Your notes

GCSE Computer Science: revision notes

CPU architecture and the fetch–execute cycle

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The CPU

- The central processing unit (CPU) processes data and instructions by carrying out the fetch–execute cycle, billions of times a second.
- **Control unit** (CU): decodes instructions and sends out control signals to coordinate the other parts.
- Arithmetic logic unit (ALU): carries out calculations and logical comparisons.
- **Cache**: very fast memory in the CPU for frequently used data and instructions. **Registers**: tiny, very fast stores inside the CPU. Clock: sends regular pulses that keep every part in step.

Von Neumann architecture

- Programs and data are stored together in the same memory, and instructions are fetched and carried out one at a time.
- The **program counter** (PC) holds the address of the next instruction. The memory address **register** (MAR) holds the address being used. The memory data **register** (MDR) holds the data or instruction just fetched, or about to be written. The accumulator holds the results of calculations.
- Buses carry addresses, data and control signals between the CPU and memory.

The fetch–execute cycle

- Fetch: the address in the PC is copied into the MAR. The instruction at that address is copied from memory into the MDR. The PC goes up by 1.
- Decode: the **control unit** works out what the instruction means.
- Execute: the instruction is carried out. For example, the ALU does a calculation and the result goes into the accumulator.

Performance

- **Clock speed**: the number of cycles per second. 3.5 GHz means 3.5 billion cycles per second, so more instructions are carried out each second.
- **Cores**: each **core** can process instructions on its own, so more **cores** can do more at once, but only if the software is written to use them.
- **Cache** size: more **cache** keeps more data close to the CPU, so there are fewer slow trips to RAM.
- (AQA) Level 1 **cache** is the smallest and fastest; level 2 and 3 are bigger but slower.

Embedded systems

- An **embedded system** is a computer built into a larger device to do one dedicated job, such as in a washing machine, a microwave or a car's engine. They are usually small, cheap, low-power and very reliable.

Key terms

CPU	The central processing unit, which processes data and instructions.
Control unit	The part of the CPU that decodes instructions and coordinates the other parts.
ALU	The arithmetic logic unit, which carries out calculations and logical comparisons.
Cache	Very fast memory in the CPU for frequently used data and instructions.
Register	A tiny, very fast store inside the CPU.
Clock speed	The number of fetch–execute cycles a CPU can carry out each second.
Core	A processing unit inside the CPU that can work independently.
Program counter	The register that holds the address of the next instruction.
Von Neumann architecture	A design where programs and data are stored in the same memory.
Embedded system	A computer built into a larger device to do one dedicated job.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. Which part of the CPU carries out calculations and logical comparisons?
2. What does the control unit do?

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3. What is cache?
4. What does the program counter hold?
5. What are the three stages of the CPU's cycle?
6. What does a clock speed of 3.5 GHz mean?
7. How does more cache improve performance?
8. Why might doubling the number of cores not double the speed?

Answers

1. The ALU
2. Decodes instructions and coordinates the other parts of the CPU
3. Very fast memory in the CPU for frequently used data
4. The address of the next instruction
5. Fetch, decode, execute
6. 3.5 billion cycles per second
7. More data is kept close to the CPU, so there are fewer slow trips to RAM
8. The software may not be written to use several cores

What to do next

Practise 12 questions on this topic

Try 5 exam questions, with mark schemes

Read the lesson, one step at a time

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