

Book Reviews

PC System Architecture Series

Addison-Wesley Publishing Company, Reading, Massachusetts, 1995

Tom Shanley, Don Anderson

ISA System Architecture

pp. xv, 515, ISBN: 0-201-40996-8

Tom Shanley

486 System Architecture

pp. xiii, 188, ISBN: 0-201-40994-1

Tom Shanley, Don Anderson

Pentium System Architecture

pp. xxvii, 433, ISBN: 0-201-40992-5

PC System Architecture Series is a crisply written and comprehensive set of guides to the most important PC hardware standards. The series addresses a readership that has had exposure to PCs in a technical capacity but otherwise assumes a moderate technical knowledge only. According to the preface of the series, the material published is intended for those professionally involved in hardware and software design as well as for PC support personnel.

The series does not duplicate common information in the single books. *ISA System Architecture* is the core one which provides essential knowledge for understanding the subject matter covered in the other books. Other topics covered in the series include the following titles: *PS2 System Architecture*, *EISA System Architecture*, *486 System Architecture*, *Pentium System Architecture*, *AMD K5 System Architecture*, *PowerPC System Architecture*, *PCI System Architecture*, *PCMCIA System Architecture* and *Plug&Play System Architecture*.

ISA System Architecture describes the AT architecture from a system point of view and gives a comprehensive reference of AT system functionality. This book features 24 chapters divided into three parts. The first part covers background information necessary for understanding the basic mechanisms used by Intel x86 processors for communications with memory and I/O devices. It gives a detailed tutorial on bus cycles, I/O devices and memory addressing, address decode logic, reset logic, power-up sequence and the system kernel essential to interface 80286, 80386DX and 80386SX microprocessors to the rest of the system.

The second part briefly elaborates on the theory of operation of RAM and ROM devices, cache memory design and their implementation commonly used in ISA systems.

The final section provides a detailed discussion of the ISA bus architecture including DMA, ISA busmastering, RTC and configuration RAM, keyboard/mouse interface, numeric coprocessors and timers. It also comprehends a detailed explanation of all critical areas of an ISA system.

486 System Architecture covers the internal structure and differences between Intel 80486 series processors. In this book the author presents a detailed explanation of the new features of 486 series processors which were developed as it became evident that earlier 80386 processors have reached the maximum of their performance, the main cause being the relatively slow access to memory and an unwieldy floating point interface. To avoid the memory bottleneck and achieve a good cost/performance implementation, the 80486 series of processors uses both internal and external cache memories storing copies of frequently accessed information read from the slower DRAM memory.

The introduction of internal cache is crucial for achieving good performance since every external memory access requires a bus cycle and the bus speed represents a serious limit to processor performance. The different cache memory schemes used by different versions of the 80486 processors are explained.

To avoid the otherwise clumsy interface between CPU and the FP coprocessor requiring a series of I/O writes to forward an instruction to the latter, the 80486 series processors integrate FPU into the processor. The book also explains power management features implemented in the 486 processors as well as the SL technology, another achievement of 486 processors.

This book is structured into 11 chapters and appendices. In the introductory chapter the author gives a brief explanation of the performance bottleneck that existed in previous families of x86 processors and solutions implemented for their alleviation. Chapter 2 discusses functional parts of the 80486 system architecture common to the most of them. Chapter 3 presents the hardware interface of 486 processors. Chapter 4 gives details related to the operation of the internal data cache and its interaction with the external one and the main memory, here including cache related bus cycles. Chapter 5 summarises bus transactions with the emphasis on non-cache transactions. Chapter 6 is focused on system management mode operation transparent to the operating system and application programs. Chapter 7 discusses instruction set enhancement, the register set and FPU registers. Chapters 8 through 11 explain differences between the standard 486DX processor and the other processors in the 80486 family (486SX, 486DX2 and 486DX4).

Pentium System Architecture describes the internal structure of Intel Pentium processors and relationship to the rest of the system. For better understanding of new features the book points out the key issues concerning 80486 bottlenecks and respective solutions implemented in Pentium processors to overcome them.

The book has 18 chapters and appendices grouped into three parts. It starts with a review of factors that limited performance of the x86 processor family after which a brief introduction into Pentium features is given.

The first part introduces in Chapter 2 the description of functional units of the original Pentium 60 and 66MHz processors. Chapter 3 presents the Pentium nonuniform internal cache organisation along with different policies for maintaining cache coherency, their comparison and interaction between bus masters and the cache controller. Chapter 4 discusses single and multiple processor implementation of the MESI cache coherency model which uses 4 possible states for each cache line (Modified, Exclusive, Shared and Invalid). Chapter 5 describes input and output signals used for communication with external devices. Instruction prefetching, integer and floating instruction pipelines with code cache structure and operation are discussed in Chapter 6. Internal data cache view of external cache and main system memory including details of the structure and bus cycles is given in Chapter 7. Chapter 8 summarises various types of bus cycles. Chapter 9 discusses system management mode features implemented in Pentium processors, while Chapter 10 overviews the instruction set enhancement, the register set, debug extensions, virtual paging and incompatibilities. Chapter 11 describes Pentium processor features associated with testing and debugging, including speculations on probe mode function and implementation.

The second part details changes introduced by Pentium 90 and 100MHz processors, also known under Intel code name P54C. Chapters 12 to 16 include P54C overview, the signal interface, dual processor operation, the integrated Advanced Programmable Interrupt Controller and enhancements to the System Management Mode.

The third part in its Chapters 17 and 18 describes the Pentium 75Mhz and OverDrive processors.

The best feature of the above books is their organisation and the wealth of technical information, together with the systematic approach that is both clear and concise. The work done in preparing the books is excellent, the authors having given proper examples on the subject and otherwise addressing their audience properly. Each book is covered with an adequate glossary and a comprehensive index. Although these books don't bring the newest achievements in PC system architecture, they certainly convey the essential information necessary for understanding it. Thus I highly recommend them

to everyone involved in PC hardware or software design or test as an excellent resource for understanding the fundamental aspects of their architecture, protocols, components, software and their mutual interaction.

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David A. Stamper

Business Data Communications

Addison-Wesley World Students Series, The Benjamin/Cummings Publishing Company Inc., Fourth Edition, 1994, pp. xxvii, 608, ISBN 0-8053-7728-X

Contrary to my habits, I will first have to mention some flaws I found in *Business Data Communications* by David A. Stamper. This is not because the book has many of them, but because they are making it difficult for me to begin writing this review. By routine I would start my writing by giving a few words about the author, to give readers some background and help them understand how and why the book was eventually created. To my disappointment there was not a word to be found about the author of this book. Seeing that the book has accentuated textbook features, someone can only infer that Mr. Stamper belongs to an academic community. I would really like to know something about the man who wrote this excellent textbook. Let's hope that the publisher will include some information about the author in the next edition.

Business Data Communications, Fourth Edition, is prepared for an introductory course in data communications. The text provides a balanced approach, giving both the managerial issues as well as the supporting technical knowledge needed to plan and manage today's communications systems. The main body of the text consists of four parts and an introductory chapter. The introductory chapter, *Introduction to Data Communications*, provides a brief

historical overview of data communications, establishes the needs and objectives of data communications, and introduces the OSI reference model. Part I, *Media and the Physical Layer*, introduces several commonly used media types and explores their advantages and disadvantages. Part II, *Local Area Networks*, outlines the considerations to be evaluated in successfully integrating hardware, software, topologies, and protocols to form a local area network system. Part III, *Wide Area Networks*, builds upon the discussion of LAN issues and explores WAN hardware, software, topologies and protocols. Part IV, *Network Interconnection and Management*, explores the way in which different types of LANs and WANs can work together, and the role of network management in the successful implementation of network interconnection. The last part is followed by four appendices clarifying some issues of asynchronous transmission, binary synchronous transmissions, synchronous datalink control and packet distribution networks. At the end there is an acronym glossary, a key term glossary and an excellent index.

Being conceived as a textbook, this book is abundantly equipped with pedagogical features. Each of four parts opens with a business or technology vignette to motivate students' interest to study the technology covered in the part that follows. Each chapter begins with a set of learning objectives that help the student to focus on and review the core concepts discussed in the chapter. New in this edition, a running glossary defines key terms in the margin as they are introduced to make them more accessible and easier for the students to review. A realistic case study, based on the fictional Syncrasy Corporation, provides students with a business context for applying the different technologies described in the text to the changing communications needs of a realistic situation. Each chapter concludes with a summary of the key concepts discussed in the chapter. Key terms, highlighted in bold throughout the text for easy identification and review, are also listed at the end of each chapter with corresponding page references. Review questions at the end of each chapter stimulate discussion and encourage reflection on key points. Problems and exercises provide specific research projects to augment each chapter. Each chapter concludes with a

bibliography which can be used as resource for independent exploration.

The book is supplemented by an Instructors' Manual (printed and disk version) bringing answers to selected review questions and problems/exercises, more than 600 test questions, and more than 100 transparencies to illustrate key figures and concepts. There is also a Casebook (printed and disk version) with six realistic case studies covering various topics. Unfortunately, the book I got for review was without this supplements so I could not get insight in their contents. Nevertheless, there is no reason to believe that they will not be at the same quality level as the book itself.

To conclude: *Business Data Communications* by D. A. Stamper is an excellent textbook, very recommendable for all students in introductory courses of data communications, and their teachers as well. Although a computer communications specialist may find it rather elementary, he can also benefit from this book by finding all the elements neatly and systematically arranged and explained.

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A. S. Tanenbaum

Computer Networks, Third Edition

Prentice-Hall PTR, Upper Saddle River, NJ, 1996, pp. xvii, 814, ISBN 0-13-349945-6

The third edition of Tanenbaum's *Computer Networks* comes in the right moment, to offer the standard classic introduction to the area, and systematize accomplishments in the past years since its second edition in 1989. Just to refresh the memories, significant technological breakthroughs took place in this period — the steady and ever increasing pace of laying optic fibers both for long-distance trunks and LANs, the growth of networking based on wireless transmission, as well as the introduction of ATM networks intended to offer a uniform transmission means for voice, (moving) pictures and

data, to mention the most important of them. Along with these, new and once unexpected applications are being introduced (think, for instance, of video-on-demand, videoconferencing or World Wide Web, or even only of e-mail on a global scale), some of which are the direct consequence of the omnipresence of the Internet. This shift in computer networks technology and use are acknowledged and appropriately described in the book.

Being the third edition and taking into consideration the above facts, the book itself got thick and amounts to an 800+ pages piece, structured along the usual layered approach to teaching network functionality. It consists of eight chapters which reflect the author's (and not only his, e.g. [1]) disenchantment with the "established" reference model (the 7-layered OSI RM) and his proposal for a 5-layered one instead, which he calls the hybrid reference model. This model accommodates to the present situation witnessing the failure of the OSI approach, for general purpose networking at least. As noted in the Preface "the OSI protocols have quietly vanished, and the TCP/IP protocol suite has become dominant [thus this model] is much closer to the TCP/IP [one] in spirit than it is to the OSI model used in the second edition." Accordingly the overall exposition of the text matter has become more informal (no service primitives any more), and, consequently, even more fluent (although Tanenbaum's style is in any instance very readable and inviting).

Conceptually, the book is remade by contracting the "transport service user" (formerly the upper three OSI layers) into the single "application layer" which is then investigated through the most popular applications (e-mail, net news, WWW and multimedia). The description of the "transport service provider" (the lower four OSI layers) is extended by including new stuff as e.g. ATM and wireless networks, new MAC protocols, and modern routing and congestion algorithms. Generally, *Internet* and ATM have been used as running examples throughout the book. In the following individual chapters will be shortly reviewed, emphasizing major differences with respect to the second edition.

Chapter 1 offers an extensive introduction by describing the fundamentals of computer network uses, their classification, protocol layering, interfaces and services, as well as refer-

ence models. It shortly describes some example networks and discusses standardization issues. After comparing the OSI and the TCP/IP reference models, both are criticized and the hybrid reference model is introduced.

In Chapter 2: *The Physical Layer*, the discussion on transmission media already done in the previous edition is extended with a more substantial treatment of fiber optics and wireless transmission. Additionally, the telephone system is given a more comprehensive overview, here including modems, local loop/access sub-networks, trunk multiplexing, SONET/SDH, and switching technology. Besides N-ISDN, new stuff which is outlined in this chapter includes the lower (PMD) sublayer of the ATM physical layer, cellular radio and communication satellites. It should be noted that the exposition of ATM is layered, the ATM layers mapped to functionally corresponding OSI ones, thus dispersed among layers 2-4.

Chapter 3: *The Data Link Layer* provides the usual data link rudiments (basic functionality, error handling - ECCs and EDCs, elementary and advanced protocols, and the FDT primer). HDLC and two Internet access data link protocols (SLIP and PPP) are described as examples, along with the upper (TC) sublayer of the ATM physical layer.

Multiaccess channels are elaborated in Chapter 4: *The Medium Access Sublayer*. As in the previous edition, along with MAC exposition, the chapter encompasses the treatment of LANs. A selection from MAC protocols described in the second edition is extended with newly developed matter (e.g. wireless MAC protocols and digital cellular radio MAC protocols). The IEEE 802 standard is described as a whole: beside the three LANs and the MAN, LLC (802.6) which was previously elaborated within the data link layer complements the exposition. Of course, new developments for 802.3 are included (Fast Ethernet, Switched Ethernet). Bridges are offered a more thorough exposition, as well as high-speed networks. Ending the chapter is an extended overview of satellite networks formerly placed in the physical layer.

Not surprisingly, *The Network Layer* (Chapter 5) is the second largest chapter of the book (139 pages). As in the second edition, the exposition starts with an overview of design issues, which

is here shortened. Follows the section on routing, completely rewritten and nearly doubled in volume: the present text is an elaborate in-depth exposition with plenty of new stuff (e.g. routing for mobile hosts, broadcast and multicast routing, respectively). Congestion issues are also given twice the space, while internetworking, now freed from some material which is dispersed in other chapters, is given a fully new coverage. Example networks outlined are Internet's IP (also covering OSPF, BGP, Internet multicasting, mobile IP, CIDR and IPv6) and the ATM layer, totaling a generous 60 pages exposition.

Chapter 6: *The Transport Layer* builds upon second edition's approach. The first three sections (on transport service, protocols, and the example simple protocol) correspond in both editions, naturally taking into account the obvious cleansing of OSI notation previously used. The examples of transport layer implementation comprehend *Internet's* TCP and UDP, as well as ATM's AAL layer protocols. The chapter ends with an interesting, newly written section on performance issues.

The largest chapter in the book is Chapter 7: *The Application Layer*, which totals nearly 200 pages of text. This is the chapter that is drafted from scratch, striving to describe the most interesting contemporary applications of computer networks which include security issues, DNS, SNMP, electronic mail, USENET, World Wide Web, and multimedia. The discussion on network security starts with some elements of traditional cryptography but soon switches to modern cryptography, encompassing a thorough overview of secret-key and public-key algorithms, with authentication and digital signatures concluding the section. The discussion on the Domain Name System explains the hierarchical naming scheme used in the *Internet*. Network management is illustrated through an exposition of *Internet's* SNMP protocol. After dealing with this supporting stuff the real network applications are explained next, four of which are deemed by the author to be the most important. First, electronic mail is tackled through the topics of message formats, transfer protocols, and specific cryptographic measures ensuring message privacy. In the following section network news (USENET) is described via its implementation and protocol, and the user view. World Wide Web is then quite deeply

delved in: ensuing some introductory notes, topics such as the protocol (HTTP), the page addressing scheme (URL), the markup language for obtaining the processable format (HTML), and a short overview of the new Web language Java are described. The section on multimedia brings the mandatory introduction to the two continuous media — audio and video, followed by a discussion on applicable compression techniques which includes JPEG and MPEG standards. Video on Demand (VoD) is given a system approach commenting on the server, set top box, and the distribution network. As an example, the *Internet* multimedia system MBone is presented.

The closing Chapter 8 contains a list of suggested literature and the comprehensive bibliography with 370 entries. The Index on 18 pages is carefully compiled and enables an easy orientation in the text matter.

What to say of this edition of a book which has for a long time been considered as *the* introductory textbook to computer networks? It is a superb book, as, after all, its preceding editions were, each of them signing a milestone in the history of teaching computer networks. The book covers all fundamental topics and expounds them in a sufficiently thorough way not to be too boring, what is a bonus when textbooks are considered. As the only remark I could raise, I would mention the perhaps too exclusive use of the 5-layered reference model since there are (still) networks (e.g. manufacturing networks) which are standardized upon the 7-layered model, as well as upon the 3-layered one (e.g. field busses). The book is written by an expert hand which at the same time affords to cultivate an elegant entertaining style (think only of Tanenbaum's frequent comments). I like the book very much. I have used the previous editions in my computer networks course and will continue to do so by using its wonderful third edition. All in all, this is a book to be highly recommended both as a textbook and as a reference book.

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References:

- [1] Draft Report of the Federal Internetworking Requirements Panel, and Selected Responses, *ACM Comp. Comm. Rev.*, Vol.24, No.2, April 1994, 51–94.

Reinhard Wilhelm, Dieter Maurer

Compiler Design

Addison-Wesley Publishing Company Inc., Amsterdam, 1995, pp. xv, 606, ISBN 0-201-42290-5

As compilers are large software systems which represent one of the most vital parts of system software, the design of compilers for high-level programming languages is usually a complex and tedious task. The compilation tasks can, however, be decomposed into simpler subtasks with well-defined interfaces and with corresponding theoretical backgrounds, developed specifically or taken over from the theory of automata and formal languages. For some of the subtasks, there even exist mechanisms for their formal description and generation procedures that generate parts of a compiler automatically from those formal descriptions.

The presentation in this book reflects special characteristics of the compiler design mentioned above, especially the existence of theoretical backgrounds and the automatic generation methods. As stated by the authors, the book is not a cook book, i.e. it does not provide recipes for constructing a compiler, however, it does provide the reader with a thorough understanding of the compilation subtasks and their corresponding theories. The presented material developed from a number of lecture courses in compiler design given by both authors at the University of Saarland in Saarbrücken, Germany.

The book is structured as follows. The first chapter is a short introduction to high-level programming languages, to the implementation of programming languages — interpreters vs. compilers, and to the concepts of real and abstract machines.

The following four chapters give thorough presentations of the important aspects of compilation of the four major classes of high-level programming languages — imperative, functional, logic and object-oriented. For imperative, functional and logic programming languages described in Chapters 2, 3 and 4, respectively, appropriate abstract machines are introduced with a precise description of the compilation of programs in each source language into the language of the associated abstract machine. Since the object-oriented languages developed from imperative languages by extending them with various new concepts related mainly to the type system (i.e. objects, object classes, inheritance, genericity, encapsulation, etc.), Chapter 5 is concerned with the compilation of these extensions only.

Chapter 6 is an overview of the well-known conceptual structure of compilers, i.e. their subtasks divided into an analysis and a synthesis phase. The tasks of main subprocesses of the compilation process (lexical analysis, screening, syntax analysis, semantic analysis, machine-independent optimization, address assignment, code generation and machine-dependent code improvement) are described briefly in this chapter.

A detailed presentation of lexical analysis is given in Chapter 7. The task of lexical analysis is discussed first, followed by the theoretical foundations of tools used in lexical analysis — regular languages, regular expressions, deterministic finite as well as non-deterministic finite automata. This chapter also introduces the scanner and the screener, gives a possible scanner generation procedure, as well as the basic properties of a well-known scanner generator *Flex*, similar to *Lex*, but available as public domain software under UNIX.

The eighth chapter is devoted to syntax analysis — its task and theoretical foundations. The concepts of context-free grammars and push-down automata are presented and illustrated by examples. This chapter also gives a very detailed description of the two possible means of syntax analysis. Top-down syntax analysis with LL(k)-parsers and examples (e.g. from Prolog) is presented first, followed by bottom-up syntax analysis with LR(k)-parsers, also illustrated by various examples (some from Prolog). A very

important aspect of syntax analysis — error handling — is also mentioned here. At the end of this comprehensive chapter, a short description can be found of *Bison*, the LALR(1)-parser generator which is a part of OSF's GNU system (and which is compatible with the popular *Yacc*).

The third analysis subprocess — semantic analysis — is presented in Chapter 9. The first section of this chapter describes the basic aspects of semantic analysis, e.g. scoping and visibility rules, context conditions, overloading of identifiers and polymorphism. The second section is devoted to attribute grammars, which are used to describe static semantic analysis in most compiler generating systems, after which examples of attribute grammars are given. The last part of this chapter is concerned with the evaluation of attributes, i.e. with the generation of attribute evaluators.

The following two chapters contain some of the advanced concepts in compiler design. Chapter 10 states the problems of abstract interpretation which can be based either on denotational or on operational semantics. Chapter 11 is a discussion of the solutions of some problems which occur in syntax and semantic analysis and which are closely related to the analysis of trees, e.g. the pattern matching problem, the tree parsing problem, finite tree automata, etc.

Finally, the problems of code generation are presented in the last, twelfth, chapter. The difference between abstract and real machines is stated first, followed by a classification of current processor architectures based on the way that they affect the subtasks of code generation. At the end of this chapter, a discussion on integrated methods of code generation, register allocation by graph colouring and instruction scheduling can be found.

This book is mainly intended for advanced undergraduate and graduate students of computer science, however, it can also be recommended as a good tutorial to anyone else involved in the task of compiler design. Each chapter contains not only a detailed presentation of its topic, but also a variety of helpful examples, a number of exercises for individual work and the related literature.

A prerequisite for understanding the material is the knowledge of an imperative programming

language. The authors suggest that it would also be advisable to learn one of the modern functional, logic and object-oriented programming languages for a better understanding of the corresponding chapters. As already mentioned, the book has developed from a series of lecture courses in compiler design given by the authors over the years, so that the presented material can serve as a good basis for one-, two- or three-term courses at the undergraduate or graduate level.

The book is equipped with an accompanying compiler laboratory project, the specification of which, as well as other material related to the book, can be obtained by anonymous ftp from the site `ftp.cs.uni-sb.de` in `/pub/compiler`.

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Fundamentals of Database Systems, Second Edition

The Benjamin/Cummings Publishing Company, Redwood City, California, 1994, pp. xxii, 873, ISBN 0-8053-1748-1

Fundamentals of Database Systems is a book written by two leading professors, researchers and authors in the database technology field Ramez Elmasri and Shamkant B. Navathe. The book introduces the fundamental concepts necessary for designing, using and implementing database systems. It stresses the fundamentals of database modeling, the language and facilities provided by database management systems, and system implementation techniques.

The book is written to be used as a textbook for a one- or two-semester course in database systems at a junior, senior or graduate level, and as a reference book too. The authors assume that readers are familiar with elementary programming and data-structure concepts, and have had some exposure to basic computer organization.

The book consists of six parts covering twenty-five chapters, three appendices, bibliography and index. The book starts in Part I with a presentation concepts from both ends of the database spectrum — conceptual modeling principles and physical file storage techniques, and conclude in Part VI with a look at influential new database models, such as object-oriented and database models, along with an overview of emerging trends in database technology. Along the way from Part I to Part VI the book provides the readers with in-depth treatment of the most important aspects of database fundamentals.

Part I describes the basic concepts for understanding of database design and implementation. The first two chapters of Part I introduce databases, their users, database management system (DBMS) concepts and architecture. In Chapter 3, the concepts of Entity-Relationship model (ER) are used to conceptual database design. Chapter 4 describes the primary methods of organizing files of records. Chapter 5 describes indexing techniques for files, such as B-tree and B⁺-tree.

Part II describes the relational data model. Chapter 6 describes the basic relational model, its integrity constraints and the operations of the relational algebra. It also includes a section that describes relational schema design starting from a conceptual ER diagram. Chapter 7 gives a detailed overview of the SQL language. Chapter 8 introduces the relational calculus languages, and includes overviews of the QUEL and QBE languages. Chapter 9 discusses commercial relational database systems, and includes a detailed overview of IBM's DB2 system.

Part III presents the conventional data models and systems, now called legacy database systems. These are network and hierarchical systems. They have been used as a basis for many existing commercial database applications, particularly for large databases and transaction processing systems. The network and hierarchical data models are covered in Chapters 10 and 11, respectively. Each model is first described independently of specific DBMSs and includes an overview of a commercial system-IDMS for network and IMS for hierarchical. A section in each chapter shows how to convert the conceptual ER diagram into a network or hierarchical schema.

Part IV covers several topics related to database design. Chapter 12 covers the formalism, theory, and algorithms developed for relational database design by normalization. It includes functional and other types of dependencies and normal forms for relations. Intuitive normalization is presented step by step. Chapter 13 defines other types of dependencies, such as multivalued and join dependencies. Chapter 14 presents an overview of the different phases of the database design process for medium or large applications, and discusses physical database design issues pertinent to relational, network and hierarchical DBMSs.

Part V discusses techniques used in implementing DBMSs. Chapter 15 describes implementation of the DBMS catalog, which is the most important part of any DBMS. Chapter 16 presents the techniques used for processing and optimizing queries specified in a high-level database language, such as SQL, and discusses various algorithms for implementing relational database operations. Chapters 17 through 20 cover transaction processing, concurrency control, recovery techniques, database security and authorization techniques.

Part VI with the title *Advanced Data Models and Emerging Trends* covers a number of advanced topics. Chapter 21 discusses data abstraction and semantic data modeling concepts, and extends the ER model to incorporate these ideas. The concepts presented include subclasses, specialization, generalization, and categories. Integrity constraints and conceptual design of transactions are also discussed. The chapter gives overviews of the functional, nested relational, structural, and semantic data models. Chapter 22 gives an introduction to object-oriented databases, and gives examples from two commercial systems. In Chapter 23 distributed databases and the client-server architecture are discussed. Chapter 24 introduces the concepts of deductive database systems. At the end, Chapter 25 surveys the trends in the database technology and includes discussions of several emerging database technologies and applications. The next generation technologies include active, temporal, and spatial databases, scientific databases, and multimedia databases. Emerging applications include engineering design and manufacturing, office and decision support systems, and biological applications.

Appendix A gives a number of alternative diagramming notations for displaying conceptual ER schema. Appendix B gives some important physical parameters of disks, and Appendix C briefly compares the various data models discussed throughout the book.

It is stated that the book can be used as a textbook in a number of database courses of different levels. The authors give helpful guidelines for using *Fundamentals of Database Systems*. The chapters in Part I through II can be used in introductory courses in the given order or in the order preferred by individual instructor. Some chapters may be left out, and the instructor can add other chapters from the rest of the book. Some sections in chapters are marked with a star symbol. By the authors' suggestions the marked sections are candidates for being left out, whenever a less detailed discussion of the topics in a chapter is desired. The given dependency chart shows the major dependencies between chapters. As an example, it is possible to start with any of the data models (ER, relational, network, hierarchical) following the introductory chapters, and to proceed to database design, query processing, etc.

The database technology is a very broad one covering various topics from conceptual modeling to physical database implementation and maintenance. The main strength of the book is coherent and balanced treatment of database technology in acceptable volume (below 1000 pages). This edition balances coverage of modern database technology with the clear explanation of theory and broad coverage of models and real systems. Rapid development in the field of database technology forces the author to constant and never-ending updating of the book. The new emerging themes of the database technology that have to be included in the next edition are data warehouse, data mining, multidimensional databases, on-line analytical processing, etc.

Elmasri's and Navathe's *Fundamentals of Database Systems* belongs to a small number of leading textbooks in the field of database technology. The authors have succeeded in keeping the book readable, thus it should be of interest for students, as well as for all professionals involved in designing, implementing and using database technology. I find the book well structured. The book material is divided into six parts

covering diverse topics of database technology. Each part is divided into a number of chapters that consist of introduction, text divided into sections, summary, review questions, exercises, and rich selected bibliography. At the end of the book the authors have given a bibliography consisting of approximately eight hundred references and a rich and well-structured index. The book style is very good. The authors have started with clear and simple definitions of basic concepts and then have covered the most important topics of database technology in a simple and understandable way. In my opinion this is an excellent textbook. I will highly value it having it on my shelf.

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Richard C. Randall

Randall's Practical Guide to ISO 9000

Addison-Wesley Publishing Company, Reading, Massachusetts, 1995, pp. xx, 437, ISBN 0-201-63379-5

Maureen S. Heaphy, Gregory F. Gruska

The Malcolm Baldrige National Quality Award

Addison-Wesley Publishing Company, Reading, Massachusetts, 1995, pp. xxi, 440, ISBN 0-201-63368-X

Competitiveness of an individual company on the global market depends strongly on the quality of its products. For a long time business and industry have focused their quality efforts on their end products. However, experience has shown that focusing on continuous improvements of the core business and engineering processes within an organization will lead to the best results and long term improvements of the quality of products and services. To facilitate the exchange of goods and services on the international market the International Organization

for Standardization (ISO) published in 1987 the ISO 9000 Standard Series on quality management and assurance. ISO 9000 is a generic, basic family of quality standards written to be broadly applicable to a wide range of nonspecific industries and products. They establish the basic requirements necessary to maintain an effective quality system. Subsequently, additional requirements for a specific technological system have to be incorporated. Of course, these standards are not the only ones to be used. The books to be reviewed are dealing with quality assurance of products and services in industry and other productive or service sectors by tackling two somewhat different approaches - the ISO 9000 and the Malcolm Baldrige National Quality Award.

The first of the books, *Randall's Practical Guide to ISO 9000* is written by R. Randall, regional director of the US National Quality Assurance, which is one of the world's largest ISO 9000 Quality system registers. The book is divided into six chapters. In the introductory one the origin and history of ISO 9000 are described. Chapter 2 deals with the implementation plan and Chapter 3 with definitions. The largest chapter of the book is Chapter 4, totalling more than 300 pages and dealing with ISO 9000 standard requirements. The following issues are covered: management responsibility, quality system, contract review, design control, document and data control, purchasing, control of customer supplied product, product identification and traceability, process control, inspection and testing, control of measuring and test equipment, inspection and test status, control of non-conforming product, corrective and preventive action, handling of storage and delivery, control of quality records, internal quality audits, training, servicing, and statistical techniques. Chapter 5 describes the registration procedure for ISO 9001/2/3, while Chapter 6 explains the way this standard has been adopted by different countries and associations like EU, EFTA and NAFTA. At the end of the book there are six useful Appendices about organizations dealing with standardization, sources for ordering standards, US SIC codes and references.

This book is primarily targeted toward discussing practical quality concepts and principles necessary to develop and implement an ISO 9000 compliant quality system.

The Malcolm Baldrige National Quality Award was established by a US Congress act in 1987 as an incentive for improvement of the quality of products and services as a mean to strengthen the competitive position of the American industry. The second book, *The Malcolm Baldrige National Quality Award*, not only depicts what the Award is about but also gives advice on how to use Award criteria to improve industry's own performance. It offers insights into the Award criteria through explanations, examples and a complete case study. The book has 15 chapters. The first two are a basic introduction to the key concepts. Chapter 3 explains how to use the criteria for self-improvement, the Criteria themselves are explained in detail in Chapter 4. Chapter 5 discusses the Award process with the idea that it can be usefully applied for self-checking purposes. The assessment process is the focus of Chapter 6, while a case study is presented in the following chapter. The review, scoring and site visit processes are described in Chapters 8 through 11. Chapter 12 deals with some organizational and cultural aspects of the self-improvement process. The last three chapters are devoted to the comparison of the Award with the ISO 9001 standard, along with future prospects and conclusions. The main difference between ISO standard and the Award, as the authors explain it, is that the standard prescribes what an organization must do to be in compliance with it, while, on the other hand, the Criteria (which are the basis for the Award), do not prescribe how the respective results are to be obtained. Instead, they consist of 24 basic, interrelated, result-oriented requirements with the objective to identify the diversity of approaches that can be used to achieve quality and performance excellence.

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