

Table of Contents

Chapter 1: An Overview of a Database System 1

- 1.1: A database System 1
- 1.2: Levels of Abstraction in a DBMS 2
- 1.3: Differing Perceptions of the Database 6
- 1.4: A Model of the Real World 10
 - Exercises 17
 - Bibliographic Notes 18

Chapter 2: Physical Data Organization 20

- 2.1: A Model for External Storage Organization 20
- 2.2: Hashed Files 24
- 2.3: Indexed Files 30
- 2.4: B-trees 42
- 2.5: Files with a Dense Index 49
- 2.6: Files with Variable Length records 52
- 2.7: Data Structures for Lookup on Nonkey Fields 58
- 2.8: Partial Match Retrieval 60
 - Exercises 69
 - Bibliographic Notes 71

Chapter 3: The Three Great Data Models 73

- 3.1: The Relational Data Model 73
- 3.2: The Network Data Model 83
- 3.3: The Hierarchical Data Model 91
- 3.4: Comparison of the Models 98
 - Exercises 100
 - Bibliographic Notes 103

Chapter 4: Data Manipulation Languages for the Relational Model 104

- 4.1: Relational Algebra 105
- 4.2: Relational Calculus 110
- 4.3: General Comments Regarding Query Languages 122
- 4.4: ISBL: A "Pure" Relational Algebra Language 125
- 4.5: SQUARE and SEQUEL: Evolutionary Steps Between Algebraic and Calculus Languages 131

- 4.6: QUEL: A Tuple Relational Calculus Language 141
- 4.7: Query-by-Example: A Domain Calculus Language 149
 - Exercises 162
 - Bibliographic Notes 164

Chapter 5: Design Theory for Relational Databases 166

- 5.1: What Constitutes a Bad Database Design? 166
- 5.2: Functional Dependencies 167
- 5.3: Decomposition of Relation Schemes 180
- 5.4: Normal Forms for Relation Schemes 187
- 5.5: Multivalued Dependencies 196
- 5.6: Fourth Normal Form 203
 - Exercises 206
 - Bibliographic Notes 208

Chapter 6: Query Optimization 211

- 6.1: General remarks About Optimization 211
- 6.2: Algebraic Manipulation 214
- 6.3: The QUEL Decomposition Algorithm 223
- 6.4: Exact Optimization for a Subset of Relational Queries 232
 - Exercises 239
 - Bibliographic Notes 240

Chapter 7: The DBTG Proposal 241

- 7.1: Basic DBTG Concepts 241
- 7.2: The Program Environment 248
- 7.3: Navigation Within the Database 250
- 7.4: Other Database Commands 258
- 7.5: Some Other Features of the DBTG Proposal 264
 - Exercises 269
 - Bibliographic Notes 270

Chapter 8: IMS: A Hierarchical System 271

- 8.1: An Overview of IMS 271
- 8.2: The IMS Data Manipulation Language 277
- 8.3: Logical Databases 285
- 8.4: Storage Organizations 292
 - Exercises 301
 - Bibliographic Notes 304

Chapter 9: Protecting the Database Against Misuse 305

9.1: Integrity 306

9.2: Integrity Constraints in Query-by-Example 307

9.3: Security 310

9.4: Security in Query-by-Example 312

9.5: Security in Statistical Databases 314

Exercises 320

Bibliographic Notes 322

Chapter 10: Concurrent Operations on the Database 324

10.1: Basic Concepts 325

10.2: A Simple Transaction Model 331

10.3: A Model with Read- and Write-Locks 337

10.4: A Read-Only, Write-Only Model 340

10.5: Concurrency for Hierarchically Structured Items 347

10.6: Protecting Against Crashes 351

Exercises 356

Bibliographic Notes 358

Bibliography 360

Index 372