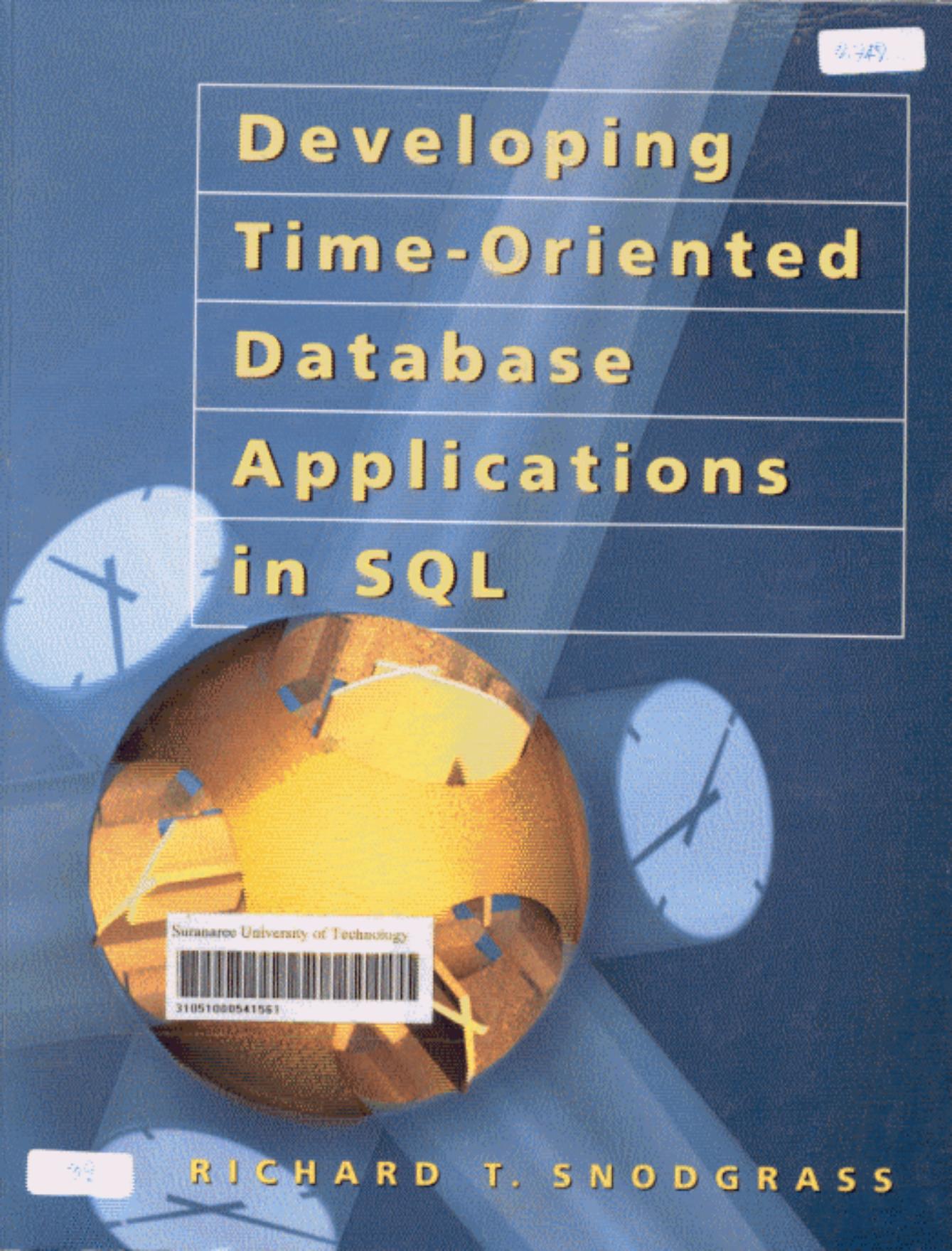


# Developing Time-Oriented Database Applications in SQL



Suranaree University of Technology



# Contents

---

Foreword by Jim Gray vii

Foreword by Jim Melton ix

Preface xvii

## **1 Introduction 1**

- 1.1 A Triad of Triples 2**
- 1.2 The SQL Standard 4**
- 1.3 Conventions 5**
- 1.4 Implementation Considerations 7**
- 1.5 Readings 8**

## **2 Fundamental Concepts 11**

- 2.1 Valid-Time State Tables 12**
- 2.2 Transaction-Time State Tables 18**
- 2.3 Bitemporal Tables 20**
- 2.4 Summary 22**
- 2.5 Readings 23**

## **3 Instants and Intervals 25**

- 3.1 Instants 26**
- 3.2 Intervals 30**

3.3	Predicates	33
3.4	Constructors	36
3.5	Implementation Considerations	42
3.6	The Year 2000 Problem*	63
3.7	Subtleties*	74
3.8	Implementation Considerations*	83
3.9	Summary	84
3.10	Readings	85

## **4 Periods** 89

4.1	Literals	90
4.2	Predicates	90
4.3	Constructors	93
4.4	Implementation Considerations	97
4.5	Summary	108
4.6	Readings	108

## **5 Defining State Tables** 111

5.1	Initial Schema	112
5.2	Adding History	113
5.3	Temporal Keys	117
5.4	Handling Now	119
5.5	Uniqueness Reexamined	121
5.6	Referential Integrity	126
5.7	Constraint Attributes*	131
5.8	Implementation Considerations	132
5.9	Summary	139
5.10	Readings	140

## **6 Querying State Tables** 143

6.1	Extracting the Current State	143
6.2	Extracting Prior States	145

6.3	Sequenced Queries	145
6.4	Nonsequenced Variants	156
6.5	Eliminating Duplicates	158
6.6	Implementation Considerations	169
6.7	Summary	173
6.8	Readings	174

## **7 Modifying State Tables 177**

7.1	Current Modifications	177
7.2	Sequenced Modifications	188
7.3	Nonsequenced Modifications	197
7.4	Modifications That Mention Other Tables*	198
7.5	Temporal Partitioning*	206
7.6	Implementation Considerations	213
7.7	Summary	215
7.8	Readings	216

## **8 Retaining a Tracking Log 219**

8.1	Defining the Tracking Log	220
8.2	Queries	222
8.3	Modifications	229
8.4	Permitting Insertions	230
8.5	Backlogs	233
8.6	Using After-Images Consistently	235
8.7	Transaction Semantics*	240
8.8	Refinements*	243
8.9	Implementation Considerations	244
8.10	Summary	248
8.11	Readings	250

## **9 Transaction-Time State Tables 253**

9.1	Definition	254
9.2	Maintenance	255

- 9.3 Queries 259
- 9.4 Temporal Partitioning\* 262
- 9.5 Vacuuming\* 268
- 9.6 Implementation Considerations 272
- 9.7 Summary 273
- 9.8 Readings 275

## **10 Bitemporal Tables 277**

- 10.1 Definition 278
- 10.2 Modifications 282
- 10.3 Queries 307
- 10.4 Integrity Constraints 323
- 10.5 Temporal Partitioning\* 329
- 10.6 Vacuuming\* 337
- 10.7 Implementation Considerations 339
- 10.8 Summary 339
- 10.9 Readings 340

## **11 Temporal Database Design 343**

- 11.1 Properly Sequencing the Design 343
- 11.2 Conceptual Design 345
- 11.3 Logical Design 355
- 11.4 Physical Design 375
- 11.5 Advanced Design Aspects\* 377
- 11.6 Benefits 382
- 11.7 Application Development 383
- 11.8 Implementation Considerations 396
- 11.9 Summary 397
- 11.10 Readings 397

## **12 Language Directions 401**

- 12.1 SQL92 401
- 12.2 SQL-92 Limitations 401
- 12.3 SQL3 402
- 12.4 Periods 403
- 12.5 Defining Valid-Time State Tables 406
- 12.6 Querying State Tables 411
- 12.7 Modifying State Tables 416
- 12.8 Retaining a Tracking Log 421
- 12.9 Transaction-Time State Tables 426
- 12.10 Bitemporal Tables 427
- 12.11 Capstone Case 437
- 12.12 Migration 446
- 12.13 Additional Constructs of SQL3\* 455
- 12.14 Implementation Considerations 457
- 12.15 Summary 460
- 12.16 Readings 465

## **13 Prospects 469**

- Glossary 471
- Bibliography 479
- Author Index 485
- Subject Index 487
- About the Author 502
- About the CD-ROM 503