

# 1. Types and Components of Computer Systems

## 1.1. Hardware & Software

### Hardware

- Tangible physical components of a computer system
- You can feel it or touch it
- **Internal Hardware Devices:**
  - Processor ✨
  - Motherboard ✨
  - RAM & ROM ✨
  - Video & Sound Cards
  - Internal Hard Disk Drives
- **External Hardware Devices:**
  - Monitor ✨
  - Keyboard ✨
  - Mouse ✨
  - Printer
  - External Storage Devices

### Software

- Programs that control computer systems
- Set of instructions that make computer do something
- You cannot physically touch software
- Relates to ideas & instructions for using physical objects

Two types of software:

- **Application software:**
  - Programs that allow the user to do specific task
  - Design to carry out tasks
  - Can be general purpose software or custom-made software (specialist software)
  - E.g. Spread sheets, databases, word processing
- **System Software:**
  - Programs that allow the hardware to run properly
  - Control computer's hardware and application program
  - Communicate with user
  - E.g. Operating system, device drivers, compilers

## 1.2. The Main Components of Computer Systems

### CPU

- Processing done by central processing unit
- Three main components:
  - 1 • Control unit - coordinates input and output devices and carries out program instructions

- 2 • Arithmetic and Logical Unit (ALU) - performs calculations and logical comparison:  $A < B?$
- Immediate access store (IAS) - holds data and program instruction in current use
- 3 • **Microprocessor:**
  - Used instead of CPU
  - Single integrated circuit

### Internal/Main Memory

- Stores all data: application software, operating system, data files
- Consists of ROM and RAM
- Both RAM and ROM are integrated chips
- **RAM:**
  - Random access memory (RAM) is an internal chip where data is stored temporarily
  - Memory can be written to and read from
  - RAM > ROM (usually; except washing machines)
  - Stores anything that needs to be changed
  - All program and data being used are on RAM
  - Contents lost when computer is turned off
  - Referred to as volatile memory
- **ROM:**
  - Read only memory (ROM) is memory used to store permanent information
  - Used to contain configuration data for a computer etc.
  - Chips cannot be altered, only read from
  - Data not lost when computer is turned off
  - Referred to as non-volatile memory
- **BIOS:**
  - ROM contains boot file, referred to as BIOS (basic input/output system)
  - Tells computers what to do when it first starts
  - Does hardware check when computer is turned on
  - Then it loads operating system into RAM
  - BIOS stores date, time and system configuration

### Input & Output Devices

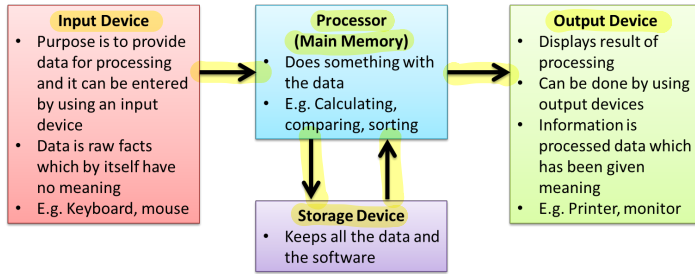
- **Input devices:**
  - Purpose is to provide data for processing
  - Data is raw facts which alone have no meaning
  - Examples: keyboard, mouse
- **Output devices:**
  - Displays result of processing
  - Information is processed data which has been given meaning
  - Examples: monitor, printer

### Secondary/Backing Storage

- Stores data/information & programs not being used at current time

- Backing store device = reader or recorder
  - Example: Hard disk drive
- Backing store media = hardware containing data
  - Example: Hard disk

## Basic Computer Model



## 1.3. Operating Systems

- ★ Enables users to communicate with computer systems
- Controls operation of input, output & backing storage
- Supervises loading, running & storage of application program
- Deals with error in application programs
- Maintains security of whole computer system
- Maintains a computer log
- Two main types of interfaces: CLI & GUI

### CLI - Command Line Interface

- Types commands to tell the computer what to do
  - The user must know all the commands
  - Must not make typing errors
- Used by technicians
- Can access everything on the computer system
- GUI users can only access places they have icons for
- **Advantages**
  - Knowing the correct commands, this can be much faster than any other interface type
  - Uses much less RAM than any other interface type
  - Low resolution, cheap monitors can be used
  - CLI does not require Windows to run
- **Disadvantages**
  - Can be confusing
  - Commands must be typed precisely, if there is a spelling error the command will fail
  - If you mistype an instruction, it is often necessary to start all over again
  - Large number of commands need to be learned

### GUI - Graphical User Interface

- Uses graphics to stand for the complicated actions
- Uses icons
- Uses a mouse to select the icons

- Screen divided into windows allows different things on each
- **WIMP - Windows Icons Menus Pointers**
- **Advantages**
  - Easy to use because requires little IT knowledge
  - Easy to explore and find your way around the system
  - Do not have to learn complicated commands
  - Exchange data between different software
  - Good help facilities provided with GUIs
- **Disadvantages**
  - Larger amount of hard disk space than other interfaces
  - Significantly more memory (RAM) to run than other interface type
  - GUI use more processing power than other types of interfaces
  - GUI can be slow for experienced programmers to use, they find CLI much faster

## 1.4. Types of Computers

### Desktop/Personal Computers

- Refers to general purpose computers
- PC refers to IBM compatible computers, distinguishing them from the Macs
- Made up of separate monitor, keyboard, mouse and processing unit
- **Advantages**
  - Spare parts standardized results in low costs
  - Tend to have better specifications
  - Large casing allows good dissipation of heat build up
- **Disadvantages**
  - Not portable since they are made up of separate components
  - Wiring clutters up desk space
  - Necessary to copy files as they aren't portable

### Laptop/Notebook Computers

- Refers to computers where monitor, keyboard, pointing device and processor together in a single unit
- Extremely portable systems
  - Low weight
  - Low power consumption
  - Processor doesn't generate too much heat
- **Advantages**
  - Portable because monitor, pointing device, keyboard, processor & backing store units are together in one box
  - No trailing wires
  - Full advantage of Wi-Fi
  - Can link into any multimedia system
- **Disadvantages**
  - Easy to steal
  - Limited battery; need to carry charger
  - Keyboard and pointing device awkward to use

- Heat dissipation is difficult due to laptop structure

## Tablet Computer

- These are small hand-held devices that can perform many functions that PCs & laptops do
- Often use touch screens to operate
- On-screen virtual keyboard replaces physical keyboard
- Often used by graphic designers to digitalize their content with a stylus pen
- Can be used like a PC and/or a Smartphone
- **Advantages:**
  - Small light & portable
  - Built in cameras for photos & videos
  - Touchscreen can be used with a stylus pen
  - Long battery life
- **Disadvantages:**
  - Less storage spaces
  - Lacks power of laptop/PC
  - Digital keyboard can be difficult to use
  - Touchscreen may be difficult to use for detailed work

## Smartphone

- Modern phones that can perform similar tasks to all the above
- Main use of smartphones is social media & day-to-day planning
- Use varies from person to person
- **Advantages:**
  - Smallest lightest most portable
  - Integrated/virtual keyboard
  - Often the least expensive device
  - More practical for day-to-day use
- **Disadvantages:**
  - Small screen may be difficult to use
  - Not as powerful as other devices
  - Often has the lowest battery life
  - Small size makes it easy to steal/lose

## 1.5. Impact of Emerging Technologies

- This is technology that is being newly developed
- These can have several impacts on our society

### Artificial Intelligence (AI)

- Technology that focuses on creating a computer system that can closely mimic or simulate human intelligence
- AI can be used to:
  - Enhance video games and computer tactics
  - Help decision making steps in expert systems
  - Make robots to imitate human behaviour
  - Understand different human languages
- Impact on everyday life:

- Can be used to accurately predict hazardous weather conditions and signal warnings automatically
- Take over menial tasks for humans; increasing our leisure time
- Can be used for safer automated travel; cars that can drive and park by themselves
- Increases home safety by being able to tell the difference between owner & intruder; call authorities automatically
- Improved medical care as decision making skills and precision can be enhanced

### Biometrics

- A part of a person's body is used to identify that individual
- Can be:
  - Fingerprints
  - Retina
  - Iris
  - Face
  - Voice
- These are all unique to everyone thus can be used as an authentication technique
- Must be added initially to a system to use as identification
- Impacts on everyday life:
  - Better security at the airport since most use at least one form of biometric check if not more
  - Increased security in certain places as only authorized personnel can gain entry
  - Reduced vehicle theft since newer car doors come with a fingerprint lock on the door handle
  - More secure mobile devices as most now have some sort of biometrics integrated into them

### Vision Enhancement

- LVES: low vision enhancement systems: video projected inside a headset in front of the user's eyes. Brings the objects closer for the viewer.
- NVE: Night vision enhancement: amplifies visible and infrared light. Light passed through image intensifier tube where light is converted to electrons, then amplified (increase in no.) and then light up screen with phosphor dust.

### Robotics

- Programmed machinery widely used to do physically demanding tasks
- Can be automated or manually operated
- Used to perform several tasks:
  - Dangerous jobs such as bomb disposal
  - Exploring extreme environments such as volcanoes
  - Repetitive manufacturing jobs such as welding
  - Moving heavy objects such as large engines
- Impacts on everyday life:

- **Increased personal time** since robots can take over domestic chores
- **Increased manufacturing efficiency** since robots are much faster and **less expensive than human labour**
- **Unemployment** as robots replace humans in autonomous jobs
- **Safer working environments** since robots can perform tasks that are too dangerous for humans

## Quantum Cryptography

- Technology that allows messages and data to be sent with complete privacy; basically, advanced **encryption**
- Older encryption is based on mathematics, but this new tech uses physics
- **Makes it much more complex to decrypt**
- Impacts on everyday life:
  - **Completely secure voting** ensuring that votes cannot be tampered with or changed
  - **Completely secure communication** eliminating the risk of being read/heard by the wrong eyes/ears
  - **Completely secure bank transactions** so money goes exactly where it is intended
  - **Completely secure personal information preventing hackers** access to intrusive details about a person

## Computer Assisted Translation (CAT)

- When **human translators use computer software to help in the translation process**
- Can **reduce translation time**
- **May not be 100% accurate**
- Common CAT tools:
  - Spell checkers
  - Translation memory software
  - Language search-engine software
- Impacts on everyday life:
  - More accurate documents since most software can automatically detect errors
  - More **multilingual society** since anyone with an internet connection can now essentially learn multiple languages using translators
  - **Quicker translations**

## 3D & Holographic Imaging

- **Technology that makes images appear to be 3-dimensional by adding a layer of depth**
- Holograms use 2 regular 2D images and manipulate them to produce a 3-dimensional image
- Different laser beams are used to record the 2D images onto a single photographic plate
- This creates an illusion of one 3D images
- Impact on everyday life:
  - **Improved security** since majority of credit/ID cards & bank notes use holograms to prevent forgery

- **Better movie experiences** since 3D viewing can provide a more immersive experience for the audience
- **Greater data storage** since holographic layers can potentially **decrease the thickness of disc storage**

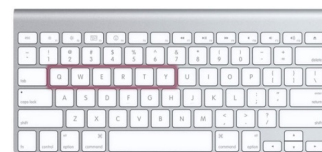
## Virtual Reality (VR)

- When computers create an **artificial environment that users can virtually interact with**
- Uses:
  - **Allow architects to walk around** a virtual version of their design
  - **Training soldiers** for combat by allowing them to fight against virtual enemies
  - **Training surgeons** by allowing them to operate on virtual patients
  - **Playing games and enhance the level of immersion**
- General VR equipment:
  - **Eye goggles** that produce 3D images to develop the artificial environment
  - **Special gloves or controllers** to perform precise actions inside the simulation
  - **Headphones** to control what is heard in the virtual world
  - Powerful computer to run the entire VR system in real time
- Impacts on everyday life:
  - **Improved medical surgeons/soldiers**
  - **Stronger buildings**
  - **Treatment of phobias** as certain situations can be treated using simulations
  - **More realistic education as students** can learn in a more **interactive environment**

## 2. Input & Output Devices

### 2.1. Input Devices & their Uses

#### Keyboards



- **QWERTY-** layout
- Ergonomic- reduces health related problems
- **Uses**
  - Keyboards are used to **input data into application software**
  - Also used to for **typing commands** to the computer (CTRL + P)
- **Advantages**
  - Enables fast **entry of new text** into a document
  - Well-tried technology & well-known method of entry

- Most people find them **easy to use**
- Easy to do verification check as data is entered, as it appears on the screen simultaneously
- **Disadvantages**
  - Users with **limited arm/wrist use can find keyboards hard to use**
  - **Entering data is slow** when compared to direct data entry (e.g. Optical mark recognition)
  - They **use up desk space** as they are quite large

## Numeric Keypads



- A numeric keypad is used to **enter numbers only**
- Although some have function key to allow input of alphabetical characters
- **Uses**
  - **Used in Automatic teller machines (ATMs)**, where customers can key in their personal identification number (PIN), or an amount of money
  - Used to key in phone numbers into telephones
  - **Electronic point of sale (EPOS) terminals have numeric keypads in case the barcode reader fails**
  - Used in Chip and PIN devices to key in PIN, or amount of money
  - **Used to enable fast entry of numeric data into a spread sheet**
- **Advantages**
  - Numeric keypads are **faster than standard keyboards for entry of numeric data**
  - Since many are **small devices** (e.g. mobile phones), they are **easy to carry around**
- **Disadvantages**
  - Can be **difficult** to use due to the **very small keys**
  - **Difficult** to use for **entering text**
  - Sometimes the order of numbers isn't very intuitive

## Mouse

- An example of a **pointing device**
- The ball underneath the mouse is used to detect movement
- The left button is for selecting by double on it and the right is to bring drop-down menus
- There is usually a scroll button which speeds up the process of moving through a document
- **Uses**
  - Used for **opening, closing and minimising software**
  - Used for **grouping, moving and deleting files**
  - Useful when editing images (e.g. controlling the size and position of the image)
  - Used for controlling the position of a pointer on the screen to allow:
    - Selection from a menu
    - Selecting an icon

- Selection from a menu
- Selecting an icon
- **Scrolling up/down and right/left**
- **Advantages**
  - **Faster to select an option by a mouse than a keyboard**
  - Enables **rapid navigation** through applications and the internet
  - Mice are **small and don't take much area**
- **Disadvantages**
  - People with **restricted hand/wrist movement can find it hard to operate a mouse**
  - Easily damaged and can easily be **clogged up with dirt**
  - They are hard to use if there is no flat surface available

## Touchpad

- Touchpads are used in many laptop computers as a pointing device
- The pointer is controlled by the user moving their finger on the touchpad
- **Uses**
  - Used for opening, closing and minimising software
  - Used for grouping, moving and deleting files
  - Useful when editing images (e.g. controlling the size and position of the image)
  - Used for controlling the position of a pointer on the screen to allow:
    - Selection from a menu
    - Selecting an icon
- **Advantages**
  - Faster to select an option by a touchpad than a keyboard
  - Enables rapid navigation through applications and the internet
  - Since the touchpad is integrated into laptop computer, there is no separate mouse, aiding portability
  - They can be used when no flat surfaces are available
- **Disadvantages**
  - People with limited hand/wrist movement can find touchpads hard to use
  - It can be more difficult to control the pointer when compared to a mouse
  - They are more difficult when doing operations such as 'drag and drop'

## Tracker Ball



- Tracker ball is like a mouse except that it has a ball on the top of the device
- Users control the pointer on the screen by rotating the ball
- **Uses**



- Have the same pointing/cursor control capability as a mouse
- Used in applications where the user has a disability (RSI)
- Used in a control room environment, where it is faster than a mouse to navigate through process screens and more robust than a mouse
- **Advantages**
  - Tracker balls don't need the same fine control as a mouse
  - People with limited hand/wrist movement find easier to use than a mouse
  - The pointer can be positioned more accurately on the screen than with a mouse
  - They take less desk space than mice since they are stationary
- **Disadvantages**
  - Tracker balls are not supplied with the computer as standard, so they are more expensive
  - User may need training since they are not standard equipment

## Remote Control

- A remote control is used to control the operation of other devices remotely by using infra-red signals
- **Uses**
  - In home entertainment devices such as Televisions, DVD player/recorder and satellite system
  - Used to control multimedia systems
  - Used in industrial applications to remotely control processes, stop and start machinery
- **Advantages**
  - Enable devices to be operated from any distance, which is useful for people with disabilities
  - Some chemical processes are hazardous, so it is safer to operate equipment from a distance
- **Disadvantages**
  - People with limited hand/wrist movement can find them hard to use
  - The signal between the control and the device can be easily blocked

## Joystick



- By gripping the stick, a pointer on the screen can be controlled
- Buttons are used to make selections
- **Uses**
  - Video/computer games are often controlled by joysticks
  - They are used in simulators to mimic actual controls

- **Advantages**
  - Easier to navigate round a screen compared to a keyboard
  - Control is in three dimensions
- **Disadvantages**
  - More difficult to control the on-screen pointer with a joystick than with other devices such as mice

## Touch Screen

- User can choose an option by simply touching a button/icon on the screen
- The selection is automatically made without the need for any pointing device
- **Use**
  - Used for service tills e.g. petrol stations
  - Used where selections are made on a screen e.g. ATMs, public information systems, airports and railway stations
  - Used in PDA's
  - Used in Interactive white boards
  - Used in computer-based training (CBT)
- **Advantages**
  - Enable faster entry of options than a keyboard/mouse
    - Very easy to choose options
    - User friendly method for inputting data
    - They are tamperproof, preventing people from keying in information (which could corrupt the system)
- **Disadvantages**
  - There is a limited number of options available
  - Using touchscreens often can lead to health problems e.g. (straining of arm muscles and RSI)
  - The screen can get very dirty with constant touching

## Scanners

- Used to input information on hardcopy e.g. text document
- **Uses**
  - Used to scan in documents and convert them into a format for use in various software packages
  - Old and valuable documents and books can be scanned, protecting the original copies from damage
  - Non-digital photographs can be scanned for storing on a computer
- **Advantages**
  - Images can be stored for editing later
  - Scanners are much faster and more accurate than typing in documents again
  - It is possible to recover damaged documents and photographs by scanning them and then using appropriate software to produce an acceptable copy
- **Disadvantages**
  - The quality can be limited depending on how good the scanner resolution is

**Digital Cameras**



- Photographs are stored in memory
- They can be easily transferred to a computer using a USB
- **Uses**
  - Digital cameras can produce photographs for direct transfer to a computer or to print out
  - Digital cameras allow short video clips to be produced
  - Photographs can be uploaded directly into application software such as word processor
- **Advantages**
  - Easier to produce better quality photographs than with a tradition camera
  - Easier and faster to upload photographs to a computer
  - There is no need to develop film and print out photographs (saves paper and no longer needs the chemicals to produce photographs from films)
  - Easy to delete an image from the memory if it's not satisfactory
  - The memory card can store several hundred photographs
- **Disadvantages**
  - The camera user needs to be computer literate to use the camera properly
  - There is some artistry lost since clever software corrects errors in the photographs
  - The resolution is not yet as good as traditional cameras
  - Images often need to be compressed to reduce the amount of memory used
  - It is possible to fill up computer memory very quickly with several photos of the same subject (to find the perfect snap shot)

**Video Camera**

- DV (digital video) camera store compressed photo frames at 25 MB/s – motion jpeg.
- Light turned into electronic signal through light sensitive sensors and automatically converted to a digital file format.
- **Advantages**
  - Easy to edit footage in a video editing.
  - High quality video captured, therefore
- **Disadvantages**
  - Storage medium (Memory cards) more expensive to buy than films.

**Microphone**



- Can be connected directly to a computer
- Sounds can be inputted and manipulated
- **Uses**
  - Microphones are used to input speech/sounds to be used in various applications
  - They are used in voice recognition software- for conversion of speech into text, and recognition of commands
- **Advantages**
  - Faster to read in text than to type it using a keyboard
  - Possible to manipulate sound in real time using special software
  - If used in a voice activation system, this has the advantage of improving safety
- **Disadvantages**
  - Sound files can use up a lot of computer memory
  - Voice recognition software isn't as accurate as typing in manually

**Sensors**

Type of sensor	Applications
Temperature	Automatic washing machines, central heating systems, automatic green houses, ovens
Pressure	Burglar alarm systems, robotics, environmental monitoring, Automatic washing machines
Light	Automatic doors, street lighting control, Burglar alarm systems, automatic greenhouses
Sound	Burglar alarm systems, monitoring liquid and powder flow in pipes
Humidity/moisture	Automatic greenhouses, environmental monitoring, factories where moisture levels are crucial
pH	Automatic greenhouse, chemical processes, environmental monitoring

- **Advantages**
  - Readings by sensors are more accurate than taken by humans
  - Readings are continuous, there is no break in monitoring
  - Because it is a continuous process any necessary action or warning will be initiated immediately
  - The system can be automatic, removing the need for human intervention, this is particularly important if the process is hazardous

- **Disadvantages**
  - Faulty sensors can give spurious results

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## Graphic Tablet



- A graphic tablet is used with a stylus to produce freehand drawings
- **Uses**
  - Graphics tablets are used to produce drawings, computer graphics
  - In countries where characters are complex e.g. Japan, they are used as a form of input
  - They are used in computer aided design (CAD) work
- **Advantages**
  - It is possible to modify drawings before they are input
  - They offer an accurate method of drawing
- **Disadvantages**
  - They are more expensive than other pointing devices

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## Web Cam



- Connected directly to a computer via a USB port
- **Uses**
  - While chatting online webcams can be used to have conversations
  - Used to enable video conferencing to take place
- **Advantages**
  - Can be left on constantly and activated when required
  - Allow people to keep in contact with each other without the need to travel, particularly useful for disabled or elderly people
- **Disadvantages**
  - Webcams have limited features and the picture is often of poor quality
  - They need to be connected to a computer

## 2.2. Direct Data Entry & Associated Devices

### Magnetic Stripe readers



- Used to read information on the magnetic stripe

- The stripe contains useful information such as start and expiry date
- **Uses**
  - Credit and debit cards have magnetic stripes that are used by ATMS or EFTPOS (electronic funds transfer point of sale) terminal
  - Security cards for entering building e.g. hotel rooms
  - Travel systems e.g. train and underground tickets
- **Advantages**
  - Data entry is fast compared with keying in using a keyboard or keypad
  - System is error free, no typing involved
  - Information is secure since there is no typing and the information can't be read directly by a person
  - Can prevent access to restricted/secure areas
  - Magnetic stripes are unaffected by oil water and moisture
  - No moving parts therefore physically robust
- **Disadvantages**
  - If the magnetic stripe is damaged the data is lost
  - Card needs to be in close contact with the reader
  - Since the information is not human readable, they need to find a way to show the information to the customer (e.g. hotel room number not printed on cards)

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### Chip & PIN readers



- The device has a slot where the card is placed, and the chip is read
- A small screen is part of the reader which gives instructions to the operator
- **Uses**
  - Chip and PIN readers are used where payments are made using cards e.g. travel agents
- **Advantages**
  - Provide a more secure payment system than requiring a signature or using magnetic stripe, since the PIN typed in must match up with the PIN stored on the chip
  - Provide a more robust system than magnetic stripe since the chip does not need to be in contact with the reader
- **Disadvantages**
  - Customer needs to be careful when typing in the PIN, so nobody reads it giving an opportunity for fraud

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### Radio Frequency Identification (RFID) Readers

- RFID readers work in similar ways to a bar code reader
- An RFID tag is attached to/inside a surface



- The reader reads the data held on the tag which is then input into the computer system for processing
- Radio waves are used to transmit data thus can be used through most materials
- **Uses**
  - Used in retail or supermarkets as barcode alternatives
  - Used to identify pets
  - Used in passports
- **Advantages**
  - Can hold a lot of data
  - Can be read from long distances
  - Does not require direct line of sight
  - Information can be read faster than barcodes
  - Can alter information
- **Disadvantages**
  - Thieves can steal information easily
  - RFID tags are expensive
  - Radio waves can experience interference

## Magnetic Ink Character Reader (MICR)



- Magnetic ink character recognition is a system which can read characters printed in a special ink
- **Uses**
  - Used to process cheques in banking operations – cheque is read using a batch processing method
- **Advantages**
  - MICR offers great security than OCR since the oriented characters cannot be altered
  - There is no manual input, thus errors are reduced
  - If somebody writes over the magnetic ink characters, it can still be read
- **Disadvantages**
  - Only certain characters can be read, and the number of different characters is very limited
  - It is a more expensive method than other methods used for direct data entry

## Optical Mark Reader



- Optical mark recognition is a system which can read marks written in pen or pencil
- **Uses**
  - OMR devices are used to read questionnaires, multiple choice examinations papers and other types of forms in the form of lines or shaded areas
- **Advantages**

- A very fast way of inputting results of a survey
- Since there is no typing, it is more accurate than keying in data
- OMR is more accurate than OCR
- **Disadvantages**
  - Forms need to be carefully designed to make sure that the marks/shadings are correctly positioned to gather accurate information
  - There can be problems if forms aren't filled correctly, sometimes they must be checked manually before being read by an OMR, this is both time consuming and expensive

## Optical Character Reader



- Optical Character recognition is a software that takes scanned text and converts it into a computer readable form
- **Uses**
  - Processing of passports and Identity cards
  - OCR is used when scanning documents to modify them using a suitable software
- **Advantages**
  - Much faster data entry system than manually keying in data
  - Since there is no manual data entry, the number of errors is reduced
- **Disadvantages**
  - The system has difficulty reading handwriting
  - It is still not a very accurate technique

## Barcode readers



- Used to read information in the form of a barcode
- Handheld scanners or wands are very common for reading barcodes
- **Uses**
  - Used in supermarkets and other shops where the goods are marked with a barcode
  - Used in libraries to scan user's library card and barcodes on books (to keep track of books on loan)
  - Used as a safety function in many companies to ensure that electrical equipment is checked on a regular basis
- **Advantages**

- Faster than keying in information, and fewer mistakes are made
- Used as a way of recording data, can improve safety
- Barcodes enable automatic stock control
- Barcode scanning is a tried and trusted technology
- When an item price is changed, only the central database needs to be updated, there is no need to change the prices individually on each item
- **Disadvantages**
  - Barcode scanning is an expensive system to administer since every item in the shops needs a barcode and every barcode needs to be entered on the system
  - Also, there is a need to invest in the computer technology together with staff training, which can all be expensive
  - The system is not fool proof- barcode can be swapped around on items

## 2.3. Output Devices & their Uses

### CRT Monitor

- Cathode Ray Tube monitors
- Least expensive type of monitor, becoming rarer as TFT monitors take over
- Come in various sizes
- Picture created is made up of tiny dots (red green or blue), the intensity of the colour of the dot determines the colour perceived by the eye
- **Uses**
  - Primary output device for computers, user can immediately see what they are typing in
  - Used with light pens to allow designs to be created on screen
- **Advantages**
  - Produce higher quality images than TFT monitors
  - Angle of viewing is better than a TFT monitor
  - They work with light pens in CAD and CAM applications (Computer Aided Design/Manufacturing)
- **Disadvantages**
  - Tend to be heavy, weight hazard if not supported properly
  - Run very hot, can cause fires if left unattended – especially if they are old
  - Consume more power than TFT monitors
  - They can flicker, this leads to headaches and eyesight problems with prolonged use

### TFT Monitor



- Thin Film Transistor monitors
- Taking over from CRT monitors as the main output device
- The progress in TFT technology is one of the reasons for the rapid development of laptop computers
- The screen is made up of thousands of tiny pixels which are made up of transistors controlled by a microprocessor
- Each pixel has three transistors-red, green or blue; the intensity of each determines the colour of the pixel seen.
- **Uses**
  - Primary output device for computers, user can immediately see what they are typing in
  - Integral part of laptop computers
- **Advantages**
  - Lightweight, so no weight hazards like CRT monitors
  - Less glare produced than in CRT monitors; also emit less radiation
  - Consume much less power and generate less heat than CRT monitors
- **Disadvantages**
  - Angle of viewing is critical; image appears unclear if viewed slightly from the side
  - This is an issue if several people are looking at the screen at the same time
  - They cannot yet be used with light pens,

### IPS/LCD Monitor

- Front layer made from liquid crystal diodes; grouped together to form pixels (RGB or RGBY-more vivid colours)
- Receive analogue and digital signals, although most modern projectors only work with digital inputs
- IPS (In-plane switching) is the technology used in LCD monitors.
- **Advantages**
  - Colour can be seen accurately from different viewing angles
  - No lightening on touching
- **Disadvantages**
  - Expensive
  - High power consumption
  - Slow response time
- Note: Old LCD monitors used CCFL (cold cathode fluorescent lamp) technology to light up the screen.

### LED Monitor:

- Front layer made from liquid crystal diodes; grouped together to form pixels (RGB or RGBY-more vivid colours)
- For the image to show up on-screen a light source of LED backlight is used.
- **Advantages (over LCD monitors):**
  - Lighter and thinner
  - Longer life
  - Lower power consumption
  - Greater contrast and more vivid colour

- Relatively more robust
  - **Disadvantages**
    - Glare gives viewers headaches
    - Images too sharp, so can cause eye strain
- 

## Touch Screen

- Automatic selection without a pointing device
  - **Uses**
    - Automatic teller machines
    - EFTPOS (electronic fund transfer point of sales)
    - PDA
    - Smartphones
    - Public information points
  - **Advantages**
    - Faster data entry
    - Easy to choose options
    - User-friendly and intuitive
  - **Disadvantages**
    - Limited options
    - Frequent usage can lead to RSI, etc.
    - Constant usage results in the screen getting dirty; visibility and sensitivity decreases
- 

## Multimedia Projector



- Receive analogue and digital signals, although most modern projectors only work with digital inputs
- The signal source is usually from a computer, television, or DVD player
- The image from the source is magnified and projected onto a large screen
- The devices usually work with a remote control, but can also use virtual mouse technology – cordless PC mouse (has a laser pointer)
  - It is then possible to direct the presentation without being tied to the computer
  - Most multimedia projectors take input from various types of video format e.g. PAL, NTSC or SECAM
- **Uses**
  - Used for training presentations (allows the whole audience to see the images from a computer)
  - Also used for advertising presentations (shown at exhibitions, shopping malls etc.)
  - Home cinema systems (projecting the images from a DVD or television) use multimedia projectors
- **Advantages**
  - Enables many people to see a presentation rather than all of them crowded around a small computer screen
  - Avoids the need for several networked computers

- e.g. when looking at a video clip on the internet, everybody can see the video on the large screen rather than logging on to several computers
  - **Disadvantages**
    - Images can sometimes be fuzzy
    - Expensive to buy
    - Setting up projectors can be a little difficult
- 

## Laser Printer



- Produce very high-quality hard copy output
  - Print rate per page is fast if many pages are being printed
  - Rely on large buffer memories – the data for the whole document is stored before pages can be printed out
  - **Uses**
    - Used where noise levels need to be kept low e.g. in an office
    - The best option for fast, high quality, high volume printing
  - **Advantages**
    - Printing is fast for high volumes, slightly faster than inkjet if only a few pages are to be printed
    - Can handle very large print jobs
    - Quality is consistently high
    - Toner cartridges last for a long time; laser printers can be a cost-effective option if colour outputs are not required
  - **Disadvantages**
    - Expensive to buy
    - Only fast if several copies are being made
    - Colour laser printers tend to be expensive to run since four cartridges are needed as well as diffuser kits, etc.
    - Produce ozone and volatile organic compounds because of their printing method and type of toner/ink used
    - These have been linked to health hazards in the office
- 

## Inkjet Printer



- Used to produce good quality hard copies – the quality is not as good as in laser printers but much better than that of dot matrix printers
- Do not have large buffers like laser printers, so printing is done a bit at a time

- Therefore, printing is sometimes paused – the whole page can't be stored in the buffer, it must wait for the computer to send more data
- **Uses**
  - Used where low volume outputs are needed
  - Ideal for high quality printing for small print jobs or single pages e.g. for photo quality printouts
- **Advantages**
  - High quality output
  - Cheaper to buy than laser printers
  - Very lightweight and take up little space (small footprint)
  - Do not produce ozone and volatile organic compounds, unlike laser printers
- **Disadvantages**
  - Output is slow if several copies needed – there is little buffer capacity to store the pages
  - The ink cartridges run out too quickly to be used for large print jobs
  - Printing can smudge if the user is not careful
  - Can be expensive to run if they are used a lot – original ink cartridges are expensive

## Dot Matrix Printer



- A type of impact printer
- A print head made up of a matrix of pins presses against an inked ribbon
- **Uses**
  - Can be used in noisy environments e.g. garage workshops
  - Can be used in applications where the print quality is not very important
- **Advantages**
  - Can be used in environments which would be a problem for laser and inkjet printers – dusty, dirty or moist atmospheres
  - Carbon copies or multi-part outputs can be produced
  - Very cheap to run and maintain
  - Easy to use if continuous stationary is required e.g. long print jobs such as wage slips
- **Disadvantages**
  - Very noisy – not good in an office environment
  - Cost more than an inkjet printer to buy
  - Very slow
  - Printing is of poor quality

## Wide Format Printer



- Devices that produce hard copies but operate in a different way to printers
- Not limited to normal printer paper size and can produce highly accurate, very large drawings and posters
- The most common types are pen plotters, electrostatic (similar method to laser printers) and inkjet plotters
  - With pen plotters, coloured pens are controlled by a computer and the paper can move backwards and forwards to allow accurate shapes to be drawn
- **Uses**
  - Used to produce large drawings e.g. blueprints of buildings; are often used with CAD applications
  - Used to produce large pictures for use on billboards or giant posters
    - They can also print on plastic coated paper
- If the pens are replaced by cutting tools, it is possible to make large signs
- **Advantages**
  - Can produce huge printouts
  - Print quality is extremely high
- **Disadvantages**
  - Slow in operation
  - Expensive to buy and maintain

## 3D Printer



- A new type of printer that produces solid 3D models using modified inkjet technology called tomography
- Very thin layers of fine powder (plaster, resin, starch) are bonded together as a 3D model is slowly built up
- Items produced are known as prototypes
- **Uses**
  - Used to produce prototypes which work from CAD packages, photograph images, stored drawings etc.
  - Scale models are produced in colour before the real thing is manufactured
  - The ultimate objective is to produce organic objects using this layering technology (such as replacement human organs)
- **Advantages**
  - Save a lot of money, other methods of making prototypes are very time consuming and expensive
  - The powders used can often be ground up and reused
  - Physical scale models are produced with working parts, which gives a better idea of how the product will look

- **Disadvantages**
  - Expensive to buy
  - Slow at producing their output
  - Product is sometimes a little rough, often further work needs to be done

## Speakers



- Can be connected directly to a computer or are built into the monitor or casing (as in laptop computers)
- Uses a digital to analogue converter (DAC) to convert digital data from the computer to analogue from so the speakers can process it; the signal is then amplified through the speakers.
- **Uses**
  - Used to output sound from multimedia presentations
  - Used in home entertainment centres
  - They can help blind people through audio output of text on the screen (together with speech generation software)
  - Used to play downloaded sound files
- **Advantages**
  - Usually long lasting and durable (if operated within their intended power levels)
  - Often provided with the computer/laptop although these may not be the best quality
- **Disadvantages**
  - Can take up a lot of desk space, compared to headphones
  - Can distract people around you, everyone can hear what you are playing
  - May not be able to hear the full sound spectrum, this requires multiple speakers

## Actuators

- A type of controlling device
- Transducers that are used to take signals from a computer and convert them into some form of motion e.g. operating motors, pumps, switches and valves
- Digital signals are sent from the computer to an actuator to operate a device
- Conversion of the digital signal to analogue is required first (using a DAC)

## Motors



- Turned on or off by the actuator
- **Uses**
  - Used in many domestic appliances
  - Automatic washing machines (to make the drum rotate)
  - Cookers (to switch on fans)
  - Water pumps in central heating systems
  - Automatic greenhouses to open windows and switch on fans
  - Used to control robot arms in the industry
  - Operate fans, disk drives and DVD drives in computers

## Buzzers

- Switched on or off by the actuator
- **Uses**
  - Used in cookers and microwave ovens to tell the operator when the cooking process is complete
  - Used in burglar alarm systems to warn if intruders are present

## Heaters

- Actuators are connected to switches which turn the heater on or off
- **Uses**
  - Used in automatic washing machines, cookers and central heating systems
  - Used in automatic greenhouses to control the temperature

## Lights

- The actuator is connected to the switch that turns the lights on or off
- **Uses**
  - Security lights
  - Used in greenhouses to control the lighting conditions

## 3. Storage Devices & Media

### 3.1. Magnetic Backing Storage Media

#### Fixed Hard Disks/Drives

- Available on all computers and is the main method used for data storage
- Uses a read/write head to write and read data from it
- Disk surface coated in magnetic film, storage is done by altering binary codes to 1s or 0s
- **Uses**



- Used to store operating systems and working data
  - Used for storing application software
  - Real time systems and online systems used fixed hard drives
  - Used in file servers for computer networks
  - **Advantages**
    - Very fast data transfer rate and fast access times to data
    - Have very large memory capacities
  - **Disadvantages**
    - Can be easily damaged
    - They lack portability
- 

## Portable & Removable Hard Disks/Drives

- Like fixed hard disks but are usually connected via universal serial bus
  - **Uses**
    - Can be used as backup systems to prevent loss of data
    - Can be used to transfer data, files and software between computers
  - **Advantages**
    - Data access time and transfer rate is very fast
    - Large memory capacities
    - Can be used to transfer information between computers
  - **Disadvantages**
    - Can be easily damaged
- 

## Magnetic Tapes & Drives

- Thin strip of plastic which is coated in a magnetic layer
- Read and written by read/write head
- **Uses**
  - Application where batch processing is used
  - Used as a backup media
- **Advantages**
  - Generally, less expensive and very robust technology
  - Data transfer rate is fast
- **Disadvantages**
  - Access time is very slow
  - When updating another tape is needed

## 3.2. Optical Backing Storage Media

### CD-ROM/DVD-ROM

- Read only memory – cannot be overwritten
- Data is stored as a series of pits and lands formed by a laser beam etching the surface at manufacturing stage
- **Uses**
  - Store music files and software.
  - Very large storage capacity and are used to store films.
- **Advantages**

- Holds more data than floppy disks
  - Less expensive than hard disk drives
  - **Disadvantages**
    - Data transfer rate and data access time are slower
- 

### CD-R/DVD-R

- The letter 'R' means the disc is recordable only once and then it becomes ROM
  - Use a thin layer of an organic dye as the recording media
  - DVDs also use an additional silver alloy or gold reflector
  - Laser beam produces heated spots and unheated spots
  - **Uses**
    - They are used for home recording of music (CD-Rs) and films (DVD-Rs)
    - They are used to store data for later use
    - Used in applications where it is necessary to prevent the deletion or over-writing of important data
  - **Advantages**
    - Cheaper than RW disks
    - Once burned (and finalized) they are like ROM
  - **Disadvantages**
    - Can only be reordered once
    - Not all CD/DVD players and can read CD-R
- 

### CD-RW/DVD-RW

- 'RW' means that these disks are re-writable media can be written over several times
  - Unlike CD-R/DVD-R they don't become ROMs
  - The recording layer uses a special phase-changing metal alloy
  - The alloy can switch between crystalline and amorphous (non-crystalline) phases, thus changing its reflectivity to light, depending on the laser beam power
  - Spots are produced which can be read by a laser
  - System allows data to be written, erased and re-written many times
  - **Uses**
    - CD-RWs and DVD-RWs are used to record radio and television programs
    - They are used in closed circuit television (CCTV) systems
  - **Advantages**
    - Can be re used many times
    - Different file formats can be used each time
    - Less wasteful than R format since files or data can be added at a later stage
  - **Disadvantages**
    - Relatively expensive media
    - Possible to accidentally overwrite
- 

### DVD-RAM

- Recent addition to optical media group
- Unlike other CD and DVD formats, DVD-RAMs have several discrete concentric tracks rather than a single spiral track
- Gives them advantage that writing, and reading can occur at the same time
- Makes it possible to watch an already recorded television program at the same time as a different program is being recorded
- Recording layer is made from similar phase-changing material to that used in RW technology
- Shiny and dull marks represent data to a computer where they are interpreted
- **Uses**
  - DVD-RAMs are used in recording devices such as satellite receivers to allow simultaneous recording and playback
  - They are used in camcorders to store films
- **Advantages**
  - Have a long life (30 years)
  - Can be re written on more than the DVD-RWs (100,000 times)
  - Very reliable as they have built in verification software to ensure accuracy of data
  - Access is very fast
  - No need to finalize the disk
  - Very large capacities
  - Ability to read and write data at the same time
- **Disadvantage**
  - DVD-RAMS are not as compatible as R or RW, many systems will not recognize this format
  - More expensive than DVD-RW

## Blu-Ray Discs

- **Uses**
  - Blu-ray disks are used in home video consoles
  - Used for storing and playing back films
  - PCs can use this technology for data storage or backing up hard drives
  - Camcorders can use this media to store film footage
- **Advantage**
  - Very large storage capacity
  - Data transfer rate is very fast
  - Data access speed is faster than with other optical media
- **Disadvantage**
  - Disks are relatively expensive
  - Blu-ray disks still have encryption problems

## 3.3. Solid State Backing Storage

- Solid state systems control the movement of electrons within a microchip: if the transistor conducts a current, this is equivalent to a 1, otherwise it is a 0
- Have no moving parts, consume much less power and are extremely robust

- Used primarily as removable storage devices and are collectively known as flash memory

## Solid State Drives

- Supports reading/writing data & maintains stored data in a permanent state even without power
- Functions much like a hard drive but different tech
- Built with an array of semiconductors that form its memory and operated using an integrated circuit
- **Uses**
  - Used to store operating systems and working data
  - Used for storing application software
  - Used in file servers for computer networks
- **Advantages**
  - Faster than hard disks because they do not need to 'spin up' the disk
  - Robust because no mechanical parts
  - Read performance is fast even when data fragmented
  - Less susceptible to data loss
  - Lighter, quieter and require less power than hard disks
- **Disadvantages**
  - More expensive than hard disks
  - Have a smaller capacity than modern hard disks
  - Lower number of write cycles causing performance to diminish over time

## Flash Drives/Memory Sticks

- Otherwise called pen drive/memory stick/USB stick
- Can store several GBs of data and use solid state technology
- Connected to a computer through USB port and power to operate drawn from host computer
- Some expensive software increasingly uses these storage methods as a form of security
- **Uses**
  - Used to transport files between computers
  - Used as a security device – a dongle – to prevent software piracy
- **Advantages**
  - Very compact and portable media
  - Very robust
- **Disadvantages**
  - Not possible to write protect the data and files
  - Small physical size and are easy to lose.
  - Lower storage capacity than hard disk

## Flash Memory Cards

- A form of electrically erasable programmable read only memory (EEPROM)
- **Uses**
  - Used to store photos on digital cameras
  - Mobile phones use them as memory cards

- Used in MP3 players to store music
- Used as a backup in hand held devices
- **Advantages**
  - Very compact
  - Very robust
- **Disadvantages**
  - Very expensive per Gb of memory when compared to hard drive disks
  - Has a finite life in terms of the number of times they can be read from/written to.

## 4. Networks & the Effects of Using them

### 4.1. Routers

- A device that enables data to be sent between different types of networks
- Commonly used to connect computers and other network capable devices to the internet
- They can be connected to through cables or wirelessly

#### Function

- Makes decisions on messages being passed between the networks
- Reads information about the message and decides where the message should go and the best route for it to get there
- Formats the messages making it suitable for the new network

#### How it Works

- To send data to a specific device, a router needs a something like an address
- **Internet Protocol Address:** a unique number assigned to all computers and devices connected to the internet which can determine its exact physical location
- A router can use this IP to send data from the internet to the exact device that requested it
- Storing IP Addresses:
  - Routers store IP addresses in a routing table
  - Routing tables list all the different routes to other networks
  - Routing table determines best route for data

#### Sending Data between Devices

- Routers can also send 'packets' of data between devices on different networks
- Each packet contains the data itself and the IP address of the device being sent to

- Occurs globally using multiple routers & re-routing until the data reaches its intended IP address

## 4.2. Common Network Devices

### Network Interface Cards

- Used to connect individual computers/devices to a network
- NICs come in two distinct types:
  - Wired: cards that have ports which allow network cables to be plugged in directly
  - Wireless: cards that connect to networks using Wi-Fi signals

### Hubs

- They are devices that can have multiple devices connected to them
- Main task is to receive data from different ports and send it to each device
- The information will be received to the device whether its relevant, or not

### Bridges

- It connects 2 different types of networks together e.g. a bus and star network
- It can only connect networks that use the same way for handling messages
- They do this by changing the form of message to suite the different type of network

### Switches

- More efficient than hubs in distributing data
- Each device has an access control media address MAC which identifies it uniquely
- **MAC Address:** a number unique to each device connected to the network (like fingerprints)
- Data sent will have a mac address which tells the source and receiving device

### Modems

- It stands for modulator demodulator.
- Converts computer's digital signals (modulates it) into analogue for transmission through telephone lines
- Reverse this process- analogue signal from a telephone line into digital for a computer to process the data (demodulates it)
- The main use it to connect to computer networks over long distances using existing telephone lines

#### Types of Modems:

- Dial-up modems: operate at 60 kilobits/sec
  - slow compared to modern standards
- Asymmetric: faster at downloading than uploading
  - (ADSL) asymmetric digital subscriber line modems operate at 11,000 kilobits/sec
  - Don't tie up line while accessing internet, which allows simultaneous internet access and usage of telephone
- Cable modems: allow cable TV users to receive TV signals as well as internet access

## 4.3. Wi-Fi & Bluetooth

### Wi-Fi

- Any system which allows you to connect to a network or computer through wireless communication
- Examples:
  - WLANs
  - PDAs
  - Laptop computers
  - Peripheral devices such as printers
- **Wi-Fi Hotspots**
  - Wi-Fi systems rely on AP (radio frequency technology) to enable the device to receive and send signals
  - Wi-Fi hotspots are places where you can access Wi-Fi (free or paid)
  - Hotspots are found in public places like Airports, hotels, and cafés
  - War driving: The act of driving and searching for unsecured Wi-Fi hotspots
  - This gives a risk to the Wi-Fi system

### Bluetooth

- Bluetooth is an example of wireless personal area networking (WPAN) technology
- Spread spectrum transmission (radio waves) is used to provide wireless links between devices such as mobile phones and allow connection to the internet
- A small home network can be created with this system
- **Uses**
  - Transfer photos from camera to mobile phone
  - Wirelessly connect different external devices

## 4.4. Accessing the Internet

- User can access by web browser

Type of access	Description
Dial up internet access	Slowest type (60kbps), Telephone line gets tied up while a dial up modem is in operation
Cable internet access	Local cable television operators give user access through cable networks

Type of access	Description
Internet access via DSL	Fastest download speed connections (at least 11000kbps)

## 4.5. Web Browser

- Software used to retrieve, present & traverse the World Wide Web
- **World Wide Web:** system of interlinked hypertext documents accessed via the Internet

### HTTP Proxy Server

- Type of server that acts as a **buffer** between a WAN and a LAN
- Retrieves web pages and passes them onto the computer that made a request
- Stores any page retrieved on the server, which means that when a different computer requests the same page it would be available
- Speeds up the browsing process

### Websites

- Web is made up of millions of websites and web pages
- Web pages are documents on a computer screen containing various multimedia and text, pictures
- A website consists of many of these pages linked together

### Uniform Resource Locator (URL)

- Web browsers use URLs to retrieve files
- They are multiple ways of locating on the internet
- Standard form: 4 numbers e.g. 194.106.220.19
- Alphanumeric form:
  - protocol://web address/path/filename
    - Where; Protocol is usually http
    - Site address consists of: computer name, domain name, domain type, and country code
    - Path is the web page
    - Filename is the item on the page

## 4.6. Email

- A method for sending text and attachments from one computer to another over a network
- **Advantages**
  - Speed of sending and receiving replies is quick
  - Low cost (no stamps, paper etc.)
  - Not needing to leave home to send the mail
- **Disadvantages**
  - Possibility of virus threats and hacking
  - Need for the email address to be correct
  - Inability to send bulky objects via emails

### 4.7. Internet Service Provider (ISP)

- These are companies that provide users with access to the internet
- Provider in return for these services is charged a monthly or annual fee
- After paying this fee, a username and password are issued which can be used to connect to the internet

### 4.8. Common Network Environments

#### Internet

- A worldwide collection of networks and computers that have joined together
- Uses of the Internet:
  - Web Browsing
  - Email
  - File Sharing
  - Entertainment
  - Video Conferencing
  - Online Banking
  - Advertising & Blogging
  - Social Media

#### Intranet

- Like the internet but only accessible to specific users
- Basically, a private internet where outsiders cannot connect to it
- Uses of an Intranet:
  - Web Browsing
  - Email
  - File Sharing
  - Schools: share information and learning resources with students
  - Businesses: share private information within a large company securely

#### Comparing Internet & Intranet

	Internet	Intranet
Phrase Origin	International Network	Internal Restricted Access Network
Purpose	Globally share data	Privately share data
Audience	Wide range of people	Specific company or organisation
Access	Anywhere if you are connected	Only from within the company

#### Local Area Networks (LAN)

- Not over a large geographical area (e.g. in one building)
- Typical LAN will consist of several computers and devices

- Devices and computers will be connected to hubs or switches
- One of the hubs or switches will usually be connected to a router/modem to allow LAN to connect to the internet
- In doing so it then becomes part of a wide area network
- **Advantages**
  - The sharing of resources
  - Communication between users
  - Network administrator can control and monitor all aspects of the network
- **Disadvantages**
  - Easier spread of viruses throughout the whole network
  - Development of printer queues
  - Slower access to external networks e.g. internet
  - Increased security risk
  - If main server breaks down, usually the networks will no longer function

#### Wireless LANs (WLANs)

- Do not involve any wiring or cabling
- Provide wireless network connection over a short distance
- They use radio or infrared signals instead of cables
- Devices known as Access Points (APs) are used for a larger range
- APs usually use spread spectrum technology (larger range)
- **Advantages**
  - All computers can access the same services and resources
  - No cabling is involved
  - The system is more flexible
  - Adding new computers and devices is very easy
  - Cost is reduced, and safety is improved
- **Disadvantages**
  - Security is an issue
  - Problems and interference can affect the signal
  - The data transfer is slow than in the wired LAN

#### Wide Area Networks (WAN)

- WAN is formed by several LANs being connected through a router or a modem
- Some companies set up Private WANs, it is expensive however it comes with a more enhanced security
- It is common to use an Internet service provider (ISP) for connections to the internet and communicate via this network system
- Additional hardware is needed for a WAN: Routers, modems and proxy servers

### 4.9. Using Different Types of Computers to Access the Internet



**LAPTOP COMPUTERS**

Advantages	Disadvantages
More portable than desktops can access internet in more locations	Less portable than tablets/smartphones
Larger screen than tablets & smartphones which allows easier reading	Screens not as large as desktop PCs may not appear as clearly
Keyboards are bigger than those on tablets/smartphones	CPUs are not as powerful as those in desktops
Touchpads allows easy navigation even on slanted surfaces	

**DESKTOP COMPUTERS**

Advantages	Disadvantages
Most websites are designed to be viewed on a desktop	Not portable so are limited to use in one room
Have larger keyboards making it easier to type on	Require keyboard and mouse as extra peripheral devices
Screens are larger so giving an easier and better viewing experience	Screen and Monitor consume separate power.
Usually use wired internet connections which is more stable/reliable than Wi-Fi	Cannot usually connect to devices like Bluetooth speakers without external adapter
Robust	Take up large desk space
Good heat dissipation- large body.	Bulky to carry around

**TABLET COMPUTERS**

Advantages	Disadvantages
Smaller & lighter than desktops & laptops making it easier to carry	Larger & less portable than smartphones
Larger screen than smartphones	Uses Wi-Fi to connect to the internet which is less reliable than wired
On-screen keyboards larger than those on smartphones	Screens are smaller than those on laptops & desktops
	On-screen keyboard is not easy to type on

**MOBILE PHONES**

Advantages	Disadvantages
Smallest most portable of all devices	Websites are often not fully displayed
People more likely to carry this wherever they go	Small screen size makes viewing websites difficult

Advantages	Disadvantages
Much easier to connect to internet on-the-go	Small keyboards make it difficult to type
	Allow children access to internet anywhere; can be dangerous

**4.10. Network Security Issues**

- Connection to a network exposes a user to:
  - **Hacking:** Unauthorised access given to computer.
  - **Phishing:** Phishing involves getting sensitive information such as usernames, passwords, and credit card detail, for malicious reasons, by mimicking a reliable webpage on the network
  - **Pharming:** Explained in chapter 8 card 2 (E-Safety)
  - **Viruses:** Explained in chapter 8 card 2 (E-Safety)

**Policing the Internet**

- Currently, the internet has no boundaries
- Anything and everything can be put online
- **For Policing:**
  - Prevent illegal material being posted
  - People can easily find info on how to become hackers or make bombs
  - Prevent children from accessing undesirable websites
  - Could reduce the amount of incorrect information
- **Against Policing:**
  - Material already available in other sources i.e. books
  - Very expensive
  - Users would have to fund
  - Difficult to enforce rules
  - Against freedom of information
  - Laws already exist to deal with perpetrators

**Inappropriate Websites**

- Risk of finding undesirable websites
- Risk of doubtful websites which are not genuine
- They could lead to problems such as undesirable web links, security risks

**4.11. Password Interception**

**Spyware**

- Spyware is software that gathers user information through their network connections without them being aware that this is happening
- Once spyware is installed, it monitors all key presses and transmits the information back to the person who sent out the spyware
- This software can install other spyware software, read cookies and personal information, and change the default

- home page or web browser
- Anti-spyware can be used to search out this software and correct the corruption

### Weak & Strong Passwords

- Strong passwords: A random mix of alphabets (uppercase and lowercase), numbers, and keyboard symbols (@, %, ^ etc.)
- Weak passwords: Easy to guess, e.g. users name or date of birth or 1234556, etc.
- Frequent password changes can help reduce the chances of password interception too
- Passwords must not be shared; their strength is then of little use.

## 4.12. Authentication Techniques

- **Magnetic Stripes:** Card swiped through a

magnetic stripe reader that authenticates the user after reading iron-based magnetic particles on a band of magnetic material on the card which is also called a magstripe.

- **ID Cards:** Usually a photo ID with a QR

or barcode that authenticates the user.



- **Passports:** Have an RFID chip on it that

responds to a signal sent by a RFID reader that sends information about the passport holder to the computer system

- **Physical Tokens:** A security token

(sometimes called an authentication token) is a small hardware device that the owner carries to authorize access to a network service. The device may be in the form of a smart card or may be embedded in a commonly used object such as a key fob.

- **Retina Scans:** Scans the

unique pattern of blood vessels in the eye of a user using an unperceived beam of low-energy infrared light into a person's eye as they look through the scanner's eyepiece.

- **Iris Scans:** A scanner scans and

compares the pattern in the iris of a user to a database of stored iris patterns, if it finds a match, the user is authenticated. Iris scans are generally more accurate than retinal scans.

- **Face Recognition:** Verifies the face of

the person attempting to access the data using a face recognition algorithm and identifies facial features by extracting landmarks, or features, from an image of the subject's face.

- **Fingerprint Scanning:** Scans the pattern

on fingers and verifies it against a stored database of authenticated fingerprints using pattern-matching software to allow access to a user.

## 4.13. Data Protection Act

- Failure to abide to rules can lead to fines or imprisonment

### Rules (SAREF DES SAS)

1. Data must be **Fairly** and **lawfully** processed
2. Data can only be **processed for the Stated** purpose
3. Data must be **A\*\*dequate, Relevant** and not **Excessive**
4. Data must be **Accurate**
5. Data must not be kept longer than necessary (**Short time**)
6. Data must be processed in accordance with the data Subject's right
7. Data must be kept **Secure**
8. **Data must not be transferred to another country unless (Domestic) they have adequate protection**

### Guidelines

- Do not leave personal information lying around
- Lock all filing cabinets when leaving an office
- Do not leave computer without locking or logging off
- Protect passwords
- Change passwords regularly
- Do not fax or email anything of sensitive nature.

## 4.14. Network Communication

### Facsimile (Fax)

- A system that scans documents electronically and converts them into a bit map image (a bit is a binary digit and is a 1 or a 0)
- Then transmitted as a series of electrical signals through the telephone network
- Receiving fax machine converts the electronic image and prints it out on paper
- It is also possible to generate fax signals from a computer to allow documents to be sent to a fax machine
- Saves printing out the document first and then passing it through the fax machine
- Fax/modem software in the computer converts the image into a form fax machines can be recognized

- **Physical Faxing:** dedicated fax machine connected via telephone line that copies and electronically sends files to the dialled recipient
- **Electronic Faxing/Online Faxing:** uses the internet to send documents through computers.

Physical Faxing	Electronic Faxing
Associated with a phone no. Only	Associated with an email address and phone no.
Need actual fax machine, paper, etc.	Cheaper- no fax machine, paper and ink
No encryption	Better safety- encryption
The signal can get busy	No busy signal issues

## Email

- A method for sending text and attachments from one computer to another over a network

## Comparing Faxing & Email

Fax	Email
Singed faxes are legally acceptable	More secure (user id and password needed to access files)
Poor quality prints at times	Digital files (no need to print - eco-friendly)
Delay is telephone line busy	Better quality
Slow if several documents need to be sent	Files can be transferred between any device connected to the internet
Every recipient must be dialled up one by one	Faster sending of documents per document and even if multiple recipients
Expensive to buy	No dedicated device needed

## 4.15. Web-Conferencing

### Video-Conferencing

- This is a method of communication between people at 2 or more separate locations
- It is done in real time and makes use of LAN, if internal, or WAN if through the internet
- Uses hardware like; webcam, microphones, speakers and monitors
- It also uses special software like CODEC converts and compresses analogue data into digital data to send down digital lines
- **How it works:**
  - Delegates at one end speak into a microphone and consider the webcam
  - The other delegates can see them and hear them using speakers and monitors

- However, there are several problems with these as the conference call often lags and quality not always high.
- Also, as travelling tickets increase in price, terrorists can use this way of communicating with each other, increasing risk

## Audio-Conferencing

- Same as video-conferencing but without webcam
- VOIP is often used
- VOIP (Voice over internet protocol) is a method used to talk to people over internet
- VOIP converts sound (picked up by a microphone) into discrete digital packets that can be sent to a destination via internet
- Advantage: free and can be used all over the world
- Disadvantage: sound quality is usually bad
- **Security Issues:**
  - Identity and service theft
  - Viruses and malware
  - Spamming (sending junk mail)
  - Phishing attacks (illegitimate scams)

## 5. The Effects of Using ICT

### 5.1. Effects of IT on Employment

- IT led to unemployment in many areas
  - Manufacturing - robots have taken over many tasks and are much faster
  - Computer controlled warehouses - automatic, does not need people
  - Labour intensive work - printing industry and filing
- New jobs have been created in ICT
  - Writing software
  - Maintenance of robots
  - Internet related jobs

#### Effects on People:

- People need to be retrained due to new technology
- Cleaner working environment
- De-skilling of workforce
- Computers can now do tasks that required high skill level
- Safer working environment
- Fewer manual tasks such as heavy lifting

#### Effect on Companies:

- Can employ less people
- Robots do not take holiday, get sick or need breaks
- Greater consistency in products made

### 5.2. Effects of IT on Working Patterns

- **Part-time working:** A contract where someone works fewer hours per week than a full-time employee, in shifts.
- **Flexible working (flexi-time):** Workers can choose their working time but will have to complete the day's work.
- **Job sharing:** Two or more part-time workers divide their job, replacing one full-time worker.
- **Compressed hours:** Employees can work longer hours per day but over fewer days, completing the workload sooner.

### 5.3. Microprocessor-Controlled Devices in the Home

Positive effects	Negative effects
Lead to more leisure time since devices can be programmed to do tasks	Unhealthy diets
More time to socialize	People become lazy and rely on devices
Becoming very sophisticated and can make use of embedded web technology	Dependency on technology increases
Save energy - switch off automatically	More wasteful society since devices thrown away if they fail, not economic to repair
Easier to program device rather than set timings & dates manually	Leaving on standby wastes resources

### 5.4. Potential Health Problems

#### Repetitive Strain Injury (RSI)

- This is when joints such as the shoulder, wrist or fingers swell, causing pain
- Damage gets worse if left untreated
- Can lead to hand/arm immobility

Causes	Prevention
Typing for extended periods of time	Take periodic breaks
Typing with incorrect posture	Use ergonomic keyboard & mouse
Clicking on mouse rapidly/extendedly	Use a wrist rest
Holding mouse incorrectly	Ensure sufficient space for comfortable work
Working in a cramped space	

#### Back Problems

- Headaches are a potential consequence

Causes	Prevention

Causes	Prevention
Not sitting upright while working	Take periodic breaks
Sitting with poor posture	Use adjustable chairs with good back support
Working in a cramped space	Sit upright with good posture
Incorrect computer screen positioning	Keep feet flat on floor

#### Eye Problems

- Headaches are a potential consequence

Causes	Prevention
Staring at a computer for extended periods of time	Take periodic breaks
Working with poor room lighting	Use TFT rather than CRT
Computer screen glare/flicker	Use anti-glare screens
Dirt can cause eye strain	Ensure good room lighting
	No direct light on screen
	Clean dirt

## 6. ICT Applications

### 6.1. Communication Applications

#### Newsletters

- Paper-based communication used to inform people about their interests
- Schools use these to inform parents about events/dates
- **Advantages**
  - Released regularly
  - The recipients have a permanent copy
- **Disadvantages**
  - Requires distribution
  - There are no special effects; sound/video/animation
  - There are printing costs; paper/ink

#### Websites

- Collection of webpages, text, graphics, video and sound
- Hosted on a web server on the internet
- Need to write code or use a web authoring application
- Hyperlinks to other pages can be added
- Interactive websites require programming knowledge
- Can use a camera, scanner, microphone to input data
- Usually hire space from web hosting company
- **Advantages**
  - Ability to add sound/video/animation
  - Links to other websites/hyperlinks
  - The use of hot spots
  - Buttons to navigate/move around the website

- Hit counters to see who has visited the websites
- **Disadvantages**
  - Can be hacked and modified or viruses introduced
  - Need for a computer and internet connection
  - Lack of portability compared with paper-based system
  - Need to maintain website once it is set up

## Multimedia Presentations

- Uses a mixture of media to present information: animations, video, sound, transitions, hyperlinks
- Produced using software packages
- Used with a projector so large audience can view
- **Advantages**
  - Use of sound and animation/video effects
  - Interactive/hyperlinks built into presentations
  - More likely to hold audience's attention
- **Disadvantages**
  - Need for special equipment – expensive
  - May require internet access

## Music Scores

- Music samplers and mixers allow original tracks that were recorded in a studio to be modified
- Electronic instruments can play back through electronic effects machines
- Synthesizers combine simple wave forms to produce complex music creations
- Electronic organs can mimic any other instrument
- Music scores can be generated from music itself using software
- Software can automatically correct music notes in a score
- There is no need to understand music notation to write a music score
- Music notes are automatically printed out in the correct format

## Cartoons

- Animations can be produced using computer hardware and software
- With 3D animations objects are designed on a computer and a 3D skeleton is produced
- Parts of the skeleton are moved by the animator using key frames
- The difference in appearance of the skeleton in these key frames is automatically calculated by the software and is known as tweening or morphing
- The final stage is to make a realistic image by a technique known as rendering

## Flyers & Posters

- A Word processor/Desktop publisher is used to create it
- Need to hold minimum amount of information and be accessible very quickly
- Need to make an immediate impact when people look at them
- Anyone can produce them but there are highly skilled professionals who can produce expert posters
- Some posters require larger printers than A4
- Sequence in which a flier or poster is produced on a computer system
- A word processor or DTP application is opened
  - The user creates frames, boxes and text boxes
  - If necessary, photos are taken, using a camera
  - The images are uploaded from the camera, loaded from a CD/DVD, scanned from hard-copy photos or downloaded from the internet
  - The photos are saved to a file
  - The photos are imported or copied and pasted into the document
  - The photos are edited and typed in or imported from a file and then put into required style

## Mobile Phones

- Wireless devices that allow users to make phone calls from anywhere with cell reception
- They connect to the telephone system using radio signals
- This requires them to be in range of a mobile tower
- Used for communication via
  - Phone calls
  - Text messaging
  - Social Media

## Internet Telephony/VOIP

- VOIP (Voice over internet protocol) is a method used to talk to people over internet
- VOIP converts sound (picked up by a microphone) into discrete digital packets that can be sent to a destination via the internet

## Publicity & Corporate Image

### Publications

- **Business Cards:**
  - Miniature printed documents that provide information about the business/organisation
  - Usually printed on thick cards
  - Easily distributable to potential clients



- Information includes company logo, services, address, contact numbers, email, website
- Gives a professional impression
- **Letterheads:**
  - Found at the top of official printed documents to be mailed to clients or for internal use
  - Makes it clear to reader who the sender is
  - Information includes company logo, name, address, contact numbers
  - Gives a professional impression
  - Easy to reply to
- **Flyers:**
  - Generally printed on single sheets of A4 paper
  - Handed out directly to people for promotions
  - Cheap to produce and easily distributable (locally)
  - Information includes company logo, promoted product or service, contact details
  - Makes it easier to target a specific audience
- **Brochures:**
  - Also called leaflets & are like flyers
  - Difference is that they are often folded into sections
  - Left on counters for pick up rather than handed out
  - Information includes company logo, promoted product or service, contact details
  - Makes it easier to target a specific audience

## 6.2. Data Handling Applications

### Surveys

- All data handling starts with data collection
  - Data capture forms can be used for many applications
  - Decide what needs to be collected and then what questions should be used to collect it
  - Paper or electronically
- Rules for creating forms
  - Make them look official
  - Spaces should be thought about giving enough space for answers
  - Restrict the amount of possible answers, do not use open questions
  - If open questions are used limit the amount of space available for answers
  - Asking for 'Name' needs to be carefully thought about
    - Are you asking for sensitive information?
      - People may not feel comfortable being truthful
    - What names do you want?
      - First name, family name etc.
  - Date of Birth
    - What format do you want it in?
  - Give instructions about how to answer questions
  - How will the data be collected?
- Paper surveys are scanned using OMR or OCR
  - Advantages
    - Faster to get results
    - Fewer errors
    - It is easier to do statistical analysis
    - Less expensive to carry out; requires fewer people

- Online questionnaires
  - Usually use radio buttons
  - No data preparation needed
  - Results sent directly to database for analysis

### Address Lists

An address book on a computer or mobile phone might have a contact's home address, phone number, email address, personal information like the date of birth etc.

Name:	Traci Williams
Home address:	3114 Grand St. New York, NY 10002, USA
Phone number:	12304560212178
Date of birth:	April 27 <sup>th</sup> 1984

### Clubs & Society Records

- Need to keep a record on members usually in a database
- Usually payment details, contact details and interests
- It makes it easy to match people with interests and send information about what they are interested in
- This can be done by using mail merging
- Easy to check memberships and send out reminders
- It is important to follow the data protection act

### School Reports

- Database applications such as SIMS store large amounts of data which can be used to create annual and termly school reports
- Things able to be gathered from here are:
  - Data individual to student – tests/exam results
  - Student progress – target grades being met or not
  - Number of absences – create a percentage of amount of days attended school
  - Teacher comments – adds comments on to report

## 6.3. Measurement Applications

- Sensors are used to send data to a computer where the data is processed
- The computer simply reviews the data from the sensors (by comparing it to data stored in memory) and updates its files and/or gives a warning signal if the values are outside given parameters
- No changes to the process are made
- Examples:
  - Scientific experiments
  - Weather stations

### Analogue & Digital Data

- **Digital data:** discrete, fixed value (used by computers)
- **Analogue data/signals:** continuous value that varies smoothly
  - Analogue device = measure length, weight, temperature etc.
  - E.g. Thermometer – represents temp. by the height of the liquid column
  - Sensors: measure physical and analogue qualities
- Analogue data from sensors needs to be converted into digital data using an analogue to digital data converter (ADC) so that the computer can understand and process the data from the sensors
- If the computer sends signals to motors, valves, etc. then this data also needs to be converted to analogue using a digital to analogue converter (DAC) so that the computer can effectively control these devices

## Analogue to Digital Converter (ADC)

- Used when you want to attach an analogue input device to a digital device such as a computer.
- This is so the analogue data can be understood/processed by the computer since computers only work w/digital data
- E.g. When processing data sent from a sensor

## Digital to Analogue Converter (DAC)

- Used when you want to attach an analogue output device to a digital device such as a computer
- E.g. If the computer is being used to control a device (motor/valve) the device will be controlled by variable voltages; the DAC will be used to send out analogue signals

## Pollution Monitoring

- Example: monitoring oxygen levels in a river
- Sensors read data from the river (oxygen levels and acidity levels using a pH sensor)
- The data from the sensors is converted into digital using an ADC
- The computer stores the received data
- The oxygen levels and acidity levels are compared to the historical data stored in memory and they are also compared to alarm levels stored in memory
- One of two things will now happen: either the data is transferred to a CD/DVD or to a memory stick and taken away for analysis later or the computer is connected into a mobile phone network and transmits the data back automatically to the monitoring station

## Intensive Care Units in Hospitals

- Sensors read key vital signs (such as pulse/heart rate, temperature, blood pressure, respiration, etc.)
- The data from the sensors is converted into digital using an ADC
- The data is stored in the computer memory
- The computer compares the data from the sensor with the values stored in its memory
- The results are output on a screen in the form of graphs and/or digital read-outs
- An alarm is activated if any of the data is outside acceptable parameters
- The system continues to monitor the patient until the computer is turned off

## Advantages of Using Computers in

### Measurement

- The computer will not forget to take readings
- The computer's response time is much faster, which is particularly important in the patient monitoring example
- Doctors, nurses, scientists, etc. can all get on with other tasks while the monitoring is done automatically
- Computer give 24 hours cover every day (i.e. 24/7)
- The readings will tend to be more accurate
- Readings can be taken more frequently if they are done by a computer and sensors
- It could also be safer if whatever is being monitored may have potential hazards (e.g. children falling into the river whilst attempting to take readings)

## Disadvantages of Using Computers in

### Measurement

- Expensive to purchase and set up
- If performed for educational purposes, reduced practical hands-on experience and learning.
- Will not function in a power cut if no backup power present (expensive to have reliable backup power)

## 6.4. Microprocessors in Control Applications

- Sensors are used to send data to a computer where the data is processed
- The computer reviews the data from the sensors (by comparing it to data stored in memory)
- If the values are outside the given parameters/pre-set value it acts to try and get the values within acceptable ranges

- It does this by sending signals to devices controlling the process

## Turtle Graphics

- Based on computer language called LOGO and is now usually known as turtle graphics
- It is the control of the movement of a 'turtle' on a computer screen by several key instructions which can be typed in
- The use of 'repeat' instructions makes a piece of code more efficient

Command	Meaning
FORWARD $x$	Move $x$ cm forward
BACKWARD $x$	Move $x$ cm backward
LEFT $d$	Turn left through $d$ degrees
RIGHT $d$	Turn right through $d$ degrees
REPEAT $n$	Repeat next set of instructions $n$ times
ENDREPEAT	Finish the repeat loop
PENUP	Lift the pen up
PENDOWN	Lower the pen

## Automatic Washing Machines

- Have a microprocessor in them which contains the software which controls the washing machine
- Applying the factors
  - Inputs
    - Pressure sensor on the door to detect if open or closed
    - Sensor to detect if the required level of water is in
    - Temperature sensor to check temperature
  - Outcome
    - Clothes have been washed
  - Outputs
    - Heater
    - Motor to spin drum
    - Lights on machine to show user stage the cycle is at
    - Actuators to turn the inlet valves on to allow hot and cold water into the machine
    - Actuator to turn the outlet valve on to let the water out of the machine when the wash is complete
    - An actuator to control the pump
  - Processing
    - Software to make decisions which will allow the clothes to be washed
  - Time taken before next inputs
    - Timer as part of the software
      - Time different cycles (when to add soap/conditioner/etc.)
      - Time delay in measuring temperature

- Needs to be time for changes to have effect
- Unmanageable situations
  - Door may not be shut
  - Needs to draw user's attention
  - Usually a buzzer and light

## Central Heating System

- Applying factors
  - Inputs
    - Inputs from the user
      - Room temperature required
      - Time systems turns on/off
    - Inputs from the system
      - Actual room temperature
      - Clock giving the time
  - Outcome
    - Heating or cooling room during the required times
  - Outputs
    - Boiler
    - Air conditioner
  - Processing
    - Check time against the one input and switches on when that time is reached
    - Same done to check when to turn off
    - When on, microprocessor reads temperature from sensor and compares it with desired temperature
      - If too low, it will heat up by turning the boiler on and if it's too high it will turn the air conditioner on
      - These will stay on until desired temperature is reached

## Automatic Cookers

- Have temperature sensors and timers with manual controls to set start and end times, and temperature for cooking.
- Working similar to Central Heating System.

## Burglar Alarms

- Burglar alarms detect any intrusion.
  - Sensors such as motion sensors, door and window sensors, magnetic sensors, multi-functional sensors (vibration, shutter, and temperature) measure the physical quantity and inputs the value to a microprocessor.
  - The microprocessor compares the input values with the preset values, if changes are detected, the microprocessor sends signals to the actuator
  - The actuator activates the sirens or gives a phone call or messages the input mobile number.

**Glasshouse**

- Temperature controlled the same as central heating system
- Humidity must also be controlled
  - Humidity sensor tells computer how humid it is
  - Computer then decides to turn the water supply to sprayers
- Windows also operated by the computer
  - Need to find the balance of how often to have windows open
- Blinds that can be computer controlled
  - Light sensor measures light intensity
  - When sun is strong the computer actuates electric motors which close blinds
- Control in glasshouse is more likely to be used in commercial areas or large glasshouses not in gardens

**6.5. Modelling Applications**

- A mathematical computer model is created to manipulate variables and see real time changes in terms of figures.
- Used to find how mechanisms control a system.
- **Advantages:**
  - Cheaper than building physical system to test
  - Safer than building system and experimenting
  - Easier to experiment with various scenarios
  - Quicker as no need to build system
  - Near-impossible tests involving space and volcanic scenarios can be modelled risk-free
- What if analysis can be conducted that allow a certain figure to be computed by letting the computer change other variables that affect the value needed to be set.
  - E.g.

- When making a computer model, consider:
  - What and how data should be collected
  - Working of the system in real life.

**6.6. Applications in Manufacturing Industries**

**Robotics**

- Robots are used in many areas of manufacturing, from heavy work right through to delicate operations e.g. car bodies, welding bodywork, manufacturing of microchips etc.
- Control of robots is either through embedded microprocessors or linked to a computer system
- Programming of the robot to do a task is generally done in two ways:
  - The robot is programmed with a sequence of instructions which allow it to carry out a series of tasks
  - Alternatively, a human operator manually carries out a series of tasks and how each task is done is relayed back to the robot (embedded processor) or controlling computer. The sequence of instructions is remembered so that the robot can automatically carry out each task identically each time (e.g. assembling parts in a television)
- Robots are often equipped with sensors so they can gather important information about their surroundings
- Sensors also prevent them from doing 'stupid things', such as stopping a robot spraying a car if no car is present, or stopping the spraying operation if the supply of paint has run out etc.
- Robots are very good at repetitive tasks
- However, if there are many different tasks (e.g. making specialist glassware for some scientific work) then it is often better to still use human operators

**Advantages**

- Robots can work in environments harmful to human operators
- They can work non-stop (24/7)
- They are less expensive in the long term (they don't need wages) however they are expensive to buy initially
- Productivity is higher, since they do not need holidays, are not ill etc.
- There is greater consistency – every car coming off a production line is identical
- They can do boring, repetitive tasks, leaving humans free to do more skilled work

**Disadvantages**

- Robots find it difficult to do 'unusual' tasks (e.g. one-off glassware for a chemical company)
- They replace skilled labour, leading to unemployment
- Since robots do many of the tasks once done by humans, there is a risk of de-skilling
- Because robots are independent of the skills base, factories can be moved anywhere in the world, again causing unemployment

## 6.7. School Management Systems

- Learner registration and attendance
  - ID cards with magnetic tapes:** The students will have to swipe their ID cards, which contain the student's name, school's name, date of birth and the registration ID, when they enter and leave the school, this way time is saved and the attendance is more accurate.
  - Biometrics:** Every student's fingerprint is stored on a database along with their personal information, the students must put their finger on a fingerprint scanner to enter or leave the school premises.

Advantages	Disadvantages
Fingerprints are unique, so another student can't give their attendance for somebody else, like with an ID card.	Collecting every student's fingerprint initially is time-consuming.
ID cards can be lost, whereas fingerprints can't be.	Fingerprint scanners are more expensive than magnetic stripe readers.
Magnetic fields can affect an ID card.	Damages on the finger will deny access.
Copies of ID cards can be made easily.	There is an invasion of privacy in storing fingerprints on a school database.

- Learner performance
  - Spreadsheets can be used to record students' performances. It is easier to compare each other's performances and an individual student's performance over the academic year.
- Organising examinations
  - Makes sure that the students are enrolled for the right exams.
  - Prints the exam timetables.
  - Allots examination rooms and the invigilator.
  - Gathers the results and puts them into the student database.
- Creating timetables and managing teaching cover/substitution
  - Considers the student's choices, availability of teachers and rooms, subject clashes and the number of hours needed for each subject to produce accurate timetables that can easily be made changes to and cover with teacher to be substituted.
- School management systems:

Advantages	Disadvantages
Absenteeism can be addressed more easily.	Operating the software will need some training.
Parents are kept updated.	The initial cost of the software is expensive.

Advantages	Disadvantages
Reduced workload for teachers.	Unauthorised access will have to be prevented as there is lots of personal information.
They are helpful for the decision making of the administration department	

## 6.8. Booking Systems

- Booking systems are used for transport (flights, trains and buses), cinemas and theatres

### Theatre booking system example:

- Customer clicks on performance they wish to see
- They enter date and time of performance and required number of seats
- A seating display at theatre is then shown on screen and user clicks where they want to sit
- Database searched to check availability of selected seats. If seating plan shown on screen, this isn't required
- If seats available, seat numbers are shown together with total price
- If customer is happy with this, they select 'confirm'
- The seats are now temporarily set at 'no longer available'
- The customer then enters their personal details or indicates that they are a returning customer
- They select a payment method and make the payment
- The theatre seats are then booked in the customer's name
- The final details are shown on the screen, together with a reference number
- An email is sent to the customer which they print out as their proof of purchase. In some cases, this also acts as their printed ticket when they go to the theatre - an e ticket
- The database is updated with the transaction

Advantages	Disadvantages
No double booking as very minimal delay.	Set-up and Maintenance expensive
Immediate booking and selection of seats	Computer and reliable internet access required
Bookings can be made any time	Sever crashes can result in the bookings completely stopping
Digital ticket; printing and postage costs reduced/eliminated	Need for website to be well designed to ensure ease of use
QR codes for authentication; no need for human, can use scanner; reduced costs	No special relation built with booking agent who can give special promotions etc.



in booking seats if the response is not immediate then can cause problems like double booking)

**Real-time Process Control**

- An example of online processing
- Very different to real-time (transaction) processing
- System usually involves sensors and feedback loops
- In real-time process control, physical quantities are continually monitored and input is processed sufficiently quickly to influence the input source

**6.9. Banking Applications**

- Online banking systems rely on the ability to update files immediately, thus preventing double booking, which could happen if the system response time was slow
- The use of computer technology has revolutionized how we do our banking transactions, for example:
  - Internet banking
  - The use of automated teller machines (ATMs)
  - Chip and PIN technology

**Automated teller machines (ATMs)**

- Automated teller machines (ATMs) are places where customers can get cash (or carry out certain other banking activities such as order a statement) using their credit or debit card

Sequence at ATM	What goes on behind the scenes
Customer puts card into ATM	Contact is made with bank's computer
PIN is entered using the keypad	PIN is checked to see if it is correct Card is checked to see if it is valid
A number of options are given: change PIN, top up mobile, see balance, get money	
The customer selects the cash option & several cash options are shown	
The customer accepts one of the options or types in a different amount	The customer's account is accessed to see if they have sufficient funds, it is checked to see if they are withdrawing more than their daily limit
The customer is asked if they want a receipt	
The card is returned	Transaction is okay
Money is dispensed	Customer's account is updated

**6.10. Computers in Medicine**

- **Patient records:** Database that holds patient details and can be accessed from any computer within the hospital intranet.
- **Patient identification:** Barcodes on wristbands of the patients can be used to access their patient record.
- **Pharmacy records:**
  - Generates labels for drugs
  - Checks if the patient is allergic to a particular drug.
- **Patient monitoring:**
  - Sensors measure changes in temperature, heart rate, breathing rate, brain activity, blood pressure, blood sugar levels and oxygen levels in the patient's body.
  - The analogue signals from the sensors are converted into digital signals using an analogue to digital converter.
  - Graphs are produced to show trends over time.
  - The readings are constantly compared with the pre-set values, if the values aren't in the prescribed range, the medical staffs are notified.
- **Hospital management system:** All the above-mentioned points come under the hospital management system which holds all of them, and can be used to access data from all the departments.
- **Expert systems:**
  - The interactive screen asks a series of question for the doctor to answers, using a keyboard or a touch screen.
  - The inference engine compares the symptoms with the knowledge base, using the rule base to find matches
  - The system suggests the possible illness with a probability of each, cures and recommendations on the next step to be taken.
  - The explanation system will explain how that particular diagnosis was suggested.
- Using 3D printers in medicine:
  - **Surgical and diagnostic aids:** A CT or MRI is used to produce images of the internal parts of the body. A 3D printer can then be used to reproduce the internal organs as a solid object.
  - **Prosthetics:** 3D printers are used to print out artificial body parts such as false tooth, artificial limbs, hearing aids, etc. This is a less expensive method of replacing body parts.
  - **Tissue engineering:** Used to produce layers of cells to replace damaged tissues.
  - **Design of medical tools and equipment:** Tools can be made faster and with reduced costs. They can also be made changes to easily, whereas it wasn't the same with traditional methods.

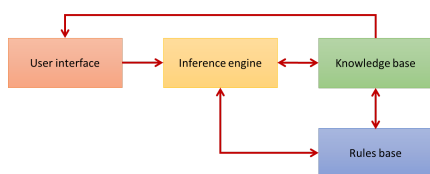
**6.11. Computers in Libraries**

- Many library systems are computer controlled

- They usually involve the use of barcodes on the books being borrowed and on the borrower's library card
- The following describes a computerized library system based on barcodes
- There are two files:
  - Book file, containing fields for example: barcode, book title, name of author etc.
  - Borrower's file, containing fields for example: borrower's number, borrower's name etc.
- When a borrower takes out a book, the book's code is scanned
- The book details are then found on book file
- The borrower's library card barcode is then scanned for the borrower's unique number
- The book file is linked to the borrower's file and both files are updated to indicate which book has been borrowed and when it is due back
- The borrower's file is interrogated daily by the computer to see which books are overdue for return:
  - The computer reads a record from the book file
  - It compares the date due back with the current date
  - If the date due back is less than (or equal to) the current date (i.e. earlier date) ...
  - ...using the barcode number of the book...
  - ...the book file is linked to the borrower's file...
  - ...and the corresponding record is read from the borrower's file
  - The customer details are then found and a letter or email is automatically sent out
  - The next record in the book file is then read...
  - ...until the whole file has been checked

## 6.12. Expert Systems

- These 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, finding faults on a circuit board, etc.)
  - Prospecting for oil and minerals
  - Tax and financial calculations
  - Chess games
  - Identification of plants, animals and chemical compounds
  - Road scheduling for delivery vehicles



### Expert System Setup

- Experts in the field are interviewed to find out what is needed in the expert system
- Data is then collected from these experts

- A knowledge base is designed and then created
- The rules base is designed and created
- The inference engine is designed and created
- The input screen and output format are also designed and created – this is known as the user interface
- The expert system is tested against known conditions and scenarios
- It is also checked to see if it meets the original specification
- Experts are interviewed about how effective it is before the expert system goes out on general release

### Advantages

- Expert systems provide consistent answers
- They never 'forget' to answer a question when determining the logic
- Using expert systems reduces the time taken to solve a problem
- A less skilled worker force is needed, which gives the potential of saving money, but also allows areas of the world access to expertise which they could not normally afford

### Disadvantages

- They tend to lack common sense in some of the decision-making processes
- Errors in the knowledge base can lead to incorrect decisions being made
- It can be expensive to set up in the first place
- Considerable training is necessary to ensure the system is used correctly by the operators

## Components of an Expert System

### User Interface

- This is the only thing that the end user sees
- Allows the user to interact with the system
- Often requires training to operate effectively

### Knowledge base

- This is a database designed to allow the complex storage and retrieval requirements of a computerized knowledge-based management system (in support of an expert system)

### Inference engine

- This is software that attempts to derive answers from the knowledge base using a form of reasoning
- It is how expert systems appear to use human-like reasoning when accessing information from the knowledge base in an effort to find a conclusion to a given problem
- The inference engine is a type of reasoning engine

## Rules base

- This is made up of a series of 'inference rules' (e.g. IF the country is in South America AND the language used is Portuguese THEN the country must be Brazil)
- These inference rules are used by the inference engine to draw conclusions
- They closely follow human-like reasoning

## Suggesting Diagnoses

- The interactive screen asks a series of question for the doctor to answers, using a keyboard or a touch screen.
- The inference engine compares the symptoms with the knowledge base, using the rule base to find matches.
- The system suggests the possible illness with a probability of each, cures and recommendations on the next step to be taken.
- The explanation system will explain how that particular diagnoses was suggested.

## 6.13. Computers in the Retail Industry

### Automatic Stock Control

- Automatic stock control systems rely on the use of barcodes
- Barcodes now appear on most products sold in shops
- They allow quick identification of product details once the barcode has been scanned by a barcode reader
- Supermarkets use electronic point of sale (EPOS) terminals, which incorporate a barcode reader that scans the barcode, retrieve the price of the article and relay information back to the computer system allowing it to update its files
- Barcodes are made up of alternating dark and light lines of varying thickness
- A number underneath the barcode usually consists of four parts: country code, manufacturer's code, product code, and a check digit
- The check digit is a form of validation which is used to make sure no errors occurred during the reading of the barcode
- Every time the barcode is read, this calculation is performed to ensure that it has been scanned correctly

### Electronic Funds Transfer at Point of Sale (EFTPOS)

- Many credit cards are equipped with a chip as well as a magnetic stripe – containing the PIN
- This system is designed to enhance security since it is better than relying only on a signature
- When paying for items using a chip and PIN card, a form of electronic funds transfer (EFT) takes place

## Paying for a meal example

- Waiter inserts card into chip and PIN reader
- Restaurant's bank contact customer's bank
- Card is checked to if valid
- If card is stolen or expired, then transaction is terminated
- Customer enters PIN using keypad
- PIN is read from chip on card and is compared to one just keyed in
- If they are the same, the transaction can proceed
- Check is then made on whether they have enough funds
- If there are not enough funds available, transaction is terminated. Otherwise, transaction is authorized
- Authorization code is sent to restaurant
- Price of meal is deducted from customer's account
- Same amount of money is credited to restaurant's bank account
- Receipt is produced as proof of purchase

## Internet Shopping

- **Online shopping:** Shopping over the internet.
- To customer:
  - **Advantages**
    - Cheaper goods (the company doesn't have to pay rent for stores and doesn't need more employees)
    - Wide range of products
    - Delivery at your doorstep
    - You can shop 24/7
    - Shop from any part of the world
    - You save the travelling costs of going for shopping
  - **Disadvantages**
    - Quality isn't assured
    - People are worried about giving their card details online.
    - Packing and postal charges are added
    - Personal services that you get from stores are missed.
    - Returning the products is harder
    - No relaxation that you get from actual shopping
    - Bogus sites are present where you pay and never receive the product
- To seller:
  - **Advantages**
    - No need to pay rents
    - No fixed working hours
    - Less/no shoplifting
    - Sell goods to customers anywhere in the world
    - Cheaper to contact customers (via e-mail)
    - Site warehouse where rental is cheap
    - Sell goods 24/7
  - **Disadvantages**
    - ICT knowledge needed to set up website
    - Unemployment
    - Business abroad is lost if the prices are cheaper there

- At times of network failures, there will be no access
- Not everybody can access the internet, so a few customers are lost
- Customer's personal data can be hacked
- Postal charges discourage people at times

## 6.14. Recognition Systems

- **Automatic Number Plate Recognition (ANPR) systems:**
  - A sensor sends signals to a microprocessor, which instructs a camera to capture the front of a vehicle.
  - OCR software is used to read the number plate from the image. The characters are then converted to text format in order to store it in a database
- **Processing of cheques:**
  - The value of a cheque is printed in special ink containing iron particles when a cheque is presented.
  - MICR is used to read the characters at the bottom of the cheque.
  - A batch processing method is then used to process all the cheques at the end of a specific time period.
- **OMR media in schools:**
  - **School registers:** Paper-based registers are fed into OMR to be scanned and are then stored on a database.
  - **Multiple-choice examination papers:** The position of a mark is stored in a computer's memory after being read by the OMR device using a template that maps out the X-Y coordinates of each lozenge (pen/pencil mark).
- **RFID in passports:**
  - The data on the RFID chip is read when the passport is scanned.
  - A photo of you is clicked which is then compared with the image stored in the RFID chip.
  - If the face-recognition passes, some checks are made in turn to make sure you are eligible to enter the country, and if you are, the gate opens automatically.
- **RFID in contactless payments:**
  - The embedded chip on credit/debit cards and the antenna enable customers to wave their card over a reader at the point of sale terminals to make payments
  - Smartphone apps can also be used to make contactless payments.

## 6.15. Monitoring & Tracking Systems

- **Public monitoring/tracking:**
  - **Ankle monitor:** uses RFID chip to give out the person's location and other details. It is tamper proof and will alert authorities if tried to remove.
  - **Phone call tracking:** the service provider tracks the calls and the exact position from which they were made

- **Worker monitoring/tracking:** Workers are monitored/tracked in the following ways:
  - **Supermarket workers:** have the number of items passing through the tills over a period of time monitored.
  - **Internet use is monitored by network managers:** they can check sites visited and time spent on that site during working hours.
  - **Emails can be read:** Employers can check that no personal mails are sent during office hours.
  - **Delivery drivers:** Their location can be tracked using GPS systems. It can also be checked if they are following the shortest route and aren't speeding.
- **Key logging:** Software that records the keys pressed by a user on the keyboard. They are used to find username and passwords of a user.
- **Employee call monitors:** Allows the employer to listen to employee's telephone calls. There are three ways it can be used:
  - **Monitor:** The manager/supervisor can listen to calls without the employee or the customer's awareness.
  - **Whisper:** The manager can help the employee with the call, but the customer can't hear the manager speak.
  - **Barge:** Both the employee and the customer can hear the manager
- **Employee call monitors:** Allows the employer to listen to employee's telephone calls. Call monitors can be used:
  - to improve the employee's performance
  - to allow the manager/supervisor to join a call where necessary
  - as a training tool
- Uses of Automatic Number Plate Recognition (ANPR) systems:
  - **Traffic enforcement:** the system can check if a vehicle is taxed, recognize cars parked illegally, cars speeding or going through red lights so a fine can be imposed.
  - **Car park management:** the system reads the registration number and if allowed into the car park, the barrier is raised.
  - **Electronic toll collection:** the system recognizes the vehicle and deducts the fare accordingly.

### Cookies

- Cookies are small files sent to a user's computer via their web browser when they visit certain websites
- They store information about the users and this data is accessed each time they visit the website
- For example:
  - They remember who the user is and send messages such as "Welcome Sarah" each time they log onto the website
  - They recognize the user's buying preferences e.g. if a user buys CDs, pop ups related to their buying habits will appear on the user's screen each time they visit the website

- Without cookies, web server would have no way of knowing that the user had visited website before
- For this reason, cookies could be used to monitor one's internet activity

## 6.16. Satellite Systems

### Global Positioning Systems (GPS)

- Used to determine the exact location of several modes of transport
- Cars usually refer to GPS as satellite navigation systems
- 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 are used in the satellites which are accurate to within a fraction of a second per day
- Each satellite transmits data indicating its position & time
- The computer on board the mode of transport calculates its exact position based on the information from at least three satellites

### Satellite Navigation

- Used to determine the exact location of a car.
  - The computers onboard can be used to show directions to a destination.

### Geographic Information Systems (GIS)

- Used to capture, manage, analyse and display geographically referenced information.
  - Use to determine distance between two places.
  - Used to find the nearest petrol station or restaurant, etc.
  - To protect animal and plant life in certain vulnerable places.
  - Can be used in geography, science or engineering lessons.

### Media Communication Systems

- Using satellite signals for communication.
  - Used by media companies when sending stories/videos/pictures from remote locations.

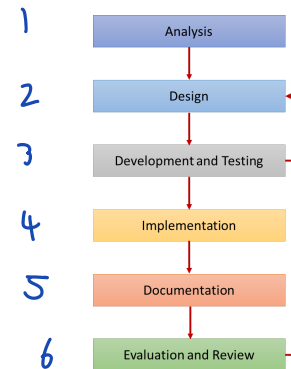
## 7. System Life Cycle

### 7.1. Introduction

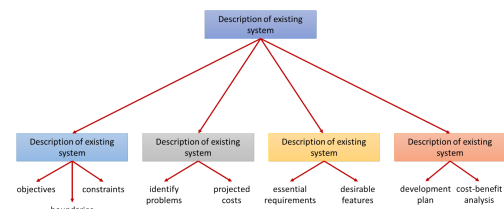
- A systems analysis team is often brought in to review an existing system and suggest several improvements
- The existing method used may be either a manual paper-based system or a computer-based operation that is no longer regarded as adequate for the task

### 7.2. Analysis

- The basic steps in the analysis stage can be summarized as follows:



1. Fact finding/collecting data from the current system
2. Description of the current system – establishing the inputs, outputs and processing being done
3. Identification of the problems with the current system
4. Agreeing the objectives with the customer
5. Identifying and agreeing the customer's requirements
6. Interpreting the customer's requirements
7. Producing a cost-benefit analysis
8. Producing a data flow diagram



## 4 Common Methods of Fact Finding

### Observation

- Involves watching personnel using the existing system to find out exactly how it works
- Advantages
  - The analyst obtains reliable data
  - It is possible to see exactly what is being done
  - It is a relatively inexpensive method
- Disadvantages
  - People are generally uncomfortable being watched and may work in a different way
  - If workers perform tasks that violate standard procedures, they may not do this while being watched



## Interviews

- Involves a one-to-one question-and-answer session between the analyst and the employee/customer
- Advantages
  - It gives the opportunity to motivate the interviewee into giving open and honest answers to the analyst's questions
  - It allows the analyst to probe for more feedback from the interviewee, as it is easier to extend a question
  - It is possible to modify questions as the interview proceeds and ask questions specific to the interviewee
  - It is a good method if the analyst wants to probe deeply into one specific aspect of the existing system
- Disadvantages
  - It can be rather time consuming
  - It is relatively expensive, due to the use of the analyst's time
  - The interviewee cannot remain anonymous

## Questionnaires

- Involves sending out questionnaires to the work force and/or to customers to find out views of the existing system and find out how some key tasks are carried out
- Advantages
  - The questions can be answered quite quickly
  - It is a relatively inexpensive method
  - Individuals can remain anonymous if they want
  - It allows quick analysis of the data
- Disadvantages
  - Often the number of returned questionnaire is low
  - The questions are rather inflexible since they have to be generic
  - There is no immediate way to clarify a vague or incomplete answer to a question

## Looking at Existing Paperwork

Allows the analyst to see how the paper files are kept, look at operating instructions and training manuals, check the accounts, etc.

- Advantages
  - It allows information to be obtained which was not possible by any of the other methods
  - The analyst can see for themselves how the paper system operates
  - It allows the analyst to get some idea of the scale of the problem, memory size requirements, type of input/output devices needed
- Disadvantages
  - It can be very time consuming
  - Because of the analyst's time, it is a relatively expensive method

## 7.3. Design

- Once the analysis has taken place and the systems analyst has some idea of the scale of the problem and

what needs to be done, the next stage is to design the key parts of the recommended system

- A list of tasks is summarized here
  - Designing data capture forms/input forms
  - Designing screen layouts
  - Designing output forms and reports
  - Producing systems flowcharts and/or pseudo code
  - Selecting and designing validation rules that need to be used
  - Selecting the most appropriate data verification methods
  - Designing and agreeing the file structures and tables
  - Selecting and designing the hardware requirements
  - Selecting and designing the software requirements
  - Producing algorithms or program flowcharts
  - Designing a testing strategy/plan

## Verification

- A way of preventing errors when data is copied from one medium to another
- **Double entry:** data is entered twice, sometimes by two different people
  - The computer compares the two entries, either after data entry or during the data entry process, and identifies any differences
- **Visual check:** checking for errors by comparing entered data on the screen with the data in the original document (not the same as proof reading)

## Validation

- Process where data is checked to see if it satisfies certain criteria when input into a computer, for example to see if the data falls within accepted boundaries
- **Range Check:** Checks whether data is within given/acceptable values.
  - E.g. A person's age should be in range  $> 0$  but  $< 150$
- **Length Check:** Checks if the input data contains the required number of characters
  - E.g. If a field needs six digits then inputting a five- or seven-digit number, for example should cause an error message
- **Character/type Check:** Checks that the input data does not contain invalid characters
  - E.g. A person's name should not contain any numbers, but a person's height should only contain digits
- **Format/picture Check:** Checks that data is in a specific format
  - E.g. Date should be in the form dd/mm/yyyy
- **Limit Check:** Similar to range check except that only one of the limits (boundaries) is checked
  - E.g. Input data must be  $> 10$
- **Presence Check:** Checks if data is actually present and has not been missed out

- E.g. In an electronic form, a person's telephone number may be a required field and if no data is present this should give rise to an error message
- **Consistency Check:** Checks if fields correspond (tie up) with each other
  - E.g. If 'Mr' has been typed into a field called title then the gender field must contain either 'M' or 'Male'
- **Check Digit:** Look at an extra digit which is calculated from the digits of a number and then put on the end of the number
  - E.g. Check digits can identify three types of error:
    - If two digits have been inverted during input
    - An incorrect digit entered twice
    - A digit missed out altogether

## 7.4. Development & Testing

- Once the design stage is completed, it is then necessary to create the system and fully test it
- This section considers some of the development stages and testing strategies which are often adopted by system analysts

### Development stages

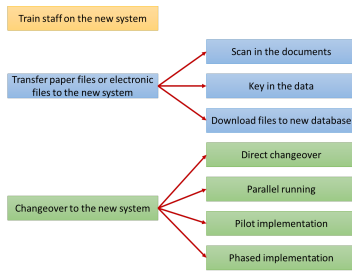
- If the system contains files (e.g. a database) then the file structure needs to be finalized at this stage (e.g. what type of data is being stored in each field, length of each field, which field will be the key field, how the data files will be linked, etc.)
- Once the file structure has been determined, it is then created and fully tested to make sure it is robust when the system actually goes live
- Since it is important that correct data is stored in files, there are certain techniques that need to be adopted to make sure the data populating the file and database is at least of the right type & that it conforms to certain rules
- Validation routines and verification methods are used to ensure this happens
- Again, routines have to be fully tested to ensure they trap unwanted data but also to make sure any data transferred from a paper-based system to an electronic system has been done accurately
- Any system being developed will have some form of user interface
- The types of hardware were chosen in the design stage
- How these are used to interface with the final system now needs to be identified, for example how the screens will be used to collect the data and the way the output will be presented
- If specialist hardware is needed (e.g. for people with disabilities), then it will be necessary to finalize how these devices are used with the system when it is implemented
- This will be followed by thorough testing to ensure the user screens are user friendly and that the correct output is associated with the inputs to the system

### Testing strategies

- Testing of each module needs to be done to ensure each one functions correctly on its own
- Once the development of each module is completed, the whole system needs to be tested (i.e. all modules functioning together)
- Even though each individual module may work satisfactorily, when they are all put together there may be data clashes, incompatibility and memory issues
- All of this may lead to a need to improve the input and output methods, file and database structures, validation and verification methods
- Then the system will need to be fully tested again
- It is a very time-consuming process but the system must be as perfect as possible before it goes live
- Testing will use many different types of data, which will fall into one of three categories: normal, extreme or abnormal
- Let us suppose one of the fields in a database is the date and this must be in the form dd/mm/yyyy, where each element of the date must be numeric:
  - **Normal:** this is data which is acceptable/valid and has an expected (known) outcome, e.g. the month can be any whole number in the range 1 to 12
  - **Extreme:** this is data at the limits of acceptability/validity, e.g. the month can be either of the two end values i.e. 1 or 12
  - **Abnormal:** this is data outside the limits of acceptability/validity and should be rejected or cause an error message
  - For example, all the following values are not allowed as inputs for the month:
    - Negative numbers (e.g. -1, -15)
    - Any value greater than 12 (e.g. 32, 45)
    - Letters or other non-numeric data (e.g. July)
    - Non-integer values (e.g. 3.5, 10.75)

## 7.5. Implementation

- Once the system is fully tested, the next stage is to fully implement it
- We will now consider changeover to the new system in more depth
- There are four common methods used for changing over from the old system to the new system
- Each one has advantages and disadvantages which need to be weighed up before the most appropriate method is chosen for a particular application



## 4 Common Methods of Changing Systems

### Direct

- The old system is stopped overnight and the **new system introduced immediately**
- Advantages**
  - The benefits are immediate
  - Costs are reduced - since only one system is used there is no need to pay for two sets of staff
  - There is less likelihood of a malfunction since the new system will have been fully tested
- Disadvantage**
  - This method can be disastrous if the new system fails

### Parallel Running

- The old and new systems are run side by side** for a time before the new system takes over altogether
- Advantages**
  - If the new system fails, the old system is still available as a back-up
  - It is possible to train staff gradually
  - Staff have time to get used to the new system
- Disadvantage**
  - It is more expensive than direct changeover, since extra staff are needed to run both systems together

### Pilot Implementation

- The **new system is introduced into one part of the company** (e.g. into a warehouse of a supermarket) and its performance assessed
- Advantages**
  - If the **new system fails, only one part of the company is affected**
  - It is possible to train staff in one area only, which is much faster and less costly than parallel running
  - The costs are also less than parallel running, since only one part of the system is being used in the pilot
- Disadvantage**
  - It is more expensive than direct changeover, since each pilot scheme needs to be evaluated before the next stage is introduced

### Phased Implementation

- Initially, **only part of the new system is introduced**
- Only **when it proves to work satisfactorily is the next part introduced**, and so on, until old system is fully replaced
- Advantages**

- If the latest part fails, it is only necessary to go back in the system to the point of failure, hence failure is not disastrous
- It is possible to ensure the system works properly before expanding
- Disadvantages**
  - This is more expensive than direct changeover, since it is necessary to evaluate each phase before moving to the next stage

## Comparing Changeover Methods

Changeover method	Direct	Parallel	Pilot	Phased
Relative costs	Low	High	Medium	Medium
Input needed by the user	Medium	High	Low	Medium
Input needed by systems team	Low*	Low	Medium	Medium
Impact of failure	High	Low	Low	Medium

## 7.6. Documentation

- Once the new system is fully developed, a considerable amount of documentation needs to be produced
  - For the end user
  - For people who may need to modify or develop the system further at some later stage
- There is some overlap between the two types of documentation, but the basic requirements are shown below

### Technical Documentation

- Technical documentation is designed to help **programmers & analysts** who need to make improvements or repair/maintain to the system
- This can consist of any of the following:
  - purpose of the system/program/software
  - program listing/coding
  - programming language used
  - flowchart/algorithm
  - input formats
  - hardware requirements
  - software requirements
  - minimum memory requirements
  - known bugs in the system
  - list of variables used (and their meaning/description)
  - file structures
  - sample runs (with test data and results)
  - output formats
  - validation rules
  - meaning of error messages

**User Documentation**

- User documentation is designed to help users to learn how to use the software or system
- This can consist of any of the following:
  - 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

**7.7. Evaluation**

- Once a system is up and running it is necessary to do some evaluation and carry out any maintenance, if necessary.
- This is done to ensure the efficiency of the system, the ease of use of the system, and the appropriateness of the system.
- The following is a list of some of the things considered when evaluating how well the new system has worked. This can ultimately lead back to a re-design of part of the system if there is strong evidence to suggest that changes need be made.
- To evaluate the system, the analyst will:
  - compare the final solution with the original requirement
  - identify any limitations in the system
  - identify any necessary improvements that need to be made
  - evaluate the user’s responses to using the new system
  - compare test results from the new system with results from the old system
  - compare the performance of the new system with the performance of the old system
  - observe users performing set tasks, comparing old with new
  - measure the time taken to complete tasks, comparing old with new
  - interview users to gather responses about how well the new system works
  - give out questionnaires to gather responses about the ease of use of the new system
- Some results from the evaluation may require changes to either hardware or software. Hardware may need to be updated because:
  - of feedback from end users

- new hardware comes on the market, making change necessary
- there are changes within the company which require new devices to be added or updated
- Software may need to be updated because:
  - of feedback from end users
  - changes to the company structure or how the company works may need modifications to the software
  - changes in legislation may need modifications to the software

**8. Safety & Security**

**8.1. Physical Safety**

Safety hazard	Ways of eliminating or minimizing hazard
Electrocution from spilling drinks	Use a residual circuit breaker (RCB), Check insulation on wires regularly, Do not allow drinks near computers, Check equipment regularly
Tripping over trailing wires	Cable ducts- make wires safe, Cover wires/tuck them away, Use wireless connections
Heavy equipment falling	Strong desk/tables to support heavy hardware, Use large desks and tables so that hardware doesn't fall off edge
Fire risk from overloading sockets or equipment overheating	Have a CO2 fire extinguisher nearby, Don't cover equipment vents- can cause equipment to overheat, Make sure hardware is fully maintained, Do not overload sockets with too many items

**8.2. E-Safety**

- E-safety refers to the safety of data and personal information while using the internet.
- E-safety is required to make sure a user’s personal information is not made vulnerable and even leaked to hacker’s for e.g., which can lead to identity fraud, bank A/C issues, etc.

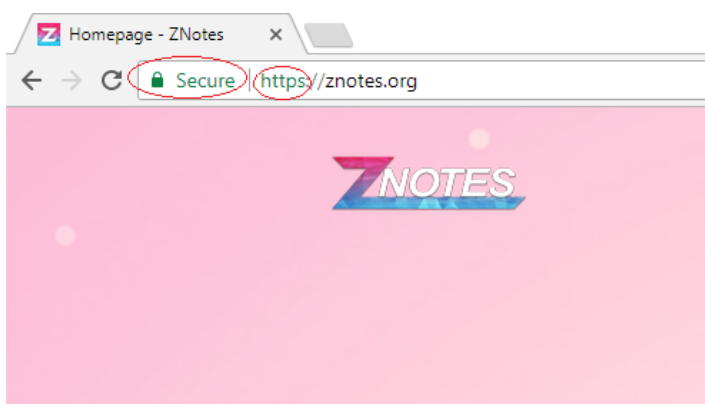
**Personal Data**

- Any data regarding a living person who can be identified against the data or the data along with any other information.
- Examples of personal data:
  - Full Name

- Home Address
- Banking details (A/C no, pin, etc.)
- Medical history (suffered from depression, etc.)
- Personal data like ethnic origin, political views, criminal activity, mental health history,
- Sexual orientation and religion can be used to blackmail victims of data breaches
- If personal data is leaked (data breach), the following can occur:
  - Identity theft
  - Bank fraud
  - Damages to personal property
  - Kidnapping (if kidnappers get access to the victim's address.
  - Etc.
- To prevent the above, it is essential that personal data is protected.
- Personal data can be leaked intentionally and unintentionally. Electronic data is at risk due to: hacking, viruses, spyware, phishing, pharming, Smishing, vishing, ransomware (A malicious program that encrypts data on a computer system and demands for a ransom to provide and decrypt the data), spam, moderated and un-moderated forums, cookies, etc.
- If a student shares a photograph of themselves in their school uniform on social media, then paedophiles, child predators, kidnappers, etc. can physically reach the student. This should not be done

## Internet Safety

- To keep personal data safe, one must:
  - Not give unknown people (on the internet) personal information or send pictures of oneself to them.
  - Maintain privacy settings to control which cookies are on their computer
  - Use learner friendly search engines and websites recommended by your educational institution, e.g. znotes.org
  - The website being accessed is from a trusted source, or has a padlock symbol/ https protocol (s for secure):



## Email Safety

- Open emails from known sources, and do not click on an emails wit hyperlinks without confirming with the sender of the email. Think before opening an email from an unknown person, never send any other sensitive information (picture in school uniform, credit card PIN, etc.)
- Ask their ISP to enable email filtering to classify spam mails as spam.

## Social Media Safety

- Block and report users who seem suspicious or use inappropriate language
- Never use you real name, only use a nickname
- Use appropriate language
- Do not enter private chat rooms, as users can lure you into giving personal information by seeming *too* nice.
- Do not meet anyone off the internet for the first time on your own, or at least speak to a trusted adult first.
- Do not misuse images (of someone to blackmail them, for e.g.)
- Respect the confidentiality of other users

## Online Games

- Similar measures apply to that taken when using social media.
- Additionally, players should be careful about:
  - In-game violence
  - Cyber bullying
  - Keeping their webcams off (other potentially dangerous players have direct access to your image)
  - Predators may use voice masking technology to lure a user to reveal their age, sex etc.
  - Cyber-attacks involving viruses, ransomware, etc.

## 8.3. Security of Data

### Hacking

- Hackers are people who get into your computer system without having the rights. It can lead to corruption or loss of data or a data breach
  - Some prove that a system is vulnerable - maybe employed to test (ethical hacking)
  - Some want to steal data
  - Alter or destroy data
  - For fun or a challenge
- Prevention:
  - Protect with authentication techniques (user ID and password, etc.)
  - Have a backup of data in case of damage
  - Firewalls



## User IDs

- To log on to a network, a user must type in a user ID
- User ID assigns user privilege once user logs in
- The top-level privilege for a network is an administrator:
  - Able to set passwords and delete files from server etc.
- User privilege may only allow to access their own work area

## Passwords

- After typing in user ID, the user will be requested to type in their password
- Generally, it is a combination of letters and numbers
- Passwords are shown as stars (\*\*\*) so nobody overlooking can see it
- Many systems ask for password to be typed in twice as a verification check, in case of input errors
- To help protect the system, user has a finite number of attempts
- If password is forgotten, administrator must reset it
- If password is forgotten on a website, it will be sent to your e-mail

## Biometric Data

- Uses features of the human body unique to every individual, such as fingerprints, retina, iris, face and voice recognitions. It is used in authentication techniques as it is very difficult / impossible to replicate.
  - **Advantages**
    - Usernames and passwords don't have to be remembered
    - Almost impossible to replicate body parts.
    - Somebody else can't gain access, like with a stolen card
    - They can't be forgotten, like a card
  - **Disadvantages**
    - The readers are expensive
    - Damages in fingerprints can deny access
    - Some people worry about their personal information being stored

## Digital Certificate

- A digital certificate is an electronic passport used in the security of data sent over the internet.
- They can be attached with mails so that the receiver can know that the mail is sent from a trusted source.

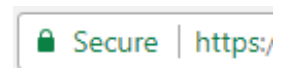
## Secure Socket Layer (SSL)

- 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
- https or padlock in the status bar
- When user wants to access a secure website:

- User's web browser sends a message, so it can connect with required website which is secured by SSL
- Web browser requests that the web server identifies itself
- Web server responds by sending a copy of its SSL certificate
- Web browser checks if certificate is authentic
- Sends signal back to web browser
- Starts to transmit data once connection is established
- If not secure, browser will display an open padlock

## Features of a Secure Web Page

- **Webpage URL:** If the webpage is secure, it will start with 'https' instead of 'http'.



- **Padlock sign**

## Phishing

- Phishing is a fraudulent operation involving the use of emails
- The creator sends out a legitimate looking email hoping to gather personal and financial information from the recipient of the email
- The message appears to be from a legitimate source (e.g. a famous bank)
- When the user clicks on the link, they are sent to a spoof website
- They will be asked for personal info e.g. credit card details, PINs
- This could lead to identity theft
- ISPs attempt to filter out phishing emails

## Pharming

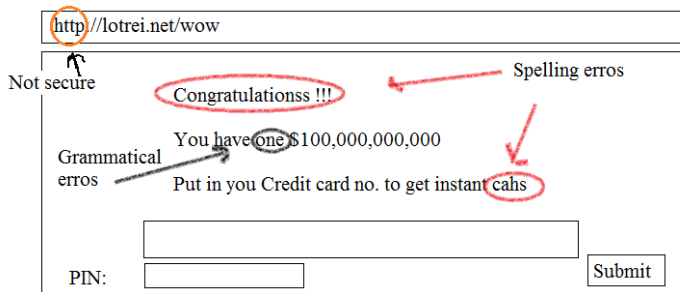
- Pharming is a scam in which malicious code is installed on a computer hard disk or a server
- This code can misdirect users to fraudulent websites without their knowledge
- Phishing requires an email to be sent to every person who has been targeted, while pharming does not require emails to be sent out to anyone
- Pharming can target a larger group of people more easily
- **How pharming works:**
  - A hacker will infect the computer with a virus, either by sending an email or installing software on their computer when they first visit their website
  - Once infected, the virus sends user to a fake website that looks identical to the one they wanted to visit
  - Personal info. from the user's computer can be picked up by the pharmer/hacker
  - Anti-spyware, anti-virus software or anti-pharming software can be used to identify this code and correct the corruption

## Smishing

- An attempt to extract a user's confidential information via SMS (short message service) by tricking the user into downloading a Trojan horse (a virus that masks itself).
- It is phishing via SMS.

## Preventing Phishing, Pharming & Smishing

- User education
- Set up anti-malware and anti-spyware software
- Enabling protocols such as SPF and DKIM
- Do not download random .exe (executable file formats), .php, .bat, .com etc.
- Users should be alert and look out for clues when being redirected to other websites.
- Therefore, technology enables unauthorised users to gain access to otherwise inaccessible information.
- If a person on the internet is asking for personal information, or to meet in real life or acting suspicious, they should be reported to cyber security agencies, or one's parents/guardians.
- Websites/pop-ups can be made to mimic legitimate ones, or seem too good to be true, for e.g. lotrei.net instead of lottery.com



- Banks and organisations will never ask for a PIN to be entered on website like this.

## Effects of phishing, pharming and Smishing on a user

- Personal and sensitive information is lost, which can be used for previously stated purposes.

## Moderated & Unmoderated Forums

Online forums are places on the internet where people can join discussions on almost any topic and also add their views.

- There are two types of forums:

Moderated Forums	Unmoderated Forums
Has a moderator who checks comments before they are posted	No moderator who checks the comments
There will be no spams or rude and offensive comments	Spams, rude and offensive comments present
No diversions from the topic	Diversions from topic are possible

Moderated Forums	Unmoderated Forums
Highly secure due to moderation	Personal information can be obtained from you
	Not secure due to lack of moderation

## Spam

- Spam is electronic junk mail and is a type of advertising from a company sent out to a target mailing list
- Harmless but can clog up networks and slow them down
- It is more of a nuisance than a security risk
- Many ISPs are good at filtering out spam, and prevent the user from getting these spam emails.
- It is often necessary to put a legitimate email address into a contact list to ensure wanted emails are not filtered out by mistake

## Encryption

- The conversion of data to code by encoding it
- Done by using encryption software
- Since data is encoded, it appears meaningless to a hacker
- This technique prevents illegal access
- Necessary to use decryption software to decode the data
- Used to protect sensitive data e.g. banking details
- Encryption keys are complex algorithms which makes codes almost unbreakable

## Computer Viruses

- It is a malicious program that replicates itself and is designed to cause harm to a computer system. They spread through downloadable files, external store media (e.g. pen drives, etc.)
  - May cause the computer to crash
  - Loss of files, corruption of the data
- Viruses infect computers through email attachments, illegal software or downloaded files
- Prevention of Viruses
  - Anti-virus software - Detects and then removes or isolates and use firewalls
  - Do not use illegal software
  - Only download from reputable sites

## The threats of using credit cards online and prevention:

- **Key logging/spywares:** records the keys pressed on a keyboard.
  - Can be used to obtain credit card details, passwords and personal information.
  - Use virtual keyboards to type in password.
  - Install anti-spyware software.
- **Bogus sites:** sites that look exactly like the original sites, but aren't.

- They can steal your card details and personal information when you make purchases.
- Always type in URLs, sometimes links in the mails can be of bogus sites.
- **Phishing, pharming and Smishing:**
  - They trick you to reveal card and personal details as responses to messages or mails.
  - Open attachments only from trusted sources.
  - Install anti-spyware software.
- **Hacking into secure sites to obtain the details:**
  - Encrypting the details will make it of no use to the hacker.
  - Use strong passwords.
  - Use firewalls.
- **Tapping into wireless networks:**
  - Always use a password-controlled Wi-Fi since it is relatively hard to tap into a secured Wi-Fi.

**\*ALL PREVENTION TECHNIQUES WRITTEN HERE ALSO APPLY FOR THE THREATS IN GENERAL (NOT SPECIFIC TO CREDIT CARDS) \***

**Cloud Storage**

- Your data is stored remotely and not on your computer, so you don't have control over the physical security of your data.
- Some of the data stored may be personal data which are open to hackers, and have to be encrypted in order to prevent hackers from obtaining them.
- The company providing the storage may go out of business. In this case what has to be done to the data will have to be considered.
- The company providing the storage will have to put in all its efforts and safety measures in order to keep your data safe.
- If the company providing the storage doesn't backup your data, you may lose it in case of power cuts or fires, etc.

**Firewalls**

- A *firewall* sits between the user's computer and an external network (internet) and filter information in and out of the computer
- Tasks carried out by firewall:
  - Examining 'traffic'
  - Checking whether incoming or outgoing data meets criteria
  - If data fails the criteria, the firewall blocks 'traffic'
  - Firewall can keep a list of all undesirable IP addresses
  - Helping to prevent viruses or hackers entering the user's computer

**Methods of Internet Security**

Authentication Method	Advantages	Disadvantages
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Authentication Method	Advantages	Disadvantages
Passwords	Inexpensive, as nothing other than a computer is required	Can be easily hacked, can be forgotten
Fingerprint scans	Highly recognized everywhere, very high accuracy, Easy to use, Relatively low storage requirement	Intrusive, Damages will prevent access
Signature recognition	Non-intrusive, very little time to identify, Relatively low expensive	Problems occur if sign is not consistent, High error rate (one in 50)
Retina scans	Very high accuracy, no known way to replicate a person's retina	Very intrusive, relatively slow to verify retina scans, very expensive to install and set up
Iris recognition	Very high accuracy, Verification time is usually less than 5 seconds	Very intrusive, Lot of memory needed for storage, very expensive to install and set up
Face recognition	Non-intrusive, Relatively inexpensive	Affected by changes in lighting, person's hairstyle, age and spectacles

**9. Audience**

**9.1. Audience Appreciation**

**Knowing Your Audience**

- When designing ICT solutions, you must consider audience
- There are 4 main characteristics of an audience
- **Age:**
  - Can affect audience's interests in your product
  - Large fonts and colours attract children
  - More stylish and trendy layout attracts young adults
- **Gender**
  - Design product for a specific gender
  - Younger girls are often attracted to pink
  - Males generally prefer blue spectrum
- **Income**
  - Knowing this will help in attractive pricing strategies
  - Promoting certain products are targeted for people within a specific range of incomes
- **Interests**
  - Can help with advertising content
  - Content that meets the exact description of audience's interest is more likely to attract them to your product

**Audience Needs**

- After finding out about your targeted audience you need to aim to meet those demands
- Developers of the ICT product must ensure that they meet as many of these needs as possible
- Common Needs for Common Audiences:

Audience	Needs
Young children	Bright/cheerful colours
	Animations/sounds/pictures
	Less text
	Simple wording
	Large text
	Games/activities
	Easy to use
Teens & adults	Attractive/stylish colours
	Interesting content
	Balance of pictures and text
	Clear fonts
	Bullet points
Seniors	Contrasting/easy-to-read colours
	Include clear instructions
	Use slightly larger font sizes
	Fewer technical terms
	Consistent design
	Easy to use

**Potential Problems**

- If products are not built towards a specific audience well then problems may arise
- An older audience may not be able to understand or read text due to poor font design
- A younger audience may not be able to understand certain text due to complex wording & structure
- Several audiences may just not find content interesting since it is not relevant enough to them
- Several audiences may not find content attractive enough and thus not purchase or use it at all
- Younger & older audience may not understand how to use the product due to lack of simple instruction

**9.2. Legal, Moral, Ethical & Cultural Appreciation**

**Copyright Legislation**

- A law that protects books, music art and other media that are written is copyright law

- It is an automatic right and does not need applying for
- The person who owns the rights must be asked before it can be used again
- Software is a specific thing created and written on a computer
- Needs to be protected as it is so easy for people to copy
- This is a way of protecting software from being used without permission
- Users create a license which determines the terms and conditions

**Copyright Laws**

- It is not legal to make a copy of software, then sell it or give it away to other people
- Software cannot be used on a network unless a network license has been acquired
- Not legal to use coding from software in your own software without permission
- Renting out software without permission is illegal
- It is illegal to use the name of copyrighted software without permission

**Software Protection**

- Installed software will require a unique reference number
- User will have to accept license agreement
- Holograms are used to indicate software is original
- Software may only run if CD-ROM or DVD-ROM is actually in the drive
- Some software will only run if a memory stick is plugged in USB ports

**Creating ICT Solutions**

- ICT solutions, for e.g. a website should be made in accordance to the legal, moral, ethical and cultural beliefs of the target audience.

**Implications of ICT Solutions**

- When creating an ICT solution, all the following have to be considered and the solution must be made in response and respect to these factors:
  - **Legal:** Ensure copyright laws are abided by including not using any coding or branding from existing copyrighted software.
  - **Morality:** To distinguish from right or wrong. Sometimes it may not be illegal to carry out an act however it could be against your morals. For example,

setting up a fake website to deceive is not illegal but questions your level of morality.

- **Ethics:** Is to break a code of conduct. For example, disclosure of information about the new software to a rival software publisher or to the press.
- **Culture:** When software is released in different cultures then care must be taken so that people are not offended. If certain computer games mock religion or cultural beliefs, then again this could cause offence.

## 10. Communication

### 10.1. Email

#### National Laws

- In some countries, emails are monitored or read, thus limiting the topics on which you can speak.

#### Acceptable Language

- Language used in emails must lie within an acceptable code of practice. The following is a list of unacceptable content that are beyond the code of practice:
  - Obscene images
  - Abusive language
  - Racist, exploitative and violent messages
  - Use of illegal materials in messages

#### Copyright

- Copyright laws apply to text in emails. Forwarding a block of text or an image without the copyright owner's permission, it would be illegal.

#### Employer Guidelines

- If the rules in the 'contract of employment' set out by the employer is not obeyed, you would be in breach of your contract and could be dismissed.

#### Security

- Emails containing personal information should be encrypted to prevent hackers from understanding the information if they manage to hack into the email.

#### Netiquette

- Some of the rules that the netiquette contains is:
  - Don't be abusive
  - Don't send spam
  - Be precise
  - Check spelling and grammatical errors
  - Ensure attachments are not too large
  - Don't use CAPITAL LETTERS to highlight comments
  - Don't plagiarize
  - Don't use too many emoticons

#### User ID and Password Protection

- Email services require a user ID to authenticate users
- Passwords should contain alphabets, numbers and special characters (#, \*).
- **Email Groups**
- Easier to send out multiple mails by grouping them under one name.
- Companies and organization can group people according to their target group for marketing purposes.
- Spammers can create email groups by buying addresses of people from a certain company and send in easier ways.
- Companies use email groups to set up meetings. Typing out individual addresses may leave out a few mail IDs.

### 10.2. Internet Fundamentals

#### \*INTERNET AND INTRANET EXPLAINED IN [CHAPTER 4](#)\*

- The world wide web (WWW) is a system of interlinked hypertext documents accessed via the Internet
- Protocols are a set of rules that are followed between the sender and recipient of data which is being transferred between devices.
- **HyperText Transfer Protocol (HTTP):** A protocol that is followed between the sending and receiving devices when data is being transferred using the internet.
- **HyperText Transfer Protocol secure variant (HTTPS):** HTTP that is followed when data being transferred is encrypted.\*\*
- **Hyperlink:** Data that redirects the user to another webpage/section of same webpage/file when clicked.
- **File Transfer Protocol(FTP):** Used to upload website files to the web hosting space. To upload these files successfully, the user needs:
  - An FTP client
  - Login details to the web hosting server (host and port used, username and password for FTP.

#### Cloud storage:

- The storage of data (remotely) on the internet.
- This data is accessible by the user with the requirement of an appropriate authentication technique (e.g. user ID and



password).

**Search Engine:**

- A search Engine is used to find information on the internet without knowing the (Uniform Resource Locator) of the webpage holding the information.

**Blog**

- Personal internet journals where the writer posts their observations on a topic
- No training is needed to do this
- Blogs range from minor projects (e.g. people gossiping about a topic) to important subjects such as politics or advertising products
- Comments are not immune from the law
- Bloggers can be prosecuted for offensive comments

**Wiki**

- Software allowing users to easily create and edit web pages without using any web browser
- A wiki will support hyperlinks and has a very simple syntax (language rules) for creating pages
- Wikis are described as 'web pages with an edit button'
- Anyone can use wikis- content should be treated with caution
- Example of a wiki: Wikipedia

**Social Networking**

- These sites focus on building online communities of users who share the same interests
- Enable people to share photos of themselves, their favourite music and videos, what they like to do, what they like to eat etc.
- Example: Facebook
- These are becoming the modern way of interacting socially
- They allow people to communicate across the world and share their interests and views with many people.

**10.3. Information on the Internet**

- Information is more likely to be up to date than in books, since websites can be updated very quickly
- Much easier to get information from websites- search engines link key words together and find information that matches the criteria- cause for popularity

- Vast amount of information on the internet- easier to locate than using indices in books
- Information on the internet however may be relevant or correct, not reliable, inaccurate or even biased- it does not go through any checking process
- Information overload can make it difficult for the user to find relevant information
- Ensure use of reliable websites that properly cite all their sources
- Always look for primary sources of information & form own conclusions
- Do not quote/use secondary often biased opinions or gossip
- Do your research

**11. File Management**

**11.1. Manage Files Effectively**

Extension name	Full form	Used for/in:
css	Cascading Stylesheet	Stylesheets in webpages
csv	Comma Separated Value	Store tabular data
gif	Graphics Interchange Format	Moving images
htm	Hypertext Mark-up (Language)	Webpages
jpg	Joint Photographic Experts Group	Standard for images
pdf	Portable Document Format	Documents to be circulated over the internet/email
png	Portable Network Graphic	Compressed images
rtf	Rich Text Format	Word processed documents
txt	Text (File)	Simple Text files
zip		Sending multiple files as one compressed file over the internet

- Generic file formats can be opened by any software to access the data held in them.

**11.2. Reduce File Sizes for Storage or Transmission**

- Files that are smaller in size upload and download faster than larger ones and thus are better for transferring data.

**12. Images**

- An image should be edited when doing so will enhance its usefulness.

## 13. Layout

- Headers and footers ensure each page has all the required information like the page numbers, logos, titles, etc.
- A common mnemonic is "An orphan has no past; a widow has no future"

## 14. Styles

- Several organisations use a 'corporate house style or corporate branding, which is used to print on websites, visiting cards, letters, etc. It refers to a specific style of fonts and formats used in the making of ICT solutions by organisations.
- A corporate house style when used effectively identifies the users of the style.
- Consistent styles enable users to associate a particular organisation with a style and also show consistency in the ICT solutions created by the organisation

## 15. Proofing

### 15.1. Software Tools

- When a person's/organisation's name is entered or sometimes newly coined terms are used, spell checkers might pick these up as errors, because they are not found in the dictionary. This makes spell checkers less efficient.
- Validation ensures that the data being entered into an ICT solution is reasonable and makes sense. Entered data is checked against set criteria to be validated.

### 15.2. Proofing Techniques

- Verification: checking of data when copied from one medium to another to prevent errors.
- Verification is also important and is a way of preventing a difference in data when it's being transferred from one system to another. This tries to make sure data entered is correct, relative to the source.

## 16. Document Production

- Widow: A paragraph-ending line that falls at the beginning of the following page or column, thus separated from the rest of the text.
- Orphan: A paragraph-opening line that appears by itself at the bottom of a page or column, thus separated from the rest of the text.

- Page, section and column breaks are used to ensure that widows and orphans are not present in a document (these show poor typography).
- A mail merge document is created in order to create a standard template and then use it to send documents personalised (by the computer system) for the respective recipient of the document

## 17. Data Manipulation

### 17.1. Create a Database Structure

- Flat file databases are tables that have data sorted in rows and columns, whereas relational databases are several tables grouped together to form a link, thus preventing unnecessary repetition of data.
- Primary key: The key field of a table which is unique and identifies each record
- Foreign key: The field linked to the primary field of the table linked to through a relationship

Relational database	Flat-file database
Complex queries can be carried out	Poor at complex queries
Better security	Poor at limiting access
Cater for future requirements	Harder to update, so inherently inefficient
Data is only stored once	Potential duplication
Require more planning	Easy to design
	Non-unique records
	Harder to change data format.

- At times placeholders for media such as images, sound bites and video clips are used to enhance the usability of a database

### 17.2. Test the Data Model

- A model prepared needs to be tested before being used to ensure that all results computed are accurate. The test plan must be justified to be apt for the model. E.g. all the mathematical operations must be tested in a model that relies on calculations.
- Definitions:
  - Testing: Checking if the designed model delivers the expected outcome when tested with data.
  - Test data: The input data used for testing model.
  - Expected outcome: The output a model is supposed to give with the test data.
  - Actual outcome: The output a model actually gives the user when the test data is input.

## 18. Data Analysis

## 18.1. Create a Data Model

- Charts: A graphical representation of (usually tabulated) data
- Accurate data ensures the results obtained by the processing of data is relevant, which is essential to the usability of the model
- Formulae are mathematical operators defined by the user to perform a function, whereas functions are predefined logical and mathematical operations a user can use in a spreadsheet
- Mathematical operations are performed in the order PEMDAS (Parenthesis [Brackets] Exponents Multiplication Division Addition Subtraction). Brackets are used to notate data used by a function, e.g. =SUM (A2:A10).
- Relative cell referencing is made when the cell reference is supposed to change when the cell it is referred to is changing. It aids more efficient designing of models. Absolute cell referencing is made when the cell referenced stays constant when the cell it is referred to is changing. This aids the preparation of a model when a set of data is constantly being referred to throughout the model. Cell reference or relative cell reference describes how far away a cell or group of cells is from some other cell in the same spreadsheet. Basically, the cell's address
- A model prepared needs to be tested before being used to ensure that all results computed are accurate.
- Definitions:
  - Cells: A space for data to be entered a table; a box formed by the intersection of columns and rows
  - Rows: Horizontal boxes that divide the table in segments
  - Columns: Vertical boxes that divide the table in segments
  - Sheets: A table of data
  - Tabs: A module of a database program that holds the tables on the computer,
  - Pages: Full pieces of papers that contain information held on one sheet of paper.
  - Ranges: A group of cells in a table
  - Named cell: A cell in a table that is given a name (like 'profit margin') and can be referred to using that name.
  - Named range A group of cells in a table that are given a name (like 'Pricing') and can be referred to using that name.
  - Nested formulae/function: A formula/function used inside a formula/function as an argument

## 18.2. Test the Data Model

- A model prepared needs to be tested before being used to ensure that all results computed are accurate. The test plan must be justified to be apt for the model. E.g. all the mathematical operations must be tested in a model that relies on calculations.
- Definitions:

- Testing: Checking if the designed model delivers the expected outcome when tested with data.
- Test data: The input data used for testing model.
- Expected outcome: The output a model is supposed to give with the test data.
- Actual outcome: The output a model actually gives the user when the test data is input.

## 19. Website Authoring

### 19.1. Web Development Layers

- Content/Structure layer: Holds the content of the webpage structure.
- Presentation layer: The layer responsible for the formatting of a webpage(s) or elements (using a stylesheet).
- Behaviour layer: scripting language of a web page or an individual element

### 19.2. Create a Webpage

- Tables make the basic structure of a webpage and organise page layout.
- Anchor: An element in a webpage that creates a hyperlink between a source anchor and a destination anchor. These can be used to link 2 resources together.
- Relative file paths are used for attached stylesheets as the stylesheet is going to be stored on a server in the same directory as the webpage, and not where it an absolute file path says.
- Definitions:
  - Relative file path: A path referring to a file in the same directory relative to the page the reference is made in.
  - Absolute file path: The full path of a file, which is not relative to anything, whereas relative links only point to a file or a file path, the browser then redirects the user to that location on the current site.
    - Absolute paths always include the domain name of the website
    - These should not be used to refer to locally saved webpages as the computer the webpage is stored on (the server) is not the same as where the webpage was developed and thus an absolute file path would point to the wrong address.

### 19.3. Use stylesheets

- CSS (cascading stylesheet) is a text-based language which is attached to webpages to set their format. CSS files have a ".css" extension
- These should be attached using relative file paths as they are stored along with the webpage and thus can be linked relative to them.
- Internal CSS have more preference over Inline CSS

- If several external stylesheets are attached to one web page, the stylesheet attached last (at the bottom of that part of the code) is given preference over the other attached ones).

## 19.4. Test and Publish a Website

- To upload and publish content on a website using FTP, a user must have:
    - FTP client software
- 
- All files in one folder
  - Host Name/URL/IP address for ftp
  - Host port to be used for upload
  - Username and password
  - The test plan used to test a webpage must be justified based on the elements being tested. E.g. If hyperlinks are being tested, it makes to check if all the hyperlinks are redirecting the user to the correct webpage/ section of webpage.