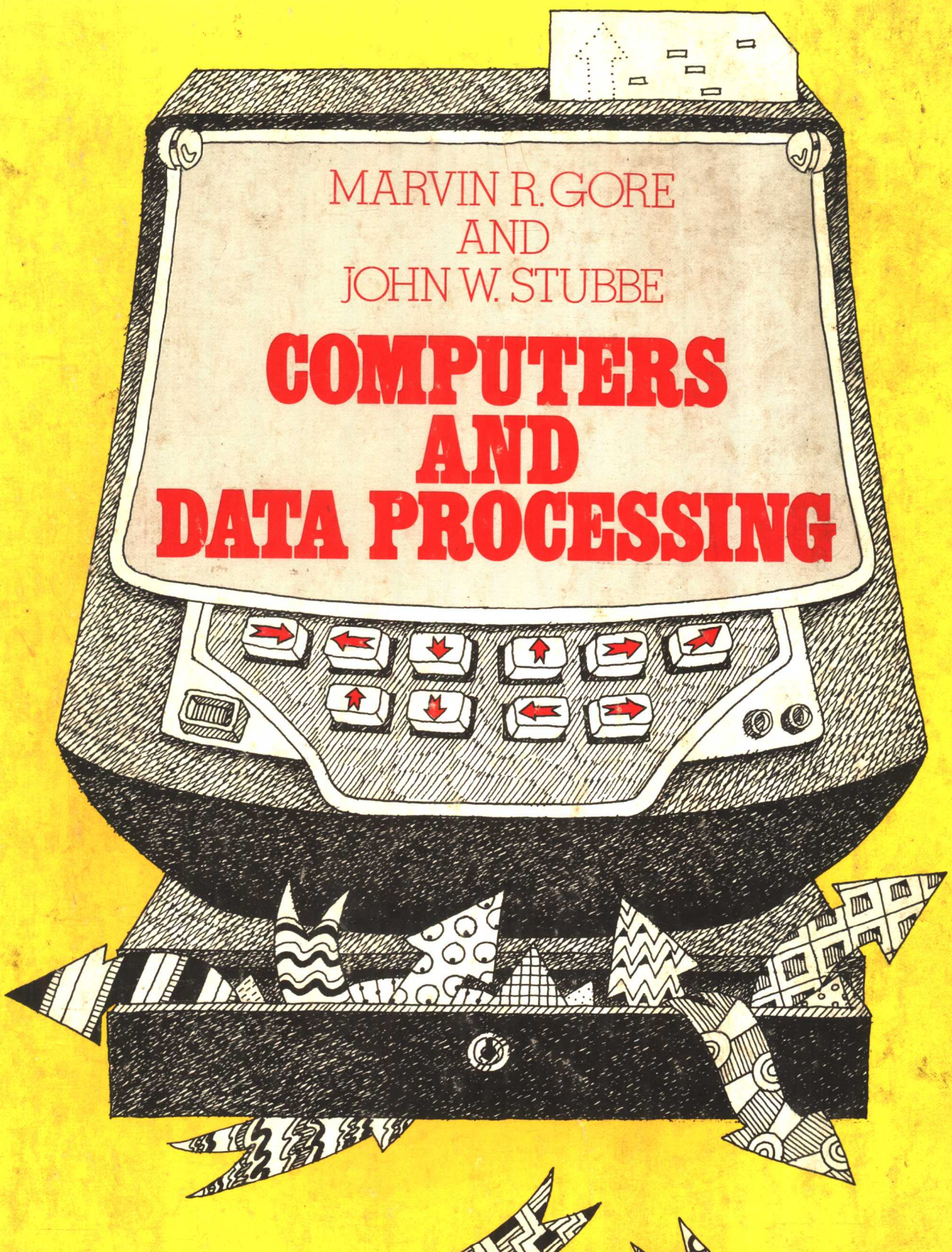
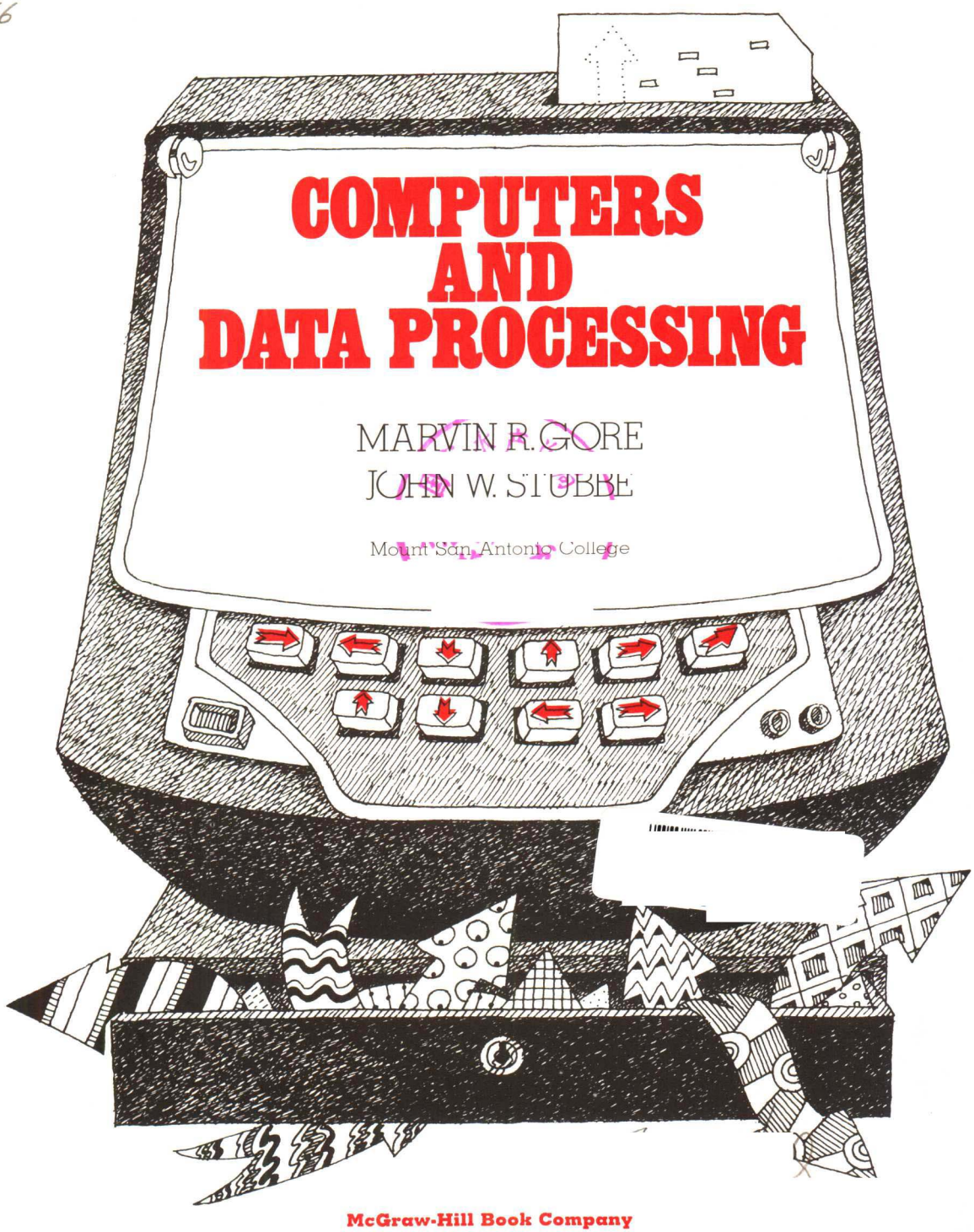
MARVIN R. GORE
AND
JOHN W. STUBBE

COMPUTERS AND DATA PROCESSING



73.87
G666



COMPUTERS AND DATA PROCESSING

MARVIN R. GORE
JOHN W. STUBBE

Mount San Antonio College

McGraw-Hill Book Company

New York St. Louis San Francisco Auckland Bogotá Düsseldorf Johannesburg London
Madrid Mexico Montreal New Delhi Panama Paris São Paulo Singapore
Sydney Tokyo Toronto

3-1303

COMPUTERS AND DATA PROCESSING

Copyright © 1979 by McGraw-Hill, Inc. All rights reserved. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.
1234567890 VHVH 7832109

This book was set in Memphis Medium
by Progressive Typographers.
The editors were Marjorie Singer and James B. Armstrong;
the designer was Jo Jones;
the production supervisor was Dennis J. Conroy.
The drawings were done by Fine Line Illustrations, Inc.
The cover and unit-opening illustrations were done
by Tom Huffman.
Von Hoffmann Press, Inc., was printer and binder.

Library of Congress Cataloging in Publication Data

Gore, Marvin.
Computers and data processing.

Includes index.
1. Electronic data processing. 2. Electronic digital computers. I. Stubbe, John, joint author. II. Title.
QA76.G598 001.6'4 78-10946
ISBN 0-07-023787-5

PREFACE

Computer data processing systems and their applications continue to increase at a breathtaking rate—a rate that is sustained by an avalanche of technical achievements. There is a need for an up-to-date text designed for use in an introductory data processing course. *Computers and Data Processing* meets this need for both the beginning data processing major and the student who wishes to acquire business-oriented knowledge about computer data processing. No prior knowledge of mathematics (beyond arithmetic), of business methods, or of data processing is required.

We believe that *Computers and Data Processing* achieves two major goals:

1. It provides students with *current* knowledge about computers and data processing.
2. It makes that knowledge *relevant* to actual applications of computers.

The major features of the text, which we believe make it current and relevant, are its timely content, its organization, and the flexibility that it provides for its users.

The pace of the information revolution made possible by computers was described well by J. Paul Lyet, president of Sperry Rand Corporation, who, in commenting on 25 years of progress in data processing, said, "If aviation had evolved at the speed computers have, Neil Armstrong would have walked on the moon less than a year after the Wright brothers took off from Kitty-hawk."

Mr. Lyet made his remark in 1976, and, subsequently, advances in microminiaturization, which have reduced the size and cost of computers and have increased their effectiveness and reliability, have created a computer revolution within the computer revolution. *Computers and Data Processing* captures the pulse of this revolution, which will affect our lives in countless ways. The technologies of the 1980s and their applications are thoroughly integrated into the text. Examples include:

1. A discussion of large and small (mini- and micro-) computers that describes their common characteristics and their differ-

ences. The text explains not only hardware and software but also firmware and its importance to the architecture of modern computer systems.

2. A unified presentation of primary and secondary storage devices in terms of a cost-access time spectrum. Electronic memory technologies such as magnetic bubble memory (MBM) and the charge-coupled device (CCD) are integrated into this presentation.
3. Emphasis upon the emergence and growth of combined computer-communications systems. Important computer-communication applications, such as distributed data processing and word processing, are fully described.
4. Abundant examples of the applications of computers, from microcomputers to supercomputers. Applications that are emphasized include business uses of computers, the impact of computers upon the consumer, and the phenomenon called personal computing.

The text is designed to improve the "teachability" of computer data processing. It features a top-down time sequence of topics; allows for students' "hands-on" learning experiences; and provides learning reinforcement. The major topics parallel the time sequence, called the life-cycle sequence, followed by organizations that are successful in using computers to solve problems.

The text is divided into six major units, with four supplementary chapters. Units One and Two provide the student with an overview of the text and with background knowledge of data processing concepts and of computer systems and their major components. As early as Chapter Two, the student is afforded an opportunity for "hands-on" laboratory experience. Units Three to Six add to and reinforce the knowledge acquired in the first two units. They enable the student to see and to understand how each topic fits into the processes for the selection, design, development, and operation of real-world computer systems.

The student is not overwhelmed initially with information that cannot be assimilated or applied until much later in the text. For example, the concept of binary codes is introduced early in order to explain how data and instructions are stored. However, details related to number systems, internal codes, and computer arithmetic are deferred until the system development activities of planning, writing, and testing computer programs are presented in later chapters.

Numerous learning aids have been incorporated into the format of the text to assist students in comprehending major con-

此为试读,需要完整PDF请访问: www.ertongbook.com

cepts. Each chapter opens with a capsule paragraph, learning objectives, and key terms, and each concludes with a concise summary. Major sections of each chapter are followed by feedback questions (with answers) that permit students to test their comprehension as they proceed through the text. Review and discussion questions follow the chapter summaries.

The text is one of three components of a learning package. The other two are a student Study Guide and a comprehensive Instructor's Manual.

The Study Guide is designed to assist the student by providing:

1. *Study hints*, which are suggestions to help the student to master the text chapter.
2. *Chapter outlines* that summarize the main points of each chapter.
3. *Vocabulary drills* that familiarize the student with the important terms and concepts introduced in each chapter.
4. *Test-yourself questions* that help students to prepare for quizzes and examinations. The answers to these questions are contained in the Study Guide.
5. *Additional practice exercises* that provide students with an opportunity to reinforce their knowledge. Answers to these exercises are in the Instructor's Manual so that they can be used for class assignments.

The Instructor's Manual identifies unit and chapter goals. For each chapter it includes:

1. Measurable student performance objectives
2. Key points, indexed to text page and text figure numbers
3. Transparency masters for important figures
4. Answers to the in-text questions and to Study Guide review and discussion questions
5. A chapter quiz and quiz answers
6. A comprehensive examination for each unit

Computers and Data Processing provides instructors with flexibility in deciding upon the depth of coverage and sequence of topics most suitable for their programs of instruction. For example, the text provides the student with an introduction to both systems analysis concepts and the most commonly used computer programming languages. The material on systems analyses may be presented in several different sequences, and the emphasis may be varied at the option of the instructor. BASIC is the in-text

programming language. However, the text contains supplementary chapters on COBOL, FORTRAN, and RPG that are complete and are supported in both the student Study Guide and the Instructor's Manual. These chapters may be substituted for or added to the chapter on BASIC. Specific teaching suggestions and alternative outlines of the text topics are contained in the preface to the Instructor's Manual.

We hope that you will find using *Computers and Data Processing* as rewarding as we have found writing it to be. We wish to express our thanks to our students who, perhaps unknowingly, have contributed to the development of the text. We also wish to acknowledge the contributions of reviewers whose suggestions and guidance have helped us to develop it. We are particularly indebted to Stanley Birkin of the University of South Florida, William L. Bonney of Hudson Valley Community College, Dwight Graham of Prarie State College, Charles F. Kelemen of Ithaca College, S. J. LaLima of Suffolk County Community College, Norbert Ludkey of the City College of San Francisco, Richard W. Manthei of Joliet Junior College, Jerry R. Murphy of Portland State College, Edward H. Rategan of the College of San Mateo, Margaret Ross of Prince George's Community College, and Victor Sherrer of Trenton State College.

We also wish to express our particular thanks to Charles Harless, graphics technician, for providing us with many fine photographs of computer data processing at Mount San Antonio College. We enjoyed working with Marjorie Singer, our editor at McGraw-Hill. We know that she added in innumerable ways to whatever successes this book may achieve. Finally, a special thanks to our wives, Iris and Connie, for sharing their husbands with *Computers and Data Processing*.

Marvin R. Gore

John W. Stubbe

UNIT ONE

Our goal in this book is to study computers and data processing and to apply what we learn to the world of business. To do this, we will follow a sequence of topics that parallels the sequence of activities followed by companies that are successfully using computers to solve business problems. First, however, we must acquire a background in computers and data processing. The first two units of this text are designed to provide this background. In Chapter 1 of this Unit, we will learn some important data processing concepts and acquire a historical perspective by examining manual and mechanical data processing systems. In Chapter 2, we will learn about punched cards and the use of codes to represent data. In Chapter 3 we will study some basic computer data processing concepts and preview subsequent units of the text by surveying the growth in computer capability and in computer applications. Chapter 4 extends this preview to a consideration of computers as parts of business systems and introduces the method for managing computer applications.

CONTENTS

	PREFACE	ix
UNIT ONE	**COMPUTER AND DATA PROCESSING FUNDAMENTALS**	
CHAPTER 1	DATA PROCESSING CONCEPTS	3
	Types of Data Processing Systems	5
	Manual Data Processing	10
	Basic Steps in a Data Processing System	11
	The Business Data Processing Cycle	14
	Mechanical Data Processing	15
	Summary	22
	For Review and Discussion	24
CHAPTER 2	PUNCHED CARD DATA RECORDING	26
	Punched Cards and Punched Card Codes	27
	Punched Card Preparation	33
	Electromechanical Processing	39
	Summary	40
	For Review and Discussion	41
CHAPTER 3	THE INFORMATION AGE	43
	Computer Data Processing	44
	Growth in Computer Capability	46
	Growth in Computer Applications	61
	Summary	72
	For Review and Discussion	74
CHAPTER 4	COMPUTERS AND BUSINESS SYSTEMS	76
	Business System Characteristics	77
	The Life-Cycle Concept	86
	Summary	91
	For Review and Discussion	93
UNIT TWO	**ELEMENTS OF COMPUTER SYSTEMS**	
CHAPTER 5	COMPUTER SYSTEMS: AN OVERVIEW	97
	Computer System Architecture	98
	Storage Units	102
	Central Processing Unit	108

	Input and Output Units	110
	Multiple Processors	111
	Summary	113
	For Review and Discussion	116
CHAPTER 6	STORAGE AND PROCESSING	117
	Storage Devices: Cost and Access Time	118
	Primary Storage	120
	Electromechanical Secondary Storage	123
	Electronic Secondary Storage	136
	Processing Units	141
	Summary	143
	For Review and Discussion	146
CHAPTER 7	INPUT AND OUTPUT	148
	Classification of Input and Output Devices	149
	High-Speed Input and Output Devices	150
	Medium-Speed Input and Output Devices	150
	Low-Speed Input and Output Devices	165
	Summary	170
	For Review and Discussion	172
CHAPTER 8	COMMUNICATIONS, DISTRIBUTED DATA PROCESSING, AND WORD PROCESSING	174
	Elements of Data Communications	176
	Distributed Data Processing	183
	Word Processing	190
	Toward the Electronic Office	194
	Summary	196
	For Review and Discussion	200
UNIT THREE	**SYSTEM SELECTION, DESIGN, AND DEVELOPMENT**	
CHAPTER 9	SYSTEM SELECTION	205
	Problem Identification	207
	Performance Definition	213
	Feasibility Analysis	216
	System Recommendation	225
	Project Plan and Cost Schedule	226
	Summary	228
	For Review and Discussion	231
CHAPTER 10	SYSTEM DESIGN AND DEVELOPMENT	232
	System Design	233
	System Development	248
	Summary	250
	For Review and Discussion	252

UNIT FOUR PLANNING AND WRITING COMPUTER PROGRAMS

CHAPTER 11 PLANNING THROUGH FLOWCHARTS AND PSEUDOCODE 257
The Computer Program 258
The Purposes of Program Planning 258
Flowcharts 259
Pseudocode 272
Summary 279
For Review and Discussion 280

CHAPTER 12 PROGRAMMING LANGUAGES 282
Writing Program Instructions 283
The Development of Programming Languages 283
Machine Code 283
Symbolic Code 285
Problem-oriented Languages 286
Common Problem-oriented Languages 288
The Conversion of Symbolic Languages 293
Summary 294
For Review and Discussion 296

CHAPTER 13 OPERATING SYSTEMS 297
Control Programs 298
Language Processors 302
Service Programs 305
Summary 309
For Review and Discussion 310

CHAPTER 14 THE LANGUAGE BASIC 311
Minimal ANS BASIC 313
BASIC Library Functions 328
Summary 329
For Review and Discussion 331

UNIT FIVE TESTING THE COMPUTER PROGRAM

CHAPTER 15 PROGRAM ERRORS 335
Types of Program Errors 336
Summary 344
For Review and Discussion 345

CHAPTER 16 NUMBER SYSTEMS 346
Basics of Number Systems 348
Converting from One Number System to Another 349
Arithmetic 363
Summary 376
For Review and Discussion 377

此为试读,需要完整PDF请访问: www.ertongbook.com

CHAPTER 17	CHARACTER CODES	378
	Hollerith Code	379
	Binary Coded Decimal Interchange Code (BCDIC)	381
	Extended Binary Coded Decimal Interchange Code (EBCDIC)	383
	American Standard Code for Information Interchange (ASCII)	387
	American Standard Code for Information Interchange-8 (ASCII-8)	388
	Memory Dumps	389
	Summary	392
	For Review and Discussion	393

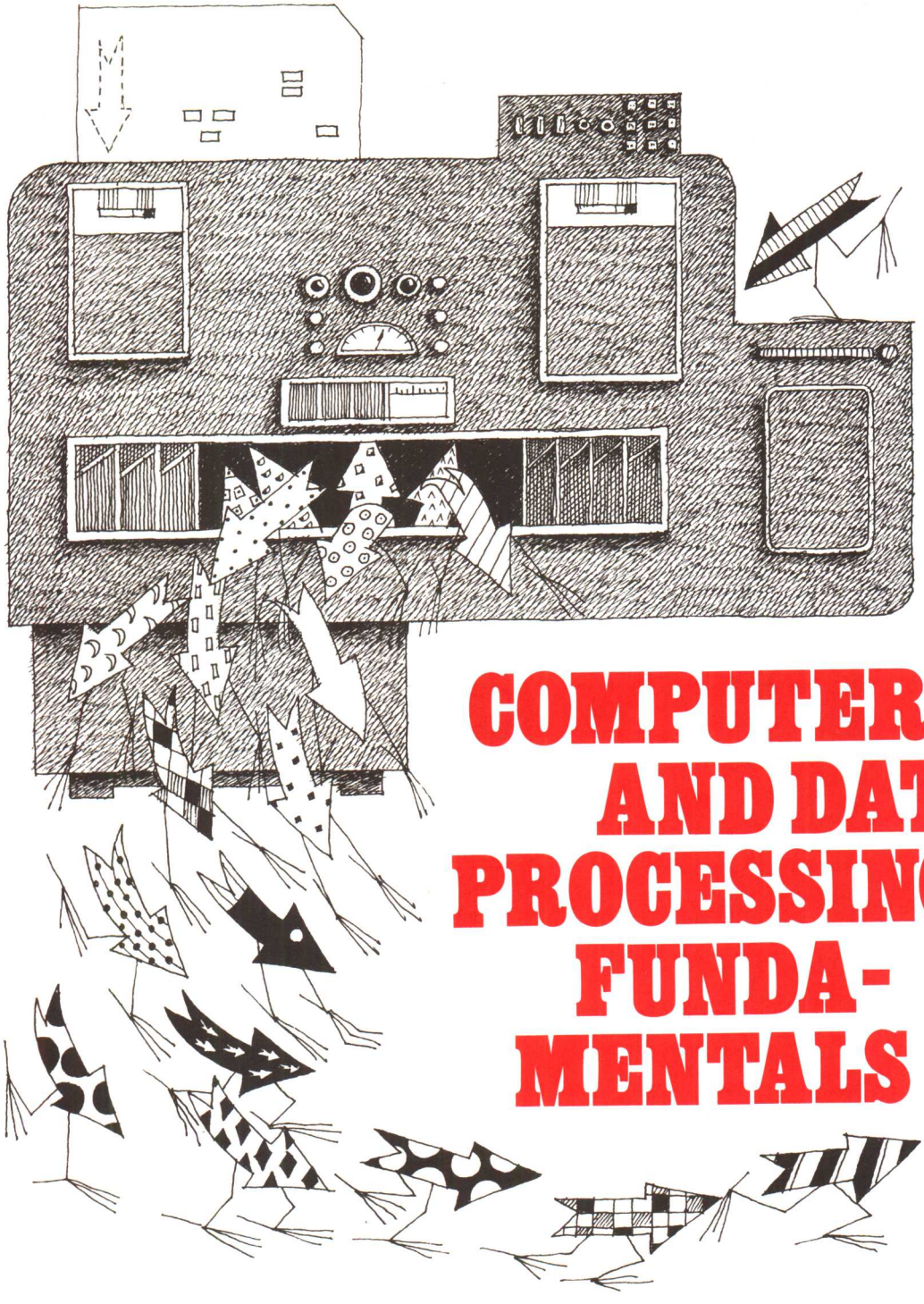
UNIT SIX THE COMPUTER APPLICATIONS ENVIRONMENT

CHAPTER 18	OPERATING THE SYSTEM	397
	Conversion to the New System	398
	Evaluating the System	402
	Coping with Change	404
	Summary	407
	For Review and Discussion	409
CHAPTER 19	PEOPLE IN INFORMATION SERVICES	410
	The Location of Information Services	411
	Careers in Information Services	412
	Information Services and the User	424
	Summary	426
	For Review and Discussion	428
CHAPTER 20	THE MATURING ERA AND BEYOND	429
	Socioeconomic Trends	431
	Computer System Architecture	432
	The Knowledge Industries	435
	The Consumer	439
	Robots and Artificial Intelligence	444
	Summary	447
	For Review and Discussion	449

SPECIAL TOPICS

APPENDIX I	The Keypunch and Data Recorder	453
APPENDIX II	COBOL	471
APPENDIX III	FORTRAN IV	504
APPENDIX IV	RPG II	532
	GLOSSARY	545
	INDEX	559

COMPUTERS AND DATA PROCESSING



COMPUTER AND DATA PROCESSING FUNDA-MENTALS

1

DATA PROCESSING CONCEPTS

Data processing relies on five basic operations, whether the data is manipulated by a computer or by a human. The goal of this chapter is to define and explore these five basic steps, drawing upon a historical perspective and using examples of manual and mechanical systems. This chapter will give you a foundation of the basic concepts and vocabulary needed to understand computer data processing.

In this chapter you will learn:

1. What data processing is and how it is defined
2. The four types of data processing systems
3. The five basic data processing operations
4. The fundamental business data processing cycle
5. Significant historic contributions to modern data processing

Key terms to watch for and remember are

- data
- information
- data processing
- data processing system
- cost-effective
- inputting
- storing
- outputting
- controlling
- transaction
- record
- file
- character
- data element
- transaction file
- master file
- key field

When you think of computers, images of carefully guarded rooms full of mysterious equipment with blinking lights may pop into your mind. You might think of large businesses or people engaged in scientific research, but if you reflect on some of the day-to-day events that took place in your life—say, over the past week—you'll see that you came into contact with computers often and that they eased your daily tasks in countless ways. When you checked out at the counter in the grocery store, when you withdrew money from your bank account, and when you made a purchase at the department store, you probably came face-to-face with a small computer or with one of the tentacles, called a **terminal,** of a large computer.

Computers are constantly busy, performing routine but important tasks with great efficiency. For example, if you received a subscription magazine in the mail, it was probably addressed by a computer. If you bought something on a bank credit card or paid a bill by check, computers helped sort the information needed to make the transaction. Your account was reduced, while the account of the person or business you paid was increased. If you got a parking ticket, a computer quickly processed the information about your car and license number into the proper form for the traffic court (fortunately or unfortunately for you!). After you registered for this course, a computer helped

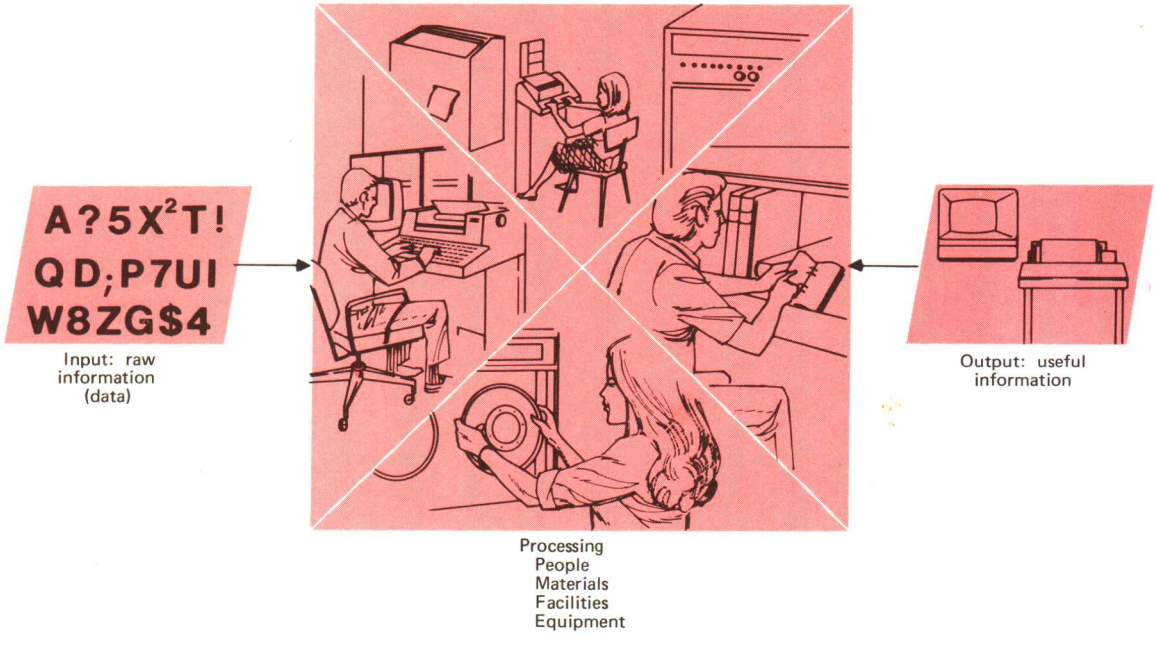


FIGURE 1-1
A data processing system. A data processing system converts unorganized facts, called data, into useful information.

sort the information about who was enrolled and the nature of their requirements, in order to create this class. Many more transactions that you have made fit into a picture similar to these examples, but what do all these events have in common?

In each case a single event in your life, which we can describe as a **fact** (for example, on Wednesday, you bought a tennis racket by using a credit card), was manipulated along with events in other people's lives by a computer to become useful information. In essence, this is the definition of data processing, and it is the subject of this book. A more complete definition is contained in the words themselves. **Data** are a collection of facts—unorganized, but able to be organized. These facts are unrefined, or raw, information. **Processing** is a series of actions or operations that lead to an end. When we speak of data processing, the end is useful information. Hence, we can define **data processing** as a series of actions or operations that converts raw information into useful information. We use the term "data processing system" to include the resources which are used to accomplish the processing of data. As shown in Figure 1-1, which depicts input data being processed to become useful output, these resources are: people, materials, facilities, and equipment.

Throughout this book, we will be focusing on computers and the ways they can be used to process data. The need for manipulation of facts into useful information is a not a phenomenon of modern life. Throughout history, and even prehistory, people have found it necessary to sort facts, numbers, and events into forms that were easier to understand. For example, the ancient Egyptians recorded the ebb and flow of the Nile River and used this information to predict yearly crops. Today, computers convert land and water information into recommendations for farmers on crop planting.

As a background for our study of computers, we'll take a look at some methods of data processing in this chapter and develop a vocabulary and a historical perspective that will help to introduce us to computer data processing. Following this chapter, we'll build on this information to develop an understanding of the modern computer and to learn how it can be used most effectively.

TYPES OF DATA PROCESSING SYSTEMS

Even in modern times, computer data processing systems are not used in every situation requiring the manipulation of data or information. Figure 1-2 lists some common systems, most of

此为试读,需要完整PDF请访问: www.ertongbook.com