Logic Design Principles with Emphasis on Testable Semicustom Circuits

Edward J. McCluskey (Prentice-Hall, Englewood Cliffs, N. J., 1986, 549 pp., $39.95)

Finally, a textbook that addresses the challenge of logic design with today's technology. With careful consideration given to testability of digital circuits, it is a practical treatment of the subject. I used a prepublication edition to teach graduate and undergraduate courses in logic at Stanford University, the University of San Francisco, and San Jose State University (SJSU), and I found it by far superior to all texts available on the same subject.

The book consists of 11 chapters, divided in four main parts: A view of basic Boolean algebra and integrated circuits, "combinational logic design," "sequential logic design," and "design structures." Each chapter includes several easy to teach and learn features: step-by-step evolution of topics, self-contained subsections, illustrative examples, and clear figures. Also, at the end of each chapter, there are extensive references and useful and stimulating problems.

The first part of the book is intended as an "introductory review." However, it has proved useful in teaching novices in the field. At SJSU, I used the book in conjunction with a digital design laboratory to teach students of computer engineering about integrated circuits. This last topic, which is covered in Chapter 4, may be skipped for the reader with an EE background. However, I intentionally included it in courses for computer science students. These students are not likely to encounter circuitry in their program of study, but they ought to learn about the technology and the circuits they will use in their professional lives.

Combinational circuit design was the topic covered in the second part. Chapter 5 "could be omitted for a first reading," says the author. However, this will depend on the reader. That is, for students who have not been exposed to the topic before, it is better to include the chapter from the onset for two reasons: to expose the students to some theoretical approaches and to accustom them to the use of these concepts in subsequent chapters. Chapter 6 is a complete treatment of combinational design. By "complete" is meant the use of the standard methods (Karnaugh maps and tabular form) as well as minimization techniques for PLAs and discussion of hazard free design. In this chapter the testing aspects of the circuits are also fully treated.

The third part of the book deals with sequential circuits. First the fundamental difference between latches and flip-flops is clarified. This is followed by the analysis of sequential circuits: finite state machines and single- and multi-pulsed networks. Chapter 9 treats the design aspect of these circuits. Careful attention is given to essential hazards and approaches to reduce them.

Part four is an excellent dénouement for all the concepts that were discussed in previous chapters. A concise, self-contained treatment of the testability of digital circuits is given in Chapter 10. It is one of the several strong features of the book. It is also a good introduction to the topic for professional designers who need to incorporate testing in their design methodology. Chapter 11, which deals with design using MSIs, includes many practical features for semicustom design.

The IEEE symbols for logic gates, which are becoming an industry standard, are used throughout the book. This might look awkward at first for those who have grown accustomed to the old notations. However, very quickly the reader will recognize the strength of these notations. Their adoption is particularly useful for the first-time reader of logic design.

Unlike other authors of logic design books, McCluskey deliberately raises, right from the beginning (Chapter 3 on), the need to look for the vulnerable features of digital circuits and to provide the proper design to make these circuits more robust. In summary, he has interwoven the testing concepts with logic design principles to give a new approach to digital circuit design.

Samih Mourad
San Jose State University

Computer Architecture

Caxton C. Foster and Thea Iberall (Van Nostrand Reinhold Co., New York, 1985, 366 pp., $38.95)

This book is suitable for use by upper-level undergraduates. Graduate students studying a book like Computer Architecture and Parallel Processing by Hwang and Briggs might find this book useful as a backup text. While the Hwang and Briggs book is dense, Computer Architecture is written in an informal style so as to be readily understandable, even to someone not in the field. An example of its informality is the presentation of tri-state logic:

Sometimes we like for other people to state their desires clearly and forcefully: "Yes! I want to go downtown," or "No! I want to stay home." But at other times a little diplomacy is called for: "What would you rather do?" So too with circuits we sometimes desire a third or passive state.

This informality might be attractive to some people and might repel others. Certainly the authors have not sacrificed rigor for style. The topics range from such elementary concepts as flip-flops to a concise discussion of von Neumann's self-reproducing automaton.

The book is organized as follows. Chapters 1-4 provide a background to the field, and Chapter 5 offers a case study. Chapter 1 discusses some of the many methods of representing information inside a computer. Chapter 2 is a brief review of elementary switching circuits. Chapter 3 covers the more common physical devices that have been used for storing information. Chapter 4 considers how these devices can be put together to provide storage for computers. Chapter 5 presents a case study of the design of a general-purpose computer called BLUE.

Beginning with Chapter 6, the authors present the reader with some of the choice points in designing a computer. Chapter 7 discusses problems arising in input and output control. Chapter 8 treats some of the instructions found in other computers. Chapter 9 looks at a few of the larger machines available and concludes with a study of a hypothetical machine designed to work in a time-share-
Secure Speech Communications

Henry J. Beker and Fred C. Piper
(Academic Press, Orlando, Fla., 1985, 267 pp., $39.50)

This book examines the various matters to be considered when designing and/or evaluating a system where confidentiality is required. This book will be useful to those interested in speech security—whether they are involved in it from a mathematical, engineering, or programming perspective.

The first chapter looks at speech security from a user's perspective. This covers the steps that users should follow when evaluating a speech security system. This includes a good explanation of how to identify exactly what the requirements for the system are, a brief outline of what type of equipment is available, and how to evaluate system proposals. It is of the utmost importance that anyone who is responsible for choosing a speech security system be fully aware of the end-user requirements, and this chapter will help to clarify the points to consider when faced with such a task.

Chapters 2 and 3 cover telecommunications theory and mathematics required later in the book. Chapter 2 is aimed at briefing the mathematician on the electronic and telecommunications side of speech security and discusses the transmission of speech, signal analysis, properties of speech, a/d converters, and modulation. Chapter 3, on the other hand, is for the electronic engineer and discusses the properties of cipher systems under the headings of theoretical security and practical security. It also covers in detail block ciphers, stream ciphers and public key systems. These chapters are well written, but I feel that it would have been better if it had been left to the readers to investigate elsewhere the areas with which they were not well acquainted. It is impossible for anyone in such a short space to do what the authors have attempted to do in these chapters. They tried admirably to make the book comprehensive, but reading these chapters from an electronic engineer's viewpoint, I covered areas with which I was quite familiar and found unnecessary, whereas in other areas I found a lack of depth in the discussion.

The rest of the book is dedicated to specific systems for speech security. Chapter 4 covers various methods employed in operation on frequency to scramble the signals. This includes frequency inverters, band shift inverters, band splitters, and, briefly, spread spectrum techniques. Spread spectrum techniques could easily merit a chapter of its own, being a method that is of increasing importance. It is disappointing to see the authors dedicate so little attention to it. Chapter 5 discusses time domain scrambling and is comprehensive in its coverage of inverted time segmentation, time element segmentation, and time sample scramblers. Chapter 6 looks at the application of systems using both time and frequency domain scrambling. It includes sections on techniques to combine the two methods and a comparison of techniques. There is a good section here on synchronization of signals.

The final chapter covers digital scramblers. The book finishes by giving two practical examples of secure systems: one being a VHF radio system and the other a digital telephone system based on DES (Data Encryption Standard initiated by the National Bureau of Standards).

I found this book readable, interesting, and informative, and it will without doubt be of use to anyone involved in the field of data security.

Eamonn Coyle
Cosmology Mfg. Ltd.
Dublin 18, Ireland

The Principles of Computer Hardware

Alan Clements (Oxford University Press, New York, 1985, 454 pp., $22.50)

This book is intended as a first-level (i.e., introductory) text in computer hardware principles. It includes information on both the theory and implementation of these principles. After a general introduction to the digital computer in Chapter 1, the concepts dealing with Boolean algebra and its use in designing logic are dealt with in Chapter 2. Basic gates are described with applications, and Karnaugh maps are explained to show logic minimization techniques. Different logic examples are shown composed of gates. Registers, flip-flops, and sequential circuits are introduced next.

Chapter 3 deals with computer arithmetic, including different number bases and binary and floating-point arithmetic. Binary adders and floating-point logic are explained. Chapter 4 begins the structure of the computer with material on the central processing unit. After some general discussion, a fairly detailed description of the 6502 architecture, originally from MOS Technologies, is given. Included in this chapter are a description of the control unit, instructions, and addressing modes of the machine. A short section on the Motorola 6809 is also included.

Chapter 5 is on input/output. A description is given of the different principles involved in various devices, such as displays, printers, and keyboards. The different types of mechanisms and the logic used in these devices are part of the chapter. Chapter 6 covers computer memory organization and structure, including storage types such as FET, core, and disks. The different technology characteristics are explained, including information on the different ways of encoding data on magnetic media. Chapter 7 is on advanced computer arithmetic, that is, multiplication and division. The book is completed by a short chapter on communications and operating systems. The chapter on communications has information on protocols and local area networks, while the operating systems chapter is mostly on general principles. There are two appendices: one with some problems and their solutions and another with the 6502 instruction set.

With a concurrent (or prerequisite course) in programming and a background in algebra, the student will find the text adequate for understanding computer hardware principles. I feel it

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would make a good textbook or it could be used for self-study. Most of the chapters contain problems—some of them worked out. The book has a good collection of diagrams. A first course could omit the last three chapters and some of the other material if necessary. Among the book’s strong points are a clear style and the inclusion of many “extra” topics, such as Huffman codes, keyboard mechanisms, thin-film memories, and communications. Another plus is the attempt by the author to illustrate the principles with actual as opposed to ideal systems. This makes the book useful as an entry to actual computer systems. In a book that should stimulate further study, however, I would have liked a more extensive bibliography. Overall, though, it is a good sound work that I can recommend.

Joseph M. Kusmiss
IBM

The Mystical Machine: Issues and Ideas in Computing

John E. Savage, Susan Magidson, and Alex M. Stein (Addison-Wesley Publ. Co., Reading, Mass., 1986, 425 pp., $22.95)

To confront the computer revolution, every concerned citizen should start by reading The Mystical Machine, a beautifully crafted, thoughtfully written textbook on computer literacy. While addressing historical, technical, and social topics significant to students, professionals, and the general public, the authors progressively unveil the computer from its concep­tion to its use and meaning today. The book contains 14 factual chapters. Each chapter contains an introduction, a set of topical sections, a summary, a bibliography, and a section of questions dealing with issues and ideas. Difficult concepts are skillfully clarified with supportive figures and tables. Historical figures are personalized with engaging photographs.

In Chapter 1, the authors claim that, for many people, the computer is a mystical machine because of its scientific origin, its initial remoteness, and its association with the electronic brains of science fiction. They say that many people fear their own ignorance of the computer, while others wish to ignore this machine. They compare the current computer revolution with the Industrial Revolution of the past and conclude that ignorance is a social danger. They claim that people must understand the computer and its potential in order to prevent human hardship. The authors deny that the computer is a mystical machine. They define it as a human artifact consisting of five parts: a means of input, a means of output, a central processing unit, memory, and a program. They proclaim that anyone can understand its essential features and approach it with confidence, and they use the rest of the book to prove their point.

In Chapters 2 through 5, the authors describe the evolution of calculation from the abacus to the 8080 microprocessor. They demystify computer architecture, describe hardware components, and treat computer families and networks. They explore word processing systems; briefly describe Bank Street Writer, WordStar, and MacWrite; and discuss supporting processors and future trends. They also delve into the evolution of the operating system; present its features; and describe CP/M, MS-DOS, and UNIX from a user’s perspective.

In Chapters 6 through 9, the authors relate problem solving to the algorithmic method. They present fundamental programming concepts with Basic. They advance to structured programming with Pascal. They discuss the spectrum of programming languages, including Cobol, Fortran, Lisp, Prolog, and Smalltalk-80. They also describe software systems, including graphical editors, spreadsheets, and database systems.

In Chapters 10 through 14, the authors relate the advantages of computer-aided instruction to solving current problems in education. They survey the topics comprising artificial intelligence. They present social issues of office and factory automation. They also review the problem of protecting privacy.

The authors conclude with a brief section introducing topics of concern in the computer age. They propose that society must control the unwanted side effects of the computer’s widespread use, assure the reliability of on-line systems providing vital functions, and prevent crucial decisions by complex systems subject to human error. They present arguments that computers are changing interpersonal relationships, attacking human qualities, altering the nature of work, and making computer access a prerequisite to entering the life stream. Despite these threats, the authors profess cautious optimism for the future, and they welcome “the careful thought and planning that human beings must invest to make the computer revolution beneficial to the human race.”

In the beginning, the authors equate people’s mystical awe for the machine with superstition and magic, and they advocate using education as the main tool to dispel ignorance. In the end, they put their trust in knowledge and moral values to control the computer revolution. In this book they supply most of the knowledge needed to understand the computer, but they also ignore one fact: In their advocacy of eliminating mysticism, they have also eliminated the other important tool needed for controlling the computer revolution—morality. For many people morality has mystical roots. Thus when people use the computer to enforce moral values, such as in crime control, the machine in a sense has a mystical purpose. Thus controlling the computer revolution entails influencing the mystical forces that motivate people. Furthermore, when the authors welcome the “careful thought and planning” required to benefit the human race, they welcome the triumph of a “mystical force” called rational humanism. Their welcome will have to wait until people are persuaded that rational humanism is the best way to deal with “the mystical machine.”

Irad D. Cole
Unisys Defense System

Programming 16-bit Machines: The PDP-11, 8086, and M68000

William H. Jermann (Prentice Hall, Englewood Cliffs, N.J., 1986, 436 pp., $32.95)

The author, in his preface, states that “It is generally accepted that Universities should teach principles rather than attempt to have students develop very specific skills. However, attempts to teach computer-related principles independent of particular machines have, at best, led to questionable outcomes.” He uses this rationale in his book to teach programming of 16-bit machines by focusing on three particular machines, the PDP-11, 8086, and M68000. I agree with the author that the evolution and applications of large scale and very large scale integrated circuits have resulted in an increased need for engineers to develop and improve programming skills. I think the author has struck a correct balance of breadth and depth by choosing three industry-standard machines instead of focusing on one particular machine (as have, for example George
Alexy and Russell Rector in their book, *The 8086 Book*), on the one hand, and general-purpose microcomputer books, on the other. Indeed, I found it interesting to flip the pages and compare and contrast the three machines, taking advantage of the diverse information available in the book.

Some highlights:

- Chapters 1 to 4 contain material that is nearly machine independent. Chapters 5 to 9 relate to the PDP-11 family of computers. Student access to a PDP-11 is required in order that skills related to assembly-language programming be developed.
- Chapter 10 is a self-contained unit relating to the 8086/88 processor and its assembly language. Access to an IBM PC is required for developing the related concepts and skills.
- Chapter 11 is devoted to the M68000 processor. According to the author, the material contained in the first nine chapters significantly facilitates the mastery of the material in Chapters 10 and 11.
- I found the author's writing style and powers of exposition quite engaging. Topics such as structured programming, macro-assemblers, DMA, and block data transfers, etc., are carefully explained. In the case of the 8086, the difference between the physical and logical address, and the use of the segment registers, always a stumbling block for beginners, is explained clearly, through small examples.
- It is worth mentioning that although the author treats interrupts at length, his omission of information on programming chips like the 8259 programmable interrupt controller is a real drawback. Knowledge of this and other special-purpose chips is essential to serious design work.
- The overall setup of the book is attractive. The typography is well done and even the assembly-language routines do not appear forbidding. Apart from the interesting examples scattered through the text, there are review points at the end of the chapters, and also some good references and exercises. I am sure a student using this book and working on a machine will achieve proficiency in programming 16-bit machines.
- I hope this book helps to usher in a new era in which software-oriented courses will be taught in US electrical engineering programs, as is done in Japan, and not relegated entirely to computer science programs, as is the case at present.

Chandan Sen

### Information Systems Management in Practice

Ralph H. Sorague, Jr. and Barbara C. McNurlin (eds.) (Prentice-Hall, Englewood Cliffs, N. J., 1986, 491 pp., $30.95)

With the rapid proliferation of computers throughout the business, scientific, academic, governmental, and private worlds, it becomes easy to find oneself adrift in an unmanageable world of incompatible hardware and software and of conflicting objectives. According to the authors, "The net result is a growing need for guidance on the issues, strategies and tactics for managing the use of information technology." This book purports to fill that need.

The volume is divided in 18 chapters. Chapter 1 is an introduction to the book, provides some history of the information technology area, presents some elementary models, and discusses the organization of the book. The remaining 17 chapters are grouped into five major topic areas. These topic areas are

1. Strategic issues, Chapters 2 through 4;
2. Managing the essential information technologies, Chapters 5 through 7;
force behind end-user computing; Chapter 14 explores decision support systems; and Chapter 15 deals with the "rocky road" to office automation. These chapters include 10 case examples, the one revolving around Lincoln National Life Insurance Company, in Chapter 15, being particularly well done and to the point.

This book is well organized, thoughtfully presented, and well documented. This reviewer found it to be thought-provoking and current. It would be a good text for upper-division courses on management in the information technology field. It would also serve as an excellent resource for managers in the field, both for ideas to aid in present-day problem-solving and as an idea pool for dealing with coming trends.

Steven J. Altig
Internal Revenue Service

Satellite Communication Systems Engineering
Wilbur L. Pritchard and Joseph A. Sciulli (Prentice-Hall, Englewood Cliffs, N. J., 1986, 399 pp., $42.95)

This book was developed from a set of seminars and short courses given by the authors between the years 1974 and 1984. It covers a wide range of topics applicable to satellites in general and communications satellites in particular. It is not, however, a particularly useful reference for the practicing satellite systems engineer since it is more an overview than a treatise.

Most concepts are well explained, and the authors' source material is cited in reference sections at the end of each chapter, or in footnotes. There are also additional readings suggested at the end of each chapter. The book contains many tables, an abbreviation glossary, and a reasonably good index. This book makes a good reference source or text for engineers, engineering managers, or students wanting an introduction to satellites and satellite communications.

The authors do not seem to have clearly identified the intended audience. Both students and working engineers are addressed in the introduction, but in the preface the authors state "we have avoided abstruse generalizations and all advanced mathematics." Hence, if the book is meant to be a text, the instructor must supply the mathematical formulae necessary for the precise calculations usually required in coursework; if the book is meant as a reference for practicing engineers, understanding those abstruse (i.e., hard to understand) generalizations is necessary to the engineers' job.

The text is well written, though sometimes its seminar/short course genesis is apparent when the material becomes either too sparse or too fundamental. Some basic concepts are not well explained, but seem to beg questions to tie their meaning to the subject at hand. Other concepts are so basic that they would be known to any person interested in this book (e.g., the frequency spectrum of an ideal filter), and seem to be included as "warm-up" material.

Another poor transition from seminar to book form is manifested by the often poor placement of illustrative material (i.e., tables and figures) with respect to the text, making it difficult for the reader to relate one to the other. The reader may also notice that footnoted references tend to be more recent than chapter-end references (which are primarily pre-1980). The negative points above notwithstanding, by producing readable text the authors have made this book one of the more successful media translations known to this reviewer.

The 12 chapters are
(1) Introduction to Satellite Communications;
(2) Orbits;
(3) The Geometry of the Geostationary Orbit;
(4) Launch Vehicles and Propulsion;
(5) Spacecraft;
(6) The RF Link;
(7) Modulation and Multiplexing;
(8) Multiple Access Systems;
(9) Transponders;
(10) Earth Stations;
(11) Interference; and
(12) Special Problems in Satellite Communications.

The reader will notice that many of the chapter headings could be book titles themselves (e.g., Spacecraft), and suspect the subject could be too intricate for the detailed treatment needed for a professional comprehension of the subject.

As stated above, this book would not be useful to an engineer actually engaged in satellite communications system design or analysis, because the authors stay at the "black-box" level of equipment function and content themselves with generalizing complex mathematical and technical concepts. However, for those people who have an engineering background and would like to know more about satellites and satellite communication systems, this book would be a good tutorial.

Terry M. Kenney
Consultant, ASPEC