## SECOND EDITION

# CAPRON/WILLIAMS COMPUTERS AND DATA PROCESSING



## **second edition**

# Computers and data Drocessing H.L. Capron Brian K. Williams



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## the galleries

Just as a museum has galleries devoted to different themes or subjects, so in this book we have presented nine "galleries" of full-color photographs for the reader to tour. These photographs are organized around themes relevant to the book and, usually, to the chapters in which they appear.

#### GALLERY 1

From Cosmos to Consciousness: The Sweep of the Computer Revolution follows p. 6

Computers now permeate our lives, extending from NASA space shots of the further reaches of space, down through links with the country and the city, to involvement in all aspects of people's pastimes and productivity.

#### GALLERY 2

A Little Gallery of Hardware: A Look at the Main Parts of a Computer System follows p. 38 An overview look at four types of computers—super, mainframe, minicomputer, and microcomputer—and examples of hardware demonstrating the four parts common to all computer systems: input, processing, output, and storage.

#### GALLERY 3

The Making of a Chip: Miniaturization
Miracles follows p. 54

An integrated circuit begins with a large drawing of electrical circuitry, which is then photographically reduced so it is more than 500 times smaller. It is then reproduced many times on a 3-inch-diameter piece of silicon, which is finally cut into individual pieces or "chips."

#### GALLERY 4

**Input:** Capturing the Stuff of Life follows p. 86

Data, the often unorganized stuff of life, can be symbols, shapes, colors, or other raw material. Various input devices have been developed to put data into machine-processable form.

#### GALLERY 5

Output: The Products of Computing follows

Printers and CRT terminals are perhaps the most pervasive output devices associated with computers, but there are other intriguing devices and forms of output, from computer graphics to robots.

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#### GALLERY 6

The "All-Purpose Machine": The Many, Often Hidden, Uses of Computing

follows p. 198

John von Neumann said that the device should not be called the computer but the "all-purpose machine." This gallery—twice as long as others—offers proof that the computer can be put to any number of applications besides calculations. Examples show uses in government, education, the military, transportation, science and medicine, the automated office, manufacturing, energy, and food and agriculture.

#### GALLERY 7

Global Search: Computer Use Around the World follows p. 230 Computers are being used in Europe, Asia, and the Third World. North Americans have no cause to feel smug about innovation, for many exciting developments are happening elsewhere, particularly in Europe and Japan.

#### **BUYER'S GUIDE**

How to Buy Your Own Microcomputer follows p.

Choosing among 150 to 200 microcomputers is not easy. This Buyer's Guide helps readers determine why they need a computer, what to look for in hardware and software, where to buy, and other matters.

#### GALLERY 8

**Personal Computers:** The Personal Convenience Machine follows p. 294

The Computer Revolution comes home in a small but spectacular way. The uses to which microcomputers may be put seem boundless—from number crunching to music making, from running a house to running a boat. Several models of personal computers are shown.

#### GALLERY 9

The Last Picture Show: Computers and Imagination follows p. 390

New machines. New ideas. New ways of seeing. The future may be evident in today's recent developments: wider communications, increased robotics, more computer-assisted labor-saving and entertainment devices. And new ways of perceiving the world as the computer assists the artist's and scientist's imagination.

## preface

#### To the Instructor: Why Adopt This Book?

Computers and Data Processing, wrote our publisher in the 1983 catalog, "sold over 100,000 copies in its first year of publication, making it one of the most successful new college textbooks of all time in any discipline." We are, to say the least, overwhelmed by this enthusiastic reception—and, of course, immensely gratified.

What were we trying to do that apparently elicited this response? Let us describe our objectives and accomplishments here, for they apply to the second edition as well—and constitute the reasons we urge you to adopt this book.

- 1. This book offers a substantive but not overly technical treatment of computers and data processing. The book was designed as a textbook for an introductory course in computers and data processing, but it will also be of interest to anyone who wants to learn about computers. Our purpose is not to saturate the reader with numbers and small details, most of which are made obsolete anyway by fast-moving technological changes. Our purpose, rather, is to show the breadth, depth, and fascination—in a word, the excitement—of computers. Accordingly, whether your students are in the course as majors in business or a computer-related field or are there as general education students, we believe you will find this book suitable.
- 2. Many instructors provided input to the book's content. Before we wrote the first edition, our publisher sent out more than 3000 detailed questionnaires to data processing instructors throughout North America. Several of these instructors participated in discussion panels and some reviewed the manuscript—both for the

first and for the second edition. The result, we believe, reflects the current needs and preferences of instructors and students nationwide, such as up-to-date coverage of programming methods, data base systems, distributed data processing, microcomputers, and computer careers.

- 3. We offer distinctive coverage. This text covers many subjects not frequently covered in one book—for example, structured programming, data communications, personal computers, the automated office, operating systems, robotics, data bases, management information systems, security and privacy, and computer and data processing careers. We also present, in Appendix A, enough material for a complete mini-course in BASIC.
- 4. We have tried to make the subject matter interesting and meaningful to students. There is no reason why a textbook cannot have an impact on people's lives for reasons other than being "required reading." Thus, we have tried to communicate our ideas with liveliness and style, using extensive and vivid examples, illustrations, and color photographs. We have also incorporated a number of learning aids, such as particularly complete summaries. Our publisher has happily retained the successful typographical design of the previous edition, which makes the book easy to read and pleasing to look at.
- 5. We have expanded coverage since the first edition. Those who used the earlier version of this book will find that a number of changes have taken place. We have extended the historical discussion to coverage of not only the Fourth Generation but also Japan's Fifth Generation. Dvorak keyboards are compared with QWERTY keyboards. Ergonomics, that new buzzword, is given more play. A section has been added on microcomputer storage in our chapter on storage devices. At the request of many users, we have reversed the sequence of Chapters 10 and 11, so that the discussion of structured program design now precedes the discussion of languages. Ada is now described fully, and other languages, such as LOGO and Smalltalk, are also included. The chapter on operating systems describes Unix, Pick, and CP/M.

Office automation is given greater prominence, as evidenced by the title of Chapter 13. Word processing, in particular, is covered more fully. The chapter on personal computers, as one might expect, is greatly revised to reflect the latest in that field's tumultuous developments, such as types of chips, electronic spread sheets, and 16-bit microprocessors. Networking is updated to reflect voice mail, personal networks, Local Area Networks, and other innovations. The chapter on MIS and data base systems has been significantly enhanced with the addition of discussion about decision support systems, information centers, and microcomputers for executives.

The careers chapter cautions students on expectations for entrylevel positions while at the same time pointing out the opportunities for freelancers and entrepreneurs with some experience. Software piracy, copyright infringement, and other security matters are enlarged upon in Chapter 18. The last chapter is considerably revised to cover automation and robotics, artificial intelligence, and new technological developments.

We are also proud to point out two important features for this edition. The first is the addition of the **Buyer's Guide: How to Buy Your Own Microcomputer**, which appears following page 278. As we point out in our notes to the student, this unique section may be read by itself; no prior knowledge of microcomputers is required. It is protected from datedness because it describes how to evaluate parts of a microcomputer system rather than particular models.

The second feature is the addition of **new color photo galleries**. Eight of the nine original galleries (the popular Gallery 3, "Making of a Chip," has been left as is) have been completely revised from the first edition. Moreover, we have introduced new themes we think will stir student interest: Gallery 1, "From Cosmos to Consciousness: The Sweep of the Computer Revolution"; Gallery 7, "Global Search: Computer Use Around the World"; Gallery 9, "The Last Picture Show: Computers and Imagination." In addition to these color pictures, the reader will find that the black and white pictures have been extensively revised throughout.

6. We have been able to make last-minute changes so that we could include the latest information. By putting the publication of this book on a special production timetable using word processing and state-of-the-art computerized production techniques, our publisher has enabled us to include many late-breaking developments. Book production is normally a 12- or 18-month process, but a glance through this book will assure the reader that a great many of the boxes, margin notes, and photographs are of very recent date. Indeed, writing and production together took only 10 months!

#### Organization: Options for Using This Book

Computers and Data Processing is divided into five parts. Part 1, You and Computer Literacy, describes the tremendous presence and influence of computers in our lives and gives a brief overview of a computer system. Part 2, Hardware, presents a one-chapter history of computers and data processing, then goes on to cover the four principal facets of a computer system: the central processor, input, output, and storage and file processing. Part 3, Software, covers some of the nonhardware side of computing, including programming, systems analysis, operating systems, and the various programming languages. Part 4, The New Story of Computing, branches out to explore the computer industry, personal computers, data communication sys-

tems, management information systems, and data bases. Part 5, Computers and Us, concludes with an examination of the computer in relation to society: careers in the field, security and privacy issues, and the future of computing. Appendixes A and B, respectively, present a course in BASIC and a brief coverage of number systems.

The chapters may be covered in other than in chronological order, if that suits your particular course organization. Chapters are often modular, which is to say that to some degree they may be taken out of sequence and read independently of other chapters. The history chapter (Chapter 3), for example, may be taught at any time. For instructors who wish to teach programming early in their course, we have written Chapter 8 so that it may be taught immediately after Chapter 2. We recommend that Appendix A on BASIC be taught only after Chapter 8 is covered. Chapters 9 through 19 may all be taught out of order; also, any of these chapters may be omitted without loss of continuity.

Detailed course outlines and further discussion of chapter interdependence may be found in the Instructor's Guide supplement, which is available from our publisher.

#### Supplements Available

Our supplements package offers a complete system of instruction that is sensitive to the needs of part-time instructors and teaching assistants as well as full-time instructors. The supplements include the following:

**Guide for Instructors** To help instructors, particularly the part-time instructor and teaching assistant, the *Guide for Instructors* by H. L. Capron offers many practical suggestions for using this textbook in the classroom. Alternative schedules are given for quarter and semester courses. For each chapter in the text, the instructor's guide offers:

- Learning objectives
- Chapter overview
- Lecture outline, with suggestions for time priorities for each topic
- Marginal examples, anecdotes, and other topics to add extra flavor to the lecture
- Glossary terms
- Information on how to use photo galleries from text

**Guide for Students** Written by Zoe Groulx and H. L. Capron, the *Guide for Students* is available for students interested in more directed and intensive study of the textbook's contents. More than the usual student guide, it includes what we believe to be *useful* aids for study. For each chapter, it includes:

- Learning objectives
- Why this chapter is important
- Key words

book: with your participation, we will help you become computer literate.

To help you succeed in this, we have employed a number of devices:

- 1. We have tried to write with liveliness and style. We want this book to speak directly to you, and we want you to enjoy reading it. Thus, we have tried to write in a conversational style and to offer information in a way you can understand. We have also used many devices to make this book interesting for you to read.
- 2. We have included an extensive and varied assortment of examples and applications that stress human interaction with computers. Computers and data processing permeate practically all aspects of life in the twentieth century. Therefore, we show applications and examples not only in business, science, and engineering but also in the arts, farming, and law. We also show computers being used not only as research and organizational tools but for fanciful and entertaining purposes as well. Throughout the book, we show how computers work and the impact they have on our lives.

We have tried to present these applications in the most effective, dramatic ways:

- Through the use of "galleries." Color photographs grouped in themes vividly illustrate such subjects as the uses of computers or how a microprocessor chip is made. See page xviii for a description of the galleries.
- Through margin notes. The immediacy and pervasiveness of computers is often best conveyed in press accounts and reports. Thus, we included many excerpts in the margins of our book from a wide range of periodicals and books. These are listed in the Detailed Table of Contents.
- Through in-depth boxes. Throughout, we have presented material boxed off from the text, such as case studies, how-to tips, and analyses, to personalize the material for you. These, too, are listed in the Detailed Table of Contents.
- Through vivid in-text examples and illustrations. Wherever we have introduced a concept, we have tried to incorporate examples that show the extensive involvement of the computer in modern life—and in your life.
- 3. We have provided a great many learning aids throughout the text. The following are designed to help you grasp the material. In This Chapter is a "preview" that appears at the beginning of each chapter, to help orient you to the main topics to be covered. Summary and Key Terms appears at the end of each chapter. This section will be particularly valuable for reviewing material before examinations. All material covered in the chapter is summarized in very specific terms. In addition, this section lists key terms in boldface type; these are the same key terms that appear in boldface throughout the text. Review consists of questions found at the end

of each chapter designed for self-testing before examinations. Suggested Readings appear at the end of most chapters, listing appropriate books for further study. The Glossary/Index at the back of the book provides a concise definition of each key term and refers you to the appropriate discussion of these terms and other key concepts in the text.

4. Special bonus: We have provided a buyer's guide to microcomputers. One of the most exciting developments in computer is the appearance of the personal computer or microcomputer—the kind you see advertised so widely on television and in magazines. As declining prices make these machines more accessible to everyone, the choices become more bewildering. To help you make these choices, we have provided a special section that appears following page 278, the Buyer's Guide: How to Buy Your Own Microcomputer. Note: We have deliberately designed the Buyer's Guide to resist datedness (if that's possible at all with computers) by avoiding specific brands of equipment or software, which are fast-changing, and describing instead categories of equipment to evaluate. The Buyer's Guide requires no prior knowledge of computers, and it may be read by itself; it is not necessary to read the text first.

Your reactions to this book are important to us. In developing this second edition, we have taken to heart the comments and suggestions of students and instructors who have used the first edition. Thus, any comments, favorable or unfavorable, will be welcomed and will be read with care. Write to us in care of the publisher, whose address is listed on the copyright page.

#### Acknowledgments

As before, we are grateful to the many hardware and software companies and computer and data processing users without whose generosity we could not have provided the pictorial treatment we have attempted. Their names are listed on pages 449–453. Our thanks are also due to those who were kind enough to grant permission to reprint excerpts from previously published material; they are listed on pages 447–448.

Many instructors responded to our questionnaire, participated in discussion groups, or reviewed the material in manuscript form, and we are grateful for their suggestions. The reviewers and consultants are listed on page xvii.

Many publishing professionals assisted in the design, graphics, editorial, and production phases of the second edition, and we are deeply appreciative of their efforts: Louise Billotte, Debbie Bowman, Ken Butler, Jenny DeGroot, the Derman brothers, Deborah Gale, Louise

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At Benjamin/Cummings, we are grateful to Margaret Moore for her production management and to Wayne Oler, Allan Wylde, and Jim Behnke for the kind of strong publishing support that makes a project of this magnitude possible. Pat Waldo as production coordinator was fantastic to work with, and we can only marvel at the way she kept so many balls in the air so successfully. Pat, thank you for everything. We felt a special bond with Susan Newman, our sponsoring editor on the first edition of the book. However, we have been fortunate in her successor, Susan Nelle, who came to the project with new vigor, enthusiasm, and dedication. Susan, we are very appreciative of your ideas and support.

Finally, we are very grateful to all the men and women at Benjamin/Cummings in promotion, marketing, and sales who did such a superb job of making the book known in its first edition. We hope we have done well enough on the second edition to deserve their renewed efforts.

H. L. Capron Brian K. Williams

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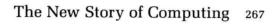
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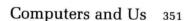


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The Making

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