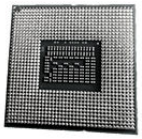
Systems Architecture

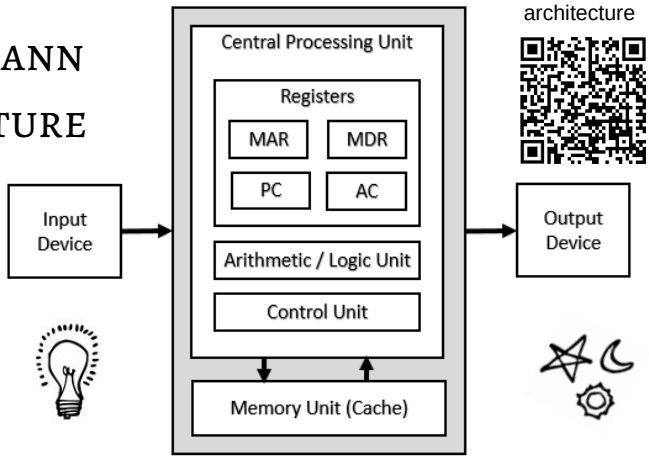
Scan this QR code to watch some YouTube videos about system architecture

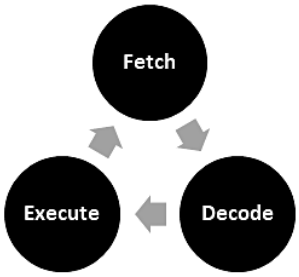
THE PURPOSE OF THE
Central Processing Unit (CPU)



The CPU is an electrical circuit that is responsible for processing the instructions on a computer system.

Von Neumann Architecture



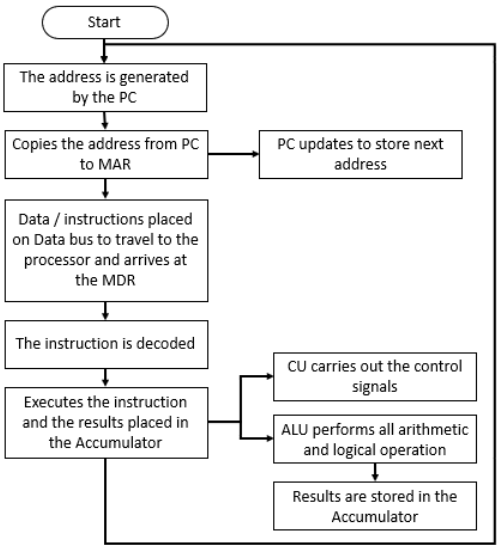


FETCH

The address is generated by the Program Counter (PC) and is carried to the Memory Address Register (MAR) using the **Address Bus**. The PC then updates and stores the next memory address, ready for the next round of the cycle. The data or instruction that is in that memory location is placed onto the **Data Bus** and carried to the processor and is stored in the Memory Data Register (MDR).

DECODE

The data or instruction is then decoded to find out if it is a piece of data or if it is an instruction to do something such as ADD, STORE, SWITCH, REPEAT etc.



EXECUTE

The CPU performs the actions required by the instruction. If it is an instruction to control input or output devices the Control Unit will execute the instruction. If it is a calculation then the Arithmetic and Logic Unit (ALU) will execute the instruction. The results of any calculations are recorded in the Accumulator.

Memory Address Register (MAR)

Stores the memory location of data that needs to be accessed

Memory Data Register (MDR)

Stores the data that is being transferred to and from memory

Program Counter (PC)

Stores the address of the next instruction to be executed

Accumulator (AC)

Stores results from calculations

Arithmetic / Logic unit (ALU)

Carries out calculations and makes decisions on the data sent to the processor

Control unit (CU)

Controls how data moves through the processor and controls the timing of operations and the instructions sent to the processor and the input and output devices (I/O devices)

Performance of the CPU

Clock speed

The clock speed describes how fast the CPU can run. This is measured in megahertz (MHz) or gigahertz (GHz) and shows how many fetch-execute cycles the CPU can deal with in a second.

Cores

CPUs with multiple cores have more power to run multiple programs at the same time.

Cache size

The more data that can be held in the cache, the shorter the trips the electric pulses need to make so this speeds up the processing time of each of those billions of electrical signals, making the computer noticeable faster overall.

Memory

The more cache there is, the more data can be stored closer to the CPU and cache is described as Level 1 (L1), Level 2 (L2) and Level 3 (L3):

- L1 is usually part of the CPU chip itself and is both the smallest and the fastest to access.
- L2 and L3 caches are bigger than L1. They are extra caches built between the CPU and the RAM. L2 and L3 caches take slightly longer to access than L1.

Embedded Systems

Embedded systems are computerised circuits that have been created for one specific purpose. For instance, the circuits inside a washing machine, car engine or MP3 player were created to perform tasks and cannot be re-programmed to perform something else.

System Architecture

Revise it

Read through the handout, watch the videos and then select a revision technique from those described in this section, you can even do more than one if you want!

Highlight

Highlight key words (maximum of 2 per sentence) and then cover the page and try to write down all the key words you can remember. Go back and fill in all the ones you have missed.

Mind map

Using the handout, draw a mind map and include as many colours, images and diagrams as you can to illustrate it

Post-it notes

Write a key word and the definition on a post-it note and stick them around your study area as a reminder of the terminology.

Record your notes

Re-write the handout in your own words and record yourself using your phone as you read your notes aloud.

Bullet Points

Write the main headings (leaving space between each) and then write bullet points of the main key points you need to remember under each heading. Re-read the handout and add any missed points to your list.

TEST YOURSELF

Cover your notes and the answer before you attempt to answer this practice exam question.

Describe what happens during each stage of the fetch-decode-execute cycle [6 marks]

Mark your answer

6 marks available in total - fetch, decode and execute stages must all be covered for full marks.

Fetch:

- The memory address from the program counter is copied to the MAR *[1 mark]*
- An instruction is fetched from memory using the address in the MAR *[1 mark]*
- The fetched data is copied to the MDR *[1 mark]*
- The program counter changes to point to the next instruction *[1 mark]*

Decode:

- The fetched instruction is decoded by the control unit *[1 mark]*

Execute:

- The decoded instruction is carried out *[1 mark]*
- The CU controls the timing of operations and sends instructions to other hardware *[1 mark]*
- The ALU carries out the calculations and the results are stored in the AC *[1 mark]*
- The cycle is repeated *[1 mark]*