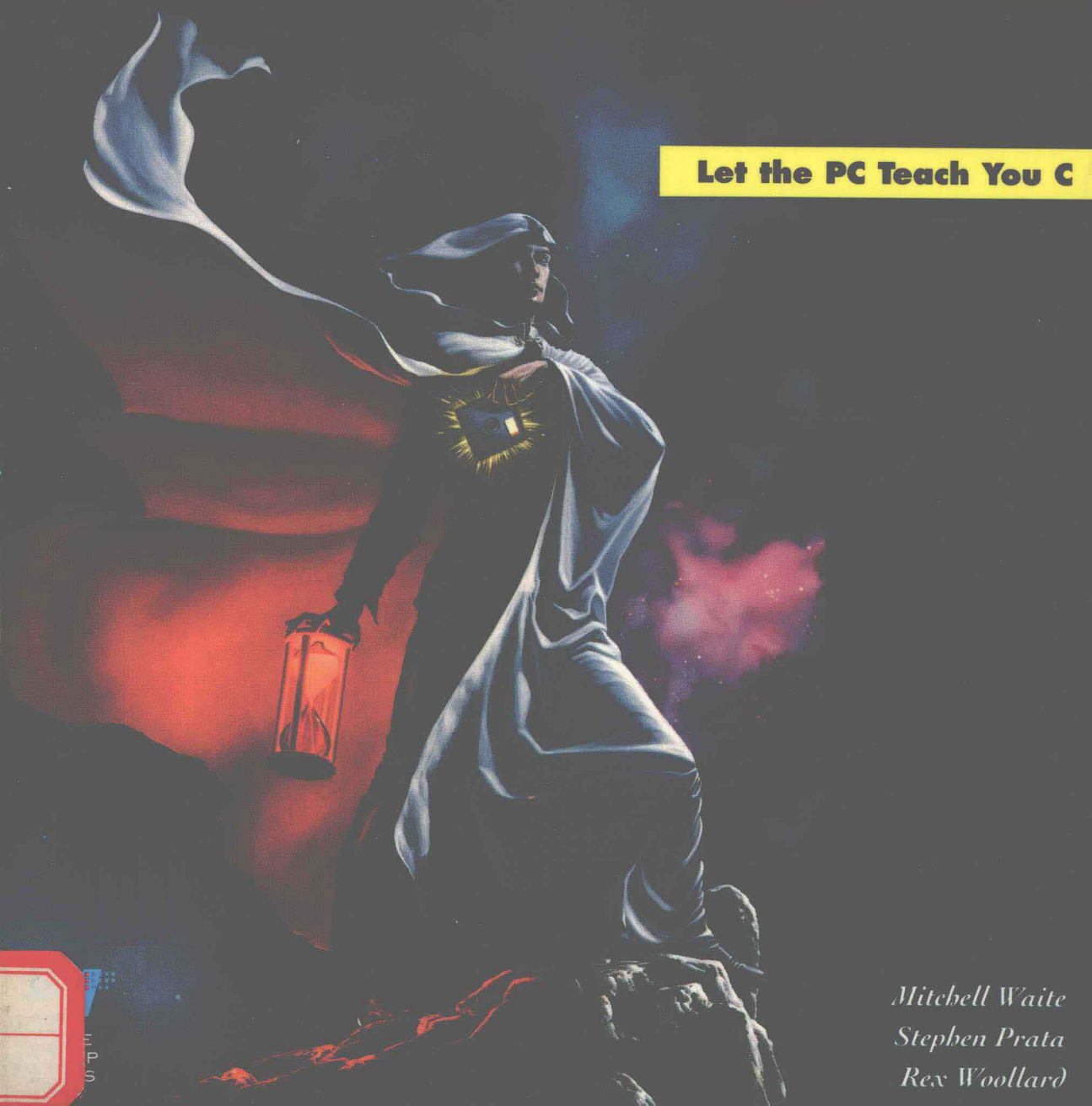
The Waite Group's

MASTER C

5.25" PC Disks Included



Let the PC Teach You C

Mitchell Waite
Stephen Prata
Rex Woollard

The Waite Group's

MASTER C™

Mitchell Waite, Stephen Prata, and Rex Woollard

PC-based teaching system that simulates a real instructor to teach C programming

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PRESS

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Dedication

To Mom and Dad. I miss you.

Mitch

Credits

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PREFACE

The story of Master C is a story of serendipity. In January of 1987 a few of us were discussing what the computer book of the future might be like. We decided it would NOT be just a CD ROM, that was too elementary and it was not taking advantage of the power of the computer to simulate a real teacher. No, we decided the book of the future would be a "teacher-on-a-disk." The software would be smart enough to teach you and test you, to probe for your weaknesses, it would be very tolerant of mistakes and would present the same question in many ways. At the same time it would let you read its pages (or screens) just like a real book. It would be structured like a book, but unlike the book it would offer many ways to enter into the learning experience. We thought about our best selling book, *C Primer Plus* (300,000 copies sold), and wondered how we could meld its proven contents with the power of an IBM PC-based delivery system.

A few days later a teacher and part-time software developer in Canada sent me a letter with an interesting idea. He had developed a computer-based teaching system that was being used at four different community colleges. He was using *C Primer Plus*, really liked it, and wanted to create a PC based training course for it. His system sounded exactly like what we had in mind.

After over 2 years of total development we believe that Master C is the first of a new generation of software teaching systems that will eventually replace the book as we know it. We plan to continue to perfect Master C, adding a windowing system, color graphics, animation, and multimedia sound and video. At the same time we will be perfecting our techniques for using artificial intelligence to make Master C the most masterful teacher we can.

I would like to thank the following individuals for helping with the development of Master C: Rex Woollard for unfaltering programming implementation of the courseware and his always helpful and optimistic attitude, David Easley for digging out bugs and bringing us the knowledge of how software is tested, Scott Calamar for editing the manual and helping with the management of the development cycle, Joel Fugazzotto for unrelenting technical support and production coordination, Earl Young for testing the software, Harry Henderson for writing, and for reviewing the software, Barbara Gelfand for cover design and the internal design of the book, Merrill Peterson for production management, Michael Whelan for exciting cover art, and Nick for growling at bill collectors.

Mitchell Waite, June 1990

INTRODUCTION TO THIS BOOK

This book is designed to get you up and running with Master C, a product that turns an IBM PC or compatible into a friendly and intelligent C instructor.

The book is divided into two parts. The first part is a basic manual for Master C; it explains what Master C is, the hardware requirements to use it, Master C's features, how to install and use it, details on exploring Master C for optimum learning, and a map of the course material provided by Master C. It presents an overview of the contents of each "chapter" in Master C, the objectives of the chapter, and an estimate of how long the chapter will take to complete. A chapter describes what to do in case you have trouble installing or using Master C. There is also a chapter on Tips and Tricks to improve your use of Master C.

The second part of this book is a detailed reference to ANSI C. It is designed to allow you to look up any keyword in the C language. The reference chapter gives a definition, syntax description, example call, and other details of using the keyword. You can use the alphabetical references when you need to quickly look up a C function you can't remember, or when you are away from the computer and wish to study or review C's vocabulary.

We recommend that you read Chapter 2 completely before installing the Master C software so you can become well acquainted with Master C's functions. Then install Master C on your PC and begin learning C. There are numerous tips that will make using Master C easier; these are covered in the chapter called *Exploring Master C.* If you have any problems with Master C you are welcome to call the offices of The Waite Group. Please have your registration number available and a detailed description of the problem.

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Chapter 1 ➤ WHAT IS MASTER C

Master C is one of the first commercial examples of the computer turned into a teacher; it is designed to teach you all the essential elements of the finalized ANSI C standard. Master C explains everything from the origins of C, running C programs, prototypes and data types, to complex data structures, pointers, and file handling. When you complete the lessons in Master C you will have covered all the topics fundamental to being a proficient C programmer. Much of Master C's contents come from our best-selling book, *The Waite Group's New C Primer Plus* (Howard W. Sams and Company, ISBN 0-672-22687-1, Carmel, IN, $26.95). Master C also parallels our C textbook *The Waite Group's C: Step by Step* (Sams, ISBN 0-672-22651-0, $27.95).

Nearly all the examples in Master C are "generic" C; that is, they're meant to run on any standard C implementation, including all those that compile for the IBM PC, as well as those that compile for minicomputers and mainframe computers. We've tested the program on a VAX 11/750 computer running under BSD 4.3 UNIX and on an IBM AT clone, IBM PC 386 clone, and a standard IBM PC XT using Microsoft 5.1 C, Microsoft QuickC, and Borland Turbo C, and under MS-DOS versions 3.2, 3.3, and 4.0. Occasionally, Master C discusses implementation-dependent matters, such as the differences between the way files are stored. However, we've confined our remarks to UNIX, MS-DOS/PC-DOS, which are currently the two most common environments.

Features of Master C

Master C has evolved over a period of several years. The underlying software engine was developed during five years of research at three educational institutions. The content of Master C was derived from a book with four years of educational and private use and resulting feedback. By blending this powerful software engine with the excellent writing of a proven book, The Waite Group has created an effective learning tool. Here are some of Master C's features.

Student Control

Master C is based on tutorial chapters that are presented as a sequence of text screens. After reading the screens, Master C asks questions and finds out if you understand the topic. The questions may be true/false,

➤ One of the beauties of Master C is that it can ask the same question in different ways.

multiple choice, or fill-in-the-blank. Often the questions are repeated in different ways. One time a question might require a complete word to be typed in, another time it may be presented in true/false format. One of the beauties of Master C is that it can change its questions to make sure you are really thinking.

Master C moves you through the tutorials along a predefined path. If you have trouble answering questions, Master C goes into the *Recall* mode, and "sends" you to the point in the tutorial where your knowledge is weak. After you successfully complete the recalled lesson you return to where you stumbled and then proceed with additional material.

Strategies to Using Master C

There are several strategies for using Master C .

Using Master C Like A Book

The most obvious way is to use Master C like a regular book, starting at the beginning and moving through its material in a linear manner, from Chapter 1 to Chapter 15. Switching to the book, *The Waite Group's New C Primer Plus*, when you are away from the computer, has been anticipated; the book and software completely parallel each other.

Jumping Directly to Tutorials

A real strength of Master C is that it is possible to jump directly to those C topics that are of interest to you. This will allow you to skip the preliminary sections of instruction and move right into the areas you want to understand. Master C will analyze your work in the review lessons, and if you are still wrong, it will send you to the proper lesson, so you can't leave the course confused. Master C tailors the instruction to the particular strengths and weaknesses of each user, something no book can do.

Once inside a Master C lesson, you have control over moving forward and backward through the material. Forward refers to moving from one page (screen) to the next, while backward is like turning pages (screens) backward. At any time you can branch off to use other related Master C features, and you will always be returned to your original position when done.

Studying a Single Concept via the Master C Glossary

Master C's built-in glossary provides a third way to access C knowledge. After looking up a related C word in Master C's glossary, you can request a lesson on the defined word. This can provide a special training path that is finely tuned to what you want to learn.

Using Master C's Review Sections

If you already think you know C and just want to check your knowledge for weaknesses, you can use the Review sections of each Chapter. These Reviews present a condensed summary of the content of the chapter, along with quizzes to test your understanding. Since taking the entire course can consume several days of work, the Reviews provide a quick way to avoid the need for studying certain chapters.

Sophisticated Answer Judging

Master C's skills are most apparent in the way it assesses your responses. Master C is designed to accept a wide range of possible user responses. You can misspell the answer, abbreviate it, and even give the answer in a poorly structured sentence, and Master C will still recognize if the answer is correct. Some questions are open-ended; there are many ways to phrase a correct response. Master C is able to figure out what you mean if you are close. This is unlike most computer-based training systems, which require you to type the exact answer to move forward.

➤ With Master C you can misspell the answer, abbreviate it, and even give the answer in a poorly structured sentence.

Retains Student Progress Information

As you complete various lessons, Master C retains information about your progress. When you ask for a list of your achievements, Master C will tell you which lessons have been completed and what your "score" is. The score is the percentage of correct answers, with 80% being considered "mastery." Master C will also tell you what lessons you have finished, and which you still need to work on.

Digital Bookmarks

You can quit Master C at almost any point in its tutorials. When you return later, Master C will take you back to the exact point in the lesson in which you were last working.

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Meaningful Feedback on Wrong Answers

Master C's feedback on answers varies depending on the nature of the questions. With particularly easy questions, a wrong answer causes the system to respond immediately.

With more demanding questions, Master C brings more of its expertise to bear. For example, if you answer a question incorrectly, the answer is analyzed and checked against anticipated problem areas. The system then responds with relevant hints designed to help you clarify your understanding. You will then be given an opportunity to try the question again.

In some cases, if you are still having difficulty with a particular question, Master C will present the same question in an easier form; displayed along with a number of alternative answers, only one of which will be correct. If you get the multiple choice question correct, Master C will deem you to have answered the question correctly. If you have trouble with the multiple choice question, Master C will switch into the Recall mode.

Recall Mode

Master C 's recall mode is one of its most powerful learning elements. Following the presentation of a question and the subsequent answer analysis and helpful hints, you might still be having difficulty with a particular topic. Here, Master C will automatically return to a tutorial lesson covering that topic. You will then have a chance to review this related material before trying to answer the question again.

On-line Glossary

Because you may encounter unfamiliar terms or keywords, Master C includes an on-line Glossary. At any point in the course, you can look up related C terms for additional information. Master C will even attempt to match close spellings when you are unsure of the exact term. With many of the terms, the glossary will offer to link you to related instructional material. If you choose to work with the related material, afterward you will be able to return to your jumping off-point—the place where you first invoked the glossary.

This feature provides an alternate and powerful learning path. Ordinarily, you are likely to access learning material by choosing lesson

items from a menu. Using the glossary, you can jump directly to instructional material by entering the desired term or keyword. There is no need to walk back and forth through menus. This feature is useful in a variety of circumstances. In one case, you may already be familiar with the C language, but need to reference the learning material on some specific topic. Using the glossary, you can jump directly to the appropriate subsection from anywhere in the course. You don't have to use the menus at all.

➤ The glossary mode allows you to hunt down a specific concept and really understand it.

Even if you are using the menus as your primary path to learning material, you can make good use of the glossary path. Imagine that you are working through a lesson dealing with control loops, and you encounter references to the ++ operator. Without leaving the lesson on loops, you can use the glossary to explore other lessons covering the ++ operator. When finished with the ++ operator, you will automatically be brought back to your jumping off point—the lesson on loops. You can pick up from where you left off.

Calculator

An on-line 9-digit, scientific calculator is also included. It supports standard trig functions and constants such as *pi*. It does not do pointer arithmetic nor allow you to do segment math for the Intel family of microprocessors.

Chapter 2 ➤ INSTALLING MASTER C

System Requirements

This package can be installed on virtually any MS-DOS based machine. The minimum system configuration is an IBM PC, XT, AT or compatible, with 384K of RAM, a floppy drive, a hard drive, and a monochrome screen which supports highlighting. Though a monochrome monitor is sufficient, Master C takes best advantage of a color monitor which is much easier to read. When installed on the hard disk, approximately 2.2 megabytes of storage is required for Master C.

Overview of Installation

➤ Master C's files are compressed, so you must run Install. About 2.2 megabytes of hard disk space are required.

Master C is easy to install. The core programs and their associated data files are supplied on 360K IBM PC floppy disks in a compressed format. Because we have used a compressed format, you must use the INSTALL program on Master C Disk 1 to get Master C up and running—simply copying the files will not work.

The first time you install Master C you will be asked to enter your name and the serial number printed on Disk One. Your copy of Master C will then be updated to include this registration information. Later, if you choose to install Master C on another computer system, the registration information will already be recorded; you will not be asked to enter your name and serial number again. *Master C can legally only be used on one computer system at a time. Be sure and fill out and mail in the enclosed registration card.*

ANSI.SYS and NANSI.SYS

Master C requires a device driver, such as ANSI.SYS, installed in your PC in order to properly use the screen. ANSI.SYS comes with all versions of PC-DOS and MS-DOS. However, many people may not have ANSI.SYS installed on their PC. Don't worry if you don't have ANSI.SYS installed. The Master C installation process automatically loads an ANSI.SYS compatible driver called NANSI.SYS, to your root directory, and creates a copy of your CONFIG.SYS file that contains the additional line DEVICE = NANSI.SYS. (Your old CONFIG.SYS is saved as CONFIG.BAK.) Once you restart the computer, this installation method will make Master C work. By the way, NANSI.SYS is actually

faster than ANSI.SYS when writing to the screen, so you may prefer to use it instead of ANSI.SYS.

If you have ANSI.SYS already installed, or prefer to use it instead of Master C's NANSI.SYS, you can restore your old CONFIG.SYS file with the DOS command

COPY CONFIG.BAK CONFIG.SYS. Enter

You can then eliminate the file NANSI.SYS with

DEL NANSI.SYS. Enter

If you want to use ANSI.SYS, make sure that it resides on the hard disk and that the command DEVICE = ANSI.SYS is in your CONFIG.SYS file. If ANSI.SYS is in a directory, such as DRIVERS, make sure the device name statement in CONFIG.SYS is

DEVICE = C:\DRIVERS\ANSI.SYS.

Before Installing Master C

Before starting this installation make sure you have at least 2.2 megabytes of free space on your hard disk to hold the Master C files.

Steps for the First Installation

➤ Master C contains a serial number that identifies it as your copy.

As a first step, take a moment to record the serial number of Master C Disk One in this guide.

Write your serial number from Disk One _____
You will be asked to enter this number during the first installation.

1. Start your computer.

2. Place Disk 1 in the A: drive (you can also use drive B:).

3. Select drive A: by typing: **A:** Enter

4. Start the INSTALL program by typing: **INSTALL** Enter

5. The first screen, shown in Figure 1, will display the Master C logo screen, overlaid with a dialog box that requests you to enter your first and last names, and the serial number on Master C Disk 1. Following this step, your copy of Master C will be permanently registered in your name. Note you must enter a valid name and serial number or Master C will not be installed.

Figure 1: The opening screen for the install program. You must enter your name and serial number.

6. As the installation program proceeds, explanations will appear and you will be asked to insert each of the subsequent Master C disks. You will also be able to choose the drive letter of the hard disk on which you wish to install Master C.

Note: During the installation process, status messages will be displayed to detail the system's progress. These can be ignored unless you encounter problems.

During installation Master C will install a "device driver." Because device drivers are loaded only when the computer is started, you should restart your computer after the installation process is complete. Additional information about device drivers is available in Chapter 6, *In Case of Trouble.*

Steps for a Subsequent Installation

Should you choose to install Master C again, you will follow the same steps which are outlined above, except step 5. Since you will have already registered your copy of Master C, you will not be asked to enter your name and disk serial number a second time.

> NOTE: Be sure to check the README file that will be on your hard disk after you install Master C. This file contains notes about using Master C, known bugs, tips, additional things to do in case of trouble, and compability issues.

Chapter 3 ➤ USING MASTER C

Getting Started

Start Master C by switching to either the \MASTERC directory or the directory you installed Master C in, and type:

MASTERC Enter

The first thing you'll see will be the logo screen as shown in Figure 2. It is displayed while several additional program and data files are loaded into your computer.

After the logo screen is displayed, you will see a welcome message inviting you to explore the online introductory tutorial (accessed by typing **T**). Following the welcome you will see the opening Table of

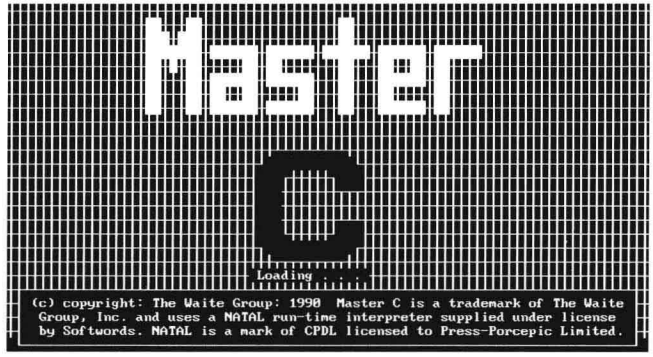

Figure 2: The opening screen for Master C appears immediately after you start the program.

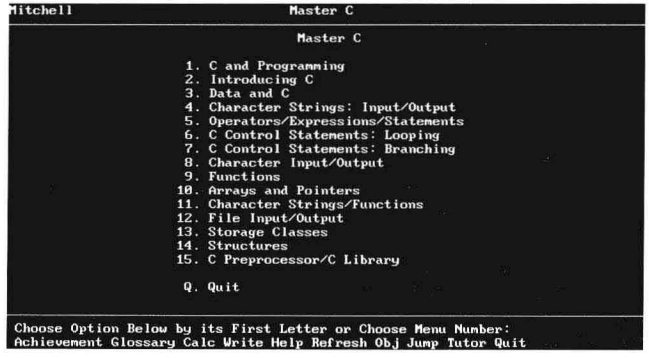

Figure 3: Main Table of Contents screen for Master C. You can access any chapter or command on the option bar.

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