

CONTENTS

<i>Preface</i>	viii
Chapter 1 BACKGROUND	1
1.1 Classifiers as Partitions	2
1.2 Use of Data in Constructing Classifiers	4
1.3 The Purposes of Classification Analysis	6
1.4 Estimating Accuracy	8
1.5 The Bayes Rule and Current Classification Procedures	13
Chapter 2 INTRODUCTION TO TREE CLASSIFICATION	18
2.1 The Ship Classification Problem	18
2.2 Tree Structured Classifiers	20
2.3 Construction of the Tree Classifier	23
2.4 Initial Tree Growing Methodology	27
2.5 Methodological Development	36
2.6 Two Running Examples	43
2.7 The Advantages of the Tree Structured Approach	55
Chapter 3 RIGHT SIZED TREES AND HONEST ESTIMATES	59
3.1 Introduction	59
3.2 Getting Ready to Prune	63
3.3 Minimal Cost-Complexity Pruning	66
3.4 The Best-Pruned Subtree: An Estimation Problem	72
3.5 Some Examples	81
Appendix	87

Chapter 4	SPLITTING RULES	93
4.1	Reducing Misclassification Cost	94
4.2	The Two-Class Problem	98
4.3	The Multiclass Problem: Unit Costs	103
4.4	Priors and Variable Misclassification Costs	112
4.5	Two Examples	115
4.6	Class Probability Trees Via Gini	121
	Appendix	126
Chapter 5	STRENGTHENING AND INTERPRETING	130
5.1	Introduction	130
5.2	Variable Combinations	131
5.3	Surrogate Splits and Their Uses	140
5.4	Estimating Within-Node Cost	150
5.5	Interpretation and Exploration	155
5.6	Computational Efficiency	163
5.7	Comparison of Accuracy with Other Methods	168
	Appendix	171
Chapter 6	MEDICAL DIAGNOSIS AND PROGNOSIS	174
6.1	Prognosis After Heart Attack	175
6.2	Diagnosing Heart Attacks	182
6.3	Immunosuppression and the Diagnosis of Cancer	189
6.4	Gait Analysis and the Detection of Outliers	194
6.5	Related Work on Computer-Aided Diagnosis	201
Chapter 7	MASS SPECTRA CLASSIFICATION	203
7.1	Introduction	203
7.2	Generalized Tree Construction	205
7.3	The Bromine Tree: A Nonstandard Example	205
Chapter 8	REGRESSION TREES	216
8.1	Introduction	216
8.2	An Example	217
8.3	Least Squares Regression	221
8.4	Tree Structured Regression	228
8.5	Pruning and Estimating	232
8.6	A Simulated Example	237
8.7	Two Cross-Validation Issues	241
8.8	Standard Structure Trees	247

Contents	vii
8.9 Using Surrogate Splits	248
8.10 Interpretation	251
8.11 Least Absolute Deviation Regression	255
8.12 Overall Conclusions	264
Chapter 9 BAYES RULES AND PARTITIONS	266
9.1 Bayes Rule	266
9.2 Bayes Rule for a Partition	269
9.3 Risk Reduction Splitting Rule	272
9.4 Categorical Splits	274
Chapter 10 OPTIMAL PRUNING	279
10.1 Tree Terminology	279
10.2 Optimally Pruned Subtrees	284
10.3 An Explicit Optimal Pruning Algorithm	293
Chapter 11 CONSTRUCTION OF TREES FROM A LEARNING SAMPLE	297
11.1 Estimated Bayes Rule for a Partition	298
11.2 Empirical Risk Reduction Splitting Rule	300
11.3 Optimal Pruning	302
11.4 Test Samples	303
11.5 Cross-Validation	306
11.6 Final Tree Selection	309
11.7 Bootstrap Estimate of Overall Risk	311
11.8 End-Cut Preference	313
Chapter 12 CONSISTENCY	318
12.1 Empirical Distributions	319
12.2 Regression	321
12.3 Classification	324
12.4 Proofs for Section 12.1	327
12.5 Proofs for Section 12.2	332
12.6 Proofs for Section 12.3	337
<i>Bibliography</i>	342
<i>Notation Index</i>	347
<i>Subject Index</i>	354