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Yong Tang
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时态信息处理 技术及应用

Temporal
Information
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Technology and
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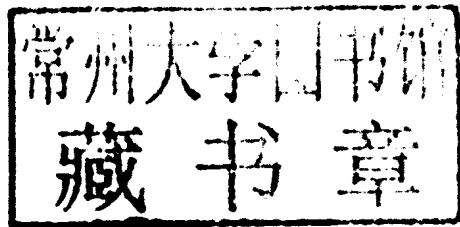
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时态信息处理技术及应用

Temporal Information Processing Technology and Its Applications

With 129 figures



内 容 简 介

时间是自然界无处不在的属性。时态信息处理已经成为现代信息系统的重要组成部分。本书系统研究时态信息处理技术及其应用,内容包括:(1)时间模型、时间演算和时态逻辑方法;(2)时态数据库基本概念、时态数据模型、时间算子 now 的语义和时态数据索引;(3)时态数据查询语言,以 TempDB 为例介绍时态数据库管理系统的设计和实现;(4)XML、工作流时态扩展和时态知识模型;(5)时态应用模式,并给出一个典型的时态应用实例。

本书读者对象为高等院校计算机专业的师生,科研机构及相关领域的研发人员等。

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Preface

Time is a natural attribute of everything. With the explosive growth of computer and network systems, temporal information has received extensive attention in both academia and industry. It plays an increasingly important role in the new generation information systems and also a key role in some applications. The use of temporal information modeling and processing technology in these applications can make them more useful and more convenient.

Temporal database and application problems have been mentioned during the 1970s. The groundbreaking study in this area was conducted by J. Ben Zvi, who proposed the bitemporal concept and a temporal database model in his dissertation, submitted to the University of California, Los Angeles, in 1982. In subsequent years, the temporal database theory research has grown vigorously and hundreds of temporal models have been proposed. James Clifford, Christian S. Jensen, Richard T. Snodgrass and Andreas Steiner made important contributions to temporal database models, theory and technology. In the recent years, along with information technology that can meet the increasing requirement for new applications, the temporal database theory and application technologies have made remarkable progress. However, there are many problems in temporal information processing, e.g., weakness in temporal calculus theory, low efficiency of temporal storage and access, complex temporal information processing and lack of the software development tools. There are three main trends in temporal technologies: model standardization, middleware development and application diversification.

We began to pay special attention to research on temporal database when we undertook the software application project: Intelligent Decision Support System of Salary (SIDSS), in 1998. The main concept behind SIDSS is that an employee's wage is paid according to information related to the employee and to the policies of the salary management department. SIDSS is a typical temporal system, in which the employee information that influences his or her salary is the typical temporal data and the salary policies that can be changed by the management department which also are time-varying knowledge. In the SIDSS, we used a

temporal database model to design the employee database. We proposed a rule-based temporal knowledge model to represent the time-varying salary policies, and implemented a reasoning mechanism to realize the employee's salary determination and change based on the employee's temporal information and the salary policies based on temporal rule knowledge. The SIDSS has been used by more than ten thousands of agencies and millions of employees since 2000. In the past decade, we have undertaken more than 20 research projects on temporal database systems and associated software that involved the temporal data/knowledge base middleware, extension temporal to workflow, XML and role-based cooperative software, and others. Remarkably, TempDB 2.01, a temporal database management middleware developed by us, has been downloaded by hundreds of users from more than 10 countries since its release on July 2008.

This book is a collection of main study and research results that we obtained in the past years. There are five parts in this book. Part I gives the time models, basic types of time data and their calculation methods. In Part II, we introduce the basic concepts of temporal database. We then discuss the complex semantics of temporal variables and the basic problems of temporal database. In Part II, we introduce database systems based on temporal information, such as spatio-temporal database systems and temporal XML database. Part III discusses some temporal index technologies and proposes some new temporal indexing methods, such as bitemporal index, spatio-temporal data indexes and temporal XML index. These are key problems in the implementation of temporal database systems and applications. Part IV introduces the basic concepts of Temporal Database Management Systems (TDBMS) and the main techniques for the implementation of TempDB 2.1. Part V discusses some temporal application technologies, such as temporal knowledge representation and reasoning mechanism, temporal extension to workflow and role management systems. In Part V, as a case study, we introduce temporal data model, temporal knowledge reasoning and their implementations on a typical temporal application of SIDSS.

The aim of this book is to provide a basic understanding on calculation methods of time data and on temporal information modeling, as well as the implementation technologies of temporal applications. Researchers, graduate students and information technology professionals who are interested in the information systems and software involving temporal attributes, will find a starting point and a reference for their study, research and development from this book.

We would like to acknowledge all of the researchers in the area of temporal database modeling and applications. Based on their publications, their influence on this book is profound. We would like to thank all of the colleagues and students in the Co-soft Research and Development Center at Sun Yat-Sen University, China. We wish to express thanks to them for their valuable suggestions, discussions and assistance. We would also like to thank Dr. Jing Xiao, Dr. Gansen Zhao and Mr. Aaron Tang for their valuable suggestions and kind help.

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Yong Tang, Xiaoping Ye and Na Tang
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Contents

- Preface..... i**
- List of Figures and Tablesxiii**
- Part I Temporal Models and Calculation Methods 1**
 - 1 From Time Data to Temporal Information..... 3**
 - 1.1 Application Requirement 3
 - 1.2 What Is Time Data 4
 - 1.2.1 Time Point..... 5
 - 1.2.2 Time Interval..... 6
 - 1.2.3 Time Span 7
 - 1.2.4 Complex Time Data 7
 - 1.3 Temporal Information, Temporal Database and Temporal System 8
 - 1.3.1 What Is Temporal Information..... 8
 - 1.3.2 Temporal Database..... 8
 - 1.3.3 Temporal System 9
 - 1.4 Origin and Development of Temporal Information Technologies 9
 - 1.4.1 Founding Phase..... 10
 - 1.4.2 Development Phase..... 11
 - 1.4.3 Application Phase 11
 - 1.5 Current Situation, Problems and Trends 13
 - 1.5.1 Current Situation..... 13
 - 1.5.2 Existent Problems in Temporal Database Research..... 15
 - 1.5.3 Trends 16
 - References..... 17
 - 2 Time Calculation and Temporal Logic Method 21**
 - 2.1 Time Model..... 22
 - 2.1.1 Continuous Model..... 22
 - 2.1.2 Stepwise Model..... 23
 - 2.1.3 Discrete Model..... 23
 - 2.1.4 Non Temporal Model 24
 - 2.2 Properties of Time Structure 24
 - 2.2.1 Order Relations of Time Sets..... 24
 - 2.2.2 First Order Properties of Time Flow 24

2.3	Point-Based Temporal Logic.....	26
2.3.1	Temporal Extensions Based Snapshot Model.....	26
2.3.2	Temporal Extensions Based Timestamp Model.....	28
2.4	Interval-Based Temporal Logic.....	29
2.4.1	From Interval to Point.....	30
2.4.2	From Point to Point.....	31
2.4.3	Temporal Predict.....	32
2.5	Calculation Based on Span	33
2.6	Other Temporal Calculations in Common Use	34
2.7	Time Granularity and Conversion Calculation	34
2.7.1	Time Granularity and Chronon	35
2.7.2	State of Existence of Time Granularity.....	35
2.7.3	Operations of Time Granularity	36
2.7.4	Relational Chart of Time Granularity Conversion	38
2.8	Tense Logic.....	38
2.8.1	Syntax and Semantics of Tense Logic	39
2.8.2	Axiomatics and Properties	40
	References.....	42
3	Temporal Extension of Relational Algebra	43
3.1	Regular Relational Operations	44
3.1.1	Basic Notions.....	44
3.1.2	Relational Algebra	45
3.1.3	Relational Calculus	47
3.2	Relational Algebra of Historical Database	47
3.2.1	Basic Notions and Terminologies	48
3.2.2	HRDM Model.....	48
3.2.3	Historical Relational Algebra of HRDM	49
3.3	Bitemporal Relational Algebra of BCDM.....	55
3.3.1	Basic Notions and Terminologies	55
3.3.2	Bitemporal Relational Algebra	59
3.4	Snapshot Reducibility and Temporal Completeness	62
3.4.1	Snapshot Reducibility	62
3.4.2	Temporal Semi-Completeness	64
3.4.3	Temporal Completeness.....	65
	References.....	65
Part II	Database Based on Temporal Information.....	67
4	Temporal Data Model and Temporal Database Systems.....	69
4.1	Time-Dimensions.....	69
4.1.1	User-Defined Time.....	69
4.1.2	Valid Time.....	70

4.1.3	Transaction Time	71
4.1.4	Two Temporal Variables: <i>Now</i> and <i>UC</i>	71
4.1.5	An Illustration	72
4.2	Temporal Database Types	75
4.2.1	Snapshot Database	75
4.2.2	Historical Database	76
4.2.3	Rollback Database	78
4.2.4	Bitemporal Database.....	81
4.3	Temporal Data Models.....	82
4.3.1	Bitemporal Time Stamps.....	82
4.3.2	BCDM.....	85
4.3.3	Temporal Entity-Relationship Data Model	86
4.4	Difference from Real-Time Database	87
	References.....	88
5	Spatio-Temporal Data Model and Spatio-Temporal Databases.....	91
5.1	Introduction.....	91
5.2	Spatio-Temporal Data Model.....	92
5.2.1	Spatio-Temporal Object	92
5.2.2	Basic Considerations of Spatio-Temporal Modeling	93
5.2.3	Version Based Data Model.....	96
5.2.4	Event-Based Data Model	100
5.2.5	Constraint-Based Data Model.....	103
5.2.6	Moving Objects Data Model.....	103
5.3	Query on Spatio-Temporal Data	106
5.3.1	Spatio-Temporal Data Query	107
5.3.2	Moving Data Query	107
5.3.3	Spatio-Temporal Database Language	108
5.4	Structure of Spatio-Temporal Database System.....	109
5.4.1	Structure of Complete Type	109
5.4.2	Structure of Layered Type.....	110
5.4.3	Structure of Extended Type.....	110
	Reference	111
6	Temporal Extension of XML Data Model.....	113
6.1	Motivation.....	114
6.1.1	XML Temporal Driven	114
6.1.2	Commercial-Driven Temporal Database.....	116
6.2	Temporal Research of the Semi-Structured Data	119
6.3	Temporal XML Model and Query Mechanism	120
	References.....	123

7	Data Operations Based on Temporal Variables.....	125
7.1	Introduction.....	125
7.2	Data Model Based on Temporal Variables	127
7.2.1	Order and Temporal Variables	127
7.2.2	Main Body Instances	129
7.2.3	Bitemporal Relation Model Based on Variables	131
7.3	Data Updating	132
7.3.1	Data Inserting.....	132
7.3.2	Data Deleting	135
7.3.3	Data Modifying.....	136
7.4	Data Querying.....	138
7.4.1	Now in Current Versions	138
7.4.2	Now in Non-Current Version.....	141
7.4.3	Temporal Querying Algorithms	142
	References.....	147
Part III	Temporal Index Technologies	149
8	Temporal Indexes Supporting Valid Time	151
8.1	Introduction.....	151
8.2	Summary of Temporal Index	152
8.2.1	Temporal Index Based on Transaction Time.....	153
8.2.2	Index Based on Valid Time	154
8.2.3	Bitemporal Index	155
8.3	TRdim	159
8.3.1	Relative Temporal Data Model	159
8.3.2	Temporal Relation Index Model	160
8.4	Data Querying and Index Updating	166
8.4.1	Index Querying	166
8.4.2	Index Updating	167
8.5	Simulation	171
8.5.1	Index Constructing.....	171
8.5.2	Query Based on Probability	172
8.5.3	Query Based on the Number of Data	172
	References.....	173
9	Indexes for Moving-Objects Data.....	175
9.1	Introduction.....	175
9.2	Data Model for Moving Objects	181
9.2.1	Data Model <i>Modm</i>	182
9.2.2	Temporal Summary	184
9.3	Index for Moving Object Data	189
9.3.1	Linear Order Division.....	189

9.3.2	Index Model <i>Modim</i>	192
9.4	Data Query.....	195
9.5	Index Update.....	198
	References.....	201
10	Temporal XML Index Schema	203
10.1	Introduction.....	203
10.2	Linear-Order Relation.....	205
10.2.1	Linear-Order Matrix.....	206
10.2.2	Linear-Order Equivalence Relation.....	207
10.3	Temporal Summary and Temporal Indexing.....	210
10.3.1	Data Model.....	210
10.3.2	Temporal Summary.....	211
10.3.3	Temporal Indexing.....	213
10.4	Data Query.....	214
10.4.1	Query Based on Absolute Paths.....	215
10.4.2	Query Based on Relative Paths.....	215
10.5	Simulation and Evaluation.....	217
10.5.1	Environment and Data Design.....	217
10.5.2	Simulation and Evaluation.....	217
	References.....	223
Part IV	Temporal Database Management Systems	225
11	Implementation of Temporal Database Management Systems	227
11.1	Introduction.....	227
11.2	TimeDB.....	228
11.2.1	Installation.....	228
11.2.2	TimeDB 2.0 Beta 4's User Interface.....	230
11.2.3	Examples.....	232
11.3	TempDB.....	234
11.3.1	Installation.....	234
11.3.2	TempDB's User Interface.....	235
11.3.3	Examples.....	238
11.4	Comparing TimeDB with TempDB.....	241
	References.....	242
12	Improvement and Extension to ATSQL2	245
12.1	Introduction.....	245
12.2	Study on ATSQL2.....	246
12.2.1	Requirements and Expatiation.....	246
12.2.2	Properties of ATSQL2.....	247
12.3	Interpretation of ATSQL2 Semantics.....	249

12.3.1	Data Definition Statement	249
12.3.2	Data Manipulation Statement	250
12.3.3	Data Query Statement	251
12.4	Improved ATSQL2	255
12.4.1	Clear Regulation to the Semantic Operator	255
12.4.2	Re-Definition of Scalar Expression	256
12.4.3	Clearly Regulate the Usage of Common Operators and Temporal Operators in Conditional Statements	257
	References	258
13	Design and Implementation of TempDB	261
13.1	Introduction	261
13.2	Framework of TempDB	262
13.2.1	Middleware Architecture	262
13.2.2	Platform of Implementation	263
13.2.3	Architecture of TempDB	263
13.3	Implementation of TempDB	266
13.3.1	Temporal DDL	266
13.3.2	Temporal DML	267
13.3.3	Temporal Query	269
13.4	Processing Mechanism of Temporal Integrity Constraints	270
13.4.1	Basic Concepts	271
13.4.2	Temporal Insertion	271
13.4.3	Temporal Deletion	272
13.4.4	Temporal Modification	273
13.5	Optimization of Performance	275
13.5.1	Temporal Indexes and MAP21	275
13.5.2	Binding on <i>Now</i>	275
13.5.3	MAP21-B	276
	References	278
Part V	Temporal Application and Case Study	281
14	Research on Temporal Extended Role Hierarchy	283
14.1	Introduction	283
14.2	Related Work	284
14.3	Extended Role Hierarchy	285
14.4	Temporal Role Hierarchy	287
14.4.1	Time Constraint on the Inheritance of Restricted Special Permission	287
14.4.2	Temporal Inheritance Character	289
14.4.3	Space and Time Efficiency Analysis	290
	References	292

15	Temporal Workflow Modeling and Its Application	293
15.1	Introduction.....	293
15.2	Related Work	294
15.3	A Modified Workflow Meta-Model and Temporal Attributes.....	295
15.3.1	Build-Time Meta-Model	296
15.3.2	Run-Time Meta-Model.....	299
15.3.3	A Formal Model of Temporal Workflow.....	300
15.4	Fuzzy Temporal Workflow Nets (FTWF-Nets).....	301
15.4.1	Fuzzy Time Point	301
15.4.2	Formal Definition for FTWF-Nets	302
15.4.3	Time Related Calculation in FTWF-Nets.....	303
15.5	Time Modeling and Time Possibility Analysis	304
15.6	An Illustration	306
	References.....	308
16	Temporal Knowledge Representation and Reasoning	311
16.1	Introduction.....	311
16.2	Temporal Production System	313
16.2.1	Basic Definitions	313
16.2.2	Temporal Reasoning.....	315
16.3	Prototype Implementation in a Salary System	318
16.3.1	Global Database	318
16.3.2	Data Structures of Temporal Production Rules in Database	319
16.3.3	Data Structures of Facts in Database.....	320
16.3.4	Details in Reasoning.....	320
16.3.5	Binding Semantics of <i>Now</i> Variable.....	322
	References.....	322
17	Temporal Application Modes and Case Study	325
17.1	Temporal Application Modes	326
17.1.1	Entire Temporal Application Mode	326
17.1.2	Embedding Temporal Application Mode	327
17.1.3	Mix Temporal Application Mode	327
17.2	Temporal Data/Knowledge View	327
17.2.1	Temporal Data View.....	327
17.2.2	Temporal Data/Knowledge Model	328
17.2.3	Links of Temporal Knowledge and Temporal Data.....	328
17.3	Temporal Application in Cooperative Software.....	330
17.3.1	Three Basic Elements of Cooperative Software.....	330
17.3.2	Temporal Relation of Collaborative Roles	331
17.3.3	Temporal Extension in the Collaboration Information.....	332
17.3.4	Temporal Extension of Workflow	332

17.3.5	Case Study.....	333
17.4	SIDSS: A Typical Example of Temporal Application.....	334
17.4.1	Introduction	334
17.4.2	Temporal Data in SIDSS	335
17.4.3	Temporal Knowledge in SIDSS	337
17.4.4	Implementation of SIDSS	340
	References.....	341
	Appendix	343
A.1	Extension ATSQL of TempDB 2.1	343
A.2	API of TempDB 2.1	345
	Index	347

List of Figures and Tables

Figure 1.1	Representation of time intervals	6
Figure 2.1	Information about a teacher	23
Figure 2.2	Allen’s temporal relations.....	30
Figure 2.3	Temporal relationships between time intervals and points	31
Figure 2.4	Temporal relationships between time points	31
Figure 2.5	Granularity in Gregorian calendar system.....	38
Figure 2.6	Conversion chart of multi-calendar	39
Figure 3.1(a)	A normal bitemporal element.....	56
Figure 3.1(b)	Not a normal bitemporal element	56
Figure 3.2(a)	u and v	58
Figure 3.2(b)	$u \cup v$	58
Figure 3.2(c)	$u \cap v$	58
Figure 3.2(d)	$u - v$	58
Figure 3.3	Snapshot reducibility	63
Figure 4.1	An additional illustration of a faculty salary temporal relation	73
Figure 4.2	The state of snapshot relation concerning valid time and transaction time	76
Figure 4.3	The states of the historical database concerning valid time and transaction time.....	77
Figure 4.4	Relation of attribute, tuple and valid time dimension in a coordinate system.....	78
Figure 4.5	The states of the transaction database concerning valid time and transaction time.....	80
Figure 4.6	The relation of attribute, tuple and transaction time dimension in a coordinate system.....	81
Figure 4.7	An illustration of the valid time and the transaction time of a fact	81
Figure 4.8	The bitemporal states concerning the valid time and the transaction time	82
Figure 4.9	The bitemporal information of Alice’s title and salary	85
Figure 4.10	Simple values and time structure in TERM.....	86
Figure 4.11	Entity definition in TERM.....	87
Figure 5.1	Spatio-temporal relationship.....	95
Figure 5.2	Modeling layers of spatio-temporal data	95
Figure 5.3	Sequential snapshots model.....	97
Figure 5.4	Base state with amendments model.....	97

Figure 5.5	Space-time cube model.....	98
Figure 5.6	Space-time composite model.....	99
Figure 5.7	Object-oriented spatio-temporal model	100
Figure 5.8	Event-based spatio-temporal data model.....	101
Figure 5.9	ESTDM's pointer structure.....	102
Figure 5.10	Three domains model	103
Figure 5.11	Summarization of spatio-temporal database	104
Figure 5.12	Layered architecture of STDBMS	110
Figure 5.13	Extending architecture of STDBMS.....	111
Figure 7.1	Past semantics and uncertainty	140
Figure 7.2	Future semantics and binding.....	141
Figure 8.1	HR-tree	153
Figure 8.2	ST-tree	154
Figure 8.3	Interval tree.....	155
Figure 8.4	Time index	156
Figure 8.5	2LBIT	156
Figure 8.6	M-IVTT	157
Figure 8.7	4R-tree	158
Figure 8.8	<i>TRqdm</i> model.....	160
Figure 8.9	Temporal summary	162
Figure 8.10	Temporal preorder $\Delta(I)$	163
Figure 8.11	Open complementary submatrix relative to 23	164
Figure 8.12	Linear order branch of $\Delta(I)$	165
Figure 8.13	Temporal index	166
Figure 8.14	Reconstruction of <i>LOB</i> based on inserting the nodes	168
Figure 8.15	Reconstruction of the <i>LOB</i> based on deleted nodes	170
Figure 8.16	Space cost of constructing the index	171
Figure 8.17	Time cost of constructing the index.....	172
Figure 8.18	Query based on the change of the probability with the same time.....	172
Figure 8.19	Query based on the number of data	173
Figure 9.1	Trajectories of moving object.....	184
Figure 9.2	Data mode for moving objects.....	186
Figure 9.3	Mode for temporal summary	188
Figure 9.4	Time order matrix	189
Figure 9.5	$UL(23)$ and $DR(23)$	190
Figure 9.6	$H_{LOM}(D)$	192
Figure 9.7	Index mode for moving object.....	194
Figure 9.8	Example for the index mode of moving objects	200
Figure 9.9	Index mode of moving objects after the inserting of segments	200
Figure 10.1	Linear matrix $LOM(D)$	206
Figure 10.2	$UL(23)$ and $DR(23)$	207
Figure 10.3	$H_{LOM}(D)$	209

Figure 10.4	<i>Least-TOER</i> and <i>longest-TOER</i> are mutually not contained in each other	210
Figure 10.5	Instance of temporal XML data	211
Figure 10.6	Temporal summary	213
Figure 10.7	Temporal indexing	214
Figure 10.8	Comparison on the space between data and indexing file	218
Figure 10.9	Time consumed in building index	219
Figure 10.10	Relation between XML data and index document	219
Figure 10.11	Comparisons on time consuming to Q_3	220
Figure 10.12	Comparison on time consuming to Q_6	220
Figure 10.13	Comparison on span of periods in Q_3	220
Figure 10.14	Comparison on span of periods in Q_6	221
Figure 10.15	Visited nodes in the same querying process	221
Figure 10.16	Comparison in path-querying	222
Figure 10.17	Relation between time span and nodes needed to view	222
Figure 11.1	TimeDB's user interface	229
Figure 11.2	Attributes setting interface	229
Figure 11.3	TimeDB menu	230
Figure 11.4	Transaction menu	231
Figure 11.5	File menu	231
Figure 11.6	Help menu	232
Figure 11.7	Welcome interface	235
Figure 11.8	User interface	235
Figure 11.9	Connection configuration dialog	236
Figure 11.10	Create database (schema)	237
Figure 11.11	Toolbar	237
Figure 11.12	ATSQL command editor	237
Figure 13.1	Architecture of TempDB	263
Figure 13.2	Transformation of overlaps' parse tree	265
Figure 14.1	Role hierarchies of adding private roles	285
Figure 14.2	Role permission of extended role hierarchy	286
Figure 14.3	Role hierarchy of extended inheritance mode	287
Figure 14.4	Up-transferring of time constraint on $Permission_{RS}$	288
Figure 14.5	Space comparisons of the two models	291
Figure 15.1	Organization meta-model	297
Figure 15.2	Information meta-model	297
Figure 15.3	Application meta-model	298
Figure 15.4	Process meta-model	299
Figure 15.5	Run-time meta-model	300
Figure 15.6	Trapezoid function of a fuzzy time point	302
Figure 15.7	$a \leq b$ (b is a fuzzy time point)	304
Figure 15.8	$a \leq b$ (b is a precise time point)	305
Figure 15.9	FTWF-net representation	306