / 2.1.2 Vectors / 2.1.3 Linearity / 2.1.4 Inner and Outer Products and Applications / 2.1.5 Measures of Similarity in Vector Space / 2.1.6 Differentiation of Matrices and Vectors / 2.1.7 The Chain Rule / 2.1.8 Multidimensional Taylor Series Expansions / 2.1.9 The Pseudoinverse of a Matrix and Least Squares Techniques (Deterministic) / 2.1.10 Eigenvalues and Eigenvectors	36
	2.2	Geometry for State-Space Visualization 2.2.1 Geometric Interpretation of ANN Mappings / 2.2.2 Hypercubes / 2.2.3 ANN Mappings, Decision Regions and Boundaries, and Discriminant Functions / 2.2.4 Quadric Surfaces and Boundaries	50
	2.3	Optimization 2.3.1 Gradient Descent-Based Procedures / 2.3.2 Error Function Contours and Trajectories	55
	2.4	Graphs and Digraphs	60
	2.5	Bibliography	61
		References	61
3	Elem	entary ANN Building Blocks	62
		Overview and Objectives	62
		Biological Neural Units	62
		3.2.1 Physical (Biological) Neurons / 3.2.2 The Scale of	
		Biological Systems / 3.2.3 Biophysical Mechanisms and Equivalent Neural Operations / 3.2.4 Neural System Hierarchies and Examples	
		Artificial Unit Structures 3.3.1 Linear Unit Structures / 3.3.2 Generalizing the Unit Model / 3.3.3 Two-Part Unit Models: Activation and Squashing / 3.3.4 McCulloch-Pitts (MP) Units / 3.3.5 Threshold Logic with Weighted Linear Input Combination	70