

Grade 12 CAT Theory Study Notes

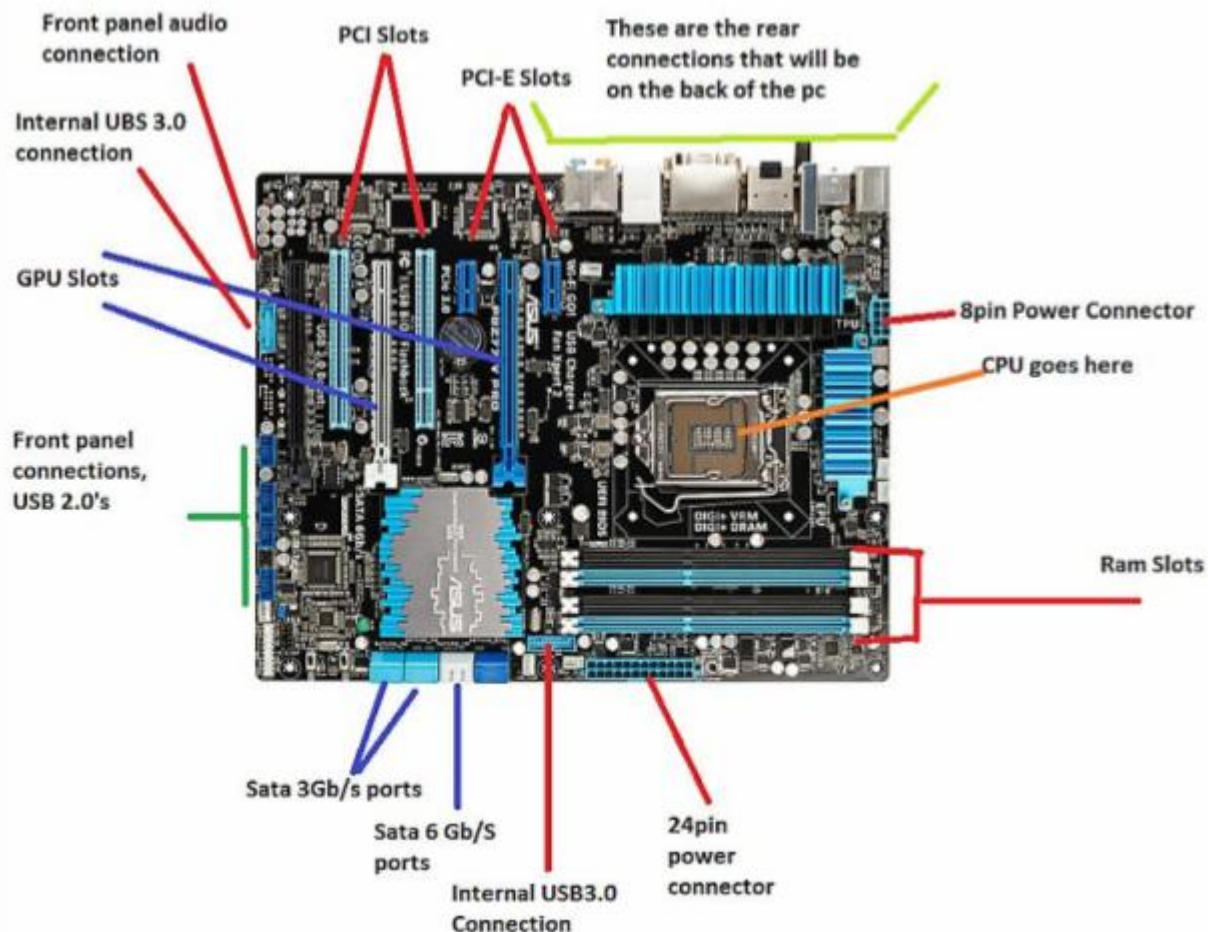
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How these notes are structured

Learning Unit 1 Hardware

1.1 Modular Design

- Purchasing a computer can be quite a daunting task.
- Fortunately, computers are built with a Modular Design, which means that the computer you buy can be put together in pieces with your requirements in mind, instead of consisting of a single unit in which all the hardware is fixed.
- Smaller technologies (Laptops, Netbooks, Smartphones and Tablets) are less modular, and parts are not easily replaceable.
- Each of the hardware parts are separate modules and are connected via the motherboard, using the ports or the slots.
- For example, RAM, PCI cards and hard drives are easily interchangeable if they are compatible with the motherboard.



Modular Design has the following advantages:

- Repairs
- Consider, due to load shedding, your power supply blows a fuse and your computer no longer has electricity.
- In the early days of personal computers, the whole computer would have to be sent in for repairs.
- This would lead to disruptions in your use of the computer (although it would be a great excuse for not having completed your homework).
- In the modern computer, it is a simple task to remove the offending power supply and replace it with a working unit.
- Upgrades
- Modular Design simplifies the upgrading of the computer with better hardware.
- For example, a gamer who wants to play extensive video games can buy a powerful desktop (fast multiple processors with large cache and lots of RAM) but will need to include a high-end card designed for the gaming needs.
- Flexibility
- Modular Design allows for a variety of components to be added to the motherboard depending on the user's needs.
- The CPU, amount of RAM, secondary storage and graphics card all contribute to the type of computer the user can choose.
- Laptops, tablets and mobile phones are not as easy to upgrade and repair as their parts are highly integrated and are not easily removable.

1.1.1 External Device Connectivity (Ports)

- USB Ports: Standard on all computers. USB 3 is significantly faster than USB 2.
- Thunderbolt & USB-C: Modern computers often include these for high-speed data and video. Note: USB-C requires checking specific speeds and capabilities of the port and cables, as it supports multiple standards.
- Network Port: Used for connecting to a cabled network.
- WiFi: Not a physical port, but standard on many computers (look for specs like 802.11 b/g/n).

1.2 Components and Devices that Affect Computer Performance

1.2.1 CPU

Overview & Processing Speed

- **Function:** The Central Processing Unit (CPU or processor) is responsible for running programs and processing data.
- **Speed Measurement:** Processor speed measures processing speed and is expressed in Gigahertz (GHz), such as 1.7 GHz, 3.2 GHz, or 4.0 GHz.
- **Cost vs. Performance:** Increasing processor speed incurs a high cost for relatively minor performance gains.

- **Identification:** CPU brand names (typically Intel or AMD) and models (e.g., Intel i7) are used to identify processors in advertisements.
- **Hardware Connection:** The CPU fits into a specific socket on the motherboard, such as an LGA 1700 socket.

Performance Enhancement Techniques

- **Multiprocessing (Multiple Cores):**
 - Modern CPUs incorporate multiple cores (e.g., Dual-Core/x2, Quad-Core/x4) on a single CPU chip, effectively functioning like having multiple processors on one chip.
 - Multiple cores allow several processes to execute simultaneously, improving overall computer performance.
 - For multiprocessing to work effectively, it must be supported by both the motherboard and the operating system.
- **Processor Cache Memory:**
 - CPU processing speed (e.g., 4.0 GHz) is more than double the speed of RAM (e.g., 1866 MHz / 1.866 GHz).
 - Cache memory runs at a speed similar to the CPU.
 - It stores pre-fetched blocks of program instructions and data from the slower RAM so the CPU can access them quickly when needed next.

Buying Recommendations by User Type

- **Personal, SOHO, and Mobile Users:**
 - Standard entry-level (cheapest) processors are sufficient.
 - Ideal for everyday activities including general computing tasks (word processing, spreadsheets), email, web browsing, casual gaming, and basic multimedia (photo viewing/editing, playing music, watching videos).
- **Power Users:**
 - Should invest in the best CPUs they can afford.
 - Required for resource-intensive applications such as demanding games, 3D graphics rendering, large databases, complex spreadsheets, and high-end photo and video editing.

1.2.2 RAM

Definition & Physical Form

- **Role:** RAM (Random Access Memory) acts as the main memory and temporary storage area for running programs and active data being processed.



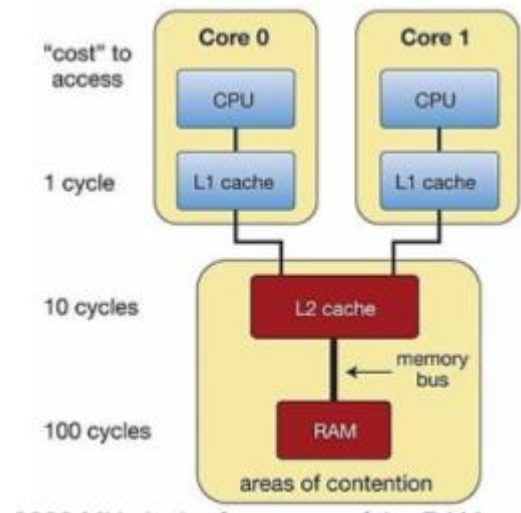
- **Physical Structure:** It consists of chips on modules (such as DIMMs) attached to dedicated slots on the motherboard.

Key Metrics & Specifications

- **Type / Architecture:** The most common type is Double Data Rate (DDR) SDRAM (e.g., DDR3 or DDR4).
- **Capacity (Amount):** Measured in GB, this determines how much data can be loaded into memory at once.
 - A larger capacity reduces the need to use slower secondary storage for virtual memory.
 - Installing more than 4 GB of RAM requires a **64-bit operating system** to fully utilize the total capacity.
- **Frequency (Speed):** Measured in megahertz (MHz), frequency determines how quickly data transfers to and from RAM. Higher frequencies allow faster delivery of instructions and data to the CPU cache.

System Performance & CPU Interaction

- **Data Flow:** The speed and type of RAM impact overall system performance because data constantly moves in and out of it. Quicker memory access allows the processor to execute tasks faster.
- **Cache Synergy:** Higher speed RAM delivers data faster to the CPU cache. A larger cache holds more instructions, reducing the need to fetch data directly from RAM.



Selection & Capacity Recommendations

- **General Recommendation:** More memory benefits all users by allowing more data and applications to run concurrently.
- **Sweet Spot: 8 GB** is generally considered the sweet spot for standard users.
- **Power Users:** Workloads involving heavy data sets (e.g., video editing or gaming) require larger memory capacities—such as **16 GB** or higher—to process multiple large files smoothly.

Example Specification Breakdown (e.g., 16 GB DDR4 2666 MHz)

- **16 GB:** Total memory capacity.
- **DDR4:** Generation/type of RAM.
- **2666 MHz:** Transfer frequency/speed.

1.2.3 Graphics Card

- A graphics card consists of a specialised processor called a Graphics Processing Unit (GPU).
- This processor is housed on a separate card that connects to the motherboard via a slot such as PCIe.
- The GPU processes (renders) images stored in the graphics card RAM, called Video RAM (VRAM).
- The GPU allows the CPU to offload the burden of image processing, freeing up the CPU to perform other tasks.
- At the time of writing, GDDR5 is the most popular and commonly used VRAM in budget, mid-range, and high-end graphics cards.
- GDDR5X is used in a few high-end graphics cards and is almost twice as fast as GDDR5.

1.2.3.1 Integrated Graphics vs. Dedicated Video Cards

Feature / Aspect	Integrated Graphics	Dedicated Video Card (Graphics Card)
Hardware Setup	GPU is embedded directly into the CPU or motherboard.	A separate circuit board that plugs into a dedicated slot on the motherboard.
Memory (RAM/VRAM)	Shares standard system RAM instead of having dedicated VRAM.	Contains its own dedicated video memory (VRAM).
Performance & Target Audience	Sufficient for average users and entry-level computers.	Adds extra processing power needed for realistic visuals, 3D graphics, video editing, and high-end gaming.

1.3 Secondary Storage

- At the high-end of processing (video editing, 3D rendering or gaming), a faster Hard Disk Drive (HDD) or Solid State Drive (SSD) will significantly improve the ability of the processing components (CPU/GPU) to access the data on secondary storage as quickly as possible.
- A summary of the comparison between Solid State Drives and Hard Disk Drives is highlighted in the following section.

1.3.1 Comparison of HDD and SSD

- SSDs have no moving mechanical components; HDDs contain spinning disks and movable read/write heads.
- Compared with electromechanical drives (HDDs), SSDs are typically more resistant to physical shock, run silently, have quicker access time and lower latency.
- SSDs are still more expensive per unit of storage than HDDs.
- SSDs take around three times less boot up time than HDDs.
- SSDs consume less power, also averaging about three times less than that of an HDD.
- Storage capacity of SSDs are typically larger than 1 TB for laptops; 4 TB for desktops.
- HDDs are typically around 500 GB and 2 TB maximum for laptops, 10 TB maximum for desktops.
- SSDs have no vibration, no sound and no moving parts; HDDs have spinning platters that can sometimes result in vibration and noise.
- SSDs file opening speeds are up to 30% faster than HDDs.
- SSDs are safe from the effects of magnetism, but magnetic interference can erase data on HDDs.
- We will discuss M.2, PCIe NVMe and SATA SSDs.

SSD vs HDD

(Solid State Drive)

(Hard Disk Drive)



This is the main, permanent storage area for all your data and software. Computers usually have one hard drive, but you can add additional hard drives.

Notes	• A file server in a network often has a number of large hard drives, because it has to store all the users' files. • Besides the capacity of a hard drive (e.g. 2 TB), hard drives can be identified in adverts by terms such as SATA (the internal hard drive interface or connection) and the speed at which it rotates, which is measured in revolutions per minute (rpm) – e.g. 7200 rpm. • SSDs use technology that is similar to flash memory. They are becoming more popular, especially on portable computers such as laptops. While they are quicker than mechanical hard drives, they are generally smaller in capacity and are a lot more expensive.
Recommendations	• Most users will almost never fill the hard drive of their computers if they simply use the computer for applications such as word processing, spreadsheets, email and web browsing. When you start using your computer for media (music, movies, video clips, photo collections), then you will want to have the largest storage you can afford.

1.3.2 Secondary Storage Formats and Busses

1.3.2.1 M.2 Format

- M.2 is a form factor – it describes the shape and size of a hardware device.
- The M.2 connector can access the PCI-express 3.0, SATA 3.0 and USB 3.0 bus, depending on the type of M.2 device.
- M.2 SSDs are small drives connected directly to an M.2 socket on the motherboard as opposed to SATA based drives that use cables to connect to the motherboard and provide power.
- The innovative lack of cables makes M.2 drives ideal for Small Form Factor (SFF) systems that have little room for cable routing.

1.3.2.2. M/2 vs. SATA

- M.2 SSDs and SATA SSDs are both SSDs but with different sizes and connectors.
- M.2 is a small form factor and SATA is a bus type.
- SATA SSDs come in two form factors, 2.5 inch and M.2.
- The 2.5 inch form factor needs two cables (data and power) to connect the SSD to the motherboard.
- M.2 SSDs have the same performance as their 2.5 inch counterparts and plug directly into the motherboard, eliminating the need for cables.
- There are two main types of M.2 SSDs, the first uses the PCIe bus (known as NVMe SSDs) and the second uses the SATA bus.



1.3.2.3 PCIe NVMe M.2 SSDs

- An exciting feature of M.2 based SSDs are the Non-Volatile Memory Express (NVMe) that connect via PCI-express.
- SSDs are essentially high-speed memory, but since SATA 3.0 was only capable of 6 GB/s, the access speeds of SSDs were limited.
- By accessing the PCI-express bus, instead of the aging SATA bus, NVMe drives can run at much faster speeds.
- NVMe SSDs produce a significant increase in speed over SATA SSDs.
- By upgrading a mechanical hard drive to an SSD increases performance in tasks from boot speeds to file load speeds; however, upgrading to an NVMe SSD will produce even more significant performance gains.
- Most modern motherboards support NVMe connections via the PCIe bus, but some older boards provide a M.2 slot connected to the SATA bus limiting the speed of the SSD drive.
- To achieve these speeds from your NVMe SSD, make sure your operating system is installed on the SSD drive together with frequently used programs, games and data.

SATA III Hard Drive	SATA III SSD	NVMe SSD
~100 MB/s Read	530 MB/s Read	3,500 MB/s Read
~100 MB/s Write	500 MB/s Write	3,000 MB/s Write



1.3.2.4 SATA SSDs

- SATA is an older, slower bus technology found in desktops and laptops.
- SATA drives require a SATA power cable as well as a separate SATA data cable unless you are using an M.2 SATA-based SSD.
- Common SATA devices include 2.5 inch SSDs, 3.5 inch mechanical hard drives and 5.25 inch optical/Blu-ray drives.

1.3.2.5 External hard drive

- These devices are basically laptop (2.5") or desktop (3.5") hard drives placed in enclosures or cases that allow them to connect to computers using USB or Thunderbolt cables. 2.5" drives can be powered by the computer using a connection cable, whilst 3.5" drives need an extra power supply to power them.

Uses

- Just like internal hard drives, external hard drives store data and software permanently. External hard drives are also used to
 - store and carry media, data and software around with you
 - store backups safely, away from the computer.

Advantages

- The advantages of external hard drives include the following:
 - A large capacity – they can often store larger amounts of data than the original internal hard drives
 - Portability – they are small and easy to carry around
 - Ease of use – they can be plugged into a USB port and used instantly
 - High speed – they are faster than optical media (CD/DVD)
 - Reliability – they are more reliable than optical media
 - Adding extra storage to your computer, without the need to open the computer

Limitations

- External hard drives are not physically as small as flash drives.
- External hard drives have the same vulnerabilities as internal hard drives and can be damaged easily because they are mechanical and magnetic. (An external hard drive should not be moved whilst it is working and should not be dropped at any time.)
- Laptops running on battery power drain more quickly if a 2.5" drive is connected to them, as the power for such a drive is provided by the computer.

Recommendations

- For most **personal users**, using a flash drive is the quickest and simplest way to transfer data and even make some measure of backup.
- **All users** can use external hard drives as storage for music and videos etc. and to back up their internal hard drives.
- **SOHO** and **power users** usually need a large external storage device for storing their data.

1.3.2.4 Flash drive

- Flash drives are small, cheap portable storage devices that now have storage capacities ranging from quite small to very large.

Uses

- Flash drives are widely used to
 - carry data and software around with you
 - make backups
 - distribute data and software.

Advantages

- The advantages of flash drives include the following:
 - Portability (they are small in size)
 - Fast data access
 - They are cheap
 - Larger capacities than optical media
 - Industry-standard use (i.e. useable with all operating systems and most devices, provided the devices have USB ports)
 - Reliability and robustness (they are not easily damaged if they are dropped)
 - Ease of use (in terms of adding and deleting files)
 - The fact that there is no need for an external power source (they are powered via the USB port)
 - The fact that flash drives may include embedded security (e.g. a password or biometrically secured encryption system)

Limitations

- Flash drives have a few limitations. Flash drives
 - are easy to lose and are easily stolen
 - are more expensive per GB than hard drives
 - have lower capacities than newer hard drives.
- Don't plug just any flash drive into your computer unless you know that it's 'clean'. Viruses are easily transferred in this way. Even if you have an anti-virus program installed on your computer, it's not worth the risk!
- **Social and ethical considerations** The widespread use of flash drives has social and ethical consequences. These devices can be built into virtually anything (key rings, credit cards, pen knives, pens, etc.). Their small size, large storage capacity and ease of use means that it has become easy for people to pirate media, copy and steal data or install illicit software on computers that are not their own.

1.3.2.5 Optical media

Uses

- The uses of optical media include
 - distributing software
 - distributing and storing content such as movies and music
 - backing up.

Advantages

- Advantages of optical media include
 - affordability
 - portability
 - industry-standard use.

Limitations

- Limitations of optical media include the following:
 - They're slow.
 - They're easily damaged (scratches, etc.).
 - They have a relatively small capacity in the context of modern storage requirements and file sizes (700 MB for a CD, 4.7 to 8.5 GB for a DVD, 25 GB and higher for a Blu-ray disc).
 - They're not as easy or intuitive to write to as flash drives.
 - Laptops are increasingly being designed without optical drives.

Troubleshooting

- Optical discs often fail or give problems because they get dirty. They are also easily damaged and scratched. You can clean a dirty disc by wiping it with a soft damp cloth. A scratched disc is difficult to repair and you can usually only replace it. Writeable and re-writeable discs are easily damaged by heat or cold and nothing can be done to fix this damage.

1.3.3 Decisions about storage

- Storage size is one of the most important buying decisions you need to make. The type of storage you add to your system can affect its cost, what it can be used for and its speed and efficiency. Some questions you need to ask are:
 - **What size hard drive do you need?** Entry-level drives (i.e. smallest and cheapest) are more than sufficient for anyone except people who
 - play computer games (games usually take up a lot of space)
 - edit photos, sound (or music) or video professionally
 - want to have large media collections (movies, photos, etc.) on their computers.
 - **Do you need an optical drive?** Yes – if you want the ability to read and play music and DVDs and the ability to read old discs. For many people with good internet connections the answer to this is NO, as most software and media is distributed online.
 - **Do you need to write optical disks?** For most people the answer should be NO, as flash drives and portable hard drives are much more effective and convenient than optical media.
 - **Do you need SSD?** SSD is ideal in laptops and mobile devices as it does not get damaged as a hard drive does when moved whilst in use. It also provides a significant speed boost. If you can afford it, get a smaller (256 GB) SSD for your system drive (to hold your operating system and apps) and a separate larger hard drive for your data. This will speed up your system considerably.

1.4 Choosing Input Devices

Keyboard

- Keyboards are the most common input device which allows a user to type data to be entered into a computer.
- Unfortunately, data entered via a keyboard is highly prone to errors.
- Users often make mistakes when typing in data, requiring this data to be validated.
- Input alphabetical, numeric and special characters one character at a time.

Mouse

- The mouse, which is the most popular pointing device, has a left button, a right button and a scroll wheel which allows a user to select icons on the screen.
- Laptops provide a track pad to serve the same purpose as a mouse.
- Most mobile devices have touch screens where users can select icons.
- Select icons, menus, dropdown lists.

Scanner

- Scanners convert captured images to a digital format.
- Most scanners can scan A4 pages and can be combined with a printer.
- Scanners can use Optical Character Recognition (OCR) to convert the images to a text editable format.
- Suitable to convert printed pages to an image or a text format.

Bar Code and QR Code Readers

- Bar code readers read data encoded as a series of lines.
- Instead of a bar code, a QR code can be used as it contains more data than a bar code.
- Bar code and QR code scanners are useful to limit a user's input.
- Read prices, ISBN numbers, links to web sites (QR Code).

Biometric Scanners

- Biometric scanners capture biometric data (fingerprint, iris, facial features) for verification of a person's identity.
- The scans match the inputted data against previously saved database to approve or deny access to the system.
- Access control to a building, user authentication for a device.



Microphone



- Converts sound to a digital form that can be stored as a file.
- Suitable for video conferences, recording messages and songs.

Webcam

- A webcam is usually a small video camera connected to a computer or built into the computer hardware that streams an image or video in real time to a computer network or the Internet.



- Suitable for video conferences.

Headphones and Headset

- Headphones are useful to hear sound from the computer without disturbing others.
- The sound is usually of a higher quality than the computer can produce with its internal speaker.
- If a microphone is included with headphones, it is called a headset and can both input and output sounds.
- Suitable for gaming and video conferences.

1.5 Choosing Output Devices

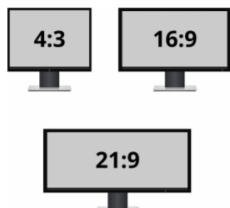
1.5.1 Monitors

A monitor is described using:

- screen size,



- aspect ratios,



- resolution, and
- refresh rate.
- Screen size is measured diagonally across opposite corners in inches.
- Laptops have screens that are usually 15", monitors normally range between 17" and 43" but some monitors can be up to 80".
- Screen resolution is the number of pixels on a screen measured in width and height.
- Aspect ratio is the width of a monitor in relation to the height.

Advantages

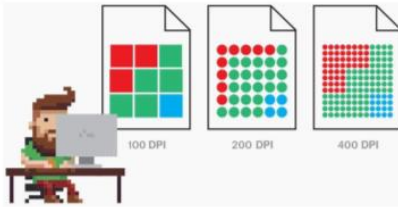
- Monitors provide immediate feedback to the user regarding active computer processes.
- They enable real-time interaction between the user and the system.
- Displayed content can be easily modified or updated by the user.
- Accessibility features allow text enlargement and high-contrast settings for visually impaired users.
- Display settings such as brightness and color options can be tailored to individual preferences.

Limitations

- Display quality is closely tied to monitor size, with larger screens typically offering higher quality.
- Physical size restricts portability, making larger screens difficult to transport.
- Output is not easily shared with large groups without external hardware like a projector.
- Ambient environmental lighting can negatively impact image clarity and quality.

Buying Decisions & Factors

- **Resolution & Aspect Ratio:** Resolution represents the max pixel count (horizontal × vertical, e.g., 1920 × 1080). Traditional 4: 3 ratios are outdated for modern widescreen media, which favors 16: 9 or 16: 10. Larger screens (above 22") require resolutions higher than 1080p to maintain clarity across the expanded display area.
- **Color Depth:** The number of bits allocated per pixel; higher bit depths (e.g., 24-bit vs. 16-bit) deliver a wider color gamut.
- **Pixel Density (DPI):** Pixels per horizontal inch. Higher density creates sharper, clearer text and images.



- **Refresh Rate:** How frequently the screen updates per second. Higher rates minimize motion blur or "ghosting" during fast-moving visuals.
- **Contrast Ratio:** The luminance difference between peak whites and deepest blacks, controlling image sharpness and depth.

Troubleshooting

Issue	Cause / Solution
Faded, overly intense, or dim image	Adjust hardware/software settings for brightness and contrast.
Blocky or stretched display	Correct display resolution settings in operating system to native specifications.
Color tinting (purple, blue, yellow, green)	Inspect, reconnect, or replace damaged display interface cables.
No display signal / blank screen	Verify power connections, test cable integrity, ensure system is powered on, or swap display hardware.

- If you pack more pixels in the same size monitor with the same aspect ratio, the image will be sharper and clearer since there are more pixels packed into the same aspect ratio.
- Ultra-wide monitors are useful as their extra width can be used to view two applications side by side on one monitor instead of using two separate monitors.
- Refresh rate is the number of frames that are displayed in a second.
- A monitor with a high refresh rate requires a graphics card and is usually required for high-end users, e.g. gamers.
- There are many different types of monitors available.
- The monitor that you choose is usually dependent on three categories:
- General or business use monitors are found at home or work offices and display software applications, web browsers, or computer programs that do not need graphics processing.
- These monitors are fairly low in price and the computer will not need a graphics card.
- Professional visuals, such as a digital artist, require a monitor that displays the images in the correct colour and to a higher resolution so that the finished product will look similar on other monitors.

- These professionals work on applications such as Adobe Photoshop for image editing or Corel VideoStudio for video editing.
- Gaming requires a monitor with a high refresh rate and a computer with a powerful graphics card.

Recommendations	• For most users an entry-level monitor will do just fine. The only specification they might worry about is the size (measured diagonally) in inches, e.g. a 27" monitor. • Power users such as gamers, video editors, photographers and architects often need larger displays, or they might even connect multiple monitors to their computers to maximise their productivity. They will pay attention to more specifications – e.g. for gamers the refresh rate is important. For photographers and video editors the resolution and colour accuracy is important.
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1.5.1.1 Touch Screens

- Touch screens are both an input and output device, eliminating the need for a keyboard and mouse, saving physical space.
- Touch screens are easier to use, easier to clean and sterilise, making them ideal for environments such as restaurants, hotels, hospitals and other medical healthcare settings.

1.5.2 Printers

Printers are needed to create hard copies of any documents that are on the computer. When choosing a printer, many factors need to be considered since there are a large variety of printers available, each suitable for a specific situation. Before settling on a printer, the purpose, environment (home, small office, or large office), and whether future business needs might change must all be evaluated.

Side Note: Make sure that you can recommend the best type of printer for a specific scenario.

1.5.2.1 Comparison of Core Printer Types

	Laser printers	Inkjet printers	Dot matrix printers
Uses	Print black and white or colour documents; ideal for higher volumes and crisp text.	Print black and white or colour documents; ideal for photo printing and low volumes.	Most often used as POS (Point Of Sale) printers for receipts, invoices, etc.
Advantages	• Fast print speeds. • High quality text. • Ideal for high volumes with a lower running cost per page as toner lasts longer.	• Cheaper initial purchase price. • Best quality photographic prints. • Smaller size/footprint for compact office setups. • Cost-effective for low printing volumes.	• Cheap to buy. • Very low running costs (uses printer ribbon). • Can create carbon copies.
Limitations	• Not the best for printing good quality colour photos.	• Higher running cost per page due to expensive ink cartridges.	Low print quality and not suitable for high-

	Laser printers	Inkjet printers	Dot matrix printers
	• Colour laser models are significantly more expensive. • Toner is not absorbed by paper, so repeated folding or scraping can rub off the toner.	• Generally slower print speeds. • Text print quality is generally not as good as laser.	quality printing.
Paper & Media Notes	Generally produces good quality graphics. Toner does not bond well with paper that has a rough or bumpy surface.	Ink tends to absorb and spread on normal paper (softer, blurrier image). High-gloss, photo-quality paper is expensive.	Requires specialized continuous tractor-feed or multi-part carbon paper.

Side Note: Quality and speed of printers change and improve constantly. While laser printers were traditionally much faster, modern lasers and inkjets can offer similar speeds and baseline qualities.

Specialized Printer Categories

1.5.2.2 Multifunction Printer (MFP)

- Combines printing, scanning, and faxing into a single unit.
- Can use either inkjet or laser technology.
- Reasonably priced, saves desk space, and is cheaper than buying standalone devices.
- Ideal for home or small office use. While scanning and printing are essential, faxing has largely become obsolete.

Photo Printers

- Specialized for printing photos immediately without waiting for professional development.
- Deliver superior print quality and high color accuracy.
- Compact size (typically printing photos 4 to 6 inches wide).
- Higher purchase price than standard MFPs, with higher paper and cartridge running costs.

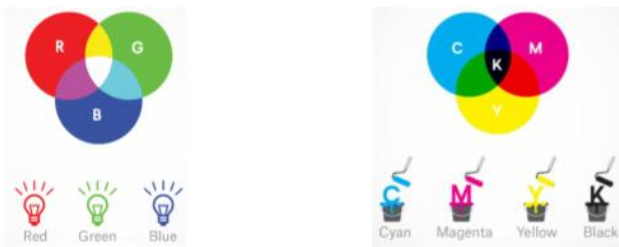
Factors & Buying Decisions

Speed and Volume

- **Pages Per Minute (PPM):** Speed is measured in PPM, usually based on an average 5% coverage page. Printers generally print black and white pages faster than colour pages.
- **Volume:** Daily usage frequency determines whether needs are high or low volume. Speed and heavy-duty capacity are critical for large offices printing high volumes, but less critical for low-volume home use.

Resolution and Colour Models

- **Dots Per Inch (DPI):** Refers to the number of dots of ink/toner applied per inch (e.g., 100 DPI, 200 DPI, 400 DPI). Higher DPI produces cleaner, crisper images. Standard text requires a minimum of 300 DPI. Higher DPI uses more ink/toner and requires photographic paper to be effective.
- **RGB vs. CMYK:**
 - Displays (monitors, TVs, digital cameras, scanners) use **RGB** (Red, Green, Blue) light. Combining all three RGB light colors produces white.
 - Printers use **CMYK** (Cyan, Magenta, Yellow, Black) pigments. Combining all four CMYK pigments produces black. Because monitors use light and printers use ink, printers cannot perfectly reproduce exact screen colors.
 - Printers with separate individual cartridges for each colour prevent having to replace all ink when only one colour runs out.



Paper Handling & Duplex Printing

- **Duplex Printing:** Automatically prints on both sides of the paper. Combining duplex printing with 2-up printing (two pages per sheet face) allows up to four document pages on a single piece of paper, drastically reducing paper consumption in high-volume offices.
- **Paper Sizes:** Most standard desktop printers handle up to A4 size, but specialized versions can print up to A3 size.

System Compatibility & Network Connectivity

- **System Compatibility:** Requires valid printer drivers supplied by the manufacturer for the host operating system (Windows, macOS, Linux, Android, iOS).
- **Network Printing:** Networked printers (wired Ethernet or Wi-Fi) allow multiple computers and mobile devices to share a single printer, cutting costs and eliminating cable clutter.
- **Direct Printing:** Some printers support Bluetooth or direct USB ports to print directly from mobile devices or flash drives without network access.

Mobility

- Portable, battery-powered printers exist, but usually sacrifice print quality and paper capacity. Small desktop inkjets or lasers are preferred unless fixed power is unavailable.

Environmental Considerations

Documents should only be printed when absolutely necessary to protect the environment. Paper manufacturing consumes immense energy, has a massive carbon footprint, and uses toxic chemicals.

- **To reduce print impact:** Print double-sided (duplex), print multiple pages per sheet, or lower the print resolution to conserve ink/toner.
- **Disposal:** Never dispose of old printers, ink, or toner in regular trash. They contain toxic chemicals that leach into groundwater in landfills. Always recycle electronic hardware and cartridges properly.

2D Printer Troubleshooting

If a printer fails to operate correctly, check for common issues:

- Power is turned off or cables are unplugged.
- Computer connection or network settings are misconfigured.
- Ink or toner levels are low (causes faded, irregular output).
- Incorrect printer selected in the print dialogue box.
- Incorrect driver installed (causes garbled or nonsensical output).
- Mismatched paper types (causes ink spreading or toner failing to bond).
- Paper jams (must be carefully cleared manually to avoid internal damage).

Side Note: Printing equipment accounts for the majority of computer system troubleshooting tasks!

1.5.2.3 3D Printing

3D printers create physical three-dimensional objects from CAD or 3D modeling software using materials such as plastic, resin, concrete, steel, and chocolate.

Applications

- Full-scale structures (bridges, houses).
- Assembled mechanical parts (gears, custom components).
- Medical prosthetics and implants (artificial limbs, replacement bones).
- Custom tools, clothing, and furniture.

Advantages & Limitations

- **Advantages:** Allows rapid prototyping without expensive traditional manufacturing setups; enables affordable on-demand, single-run custom parts; eliminates massive spare part inventory needs.
- **Limitations:** High initial printer and material costs; operation can be slow, noisy, and produce unpleasant fumes (e.g., melting plastic); requires precise setup and calibration.

3D Printer Troubleshooting

- Failures can stem from errors in the CAD design model, incorrect speed/temperature settings for the material, faulty heating elements, or defective raw filament/material.

Side Note: Due to these operational complexities, 3D printing remains primarily a professional and hobbyist tool rather than a standard household appliance.

Recommendations

- A **SOHO** or even a **personal user** might consider a multi-function printer that combines a fax facility, email functions, scanning/copying and printing all in one device.
- While printers are generally not designed to be mobile, the **mobile user** may want a mobile printer that works with batteries, although their general print quality is not great.

1.5.3 Speakers and headphones

Speakers and headphones make it possible to hear the sound from the computer or device. Most mobile devices are already fitted with speakers. Headphones and speakers can easily be added to computers as most motherboards come with the necessary jacks or ports.

Uses

Speakers and headphones can be used to:

- play sound
- provide audible feedback to the user
- provide extra notifications or alerts to people with visual disabilities (e.g. software can 'read' text to the user)
- listen to voice messages and interact via communication software such as Skype.

Advantages

- Headphones make it possible to listen to sounds without disturbing other people around you.
- Speakers enable a group of people to hear sound at the same time.
- Headphones make it possible to use mobile devices on the go, such as listening to music on an mp3 or mp4 device while jogging.

Limitations

- The sound quality depends largely on the quality of the peripheral (i.e. the specific speaker or headphone used).
- You may need additional audio equipment, such as an external amplifier, if, for example, you want to play sound loud enough for everyone in an auditorium or classroom to hear.
- The use of speakers can cause a distraction, and be annoying to people who are within earshot, but not directly involved.

Troubleshooting

If there is no sound from the speakers or headphones, there are a few possible causes:

- They are plugged into the wrong jack (e.g. the microphone jack).
- Speakers that need power might be switched off or they might not be plugged in.
- The computer's sound settings (volume control) may be low or set on mute.
- The computer might be set to use the wrong sound output device.

The modern trend to do away with the headphone jack in smartphones and tablets is meant to free up space in the device for more components – and encourage you to use wireless / Bluetooth headphones (not a dongle!).

1.5.3 Data projector

Data projectors are becoming more common and are often seen in classrooms and boardrooms.

Use

Data projectors can be used to project a large image of the display onto a screen, wall or other surface to share it with a large audience or group of people.

Advantage

Data projectors allow the display or presentation or a movie to be viewed by a large group of people.

Limitations

- The resolution of images produced by projectors are not as good as those of high quality display monitors.
- Data projectors are normally limited to a 4:3 aspect ratio (which is almost square) and are therefore not suited to the 16:9 aspect ratio used for most movies.
- Data projectors have lower contrast ratios which result in muddier images with lower colour quality than the images displayed on a normal monitor.
- Images produced by data projectors are not as bright as those of high quality display monitors

Troubleshooting

Problems with projectors are similar to those experienced with monitors, except that when a projector is not working, the bulb might be blown and may need replacing. Special drivers may also be needed to make the projector work.

1.5.3 Scanner

Image scanner capture images, whilst barcode scanners read barcodes

- Image scanners have lost their popularity because of digital photography. **Personal users** will seldom need a scanner, because they can just as easily photograph an image as scan it.
- Any **SOHO** or **power user** who needs to scan documents and convert them into editable text needs a good quality scanner and an OCR program.
- If a **SOHO** or **power user** runs a business that deals with images or photos, then it is probably a good idea for them to get a good quality scanner to ensure that they can deal with any type of image (not just photos) that people might need to edit digitally.

1.6 Upgrade vs Replace

A computer should be replaced if:

- your computer is more than eight years old,
- there are few compatible components available, or
- the price of the components you need to replace is close to or more than the cost of a new computer.
- When looking for a new computer, choose one that will last for many years and can be easily upgraded.
- Investigate the warranties and guarantees offered with the computer.
- A three-year onsite warranty may seem costly but will be beneficial should your computer break down as it can be repaired at your home or business.
- Sending a computer in for repairs can leave you without a computer for weeks which can be inconvenient.

1.6.1 Upgrading RAM

- If you are experiencing trouble opening new Internet browser tabs or there is a delay when you are working with large documents, you might need more RAM.
- You can either add more RAM to what you currently have, provided there are available slots on the motherboard and the new RAM is like existing RAM; or you can update all the RAM in your system to a faster speed and more capacity that is compatible.
- Adding more RAM will reduce the amount of virtual memory needed as more programs and data can be stored in RAM at one time.

1.6.2 Upgrading Secondary Storage

- If opening large files and documents is problematic, or if your computer is displaying messages stating that you do not have enough space when you save photos, music, or movies, you need more secondary storage space.
- A simple solution would be to move your photos, music and movies to another storage device like an external hard drive or to the cloud, alternatively you could buy a larger hard drive.
- When buying a new hard drive, consider upgrading to a solid state drive to improve access time when saving and loading files.
- A faster hard drive will speed up virtual memory when the computer runs out of RAM.

1.7 Typical Computer Systems

Type of Computer	Example Specifications	Typical User
Laptop or Desktop PC (entry level)	Slowest CPU, minimum amount of	This PC will adequately perform

	RAM, storage and lowest screen resolution: Celeron Processor (2 to 2.7 GHz); 4 GB RAM; 500 GB Hard Drive; HD Graphics card.	Web surfing, email, word processing and basic business tasks. It would suit home or small business users that do not need high performance or graphics capabilities.
Laptop or Desktop PC (mid-level)	i3, (usually 2 cores, may be 4); 2 to 3 GHz Processor; 4, 6 or 8 GB RAM; 1 TB HDD or up to 512 GB SSD; UHD Graphics card.	The mid-level category which fits between the entry level and high level categories, suits users that need faster processing and improved graphics capabilities for business or gaming, but do not need the expense of buying the fastest or best computer. These computers can be used in small networks.

- Laptop or Desktop PC (high level)

Example Specifications:

- I5 (4 to 6 cores); 2.4 to 3.4 GHz Processor; 8 GB RAM; 1 to 2 TB HDD or 256 to 480 GB SSD; GPU.
- I7 (4 to 8 cores); 3.2 GHz Processor; 8 GB RAM; 1 to 2 TB HDD or 256 to 480 GB SSD; GPU.

Typical User:

- These computers are for power users who utilise the most advanced features of applications requiring the most capable machines that are optimised for their work purposes.
- Power users include video-editing professionals, high-end graphic designers, audio producers, and those who use their computers for scientific research.
- Professional gamers are included in this category as they require machines that will play their games at a high frame rate.

1.8 Newer Technologies

1.8.1 Drones

- Drones, more formally known as Unmanned Aerial Vehicles (UAVs), are aircraft devices that fly above the ground and are not piloted.
- They perform actions that are either controlled remotely by a human operator or are pre-programmed to respond to sensors and make decisions.

Advantages

- Maintain a safe environment – Drones can monitor dangerous or hard-to-reach locations such as radiation sites, bomb sites, oil and gas refineries, pipelines and high-voltage lines.
- They can be used to obtain real-time data to create and preserve a safe environment.
- Cost saving – As drones are becoming more readily available, they are more economical to buy, maintain, and fuel than airplanes.
- Quality of aerial imaging – UAVs can take high quality photographs and



videos which can be transformed into detailed 3D maps and 3D models to discover cracks, damages, or other hazardous elements in disaster areas.

- When combined with high-resolution images or videos they can be used to live stream events such as entertainment, personal, political, and global affairs.
- Precision – Using a GPS, a drone can be guided to precise locations.
- For example, a drone can perform precision tasks such as spraying crops with pesticides, identifying weeds and monitoring crop health.
- Easy to control and deploy – Drone operators can quickly deploy and operate drones with a relatively minimal technical background.
- Drones have a wider range of movement, can fly lower in all directions, and can navigate easily compared to a crewed aircraft.
- Package delivery – Drones can be used to deliver packages thereby reducing traffic.
- They can deliver vital medicines and vaccines to accessible places.

Disadvantages

- Privacy and spying – Drones can be used to trespass or spy on a group or individual's privacy.
- Drones are small and are fairly quiet, making them difficult to notice.
- They are used by paparazzi to photograph celebrities and by criminals to track their targets.
- The rules regarding regulation of drone movement and property protection from aerial trespassing needs to be clarified.
- Vulnerable to wild animals – drones are frequently attacked by wild animals such as large flying birds like eagles.
- Poachers make use of drones to locate animals for exotic trade in rhino horn, elephant tusks and pangolin scales amongst others.
- Easy to hack – hackers can take control of the drone's central control system to access private information, corrupt or damage the files, and leak data to third parties.
- Weather dependant – drones are more vulnerable to weather conditions compared to traditional aircraft.

Application in an ICT environment / (Examples of the technology in practice)

- **Agriculture** – farmers can use drones to measure and record the growth of their crops, insect infestation, etc. * **Disaster management** – drones can be used to survey the extent of wild fire damage in a specific area. * Drones can be used in situations where it is too dangerous to send in a manned aircraft.
- **Photography, filming, journalism** – drones are used by television sport networks to capture sporting footage.
- **Scientific** – drones with biological sensors can fly to unsafe areas to take the air quality readings and check for micro-organisms or atmospheric elements.
- **Nature conservation and game ranging** – in combination with geospatial imagery, drones are used to monitor and track animals.
- **Military** – drones are deployed mainly for intelligence, reconnaissance, and surveillance missions. * Security companies use drones to provide surveillance systems for industrial, commercial, and residential properties.
- **Commercial use** – drones are used for parcel deliveries, delivery medical supplies in remote areas, etc. Insurance companies use drones to assess the damage to buildings, roof damages, etc.
- **Geographic mapping** – drones that use 3D mapping are used to access dangerous coastlines or unattainable mountain tops.

1.8.2 Head-Mounted Displays

- A Head-Mounted Display (HMD) is worn on the head or is embedded in a helmet with a small display for one or both eyes and is used in gaming, aviation, engineering, and medicine.
- The first HMD used a standard LCD screen to display images, movies, and 3D videos.
- For example, Google Cardboard used a low cost cardboard design combined with a smartphone.
- Augmented Reality (AR) creates an effect of digital content interacting with the world by overlaying projected images on top of a pair of see-through glasses.
- Virtual Reality (VR), such as Oculus Rift, increases user participation bringing the user into a complete different virtual world.

1.8.2.1 VIRTUAL REALITY (VR)

- Completely digital environment
- Fully enclosed, synthetic experience with no sense of the real world.

Category	Details
Purpose and function • what it does • why it is needed	VR deceives your brain into believing you are in a 3D virtual world. VR allows users to be immersed into a virtual world, it can include 4 to 5 senses. This is achieved by using equipment, such as helmets with screens and gloves fitted with sensors.
Advantages/Benefits	• Allows for training in a safe, controlled area in realistic scenarios, improving retention and recall. • Allows for virtual experience, explores places such as travel destinations, museums, art galleries, etc. • The virtual experience helps students to learn faster and remember longer. • Can be used to train employees (for example, pilots, medical doctors, factory workers, etc.) without causing damage or risking lives.
Disadvantages	• Physical effects: motion sickness, balance is affected by changes in the inner ear.
Limitations	• Psychological, moral and ethical concerns, especially for children who may not be able to distinguish between what is real and what is virtual. • Limited access to the special equipment: VR glasses, video cameras, VR gloves, etc.
Application in an ICT environment / Examples of the technology in practice	• Used to train employees (example: pilots, engineers, miners, etc.). • Games – range of Nintendo games. • Media – marketing campaigns creating interactive forms of media (e.g. estate agents). • Education and training – used by trainers to provide learners with a

	virtual environment where they can develop their skills without the real-world consequences of failing. • Medical personnel are able to train through VR to deal with a wider variety of conditions/operations. • See Oculus, HTC Vive and Playstation VR.
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1.8.2.2 AUGMENTED REALITY (AR)

- Real world with digital information overlay
- Real world remains central to the experience, enhanced by virtual details.

Category	Description / Details
Purpose and function • what it does • why it is needed	Augmented Reality turns the environment around you into a digital interface by placing virtual objects in the real world, in real-time. Handheld devices such as smartphones and the iPad are other ways to use augmented reality. They contain software, sensors, a compass and small digital projectors which display images onto real world objects.
Advantages/Benefits	• Highly interactive and operates simultaneously with the real-time environment/enhance personal experiences. • AR is used by marketers to promote products as it allows a user to 'try out' new products in their own environment – the colour of a paint on your wall, make-up on your own face, new furniture in your house.
Disadvantages	• Lack of privacy - it collects a lot of information about the user, more than other forms of technology. • It is expensive to develop AR apps. • Skills are needed to use AR devices effectively.
Application in an ICT environment /	• Both VR and AR are used in areas ranging from entertainment (for example, the augmented reality game Pokémon GO), training in aircraft simulators, and healthcare, (for example, an app used to show veins when a drip is inserted or surgeons being able to perform remote surgery on patients:). • Entertainment and education applications include cultural apps with sightseeing and museum guidance, gaming apps with traditional games using AR interfaces, and some smartphone apps that make use of AR for an entertainment and/or educational purpose. • AR can be applied so that the surgical team can see the imaging data in real-time while the procedure is in progress.
Examples of the technology in practice www.augmented-reality-games.com/impact.php	• Medical training • Entertainment • Military training • Marketing/advertising • Engineering design

	• Consumer design • Robotics • Manufacturing, maintenance, and repairs • Hazard detection
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1.9 Hardware and New Technology Additions

1.9.1 Near Field Communication (NFC)

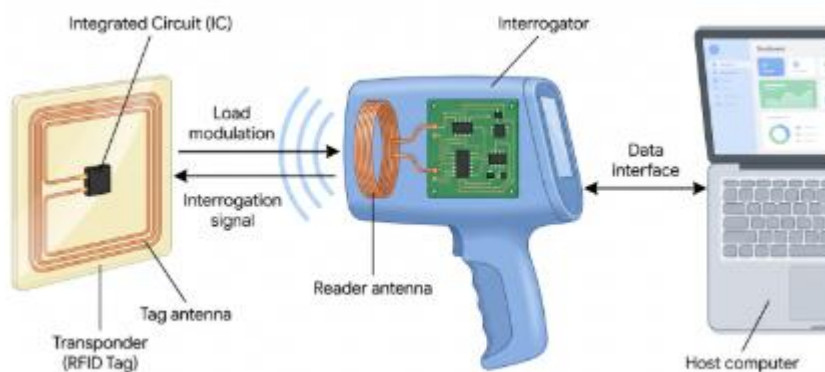
- NFC is a short-range wireless communication technology that allows compatible devices to exchange data when they are brought very close together.
- NFC is commonly used for contactless payments, access cards and quick device-to-device interactions.

Section	Details
Definition/Description • what it is	Near Field Communication (NFC) is a standard that allows devices such as smartphones to connect wirelessly simply by touching them together or bringing them into close proximity.
Purpose and function • what it does • why it is needed	NFC is a technology built upon radio-frequency identification, or RFID, which allows a gadget to send radio waves to another gadget or to another RFID-enabled tag and to trigger a certain action. NFC makes tap-and-go services possible and is often used in smartphones and smartwatches.
Advantages/Benefits	• NFC offers a certain amount of security, as a hacker would need to be close to the target to access NFC-data exchange. • NFC can be used to change settings automatically on devices such as smartphones. • Makes quick contactless data transfer by a single tap on a screen possible, for example, contactless tap-and-go card transactions.
Disadvantage/Limitation	• NFC has a comparatively low transfer speed – so it is not the best method for transferring large files such as videos.
Application in an ICT environment / <i>(Examples of the technology in practice)</i> <i>(Image: Near Field Communication example)</i>	Basically, you can use NFC to do most things in your daily life, for example: • exchange data by just touching two smartphones together • pay and transfer data using NFC technology • launch an app on someone else's smartphone • send directions to someone if you are near to them • use NFC when travelling, for example, manage your trips or to scan your boarding pass at an airport checkpoint • connect with different NFC tags

- pair tech accessories like speakers with **NFC**
- log in to your work computer with just a tap of the phone
- unlock your car doors
- control your car or home (using **NFC** chips and a smartphone)
- keep track of your health and fitness stats, etc.

1.9.2 Radio Frequency Identification (RFID)

- RFID uses radio waves to identify and track objects or people using an RFID tag and a reader.
- An RFID tag stores identifying information and can be read without the tag having to be physically touched by the reader.
- RFID is commonly used for tracking stock, access control, identification and logistics.



Purpose

- **Automated Identification & Tracking:** Electronically capture data stored on tags without human intervention.
- **Supply Chain & Inventory Management:** Track goods from manufacturing through warehouses to retail checkout in real time.
- **Access Control & Security:** Manage physical entrance permissions (keycards, vehicle toll tags) and prevent theft.
- **Asset Tracking:** Monitor high-value equipment, livestock, or medical devices across large facilities.

Advantages

- **No Line-of-Sight Required:** Readers communicate with tags wirelessly through cardboard, plastic, and non-metallic enclosures.
- **Bulk Scanning:** Hundreds of tags can be read simultaneously in seconds (e.g., scanning an entire pallet of goods at once).
- **Durability:** Tags can be encased in rugged plastic or weather-resistant materials, making them resistant to dirt, moisture, and wear compared to printed barcodes.
- **Read/Write Capability:** Unlike static barcodes, many RFID tags allow data to be updated or overwritten dynamically as an item moves through a workflow.
- **Higher Data Capacity:** Can store detailed asset history, batch numbers, and timestamps directly on the chip.

Disadvantages

- **Higher Initial Cost:** Readers, infrastructure software, and tags (especially active battery-powered ones) are significantly more expensive than standard printed barcodes.

- **Signal Interference:** Materials like liquid absorb radio signals, while metals reflect them, causing read errors without specialized tag design.
- **Security & Privacy Risks:** Unauthorized readers can potentially scan tags remotely ("skimming") if data is unencrypted, creating privacy or tracking concerns.
- **Complex Implementation:** Requires integration with backend databases, reader placement calibration, and ongoing middleware management.

Limitations

- **Read Range Bounds:** Passive tags rely entirely on the reader's signal for power and typically cap out at 10–15 meters, while long-range active tags require built-in batteries with limited lifespans.
- **Collision Issues:** If too many tags respond at once without anti-collision protocols active, signal overlap can cause missed reads.
- **Environmental Degradation:** Extreme electromagnetic fields or dense metal environments can render standard low-cost RFID systems unreliable.

1.9.3 Communication devices

- We live in a world where we can constantly connect with one another via networks such as the internet using a range of devices. Most computers and many devices such as smartphones have built-in communications hardware (such as Bluetooth, 3G/4G and WiFi), but there are also some specialised communication devices. Let's examine some of the uses, advantages and limitations of common communication devices.
- *(Side note: Internet connections are discussed in Module 2.1.)*

1.9.3.1 Cellular modem

- Most people make use of cellular data if they need to be mobile, as they can access the internet wherever there is cellphone reception. An external cellular modem looks like a flash drive and connects to a USB port. It has a cellphone SIM card that is used to access the internet.
- There is also a cellular router with space for a sim card and the ability to connect to the cellular network. This router typically connects to the cellular network and creates a WiFi network so that multiple devices can share the internet connection. Some can also work as switches for a wired network because they have network ports.

Advantages of cellular modems are that:

- they are easy to install and use (they plug into a USB port)
- they are so small that you can take them with you and have internet access on any computer (you don't need access to a telephone line)
- the 3G/4G network is fast.
- The problem with an external cellular modem is that it can get lost or stolen easily.
- *(Side note: General advantages and disadvantages of wired and wireless connection options, in relation to one another, are discussed in Module 2.1.)*

1.9.3.2 ADSL and fibre router

- You need an ADSL router if you want to make use of an ADSL internet connection (via a normal telephone line), and a fibre router if you want to make use of a fibre internet connection.

The major **advantages** of a router are the following:

- If you have an ADSL router you can make and receive phone calls and be connected to the internet at the same time, as these services are designed to share your telephone line.

- Both an ADSL router and a fibre router usually includes a built-in switch, which allows you to connect computers and other devices (such as printers) in a LAN to the router, thereby allowing these devices to communicate with each other and also to share the internet connection.
- The WiFi capability of a router (ADSL or fibre) similarly allows you to connect computers and devices to the router, in this case wirelessly – which is ideal in a home environment. The small antenna on the router is used to enable the WiFi / wireless connectivity.
- The term 'modem' or 'modem / router' is still sometimes used instead of 'router'. The device is actually a multifunction device. For ADSL, it also needs to perform a type of 'modem' function (converting the data to and from a format that can be sent on the DSL line).
- *(Side note: VDSL (Very high speed digital subscriber line) is an improvement on ADSL technology that offers faster speeds than ADSL does.)*

Limitations of ADSL and fibre

- With ADSL you need a landline to be able to access the internet, and fibre also needs a physical cable connection to an existing fibre network. These wired connection methods can only be used when the telephone or fibre company has laid down the necessary cables in your suburb, and so are largely limited to urban areas.
- ADSL cable theft is unfortunately a problem in South Africa, on account of the copper content of the wiring. Stolen copper can easily be resold. Fibre cables are not targeted in this way, as the material used has little other commercial value.
- *(Side note: The growing popularity of fibre connections has meant that the ADSL method of connection is becoming less common.)*

1.10 Devices for disabled users

Most disabled people need tailor-made ICT solutions that combine hardware devices and software in different ways, depending on what the users' disabilities are and what they want to use their computing technology for.

What follows is a basic list of the types of devices that could be used, organised by disability type.

Visually impaired / Blind

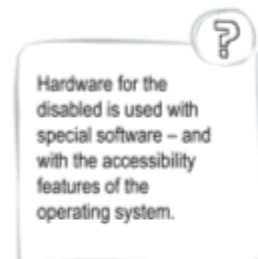
- Braille keyboard and Braille display/terminal
- Magnification devices
- Large-key keyboards
- Braille printers

Hearing impaired / Deaf

- Devices that vibrate instead of emitting sound

Motor control (paralysed / poor motor control / arthritic / etc.)

- Eye movement tracking devices
- Head movement tracking devices
- Large key (outsized) keyboards
- Trackballs
- Joysticks
- Foot pedal control devices
- Sip and puff devices (you suck/blow into a straw in different ways to control devices)



1.11 Internet of Things (IoT)

- The Internet of Things refers to physical devices that contain sensors and/or other technology that allows them to collect, send or receive data over a network or the Internet.
- IoT devices can collect data automatically using sensors and can communicate with other devices or systems.
- Examples include smart watches, smart home devices, connected security cameras and environmental sensors.

Aspect	Content
Purpose and function • what it does • why it is needed	Physical objects are embedded with sensors, software, etc., which connect and exchange data with other devices and systems over the internet, not dependent on human intervention.
Advantages	• Appliances can be started remotely before getting home. • Check on the status of appliance (is it still operational). • Manufacturer can diagnose problems without visiting. • Firmware can be upgraded. • Usage can be monitored (e.g. coffee machine in an office). • Data can be retrieved from these devices.
Disadvantages	• IoT may have negative implications for user privacy. • Cybercriminals can hack into a network via IoT devices and gain access to private information. • IoT may lead to an over-reliance on technology.
Application in an ICT environment / <i>(Examples of the technology in practice)</i>	• This can range from surveillance systems to geysers, washing machines, 'smart' motor cars and traffic lights, etc. • Scenario 1: Smart thermometer on the roof automatically communicates with the smart air conditioner in the building to automatically turn on and off as the temperature drops / rises. • Scenario 2: If you buy products with RFID tags on them, your smart fridge can automatically pick up what items are in it, warn you early when something is close to the expiration date and suggest recipes. Your smart dustbin can also register which items you have thrown away, and automatically update your shopping list on your smartphone. • Biochip transponders on animals. • Wearable health monitors. • DNA analysis devices for environmental/food/pathogen monitoring.

Touch Display

Learning Unit 2: Software

Types of Software

- Software refers to the set of intangible programs, instructions, and data that tell a computer's hardware what to do and how to perform specific tasks.
- Unlike hardware, which consists of physical components you can touch, software consists of code stored digitally in memory or on storage drives.
- **Primary Purpose:** System software manages, controls, and maintains the computer's hardware and internal operations, whereas application software enables users to carry out specific end-user tasks.
- **Dependency:** System software runs independently directly on the hardware and creates a platform for other software, while application software cannot run on physical hardware alone and relies on an operating system to function.
- **User Interaction:** System software operates largely in the background with low or indirect user interaction, whereas application software features a high level of direct, interactive engagement with the user.
- **Execution:** System software boots up automatically when the computer turns on and runs continuously, while application software is launched manually on demand whenever the user needs it.
- **Necessity:** System software is essential for computer operation (a device cannot start without an operating system), whereas application software is optional and installed based on individual user preference.
- **Core Categories:** System software includes operating systems, device drivers, and utility programs, while application software includes productivity suites, web browsers, media players, and games.
- **Examples:** System software is represented by platforms like Windows 11, macOS, Android, GPU drivers, and Disk Cleanup; application software includes programs like Microsoft Word, Google Chrome, Microsoft Excel, and Photoshop.

GUI

- Graphical User Interface (GUI) is a visual way for users to interact with a computer using graphics like icons, menus, and windows instead of typing text commands.
- Key Components of a GUI

1. Icons

- **Description:** Small graphic symbols or pictures on the screen.
- **Purpose & Usage:** Visually represent files, folders, applications, or shortcuts.
- Double-clicking or tapping an icon opens or executes the associated item.

2. Toolbars & Ribbons

- **Description:** Horizontal or vertical rows of buttons and icons (often organized into tabbed "ribbons" in apps like MS Office).
- **Purpose & Usage:** Provide quick, one-click access to frequently used commands (e.g., Bold, Save, Undo) without needing to search through drop-down menus.

3. Menus & Navigation

- **Description:** Structured lists of commands grouped logically (e.g., File, Edit, View, Format).

Purpose & Usage:

- Drop-Down / Pull-Down Menus: Click a heading to reveal a vertical list of options.
- Context Menus: Right-click an item to open a menu with commands specific to that item.
- Navigation Panes: Left-hand panels in file managers (like File Explorer) that allow users to browse drives, folders, and network locations quickly.

4. Radio Buttons

- Description: Small, round option buttons grouped together where only one option can be selected at a time.
- Purpose & Usage: Selecting one radio button automatically deselects all others in that group (e.g., selecting paper orientation: (•) Portrait or () Landscape).

5. Checkboxes

Description:

- Purpose & Usage: Allow users to select multiple independent options or turn features on/off (e.g., selecting features in a setup wizard: and).

6. Text Boxes & Spin Boxes

- Description: Input areas on screen forms or dialog boxes.

Purpose & Usage:

- Text Box: Type custom text or numbers (e.g., entering a filename or username).
- Spin Box: Uses small up/down arrows to adjust a numerical value incrementally (e.g., setting font size or print copy counts).

7. Combo Boxes & Drop-Down Lists

- Description: A field combined with a drop-down arrow.
- Purpose & Usage: Saves screen space by hiding a list until clicked.
- Users can select an option from the list or sometimes type a custom entry (e.g., choosing a font style or country).

8. Command Buttons

- Description: Rectangular visual buttons labeled with text or icons.
- Purpose & Usage: Perform an immediate action when clicked (e.g., OK, Cancel, Apply, or Submit).

System Software

- System software is a set of programs that control and manage the operations of a computer, so that applications can run properly.
- There are two types of System Software:

Operating Systems

Utility Software

Operating Systems

- Operating System is defined as the primary system software that manages all hardware and software components of a computer, providing common services for applications to run and allowing the user to interact with the device. e.g.
- Linux, Windows, iOS, Android.

Purposes and functions of operating systems:

- Providing a User Interface: Allows human users to give instructions to the computer through visual elements (GUI) or text commands (CLI).
- Managing Hardware & Peripherals: Controls input, output, and storage devices using built-in software routines or specialized device drivers.
- A device driver is specialized system software that allows the operating system to communicate directly with a specific hardware device.
- Managing Files & Folders: Provides a structure (file directory tree) to save, organize, copy, move, rename, and delete files on storage drives.
- Managing Memory (RAM): Allocates memory space to different open programs so they run smoothly without crashing into each other.
- Managing Tasks & Processing (Multitasking): Schedules CPU execution time so multiple programs can run simultaneously.
- Managing Security & Access: Handles user login accounts, password controls, and basic access permissions to keep data secure.
- Examples of Operating Systems
- Desktop OS
- Designed for personal computers, laptops, and workstations.
- They feature comprehensive file management systems, support complex multi-window multitasking, and are optimized for keyboard and mouse input.
- Microsoft Windows: Windows 10, Windows 11
- Apple macOS: macOS Sequoia, macOS Sonoma
- Linux Distributions: Ubuntu, Fedora, Linux Mint, Arch Linux
- ChromeOS: Google's lightweight web-focused OS for Chromebooks
- Mobile OS
- Engineered specifically for smartphones, tablets, and smartwatches.
- They are lightweight, optimized for touchscreens and battery efficiency, and rely heavily on app ecosystems and wireless connectivity.
- Android: Developed by Google (used on Samsung, Google Pixel, Xiaomi, etc.)
- iOS: Apple's proprietary OS for iPhones
- iPadOS: Apple's tablet-focused variant derived from iOS
- watchOS / Wear OS: Specialized mobile operating systems for smartwatches
- Embedded OS

- Compact, dedicated operating systems built into specific hardware systems (such as appliances, vehicles, and smart devices).
- They are often Real-Time Operating Systems (RTOS) designed to perform specific, repetitive tasks with immediate response times and minimal system resources.
- FreeRTOS: Extremely popular open-source RTOS for microcontrollers and IoT devices
- Embedded Linux: Customized, stripped-down Linux builds used in smart TVs, routers, and automotive displays
- VxWorks: High-reliability RTOS used in aerospace, defense, industrial robotics, and automotive systems
- QNX: Unix-like RTOS widely used in modern car infotainment and safety control systems
- Windows IoT: Microsoft's platform for enterprise smart edge devices and industrial equipment

Utility Software

- Utility software is a category of system software designed to analyze, configure, optimize, or maintain a computer system.
- Unlike application software—which focuses on user tasks like document creation or web browsing—utilities focus on keeping the computer's infrastructure running efficiently and securely.

2.1 Windows Security Screen

- This Learning Unit is based on Windows 10 Pro Version 20H2.
- Any variations that you may experience in the following activities may be the result of a different version.
- The Windows Security Screen is accessed by simultaneously pressing <Ctrl> + <Alt> + <Delete>.
- A menu appears to Lock your PC, Switch users, Sign out, Change a password, and run Task Manager.

2.1.1 Locking and Unlocking Your Computer

- A lock screen is a security measure used on computers, laptops and other devices to prevent an unauthorised user from using a device unless they are currently logged on.
- A lock screen is particularly useful on smartphones to stop accidental commands when it is still in our pocket.
- Lock screens can also provide us with quick information without the need to unlock our devices.
- A computer can be locked when a user intends to move away from the computer for a short time.
- Instead of signing out and closing all the apps the user is working on, a user can lock the screen when they leave the computer and then unlock the computer when they return, ensuring that all the apps remain in the same state as when they left.

ACTIVITY 1

- Press <Ctrl> + <Alt> + <Delete> to open the Windows Security Screen.
- Click on Lock.
- The lock screen will be displayed with the date and time in the bottom left-hand corner.
- To unlock the computer, click on the screen so that your username appears requiring your password to be entered.
- Type in your current password and your computer should return to the state you left it in when you locked your computer.

2.1.2 Changing Your Password

- To protect access to your computer, it is important to frequently change your password.
- Choose a password that is a combination of upper-case and lower-case letters, numbers and special characters and at least eight characters in length.

ACTIVITY 2

- Press <Ctrl> + <Alt> + <Delete> to open the Windows Security Screen.
- Click on Change a password.
- Type in your current password.
- Type in your new password.
- Verify the new password by entering the same new password again.

2.2 Task Manager

- The Task Manager is a program provided by the operating system to monitor the system by displaying information about the computer's hardware configuration and the processes and applications running on a computer.
- A process is one of the many parts of an application that is currently executing.
- The task manager can terminate unresponsive processes and applications.
- The Task Manager can be opened from the Windows Security Screen.
- The Task Manager displays extensive information about the computer.
- Only the relevant information will be discussed.

ACTIVITY 3

- Press <Ctrl> + <Alt> + <Delete> to open the Windows Security Screen.
- Click on Task Manager.
- Click on the Performance tab to view a real-time status of the computer's hardware.
- Click on the CPU in the left-hand menu to view details about the CPU.

2.2.1 Processor (CPU)

- The type and speed of the processor are indicated in the top right-hand corner.
- In the image provided the processor is an Intel i7 with a speed of 2.60 GHz.
- The graph shows the real-time overall CPU usage which is 43%.
- Some processors have more than one core, each split into two logical cores.
- This CPU has six cores producing 12 logical processors (cores).
- The usage of each processor can be viewed individually.
- Right-click on the graph in Task Manager, select Change graph to, then choose Logical processors.
- NOTE: Some of the cores are busier than other cores depending on the processes that they are executing.
- Return to view the overall CPU usage graph by again right-clicking on the graphs and selecting Change graph to, then choosing Overall utilisation.
- The details of processor cache memory are included.
- L1 cache (Level 1): 384 KB.
- Cache memory found closest to the CPU.
- It is the fastest, smallest and most expensive cache that runs at the same speed as the CPU.
- L2 cache (Level 2): 1.5 MB.

- Larger, slower and further away from the CPU.
- L3 cache (Level 3): 12.0 MB.
- The largest and slowest cache which may be on the motherboard or on the CPU.

2.2.2 Memory (RAM)

- A real-time graph of RAM usage can be viewed.
- Click on Memory in the left-hand menu to view the details about RAM.
- The total RAM in the computer is shown in the top right-hand corner (16.0 GB).
- The speed of the RAM is 2667 MHz on two slots.
- The 2 of 2 indicates that both RAM slots are used with no free slots available.
- The slots used, speed and form factor are important information when buying new or replacing RAM.

The memory panel shows two graphs:

- The top graph shows total memory usage over a 60-second period.
- The graph below shows how the memory is currently allocated.
- Hover your mouse over the Memory composition graph to view details of the memory usage.
- 7639 MB is in use by processes, drivers or the operating system.
- To view a change in the RAM's usage graph, open four large database applications and view the graph again.
- The graph should increase as each application is opened.

2.2.3 Secondary Storage

- Click on Disk 0 (G: C:) to view details of the hard drive.
- The type (SSD) and size (1024 GB) of the hard drive is listed in the top right-hand corner.
- The top graph displays the hard drive activity over a 60 second period.
- The bottom graph displays the transfer speeds in Megabytes per second over a 60 second period.
- CPU
- 38% 3.82 GHz
- Memory
- 8.1/15.9 GB (51%)
- Disk 0 (G: C:)
- 1%
- Disk 1 (D:)
- 0%
- Wi-Fi
- Wi-Fi
- S: 0 R: 0 Kbps
- GPU 0
- NVIDIA GeForce G...
- 38%
- Disk 0 (G: C:)
- Active time: 100%
- HS-SSD-E2000 1024G
- 60 seconds
- Disk transfer rate: 10 MB/s

- 7 MB/s
- 60 seconds
- Active time: 1%
- Average response time: 2.7 ms
- Capacity: 954 GB
- Formatted: 954 GB
- System disk: Yes
- Page file: Yes
- Read speed: 0 KB/s
- Write speed: 87.0 KB/s
- Disk 0 appears to have two drives G: and C:.
- The G: drive is synchronised to a cloud-based Google Drive but is stored on the C: drive.
- The C: and G: drives are shown in Windows Explorer under This PC.
- The D: drive is a second, unused mechanical hard drive installed on this computer.
- Devices and drives (3)
- Windows-SSD (C:)
- 836 GB free of 952 GB
- Data (D:)
- 928 GB free of 931 GB
- Google Drive File Stream (G:)
- 794 GB free of 952 GB
- Click on Disk 1 (D:) to view the details of the second hard drive if it exists on your computer.

2.2.3.1 Disk Optimisation

- If your mechanical hard drive is slow to respond and slow to load and save files, it may benefit from disk optimisation.
- When many files are repeatedly loaded, lengthened and saved on a hard drive, the newly added part to the file is placed in the next vacant area on the hard drive, effectively storing the file in fragments across the hard drive.
- Therefore, the time taken to access the fragmented file will increase, reducing performance.
- Defragmentation is a process of moving the file fragments so that they are stored together on the hard drive which improves access time.
- If your hard drive is a Solid State Drive (SSD), defragmentation is not needed as an SSD has no moving parts.
- Instead, a function called TRIM is used to remove data that is no longer in use.
- Disk optimisation will detect the type of drive (mechanical or SSD) and apply the appropriate mechanism to improve the efficiency of the drive (defragmentation or TRIM).
- Type in "optimize" in the Windows search area at the bottom left corner of the screen.
- Select Defragment and Optimize Drives.
- Optimize Drives
- You can optimize your drives to help your computer run more efficiently, or analyze them to find out if they need to be optimized.
- Only drives on or connected to your computer are shown.
- Analyze
- Optimize
- The operating system is set to weekly analyse the drives.

- Both drives show as status of OK.
- The second hard drive has no data stored on it, showing 0% fragmented.
- If your drive is showing a high level of fragmentation, then click on the Optimize button.
- Optimisation can take a long time to complete so is worthwhile running this process overnight.

2.2.4 Processes

- To view the executing processes and applications, click on the Processes tab in the Task Manager.
- Click on Fewer details to only show the applications.
- Click on More details to view the applications and processes.
- The Processes tab shows a list of executing processes divided into three categories: the Apps group shows the same list in the simplified Fewer details view, the Background processes and Windows processes list processes that the user has not specifically loaded like antivirus, Google synchronisation, update processes and hardware utilities with notification area (system tray) icons appearing in the background processes list.
- Windows processes include the many processes and services that are part of the Windows operating system.
- Task Manager
- File Options View
- Processes
- Performance
- App history
- Startup
- Users
- Details
- Services
- Fewer details
- howtogeek.com
- Next to each process or application, the CPU, Memory, Disk and Network usage is displayed as percentages.
- These values are constantly changing as you use your computer.
- Click on the CPU heading to view the usage in descending order.
- Task Manager
- File Options View
- Processes
- Performance
- App history
- Startup
- Users
- Details
- Services
- In this case, the author has many Google tabs open with multiple extensions running using 12.4% of the CPU and 1257.3 MB of RAM.
- The processes that are using the most CPU time include the user's apps, background processes and Windows processes.
- Click on the Memory heading to view the processes that take the most amount of RAM.

2.2.4.1 Terminate a Process

- Should an application become sluggish, fail to respond, consume a lot of system resources (Memory, Disk or Network), behave unexpectedly, or cannot be closed, it should be terminated.
- Ending a process will close the process but may result in the loss of unsaved data.
- Try to save the data before you end a process, but this is not always possible if the app does not respond.
- Be careful of ending Background or Windows processes as it may negatively affect your computer.
- Rather close any offending applications, and if the problem persists, reboot the computer.
- Alternatively, right-click on the process and select the Search online option to understand how terminating the process affects your PC.
- To end an application, first click on the Name heading to sort the processes with the Apps listed first.
- Select an application (in this case the Snipping Tool) and click the End task button.
- The Apps list should be updated without the application and the application's icon should disappear from the Taskbar.
- Fewer details
- End task

2.3 Windows Operating System Management

2.3.1 Storage Sense

- Storage Sense is a Windows 10 operating system feature to automatically free up space on your local hard drive.
- It deletes files that are not needed, like temporary Internet files, app temporary files and Recycle Bin contents including the Downloads folder.
- These settings can be customised.

2.3.1.1 Turn on Storage Sense

ACTIVITY 4

- Type in "storage" in the Windows search area at the bottom left corner of the screen.
- Select Storage Settings.
- Click on Configure Storage Sense or run it now.
- Set Storage Sense to be On and select During low free disk space from the drop-down box under Run Storage Sense.
- Under Temporary Files, select 30 days from the drop-down box under Delete files in my recycle bin if they have been there for over.
- Under Delete files in my Downloads folder if they have been not been open for more than, select Never in the drop-down box.
- By default, Storage Sense is enabled, and Windows 10 runs it automatically whenever you are low on disk space.
- However, you can also configure it to run on a schedule, every day, week, or month.
- You can also free up space manually whenever you want to.
- Storage
- Storage Sense can automatically free up space by getting rid of files you don't need, like temporary files and content in your recycle bin.
- Off

- Configure Storage Sense or run it now
- Configure Storage Sense or run it now
- Storage Sense runs when disk space is low.
- We clean up enough space to help your system run its best.
- We cleaned up 0 bytes of space in the past month.
- Run Storage Sense
- During low free disk space
- Temporary Files
- Delete temporary files that my apps aren't using

Delete files in my recycle bin if they have been there for over:

- 30 days

Delete files in my Downloads folder if they haven't been opened for more than:

- Never

2.3.2 Regional Settings

- The regional settings of the Microsoft operating system will influence how your date/time, numeric, and currency data types appear after applying formatting options.
- Windows provides support for many different languages, including currency and date/time formats for the countries or regions that use those languages.
- For example, you enter a date value with forward slashes for a Date/Time field (for example, 20/9/2021) but when you format the date using the General Date display format, the forward slashes may or may not be displayed depending on the regional settings for Windows.
- This concept also applies to numeric and financial data.
- You can enter a currency amount using the Dollar symbol (\$) but it is displayed in Access and Excel as South Africa Rand because that is the currency symbol selected for Windows.
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2.3.4 Personalisation

- Windows provides many setting to personalise, secure and customise your computer.

2.3.4.1 Lock Screen

ACTIVITY 6

- In the Windows search area type "lock screen" and select Lock screen settings to open the Lock Screen tab in the Settings window.
- Specify the background to be displayed when the user locks their computer by clicking on the drop-down box under the current background image and selecting Picture.
- Select an image from the suggested images or upload you own image.
- Lock your computer to check that the selected image is displayed as a background.
- Once you are satisfied, unlock your computer.
- Scroll to Location history and click Clear.
- A tick will appear showing the history has been cleared.
- Instead of turning off your location, you can choose which apps use your location.

- Scroll down in the Location Window.
- Select which of your apps may use your location.
- 1.
- Software Installation Methods

Summary: Application software can be installed onto a computer in more than one way. The two main methods are installing from a portable storage medium (e.g. a USB flash drive or DVD containing the installation files) or installing via an internet download (downloading the installer directly from the internet, then running it). Which method is used affects how quickly software can be installed, whether an internet connection is required, and how easy it is to get the very latest version.

Example scenario: A school’s CAT lab has no reliable internet connection on exam day. The IT technician needs to install a new version of a typing tutor program on 30 computers. Rather than downloading it individually on each machine (which would use a large amount of data and time), the technician copies the installer onto a USB flash drive once and installs it from the portable storage medium on each computer in turn — avoiding the need for an internet connection at all during installation.

- 2.
- Risks of Using Flawed Software

Summary: Software that is outdated, buggy, or otherwise “flawed” — meaning it has known errors or security weaknesses that have not been fixed — creates real risks. Continuing to run flawed software can expose a system to security vulnerabilities that attackers already know how to exploit, cause instability (crashes, data corruption), and lead to compatibility problems when trying to open newer files or work with newer systems.

Example scenario: A small business keeps using an old version of its accounting software because staff are used to it and don’t want to learn a new interface. A cybercriminal exploits a known, unpatched security flaw in that old version to gain access to the company’s financial records — a flaw that was fixed in an update the business never installed. This illustrates why continuing to run flawed, un-updated software is a genuine security risk, not just an inconvenience.

- 3.
- Recommending Specific Software for a Scenario

Summary: Choosing the right software for a task means matching the software to both the task itself and to the hardware it will run on. Key factors that influence whether a recommended piece of software will actually perform well include: the amount of RAM available, the type of processor, its speed, number of cores, and amount of cache, the number of other applications running at the same time (and how well the system caches between them), and disk optimisation (how efficiently data is arranged on the storage device).

Example scenario: A learner asks whether they should install a professional video-editing package on their laptop, which only has 4GB of RAM and an entry-level dual-core processor. Based on the system’s specifications, a lighter-weight video editor (with lower RAM and processing requirements) would be the correct recommendation, since the professional package would run poorly, freeze frequently, or fail to render video properly on that hardware — fitness for purpose has to consider both the software’s demands and the system’s actual capability.

- 4.
- Utility Programs — Schedule/Update

Summary: A schedule/update utility is a type of utility program that automates routine maintenance tasks (such as running a disk clean-up at a set time) or automatically checks for and installs software updates — removing the need for the user to remember to do this manually.

Example scenario: A parent sets their home computer's operating system to automatically check for and install security updates every night at 2am, when the computer is not in use. This ensures the system always has the latest security patches installed without anyone having to remember to check for updates manually, directly reducing the household's exposure to the kind of flawed-software risks described in Topic 2.

- 5.
- Utility Programs — Backup/Archive

Summary: A backup/archive utility is a type of utility program that creates protective copies of important data (a backup) in case the original is ever lost, corrupted, or damaged, and/or compresses data into a smaller, more storage-efficient archive format for easier storage or transfer.

Example scenario: A learner working on their CAT PAT project sets up an automatic backup utility to copy their project files to an external hard drive every evening. Weeks later, their laptop's hard drive fails completely just before the PAT deadline. Because the backup utility had been quietly running every night, the learner is able to restore their most recent work from the external drive and submit the PAT on time — demonstrating exactly why regular backups (see also Section D7, Data Protection) are essential.

- 6.
- Application Software (Apps) — Definition and Examples

Summary: Application software is software specifically designed to help the end user perform a particular productive, creative, or entertainment-related task, as opposed to system software, which manages the computer itself. Common/generic examples include Office suites (word processing, spreadsheets, presentations), financial applications (e.g. accounting or budgeting software), design software, and gaming/entertainment applications.

Example scenario: A small graphic design business uses several different types of application software in a single day: a design/illustration package to create client artwork, an office suite to draft invoices and quotes, and financial application software to track expenses and generate a tax return — showing how a single organisation typically relies on multiple categories of application software for different tasks.

- 7.
- Application Software Installation — Compatibility Issues

Summary: Before installing any application software, it must be checked for compatibility — meaning it needs to match the operating system it will run on and meet the device's minimum hardware specifications. Installing incompatible software can cause it to run poorly, malfunction, or fail to install at all.

Example scenario: A learner tries to install a piece of software designed only for the Windows operating system onto a school iPad running iOS. The installation fails immediately, because the software is fundamentally incompatible with the device's operating system — no amount of retrying will fix this; a version built specifically for iOS (or an entirely different app) would be needed instead.

- 8.
- Application Software Installation — Versions, Patches, and Service Packs

Summary: Software developers regularly release different kinds of updates to their applications. A new version typically adds major new features or a significant redesign. A patch is usually a smaller, targeted fix for one specific bug or security flaw. A service pack is a larger, bundled collection of many patches and minor updates, released together as a single package.

Example scenario: A word processing application releases a critical security patch after a vulnerability is discovered that could let attackers access documents remotely. A few months later, the same company bundles that patch together with several other small fixes into a service pack. A year after that, they release an entirely new version of the software with a redesigned interface and new AI-writing features. This shows the three terms represent different scales of update to the same underlying software.

- 9.
- Updating Software

Summary: Keeping application software current/updated is important for three main reasons: security (patching known vulnerabilities before attackers can exploit them), stability (fixing bugs that cause crashes or errors), and access to new features. Running outdated, un-updated (“flawed”) software (see Topic 2) creates real security risks and can cause compatibility problems when working with newer files or systems.

Example scenario: A user keeps postponing a prompted software update on their laptop because it would interrupt their work. Weeks later, they discover their files have been encrypted by ransomware that exploited a vulnerability the postponed update would have fixed. This directly illustrates why promptly updating software — rather than delaying it — is a genuine security practice, not just a formality.

- 10.
- Software That Enhances Input — Typing Tutor/Keyboarding Skills

Summary: Certain software is specifically designed to enhance a user’s input ability — the clearest example being typing tutor/keyboarding skills software, which helps a user build the muscle memory needed to type faster and more accurately over time, typically through structured lessons and practice exercises.

Example scenario: A Grade 8 learner who is new to CAT struggles to keep up with typing tasks during timed practicals. Their teacher recommends daily practice with typing tutor software, which times their words-per-minute and accuracy and gradually introduces harder exercises. Over a term, the learner’s typing speed noticeably improves, directly benefiting their performance in later timed practical assessments.

- 11.
- Knowing Which Application Package to Use for a Task

Summary: Being able to use application packages effectively also means knowing when to use which one — recognising that different application software categories are suited to different kinds of tasks, and choosing the correct tool for the job rather than trying to force one application to do everything.

Example scenario: A learner needs to calculate and compare the total cost of three different cellphone contracts using formulas, then present the winning option to the class. Rather than trying to do the calculations in a word processor (which is poorly suited to formulas) or trying to build a full slideshow in a spreadsheet, they correctly use a spreadsheet for the calculations and comparison, and then a presentation package to present the final recommendation — using each application package for what it’s actually designed to do.

- 12.

- Universal Apps and App Stores

Summary: Universal apps are modern applications designed to work consistently across different device types running the same underlying operating system ecosystem. They are typically installed through an official app store — the Windows Store on Windows devices, the App Store on Apple/iOS devices, and the Play Store on Android devices — rather than being manually downloaded and installed from an arbitrary website.

Example scenario: A learner buys a new Windows laptop and wants to install a note-taking app. Instead of searching the open internet (which risks downloading a fake or malicious version), they open the Windows Store, search for the app, and install it directly — the app store checks and verifies software before listing it, offering a safer, more standardised installation process than downloading directly from a random website.

- 13.
- Advanced File/Folder Management — File Metadata

Summary: File metadata is extra descriptive information stored alongside a file's actual content — for example, its author, title, or the date it was created. This information is not part of the visible content of the file itself, but is useful for organising, identifying, and searching through large collections of files.

Example scenario: A learner has hundreds of research documents saved for their PAT project, many with unhelpful, generic filenames like "Document1.docx". Rather than opening each file individually to check its content, they use their file manager's "author" and "date created" metadata columns to quickly identify which document a specific classmate contributed, and when it was last worked on — without needing to open a single file.

- 14.
- Advanced File/Folder Management — Wildcard Search

Summary: A wildcard search is an advanced file-search technique that uses special symbols (most commonly an asterisk *, representing "any characters") to search for files when the user only knows part of the filename. For example, searching report*.docx would find every Word document whose filename starts with "report", regardless of what comes after it.

Example scenario: A learner remembers they saved a spreadsheet somewhere with "budget" in the filename, but can't remember the exact full name or which folder they saved it in. Instead of manually browsing through every folder, they search *budget* in File Explorer, which instantly finds every file containing that word anywhere in its filename, regardless of what comes before or after it.

- 15.
- Advanced File/Folder Management — File Conversion

Summary: File conversion means changing a file from one format to another — for example, converting a .docx Word document into a .pdf — so that it can be opened by different software, shared more universally, or preserved in a fixed, non-editable format.

Example scenario: A learner has finished writing their CAT PAT report in a word processor and needs to submit it in a format that cannot easily be accidentally edited and that will look identical no matter which device or software the teacher opens it with. They convert the final .docx file into a .pdf before submitting it, ensuring the formatting stays exactly as intended and the content can no longer be casually altered.

- 16.
- Chatbots

Summary: Chatbots are software programs specifically designed to simulate a natural conversation with a human user, commonly deployed for automated customer service. They can meaningfully improve business efficiency and offer round-the-clock (24/7) availability compared to human staff, but often still struggle with complex, nuanced, or unusual queries that fall outside their programming, and — like any software — can occasionally be exploited maliciously (for example, to help spread scams).

Example scenario: A retail website uses a chatbot to instantly answer common customer questions like “What are your delivery times?” or “How do I return an item?” at any hour of the day or night, without needing a human agent on standby. However, when a customer asks a complicated, unusual question about a damaged order involving a special circumstance, the chatbot fails to understand the nuance and the customer has to be transferred to a human agent — illustrating both the strength (24/7 availability, efficiency for routine queries) and the limitation (struggles with complexity) of chatbots.

- Active Recall Questions
- Pure questions only — no answers included.
- Test yourself from memory using only the topic numbers below, then check the summaries above to mark yourself.
- 1.
- Name the two main methods used to install application software onto a computer.
- 2.
- Explain one advantage of installing software from a portable storage medium instead of downloading it over the internet.
- 3.
- Explain the security risk created by continuing to use flawed/outdated software.
- 4.
- List four factors that influence whether recommended software will actually perform well on a given system.
- 5.
- Define a schedule/update utility, and explain what it automates.
- 6.
- Define a backup/archive utility, and explain the difference between its two functions (backup vs archive/compress).
- 7.
- Define application software, and give three examples of categories of application software.
- 8.
- Explain what a compatibility issue is when installing software, and give an example of one.
- 9.
- Explain the difference between a version, a patch, and a service pack.
- 10.
- Give three reasons why it is important to keep software updated.
- 11.
- Define typing tutor/keyboarding skills software, and explain what it is designed to improve.
- 12.

- Explain what it means to “know when to use which” application package, with an example of matching a task to the correct type of software.
- 13.
- Define a universal app.
- 14.
- Name the official app store associated with Windows, iOS, and Android respectively.
- 15.
- Explain one advantage of installing an app through an official app store rather than downloading it from a random website.
- 16.
- Define file metadata, and give two examples of information it might include.
- 17.
- Explain how a wildcard search works, and give an example search term using an asterisk.
- 18.
- Define file conversion, and explain why someone might convert a Word document into a PDF before submitting it.
- 19.
- Define a chatbot.
- 20.
- State one advantage and one limitation of chatbots.
- Mixed Round (all 16 topics, shuffled)
- 1.
- Explain the difference between a patch and a service pack.
- 2.
- Define a wildcard search and explain when it would be useful.
- 3.
- Explain why flawed software poses a security risk.
- 4.
- Define application software and name two examples of application categories.
- 5.
- Explain what a backup/archive utility does.
- 6.
- Name the app store used on Android devices.
- 7.
- Explain what file metadata is used for.
- 8.
- State one strength and one weakness of chatbots.
- 9.
- Explain what a compatibility issue is.
- 10.
- Explain the purpose of typing tutor software.
- 11.
- Explain the two main methods of installing software.
- 12.
- List the factors that determine whether software will run well on a specific system.

- 13.
- Explain why file conversion to PDF is often used before submitting a document.
- 14.
- Explain what a schedule/update utility automates.
- 15.
- Explain what it means to know “when to use which” application package.
- 16.
- Give three reasons software updates matter.

Software and Security Additions

Booting

- Booting is the process of starting a computer and loading the operating system into memory so that the computer can be used.
- When a computer is switched on or restarted, the system performs startup checks and then loads the operating system.

Open-Source Software

- Open-source software is software whose source code is made available so that users or developers can inspect, modify and redistribute it according to its licence.
- Examples of open-source software include Linux and LibreOffice.

Software Updates

- Software updates can fix security vulnerabilities, correct errors, improve performance and add or improve features.
- Regular updates reduce the risk of attackers exploiting known weaknesses in outdated software.

Multi-Factor Authentication (MFA)

- MFA requires two or more different authentication factors before access is granted.
- A password is one authentication factor; a verification code, authentication app, security key or biometric feature can provide an additional factor.
- MFA provides stronger security than a password alone because an attacker who obtains the password still needs the additional factor.

Learning Unit 3: Solution Development – Exam-Required Study Notes

File Compression

- Compression is the process of reducing the size of a file.
- Compression can reduce storage requirements and make files quicker to transfer over a network.

Absolute Cell Reference

- An absolute cell reference keeps a cell reference fixed when a formula is copied to another cell.
- The dollar sign (\$) is used to make a row and/or column reference absolute, for example \$A\$1.

Excel Error Messages

#VALUE!

- The #VALUE! error occurs when a formula or function receives a value of the wrong data type or an invalid type of argument.
- Check the cells and arguments used in the formula and make sure that the required values are the correct type.

#REF!

- The #REF! error indicates an invalid cell reference, often because a referenced cell, row or column has been deleted or moved in a way that breaks the reference.
- Edit the formula and replace the invalid reference with the correct cell or range.

VLOOKUP and HLOOKUP

- VLOOKUP searches vertically: it searches for a value in the first column of a table and returns a value from another column in the same row.
- HLOOKUP searches horizontally: it searches for a value in the first row of a table and returns a value from another row in the same column.

CONCATENATE

- The CONCATENATE function joins two or more pieces of text into one text string.
- It can be used to combine the contents of two or more cells into one result.

Endnotes and Footnotes

- A footnote is a note or reference placed at the bottom of the page where the relevant text appears.
- An endnote is a note or reference placed at the end of a document or section rather than at the bottom of the current page.

Learning Unit 4: Data Management and HTML – Exam-Required Study Notes

Database: NOT NULL

- A NOT NULL property/constraint prevents a field from being left blank when a value is required.

Primary Key

- A primary key is a field, or combination of fields, that uniquely identifies each record in a database table.

- A primary key prevents duplicate identification of records and provides a reliable way to refer to a specific record.

Validation Rule

- A validation rule is a rule applied to a database field to restrict the values that may be entered.
- It helps ensure that data entered into a field is valid and falls within the required limits.
- Example: <16 allows only values less than 16.

Query Criteria

- Query criteria are conditions used to specify which records should be displayed by a query.
- The criterion Like "J*" finds text values that begin with the letter J.

HTML: Title Tag

- The <title> tag specifies the title of the web page shown in the browser tab or window title.

HTML: Image Tag

- The src attribute specifies the location or filename of an image.
- Correct example:
- The alt attribute provides alternative text describing the image.

HTML: Line Break

- The
 tag inserts a line break.

HTML: Hyperlink

- The <a> tag creates a hyperlink.
- The href attribute specifies the destination of the link.
- Correct example: Book Tickets

HTML: Table Attributes

- cellpadding specifies the amount of space between the contents of a table cell and the cell border.
- The width attribute can be used with table-related tags, including <tr>, to specify width where supported by the HTML context being taught.
- The colspan attribute allows a cell to span across two or more columns.

Learning Unit 5: The Internet and the World Wide Web (WWW)

5.1 Internet Connections

- When connecting a device to the Internet, there are several connection options available.
- We can connect wirelessly using mobile technologies such as 3G, LTE, 4G, and 5G, or use cable technologies such as ADSL and Fibre to the Home (FTTH).

Wired versus wireless connections:

- 1.
- Wired connections – ADSL or Fibre
- ADSL (Asymmetric Digital Subscriber Line) is a permanent digital connection to the internet using a normal landline or telephone line.
- The connection is split into two channels: one for making normal phone calls and one for connecting to the internet.
- Fibre is one of the exciting developments in fast internet connection for homes and businesses.
- Data is transmitted along thin glass tubes (or 'fibres').
- The ability of fibre to carry far more data at a time (the 'bandwidth') makes it much faster than the electrical transmission over copper cables used in ADSL.
- More bandwidth is allocated for downloading than for uploading.
- This is because you usually download much more (web pages, music or video files), than upload (pictures to Instagram or Snapchat, messages on Facebook, etc.).
- So you need a higher speed for downloading than uploading.

Cost of connection:

- The cost of your ADSL or fibre internet connection includes a monthly ISP cost, dependent on your chosen data package.
- In the case of ADSL you also pay a fixed monthly cost for the line rental, and although you don't pay for the time that you are connected to the internet, you still pay for normal telephone calls at the normal rates.

Advantages, Disadvantages, Limitations:

- ADSL generally provides cheaper connections to the internet than cellular connections.
- ADSL and fibre are more stable than cellular connections, as they are not affected by issues such as cellphone reception.
- Fibre generally provides much faster, cheaper and more stable connections to the internet than ADSL or cellular connections.
- ADSL speed drops the further you are away from the telephone exchange, and for this reason ADSL is better suited for urban areas. With a fibre connection, data can travel much further than ADSL to or from an exchange, before the signal starts weakening, so distance from the exchange is less of a problem.
- Fibre uses light and is not affected by electrical interference. (ADSL, which uses copper cables, can be so affected.)
- 2.
- Wireless connections – cellular technology
- It is also possible to connect to the internet wirelessly using the existing cellular network.
- This method offers internet connectivity without having to have an ADSL or fibre line installed, and also provides mobile access while you are on the move.
- 3G and 4G/LTE are the generations of cellular technologies currently in use.
- A 3G or 4G dongle can be used on a desktop computer or laptop to connect it to a cellular network for internet access.
- You can also use a smartphone or a tablet with its data bundle as a personal WiFi hotspot (see the discussion further on) to connect another smartphone, tablet or a computer to the internet.

Advantage:

- The main advantage of using cellular technology to connect to the internet, is that you can have mobile access to the internet, using your mobile device.

Disadvantages and limitations:

- If you are in an area that has poor cellular coverage, you may have limited or slow access.
- On a personal level – you never really escape communication, which can result in an information overload.
- You might need to limit the amount of data that you use, for example by ensuring that your cellular connection is switched off for updates on a smartphone or tablet.
- Asymmetric Digital Subscriber Line (ADSL) is a permanently connected Internet access service that uses a telephone line to send and receive Internet data at much faster speeds than a traditional dial-up connection.
- One advantage of ADSL is that users can make and receive telephone calls while connected to the Internet.
- Since users generally download more data than they upload, the download speed is faster than the upload speed, making the connection asymmetrical.
- Fibre to the Home (FTTH) provides a fibre-optic cable connection from an Internet service provider directly to a home or business, provided fibre cables are available in the area.
- The user requires a router with a special fibre port to connect the Local Area Network (LAN) to the fibre cable.
- The router also provides Ethernet LAN ports and a Wi-Fi hotspot for connecting multiple devices.
- Before choosing between mobile technologies (such as 3G, LTE, 4G, 5G, or satellite) and cable technologies (such as ADSL or FTTH), it is important to understand the terms used to describe the features of an Internet connection.

5.1.1 Broadband and Bandwidth

- Broadband refers to the high-speed transmission of data, voice, and video over long distances through an Internet connection.
- Bandwidth is the maximum amount of data that can be transmitted over an Internet connection in one second.
- It was originally measured in bits per second (bps) but is now commonly measured in megabits per second (Mbps) and gigabits per second (Gbps).
- Bandwidth is often confused with Internet speed.
- However, bandwidth refers to how much data can be transferred each second, while Internet speed refers to how quickly data can be uploaded or downloaded using the connection.
- For example, if it takes 10 seconds to download a file that is 100 megabits (Mb) in size, the download speed is:

$$100 \div 10 = 10 \text{ Mbps}$$
- The speed of an Internet connection can change over time depending on network conditions.
- Users can test their Internet speed using any device with a web browser connected to the Internet.
- One way to do this is by opening Google Chrome, typing "speed test" into the search bar, and selecting Run Speed Test.
- The test measures the connection's download speed, upload speed, and latency, after which a summary of the connection's performance is displayed.

Advantages:

- Broadband internet access allows us to be connected to the internet while the phone line is in use.
- Connection speed is up to 100 times faster than dialup connection.
- It is convenient because the internet connection is always on.

Disadvantages:

- Not all phone wires are equipped for DSL service.
- May not be available in rural or remote areas.
- Higher security risk than dialup connection.
- A personal firewall is needed to protect your computer.
- Relevance and impact on personal lives
- Home Entertainment and Connectivity (Look up a recipe, the latest stock information, video chat, stream a movie or music, play interactive on-line games)
- Work from anywhere (makes it possible for professionals to work from home)
- Distance Learning (colleges, adult education programs etc.)

Examples of the technology in practice:

- Web-page viewing, e-mail access, messaging etc.
- Improved access to audio materials (music and internet radio) and video.
- Network backup and storage.

5.1.2 Data Cap and Data Bundle

- Some Internet service providers place a data cap on Internet usage.
- A data cap limits the amount of data that can be transferred during a specific period, usually one month, for an agreed monthly fee.
- Users can purchase a data bundle, which provides a fixed amount of data at a set price.
- Depending on a person's Internet usage, buying a data bundle is often more cost-effective than paying for data on a pay-as-you-go basis.
- Service providers usually offer a variety of data bundle packages to suit different users' needs.
- A data cap (as previously mentioned) is the limit the ISP sets for customers on the amount of data used over a certain period, at a specified speed (or bandwidth) and specified price.
- A bundle is a specific amount of data purchased from the ISP, which might expire after a certain period.

Simple explanation of how it works:

- Once the data cap has been reached (or if a data bundle has been used up) the ISP stops providing internet access.

Advantages:

- User only pays for data they actually use.
- It's easier to budget an exact amount for data usage each month.
- Large data bundles are usually cheaper (per megabyte) than smaller bundles.

Disadvantages:

- It can be expensive to purchase 'top-up' data after a cap is reached, or if a data bundle is exceeded.
- Transfer speeds may be drastically reduced (or throttled) once the data cap is reached.
- High data caps or uncapped connections can be expensive.

Relevance and impact on personal lives:

- Streaming high-definition media or frequent downloading/uploading means the data cap can be exceeded quickly.
- Smartphone apps can consume large amounts of mobile data, and may deplete data bundles quickly.
- Examples of the technology in practice
- If you buy a 1 GB data bundle for R149, internet access will stop once that 1 GB has been used (or the data 'expires').
- A small business may have a 50 GB monthly data cap on their fibre internet line.
- Once 50 GB has been downloaded, they won't be able to access the internet for the rest of the month.
- If a user exceeds the limit of their data bundle, they may either be charged a higher rate for additional data or have their connection throttled, meaning the transfer speed is reduced.
- For example, a user on a 4G mobile plan may automatically be reduced to 3G speeds after exceeding their monthly data allowance.

5.1.3 Throttling and Shaping

- Having an uncapped Internet connection does not necessarily mean that users will always receive the maximum speed they paid for.
- Internet service providers often share available bandwidth among many users to reduce costs, which can result in slower speeds during busy periods.
- The contention ratio describes the number of users sharing a single Internet connection.
- A 1:5 contention ratio means that five users share one connection, so the available bandwidth is divided among everyone using the connection at that time.
- A 1:1 contention ratio means that only one user has access to the connection, allowing them to use the full available bandwidth.
- Throttling is the intentional slowing down or speeding up of an Internet connection by an Internet service provider.
- It is used to regulate network traffic and reduce congestion during periods when many users are online.
- Throttling may also be applied to a specific user who exceeds their data bundle.
- This reduction affects all types of Internet traffic, including voice, video, and text.
- Shaping differs from throttling because it only limits specific types of Internet traffic rather than the entire connection.
- For example, normal web browsing may continue at full speed, while activities such as downloading torrents or streaming large video files are deliberately slowed down.
- Shaped and unshaped: The term shaped connection means that preference is given to certain services on the internet, such as email, downloading and browsing.
- Other services, such as online gaming and VoIP, are given less preference and are slower.
- The term unshaped means that all the internet services are given the same priority.
- A shaped connection works well, unless you have a specific need, such as wanting to do a lot of online gaming.

5.2 Internet Browser Features

5.2.1 Caching

- Caching is the temporary storage of web documents that you have visited to reduce bandwidth usage, server load and lagging.

5.2.1.1 Browser Cache

- Every time a website is accessed, a copy of the website is stored on your local hard drive in the browser cache.
- The browser cache stores downloaded web content, including web pages, images, music, videos, and cookies.
- In Google Chrome, you can open the History section to see what has been stored in the cache.
- You can also clear your browsing history or adjust the browser's settings to suit your needs.
- When a web page is loaded from the browser cache instead of a remote web server, it opens much faster.
- However, cached pages may not always be the latest version because they were saved during a previous visit.
- Most browsers allow you to customise how often they check for updated versions of web pages.

5.2.1.2 Web Cache

- A web cache, also known as a proxy server cache, stores recently accessed web pages on a server within a network.
- If another user on the same network requests a website that has already been accessed, the page is delivered from the organisation's proxy server instead of downloading it again from the remote web server.
- This makes the website load much faster and reduces overall network traffic.
- However, the cached version may not always be the most up-to-date version of the website.
- The first time a user on a network accesses a website, the page is downloaded from the Internet and stored in the proxy server's cache.
- A copy is also stored in the user's local browser cache.
- If another user on the same network later requests the same website, the proxy server provides the cached copy without accessing the Internet.
- The page is then stored in the second user's browser cache as well.

5.2.2 Plug-ins and Browser Extensions

- The terms plug-in and browser extension are often confused.
- A plug-in (also called an add-in or add-on) is a software module that adds a special feature to an existing computer program to customise its functionality.
- Web browsers previously supported executable plug-ins, but these are now largely deprecated (discouraged).
- Adobe Flash Player is a well-known example of a browser plug-in.
- A browser plug-in allows you to listen to music and view animations, videos and other multimedia effects within your web browser. (TechTerms, 2018) Examples of plug-ins are Adobe Flash, Macromedia Flash, Apple QuickTime, Microsoft Silverlight, Windows Media Player and Adobe Shockwave Player.
- Advantages: Enhanced functionality without having to purchase any additional software.
- Gives users easy customisability.
- Paid plugins often include some type of support or installation assistance if necessary.
- Disadvantages: Not all programs use the same plug-ins It is hard to find support for an ill functioning plug-in.
- If there is an update for the plug-in that is installed, it can throw off your personalisation of the software.
- One plug-in is used by many users, which can lead to a security vulnerability, because some users have malicious tendencies when it comes to software. (BLUEPRINT, n.d.)
- Limitations: Some plug-ins are created for specific programs.
- Plug-ins are created specifically for something, which makes its usage limited.

- Relevance and impact on personal lives: Some websites cannot function without a plug-in, the plug-ins form an integral part of certain websites.
- For example interactive maps, content sliders, contact forms, and other dynamic or interactive content on a page.
- A browser extension is a small software module that adds extra features or customisation to a web browser.
- Extensions can provide tools such as productivity features, password managers, ad blockers, and cookie management.
- Unfortunately, some browser extensions may install unwanted pop-up advertisements, open new browser tabs that cannot be closed, change the browser's homepage, or change the default search engine without the user's permission.
- POP-UP BLOCKER
- A pop-up blocker is software that prevents pop-up windows from appearing on a website. Simple explanation of how it works.
- Websites advertise products or features while you are busy on your smartphone or browser.
- Advantages: No unwanted advertisements appear.
- Protects your computer from viruses.
- You can filter what pop-up ads you want to see.
- Disadvantages: You may not be able to move to a next webpage if the website uses pop-ups to move forward or backwards.
- Online marketing of shops decrease.
- A person only sees and browses what they know.
- Blocking websites: Blocking websites is when an internet proxy or firewall prevents a user from gaining access to certain network resources such as certain websites or FTP Servers.
- One would block certain websites to avoid phishing websites, to avoid spam disturbing your computer with adware and popups or to add parent filters to content for children.
- Examples include most antivirus software which uses software filters to block unsafe websites to ensure a safe browsing experience
- Search engines: Search engines are websites that allows you to type in a keyword or a phrase and then searches through the internet to find what you are looking for.
- Extensions such as Google Chrome's AdAware and Microsoft Edge's Adblock can block annoying pop-up advertisements and video ads, resulting in faster browsing speeds while also protecting users from cyber threats.
- Entire websites can also be blocked by using browser extensions that filter website URLs.
- These URLs may also be blocked using a firewall.

5.3 Internet Searches

5.3.1 Search Engine Optimisation (SEO)

- Search Engine Optimisation (SEO) is a combination of strategies used to increase the number of visitors to a website by achieving a high ranking on the Search Engine Results Page (SERP).
- In simple terms, SEO helps search engines recognise that a website provides the best information for a particular search topic.
- Search engines crawl websites, index their pages, and use algorithms to determine how highly each page should rank in search results.
- Good SEO increases the likelihood that a website will appear near the top of those results.

5.3.1.1 On-Site/Page SEO Elements

- On-page SEO refers to techniques used within a website to improve its search engine ranking and make the website more effective internally.
- A Title Tag is an HTML element that defines the title of a web page and provides an overall description of its content.
- A Meta Description is an HTML element containing a short description (usually up to 160 characters) that summarises the content of a web page.
- Header Tags organise the content of a web page and provide structure and meaning.
- The <h1> tag is used for the main section heading, while <h2> and <h3> tags are used for subheadings and lower-level headings within the page.

5.3.1.1 On-Site/Page SEO Elements (continued)

- Internal Links provide users with links to other pages or content within the same website.
- This makes the website easier to navigate and improves the overall user experience, making the site more useful.
- Image Names and ALT Tags are also important for SEO.
- When using images on a website, appropriate keywords should be included in both the image filename and the ALT (alternative text) tag.
- This helps search engines understand what the image is about and improves the website's search engine ranking.

5.3.1.2 Off-Site SEO Elements

- Off-site SEO refers to activities performed outside a website that help improve its ranking on search engines.
- One important off-site SEO element is Links.
- Building relationships with reputable websites that link to your website increases trust and credibility, improving your search engine ranking.
- Another important factor is Social Media.
- Collecting likes, shares, and recommendations from influencers and other users increases the visibility of your content.
- The higher the quality of your content, the more likely people are to share it.

5.3.1.3 Good Content

- Creating reliable, well-written, and useful content is one of the easiest ways to satisfy both users and search engines.
- Although it is important for a website to look attractive and have well-structured headings, titles, and images, the content itself must also be relevant, informative, and well written.

5.4 Web-based Applications

- Web-Based Application: Known as web apps.
- Software that is accessed via a web browser by connecting to the internet.
- Sometimes known as cloudware.
- Web-based applications versus installed applications
- Web-Based Application: May be used to run local Intranets in companies or schools
- Installed Software: that needs to be installed onto your local device before you can use it also known as a 'desktop version'.

- Simple explanation of how it works
- Web-Based Software runs in a web browser.
- The software is delivered to the user location.
- Documents that are created using web-based software are stored online (in the cloud).
- Web-based software may be free or purchased at a cost.
- There are websites that offer free alternative software to some licensed (proprietary) software.
- For example you can use Google Docs or ThinkFree Online instead of having to pay for Microsoft Office.
- Installed Desktop software may be purchased on a CD or downloaded from the internet.
- Once the program is installed locally on the device it is ready to use.
- Advantages

Web-Based:

- Accessible everywhere with internet access.
- No installation of software is required.
- Vendor is responsible for backups of data.
- Automatic software updates.
- Centralised storage of data (often off site).
- More secure environment – stored on secure servers that get latest patches and antivirus vaccines.

Installed:

- Never lose access to your locally stored data.
- No internet required to access work.
- Faster data entry, reporting than over internet connection.
- Can be customised to meet your specific needs.
- You own and control your own data.
- Less expensive over time.
- Have the full version of the program as opposed to the web-based 'lite' version that doesn't have all the features.

5.4.1 Government Services

- As society becomes more digital, the South African government provides many online services to help citizens save time.
- Examples include:
- Driver's Licence Services: Booking learner's licence tests, driving licence tests, licence card renewals, and professional driving permits.
- Identity Services: Applying for a Smart ID card and/or passport.
- Tax Services: Submitting tax returns electronically.
- Education Services: Checking matric examination results, finding places for tertiary studies, and applying for admission to Gauteng or Western Cape schools.
- Labour Services: Registering on the Employment Services of South Africa (ESSA) database for jobs, submitting Unemployment Insurance Fund (UIF) declarations, and applying for National Minimum Wage exemptions.
- TV Licence Services: Paying SABC TV licences online.

- Postal Services and Traffic Fines: Renewing post boxes, buying stamps, obtaining information about traffic fines, and paying traffic fines online.

5.4.2 Wikis

- A wiki is a collaborative online tool that allows users to create, edit, and modify linked web pages to share information and ideas.
- Because all users can contribute, wikis are useful within organisations for sharing knowledge and collaborating on projects.
- A well-known example is Wikipedia, which is an online encyclopaedia made up of hundreds of wikis in different languages.

5.4.3 Global Positioning System (GPS)

- The Global Positioning System (GPS) is a satellite-based navigation system consisting of at least 24 satellites.
- GPS works anywhere in the world, in all weather conditions, 24 hours a day, without requiring subscription fees or setup charges.

5.4.4 Geotagging

- Geotagging, also known as GPS photo tagging, is the process of embedding location information (called metadata) into digital media such as websites, photographs, and videos.

The information stored in a geotag may include:

- Place coordinates (latitude and longitude)
- Bearings
- Altitude
- Distances
- Place names
- Search engines use geotag information to connect images with the locations they represent or where they were taken, which contributes to a website's Search Engine Optimisation (SEO).
- Geotagging also helps organise photos stored in the cloud.
- Instead of remembering the date a photo was taken, users can search for photos based on the location.
- Some online photo applications can even recognise buildings or landmarks shown in the images.
- Geotagged photos can also be embedded into maps, allowing website visitors to view images related to a specific location, such as shopping malls, places of interest, or accommodation.

5.4.5 Location-Based Services (LBS)

- Location-Based Services (LBS) use the geographical location of a device to provide contextual information, including geotagged images and videos, or information about nearby facilities such as ATMs, restaurants, and retail stores.
- LBS mainly uses GPS technology to determine a user's location, provided the service is enabled.
- If GPS cannot provide an accurate location, such as when the device is underground or inside a tunnel, the location can be determined using cell towers.
- One of the best-known LBS applications is Google Maps.

Location-Based Services are used in several ways:

- Store Locators: Helping customers find the nearest store.
- Proximity-Based Marketing: Sending advertisements to users within a specific geographical area.
- Travel Information: Providing real-time traffic updates and weather reports.
- Roadside Assistance: Allowing assistance companies to track a user's exact location during emergencies.
- Mobile Workforce Management: Enabling employees working in the field to check in at different work locations using their mobile devices.
- Fraud Prevention: Banks compare a customer's smartphone location with credit card transactions to detect fraudulent purchases made where the cardholder is not present.
- Social Networking: Allowing users to tag their location and discover events happening nearby.

5.5 Chatbots

- A chatbot is a software application that carries out online conversations using text or voice commands.
- These AI-powered programs are mainly used by organisations to improve customer service.
- Customers interact with chatbots to get answers to product-related questions, obtain information about products and services, and book appointments with product specialists.
- Although chatbots are similar to digital assistants, there are important differences.
- Digital assistants use Artificial Intelligence (AI) and Natural Language Processing (NLP) to learn from previous interactions and improve over time.
- Chatbots, however, generally follow a fixed set of programmed rules and have limited decision-making abilities.
- They also do not remember the context of a conversation if it is interrupted or restarted.

5.6 Surface, Deep and Dark Web

5.6.1 Surface Web

- The Surface Web is the part of the World Wide Web that is indexed by search engines and can therefore be searched using standard search engines such as Google, Bing, and Yahoo.

Examples of content found on the Surface Web include:

- Websites
- Blogs
- Wikipedia
- YouTube
- Facebook
- E-commerce websites

5.6.2 Deep Web

- The Deep Web consists of web pages that are not indexed by search engines and therefore cannot be accessed through normal web searches.

Deep Web content includes:

- Information behind paywalls
- Pages requiring login credentials
- Content blocked from search engine indexing

- Medical records
- Membership websites
- Confidential corporate web pages
- Research papers
- Information stored in searchable databases
- The Deep Web is estimated to make up more than 90% of the Internet, with only a small portion accessible through a standard web browser.
- The Deep Web contains unlinked content, limited-access content, private information, and searchable databases that are accessed using specialised deep web search engines.
- Advantages of the Deep Web
- Provides access to detailed and comprehensive information that cannot be found using normal search engines such as Google, Bing, or Yahoo.
- Deep web search engines analyse the full content of webpages, often producing more accurate and relevant search results.
- Disadvantages of the Deep Web
- Deep web searches are generally slower because there is much more information to analyse.
- Search queries must be precise, making deep web searches better suited for detailed research rather than everyday browsing.
- Searches may expose sensitive personal information from restricted databases, increasing the risk of fraud and identity theft.
- Since the Dark Web forms part of the Deep Web, there is always a possibility of encountering illegal, harmful, or criminal content.

5.6.3 Dark Web

- The Dark Web is another part of the Internet that is not indexed by search engines.
- It is intentionally hidden, uses masked IP addresses, and can only be accessed using a special web browser.
- The Dark Web is estimated to make up about 5% of the Internet.
- Part of the Dark Web is associated with illegal activities.
- Illegal goods and services that may be found include:
- Credit card numbers
- Drugs
- Guns
- Counterfeit money
- Stolen subscription credentials
- Hacked Netflix accounts
- Malware and hacking software
- Bank account information
- Botnet rentals
- Weapons
- Hackers for hire
- Hitmen for hire
- However, not all activity on the Dark Web is illegal.
- Journalists may use it to protect the identity of their sources, political activists and whistle-blowers may use it to avoid persecution, and people living in countries with censorship may use it to express their opinions freely.

- Individuals who value privacy may also use the Dark Web to protect their identity.
- Advantages of the Dark Web
- It is difficult to block because normal forms of Internet censorship are often ineffective.
- It allows users to maintain privacy and express their opinions freely.
- It provides protection for innocent people who may be targeted by stalkers or other criminals.

5.6.3 Dark Web (continued)

- Advantages of the Dark Web (continued)
- The increasing tendency of potential employers to monitor posts on social media can make it difficult for people to participate in honest public discussions.
- The Dark Web provides a platform where users can communicate more privately.
- The popularity of the Dark Web among criminals also makes it a useful platform for undercover police officers to communicate anonymously during investigations.
- Disadvantages of the Dark Web
- One disadvantage is its slow speed.
- Multiple layers of encryption and routing traffic through servers around the world significantly slow Internet connections.
- The Dark Web can make serious crimes easier to commit.
- For example, the combination of the Dark Web and cryptocurrencies can make it easier for criminals to hire others to commit crimes.
- Although the Dark Web offers privacy, it can also be used to violate the privacy of others.
- Stolen private photographs, medical records, and financial information have all been shared on the Dark Web.

5.7 Cryptocurrencies

- Unlike traditional currencies that exist in physical form, digital currencies exist only in digital or electronic form.
- They are also known as digital money, electronic money, electronic currency, or cyber-cash.
- Digital currencies allow payments to be made quickly, cheaply, and without unnecessary intermediaries such as Visa or Mastercard.
- Accessing digital currency requires an Internet-connected device.
- There are different types of digital currencies, one of which is cryptocurrency, which relies on blockchain technology.

5.7.1 Introduction to Blockchain Technology

- The following example explains how blockchain technology works.
- Imagine Alice owns a physical arcade token and gives it to Bob.
- Once the transaction is complete, Bob has the token and Alice no longer has it.
- Since Alice no longer possesses the token, she cannot give the same token to Charlie.
- No third party is needed to verify this physical transaction.
- However, if the arcade token is digital, Alice could email a copy of the token to Bob while still keeping a copy herself.
- She could also send the same token to Charlie, effectively spending the same digital token twice.
- This problem is known as double spending.
- To prevent this, a ledger is used.

- A ledger records every transaction, including when Alice transfers the token to Bob.
- A new problem then arises: Who should keep the ledger?
- If Alice keeps the ledger, she could erase the record and claim she still owns the token.
- If Bob keeps the ledger, he could change the ledger to make it appear that Alice gave him two tokens instead of one.
- One solution is to use a trusted third party, called Dave, who keeps the ledger and verifies all transactions.

However, this creates another problem. Dave might:

- Charge fees that Alice and Bob do not want to pay.
- Accept a bribe from Alice to remove a transaction.
- Add false transactions and keep digital tokens for himself.
- To eliminate the need for a trusted third party, the ledger is distributed to many trusted participants.
- This is known as decentralising trust.
- Since the ledger is digital, every participant keeps a copy, and all copies are synchronised.
- When a transaction is made, most participants must agree that it is valid before it is added to the ledger.
- Because many people hold identical copies of the ledger, cheating becomes extremely difficult.
- If Alice or Bob attempted to change a transaction, they would need the majority of participants to agree, which is far more difficult than changing a single copy of the ledger.

For example:

- Alice cannot claim she never sent the token to Bob because the majority of ledger copies show that she did.
- Bob cannot claim that Alice sent him two tokens because the majority of ledger copies record only one transaction.
- Even if Alice bribed Dave to change his copy of the ledger, Dave's copy would differ from everyone else's, and the majority would still show the correct transaction.

5.7.2 Details of Blockchain Technology

- A blockchain is a decentralised, distributed, and public digital ledger designed to create trust.
- A blockchain functions as a shared database that is distributed across a large peer-to-peer network, meaning there is no single point of failure.
- No individual or organisation owns the blockchain network, and no one can change the stored data without the agreement (consensus) of the other participants in the network.
- New information can only be added to a blockchain if the nodes (computers) on the network agree that the transaction is valid.
- Each node stores its own complete copy of the ledger.
- This ensures that all nodes keep one another honest.
- If one node changes its local copy of the blockchain, the other nodes can reject those changes because they do not match the majority of the network.

5.7.2 Details of Blockchain Technology (continued)

- Cryptocurrencies, such as Bitcoin, are a type of digital currency that uses blockchain technology, making them extremely difficult to counterfeit or double-spend.
- A cryptocurrency is a form of payment that can be exchanged online for goods and services.
- Many companies have also created their own digital currencies, called tokens, which can only be used to purchase the goods or services provided by that specific company.

- Characteristics of Cryptocurrency
- It is a medium of exchange that is created and stored electronically on the blockchain.
- It has no intrinsic value, meaning it cannot be redeemed for another commodity such as gold.
- It has no physical form and exists only within a digital network.
- Its supply is not controlled by a central bank because the network is completely decentralised.
- It uses encryption techniques to control the creation of new monetary units and to verify the transfer of funds.
- Bitcoin is the best-known example of a cryptocurrency.
- Cryptocurrencies operate using blockchain technology, which is widely recognised for its high level of security.
- Although there have been reports of fraud and financial losses involving cryptocurrencies, these incidents have been relatively isolated.
- However, they have made many investors cautious about investing in cryptocurrencies.
- Governments around the world have also criticised cryptocurrencies because they have very little control over them.
- Potential Applications of Blockchain Technology

Blockchain technology has many possible applications beyond cryptocurrencies, including:

- Automotive: Consumers could use blockchain technology to manage fractional ownership of autonomous vehicles.
- Financial Services: Faster and cheaper financial settlements could reduce transaction costs while improving transparency.
- Voting: Blockchain technology could allow citizens to vote using smartphones, tablets, or computers, producing immediately verifiable election results.
- Healthcare: Encrypted medical records could be securely shared among multiple healthcare providers while reducing the risk of privacy breaches.
- Cryptocurrency and the Dark Web
- It is important not to confuse the Dark Web with cryptocurrencies.
- The Dark Web provides websites that offer a high level of anonymity for users.
- Many of these websites simply contain information and do not involve buying or selling products or services.
- Although cryptocurrencies such as Bitcoin are often used for transactions on the Dark Web because they offer greater anonymity, using cryptocurrencies does not require access to the Dark Web.
- Cryptocurrencies can be used independently of the Dark Web for many legitimate online transactions.

Additional information:

- DOCUMENT MANAGEMENT SOFTWARE
- Document management is the use of a computer system and software to store, manage and track electronic documents and electronic images of paper based information scanned by a scanner.

Simple explanation of how it works:

- Documents can be stored electronically or as paper.
- Many documents are available in electronic format.
- Therefore, it is more efficient to store documents electronically.
- Paper documents are scanned by a scanner in any of the following formats, PDF, TIF, JPEG and PNG
- PDF (Portable Document Format).

- A PDF file is among the most commonly used file types.
- This file type is great for documents with text, forms, and images that contain words.
- Certain programs use OCR technology to make the characters in the document searchable and editable.
- JPG or JPEG (Joint Photographic Experts Group).
- JPEGs are great for images because they can compress very large files down to a small size.
- PNG (Portable Network Graphics).
- PNG files are mostly for digital image files and they utilise document compression, but not as much as JPEGs do.
- TIF or TIFF (Tagged Image File Format)
- TIFs are great for files that you don't want compressed, because you want every bit of the data in your document.

Advantages:

- Reduced storage space – no need for file cabinets.
- Enhanced security – all documents can be stored securely with passwords.
- Easier retrieval – if an electronic file system is logically arranged, retrieval of documents is easier.
- Better collaboration – documents can be sent through e-mail to many recipients.
- Better backup – backups can be made online and offline.
- Versioning – earlier versions are readily available. Paperless office – no need for hard copies.
- Access to documents is available anywhere.

Disadvantages:

- Too much dependence on technology.
- Can cause RSI and other health issues.
- Security may be compromised because many people have access to documents.
- If no backups are made, loss can be huge.
- Updated hardware and software is necessary.

Internet and Web Additions

Wi-Fi

- Wi-Fi stands for Wireless Fidelity.
- Public Wi-Fi can create security risks because other users may attempt to intercept data or connect to unsecured devices.

Cloud Storage

- Cloud storage is the storage of files and data on remote servers that are accessed through the Internet.
- Advantages include access from different locations/devices, easier sharing and the ability to store data without relying only on local storage.

Internet Service Provider (ISP) Services

- An ISP provides Internet connectivity and may also provide services such as email accounts, web hosting, cloud/storage services, security services or technical support, depending on the provider.

Web-Based Applications

- Web-based applications run through a web browser rather than requiring the main application to be installed locally on every computer.
- Advantages can include access from different devices, easier centralised updates and easier collaboration/sharing.

Cookies

- A cookie is a small piece of data stored by a website in a user's browser.
- Cookies can be used to remember preferences, maintain sessions/login information and support website functionality.

Wired vs Wireless Connections

- A wired connection generally provides a stable, reliable connection and is less susceptible to wireless interference.
- A wireless connection provides mobility and avoids the need for physical network cables, but can be more susceptible to interference and security risks.

Learning Unit 7 Social Implications

7.1 Impact on Society

- The impact of computers on society has been discussed in various measures in Learning Unit 10 of Exploring CAT: Grade 10 and Learning Unit 8 of Exploring CAT: Grade 11.
- Refer to these sections in conjunction with the following topics.

7.1.1 Distributed Computing Projects

- Distributed computing is the technique of using the unused power of networked computers.
- For example, when a user on a client computer in a network has finished working and leaves the computer, the CPU becomes idle, wasting the CPU's processing power.
- However, if distributed computing software is installed on this networked client computer, this software will begin to run once the user has left the machine.
- The results are immediately transmitted to the server and then processed.
- In utilising the idle CPU time of networked computers, the server can complete computations that would be impossible to process on a single computer.
- Users can volunteer for their computers to form part of a project by installing the relevant software on their computers.
- This software would complete computations that would otherwise require centuries on a single supercomputer which will significantly improve research by reducing the numbers of hours to complete the task.

- By spreading the task between many computers, no single computer will spend a large amount of time on computation and no expensive supercomputer is required.
- Examples of research projects categories include climate prediction, cryptography, molecular biology, mathematics, computer games, statistics and astronomy.

7.1.2 Information Overload

- Information overload is caused by the excessive quantity of information available today.
- It leads to difficulties in understanding an issue leading to ineffective decision making.
- Users need to manage the volume of information they receive.

7.1.3 Social Networking Technologies

- Social networking allows users to collaborate, communicate and connect with other users.
- The websites allow users to develop profiles describing their interests, achievements and personal history.
- Users can upload personal resources and connect with multiple networks via the Internet sRefer to the types of
of
- social media in section 6.1.5, Learning Unit 6 in Exploring CAT: Grade 11.

7.1.3.1 Digital Footprint

- A digital footprint is a trail of data created while using the Internet both intentionally and unintentionally.
- Passive digital footprint - is your unintentional online data trail. For example, your IP address may be logged when you visit a website, identifying your Internet service provider and your approximate location. A more personal aspect is your search historyssich is saved by some
search engines while you are logged in.
- Active digital footprint - includes data intentionally submitted online. For example, sending an email, since you expect the data to be seen and/or saved by another person. The more email you send, the more your digital footprint grows. Since most people save their email online, the
messages you send can easily remain online for several years or more.
- Publishing a blog and posting on social media quickly expands your digital footprint.
- Every tweet posted on Twitter, every status update on Facebook, and every photo shared on Instagram increases your digital footprint.
- The more you interact with social networking websites, the larger your digital footprint will be.
- "Liking" a post contributes to your digital footprint, since the
data will be saved on social networking servers

7.1.3.2 Crowdfunding

- Crowdfunding uses the Internet to raise money for a project by raising small amounts of money from many people.
- To create a successful crowdfunding campaign, the user needs to convince many people that their project is worthwhile.
- These projects can include raising capital to start a new project, charity donations and loans.
- In the case of donations, contributors will not receive anything in return, whilst in new business ventures investors may receive a return of their investments if the business is successful.
- With regards to loans, the money pledged is expected to be repaid with interest.

7.1.3.3 Virtual Communities

- A virtual community is an online group of individuals who share their interests, fears, and personal opinions usually through social media platforms.
- Examples include backing a political party, sharing experiences with people who have a similar medical condition, or to support a sports team.
- Members of a virtual community can interact with other people across the world who have different ethnic, racial, sexual, religious and political backgrounds.

7.2 Computer Crime

- Computer crime has been discussed in Learning Unit 10 of Exploring CAT: Grade 10 and Learning Unit 8 of Exploring CAT: Grade 11.
- The following is an extension to these sections.

7.2.1 Theft

7.2.1.1 Hardware Theft

- Theft of either the software or data or the hardware is a huge concern to the security of a computer or network (especially if the stolen computer is a server).
- If the hardware is stolen, the software goes with it; the hardware and applications may be replaced at considerable cost and should be insured.
- If the data is stored remotely or is regularly backed up it can be easily replaced.
- If the data is confidential it should be

7.2.1.2 Software Theft

- Software theft means the unauthorised or illegal copying, sharing or usage of copyright-protected software programs.
- Software theft may be carried out by individuals, groups or, in some cases, organisations who then distribute the unauthorised software copies to users.

Software theft is committed when someone performs any of the following:

- Steals software media.
- Deliberately erases programs.
- Illegally copies or distributes a program.
- Registers or activates a software program illegally.

7.2.1.3 Information Theft

- Information or data theft is when digital information stored on computers, servers, or electronic devices is copied from a victim to compromise their privacy or obtain confidential information such as credit card numbers, bank accounts details, or personal information, like identity numbers, driver's licence numbers, and health records.
- This information can be used for identity theft, drain a bank account or to blackmail a user.

7.2.1.4 Theft of Time and Services

- Theft of time is when an employee accepts payment for work not done or the time that they should have spent doing work related tasks.

- Examples include spending time on social media, online shopping, extended personal calls or operating another business during work hours.
- Any person who intentionally uses a service without paying for the service is guilty of theft of service.
- Examples include accessing secured Wi-Fi and using electricity without paying.

7.2.1.5 Bandwidth Theft

- Stealing wireless bandwidth is connecting to the Internet through a wireless Internet router which does not belong to you or you do not have permission to use.
- People who pay for their wireless service expect it to function optimally but suffer from slower performance or intermittent disconnection due to bandwidth theft.
- In more malicious cases, it can be used to gain access to the owners computer and commit identity theft as well.
- Because it is so easy to do, and because Wi-Fi is so common, bandwidth theft happens often and is rarely ever punished.

7.2.2 Fraud Scams

- Internet fraud uses online services to take advantage of people or trick them into giving away their Personal and financial information.
- This information is often obtained using social engineering techniques described in section 8.3.1, Learning Unit 8 of Exploring CAT: Grade 11.
- Examples of Internet scams
- Phishing email scams - Cyber criminals send messages/emails to users to attempt to trick them into providing them with valuable and sensitive data.
- The communications seem to originate from an official source to convince users they are legitimate The users will be redirected to a fake login access page that resembles the real website.
- Nigerian 419 scams - One of the oldest and most popular Internet scams named after the section of Nigeria's Criminal Code which outlawed the practice.
- A typical Nigerian scam involves an emotional email, letter, text message or social networking message from a scammer requesting help in retrieving a large sum of money from some institution.
- Usually, a smaller amount is required to release these funds whereby a percentage of the larger sum is promised.
- Once hooked, the user is required to pay more and more money for additional "costs" with user never receiving any of the promised funds.
- Greeting card scams- Greeting card scammers send emails with birthday or holiday messages to users so that when the user opens the email and views the card, malware is installed on the user's computer.
- This malware takes the form of annoying pop-ups, join the computer to a botnet or ransomware.
- Bank loan or credit card scam -Any bank offers that guarantee loans of large amounts of money that have been pre-approved by the bank, generally are too good to be true.
- Many people have lost money paying the "mandatory" processing fees required by the scammers.

7.2.3 Crime using Deep and Dark Web

- Cyber criminals often choose to use the dark web to facilitate malicious activities.
- The dark web is full of illegal marketplaces and forums where criminal activity is advertised and communicated about.

- It is not illegal to browse the dark web but it is illegal to view explicit child exploitation material or buy or sell illegal goods and services such as illicit drugs, malware, firearms, stolen credit cards, and banking information.
- Cyber-attack services include access to botnets capable of Distributed Denial of Service(DDoS) to temporarily disable websites.
- Exploring the dark web can be dangerous.
- Think twice before clicking any returned search links, since there is no ruling authority to regulate the dark web.
- The result of the search could return links to illegal activities such as trading copyrighted materials, selling narcotics, circulating child pornography and negotiating for other criminal acts.
- Exploring a search engine's results may leave you vulnerable to nefarious characters and sites designed to spread malware or hack your computer.
- Since the dark web differs from the visible Web, it is important to take extra security precautions to protect your computer and any other computers on your network.

7.2.3.1 Pornography

- There is a common misconception that pornographic films are legal in South Africa, which is not completely true.
- In 2006, websites hosting sexually explicit content including child pornography and depictions of violent sexual acts) were banned by the South African government and were punishable under the Film and Publications Act 1996.
- In 2007 a South African "sex blogger" was the first to be arrested and charged under this offence.
- Any online pornography where the source is a South Africa server is technically illegal whilst pornographic films and photographs originating from different countries are entirely legal.
- It is also illegal for any person under the age of 18 to participate in or view a pornographic film.

7.2.4 Cryptocurrencies in Crime

- Digital currencies are a frequent target of criminals, who use techniques such as phishing, scamming and hacking to net millions of dollars' worth of cryptocurrency.
- In addition, cryptocurrencies provides opportunities for criminals to hide behind the privacy and anonymity.
- Examples include ransomware attackers who demand payment in bitcoin and traders of illicit products and services such as firearms, illegal narcotics, stolen databases and malware who rely on cryptocurrency that help disguise transactions.

7.3 Online Authentication

7.3.1 Multi-Step Verification

- Multi-Step Verification or Authentication is when there is more than one stage involved in ensuring a user is authentic to improve a system's security.
- Single-step authentication could be a user entering their username and password to access a computer system.
- Once the user is authenticated, the user will be granted access to the appropriate resources such as files, folders and printers.
- If a hacker steals your password then in single-step authentication, the hacker has complete access to the user's resources.
- In multi-step authentication, a second and even third form of authentication is required.

- This could include biometric data such as a retina scan or fingerprint; a one-time pin sent to a separate device or answers to pre-determined questions.

Information Management

- Information Management (IM) is the process of gathering, organising, processing, analysing and presenting data so that it becomes useful information.
- The purpose of Information Management is ultimately problem-solving and informed decision-making.
- Information Management can be used for very small problems, such as deciding which theme learners prefer for a school event, or large problems, such as analysing population statistics for an entire country.

The general Information Management process can be remembered as:

- The important idea is that simply collecting lots of data is not enough.
- The data must be relevant and reliable, processed into information, analysed to discover patterns and relationships, and then communicated in a form that allows someone to make an informed decision.

Data, Information, Knowledge and Insight

- These four concepts describe how raw facts gradually become something that can be used to make decisions.
- Data
- Data is raw, unprocessed facts.
- It can consist of numbers, text, dates, images, audio or video.
- Data does not necessarily have useful meaning until it has been processed.
- For example, imagine that a teacher records the marks of five learners as 52, 67, 71, 83 and 92.
- These individual marks are data.
- They tell us the results of individual learners, but by themselves they do not necessarily tell us whether the class performed well overall.
- Information
- Information is data that has been processed so that it has meaning.
- If the teacher calculates the average of those five marks and obtains 73%, the 73% is information because the individual marks have been processed into a meaningful result.
- Knowledge
- Knowledge is the understanding gained by analysing information.
- Suppose the teacher compares the results of several classes and discovers that the class with the highest average also spent more time completing revision activities.
- The teacher has now gained knowledge about a possible relationship between revision and performance.
- Insight
- Insight is a deeper understanding gained after analysing information, identifying relationships, trends and patterns, and considering what those findings mean.
- Insight can help someone determine what action should be taken.

The full process:

A good way to understand this is:

- Data tells you what happened.

- Information organises it into something meaningful.
- Knowledge helps you understand why or how things are related.
- Insight helps you decide what should be done.
- Understanding the Problem — Task Definition
- Before collecting any information, you must first understand exactly what problem you are investigating.
- This is known as the task definition.
- The task definition involves breaking the problem into smaller parts and determining what the investigation needs to accomplish.
- You should establish the current situation, the purpose and desired outcome, how the investigation will be conducted and who the target audience is.
- Example scenario
- Imagine that a school wants to determine whether learners would support introducing a new school transport service.
- Before immediately creating a questionnaire, the school needs to define the problem.
- It might determine that the current situation is that many learners struggle to get to school on time because of unreliable transport.
- The purpose of the investigation would therefore be to determine whether there is sufficient demand for a school transport service, what type of transport learners would prefer and what concerns they have about the service.
- The target audience would be the learners and possibly their parents.
- This makes the investigation focused instead of simply collecting random opinions about transport.
- Focus Question
- A focus question is a single, precise and researchable question that guides the entire investigation.
- It needs to be broad enough to allow research, but focused enough to prevent the investigation from becoming irrelevant.
- A focus question cannot simply be answered by copying information from a website.
- The researcher must gather and analyse data and then construct an answer based on the evidence.
- Example scenario
- A school wants to investigate learners' use of technology.
- A weak focus question would be:
- What is technology?
- This can simply be answered using existing information.

A better focus question would be:

- How does the use of digital technology affect the academic productivity of Grade 12 learners?
- To answer this, the school would need to gather data about learners' technology use, process the results, identify trends and patterns, interpret the findings and reach a conclusion.
- Types of Questions
- Closed-ended questions
- Closed-ended questions have a limited number of possible answers, such as Yes/No, multiple choice or selecting a value from a list.
- They are particularly useful for questionnaires because the answers can easily be entered into a spreadsheet and processed statistically.
- Example scenario
- Suppose a school wants to find out whether learners support a new computer laboratory.

- Instead of asking learners to write long explanations, the questionnaire could ask:
- Do you support the introduction of a new computer laboratory?
- Yes / No / Unsure
- Because every learner selects from the same options, the results can easily be counted and represented in a graph.
- Open-ended questions
- Open-ended questions require a more detailed response and allow respondents to explain their opinions, give reasons or make recommendations.
- They are useful when detailed qualitative information is required.

For example:

- What improvements would you recommend for the school's computer facilities?
- The answers could be very different from one learner to another, which makes them more difficult to process numerically but potentially more useful for understanding opinions.
- Four Levels of Questioning
- Questions can also be divided according to the level of thinking required.
- Level 1 focuses on facts.
- These questions usually ask Who, When, Where, What or How many?
- For example, a school might ask, “How many Grade 12 learners own a laptop?”
- Level 2 focuses on exploration.
- These questions investigate how something works or why something happens.
- For example, “How does access to a laptop affect learners' ability to complete CAT projects?”
- Level 3 focuses on predictions and alternatives.
- These questions consider possible situations and usually use “What if...?” or “If...?” For example, “What if the school provided every learner with a laptop?”
- Level 4 focuses on judgement and evaluation.
- These questions require recommendations or decisions, such as “Would it be better if the school provided laptops instead of maintaining computer laboratories?” or “What would be the best solution?”

So the progression is:

- Gathering Data and Information
- Once the problem and research questions have been established, relevant data must be gathered.
- Information can come from electronic sources such as websites, e-books, blogs and online articles, printed sources such as books and journals, social media, videos, interviews and questionnaires.
- Digital information has several advantages.
- It can generally be accessed and distributed quickly, does not necessarily have to be retyped or scanned, and can often be updated faster than printed information.
- However, the fact that information is digital does not automatically mean that it is reliable.
- It still needs to be evaluated.
- Surveys and Questionnaires
- A survey is a research method used to collect people's opinions, feelings or information about a specific topic.
- A questionnaire is the set of questions used to collect this data.
- Example scenario
- Suppose a school's Events Committee wants to decide whether it should host a Valentine's Ball.

- Instead of simply assuming that learners want one, the committee could create a questionnaire asking learners whether they support the event, whether they would attend, which grade they are in and which prizes they would prefer in a lucky draw.
- The responses could then be entered into a spreadsheet and analysed to determine the level of support.
- A good questionnaire should have clear instructions, be professionally formatted, group related questions under appropriate headings and use questions that can be processed easily.
- Form controls should also be used where appropriate to validate the information entered.
- Searching for Information
- Because the Internet contains an enormous amount of information, effective searching is important.
- You should use specific search terms rather than extremely broad terms.
- Searches can also be narrowed using operators and advanced search options.

Important search operators include:

- + includes a word.
- - excludes a word.
- " " searches for an exact phrase.
- ~ searches for synonyms.
- * acts as a wildcard.
- OR searches for either of two terms.
- Example scenario
- Suppose you want information about the impact of social media on South African teenagers.
- Searching:
- social media
- would produce an enormous number of results.

A more specific search such as:

- "social media" "South African teenagers" effects
- would narrow the results considerably.
- If you wanted to exclude Facebook-specific results, you could use:
- "social media" "South African teenagers" -Facebook
- Advanced searches can also narrow results by date, country, language or file type.
- Evaluating Sources and Information
- You should never assume that information is reliable simply because it appears on a website.
- Quality control involves evaluating both the source and the information itself.
- When evaluating the source, consider the date it was created, whether an author is identified, when it was updated, who published it, the language and grammar used, its target audience and its overall format and layout.

For the information itself, remember ACCOC:

- Authority asks whether the author or publisher has suitable credentials.
- Currency asks how recent the information is.
- Accuracy asks whether the information agrees with other reliable sources.
- Objectivity asks whether the information contains bias or prejudice.
- Coverage asks how extensively the topic is covered.

- Example scenario
- Imagine you find two websites claiming different statistics about Internet usage in South Africa.
- One was published yesterday by a recognised research organisation, while the other was published eight years ago by an unidentified author.
- Even if both websites look professional, the first source would generally deserve greater consideration because its authority and currency are stronger.
- You could then compare its figures with another reliable source to check their accuracy.
- Information Sifting
- Information sifting means deciding which information is useful and removing information that does not contribute to solving the problem.
- Example scenario
- Imagine you are researching whether South African learners would benefit from a trip to South Korea.
- You might find information about Korean history, food, K-pop, transport, visa requirements, accommodation, school exchange programmes and weather.
- Not all of this information will be equally relevant to your focus question.
- If your focus is specifically about the educational benefits of the trip, information about transport costs might be useful as supporting information, while an unrelated article about Korean celebrities would probably be discarded.
- The information you retain should be relevant, valid, reliable, current and objective.
- Processing Data
- After data has been gathered and sifted, it needs to be processed so that useful information can be obtained.
- Processing can involve sorting, filtering, calculations, formulas, graphs, conditional formatting, subtotals, database queries and reports.
- Example scenario
- Suppose 200 learners complete a questionnaire about their preferred school-trip activities.
- The raw questionnaire responses are data.
- Once the responses are entered into Excel, you could use COUNTIF to count how many learners selected each activity, sort responses by grade, filter responses to examine only Grade 12 learners and create a graph showing the most popular activities.
- The raw responses have now been processed into information that is much easier to understand.
- Spreadsheets and Databases
- A spreadsheet is generally better when the main purpose is calculations, statistics, organising manageable amounts of data and creating graphs.
- Excel can sort and filter information, apply formulas and functions, and visually represent data.
- A database is more appropriate when the amount of data is large, when information needs to be linked between tables, when complex queries are required or when formatted reports need to be produced.
- Databases can also improve data integrity and reduce unnecessary duplication of information.
- Example scenario
- Imagine a small shop that sells 50 products per month.
- A spreadsheet could easily store the product names, prices, quantities and monthly sales and calculate totals.
- Now imagine a large company with thousands of products, thousands of customers and many years of sales records.
- The company may need to connect customers with orders, products with suppliers and orders with payments.

- A database would be much more suitable because the information can be linked across tables and queried efficiently.

Remember:

- Charts
- Charts make processed information easier to understand visually, but the type of chart must match the purpose.
- A column chart is useful when comparing different categories.
- For example, if a school wants to compare the number of learners who prefer different school-trip destinations, a column chart could clearly show which destination is most popular.
- A bar chart is essentially a horizontal column chart and is particularly useful when category names are long or when many categories need to be compared.
- A pie chart shows how different categories form part of a whole.
- For example, if learners choose between four different activities, a pie chart could show what percentage chose each activity.
- The total must equal 100%.
- A line chart is particularly useful for showing changes or trends over time.
- For example, a school could use a line graph to show how average CAT marks changed from Term 1 to Term 4.
- A stacked bar chart allows you to compare categories while also showing how each category is divided into components.
- A chart should generally contain an appropriate title, legend, data labels and axis titles so that the reader can interpret it correctly.
- Trends and Patterns
- A trend is the general direction in which something changes over time.
- A pattern is a repeated or recognisable arrangement in the data.
- Example scenario
- Suppose a shop records its sales for five years and notices that sales increase every year.
- This is an upward trend because the general direction is increasing.
- However, if the shop notices that sales always increase dramatically during December and decrease again in January, that is a pattern because the same behaviour repeatedly occurs.

Remember:

- Trend = direction
- Pattern = repetition
- Interpreting Data
- Creating a graph, query or report does not automatically mean that you have analysed the information.
- You must interpret the results by explaining what they actually mean.
- Example
- Suppose a graph shows that 70% of learners prefer travelling by aeroplane, while only 15% prefer travelling by bus.

Simply stating:

- “70% of learners prefer aeroplanes.”
- is describing the data.

A stronger interpretation would be:

- “The majority of learners prefer travelling by aeroplane, suggesting that air travel would be the most acceptable transport option for the proposed trip.”
- The second statement explains the meaning and possible implication of the evidence.
- Knowledge, Insight and Decision-Making
- Once information has been processed and analysed, you can identify relationships, trends and patterns.
- This allows you to gain knowledge, and deeper understanding produces insight.
- The purpose of gaining insight is ultimately to help solve the original problem and make a decision.
- Example scenario
- Imagine that a school surveys learners about their preferred method of studying.
- The raw data shows the individual responses.
- After processing, the school discovers that 65% prefer digital study materials.
- This is information.
- When the school compares these results with learners' academic performance and finds that learners using digital study resources generally perform better, it develops knowledge.
- If the school then concludes that providing better digital resources could improve access to effective study materials and recommends investing in an online learning platform, this demonstrates insight and decision-making.
- Reports
- A report is a document presenting the results or findings of an investigation or research project.
- A good report organises information logically so that the reader can understand the investigation and its conclusions.

A formal report can contain a:

- The introduction explains the background, purpose and focus of the investigation.
- The discussion/analysis contains the main research and interpretation, organised under headings.
- The findings explain the knowledge and insights gained from the evidence.
- The conclusion summarises the investigation, answers the original problem and can provide recommendations.
- When including graphs or other visualisations, you should explain them rather than simply placing them in the report.
- Claims made in the report should be supported by information obtained from your research, spreadsheets or databases.
- Referencing, Plagiarism and Copyright
- When information from another person's work is used, the original source must be acknowledged.
- Plagiarism is passing someone else's work, words, images or ideas off as your own without acknowledging the original source.
- A citation identifies a source within the document, while a bibliography is the list of sources provided at the end of the report.
- Copyright is the law that gives the owner of a work, such as a book, image, movie, song or website, rights over how that work may be used.

IPO — Input, Processing and Output

- The IPO model describes how a system receives data, performs an operation on that data and produces a result.
- Input is the data that enters the system.
- Processing is what the system does to the input.
- This can include calculating, comparing, sorting, searching, filtering, checking, grouping or analysing.
- Output is the result produced by the system.
- This could be information displayed on a screen, printed on paper, sent by email, played through speakers or physically produced by a machine.
- IPO Scenario — ATM
- An ATM is a straightforward example of the IPO model.
- When a person wants to withdraw money, they first insert their bank card, enter their PIN, select their account and enter the amount they want to withdraw.
- All of these are inputs because the information is being supplied to the ATM.
- The ATM then processes the information by verifying the PIN and checking whether the selected account has enough available funds for the requested withdrawal.
- If the transaction is approved, the ATM produces the output, which is the requested cash and usually a transaction slip.

So the scenario can be understood as:

Input: Processing: Output: Cash and transaction slip.

- IPO Scenario — Microwave
- A microwave also follows IPO.
- The user selects the power level and cooking time, places the food inside the microwave and presses the Power button.
- These actions provide the input.
- The microwave then processes this information by using electromagnetic energy to heat the food according to the selected power and time.
- When the process finishes, the output is the cooked food that the user removes from the microwave.
- IPO Scenario — Air Conditioner
- An air conditioner demonstrates a slightly more interesting IPO system because it uses sensor information.
- The user provides an input by selecting the desired temperature and cooling/heating mode.
- The air conditioner also receives input from a temperature sensor that measures the current temperature of the room.
- The system then processes the information by comparing the desired temperature with the actual room temperature.
- If the room is warmer than the selected temperature, the system determines that cooling is required.
- If the room is colder, heating may be required.
- The output is the adjustment made by the air conditioner to change the room temperature.
- IPO Scenario — Spreadsheet
- A spreadsheet calculation is another simple example.
- Suppose a learner enters 25 into cell A1 and 15 into cell B1, then enters the formula =A1+B1 into cell C1.
- The values in A1 and B1 and the formula are the input.
- The spreadsheet processes the information by performing the addition.

- The output is 40, which appears in cell C1.
- This is important because it shows that the formula itself can be considered part of the input, while the calculation is the processing.
- Extended IPO — Storage
- The basic IPO model can be extended by adding Storage.
- Storage means that data or information is saved so that it can be accessed again later.
- It could be stored in a text file, spreadsheet, database, local computer, network computer or cloud system.
- Storage is particularly important in real-world information systems because the data often needs to be reused rather than processed once and immediately discarded.
- Extended IPO Scenario — University Enrolment
- Imagine that a student applies to a university.
- The student enters their full name, ID number, address, Grade 11 results and requested course into an application form.
- This is the input.
- The information is then saved in a university database, which represents storage.
- The university can then process the data in different ways.
- It might search for all students applying for first-year study, identify students whose average is above 80%, or identify students requesting university residence.
- These are examples of processing because the system is searching and analysing the stored data.
- The results can then be output by displaying them on a monitor or emailing information to the applicant.
- The results can also be stored for future use.
- This scenario shows that one piece of data can go through multiple stages of the IPO cycle rather than simply being entered once and producing one result.
- Extended IPO Scenario — CD/DVD Catalogue
- Imagine that a music centre has thousands of CDs and DVDs and wants to create a searchable catalogue.
- First, information about every item must be entered.
- This could include the artist, title, genre, length of play, release date, type of media and quality of the disk.
- This is the input.
- The information can then be stored in a local database or remote database.
- Once stored, the system can process it by sorting the items according to artist, genre or release date.
- It can also search for a particular CD or DVD using criteria such as the artist, title or genre.
- The results of those searches could be displayed on the computer or printed as a catalogue, which is the output.
- If the user selects a particular song that has been uploaded to a media application, the music can also be played on their device.
- This scenario demonstrates that input, processing, storage and output can occur repeatedly within one system.
- Extended IPO Scenario — Automated Greenhouse
- Consider a computer-controlled greenhouse.
- Sensors are placed around the greenhouse to monitor the conditions affecting the plants.
- The sensors provide input, such as the current temperature and the amount of water or moisture in the soil.
- The computer then processes this data by comparing the readings with the conditions required for the plants.
- If the temperature becomes too high or the soil becomes too dry, the system can determine that the conditions need to be adjusted.
- The resulting information can then be used to control the greenhouse conditions.

- The sensor readings can also be stored so that they can be reviewed later.
- This is a good example of how computers can continuously collect data, process it and respond without a person having to manually perform every calculation.
- How to Identify IPO in a Long Exam Scenario
- This is one of the most useful exam techniques.
- When you are given a long scenario, don't try to identify the IPO categories from the entire paragraph at once.
- Instead, break the scenario into individual actions and ask yourself:
- 1.
- Input — What enters the system?
- Look for information being entered, captured, measured, scanned, selected or supplied.
- 2.
- Processing — What happens to the data?

Look for actions such as:

- Calculate, compare, check, sort, search, filter, group or analyse.
- 3.
- Storage — What is saved?

Look for information being saved in a:

- Database, spreadsheet, file, hard drive, network or cloud.
- 4.
- Output — What comes out?

Look for information being:

- Displayed, printed, emailed, played or otherwise produced.
- Example
- A school captures learners' names, grades and CAT marks into a database.
- The system calculates each learner's average, stores the results, searches for learners with averages above 80%, and displays the names on the screen.

You can break this into:

Input: Learners' names, grades and marks are entered.

Processing: The system calculates averages and searches for averages above 80%.

Storage: The learner information and results are saved in the database.

Output: The names of learners with averages above 80% are displayed.

- The key is to focus on what the system is doing with the data, rather than getting distracted by the story surrounding the scenario.

Choosing the Correct Software

- The appropriate software depends on what you need to accomplish.
- A word processor is best for creating and formatting documents such as letters and reports.

- A spreadsheet is ideal for calculations, statistics, budgets, data analysis and graphs.
- A database is more appropriate for large quantities of related information, complex searches and queries, and database reports.
- Presentation software is used to communicate findings visually, while online forms are useful for collecting information from many respondents.
- Example scenario
- If a business wants to write a formal letter to a customer, a word processor would be suitable.
- If it wants to calculate the total sales and profit for the month and create a graph, a spreadsheet would be more appropriate.
- If it wants to maintain thousands of customer records and search for customers based on multiple criteria, a database would be better.
- If management needs to present the findings at a meeting, presentation software would then be used.
- The important thing is that one project can require multiple applications.
- You do not necessarily have to choose only one program for an entire task.

Social Implications Additions

Consent and Personal Information

- Consent means that a person gives permission for their personal information to be collected or used.
- Organisations should obtain appropriate consent before collecting personal information and should explain why the information is needed and how it will be used.

Reusing Digital Content Without Permission

- Using another person's copyrighted digital content without permission or appropriate rights can constitute copyright infringement.

Using the Same Password for Multiple Accounts

- Reusing the same password across accounts is unsafe because if one account is compromised, attackers can try the same password on the user's other accounts.

Sharing Location Information Online

- Publicly sharing a current location can expose a person to risks such as unwanted tracking, stalking, theft or other physical-security threats.

Source Links Retained from Original Document

- <http://www.snakebytez.com/other/introduction-computer-components>
- <https://medium.com/computing-technology-with-it-fundamentals/system-hardware-component-motherboard-8e3d44e29f74>
- <https://www.crucial.com/usa/en/differences-among-ddr2-ddr3-and-ddr4-memory>
- <https://www.geekboots.com/story/hdd-vs-ssd>
- <https://www.performance-computer.com/learn/ssds-comparison>

- <https://www.crucial.com/articles/pc-builders/what-to-do-with-an-old-computer>
- <https://www.equinoxdrones.com/blog/10-major-pros-cons-of-unmanned-aerial-vehicle-uav-drones>
- <https://geospatialmedia.s3.amazonaws.com/wp-content/uploads/2018/10/d-in-retail.jpg>
- <https://www.glassup.com/en/augmented-reality-virtual-reality/>
- https://cs.stanford.edu/people/eroberts/courses/soco/projects/2001-02/distributed-computing/html/what_is_it_.html
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- <https://witbanknews.co.za/116279/law-say-pornography-south-africa/>
- https://en.wikipedia.org/wiki/Cryptocurrency_and_crime
- <https://www.bankinfosecurity.com/blogs/criminals-still-going-crazy-for-cryptocurrency-p-2955>

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