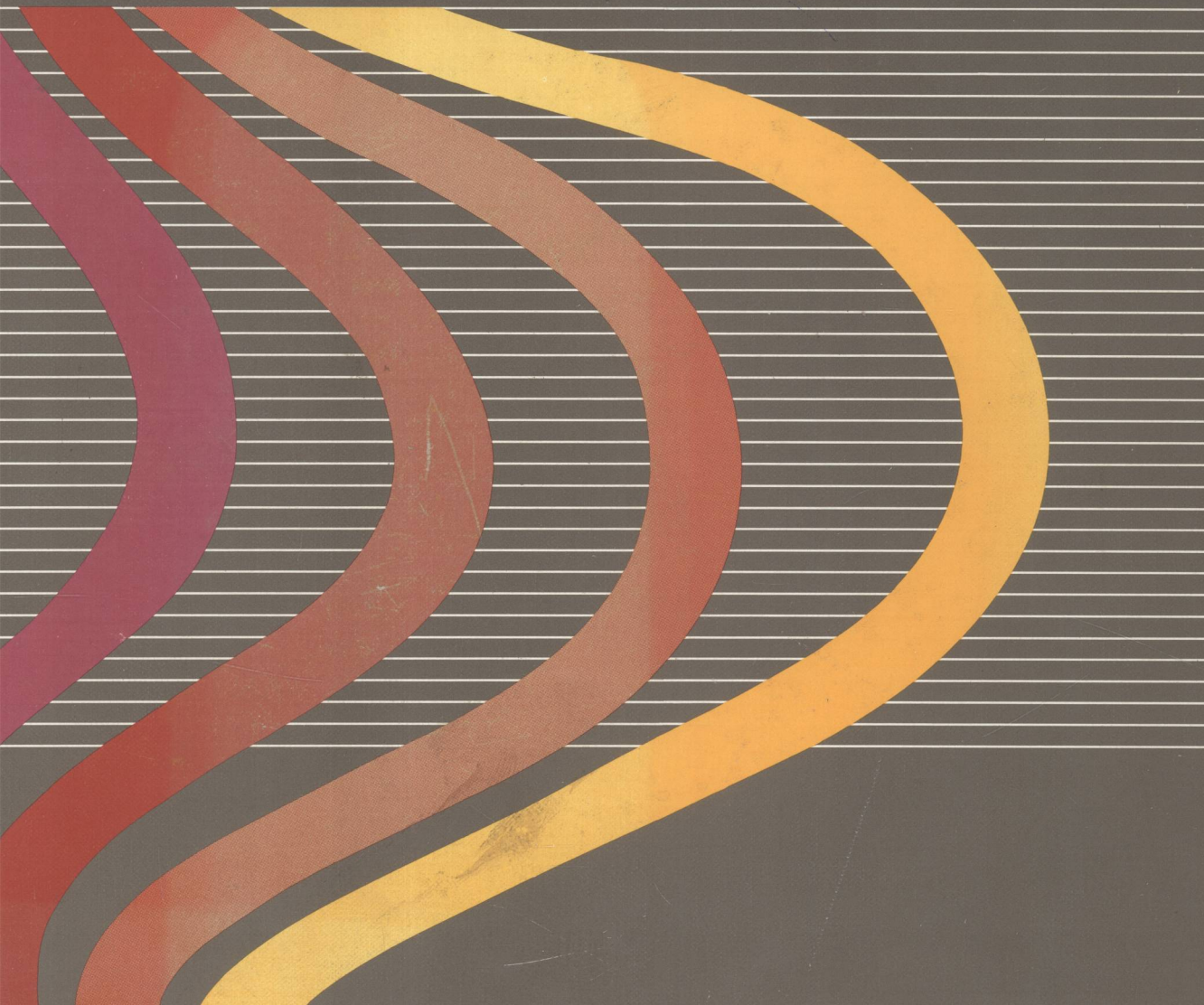
Computer Information Systems

An Introduction to Data Processing

Gerald M. Weinberg
Dennis P. Geller



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Preface

Since 'tis Nature's law to change,
Constancy alone is strange
—John Wilmot

Why This Book?

It wasn't too long ago that microcomputers were something electrical engineers bought in kit form, the only computer game was about a ping-pong ball, the Apple Computer Company had just begun, and *Time* magazine generated controversy by naming "the computer" its Man of the Year. Today these events seem buried in prehistory, almost contemporary with the fall of Rome. Yet those of us who watched these events unfold aren't twenty centuries old. To people caught up in a revolution, things often seem to move quickly.

Within your lifetime, actually in just the past few years, computers have begun to change almost every sector of our civilization. We are all caught up in the unremitting change that characterizes the revolution—but that doesn't mean we must drift aimlessly in its current. To survive in a world of change we must learn to understand the forces of change—what gives rise to them, and what their effects are. We can't predict the future, but we can prepare ourselves for it.

Many books on information systems teach survival skills for the present. This is the kind of material whose relevance is easy to understand, but which may seem hollow once the student has reached the business world. It isn't enough to understand the way things were five years ago, or even to be able to work from that knowledge to understand the way things are today. We must be able to understand not only why things are the way they are, but also where they are going.

Our approach to this book is consonant with this message. As a wider range of students perceive the role of computers in their lives and opt to take courses that explain information processing concepts, the character of those courses—once designed with only computer science or MIS majors in mind—must undergo drastic change. We designed our book to assist both students and teachers in making that change.

We have designed a pathway through the subject matter that has proved equally effective in preparing computer science majors for specialized coursework and also in orienting non-majors to the bewildering technologies that are both enhancing and invading their lives. Over the years we have taught this

material to audiences as diverse as liberal arts undergraduates, MBA students, engineers, and prospective programmers. We have discovered three threads that can be woven together in a way that is relevant to the current and future needs of most students, while covering most of what one expects to find in an introductory course on information processing in business.

The first of these threads, not surprisingly, is *change*. The current generation of students is different from the ones that preceded it. For older generations, technological change was a special event, but for today's students it is a normal process. Yet both generations are surprisingly unaware of the mechanics of change.

We have attempted to demonstrate that current technology represents but a single frame in a moving picture. Rather than tell students what the world was like when we wrote this book, we have attempted to give them an understanding of the fundamental factors that lead to technological change in areas of hardware, software, and the patterns of computer use.

The second thread is the notion of a *system*. To some, the word "system" has an unpleasant mathematical flavor, and others have used the word so loosely that it sometimes seems devoid of meaning. To us, a middle ground is a firm and necessary foundation for building the complex concepts of this course. That middle ground is best expressed by the notion of a context for understanding. A computer or program is not created to be put on a pedestal and admired. It exists in a context defined by the uses it is put to and the needs it was designed to satisfy. It must work within this context with other computers, programs, programmers, users, customers, and often with others as well. As we expand our point of view from the entity itself to include those people and things it must work with, we begin to see a system with various parts, and learn that it is the system, rather than the individual program or piece of equipment, whose behavior must be made effective and efficient.

The majority of students will be users of computer systems. To be intelligent users, they will need to understand the systems they interact with. They will need analytical tools to study the complexities of their own needs in order to see them as composed of simpler, and hence more tractable, units, working in concert. They will also need the synthetic tools to frame solutions to small problems and use them to help build solutions to larger ones. Without introducing any specific instructional material about "systems thinking," we have adopted these approaches to explaining about information systems.

The third thread is *people*—more specifically the balance between the technological and human dimensions. Information systems are for and about people. The computers may be the most dazzling components, but the people and their needs were, are, and always will be primary. Students must learn that no technological solution that ignores people can possibly succeed. For every technology and direction we study, we have attempted to point out the potential human costs and benefits. We have provided material on the "human side," such as information about career paths. Rather than have a chapter

with a title like "People and Computers," we have incorporated the human element directly into material on the technical element. We thus can avoid giving the student the impression that human aspects of information systems can somehow be wrapped up in a tidy, separate package and disposed of as soon as technology improves.

Consequently, all three threads weave throughout the book's major sections. The result, we hope, is to prepare the student for a future we can't presently describe. A student who learns how to write a simple program in BASIC is hardly prepared for the use of fifth-generation languages; one who learns how to create an ISAM file will not be prepared for secondary storage based on genetically engineered organisms. Of course, these topics are important because they describe the present. But there are more general concepts that can be applied to each of these systems. Programming languages will change, but the principles of good programming, based equally on the technologies that support them and the people that use them, will not. Rules that specify when to use an ISAM file will be irrelevant with storage media other than disks, but the fundamental trade-offs on which these rules are based will still be important.

The Plan of the Book

In the first section we examine the critical concepts upon which the subsequent material is based. We begin with a detailed examination of the concepts of data and information. We examine the attributes of data that must ultimately be considered in any real information system—cost, reliability, utility, and so on. In the context of some simple applications we show how these attributes can be identified, sometimes quantified, and always traded off against each other. We then introduce three contrasting information systems in sufficient detail for the student to develop an appreciation for system diversity. We have discovered that many students find material on information systems confusing or mystifying because they do not have a background to which they can relate the concepts. By providing three concrete examples, we build a base of experience we can refer to in later chapters.

We then proceed to examine these three very different systems by looking for common features, discovering in the process that there are certain fundamental processes shared by all information systems. Before examining each of these fundamental processes in detail, we devote a chapter to introducing the central concept of programming.

A word about our programming language is in order. It is BASIC-like because many students now have some familiarity with microcomputers using BASIC. The programs we develop might well run without modification on certain full-featured BASIC systems, but this was not our goal. We wanted, rather, a language that was suitable for expressing algorithmic ideas in a structured and readable manner, without excessive distraction by detail. Dialects of BASIC vary widely from one machine to another, and we don't wish

to encourage fruitless classroom debate over which dialect is "better." Our dialect is close enough to most real dialects that students will have no trouble moving from ours to the one for whatever machine they favor. The Instructor's Manual contains guidelines for transforming programs in our dialect to a less-featured or differently featured BASIC.

An instructor who wishes to teach programming in conjunction with this text may well wish to provide supplementary materials such as a manual for the language being used. Our language approach means that the book will cause little or no difficulty for the instructor who uses FORTRAN, COBOL, PL/I, Pascal, Ada, or any other non-BASIC language. Those instructors who do not wish to teach any more programming than the text provides will find that our material serves well to teach the principles of expressing algorithms and the skill of program reading.

In the second section, we examine in detail each of the fundamental information processes—input, processing, storage, and output. Without tying the material too tightly to any particular current technology, we cover the function of the hardware, the kinds of activities associated with the process, and the most important trade-offs in which this process participates. We also take a close look at the role of the operating system as the coordinator of these processes.

The final section addresses actual applications. We look at traditional applications such as payroll and telecommunications. We also look at applications that are still rather innovative, such as the use of artificial intelligence in business or computer assistance to the disabled. We pay particular attention to the use of computer tools in the knowledge industries, particularly office automation and programmer productivity, because this is the type of work many students will eventually do.

Through the use of a detailed case study we examine the processes of developing a business system, from its initial functional specification, through its completion and transfer to a maintenance group. We also examine the special role of software—how it can be acquired and how it should be evaluated. In these chapters the student has the opportunity to see careers in information processing in their actual context to assist them in choosing directions for further study.

Other Materials

We have provided each chapter with a full range of exercises. Some of these test the students' understanding of the basic concepts presented. Others go further, by asking them to apply these concepts in new ways or in larger contexts. The exercises provide the students with both the opportunity to exercise their new skills and the challenge to extend and evaluate them.

Some of the exercises suggest visits to real information systems, in small stores or large corporations. Realistically, we know that a group of students descending on the local supermarket might not be welcomed, but there is

valuable learning to be done outside of the classroom. If such visits were apportioned among various student teams that reported back to the class on their experiences, they would provide a wealth of additional experience and examples for the class as a whole to draw upon.

At the end of each chapter we have placed a "Last Word." While these are occasionally humorous, they all touch on important issues that space limitations prevented us from covering in depth. These Last Words can serve as the basis for lively discussions that integrate the material in the chapters with wider concerns. For example, in an excerpt that talks about the use of computers in the Watergate hearings we find out that the computer files were later shared with the chief defendants; this raises the issue of possible inequities in our legal system that may arise when only one side in a case has the funds to use computers to support its trial preparation.

We have provided an Instructor's Manual which suggests approaches to teaching the material. The Manual also contains additional material for classroom discussion or student projects, and provides answers for the exercises.

Acknowledgments

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