Deterministic Optimization	1
Traditional Backpropagation	2
An Advantage of Steepest Descent	8
Line Minimization	8
Refining the Interval	. 18
Incorporating Derivative Information	. 26
Conjugate Gradient Methods	. 31
Levenberg-Marquardt Learning	
Code for Levenberg-Marquardt Learning	. 57
Stochastic Optimization	. 73
Overview of Simulated Annealing	. 74
Primitive Simulated Annealing	. 76
Refinements	. 77
Code for Primitive Annealing	
Conventional and Advanced Simulated Annealing	. 83
The Details	. 92
Code for General Simulated Annealing	. 96
Usage Guidelines	
Stochastic Smoothing	
Random Perturbation	
Code for Perturbing a Point	
Generating Uniform Random Numbers	
Chopping, Stacking, and Shuffling	
Normally Distributed Random Numbers	
Cauchy Random Vectors.	
A Final Thought	. 133
Hybrid Training Algorithms	
Simple Alternation	
Stochastic Smoothing with Gradient Hints	. 144
Probabilistic Neural Networks I: Introduction	. 157
Foundations of the PNN	. 158
PNN versus MLFN versus Traditional Statistics	. 161
Bayes Classification	. 162
Parzen's Method of Density Estimation	. 163
Multivariate Extension of Parzen's Method	. 170
The Original PNN	. 171
Computation in the PNN	. 173
Code for Computing PNN Classification	
Optimizing Sigma	
Accelerating the Basic PNN	
Bayesian Confidence Measures	. 192

Probabilistic Neural Networks II: Advanced Techniques	193
Different Variables Rate Different Sigmas	194
A Continuous Error Criterion	197
Derivatives of the Error Function	201
Incorporating Prior Probabilities	
Efficient Computation	
Classes May Deserve Their Own Sigmas, Too	212
Optimizing Multiple-Sigma Models	
Generalized Regression	223
Review of Ordinary Regression	
Simple Linear Regression	
Multiple Regression	
Polynomial Regression	
The General Regression Neural Network	234
An Intuitive Approach	237
Donald Specht's GRNN Architecture	239
Computing the Gradient	240
The GRNN in Action	246
The Gram-Charlier Neural Network	251
Structure and Overview of Functionality	
Motivation	
Series Expansions of Densities and Distributions	
Hermite Polynomials and Normal Density Derivatives	
An Alternative Representation of the Density	
Computing Hermite Polynomials	
Computing the Coefficients	
Finding the Coefficients from a Sample	
What's Wrong with This Picture?	
Other Problems	
Edgeworth's Expansion	
Mathematics of the Edgeworth Expansion	
Code for a GCNN with Edgeworth's Modification	
Comparing the Models	
Multivariate Versions of the GCNN	
Dimension Reduction and Orthogonalization	293
Principal Components	
Scaling and Computation Issues	300
Code for Principal Components	
Principal Components of Group Centroids	
Discriminant Functions	319

Assessing Generalization Ability	335
Bias and Variance in Statistical Estimators	
Notation	338
What Good Are They?	340
Bias and Variance of the Sample Mean	341
The Jackknife and the Bootstrap	343
The Jackknife	343
Code for the Jackknife	349
The Bootstrap	351
Code for the Bootstrap	
Final Comments on the Jackknife and the Bootstrap	356
Economical Error Estimation	
Population Error, Apparent Error, and Excess Error	360
Overview of Efficient Error Estimation	
Cross Validation	365
Code for Cross Validation	367
The Bootstrap Estimate of Excess Error	369
Code for the Bootstrap Method	371
Efron's E0 Estimator	373
Code for the E0 Estimator	374
The E632 Estimator	376
Using the PNN Program	379
Output Mode	
Network Model.	
Kernel Functions	
Building the Training Set	
Learning	
Confusion Matrices	
Testing in AUTOASSOCIATION and MAPPING Modes	389
Saving Weights and Execution Results	
Alphabetical Glossary of Commands	
Verification of Program Operation	
Disk Contents	
Hardware and Software Requirements	
Making a Backup Copy	
Installing the Disk	