

Part 1

Theory

1. The basic components of computers

What is a computer?

Many people see a computer as a sort of magical grey box that you get from Compaq or IBM which you use to run programs (and the occasional game when your boss or parents aren't watching). However, the formal definition of a computer is somewhat broader. Simply put, a computer is an electronic device that can accept data and instructions, process them or store them for later retrieval, and sometimes generate output (usually based on the processing) (see Figure 1.1). As you would expect, this definition includes more than the PC (personal computer) that you have at home or at school. For example, most new models of cars come with a computer to manage their fuel injection systems.

Advantages of using computers

Computers obviously wouldn't be as popular as they are now if they did not offer advantages over doing tasks manually. Some of these advantages are:

- Computers can perform calculations much more quickly and accurately than humans. For example, modern computers can perform hundreds of millions of calculations per second.

- Large amounts of data can be stored in a small amount of space. For example, hundreds of pages worth of text can be stored on a flash drive.
- Computers can work continuously and perform repetitive tasks well. Unlike their human counterparts, computers do not get bored or tired.
- Computers can simulate things that would take too long, be too dangerous or simply be impossible for humans to attempt.

Drawbacks of using computers

What? There are disadvantages to using computers? As hard as it is to believe, computers do have their drawbacks. These include:

- The introduction of computers can cause redundancy in the workplace. Employees may lose their jobs if a computer can do a job more efficiently and ultimately more cheaply.
- Computers make it easy for people to misuse information. Computers make it easy to store large amounts of information about people. In some cases this information can be freely and easily accessed and used for purposes for which it was not originally intended.

- Downtime happens when a computer breaks down or data becomes corrupted. Businesses often rely so much on technology that when computers fail they have no back-up manual systems and are temporarily rendered helpless as a result.
- The introduction of computer systems in the workplace is expensive. The cost is not only due to the purchasing of the equipment; in some companies, the time it takes to train the staff to use the system causes several thousands of dollars of lost productivity.
- There are health risks associated with excessive or improper use of computers. The glare from the screen can cause eyestrain and inadequate support for the wrists when typing can cause carpal-tunnel syndrome.

However, most people see these disadvantages as minor (especially when compared with the tremendous benefits); hence the popularity of computers today.

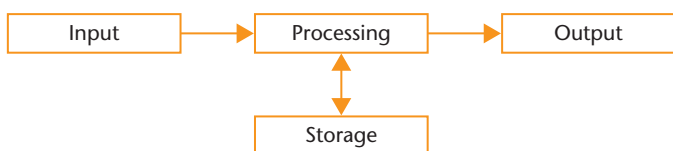


Figure 1.1 A diagram outlining how the typical computer system functions

Types of computer

Ask the average person what types of computer he/she knows and the response will probably be, 'That's easy! Dell, Gateway, Compaq, IBM ...'. However, these are merely brands of computers. The types of computer are (roughly in order of size and speed): supercomputers, mainframes, minicomputers and microcomputers.

Supercomputer

'Supercomputer' is the general term given to the fastest computers in the world. These computers are very large and may take up several rooms. Because of their tremendous processing power, supercomputers are used in fields that require vast amounts of complex mathematical calculations, such as weather simulation and nuclear research.

Did you know?

The fastest computer in the world (at the time of writing) is IBM's Roadrunner supercomputer. It is over 20000 times as fast as the most powerful desktop computer. It cost US \$133 million to build and takes up over 6000 square feet.

Mainframe

Like supercomputers, mainframes are very fast large-scale computer systems. Mainframes have a large number of terminals and peripheral devices because they are used simultaneously by hundreds (or even thousands) of persons. As a result, mainframes may be even larger than supercomputers. To meet the demands of the large number of users, they have a large memory and large storage capacity.

Three applications of the use of a mainframe computer are:

- in banks for processing customer accounts
- by utility companies for processing telephone, water and electricity bills
- by airlines for making flight arrangements

What is the difference between a supercomputer and a mainframe?

If mainframes and supercomputers are both very large and fast computers, what is the difference between them? The mainframe divides its processing power among several users and programs at the same time (multiprocessing). A supercomputer, on the other hand, runs very few programs at the same time, so that those programs are run as quickly as possible.

Minicomputer

A minicomputer is a multiprocessing computer system that is smaller and slower than a mainframe. The term 'mini' is a bit misleading, though, because minicomputers are still a lot larger than the PCs people have in their homes. Minicomputers support fewer users than mainframes (200 is the limit used in some definitions).

If you are beginning to think that you do not see much of a difference between a mainframe and a minicomputer, don't worry. The distinction between the two is becoming increasingly blurred and is based mainly on the size and number of users.

Two examples of the applications of a minicomputer are:

- in networking, the operations in an automobile sales and service outlet
- in manufacturing, for inventory control, accounts and process control

Microcomputer

'Microcomputer' is a term used to refer to computers that contain a microprocessor. You know this type of computer by its more familiar name – the PC. This is the type of computer that you are most likely to use. As the name suggests, a microprocessor is a very small processor. This is in the form of a silicon chip like the Pentium processor.

Since they use smaller processors, microprocessors are much smaller than other forms of computers. Note that for this same reason, microprocessors are nowhere near as powerful as other types of computer. Microcomputers come in different types and sizes:

- The desktop, which is the most popular type, is usually supplied with separate units such as the tower, a monitor, keyboard, mouse and external speakers.
- The laptops or notebooks are small portable computers. These machines come with the monitor, keyboard and CPU assembled as a single unit.



Figure 1.2 A notebook computer

Three examples of the application of a microcomputer are:

- in homes for recreation
- in an office for producing documents and processing data, such as payroll, inventory and billing
- for communication through the use of Internet services

Computer systems

A computer system is the combination of **hardware** and **software**. The hardware consists of the physical components of the computer, such as the monitor or the keyboard. In other words, the parts of the computer

that you can touch are all hardware. 'Software' is the term that is used to refer to the programs that run on the hardware. Neither one is much use without the other, since without hardware you would not be able to run software and without software you would just have an expensive piece of equipment that does nothing.

The two main types of software are the operating system and the application programs that run on top of the operating system.

Categories of computer hardware

There are four main categories of computer hardware:

- 1 the Central Processing Unit (CPU)
- 2 input devices, which allow data to be entered into the computer
- 3 output devices, which are used for outputting ('sending out') data from the computer
- 4 storage devices, both primary and backing

The Central Processing Unit (CPU)

As its name suggests, the Central Processing Unit (CPU) is the part of the computer that does the processing. It also controls the transfer of data between memory and the other devices that make up the computer system. The CPU consists of:

- the Control Unit (CU)
- the Arithmetic/Logic Unit (ALU)
- small, very fast areas of memory. The smallest and fastest memory is in the form of registers. There is also cache, which is larger and slower than the registers but is still much faster than RAM (you do not have to worry too much about these terms)

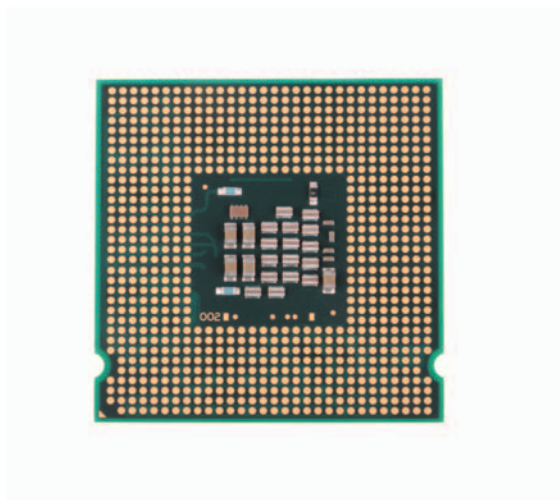


Figure 1.3 A CPU chip

Did you know?

The best-known register is the **accumulator**. It is the place in the CPU where results of calculations are temporarily stored.

The Control Unit (CU)

The Control Unit (CU) is the part of the CPU which, as you may be able to guess, controls the operations of the CPU. It is used:

- to direct the operation of the internal processor components (components that process the data)
- to control the flow of programs and data in and out of the primary memory (main memory)
- to read and interpret program instructions (instructions that allow the computer to perform various tasks)
- to control the flow of information to and from all the components of the computer, eg input and output devices (I/O devices), disk drives and printers

The Arithmetic/Logic Unit (ALU)

This is the part of the CPU that does the following:

- performs arithmetic operations. These operations include addition, subtraction, division, multiplication, etc.
- performs logical operations. These operations include reasoning and performing the comparisons necessary to make decisions.

Storage devices

A computer would not be a very useful device if it did not have the ability to store data or to allow instructions to be loaded at a later time (even if the 'later time' is a few seconds later). Imagine having to enter the same instructions and data every time you wanted the computer to perform a common task – or if the computer could not remember anything that it had done before!

Technology certainly would not have progressed as much as it has today. For this reason, computers come with storage devices. There are two types: primary and secondary.

Primary storage (main memory/immediate access storage)

There are two types of primary storage (note that both use chips):

- 1 **Random Access Memory (RAM)**. The contents in this type of memory are temporary and are lost when

the computer is turned off (the data is volatile). RAM is used to store the instructions and data for currently running programs and the operating system.

- 2 **Read Only Memory (ROM)**. This type of memory is permanent (usually) and the data stored in it is not lost when the computer is turned off (the data is non-volatile). As a result, ROM is used to store data that must not be lost even when the computer is turned off, such as the commands which start up (boot up) the computer. These instructions are programmed into the ROM chips by the manufacturers.

Secondary storage (backing storage/auxiliary storage devices)

Unlike primary storage, secondary storage is not done on chips. Some examples of secondary storage devices are:

- hard disks
- magnetic tape
- floppy disks
- microfilm
- CDs
- DVDs

These devices are used to store programs, as well as data that is not being processed, for later retrieval.

Peripheral devices

In order to understand what a peripheral device is, it is important to first become familiar with a few terms. The CPU is located on the main processor board (also known as the **motherboard**). The motherboard is found inside the **tower** (the rectangular 'box' to which most other components that make up the computer system are attached). The term '**peripheral device**' refers to those devices that make up the computer system apart from the motherboard, its associated electronics and main memory.

Why isn't 'peripheral devices' listed as a category of computer hardware?

When listing the categories of computer hardware in this book, 'peripheral devices' was not mentioned. The reason for this is quite simple – input devices, output devices and backing storage devices are all peripheral devices.

Some examples of peripheral devices are:

- input devices – keyboard, mouse, joystick, OMR (Optical Mark Reader), OCR (Optical Character Reader), MICR (Magnetic Ink Character Reader)
- storage devices – magnetic tape drive, hard drive, floppy drive
- output devices – dot matrix, laser and ink-jet printers, VDU (Visual Display Unit: monitor), speakers

Tips

In order to be able to give a list of peripheral devices, rather than commit a long list to memory, many students simply remember that all devices that are part of the computer system and are outside the tower (external devices) are peripheral devices. However, note that even if a device is not outside the tower, it can still be a peripheral device, for example the hard drive.

Exercise 1



- 1 Explain why a computer is so beneficial to a business or a home user.
- 2 What are the functions of a typical computer system?
- 3 Name one type of computer and give three applications for which it can be used.
- 4 Give the meanings of the following abbreviations and state one function of each:
 - a ALU
 - b CU
 - c ROM
 - d RAM
- 5 What is a peripheral device? Give four examples of peripheral devices.
- 6 State two limitations of computers.
- 7 State two advantages of computers.
- 8 At lunch Mary met with her two friends at a popular restaurant. They were discussing the growing need for computers within their various work institutions to assist with their tasks. However, the type of computer needed for each task is different. Mary is a secretary at a local insurance company and her company *needs a computer for her to type letters and store important records*. Suzy, on the other hand, is a data entry clerk at a telephone company and her company *needs a computer for the data entry staff to use simultaneously to process telephone bills*. John is a scientist and his company *needs a very fast computer to perform complex mathematical calculations*.
 State the type of computer that is best suited for each company.
- 9
 - a Explain why it is necessary for a computer to be equipped with secondary storage.
 - b Give three examples of secondary storage devices.
- 10 Explain the difference between hardware and software.