Wilfried Grossmann • Stefanie Rinderle-Ma

Fundamentals of Business Intelligence



Contents

11	Defini	ition of Business Intellivence
1.1	Puttin	a Business Intelligence into Context
1.2	121	Business Intelligence Scenarios
	12.1	Perspectives in Business Intelligence
	12.2	Business Intelligence Views on Business Processes
	12.3	Goals of Rusiness Intelligence
	1.2.5	Summary: Putting Business Intelligence in Context
1.3	Busin	ess Intelligence: Tasks and Analysis Formats
	1.3.1	Data Task
	1.3.2	Business and Data Understanding Task
	1.3.3	Modeling Task
	1.3.4	Analysis Task
	1.3.5	Evaluation and Reporting Task
	1.3.6	Analysis Formats
	1.3.7	Summary: Tasks and Analysis Formats
1.4	Use C	Cases
	1.4.1	Application in Patient Treatment
	1.4.2	Application in Higher Education
	1.4.3	Application in Logistics
	1.4.4	Application in Customer Relationship Management
1.5	Struct	ure and Outline of the Book
1.6	Recor	nmended Reading (Selection)
Refe	erences	
Mo	deling i	n Business Intelligence
2.1	Mode	Is and Modeling in Business Intelligence
	2.1.1	The Representation Function of Models
	2.1.2	Model Presentation
	2.1.3	Model Building

est.

		2.1.4	Model Assessment and Quality of Models	44		
		2.1.5	Models and Patterns	45		
		2,1.6	Summary: Models and Modeling in Business			
			Intelligence	46		
	2.2	Logica	al and Algebraic Structures	46		
		2.2.1	Logical Structures	46		
		2.2.2	Modeling Using Logical Structures	48		
		2.2.3	Summary: Logical Structures	51		
	2.3	Graph	Structures	51		
		2.3.1	Model Structure	51		
		2.3.2	Modeling with Graph Structures	54		
		2.3.3	Summary: Graph Structures	57		
	2.4	Analy	tical Structures	58		
		2.4.1	Calculus	58		
		2.4.2	Probabilistic Structures	61		
		2.4.3	Statistical Structures	67		
		2.4.4	Modeling Methods Using Analytical Structures	70		
		2.4.5	Summary: Analytical Structures	73		
	2.5	Mode	ls and Data	74		
		2.5.1	Data Generation	74		
		2.5.2	The Role of Time	76		
		2.5.3	Data Quality	78		
		2.5.4	Summary: Models and Data	82		
	2.6	Concl	usion and Lessons Learned	82		
	2.7	Recor	nmended Reading (Selection)	83		
	Refe	rences .	-	83		
3	Data	Provis	ioning	87		
•	3.1	Introd	oduction and Goals			
	3.2	Data (Collection and Description	88		
	3.3	Data H	Extraction	90		
	2000	3.3.1	Extraction-Transformation-Load (ETL) Process	90		
		3.3.2	Big Data	93		
		3.3.3	Summary on Data Extraction	98		
	3.4	From	Transactional Data Towards Analytical Data	98		
		3.4.1	Table Formats and Online Analytical Processing (OLAP)	100		
		3.4.2	Log Formats	104		
		3.4.3	Summary: From Transactional Towards			
			Analytical Data	108		
	3.5	Schen	na and Data Integration	108		
		3.5.1	Schema Integration	108		
		3.5.2	Data Integration and Data Quality	112		
		3.5.3	Linked Data and Data Mashuns	113		
		3.5.4	Summary: Schema and Data Integration	114		
	3.6	Concl	usion and Lessons Learned	115		
	210		action and a work of a state of the state of			

	3.7	Recon	nmended Reading	115
	Refe	rences.		115
4	Data Description and Visualization			
	4.1	Introd	uction	119
	4.2	Descri	iption and Visualization of Business Processes	120
		4.2.1	Process Modeling and Layout	121
		4.2.2	The BPM Tools' Perspective	122
		4.2.3	Process Runtime Visualization	123
		4.2.4	Visualization of Further Aspects	123
		4.2.5	Challenges in Visualizing Process-Related Information	126
		4.2.6	Summary: Description and Visualization	
			of Business Processes	127
	4.3	Descr	iption and Visualization of Data in the Customer	
		Perspe	ective	127
		4.3.1	Principles for Description and Visualization	
			of Collections of Process Instances	127
		4.3.2	Interactive and Dynamic Visualization	131
		4.3.3	Summary: Visualization of Process Instances	133
	4.4	Basic	Visualization Techniques	133
		4.4.1	Description and Visualization of Qualitative	
			Information	134
		4.4.2	Description and Visualization of Quantitative Variables	137
		4.4.3	Description and Visualization of Relationships	140
		4.4.4	Description and Visualization of Temporal Data	143
		4.4.5	Interactive and Dynamic Visualization	145
		4.4.6	Summary: Basic Visualization Techniques	146
	4.5	Repor	ting	147
		4.5.1	Description and Visualization of Metadata	147
		4.5.2	High-Level Reporting	149
		4.5.3	Infographics	151
		4.5.4	Summary: Reporting	152
	4.6	Recor	nmended Reading	153
	Refe	rences.		153
5	Data) Minin	g for Cross-Sectional Data	155
	5.1	Introd	luction to Supervised Learning	155
	5.2	Regre	ssion Models	159
		5.2.1	Model Formulation and Terminology	159
		5.2.2	Linear Regression	161
		5.2.3	Neural Networks	166
		5.2.4	Kernel Estimates	169
		5.2.5	Smoothing Splines	171
		5.2.6	Summary: Regression Models	172

	5.3	Classi	fication Models	173
		5.3.1	Model Formulation and Terminology	173
		5.3.2	Classification Based on Probabilistic Structures	177
		5.3.3	Methods Using Trees	182
		5.3.4	K-Nearest-Neighbor Classification	185
		5.3.5	Support Vector Machines	186
		5.3.6	Combination Methods	190
		5.3.7	Application of Classification Methods	191
		5.3.8	Summary: Classification Models	192
	5.4	Unsup	ervised Learning	193
		5.4.1	Introduction and Terminology	193
		5.4.2	Hierarchical Clustering	195
		5.4.3	Partitioning Methods	199
		5.4.4	Model-Based Clustering	201
		5.4.5	Summary: Unsupervised Learning	203
	5.5	Concl	usion and Lessons Learned	204
	5.6	Recon	nmended Reading	204
	Refe	rences.		205
6	Data	Minin	e for Temporal Data	207
v	Data 6 1	Tormi	pology and Approaches Towards Temporal Data Mining	207
	6.7	Classi	ficition and Clustering of Time Sequences	207
	0.2	621	Segmentation and Classification Using Time	212
		0.2.1	Warning	214
		622	Segmentation and Classification Using Response	214
		0.2.2	Features	217
		623	Summary: Classification and Clustering of Time	417
		0.2)	Sequences	220
	63	Time-	to-Event Analysis	220
	6.4	A nalv	rie of Markov Chaine	220
	0.4	641	Structural Analysis of Markov Chains	226
		612	Cluster Analysis for Markov Chains	220
		643	Generalization of the Basic Model	231
		614	Summary: Analysis of Markov Chains	223
	65	A 8600	jation Analysis of Markov Chanis	233
	6.6	Securi	nga Mining	230
	67	Enico	de Mining	240
	6.8	Concl	usion and Lessons Learned	240
	60	Pocor	nmended Reading	242
	0.7 Refe	rances	unicided Reading	244
	Noie	i chiçes		
7	Proc	ess An	alysis	245
	7,1	Introd	luction and Terminology	245
	7.2	Busin	ess Process Analysis and Simulation	247
		7.2.1	Static Analysis	248
		7.2.2	Dynamic Analysis and Simulation	248

		7.2.3	Optimization,	251
		7.2.4	Summary: Process Analysis and Simulation	252
	7.3	Proces	s Performance Management and Warehousing	252
		7.3.1	Performance Management	252
		7.3.2	Process Warehousing	253
		7.3.3	Summary: Process Performance Management	
			and Warehousing	255
	7.4	Proces	ss Mining	255
		7.4.1	Process Discovery	256
		7.4.2	Change Mining	263
		7.4.3	Conformance Checking	266
		7.4.4	Summary: Process Mining	267
	7.5	Busine	ess Process Compliance	268
		7.5.1	Compliance Along the Process Life Cycle	268
		7.5.2	Summary: Compliance Checking	270
	7.6	Evalua	ation and Assessment	270
		7.6.1	Process Mining	270
		7.6.2	Compliance Checking	271
	7.7	Concl	usion and Lessons Learned	271
	7.8	Recon	nmended Reading	272
	Refe	rences.		272
8	Anal	vsis of	Multiple Business Perspectives	275
Ť	8.1	Introd	uction and Terminology	275
	8.2	Social	Network Analysis and Organizational Mining	277
		8,2.1	Social Network Analysis	277
		8.2.2	Organizational Aspect in Business Processes	282
		8.2.3	Organizational Mining Techniques for Business	
			Processes	284
		8.2.4	Summary: Social Network Analysis	
			and Organizational Mining	290
	8.3	Decisi	ion Point Analysis	290
	8.4	Text M	Aining	294
		8.4.1	Introduction and Terminology	294
		8.4.2	Data Preparation and Modeling	296
		8.4.3	Descriptive Analysis for the Document Term Matrix	301
		8.4.4	Analysis Techniques for a Corpus	303
		8.4.5	Further Aspects of Text Mining	307
		8.4.6	Summary: Text Mining	313
	8.5	Concl	usion and Lessons Learned	313
	8.6	Recor	nmended Reading	315
	Refe	rences	- 	315
Ģ	Sum	marv		319
	C UIII	annar y		211

A	Survey on Business Intelligence Tools			
	A.I	Data Modeling and ETL Support	329	
	A.2	Big Data	330	
	A.3	Visualization, Visual Mining, and Reporting	334	
	A,4	Data Mining	337	
	A.5	Process Mining	338	
	A.6	Text Mining	339	
	Refe	rences	340	
In	dex		343	