

# Computer basics

# Part 1

## 1 Introduction to computers

### In this chapter, you will learn:

- the definition of a computer
- the different types of computers
- advantages and disadvantages of computers
- health risks associated with computers

### What is a computer?

Since this chapter is all about computer systems, it would be remiss of me not to start by giving a definition of what a computer is. A **computer** is an electronic device that can accept data and instructions, process them, then store the result or produce output.

'mini' in minicomputer is only in relation to their larger mainframe counterparts, however; they are still much larger than your average PC.



In the context of computing, **processing** is when you manipulate data in some way e.g. sorting it or performing calculations on it.

### Types of computers

Computers may be categorised according to their size and form factor. From largest to smallest, the main categories are: mainframe, minicomputer and microcomputer.

#### Mainframe

Mainframes are very large (about the size of a small room) and powerful computers which support hundreds of simultaneous users via connected terminals (Figure 1.1). To support so many users, a mainframe must have vast amounts of memory and secondary storage.

Mainframes are typically only found in large organisations (no doubt because they are so expensive) such as universities, banks and utility companies.

#### Minicomputer

A **minicomputer** is a multiuser computer that is smaller and less powerful than a mainframe. The



**Figure 1.1** A mainframe computer.

As the computing power in microcomputers jumped by leaps and bounds, minicomputers became obsolete but in their heyday they could be found in many a company department.

### Microcomputer

Technically, the term **microcomputer** refers to a particular class of computer which contains a microprocessor. However, you would know it by its more common name – the PC (personal computer). This is the smallest (and by far the most popular) type of computer (see Figure 1.2). It comes in a variety of form factors:

- 1 Desktop – A desktop computer is the largest type of PC, typically consisting of a separate monitor, tower, keyboard and mouse.
- 2 Laptop (or notebook) – These are smaller, portable PCs which come with the monitor, keyboard and CPU in a single unit.
- 3 Tablet – This type of PC is also smaller than a laptop computer but unlike a netbook it does not usually come with a keyboard. Instead, you interface with it using a touchscreen. The popular iPad is a tablet PC.
- 4 Netbook – These are smaller, lighter, less powerful notebooks that are best suited for web browsing.

- 5 Palmtop – These are handheld PCs which have touchscreens. Some require a pen-like stylus but the more modern ones are controlled by making gestures on the screen with your fingers. Smartphones fall into this category.

Of these form factors, only numbers 1, 2 and 5 are on the CXC syllabus. But it is good to know the others as well.

### Embedded systems

Rather than functioning as standalone devices, some computers are part of other devices like MP3 players, household appliances and digital cameras. These computers are known as **embedded systems**.

### Advantages of computers

Computers have had a profound impact on our society, making our lives significantly easier and much more productive. Let us look at the main advantages that computers provide.

#### Speed and accuracy

Computers are widely known for their speed and accuracy. How long would it take you to multiply 1734590 by 8986? Computers can perform millions of calculations like this each second, and get every single one correct!



**Figure 1.2** Different PC form factors: a. desktop; b. laptop; c. tablet; d. netbook and e. palmtop.

But it is not just mathematical calculations that computers are good at. Computers can quickly and accurately retrieve information, even if it was stored years ago. Contrast that to the average human who would be hard pressed to remember what he had for breakfast yesterday.

### Storage capacity

Computers have an unbelievable ability to store lots of data in a tiny space. They can store a library's worth of information on a drive the size of a human thumb. And as was mentioned before, not only can they store all that information; they can retrieve it in a split second.

### They do not get bored or tired

If you give a computer a sequence of instructions to perform, no matter how complex they are, it will carry out each step correctly and reliably. Unlike humans, computers do not get bored or tired and as such are not prone to fatigue-induced mistakes.

## Disadvantages of computers

Hard as it is to believe, there are some disadvantages associated with computers. We will look at three of the main ones below.

### Downtime from power outages and hardware failures

As people and businesses rely more and more on computers, they become increasingly susceptible to power outages and hardware failures. How often have we heard this sheepish response 'Our system is currently down. Could you call back again later?'

### Health risks

Improper or extended usage of computers can result in a number of health risks including:

- 1 Carpal Tunnel Syndrome – This painful condition which affects the wrists and arms is common among people who do a lot of typing. In the Keyboarding section, we will look at how to properly position your hands on the keyboard to mitigate this risk.
- 2 Eyestrain – If you spend too long looking at the screen, particularly if there is poor lighting, you run the risk of eyestrain. To reduce the chance of this happening, use antiglare screens and take regular breaks from looking at the screen.

- 3 Neck and Shoulder Pain – Incorrect posture, inappropriate furniture and poor positioning of the monitor can all lead to neck and shoulder pain.

### Job losses

The computerisation of certain aspects of business has the unfortunate side effect of costing some people their jobs. Using a computer is often cheaper than paying people to do the same thing. And since in some cases the computer can do the job better than a human can, it makes the person's job redundant.

## Summary

- A computer is an electronic device that can accept data and instructions, process them, then store the result or produce output.
- Mainframes, minicomputers and microcomputers are the main types of computers.
- Desktop, laptop and palmtop PCs are all examples of microcomputers.
- Advantages of computers include increased speed and accuracy, increased storage capacity and the ability to work without getting bored or tired.
- Disadvantages of computers include job losses, downtime due to power/hardware failures and health risks like carpal tunnel syndrome, eyestrain, neck and shoulder pain.



## Review exercises

### Exercise 1

- 1 In your own words, explain what a computer is.
- 2 Explain the difference between:
  - a A mainframe and a minicomputer.
  - b A mainframe and a microcomputer.
- 3 Put the following PC form factors in descending order of size and power: notebook, desktop, palmtop.
- 4 Give three advantages of computers. Can you think of any others?
- 5 Shanika, who works at a data-entry company, has been complaining of pain in her wrists. What is the name of the condition she is most likely experiencing? List two other ailments that affect frequent computer users.

## 2 Computer systems

### In this chapter, you will learn:

- the components of a computer system
- the difference between hardware and software
- about the ‘brains’ of the computer
- the two main types of software
- the difference between data and information

### Components of a computer system

In the last chapter we established what a computer is. Now we will turn our attention to the elements that comprise a computer system. A computer system is made up of the following components: hardware, software, people, procedures and data.

Let us look at each component in turn.

### Hardware

These are the parts of the computer that you can touch such as the monitor, keyboard, mouse and speakers. They may be divided into five categories:

- 1 Input devices.
- 2 Output devices.
- 3 Storage devices.
- 4 Communication devices.
- 5 The CPU.

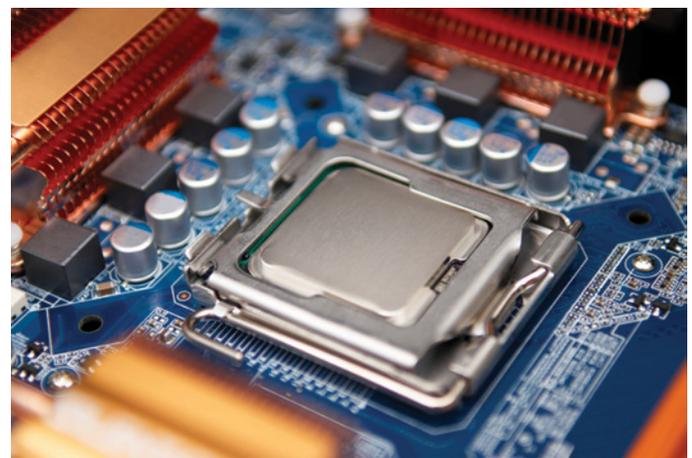
We will look at the other types of hardware in future chapters, but right now, let us look at the ‘brains’ of the computer – the CPU.

#### The CPU

CPU stands for ‘Central Processing Unit’. Remember the processing that we talked about in Chapter 1? This is where it is done. So it is no exaggeration to say that this tiny chip is the brains of the computer. The CPU is responsible for:

- decoding instructions
- executing instructions
- performing calculations (e.g. adding, subtracting etc.)
- performing comparisons and other logic operations.

The CPU is found on the **motherboard** (the main system board) as shown in Figure 2.1.



**Figure 2.1** The CPU Chip on a Motherboard.

#### Peripheral devices

The term ‘peripheral devices’ refers to a particular set of computer hardware devices. The formal definition is that a **peripheral device** is any device (apart from the CPU, primary memory and motherboard), that is part of the computer system. According to this definition, all of the following are peripheral devices:

- all input devices
- all output devices
- all communication devices
- some storage devices (secondary storage devices only).

## Software

The term **software** refers to the programs that run on the computer, for example Microsoft Windows and Internet Explorer. There are two main categories of software:

- 1 Operating Systems like Microsoft Windows which control the computer hardware as well as the other programs.
- 2 Applications Software which runs on the operating system e.g. Internet Explorer, Microsoft Word or Adobe Photoshop.

We will cover these in more depth in later chapters.

## People

It is easy to overlook the human element of computer systems, but that does not make it any less important. After all, people (also known as end users) are the ones who use the computer hardware, the ones who enter the data and tell the computers what to do. Other persons ('surprisingly' called programmers) write the software that the end users work with.

## Procedures

Every computer system has several procedures that the users must follow. For example, there are procedures for starting up the computer, shutting it down, backing up data and copying files.

## Data

The last, but by no means least part of a computer system is the actual data. This data may be entered by the end user, stored on disk, retrieved later or processed to generate information.



Data is raw facts and figures. Information is data that has been processed, for example by sorting or summarising.

## Summary

- The five components of a computer system are hardware, software, people, procedures and data.
- Hardware refers to the physical components of the computer whereas software refers to the programs that run on the computer.

- People are part of the computer system either in the role of end users or programmers.
- Data is raw facts and figures whereas information is data that has been processed.



## Review exercises

### Exercise 2

- 1 What are the components of a computer system? Give descriptions of each.
- 2 What is the difference between hardware and software?
- 3 Give four categories of hardware.
- 4 What do the letters CPU stand for?
- 5 Give four things the CPU has to do.
- 6 What are the two main categories of software? Give examples of each.
- 7 Give two types of people associated with computer systems.
- 8 What are some of the procedures you have to follow in your school's computer lab?
- 9 Explain why a set of ages is considered raw data, but if you sort them or find the maximum, minimum and average, it becomes information.

## 3 Input and output devices

### In this chapter, you will learn:

- the difference between an input device and an output device
- examples of input devices
- examples of output devices
- the difference between hard copy and soft copy
- types of printers

### Input devices

**Input devices** are peripheral devices that allow users to enter information into the computer. Keyboards, mice, microphones, digital cameras, webcams, scanners and laser pens are all examples of input devices.

#### Keyboard

The most common type of input device is the **keyboard**, which, of course, gets its name from the several keys it contains (see Figure 3.1).

There are keys for each letter of the alphabet, the numbers 0–9 and for common symbols like the full stop and question mark. You will learn more about the keys on the keyboard in Part 2 of this book.

Although the keyboard can be used for a variety of purposes, it is most suited for data entry and typing documents.



**Figure 3.1** A wireless mouse and keyboard.

#### Mouse

As you can see in Figure 3.1, a computer mouse does bear some resemblance to its namesake. The typical mouse has two buttons on top as well as a scroll wheel. If you turn the mouse over, you'll see a red light, which is actually a low-powered laser beam that is used to track the movement of the mouse. If you have an older mouse, there may be a small ball instead.

As the mouse moves, the pointer on the screen moves as well. When the pointer is over the item that the user wishes to select, he or she clicks one of the mouse buttons. You can use a mouse:

- to select a menu command or 'press' a button on the screen
- for highlighting icons and text
- to draw in graphics programs (although laser pens and graphics tablets are more suited to this task).

Even though the mouse is a very versatile input device, it can only be used for items on the screen. In addition, mice that use a laser may move erratically if placed on reflective surfaces. Mice that use a ball can cause erratic movement on screen when they need cleaning.



Laptops do not usually come with a mouse; instead they have a touchpad that serves a similar function.

#### Laser pens and graphics tablets

The best way to create drawings on the computer is by using either a **laser pen** (Figure 3.2) or a **graphics tablet** (Figure 3.3). While both allow you to actually draw images, the laser pen allows you to draw directly on the screen. Of course this requires a special screen.



**Figure 3.2** A laser pen.



**Figure 3.4** A flatbed scanner.



**Figure 3.3** A graphics tablet and stylus (pen).

### Scanner

A **scanner** is a device that scans existing photographs or printed documents and converts them to digital images. Most scanners are flatbed like the one in Figure 3.4, where you put a page of the document face-down on the flat surface and close the lid. However, all-in-one printers often come with sheet-fed scanners, where you put all the sheets of paper in the tray and the scanner pulls them through one by one like a fax machine does.

Scanners are useful when you do not have the original document or image on your computer. They save you from having to retype the document. However, because documents are scanned as images, you need to use optical character recognition software if you want to edit the scanned text in a word processor.

### Digital camera

A **digital camera** (see Figure 3.5) is a camera that uses an electronic sensor instead of film. The images are stored digitally on removable flash memory cards.

Cameras nowadays have resolutions of about 14 megapixels (approximately 14 million pixels). A **pixel** is simply a dot in the image: the more dots, the higher the resolution and the more detail that can be recorded.



**Figure 3.5** The back of a digital camera showing the LCD screen.

Digital cameras are more convenient than their film counterparts. They have LCD screens that allow you to compose shots and view images right after you take them, to make sure they come out properly. The memory cards are reusable and store hundreds of images at a time, compared to the 36 on a typical

roll of film. You do not have to send them to get developed either, so you save a lot of money. And because the images are stored digitally, they can easily be edited on the computer, imported into documents or uploaded to the Internet.

### Webcam

A **webcam** is a small camera that you use to send live video over the Internet (see Figure 3.6). The video quality is not usually very good but this does not matter since you do not use webcams to do professional videos. Instead, webcams are normally used so you can see the people you are videoconferencing or chatting with.



**Figure 3.6** A webcam.

### Microphone

Computer microphones (see Figure 3.7) work the same way as normal ones – the only difference is that they are smaller. Common uses are voice chatting online, recording audio and giving voice commands to the computer. However, all of these applications require special software.



**Figure 3.7** A computer microphone (and headset).

### Optical Mark Reader (OMR)

Have you ever done a multiple-choice exam where you had to shade the correct answers? After the exam, the batch of answer forms would most likely be placed into a device called an **Optical Mark Reader (OMR)**.

An OMR is a device that can detect the position of pen and pencil marks and determine which options they correspond to. In addition to multiple-choice quizzes, it is also used for surveys (Figure 3.8). OMRs are very fast and require less labour (and the associated costs) when inputting large amounts of data. Unfortunately they require specially formatted forms and can get confused if the answers are not shaded correctly.



**Figure 3.8** A survey sheet that can be read by an OMR.

### Optical Character Reader (OCR)

An **Optical Character Reader (OCR)** is a device that detects characters in printed documents. It allows you to quickly enter printed text into the computer, without having to retype it. This technology is used to capture data from airline tickets, envelopes and utility bills. However, OCRs have trouble reading handwriting and low quality text.

### Barcode scanner

You probably are already familiar with barcode scanners used in supermarkets (Figure 3.9). These



**Figure 3.9** A barcode scanner being used to read the barcode on a bottle of shampoo. Inset: a barcode.

devices scan patterns of parallel black lines (called barcodes) which are used to identify items. The particular store or supermarket maintains a database which associates each barcode with the item's current price. This system is much faster and more accurate than manually keying in the prices into a cash register.

## Output devices

**Output devices** are also peripheral devices but they are like the opposite of input devices – they allow you to get information out of the computer so that humans can read or understand it. The most obvious examples are computer monitors and printers, but speakers are output devices as well.

### Monitor

A **monitor** is what people commonly refer to as the computer screen. In the past, all monitors were **CRT** monitors (see Figure 3.10) – big, bulky devices that looked, and worked, similar to an old television set. Nowadays, computers come with thin **LCD** monitors like the one in Figure 3.11 instead.



**Figure 3.10** A CRT monitor.



**Figure 3.11** An LCD monitor.

### Printer

A **printer** is a device that produces hard-copy output on paper. Let us look at the four main types of printers:

- inkjet printers
- laser printers
- dot-matrix printers
- thermal printers.



What is the difference between hard copy and soft copy? A **soft copy** is the digital form of a document whereas a **hard copy** is the printed, human-readable copy of that document.

### *Inkjet printers*

These are the small printers found in most homes and offices like the one in Figure 3.12, see page 10. They work by squirting tiny droplets of ink on the paper. Their initial cost is cheap but the ink is expensive. Despite printing fairly quickly, they produce high quality images and text.



**Figure 3.12** An inkjet printer.

### *Laser printers*

Laser printers (see Figure 3.13) are the biggest, fastest, most expensive printers so they are usually only found in offices that do a lot of printing. Instead of ink, they use lasers to fuse toner onto the paper, which results in excellent text quality.



**Figure 3.13** A laser printer.

### *Dot-matrix printers*

A dot-matrix printer (Figure 3.14) works almost like a typewriter. Tiny pins in the print-head strike the

paper through an inked ribbon and the resulting dots form text and images. This makes dot-matrix printers slow and noisy but also makes them uniquely able to print in duplicate using carbon paper.



**Figure 3.14** A dot-matrix printer.

### *Thermal printers*

As the name suggests, this class of printer works by using heat. A thermal printer does not require ink, toner or a ribbon, only heat-sensitive paper. So its running cost can be as cheap as, or even cheaper than, a dot-matrix printer. Thermal printers are used when low quality text is acceptable, for example when printing cash register receipts or movie tickets. They are also used in some fax machines.

### *Impact printers versus non-impact printers*

Like the names suggest, impact printers print by striking the paper whereas non-impact printers print by other means. So a dot-matrix printer is an example of an impact printer whereas inkjet, laser and thermal printers are non-impact printers.

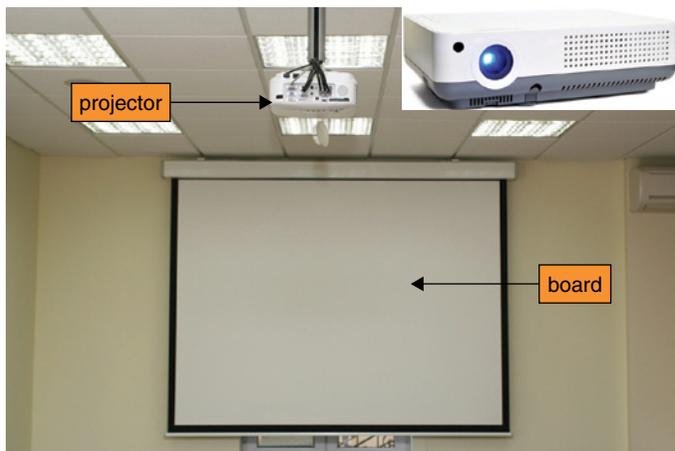
### *Page printers versus line printers*

The terms 'page printer' and 'line printer' refer to how fast a printer appears to be printing. Inkjet and laser printers, which print so quickly that they appear to print an entire page at a time, are called **page printers**. A **line printer**, on the other hand, is a printer that appears to print an entire line at a time.

### *Multimedia projector*

A multimedia projector is an output device that connects to a display port on your PC and uses a lens

to project whatever is showing on your screen onto a flat surface such as a wall or a board. You usually plug one into your laptop when you are doing PowerPoint presentations so the audience can see your slides.



**Figure 3.15** A typical set up of a projector and a board on which the content of the screen is projected. Inset: A close up of a typical projector.

### Speakers

Computer speakers are output devices as well, even though users hear the data as opposed to seeing it. They work and look like normal speakers, only smaller.

### Summary

- Input devices allow you to put information into the computer whereas output devices are used to get information out.
- Keyboards, mice, laser pens, graphics tablets, scanners, digital cameras, webcams, OMRs, OCRs and microphones are all input devices.
- The most common output devices are monitors, printers, multimedia projectors and speakers. Printers produce hard copy.
- There are four types of printers: inkjet, laser, dot-matrix and thermal.
- Page printers appear to print a page at a time; line printers appear to print a line at a time.
- Impact printers print by striking the paper.



### Review exercises

#### Exercise 3A

- 1 a What is an input device?
- b What is an output device?

- c List three input devices and three output devices.
- 2 Give a similarity and a difference between a light pen and a graphics tablet.
- 3 Give two uses of a keyboard.
- 4 What are three things you can use a mouse to do?
- 5 Timothy goes to use a PC in his school's computer lab but finds that the mouse is, in his words, 'jumping all over the place'. Give two possible causes.
- 6 Describe the two types of scanners.
- 7 Cynthia has lost an important document from her computer but has managed to find an old printed copy. Explain how she can get the information into Microsoft Word so she can make changes to it.
- 8 What is a pixel? Using the word 'pixel', explain how the resolution of a digital camera relates to its image quality.
- 9 How are digital cameras more convenient than normal film cameras?
- 10 What are webcams normally used for?
- 11 What input device would you use to enter voice commands into your computer?
- 12 What is the biggest difference between the two types of monitors?
- 13 Give a brief description of how the four types of printers work.
- 14 What does the term 'soft copy' refer to?
- 15 Give the advantages and disadvantages of:
  - a a laser printer over an inkjet printer
  - b an inkjet printer over a dot-matrix printer
  - c a thermal printer over a laser printer.
- 16 What is the input device best suited for:
  - a Reading telephone bills?
  - b Recording the results of a survey?
  - c Determining the prices of items in a retail store?
  - d Grading quizzes?
- 17 Give two disadvantages of optical mark readers.
- 18 Explain what a page printer is and give two examples.
- 19 Why is an inkjet printer not considered an impact printer?