Contents

About the Authors xvi
Foreword xix

Part 1: All About Programming 1

Chapter 1 Introduction 3
   SQL Variations 3
      1 of 5 3
      2 of 5 4
      3 of 5 4
      4 of 5 4
      5 of 5 5
   Where We Go from Here 6

Chapter 2 SQL Basics 9
   SELECT Statement and Logical Query Processing 10
   Joins 13
      Cross Join 13
      Inner Join 15
      Outer Join 17
   Subqueries 20
   Table Expressions 23
   UNION Operator 25
   UPDATE Statement 27
   TOP Option 31
   CASE Expression 34
CUBE, ROLLUP, and GROUPING SETS Options 35
SELECT INTO Statement 41
Dynamic SQL 42
Summary 45
Additional Reading 45
Exercise 46
Exercise Solution 46

Chapter 3  Tables 49
Table Creation 49
   Real and Implied Limitations 51
Data Types 52
   Exact Numerics 52
   Approximate Numerics 53
   Date and Time 54
   Character/Unicode Strings 55
   Other Data Types 56
   Working with CLR User-Defined Types 56
   Data Type Selection 57
Identity Columns 58
ROWGUIDCOL 60
Computed Columns 60
Some General Tips for Creating Tables 61
Temporary Tables 62
   Creating Temporary Tables 62
   “Permanent” Temporary Tables 63
Table Variables 63
Summary 63
Exercise 64
Exercise Solution 64

Chapter 4  Views 65
Why Use a View? 65
The View in General 66
   WITH CHECK OPTION 67
   WITH ENCRYPTION 68
Error Handling with TRY...CATCH 107
   Notes on TRY...CATCH 108
Statement Blocks: BEGIN...END 109
Conditional Execution: IF...ELSE 110
   IF EXISTS 111
   Notes on IF...ELSE 112
Repeated Execution: WHILE 112
Control Transfer: GOTO 113
Event Handling: WAITFOR 113
   Notes on WAITFOR 114
Exiting Batches with RETURN 115
Summary 115
Exercise 115
Exercise Solution 116

Chapter 7  Transactions 117
ACID Properties 118
Transactions and Batch Flow 122
Nested Transactions 122
Transactions and Stored Procedures 123
Locking 126
Granularity 127
Identifying Locks 128
Transaction Isolation Levels 129
Deadlocks 130
What Happens at Update Time 133
Summary 134

Chapter 8  Cursors 135
Cursors 136
Cursor Types 137
Cursor Steps 137
Transact-SQL Cursor Types 137
   Dynamic Cursors 137
   Static Cursors 138
   Keyset Cursors 138
Summary 170
Additional Reading 170
Exercise 170
Exercise Solution 171

Chapter 10  User-Defined Functions  175
UDF Components  176
Types of Functions  177
Table-Valued Functions  178
Summary  180
Exercise  180
Exercise Solution  180

Chapter 11  Triggers  181
The Trigger Mechanism  182
Trigger Creation  183
Removing Triggers  184
Modifying Triggers  185
Deleted and Inserted Tables  185
What Happens on Delete  186
What Happens on Insert  188
Handling Multirow Inserts/Updates  189
If Update Test Syntax  190
Checking Columns for Modification  191
Decoding a Bitmask  192
Insert Trigger Example  193
Conditional Insert Trigger Example  194
Update Trigger Example  195
Trigger Limitations  196
Triggers during Transactions  197
Using Savepoints in Triggers  198
Nested Triggers  199
Additional Notes on Triggers  200
Summary  201
Exercise  202
Exercise Solution  202
Chapter 12  Common Table Expressions  203
CTE Basics  203
CTE and Recursion  205
Multiple Anchor Members  206
Multiple Recursive Members  207
Recursion Limit  212
Uses for Common Table Expressions  213
  Traversing a Hierarchy  214
  Date Ranges  214
  Parsing CSV Values  215
  Beyond 32767  216
Summary  219

Part 2: Focus on Performance  221

Chapter 13  Understanding Graphical Query Plans  223
What Is an Execution Plan?  223
Retrieving Query Plans  224
Graphical Execution Plan Sections  226
Reading the Graphical Execution Plan  228
Analyzing Graphical Execution Plans  229
Common Operators in Graphical Plans  234
  Clustered Index Scan/Nonclustered Index Scan/Table Scan  234
  Clustered Index Seek/Index Seek  235
  (Bookmark) Key Lookup/RID Lookup  237
  Nested Loop Join  240
  Merge Join  242
  Hash Match  244
  Sort  248
  Stream Aggregate  250
  Compute Scalar  251
Summary  252
Additional Reading  252

Chapter 14  Indexes  253
How Does the Index Work?  254
  Covered Queries  255
Index Classification 256
  Clustered Indexes 256
  Nonclustered Indexes 257
  Composite Index 259
Index Architecture 259
  Index Structure and Access 260
Clustered versus Nonclustered Index Architecture 261
  Clustered Index Architecture 262
  Nonclustered Index Architecture 263
Data Storage and Data Access 264
  Data Storage 264
  Data Access 264
Indexing Strategy 265
  When Not to Index 270
  When to Use an Index 272
Index Creation and Maintenance 274
  CREATE INDEX Command 274
  DROP INDEX Command 275
  FILLFACTOR Option 276
Database Reorganization 277
  DBCC Command 278
Database Defragmentation 279
SQL Server Index Optimization 282
  Auto Create Statistics 283
  Index Selection 284
  Column Selectivity and Joins 284
  Operators and Clauses 285
  INCLUDE Columns 287
  Filtered Indexes 288
SYS.INDEX and SYS.SYSINDEXES System Tables 288
Constraints 292
Data Integrity 293
  Domain Integrity 293
  Entity Integrity 294
  Referential Integrity 296
  User-Defined Integrity 296
Constraint Types 297
  PRIMARY KEY Constraints 297
  UNIQUE Constraints 298
  CHECK Constraints 299
  FOREIGN KEY Constraints 300
  NOT NULL Constraint 301
  ER Diagrams with Key Constraints 302
Summary 303

Chapter 15 Join Optimization 303
  Does Join Order Matter? 306
  Nested Loops Join (aka Nested Iteration Join) 308
  Merge Joins 310
  Hash Joins 310
    In-Memory Hash Join 311
    Grace Hash Join 312
    Recursive Hash Join 312
  Forcing a Join Order 313
  Influencing the Joins 314
    Things to Note While Giving Hints 316
  Self-Joins 317
    Matching Data Self-Join 318
    Parent–Child Self-Join 320
  Outer Joins 323
Summary 324
Exercise 324
Exercise Solution 325

Chapter 16 Subquery Optimization 327
  Subquery Basics 330
  Optimizer Rewrites 332
  Optimizing Subqueries in the SELECT Clause 334
  Optimizing Subqueries in the WHERE Clause 337
  Scalar Subqueries 340
Summary 342
Exercise 342
Exercise Solution 343
Chapter 17  Hardware  345

CPU  348
   CPU Precision  349
   CPU Speed  350
   CPU Cache  350
   Operating System Effects on Processor Use  351
   Before You Buy  352
   Once the System Is in Place  352

Memory  357
   Memory Size  357
   Memory Speed  358
   SQL Server's Memory Use  358
   Before You Buy  361
   Once the System Is in Place  361

Front-Side Bus  366
   Before You Buy  367
   Once the System Is in Place  367
   Before You Buy  370
   Once the System Is in Place  370

I/O  372
   Solid State Drives (SSDs) and SQL Server  375
   SANs, NAS, and Other Storage Types  375
   How SQL Server Uses Files  376
   Before You Buy  378
   Once the System Is in Place  378

The Virtualization Question  384

Summary  385

Part 3: Advanced SQL Techniques  387

Chapter 18  Set-Oriented Programming versus Procedural Code  389

A Bit of History  389
Classic Structured Programming  390
   BEGIN-END  390
   IF-THEN-ELSE  391
   WHILE-DO  393
MERGE Statement  396

Summary  398
Chapter 19  Dynamic SQL  399
  Types of Dynamic SQL  399
    T-SQL Dynamic SQL  399
    .NET Application Dynamic SQL  402
  Security Concerns  403
    Table-Level Access Requirement  403
    Using Impersonation with EXECUTE AS  404
  SQL Injection  405
    Unchecked User Inputs  405
    Preventing SQL Injection  406
    Using Certificates and EXECUTE AS to Circumvent SQL Injection  406
  Putting Dynamic SQL to Work  408
    Cache Bloat from Dynamic SQL  409
    Using T-SQL Stored Procedures  410
    Using .NET Application Dynamic SQL  416
  Administration and Maintenance  418
  Summary  419

Chapter 20  Grouping Data  421
  CUBE Option  426
  ROLLUP Option  426
  GROUPING Function  428
  GROUPING SETS  429
  GROUPING_ID Function  432
  Summary  433
  Additional Reading  434
  Exercise  434
  Exercise Solution  435

Chapter 21  Refactoring  437
  Design Refactoring  437
  Entity-Attribute-Value Problem  438
  T-SQL Code Refactoring  445
    Ranking Solutions  445
    Refactoring Data Merge  449