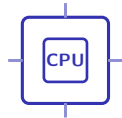


Hardware

IGCSE Computer Science ■ Topic 3

IGCSE Computer Science



Hardware

What we will cover

- 1 The CPU & buses
- 2 The fetch–execute cycle
- 3 Input & output devices
- 4 RAM, ROM & storage
- 5 Virtual memory
- 6 Network hardware



1

The CPU

Inside the CPU

Von Neumann 冯·诺依曼: one memory for data and instructions, shared buses.

- **ALU** 算术逻辑单元 – arithmetic and logic
- **control unit** 控制器 – decodes and directs
- registers, stepped by the clock

The special registers

PC 程序计数器 – address of the *next* instruction

MAR 内存地址寄存器 – the address to read/write

MDR 内存数据寄存器 – the data just fetched

CIR 当前指令寄存器 – the instruction now running

ACC 累加器 – the ALU's result

The fetch–execute cycle

- **Fetch**: PC → MAR, memory → MDR, copy to CIR, PC +1
- **Decode** the opcode
- **Execute** (ALU, load, store, jump) – then repeat

What makes a CPU faster

cores 核心

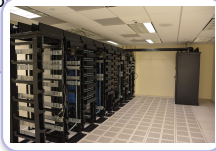
each runs instructions on its own – more do more at once

cache size

more data kept ready, so the CPU waits less

clock speed 时钟速度

cycles per second
– more instructions per second



Cloud servers

Faster CPU: more **cores**, more **cache**, higher **clock speed**. An **embedded system** 嵌入式系统 is a small computer built into a device to do **one** fixed job.

2 Devices and storage

Input and output devices



keyboard



mouse



sensor



Digital camera

Input sends data *into* the computer (keyboard, mouse, sensor, scanner);
output sends it *out* (monitor, printer, speaker, actuator).

RAM vs ROM

	RAM	ROM
access	read & write	read only
power off	loses data (volatile)	keeps data (non-volatile)
holds	programs in use	start-up code

RAM 随机存储器 is volatile working memory; **ROM** 只读存储器 keeps the start-up code with the power off.

Secondary storage

magnetic 磁存储
magnetised spots
on spinning disks
HDD, tape

optical 光存储
marks read by a laser
CD, DVD, Blu-ray

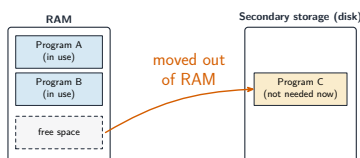
solid state 固态
flash memory
no moving parts
SSD, USB drive



Flatbed scanner

Secondary storage is **non-volatile** – it keeps data with the power off, unlike RAM.

Virtual memory



This frees RAM, so more programs can run than RAM alone could hold — but it is slower, because the disk is much slower than RAM.

- **Advantages:** reach it from anywhere on any device; no local storage hardware to buy or maintain; easy to share files and to back up automatically.
- **Disadvantages:** needs a working internet connection; an ongoing subscription cost; security and privacy depend on the provider; you rely on that provider staying available and in business.

3 Networks

Hardware
└ Networks

Network hardware

- **NIC** 网络接口卡: the card that joins a device to a network
- **MAC address** 介质访问控制地址: identifies one physical device – *fixed*
- **IP address** 网际协议地址: identifies a device on a network – *depends on the network*
- **router** 路由器: connects networks (home → internet)



Headphones

4 Recap

Topic 3 – key takeaways

1 CPU

ALU + CU + registers, joined by buses

2 Cycle

fetch → decode → execute, PC +1

3 Memory

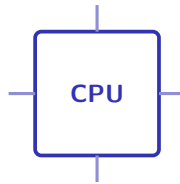
RAM volatile, ROM non-volatile; disk is secondary

4 Network

MAC fixed to device; IP set by the network

Check yourself

- 1 Which register holds the next instruction's address?
- 2 Is RAM volatile or non-volatile?
- 3 Which memory holds the start-up instructions?
- 4 Which address is fixed to the physical device?



Answers 1. the PC 2. volatile 3. ROM 4. the MAC address