
Contents

PREFACE	ix
Acknowledgments, xii	
CHAPTER 1 INTRODUCTION	1
1.1 What Is Object-Oriented?, 1	
1.2 What Is Object-Oriented Development?, 4	
1.3 Object-Oriented Themes, 7	
1.4 Evidence for Usefulness of Object-Oriented Development, 9	
1.5 Organization of this Book, 10	
Bibliographic Notes, 12	
References, 12	
Exercises, 13	
Part 1: Modeling Concepts	
CHAPTER 2 MODELING AS A DESIGN TECHNIQUE	15
2.1 Modeling, 15	
2.2 The Object Modeling Technique, 16	
2.3 Chapter Summary, 19	
Exercises, 19	
CHAPTER 3 OBJECT MODELING	21
3.1 Objects and Classes, 21	
3.2 Links and Associations, 27	
3.3 Advanced Link and Association Concepts, 31	
3.4 Generalization and Inheritance, 38	
3.5 Grouping Constructs, 43	
3.6 A Sample Object Model, 43	
3.7 Practical Tips, 46	

- 3.8 Chapter Summary, 47
- Bibliographic Notes, 48
- References, 48
- Exercises, 49

CHAPTER 4 ADVANCED OBJECT MODELING

57

- 4.1 Aggregation, 57
- 4.2 Abstract Classes, 61
- 4.3 Generalization as Extension and Restriction, 63
- 4.4 Multiple Inheritance, 65
- 4.5 Metadata, 69
- 4.6 Candidate Keys, 71
- 4.7 Constraints, 73
- 4.8 Chapter Summary, 77
- Bibliographic Notes, 79
- References, 79
- Exercises, 80

CHAPTER 5 DYNAMIC MODELING

84

- 5.1 Events and States, 84
- 5.2 Operations, 92
- 5.3 Nested State Diagrams, 94
- 5.4 Concurrency, 99
- 5.5 Advanced Dynamic Modeling Concepts, 101
- 5.6 A Sample Dynamic Model, 105
- 5.7 Relation of Object and Dynamic Models, 110
- 5.8 Practical Tips, 111
- 5.9 Chapter Summary, 112
- Bibliographic Notes, 113
- References, 115
- Exercises, 115

CHAPTER 6 FUNCTIONAL MODELING

123

- 6.1 Functional Models, 123
- 6.2 Data Flow Diagrams, 124
- 6.3 Specifying Operations, 130
- 6.4 Constraints, 132
- 6.5 A Sample Functional Model, 133
- 6.6 Relation of Functional to Object and Dynamic Models, 137
- 6.7 Chapter Summary, 139
- Bibliographic Notes, 140
- References, 140
- Exercises, 141

Part 2: Design Methodology

CHAPTER 7	METHODOLOGY PREVIEW	144
7.1	OMT as a Software Engineering Methodology, 144	
7.2	The OMT Methodology, 145	
7.3	Impact of an Object-Oriented Approach, 146	
7.4	Chapter Summary, 146	
	Exercises, 147	
CHAPTER 8	ANALYSIS	148
8.1	Overview of Analysis, 148	
8.2	Problem Statement, 150	
8.3	Automated Teller Machine Example, 151	
8.4	Object Modeling, 152	
8.5	Dynamic Modeling, 169	
8.6	Functional Modeling, 179	
8.7	Adding Operations, 183	
8.8	Iterating the Analysis, 185	
8.9	Chapter Summary, 187	
	Bibliographic Notes, 188	
	References, 188	
	Exercises, 189	
CHAPTER 9	SYSTEM DESIGN	198
9.1	Overview of System Design, 198	
9.2	Breaking a System into Subsystems, 199	
9.3	Identifying Concurrency, 202	
9.4	Allocating Subsystems to Processors and Tasks, 203	
9.5	Management of Data Stores, 205	
9.6	Handling Global Resources, 207	
9.7	Choosing Software Control Implementation, 207	
9.8	Handling Boundary Conditions, 210	
9.9	Setting Trade-off Priorities, 210	
9.10	Common Architectural Frameworks, 211	
9.11	Architecture of the ATM System, 217	
9.12	Chapter Summary, 218	
	Bibliographic Notes, 220	
	References, 220	
	Exercises, 221	
CHAPTER 10	OBJECT DESIGN	227
10.1	Overview of Object Design, 227	
10.2	Combining the Three Models, 229	
10.3	Designing Algorithms, 230	

10.4	Design Optimization, 235	
10.5	Implementation of Control, 239	
10.6	Adjustment of Inheritance, 242	
10.7	Design of Associations, 245	
10.8	Object Representation, 248	
10.9	Physical Packaging, 249	
10.10	Documenting Design Decisions, 251	
10.11	Chapter Summary, 252	
	Bibliographic Notes, 254	
	References, 254	
	Exercises, 255	
CHAPTER 11	METHODOLOGY SUMMARY	260
11.1	Analysis, 261	
11.2	System Design, 262	
11.3	Object Design, 263	
11.4	Chapter Summary, 264	
	Exercises, 264	
CHAPTER 12	COMPARISON OF METHODOLOGIES	266
12.1	Structured Analysis/Structured Design (SA/SD), 266	
12.2	Jackson Structured Development (JSD), 268	
12.3	Information Modeling Notations, 271	
12.4	Object-Oriented Work, 273	
12.5	Chapter Summary, 274	
	References, 275	
	Exercises, 275	
Part 3: Implementation		
CHAPTER 13	FROM DESIGN TO IMPLEMENTATION	278
13.1	Implementation Using a Programming Language, 278	
13.2	Implementation Using a Database System, 279	
13.3	Implementation Outside a Computer, 280	
13.4	Overview of Part 3, 280	
CHAPTER 14	PROGRAMMING STYLE	281
14.1	Object-Oriented Style, 281	
14.2	Reusability, 282	
14.3	Extensibility, 285	
14.4	Robustness, 286	
14.5	Programming-in-the-Large, 288	
14.6	Chapter Summary, 291	
	Bibliographic Notes, 291	

References, 292

Exercises, 292

CHAPTER 15 OBJECT-ORIENTED LANGUAGES 296

15.1 Translating a Design into an Implementation, 296

15.2 Class Definitions, 297

15.3 Creating Objects, 301

15.4 Calling Operations, 305

15.5 Using Inheritance, 308

15.6 Implementing Associations, 312

15.7 Object-Oriented Language Features, 318

15.8 Survey of Object-Oriented Languages, 325

15.9 Chapter Summary, 330

Bibliographic Notes, 332

References, 333

Exercises, 334

CHAPTER 16 NON-OBJECT-ORIENTED LANGUAGES 340

16.1 Mapping Object-Oriented Concepts, 340

16.2 Translating Classes into Data Structures, 342

16.3 Passing Arguments to Methods, 344

16.4 Allocating Objects, 345

16.5 Implementing Inheritance, 347

16.6 Implementing Method Resolution, 351

16.7 Implementing Associations, 355

16.8 Dealing with Concurrency, 358

16.9 Encapsulation, 359

16.10 What You Lose, 361

16.11 Chapter Summary, 362

Bibliographic Notes, 363

References, 364

Exercises, 364

CHAPTER 17 RELATIONAL DATABASES 366

17.1 General DBMS Concepts, 366

17.2 Relational DBMS Concepts, 368

17.3 Relational Database Design, 373

17.4 Advanced Relational DBMS, 387

17.5 Chapter Summary, 388

Bibliographic Notes, 389

References, 390

Exercises, 390

Part 4: Applications

CHAPTER 18	OBJECT DIAGRAM COMPILER	397
18.1	Background, 398	
18.2	Problem Statement, 399	
18.3	Analysis, 401	
18.4	System Design, 407	
18.5	Object Design, 408	
18.6	Implementation, 412	
18.7	Lessons Learned, 412	
18.8	Chapter Summary, 413	
	Bibliographic Notes, 413	
	References, 413	
	Exercises, 414	
CHAPTER 19	COMPUTER ANIMATION	416
19.1	Background, 417	
19.2	Problem Statement, 418	
19.3	Analysis, 420	
19.4	System Design, 424	
19.5	Object Design, 426	
19.6	Implementation, 428	
19.7	Lessons Learned, 430	
19.8	Chapter Summary, 431	
	Bibliographic Notes, 431	
	References, 432	
	Exercises, 432	
CHAPTER 20	ELECTRICAL DISTRIBUTION DESIGN SYSTEM	433
20.1	Background, 433	
20.2	Problem Statement, 435	
20.3	Analysis, 436	
20.4	System Design, 444	
20.5	Object Design, 445	
20.6	Implementation, 448	
20.7	Lessons Learned, 448	
20.8	Chapter Summary, 449	
	Bibliographic Notes, 449	
	References, 449	
	Exercises, 450	
APPENDIX A	OMT GRAPHICAL NOTATION	453
APPENDIX B	GLOSSARY	454
ANSWERS TO SELECTED EXERCISES		465
INDEX		491