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Introduction to Computer Data Processing with BASIC

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CHAPTER 1 Courtesy of International Business Machines Corporation, p. 8. Courtesy of International Business Machines Corporation, p. 9. Courtesy of International Business Machines Corporation, p. 11. Courtesy of International Business Machines Corporation, p. 12. Courtesy of International Business Machines Corporation, p. 15. Courtesy of International Business Machines Corporation, p. 16. Harvard University, Paul Donaldson, p. 17. Des Moines Register and Tribune, p. 18. Smithsonian Institution photo #53192, p. 19. Smithsonian Institution photo #72-2616, p. 23 *(top)*. Sperry UNIVAC, Division of Sperry Rand Corporation, p. 23 *(bottom)*. Burroughs Corporation, p. 26. Honeywell, Inc., p. 27.

CHAPTER 2 Lynda Gordon, p. 35. NCR Corporation, p. 36 *(top)*. NCR Corporation, p. 36 *(bottom)*. Control Data Corporation, p. 38 *(middle)*. Plato Computer Based Education, University of Illinois, p. 38 *(bottom)*. Courtesy of International Business Machines Corporation, p. 39. IIT Research Institute, Chicago, p. 40.

CHAPTER 4 Courtesy of International Business Machines Corporation, p. 65. Courtesy of International Business Machines Corporation, p. 69. Courtesy of International Business Machines Corporation, p. 72. HBJ Photo, p. 73. Courtesy of International Business Machines Corporation, p. 74. HBJ Photo, p. 76 *(top)*. Sperry UNIVAC, Division of Sperry Rand Corporation, p. 76 *(bottom)*. Courtesy of International Business Machines Corporation, p. 77.

CHAPTER 5 Courtesy of International Business Machines Corporation, p. 87. Control Data Corporation, p. 89. Energy Conversion Devices, p. 90. National Semiconductor Corporation, p. 91.

CHAPTER 6 HBJ Photo, p. 105 *(top)*. HBJ Photo, p. 105 *(bottom)*. HBJ Photo, p. 106. HBJ Photo, p. 107. Courtesy of International Business Machines Corporation, p. 109. HBJ Photo, p. 111. Burroughs Corporation, p. 112. HBJ Photo, p. 113. Courtesy of International Business Machines Corporation, p. 114 *(top)*. Courtesy of International Business Machines Corporation, p. 114 *(bottom)*.

Illustration credits continue on page 462.

PREFACE

In the late 1940s, the computer emerged as one of the wonders of the age. At that time, it was estimated that less than 100 computers would be required to fulfill all the demands for computing power for the remainder of the century. In fact, one forecast predicted that only a dozen computers would more than adequately serve this purpose.

Today, we stand at a milestone in computer history: More than 100,000 computers are in active use in the United States alone. But the demand for computer processing appears to be almost insatiable as microprocessors and microcomputers are now being incorporated into automobiles, cameras, phonographs, electric ranges, and many other devices never before considered to be within the realm of computer application. Huge computerized files containing a multiplicity of information about almost every person in our society are currently maintained. Welfare recipients, federal income-tax payers, hospital patients, licensed automobile drivers, persons who apply for credit, and criminals are only a few of the individuals who have entries in such files. The public is justifiably apprehensive about the computer's potential to invade personal privacy.

We are caught up in a revolution that is beyond our once wildest dreams: a revolution that affects all of us in our daily lives, a revolution that has changed and will continue to change the way in which we perceive our world and process information. The breadth and depth of the impact of computers on our lives makes it imperative for everyone to be educated in both the fundamentals of computers and their myriad uses. The aim of this text is to present the basic concepts of computer technology, programming, and processing, with an emphasis on new programming methodologies and hardware advances in general and on the BASIC language in particular.

Introduction to Computer Data Processing with BASIC is designed for the introductory data-processing course. The book presents an overall view of

the computer and its applications, focusing on the fundamental concepts of computer hardware and software rather than on a detailed description of a particular computer and its software.

Chapters 1 and 2 put the computer in historical perspective and illustrate its current role in a variety of applications; Chapter 20 discusses the computer's place in and impact on our society. Chapter 3 explains the binary, octal, and hexadecimal number systems, and Chapter 4 introduces punched-card equipment. (Because many small data-processing installations are beginning to use minicomputers instead of punched-card equipment, some instructors may wish to omit Chapter 4.) Chapters 5, 6, 7, and 9 introduce the hardware and software of the computer; data input, output, and storage devices are discussed and compared. Chapter 8 presents data-entry devices, and Chapter 10 provides an extensive examination of both mini- and microcomputers. Chapters 11–16 consider the use of the computer from the start to the finish of a problem: designing the problem, choosing a language, testing the programming system, and the remaining elements that must be combined to produce a successful computer system. Chapter 11 provides a guide to the analysis of a business data-processing problem and the decisions to be made regarding the design of the programming system. Chapter 12 introduces the basic features of flowcharting and of decision tables, which are in increasingly common use. The features of BASIC—one of the most popular programming languages—are discussed in Chapter 13. Chapter 14 incorporates an explanation of structured programming as well as other recent developments in program methodology. Chapters 17, 18, and 19 present information related to the management of computer centers and computer personnel. An appendix summarizes the BASIC statements and directs the student to the appropriate pages in the text for further information. A glossary of data-processing terms appears at the back of the book for easy reference.

Much of the material in *Introduction to Computer Data Processing with BASIC* has been taken from my earlier book, *Introduction to Computer Data Processing,* Second Edition. The aim of both books is to present a survey of the areas of computer hardware and software. In addition, the present text provides an in-depth examination of the BASIC language that enables the instructor to teach BASIC programming specifically, if he or she wishes to do so. To meet this objective, Chapter 9 has been expanded to include an overview of the most popular programming languages: FORTRAN, COBOL, BASIC, PL/I, RPG II, ALGOL, and PASCAL. These languages are discussed in sufficient detail for the student to gain a broad understanding of the various programming languages currently in use. Chapter 13 then presents a detailed discussion of the main features of BASIC. Supplementary teaching materials, including programming problems and their solutions, can be found in the Instructor's Manual to accompany *Introduction to Computer Data Processing,* Second Edition, which has been adapted for use in conjunction with *Introduction to Com-*

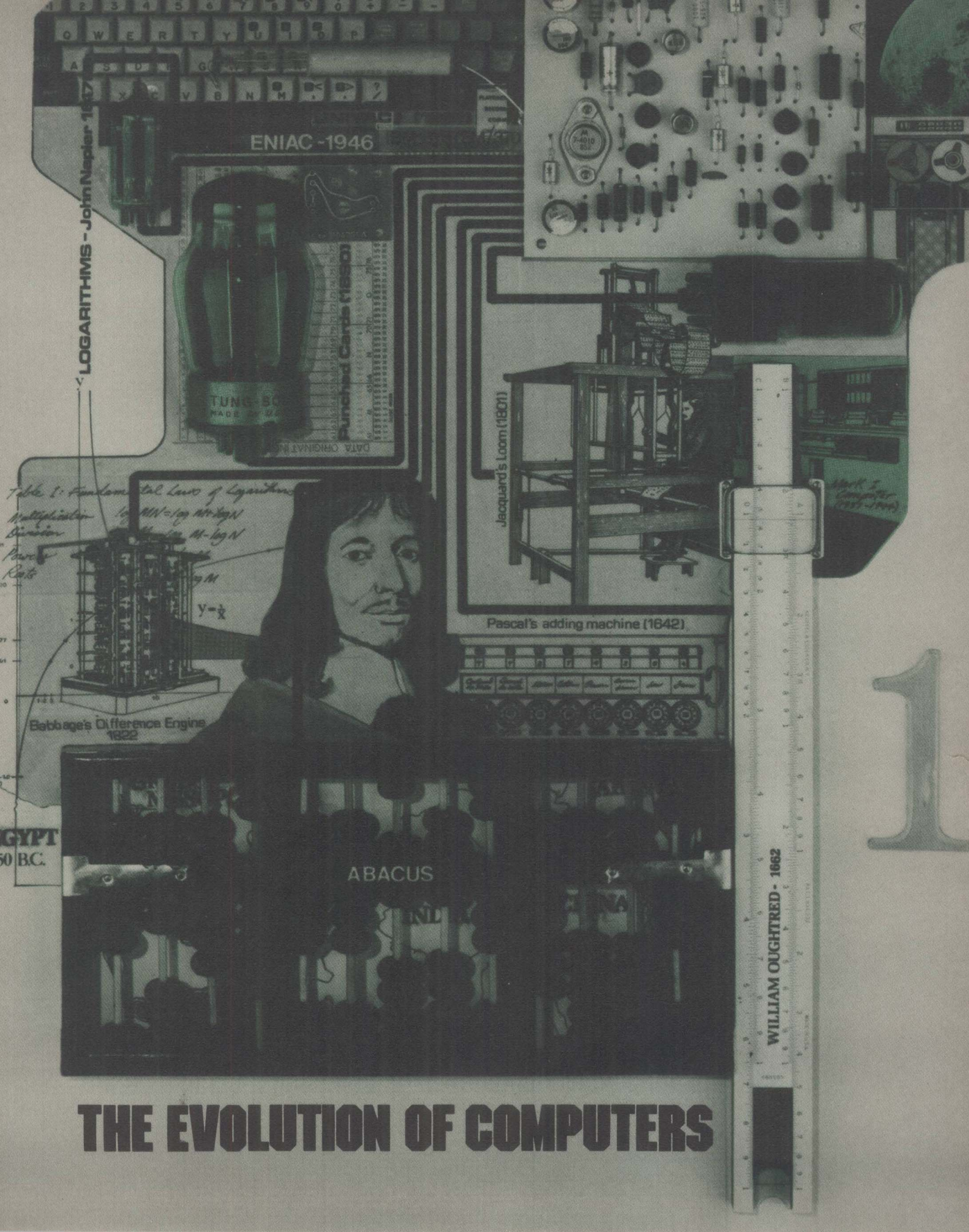
puter Data Processing with BASIC. Chapters 13 and 14 (FORTRAN and COBOL) and Appendixes A and B (PL/I and RPG II) in the Second Edition are not included in this book.

For his help on Chapter 10, I want to thank Professor Harold Shipton, University of Iowa, and also to express my appreciation for his encouragement in the initial undertaking. In addition, I again wish to acknowledge the many people who assisted in the preparation of the first edition. I want to thank Captain Grace Hopper and Dr. John Atanasoff for supplying information; Professor Thomas G. De Lutis, Information Systems Architects, Inc., and Professor Edwin Towster, University of Southwestern Louisiana, for their careful reading of the initial manuscript; and the representatives of various computer manufacturers, particularly Mr. Howard Soroos of IBM and Mr. David R. Paul (formerly with Sperry UNIVAC; currently with E.F. Hutton and Co., Inc.), for their assistance. This text was begun while the author was employed at the Bioengineering Resource Facility, University of Iowa.

I also wish to thank Nancy Shively for her help and encouragement, and I dedicate this book to her.

MARGARET S. WU

CONTENTS



THE EVOLUTION OF COMPUTERS

In today's highly developed, sophisticated world, astronauts travel to the moon and bring back samples of moon rock, television pictures are transmitted by satellite to distant locations around the earth, and nuclear plants supply a portion of our electricity. Although we marvel at these human achievements, we often ignore the complexities and wonders of life on a day-to-day basis. At the click of a switch, we turn on the lights in a room. Our houses are comfortably heated by fuel and the internal temperature regulated by a thermostat. The cars most of us drive were manufactured on assembly lines many miles from where we live–often in foreign countries. The gasoline for their engines was refined at a distant location and transported to a gas station near our home. Our television set brings us "live" coverage of the Olympic games held thousands of miles from our home. We can pick up our telephone and call nearby friends or, if we wish, a friend on the other side of the world. Our supermarkets offer us an array of food items, many of which are processed hundreds of miles from our home. These are only a few of the numerous goods and services that are supplied to us by others. The outstanding attribute of modern society is the interdependence of its components.

But such technological accomplishments would mean nothing without the modern marketing and distribution of goods and services. And handling such a massive amount of products would be economically impossible without the use of modern data-processing techniques. To function successfully, a modern business must record, process, and analyze large amounts of information. For example, an electric company must bill its customers for their use of electricity; a bank must maintain accurate records of all customer accounts and issue monthly statements for checking accounts. All levels of government—local, state, and federal—are similarly involved with the retention of data and its manipulation. The federal government, for example, must process income-tax returns, verify the accuracy of calculations, check the truth of statements made by taxpayers, and issue any refunds due. Data processing encompasses all of these activities. We can define *data processing* as the manipulation of data, the retention of data, and its subsequent retrieval. The term *data* can be applied to

any meaningful facts or figures. A list of data pertinent to an individual, for example, may include

- name
- Social Security number
- birthdate
- place of birth
- street address, city, and state of residence
- citizenship
- marital status
- height
- weight
- color of eyes

Another example is a list of data relevant to a machine part; this list may contain

- part number
- supplier
- manufacturer
- unit price
- price per hundred

For some purposes, of course, certain data, such as a person's place of birth, may not be relevant.

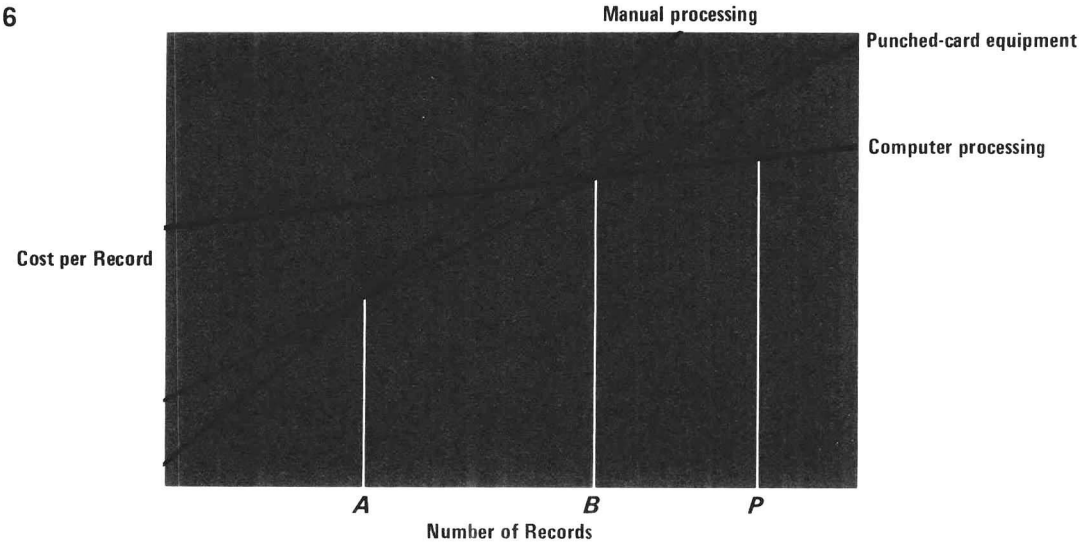
COMPUTER DATA PROCESSING

Data processing can be accomplished manually, mechnically, electronically, or by a synthesis of these methods. For example, an insurance sales representative may manually record the issuance of a policy to a new client. Subsequently, the insurance company may record the pertinent information on the policy onto punched cards while the actual billing statement is prepared by an electronic computer. *Manual methods* of data processing are those that can be performed without using any machine except a desk calculator. Data processing by *mechanical* or *electromechanical* facilities generally indicates the use of punched-card equipment. At one time, the term *automatic data processing (ADP)* indicated the use of this type of equipment. Now this term is also used to indicate the use of computers. By *electronic data processing (EDP),* we mean the processing of data by electronic computers. The introduction of computers into data processing in the late 1950s made it possible to process a voluminous number of records quickly and efficiently. Today developments in computer technology markedly exceed original

expectations. Computers are used to prepare bills, issue payroll checks, provide current inventory information, produce weekly and monthly summaries of sales, and to give management immediate access to up-to-date information for decision making, as well as for such routine activities as record keeping and billing.

BUSINESS AND SCIENTIFIC DATA PROCESSING There are two major areas of data processing: business and scientific. *Business data processing* includes all the routine handling of data such as payroll, sales, and billing information as well as highly sophisticated management-information systems. *Scientific data processing* requires the collection and analysis of data produced by scientific activities. It includes, for example, the collection of data from the manned spaceflights and its subsequent analysis by a computer. It also includes the development of files containing data from scientific experiments and their processing for experimental analysis. On the other hand, the basic aims of business data processing are the retention of information, the updating of information, and the summarization of the data. For example, a college or university must maintain records of all students currently enrolled at the school. The names and addresses of the current student population, the courses they have taken, the courses they are currently taking, and other data must be retained in files. In addition, records must be permanently retained for all the students who have ever been enrolled in the school. The data file for the current student population is constantly changing. The cumulative file of all students—past and present—increases each year. The purpose of these data files is to retain this information accurately. This information may be used in many ways: to report student enrollments over the past ten years, to analyze the geographic areas from which students are drawn, and so on.

Another illustration of business data processing is the recording of insurance policies issued by an insurance company. Each policy must be identified by the name of the policyholder, the policyholder's current address, the provisions of the policy, the cost of the policy, the date of the policy, and so on. This information is recorded in a file, which is kept, in effect, as the company's recording of its relationship with a policyholder. In an automated system, such files may be used



in a statistical analysis of the policyholders or of the type and number of claims paid for the policies. The files may also provide input for a computerized billing system.

WHY DO WE AUTOMATE DATA PROCESSING? The volume of data generated and processed in one day in the 1970s exceeds the quantity produced in an entire year in the nineteenth century. A major New York bank issues over 25,000 checking-account statements daily. The U.S. government annually processes income-tax returns for a population of more than 210 million. (There were only 62 million persons in the country in 1890.) A utility company in a large city must issue over 100,000 bills monthly. All this processing could be accomplished manually, but it is not. Why are computers used in data processing?

Accuracy The repetitive nature of data-processing activities make them ideally suited to computer processing. Computers can tirelessly perform the same task again and again with complete accuracy and without complaint. In the same situation, human workers become bored and tired. They find the constant repetition of the same task tedious and begin to make errors. They begin to record information incorrectly, write illegibly, transpose letters or numbers—in short, they no longer function efficiently. But maintaining accurate records and calculating billing information correctly are essential to the operation of a successful business.

Economies of Scale The cost of processing records manually can be calculated at a fixed cost per record. After the number of records surpasses a certain volume, the cost per record increases slightly for two reasons: (1) at this point, the manual worker begins to make more errors, and it becomes necessary to maintain a closer check on the processing, and (2) the sheer volume of data make the handling and storing of records increasingly difficult.

When a computer is employed to process records, the cost per record decreases as the volume of records increases. The initial costs of establishing a computer data-processing system are high and are usually justified by the problem of processing vast quantities of information manu-