

80x86 Family, The: Design, Programming, and Interfacing

By John Uffenbeck

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Comprises a revision of the 1987 edition, expanded to include coverage of all 80x86 processors from the 8-bit 8088, the 16-bit 8086, and the 80286 to the 32-bit 80386, 80486, Pentium, and Pentium Pro processors. More than a survey of Intel microprocessor chips, the text presents concepts relative to

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Editorial Review

From the Back Cover

Written for introductory courses in microcomputers or microprocessors, this text's clarity and easy-to-follow writing style have been highly and consistently praised by reviewers and readers. Each chapter contains a chapter outline, learning objectives, a chapter overview, hierarchical design, self-review questions, self-test questions, and analysis and design questions-all of which enhance learning.

This new edition of *The 80x86 Family. Design, Programming, and Interfacing* has been extensively updated to include material on the newest processors, including the Pentium II and III, the Xeon, the Itanium, and AMD's Athlon. More than 65 new end-of-chapter questions and problems have been added, along with numerous new figures and tables. Also included in the text are suggestions for Internet and hands-on lab projects.

Included with each book is a CD, organized by chapter, that contains the assembly listings for all of the programs in the book. The disk also contains a copy of DEBUG32, enhanced software that allows full access to the 32-bit registers and addressing capabilities of 80x86 processors. DEBUG32 also can be used for debugging protected mode programs.

An Instructor's Manual (0-13-032833-2) containing answers and solutions to all of the end-of-chapter questions and problems is available free of charge to instructors who are using this book for a course.

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Preface

What Is This Book About? First and foremost, this book is about microprocessor and microcomputer technology. That is, it deals with microprocessor chips, memory chips, I/O devices, and the logic circuits needed to "glue" these parts together. To make these topics real, the Intel family of 80x86 processors is covered. As these parts are among the most popular in the industry, they represent a good starting point if you are just beginning to learn about microprocessors.

Who Should Read This Book? My intention in writing this book is to provide an entry-level college textbook that exposes the reader to the nitty-gritty details of the 80x86 processors and the microcomputer systems around which these chips are built. However, you need not be formally enrolled in a college course to find this book useful. You can pick and choose the topics that interest you, beginning with a brief history of computer technology in Chapter 1 and ending with a description of personal computer architecture and bus systems in Chapter 11. Indeed, you may find the book interesting simply for the historical chapter opener photos obtained from the Smithsonian Institution.

What Are the Key Features of This Book? In the years since this book was first written, reviewers have consistently praised its clarity and easy-to-follow writing style. In addition, each chapter is laid out in a way that enhances learning.

- *Chapter Outlines.* Each chapter begins with an outline that lists the major topics of that chapter.

- *Learning Objectives.* The major points to be learned are presented in a list at the beginning of the chapter and later repeated as these objectives are covered in the text.
- *Chapter Overview.* Each chapter includes an overview that "warms the reader up" for the topics about to be covered in the chapter.
- *Hierarchical Design.* Major topics are broken into numbered subsections that begin with an introduction and a list of learning objectives. Subtopics are then set off by themselves in **bold.**
- *Self-Review Questions.* Each section ends with a set of questions that reviews the important topics in that unit. Answers are included at the end of every chapter.
- *Self-Test Questions.* Each chapter includes a set of 20 to 25 multiple-choice or fill-in-the-blank questions. These are intended to measure understanding of basic facts presented in the chapter.
- *Analysis and Design Questions.* These questions are keyed to the chapter subsections and require an application of the concepts developed in that chapter.

What Are the Main Topics of This Book? Logically, you can view this book as having four main parts:

1. *Introduction.* Chapters 1-3 provide an introduction to microprocessor technology and the Intel 80x86 family of processors in particular. Also included are descriptions of the binary and hexadecimal number systems, computer codes, computer operating systems, and computer programming. Pay particular attention to the historical sections of Chapter 1. This was fun to write—and in a way is my tribute to the men and women who designed and built the wondrous machines we now take for granted.
2. *Software.* Chapters 4-6 cover 80x86 programming. Initially DOS's DEBUG utility is used for program construction and testing. Later, in Chapter 6, Microsoft's assembler (MASM) is introduced along with its companion, the Codeview debugger. As in the previous edition, all of the program examples can be developed and tested on a standard PC.
3. *Interfacing.* Chapters 7-10 cover microcomputer hardware. Included are a lengthy discussion of memory technologies and interfacing examples, parallel and serial I/O ports, and programmed and interrupt driven I/O control schemes. Common serial I/O standards and modem technologies are also covered.
4. *PC Systems.* Chapter 11 concludes the book with a description of the PC XT, AT, and PCI bus structures and architectures. The SCSI and USB I/O buses are also covered in this chapter.

What's New in the Third Edition? Writing a microprocessor book can be a frustrating experience. No sooner have you updated a section or chapter and along comes a new processor that renders all of your work obsolete! Nevertheless I have attempted to "chase the chips" and keep the book as current as possible. The following list summarizes the major changes:

1. Chapter 1 has been extensively updated to include material on the newest processors, including the Pentium II and III, the Xeon, the Itanium, and AMD's Athlon. Table 1.1 in particular has been reworked to provide a more useful and updated summary of the various 80x86 chips.
2. A new section entitled *Measuring Processor Performance* has been added to Chapter 1. Two graphs comparing the various 80x86 and AMD processors have been included.
3. The section in Chapter 2 describing MS-DOS has been rewritten and now includes more historical information.
4. The description of 80386 Protected Mode has been greatly expanded and now includes several new figures and examples.
5. Chapter 3 now includes detailed descriptions of the various P6 processors (Pentium Pro, 11,.111, and Xeon).
6. A sidebar comparing superpipelining and superscaler processor architectures has been added.
7. Several examples have been added to the processor instruction descriptions in Chapter 4.
8. A new section (program example) featuring string instructions was added to Chapter 5. Eight fully documented program examples in DEBUG format are now included.

9. Chapter 7 has been extensively updated to include the latest memory technologies, including synchronous SRAM, DRAM, and RAMbus DRAM. RIMMs and DIMMs are also covered. Each memory technology is now characterized by its bandwidth capabilities.
10. Descriptions and examples of the 8254 timer have been added to Chapter 8.
11. The appendix now includes 16 tables that summarize and provide examples of each of the 8086 program instructions.
12. More than 60 new end-of-chapter questions and problems have been added, along with 75 new figures and tables.

Are There Any Supplements? In the back of the book you will find a CD that includes the assembly listings for all of the programs in this book. These are organized by chapter with the figure name used as the program name. In addition, you will also find on this disk a copy of DEBUG32. This is an enhanced version of the popular DEBUG utility supplied with MS-DOS. It allows full access to the 32-bit registers and addressing capabilities of the 80x86 processors. In addition, it can also be used for debugging protected mode programs. A special thanks to Rob Larson of Larson Computing and Michael Schmit of Quantasm Corporation for their permission to include this program.

An instructor's manual is also available that includes answers and solutions to all of the end-of-chapter questions and problems. Also included in this manual are suggestions for Internet and hands-on lab projects. Pay particular attention to Chapter 5, which includes solutions to more than 20 additional 80x86 programs.

Acknowledgments. Numerous people assisted me in the development of this textbook. I would like to thank the following reviewers: Isaac Ghansah, California State University, Sacramento, CA; Lubomir Ivanov, Stevens Institute of Technology, Hoboken, NJ; Karl E. Stoffers, California State University, Sacramento, CA; and Norman E. Thagard, Florida State University, Tallahassee, FL. I would also like to thank Rob Larson of Larson Computing for permission to use DEBUG32, and Tracy Mazur of Intel Corporation for her help locating several photos. Finally a special thanks to my editors Charles Stewart, Delia Uherec, and Tricia Rawnsley at Prentice Hall, and Kathy Davis at Carlisle Publishers Services who kept me on the task.

Is There Anything Else? That's about it. If you would like to contact me regarding this book, my e-mail address is *juffenbe@witc.tec.wi.us.* Good luck as you begin your study of the 80x86 family of microprocessors.

John Uffenbeck
Wisconsin Indianhead Technical College

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