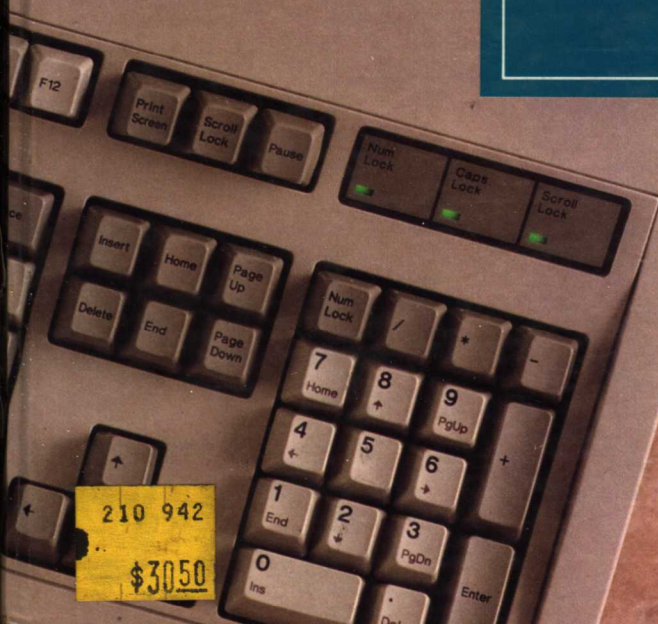SECOND EDITION

# COMPUTERS AND INFORMATION SYSTEMS

O'Leary/Williams

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SECOND EDITION

T.J. O'LEARY

BRIAN K. WILLIAMS

*Arizona State University*

*To my wife, Linda Perley Coats O'Leary,*
*and my son, Daniel Albert O'Leary*

   —T.J. O'L.

*To my mother, Gertrude Smoyer Williams*

   —B.K.W.

Credits and acknowledgments appear at the end of this book. Company names used in parts of the text are fictitious and for educational purposes; any resemblance to actual company names is purely coincidental.

# TO THE INSTRUCTOR: WHY USE THIS BOOK?

We have become used to surprises, but perhaps the real surprises are still to come.

We have become used to startling developments in such separate industries as telephone, overnight delivery, data processing, microcomputers, database, telecommunications, and office technologies. But perhaps the most significant new development is that all these industries have begun to fuse into one—the Information Industry—the product of the 30 year revolution in electronics we have all been living through.

To anyone contemplating or engaged in a career in today's organizations, public sector as well as private, ignoring this monumental change is to concede the advantage before the game has even begun. For the name of the game is not so much courage or luck, or even superior position or intelligence. To prevail in the rest of this century and the next, the name of the game is handling information.

## The Promise of This Book: The Student Career Tool

*Computers and Information Systems, Second Edition,* is designed as a textbook for an introductory college course in computers, information processing, and information systems. No academic prerequisites in mathematics, computer science, programming languages, or business are necessary. We introduce terminology as needed throughout the text.

A question many students ask is: How much does one *really* have to know about *computers* for most of today's careers? We believe the answer is: Only as much as is useful. This book is intended for people who plan to go into business

or the professions—to become managers, administrators, or white-collar professionals—and who therefore will become *users* of the computer. Our aim is to introduce students to the organizational tool they will be using the rest of their working lives.

Accordingly, the book has the following features:

**1. The book treats the computer as a tool for end-users.** It is possible to learn a great many technical things about computers and information systems. However, most people in business, professional, and nonprofit organizations do not *need* to know all of them. Consequently, we focus only on the technical material that people planning careers in organizational life *need* to know to do their jobs. Thus, this book presents the computer for what it is: a valuable part of the end-user's tool kit. On the one hand, we show it as a tool for personal professional activities—for word processing, electronic spreadsheets, database management, business graphics, and communications. On the other hand, we show it as a tool for managing corporate information—transaction processing information systems (TPIS), management information systems (MIS), and decision support systems (DSS).

**2. Material is arranged to help students with early hands-on use.** Many students are impatient to see what computers can do for them right away. Accordingly, after presenting an introductory motivational chapter (Chapter 1, pp. 1–21) and an overview chapter of hardware, software, and systems (Chapter 2, pp. 22–55), we demonstrate (in Chapter 3, pp. 58–104) several uses of

popular commercial microcomputer software: word processing, spreadsheets, data base managers, graphics, communications, and integrated packages. Therefore students taking concurrent laboratories involving microcomputer applications programs will have a sense of how such software may be used in an organizational environment. Other aspects of software—structured programming and programming languages (see pp. 134–169)—are described before the main discussion of hardware (Part 3, pp. 172–349), so that students can be better prepared for hands-on manipulation of computers as early in the course as possible.

### 3. The book has a strong systems orientation.
We believe students should not study hardware and software in a vacuum, but rather within the framework of a total information *system*. Thus, quite early in the book, in Chapter 2 (pp. 22–55), we present an overview of how business systems and computer systems work together. We return to this treatment in great detail in Part 4 (pp. 352–497), when we describe systems analysis and design and the various levels of information systems: transaction processing information systems, management information systems, and decision support systems. *New to this edition:* This part on systems concludes with a new chapter, Chapter 15 (pp. 468–497), which discusses artificial intelligence and expert systems and the impact they have on our ways of using information.

### 4. We emphasize the integration of microcomputers with mainframes and data bases.
As microcomputers have become more powerful, and as data communications has become more sophisticated, micros have become connected into larger information systems, using mainframes and data bases. This changes the nature of what were formerly more isolated elements. *New to this edition:* A new chapter, Chapter 9 (pp. 285–318), describes data base management systems in considerable detail.

### 5. The book offers many cases and case problems.
Because we want managers to learn how best to develop and use computer-based in-

formation, we offer three kinds of case examples covering a variety of industries:

▶ **"Curtain raiser" cases begin each chapter.** Drawn from highly readable reports in publications ranging from *Computerworld* to the *Wall Street Journal* to the *Harvard Business Review*, these boxed-off "curtain raiser" case studies, which appear on the second page of each chapter, generally present actual uses of the technology and processes to be discussed. Students thus become engaged in each chapter with a sense of the real-world problems and opportunities associated with the material they are about to read.

▶ **Ongoing "You Are There" cases cover several chapters.** With these in-text cases, we give the student a "hands-on" feeling of participation as the right-hand assistant to a manager or chief executive in four industries: health, films, banking, and clothing. The student thus becomes closely identified with business problem-solving processes.

▶ **Realistic case problems conclude each chapter.** How do you present computer and organizational problems for people without experience in these areas? How do you make case problems meaningful and not silly or superficial? We have tried to present case problems that students will *want* to read—because they provide added information of value and alert them to challenges and opportunities they may actually face. Thus, the case problems introduce topics such as computerized recruitment services, managing cash flow, determining billable time for professionals, and other subjects we hope students will be reluctant to pass up.

### 6. We have tried to make the material interesting and meaningful.
All of us are dazzled every day by television programs, magazines, and advertising with lively writing and flashy graphics. These are the seductive messages with which education must compete. We believe that, without trivializing the material at hand, we can enhance the educational process by avoiding dullness. Thus, we have tried to

write with liveliness and style, using many journalistic devices to hold reader interest. We have also tried to pay attention to the importance of graphics, offering vivid, well-conceived illustrations. And throughout the text and in boxed-off material we have provided historical perspectives, biographical profiles, commentary, how-to tips, and other material that sheds light on the immediacy and pervasiveness of computers in today's organizations.

Finally, we should mention that this book expresses a viewpoint or vision. Facts by themselves are not enough; they are given coherence when expressed with a philosophical viewpoint. Students want to know how to be prepared to deal with computers in business; however, we believe that technology is changing the ways of doing business so rapidly that one cannot possibly be prepared for everything. But one can be prepared with an *attitude*—the attitude that one must be able to cope with all kinds of changes. One must be ready to deal both with old technology and with very new, with a great deal of business information and with very little, with commonplace ways of doing business and with cutting-edge surprises. This is a viewpoint you will find expressed repeatedly throughout this book.

## Organization: Options for Using This Book

*Computers and Information Systems, Second Edition,* is divided into five parts.

**Part 1, The Tool for New Careers,** introduces the computer as a business tool from a macro point of view. Chapters 1 and 2 provide a general introduction, and then explain how business systems work, how computer systems work, and how the worlds of business and computers fuse together as computer-based information systems.

**Part 2, The Uses of Software,** starts with material most useful to students in today's for-profit and nonprofit organizations: how to use some prominent commercial software in word processing, spreadsheets, data base management, graphics, communications, and integrated packages. We believe that it is important to have

students using computers in a computer lab as early as possible in the course in order to satisfy their desire for hands-on experience and to stimulate their interest in using the computer as an organizational tool. Consequently, we have deliberately organized the book so that practical matters of software precede the issues of hardware (although any instructor who feels that hardware, Part 3, should be taught before software will find the text organization flexible enough to permit this).

Part 2 also covers programming. Although we think it is important that students learn at least some programming logic and problem solving, it is our belief that the ordinary business user of computers in the rest of this century will not be using today's programming languages such as BASIC so much as integrated business software packages and fifth-generation languages. Nevertheless, we believe that structured programming concepts are important—both because of their general applicability to logical thinking and because managers must be able to communicate their needs to programmers—and so we have included a chapter on application software development and a chapter on programming languages.

**Part 3, The Uses of Hardware and Technology,** covers input and output devices, CPU and operating systems, external storage and file organization, data base management systems, and networks and data communication systems. As we mentioned above, this part can be introduced whenever the instructor desires—or covered in part or skipped altogether. We have written Part 3 from the point of view of executives of the 1990s who will be *using* computers, not designing and installing them, yet who need to have enough familiarity with hardware to communicate their desires to people with more technical backgrounds.

**Part 4, Computer-Based Information Systems,** covers systems analysis, systems design, transaction processing information systems, management information systems, decision support systems, and artificial intelligence and expert systems—the crucial organization-related disciplines a future manager needs to know. We have illustrated the conceptual information with

case studies in order to give students a feel for the problems of the work world and some of the solutions that computers can provide.

**Part 5, The Rewards and Risks of the Information Age,** addresses some top concerns about the use of computers in our time. Chapter 16 describes the evolution of information systems, the importance of information resource management, and the possible course of computer-based information systems in the future. Chapter 17 covers privacy, security, and legal issues—important and necessary concerns for all of us. The last chapter describes some of the risks in computer technology, including the problems of automation and employment. It also suggests the impact of the technology of the future.

**Appendix A** presents a history of computers and information processing, and **Appendix B** offers a succinct but complete course in programming in BASIC.

# SUPPLEMENTS AVAILABLE

Because teaching a large introductory course can be a rigorous activity, we believe a solid package of supplementary materials is almost as important as a solid textbook. Accordingly, our publisher has produced a supplementary package that provides a complete system of instruction and is sensitive to the needs not only of full-time instructors but also of part-time instructors and teaching assistants. The ancillary items include the following:

    **1. Instructor's guide.** Written by Professor Albert Kagan, of the College of Business, North Dakota State University, the instructor's guide is available on diskette as well as on hard copy. It offers many practical suggestions for using the textbook, and for each chapter in the text it features

▶ Learning objectives

▶ Chapter overview

▶ Lecture outline

▶ Key concepts and key terms

▶ Answers to review questions and case problems.

    **2. Student study guide.** Written by Professor James Adair of the School of Public Health, Harvard University, the study guide is available for students who desire an intensive study of the book's contents. In addition to several "mini-cases," for each chapter in the text the study guide provides

▶ What to look for in the chapter

▶ Key terms

▶ Self-tests in a variety of formats

▶ Comprehensive review tests for each of the five parts of the text

▶ Answers to all self-tests.

    **3. Test item file.** Prepared by P.S. Associates, Inc., the test item file contains approximately 100 items per chapter. *MicroTest*, the Benjamin/Cummings computerized testing program, is available for qualified adopters: contact your local representative or Benjamin/Cummings for information.

    **4. Transparencies and transparency masters.** Approximately 100 illustrations from the text have been collected as transparency masters, and a select number are also available as acetate transparencies.

    **5. Applications software.** To encourage skill in using modern software tools, adopters can obtain educational versions of WordPerfect and dBASE III Plus from Benjamin/Cummings. This software is available alone, or as a package with *Hands-On: MS-DOS, WordPerfect, dBASE III Plus and Lotus 1-2-3* by Lawrence Metzelaar and Marianne Fox. If you plan to use this software in conjunction with the text, please read *A Note on Software*.

    **6. University Gradebook.** Written by David Herrick, of the University of Oregon, *University Gradebook* is class recordkeeping software that allows you to build a database of class records for up to 300 students. Its functions allow you to add or drop students; sort lists alphabetically, by student score, and by student ID number; calculate final grades based on a user-defined weighting system of quizzes, mid-terms,

and final exams; calculate class averages; perform "what-if" analyses; and print and display information in a wide variety of formats.

**Related Titles.** Benjamin/Cummings titles that complement this text include:

▶ *Student Edition of Lotus 1-2-3*, by T.J. O'Leary. This is a special, educational version of the world's leading business productivity software.

▶ *Hands-On: MS-DOS, WordPerfect, dBASE III Plus and Lotus 1-2-3*, by Lawrence Metzelaar and Marianne Fox. This skill-building text is available in two versions, with and without educational versions of WordPerfect and dBASE III Plus.

▶ *Using VP-Expert* by Wallace Growney. This book first introduces students to broad concepts of expert systems, and then demonstrates specifics by presenting the student edition of Paperback Software's VP-Expert.

# TO THE STUDENT: WHAT'S IN THIS BOOK FOR YOU?

You are probably a member of a generation that is not afraid of technology. Television has been around as long as you have. You probably use the phone more often than you write letters. An automatic teller machine is a convenience, not an irritation. Personal computers may be unfamiliar, but they are not threats.

But whether you are of this generation that has grown up with three decades of the revolution in electronics or of an older one, you are probably aware that the knowledge of technology will only become more essential to future careers. That indeed is the concern we are addressing in this book: We expect that computers will be the ordinary tools of the future and that most people will be required to use them as a matter of course. Our aim is to help you succeed with these tools.

To assist you we have employed a number of devices:

**1. We have tried to make the material both entertaining and meaningful.** Organizations and computers are not dull—far from it. Thus, we have tried to convey the fast pace of the Information Revolution that you are living in, the rewards and risks of the workplace, the spirit of enterprise and innovation. What helps some executives and professionals succeed? What makes some organizations outlast others? How does technology help you compete? Such questions suggest stories worth telling, for they are questions that will no doubt be of vital concern to you beyond the classroom.

**2. We have included extensive, varied examples and cases.** Because this book should above all be practical, we have tried to show in great detail how the Information Revolution is permeating the workplace, as follows:

▶ **Case studies at the beginning of each chapter**: These descriptions of computers and information systems in action are intended to give you a real-world taste of the concepts to come.

▶ **Case examples within chapters**: How does it feel to be using computer technology and concepts in the workplace? We put you in a "hands-on" situation as the valued assistant of a top executive in four enterprises: a health services company, a film production company, an international bank, a stylish clothing manufacturer.

▶ **Case problems at the end of each chapter**: These case problems are not merely repetitions of chapter material, but provide additional valuable information. They are not so much problems as opportunities.

▶ **Boxes:** These include how-to tips, explanations, historical flashbacks, further examples, and other interesting topics that flesh out the text discussion.

**3. We have provided many learning aids.** The following are designed to help you get a grasp on the material. The **preview** at the beginning of each chapter does just that—preview the important headings in the chapter, to help orient students to the main topics being covered. A **summary** appears at the end of each chapter, which we hope students will find especially helpful when reviewing for tests. The summary also includes important words in boldface (darker) type, the same boldfaced terms that appear throughout the text. **Key terms** sections repeat these terms, and indicate the page in the chapter where the terms are first mentioned. The **review questions** at the end of each chapter con-

sist of questions designed for self-testing before examinations. The **case problems** at the end of each chapter, as mentioned, pose situations that invite you to apply the concepts learned in the chapter. Finally, a **glossary/index** appears in the back of the text, to provide a concise definition of each key term and to refer students to the appropriate discussion within the text.

How you feel about this book is important to us. Any comments, favorable or unfavorable, will be read carefully. Write to us in care of the Computer Information Systems Editor, The Benjamin/Cummings Publishing Company, 390 Bridge Parkway, Redwood City, California, 94065.

T.J. O'Leary
Brian K. Williams

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# PROLOGUE:
# THE BUSINESS OF CHANGE

Shepherd's Mill is still. Built in the 1730s in Shepherdstown, West Virginia, as one of many rural water mills that converted grain into flour, Shepherd's Mill is now a silent monument to the industrial age that once formed the whole order of society.

In the century and a half of its existence, the mill was modified several times in response to advances in milling and water power technology. In the late 1700s, a conveyor system was introduced that automated the movement of grain through the various stages. In the 1890s, grindstones were replaced by chilled iron rollers, which milled a finer, better flour. The new technique required greater power than before: Other millers went to steam power or water turbines, but the owner of Shepherd's Mill installed the 40-foot-diameter waterwheel shown here. At the same time, he added the wood-frame third floor to the original stone structure.
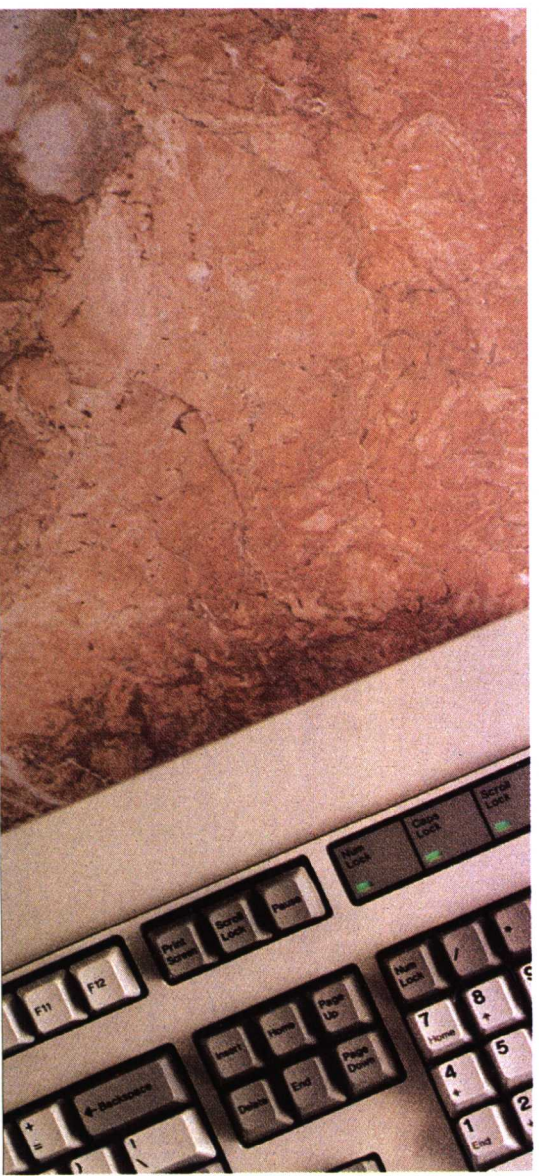
Today, however, Shepherd's Mill is still, a relic of an economic and technological order long gone by. Though a monument, it has lessons for the present, for it shows how organizations and institutions must adapt to technological change. The mill changed much during it long life. For us living in the Computer Age, however, the changes we will witness in our institutions will be far more dramatic and certainly far more rapid. Indeed, for the rest of our lives, we will need to make it our business to understand the business of change.
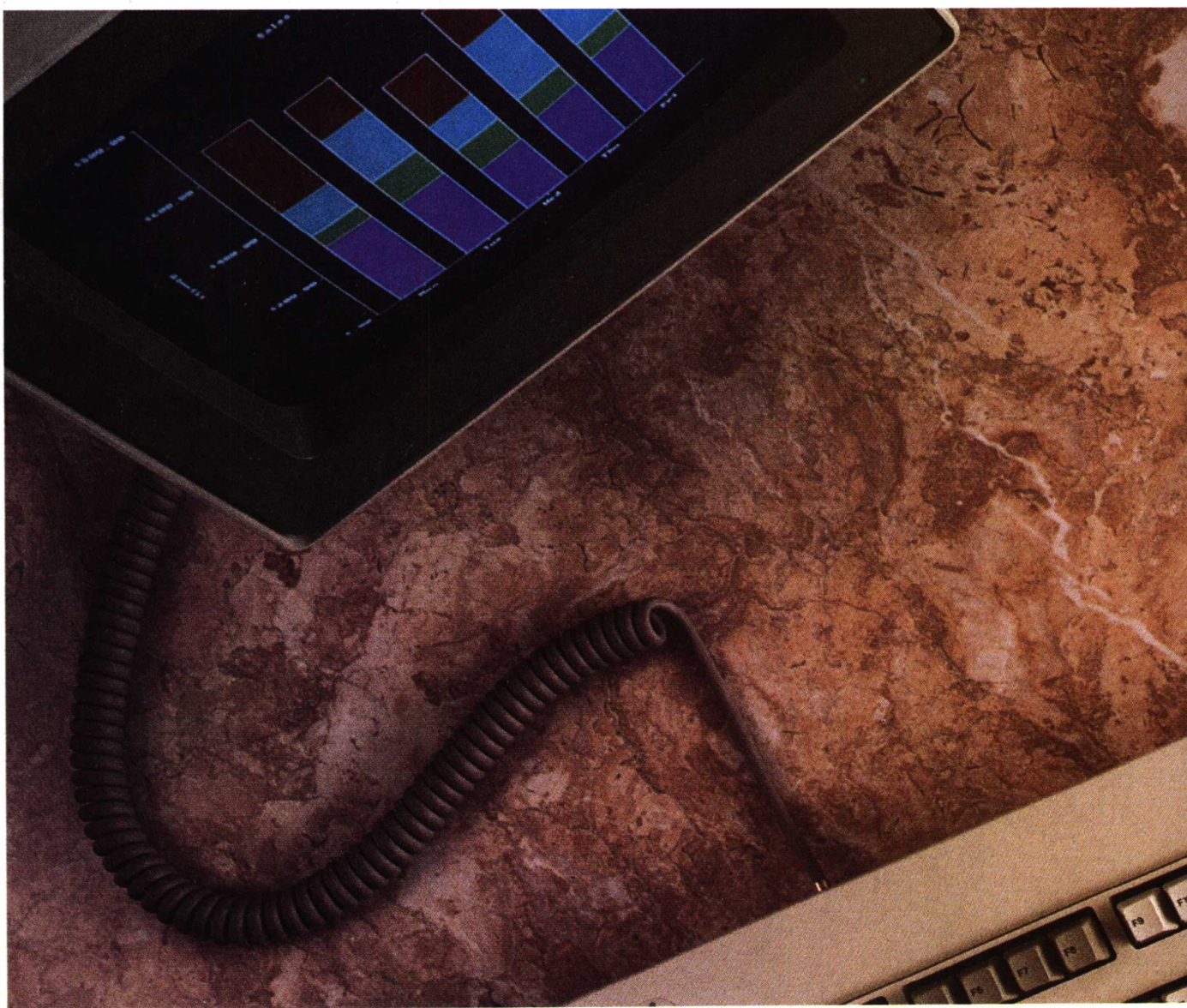
# THE TOOL FOR NEW CAREERS

The old ways are changing, and changing fast. Once upon a time, the pace of business enterprise was measured in weeks and days and hours—by the speed of clipper ships or transcontinental trains or the Western Union telegraph. Today it is measured in hours and minutes and seconds—by the speed of the Concorde jetliner or the Telex message or the communications satellite signal. Once, back in 1874, Philo Remington began marketing a curious printing machine, known as a "typewriter," which began the retirement of the quill pen. Today the workplace has been revolutionized by word processing and other office technology, changing the nature of white-collar work more rapidly than at any time in the past hundred years. Once, two decades ago, the Wall Street stock exchanges almost collapsed under the pressure of trading 11 million shares a day. Today they can handle more than twenty-five times that many.

The midwife of these changes is, of course, the computer. The chief characteristic of the computer is that by its speed and its ability to handle enormous amounts of data *it greatly extends our human capabilities.* The result has been the arrival of the Information Age and massive changes in the production, dissemination, and handling of all the information that managers and professional people need to know to bring goods and services to other people. Moreover, in a single human generation, computers have moved beyond churning out payrolls and reports and into marketing, strategic planning, customer service, and many other areas. "The diffusion of technology is changing the way we do business and the way companies relate to customers and suppliers," a Harvard business professor points out. "This is no longer a technological phenomenon but a social one."

In this first part of the book, we begin to examine this phenomenon. First, we give some brief background in computers. Then we show how the computer is being used to benefit those known as end-users—people who are not computer professionals but rather people probably much like yourself: members or soon to be members of business, government, and nonprofit organizations who need information to do their jobs successfully. Finally, we introduce you to systems and systems analysis—business systems, computer systems, and the fusion of the two into business information systems.

# BRIEF CONTENTS