

Contents at a Glance

Part I A Quick Start to C and C++ Programming

1	The Microsoft C and C++ Compiler Package	3
2	Getting Started with the Programmer's WorkBench	25
3	Getting Started with the C/C++ Compiler	51
4	Getting Started with Advanced Tools: CodeView, Browser, and Profiler	77

Part II C and C++ Programming Foundations

5	C and C++ Foundations	107
6	Data	139
7	Control	179
8	Writing and Using Functions	217
9	Arrays	257
10	Pointers	291
11	Complete I/O in C	341
12	An Introduction to I/O in C++	371
13	Structures, Unions, and Miscellaneous Items	397
14	Advanced C and C++ Programming Topics	429

Part III Foundations for Object-oriented Programming in C++

15	An Introduction to Object-oriented Programming	461
16	C++ Classes	479
17	Complete I/O in C++	513
18	Working in an Object-oriented Environment	547

Part IV DOS Graphics, System Access, Libraries, and Mixed Language Interface

19	Graphics Under DOS	573
20	Power Programming: Tapping Important C and C++ Libraries	661
21	Binding Microsoft C/C++ and Assembly Language	707

Part V Programming for Windows

22	Windows Programming: Concepts and Tools	733
23	Writing Windows Applications in C	777
24	Windows Programming: The Foundation Class Library	821
25	Windows Programming: Using the Foundation Class Library	835

Part VI Appendixes

A	Extended ASCII Table	893
B	DOS 10H, 21H, and 33H Interrupt Parameters	899
C	Windows API Functions and Foundation Class Library Items	913

Index	1031
--------------	-------------

Contents

Acknowledgments	xix
Introduction	xxi

Part I

A Quick Start to C and C++ Programming

1	
The Microsoft C and C++ Compiler Package	3
A Typical Windows Installation	3
A Typical DOS Installation	4
Recommendations	5
Minimum Hardware and Software Requirements	5
Recommended Hardware and Software	5
Planning a Good Installation	6
Your AUTOEXEC.BAT and CONFIG.SYS Files	6
Working Under DOS or Windows	7
Package Components	7
Programmer's WorkBench (PWB)	8

CL—The DOS Command-line Compiler	8
PWB Integrated Compiler	8
LINK—The Linker	8
EXEHDR—The EXE File Header Utility	9
NMAKE—Project Maintenance	9
BUILD—PWB Project Maintenance	9
LIB—The Library Manager	9
HELPMAKE—Help File Maintenance	10
BSCMAKE and SBRPACK—Browser Database Maintenance	10
CVPACK—The Debug Info Compactor	10
IMPLIB—The Import Library Manager	11
RM—File Removal	11
UNDEL—Undelete	11
EXP—Remove Hidden DELETED Subdirectory	11
CodeView Debugger	11
Profiler	12
Source Browser	12
Windows Development Tools	13
Resource Compiler	14
Spy	14
WXServer	15
QH Advisor	15

386MAX	15
Documentation	15
C/C++ and Windows Programming	
Features	16
C++ 2.1 Validation Suite	16
Compiler Optimizations	17
Compiler Memory Models	18
P-code	18
Precompiled Headers and Types	19
MOVE—The Microsoft Overlay	
Virtual Environment	20
The Foundation Class Library	21
Function Inlining	23
Auto-inlining	23

2 --- Getting Started with the Programmer's WorkBench 25

Entering the PWB Environment	26
PWB Main Menu Categories	26
Writing a New Application	34
Editing the Application	36
Copying, Cutting, and Pasting	37
Compiling and Linking	38
Working from the PWB	39
Working from the DOS	
Command Line	41
Using the Microsoft Advisor	
for Help	41
Help with Program Items	41
Help with Other Features	42
Printing Help Information	43
Setting Important PWB Options	44
The Key Assignment Menu Item	45
The Editor Settings Menu Item	45
The Colors Menu Item	48
The TOOLS.INI File	48
Altering the Build Process	49

3 --- Getting Started with the C/C++ Compiler 51

Simple Compiles with Default	
Compiler Options	51
Compiling from the PWB	52
Compiling from the DOS	
Command Line	54

Setting Compiler and Linker	
Switches	55
Compiler Switches	55
Linker Options	63
Controlling Compile Operations	
with Make Files	63
PWB Project Files	66
DOS NMake Utility	70
Special Compiling Items	72
Module Definition Files (.DEF)	72
Resource Compiler	74
Getting the Bugs Out	74

4 --- Getting Started with Advanced Tools: CodeView, Browser, and Profiler 77

CodeView	78
A Simple DOS Example for	
CodeView	78
Using CodeView with a C++	
Program Utilizing Classes	88
Using CodeView with a Windows	
Program	91
The Source Browser	96
Generating Browser Information	96
Finding Symbol Definitions	97
Finding Symbol References	97
Creating a Call Tree	98
The Profiler	101
Profiler Batch Files	101
Writing Code	103

--- Part II C and C++ Programming Foundations ---

5 C and C++ Foundations 107	
History of C	107
Relationship to Other Languages	109
Strengths of C	110

Weaknesses of C	113
Programming Discipline	114
The ANSI C Standard	115
The Evolution of C++ and Object-oriented Programming	115
History of C++	117
Using C++ Objects to Streamline Code Design	118
Small Enhancements to C	119
Major Enhancements to C	122
The Basic Elements of a C Program	124
The Five Basic Components of a Program	125
Your First C Program	125
Your First C++ Program	127
Your Second C Program	127
Your Second C++ Program	132
Files	134

6

Data 139

Identifiers	139
Keywords	141
Standard C and C++ Data Types	142
Characters	143
Three Integers	145
Unsigned Modifier	145
Floating-Point	147
Enumerated	149
Access Modifiers	151
const Modifier	151
#define Constants	152
volatile Modifier	153
const and volatile Used Together	153
pascal, cdecl, near, far, and huge Modifiers	154
pascal	154
cdecl	155
near, far, and huge	156
Data Type Conversions	156
Explicit Type Conversions Using the Cast Operator	158
Storage Classes	159
Variable Declarations at the External Level	160
Variable Declarations at the Internal Level	161
Variable Scope Review	163

Function Declarations at the External Level	163
Operators	164
Bitwise Operators	164
Left Shift and Right Shift	165
Increment and Decrement	166
Arithmetic Operators	167
Assignment Operator	168
Compound Assignment Operators	169
Relational and Logical Operators	171
Conditional Operator	174
Comma Operator	175
Understanding Operator Precedence Levels	175
Standard C and C++ Libraries	176

7

Control 179

Conditional Statements	179
if Statements	179
if-else Statements	181
Nested if-elses	183
if-else-if Statements	185
The ? Conditional Statement	186
switch Statements	188
if-else-if and switch Statements Combined	194
Loop Statements	196
for Loops	197
while Loops	202
do-while Loops	204
break Statement	207
continue Statement	208
Using break and continue Together	209
exit() Statement	211
atexit() Statement	214

8

Writing and Using Functions 217

Function Prototyping and Style	218
Prototyping	218
Call-by-Value and Call-by-Reference	221
Storage Classes	223
Scope	223

Recursion	224
Function Arguments	225
Formal and Actual Arguments	225
Type void as an Argument	226
Characters as Arguments	227
Integers as Arguments	228
Floats as Arguments	229
Doubles as Arguments	230
Arrays as Arguments	232
Function Types	234
Function Type void	234
Function Type char	236
Function Type int	237
Function Type long	238
Function Type float	239
Function Type double	240
Arguments for Function main()	241
Strings	241
Integers	242
Floats	244
Important C++ Features	245
inline	246
Overloading	246
Ellipsis (...)	248
Problems Encountered with Scope	
Rules	250
An Undefined Symbol in a C	
Program	250
Use a Variable with File Scope	251
Overriding a Variable with File	
Scope by a Variable with Local	
Scope	252
A Scope Problem in C++	253
The C++ Scope Resolution	
Operator	254

9

Arrays	257
What Is an Array?	257
Arrays and C	257
Array Declarations	258
Array Initialization	259
Default Initialization	260
Explicit Initialization	261
Unsize Initialization	261
Accessing Array Elements	262

Calculating Array Dimensions	265
(sizeof())	265
Array Index Out of Bounds	268
Output and Input of Strings	268
Multidimensional Arrays	271
Arrays as Function Arguments	274
Passing Arrays to C Functions	275
Passing Arrays to C++ Functions	277
String Functions and Character	
Arrays	283
gets(), puts(), fgets(), fputs(),	
and sprintf()	283
strcpy(), strcat(), strcmp(), and	
strlen()	286

10

Pointers	291
Defining Pointer Variables	291
Pointer Variable Declarations	293
Simple Statements Using Pointer	
Variables	294
Pointer Variable Initialization	299
Improper Use of the Address	
Operator	300
Pointers to Arrays	301
Pointers to Pointers	302
Pointers to Strings	304
Pointer Arithmetic	306
Pointer Arithmetic and Arrays	309
Problems with the Operators ++	
and --	311
Comparing Pointers	311
Pointer Portability	312
Using sizeof with Pointers	313
Pointers to Functions	315
Dynamic Memory	318
Using void Pointers	321
Pointers and Arrays	324
Strings (Arrays of Type char)	325
Arrays of Pointers	326
More on Pointers to Pointers	329
Arrays of String Pointers	336
The C++ Reference Type	338
Functions Returning Addresses	339
Using CodeView	340
When Should You Use	
Reference Types?	340

11 --- Complete I/O in C 341

Stream Functions	342
Opening Streams	345
Input and Output Redirection	345
Altering the Stream Buffer	346
Closing Streams	349
Low-level Input and Output in C	349
Character Input and Output	350
Using <code>getc()</code> , <code>putc()</code> , <code>fgetc()</code> , and <code>fputc()</code>	350
Using <code>getchar()</code> , <code>putchar()</code> , <code>fgetchar()</code> , and <code>fputchar()</code>	351
Using <code>getch()</code> and <code>putch()</code>	352
String Input and Output	352
Using <code>gets()</code> , <code>puts()</code> , <code>fgets()</code> , and <code>fputs()</code>	353
Integer Input and Output	354
Using <code>getw()</code> and <code>putw()</code>	354
Formatting Output	357
Using <code>printf()</code> and <code>fprintf()</code>	358
Using <code>fseek()</code> , <code>ftell()</code> , and <code>rewind()</code>	362
Using CodeView	365
Formatting Input	367
Using <code>scanf()</code> , <code>fscanf()</code> , and <code>sscanf()</code>	367

12 --- An Introduction to I/O in C++ 371

Streamlining I/O with C++	371
<code>cin</code> , <code>cout</code> , and <code>cerr</code>	372
The <code>>></code> Extraction and <code><<</code> Insertion Operators	372
From <code>stream.h</code> to <code>iostream.h</code>	380
Operators and Member Functions	381

13 --- Structures, Unions, and Miscellaneous Items 397

C and C++ Structures	398
C and C++ Structures: Syntax and Rules	398

C++ Structures: Syntax and Rule Extensions	400
Accessing Structure Members	401
Constructing a Simple Structure	401
Passing Structures to Functions	403
Constructing an Array of Structures	405
Using Pointers to Structures	409
Passing an Array of Structures to a Function	411
Structure Use in C++	414
Additional Manipulations with Structures	417
Unions	420
Unions: Syntax and Rules	420
Constructing a Simple Union	421
Miscellaneous Items	423
Using <code>typedef</code>	423
Using <code>enum</code>	425

14 --- Advanced C and C++ Programming Topics 429

Type Compatibility	429
ANSI C Definition for Type Compatibility	429
What Is an Identical Type?	430
Enumerated Types	431
Array Types	431
Function Types	432
Structure and Union Types	432
Pointer Types	432
Multiple Source File Compatibility	432
Macros	433
Defining Macros	433
Macros and Parameters	434
Problems with Macro Expansions	435
Creating and Using Your Own Macros	437
Macros Shipped with the Compiler	438
Advanced Preprocessor Statements	438
<code>#ifdef</code> and <code>#endif</code> Directives	439
<code>#undef</code> Directive	439
<code>#ifndef</code> Directive	440

#if Directive	440
#else Directive	440
#elif Directive	441
#line Directive	441
#error Directive	442
#pragma Directive	442
Conditional Compilation	442
Advanced Preprocessor Operators	444
# Stringize Operator	444
## Concatenation Operator	444
#@ Charizing Operator	445
Proper Use of Header Files	446
Making Header Files More Efficient	446
Precompiled Header Files	447
Creating Precompiled Headers	448
Using Precompiled Headers with PWB	448
limits.h and float.h	448
Handling Errors: perror()	449
Memory Models	451
Tiny	452
Small	452
Medium	452
Compact	452
Large	453
Huge	453
Dynamic Memory Allocation:	
Linked Lists	453
Considerations When Using Linked Lists	455
A Simple Linked List	455

Part III

Foundations for Object-oriented Programming in C++

15	An Introduction to Object-oriented Programming	461
	There Is Nothing New Under the Sun	461

Traditional Structured Programming	462
Object-oriented Programming	463
C++ and Object-oriented Programming	464
Object-oriented Terminology	464
Encapsulation	466
Class Hierarchy	467
A First Look at the C++ Class	468
A Structure as a Primitive Class	468
The Syntax and Rules for C++ Classes	474
A Simple C++ Class	475

16	C++ Classes	479
	Additional Class Features	480
	A Simple Class	480
	Nesting Classes	480
	Constructors and Destructors	484
	Overloading Class Member Functions	492
	Using Friend Functions to Access Private Class Variables	497
	Using the this Pointer	500
	Using Operator Overloading	501
	Overloading Operators and Function Calls	502
	The Syntax of Overloading	502
	Derived Classes	505
	The Syntax of a Derived Class	505
	Creating Derived Classes	506

17	Complete I/O in C++	513
	enum Types	513
	Reference Variables	514
	Default Arguments	517
	memset()	518
	Formatting Output	519
	C/C++ I/O Options	524
	iostream Class List	525
	Input Stream Classes	528
	Output Stream Classes	530
	Buffered Stream Classes	532
	String Stream Class	534
	Binary Files	536

Combining C and C++ Code Using extern "C"	539
Writing Your Own Manipulators	541
Manipulators Without Parameters	541
Manipulators with One Parameter	543
Manipulators with Multiple Parameters	544

18

Working in an Object-oriented Environment 547

An Object-oriented Stack in C++	548
An Object-oriented Linked List in C++	551
Creating a Parent Class	551
A Derived Child Class	552
Using a Friend Class	554
Examining the Complete Program	558
Linked-list Output	566
More Object-oriented C++	569

Part IV

DOS Graphics, System Access, Libraries, and Mixed Language Interface

19

Graphics Under DOS 573

Text and Graphics Modes	574
Utilizing Simple Graphics Functions	578
Drawing a Rectangle	579
Determining the Screen's Resolution	581
Information on the Graphical Environment	583
Graphics Details	584
Working with Graphics Primitives	593

Using Fonts in Graphics Mode	599
Basic Font Attributes	602
Displaying Different Fonts in Different Sizes	603
Rotating Fonts	607
Scientific and Business Applications with Graphics Primitives	612
Drawing a Sine Wave	612
A Fourier Series	617
A Pie Chart from Graphics Primitives	623
Presentation Graphics	629
An Interactive Pie Chart	634
An Interactive Bar Chart	638
An Interactive Line Chart	641
A Scatter Chart	644
Special Graphical Effects	648
Using Four Viewports	648
Sizing the Viewport	650
Simple Animation	653

20

Power Programming: Tapping Important C and C++ Libraries 661

Microsoft C and C++ Header Files	661
The Standard Library Functions (stdlib.h)	662
Performing Data Conversions	662
Performing Searches and Sorts	666
Miscellaneous Operations	669
The Character Functions (ctype.h)	672
Checking for Alphanumeric, Alpha, and ASCII Values	673
Checking for Control, White Space, and Punctuation	674
Conversions to ASCII, Lowercase, and Uppercase	676
The String Functions (string.h)	678
Working with Memory Functions	678
Working with String Functions	682
The Math Functions (math.h)	687
Building a Table of Trigonometric Values	687
The Time Functions (time.h)	689
Time and Date Structures and Syntax	690

System-dependent Functions	696
The bios.h Header File	697
The dos.h Header File	700

21 --- **Binding Microsoft C/C++ and Assembly Language** 707

Inline Assembly Language	708
Producing Sound	708
The Parallel Port as a General-purpose I/O Port	710
Controlling LED Lights	710
Creating C/C++ and Assembly Language Modules	714
Passing Function Arguments	714
Passing Arguments of Differing Data Types	715
A Simple C and Assembly Language Connection	718
Wiring a Hardware Interface Using C and Assembly Language	722
Passing Arrays from C to Assembly Language	727

--- **Part V Programming for Windows** ---

22 --- **Windows Programming: Concepts and Tools** 733

The Language of Windows	734
A Quick Perspective of the Windows Environment	734
Advantages of Using Windows	734
The New Windows Executable Format	741
Windows Programming: Concepts and Vocabulary	742
The Windows Window	742
The Windows Layout	743
A Windows Class in C/C++	745
OOPs and Windows	746

Sending and Receiving Windows Messages	750
Gaining Access to Windows Functions	754
The Windows Header File: windows.h	754
The Components of a Windows Application	755
The Microsoft C/C++ Windows Tools	756
The Need for a Make File	757
Creating Resources	757
Using the Image and Dialog Editors	757
Using the Resource Compiler (RC) from the Command Line	771
Additional Resource Information	775

23 --- **Writing Windows Applications in C** 777

A Framework for All Applications	777
Using Handles Effectively	778
Examining the Components in a Windows Application	779
A Simple Application and Template	792
Drawing an Ellipse	796
Drawing a Chord	797
Drawing a Pie Wedge	798
Drawing a Rectangle	800
Using the SWA to Develop a Sine Wave Application	801
Creating a Windows Pie Chart Application	805
The 23PIE and 23PIE.DEF Files	814
The 23pie.h Header File	814
The 23PIE.RC Resource File	814
The 23PIE.C Program	815
More on Traditional C Windows Programming	820

24 --- **Windows Programming: The Foundation Class Library** 821

The Need for a Foundation Class Library	822
--	-----

Foundation Class Library Design Considerations	822
Key Foundation Class Library Features	823
It All Begins with CObject	824
Important Foundation Library Classes	826
A Simplified Application Establishing a Window with 24SIMPLE.CPP	828
Running 24SIMPLE.CPP	833
A Simplified Design Ensures Easy Maintenance	834

25

Windows Programming: Using the Foundation Class Library 835

A Simple Application and Template Understanding the 25SFCWA Make File	836
Understanding the 25SFCWA.DEF Module Definition File	838
Understanding the 25Sfcwa.h Header File	839
The 25SFCWA.CPP Application	840
Running 25SFCWA	841
Drawing Graphics Primitives in a Window	842
The 25GDI Make, 25GDI.DEF Module Definition, and 25gdi.h Header Files	847
The 25GDI.CPP Application	847
Running the 25GDI Application	849
A Scientific Waveform with Menu and Dialog Boxes	850
The 25FOUR Make and 25FOUR.DEF Module Definition Files	857
The 25four.h Header File	857
The 25fourr.h Resource Header, 25FOUR.RC Resource Script, and 25FOUR.DLG Dialog Script Files	859
The 25FOUR.CPP Application File	861

Running 25FOUR	866
A Bar Chart with Menu and Dialog Boxes	866
The 25BAR Command-line Make, 25BAR.MAK Project Make, and 25BAR.DEF Module Definition Files	880
The 25bar.h Header File	881
The 25bar.h Resource Header, 25BAR.RC Resource Script, and 25BAR.DLG Dialog Script Files	881
The 25BAR.CPP Application File	883
Running 25BAR	890

Part VI Appendixes

A Extended ASCII Table 893

B DOS 10H, 21H, and 33H Interrupt Parameters 899

Screen Control with Bios-type 10H Interrupts	899
Interface Control of the CRT	899
Handling Characters	901
Graphics Interface	901
ASCII Teletype Output	902
Specifications and Requirements for the DOS 21H Interrupt	903
Mouse Control Functions Accessed Through Interrupt 33H	909

C Windows API Functions and Foundation Class Library Items 913