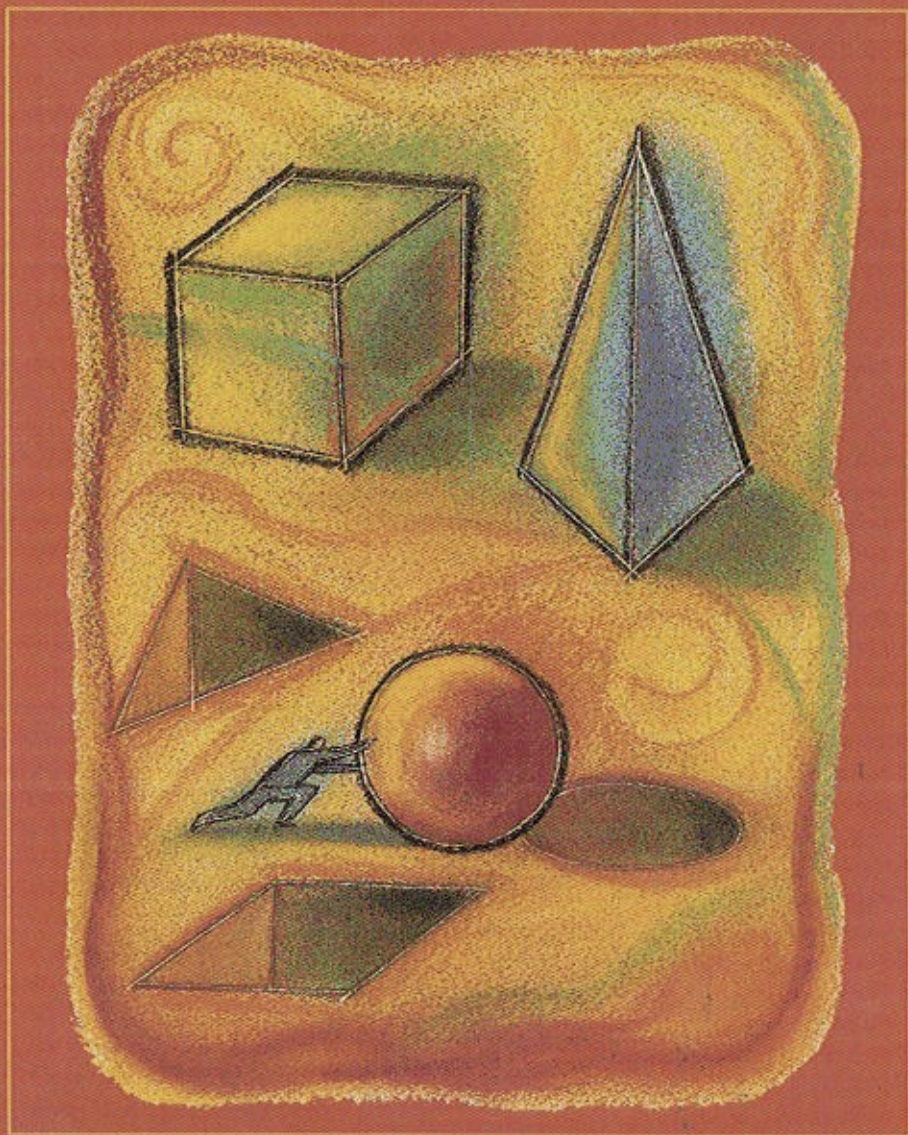


Second Edition

An Introduction to  
**OBJECT-ORIENTED ANALYSIS**  
Objects and UML in Plain English

**INTERNATIONAL EDITION**  
**RESTRICTED**  
Not for sale in North America



**DAVID WILLIAM BROWN**

# Contents

<b>PREFACE</b>	<b>VII</b>
<b>CONCEPT AND PURPOSE.</b>	<b>VII</b>
<b>MY REASON FOR WRITING THIS BOOK.</b>	<b>VIII</b>
Who Should Use This Book	x
<b>PEDAGOGICAL DEVICES AND FEATURES</b>	<b>XII</b>
<b>CHANGES FOR SECOND EDITION</b>	<b>XVII</b>
Key Points	xvii
Changes in Topic Areas	xix
Acknowledgements	xix
Chapter Glossary.	xx
<b>CHAPTER ONE</b>	
<b>An Introduction to the Book</b>	<b>1</b>
Start Here	1
What You Will Learn in This Chapter	1
What You Should Know to Start This Chapter	1
Chapter Overview	2
“The Outhouse Bathroom Boutique”	2
Thought Questions	3
<b>1.1 WHY THIS BOOK?</b>	<b>4</b>
<b>1.2 WHY OBJECT-ORIENTED ANALYSIS?</b>	<b>4</b>
Yet Another Paradigm?	5
<b>1.3 YET ANOTHER METHODOLOGY?</b>	<b>5</b>
<b>1.4 OTHER BOOKS IN THE FIELD</b>	<b>5</b>
<b>1.5 WHAT THIS BOOK CAN DO FOR YOU</b>	<b>6</b>
A Bang for Your Buck	6
Writing Style	6
The Objectives of the Book	6
Systems Development Methodologies	7
Pedagogical Devices (Things to Help You Learn)	7
<b>The Outhouse Bathroom Boutique</b>	<b>11</b>
<b>Deliverables</b>	<b>11</b>
<b>Further Reading</b>	<b>11</b>
<b>Chapter Summary</b>	<b>12</b>
<b>Chapter Glossary</b>	<b>12</b>
<b>What Comes Next</b>	<b>12</b>

**CHAPTER TWO****Systems Development and the Software Crisis 13**

- What You Will Learn in This Chapter 13
- What You Should Know to Start This Chapter 13
- Chapter Overview 13
- Key Concepts 13
- “The Outhouse Bathroom Boutique” 14
- Thought Questions 15

**2.1 A BRIEF HISTORICAL PERSPECTIVE 15**

- Maintenance 15
- Backlogs 16
- Reliability 17

**2.2 THE NEED FOR A NEW APPROACH TO SYSTEMS DEVELOPMENT 17****2.3 BENEFITS OF OBJECT-ORIENTED TECHNIQUES 18**

- System Stability 18
- Maintainability 18
- Reusable Components 19
- Reality-Based Systems 19
- Data Accessibility 19
- User Involvement and Ownership 19

**2.4 COSTS OF OBJECT-ORIENTED TECHNIQUES 20**

- Installed Base 20
- Retraining 20
- Deliverables 21
- Further Reading 21
- Chapter Summary 21
- Chapter Glossary 22
- What Comes Next 22
- Class/Group and Individual Exercises and Problems 22
- Projects and Cases 23
- Self-Test Questions 23

**CHAPTER THREE****Models and Modeling 25**

- What You Will Learn in This Chapter 25
- What You Should Know to Start This Chapter 25
- Chapter Overview 25
- Key Concepts 26
- The Outhouse Bathroom Boutique 26
- Thought Questions 28

**3.1 DEFINITIONS 29**

- Data and Information 29
- Model 29
- Abstraction 30

**3.2 MODELS AS AN AID TO UNDERSTANDING 31**

- A Child’s First Model 31

- 3.3 EARLY (PRE-MODELING) SYSTEMS DEVELOPMENT METHODS 33**
  - Unsystematic Early Approaches: 33
  - 1950s to the Early 1960s 33
  - The Systems Development Life Cycle 34
  - “Output-Oriented” Methods of the Late 1960s 34
- 3.4 MODELS IN SYSTEMS DEVELOPMENT 37**
  - Information Aspects New to the Users! 38
  - Development Effort Moved Up Front 39
  - Need for Early Detection of Errors 41
  - Quality 42
- 3.5 EARLIER MODELS 42**
  - Functional Decomposition 43
  - Process Models: Data Flow Diagrams 45
  - Structured Systems Analysis 49
- 3.6 SHORTCOMINGS OF OUTPUT-BASED AND PROCESS-BASED METHODS 50**
  - Deliverables 51
  - Further Reading 52
  - Chapter Summary 52
  - Chapter Glossary 53
  - What Comes Next 55
  - Class/Group Exercises and Problems 55
  - Individual Exercises and Problems 55
  - Projects and Cases 56
  - Self-Test Questions 56

## CHAPTER FOUR

### Data-Oriented Models

59

- What You Will Learn In This Chapter 59
- What You Should Know to Start This Chapter 59
- Chapter Overview 59
- Key Concepts 60
- The Outhouse Bathroom Boutique 60
- Thought Questions 62
- 4.1 DATA MODELS: THE ENTITY-RELATIONSHIP DIAGRAM 63**
- 4.2 PARADIGM SHIFT 63**
- 4.3 ENTITY-RELATIONSHIP MODELING 64**
  - The Entity-Relationship Principle 64
  - Entity-Relationship Models for Database Design 67
  - The Stability of Data 69
  - The Significance of Data 70
  - Data as a Corporate Asset 71
  - Entity-Relationship Notation 72
- 4.4 OBJECT-ORIENTED MODELS 74**
- 4.5 AN INTRODUCTION TO OBJECTS 77**
- 4.6 OBJECT-ORIENTED VERSUS OBJECT-BASED LANGUAGES 79**
- 4.7 CONCEPTUAL, LOGICAL, AND PHYSICAL MODELS 81**

<b>4.8 MODELS AS COMMUNICATION TOOLS</b>	<b>84</b>
Deliverables	86
Further Reading	87
Chapter Summary	87
Chapter Glossary	89
What Comes Next	91
Class/Group Exercises and Problems	91
Individual Exercises and Problems	92
Projects and Cases	92
Self-Test Questions	93

## CHAPTER FIVE

# Objects and Classes

97

What You Will Learn in This Chapter	97
What You Should Know to Start This Chapter	97
Chapter Overview	97
Key Concepts	98
“The Outhouse Bathroom Boutique”	98
Thought Questions	99
<b>5.1 REAL-WORLD OBJECTS VERSUS DATA OBJECTS</b>	<b>100</b>
What an Object Is	100
Jacobson’s Three Types	104
Attributes	109
Behavior	111
Identity	114
Encapsulation	115
Object States	120
<b>5.2 CLASSES AND CLASSIFICATION</b>	<b>123</b>
Classes in the Real World	124
Subclasses in the Real World	128
Classes in the Data World	131
Managing Complexity	132
Mapping Classes	133
Additional Data-World Classes	134
<b>5.3 TRANSIENT AND PERSISTENT OBJECTS</b>	<b>136</b>
<b>5.4 OBJECTS: CLASSES OR INSTANCES?</b>	<b>136</b>
<b>5.5 ASSOCIATIONS</b>	<b>136</b>
<b>5.6 ANTHROPOMORPHISM</b>	<b>137</b>
<b>5.7 USERS’ LEARNING STYLES</b>	<b>137</b>
Deliverables	138
Further Reading	138
Chapter Summary	139
Chapter Glossary	141
What Comes Next	143
Class/Group Exercises and Problems	143
Individual Exercises and Problems	143
Projects and Cases	144
Self-Test Questions	145

**CHAPTER SIX****The Object-Oriented Development Life Cycle****148**

- What You Will Learn in This Chapter 148
- What You Should Know to Start This Chapter 148
- Chapter Overview 148
- Key Concepts 148
- “The Outhouse Bathroom Boutique” 149
- Thought Questions 149

**6.1 THE LIFE CYCLE 150****6.2 THE OBJECT-ORIENTED ANALYSIS PHASE 151**

- The Requirements Model 151
- The Object Model, or Class Diagram 155
- The Statechart Diagram Model 156

**6.3 THE OBJECT-ORIENTED DESIGN PHASE 156****6.4 THE CONSTRUCTION PHASE 156****6.5 THE OBJECT-ORIENTED TESTING PHASE 157****6.6 THE MAINTENANCE PHASE 157**

- Bug Fixes 158
- Viruses 159
- Enhancements 160
- End-User Computing 160
- Backups and Restores 160
- Disaster Preparedness and Recovery 161

**6.7 CONSISTENT NOTATION THROUGHOUT THE OODLC 163**

- Seamless Transitions 163

**6.8 TRACEABILITY 164****6.9 FEASIBILITY ANALYSIS 165**

- Operational Feasibility 165
- Technical Feasibility 168
- Schedule Feasibility 169
- Economic Feasibility 169

**Deliverables 174****Further Reading 175****Chapter Summary 175****Chapter Glossary 178****What Comes Next 178****Class/Group Exercises and Problems 179****Individual Exercises and Problems 179****Projects and Cases 179****Self-Test Questions 180****CHAPTER SEVEN****Building the Requirements Model****184**

- What You Will Learn in This Chapter 184
- What You Should Know to Start This Chapter 184
- Chapter Overview 184
- Key Concepts 185
- “The Outhouse Bathroom Boutique”
- Sales Reporting System – Episode 7A 185
- Thought Questions 185

<b>7.1 PREPARATIONS TO BEGIN ANALYSIS</b>	<b>185</b>
Attendees	188
Recording Analyst	189
User Majority	189
Distractions	189
Background	189
Environment	190
Scheduling	190
Confirmation	190
<b>7.2 DEVELOPING THE REQUIREMENTS MODEL: THE PROJECT SCOPE</b>	<b>191</b>
“The Outhouse Bathroom Boutique”	
Episode 7B: Getting Started	192
<b>7.3 DEVELOPING THE REQUIREMENTS MODEL: THE CONTEXT DIAGRAM</b>	<b>193</b>
“The Outhouse Bathroom Boutique”	
Episode 7C: The Context Diagram	196
<b>7.4 DEVELOPING THE REQUIREMENTS MODEL: THE USE CASE MODEL</b>	<b>197</b>
Actors	198
Use Cases	201
Inheritance Among Actors	206
<b>7.5 DEVELOPING THE REQUIREMENTS MODEL: INTERFACE DESCRIPTIONS</b>	<b>207</b>
Human Interfaces	207
Interfaces to Other Systems	208
“The Outhouse Bathroom Boutique”	
Episode 7D: The Use Case Model	208
Deliverables	209
Further Reading	210
Chapter Summary	211
Chapter Glossary	213
What Comes Next	213
Class/Group Exercises and Problems	213
Individual Exercises and Problems	214
Projects and Cases	214
Self-Test Questions	215

## CHAPTER EIGHT

### Properties of Objects and Classes 216

What You Will Learn in This Chapter	216
What You Should Know to Start This Chapter	217
Chapter Overview	217
Key Concepts	217
“The Outhouse Bathroom Boutique”	217
Thought Questions	218

#### 8.1 SUBCLASSES AND INHERITANCE 218

Associations and Subclasses	227
-----------------------------	-----

#### 8.2 MORE ABOUT INHERITANCE 227

Generalization and Specialization	227
-----------------------------------	-----

- 8.3 POLYMORPHISM AND OVERRIDING 233**
  - Polymorphism 233
  - Resolving Polymorphism 236
  - Static and Dynamic Binding 238
  - Overriding 240
  - Multiple Inheritance 243
  - Object Class Libraries 248
- 8.4 ABSTRACT CLASSES 250**
  - Analysis or Design? 253
- 8.5 AGGREGATION: COMPONENTS AND WHOLES 254**
  - Whole-Part or Component-Assembly 255
  - Container-Contents 264
  - Collection-Member 264
  - Associations with Aggregation 265
- 8.6 THE DIFFERENCE BETWEEN SUBCLASSING AND AGGREGATION 266**
  - Deliverables 269
  - Further Reading 270
  - Chapter Summary 270
  - Chapter Glossary 273
  - What Comes Next 274
  - Class/Group Exercises and Problems 274
  - Individual Exercises and Problems 275
  - Projects and Cases 276
  - Self-Test Questions 276

## CHAPTER NINE

# Finding Objects and Classes in the Real World 278

- What You Will Learn in This Chapter 278
- What You Should Know to Start This Chapter 278
- Chapter Overview 278
- Key Concepts 279
- “The Outhouse Bathroom Boutique” 279
- Thought Questions 280
- 9.1 THE IMPORTANCE OF THIS STEP 280**
  - The Basis of All That Follows 280
- 9.2 THE KRB SEVEN-STEP METHOD 281**
  - Step 1: Candidate Classes 281
  - “The Outhouse Bathroom Boutique” Episode 9A 284
  - Step 2: Define Classes 287
  - Step 3: Establish Associations 293
  - Capturing All Possible Associations 295
  - Step 4: Expand Many-to-Many Associations 305
  - Step 5: Attributes 317
  - Step 6: Normalization 318
  - Step 7: Operations (Behavior) 327
- 9.3 IS IT A CLASS OR IS IT AN ATTRIBUTE? 329**



- 9.4 FINDING AGGREGATION AND SUBCLASS STRUCTURES 330**
  - Subclass Hierarchies 330
  - Components and Wholes 331
- 9.5 ADAPTING THE METHOD 331**
  - Deliverables 333
  - Further Reading 333
  - Chapter Summary 333
  - Chapter Glossary 336
  - What Comes Next 337
  - Class/Group Exercises and Problems 337
  - Individual Exercises and Problems 338
  - Projects and Cases 338
  - Self-Test Questions 338

## CHAPTER TEN

# Object States and the Statechart Diagram 342

- What You Will Learn in This Chapter 342
- What You Should Know to Start This Chapter 342
- Chapter Overview 342
- Key Concepts 342
- “The Outhouse Bathroom Boutique” 343
- Thought Questions 344
- 10.1 LIFETIMES AND LIFE CYCLES 344**
  - A Day in the Life of a Book 344
- 10.2 EVENTS AND STATES 347**
- 10.3 TRANSITIONS 349**
- 10.4 ACTIONS AND ACTIVITIES 350**
  - Actions and Transitions 351
  - Atomic actions 351
  - Activities 352
- 10.5 THE STATECHART DIAGRAM 353**
  - Statechart Diagram Notation 353
  - State Machines 357
  - Complex and Multipath Life Cycles 357
  - Internal Transitions 358
  - Self Transitions 358
  - Postponing and Remembering Events 360
- 10.6 OBJECT LIFE CYCLES ON THE STATECHART DIAGRAM 360**
  - Coordinated Life Cycles 361
  - States, Transitions, and Events 362
- 10.7 STATE TRANSITION TABLES (STTs) 367**
  - Deliverables 372
  - Further Reading 374
  - Chapter Summary 374
  - Chapter Glossary 376
  - What Comes Next 377
  - Class/Group Exercises and Problems 378
  - Individual Exercises and Problems 378
  - Projects and Cases 379
  - Self-Test Questions 379

**CHAPTER ELEVEN****Following the Trail: Examining Execution Sequences 382**

What You Will Learn in This Chapter 382

What You Should Know to Start This Chapter 382

Chapter Overview 382

Key Concepts 383

"The Outhouse Bathroom Boutique" 383

Thought Questions 384

**11.1 OBJECTS AND RESPONSIBILITIES 384****11.2 CONTRACTS 386****11.3 COLLABORATIONS 387****11.4 CRC CARDS 389****11.5 IDENTIFYING RESPONSIBILITIES 390**

Reporting and Updating Attribute Values 390

Use Cases 390

Input/Output 390

User Interactions 393

Prompts and Error Messages 393

Instance Creation and Deletion 393

**11.6 ASSIGNING RESPONSIBILITIES 393**

Two Principles 394

**11.7 IDENTIFYING COLLABORATIONS 395**

Finding Collaborations 395

Role-Play Use Cases 396

**11.8 SEQUENCE DIAGRAMS 397**

Sequence Diagram for Outhouse Episode 11 397

Rules for Sequence Diagrams 401

**NAMING THE OBJECTS 401****THE ORIGINATING OBJECT 401****THE MESSAGES 402**

Deliverables 403

Further Reading 403

Chapter Summary 403

Chapter Glossary 405

What Comes Next 405

Class/Group Exercises and Problems 405

Individual Exercises and Problems 406

Projects and Cases 406

Self-Test Questions 406

**CHAPTER TWELVE****Subsystems 409**

What You Will Learn in This Chapter 409

What You Should Know to Start This Chapter 409

Chapter Overview 409

Key Concepts 410

"The Outhouse Bathroom Boutique" 410

Thought Questions 411

- 12.1 DIVIDING UP A PROJECT 412**
  - Atomic Packages 415
  - Purpose of Using Subsystems 415
- 12.2 HOW TO SUBDIVIDE 416**
  - Intuitively Obvious 416
  - Minimal Interactions and Dependencies 416
  - Functional Grouping 417
  - Real-Time Considerations 417
- 12.3 WHEN TO SUBDIVIDE 419**
  - Before You Begin 419
  - The Systems Request Document 420
  - Completion of Requirements Analysis 420
  - The System Architecture 420
  - The Class Diagram 420
  - During Behavior Analysis 420
  - Completion of Analysis 421
  - The Design Phase 421
- 12.4 SOME SPECIAL CLASSES THAT APPEAR  
IN SEVERAL SYSTEMS OR SUBSYSTEMS 421**
  - Classes on the Boundaries 422
- 12.5 COMPARISON OF TERMS 424**
  - Subjects (Coad and Yourdon) 424
  - Domains (Shlaer and Mellor) 424
  - Subassemblies (Firesmith) 424
- 12.6 PACKAGES 425**
- 12.7 THE MULTILAYER MODEL 425**
  - The Five Layers 425
  - Layers Versus Subsystems 426
  - Deliverables 427**
  - Further Reading 427**
  - Chapter Summary 428**
  - Chapter Glossary 430**
  - What Comes Next 431**
  - Class/Group Exercises and Problems 431**
  - Projects and Cases 432**
  - Self-Test Questions 432**

## CHAPTER THIRTEEN

### Object-Oriented Design

435

- What You Will Learn in This Chapter 435
- What You Should Know to Start This Chapter 435
- Chapter Overview 435
- Key Concepts 436
- "The Outhouse Bathroom Boutique" 436
- Thought Questions 437

#### 13.1 OVERVIEW OF DESIGN CONSIDERATIONS 437

- Design: The Process and the Issues 438

- 13.2 CONCURRENCY AND THREADS OF CONTROL 439**
  - Multithreaded Execution 439
- 13.3 ADDING CLASS HIERARCHIES WITH ABSTRACT CLASSES 441**
- 13.4 COMMON REPRESENTATION THROUGHOUT THE OODLC 443**
  - Design by Adding to the Analysis Model 444
- 13.5 USER INTERFACE DESIGN 444**
- 13.6 CHOICE OF IMPLEMENTATION LANGUAGE AND ENVIRONMENT 446**
  - Languages 447
  - Databases 448
  - Administrative Issues 448
- 13.7 DISTRIBUTED OBJECTS 449**
- 13.8 OMG, ORBs, AND CORBA 451**
  - ODMG 453
- 13.9 COMPONENTS 454**
  - Intelligent Agents 456
- 13.10 TESTING 459**
  - Testing and Reusability 460
  - Testing Must Happen, Even Under  
Deadline Pressure 461
  - Testing Under Inheritance and Polymorphism 462
- 13.11 DOCUMENTATION 463**
  - Deliverables 464
  - Further Reading 464
  - Chapter Summary 465
  - Chapter Glossary 468
  - What Comes Next 469
  - Class/Group Exercises and Problems 469
  - Individual Exercises and Problems 471
  - Projects and Cases 471
  - Self-Test Questions 471

## CHAPTER FOURTEEN

### Implementation: OOPs and ODBMSs 478

- What You Will Learn in This Chapter 478
- What You Should Know to Start This Chapter 478
- Chapter Overview 478
- Key Concepts 479
- “The Outhouse Bathroom Boutique” 479
- Thought Questions 479
- 14.1 LANGUAGES AND DATABASES 480**
  - Database DDL, DML, and Query Language 480
  - DDL/ODL 480
  - DML/OML 481
  - DCL/OCL 481
  - SQL, OSQL, and OQL 481

- 14.2 DIRECTIONS 482**
  - OMG and ODMG 482
  - The ODMG 3.0 Specification 482
  - ODMG 3.0 Object Model 482
  - Object Definition Language (ODL) 482
  - Object Query Language (OQL) 483
  - Bindings 483
- 14.3 ISSUES FOR OBJECT-ORIENTED LANGUAGES AND DATABASES 483**
  - Garbage Collection 483
  - Memory Leaks 484
  - Dynamic Versus Static Binding 484
  - Execution Speed 484
  - Upward Compatibility 484
  - Multiple Inheritance 484
  - Dynamic Typing of Objects 485
  - Standardized Class Libraries 485
- 14.4 OBJECT-ORIENTED PROGRAMMING LANGUAGES (OOPs) 487**
  - Java 487
  - Smalltalk 487
  - C++ 488
  - The Visuals 488
  - Eiffel 488
  - Objective-C 489
  - OO COBOL 489
  - ISO1/ANSI Ada 95 490
- 14.5 OBJECT-ORIENTED DATABASES (OODBMSs or ODBMSs) 491**
  - The Current State of the Art 491
  - Differences from RDBMSs 492
  - Approaches to ODBMSs 493
  - Benchmarking ODBMSs 493
  - Engineering Database Benchmark 495
  - HyperModel Benchmark 496
  - ODBMS Products 496
- 14.6 OBJECT-ORIENTED DEVELOPMENT ENVIRONMENTS 496**
  - Deliverables 497
  - Further Reading 497
  - Chapter Summary 498
  - Chapter Glossary 501
  - What Comes Next 501
  - Class/Group Exercises and Problems 501
  - Individual Exercises and Problems 502
  - Projects and Cases 502
  - Self-Test Questions 503

**CHAPTER FIFTEEN****Moving to Object-Oriented Techniques 507**

- What You Will Learn in This Chapter 507
- What You Should Know to Start This Chapter 507
- Chapter Overview 507
- Key Concepts 508
- “The Outhouse Bathroom Boutique” 508
- Thought Questions 509

- 15.1 IS OOT THE FINAL ANSWER? 509**
- 15.2 IS YOUR ORGANIZATION READY FOR OO? 509**
- 15.3 EVOLUTION OR REVOLUTION? 510**
- 15.4 GETTING STARTED 510**
- 15.5 STAFFING AND TRAINING 511**
  - Selecting the Team 512
- 15.6 THE PILOT PROJECT 514**
  - Choose Three Pilots 514
  - Keep a Low Profile 515
  - Other Points 515
  - Steps in the Conversion Process 516
  - Don't Do It This Way! 517
- 15.7 MIGRATION PROBLEMS 518**
  - New Technology Problems 519
- 15.8 DEALING WITH LEGACY SYSTEMS 520**
- 15.9 TESTING AND QUALITY ASSURANCE 522**
  - What Is Quality? 523
  - Objects and Quality 525
  - Quality and Class Libraries 526
  - Deliverables 526
  - Further Reading 526
  - Chapter Summary 527
  - Chapter Glossary 530
  - What Comes Next 530
  - Class/Group Exercises and Problems 531
  - Individual Exercises and Problems 531
  - Projects and Cases 532
  - Self-Test Questions 532

**CHAPTER SIXTEEN****The People Side of Systems Development 539**

- What You Will Learn in This Chapter 539
- What You Should Know to Start This Chapter 539
- Chapter Overview 540
- Key Concepts 540
- “The Outhouse Bathroom Boutique” 540
- Thought Questions 541

- 16.1 SENSITIVITY AND PEOPLE ISSUES 541**
- 16.2 TEAM BUILDING 542**
  - Small Group 542
  - Technical Skills 545
  - Functional (Process Improvement) Skills 545
  - Interpersonal Skills 545
  - Communication 546
  - Trust 548
  - Leadership 548
  - Arbitration Skills 549
  - Commitment 549
  - Specific Performance Goals 549
  - Mutually Accountable 552
  - Life Cycle of a Team: The Stormin' Normin' Model 552
- 16.3 SPECIFIC INTERPERSONAL TECHNIQUES FOR OBJECT-ORIENTED ANALYSTS 555**
  - Listening Skills 555
  - Reflective Listening/Paraphrasing 557
  - Conflict Arbitration 559
  - Feelings Perception Check 560
  - Open-Ended Questions 562
  - One Question at a Time 563
  - Specific Instances from the Past 564
  - Introductions 566
- 16.4 TRAINING 567**
- 16.5 OVERCOMING RESISTANCE 568**
  - Deliverables 569
  - Further Reading (and Seminars) 569
  - Chapter Summary 571
  - Chapter Glossary 573
  - What Comes Next 574
  - Class/Group Exercises and Problems 574
  - Individual Exercises and Problems 575
  - Projects and Cases 576
  - Self-Test Questions 576

## CHAPTER SEVENTEEN

### “The Royal Korona Yacht Club” Membership System 582

- What You Will Learn in This Chapter 582
- What You Should Know to Start This Chapter 582
- Chapter Overview 582
- Key Concepts 583
  - “The Royal Korona Yacht Club” 583
- 17.1 THE CASE STUDY PROJECT AND ITS BACKGROUND 583**
  - Structure of the Case Study 584
- 17.2 THE PROJECT SCOPE/MISSION STATEMENT 584**
- 17.3 THE CONTEXT DIAGRAM 588**
- 17.4 USE CASES 588**

**17.5 THE OBJECT MODEL 597**

**17.6 THE KRB SEVEN STEPS 598**

- Step 1: Brainstorming 598
- Step 2: Define Classes 599
- Step 3: Establish Associations 606
- Step 4: Expand Many-to-Many Associations 612
- Step 5: Attributes 615
- Step 6: Normalization 619
- Step 7: Operations/Behavior 619

**Deliverables 628**

**Further Reading 629**

**Chapter Summary 629**

**Chapter Glossary 630**

**What Comes Next 630**

**Individual Exercises and Problems 630**

**Projects and Cases 631**

**Self-Test Questions 631**

**APPENDIX**

**Answers to End-of-Chapter Exercises 636**

- Chapter 2 636
- Chapter 3 636
- Chapter 4 636
- Chapter 5 637
- Chapter 6 638
- Chapter 7 640
- Chapter 8 641
- Chapter 9 641
- Chapter 10 642
- Chapter 11 642
- Chapter 12 643
- Chapter 13 644
- Chapter 14 645
- Chapter 15 646
- Chapter 16 647
- Chapter 17 649

**BIBLIOGRAPHY 650**

**INDEX 654**