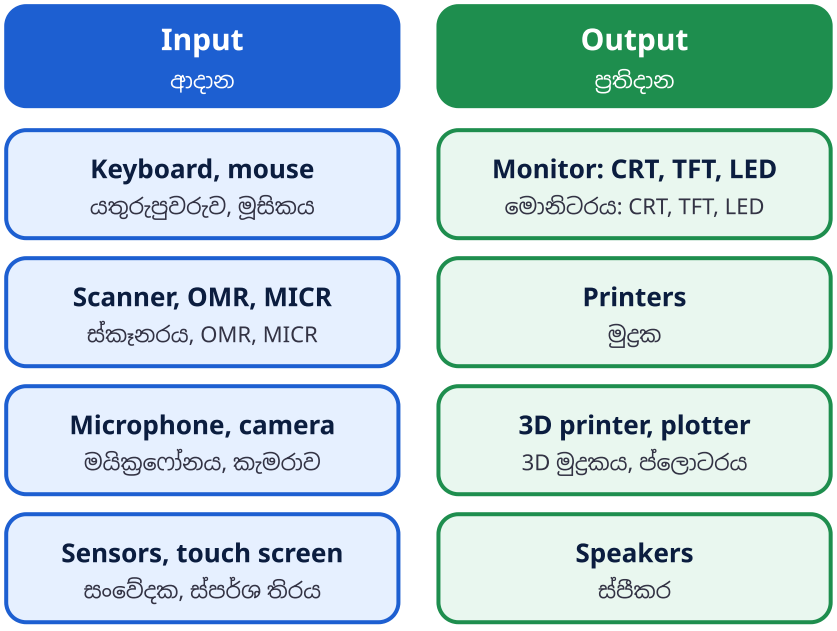
Grade 12 A/L ICT · Lesson 2

2.2 Computer Hardware: Input, Output, CPU, Storage and Interfaces

Syllabus 2.2. A computer is a team of hardware parts. **Input devices** bring data in, the **CPU** on the **motherboard** processes it, **output devices** show the results and **storage devices** keep data for later. Each part connects through an **interface (port)** such as USB or HDMI. In this part you learn every device in the syllabus, why **direct entry** is better than typing, how to match a **CPU with a motherboard**, the features of each **storage device**, and why we need **parallel and grid computing**.

1. Input devices

There are two ways to input data. **Keyboard entry**: a person types the data (keyboard, keypad). **Direct entry**: the device reads data straight from the source without typing (barcode reader, scanner, sensors and so on).



Common input and output devices.

Device	What it does	Example use
Keyboard	Keys for letters, digits and commands	Typing a letter
Pointing devices (mouse, trackball, joystick)	Move a pointer and click	Choosing a menu item; games
Touch pad	Finger moves on a flat pad move the pointer	Laptops

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Remote control	Sends infrared or radio signals	TV, projector
Touch screen	Screen that senses touch – input and output together	Phones, ATMs, kiosks
Magnetic strip reader	Reads the magnetic strip on a card	Old bank cards, hotel keys
Barcode reader	Reads black and white bars with light	Supermarket checkout, library
Smart card reader	Reads a chip inside a card	Chip bank cards, e-NIC
Scanner	Turns a paper page into a digital image	Copying documents
Digital camera / video camera	Capture photos or moving pictures	Photos, CCTV
Web cam	Small camera for live video over a network	Online classes
Microphone	Turns sound into a signal	Voice calls, voice commands
Sensors	Measure light, heat, pressure, motion and so on	Weather station, smart home
Graphic tablet / digitizer	A pen on a flat board turns drawings into digital data	Drawing, maps, design
MICR reader	Reads characters printed in magnetic ink	Bank cheques
OMR reader	Reads pencil marks in fixed boxes	MCQ answer sheets
OCR	Software and scanner read printed text as characters	Passports, number plates

1.1 Advantages of direct entry over keyboard entry

- **Faster** – a barcode is read in less than a second.
- **More accurate** – no typing (transcription) errors.
- **Less labour and cost** – fewer data entry staff are needed.
- **Works all the time and in hard places** – sensors work 24 hours, even in dangerous or remote places.
- **Large amounts of data** can be captured quickly, e.g. thousands of OMR sheets.

2. Output devices

Device	How it works	Features
CRT monitor	An electron beam lights phosphor dots on a glass tube	Heavy, deep, uses much power; now old
TFT (LCD) monitor	Liquid crystals controlled by thin film transistors	Flat, light, less power than CRT

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LED monitor	An LCD panel lit by light emitting diodes	Thinner, brighter, lowest power, long life
Dot matrix printer	Impact: pins hit an ink ribbon	Noisy, low quality, cheap to run; prints carbon copies
Inkjet printer	Non-impact: sprays tiny ink drops	Good colour photos; cheap printer, costly ink
Laser printer	Non-impact: a laser charges a drum; toner powder sticks and is heated on	Fast, sharp, quiet; low cost per page for many pages
3D printer	Builds a solid object layer by layer (often melted plastic)	Models, spare parts, medical implants
Graph plotter	Pens draw lines on large paper	Accurate large drawings: plans, maps, CAD
Speakers	Turn electrical signals into sound	Music, alarms, voice output

3. The CPU and the motherboard

The **motherboard** is the main circuit board. It holds the CPU socket, RAM slots, chipset, expansion slots (PCIe) and ports, and connects all parts. A CPU works only on a motherboard that is **compatible** with it.

Socket
The CPU pins or pads must match the socket, e.g. Intel LGA 1700 or AMD AM5.

Chipset and BIOS
The chipset must support the CPU family; a BIOS/UEFI update may be needed.

Memory type
The board and CPU must support the same RAM type, e.g. DDR4 or DDR5.

Power
The board must supply enough power for the CPU (TDP in watts).

Form factor
The board size (ATX, micro-ATX, mini-ITX) must fit the case.

Evolution of the CPU package: early chips had two rows of pins (**DIP**); later chips had many pins underneath (**PGA**); modern Intel and AMD desktop chips have flat pads and the pins are in the socket (**LGA**). Laptop and phone CPUs are soldered straight onto the board.

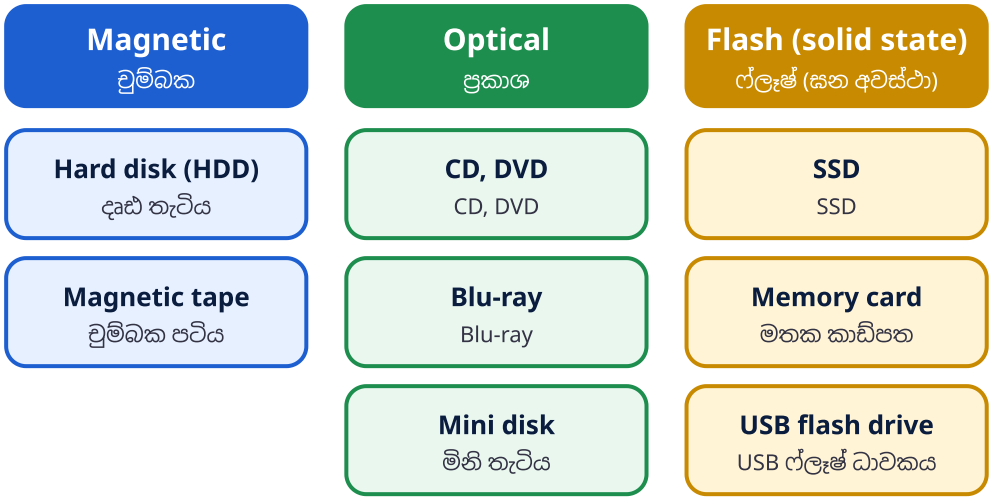
4. Peripherals and their interfaces (ports)

Interface	Typical devices
USB (Type-A, Type-C)	Keyboard, mouse, flash drive, printer, phone, external hard disk
HDMI, DisplayPort	Monitor, TV, projector (video and sound)

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VGA, DVI	Older monitors and projectors
Ethernet (RJ45)	Wired network, router
Audio jack (3.5 mm)	Speakers, headphones, microphone
SATA, M.2 (NVMe)	Internal hard disk, SSD, DVD drive
PCIe slot	Graphics card, network card
PS/2, serial, parallel (legacy)	Old keyboards, mice, printers
Bluetooth, Wi-Fi (wireless)	Wireless mouse, headset, phone, network

5. Storage devices



Magnetic, optical and flash storage.

Device	Type and access	Typical capacity	Features and uses
Fixed internal hard disk	Magnetic; direct access	1–20 TB	Spinning platters and moving heads; stores the OS and files
Portable external hard disk	Magnetic; direct access	1–5 TB	Connects by USB; backups and moving large files
Magnetic tape	Magnetic; sequential access	Up to about 18 TB per cartridge	Very cheap per GB, slow to find data; long term backups
CD-ROM / DVD-ROM	Optical; read only	CD 700 MB; DVD 4.7 GB	Data pressed at the factory; software, films
CD-R / DVD-R	Optical; write once, read many	CD 700 MB; DVD 4.7 GB	Cannot be erased; permanent records
CD-RW / DVD-RW	Optical; rewritable	CD 700 MB; DVD 4.7 GB	Erase and rewrite about 1,000 times
DVD-RAM	Optical; rewritable, random access	4.7 GB per side	Rewritten up to about 100,000 times; used like a disk; video recorders

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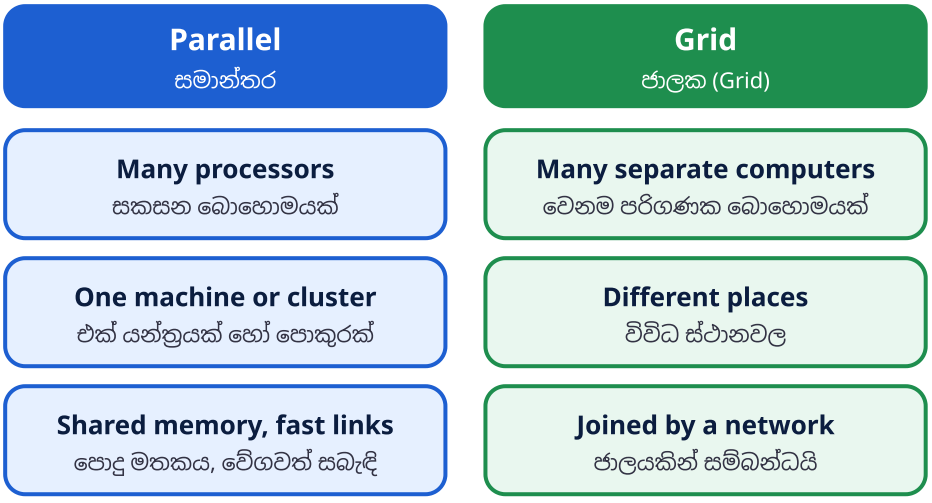
Blu-ray disc	Optical; blue-violet laser	25 GB per layer	Shorter wavelength → smaller pits → more data; HD films, games
Flash memory card	Flash (solid state); no moving parts	16 GB – 1 TB	SD, microSD; small, tough; cameras and phones
Mini disk	Magneto-optical; rewritable	About 140–177 MB (80 min audio)	Sony 1992; small disc in a case; music recording; now rare

🧱 **Worked example: How many full 700 MB CDs can be copied onto one 25 GB Blu-ray disc? (Disc makers use 1 GB = 1000 MB.)**
25 GB = 25,000 MB. 25,000 ÷ 700 = 35.7. Only whole CDs fit, so **35 CDs**.

🧱 **Worked example: A 64 GB memory card stores photos of 4 MB each. How many photos fit? (1 GB = 1000 MB)**
64 × 1000 = 64,000 MB. 64,000 ÷ 4 = **16,000 photos**.

💡 Access methods: **sequential** (tape – read from the start in order), **direct** (disks – jump near the data) and **random** (RAM and flash – any place in the same time).

6. Parallel and grid computing



Parallel computing and grid computing compared.

Parallel computing splits one big job into small parts and runs them **at the same time on many processors** in one computer or a closely linked cluster. **Grid computing** joins **many separate computers in different places** over a network so they share their processing power and storage to solve a big problem (e.g. CERN's worldwide grid, Folding@home).

- **Why we need them:** some problems are too big for one processor – weather and climate models, medical and DNA research, AI training, space science.
- **Faster results** – many parts are worked on at the same time.

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- **Lower cost** – grid computing uses idle computers that already exist instead of buying one giant machine.
- **Sharing resources** – universities and labs share data and power.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* **USB4, Thunderbolt and NVMe.** In 2026 one **USB-C** port can carry data, video and power. **USB4 version 2** and **Thunderbolt 5** reach 80 Gbit/s. Inside the PC, **NVMe SSDs** plug into an M.2 slot and use PCIe lanes, reaching about 7,000 MB/s (PCIe 4.0) to 14,000 MB/s (PCIe 5.0) – many times faster than a hard disk (about 200 MB/s). Wi-Fi 7 and Bluetooth 5 connect wireless devices.

Key Words

Direct entry – Input read straight from the source without typing.

Barcode reader – A device that reads printed bars with light.

MICR – Reading characters printed in magnetic ink on cheques.

OMR – Reading pencil marks made in fixed places on a form.

OCR – Turning printed or written text into editable characters.

Digitizer – A pen and board that turn drawings into digital data.

Laser printer – A non-impact printer that uses a drum and toner.

Graph plotter – An output device that draws accurate large drawings with pens.

Motherboard – The main circuit board that connects the CPU, memory and devices.

CPU socket – The place on the motherboard where a matching CPU is fitted.

Interface (port) – A connection point between a computer and a device.

Magnetic tape – Cheap sequential access storage used for backups.

Blu-ray – An optical disc read with a blue-violet laser, 25 GB per layer.

DVD-RAM – A rewritable optical disc with random access, rewritten many times.

Grid computing – Many separate networked computers sharing power to solve one problem.

Sample Q&A

1. Give three advantages of direct entry input over keyboard entry.

> **Answer:** It is faster; it has fewer errors because nothing is typed; it needs fewer staff and can work all day, even in dangerous places (sensors).

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2. Which input device suits each: (a) cheques (b) MCQ sheets (c) supermarket items?

> **Answer:** (a) MICR reader (b) OMR reader (c) barcode reader.

3. Compare an inkjet printer and a laser printer.

> **Answer:** Inkjet sprays ink drops; it is cheap to buy and good for colour photos but ink is costly. Laser uses a drum and toner; it is faster and cheaper per page for large amounts.

4. What must you check so that a CPU is compatible with a motherboard?

> **Answer:** The socket type, the chipset and BIOS support, the RAM type (DDR4 or DDR5), the power (TDP) and the form factor of the board.

5. Distinguish CD-R, CD-RW and DVD-RAM.

> **Answer:** CD-R can be written once only. CD-RW can be erased and rewritten about 1,000 times. DVD-RAM can be rewritten about 100,000 times and is used with random access like a disk.

6. Distinguish parallel computing from grid computing.

> **Answer:** Parallel computing uses many processors in one machine or a close cluster at the same time. Grid computing joins many separate computers in different places through a network to share their power.

MCQ

1. Which is a direct entry input device?

A. Barcode reader
B. Speaker
C. Numeric keypad
D. Keyboard
E. Laser printer

2. Bank cheques are read using:

A. A touch pad
B. MICR
C. A graph plotter
D. OMR
E. A web cam

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3. The MAIN advantage of direct entry over keyboard entry is:

A. Fewer transcription errors and faster input
B. It always costs nothing
C. It stores data forever
D. It needs more staff
E. It prints the data

4. Which printer can make carbon copies of a bill?

A. 3D printer
B. Inkjet printer
C. Dot matrix printer
D. LED monitor
E. Laser printer

5. Which monitor is heavy and uses an electron beam?

A. OLED
B. CRT
C. Touch screen
D. TFT
E. LED

6. An architect needs large, accurate building plans on paper. The best device is:

A. Dot matrix printer
B. OMR reader
C. Speaker
D. Graph plotter
E. Web cam

7. Which is NOT needed for CPU and motherboard compatibility?

A. The colour of the case
B. Power (TDP)
C. RAM type
D. Chipset support
E. Socket type

8. A monitor is connected using:

A. 3.5 mm audio jack
B. PS/2
C. SATA
D. RJ45
E. HDMI

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9. Which storage uses sequential access?

A. Magnetic tape
B. Hard disk
C. Flash memory card
D. DVD-RAM
E. RAM

10. How many full 700 MB CDs fit on one 25 GB Blu-ray (1 GB = 1000 MB)?

A. 25
B. 35
C. 357
D. 36
E. 3

11. A disc that can be written only once is:

A. Hard disk
B. CD-RW
C. DVD-RAM
D. DVD-R
E. DVD-RW

12. Many university computers around the world share power to analyse physics data. This is:

A. Analog computing
B. Keyboard entry
C. Sequential access
D. Batch printing
E. Grid computing

13. Which term means: “Input read straight from the source without typing”?

A. MICR
B. Digitizer
C. Graph plotter
D. Interface (port)
E. Direct entry

14. Which term means: “A device that reads printed bars with light”?

A. OMR
B. Barcode reader
C. Laser printer
D. Motherboard
E. Magnetic tape

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15. Which term means: “Reading characters printed in magnetic ink on cheques”?

A. Blu-ray
B. OCR
C. CPU socket
D. MICR
E. Graph plotter

16. Which term means: “Reading pencil marks made in fixed places on a form”?

A. Digitizer
B. DVD-RAM
C. OMR
D. Interface (port)
E. Motherboard

17. Which term means: “Turning printed or written text into editable characters”?

A. Magnetic tape
B. Laser printer
C. CPU socket
D. OCR
E. Grid computing

18. Which term means: “A pen and board that turn drawings into digital data”?

A. Graph plotter
B. Direct entry
C. Digitizer
D. Interface (port)
E. Blu-ray

19. Which term means: “A non-impact printer that uses a drum and toner”?

A. DVD-RAM
B. Magnetic tape
C. Laser printer
D. Barcode reader
E. Motherboard

20. Which term means: “An output device that draws accurate large drawings with pens”?

A. Blu-ray
B. CPU socket
C. MICR
D. Grid computing
E. Graph plotter

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Structured Questions

1. (a) Name two keyboard entry and four direct entry input devices. (b) Give two advantages of direct entry. *(4 marks)*

> (a) Keyboard, keypad; barcode reader, OMR, MICR, sensor; (b) faster; fewer errors because there is no typing.

2. Suggest a suitable output device for each and give a reason: (a) colour photos at home (b) 5,000 school reports (c) a plastic model of a gear. *(3 marks)*

> (a) Inkjet – good colour, cheap printer; (b) laser – fast and low cost per page; (c) 3D printer – builds solid objects layer by layer.

3. A student buys an AMD AM5 CPU and an Intel LGA 1700 motherboard. (a) Will it work? Explain. (b) List two other things to check. *(3 marks)*

> (a) No – the CPU does not fit the socket; the chipset does not support it; (b) RAM type (DDR5) and power or BIOS support.

4. (a) Classify into magnetic, optical or flash: hard disk, Blu-ray, SD card, tape, DVD-RW. (b) How many 4 MB photos fit on a 64 GB card (1 GB = 1000 MB)? *(4 marks)*

> (a) Magnetic: hard disk, tape; optical: Blu-ray, DVD-RW; flash: SD card; (b) 64 × 1000 ÷ 4 = 16,000 photos.

5. Explain why weather forecasting needs parallel or grid computing. *(4 marks)*

> The model has billions of calculations; one processor would take too long; the work is split so many processors work at the same time; the forecast is ready before the weather arrives.

Summary

- Input is keyboard entry (typing) or direct entry (barcode, OMR, OCR, MICR, sensors, cameras and more).
- Direct entry is faster, more accurate, cheaper in labour and works all the time.
- Outputs: CRT, TFT, LED monitors; dot matrix, inkjet, laser and 3D printers; plotters; speakers.
- A CPU must match the motherboard socket, chipset, RAM type and power.
- Storage: magnetic (HDD, tape), optical (CD, DVD, DVD-RAM, Blu-ray, mini disk) and flash (cards, SSD).
- Parallel computing uses many processors together; grid computing joins many networked computers.

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MCQ answer key – 2.2

1. **A** – Reads data without typing.
2. **B** – Magnetic ink characters.
3. **A** – No typing step.
4. **C** – Impact printer.
5. **B** – Cathode ray tube.
6. **D** – Pens draw accurate lines.
7. **A** – Colour does not matter.
8. **E** – Video and sound.
9. **A** – Read in order from the start.
10. **B** – 25,000 ÷ 700 = 35.7 → 35.
11. **D** – Write once, read many.
12. **E** – Separate computers in different places.
13. **E** – Direct entry – Input read straight from the source without typing.
14. **B** – Barcode reader – A device that reads printed bars with light.
15. **D** – MICR – Reading characters printed in magnetic ink on cheques.
16. **C** – OMR – Reading pencil marks made in fixed places on a form.
17. **D** – OCR – Turning printed or written text into editable characters.
18. **C** – Digitizer – A pen and board that turn drawings into digital data.
19. **C** – Laser printer – A non-impact printer that uses a drum and toner.
20. **E** – Graph plotter – An output device that draws accurate large drawings with pens.

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