

# MODERN DATA PROCESSING

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The primary objectives of this book are:

1. To provide a broad insight into the many techniques and applications of modern data processing for those desiring a general knowledge of this important and dynamic field.

2. To provide a good foundation for those planning further study in specific areas of data processing.

The book is designed for use as a text in basic data processing classes or for independent study.

*Modern Data Processing* incorporates the format and basic content of the authors' previous book, *Introduction to Data Processing*. However, this book has been reorganized and expanded to reflect the increasing scope and complexity of data processing activities. Specifically, a more extensive treatment of the various facets of electronic data processing has been included.

Technical topics are presented in a manner that will make them understandable to readers with little or no background in the subjects discussed. Pertinent illustrations are used liberally as a further aid to comprehension. However, no attempt has been made to omit or oversimplify challenging topics, as it is our conviction that this would deprive readers of a full appreciation of the technological accomplishments of modern data processing. Nevertheless, any reader wishing to skip

some of the more technical material, such as the analyses of computer programs, can do so without affecting the continuity or usefulness of the remaining text.

Another objective of this book is to create an awareness of the great variety of data processing methods and devices that are now in use, their relative significance, advantages, and limitations. Thus, manual and mechanical data processing techniques are covered along with punched card machines and electronic computers. This approach reflects our opinion that the well-informed reader should be cognizant of all types of data processing, not just the most sophisticated. Nevertheless, major emphasis is placed on electronic data processing, related data collection techniques, and data communications. In addition, a chapter dealing with industrial uses of computers has been included in recognition of the growing interest in this important field.

The text is organized as follows. Chapter 1 presents an overview of data processing that serves as a general introduction and frame of reference for comprehending and relating the topics in succeeding chapters. Chapter 2 is devoted to the history of data processing from ancient recording and computing techniques to modern mechanical and electronic devices. Chapter 3 presents a brief survey of types of business, legal forms of business, internal organization of business, basic opera-

tions including accounting procedures, and sources of data. Chapter 4 surveys manual and mechanical data processing methods and devices—some conventional and others newly developed.

The material in Chapters 5 to 9 covers punched card data processing. The punched card unit record is discussed in Chapter 5 with the succeeding three chapters devoted to punched card recording functions, manipulation of punched card data, and punched card summarizing and reporting. Chapter 9 includes procedure development, flow charting, and a comprehensive punched card application.

Chapter 10 outlines the codes, media, and devices used to collect machine-sensible data. Chapters 11 to 17 are concerned with electronic data processing, including a survey of computer characteristics, physical elements and functions of a computer system, numbering systems, basic programming techniques, coding, programming systems, problem-oriented languages,

and electronic data processing operations. Data communications is discussed in Chapter 18. The uses of computers in industrial automation are outlined in Chapter 19. Chapter 20 is devoted to systems study and design.

End-of-chapter questions are furnished to help the student review the text material and as a basis for discussion. The glossary contains definitions of terms that appear in this book, or that the reader is likely to encounter in supplementary reading.

We express appreciation to the many individuals and companies who provided information and illustrations for this book, or who otherwise assisted in its preparation. Specific credit is included with illustrations wherever appropriate.

*Robert R. Arnold*  
*Harold C. Hill*  
*Aylmer V. Nichols*

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## SCOPE AND SIGNIFICANCE OF DATA PROCESSING

Although the term “data processing” is of relatively recent origin, this does not mean that the activity itself is new. On the contrary, there is evidence that the need to process data originated as far back as the beginning of recorded history when man’s activities first exceeded his ability to remember the details of his actions. Throughout history, commercial and governmental activities have created the need for record keeping of one sort or another.

In its broadest sense, data processing refers to the recording and handling that are necessary to convert data into a more refined or useful form. In the past these tasks were referred to as record keeping or paperwork. They were accepted as a routine clerical activity. With the advent of more sophisticated electromechanical and electronic business machines in recent times, the terms “paperwork” and “record keeping” have been replaced by the phrase “data processing.” In addition, the proc-

essing of data has grown to such an extent that the activity itself has become a center of interest. This interest is justifiable, but it should not lead to the conclusion that data processing is an end in itself. It is rather a means of achieving objectives that are almost as varied as the nature of data.

### DEFINITION OF DATA

Because of the widespread application of new data processing techniques to banking operations, billing, and other financial situations, there is a tendency to assume that the term “data” refers primarily to accounting functions. Actually, data can include any facts, figures, letters, words, charts, or symbols that represent an idea, object, condition, or situation. Thus data can include such diverse things as completed election ballots, inventory figures, gas meter readings, school attend-

ance records, medical statistics, engineering performance reports, and production figures. In fact, this list could continue for pages because examples of data can be found in every field of activity.

There is, of course, a difference in the type of data being handled in various fields. In science, for example, chemists, physicists, and mathematicians find it necessary to perform vast calculations on relatively limited amounts of data. This is also true of the many fields of engineering where extremely complex design and performance calculations must be made.

In business and government operations the situation is usually quite different. Here the data being handled is voluminous and repetitive, but processing requirements, although varied, are less complex. Attention in this book will be focused on this type of data processing, although the techniques to be discussed will be found to some extent in virtually every field.

## DATA VERSUS INFORMATION

A distinction is often made between data and information; namely, that data is the raw material from which information is derived. According to this concept, the significant characteristic that separates data from information is usefulness. Thus a compilation of data may, in itself, be of little value unless it provides knowledge leading to the achievement of some objective. Although any collection of data may have potential informational value, what constitutes information for one individual in a specific instance may lack significance for another or even for the same individual at a different time or for a different problem. Specifically, in-

formation consists of *selected data*—data selected and organized with respect to user, problem, time, place, and function. The conversion of data to information is a primary function of data processing.

## THE NEED FOR DATA PROCESSING

Although the needs for gathering and processing data have many specific origins, in general, they may be classified as *external* or *internal*. In business organizations external requirements may be regarded as mandatory since they are imposed by various government agencies, unions, or stockholders. The federal government, for example, requires quarterly reports on the income taxes and social security taxes withheld from the pay of employees, and state and local agencies require reports of sales taxes collected.

In addition to the financial and statistical data required by governmental agencies, business enterprises must furnish annual reports to stockholders, and various data to customers, creditors, and the general public. Some external data needs have their counterparts within the organization. Payroll records, for example, provide necessary internal data and also form the basis for financial and personnel reports to the government and to unions.

Internal needs fall broadly into two classes: *operations* and *control*. First, a tremendous amount and variety of routine operating documents are necessary as evidence of (1) primary transactions with customers and vendors; and (2) subsequent activities involving production, personnel, materials, equipment, and accounting. For example, the issuance of a purchase requisition indicating a departmental need for materials may start a