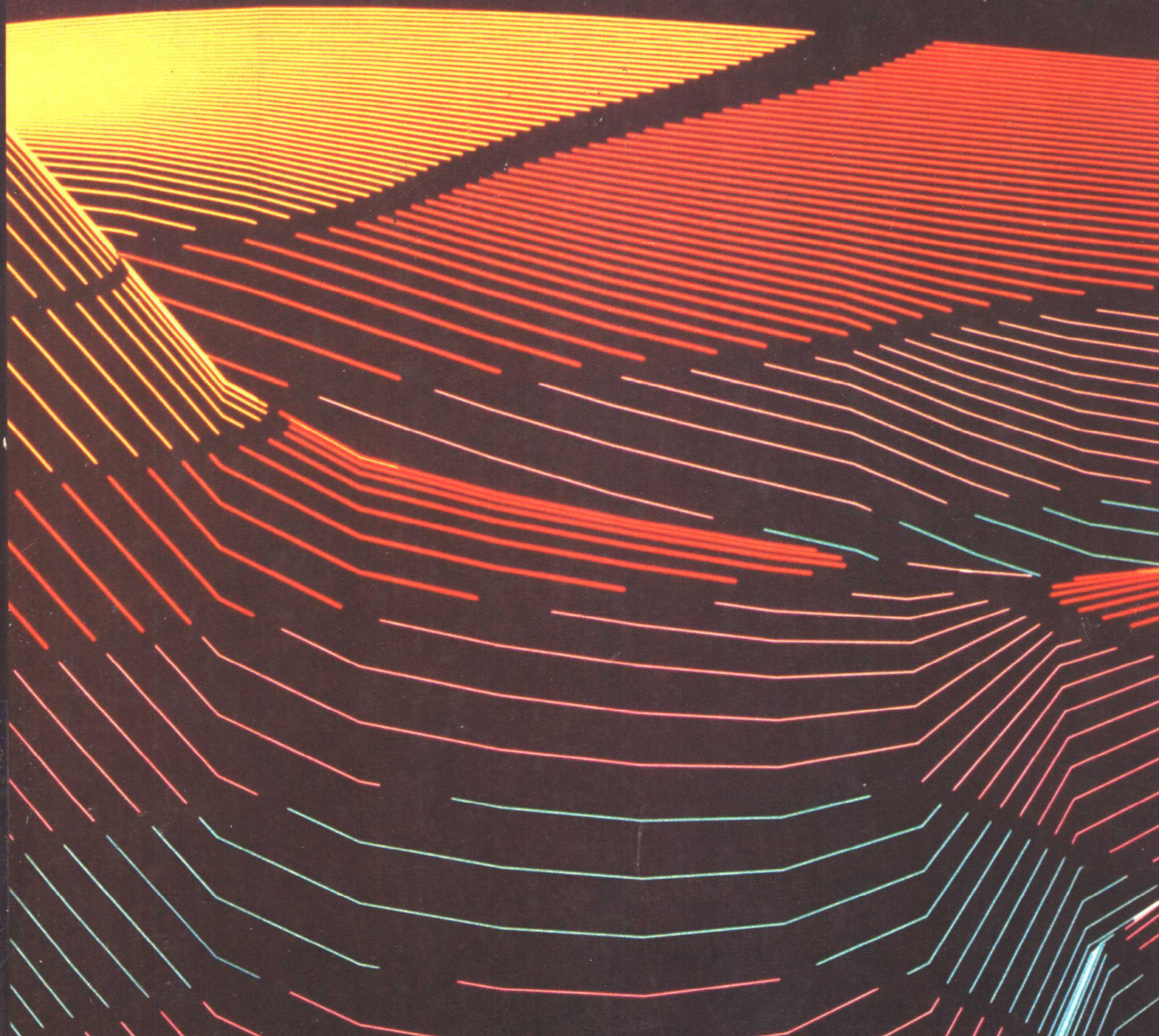
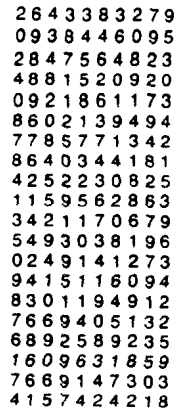
Data Processing
Systems and Concepts

Robert J. Verzello and John Reutter III





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Data Processing: Systems and Concepts

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Preface

As a relatively new subject for academic study, data processing does not yet have a common set of course objectives or a core of widely recognized teaching concepts. In this respect, it is unlike subjects such as accounting, for which there is a set of generally accepted principles that provide direction and perspective.

Our experience in both education and industry leads us to believe that, without an established perspective, students emerge from their studies unable to relate what they are doing as data processors to the needs of the organizations they are serving. They have unexpected difficulty adjusting to new systems, new languages, and new methods.

Different groups of educators and industry professionals have been at work trying to develop a standard approach to data processing and trying to obtain agreement on the most important material to cover in introductory data processing courses. Despite a lack of total agreement, a consensus does appear to be emerging on key concepts, methods, and degrees of emphasis.

In response to these efforts and as a result of our own concerns, we have developed a conceptual framework that puts the intertwined subjects of systems, data, processing, computers, and programming languages into a manageable perspective independent of any particular hardware or software. In this text, students are immediately introduced to the needs of information in organizations, and they are given a means of understanding complex interrelationships through the systems approach.

Using concepts as building blocks, the systems approach not only is described but also is used in the presentation of the materials. The fundamental concepts are treated as components of a textbook system whose goal is to provide information about computers and data processing.

Our objectives in writing this text were as follows:

- To dispel student anxiety about the subject by showing how commonplace data processing is and by bringing to light the students' own experiences as data processors
- To provide students with a conceptual framework for the study of data processing and information systems that will give them a perspective on a complex body of knowledge
- To equip students with tools that have application beyond specific programming languages and hardware configurations, tools which will not go out of date quickly but which can be tailored to meet new situations

- To demonstrate to students the means of spelling out the logic of procedures both graphically (in flowcharts) and verbally (in pseudocode), preparing them for the new emphasis in industry on pseudocoding as the primary means of program design
- To acquaint students with those technologies with which they are most likely to come into contact, whether or not they become data processing professionals
- To make sure that students are constantly reminded of the applicability of what they are learning

WHAT IS NEW AND INNOVATIVE?

Unique features of this book include the following:

- A conceptual framework which is simply not found elsewhere and which has proved over several years of testing to be capable of providing job skills and a foundation for further coursework
- A complete integration of word and text processing with data processing
- A strong discussion of data communication and network structures
- An emphasis on systems and software
- An explanation of a typical business applications package (Business Manager) by an author who developed the system for resale by a major microcomputer manufacturer
- An appropriate emphasis on the latest technology, particularly microcomputer systems, with which virtually all students can be expected to have "hands-on" experience in the near future
- A fresh approach to some familiar subjects such as computer hardware (the shift of emphasis toward smaller systems) and a side-by-side presentation of flowcharting and pseudocode concepts
- A more extensive use of exercises to provide opportunities for students to apply concepts in the classroom or at home
- An up-to-date look at the problems of managing information resources in the modern office
- A thoroughly integrated coverage of concepts and applications in BASIC programming language (with the result that Chapters 3, 4, 13, and 14 are a programming text within the data processing text)

PEDAGOGY: THE APPROACH TO TEACHING

In the Text

To make the text as complete a teaching tool as possible, we have included the following for each chapter:

- *Learning Objectives* to motivate students and to provide a means of measuring personal achievement

- An *Overview* of the subject matter to guide students to the key ideas introduced in the chapter
- A *Chapter Outline* to sever as a roadmap to the development of the subject
- A *Summary* on the main topics covered in the chapter
- A *Glossary* of new terms introduced, with some expansion of the definitions in the text where appropriate
- *Discussion Questions* to provoke thought and stimulate involvement
- *Exercises* to provide in-class activities or homework that requires students to apply their newly acquired knowledge
- A brief *Problem* that requires application of concepts and extension into practical considerations involving other subject areas like human relations or accounting
- A *Reading* related to the chapter's subject and chosen to bring awareness of the applicability of the subject to the "real" world

In the Supplements

Also available are a companion student *Study Guide, Instructor's Manual, Test Bank* (computerized and noncomputerized), and overhead transparencies.

The *Study Guide* (coauthored by J. F. Martinez) includes self-testing material and a fresh overview of each chapter to reinforce concepts in the text, provide students with an opportunity to test their skills, and encourage their interest in the subject of data processing.

The *Instructor's Manual* (coauthored by Al Bauer) provides the basic motivation for each chapter and offers teaching objectives; expanded glossaries and learning objectives; teaching tips; relevant anecdotes; and answers to the text questions, exercises, and problems. It also suggests alternative course organizations and emphases.

The *Test Bank* includes approximately 60 objective questions for each chapter as well as two finals. These materials are also available in computer tape form through the EXAMINER system.

The set of 48 overhead transparencies includes teaching transparencies and figures drawn directly from the text.

ORGANIZATION

The text is organized in such a way that the first four chapters lay the conceptual foundation for the rest of the book. They begin by showing where the need for information arises and how information systems operate in organizations. Chapter 2 describes what is meant by data, while Chapters 3 and 4 define the activities and procedures used to process data into information.

For those who teach BASIC in this course, Chapters 3 and 4 can be studied concurrently with Chapters 13 and 14 to form a complete language supplement. The concepts are in the early chapters, and the applications, following the same sequence and terminology, are in the latter chapters.

Our heavier-than-usual emphasis on text processing is consistent with the fact that a major portion of data processing is involved with text manipulation of data fields in records, reports, and input forms rather than with numerical calculation. With word processing becoming such an important companion of data processing in the modern office, it is important to extend the conceptual framework to include this activity as well.

Chapters 5, 6, and 7 describe the components of a computer system. By the time they reach these chapters, students will have a good idea of what it is that computers are supposed to be doing and they will appreciate what makes computers so useful to organizations. Our approach in these chapters is to teach students as much about computer hardware as they need to know to be successful at using it to accomplish other goals.

Following the hardware chapters, students will learn much about the capabilities of software, the types of software, business application packages, systems analysis and design, and the issues and concepts of managing information resources.

A glimpse of some future impacts of information technology rounds out the text on a lighter and stimulating note.

There are three appendixes. The first deals with careers in data processing, describing the types of jobs available and the preparation required to enter them. The second is a unique approach to cataloging the historical development of data processing from prehistory to the modern office. The third presents the answers to the odd-numbered exercises from each chapter. These will be especially helpful to students studying on their own and to those who need model answers to follow when developing their own solutions.

ACKNOWLEDGMENTS

Many people have cooperated in refining the materials presented in this text. Foremost among these are over 2000 students who challenged our thinking, worked their way through various versions of the manuscript, and gave us valuable feedback.

Then there are the dozen other instructors who taught from the materials and provided similarly valuable feedback. They include Steve Maddox (City College of San Francisco) and Roger Cutler, Jim Hodges, Jan Peterson, Bonnie Best, Rich John, Barbara Nielsen, Don DuGrey, Len Herzstein, J. F. Martinez, Ruth Ruskin, and Al Bauer (Skyline College).

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(University of Portland), Richard J. Westfall (Cabrillo College), and David C. Whitney (San Francisco State University).

How any publisher could do more to help its authors create a text that is valuable to students and instructors alike than McGraw-Hill has done is beyond our imagining. We are especially grateful to Elisa Adams, Jim Armstrong, Dennis Conroy, Mel Haber, Jim Vastyan, Charles Stewart, and Ellen Friedman for their craftsmanship, inspiration, and good humor.

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ROBERT J. VERZELLO
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Contents

You Are a Data Processor

You are already a data processor. You've been one all your life! You do all or most processing without a computer (except the one you carry above your shoulders). When you look up a friend's phone number, balance your checkbook, copy a recipe, write a report, monitor your speed as you drive a car, or even read this book, you are processing data. The result of your data processing activities is information which you use to guide your actions. The better informed you are, the more likely it is that you will achieve your objectives.

The many types of organizations that make up modern society also rely on information to guide their activities. Families rely on records of past expenditures to budget future expenses. Fast-food chains research the number of people of different age groups who live in an area where they plan to open outlets. Colleges keep records of the courses taken and the grades earned by students so as to determine who is eligible for graduation. Professional sports organizations rely on game films and scouting reports to plan their strategy for upcoming games.

Information is used at every level of an organization from guiding the most basic activities such as filling orders in a warehouse to helping develop strategies to be employed by the organization for realizing its long-range goals.

An increasing number of people are employed directly or indirectly in jobs that involve some aspect of information processing. (See Figure I-2.) Estimates vary from just under 50 percent of the U.S. labor force to 60 percent.

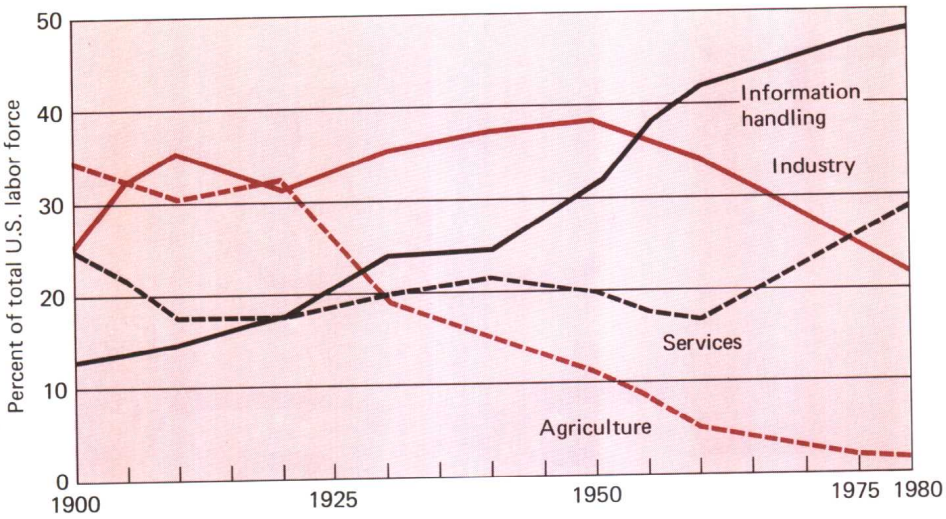
IMPORTANCE OF INFORMATION PROCESSING TO MODERN ORGANIZATIONS

At least three major trends have combined to make information processing so important to organizations: the growing complexity of modern society, the introduction of scientific management, and computer technology.

Figure I-1 You already have experienced processing data. As you can see from the scenes in this figure, data processing is a very commonplace activity.

The Growing Complexity of Modern Society

Picture yourself in a general store in the Old West. Whether you want a hammer or a can of beans, the general store probably has it. There are no price tags, though, no sales tax, and no receipts. The proprietor keeps a few simple records of how much merchandise is on hand and how much he pays for occasional help in the store, but there are no continuous inventory or payroll records. There are few government regulations or taxes requiring records and periodic reports. There are no credit account bills to send, no reports to unions or insurance companies or stockholders. All in all, the proprietor probably spends no more than an hour or two every week on formal record keeping for the store.



Data: Stanford University Institute for Communications Research

Figure I-2 More people are finding that the biggest part of their job is handling information. (*Source: Business Week*, June 30, 1980, by special permission, © 1980 by McGraw-Hill, Inc., New York, NY 10020. All rights reserved.)

By contrast, less than 100 years later, the job of handling information in most organizations today takes the efforts of about half the entire work force every day.

Consider the record keeping that must be done in a modern department store when a sale is made. The sales transaction is recorded by dollar amount, item, department, salesperson, type of sale (credit, layaway, etc.), time of day, date, and so forth. Summary reports on sales are used to update inventory records, sales records, cash balances, accounts receivable, and productivity records.

Many of the economic, social, and government programs and systems we take for granted in our everyday life are relatively new and create an increasing need for information reporting. Commercial banking, stock investing, consumer credit, insurance, social security, income taxation, extensive government regulation, and other activities make it necessary for individuals and organizations to gather, manipulate, store, and report vast quantities of information.

The Introduction of Scientific Management

In the early part of this century, Frederick Taylor, Frank and Lillian Gilbreth, and others developed "scientific management" techniques that made it possible to operate a business more efficiently.

Scientific management involves studying processes in detail, analyzing the information gathered, making changes to improve the processes, obtaining

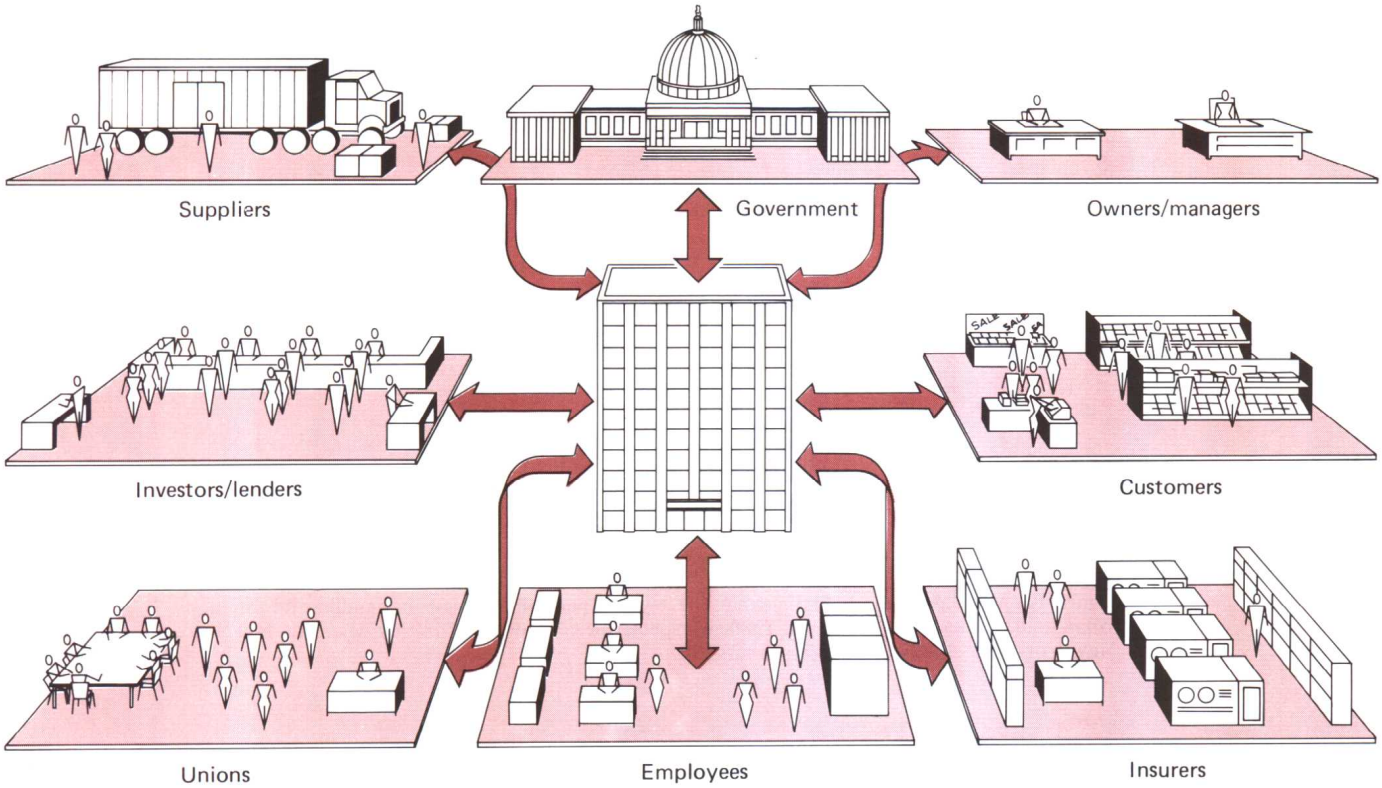


Figure I-3 Modern organizations, represented here by the office building in the center of the figure, have many different demands for information placed on them. These demands arise both internally from the need to operate and manage the organization and externally from regulators, lenders, suppliers, customers, and others.

feedback about the processes, and studying that feedback to see whether the changes have brought about any improvements. The process requires business managers to have considerable information available on which to base their decisions. In fact, now that many large corporations are publicly owned (by their stockholders) and taxpayers support so many large government agencies, it is more important than ever for managers to be able to readily summarize information, draw comparisons, determine trends, find relationships among pieces of information, measure performance, and relay all this information to the owners or taxpayers.

Computer Technology

Technology has *more* than kept pace with the growing demand for information. Its availability has, in itself, created an increasing demand for its use. Useful information that was deemed too costly or impractical to obtain under older techniques is now readily available at a reasonable cost. The result is an increasing demand for such information. Computers especially have enabled people to gather and store large quantities of data in such a way that the data