

Section 1

System Software

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Excerpt
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Components of a Computer System and Modes of Use

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Revision Objectives

After you have studied this chapter, you should be able to:

- ☞ define the terms hardware, software, input device, storage device and output device
- ☞ describe the purpose of input devices, storage devices and output devices
- ☞ define the different types of software: operating system and general/common application software.

1.1 Hardware, software, input devices, storage devices and output devices

Hardware

Hardware is the physical – mostly electrical – components which make up the computer system. Examples of hardware would be the motherboard and a device controller circuit board.

Software

Software are the programs – made up of program instructions – which run on the hardware. Software makes the hardware useable.

Input devices

One of the fundamentals principles of any computer system is that its operation consists of a continuous cycle of input – processing – output.

Consider when a user keys in a search phrase to say Amazon (the input) – the computer system searches the database for that product (the processing) and then produces the search results (the output).

Consider the embedded computer system inside a washing machine. A user selects the wash programme to use on their washing machine (the input) – the computer system senses that the door is shut etc. (the processing) and an LED display shows the wash time remaining (the output).

The keyboard

The standard QWERTY keyboard is the widely used input device.

Sensors

Sensors are used to ‘sense’ physical attributes in the real-world.

Specialist input devices

These are often designed for the rapid input of large quantities of data such as optical character recognition (for billing applications) and high speed scanning devices (for the scanning of student examination scripts).

Later

Chapter 4 Peripheral devices

Storage

Temporary storage

Short term storage is required for the intermediate processing of data. The Amazon search example requires that the search results are temporarily stored immediately before being displayed to the user. This type of storage is called primary storage.

Permanent storage

Permanent storage is required for all files which are used by the computer system. A personal computer

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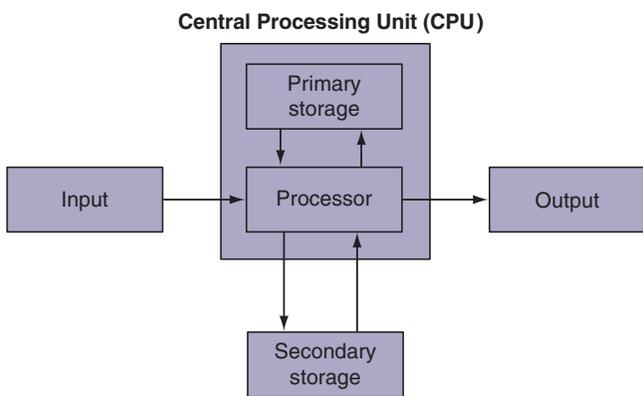
(PC) which has the programs and user’s data stored on the PC will all require permanent storage. This is done with an internal hard drive. Other devices used for permanent storage are discussed later. This type of storage is called secondary storage.

Later

Chapter 4 Secondary storage devices

Output devices

A monitor used as a display screen is the most popular output device. Other forms of output would be hard copy output using a printer or some form of sound using speakers/earphones such as speech output or simply a warning ‘bleep’ to the user.



1.2 Different types of software

Software falls into two categories:

- ✓ *system software*
- ✓ *applications software*

Later

Library programs in Section 2
Programming language translators in Chapter 18

Some of these are discussed here – other software are discussed in later sections.

Operating System

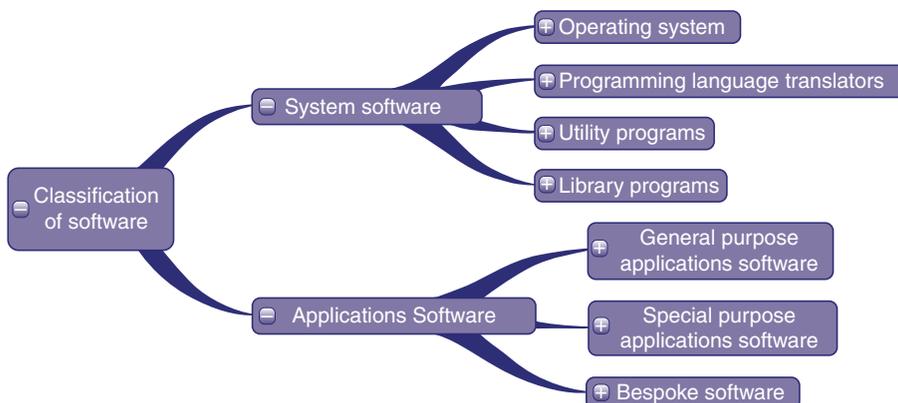
The one piece of software which will be provided when we purchase a computer is the operating system. The computer system is unusable without an operating system.

The role of the operating system is to manage the resources of the processor.

The operating system provides the interface between the hardware and the user and hides all the complexities of the hardware away from the user.

Progress Check 1.1

When the definition of the operating system describes the ‘resources’ of the computer – what are these?



Later

A fuller discussion of the operating system follows in the next chapter.

Applications programs

Applications programs are generally mass marketed and so the user will have a choice to make.

Applications programs can be classified as either:

- ✓ **general purpose applications programs**
- ✓ **special purpose applications programs**

General purpose applications

Also known as '**generic**' software. A general purpose applications program can be used for a variety of tasks.

Word processor

A word processor can be used for a variety of task including:

- ✓ basic word processing
- ✓ producing a company report
- ✓ writing a textbook etc.

The software has features for the basic creation, saving, retrieval and editing of text.

Spreadsheet

A spreadsheet consists of a grid of columns and rows called **cells** into which text, numbers and formulae can be arranged.

A spreadsheet can be used for a variety of tasks:

- ✓ presenting a costing for an event such as a music concert
 - This allows for 'what-if' type use – what if we increase the cost of a ticket to \$30? What effect will this have on the projected profit?
- ✓ maintaining a simple list of information.

Database

Early databases were little more than a computerised 'card file'. Modern relational databases and database management systems are the backbone of most large commercial applications.

Presentation software

There are now many different applications of presentation software, such as Microsoft PowerPoint, that it can be classified as general purpose. Applications include:

- ✓ a student presentation of some research work
- ✓ teaching a new topic to a class
- ✓ running a rolling display of slides advertising the school at a marketing event.

As the presentation is in electronic form it can be distributed on a magnetic medium or through a website to make it more widely available.

General points

Many of these general purpose software programs (for example, Microsoft Office) now come with a built-in programming language (for example, Visual Basic for Applications) and so this extends the scope of the software's usage and so fits even closer to our definition of being 'suitable for a variety of tasks'.

Use of general purpose software is the 'starting point' to develop a computer solution which assumes that:

- ✓ an audit of the features available with (for example a spreadsheet) has been done and we are satisfied that the required software features are present from which the solution can be produced
- ✓ the user has sufficient skills with the software to do this.

Special purpose applications software

Special purpose software is software designed for one particular task. The list of applications and uses is almost endless!

For the purpose of the exam, learn (for example) two or three which are clearly special purpose and make sure you can justify each as such. Some suggestions are given here.

Route planner software

The software is designed for the user to key in the start and final destination (could be the name of the town or some form of postal code). The software calculates and displays the route, estimated time etc.

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Progress Check 1.2

Use the route planner software to explain the input-processing-output cycle.

Tax calculator software

The only task for which this is appropriate is the calculation of the income tax a person will have to pay.

Bespoke software

We showed this on the classification of software diagram. It is really a description for the way in which the software was developed.

Bespoke software is written for a particular client following their program specification.

For example, the software needed for a Cambridge Examiner to upload all the marks from the scripts they have been allocated was written specifically for Cambridge International Examinations.

Progress Check 1.3

In which software category would you put a web browser?

Exam-style Questions

1. Define the terms:

(i) hardware

.....

(ii) software

..... [2]

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2. (a) Describe the purpose of storage devices.

..... [2]

(b) A student has a computer at home as well as using computers at school. State **two** different storage devices that the student would use on her computer and explain what she would use each for.

1.

.....

2.

..... [4]

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3. Define what is meant by:

(i) an input device

..... [1]

(ii) an output device

..... [1]

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System Software

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Revision Objectives

After you have studied this chapter, you should be able to:

- ☞ describe the purpose of operating systems
- ☞ describe the characteristics of different types of operating systems and their uses: batch, real-time (transaction processing and process control), single-user, multi-user, multiprogramming, multi-tasking and network
- ☞ identify a range of applications requiring batch processing, transaction processing and process control
- ☞ describe different types of user interface: forms, menus, GUI, natural language and command line, suggesting the characteristics of user interfaces which make them appropriate for use by different types of user
- ☞ describe the purpose of a range of utility software, for example, disk formatting, file handling, hardware drivers, file compression and virus checkers.

2.1 The Operating System (OS)

The computer hardware is unusable without an operating system. When we purchase a PC it is the one item of software we expect to be provided along with the hardware.

The OS is the software which makes the hardware usable. This is obvious but we need to appreciate what the computer system has to perform behind the screens.

← Look Back

To Chapter 1 for a definition of the OS.

Consider the following example:

You load the word processing software and at the end of the session save the document.

You simply have to key in a document name and click the save button. Consider what the operating system is doing behind the screens.

The OS must:

- ✓ check that the document name is valid
- ✓ check that there is sufficient free disc space. If so, decide which sectors on the disc it will use for storage of the file

- ✓ mark these sectors as used
- ✓ remove these sectors from the list of 'free space' on the secondary storage
- ✓ make a new entry in the file directory for the device.

This suggests that the purpose of any operating system is to:

- ✓ hide the complexity of the computer hardware away from the user
- ✓ provide a user-friendly interface between the user and the computer hardware.

Progress Check 2.1

1. Is the operating system applications software or systems software?
2. Write two possible definitions for the operating system.

← Look Back

To the previous chapter.

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The discussions so far are points which would apply to any computer system. We shall now study computer systems which operate in a specific way.

Batch processing OS

Before the advent of the microcomputer the majority of computer usage was batch processing. A program would be loaded together with the data which the program would process and the printed output produced.

Key features

Characteristics of any batch processing system are given here.

- ✓ All aspects of the processing occur as a 'batch'
 - The data is collected and entered as a batch
 - The data is all processed at the same time (i.e. as a batch)
 - The output is also produced as a single 'batch' of documents.
- ✓ This may result in an acceptable time delay between the data entry stage and final production of the output
- ✓ The 'job' once started will run to completion without any interaction from the user.

Progress Check 2.2

A college operates a payroll program for the payment of all monthly paid staff. Staff must submit a form showing their hours worked before the 14th of each month. The data from these forms is keyed in and saved a batch. The payroll program is run on the 25th of each month and the payslips are posted to employees the following day.

Does this application meet all the key points bulleted above?

Real-time OS

Real-time processing is the exact opposite of batch processing. Whereas with batch the nature of the application means there is an acceptable time delay between inputs and outputs, for a real-time application the processing must occur almost instantaneously.

Applications which require a real-time OS therefore are process control type applications.

Key features

Characteristics of real-time processing are:

- ✓ there is a continuous cycle of input-processing-output called a *feedback loop*
- ✓ the inputs may not be sequential in nature
- ✓ the nature of the output(s) will affect the next input
- ✓ events (and so inputs) may occur in parallel and at intermittent intervals.

Progress Check 2.3

A large greenhouse is temperature controlled. The inputs come from a number of temperature sensors. Each sensor sends temperature readings back to the computer (for example) every 1/100 th of a second. The computer processes these readings and will, if required, send signals to a set of motors which control the opening and closing of the windows. This continuous cycle of input-processing-output maintains a constant temperature inside the greenhouse.

Does this application meet the bullet pointed requirements for a real-time operating system?

Transaction processing

Some computer applications require the processing and outputs to take place quickly but on a time scale of seconds (rather than fractions of a second as with our greenhouse application).

Consider purchasing concert tickets from a ticketing agency. Once a reservation is made for tickets, the reservation data must be brought up-to-date immediately as each new reservation transaction is completed. If not, the likely outcome will be a 'double booking'. Modern websites will often 'reserve' the selection made by the user for around two minutes, to give the user sufficient time to make payment for the tickets selected.

Single-user – Multi-user OS

A stand-alone microcomputer system will require a single-user operating system. This is clouded by the

ability to create different user profiles for use on the same computer, but when the computer system is in use it is always a single-user system.

Multi-user means the computer system can be concurrently used by several users.

Progress Check 2.4

A small office environment may require that all users have access to a central database of data for order processing etc.

Could you describe another computer application which would require multi-user access?

Network OS

Each computer on the network will have its resident operating system software. Communication across the network is provided for with another layer of software called the network operating system.

Tasks for the network OS include:

- ✓ control of access to the network (user IDs and passwords)
- ✓ management of all available resources (for example, a printer)
- ✓ management of all users' data files.

Multiprogramming

When using a stand-alone computer we almost take for granted that we can have several programs concurrently loaded. Strictly we should use the term '*process*'. For example, there may be two copies of the word processor program loaded and the OS will treat each of these as a separate process. However, remember that there is only one processor and so – although there are several programs loaded into the main memory – the processor is only ever actually processing one of the processes at any one time.

Multiprogramming is the ability to have more than one program concurrently loaded in main memory.

- ◆ For the Windows operating system we can see the loaded programs sitting on the taskbar.
- ◆ Running the 'Task Manager' utility will display the list of processes loaded.

Don't confuse

- ◆ Multi-tasking
- ◆ Multi-processing
- ◆ Multiprogramming



Note

Some of the OS classification descriptions are not mutually exclusive.

A multi-user operating system is likely to be provided for by on a network; the operating system therefore provides both network and multi-user usage.

2.2 User interfaces

We have already stated that it is a key role of the operating system to provide the user of the computer system with an interface through which the computer hardware is made usable.

Forms based interface

Many applications are web-based and require the completion of a form for data capture. The screen shows the entry of the data for ordering a pair of spectacles on-line. The form will contain the usual 'widget' controls for data entry including:

- ✓ text boxes
- ✓ radio buttons
- ✓ check boxes
- ✓ drop-down lists.

- ◆ Why does drop-down list help with data validation?
- ◆ Note the fields marked with the star must be entered – a form of validation.

Progress Check 2.5

Do you know where it would be appropriate to use check boxes (usually square) or radio buttons?

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* marks a required field

New customers

* Title:

* First name:

* Surname:

* Email address:

* Telephone no.

We will email you to confirm your order and let you know when we've dispatched your glasses.

Ideally a mobile - this is often the quickest and easiest way of getting in touch if there's something we need to ask you - means less delay

Billing address

* Post code:

Figure 2.1

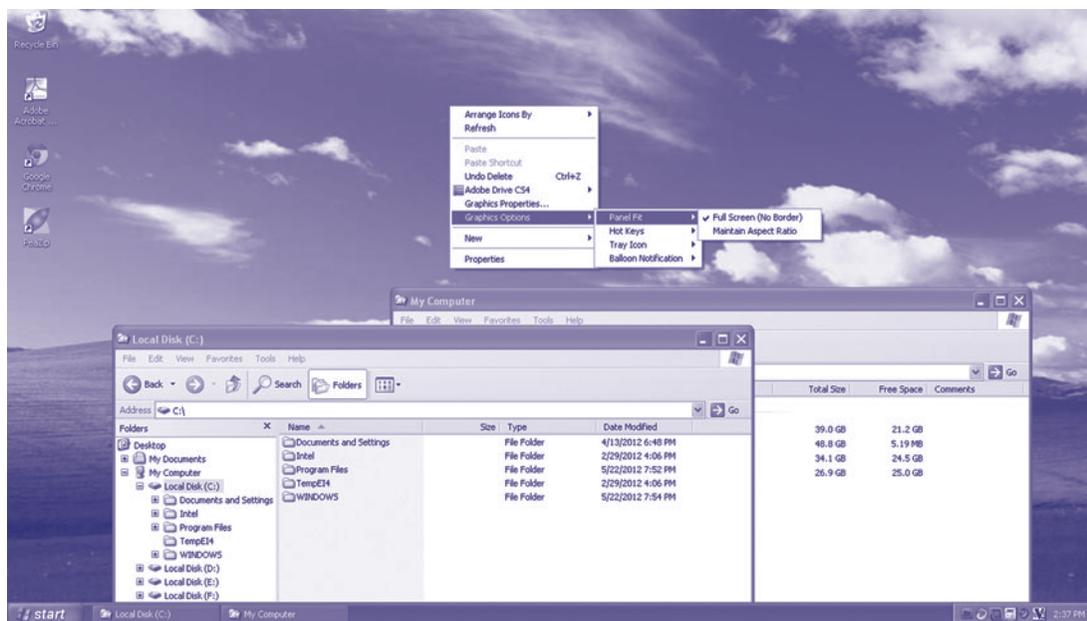


Figure 2.2

Graphical User Interface (GUI)

A GUI uses:

- ✓ windows (This means a 'program window' and not the Windows operating system)
- ✓ icons
- ✓ menus
- ✓ pointing device (for example, a mouse).

Hence a graphical user interface is called a 'WIMP' interface. This screen illustrates all these points. The Windows Explorer program uses multi-level menus (see screenshot). The desktop and taskbar has *icons* to represent various programs.

A more recent trend is to organise the menu selections using ribbons and tabs. This is illustrated with the Articulate Quizmaker software (Figure 2.3).