

Contents

1	Introduction	1
1.1	Knowledge Discovery in Databases and Data Mining	1
1.2	Focusing for Data Mining	4
1.3	Overview	6
2	Knowledge Discovery in Databases	11
2.1	Knowledge Discovery Process	11
2.1.1	Humans in the Loop	11
2.1.2	KDD Project Phases	13
2.2	Data Preparation	16
2.2.1	From Business Data to Data Mining Input	17
2.2.2	Data Selection and Focusing	19
2.3	Data Mining Goals	20
2.3.1	From Understanding to Predictive Modeling	21
2.3.2	Classification	23
2.4	Data Characteristics: Notations and Definitions	25
2.4.1	Database Tables	25
2.4.2	Statistical Values	29
2.5	Data Mining Algorithms	31
2.5.1	Classification Algorithms	32
2.5.2	Top Down Induction of Decision Trees	33
2.5.3	Nearest Neighbor Classifiers	37
2.6	Selecting the Focusing Context	44

3	Focusing Tasks	45
3.1	Focusing Concepts: An Overview	45
3.2	Focusing Specification	47
3.2.1	Focusing Input	48
3.2.2	Focusing Output	49
3.2.3	Focusing Criterion	50
3.3	Focusing Context	52
3.3.1	Data Characteristics	54
3.3.2	Data Mining Algorithms	55
3.4	Focusing Success	55
3.4.1	Filter Evaluation	57
3.4.2	Wrapper Evaluation	64
3.4.3	Evaluation Criteria	70
3.5	Selecting the Focusing Task	83
4	Focusing Solutions	85
4.1	State of the Art: A Unifying View	85
4.1.1	The Unifying Framework of Existing Focusing Solutions	85
4.1.2	Sampling	87
4.1.3	Clustering	95
4.1.4	Prototyping	104
4.2	More Intelligent Sampling Techniques	109
4.2.1	Existing Reusable Components	111
4.2.2	Advanced Leader Sampling	113
4.2.3	Similarity-Driven Sampling	134
4.3	A Unified Approach to Focusing Solutions	149
4.3.1	Generic Sampling	150
4.3.2	Generic Sampling in a Commercial Data Mining System	153
5	Analytical Studies	159
5.1	An Average Case Analysis	159
5.2	Experimental Validation of Theoretical Claims	170

6	Experimental Results	173
6.1	Experimental Design	173
6.1.1	Experimental Procedure	173
6.1.2	Data Characteristics	179
6.2	Results and Evaluation	182
6.2.1	Filter Evaluation	182
6.2.2	Wrapper Evaluation for C4.5	188
6.2.3	Wrapper Evaluation for IB	195
6.2.4	Comparing Filter and Wrapper Evaluation for C4.5	201
6.2.5	Comparing Filter and Wrapper Evaluation for IB	208
6.2.6	Comparing Wrapper Evaluation for C4.5 and IB	215
6.3	Focusing Advice	222
6.3.1	Sorting, Stratification, and Prototype Weighting	222
6.3.2	Focusing Solutions in Focusing Contexts	223
7	Conclusions	231
7.1	Summary and Contributions	231
7.2	More Related Work	235
7.3	Future Work	236
7.4	Closing Remarks	238
	Bibliography	239
	Acknowledgments	253
A	Notations	257
A.1	Indices, Variables, and Functions	257
A.2	Algorithms and Procedures	264
B	More Evaluation Criteria	267
B.1	Filter Evaluation Criteria	267
B.2	Wrapper Evaluation Criteria	272

C Remaining Proofs	277
D Generic Sampling in GenSam	281
E More Experimental Results	283
Index	303
Curriculum Vitae	309