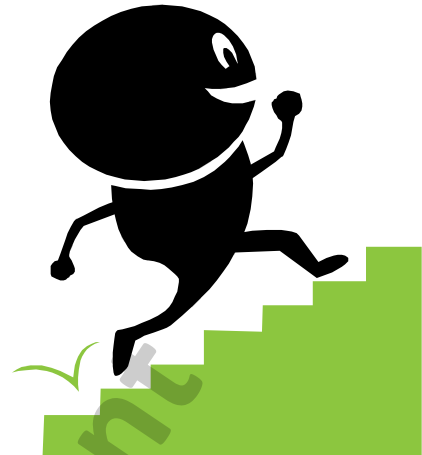


Easy Steps



Unit 2783 (V6)

Demonstrate knowledge of
the components of
personal computer systems

- ☒ Easy to follow
- ☒ Step-by-step instructions
- ☒ Covers Unit Standard Criteria

A Cheryl Price Publication

Unit Standard 2783 (Version 6)

Demonstrate knowledge of the components of personal computer systems

This book covers the course outline for the following New Zealand Qualifications Authority Unit Standards:

Unit Standard 2783 - GENERIC COMPUTING (Level 3, Credit 3) - Version 6
Demonstrate knowledge of the components of personal computer systems

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Unit Standard 2783 Version 6

Demonstrate knowledge of the components of personal computer systems

Level 2

Credits 3

Purpose People credited with this unit standard are able to: demonstrate knowledge of: the features of main hardware components of a personal computer system and interaction between the components; operating system software and applications software and their interaction; and the relationship between hardware, software and data.

Subfield Computing

Domain Generic Computing

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Special notes

- 1 Range
The main components of a personal computer system include but are not limited to – memory, central processing unit (CPU), motherboard, storage devices, USB devices, monitor, keyboard, mouse.
- 2 Demonstration of knowledge can be oral, written, practical, and/or a combination, as appropriate to the assessment situation.
- 3 Definition
Application software means software operated by end-users rather than the computer system itself, eg word processing.
CPU means central processing unit.
System software means software employed by the computer system rather than end-users, eg operating systems.

- 4 Legislation relevant to this unit standard includes:
Health and Safety in Employment Act 1992, Copyright Act 1994, and their subsequent amendments.

Elements and performance criteria

Element 1

Demonstrate knowledge of the features of main hardware components of a personal computer system and interaction between the components.

Performance criteria

- 1.1 System components are identified in terms of their specifications.
Range: may include but is not limited to – clock frequencies, CPU speed, bus speed, memory size, bit rate.
- 1.2 The CPU is identified in terms of its main components.
- 1.3 The relationship between the CPU, memory and input/output is identified in terms of the data flow.
- 1.4 The interaction of the fetch and execute cycle is described in terms of the events that occur and their sequence.

Element 2

Demonstrate knowledge of operating system software and applications software and their interaction.

Performance criteria

- 2.1 Operating systems and operating system tasks are identified and described in terms of how they interact in a personal computer.
Range: a minimum of two different operating systems and three tasks for each.
- 2.2 Applications software for a personal computer system is identified and described in terms of how they interact with each other.
Range: any two different types of applications.
- 2.3 Operating systems are compared in terms of features and functions.
Range: any three operating systems.

- 2.4 The purpose of the operating system and its interaction with application software is described in terms of the need for compatibility.
- 2.5 Popular file formats and the utilities to convert between them are identified and described in terms of the processes used in conversion.

Element 3

Demonstrate knowledge of the relationship between hardware, software and data.

Performance criteria

- 3.1 The relationship between hardware, software and data is described in terms of interaction.
- 3.2 The purpose of language and data translation utilities is described in terms of their function.

Range: may include but is not limited to – compiler, interpreter, assembler.
- 3.3 The steps of the processing cycle are identified and described in terms of input, processing and output.

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Sample Document

Data and Information

Learning Outcomes

At the end of this section you should be able to -

- ☐ Understand the differences between data and information
- ☐ Understand the difference between analogue and digital devices
- ☐ Understand bits, bytes, and binary numbers
- ☐ Identify the steps in the processing cycle

Data versus Information

The terms **data** and **information** are often used to mean the same thing. When it comes to computers, however, it's best to distinguish between the two.

Data is the plural of the word datum, which means a single piece of evidence. In computing terms, data are the raw facts that are entered into a computer for processing. Data are used to represent a fact, figure, or idea in a way that a computer can understand and work with. Although the word "data" was originally used only as a plural, it is now used in place of "datum" to also indicate a single piece of evidence.

Information results from the processing of data by the computer. Information is presented in some understandable way to the computer user. Data is abstract and unusable in its raw form to the average computer user. It exists in the computer as a collection of electrical signals. Information, however, is meaningful to the computer user. Information is always presented in a way that a person can understand, for example, on an output device such as a monitor, or on a printed page.



Data is entered into the computer using an **input device**. These hardware devices provide a way for people to "talk" to a computer in the computer's language. For example, when you type on a keyboard you are sending signals to the computer that correspond to the letters you are pressing. The combination of all those keystrokes, as well as mouse clicks and other actions using input devices, can all result in a single document, like a business report.

There are many types of input devices that enable people to input data into the computer. They include:

- Keyboards • Mice • Trackballs • Touchpads • Tablets • Scanners • Digital cameras • Webcams • Microphones • Touch screens • Barcode readers • Digital music instruments

Note Hardware is the generic term used to describe any part of the computer you can physically touch.

Processed data is delivered by the computer to the user as information through one or more **output devices**. Like input devices, output devices bridge the gap between the computer and human user—just in the opposite direction. They make what the computer is doing meaningful and useful to the user. The business report the user typed using input devices can then be displayed on an output device such as a monitor or a printer.

Output devices include:

- Monitors • Printers • Plotters • Speakers • Headphones

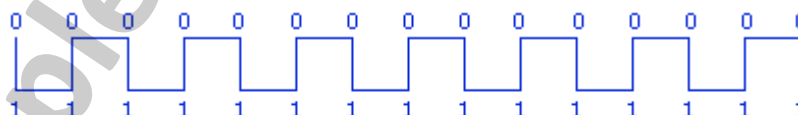
Digital versus Analogue

Understanding how computers work also requires some understanding of the difference between digital and analogue signals.

An analogue signal is continuous. Data is obtained from an analogue signal by measuring small changes over time in this continuous signal. A good example of an analogue signal is a sound wave through the air. The human ear distinguishes differences in sound by registering the changes in the sound wave's frequency. A phonograph is an example of an analogue device.

A digital signal, however, is not continuous; it is discrete, or made up of individual elements. Digital signals are sent using the binary number system of 0 and 1. Digital systems are rare in the natural world, but computers rely on them. A computer is a digital device; its hardware and software work with data in digital form. The 0 in a computer refers to an "off" electrical state; a 1 means "on." An MP3 player is another example of a digital device.

A digital signal is a sequence of 0s and 1s:



An analogue signal is a continuous



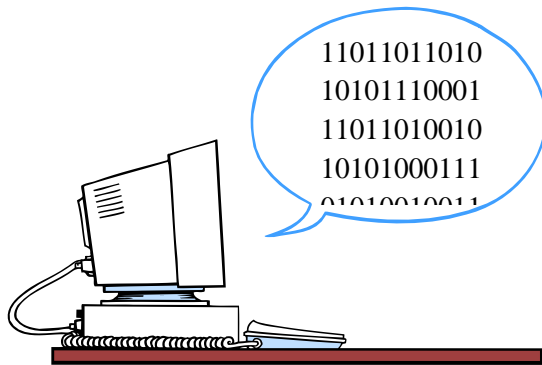
Let's look at an example of analogue and digital devices that perform the same function but in different ways. The traditional clock (right) is an analogue instrument because the hands move continually around its face. The hands of the traditional clock are controlled by the continuous movements of tiny mechanisms inside it.



A digital clock, however, represents time in discrete increments, such as hours, minutes, seconds, and divisions of seconds. Instead of the mechanisms of a traditional clock, the digital watch has a digital processor. The digital signal is pulsed so quickly that the digital clock seems to present the time as smoothly as a traditional, analogue one.

Bits and Bytes

Now let's look at how computers speak this digital language of 1s and 0s. The smallest unit of data communications for a computer is called a **bit**, which is short for "binary digit." In



computers, a bit of data is represented by the presence or absence of an electrical signal. If an electrical signal is present, the bit is represented by a 1. If there is no signal, the bit is represented by a 0.

Taking this information, we can see that two bits of information would have four possible combinations: 00, 01, 10, and 11. Three bits would allow eight possible combinations: 000,

001, 010, 011, 100, 101, 110, and 111. Seven bits, or a sequence of seven 0s and 1s, would have 128 possible combinations. This is the same as 2 to the 7th power, or 2^7 .

Eight bits make up a **byte**. The bits in a byte follow a particular order understandable by the computer. Historically, a byte contained the minimum number of bits required to encode an alphabetic character in a computer. Today, with the adoption of many non-Western languages into the computing world, a byte is not always sufficient to represent a character.

Counting with Binary Numbers

How do you represent numbers in a binary, or base 2, system? As humans, we usually count with a decimal, or base 10, system. Each place in a decimal or binary number has a value. For example, the decimal number 4,517 has a 7 in the ones place, a 1 in the tens place, a 5 in the hundreds place, and a 4 in the thousands place.

Here is the decimal number 4,690,489 with all of its decimal places named.

Number	4	6	9	0	4	8	9
Place	Millions	Hundred-thousands	Ten-thousands	Thousands	Hundreds	Tens	Ones
Place as a power of 10.	10^6	10^5	10^4	10^3	10^2	10^1	10^0

We can do the same thing for a binary number. Here is the binary number 10101101 with all of its places named.

Number	1	0	1	0	1	1	0	1
Place	128s	64s	32s	16s	8s	4s	2s	1s
Place as a power of 2.	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

The first column, starting on the right, represents multiples of 1. The second row represents 2, then 4, 8, 16, 32, 64, and 128 in the subsequent columns. Notice that in both tables the exponent increases by 1 each time you move to the left.

By using the values in the table, we can convert a binary number to a decimal. The binary number 10101101 would therefore represent one multiple of 128, zero of 64, one of 32, zero of 16, one of 8, one of 4, zero of two, and 1 of 1. Adding these multiples together, we get:

$$128 + 32 + 8 + 4 + 1 = 173.$$

Now let's use the table above to convert the decimal number 7 to binary. The highest binary number that "works" is in the 4s place, so we put a 1 there. We have 3 remaining, so we put a 1 in the 2s place and another 1 in the 1s place. The decimal number 7 is 111_2 in binary. Notice the small "2" in the answer? That indicates the number is binary, or base 2. (We could put a small "10" next to a decimal number if there were some question about the number system being used. Otherwise, decimal is assumed.)

This shows us how to convert a binary number to base 10 and vice versa, but remember that computers don't need to convert when working with data. As strange as binary math may seem to us, computers are quite comfortable with it!

ASCII

ASCII stands for the American Standard Code for Information Interchange. It was developed by the American Standards Association in 1968. ASCII was one of the early attempts to provide a common way for computers to exchange data in a language they all could understand.

ASCII is a code, or character set, which uses binary numbers to represent the characters and symbols of a language, such as English. Standard ASCII characters are 7 bits in size and are written in one group of three numbers and a second group of four. The English capital letter A, for example, is rendered in ASCII as 100 0001.

ASCII is still widely used because it is understandable by any computer, but other character sets have been developed which use 8 or more bits to represent characters. This has become necessary to represent characters in non-English languages, as well as special symbols for math and science.

Unicode

ASCII is gradually being superseded by a new computing industry standard called Unicode. Unicode provides more than 100,000 character representations in dozens of languages, with the potential for even more. In addition to providing coding for non-Western languages, Unicode accommodates right-to-left scripts such as Hebrew and Arabic. Development of Unicode is overseen by the Unicode Consortium, a non-profit organization.

Unicode was created in the late 1980s. It originally used 16 bits to represent each character, meaning it could represent more than 65,000 (2^{16}) unique characters. The emphasis at the time was on representing only modern languages, rather than also preserving older ones. In 1996, however, Unicode's scheme was changed so that it could represent more than 1 million characters.

Kilobytes, Megabytes, Gigabytes . . . and Terabytes

The byte is also the foundation of understanding size in the computer world. Hard drives, memory, documents, images, and many other objects are measured in bytes—or more likely, kilobytes, megabytes, and gigabytes.

Notice that each of these words consists of the word "byte" with a prefix indicating "how many." Just as 1,000 metres is a kilometre and 1,000 grams is a kilogram, 1,000 bytes is a kilobyte, shown with the notation KB. For example, 500 kilobytes is usually written "500 KB." (A kilobyte is more accurately 1,024 bytes, or 2^{10} bytes. Remember that computers think in base 2, not decimal.)

A megabyte (MB) is 1 million bytes and a gigabyte (GB) is 1 billion bytes. Today hard drives of 1 trillion bytes, or a terabyte (TB), are becoming common. Computer technology has come a long way since the floppy disk, which contained only 1.44MB of storage space.

The Processing Cycle

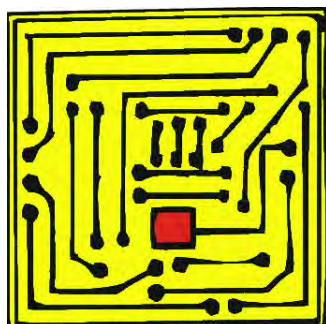
A computer is constantly processing data while it is running. There are four main actions undertaken during this process, in which data goes in and processed information comes out:

- Input • Processing • Storage • Output

Input

Raw data is entered into the computer using input devices such as keyboards.

Processing



Data processing is performed by the central processing unit or CPU. The CPU is a key component found in the system unit (contained in the computer's case). The CPU interacts with other parts of the system unit to process the raw data and turn it into meaningful information.

Data is processed by the computer using computer programs called software. Programs are sets of instructions that tell a computer what to do with data after it has been inputted.

The processing being performed by a computer includes a range of activities, such as:

- Verifying the accuracy of inputted data.
- Performing any calculations required.
- Consolidating separate pieces of data into a cohesive whole.

Note Computer programs are called software because, unlike hardware, they cannot be touched physically.

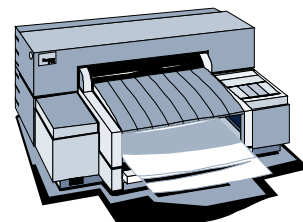
Storage

Before and after being processed, data is stored in one of a variety of locations in the system unit. Data which is needed for current operations is stored in some type of memory. When the data is needed again for processing it is retrieved from memory and acted upon by the processor. Data which is not currently needed for operations is stored on a medium like a disk drive.

The main storage device within the system unit is the hard disk drive (HDD). Most computers also have removable storage capabilities like compact disc drives and floppy drives, and some computer users have a personal flash drive that can be plugged into the computer's USB port.

Output

Output is the process of making information available to the computer user. Information can be presented in many ways, such as an image on a screen, a sound made through speakers, or a document printed on paper.



Important note: When a completed document is stored in a storage device such as a hard drive, it is still referred to as data (more specifically, as **processed data**). This is because information is user-driven; it only becomes information when the computer user views it on the screen or reads it on a printed document. The word "information" is only used for material which is meaningful to a human, not to the stored electronic data.

Now that we have the basics, we can offer a definition of a computer:

A computer is a programmable machine that receives input, stores and processes data, and provides output in a format that has meaning to the user.

Revision

1 What is the difference between data and information?

.....

.....

.....

2 How many bytes (rounded to the nearest thousand) are in a kilobyte?

3 Which is larger: 1GB, 1MB, or 1KB?

4 How would you write the number **6** in binary?

5 Describe the **four** stages of the processing cycle.

.....

.....

.....

.....

.....

.....

6 What does CPU stand for?

.....

7 Name **three** input devices.

.....

.....

.....

8 Give a definition of the term **hardware**.

.....

.....

Computer Hardware – Peripherals

Learning Outcomes

At the end of this section you should be able to -

- ☐ Describe the specifications of input devices, including keyboards, mice, trackballs, scanners, and microphones
- ☐ Describe the specifications of storage devices, including hard drives, floppy disks, compact discs (CDs), digital versatile discs (DVDs) and USB/portable drives
- ☐ Describe the specifications of output devices, including monitors, graphics cards, sound cards, speakers, and printers
- ☐ Describe the principles of networking and the hardware required to communicate across a network

What are Peripherals?

Peripherals are hardware devices that are not part of the core processing computer, but which are attached to it. Some peripherals, such as a hard drive, can be attached inside the computer system unit (that is, inside the computer's case). These are referred to as **integrated** peripherals. Other peripherals, such as the keyboard, mouse, and printer, are attached to the outside of the computer system unit.

Input Devices

Input devices, as the name suggests, are used to input data into the computer for processing.

Keyboard

The computer keyboard is the most commonly used computer input device. The computer keyboard borrows its layout of letter keys from the traditional typewriter. It also has additional keys, such as Ctrl, Alt, and the Function keys, which are of use in a computing context. Keyboards allow you to communicate with the computer and to enter or edit data. They are used to enter characters or perform functions that give instructions to a computer program.

The keyboard contains a small microprocessor and a sensor grid upon which the keys rest. When a key is pressed, the sensor grid detects it and sends a message to the keyboard's microprocessor. The microprocessor then sends a message to the computer, telling it which key has been pressed. The software that is being used then interprets the keystroke.

There are various types and designs of keyboards available.

Standard keyboard

The standard keyboard has all the keys positioned in straight rows. This version is most similar to the traditional typewriter.

Natural keyboard (split or angled keyboard)

Natural keyboards, also called split keyboards, are designed in a curve, with the keyboard split into two halves—one for the keys struck by the left hand, and one for the right. These are meant to encourage a natural hand, wrist, and forearm position.



Multimedia keyboard

Multimedia keyboards have additional function buttons that are used to issue instructions to the software. These extra keys provide additional functionality for quick access to often-used software, for gaming, and for Internet access.

Mouse

A mouse is an input device used to select and access features within a software program. When a mouse is moved, a pointer, or some other symbol determined by the software, also moves across the monitor screen. This lets the user position the pointer, or in the case of a word processing program, the cursor, exactly where it is needed. Then an action can be taken, such as typing text or launching a software application.



The mouse also has buttons, which are used to perform actions. The traditional PC mouse has two buttons at the top of the mouse. The left button is used to select items and perform operations. The right button is used to display a so-called context sensitive menu. The menu that appears when you click the right button depends upon the software being used. Before 2005, the mouse used with Apple Macintosh computers had only one button.

Some mice also have a scroll wheel, usually set between the two buttons. This wheel allows the user to scroll up and down the screen and through documents. In some cases, the scroll wheel can also be clicked, and so functions like a third button.

There are several different mouse types available.

Traditional trackball mouse

With a traditional, trackball mouse, a ball located on its underside moves when the mouse is moved. The movement of the ball is transferred to two sets of rollers that are touching it. The movement of the rollers is registered by the software and is used to calculate the amount and direction of movement of the pointer on the screen. Trackball mice work best on specially designed mouse pads, which provide a suitable surface for the ball to glide over.

Optical mouse

In an optical mouse, the trackball is replaced with a light-emitting diode (LED) and an optical sensor. The movement and location of the mouse is detected by changes in reflected light. An optical mouse can be used successfully on a wide range of surfaces; it does not require a mouse pad. Optical mice tend to be more robust than trackball mice as they do not have moving parts. The optical technology is also more accurate in detecting mouse movements.

Wireless mouse

As the name suggests, wireless mice are not connected to the system unit with a cable. Instead, radio waves or infrared beams are used to communicate with the computer. The mouse is powered by rechargeable batteries. The wireless mouse offers the flexibility of being able to move the mouse independently of the system unit. However, there is a limit to the range at which the signals will work, and the mouse batteries need to be replaced when they run out.



Trackball

Trackballs are used to perform the same functions as a mouse. The ball is spun by the thumb to move the pointer to a location on the screen that allows the user to select an object or access features within a software program.

The same working principles of a mouse apply to a trackball. The ball's movements result in the movement of rollers inside the trackball. The rollers are used to calculate the cursor movement on screen. Trackballs also have some configuration of buttons, also like a mouse.

Laptop computers often have a built-in trackball. Large trackballs are often used as a teaching aid for children or by people with disabilities.



Touchscreen

Some types of computers let you use the monitor itself for input, instead of a mouse and keyboard. These monitors are called touchscreens and they are popular on computers in public places and on tablet PCs. Touchscreen monitors have a flat screen that responds to the touch of a finger, a stylus, or a digital pen. The screen may also display a software keyboard to take the place of a hardware one. Some newer touchscreens even have a multi-touch capability that lets you perform actions with two fingers at once.

Touchscreens use many different technologies. One of the most popular is the resistive touchscreen. It is made up of two flexible sheets of plastic coated with a material that is sensitive to the touch. These sheets are separated by a gap of air. When the user presses on the screen, the two sheets touch at that point. This creates an electrical connection which can be received by the computer.

Scanner

A scanner is used to convert a paper document into a digital form that a computer can then process. Modern scanners can work with documents that contain text or images, in black and white or in colour. The scanner software often contains functions for editing images or "reading" text. The ability to read text from a scanned document and convert it into a document file is called Optical Character Recognition (OCR).



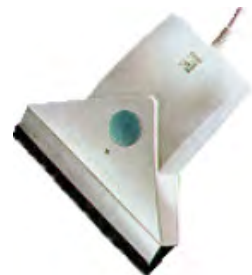
There are many kinds of scanners, but they all contain a light and a scanning element. These are passed over the document, recording a digitized image of it. The captured image is then sent to the computer and can be manipulated by software.

Flatbed scanners

A flatbed scanner is a scanner that sits on a desk. This type of scanner has a glass pane upon which the document is placed, face down, either by hand or by a document feeder. (Document feeders allow the easy scanning of multipage documents.) The light and scanning element are then passed under the glass to create an image of the document.

Handheld scanners

A handheld scanner can be used in the hand and on any size document. The scanner is placed on top of the page and turned on, and is then dragged down the page at a slow and constant speed. If an image is large, parts of the picture will need to be scanned in separate stages and then "stitched" together using software.



Scanner/printer/copier

Many scanners available today combine the input functionality of a scanner with the output functionality of a printer and a photocopier. These versatile machines, often called multifunction devices, are now becoming invaluable in both the home and small office.

Microphone



A microphone allows you to record sound directly into your computer. The analogue sound signal is digitized and turned into a digital sound file, which can then be played back and edited using special software. It is also possible to set up a computer to function like a telephone, with the microphone and speakers replacing the telephone handset. This is called computer telephony integration.

Headsets incorporating both headphones and a microphone are available for this use.

Microphones are becoming more popular with the development of accurate speech recognition software. This type of software allows you to give spoken commands to the computer. Speech recognition software needs to be "trained" to be able to understand the user's speech patterns. Speech recognition software is particularly useful for people with physical disabilities that prevent them from using a keyboard.

There are many different types of microphone, each using different technologies. All of them are designed to pick up sound waves, which are collected by a diaphragm. These waves are then converted into electrical signals that can be manipulated by software.

Exercise 1

1 What is a "peripheral"?

.....

.....

2 Describe the differences between a standard keyboard and a natural keyboard?

.....

.....

.....

3 What is the scroll wheel on a mouse used for?

.....

4 A trackball is an alternative to which device?

- ☐ keyboard
- ☐ mouse
- ☐ scanner

5 What does OCR technology allow a scanner to do?

.....

.....

.....

.....

.....

6 Why would you use a microphone with a computer?

.....

.....

.....

Storage Devices

Storage devices are used to store data so that it can be processed by the computer. Data storage is one of two types: **volatile** and **non-volatile**. Volatile storage relies on electric power always being available. Without power, the data can no longer be stored. An example of volatile storage is the computer's random-access memory, or RAM. We will discuss RAM in a later section. Non-volatile storage does not rely on a continual power supply. An example of non-volatile storage is a disk drive.

Data can be retrieved from a connected storage device at any time for processing. There are many types of storage devices available using widely different technologies. Some reside inside the system unit while others are external to it and are joined to the computer through a connection called a port.

Reading and Writing

Read: When data is *accessed* from a storage device, it is being **read**.

Write: When data is *added to* a storage device, it is being **written**.

The Hard Drive

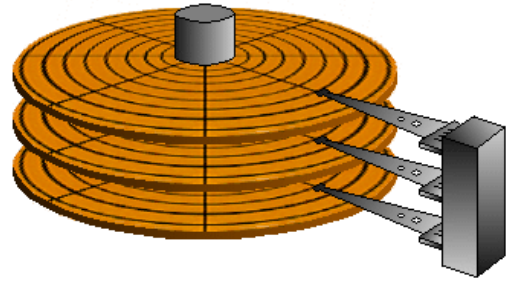
The hard drive, also known as the hard disk drive (abbreviated HDD), is the main data storage area in most modern computers. A single computer may have a single hard drive or one primary hard drive and one or more secondary hard drives.

The primary hard drive (named C:) is used to store the operating system and other basic data needed to start up (or boot) and run the most basic computer functions. The primary and secondary drives contain all of the programs installed on the computer, as well as files created and stored by the user.

The storage capacity of a hard drive is usually measured in gigabytes (GB), although terabyte-size (TB) hard drives are now widely available in new PCs. New desktop PCs are generally fitted with hard drives of between 100GB and 750GB.

Hard Drive construction

The components of a standard hard drive are contained inside a rectangular metal case. Inside the case is a series of round, flat disks called **platters**, which are coated on each side with a material that allows them to store data in a series of magnetic patterns. These platters are mounted at the centre onto a spindle, which in turn is driven by a spindle motor. Hard drives are usually 3.5 inches in diameter for desktop PCs or 2.5 inches in laptops and other portables.



The data on the disks is read by electromagnetic read/write heads, with one below and one above each platter. The read/write heads are mounted on the ends of slider arms, which are connected to a device called an actuator.

External and removable hard drives

External and removable hard disk drives work in essentially the same way as those connected more permanently inside the computer case. External and removable hard drives have the advantage of portability; they can be disconnected or removed, carried to a different computer, and then reconnected.

An external hard drive consists of the hard drive itself, which is usually of the same form as an internal hard drive, and an enclosure. The enclosure consists of a case to protect the hard drive plus electronics that allow it to be connected to the computer via a cable. Most modern external hard drives are connected to a computer via a USB port. The data transfer rate to an external hard drive is slower than to an internally connected disk drive.

A removable hard drive fits into a special slot inside the computer case. It can be removed for portability or security purposes.

USB/Portable hard drives

As we noted, external and removable hard drives can be disconnected and carried to a different location, making them portable. An even more portable storage solution is the USB flash drive. These aren't disk drives in the sense of a hard disk as described above. USB flash drives instead use a form of non-volatile flash memory to store data and programs and draw their power from the USB connection.



USB drives can be very small—down to the size of a key—and thus are highly portable. They plug into any computer with a USB port. USB drives can hold several gigabytes of data. Today USB drives have taken on the same tasks that floppy disks were previously used for. They have thousands of times the capacity of floppies, however, and are more reliable due to their lack of moving parts. They are the most common portable storage devices nowadays.

Floppy Disks

The floppy disk drive (or FDD) was one of the original removable storage options for computer users. Although new computers are rarely built with floppy disk drives, you may still



run across them in some settings.

Floppy disks in their various forms were a standard means of carrying data from one computer to another from the mid-1970s to the late 1990s. They have now been replaced by cheaper, faster, and higher capacity devices like USB drives, CDs, DVDs, and memory cards.

Form and capacity

The modern floppy disk is 3.5 inches square and provides 1.44 MB of data capacity. Why are they called floppy disks when they aren't really "floppy" at all? The disk that holds data is made of a flexible plastic material encased in a hard plastic shell. Earlier floppy disks, such as the 8-inch variety, didn't have this hard shell, so it was truly "floppy" all the way.

Formatting and Write Protecting

Most floppies come already formatted. If not, simply insert the floppy into the drive and follow the instructions for your operating system. For a Windows PC, right-click the A: drive and choose Format from the pop-up menu. You can also prevent a floppy from being accidentally overwritten with other data. To do so, move up the small tab in the upper-right of the disk case so that the small window is open.

Floppies' many uses

Floppies were used for many purposes other than the transferring of files. The earliest computers contained the entire operating system on a floppy. Before the advent of the CD, floppies were also the medium used to sell software. A word processing program, for example, might be delivered on six or more floppies, which had to be inserted one after the other to install the program. Computer system administrators often carried floppies containing diagnostic tools they could use to troubleshoot a computer.

Despite the disappearance of the floppy, its presence lives on in the naming scheme for computer drives. By default, the primary hard drive is labelled C:, with A: and B: being reserved for floppy drives that are no longer present.

Optical Discs

As computers became more powerful and able to work with larger amounts of data, the need arose for a more capable removable storage system. In addition to holding only 1.44 MB of data, the data transfer rate from a floppy to the other computer components was too slow. Compact discs and digital video discs, both forms of optical media, came to the rescue.

Compact Discs

Compact discs were invented in 1982, but these original discs held only digital audio. Compact discs designed to hold computer data were invented a few years later in 1985. These discs are called CD-ROMs. The "ROM" part of CD-ROM stands for "read-only memory." Data could be read from these first CDs but could not be written upon them by the user. This is different from the floppy and hard drive, which were read/write devices.

Standard CD-ROMs hold up to about 700 MB of data, which was about 480 times the amount a floppy could hold. This made them suitable for delivering large amounts of data, especially data files like images, video, and sound. In addition to holding data, CD-ROMs are used to distribute software.

A compact disc is 12 cm in diameter, 1.2 mm thick, and made of injection-moulded polycarbonate plastic. The discs have a 15 mm hole at the centre. Data is arranged in a spiral pattern, starting at the centre of the disc and working around to the outside. This spiral track contains billions of pits, with spaces between them called lands, which are read by a laser. The layer containing the data is coated with a thin layer of aluminium or gold, and then by a further protective lacquer outer layer.

The CD drive reads the CD-ROM with a laser that passes over the spiral of pits and lands. The variable sizes of the bumps and pits reflect light differently; data is read by registering these changes. The reflected light is converted into a high-frequency signal and encoded into readable data.

Writable compact discs

Writable compact discs, called CD-Rs (for Compact Disc-Recordable), became available in 1988. These discs could be written to only once, unlike hard drives and floppies, which could be written to many times. The first equipment created that could write compact discs was very big and expensive. Early models cost tens of thousands of U.S. dollars and were the sizes of cabinets. The discs were expensive, too. Blank CD-Rs for recording were around US\$40 in 1991. Now CD writers are quite cheap and are standard equipment with all new computer systems. Blank CD-Rs are also very inexpensive.

CD writers installed in computers write the data one track at a time, while writers for commercial use—for example, making thousands of copies of a music CD—stamp the data onto the disc surface in a single step.

Rewritable compact discs, called CD-RWs (for Compact Disc-ReWritable), became available in 1997. Data can be written to CD-RW discs many times, erased, and then written to again. CD-RW discs are more expensive than CD-R disks, which has limited their popularity in most settings.

Note You can record a music CD-R with a computer, and that CD can then be played on most music CD players. A recorded CD-RW disc, however, cannot be played on most music CD players.

DVDs

The DVD (Digital Versatile Disc) was invented in 1995. A DVD looks like a compact disc but has a much higher data capacity. DVDs most popular initial use was for showing recorded movies. In most areas of the world, the DVD has replaced videotape for consumers wanting to view movies at home. DVDs can also be used for data storage and software packaging in the same way as CDs. DVDs come in several types, with data capacity from 4.7 GB up to about 17 GB.

The surface upon which data is written on a DVD is only half as thick as that of a compact disc. The pits and lands are also much closer together, and the laser that reads the disk has a much shorter wavelength than a CD reader's. These features are what allow the standard DVD to hold so much more data than a CD.

Dual-layer DVDs (DVD-DL) provide about 8.5 GB of data capacity, compared to the standard DVD's 4.7 GB. Dual-layer DVDs have two, distinct layers of data on the disc. DVD drives that support dual-layer discs shine the laser reader through the first layer to access the data on the layer underneath.

Writable DVDs

The development of DVDs followed the same path as compact discs. The first discs were read only and were written at a factory. A writable version of the disc and needed hardware came later. Also like CDs, the cost of writable discs and the drives started high but now are inexpensive and are standard components in most new computers.

Unlike CDs, however, two different technologies exist for writable DVDs. These are denoted by a – (minus) or a + (plus) sign. So there are DVD-R and DVD+R writable discs and hardware. The rewritable DVDs are likewise labelled DVD-RW and DVD+RW. There are also rewritable dual layer discs that are written the same except with the letters DL at the end.

Modern DVD writers can handle both technologies, so there is rarely any problem with compatibility.