

Chapter 1

Types and Components of computer systems

Hardware and Software:

A computer system consists of Hardware and Software

Hard ware: The physical components of a computer system.

Internal Components:

Central Processing Unit (CPU), processor, motherboard.

Internal memory: Random access memory (RAM), read-only memory (ROM),

Hardware Components: Graphics card, video cards, sound cards and internal hard disk drives

External Hardware devices and peripherals:

Input and output devices like monitors, keyboards, mice and printers

External storage devices like CD and DVD drives, external hard drives and pen drives

Software: Programs for controlling the operation of a computer or processing of electronic data

There are two types of software:

Application Software:

Provides services that the user requires to perform a task

e.g. word processing, spreadsheet, database management systems, control software, measuring software, applets and apps, photo-editing software, video-editing software, graphics editing, audio editing, CAD.

System Software:

Provides the services that the computer requires to operate.

e.g. compilers, linkers, device drivers, operating systems and utilities

Analogue and digital data:

Analogue Data

- Data that is continuous
- Can take infinite values
- e.g. Temperature, Pressure

Digital Data

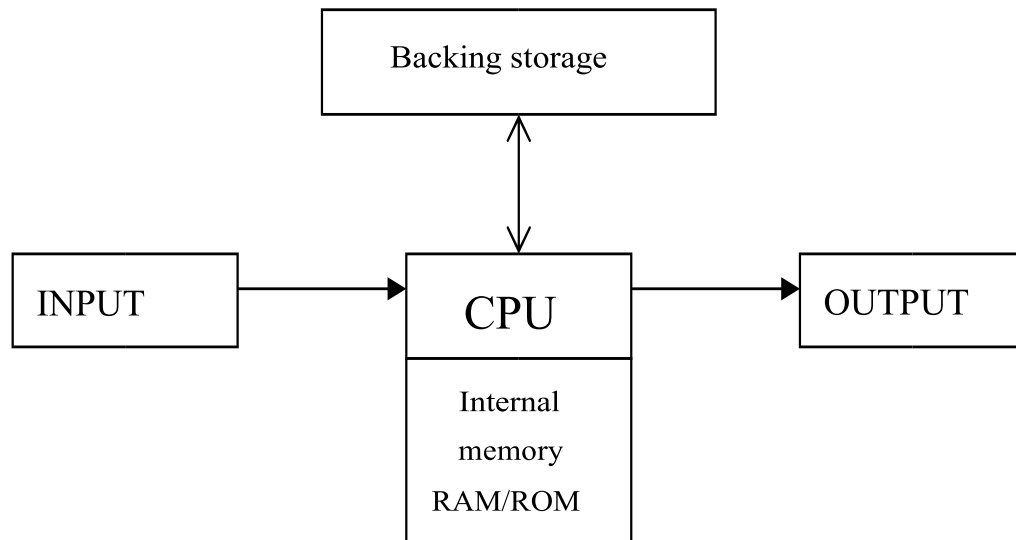
- Discrete data
- Can only be 0 or 1
- e.g. Computer data

Analogue data needs conversion to digital data to be processed by a computer (ADC)

Digital data needs to be converted to analogue so it can be used to control devices (DAC)

The main components of computer systems

The following figure shows the components of a computer system:



CPU: Central processing unit:

Processes instructions entered into the computer in order to produce output

CPUs nowadays are single chips also called Microprocessors.

Internal memory (RAM/ROM)

Is the memory immediately accessed by the processor, it includes RAM and ROM

RAM is random access memory, where all programs and data are temporarily stored, but it is volatile (loses data when computer is switched off)

ROM is read only memory, this part cannot be deleted or changed, it holds instructions needed to start up computer (System BIOS)

RAM	ROM
Random Access Memory	Read only memory
Volatile	Non-volatile
Contents can be changed	Contents cannot be changed
Stores data temporarily	Stores data permanently
Can be written to or read from	Can only be read from
Stores data and programs in current use	Stores start-up instructions, System BIOS

Input Devices:

Are devices used to send data to the microprocessor,

Output Devices:

Are devices used to display or deliver data from the microprocessor,

Backing Storage Devices:

Are devices used to store data permanently or semi-permanently They are used to:

- Keep data for later use
- Transfer files and programs between computers
- Store parts of programs larger than RAM capacity
- e.g. Hard Disk Drives, CD/DVD drives, Pen drives , magnetic tapes, ..

Internal memory	Backing storage
RAM contents are lost when computer is powered down; ROM contents are readable only.	Backing storage devices hold their contents permanently, even when powered down.
RAM and ROM are much smaller memories than backing storage.	Have considerably larger capacity to store data than RAM or ROM.
Data access time on RAM and ROM is extremely fast.	Has much slower data access time than RAM and ROM.
Much more expensive per byte than backing storage devices.	Is much cheaper per byte than RAM or ROM.
RAM and ROM are fixed inside the computer (internal memories).	Backing storage can either be fixed (external or internal) or it can be removable.
RAM and ROM can be read directly by the CPU.	Before data on a backing storage device can be read by the CPU, it must first be moved into RAM; this means backing storage is not directly addressable by the CPU.

Operating systems (OS)

The operating system (OS) is essentially software running in the background of a computer system. It manages many of the basic functions.

The general tasks for a typical operating system include:

- control of the operation of the input, output and backing storage devices
- supervising the loading, running and storage of applications programs
- dealing with errors that occur in application programs
- maintaining security of the whole computer system
- maintaining a computer log (which details computer usage)
- allowing communication between user and the computer system (userinterface).

Types of User Interface:

- command line interface (CLI)
- graphical user interface (GUI)
- dialogue-based user interface
- gesture-based user interface.

Command Line Interface (CLI):

- User has to type commands to perform any task
- User has to learn command syntax
- User has to memorize commands
- Commands cannot be edited once entered
- Requires a keyboard as an input device

Advantages:

- Occupies less memory
- Faster response
- User has access to all computer resources

Disadvantages:

- Requires typing which is slow and prone to errors
- User needs to learn and memorise commands
- Commands cannot be edited once entered
- Needs an experienced user

Graphical User Interface (GUI):

- Creates a WIMP environment, Windows, icons Menu and pointer
- User can make selections from menus or icons using a pointing device
- Programs are displayed in windows to allow multitasking
- Icons are displayed on screen as shortcuts to open programs and files
- Menus display available options for user to select

Advantages:

- No need to learn or memorise commands
- User can make selections from icons and menus rather than typing
- Suitable for beginners
- More user friendly
- Can make use of touch screens, mice or any pointing device

Disadvantages:

- Occupies more memory
- User is restricted to available icons and menus
- Slower to execute commands

Dialogue based Interface

use the human voice to give commands to a computer system.

Examples:

- In modern cars where voice is used to control entertainment system or satellite navigation
- In homes, voice commands are used to switch lights on/off or operate electronic equipment
- Apple Siri or Microsoft Cortana which act as personal assistants

Advantages:

- No need for a driver to take their hands off the steering wheel
- Useful for people with disabilities at home
- Can be used as a security feature applying voice recognition

Disadvantages:

- Still unreliable as many commands cannot be recognised
- May need to repeat command many times if there is noise
- May be complex to setup
- User need to know what commands are used

Gesture Based Interface

- relies on human interaction by the moving of hands, head or even the feet.
- allows humans to interface with a computer in a more natural fashion without the need for any mechanical devices.
- User techniques known as computer vision and image processing.

Examples:

- In cars, rotating a finger clockwise near the radio will increase the sound volume
- Opening the thumb and next finger will change the track being listened to in a playlist
- Moving the foot under the rear bumper of the car automatically opens the boot lid
- moving a hand near a window switch automatically opens a window.

Advantages:

- replaces mechanical input devices
- no physical contact required
- very natural for a human
- no training needed

Disadvantages:

- can pick unintentional movement
- only work near a camera or sensor (maximum 1.5 meters)
- may only accept limited number of movements

Types of computers

PC or Desktop computer:

A general purpose computer made up of separate monitor, keyboard, mouse and processor unit. PCs can be used as stand alone computers or connected in a LAN.



Advantages:

- Less expensive than a laptop
- Can be easily upgraded by replacing individual components
- Less risk of overheating due to large size of case
- Tends to have better specifications for a given price
- Less prone to stealing, loss or damage as they are in one location
- More stable internet access as it can use a wired connection

Disadvantages:

- Cannot be carried around easily
- Occupies large physical space, has a large footprint
- Uses:
- Office and business work
- Educational use
- Gaming and entertainment



Mobile Computers:

- Laptop
- Smartphone
- Tablet
- Phablet

Laptop:

A laptop is a computer where all devices are altogether in a single unit. This makes it extremely portable.

Advantages:

- Easily carried around
- Takes up less physical space, smaller footprint
- Can be easily connected to a WLAN using WiFi technology
- Can be used if electricity is cut using its charged battery
- No trailing wires

Disadvantages:

- Can be easily stolen
- Can be easily damaged
- Needs charging from time to time
- Heat dissipation is more difficult
- Difficult to upgrade

Uses:

- Office and business work
- Educational use
- Gaming device and entertainment
- Control and monitoring purposes

Smart Phones:

A smart phone is a mobile phone with an advanced mobile operating system which combines features of a personal computer operating system with other features useful for mobile or handheld use



Advantages:

- Small and lightweight so easier to carry
- Contains a SIM card, so can make phone calls and connect to 3G/4G internet
- Easier to use on the move
- Have with you all the time
- Can browse internet from anywhere
- They have apps that make use of sensors, for instance location on maps
- Have reasonable battery life compared to laptops

Disadvantages:

- Small screens and keyboards make pages difficult to read
- Slower and more difficult typing
- Web browsing may drain battery quicker
- Smaller memory and storage
- Websites don't have full features
- Easier to be stolen or damaged

Tablet computers:

commonly shortened to tablet, is a mobile computer with a touch screen display, circuitry and battery in a single device



Advantages:

- More portable than a laptop
- Very fast to switch on
- Fully portable
- Can use several apps as standard (camera, MP3 players,...)
- Not much heat as they use SSD
- Battery life longer than laptop battery

Disadvantages:

- More expensive than laptops
- Less memory and storage than laptops
- Typing on a touch screen may be slow and error prone
- Laptops support more file formats

Phablets:

Some of the latest smart phones are designed as a hybrid between tablets and smartphone, these are called phablets. They have a larger screen than a smartphone and are smaller than a tablet

Uses of smartphones, tablets and phablets:

- Entertainment; streaming og music and videos, gaming
- As a camera or video camera
- Internet use
- Sending and receiving emails
- GPS
- Calendar functions, clock and alarm
- Telephone banking
- VOIP
- Education use
- Remotely controlling devices

Emerging technologies

Artificial intelligence

Machine or application that requires some degree of intelligence

Examples:

- Use of language
- Recognising a person's face
- Analysing data to make future predictions; weather forecast

AI duplicates human tasks which require decision-making and problem-solving skills. Eventually, many tasks presently done by humans will be replaced by robots or computers, which could lead to unemployment. However, the positive side includes improvements in safety and quality of services and products.



Extended Reality:

Refers to real and virtual combined environments

- Augmented Reality (AR)
- Virtual Reality (VR)

AR Features:

- Virtual objects are overlaid onto real world situation
- Real world is enhanced with digital details such as images, text and animation
- User can experience AR world using special goggles or smartphone screen
- User is not isolated from the real world
- Examples: Pokemon go game

VR Features:

- Takes the user out of the real world environment into a virtual digital environment
- User is fully immersed in a simulated world
- Requires special hardware such as: headsets, head mounted display, tactile gloves, treadmills,joystick....

CHAPTER 2

INPUT & OUTPUT DEVICES

Input Devices and their uses

.Keyboard:

keyboards are available in most PCs and laptops. They are used to type in text as well as perform some tasks.



Advantages:

- Robust
- Suitable for typing text

Disadvantages:

- Human errors may occur during typing
- It is a slow method for data entry
- Difficult to input diagrams
- Continual typing on keyboard may lead to RSI

RSI: (Repetitive strain injury) is a damage in wrist and fingers caused by continual use of the keyboard for long periods.

To minimize the risk of RSI:

- use ergonomic keyboards
- take regular breaks
- regularly exercise fingers
- use wrist rests
- use wrist pads

Numeric keypad:

They are smaller keyboards that can only input numbers and symbols.



Uses:

- ATMs
- PIN pads when using bank cards to pay for goods
- In supermarkets to input quantity sold of goods or for manual input of barcode
- In smart phones

Advantages:

- Occupies less space and can be used for portable devices

Disadvantages:

- May be difficult to use due to small size of buttons
- Difficult to enter text

Pointing Devices:

Mouse

Movements of the mouse control the position of a pointer on the screen. Mouse is also provided by two buttons, one to make selections, the other to display shortcut menu as well as a scroll button to allow moving between pages



Uses:

- Opening, closing or minimizing windows
- Used to drag and drop objects to copy or delete
- Drawing shapes or lines
- Selecting text or images for editing and formatting

Advantages:

- Faster than keyboard in selecting objects
- Occupies small space

Disadvantages:

- Difficult for people with hand or wrist disabilities
- Needs a flat surface

Touch pad

Used in laptops. Pointer is controlled by moving fingers on touchpad

Advantages:

- Does not need a flat surface

Disadvantages:

- More difficult to drag objects than a mouse



Tracker ball

A tracker ball is similar to a mouse, but user has to rotate a ball on top of the device using fingers.

Uses:

- Can replace a mouse
- Suitable for people with disabilities

Advantages:

- Does not need a flat surface
- More accurate positioning of pointer than mouse
- Disabled people find it easier than a mouse

Disadvantages:

- Not supplied with the computer as standard, so more expensive



Remote control

Used to control the operation of other devices remotely by using infrared signals.

Uses:

- Most home entertainment devices such as a television, satellite receiver, DVD player or Air conditioner have remote controls
- Used in industrial applications to remotely control process, stop and start machinery



Advantages:

- Useful for disabled and elder people
- Some processes are dangerous, so it is safer to operate from a distance

Joystick/ Driving wheel:

Uses of a joystick

- Used in video/computer games.
- Used in simulators (for example, flight simulators) to mimic actual controls.

Advantages of a joystick

- Easier than a keyboard to navigate the screen.
- Control is more realistic for some applications than, for example, using a mouse.

Disadvantages of a joystick

- More difficult to control the on-screen pointer than with other devices, such as a mouse.

Uses of a driving wheel

- Used in video/computer games (for example, car racing games).
- Used in simulators (for example, car-driving simulators) to mimic actual vehicle controls.

Advantages of a driving wheel

- Easier than a keyboard or joystick to control steering movements; it is more natural.
- The 'driving experience' is nearer to how an actual steering wheel and other controls operate in real life.

Disadvantages of a driving wheel

- It can be a rather expensive input device compared to mouse or joystick.
- Movements in the steering can be too sensitive, giving an unrealistic 'feel'.
- Unless it is an expensive simulator, feedback to the driving wheel is non-existent.

Touch screen

Touch screens are input devices where fingers are used for selection or pointing to objects as well as entering text.

Uses:

- In tablets and smart phones to replace keyboard and mouse
- Interactive maps in shopping malls
- ATM machines, banks and restaurants
- Tourist information kiosks



Advantages:

- Suitable for outdoor use
- Easier for inexperienced users
- Replaces several devices

Disadvantages:

- Difficult to type text

Scanner

Scanners are used to scan text or pictures from a hard copy into the computer's memory where they can be manipulated in some way (image processing) before being printed.

***Uses:***

- Scan photographs and pictures for use in desktop publishing.
- Scan part of a design to be used with CAM (Computer aided design)

Digital Camera

Digital cameras look like traditional cameras except that they have a flash memory card to store the image instead of a film. The amount of memory taken by a picture depends on its resolution (number of dots which forms the image); the greater the resolution, the better the image.



Special software is needed to edit, store and display pictures on the computer. You can remove things that you did not spot while taking the image.

Uses:

- In tablets and smart phones to capture images to be uploaded and shared on the internet
- To capture photographs of different events to be enhanced and printed
- To capture images for inclusion in articles in newspapers, books or presentations

Advantages:

- Cheaper running cost than traditional camera
- Can edit, share or store images in digital form

Microphone

Sound can be input using a microphone then manipulated. A computer sound card is needed to convert analog sound into digital signals.

***Uses:***

- Input of human speech to be used in presentations, movies or songs
- As voice commands to a computer system
- In speech to text applications to input text without typing
- Used for authentication in voice recognition systems

Advantages:

- No typing or data preparation is needed
- Disabled people can control their equipment using voice commands
- It can be used remotely by telephone

Disadvantages:

- Recognition may be slow
- Unsuitable for noisy places
- Not as accurate as typing

Sensors

A sensor is a device which measures a value (usually a physical quantity) which is continually changing.

e.g. temperature, pressure, humidity, light....



Physical quantities are analog in nature. Computers can only use and understand digital signals. A device called Analog to Digital Converter (ADC) is required to convert analog signals from sensors into digital signals so that it can be received, understood and processed by a digital computer.

Examples of sensors and their uses:

Sensor	Applications
Temperature	Weather stations, central heating system, green house, automatic cooker, washing machine, fire alarm
Pressure	Weather stations, washing machine, burglar alarm system, robotics
Light	Burglar alarm, automatic doors, street light control, green house
Sound	Burglar alarm system
PH	Chemical processes, green house

Advantages:

- More accurate readings
- More frequent readings can be recorded
- Can take measurements at regular intervals
- Measurement is continuous
- System can be automatic which reduces the need for human workers thus less wages

Light pen

Light pens contain sensors that send signals to a computer whenever light changes are detected. The devices only work with CRT monitors

Uses :

- Selecting objects on CRT screens.
- Drawing on screen (for example, with CAD packages)

Advantages

- Greater accuracy than touch screens.
- Small (can be used where space is an issue).
- Easy-to-use technology.

Disadvantages

- Problems with lag when drawing on screen.
- Only works with CRT monitors (at the moment).
- Not that accurate when drawing.
- Rather dated technology.

Direct data entry and associated devices

Magnetic stripe reader

Used to read information on a magnetic stripe found, for example, on the back of bank cards. The stripe contains information about account like account number, sort code or issue and expiry dates.



Uses

- Credit cards at ATMs or EFTPOS (Electronic fund transfer at point of sale) terminals
- Security cards for entrance of buildings or hotel rooms

Advantages

- Faster method of data entry
- No human errors

Disadvantages

- Information may be affected by magnetic fields
- Magnetic stripes may be scratched

Applications of magnetic stripe readers:

ATM

Advantages

To the customer

- 24 hrs/7days a week service.
- Machines are found everywhere.
- No long queues like inside the bank.

To the bank

- Extra service without extra wages.
- Less work load inside the bank.

Disadvantages

- Machines are sometimes empty.
- Limited amount of cash can be withdrawn per withdrawal.
- Limited amount of transactions can be performed per day.
- Some services are not available. Ex. loans, opening or closing accounts

Information stored on the magnetic stripe of a credit card:

- account number
- bank sort code
- card number
- issue date
- expiry date



The machine performs the following checks on the card:

- if account exists or not
- if card is valid or not
- if card is expired or not
- if card is reported as stolen or not
- PIN code entered by user is correct
- sufficient funds in account

Steps of withdrawing money from an ATM:

1. Insert the card into the card reader.
2. The machine checks if card is valid.
3. Machine connects to bank's computer and opens user's account.
4. Machine checks if card is reported as stolen or not.
5. Machine asks user to input his PIN, and compares it with PIN in account.
6. Machine asks user to select the required service and the amount of money to be withdrawn.
7. Machine checks account for sufficient funds, then releases money.
8. Amount of money is deducted from customer's account.

Electronic fund transfer at point of sale (EFTPOS):

The ability to pay for goods electronically using credit or debit cards.

Steps of paying for goods using a magnetic stripe bank card:

1. Credit/debit card is inserted into magnetic stripe reader
2. Card is checked for validity
3. Machine connects to bank's computer
4. Account is checked for sufficient funds for the receipt's total
5. If card is accepted, receipt's total is deducted from customer's account

6. Then added into shop's account
7. A receipt is printed out to be signed by customer

Contactless debit card readers

Contactless debit or credit cards allow customers to pay for items worth up to a certain amount of money without entering their PIN. All contactless cards have a small chip that emits radio waves embedded in them. The card is held within a few centimetres of the payment terminal to pay for an item; the terminal picks up the signal from the chip and allows the transaction to be processed.

The steps taken are:

1. Customers look out for the contactless symbol on the payment terminal.
2. The shop assistant enters the amount for payment.
3. The card reader informs the customer to present their contactless card.
4. The customer holds their card close to the front of the card reader.
5. The terminal display will indicate that the card has been read successfully.

Advantages of using contactless cards

- Faster transactions
- The contactless card system uses 128-bit encryption systems to protect the data.
- Customers do not have to worry about typing errors (such as incorrectly typing in a PIN).
- The chip in the contactless credit card responds to the payment terminal reader with a unique number used for that transaction only; it does not simply transmit the consumer's account number; this number is also encrypted.

Disadvantages of using contactless cards:

- They are more expensive than normal credit/debit cards.
- Can take money twice if the customer uses it as a chip and PIN card (one is contactless and the other is chip and PIN).
- Transactions are usually limited to a small maximum value (for example, \$50).
- Transactions have been carried out, in some countries, without the card holder being aware of this while they were just standing in the payment queue (although it should be pointed out that this is much rarer today with new technologies in most countries).

Chip and PIN readers

Chip and PIN readers are similar to smart card readers but are used at EFTPOS terminals. The device has a slot into which the card is placed and the chip is read; the PIN is entered using the keypad. The reader also has a small screen which gives instructions to the operator. They are similar to the contactless system, except for two points:

1. The customer has to key in their PIN to make a transaction.
2. These cards do not make use of radio frequency technology.

Advantages of chip and Pin technology over magnetic stripes:

- Chips are more robust than magnetic stripes
- Chips cannot be hacked as easy as a magnetic stripe
- Takes less time at the supermarket's checkout
- Chips can store more information than magnetic stripes
- Adds to the security level by checking PIN at EFTPOS



Steps of withdrawing money from an ATM using a chip card:

1. Card inserted into ATM machine
2. Machine checks card validity
3. User types in PIN
4. Machine compares Pin with Pin stored on chip
5. If identical, user selects required service
6. User types in amount of money
7. Machine contacts bank's computer and checks for sufficient funds in account
8. Money released, and deducted from account
9. Receipt is printed on request

Steps of paying for goods using a chip card (EFTPOS):

10. Card inserted into reader
11. Machine checks card validity
12. User types PIN using PIN pad
13. Pin is checked against PIN stored in chip
14. If identical, machine contacts bank's computer
15. Account is looked up
16. Card is checked if reported as stolen
17. Account is checked for sufficient funds
18. Money is deducted from customer's account and added to shop's account
19. Receipt is printed out; 2 copies

Radio Frequency Identification (RFID) readers

These are types of devices that use electromagnetic fields to transfer data. RFID readers can identify and input data from tags attached to objects remotely.

A tag is an integrated circuit which contains an aerial which receives and transmits data

Uses:

- In many industries, for example an RFID tag is attached to a car during production to track its progress through the assembly line
- Tracking of goods
- Tracking of persons and animals
- Toll collection and contactless payment
- Machine readable travel documents (passports)
- Airport baggage tracking logistics

Example;

A passenger places his passport against the RFID reader, he stands in front of a scanner or a fingerprint scanner, his facial characteristics/fingerprints are compared with those stored on the RFID chip

Advantages:

- RFID readers input data from a long distance
- Can input or identify different items simultaneously
- Takes less time to input data
- No need to be in line of contact

Disadvantages:

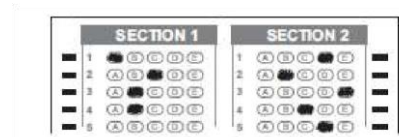
- Tags and readers are expensive
- Errors may occur due to detection of different RFID

Optical Mark Reader (OMR)

Optical mark readers are able to sense marks made on special forms. A light beam is directed to the document's surface, and the reflection is sensed. When a mark passes under the beam, less light is reflected and the mark is detected.

Uses:

- For multiple choice examination papers correction.
- For data collected in the field by research workers.
- For school registers



Advantages:

- Reads huge amounts of data in a small time.
- Minimum errors.

Disadvantages:

- Documents are difficult to design.
- Documents are complicated to fill.

Optical character reader (OCR)

Are scanners, with special software to scan the image of a page of text and recognize each of the characters separately, so they may be altered using a word processor. Scanners often have OCR software.

Uses:

- It is useful for turnaround documents, where some characters are printed by the computer and others are added later by hand.
- Used to scan handwritten text to be neatly printed

Advantages:

- Reads different types of fonts, even hand written characters.
- Quicker than typing
- Design of forms is less complicated.

Disadvantages:

- High rejection rate if document is smeared or handwritten.

Bar code reader

A bar code is a set of parallel lines of different thickness used to represent a number. Often the number represented by the bar code is written below (to be input through the keyboard if the reader fails to input the barcode). When a bar code is used to identify a product, it may contain the country of origin code, the manufacturer code, an item code and a check digit.

***Uses:***

- In point of sale terminals in supermarkets. (Bar codes are printed on goods to identify them)
- Library systems. (ISBN of books is represented by a bar code)
- Warehouse stock control. (on labels on the shelves)
- Luggage handling systems at airports

Advantages of EPOS (Electronic Point of Sale):***To the customer***

- No typing of prices so less time and eliminates wrong pricing.
- An itemized receipt is obtained.

***To the supermarket***

- No stealing by cashiers.
- Better customer service.
- Super market will never run out of stock.
- Full stock control is held.
- Changing of prices is easier, as well as making special offers.

Disadvantages:

- Barcodes are not suitable for recording prices, or any changeable information.
- Can only be read by machines.
- Only numbers can be coded in this way.

Steps of processing when an item is sold in a supermarket (EPOS)

- 1- Barcode of product is scanned by a barcode reader.
- 2- Check digit is performed to validate barcode.
- 3- Computer compares barcode with barcodes in products file.
- 4- Until a match is found.
- 4- Price and description of matching record are sent to receipt.
- 5- Price is added to receipt's total.
- 6- Amount in stock of matching record is reduced by 1 (or by quantity sold)
- 8- New amount in stock is compared with reorder level.
- 7- If higher nothing happens.
- 8- If less or equal, produce order.
- 9- New amount in stock is written back to record.

QR Code Scanner

Another type of barcode is the quick response (QR) code. This is made up of a matrix of filled-in dark squares on a light background. For example, the QR code in the figure is a website advertising rock music merchandise. It includes a web address in the code. QR codes can hold considerably more information than barcodes.



The three large squares at the corners of the code function as a form of alignment; the remaining small corner square is used to ensure the correct size and correct angle of the camera shot when the QR code is read.

Because of modern smartphones and tablets, which allow internet access on the move, QR codes can be scanned anywhere. This gives rise to a number of uses:

- advertising products (for example, the QR code in Figure 2.26)
- giving automatic access to a website or contact telephone number
- storing boarding passes electronically at airports and train stations

By using the built-in camera on a mobile smartphone or tablet and by downloading a QR app (application), it is possible to read QR codes on the move

Advantages

- They can hold much more information than normal barcode.
- There will be fewer errors than with barcodes; the higher data capacity of the QR code allows the use of built-in error-checking systems
- QR codes are easier to read; they do not need expensive laser or LED (light emitting diode) scanners like barcodes – they can be read by the cameras used on smartphones and tablets.
- It is easy to transmit QR codes either as text messages or images.
- It is also possible to encrypt QR codes, which gives them greater protection than traditional barcodes.

Disadvantages of QR codes

- More than one QR format is available.
- QR codes can be used to transmit malicious codes; known as attagging.

Output Devices

Monitors

CRT monitors

Uses:

- They are only used in computer-aided design (CAD); the screens are usually very large to enable complex diagrams to be created or modified.
- They are used with light pens to allow designs to be created on screen.



Advantages

- The screen can be clearly seen at a wider range of viewing angles than with most LCD monitors.
- They allow the use of light pens in, for example, CAD/CAM applications.

Disadvantages

- Heavy
- Have a large footprint
- Run very hot
- Consume considerably more power than LCD monitors.
- They can flicker, which can lead to headaches and eyesight problems with prolonged use.

TFT/LCD/LED monitors

LCD monitors are taking over CRT

Uses

- Used as the main output device for most modern computers.
- Many LCD screens offer touch-screen input.
- Mobile phones, tablets, laptops and portable video games all use LCD screens.



Advantages

- Very efficient, low power consumption.
- Lightweight devices.
- Screens can be made in large variation of sizes.
- Do not suffer from a flickering image, unlike CRT monitors.
- Very sharp image resolution (allow a vast range of colours).
- Produce low electromagnetic fields compared to CRT monitors.

Disadvantages

- Colour and contrast from various viewing angles can be inconsistent.
- Lower contrast than CRT monitors, because it is harder to produce a deep, rich level of black.
- The LCD panel may not be uniformly illuminated by the back light, resulting in uneven intensity and shading over the screen.

Multimedia projector

used to display multimedia presentations on a board or a screen on the wall, it is also used for home cinema devices when used with a DVD player.



Uses

- For training presentations
- Advertising presentations
- Home cinema systems

Advantages:

- Enables many people to see the same view

Disadvantages:

- Images may be fuzzy
- Expensive to buy

Laser printers

Laser printers offer the best quality of printing of text, together with high printing speed. They use toner cartridges which contain a fine powdered black plastic called toner. They print page by page.



Uses:

- Laser printers are used when a large amount of printing is to be produced with high quality.

Advantages:

- High quality of text printing
- Fast printing
- Silent
- Large paper tray and large toner size make it suitable for high volume printing

Disadvantages:

- Expensive to buy
- Expensive to repair or maintain
- Cannot use multipart or continuous stationary
- Cannot be used in difficult weather conditions(dirt, dust or hot and moist weather)
- Coloured laser printers are expensive to run
- They produce ozone and volatile organic compounds because of their method of printing and type of toner/ink used (these have been linked to health hazards in the office).

Inkjet printers:

They can print high quality text and graphics, almost compared to that produced by laser printers. Ink-jet printers are cheap to buy but expensive to run.

Inkjets can print in colours.

Uses:

- They can print high quality coloured images and pictures
- Used for high quality low volume colour printing in homes, schools or small business

Advantages:

- High quality of printing
- Produces photo quality
- Cheap to buy
- Can print in colour

Disadvantages:

- Noisy
- Slow printing
- Cannot work in difficult weather conditions
- Needs frequent replacement of ink
- Expensive to run

Dot matrix printers

They are impact printers, they tend to be slow, noisy and output is of low quality, but they are useful where multipart or continuous stationery is used

Uses:

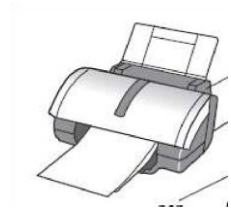
- In noisy environment (e.g. garage workshops)
- When print quality is not very important
- Where carbon copies are needed

Advantages:

- Can be used in dusty,dirty or moist environment
- Carbon copies can be produced
- Very cheap to run or maintain
- Can use continuous stationery

Disadvantages:

- Noisy
- Very slow
- Poor quality of printing
- Expensive to buy



Graph plotter:

These are printers capable of producing large sizes of printouts.

Uses:

- Produce CAD designs of buildings
- Produce posters and advertising material
- Produce signs and maps

Advantages:

- Can produce huge printouts
- High print quality
- Can use continuous stationary

Disadvantages:

- Expensive to run or maintain
- Occupies large physical space



3D printers

Produce 3D models using modified inkjet technology. Thin layers of fine powder are bonded together as a 3D model is slowly built up (each layer is about 0.25 mm thick).

Uses:

- Produce prototypes of CAD designs
- Scale models are produced in colour before real thing is manufactured
- Produce organic objects such as replacements of human organs

Advantages:

- Cheaper and faster to produce prototypes
- Powder used can often be grounded up and reused
- Produce accurate models of the real thing

Disadvantages:

- Expensive to buy
- End product can sometimes be rough and needs further work to be done on it
- Slower than other types of printers

Speakers

Uses:

- Small hand-held devices which produce synthesized speech which makes learning more interesting and help in translation of foreign languages
- Emergency messages in cars like: "You are running out of petrol", in a washing machine like: "I'm overloaded"
- Text-to-speech translation (reading machines) for blind people
- To output voice of participants in video conferences
- To listen to music files and videos
- As an output device in phones



Actuators:

Uses

- They are used to control motors, pumps, switches, buzzers and so on.
- They allow a computer to control physical devices that normally require analogue inputs.

Advantages

- They allow remote operation of many devices (for example, pumps in a nuclear reactor where remote operation is a big safety factor).
- They are relatively inexpensive devices.

Disadvantages

- They are an additional device in the system that could go wrong.
- Because they are usually analogue devices, computer signals need to be converted using a DAC to enable computer control.

Chapter 3

Storage Devices and Media

Storage media and devices:

It is important to use the terms "medium" and "device" carefully.

A medium is where data is stored while a device is the hardware used to read and write data into the storage medium.

Magnetic Backing storage Media and Devices:

Fixed Hard Disk Drives:

A fixed hard disk is used in PCs and laptops. It is an internal storage device. It is used to store the operating system as well as the entire library of programs and data used within a computer system.



Advantages:

- Cheaper per unit storage than main memory and solid state drives
- Have a large storage capacity (up to terabytes)
- Have fast speed of access
- Have direct access
- Hard disks are robust

Disadvantages:

- More expensive per unit storage than magnetic tape
- Can be affected by magnetic fields
- Less reliable than SSD as it has moving parts

Portable Hard Disk Drives:

External hard drives that can be connected to the computer through a USB port, and can be used to move large size files and programs between computers.



Advantages:

- Does not need a device to read and write data
- High storage capacity
- Fast rates of data transfer
- Fast access to data
- Portable

Disadvantages:

- Expensive per unit of storage
- Larger size than other media

Magnetic Tape Drives:

Are devices that can store data on tapes similar to those used for audio and video recording, but data on them can only be accessed serially.

Uses:

- In batch processing applications (e.g. utility bills production)
- For backups of network servers

Advantages:

- Tapes are cheaper per unit of storage
- Tapes are more compact than a portable hard disk for the same memory
- Tapes are less prone to data loss and mechanical failure
- High storage capacity
- Fast data transfer rates

Disadvantages:

- Tape drives are not available in most computers
- Cannot use direct access
- Slow rates of data access



Optical Backing storage Media and Devices:

In these types of drives data is stored in the form of burnt pits on the disk surface; these pits are burned by a laser beam, which can scan the disk also to read the data

CD-ROM and DVD-ROM:

Are read only memory, which means they cannot be written over and can only be read.

Uses:

- CD-ROMs are used by manufacturers to store music files, computer games and encyclopedias
- DVD-ROMs have much larger capacity and are used to store films, software and games

Advantages:

- Cheaper method to distribute software and data
- Contents cannot be changed
- Portable

Disadvantages:

- Slow data access rates
- Slow data transfer rates
- Can be easily scratched or broken
- Needs an optical drive



CD-R and DVD-R:

Recordable CDs and DVDs where data can be written to the disk only once and cannot be changed anymore.

Uses:

- Home recording of music files and films
- To store data which will not be changed anymore (photos, coursework,...)
- To transfer files and software between computers

Advantages:

- Cheaper than rewritable disks
- No risk of changing or deleting important data

Disadvantages:

- Unsuitable for changing information

CD-RW and DVD-RW:

RW stands for re-writable, so this type of disks can be written over several times.

Uses:

- To record radio and television programs
- For backups of data
- To transfer files between computers
- In CCTV security systems

Advantages:

- Can be re-used many times

Disadvantages:

- It is possible to accidentally overwrite data

Blu Ray:

- Blu-Ray disks have the largest capacity of all optical media and go up to 100 GB.

Uses:

- The main use of blu rays is in home video game consoles
- For high definition movies
- To store films in video cameras

Advantages:

- Large storage capacity(25 GB,50 GB,100 GB)
- High rates of data transfer
- High access speeds of data

Disadvantages:

- They are relatively expensive



Solid State Storage Devices:

Solid state technology has been developed to the point where solid state drives will soon replace hard disk drives in laptops. This is due to their thinness, their much faster data access and the fact that they are extremely robust.

Pen Drives/ Memory Sticks:

Pen drives can store several gigabytes of data, they can be plugged directly to the USB port of a computer. They are extremely small and very portable. No additional hardware or software are needed to read or write data to a memory stick.



Uses:

- Transporting files between computers
- As a backup store
- Used as a security device - a dongle -to prevent software piracy

Advantages:

- Small and light, so can be easily carried
- High storage capacity
- Fast data transfer rates
- Very robust
- No need for a device for reading and writing

Disadvantages:

- Expensive
- Can be easily lost
- Cannot write protect data stored on them

Flash Memory Cards:

Memory cards use the same technology of a memory stick.

Uses:

- To store photos in digital cameras
- In mobile phones
- In MP3 players to store music files



Advantages:

- They are very compact so can be easily removed from a device and inserted into another
- Very robust

Disadvantages:

- Expensive per Gbyte of memory when compared to hard disks

Chapter 4

Networks and the effects of using them

Networks:

A network is a series of computers systems connected together to share computer resources. It may be a wide area network (WAN), a local area network (LAN) or a wireless local area network (WLAN)

Types of Networks:

Local area networks:

LANs are confined to a small area usually within the same building, and sometimes through several buildings in the same site. The link in this case is permanent, it is via cables.

A school network is a LAN.

Wide area networks:

WANs cover a wide geographical area. Computers may be linked together in different countries. The link is temporary; it is through satellites, microwaves or telephone lines.

Internet is a WAN.

Wireless local area networks:

WLANs are local area networks in which the connection between computers is through wireless technology. Wifi Devices known as access points (APs) or wireless nodes, are connected at the wired network at fixed locations.

A wifi network at home is a WLAN

Advantages of a WLAN over a LAN:

- Less use of cables, so cheaper
- Less use of cables, so less risk of tripping on cables
- Portable devices can be easily added to the network
- Covers a smaller area than a cabled LAN
- More difficult security
- Strength of network can be affected by obstacles
- Slower transfer rates

Disadvantages:

Network Devices:

LAN Devices:

Network Interface cards (NIC)

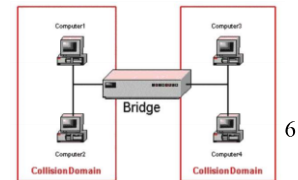
Each computer needs a network card to be connected in a network. It looks like a small circuit board and slots into the mother board. Network cards have connectors on them for network cables.



Device Mac address is determined by their NIC.

Hubs

Connect network devices together in a LAN; hubs broadcasts data to all connected devices.



Switches

Switches are used for connecting computers but unlike hubs, switches inspect the data received and forward it to the appropriate device.

Each device has a media access control (MAC) address that uniquely identifies it. Data packets sent to switches will have a MAC address identifying the source of the data and an additional address identifying each device that should receive it.



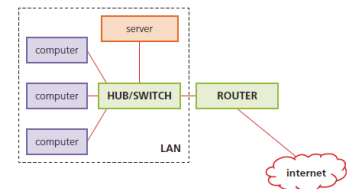
Bridges

Connect two different LAN segments. It passes messages from one segment to the other. For example, if there was a LAN segment in two different buildings, a bridge usually has two ports.

WAN Devices:

Routers:

Routers are used to route data packets from one network to another network, based on IP addresses. It can do this because each router has its own IP address. Routers are used to join a LAN to the internet.



When a data packet is received at one of its ports, the router inspects the IP address and determines whether the data packet is meant for its own network or for another, external network. If the data packet is meant for its own network, then the data packet is routed to the local switch or hub. Otherwise, the data packet is transmitted to a different router (and therefore to an external network). Routers know where to send data packets by consulting a routing table (stored on the router's RAM). The routing table will contain information about the router's immediate network (such as computer addresses) and information about other routers in its immediate vicinity. When a data packet reaches a router, it examines the IP address. Because the routing table contains computer addresses of all the computers/devices on its network, it will be able to work out that the data packet is intended for a computer on its network. Routers however, do not store the MAC addresses of devices (only IP addresses of all computers and devices are stored). The router does not need the MAC address because the data packet will be sent by the router to the switch on the recipient local network. The switch can then use its look-up table to send the data packet to the correct device.

Functions of a router:

- Connects LAN computers to the internet
- Selects the best routes for data packets
- Directs data packets to the correct computer or device in the network
- Allows data transfer between different LANs or between LAN and the internet
- Connects a LAN to a WAN
- Connects several LANs together



WLAN Devices:

Wireless adaptor/wireless access point

A wireless transmitter (WAP) receives information from a network via its connection. This transmitter converts received information into radio waves and transmits them.

A device (e.g. a computer) receives the radio waves via an installed wireless adaptor which allows it download the information from the data source. This works in reverse when the device wishes to transmit data over the network.

WI-FI or Bluetooth technologies are used for wireless connections:

- Bluetooth technology is limited to a short range of metres and generally used to transfer data between mobile devices, smart phones, and computer peripherals like the keyboard, mouse or printer.
- WI-FI technology has a much wider range, able to transfer large amounts of information and used with larger computer networks and devices.

Feature	Bluetooth	Wi-Fi
Transmission frequency used	2.4 GHz	2.4, 3.6, 5.0 GHz
Data transfer rate (maximum)	25 Mbits/second (~3.1 Mbytes/second)	250 Mbits/second (~31 Mbytes/second)
Maximum effective range (metres)	30 metres	100 metres (but can be obstructed by walls, etc. reducing effective range to only a few metres)
Maximum number of devices connected	Up to 7	Depends on the router used (can be one device or many devices)
Type of data transmission security	Key matching encryption	WEP (wireless equivalent privacy) and WPA (Wi-Fi protected access) are the most common security systems)

Cloud Computing:

Cloud storage

Cloud storage is a method of storing data on offsite servers. The same data is stored on more than one server in case of maintenance or repair, allowing clients to access data at any time. This is known as data redundancy.

There are three main types of systems:

- Public cloud: this is a storage environment where the customer/client and cloud storage provider are different companies
- Private cloud: this is a storage provided by a dedicated environment behind a company firewall; customer/client and cloud storage are integrated and act as a single entity
- Hybrid cloud: this is a combination of the two previous environments; some data resides in the private cloud while less sensitive data can be accessed from a public cloud storage provider

Advantages of cloud storage:

- Customer/client files stored in this cloud can be accessed at any time, from any device, anywhere in the world, provided internet access is available
- There is no need for clients to carry external storage devices with them
- The cloud provides the user with remote backup of data
- Cloud storage allows data recovery in case of client's computer failure or data loss
- The cloud storage provides almost unlimited capacity

Disadvantages:

- Security aspects of cloud storage are discussed later
- If the customer has a problem in internet connection, data cannot be accessed
- Costs can be high if a large storage capacity is needed
- The potential failure of the cloud storage company is always possible

Data security using cloud storage/computing

Companies that transfer vast amounts of confidential data to a cloud service provider are potentially losing control of their own data security. This raises a number of questions:

- What physical security exists regarding the building where the data is housed?
- How good is the cloud service provider's resistance to natural disasters or power cuts?
- What safeguards exist regarding personnel who work for the cloud service company? Can they use their authorisation codes to access confidential data for monetary purposes?

Data loss

- There is a risk that important and irreplaceable data could be lost from cloud storage facilities.
- Actions from hackers (gaining access to accounts or phishing attacks, for example) could lead to loss or corruption of data.
- Users need to be certain that sufficient safeguards exist to overcome these potentially very harmful risks.

Common Network Environments:

- Intranet
- Extranet
- Internet

Intranets

An intranet is defined as 'a computer network based on internet technology but designed to meet the internal needs for sharing information within a single organisation or company'. Access to an intranet is usually confined to a company or organisation and, unlike the internet, is not available to the general public. Intranets reside behind a firewall and are only accessible internally to members of the company

There are a number of reasons for adopting intranets rather than using the internet:

- Intranets are safer because there is less chance of external hacking or viruses.
- It is easier to prevent external links to, for example, certain websites.
- Companies can ensure that the information available is specific to their internal audience's needs.
- It is easier to send out sensitive messages in the knowledge that they will remain within the company.

Extranets:

Allow intranets to be extended outside the organisation, but with the same advantages as an intranet; this allows, for example, trading partners to have controlled access to some information (commercially-sensitive information is password protected).

Internet:

The word internet comes from INTERconnected NETwork, because it is basically a worldwide collection of interconnected networks. It relies on a physical infrastructure that allows networks and individual devices to connect to other networks and devices.

In contrast, the World Wide Web (WWW) is only a part of the internet which users can access using web browser software. The World Wide Web consists of a massive collection of web pages, and has been based on the hypertext transfer protocol (http) since 1989.

Differences between the internet and an intranet?

- As discussed, the term internet comes from the phrase: INTERconnected NETwork.
- The term intranet comes from the phrase: INTernal Restricted Access NETwork.
- An intranet is used to give local information relevant to the company or organisation; whereas the internet covers everything.
- It is possible to block out certain websites using the intranet; while this is also possible with the internet, it is more difficult.

Network issues and communication:

Security issues regarding data transfer

Many aspects of security (such as hacking, phishing, pharming and viruses) are covered in depth in Chapter 9.

Passwords

Passwords are used in many instances when accessing the internet and in many cases, a user ID. For example:

- when accessing your email account
- when carrying out online banking
- accessing social networking sites

It is important that passwords are protected. Some ways of doing this are described below:

- Run anti-spyware software to make sure that your passwords are not being relayed back to whoever put the spyware on your computer
- Change passwords on a regular basis in case it has come into the possession of another user illegally or accidentally.
- Passwords should not be easy to crack (e.g. your favourite colour, name of a pet or favourite rock group); passwords are grouped as either strong (hard to crack or guess) or weak (relatively easy to crack or guess).
- Strong passwords should contain:
 - at least one capital letter
 - at least one numerical value
 - at least one other keyboard character (such as @, *, & etc.).
 - An example of a strong password is: Sy12@#TT90kj=0
 - An example of a weak password is: GREEN1

Other authentication methods

Passwords are one of the most common types of authentication (that is, a way of proving your identity). This section will look at a number of other types of authentication:

- zero login
- biometrics
- magnetic stripes
- smart cards
- physical tokens
- electronic tokens.

Zero login and biometrics

- Zero login essentially relies on devices being smart and secure enough to instantly recognise a user by a number of features based on:
 - biometrics
 - behavioural patterns.
- Instead of using passwords, the zero login system builds up a complex user profile based on the above two features.
- Biometrics is already used on many smartphones as a way of logging into the phone using finger prints and recently face recognition.
- Behavioural patterns include: how you walk, your typing speed, your normal location, how you swipe the screen, and so on.
- These behavioural patterns, coupled with biometric data, should be enough to uniquely identify a user, and allow them into a system without actually supplying any passwords or other security information.
- The advantages of zero login are fairly clear:
 - Enhanced security (it is difficult to copy biometrics and behavioural patterns) and an easier and much quicker way to login to a system. But there are certain ***disadvantages*** that need consideration:
 - How do users know when they are being monitored?
 - How do you know if and when you have been logged out?
 - How well protected is it in reality?

Magnetic stripe cards

- The stripe is read by swiping it through a card reader.
- Data such as name, ID number, sex, and date of birth may be contained on a magnetic stripe when used as a security device to allow entry to a building, for example. Access will only be allowed if the scanned data matches data in a database.

Advantages of magnetic stripe cards

- They are easy to use.
- It is not an expensive technology.
- Magnetic cards can be remotely deactivated (if lost or stolen).
- The cards can be multi-purpose (for example, door key cards, network access cards or used in vending machines to buy food or drink).

Disadvantages of magnetic stripe cards

- Less secure than, for example, biometric methods (no encryption is used and the stripe contents can be copied fairly easily).
- The cards wear out with a lot of use.
- Magnetic readers often fail to read the cards on first attempt.

Smart cards

Smart contactless cards (that is, it can be read from a distance and does not have to be swiped through a card reader). The chip on the smart card can store data such as name, security number, sex, date of birth and a PIN. Smart cards can therefore be used as a security device. If the card is in a wallet or a pocket as the owner of the card walks up to a security gate, readers on either side of the gate quickly scan the security data stored on the RFID tag embedded in the card. The user will then be invited to enter a PIN on the keypad. If all details match, then access will be allowed.

Physical tokens

A physical (or hardware) token is a form of authentication in the form of a physical, solid object. The user's interaction with a login system is used to prove that the user has possession of the token. Physical tokens contain internal clocks and when a PIN and other authentication details are entered, then a one-time password (OTP) is generated. The OTP is shown on a small screen. The code changes on a regular basis and is usually only valid for less than a minute.



Electronic tokens

Electronic (software) tokens are software installed on a user's device, such as a smartphone. User opens the app to log in to a website. The app generates a one-time password (OTP) which is valid for less than a minute. The user enters this OTP when prompted by the website, together with some other form of authentication, such as PIN, touch ID or face ID. The website server runs the same software as the app. Because both the server and smartphone have synchronised clocks, they will generate the same numbers. Once the OTP and other form of authentication are verified by the website, the user will be allowed access.

Anti-virus software

Protects devices against a potential virus attack.

Features of anti-virus software

- They check software or files before they are run or loaded on a computer.
- Anti-virus software compares a possible virus against a database of known viruses.
- They carry out heuristic checking – this is the checking of software for types of behaviour that could indicate a possible virus; this is useful if software is infected by a virus not yet on the database.
- Any possible files or programs which are infected are put into quarantine which:
 - allows the virus to be automatically deleted, or
 - allows the user to make the decision about deletion (it is possible that the user knows that the file or program is not infected by a virus – this is known as a false positive and is one of the drawbacks of anti-virus software).
- Anti-virus software needs to be kept up to date because new viruses are constantly being discovered.
- Full system checks need to be carried out once a week, for example, because some viruses lie dormant and would only be picked up by this full system scan.

Electronic conferencing

- video conferencing
- audio conferencing
- web conferencing.

Video conferencing

- Video conferencing is a communication method that uses both video and sound. It is a substitute for face-to-face conferences between a number of people, who may be in a different part of the country or live overseas. It is carried out in real time and makes use of some form of network.
- The basic hardware includes:
 - webcams
 - large monitors/television screens
 - microphones
 - speakers.
- There are a few items to consider when a conference is about to begin:
 - It is essential to agree a time and date for the conference to take place.
 - The delegates in each conference room must log into the video-conference system.
 - The video-conference set-up needs to be checked before the meeting goes live.
 - Webcams need to be placed in the correct position so that all the delegates in the room are within visual contact (the webcams will capture the images and then transmit them to the other delegates – they will see the images on their own large screens).
 - Microphones need to be placed centrally so that all of the delegates can speak – the sound is picked up by the microphones and is transmitted to the other delegates (they hear the voices through speakers in their own conference room).
 - It is important for one person to be the main contact in each conference room to make sure each delegate is able to be heard; this is particularly important if more than two video-conference rooms are linked up at the same time.
- In addition to the hardware items described above, it is also important to realise that software plays an important role in a successful video conference.

Software	Description
Webcam and microphone software drivers	It is vital that the correct software is used to ensure that the webcam and microphone transmit their images and sound to the other delegates (these are sometimes referred to as hardware drivers).
CODEC	CODEC can stand for C oder- DEC oder or C ompression- DEC ompression. The first is used to encode or decode the digital data stream to allow data to be transmitted (encoded) and played back (decoded). The second is used to compress the data before it is transmitted and then decompress it again at the receiving conference room.

Advantages of using video conferencing

- No need to move important documents out of the office.
- It is possible to hold conferences at short notice (a conference date can be set up within a few hours as no person needs to travel very far).
- Not travelling physically to meetings reduces costs:
 - reduced travelling costs
 - no need to pay for hotel accommodation or venue hire

- it also reduces the cost of taking people away from their work for two or three days to travel – people are still paid their wage even though they are not in the office, so this is a large ‘hidden’ cost.
- It may be better to use video conferencing than have delegates travel to potentially unsafe places around the world.
- It is better for the environment – less travel means less pollution.

Disadvantages of using video conferencing

- There is potential time lag in responses/delays when talking.
- Images can jerk – usually due to poor internet/network performance or poor bandwidth.
- It can be very expensive to set up in the first place (both the hardware and the software are expensive to purchase and get set up correctly).
- There can be problems if the delegates live in different countries where the time zone differences are large.
- Training people to use the system correctly can be both costly and time consuming.
 - It can be demotivating for staff if they believe that one of the ‘perks’ of their job is international travel.
 - The whole system relies on a good network connection – if it breaks down or the signal strength is diminished in any way, then the video conference can be almost unusable.

Audio conferencing

Audio conferencing refers to meetings held between people using audio (sound) equipment. It can be done over the standard telephone network.

It is also possible to hold an audio conference using a computer, as long as a microphone and speakers are connected. This makes use of Voice over Internet Protocol (VoIP). It is also possible to connect an internet telephone, which usually plugs into the router or other internet device.

In this case equipment can include:

- a computer (with built-in microphones and speakers)
- external microphone and/or speakers
- an internet phone
- a standard phone.

Web conferencing

Web conferencing (often referred to as a webinar or webcasts) uses the internet to permit conferencing to take place. Multiple computers are used with this system, all connected over the internet. As with video conferencing, it is carried out in real time and allows the following types of meeting to take place:

- business meetings to discuss new ideas
- presentations
- online education or training.

The only requirement is a computer and a high-speed, stable internet connection. To carry out web conferencing, each user either downloads an application or logs on to a website from a link supplied in an email from the conference organiser. Delegates can leave or join the conference as they wish. The organiser can decide on who can speak at any time using the control panel on their computer. If a delegate wishes to speak, they raise a flag next to their name. Delegates can post comments using instant messaging for all delegates to see at any time.

Some of the main features include:

- Slide presentations using presentation software can be posted on the conference website in advance of the meeting.
- The host's computer screen can be shared for live presentations, or other live demonstrations.
- It is possible for any delegate to draw or write on a 'whiteboard' using their own keyboard or mouse.
- It is possible to transmit images or videos using the webcam throughout the conference.
- Documents can be shared by first uploading them to the website before the conference begins.
- As described earlier, it is possible to chat verbally or by using instant messaging throughout the conference.

As indicated earlier, there is cross-over between web conferencing, video conferencing and audio conferencing through the use of webcams and the built in microphone and speakers. It is possible to have a conference using any device which allows these functions (for example, tablets and smartphones would both permit this type of group communication).

CHAPTER 5

DATA

Data gathering, verification, validation and Databases

Data Types:

- Text/ Alphanumeric:
 - May consist of letters, numbers or symbols
 - Cannot be used in calculations
 - Examples: Name, passwords, codes, phone number
- Numeric:
 - Consists of digits, decimal point or +_ signs, can be used in calculations
 - Integer(whole numbers only); number of students, number of subjects, ..
 - Real(has decimals or fractions); temperature, length,..
 - Currency(used for money); price, taxes, wage,...
- Boolean/Logical
 - Data that has only 2 possibilities
 - Yes/No, True/False...
 - Examples: Attendance, Pass/Fail, ..
- Date
 - Any date/time
 - Examples: Date of birth, exam date,...

Data gathering:

Data is collected from users by filling forms, other paper based or screen data entry forms. A good form to collect data is an easy form to fill, with enough space for your data.

Data entry form form design:

To design a good form you should bear in mind:

(These rules should apply to a printed form)

- Consult people who will be using the form
- Has a title to explain its use
- Enough spaces for data items
- Questions follow a logical sequence
- Readable (legible) font size
- Readable colour scheme (contrast between background and font colours)
- Examples or instructions where needed
- Good layout (Information fills the screen with good use of white space)
- Suitable spacing between items to allow easy filling
- Check boxes where appropriate
- A space for user to sign if required

For a screen input form, it should contain the following should be added:

- Use of radio buttons and drop down lists where appropriate
- navigation buttons (buttons to exit, next, previous, ...)
- buttons to submit, save or edit

Data verification and validation:

To minimize transcription errors during input of data, the computer system must include extensive checking procedures to guard against incorrect, missing or duplicate data. Data checks can be broadly classified into verification and validation.

Data verification:

Verification is the user's task; it checks that data entered is what was meant to be entered.

Verification methods:

Double data entry:

Data is entered twice, either by the same user or by different users. Both entries are compared by the computer, if they are identical data is assumed to be correct.

Visual verification:

The operator checks the data on the screen against what they are entering and correct errors they detect.

Data validation:

Checking that data entered is sensible, reasonable and complete. Validation checks that data matches a given rule.

Character/data type checks:

Type checks make sure that the correct type of characters has been entered. It will detect numbers where characters should have been entered and vice versa.

E.g. a phone number is composed of digits; this can be tested by the computer at the input stage and it will only accept digits for the phone number.

Range checks:

Range checks are performed on numbers to make sure they lie within a specified range.

Length checks:

Length checks determine the number of characters in a particular data item.

Lookup list check (also called existence check)

It checks the input data against known values by looking up a record in the files to ensure that the input is valid.

Format check:

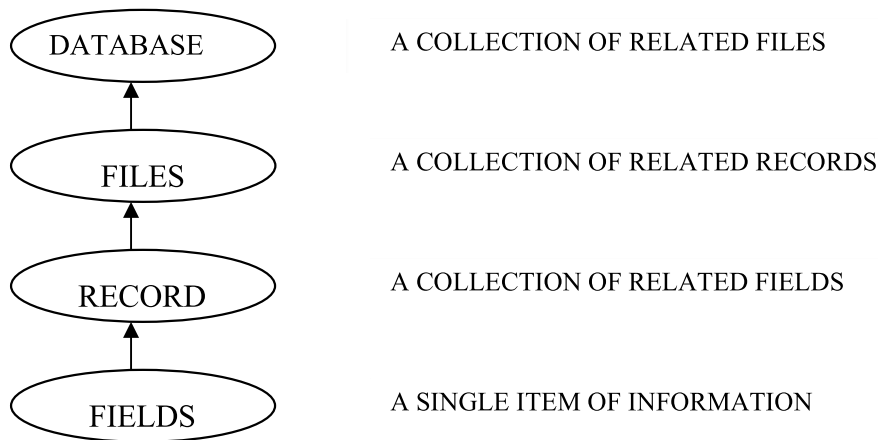
Used when data should follow a given pattern; a centre number should consist of 2 letters followed by 3 digits

Check digit:

It is an extra digit appended to a code number. The digit is generated from the code number itself by applying an algorithm. Each time a code number is input, the computer follows the same steps, calculate the check digit and compares the calculated with the input check digit, if they are equal the code number is accepted.

How data is stored:

Data must be organized in a logical and consistent way if it is to be of use. In computer systems data is organized into the hierarchy shown.



- A Database is a collection of related files.
- A file is an organized collection of related records.
- A record is a collection of related fields.
- A field is a single item of data.

Below is an example of a file:

It has 8 records, and 7 fields.

<i>Field</i>						
Category	Country	Code	Product	Stock	Reorder	Price
Tea	India	272	Singbulli Champagne Oolong	24	50	16
Tea	India	347	Phuguri Supreme	27	50	16
Tea	India	348	Tumsong Supreme	34	50	16
Tea	India	349	Pussimbing Supreme	29	50	16
Tea	India	3	Phuguri F.T.G.F.O.P	223	50	8.5
Tea	India	5	Goomtee F.T.G.F.O.P	379	50	8
Tea	India	6	Risheehat F.T.G.F.O.P	98	50	6.4
Tea	India	7	Makaibari Organic F.T.G.F.O.P	32	50	4.9

← Record

Primary key field:

A primary key field is a single item of data that uniquely identifies each record in a file. It should be different for each record. Key fields are used for locating records in the file.

File/Table Structure:

To design a file some items of information should be specified:

- Field names
- Data types
- Field sizes
- Validation rules (for each field)
- Primary key field
- Data coding to reduce space

Database Structure:

To design a database with all its elements

- File structure
- Data input forms
- Relationships between files
- Passwords
- Encryption of data
- Report design
- Query design

Types of database files:

Flat files:

A flat file is a database that only consists of one table.

Relational databases:

A relational database is a database that consists of several tables related to each other in some form.

Ex. in a supermarket database, there is the products' file and the suppliers' file, in each product's record there is some information about the supplier, this information is the supplier code which relates to the supplier's information in the suppliers' file.

The barcode of the product is the primary key in the products' file and the supplier code is a foreign key. (since it uniquely identifies the supplier but not the product) .

Advantages of a relational database:

- Relational databases occupies less memory space
- No duplication of data
- Updating of data is easier
- Searching takes less time
- Can link data from different tables
- Less errors in data entry as data is entered once

CHAPTER 6

The effects of using IT

Microprocessor-controlled devices in the home

Examples of these devices are automatic washing machines, automatic cookers, air conditioning systems, dish washers, burglar alarm systems, and fire alarm systems

Positive effects:

- Microprocessor controlled devices do much of housework
- Do not need to do many things manually
- Do not need to be in the house when food is cooking
- Do not need to be in the house when clothes are being washed
- Can leave their home to go shopping
- Can work at any time of the day
- Greater social interaction
- More family time
- More time to go out/more leisure time/more time to do other things/work
- Are able to do other leisure activities when convenient to them
- Can encourage a healthy lifestyle because of smart fridges analyzing food constituents
- Microprocessor controlled burglar alarm provides a sense of security Do not have to leave home to get fit

Negative Effects:

- Can lead to unhealthy eating due to dependency on ready meals
- Can lead to laziness/lack of fitness
- Manual household skills are lost

Monitoring and controlling transport

The use of microprocessors in transport systems is becoming more and more widespread. Examples of where they are currently used include:

- monitoring of traffic on motorways
- congestion zone monitoring
- automatic number plate recognition (ANPR)
- automatic control of traffic lights
- air traffic control systems
- railway signalling systems

Advantages:

- smart motor ways adapt to traffic conditions, reducing traffic jams and journey time
- transport systems are more efficient, more vehicles can use the transport system
- traffic offences can be automatically penalised using ANPR
- stolen cars and criminals can be easily spotted
- better to the environment because vehicles will operate more efficiently
- reduced traffic congestion due to the phantom traffic jam
- human errors are minimised which reduces the rate of accidents
- increased lane capacity
- stress free parking
- improves punctuality of trains and planes

Disadvantages:

- system is expensive to setup
- risk of hacking that may cause disruption
- driver and passenger reluctance of the new technology
- system needs to be well maintained all the time
- may lead to unemployment
- passenger behaviour should be acceptable
- if computer system fails (software glitches), the whole transport system could stop
- ANPR systems mean that people's movement can be tracked, who has access to this data?

Potential health problems related to the prolonged use of IT equipment:

Health risk	Causes of health risk	Elimination or reduction of health risk
Back and neck strain	Caused by sitting in front of a computer screen for long periods of time	» Use fully adjustable chairs to give the correct posture » Use foot rests to reduce posture problems » Use tiltable screens, raised to the correct height, to ensure the neck is at the right angle
Repetitive strain injury (RSI)	Damage to fingers and wrists caused by continuous use of a keyboard or repetitive clicking of mouse buttons, for example	» Ensure correct posture is maintained (for example correct angle of arms to the keyboard and mouse) » Make proper use of a wrist rest when using a mouse or keyboard » Take regular breaks (+ exercise) » Make use of ergonomic keyboards » Use voice-activated software if the user is prone to problems using a mouse or keyboard
Eyestrain	Caused by staring at a computer screen for too long or by having incorrect lighting in the room (causing screen reflections)	» If necessary, change screens to LCD if older CRT screens are still used » Take regular breaks (+ exercise) » Make use of anti-glare screens if the room lighting is incorrect (or use window blinds to cut out direct sunlight) » Users should have their eyes tested on a regular basis (middle vision glasses should be prescribed if the user has a persistent problem with eye strain, dry eyes, headaches, etc.)
Headaches	Caused by incorrect lighting, screen reflections, flickering screens, and so on	» Make use of anti-glare screens if the room lighting is incorrect (or use window blinds to cut out reflections which cause squinting, leading to headaches) » Take regular breaks (+ exercise) » Users should have their eyes tested on a regular basis (middle vision glasses should be prescribed if the user has a persistent problem with headaches)
Ozone irritation	Caused by laser printers in an office (symptoms are dry skin and respiratory problems)	» Proper ventilation should exist to lower the ozone gas levels to acceptable values » Laser printers should be housed in a designated printer room » Change to using inkjet printers where possible

RSI

Repetitive Strain Injury is a damage in wrist and fingers due to continual typing on keyboard (wrist) or continual clicking of mouse (fingers).

Protection:

- Use ergonomic keyboards
- Take regular breaks
- Regularly exercise fingers
- Use wrist rests and wrist pads

Eye problems

Due to using computers and staring at the monitor for long periods of time, some eye problems may occur like:

- Eye strain
- Eye dryness
- Sight problems

Protection:

- Wear special glasses
- Have regular sight checks
- Use an antiglare screen
- Use an LED monitor instead of CRT monitors

Back Problems

Back problems take place due to bad posture while working with a computer.

Protection:

- Use ergonomic chairs
- Use straight back chairs
- Take regular breaks

Headaches

Headaches occur due to prolonged use of computers

Protection:

- Take regular breaks
- Have regular sight checks
- Take care of lighting in computer rooms

Chapter 7

ICT Applications

1 Communication

Communication Media:

- Newsletters and posters
- Websites
- Multimedia presentations
- Media streaming
- E-Publications

Newsletters and posters:

Newsletters:

Steps of creating newsletters using a word processor:

- First a word-processor application would be opened
- Photos could be obtained by:
 - using a digital camera and taking photos
 - searching for images/photos on the internet, or suitable photos could already be stored on the hard drive or cloud
 - using hard copy photos, which could be scanned in.
- If necessary, camera images would then be uploaded (either by connecting the camera or camera memory card) to the computer via a USB port, or by using Bluetooth connectivity).
- Photos from all selected sources would then be saved to a file on the HDD or SSD.
- Photos are imported from the stored file, photos would need to be cropped, edited and/or resized.
- Text would be typed in using a keyboard, and any previously saved text would need to be imported.
- Photos need to be placed in their correct position and the text wrapped.
- Finally, the whole document would need to undergo proofreading for errors and then saved, ready for printing.

Posters:

Posters are a good way of publicising, for example, a sporting event or an advertisement for a forthcoming movie.

A sporting event poster would need to include at least the following information:

- what the event is and where it will take place
- date, time and place of event
- admission fees (if any)
- other information such as facilities for people with disabilities).

The movie poster would need to include:

- an image taken from the movie to give some idea of the type of movie
- the date of release
- a list of the main characters.

As with newsletters, posters can be printed out using high-quality printers or can be posted online. Printed posters can be any size. Large posters have the advantage that they are eye-catching and usually very difficult to miss. They are used in many countries on the sides of roads so motorists see them on their way to work. By placing the posters in strategic positions, it is possible to target certain people rather than the general public (for example, advertising expensive cars by placing the posters on buildings or advertising hoardings in financial districts in big cities). The drawback is the cost of display (the advertising areas can only be rented) and that they are subject to weather conditions, so only have a limited life.

Websites:

Websites are made up of web pages and can contain a variety of content, for example:

- Text
- Images
- Sound
- Animation
- Videos
- Hyperlinks
- User interaction (comment boxes, reviews, forums, hit counters....)

Many companies choose to advertise their products on websites rather than on paper-based documents. This is because websites can be accessed by millions of people.

Advantages	Disadvantages
<ul style="list-style-type: none"> » sound/video/animation can be added » links to other pages and websites can be added in hyperlinks and hot spots » buttons to navigate/move around the website, leading to more information » 'hit counters' allow the owner to see detailed information about how many people have visited the website » can be seen by a global audience » cannot be defaced or thrown away » it is much easier to update a website (and there is no need to do a reprint and then distribute the new version) 	<ul style="list-style-type: none"> » websites can be hacked into and modified or viruses introduced » risk of potential phishing » it is necessary for the potential customers to have a computer and internet connection » it is not as portable as a paper-based system (although with modern smartphones and phablets this is fast becoming untrue) » possible for customers to go to undesirable websites (either by accident or as a result of a phishing attack) – this can lead to distrust from customers » there is a need for the company to maintain the website once it is set up – this can be expensive » because it is a global system, it is more difficult to target the correct audience using website advertising » still need to find a way for people to find out about the website

Multimedia presentations

Multimedia is a term given to documents or software that contains a combination of:

- Text
- Images
- Sound
- Animation
- Videos

Advantages of multimedia presentations

- use of sound and animation/video effects to grab the attention of the audience, and make the presentation easier to understand
- possible to have interactive hyperlinks to access a company's website or even key files stored on the cloud (such as video footage, images, spreadsheets and so on)
- use of transition effects allow a presentation to display facts in a key or chronological order
- can be interactive

Disadvantages of multimedia presentations

- a need to have special equipment which can be expensive
- danger that equipment could fail while giving multimedia presentations
- there may need to be internet access
- danger when using multimedia in presentations that the focus is on the medium (that is, the multimedia presentation) rather than the message or facts
- very easy to make a bad presentation with too many animation effects and too much text or images.

Media Streaming:

- Media streaming is when users watch movies/videos or listen to music on devices connected to the internet without the need to download and save videos and audio files
- This means data is transmitted and played in real time.
- With streaming, the file is sent as a series of packets of data. Each packet is interpreted by the web browser.
- Streaming only works well if the internet speed is stable, and at least 25 Mbits/second (for an HD video).

Epublications:

- Most material which is published on paper is also available in an electronic format. For example:
 - e-books
 - digital magazines
 - digital newspapers
 - digital libraries.
- In all cases, the publication can be downloaded to a device connected to the internet where it can be read.
- Moving between pages is usually done by swiping a finger across the screen (gesture based interface).
- E-publications also have the advantage that pages can be expanded in size and it is possible to include media, which would be impossible with the more traditional paper-based publications.
- Specific devices, such as the Kindle, have been developed to allow a library of e-books to be stored on the device.
- These devices use a white background with black text to fully replicate reading a normal book. Because no printing costs are incurred, e-publications are usually cheaper than their paper-based counterparts.

Mobile communication:

Mobile devices either use a **SIM (subscriber identity module) card** to allow it to connect to the mobile phone cellular network, or they use wireless internet connectivity. Together they allow all of the following features:

- SMS (short message service) messaging
- phone calls
- Voice over Internet Protocol (VoIP) communication
- video calling
- internet access.

SMS

Features and advantages:

- quicker and less expensive than making phone calls
- can be sent at any time of the day even if the recipient's phone is switched off
- predictive texting, where the system completes a word from the first few letters keyed in, texting also allows the system to remember frequently used words – together they increase typing speed

Phone Calls:

Features and advantages:

- There is no need to look for an operational public telephone in an emergency.
- It is possible to conduct business or personal phone calls on the move.
- It is easier to keep in contact with co-workers at the office no matter where you are

VOIP:

- Voice over Internet Protocol (VoIP) is a method used to talk to people using the internet.
- VoIP converts sound, picked up by the mobile device's internal microphone, into digital data packets that can be sent to their destination via the internet.
- The internet can be accessed via a mobile phone network or a broadband network (wifi)
- Advantages:
 - phone calls are free, no matter where in the world the caller and receiver are.
 - device's built-in cameras can also be used so that it becomes a type of video call.
 - it is much cheaper than a video-conference (no need for special software and additional hardware items – VoIP uses built-in microphones, speakers and cameras).
- Disadvantages:
 - sound quality (echo and 'weird sounds' are both common faults).
 - Security is also a main concern with VoIP, as it is with other internet technologies.

Video Calling:

- Video calling uses software such as FaceTime or Zoom.
- Both these options require the user to download an app.
- FaceTime makes use of the built-in smartphone cameras and microphone/speakers.
- A split screen allows you to see a number of people at the same time; although the small screen size limits the potential of this feature.
- Zoom is a cloud-based video calling service that allows live video chatting on any device.
- Advantages:
 - It is also possible to record sessions to be played back at a later date.
 - Cloud-based video calling prevents the need for users to invest in expensive infrastructure; users can simply dial into a virtual meeting room which makes it much cheaper than conventional video conferencing
- Features:
 - Video calls permit:*
 - live video and audio chat
 - screen-sharing during the call
 - recording during sessions.

Internet Access:

- Any mobile device can connect to the internet either using a wireless broadband connection or via the mobile phone network.
- Due to the use of smaller screens, internet pages displayed on mobile phones are often different to those on desktop or laptop computers.
- Software detects which type of device is connecting to a website, which then sends out the web page optimised for that device.
- Mobile devices also have a built-in feature which automatically selects wireless broadband connectivity (if possible), instead of the mobile phone network, when connecting to the internet.
- This has the following advantages:
 - less expensive (mobile phone company 'data plans' often have a cap on how much data can be downloaded, and charge for exceeding this maximum)
 - lower power consumption (Wi-Fi routers are usually much closer than the mobile phone towers; the longer the range, the greater the power consumption)
 - quality of service (Wi-Fi usually offers greater bandwidth than the mobile phone network giving the possibility of downloading more data more quickly)

2 Modelling applications

A computer model is the creation of a model of a real system in order to study its behaviour. The model is computer generated and based on mathematical representations.

The whole idea is to try to find out what mechanisms control how a system behaves. This makes it possible to predict future behaviour of the system and see if it's possible to influence future behaviour.

Examples:

- Personal Finance
- Bridge and building design
- Flood water management
- Traffic management
- Weather Forecasting

Advantages of using models

- Using computer models is less expensive than having to build the real thing (for example, a bridge!).
- On many occasions it is safer to use a computer model (some real situations are hazardous, for example, chemical processes).
- Computer modelling allows you to try out various different scenarios in advance.
- It is nearly impossible to try out some tasks in advance in real life because of the high risk involved or the remoteness (for example, in space, under the sea, in nuclear reactors, when crash testing cars, etc.).
- It is often faster to use a computer model than do the real thing (some applications would take years before a result was known, for example, climate change calculations, population growth, etc.)

Disadvantages of using models

- A model is only as good as the programming or the data entered; the simulation will depend heavily on these two factors.
- Although building the real thing can be expensive, sometimes computer modelling is also a very costly option, and the two costs need to be compared before deciding which to use.

- People's reactions to the results of a simulation may not be positive; they may not trust the results it produces (there will always be a difference between the results from modelling and reality).

3 Control Applications

- Robotics
- Production lines
- Autonomous Vehicles

Robotics

Robots are used in many industries, control of robots is either through a built in microprocessor or linked to a computer system.

Programming of robots is done in two ways:

1. Robot is programmed with a sequence of instructions which allow it to carry out the series of tasks.
2. Robot arm is guided by a worker so each movement or step is stored as an instruction in the computer.

Whichever method is used, once the instructions have been saved, they can be carried out by the robot automatically to give the consistent product.

Advantages of robots:

- They can work in dangerous environment
- They can work 24/7
- Do not need wages so less running cost
- Higher productivity
- Greater consistency (produce the same standard of product each time)
- They can do boring, repetitive tasks leaving human free to do more skilled work (e.g. quality control or design tasks)

Disadvantages:

- They find it difficult to do unusual tasks
- Can cause higher unemployment
- There is a real risk of deskilling or loss of some skills
- Initial set up cost of robots and maintenance costs are expensive

Automated Production lines:

Advantages:

- faster operations (the number of cans of baked beans filled is 120 per minute)
- much greater productivity (the production can run 24 hours a day for every day)
- greater consistency (every can contains exactly the correct weight of baked beans)
- built-in quality control (automatic testing for foreign material, such as metal filings, which would result in automatic rejection from the production line)
- reduced cost to the consumer (although initial robot arms are expensive, there are far fewer staff in the factory who would need wages).

Autonomous Vehicles:

Advantages	Disadvantages
Safer because human error is removed, leading to fewer accidents	Very expensive system to set up in the first place (high technology requirements)
Better for the environment because vehicles will operate more efficiently	The ever-present fear of hacking into the vehicle's control system
Reduced traffic congestion (humans cause 'stop-and-go' traffic known as 'the phantom traffic jam' – autonomous vehicles will be better at smoothing out traffic flow, reducing congestion in cities)	Security and safety issues (software glitches could be catastrophic; software updates would need to be carefully controlled to avoid potential disasters)
Increased lane capacity (research shows autonomous vehicles will increase lane capacity by 100% and increase average speeds by 20%, due to better braking and acceleration responses together with optimised distance between vehicles)	The need to make sure the system is well-maintained at all times; cameras need to be kept clean so that they do not give false results; sensors could fail to function in heavy snowfall or blizzard conditions (radar or ultrasonic signals could be deflected by heavy snow particles)
Reduced travel times (for the reasons above) therefore less commuting time	Driver and passenger reluctance of the new technology
Stress-free parking for motorists (the car will find car parking on its own and then self-park)	Reduction in the need for taxis could lead to unemployment (imagine New York without its famous yellow cabs!)

4 School management systems

Schools have to manage a number of different tasks in the day-to-day running of a school. These include:

- Registration and attendance of students
- Students performance

School registration systems

To record students attendance accurately using a computer system, two methods can be used:

Method 1

Give each student a magnetic stripe card; student's information is stored on the magnetic stripe. The card is read when student arrives at school and when leaves school so exact information about date and hours of attendance are recorded on a database.

Method 2

Make use of biometrics by taking the fingerprints of all students, their personal details as well as their fingerprints are stored on a database. Students pass their fingers on a fingerprint scanner as they enter or leave school.

Advantages of fingerprint method:

- Fingerprints are unique, so it is impossible for a student to pretend to be someone else
- Cards could be easily lost
- Cards could be affected by magnetic fields
- Fingerprints are difficult to replicate but cards can be cloned

Disadvantages:

- It would take a long time to collect the initial fingerprints of all students
- Equipment needed for fingerprints are more expensive than card readers
- Some parents may object on these methods due to invasion of privacy

Student performances:

Teachers can use spreadsheets efficiently to monitor the performance of their students

Computer Aided Learning (CAL):

Advantages of using CAL to enhance the learning process

- Students can learn when they want to and at their own place.
- It allows virtual reality (VR) learning to be used; with VR, the student is fully immersed into the learning environment.
- The student can stop at any point and return later to continue where they left off.
- It is possible to re-take tests until the student reaches the required skills level.
- CAL can make learning more interactive.
- CAL makes use of various multimedia (for example, short video clips, animation, music and interactive learning methods)
- CAL can make use of multiple-choice questions (MCQs) which can be marked immediately by the computer system, giving instantaneous feedback to the student
- It can deliver micro-learning; this is where a topic is broken down into small modules which are easy to learn, and is when CAL is most effective.

Disadvantages of using CAL to enhance the learning process

- CAL cannot give students the experience of handling laboratory equipment; for example, experiments shown in CAL are virtual in nature.
- It is expensive and time consuming to integrate CAL properly into the learning environment.
- Students can easily be distracted while online; for example, going on to social media sites, visiting websites or even playing online games.
- It can lead to the isolation of a student because they are spending their time on their own in front of a computer screen; this needs to be carefully managed.
- CAL cannot answer unusual questions, and the student will need to seek out guidance from a teacher; in other words, CAL is not a self-contained learning system.

5 On-line Booking systems

Online booking systems are used in:

- the travel industry
- for concerts (theatre and music events)
- for cinema tickets
- booking sporting events.

Theatre and cinema booking systems

Online booking systems rely on the ability to update files immediately thus preventing double booking

Steps of online theatre booking:

- Customers click on the performance they want to see
- A date and time are typed in
- The required number of seats are also entered
- The seating display of the theatre is displayed on screen
- User selects required seats by highlighting the actual seats on the screen and click confirm
- Customer enters his personal details and payment information
- Theatre seats are marked as booked in the customer's name
- An email is sent to customer with a printable evidence of tickets
- Seats become no longer available

Flight booking systems

Flight booking is done exactly the same way as theatre booking except that the selection will refer to destination and departure airports, ticket class as well as type of meals.

Advantages of online booking:

- Prevents double booking
- Customer gets immediate feedback on availability of seats
- Customer can book at any time of the day
- Customer's email allows customer to receive any special offers from booking company

Disadvantages:

- Setting up and maintenance of online booking systems is expensive
- Customers need a computer with a reliable internet connection
- It is often more difficult to cancel booking and get your money back
- Less personal touch and social contacts

6 Banking applications:

Computers are used in many applications in banks like:

- Automatic Teller Machines (ATM)
- Internet banking
- Clearing of cheques
- Electronic fund transfer

ATM offers the following:

- withdraw cash
- deposit cash
- deposit cheques
- check the balance of their account
- see a mini bank statement
- pay a bill
- do a money transfer.

Depositing cheques at an ATM:

- The user is asked to insert their debit card and type in the PIN.
- A message will then appear asking the customer which service they require.
- The customer chooses to deposit a cheque.
- A drawer will then open and the customer inserts the cheque.
- The drawer will then close and an OCR device will read the cheque details including the amount of money.
- The amount appears on the screen and the customer confirms the amount.
- The customer's account is updated with the amount on the cheque (pending cheque clearance within 24 to 48 hours).
- A printed receipt of the cheque is then given to the customer.
- If they do not require another service, the card is returned to the customer.

EFT:

- Electronic funds transfer (EFT) is a system that allows money transfer instructions to be sent directly to a bank's computer system.
- No actual money is transferred; money is electronically transferred between accounts.
- When an EFT instruction is received, the computer system automatically transfers the specified amount from one account to another.

Advantages of EFT

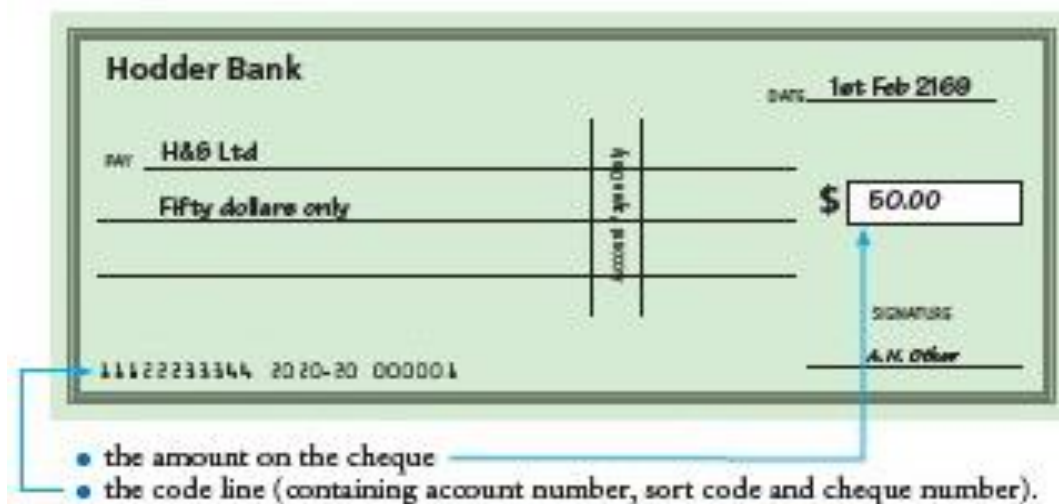
- It is a very secure payment method.
- It is a very quick payment method.
- It is less expensive than, for example, using cheques.
- The customer has the right to dispute an EFT payment for up to 60 days.

Disadvantages of EFT

- Once an amount has been transferred the bank cannot reverse a transaction (requires a full dispute investigation).
- The customer needs to have funds available immediately (unlike when using a cheque).
- It cannot guarantee the recipient (someone with a fake ID could collect the money).

Clearing of cheques:

Cheques are collected to be sent at the end of the day to a centralised cheque clearing centre, a cheque is processed by passing it through a reader/sorter machine. This machine reads:



All the cheques are then sorted using their sort codes(unique 6 digits to identify a bank) ready for sending to an exchange centre.

Data from the cheque is converted into an encrypted file known as IBDE file (Inter bank data exchange).

Every IBDE file is signed with a digital signature so that the receiving bank can be sure data was not altered.

Later the cheque is sent to an exchange centre which passes the cheque back to the paying bank which then sends it to its own clearing centre.

Later on the paying bank checks to see if the account has enough money to cover the cheque, it has been signed, dated and is genuine.

The bank then decides whether to pay the cheque or return it unpaid to the receiving bank.

A cheque is unpaid if:

- The customer hasn't got sufficient funds in account
- It is fraudulent for some reason
- It is not signed, dated or written correctly

7 Computers in medicine:

Computers are used in many areas of medicine such as:

- Keeping patients' records' and pharmacy records
- Use of 3-D printers in many areas of surgery

Patient and pharmacy records

- Doctors and hospitals need to keep accurate records of all their patients.
- This is essential to ensure correct diagnosis and treatment.
- An up-to-date medical history is part of the diagnosis process.
- Databases are kept by doctors and hospitals so that data can be shared between medical practitioners and pharmacies (for example, to ensure no drugs are prescribed which interact with each other in an unsafe manner).
- Databases also allow a quick and easy search for patient records – this could be very important in an emergency, when accessing the patient's medical history could mean the difference between life and death. It also means that medication can be prescribed without issuing paper prescriptions – an email could be sent to the pharmacy instead.

Using 3-D printers:

- Surgical and diagnostic aid
- Prosthetics
- Tissue engineering
- Artificial blood vessels
- Customised medicines

8 Expert Systems:

Expert systems have been developed to mimic the expertise and knowledge of an expert in a particular field. Examples include:

- Diagnosing a person's illness
- Diagnostics (finding faults in a car engine, faults in a circuit board, etc)
- Prospecting for oil and minerals
- Tax and financial calculations
- Chess games
- Road scheduling for delivery and cab vehicles
- Identification of plants, animals or chemical compounds

Parts or features of an expert system:

- Knowledge base
- Rules base
- Explanation system
- Inference engine
- Interactive screens for input and output

How to set up an expert system:

- Experts in the field are interviewed
- Data is then collected from these experts
- A knowledge base is first designed and then created (and filled with knowledge collected from experts)
- The rules base is then designed and created
- Inference engine is designed and created (steps followed to reach a reasonable conclusion from given input)
- An explanation system is then developed
- The expert system is tested against known conditions
- Experts are interviewed about how effective it is before it goes out on general release

Using an expert system:

Using oil prospecting as an example:

1. An interactive user screen appears
2. The system asks questions about geological profile
3. User types in answers
4. The system then asks questions based on the previous responses
5. The inference engine compares answers to questions with the facts stored in the knowledge base using the rules base
6. The system suggests probability of finding oil as an output
7. It also indicates the probable depth of deposits
8. The explanation system will also explain how the expert system arrived at its conclusions
9. It will then make predictions about geological deposits in the soil
10. Finally, it will produce contour maps showing concentration of minerals, rocks, oil, etc

9 Retail industry:

- EFTPOS, POS
- Internet shopping

Near Field Communication Devices: (NFC)

When using NFC payment at a POS terminal the sequence of events taking place is:

- The electronic device (for example, mobile phone) is held close to the NFC reader (the terminal); this only works up to a distance of 5 cm, so the devices need to be very close together.
- When the NFC (contactless) payment is initiated, the NFC terminal and electronic device (smartphone) pass encrypted data back and forth to each other to enable the payment to be made.
- This is very secure because NFC communications are encrypted and are dynamic (which means encrypted data being shared changes every time a transaction takes place).
- Mobile phone manufacturers use tokenisation to improve security.

Internet Shopping:

Advantages of online shopping and banking

- There is no longer a need to travel into town centres, thus reducing costs and time; it also helps to reduce town centre congestion and pollution.
- Users now have access to a worldwide market and can thus look for products that are cheaper; and they will also have access to a much wider choice of goods.
- Being able to access any shop or bank without the need to leave home may be of benefit to some people with disabilities and elderly people.
- Because it is online, shopping and banking can be done at any time on any day of the week (i.e. 24/7) as the shops and banks can often be closed when people finish work.
- People can spend more time doing other things, for example, going shopping to the supermarket probably took up a lot of time; by doing this online (and being able to set up repeat items) people are now free to do more leisure activities.
- Many people find it less embarrassing to ask for a bank loan using the internet rather than enduring a face-to-face discussion with bank staff.
- There are often long queues at the banks so internet banking saves time.
- The shops and banks save money by not having as many staff working for them (reduced wage bill) or needing as many high-street premises (reduction in rental costs) – these savings may be passed on to the customer in the form of lower interest rates, cheaper goods or higher rates of interest for savers.

Disadvantages:

- There is the possibility of isolation and lack of socialisation if people stay at home to do all their shopping and banking.
- There are possible health risks associated with online shopping or banking because of lack of exercise;
- Security issues are a major concern (for example, hacking, stealing credit card details, etc.) as are viruses and other malware (for example, phishing, pharming, and so on).
- Accidentally using fraudulent bank or shopping websites is always a risk and this is linked to security issues.
- It is necessary to have a computer and to pay for the internet to take part in online shopping and banking.
- Unlike high-street shopping, it is only possible to see a picture of the goods, (which might not portray the exact colour of an item of clothing, for example) and nor can you try something on to see if it fits before buying them; you also have to wait several days for the goods to arrive and returning goods may be expensive and time consuming.
- It is easier to make errors with online banking and transfer money incorrectly to different accounts.

10 Recognition systems:

OCR, OMR, RFID

These were discussed in chapter 2.

Automatic Number Plate Recognition (ANPR) System:

ANPR systems are used to read the number plates of cars in a number of applications.

Example: use of ANPR in a car parking system:

Step 1

A sensor detects a vehicle and sends a signal to a microprocessor to instruct a camera to capture an image of the front of the vehicle. (Often an infrared camera is used to give a clearer image and for use at night)

Step 2

Each character is then recognized using OCR software. The characters are converted into a string of editable text by the software and stored in a database.

Step 3

The car park barrier is raised and the motorist is issued with a ticket. The ticket shows the date and time of entering the car park.

Step 4

When the motorist returns to the car park, they insert their ticket into a machine which calculates the car park charges. Payment is registered on the database. When the car comes to the exit barrier, the ANPR system again reads the number plate and checks its database. If the number plate is recognised (and payment fulfilled), the exit barrier is raised.

Advantages of ANPR

- It can be used to automatically monitor average speed of vehicles over a stretch of road; this can be used in smart traffic management systems (see also Section 6.2).
- There is no need to employ car park security guards, which saves money.
- It is a much faster system than having to check a ticket at the exit; car parks can issue tickets on entry, but this ticket is simply used for payment purposes by the motorist before leaving the car park and is not used at the exit since payment will now be linked to the number plate on the car.
- It can be used to automatically control the entry and exit to a car park or private roads.
- It can be used as a security system; preventing illegal parking and preventing unauthorised access to private car parks.
- It can be used to analyse driver behaviour (that is, route choice and destinations) to help in transport planning.
- It can be used in inner-city congestion charging systems; it is possible to automatically charge a motorist if they enter a congestion zone, but also allows in permitted vehicles without charge (for example, emergency vehicles, buses and electric zero-emission vehicles).

Disadvantages of ANPR

- There is a lack of manned security car park surveillance which could lead to vandalism (and other crimes) because nobody is checking on a regular basis; CCTV is often used, but this is often just used 'after the event'.
- There could be invasion of privacy issues due to the recording of drivers' number plates. » Damaged or very dirty number plates will not be recognised by the system.
- Number plate cloning; the ANPR system only recognises the number plate and not the car, so it is possible for a car to be fitted with a cloned number plate thus by-passing car park security, for example.

Biometric Recognition systems:

Biometric recognitions systems include:

- face recognition
- iris and retina recognition
- finger and thumb recognition
- hand recognition
- voice recognition

Retina recognition

- The retina is the light-sensitive area at the back of the eye that has a unique pattern of blood vessels.
- The retina cannot be seen without specialised equipment – this means it is a secure technology, but more expensive to implement.
- The special equipment is used to take an infrared photograph of the retina.
- It is quite invasive – the subject has to sit very still and stare directly into the light source.
- It is slower to scan and verify.
- It is only used in very specialised high-security settings

Iris recognition

- The iris is the coloured part of the eye, surrounding the pupil.
- A digital camera is utilised which uses both visible and near infrared light to take a sharp photograph of a person's iris.
- The method produces a unique pattern of a person's iris by locating and taking an image of:
 - the centre of the pupil
 - the edge of the pupil
 - the edge of the iris
 - the eyelids and eye lashes
- The system works with:
 - contact lenses and glasses
 - blind people.
- It can uniquely identify a person in less than 5 seconds
- used a security system in:
 - immigration control (in some countries)
 - some banks have introduced this in some branches as a security feature

11 Satellite Systems

11.1 Global positioning satellite (GPS) systems and satellite navigation

GPS systems are used to determine the exact location of a number of transports (airplanes, cars, ships, etc.)

Satellites surrounding the earth transmit signals to the surface. Computers installed in the mode of transport receive and interpret these signals. Knowing their position on the earth depends on very accurate timing (atomic clocks in satellites). Each satellite transmits data indicating its position and time. The computer on board the mode of transport calculates its exact position based on information sent from at least three satellites.

In cars, the on-board computer contains stored road maps. With these satnav systems, the car's exact location, based on satellite positioning, can be shown on the map and the driver can also give verbal instructions such as: "after 100 metres, take the next turn ..."

A screen on the satnav device will also show the car's position in relation to the road network.

Advantages:

- the driver doesn't have to consult paper maps, so it is far safer
- It removes errors (can warn drivers about one way streets, street closures, etc.)
- The system can estimate journey time
- System can give useful information like the nearest gas station

Disadvantages:

- Maps need to be up to date
- Loss of satellite signals may cause problems

15.2 Geographic information system (GIS)

GIS is a computer system that allows us to map, model, query and analyse large amounts of data according to their location.

The technology combines maps with computer graphics and databases.

GPS enables the following:

- Converts information into easily understood maps
- Geographers, scientists and engineers are able to see data in several formats in order to see patterns and relationships.

Uses:

- Emergency services use GIS to send the closest emergency personnel to a location
- Biologists and environmentalists use GIS to protect animal life and plants in certain vulnerable areas
- Teachers use GIS in their geography, science and engineering lessons

15.3 Media Communication Systems:

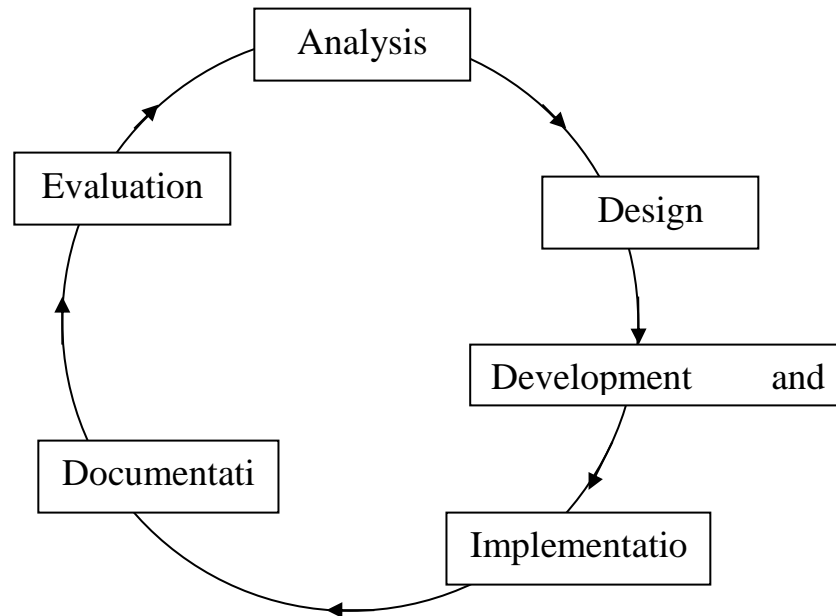
- A method of delivering and receiving data/information using telecommunications.
- Satellites contain antennas, transponders (to allow receiving and sending of data), solar panels (for power from the Sun) and propulsion (to ensure the satellite is in the correct orbit at all times).

- Signals are converted to analogue (if necessary) and then beamed to the satellite from a satellite dish on the Earth.
- The signals are delivered by carrier waves which consist of radio waves. Each signal has its own frequency and bandwidth (the larger the bandwidth the more data can be transmitted). Once the data reaches the satellite, it is then re-sent to Earth.
- The satellite usually 'boosts' the signal before sending it back. Often the frequency of the signal is changed to prevent the signal received being confused with the signal sent.
- Satellite systems are used to transmit data from one part of the planet to another. Due to the great distances involved, cables would be too costly and there is also the problem of signal deterioration in cables over long distances
- Satellites systems are used to transmit television, telephone and internet data around the world.

Chapter 8

Systems Analysis

Systems analysis is the process of developing a new system to operate and manage the performance of some business or application in real life. The job of a system analyst is to study the existing system, find out its problems together with the requirements of the new system and try to come out with the optimum solution.



System Development Life Cycle

Steps of systems analysis:

Analysis:

Before starting this step, the systems analyst will have to *investigate* the current system, or in other words to research the situation to find out facts about the system.

Different methods of fact finding (investigation):

1. Interviewing the staff to find the problems, tasks done,...

Advantages of interviewing method:

- Can add or change questions according to user response (interactive)
- Can express more details than questionnaires

Disadvantages:

- Time consuming
 - Relatively expensive (analyst's time)
2. Getting people to fill in carefully designed questionnaires.

Advantages:

- Quicker to be answered and analysed
- Does not need a previous appointment unlike interviews

Disadvantages:

- Some workers may ignore
 - Limited to short responses
3. Observing the daily work details.

Advantages:

- Relatively inexpensive
- Can give detailed idea about the whole system

Disadvantages:

- People may work in a different way when monitored
4. Examining the existing documents.(ex. Any bits of papers, screen displays, files)

Advantages:

- Shows a good idea about inputs and outputs of the system

Disadvantages:

- No idea about processing

After this step, a report should be produced which includes:

- Detailed information about the existing system.
- Inputs, processing and output in the existing system.
- Problems with the existing system, together with possible solutions.
- The objectives of the new system.
- User and information requirements for the solution.
- Any constraints about the proposed system.
- Hardware and software required to for the new system.
- A cost benefit analysis
- A data flow diagram

System Design:

If the directors of the business are convinced with the proposed system, then work can be started designing the new system.

Items in the design:

- data capture forms/input forms
- screen layouts
- output forms and reports
- systems flowcharts
- validation rules
- data verification methods
- file structures and tables
- hardware requirements
- software requirements
- algorithms or program flowcharts
- testing strategy/plan.

Development and Testing:

Once the system has been designed, it needs to be created and fully tested.

Development stage:

To create a system, file structure needs to be finalized, and then files are created.

Then data needs to be entered into these files.

File structure needs to be tested, as well as verification and validation routines to make sure that the system will work properly.

Testing strategies:

There are four types of test data:

1. Normal values: is data which is usual for the situation (e.g. a number in the range 0 to 100 for an exam score)/has an expected outcome.
2. Abnormal data: is data which is outside the acceptable range (e.g. -20 or 125 for an exam score) or is of a wrong data type
3. Extreme values: is data which is at either end of a normal range of data (e.g. the numbers 0 and 100 for an exam score)
4. Live data: is data from a real life situation already used with the old system , so output from both systems can be compared.

As a result of system testing, some parts of the design can be changed to correct any errors; examples:

- File structure
- Programs
- Hardware specification
- Verification methods
- Validation routines

Implementation:

Implementation is replacing the old system with the new system.

Methods of system implementation:

Direct implementation (direct changeover):

Scrap the old system and start using the new system immediately.

Advantage: the benefits are immediate, costs are reduced.

Disadvantage: If the solution does not work properly, it will be difficult to get the old system back.

Parallel running:

Running both the old system and the new system until the new system has proved itself.

Advantage: can use the old system if the new system fails, no data loss, can train staff gradually.

Disadvantage: it costs a lot in wages for two sets of staff.

Pilot implementation:

Making the conversion in a small part of the system (e.g. a branch of an organization), when settled down, move to another part.

Advantage: if the new system fails, only one part is affected, it is possible to train staff in one area only.

Disadvantage: It takes time to implement.

Phased Implementation:

One part of the new system is introduced. Only when it proves to work satisfactorily is the next part introduced, and so on, until the old system is fully replaced.

Advantage: if the latest part fails, it is only necessary to go back in the system to the point of failure, it is possible to ensure the system works before expanding.

Disadvantage: more expensive, since each stage needs evaluation before moving to the next stage.

Documentation:***User documentation:***

It is a user guide or manual. It should be written in simple language and contains no terms, contains:

- the purpose of the system/program/software package
- how to log in/log out
- how to load/run the software
- how to save files
- how to do a search
- how to sort data
- how to do printouts
- how to add ,delete or amend records
- screen layouts (input)
- print layouts (output)
- hardware requirements
- software requirements
- sample runs(with test data and results)
- error handling/meaning of errors
- troubleshooting guide/help lines/FAQs
- tutorials
- input and output formats.
- how to perform certain functions.
- what do in exceptional circumstances.

Technical documentation:

It is used to explain the system to a specialist. The guide does not need to be as simple as the user's guide. It is used for any development, changes or for maintenance of the system. It contains:

- the purpose of the system/program/software package
- Program coding
- Programming language used
- Program flowcharts, system flowcharts

- Input formats
- Hardware requirements
- Software requirements
- Minimum memory requirements
- Known bugs in the system
- List of variables used
- File structures
- Sample runs
- Output formats
- Validation routines
- Meaning of error messages

System Evaluation:

After a system has been implemented it should be reviewed periodically to make sure that it meets its objectives.

A good way of evaluating a solution is to ask the users of the system to find out their responses to using the system and to state how easy and efficient the system is.

It is also needed to compare the solution with the original task requirements.

Finally, limitations of the system and any required improvements should be identified, and this may lead us to start developing a new system.

Items in a system evaluation:

- Compare the solution with the original requirements
- Identify any limitations to the system
- Evaluate the users' response
- Compare test results from the new system with results from the old system
- Compare the new system performance with that of the old system
- Give out questionnaires to gather responses about the ease of use of the new system
- Identify any required improvements
- Interview users to find out how did it increase productivity and profitability

Chapter 9

Safety and Security

Physical safety:

The increased use of computers brings its own physical dangers, which can cause harm to users unless they take some sensible precautions.

Safety Risks:

Safety Risk	Ways of eliminating or minimising risk
Electrocution	<ul style="list-style-type: none">• Use an RCB (residual current breaker)• Check wire insulation regularly• Don't allow drinks near computers• Check equipment on regular basis
Trailing wires (trip hazard)	<ul style="list-style-type: none">• Use cable ducts• Cover wires or have them neatly tucked away (under desks,...)• Use wireless connection where possible
Heavy equipment falling causing injuries	<ul style="list-style-type: none">• Use sturdy or strong tables• Use large desks and tables so equipment are away from table edges
Fire risk	<ul style="list-style-type: none">• Have a fully tested CO2 extinguisher nearby• Don't cover equipment vent (causing equipment to overheat)• Ensure good room ventilation• Don't overload electrical sockets

Data Protection Act:

- Data must be fairly and lawfully processed.
- Data can only be processed for the stated purpose.
- Data must be adequate, relevant and not excessive.
- Data must be accurate.
- Data must not be kept longer than necessary.
- Data must be processed in accordance with the data subject's rights.
- Data must be kept secure.
- Data must not be transferred to another country

E-Safety:

It refers to safety when using the internet, i.e. keeping personal data safe and applies to any of the following devices:

- Mobile phones
- Computer or tablet
- Game consoles
- Wireless technology

Personal Data:

Personal data refers to any data concerning a living person who can be identified from the data itself or from the data in conjunction with other information. For example, 'Peter Smith has long purple hair and lives at 40 Green Street' would very clearly identify this individual!

Examples of personal data include:

- Name
- Address
- Date of birth
- Medical history
- Banking details

Some personal data is often referred to as sensitive data and includes:

- Political views
- Religion
- Criminal activity
- Sexual orientation
- Membership of a trade union
- Membership of a political party

The following list is exhaustive but gives some idea of the e-safety issues that can be encountered by users of ICT:

- Don't give out any personal information to unknowns especially online and it is very difficult to determine whether they are genuine or not.
- Don't send people photos of yourself- either online or via a mobile phone- unless the person is known to you. This is a particular risk in social websites.
- Always maintain privacy settings on whatever device is being used online, which allow user to control which cookies are stored on their computer or enable user to decide who can view information about them, for example, in social websites.
- Only use websites recommended by teachers or learner friendly search engines.
- Only open emails from known sources.

In social websites or chat rooms:

- Block or report any suspicious person
- Be careful with language used
- Always use a nick name and not your real name
- Keep private and personal data secret
- Don't enter private chat rooms, stay public
- Never arrange to meet someone for the first time in your own
- Avoid the misuse of images

Security of data:

There are a number of security risks associated with any device connected to a network:

Hacking:

This is the act of gaining unauthorised/ illegal access to a computer system

Effects:

This can lead to identity theft or the misuse of personal information; data can be deleted, changed or corrupted on a user's computer

Prevention:

- Use of firewalls
- Use of strong (frequently changed) passwords and user IDs
- Use of anti-hacking software

Phishing

The creator sends out legitimate-looking emails to target users. As soon as the recipient clicks on a link in the email or attachment, they are sent to a fake website or they are fooled into giving personal data in replying to the email. The email often appears to come from a trusted source, such as a bank or well-known service provider

Effects:

- The creator of the email can gain personal data, such as bank account data or credit card numbers, from the user
- This can lead to fraud or identity theft

Prevention:

- Many ISPs or web browsers filter out phishing emails
- Users should always be cautious when opening emails or attachments
- Don't click on executable attachments that end in .exe, .bat, .com or .php, for example

Smishing

Short for SMS phishing, use of mobile phones SMS to send out fake messages in order to get sensitive personal details.

Vishing

Voice mail phishing is another version of phishing.

Pharming

This is malicious code installed on a user's computer or on a web server; the code will redirect the user to a fake website without their knowledge (the user doesn't have to take any action, unlike phishing)

Effects:

- The creator of the malicious code can gain personal data such as credit/debit card details from users when they visit the fake website
- Pharming can lead to fraud or identity theft

Prevention:

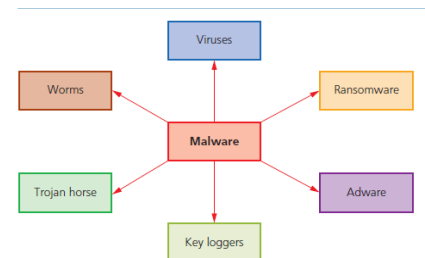
- Some anti-spyware software can identify and remove pharming code from a user's computer
- The user should always be alert and look out for clues that they are being redirected to another website

Viruses and malware:

Malware is one of the biggest risks to the integrity and security of data on a computer system. Many software applications, such as anti-virus, are capable of identifying and removing most of the forms of malware. There are many forms of malware; this section details just a selection of those forms.

Virus:

This is program code or software that can replicate/copy itself with the intention of deleting or corrupting files on a computer; they often cause the computer to malfunction (for example, by filling up the hard drive with data)



Effects:

- Viruses can cause the computer to ‘crash’, stop functioning normally or become unresponsive (e.g., the user gets the ‘not responding’ message)
- The software can delete files or data on a computer
- The software can corrupt operating system files, making the computer run slowly or even ‘crash’

Prevention:

- Install anti-virus software and update it regularly
- Don’t use software from unknown sources
- Be careful when opening emails or attachments from unknown senders

Viruses	Programs or program code that can replicate/copy itself with the intention of deleting or corrupting files, or cause the computer to malfunction; they need an active host program on the target computer or an operating system that has already been infected before they can run
Worms	This is a type of stand-alone virus that can replicate itself with the intention of spreading to other computers; often uses networks to search out computers with weak security which are prone to such attacks
Trojan horses	These are malicious programs often disguised as legitimate software; they replace all or part of the legitimate software with the intent of carrying out some harm to the user’s computer system
Spyware	Software that gathers information by monitoring, for example, all the activity on a user’s computer; the gathered information is then sent back to the person who sent the software (sometimes they monitor key presses, which is referred to as key logging software)
Adware	Software that floods a user’s computer with unwanted advertising; usually in the form of pop-ups, but can frequently appear in the browser address window redirecting the browser to a fake website which contains the promotional adverts
Ransomware	Programs that encrypt the data on a user’s computer; a decryption key is sent back to the user once they pay a sum of money (a ransom); they are often sent via a Trojan horse or by social engineering

Card fraud

Card fraud is the illegal use of a credit or debit card. This can be due to:

- shoulder surfing when using the card on an ATM or a handheld POS terminal
- card cloning
- key logging software.

Shoulder surfing

Examples:

- somebody watching you key in data, such as your PIN; by just looking over your shoulder or watch from a distance using binoculars or using a video camera
- somebody listening in when you are giving credit or debit card details over the phone
- use of tiny digital cameras which take high-quality images of the keys being pressed.

There are ways to overcome this security risk:

- When using ATMs shield the keyboard with your other hand (many ATMs also have a small mirror built into them so you can see if somebody is standing right behind you).
- When using a mobile device (such as a smartphone, tablet or laptop) never key in data in a public place; nor should you speak card details into your smartphone in a public place.
- If you are using a public place, make sure you are nowhere near security cameras which could record passwords or use biometrics (touch ID or face ID) on your smartphone or tablet, because these cannot be duplicated by simply watching you.

Card cloning

Card cloning is the copying of a credit or debit card which uses a magnetic stripe. Cloning of this type of card employs an electronic device known as a skimmer.

Skimmers can be placed in ATM slots where they can read all the data from a card; this data is then copied to the magnetic stripe of a fake card. The skimmer would also make use of shoulder surfing to know the PIN. Smart cards, which give considerably more security can be cloned by a different device, known as a **shimmer**. This uses a paper-thin shim (that contains a chip and a flash drive) that can be put into a card reading slot. It is so thin that it is almost impossible to detect. When a customer puts their card into the reader slot, the shim reads all the data from the credit/debit card, allowing the criminal to create a fake replica credit/debit card. Although the chip itself cannot be cloned, all the data gathered from the cloned card is now stored on a magnetic stripe and a fake card is produced. The fake card can be used to make purchases where a magnetic stripe card is still acceptable; for example, when making purchases online. Obviously, the best way to check on this type of fraud is to do regular checks of your spending and query any unusual activity.

Key logging

The use of key logging software has been discussed earlier. This is used to detect all key presses, such as when entering a credit or debit card:

- number
- security code (card verification value – CVV)
- PIN.

Because all this data can be obtained by key logging software, illegal use of a credit or debit card to buy things online is a continued risk.

Protection of Data:

- biometrics
- digital certificates
- secure sockets layer (SSL)
- encryption
- firewalls
- two-factor authentication
- user ID and password

Biometrics:

Biometrics relies on certain unique characteristics of human beings. Examples include:

- fingerprint scans
- signature recognition
- retina scans
- iris recognition
- face recognition
- voice recognition.

Fingerprint scans

Images of fingerprints are compared against previously scanned fingerprints stored in a database; if they match then access is allowed. The system compares patterns of ‘ridges’ and ‘valleys’ which are unique.

Advantages:

- Fingerprints are unique and difficult to replicate
- Other security devices (such as magnetic cards) could be lost or even stolen
- It would be impossible to 'sign in' for somebody else
- Fingerprints cannot be misplaced; a person always has them!

Disadvantages:

- It is relatively expensive to install and set up.
- If a person's fingers are damaged through an injury, this can have an effect on the scanning accuracy.
- Some people may regard it as an infringement of civil liberties.

Biometric technique	Advantages	Disadvantages
Fingerprint scans	<ul style="list-style-type: none">» very high accuracy» one of the most developed biometric techniques» very easy to use» relatively small storage requirements for the biometric data created	<ul style="list-style-type: none">» for some people it is very intrusive, because it is still related to criminal identification» it can make mistakes if the skin is dirty or damaged (for example, cuts to the finger)
Signature recognition	<ul style="list-style-type: none">» non-intrusive» requires very little time to verify (about five seconds)» relatively low-cost technology	<ul style="list-style-type: none">» if individuals do not sign their names in a consistent manner there may be problems with signature verification» high error rate of 1 in 50
Retina scans	<ul style="list-style-type: none">» very high accuracy» there is no known way to replicate a person's retina pattern	<ul style="list-style-type: none">» it is very intrusive» it can be relatively slow to verify retina scan with stored scans» very expensive to install and set up
Iris recognition	<ul style="list-style-type: none">» very high accuracy» verification time is generally less than five seconds	<ul style="list-style-type: none">» very intrusive» uses a lot of memory for the data to be stored» very expensive to install and set up
Face recognition	<ul style="list-style-type: none">» non-intrusive method» relatively inexpensive technology	<ul style="list-style-type: none">» it is affected by changes in lighting, the person's hair, their age, and if the person is wearing spectacles
Voice recognition	<ul style="list-style-type: none">» non-intrusive method» verification takes less than five seconds» relatively inexpensive technology	<ul style="list-style-type: none">» a person's voice can be easily recorded and used for unauthorised access» low accuracy» an illness, such as a cold, can change a person's voice, making absolute identification difficult or impossible

Digital certificates

A **digital certificate** is a pair of files stored on a user's computer to ensure the security of data sent over the internet. Each pair of files is divided into:

- a public key (which can be accessed by anyone)
- a private key (known to the computer user only).

For example, when sending an email, the message is made more secure by attaching a digital certificate. When the message is received, the recipient can verify that it comes from a known or trusted source by viewing the public key information (this is usually part of the email attachment). This is an added level of security to protect the recipient from harmful emails. The digital certificate is made up of six parts:

- the sender's email address
- the name of the digital certificate owner
- a serial number
- expiry date
- public key (which is used for encrypting the messages and for digital signatures)
- digital signature of certificate authority (CAs)

Secure sockets layer (SSL)

- Secure sockets layer (SSL) is a type of protocol that allows data to be sent and received securely over the internet.
- When a user logs onto a website, SSL encrypts the data – only the user's computer and the web server are able to make sense of what is being transmitted.
- A user will know if SSL is being applied when they see https (as part of the website address) or the small padlock in the status bar at the top of the screen.
- SSL certificates are small data files that digitally bind an encryption key to an organisation's details.
- When installed on a web server, it shows as the green padlock and the https protocol ensures secure connections from a web server to a web browser.

Encryption

- Encryption is used primarily to protect data in case it has been hacked or accessed illegally.
- While encryption will not prevent hacking, it makes the data meaningless unless the recipient has the necessary decryption tools
- Encryption uses a secret key that has the capability of altering the characters in a message.
- The key used to encrypt (or encode) the message is known as the encryption key; the key used to decrypt (or decipher) the message is known as the decryption key.

Firewalls

- A **firewall** can be software or hardware.
- It sits between the user's computer and an external network (for example, the internet).
- The criteria for allowing or denying access to a computer can be set by the user.
- firewall examines the 'traffic' between user's computer (or internal network) and a public network (for example, the internet)
- checks whether incoming or outgoing data meets a given set of criteria
- if the data fails the criteria, the firewall will block the 'traffic' and give the user (or network manager) a warning that there may be a security issue
- the firewall can be used to log all incoming and outgoing 'traffic' to allow later interrogation by the user (or network manager)

- the firewall can keep a list of all undesirable IP addresses
- firewalls help prevent viruses or hackers entering the user's computer (or internal network)
- user is warned if some software on their system is trying to access an external data source (for example, automatic software upgrade)

Two-factor authentication

Authentication refers to the ability of a user to prove who they are. There are three common factors used in authentication:

- something you know (for example, a password or PIN code)
- something you have (for example, a mobile phone or tablet)
- something which is unique to you (for example, biometrics).

Two-factor authentication is a form of verification which requires two methods of authentication to verify who a user is. It is used predominantly when a user makes an online purchase, using a credit/debit card as payment method.

For example, suppose Kate wishes to buy a new camera from a website. She logs into the website using her computer. This requires her to enter a user name and a password, which is step one of the authentication process.

To improve security, an eight-digit PIN (called a one-time pass code) is sent back to her either in an email or as a text message to her mobile phone (the mobile phone has already been registered by Kate on the website as the second stage of the authentication process).

Kate now enters this eight-digit PIN into her computer and she is now authorised to buy the camera.

Using the definitions of authentication at the start of this section, the mobile phone is something she has and the password/PIN code is something she knows.

User IDs and passwords

- Passwords are used to restrict access to data or systems.
- They should be hard to break and changed frequently to retain any real level of security.
- Passwords are frequently used when accessing the internet, for example:
 - when accessing email accounts
 - when carrying out online banking or shopping
 - when accessing social networking sites.

Passwords should be protected as follows:

- Run anti-spyware software
- Change passwords on a regular basis
- Passwords should not be easy to guess
- Strong passwords should contain:
 - at least one capital letter
 - at least one numerical value
 - at least one other keyboard character (such as @, *, &. etc.)
 - An example of a strong password would be: Sy12@#TT90kj=0
 - An example of a weak password would be: GREEN

Chapter 10

Audience

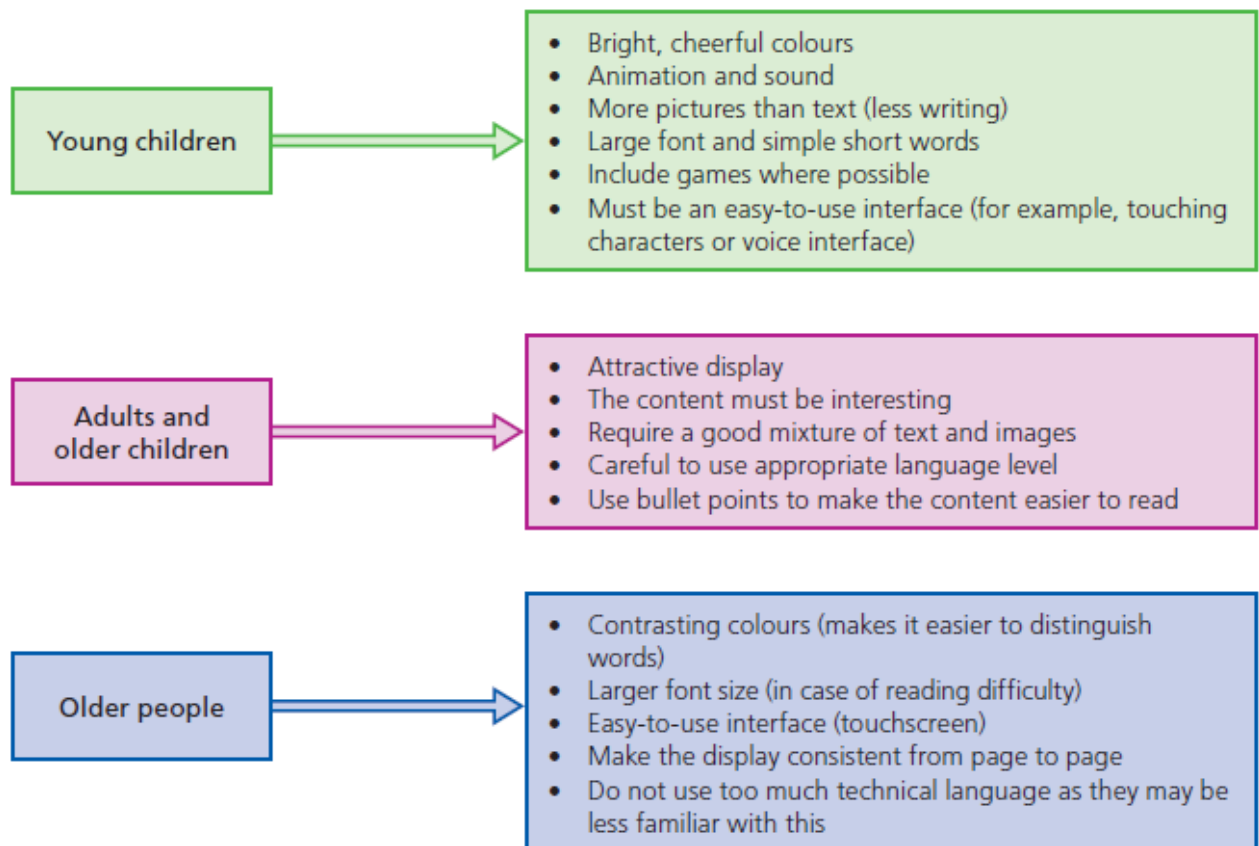
Audience Appreciation:

When planning and creating ICT solutions, it is important to consider the audience who will use the solution. The following list shows a number of factors to be considered:

- The age of the target group (young children or adults)
- The experience of the audience (a board of company directors or teenage students)
- The expectation of the audience
- Knowledge of the audience (maths students or history students)

When starting to look at the ICT solution, some research needs to be done first to find out about the target audience:

- Interviewing a sample of the target group to find out how to engage the audience
- Giving out questionnaires to target people to find out their background, interests so that to fulfil their expectations
- Carrying out market research



Software copyright

Software is protected by copyright laws in the same way as music CDs, videos or articles from magazines and books are protected.

It is illegal to:

- Make a software copy and sell it or give it to a friend or colleague
- Use software in a network or multiple computers without a license
- Use coding from a licensed software in your own software and then pass this software on or sell it as your own without permission from copyright owners
- Rent out software without permission from publishers
- Use the name of copyrighted software on other software without an agreement to do so

Software piracy (illegal copying of software) is a big issue among software companies. They take some actions to protect their work.

Examples of these actions:

- Some software will only run if a dongle is plugged in one of the USB ports
- Some software will only run if the original CD/DVD is actually in the drive, this prevents illegal multiple use
- User has to key in a unique product key in order to install software
- The user has to accept the license agreement before installing software
- Original software comes with a hologram (a sticker to indicate the copy is genuine)

Chapter 11

Communication

Communication using email:

Constraints

There are many rules we need to follow to ensure the security of messages sent and to prevent people from writing things regarded as unacceptable. This part considers these constraints:

Law

Many countries have laws to protect people against misuse of emails.

Here are some of these rules:

- It is important that emails are not sent with false or misleading subject lines
- A valid postal address must accompany emails from companies or organizations
- Companies must provide subscribers with a very clear way to unsubscribe from their listing

Acceptable language

Language used by people when writing emails must lie within an acceptable code of practice.

Copyright

It is very important to realize that emails are subject to copyright laws. Just because it is relatively easy to forward an email does not mean it is always legal to do so. This is also true of any attachments.

As with a webpage, copyright is determined by its content. Printing, copying or forwarding an email is not considered a breach of copyright unless the sender has indicated clearly that the message is confidential or subject to copyright.

Security and password protection

Some methods of increasing email security include:

- Using strong passwords when logging on to your email
- Changing passwords on regular
- Using spam filters to remove suspicious emails to a junk folder or even block email entirely
- Running antivirus software at all times on your computer

Netiquette (Internet etiquette)

There are a number of rules governing netiquette:

- Don't be abusive- don't threaten people
- Don't send spam-don't repeatedly send someone the same information
- Be clear with your message
- Always check your grammar and spelling-give a good impression
- Respect people's privacy and don't discuss or publish information that might embarrass someone
- Don't use CAPITAL LETTERS to highlight comments-this is shouting in email
- Don't use too many emotions as they might annoy your readers

Spam

Unsolicited email sent over the internet to multiple recipients and can range from being simply annoying to dangerous, spam is used for advertising but can contain viruses or be part of a phishing scam.

Disadvantages of spam:

- It uses up people's time
- It generally annoys people
- It uses up valuable bandwidth on the internet, slowing it down
- It can fill up user's inbox

How to recognise spam:

- Content too good to be true
- Sender unknown(not in contact list)
- May contain grammar or spelling mistakes
- General greeting(not personalized)
- May contain links

How to prevent spam:

- Never reply to a spam mail
- Learn how to block and report spammer
- Use an ISP with a spam filter
- Move spam to junk folder

Email groups

Email groups are used for a number of purposes:

- It is easier for a user to send out multiple emails if the addresses are grouped together under a single name
- Companies and organisations can group people together for marketing purposes
- Spammers can create email groups by buying addresses of people from certain companies- this means that several thousands of people can be sent spam by pressing the send key
- Companies use email groups to set up meetings

Other email operations

Apart from the person you are sending the email to, there are other options available, such as:

- carbon copies (cc)
- blind carbon copy (bcc)
- forward
- attachments.

Carbon copies (Cc) and Blind carbon copies (Bcc)

The difference between carbon copies (Cc) and blind carbon copies (Bcc) is that the Bcc address details are invisible to everyone receiving the email, apart from the Bcc recipient. All recipients in a Cc list, however, can be seen by all other recipients.

- The use of Cc is really just netiquette; those on the 'To' are the main recipients and those in the 'Cc' list are interested parties.

- Bcc is often used as a security measure when using email groups. When sending an email to many recipients, the following is an added security to keep the addresses of everyone safe:
 - Put your own email address in the 'To' field.
 - Set up an email group containing all the recipients and give it a name; then store this.
 - Put this named email group in the 'Bcc' field.
 - This will provide some additional protection, because anyone seeing the email (authorised or unauthorised) will not be able to see the email addresses of the other recipients.

Forwarding of emails

Resending a received email to other recipients

Attachments

- Files sent within an email, they should be treated with great caution as they could be phishing or viruses.
- Attachments should be scanned for viruses and malware before download.

Effective use of the internet

The internet

The internet is a worldwide collection of networks that allows users to:

- Send and receive emails
- Chat online
- Transfer files from computer to computer (using file transfer protocol)
- Browse the world wide web

Internet Functionality:

Internet service provider (ISP)

An ISP is a company that provides users with access to the internet. It is normal to pay a monthly fee for this service. When a user register with an ISP, an account is set up and they are given login details that include a user ID and password.

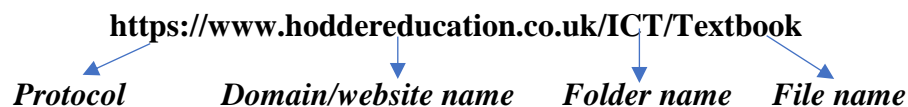
An ISP has the equipment and telecommunications line access required to have internet access- usually broadband connections, which use copper cables, or more recently, fibre-optic cables.

Web browsers and URLs

A web browser is software that allows a user to display a web page on their computer screen. They translate the HTML codes from websites and show the results of the translation. This can often be in the form of videos, images or sound.

Web browsers use uniform resource locators (URLs) to access websites, retrieve files and so on.

URL contains the protocol, site address and file name.



Hypertext transfer protocol (http and https)

Set of rules used while transferring data across the internet. Protocols are sets of rules agreed between sender and receiver when data is being transferred between devices. When opening a webpage, entering `http://` at the front of an address tells the web browser that http rules are to be obeyed.

When some sort of security is used, SSL or TLS, then the protocol is changed to https (the letter “s” refers to secure)

File transfer protocol (ftp)

FTP is a network protocol used when transferring files from one computer to another over the internet.

Blogs, wikis, forums and social networking sites

Blogs

Blogs (web logs) are personal internet journals where the blogger will type in their observations on some topic and perhaps provide links to some relevant websites.

Features of a blog:

- Updated regularly by the author
- Usually organised in reverse chronological order (most recent to less recent)
- Normally public-anyone can read
- Usually have a single author
- Other internet users can't change blogs-they can only read them

Microblogs are similar to blogs but are most often used on social networking sites to make short, frequent posts such as tweets.

Wikis

Wikis are web applications or websites that allow users to create and edit web pages using a web browser. A wiki will support hyperlinks and uses a very simple syntax (known as wiki markup) to create pages. They can be described as webpages with an <edit> button.

Features of wikis:

- Anyone can edit, delete or modify the content
- Many authors can be involved in a wiki
- It is possible to organise the page anyway that the users wish
- Keeps track of all entries-i.e. stores a document history
- Can be easily edited using a web browser
- Allows many people to see large documents

Forums:

A moderated forum refers to an online discussion forum in which all the posts are checked by an administrator before they are allowed to be posted. Many users prefer this type of forum, compared to an unmoderated one, as the moderator can not only prevent spam, but can also filter out any posts that are inappropriate, rude or offensive, or even those that wander off the main topic.

The internet is essentially a huge unmoderated forum. No one ‘owns’ the internet, and it is essentially not policed. The only real safeguards are a voluntary cooperation between the users and the network operators. However, most social forums or networking groups on the internet have a set of rules or protocols that members are requested to follow or they will be deleted.

Social networking sites

Social sites focus on building online communications of users who share the same interests and activities. They enable users to share photos, videos and music, hobbies, favourite eating places, and so on. The members do this by creating public profiles and thus form 'relationships' with other users.

Features of social networking sites:

- Each member is provided with free web space
- Each member can build own public and private profiles
- It is possible to upload content such as text messages, photos and videos
- Free instant messaging and video chatting
- Members can create pages where they can post photos, articles, and so on
- It is possible to invite people to become friends
- Members have control over who can access their data

Searching the internet for information

One of the most useful and powerful aspects of the internet is the ability to easily search for vast amount of information on almost any given topic.

Search engines

Search engines are useful when you don't know the URL of the website or if you want to find some information but don't know where to look.

Search engines use a variety of search methods, but they all have one common feature: they use the words entered in the search box and look up in their database of web pages to find out which of them match your search string.

Why isn't it always easy to find reliable information on the internet?

There is no guarantee that information found is accurate or unbiased. Essentially anybody is able to set up a website and write whatever they like without having it verified. However, the material can be inaccurate or unverified and it can also be biased towards one way of thinking only. Unlike books, the material posted on websites doesn't have to be checked by other people to ensure it is factually correct.

How can you evaluate reliability of information found on the internet?

- Anybody can set up a website, so information is not necessarily reliable or accurate
- Some commercial websites will be biased
- If a website has excessive advertising it could be unreliable
- If the advertising on a website is related only to its own products it could be unreliable
- It is possible to use the final part of a URL to identify a website's reliability- for example, websites ending with .org and .gov are more likely to be reliable
- User can compare information with information in books or reliable websites
- It is a good idea to see if responsible bodies endorse the website
- Check if the website has links to other reliable websites or to unreliable websites
- If the date of last update was a long time ago it is likely to be unreliable
- If the author of the website has good credentials, then it is more likely for the content to be reliable.

Practical Questions

Generic file formats:

Generic file formats allow you to open files in different applications. They may not contain all formatting but can be used in different systems.

Some file types, such as spreadsheets (.xls) or databases (.accdb) are not generic. It is not always possible to open these files on other applications.

Common generic text files:

- *Comma separated values (.csv)*, these keep data as tables in spreadsheets and databases as text separated by commas.
- *Text (.txt)*, a text file is not formatted and can be opened by a word processor.
- *Rich text format (.rtf)*, a text file that saves some formatting

Common generic image files:

- *Graphics interchange format (.gif)*, this format stores still or moving images and is an efficient method to storing images using a smaller file size. It is widely used in web pages
- *Joint photographic expert groups (.jpg)*, stores still images only using smaller file size and widely used in web pages.
- *Portable document format (.pdf)*, a document converted into an image format. It allows documents to be seen as images so they can be viewed on most computers. The pages look just as they would be printed but can contain clickable links and buttons, video and audio.
- *Portable network graphics (.png)*, it is a file format that compresses graphics files without any loss of image quality. It was created to replace gif images.
- *Moving picture experts group layer 4 (.mp4)*, it is a multimedia container used for storing video files, still images, audio files, and so on. This is often used to transfer files on the internet.

Common generic audio files:

- *Moving picture experts group layer 3 (.mp3)*, a compressed file format used for audio files. The file sizes are relatively small but have near CD quality, suitable for use on the internet.

Common generic files used for website authoring:

- *Cascading stylesheet (.css)*, this is a stylesheet that is saved in cascading stylesheet format to be attached to webpages to define formats, colour schemes, fonts and so on.
- *Hypertext markup language (.htm)*, this text based language is used to create markup that a web browser will be able to display as a webpage.

Reducing file sizes:

All computer systems have a limited storage capacity, so the most efficient use of that storage space is important. The speed at which files are transmitted between devices also depends on the file sizes. Size is also important when sending file attachments. The larger the file size, the more time it takes to transmit.

To reduce a file size:

- Resize an image

This method is used to physically resize an image in a graphics package and then to save the new image with a new file name. This method has the advantage of reducing the file size of the image so that a web page will be displayed more quickly. It has the disadvantage of using lower resolution images which may be of less quality.

Use file compression

If a document contains lots of formatting or lots of images, its file size tends to be large. To reduce its size, you can turn it into pdf format or place it in a zipped folder.

Corporate house styles:

Most companies and organizations have a corporate house style. This can be seen on a company's products, printed stationery, websites and often on company vehicles. House style can range from logos to recognized colour schemes, fonts, point sizes,...etc

Anything produced for a company will usually have a logo, colour scheme, font style, paragraph style, page layout, page formatting, and defined styles for bullets and numbering.

The purpose of a house style is to make sure that documents and other material of a company have consistency. It is also used to save time of planning, setting up or creating documents and other material. It is also used to support brand recognition and reduces the risk of mistakes in documents like typing errors in address or phone number.

Web development layers:

A website is a collection of individual but related web pages that are often stored together and hosted by a web server. Web pages can include different objects such as text, sound and images. A web page is created using three layers:

- The content layer (sometimes called structure layer)
This refers to the content and layout of the page
- The presentation layer
This refers to formatting of objects and styles applied to the page and contents
- The behaviour layer (involves the script language)
As well as actions done within the page

Publishing websites:

All websites have a domain name, such as www.cie.org.uk, which is used to find the site. To publish your website you must register the domain name you wish to use. You will use FTP, or file transfer protocol, to upload your files to your web hosting space.

To publish a website you need to upload:

- All the files in one folder
- An FTP client
- Login details to a web hosting server (this includes name of FTP host, port used, and user name and password for the FTP)

Once you have logged on you upload the files. This will publish your website and it should appear when you write domain name in your browser.