

Table of Contents

1	Object-Oriented Programming		1
1.1	Object-Oriented Problem Solving	2	
1.2	Classes, Objects, and Encapsulation	4	
1.3	Subclasses—Inheritance and Polymorphism	7	
1.4	Challenges in Object-Oriented Programming	7	
1.4.1	Partitioning Software into Classes	8	
1.4.2	Adding Functionality to an Existing Software System	8	
1.4.3	Hierarchical Structure of Types and Subtypes	8	
	Exercises	10	
	References	10	
2	From C to Shining C++		11
2.1	The Language and Its History	11	
2.2	How C++ Enhances C in Small Ways	13	
2.2.1	Comments	14	
2.2.2	Enumeration Names	14	
2.2.3	Struct or Class Names	14	
2.2.4	Declarations within Blocks	15	
2.2.5	Scope Qualifier Operator	15	
2.2.6	The Const Specifier	15	
2.2.7	Anonymous Unions	15	
2.2.8	Explicit Type Conversion	15	
2.2.9	Function Prototypes	16	
2.2.10	Overloading of Function Names	16	

2.2.11	Default Value for Function Parameters	16
2.2.12	Functions with an Unspecified Number of Parameters	16
2.2.13	Reference Parameters in a Function	17
2.2.14	The Inline Specifier	17
2.2.15	The New and Delete Operators	17
2.2.16	Pointers to Void and Functions That Return Void	17
2.3	How C++ Enhances C in Large Ways	18
2.3.1	The Class Construct and Data Encapsulation	18
2.3.2	Struct as a Special Case of a Class	18
2.3.3	Constructors and Destructors	18
2.3.4	Private, Protected, and Public Sections	19
2.3.5	Objects and Messages	19
2.3.6	Friends	19
2.3.7	Overloading of Operators and Function Names in Classes	20
2.3.8	Derived Classes	20
2.3.9	Virtual Functions	20
2.3.10	The Stream Library	21
	Exercises	21
3	Getting Up to Speed with C++	22
3.1	Comments	22
3.2	Constants, Types, and Declarations	23
3.3	C++ Operators	30
3.4	Pass-by-Reference	31
3.5	Pointers	33
3.6	The Const Specifier	42
3.7	Enumeration Types	43
3.8	Anonymous Unions	44
3.9	Explicit Type Conversion	44
3.10	Functions	46
3.10.1	Function Prototypes	46
3.10.2	Inline Functions	46
3.10.3	Default Arguments	47
3.10.4	Overloading Function Names	47
3.10.5	Functions with an Unspecified Number of Arguments	49
3.10.6	Pointers to Functions and Generics	49
3.11	Files and the Physical Organization of C++ Systems	54
	Exercises	55

4 Data Encapsulation and Data Hiding Using Classes	58
4.1 Procedural Languages, Data Abstraction, Encapsulation, and Data Hiding	58
4.2 An Introduction to Classes in C++	60
4.3 Self-Reference in Classes	67
4.4 Constructors and Destructors	69
4.4.1 Stack Abstract Data Type Implemented as a C++ Class	70
4.4.2 Stack Abstract Data Type Implemented in Modula-2	72
4.5 Class Objects as Members	75
4.6 Vectors of Objects	77
4.7 Friends	78
4.8 Static Members of a Class	80
4.9 Overloading of Operators	81
4.9.1 Binary and Unary Operators	82
4.9.2 Some Examples of Operator Overloading	84
4.9.3 The <stream.h> Library	95
4.10 Some Baseline Classes	100
4.10.1 Generic Lists	101
4.10.2 A Generic Search Table Implemented as a Binary Search Tree	106
4.10.2-1 Modula-2 Encapsulation of Search_Table Abstraction	107
4.10.2-2 C++ Encapsulation of Search_Table Abstraction	110
Exercises	121
5 Inheritance and Derived Classes	124
5.1 The Derived Class Construct	125
5.2 Derived Classes with Parent Class Constructors	130
5.3 Some Examples of Derived Classes	132
5.3.1 Derived Counter Class	132
5.3.2 The Class System at a University	134
5.3.3 A Stack and Queue Derived from a Generic List	139
Exercises	142

6 Polymorphism and Virtual Functions	144
6.1 Virtual Functions 145	
6.2 An Object-Oriented Solution to Generating a Linked List 150	
6.2.1 Nonpolymorphic Solution to Heterogeneous Linked List 150	
6.2.2 Object-Oriented Solution to Heterogeneous Linked List 157	
6.2.3 Maintenance on the Non-Object-Oriented and Object-Oriented Systems 165	
6.3 A Heterogeneous Search Tree Using Polymorphism 170	
6.4 Finite-State Machine Using Polymorphism 176	
Exercises 181	
7 Case Studies in Object-Oriented Programming	182
7.1 A “Super Fast” Spelling Checker 182	
7.1.1 Specifications for Spelling Checker 182	
7.1.2 High-Level Design of Spelling Checker 183	
7.1.3 Low-Level Design of Spelling Checker 186	
7.1.4 Implementation of Spelling Checker 187	
7.2 Bank Teller Discrete Event Simulation 199	
7.2.1 Specifications for Queue Simulation 199	
7.2.2 High-Level Design of Queue Simulation 200	
7.2.3 Low-Level Design of Queue Simulation 206	
7.2.4 Implementation of Queue Simulation 206	
7.2.5 Simulation Output 223	
7.2.6 Maintenance of Queue Simulation 224	
7.3 Interactive Function Evaluator 229	
7.3.1 Specifications for Function Evaluator 230	
7.3.2 Review of Expression Trees 233	
7.3.3 High-Level Design of Function Evaluator 239	
7.3.4 Low-Level Design of Function Evaluator 246	
7.3.5 Full Implementation of Function Evaluator 253	
Exercises 268	
Index	269