

Contents

Preface to the Third Edition

xii

1. Principles of Object-Oriented Programming **1**

- 1.1 Software Crisis 1
- 1.2 Software Evolution 3
- 1.3 A Look at Procedure-Oriented Programming 4
- 1.4 Object-Oriented Programming Paradigm 6
- 1.5 Basic Concepts of Object-Oriented Programming 7
- 1.6 Benefits of OOP 12
- 1.7 Object-Oriented Languages 13
- 1.8 Applications of OOP 14
- Summary 15*
- Review Questions 17*

2. Beginning with C++ **19**

- 2.1 What is C++? 19
- 2.2 Applications of C++ 20
- 2.3 A Simple C++ Program 20
- 2.4 More C++ Statements 25
- 2.5 An Example with Class 28
- 2.6 Structure of C++ Program 29
- 2.7 Creating the Source File 30
- 2.8 Compiling and Linking 30
- Summary 31*
- Review Questions 32*
- Debugging Exercises 33*
- Programming Exercises 34*

3. Tokens, Expressions and Control Structures **35**

- 3.1 Introduction 35
- 3.2 Tokens 36
- 3.3 Keywords 36
- 3.4 Identifiers and Constants 36
- 3.5 Basic Data Types 38
- 3.6 User-Defined Data Types 40
- 3.7 Derived Data Types 42

3.8	Symbolic Constants	43
3.9	Type Compatibility	45
3.10	Declaration of Variables	45
3.11	Dynamic Initialization of Variables	46
3.12	Reference Variables	47
3.13	Operators in C++	49
3.14	Scope Resolution Operator	50
3.15	Member Dereferencing Operators	52
3.16	Memory Management Operators	52
3.17	Manipulators	55
3.18	Type Cast Operator	57
3.19	Expressions and their Types	58
3.20	Special Assignment Expressions	60
3.21	Implicit Conversions	61
3.22	Operator Overloading	63
3.23	Operator Precedence	63
3.24	Control Structures	64
	<i>Summary</i>	69
	<i>Review Questions</i>	71
	<i>Debugging Exercises</i>	72
	<i>Programming Exercises</i>	75

4. Functions in C++

77

4.1	Introduction	77
4.2	The Main Function	78
4.3	Function Prototyping	79
4.4	Call by Reference	81
4.5	Return by Reference	82
4.6	Inline Functions	82
4.7	Default Arguments	84
4.8	const Arguments	87
4.9	Function Overloading	87
4.10	Friend and Virtual Functions	89
4.11	Math Library Functions	90
	<i>Summary</i>	90
	<i>Review Questions</i>	92
	<i>Debugging Exercises</i>	93
	<i>Programming Exercises</i>	95

5. Classes and Objects

96

5.1	Introduction	96
5.2	C Structures Revisited	97
5.3	Specifying a Class	99

5.4	Defining Member Functions	103
5.5	A C++ Program with Class	104
5.6	Making an Outside Function Inline	106
5.7	Nesting of Member Functions	107
5.8	Private Member Functions	108
5.9	Arrays within a Class	109
5.10	Memory Allocation for Objects	114
5.11	Static Data Members	115
5.12	Static Member Functions	117
5.13	Arrays of Objects	119
5.14	Objects as Function Arguments	122
5.15	Friendly Functions	124
5.16	Returning Objects	130
5.17	const Member Functions	132
5.18	Pointers to Members	132
5.19	Local Classes	134
	<i>Summary</i>	135
	<i>Review Questions</i>	136
	<i>Debugging Exercises</i>	137
	<i>Programming Exercises</i>	142

6. Constructors and Destructors

144

6.1	Introduction	144
6.2	Constructors	145
6.3	Parameterized Constructors	146
6.4	Multiple Constructors in a Class	150
6.5	Constructors with Default Arguments	153
6.6	Dynamic Initialization of Objects	153
6.7	Copy Constructor	156
6.8	Dynamic Constructors	158
6.9	Constructing Two-dimensional Arrays	160
6.10	const Objects	162
6.11	Destructors	162
	<i>Summary</i>	164
	<i>Review Questions</i>	165
	<i>Debugging Exercises</i>	166
	<i>Programming Exercises</i>	169

7. Operator Overloading and Type Conversions

171

7.1	Introduction	171
7.2	Defining Operator Overloading	172
7.3	Overloading Unary Operators	173
7.4	Overloading Binary Operators	176

- 7.5 Overloading Binary Operators Using Friends 179
- 7.6 Manipulation of Strings Using Operators 183
- 7.7 Rules for Overloading Operators 186
- 7.8 Type Conversions 187
 - Summary* 195
 - Review Questions* 196
 - Debugging Exercises* 197
 - Programming Exercises* 200

8. Inheritance: Extending Classes **201**

- 8.1 Introduction 201
- 8.2 Defining Derived Classes 202
- 8.3 Single Inheritance 204
- 8.4 Making a Private Member Inheritable 210
- 8.5 Multilevel Inheritance 213
- 8.6 Multiple Inheritance 218
- 8.7 Hierarchical Inheritance 224
- 8.8 Hybrid Inheritance 225
- 8.9 Virtual Base Classes 228
- 8.10 Abstract Classes 232
- 8.11 Constructors in Derived Classes 232
- 8.12 Member Classes: Nesting of Classes 240
 - Summary* 241
 - Review Questions* 243
 - Debugging Exercises* 243
 - Programming Exercises* 248

9. Pointers, Virtual Functions and Polymorphism **251**

- 9.1 Introduction 251
- 9.2 Pointers 253
- 9.3 Pointers to Objects 265
- 9.4 *this* Pointer 270
- 9.5 Pointers to Derived Classes 273
- 9.6 Virtual Functions 275
- 9.7 Pure Virtual Functions 281
 - Summary* 282
 - Review Questions* 283
 - Debugging Exercises* 284
 - Programming Exercises* 289

10. Managing Console I/O Operations **290**

- 10.1 Introduction 290
- 10.2 C++ Streams 291

- 10.3 C++ Stream Classes 292
- 10.4 Unformatted I/O Operations 292
- 10.5 Formatted Console I/O Operations 301
- 10.6 Managing Output with Manipulators 312
 - Summary* 317
 - Review Questions* 319
 - Debugging Exercises* 320
 - Programming Exercises* 321

11. Working with Files **323**

- 11.1 Introduction 323
- 11.2 Classes for File Stream Operations 325
- 11.3 Opening and Closing a File 325
- 11.4 Detecting end-of-file 334
- 11.5 More about Open(): File Modes 334
- 11.6 File Pointers and Their Manipulations 335
- 11.7 Sequential Input and Output Operations 338
- 11.8 Updating a File: Random Access 343
- 11.9 Error Handling During File Operations 348
- 11.10 Command-line Arguments 350
 - Summary* 353
 - Review Questions* 355
 - Debugging Exercises* 356
 - Programming Exercises* 358

12. Templates **359**

- 12.1 Introduction 359
- 12.2 Class Templates 360
- 12.3 Class Templates with Multiple Parameters 365
- 12.4 Function Templates 366
- 12.5 Function Templates with Multiple Parameters 371
- 12.6 Overloading of Template Functions 372
- 12.7 Member Function Templates 373
- 12.8 Non-Type Template Arguments 374
 - Summary* 375
 - Review Questions* 376
 - Debugging Exercises* 377
 - Programming Exercises* 379

13. Exception Handling **380**

- 13.1 Introduction 380
- 13.2 Basics of Exception Handling 381

- 13.3 Exception Handling Mechanism 381
- 13.4 Throwing Mechanism 386
- 13.5 Catching Mechanism 386
- 13.6 Rethrowing an Exception 391
- 13.7 Specifying Exceptions 392
 - Summary* 394
 - Review Questions* 395
 - Debugging Exercises* 396
 - Programming Exercises* 400

14. Introduction to the Standard Template Library 401

- 14.1 Introduction 401
- 14.2 Components of STL 402
- 14.3 Containers 403
- 14.4 Algorithms 406
- 14.5 Iterators 408
- 14.6 Application of Container Classes 409
- 14.7 Function Objects 419
 - Summary* 421
 - Review Questions* 423
 - Debugging Exercises* 424
 - Programming Exercises* 426

15. Manipulating Strings 428

- 15.1 Introduction 428
- 15.2 Creating (string) Objects 430
- 15.3 Manipulating String Objects 432
- 15.4 Relational Operations 433
- 15.5 String Characteristics 434
- 15.6 Accessing Characters in Strings 436
- 15.7 Comparing and Swapping 438
 - Summary* 440
 - Review Questions* 441
 - Debugging Exercises* 442
 - Programming Exercises* 445

16. New Features of ANSI C++ Standard 446

- 16.1 Introduction 446
- 16.2 New Data Types 447
- 16.3 New Operators 449
- 16.4 Class Implementation 451

16.5	Namespace Scope	453
16.6	Operator Keywords	459
16.7	New Keywords	460
16.8	New Headers	461
	<i>Summary</i>	461
	<i>Review Questions</i>	463
	<i>Debugging Exercises</i>	464
	<i>Programming Exercises</i>	467

17. Object-Oriented Systems Development

468

17.1	Introduction	468
17.2	Procedure-Oriented Paradigms	469
17.3	Procedure-Oriented Development Tools	472
17.4	Object-Oriented Paradigm	473
17.5	Object-Oriented Notations and Graphs	475
17.6	Steps in Object-Oriented Analysis	479
17.7	Steps in Object-Oriented Design	483
17.8	Implementation	490
17.9	Prototyping Paradigm	490
17.10	Wrapping Up	491
	<i>Summary</i>	492
	<i>Review Questions</i>	494

Appendix A: Projects	496
Appendix B: Executing Turbo C++	516
Appendix C: Executing C++ Under Windows	529
Appendix D: Glossary of ANSI C++ Keywords	541
Appendix E: C++ Operator Precedence	547
Appendix F: Points to Remember	549
Appendix G: Glossary of Important C++ and OOP Terms	561
Appendix H: C++ Proficiency Test	573
<i>Bibliography</i>	609
<i>Index</i>	610