

# Contents

## Part I Domain Driven KDD Methodology

<b>1</b>	<b>Introduction to Domain Driven Data Mining</b> .....	3
	Longbing Cao	
1.1	Why Domain Driven Data Mining .....	3
1.2	What Is Domain Driven Data Mining .....	5
	1.2.1 Basic Ideas .....	5
	1.2.2 $D^3M$ for Actionable Knowledge Discovery .....	6
1.3	Open Issues and Prospects .....	9
1.4	Conclusions .....	9
	References .....	10
<b>2</b>	<b>Post-processing Data Mining Models for Actionability</b> .....	11
	Qiang Yang	
2.1	Introduction .....	11
2.2	Plan Mining for Class Transformation .....	12
	2.2.1 Overview of Plan Mining .....	12
	2.2.2 Problem Formulation .....	14
	2.2.3 From Association Rules to State Spaces .....	14
	2.2.4 Algorithm for Plan Mining .....	17
	2.2.5 Summary .....	19
2.3	Extracting Actions from Decision Trees .....	20
	2.3.1 Overview .....	20
	2.3.2 Generating Actions from Decision Trees .....	22
	2.3.3 The Limited Resources Case .....	23
2.4	Learning Relational Action Models from Frequent Action Sequences .....	25
	2.4.1 Overview .....	25
	2.4.2 ARMS Algorithm: From Association Rules to Actions ..	26
	2.4.3 Summary of ARMS .....	28
2.5	Conclusions and Future Work .....	29

References .....	29
<b>3 On Mining Maximal Pattern-Based Clusters .....</b>	<b>31</b>
Jian Pei, Xiaoling Zhang, Moonjung Cho, Haixun Wang, and Philip S.Yu	
3.1 Introduction .....	32
3.2 Problem Definition and Related Work .....	34
3.2.1 Pattern-Based Clustering .....	34
3.2.2 Maximal Pattern-Based Clustering .....	35
3.2.3 Related Work .....	35
3.3 Algorithms <i>MaPle</i> and <i>MaPle+</i> .....	36
3.3.1 An Overview of <i>MaPle</i> .....	37
3.3.2 Computing and Pruning MDS's .....	38
3.3.3 Progressively Refining, Depth-first Search of Maximal pClusters .....	40
3.3.4 <i>MaPle+</i> : Further Improvements .....	44
3.4 Empirical Evaluation .....	46
3.4.1 The Data Sets .....	46
3.4.2 Results on Yeast Data Set .....	47
3.4.3 Results on Synthetic Data Sets .....	48
3.5 Conclusions .....	50
References .....	50
<b>4 Role of Human Intelligence in Domain Driven Data Mining .....</b>	<b>53</b>
Sumana Sharma and Kweku-Muata Osei-Bryson	
4.1 Introduction .....	53
4.2 DDDM Tasks Requiring Human Intelligence .....	54
4.2.1 Formulating Business Objectives .....	54
4.2.2 Setting up Business Success Criteria .....	55
4.2.3 Translating Business Objective to Data Mining Objectives .....	56
4.2.4 Setting up of Data Mining Success Criteria .....	56
4.2.5 Assessing Similarity Between Business Objectives of New and Past Projects .....	57
4.2.6 Formulating Business, Legal and Financial Requirements .....	57
4.2.7 Narrowing down Data and Creating Derived Attributes ..	58
4.2.8 Estimating Cost of Data Collection, Implementation and Operating Costs .....	58
4.2.9 Selection of Modeling Techniques .....	59
4.2.10 Setting up Model Parameters .....	59
4.2.11 Assessing Modeling Results .....	59
4.2.12 Developing a Project Plan .....	60
4.3 Directions for Future Research .....	60
4.4 Summary .....	61
References .....	61

**5 Ontology Mining for Personalized Search** . . . . . 63  
 Yuefeng Li and Xiaohui Tao

5.1 Introduction . . . . . 63

5.2 Related Work . . . . . 64

5.3 Architecture . . . . . 65

5.4 Background Definitions . . . . . 66

    5.4.1 World Knowledge Ontology . . . . . 66

    5.4.2 Local Instance Repository . . . . . 67

5.5 Specifying Knowledge in an Ontology . . . . . 68

5.6 Discovery of Useful Knowledge in LIRs . . . . . 70

5.7 Experiments . . . . . 71

    5.7.1 Experiment Design . . . . . 71

    5.7.2 Other Experiment Settings . . . . . 74

5.8 Results and Discussions . . . . . 75

5.9 Conclusions . . . . . 77

References . . . . . 77

**Part II Novel KDD Domains & Techniques**

**6 Data Mining Applications in Social Security** . . . . . 81  
 Yanchang Zhao, Huaifeng Zhang, Longbing Cao, Hans Bohlscheid,  
 Yuming Ou, and Chengqi Zhang

6.1 Introduction and Background . . . . . 81

6.2 Case Study I: Discovering Debtor Demographic Patterns with  
 Decision Tree and Association Rules . . . . . 83

    6.2.1 Business Problem and Data . . . . . 83

    6.2.2 Discovering Demographic Patterns of Debtors . . . . . 83

6.3 Case Study II: Sequential Pattern Mining to Find Activity  
 Sequences of Debt Occurrence . . . . . 85

    6.3.1 Impact-Targeted Activity Sequences . . . . . 86

    6.3.2 Experimental Results . . . . . 87

6.4 Case Study III: Combining Association Rules from  
 Heterogeneous Data Sources to Discover Repayment Patterns . . . . . 89

    6.4.1 Business Problem and Data . . . . . 89

    6.4.2 Mining Combined Association Rules . . . . . 89

    6.4.3 Experimental Results . . . . . 90

6.5 Case Study IV: Using Clustering and Analysis of Variance to  
 Verify the Effectiveness of a New Policy . . . . . 92

    6.5.1 Clustering Declarations with Contour and Clustering . . . . . 92

    6.5.2 Analysis of Variance . . . . . 94

6.6 Conclusions and Discussion . . . . . 94

References . . . . . 95

<b>7</b>	<b>Security Data Mining: A Survey Introducing Tamper-Resistance</b> . . .	97
	Clifton Phua and Mafruz Ashrafi	
7.1	Introduction . . . . .	97
7.2	Security Data Mining . . . . .	98
	7.2.1 Definitions . . . . .	98
	7.2.2 Specific Issues . . . . .	99
	7.2.3 General Issues . . . . .	101
7.3	Tamper-Resistance . . . . .	102
	7.3.1 Reliable Data . . . . .	102
	7.3.2 Anomaly Detection Algorithms . . . . .	104
	7.3.3 Privacy and Confidentiality Preserving Results . . . . .	105
7.4	Conclusion . . . . .	108
	References . . . . .	108
<b>8</b>	<b>A Domain Driven Mining Algorithm on Gene Sequence Clustering</b> . .	111
	Yun Xiong, Ming Chen, and Yangyong Zhu	
8.1	Introduction . . . . .	111
8.2	Related Work . . . . .	112
8.3	The Similarity Based on Biological Domain Knowledge . . . . .	114
8.4	Problem Statement . . . . .	114
8.5	A Domain-Driven Gene Sequence Clustering Algorithm . . . . .	117
8.6	Experiments and Performance Study . . . . .	121
8.7	Conclusion and Future Work . . . . .	124
	References . . . . .	125
<b>9</b>	<b>Domain Driven Tree Mining of Semi-structured Mental Health Information</b> . . . . .	127
	Maja Hadzic, Fedja Hadzic, and Tharam S. Dillon	
9.1	Introduction . . . . .	127
9.2	Information Use and Management within Mental Health Domain . . . . .	128
9.3	Tree Mining - General Considerations . . . . .	130
9.4	Basic Tree Mining Concepts . . . . .	131
9.5	Tree Mining of Medical Data . . . . .	135
9.6	Illustration of the Approach . . . . .	139
9.7	Conclusion and Future Work . . . . .	139
	References . . . . .	140
<b>10</b>	<b>Text Mining for Real-time Ontology Evolution</b> . . . . .	143
	Jackei H.K. Wong, Tharam S. Dillon, Allan K.Y. Wong, and Wilfred W.K. Lin	
10.1	Introduction . . . . .	144
10.2	Related Text Mining Work . . . . .	145
10.3	Terminology and Multi-representations . . . . .	145
10.4	Master Aliases Table and OCOE Data Structures . . . . .	149
10.5	Experimental Results . . . . .	152
	10.5.1 CAV Construction and Information Ranking . . . . .	153

- 10.5.2 Real-Time CAV Expansion Supported by Text Mining . . . 154
- 10.6 Conclusion . . . . . 155
- 10.7 Acknowledgement . . . . . 156
- References . . . . . 156
- 11 Microarray Data Mining: Selecting Trustworthy Genes with Gene Feature Ranking . . . . . 159**
  - Franco A. Ubaudi, Paul J. Kennedy, Daniel R. Catchpoole, Dachuan Guo, and Simeon J. Simoff
  - 11.1 Introduction . . . . . 159
  - 11.2 Gene Feature Ranking . . . . . 161
    - 11.2.1 Use of Attributes and Data Samples in Gene Feature Ranking . . . . . 162
    - 11.2.2 Gene Feature Ranking: Feature Selection Phase 1 . . . . . 163
    - 11.2.3 Gene Feature Ranking: Feature Selection Phase 2 . . . . . 163
  - 11.3 Application of Gene Feature Ranking to Acute Lymphoblastic Leukemia data . . . . . 164
  - 11.4 Conclusion . . . . . 166
  - References . . . . . 167
- 12 Blog Data Mining for Cyber Security Threats . . . . . 169**
  - Flora S. Tsai and Kap Luk Chan
  - 12.1 Introduction . . . . . 169
  - 12.2 Review of Related Work . . . . . 170
    - 12.2.1 Intelligence Analysis . . . . . 171
    - 12.2.2 Information Extraction from Blogs . . . . . 171
  - 12.3 Probabilistic Techniques for Blog Data Mining . . . . . 172
    - 12.3.1 Attributes of Blog Documents . . . . . 172
    - 12.3.2 Latent Dirichlet Allocation . . . . . 173
    - 12.3.3 Isometric Feature Mapping (Isomap) . . . . . 174
  - 12.4 Experiments and Results . . . . . 175
    - 12.4.1 Data Corpus . . . . . 175
    - 12.4.2 Results for Blog Topic Analysis . . . . . 176
    - 12.4.3 Blog Content Visualization . . . . . 178
    - 12.4.4 Blog Time Visualization . . . . . 179
  - 12.5 Conclusions . . . . . 180
  - References . . . . . 181
- 13 Blog Data Mining: The Predictive Power of Sentiments . . . . . 183**
  - Yang Liu, Xiaohui Yu, Xiangji Huang, and Aijun An
  - 13.1 Introduction . . . . . 183
  - 13.2 Related Work . . . . . 185
  - 13.3 Characteristics of Online Discussions . . . . . 186
    - 13.3.1 Blog Mentions . . . . . 186
    - 13.3.2 Box Office Data and User Rating . . . . . 187
    - 13.3.3 Discussion . . . . . 187

13.4	S-PLSA: A Probabilistic Approach to Sentiment Mining . . . . .	188
13.4.1	Feature Selection . . . . .	188
13.4.2	Sentiment PLSA . . . . .	188
13.5	ARSA: A Sentiment-Aware Model . . . . .	189
13.5.1	The Autoregressive Model . . . . .	190
13.5.2	Incorporating Sentiments . . . . .	191
13.6	Experiments . . . . .	192
13.6.1	Experiment Settings . . . . .	192
13.6.2	Parameter Selection . . . . .	193
13.7	Conclusions and Future Work . . . . .	194
	References . . . . .	194
<b>14</b>	<b>Web Mining: Extracting Knowledge from the World Wide Web . . . .</b>	<b>197</b>
	Zhongzhi Shi, Huifang Ma, and Qing He	
14.1	Overview of Web Mining Techniques . . . . .	197
14.2	Web Content Mining . . . . .	199
14.2.1	Classification: Multi-hierarchy Text Classification . . . . .	199
14.2.2	Clustering Analysis: Clustering Algorithm Based on Swarm Intelligence and k-Means . . . . .	200
14.2.3	Semantic Text Analysis: Conceptual Semantic Space . . . . .	202
14.3	Web Structure Mining: PageRank vs. HITS . . . . .	203
14.4	Web Event Mining . . . . .	204
14.4.1	Preprocessing for Web Event Mining . . . . .	205
14.4.2	Multi-document Summarization: A Way to Demonstrate Event’s Cause and Effect . . . . .	206
14.5	Conclusions and Future Works . . . . .	206
	References . . . . .	207
<b>15</b>	<b>DAG Mining for Code Compaction . . . . .</b>	<b>209</b>
	T. Werth, M. Wörlein, A. Dreweke, I. Fischer, and M. Philippsen	
15.1	Introduction . . . . .	209
15.2	Related Work . . . . .	211
15.3	Graph and DAG Mining Basics . . . . .	211
15.3.1	Graph-based versus Embedding-based Mining . . . . .	212
15.3.2	Embedded versus Induced Fragments . . . . .	213
15.3.3	DAG Mining Is <i>NP</i> -complete . . . . .	213
15.4	Algorithmic Details of DAGMA . . . . .	214
15.4.1	A Canonical Form for DAG enumeration . . . . .	214
15.4.2	Basic Structure of the DAG Mining Algorithm . . . . .	215
15.4.3	Expansion Rules . . . . .	216
15.4.4	Application to Procedural Abstraction . . . . .	219
15.5	Evaluation . . . . .	220
15.6	Conclusion and Future Work . . . . .	222
	References . . . . .	223

<b>16</b>	<b>A Framework for Context-Aware Trajectory Data Mining</b> . . . . .	225
	Vania Bogorny and Monica Wachowicz	
16.1	Introduction . . . . .	225
16.2	Basic Concepts . . . . .	227
16.3	A Domain-driven Framework for Trajectory Data Mining . . . . .	229
16.4	Case Study . . . . .	232
16.4.1	The Selected Mobile Movement-aware Outdoor Game . . . . .	233
16.4.2	Transportation Application . . . . .	234
16.5	Conclusions and Future Trends . . . . .	238
	References . . . . .	239
<b>17</b>	<b>Census Data Mining for Land Use Classification</b> . . . . .	241
	E. Roma Neto and D. S. Hamburger	
17.1	Content Structure . . . . .	241
17.2	Key Research Issues . . . . .	242
17.3	Land Use and Remote Sensing . . . . .	242
17.4	Census Data and Land Use Distribution . . . . .	243
17.5	Census Data Warehouse and Spatial Data Mining . . . . .	243
17.5.1	Concerning about Data Quality . . . . .	243
17.5.2	Concerning about Domain Driven . . . . .	244
17.5.3	Applying Machine Learning Tools . . . . .	246
17.6	Data Integration . . . . .	247
17.6.1	Area of Study and Data . . . . .	247
17.6.2	Supported Digital Image Processing . . . . .	248
17.6.3	Putting All Steps Together . . . . .	248
17.7	Results and Analysis . . . . .	249
	References . . . . .	251
<b>18</b>	<b>Visual Data Mining for Developing Competitive Strategies in Higher Education</b> . . . . .	253
	Gürdal Ertek	
18.1	Introduction . . . . .	253
18.2	Square Tiles Visualization . . . . .	255
18.3	Related Work . . . . .	256
18.4	Mathematical Model . . . . .	257
18.5	Framework and Case Study . . . . .	260
18.5.1	General Insights and Observations . . . . .	261
18.5.2	Benchmarking . . . . .	262
18.5.3	High School Relationship Management (HSRM) . . . . .	263
18.6	Future Work . . . . .	264
18.7	Conclusions . . . . .	264
	References . . . . .	265

<b>19</b>	<b>Data Mining For Robust Flight Scheduling</b> .....	267
	Ira Assent, Ralph Krieger, Petra Welter, Jörg Herbers, and Thomas Seidl	
19.1	Introduction .....	267
19.2	Flight Scheduling in the Presence of Delays .....	268
19.3	Related Work .....	270
19.4	Classification of Flights .....	272
19.4.1	Subspaces for Locally Varying Relevance .....	272
19.4.2	Integrating Subspace Information for Robust Flight Classification .....	272
19.5	Algorithmic Concept .....	274
19.5.1	Monotonicity Properties of Relevant Attribute Subspaces	274
19.5.2	Top-down Class Entropy Algorithm: Lossless Pruning Theorem .....	275
19.5.3	Algorithm: Subspaces, Clusters, Subspace Classification	276
19.6	Evaluation of Flight Delay Classification in Practice .....	278
19.7	Conclusion .....	280
	References .....	280
<b>20</b>	<b>Data Mining for Algorithmic Asset Management</b> .....	283
	Giovanni Montana and Francesco Parrella	
20.1	Introduction .....	283
20.2	Backbone of the Asset Management System .....	285
20.3	Expert-based Incremental Learning .....	286
20.4	An Application to the iShare Index Fund .....	290
	References .....	294
	<b>Reviewer List</b> .....	297
	<b>Index</b> .....	299