INTRODUCING COMPUTERS

PETER BISHOP

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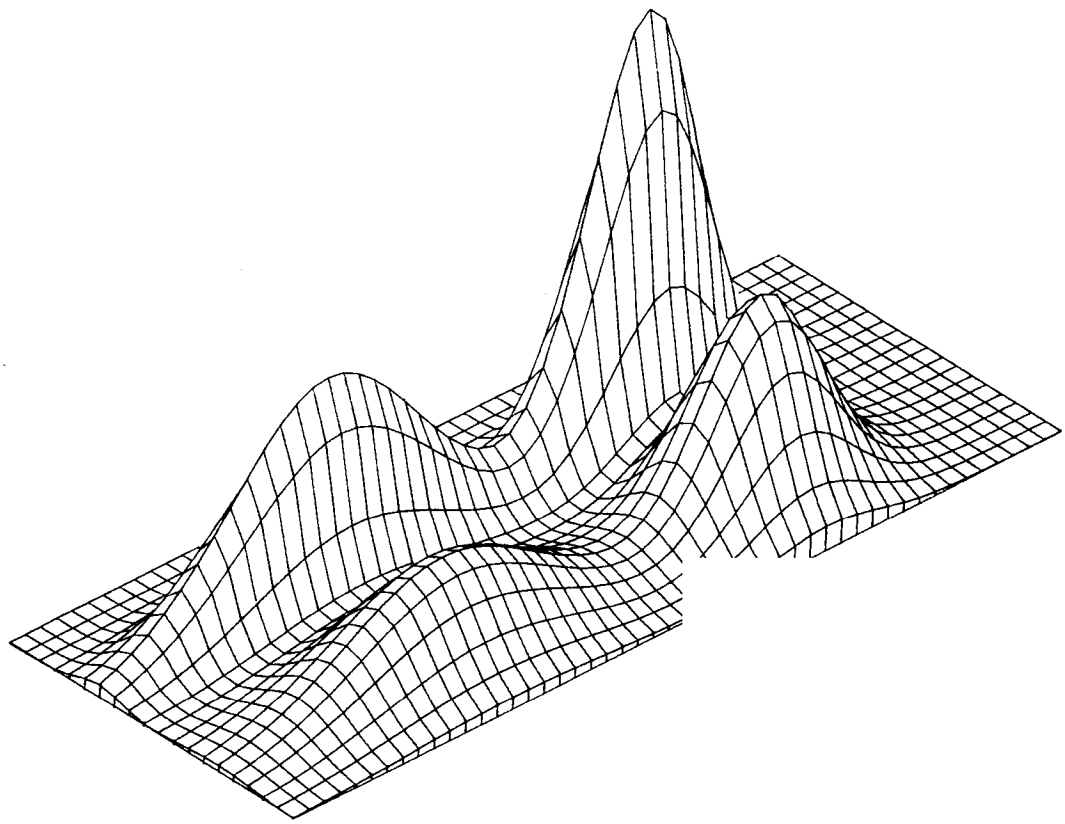

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The photograph on the cover, reproduced by kind permission of Dr Jean Lorre and the Science Photo Library, shows a very modern application of Computers. It is a picture of the spiral galaxy NGC 1097, enhanced by computer to reveal features not shown up by normal telescopic methods. This technique is known as image processing.

PREFACE

This book aims to provide a first introduction to computers. It is intended to be used by lower secondary school pupils, either as a preparation for an O-level or CSE course in Computer Studies, or as a complete course in its own right. It may also be used as a non-examination course for older pupils, and as a background reading for teachers, parents and any interested general readers.

The book assumes no previous knowledge of computers. The material is self-contained, but does link with other areas of knowledge at a very elementary level, such as electricity, binary numbers (no previous knowledge assumed), money (wages, accounts, gas bills etc.) and social and moral issues such as unemployment and peoples' rights to privacy.

The study of computers is a very broad subject, requiring a number of diverse skills. This book teaches the following skills:

- An appreciation of the nature, capabilities and limitations of computers.
- An appreciation of the role played by information in many contemporary activities, and the relationship between information and computers.
- An awareness, at an elementary level, of the structure of computers, and the way in which they work.
- An ability to write, run and correct simple programs on a computer, and to use programs already provided.
- An awareness of the jobs done by computers in industry, commerce, education and research, and the jobs done by people working with computers.
- An awareness of the way in which computers have developed.
- An appreciation of the effects that computers are having on society, both in Britain and elsewhere in the world.

Case studies are used quite frequently in the book, and these are of

two types. Computer case studies outline some of the ways in which computers are used. 'People' case studies show some of the ways in which people work with computers, or can be affected by them. They are stories, written to be as realistic as possible, but they are not based on actual events. Any resemblance of the people described to actual people is entirely coincidental.

This book includes a number of 'package' programs. They are intended to be copied on to the school's computer, and then used by the pupils. The programs are written in a very simple subset of BASIC, and should work on the computers commonly available to schools. They have been tested on a Research Machines 380Z micro computer.

Cassette and disc versions of the packages are available for Research Machines 380Z and Commodore Pet microcomputers.

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CHAPTER 1

INTRODUCTION: A FIRST LOOK AT COMPUTERS

Computers are everywhere. You can find them in offices, factories, shops, hospitals, schools, ships, satellites and even in some people's homes. Their numbers are increasing all the time. Some people like computers, other people hate computers. Unfortunately, many people do not know much about them.

This book gives you a first look at computers. It tells you a little about how they work, how they are used and how they have developed. It teaches you how to use a computer yourself. It also tells you about some of the effects, both good and bad, that computers are having on society.

This chapter, the introduction, concerns two very important questions:

- What is a computer?
- What can and can't a computer do?

In the process of answering these questions, computers are compared with a number of everyday objects, with which you are probably quite familiar. Computers are similar in several ways to washing machines, lathes, traffic lights and pocket calculators. This should start to remove some of the mystery which surrounds computers.

WHAT IS A COMPUTER?

There is quite a lot to this question. In this chapter, it is answered in three stages. At the end of the book, there is another look at the question.

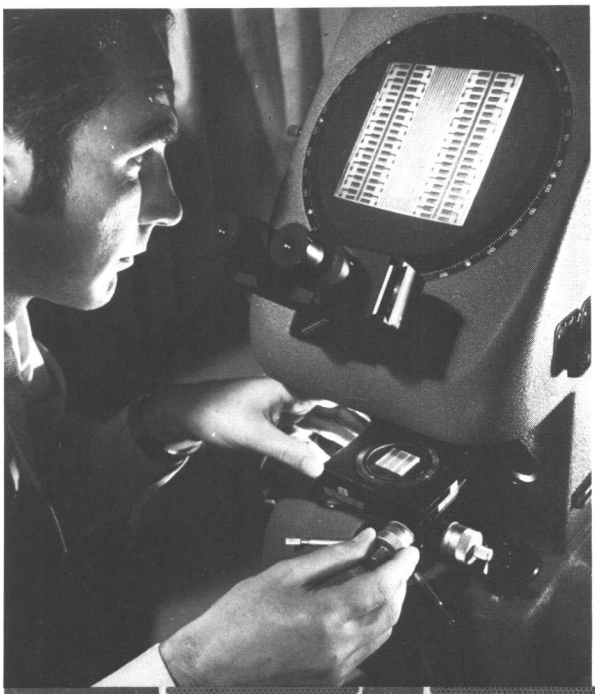
FIRST ANSWER: A COMPUTER IS A MACHINE

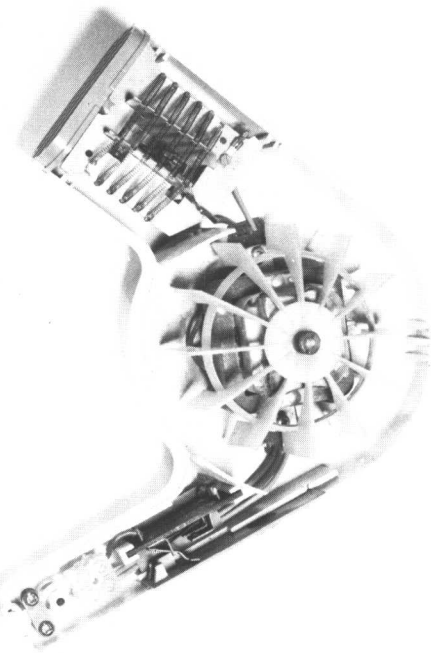
The sewing machine, lathe and computer are all devices which do things. Like a sewing machine and a lathe, a **computer is a machine**.

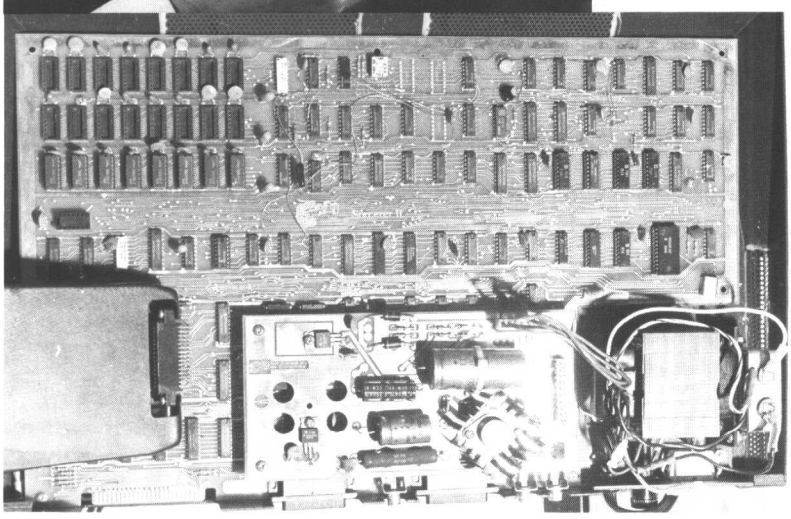
However, there are some important differences. A lathe cuts and shapes metal, and a sewing machine stitches cloth. On the other hand, a computer can do more than one type of work. A computer is much more versatile than a lathe or a sewing machine.

SECOND ANSWER: A COMPUTER IS AN ELECTRONIC MACHINE

The machines shown in the photographs below use electricity. But there is an important difference between the computer circuits and the hairdryer. The hair dryer has moving parts inside it. On the other hand, a computer has no moving parts inside it. It works entirely by the behaviour of the electrons, which make up electricity, as they travel through its circuits. For this reason, **a computer is an electronic machine**.

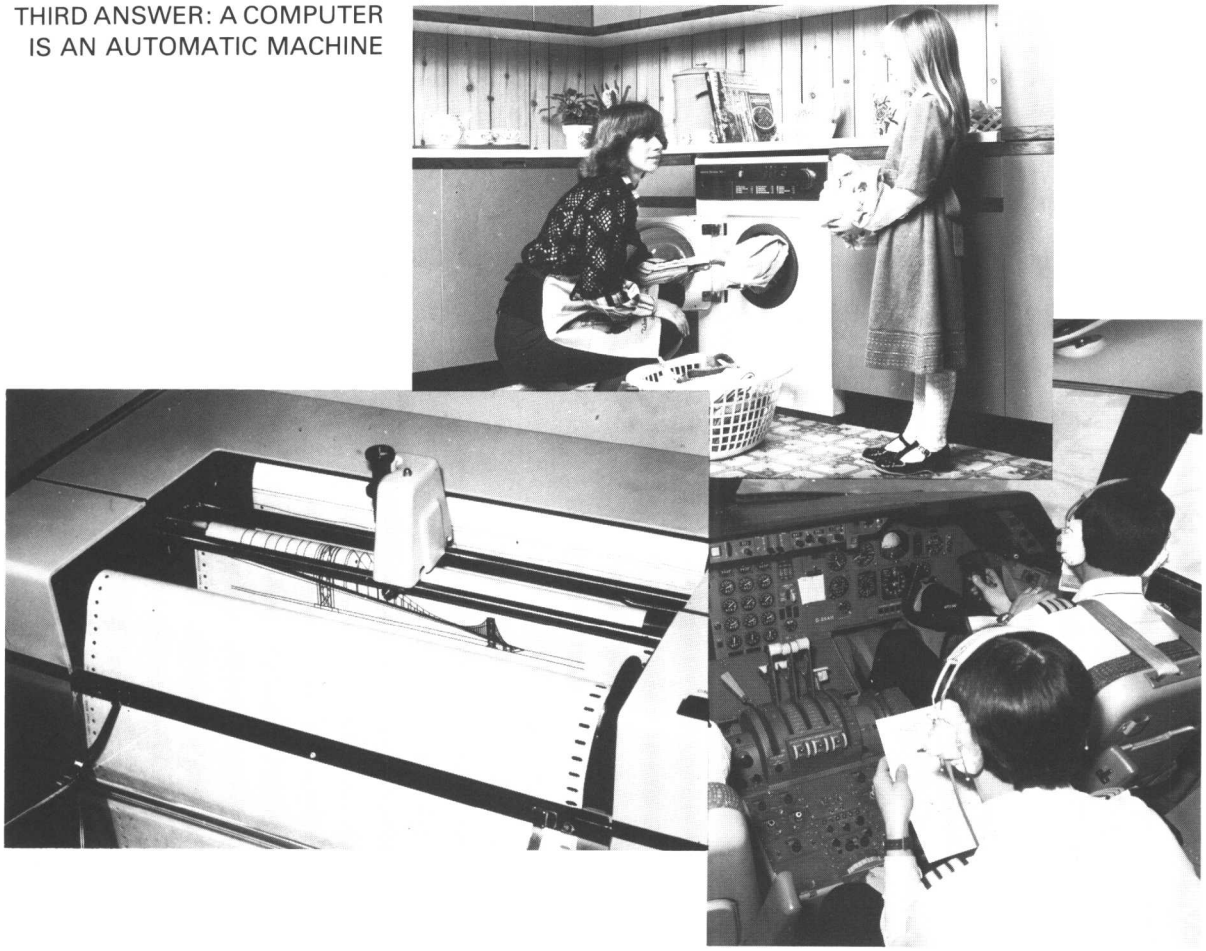






The absence of moving parts is the main reason that computers can work so quickly.

THIRD ANSWER: A COMPUTER IS AN AUTOMATIC MACHINE



The washing machine has just washed, rinsed and spun the clothes automatically. The automatic pilot is keeping the aeroplane on course without the pilot having to do anything. The computer has just finished drawing a plan of a suspension bridge all by itself. Like an automatic washing machine and an aeroplane automatic pilot, **a computer is an automatic machine**.

But how do these automatic machines know what to do? The answer is that they are instructed. An automatic washing machine is told how many times to wash, rinse and spin the clothes, and how long to take. An automatic pilot is set to keep a certain course. Before a computer can start doing a piece of work, all the instructions which tell it what to do are stored inside it. These instructions are called a **program**.

It is important to remember that a computer can do a much wider range of work than either an automatic washing machine, or an automatic pilot. In other words, a computer can run a very wide variety of programs.

ONCE AGAIN, WHAT IS A COMPUTER?

A computer is an automatic, electronic machine. A computer can perform a wide variety of tasks. Each task follows a set of instructions called a program.

EXERCISE

1 Answer these questions from the text you have just read:
- **a** Why is a computer called an electronic machine?
- **b** What is a program?
- **c** What is the main difference between a computer and an automatic pilot?
- **d** Do computers contain moving parts?
- **e** Are computers very scarce?

2 Look at this list of machines and devices:

traffic lights	digital watch
photograph booth	typewriter
television set	film projector
pocket calculator	guitar amplifier

Write down the ones which are:
- **a** automatic
- **b** electronic

It is hard to decide about one or two of them. Discuss these.

3 A computer needs a program to tell it what to do. So does an automatic washing machine. Write down a list of some other machines or devices which can be programmed.

4 Find out where the nearest computer to your school is. What kind of work does it do? Try to arrange to visit it.

WHAT CAN AND CAN'T A COMPUTER DO?

You hear all sorts of stories about what computers can do, or have done. Unfortunately, not many of them are true. This section is about the capabilities and limitations of computers – what can and can't a computer do?

Computers can do a wide variety of tasks. Just a few of them are shown in the photographs on the next page. In fact, many of these tasks could be carried out by the same computer. What do these tasks have in common?

CALCULATIONS

Some of the tasks shown in the photographs on page 6 involve calculations. As most people realise, computers can calculate. These calculations can be extremely complicated. On the other hand, many computers spend much of their time doing very easy calculations over and over again. It is the very high speed and extreme accuracy of computers that makes them suited to calculations of all types.

INFORMATION PROCESSING

Computers can do much more than calculate. For example, calculating wages involves knowing such information as hours worked, pay rate and income tax code. Computers can look up this information. Making airline seat reservations requires several items of information: details of the flight, whether there are any seats available, etc. In fact, all the tasks shown in the photographs are concerned with information.

Information is the key to the question: '**What can computers do?**' A brief answer to this question is:
Computers process information

Calculating is only one type of information processing. Other types are storing, sorting and locating information, and bringing information up to date. Some of these processes involve making simple decisions like 'which of two numbers is larger?' Computers can make decisions of this sort, but **computers cannot think for themselves**.

Remember that everything a computer does is in response to instructions in a program.

What kind of information can a computer process?
Computers can do a wide variety of tasks. This means that they must process many kinds of information. Information which computers can process includes numbers, names, addresses, codes and passages of writing. The information is always made up of figures, letters or punctuation marks. This is why computers are sometimes called **digital computers**. Digital computers cannot process sounds or pictures directly.

ONCE AGAIN: WHAT CAN AND CAN'T A COMPUTER DO?

A computer is an information processing machine. Information processing includes storing, locating, and sorting information, doing calculations, and making simple decisions. The information which computers process is made up of figures, letters and punctuation marks.

Computers cannot think for themselves. They can only follow program instructions.

EXERCISE

1 Answer these questions from the text you have just read:
- **a** Can a computer process sounds directly?
- **b** Why are computers suited to doing repetitive calculations?
- **c** Can the same computer do more than one kind of information processing task?
- **d** Could a computer decide whether murderers should be hanged?
- **e** Do all computers spend most of their time doing complicated calculations?

2 Decide which of these tasks you think a computer could be programmed to do:
predict the winner of this season's F.A. Cup
calculate a person's income tax
forecast tomorrow's weather
control a rocket
decide who will win if there is a Third World War
translate a book from one language to another
decide whether war is a bad thing

Some of these are quite difficult to decide. Discuss them.

3 Write a list of tasks which you think a computer cannot be programmed to do.

4 Find out from other people, who are not studying computers, what they think computers can and cannot do. Discuss your findings.

INFORMATION IN AND OUT

You have already learned that a computer is an automatic, electronic machine which processes information. In order to process information, a computer must be supplied with the information in the first place. Large quantities of information are often involved. In a similar way, when a computer has finished processing, it must supply the results of the processing. Many computer applications require a flow of information to and from the computer while processing is taking place.

To get information in and out of a computer, there are operations called **input** and **output**. Input is the operation of supplying information to a computer. Output is the operation of printing or displaying information that has been processed by a computer. As you will see later in the book, computers include devices to carry out the operations of input and output.

Most computer programs include instructions for all three types of operation: input, processing and output. Before a computer can run a program, the program itself must be input into the computer.

The ideas of input and output raise the point that a computer cannot work completely on its own. **People** are required to collect and prepare information to be input. Computer output is designed to be used by people. Also, people write the programs which tell a computer what to do.

SOME EXAMPLES OF INPUT, PROCESSING AND OUTPUT

If you think about it, you will realise that many everyday tasks have input, processing and output stages. A few examples of these tasks are given here. Thinking about a task in terms of input, processing and output often makes the task easier to understand. It also helps when writing a program to carry out a task, as you will see in a later chapter.

Example 1 – Making milkshake

A recipe for vanilla milkshake is:

Ingredients:

1 cup chilled fresh milk
¼ cup powdered milk
½ cup vanilla ice cream
2 teaspoons sugar
⅛ teaspoon vanilla flavouring

Instructions:

Place all the ingredients in a bowl.	**(Input)**
Beat with an egg beater until smooth.	**(Processing)**
Pour into a large glass and serve.	**(Output)**

The input, processing and output steps are fairly obvious.

Example 2 – A bus conductor
The job of a bus conductor is to:

Ask each passenger where he or she is going.	**(Input)**
Look up the fare if necessary.	**(Processing)**
Tell the passenger the fare.	**(Output)**
Collect the money.	**(Input)**
Work out the change.	**(Processing)**
Issue the tickets and the change.	**(Output)**

In this example, each step occurs twice.

These examples show that it is not only computers which have input, processing and output stages to their work.

A WORD OF CAUTION: GARBAGE IN, GARBAGE OUT

Stories of computers producing million pound gas bills are quite common, and sometimes true. But it is also true that computers hardly ever make mistakes. How is it, then, that computers sometimes output wrong information?

In most cases the problem is with the input information. If input information is wrong, the output it produces will also be wrong. There is a saying for this in the computer world: **Garbage In, Garbage Out**. It is sometimes shortened to **GIGO**.

Most computer programs test all input information, and reject any which is obviously wrong. But it is impossible to detect every item of wrong information.

END-OF-CHAPTER SUMMARY

This chapter has introduced a number of very important ideas:

- A computer is an automatic, electronic information processing machine.
- A program is a set of instructions to a computer. Everything a computer does is in response to program instructions.
- Information processing includes storing, locating and sorting information, doing calculations and making simple decisions.
- Getting information in and out of a computer requires input and output operations respectively.
- Many tasks, not only ones done by computers, can be described in terms of input, processing and output steps.
- Garbage In, Garbage Out.

The rest of the book develops these ideas. You will learn more about how computers work, how they are used, how to program a computer yourself, and how computers are affecting society.

EXERCISE

1 Answer these questions from the text you have just read:
   - **a** Can a computer work completely on its own?
   - **b** What is input?
   - **c** Is the output from a computer always correct?
   - **d** What is the most common reason for wrong output?
   - **e** How often do computers make mistakes?

2 Identify the input, processing and output stages of these tasks:
   - **a** Working at a till at a supermarket:
     Enter the price of each item.
     Ring up the total.
     Tell the customer the amount.
     Collect the money.
     Work out the change.
     Give the change and the receipt.
   - **b** Developing a film:
     1 Place the film in its holder, and both in the developing tank.
     2 Add the developing fluid.
     3 Leave until the correct time has elapsed, agitating the film at regular intervals.
     4 Pour off the developing fluid.
     5 Repeat steps 2, 3 and 4 using the stop bath, then the fixing fluid.
     6 Rinse the film for at least 30 minutes in running water.
     7 Carefully remove the holder from the tank, and the film from the holder, and hang the film up to dry.

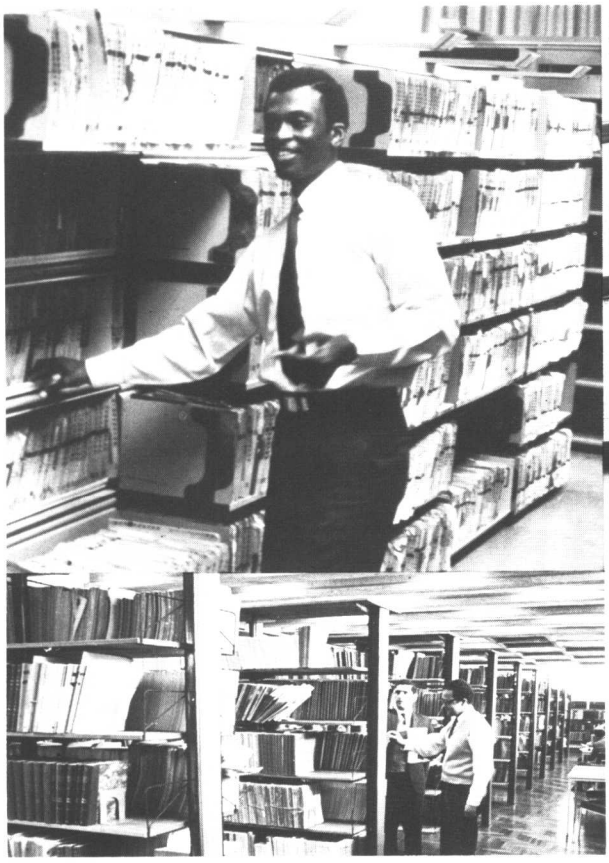
3 Investigate other tasks which you think involve input, processing and output stages. Write down the steps of each task, and identify the input, process and output steps.

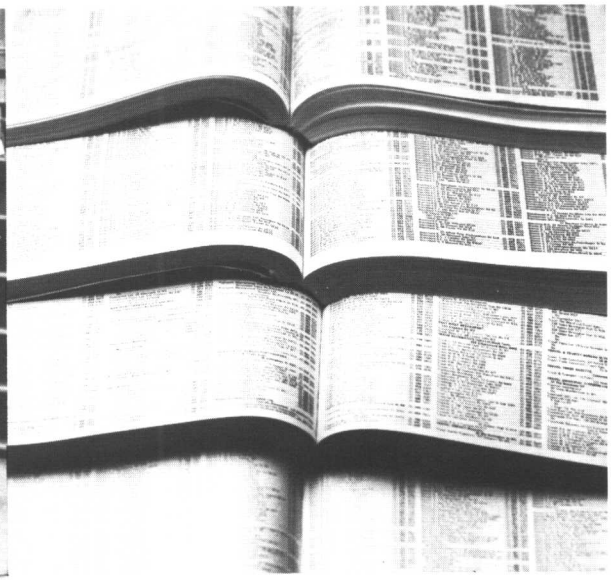
4 Discuss how your ideas about what a computer is, and what a computer can and cannot do, have changed while you have worked through this chapter.

CHAPTER 2

INFORMATION AND COMPUTERS

In the previous chapter you learned that a computer is an information processing machine. This chapter takes a closer look at information. You will learn (if you have not noticed already) how much information there is all around us. Your attention is drawn to some of the problems of keeping large quantities of information. Finally you will be introduced to some of the ways in which information is stored on computers.





Information stored on paper takes up a lot of room