Section 2: Input & Output Devices
A very common, general purpose, input device that allows **text** (abc...), **numbers** (123...) and **symbols** (%$@...) to be entered into a computer.

A keyboard is simply a set of buttons. Each button has a symbol assigned. Also known as **QWERTY**
Input Devices & their uses: Numeric Keypad

- A small keyboard that only has numbers.

Used to enter numeric data into computers such as those in ATMs.

Most computer keyboards have a numeric keypad on the right side, and most mobile phones (there are also computers) have a one for entering phone numbers, etc.
Mouse

- A **pointing** device found on most PCs. Sensors on the bottom of the mouse detect when the mouse is moved. Data about this movement is sent to the computer.
- Often used to control the pointer in a **Graphical User Interface**.

Touchpad

- A **pointing** device found on most **laptops**.
- Used instead of a mouse since it takes up **less space**. The user moves a finger across the touch pad and this movement data is sent to the computer.
Input Devices & their uses: Pointing Devices

Tracker ball

- This **pointing** device is not moved about like a mouse, instead it has a **large ball** that the user spins. Data about which direction the ball is spun is passed to the computer.
- It can be used to control a **GUI** pointer.
- Tracker balls are often used by people with **limited movement** (disabled) or by the very **young** since they are **easier to use** than a mouse.

Touch Screen

- A touch screen is an alternative to a separate pointing device. With a touch screen the user selects items on the screen by **touching** the surface. This makes touch screen systems very **intuitive** and **simple to use**.
- Often used for **information terminals** in public places
  - e.g. libraries or museums where mice or keyboards may be stolen or damaged.
Input Devices & their uses: Pointing Devices

Joystick / driving wheel

- Used mainly for playing games. The user moves the joystick left/right, forward/back or uses the wheel and data about these movements are sent to the computer.

Light Pen

- A light pen is a device used as a pointing device or to ‘write’ on the screen of a computer.
- Light pens are rarely used today since graphics tablets and high-quality touch screens provide similar functionality.
These devices are very common. They send data signals each time a button is pressed using infrared light or radio signals.

The signals can control a computer (or a system that contains a small computer such as a DVD player) from some distance.

Often used to control a presentation slideshow.
Input Devices & their uses: Graphics Tablet

- A pointing device often used by designers and artists to allow natural hand movements to be input to graphics applications.

- A stylus is held like a pen and moved over the surface of the tablet. Data about the stylus movements are sent to the computer. Since it is so like using a pen, it is very easy to create ‘hand-drawn’ sketches.
Scanner

- A device that ‘scans’ images, book pages, etc.

Scanning is basically taking a close-up photograph (just very slowly and with great detail). The scanned image data is passed to the computer.

The most common type of scanner is the flat-bed scanner which has a glass plate on which the item to be scanned is placed. The item is illuminated and an image of it is captured by a moving scan ‘head’.

Scanned images can be further processed once inside the computer, e.g. OCR of printed text.
Video Camera

- A device that captures moving images, or video.

Like a digital camera, most video cameras do not directly input data into a computer – the captured movies are stored on video-tape or memory cards and later transferred to a computer.

However, there are some situations where video cameras do feed video data directly into a computer: television production and video-conferencing. In these situations the video data is required in real-time.
Input Devices & their uses: Visual Input Devices

Video Camera

QUESTION 21

- What is a Video Camera?
- Give **TWO** advantages of Video Camera.
Web Cameras (web cams)

- This is a very **basic video camera** used to feed **live video** into a computer.

The video data from a web cam is **low quality** compared to a full video camera. However it is good enough for **web chats** (e.g. using a messenger application such as MSN Messenger or Skype).

Usually a web cam is clipped to the top of a monitor, but many laptops now have web cams built into the edge of the screen.
Web Cameras (web cams)

QUESTION 22

- What is a Web Camera?
- Give TWO uses of Web Camera.
- Give ONE advantage of Web Camera.
- Give ONE disadvantage of Web Camera.
Input Devices & their uses: Microphone

- An input device that converts sound into a signal that can be fed into a computer.

The signal from a microphone is usually analogue so, before it can be processed by a computer, it must be converted into digital data. An Analogue-to-Digital Convertor (ADC) is used for this (usually built into the computer’s sound card).

- Many headphones now come with microphones to allow them to be used with chat and phone applications.
QUESTION 23

- Describe **TWO** uses of a Microphone.
- Give **ONE** advantage of Microphone.
- Give **ONE** advantage of Microphone.
Many plastic cards, such as credit cards, have a *strip of material that can be magnetised* on the back. Data can be stored here in the form of *magnetised dots*.

Usually the *data stored on this strip* in the same *data shown on the front* of the card (e.g. the credit card number, expiry date and customer name).

The stripe allows this data to be input to a computer system *faster* and *more accurately* than by typing it in.

A magnetic strip/stripe reader is used to read the data from the stripe. This is usually done by ‘*swiping*’ the card through a slot on the reader.
Direct data entry & associated devices: Magnetic Stripe Reader

QUESTION 33

- What is Magnetic Stripe Reader?
- State **TWO** important uses of Magnetic Stripe Reader.
- Give **TWO** advantages of Magnetic Stripe Reader.
- Give **TWO** disadvantages of Magnetic Stripe Reader.
Direct data entry & associated devices: Contactless Card Reader

QUESTION 34

- What is Contactless Card Reader?
- Give **TWO** advantages of Contactless Card Reader.
- Give **TWO** disadvantages of Contactless Card Reader.
PIN Pad

- This is a device with a **numeric keypad** used to enter a person’s **Personal Identity Number** (PIN) e.g. when paying with a credit card.

PIN pads are also found on electronic door **locks** – you enter a PIN to unlock the door.
Modern credit cards and ID cards don’t use a magnetic strip. Instead they have a tiny ‘chip’ of computer memory embedded inside them. (These cards are often referred to as smart cards.)

Data can be stored in this memory and read back using a ‘chip’ reader.

A card is inserted into the reader where metal contacts connect to the metal pads on the front face of the card. The reader can then access the memory chip and the data stored on it.

Smart cards can store much more data than magnetic strip cards, e.g. an ID smart card would store not only the owner’s name and card number, but might also have a digital image of the person.

Satellite TV decoders use smart cards to store which channels a user has paid for. The data is encrypted so that it is not easy to alter (you can’t add new channels without paying!)

Many types of card use this system: id cards, phone cards, credit cards, door security cards, etc.
QUESTION 35

- Briefly describe Pin Pad
- Give **TWO** uses of Chip & Pin readers.
- Give **ONE** advantage of Chip & Pin readers.
- Give **TWO** disadvantages of Chip & Pin Reader.
- Compare Chip & Pin readers vs Smart Cards
RFID stands for Radio-Frequency Identification Reader.

The acronym refers to small electronic devices that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less.

The RFID device serves the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. And, just as a bar code or magnetic strip must be scanned to get the information, the RFID device must be scanned to retrieve the identifying information.
QUESTION 36

- Define the term **RFID**.
- Give **TWO** uses of RFID.
- Give **TWO** advantages of RFID.
- Give **TWO** disadvantages of RFID.
Direct data entry & associated devices: Reading Text / Codes

MICR Reader

- Magnetic Ink Character Recognition (MICR) is a technology that allows details from bank cheques to be read into a computer quickly and accurately.

The cheque number and bank account number are printed at the bottom of each bank cheque in special magnetic ink using a special font. These numbers can be detected by an MICR reader.
QUESTION 37

- Define the term **MICR reader**.
- Give **ONE** use of MICR reader.
- Give **TWO** advantages of MICR reader.
- Give **TWO** disadvantages of MICR reader.
**OMR Reader**

- **Optical Mark Recognition (OMR)** is a technology that allows the data from a *multiple-choice* type form to be read *quickly* and *accurately* into a computer.

Special OMR forms are used which have *spaces* that can be *coloured in* (usually using a pencil). These *marks* can then be *detected* by an OMR scanner.

Common uses of OMR are *multiple-choice exam* answer sheets and *lottery number* forms.
QUESTION 38

- Define the term **OMR reader**.
- Give **ONE** use of OMR reader.
- Give **TWO** advantages of OMR reader.
- Give **TWO** disadvantages of OMR reader.
OCR Reader

- Optical Character Recognition (OCR) is a software technology that can convert images of text into an actual text file (digital format) that can then be edited, e.g. using word-processing software). The result is just as if the text had been typed in by hand.

OCR is typically used after a page of a book has been scanned. The scanned image of the page is then analysed by the OCR software which looks for recognisable letter shapes and generates a matching text file.
QUESTION 39

- Define the term **OCR reader**.
- Give **ONE** use of OCR reader.
- Give **TWO** advantages of OCR reader.
- Give **TWO** disadvantages of OCR reader.
- Compare **OCR vs OMR**. (3)
Barcode Reader / Scanner

- A **barcode** is simply a **numeric code** represented as a series of **lines**.

These lines can be read by a **barcode reader/scanner**.

The most common use of barcode readers is at **Point-of-Sale (POS)** in a shop. The **code** for each item to be purchased needs to be entered into the computer. Reading the **barcode** is far **quicker** and more **accurate** than **typing** in each code using a keypad.
QUESTION 40

- Define the term **Barcode reader**.
- Give **TWO** uses of Barcode reader.
- Give **TWO** advantages of Barcode reader.
- Give **TWO** disadvantages of Barcode reader.
Quick Response (QR) codes

- Type of barcode is the QR.
- Matrix of filled in dark squares on a light background.
- Barcodes can hold up to 30 digits.
- QR can hold up to 7000 digits.
- Using smartphones, QR codes can be scanned anywhere.
QUESTION 41

- Define the term **QR codes**.
- Give **TWO** advantages of QR.
Sensor is a device which automatically inputs data into a computer system, where the data is constantly changing and can be measured.

Used to detect data in the surrounding environment that constantly changes, for example:

- **Temperature** – measuring heat in a room
- **Light** – setting off a burglar alarm
- **Humidity** – detecting when plants become too dry

This information is “physical” and “analogue”
Computers don’t understand analogue data and therefore it needs to be converted into digital (e.g. 0’s and 1’s).

The computer can then read the data.

A special device called an Analogue to Digital Converter (ADC) is used in order to achieve this.
Direct data entry & associated devices: Uses of Sensors

- **Sensors** are used in monitoring & control applications.
- When monitoring, the data is sent directly to some sort of a computer & is then processed & used.

**For example:** A burglar climbs through a window and walks through an alarm’s light sensor. The computer inside the alarm will pick up on the broken light signal and use this information to sound the alarm.

- **Sensors** can also be used for a wide range of data collection & everyday applications.

**For example:**
- Taking measurements in scientific experiments
- Measuring pollution in the atmosphere
- Sensing the temperature in a room and using this to either turn a heating system on or off
- Automatic doors open themselves when they detect a person nearby.
# Direct data entry & associated devices: Types of Sensors

<table>
<thead>
<tr>
<th>Type of Sensor:</th>
<th>Used For:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Automatic washing machines, Central heating systems, Automatic greenhouses, Cookers.</td>
</tr>
<tr>
<td>Pressure</td>
<td>Burglar alarm systems, Washing machines, Robotics, Environmental monitoring.</td>
</tr>
<tr>
<td>Light</td>
<td>Automatic greenhouses, Automatic doors, Burglar alarm systems, Street lighting control.</td>
</tr>
<tr>
<td>Sound</td>
<td>Burglar alarm systems, Voice recognition systems (like using a voice command to start a car).</td>
</tr>
<tr>
<td>Humidity/Moisture</td>
<td>Automatic greenhouses, Environmental monitoring, Agriculture, Factories that manufacture items that can be ruined by too much air moisture (microchips etc).</td>
</tr>
<tr>
<td>pH</td>
<td>Automatic greenhouses, Chemical manufacturing, Environmental monitoring, Aquariums (wrong pH can kill fish).</td>
</tr>
</tbody>
</table>
# Advantages & Disadvantages of Sensors

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readings taken using sensors are more accurate than those taken by a human.</td>
<td>Faulty sensors can give incorrect results.</td>
</tr>
<tr>
<td>Sensors can <strong>monitor</strong> information <strong>constantly</strong> (They don’t get tired like humans can).</td>
<td><strong>For example:</strong> if the sensors on a car that help with reverse parking become dirty they may not identify an obstacle and cause you to crash into it.</td>
</tr>
<tr>
<td>Sensors can <strong>respond</strong> to information <strong>immediately</strong> (Burglar alarms goes off as soon as an intruder is detected).</td>
<td></td>
</tr>
<tr>
<td><strong>No need for humans</strong> to operate the sensor. This can be useful if gathering the information is <strong>hazardous</strong> like in detecting radiation levels for example.</td>
<td></td>
</tr>
</tbody>
</table>
Direct data entry & associated devices: Sensors

QUESTION 42

- What is Sensor?
- What is Sensor useful for?
QUESTION 43

- Distinguish between **Analogue** and **Digital** Data.
- What is the purpose of **ADC**?
Direct data entry & associated devices: Sensors

QUESTION 44

- Give **ONE** example of **monitoring** application.
- Give **ONE** example of **control** application.
Direct data entry & associated devices: Sensors

**QUESTION 45**

- List 6 types of **sensor**.
- Explain any 2 types of **sensor**.
Direct data entry & associated devices: Sensors

QUESTION 46

- Give **TWO** advantages of sensor.
- Give **TWO** disadvantages of sensor.
CRT Monitor

- A monitor displays **text** and **image** data passed to it by the computer.

A **Cathode Ray Tube** (CRT) monitor is the type that has been around for years and is **large** and **boxy**.

CRT monitors are **heavy** and they take up a **lot of desk space**. They have largely been **replaced** by flat-screen monitors.

Also, CRT monitors are generally **cheaper** than flat-screen.
Output Devices & their uses: Visual

**TFT Monitors (Thin Film Transistor)**

- Over the past few years, as they have come down in price, flat-screen displays have replaced CRT monitors.

  Flat-screen monitors are **light in weight** and they take up very **little desk space**. Modern flat-screen monitors have a **picture quality** that is as good as CRT monitors.
LED Monitor (Light Emitting Diode)

- **LED display** is a *flat panel* display, which uses an array of light-emitting diodes as pixels for a video display.

- Their brightness allows them to be used *outdoors* in store signs and billboards, and in recent years they have also become commonly used in *destination signs* on public transport vehicles.
Digital / Multimedia Projector

- Digital projectors are used in situations when a very large viewing area is required, for example during presentations, for advertising, or in your home for watching movies.

- A projector connects to a computer, a DVD player or a satellite receiver just like a ordinary monitor.

The image is produced inside the device and then projected out through a large lens, using a powerful light source.
If you want to hear music or sounds from your computer, you will have to attach loudspeakers.

- They convert electrical signals into sound waves.

- Loudspeakers are essential for applications such as music editing, video conferencing, watching movies, etc.
OUTPUT DEVICES & THEIR USES: VISUAL

QUESTION 47

- Distinguish between CRT and TFT.
- Give ONE advantage of LED.
- What is a Projector?
- Give TWO uses of Speakers.
Hint! Comparison of printers

Keep these in mind:

- **Cost to buy** (price)
- **Quality of printing** ➔ .dpi = dots per inch
- **Speed of printing** ➔ .ppm = pages per minute
- **Maintenance** ➔ (paper, cartridges, toner etc.)
Laser printers are very complex devices, and thus expensive to buy. However they are very cheap to use. This is because they produce marks on paper using a fine dust called toner which is relatively cheap to buy.

The laser printer uses a complex system, involving a laser, to make the toner stick to the required parts of the paper.

The laser and toner system allows very fast printing compared to other printers (just a few seconds per page).

Laser printers are very common in offices since they print very quickly, are cheap to use and are reasonably quiet.
Cheap, high-quality, full-colour printing.

The print-head passes left and right across the paper. However, instead of using pins to hit inky marks onto the paper, the ink-jet squirts tiny droplets of ink onto the surface of the paper. Several coloured inks can be used to produce full-colour printouts.

The quality of the printout is excellent (1200 dots-per-inch are possible). This is perfect for photographs.

Ink-jet printers are very quiet in use. Since they have so few moving parts they are also cheap to manufacture and thus cheap to purchase. However, the ink is very expensive to buy (this is how the printer companies make their profits!) so the printers are expensive to use.
Output Devices & their uses: Dot Matrix Printer

- A **dot-matrix printer** is named after the pattern (a grid or ‘matrix’) of dots used when creating the paper printout.

- These dots are formed by tiny **pins** in the printer’s print head that **hit** (impact) an inked ribbon against the paper leaving marks. As the print head moves along it leaves a pattern of **dots** behind it which can form letters, images, etc.
Dot matrix printers often use **continuous stationary**: long, continuous strips of paper (rather than separate sheets of A4 like ink-jet and laser printers use).

After printing, the printout is torn off from the long strip.

Dot-matrix print **quality is poor**, the printers are **noisy**, and there are much better printing systems available today. However, the dot-matrix printers are still used in certain situations:

- Since the pins actually hit the paper, several ‘**carbon-copies**’ can be printed in one go. An example of this is **airline tickets** which have several **duplicate pages**, all printed in **one go**

- The print mechanism is **very cheap**, and the inked ribbons last for a **long time**. So, where cheap, low-quality printouts are required, dot-matrix printers are used. An example is **shop receipts**.
QUESTION 48

- Give **TWO** advantages and **ONE** disadvantage of **Laser printer**.
- Give **TWO** advantages and **ONE** disadvantage of **Ink-Jet printer**.
- Give **TWO** reasons why **Dot-Matrix printers** are still in use.
Output Devices & their uses: Plotter (Wide Area/Format Printer)

- Wide format printers are generally accepted to be any computer-controlled *printing* machines that support a maximum print roll width of between 18" and 100". Printers with capacities over 100" *wide* are considered Super Wide or Grand format.
3D printing is a process of making three dimensional solid objects from a digital file.

The creation of a 3D printed object is achieved using additive processes.

- In an additive process an object is created by laying down successive layers of material until the entire object is created.

They are commonly used to print prototypes within industry, Prototypes are build in order to find any product design flaws before it is mass produced.

- A range of materials can be used when printing including metal, plastic, gold, fabric, acrylic and porcelain.
Uses of 3D Printer

3D printers can be used to create a variety of three-dimensional products such as:

- **Medical Industry** - prosthetics such as ears, legs and even printed organs
- **Aviation Industry** - NASA prints some jet engine parts on a 3D printer
- **Car Industry** - printing of prototype car models and functional parts such as vents
- **Rapid Prototypes** - cheap and quick printing of prototypes such as shoes, mobile phones, car parts and many many more.
- **Personal Printing** - hobbyists can print their own parts for models trains/planes.

**Rapid Prototyping** is where companies use 3D printers to very **quickly** and **cheaply** produce three-dimensional **designs** for products. In the past, producing prototypes was very expensive and could take weeks or months.

**For example:** Nike uses 3D printers to produce **prototypes** of their **shoes**. They used to spend thousands of dollars on a prototype and have to wait weeks to receive it. Now the prototype can be printed **in-house**, costing only hundreds of dollars, and changes can be quickly made on the computer and reprinted there and then.
Output Devices & their uses: Control Devices & Actuators

- A normal PC has no way of affecting what is happening around it. It can’t turn on the lights, or make the room hotter. How do we change what is happening around us? We use our muscles to move things, press things, lift things, etc. (and we can also make sound using our voice).

A normal PC has no muscles, but we can give it some. In fact we can give it the ability to do lots of things by connecting a range of actuators to it...

An actuator is a device, controlled by a computer, which can affect the real-world.

Examples of actuators and what they can do are...

- Motor
- Buzzer
- Heater
- Light / Lamp

REMEMBER!
Control devices require inputs from sensors and instructions from a computer in order to produce the correct output.
<table>
<thead>
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<td><strong>Motor</strong></td>
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<tr>
<td></td>
<td>• Automatic washing machines (to make drum spin)</td>
</tr>
<tr>
<td></td>
<td>• DVD player (to make disc spin)</td>
</tr>
<tr>
<td></td>
<td>• Air conditioners (to make fans spin)</td>
</tr>
<tr>
<td><strong>Industry:</strong></td>
<td>• Controlling robot arms</td>
</tr>
<tr>
<td><strong>Computer systems:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Spinning disks in hard disk drives</td>
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<tr>
<td></td>
<td>• Spinning cooling fans</td>
</tr>
<tr>
<td><strong>Buzzer</strong></td>
<td>• Microwave ovens (to signal that the food is cooked)</td>
</tr>
<tr>
<td></td>
<td>• Alarm systems (loud siren to warn of intruders)</td>
</tr>
<tr>
<td><strong>Heater</strong></td>
<td>• Central heating systems (to keep rooms correct temperature)</td>
</tr>
<tr>
<td></td>
<td>• Washing machines (To keep water the correct temperature)</td>
</tr>
<tr>
<td></td>
<td>• Automatic greenhouses (ensures air is correct temperature for plants)</td>
</tr>
<tr>
<td><strong>Light / Lamp</strong></td>
<td>• Security lights</td>
</tr>
<tr>
<td></td>
<td>• Automatic greenhouse (to give plants correct amount of light)</td>
</tr>
</tbody>
</table>
QUESTION 49

- What is the purpose of a Plotter?
- Briefly describe 3D Printer.
- Name FOUR types of Actuators.
- Give TWO uses of Actuator.