3.1 Storage devices and media

- Identify storage devices, their associated media and their uses, e.g.
  - Magnetic backing storage media: fixed hard disks and drives, portable and removable hard disks, portable and removable hard drives, magnetic tape drives and magnetic tapes, memory cards
  - Optical backing storage media (CD/DVD/Blu-ray): CD ROM/DVD ROM, CD R/DVD R, CD RW/DVD RW, DVD RAM, Blu-ray discs
  - Solid state backing storage: solid state drives, flash drives (pen drive/memory stick/USB stick)

- Describe the advantages and disadvantages of the above devices
3.1 Storage devices and media

What is Storage

- **Secondary Storage** devices ensure data is stored **permanently** so that it can be used **again at a later date**.

- **Storage medium** is the name given to the device that actually **holds the data**.

- Sometimes the **storage medium** is **fixed** i.e. magnetic coated disks build into hard drive.

- Sometimes the **storage medium** is **removable** from the device i.e. CD ROM that can be taken out of the drive.

Think about what we store:
Documents, Images, Video, Music, Software, Games etc.
Storage devices or files sizes are measured in: Kilobytes (KB), Megabytes (MB), Gigabytes (GB) and Terabytes (TB)

- 1 KB = 1000 Bytes
- 1 MB = 1000 KB
- 1 GB = 1000 MB
- 1 TB = 1000 GB

Diagram not to scale
Data storage devices have very different capacities. Over time the capacity has increased which has allowed for more data to be stored:

- **Floppy Disk**: 1.4MB
- **CD-ROM**: 700MB
- **DVD**: 4.7GB
- **Blu-Ray**: 25 GB – 128GB
- **Hard Drive**: 8 TB
- **Magnetic Tape**: Up to 185 TB

Increase in storage capacity
## 3.1 Storage devices and media

### Type of Access

<table>
<thead>
<tr>
<th>Serial (sequential Access)</th>
<th>Direct (Random Access)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Files are stored <strong>one by one</strong> in a sequence</td>
<td></td>
</tr>
<tr>
<td>- Must search through the files one by one until you get to the one you want.</td>
<td></td>
</tr>
<tr>
<td>- Example: VHS tape, Cassette Tape, Magnetic Tape</td>
<td></td>
</tr>
<tr>
<td>- Stores files so that they can <strong>instantly</strong> be accessed</td>
<td></td>
</tr>
<tr>
<td>- No need to search through files to get to the one you want</td>
<td></td>
</tr>
<tr>
<td>- Example: DVD, CD ROM, Blu-ray, external hard drive, flash drive</td>
<td></td>
</tr>
</tbody>
</table>

**Example Images:**
- Serial (VHS tape)
- Direct (CD)
### 3.1 Storage devices and media

#### Main Memory Vs Backing Storage

<table>
<thead>
<tr>
<th><strong>Main Memory</strong></th>
<th><strong>Backing Storage</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sometimes known as <em>Internal Memory</em> or <em>primary memory</em>.</td>
<td>• <strong>Backing storage</strong> some known as <em>secondary storage</em>.</td>
</tr>
<tr>
<td>• Includes <em>RAM</em> and <em>ROM</em></td>
<td>• Name for all other <em>storage devices</em> which are part of a computer like hard drive.</td>
</tr>
<tr>
<td>• Usually used to <strong>store data temporarily</strong> (in the case of RAM).</td>
<td>• Usually used to <strong>store data over a long time</strong>.</td>
</tr>
<tr>
<td>• Usually used to store data while it is <strong>being processed by the CPU</strong>.</td>
<td>• Usually used to store application software, operating system software, files etc.</td>
</tr>
<tr>
<td>• Is <strong>volatile</strong> – means data will be <strong>lost</strong> if computer is turned off.</td>
<td>• Is <strong>Non-volatile</strong> - Means data will <strong>not be lost</strong> of computer is turned off.</td>
</tr>
</tbody>
</table>
3.1 Storage devices and media

Magnetic Storage Devices

**Use:** Main backing storage device used by all computers to store:
- Operating Systems & System Files
- Applications
- Files (Documents, Images, videos, audio etc.)

**Access Type:** Direct (Random Access)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Less likely to break as fixed.</td>
<td>• More moving parts compared to solid state drives.</td>
</tr>
<tr>
<td>• High storage capacities compared to external drives.</td>
<td>• Incorrect shut down procedure could cause hard drive to malfunction.</td>
</tr>
<tr>
<td>• Fast data transfer rate.</td>
<td></td>
</tr>
</tbody>
</table>

- Magnetic storage media devices store data in the form of tiny magnetised dots.
- These dots are created, read and erased using magnetic fields created by very tiny electromagnets.
### 3.1 Storage devices and media

#### Magnetic Storage Devices

**Use:** This device connects to the computer using the USB Port. External Hard drives are used to store:
- Personal backup data.
- Transfer files between computers/devices.

<table>
<thead>
<tr>
<th>Access Type: Direct (Random Access)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages:</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>Portable – transfer files between computers.</td>
<td>More prone to errors than fixed hard drive.</td>
</tr>
<tr>
<td>High Storage capacity compared to optical disks.</td>
<td>Could be damaged if incorrectly ejected from computer.</td>
</tr>
</tbody>
</table>

- Magnetic storage media devices store data in the form of **tiny magnetised dots**.
- These dots are created, read and erased using magnetic fields created by very tiny electromagnets.

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**Portable Hard Drive**

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3.1 Storage devices and media

Magnetic Storage Devices

Access Type: Serial

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Huge storage capacity compared to fixed and portable hard drives.</td>
<td>• Slower Access Tape reader has to start at the beginning of the tape and continue fast forwarding until it gets to the piece of data that needed.</td>
</tr>
<tr>
<td>• Stored away in a fire proof safe.</td>
<td></td>
</tr>
<tr>
<td>• Robust – last for long time</td>
<td></td>
</tr>
</tbody>
</table>

Use:

- Large organisations make daily backups of their networks on to Magnetic Tapes
- Long-term archiving of data.

Magnetic Tapes

- Magnetic storage media devices store data in the form of tiny magnetised dots.
- These dots are created, read and erased using magnetic fields created by very tiny electromagnets.
# 3.1 Storage devices and media

## Optical Media

**Use:** CD-ROM disks are read-only. CD-ROMs are normally used to store:
- Audio CDs
- Software Applications
- Device Drivers

**Access Type: Direct**

<table>
<thead>
<tr>
<th>Advantages:</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hold more data than floppy disks.</td>
<td>• Data transfer rate is slower compared to other storage medium.</td>
</tr>
<tr>
<td>• Cheaper than hard drives and USBs.</td>
<td>• Not Robust - easily be damaged or scratched.</td>
</tr>
<tr>
<td>• Compatible with audio systems.</td>
<td></td>
</tr>
</tbody>
</table>

- Optical storage devices save data as patterns or dots.
- Data is read by bouncing the laser beam off the surface off the medium.
### Optical Media

**Use:** DVD-ROMs disks are read-only. DVD-ROMs are normally used to store:
- DVD Movies
- Software Applications
- Computer Games

**Access Type:** Direct

<table>
<thead>
<tr>
<th>Advantages:</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| - Hold more data than CD-ROMS.  
  - Can store larger applications.  
  - Videos is higher resolutions. | - Data transfer rate is slower compared to other storage medium.  
  - Have to buy a separate DVD player. |

- Optical storage devices save data as patterns or dots.
- Data is read by bouncing the laser beam off the surface off the medium.
3.1 Storage devices and media

Optical Media

Use: Blu-Ray disks use a blue laser instead of red laser used with CD/DVD ROMs. Blu-Ray disks are normally used to store:
- HD Movies
- Large Software/Game Applications
- In camcorders in cartridge form.

Access Type: Direct

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Large storage capacity used to store HD video content.</td>
<td>- More expensive compared to other optical media.</td>
</tr>
<tr>
<td>- Access Speeds are greater than other optical medium.</td>
<td>- Separate player required – more expensive.</td>
</tr>
<tr>
<td>- Secure Encryption System to minimise chance of copyright.</td>
<td>- Not all movie titles available on Blu-Ray.</td>
</tr>
</tbody>
</table>
### 3.1 Storage devices and media

#### Optical Media

**R** – Write once only  
**RW** – Can be written to or read many times.

<table>
<thead>
<tr>
<th></th>
<th>CD-R and DVD-R</th>
<th>CD-RW and DVD-RW</th>
<th>DVD RAM</th>
</tr>
</thead>
</table>
| **Overview**   | CD-R and DVD-R are only recordable once. Once the process has been finalised then the disks become Read Only.  
• Backup of data  
• Audio CDs | CD-RW and DVD-RW allows for data to be written, erased and rewritten many times.  
• Used in CCTV  
• Record television programs | DVD RAMS are used when data constantly needs to be re-written. DVD RAMs can hold up to 10GB of data and commonly used in recording equipment. |
| **Advantages** | • Cheaper than RW disks. | • Can be reused many times. | Long life, large capacity, and can be rewritten many times. |
| **Disadvantages** | • Not compatible with all players.  
• If disk has a burn error it can not be used again. | • Can be expensive.  
• Data could be overwritten. | Not compatible with all playback formats. Can be expensive. |
Solid ‘state’

- Solid-state storage devices are based on electronic circuits with no moving parts.
- Solid-state storage devices store data using a special type of memory called flash memory.
- USB/Memory Cards use Direct Access

<table>
<thead>
<tr>
<th>Examples</th>
<th>USB Memory Stick</th>
<th>Memory Card</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses:</strong></td>
<td>Used to transfer files/backup (work) between computers.</td>
<td>Used to store files on digital cameras, mobile phones and mp3 players.</td>
</tr>
<tr>
<td><strong>Advantages</strong></td>
<td>• Portable &amp; Small</td>
<td>• Very small and can be removed and placed in other devices.</td>
</tr>
<tr>
<td></td>
<td>• Robust</td>
<td>• Robust</td>
</tr>
<tr>
<td></td>
<td>• large capacities</td>
<td>• No need for additional drivers/software</td>
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<td></td>
<td>• No need for additional drivers/software</td>
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</tr>
<tr>
<td></td>
<td>• Easy to loose</td>
<td>• Smaller storage capacities.</td>
</tr>
<tr>
<td></td>
<td>• USB could be damaged if not ejected correctly.</td>
<td>• Quite expensive.</td>
</tr>
</tbody>
</table>

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Backup means making one or more copies of your data in a different storage medium.

Why?
- You could delete a file by accident
- Your computer could break down
- Your computer could get infected by a virus which could edit data
- Your laptop is stolen or becomes damaged.
- Data could be corrupted by hackers.

- Most businesses use computers to store very important data (customer records, financial information, designs for products, etc.)
- If this data is lost, then this would cause disruption to the business. Backing-up business data is essential.
3.1 Storage devices and media

How are Backups created

**Personal Backups:**
- Burning files to a **CD-R**
- Copying files to an **external hard-drive**
- Copying files to a **USB**
- Copying the files to another computer on a network

**Business Backups:**
- Making copies of data **very regularly (daily).**
- Using large-capacity media such as **magnetic tape**
- Keeping **old copies** of backups, just in case.
- **Automating** the system so that nobody forgets to do it!
- Keeping backup media **off-site** (in case of fire or theft)