Memory

There are 4 types of memory you need to know about:

1. **RAM**
2. **ROM**
3. **Registers** - locations inside the CPU
4. **Caches** - locations close to the CPU used to store recently used data

Memory

Registers:

Specialised, quick memory locations in the CPU.

Data and instructions are copied into registers from RAM and processed as part of the Fetch-Decode-Execute cycle

Data stored here only whilst it's being actively used in a process.

Memory

Caches:

Quick memory locations close to CPU - so quick to transfer into/out of

Used to store data and instructions most recently used - so things that need using a lot can quickly be moved back into registers in the CPU rather than fetched from RAM

Main Memory

Main memory is the memory the CPU can access directly.

It is the CPU's working memory where **data and instructions** are stored.

Made up of:
- **RAM** (mainly)
- **ROM**

It doesn't include registers or caches...

Main Memory

Main memory is the memory part of the von Neumann architecture.

It was von Neumann's idea to be able to store data or instructions in the same memory address. This made general purpose computers possible rather than the hard-wired machines that existed in 1945.
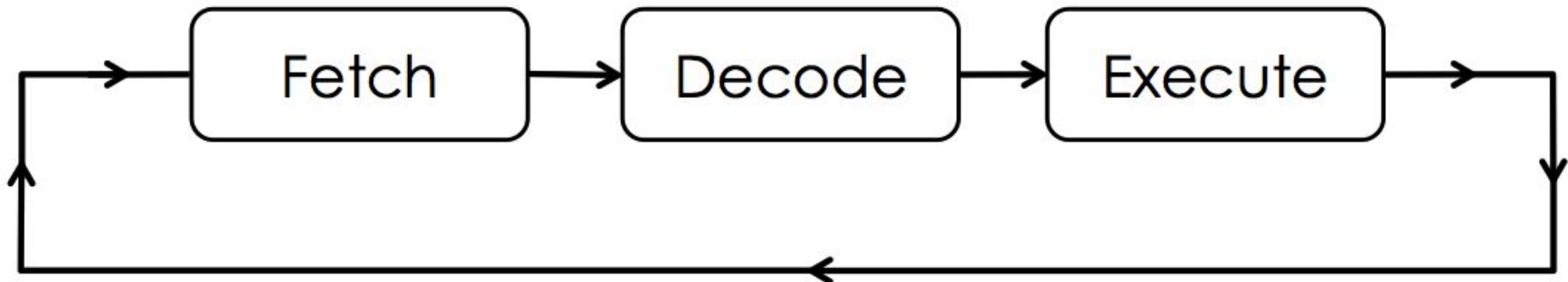
Main Memory

Instructions are **fetch**ed from main memory into the CPU where they are **decode**d and then **execute**d.

Data is **fetch**ed from main memory into **registers** as part of executing instructions.

Data or instructions will sometimes need to be moved into main memory from the **hard drive**.

Buses are used to move data around.

```
        ┌─────────┐      ┌─────────┐      ┌─────────┐
───────→ │  Fetch  │ ───→ │ Decode  │ ───→ │ Execute │ ───→
   ↑     └─────────┘      └─────────┘      └─────────┘      │
   │                                                        ↓
   └────────────────────────←───────────────────────────────
```

Main Memory - RAM

Random **A**ccess **M**emory

Data and instructions fetched from RAM when required.

- located in DIMM slots on the motherboard
- **volatile**
- can be reused (changed, deleted, overwritten) - this makes it flexible
- stores data and instructions as required
- registers and caches are also volatile

Main Memory - ROM

Read **Only M**emory

Small area of memory which never changes

- located on the motherboard
- **non-volatile**
- can never be changed - the contents are fixed
- used to store boot commands and BIOS
- slower and cheaper than RAM

Main Memory

RAM is **volatile**

ROM is **non-volatile**

IMPORTANT!

Main Memory

Volatile = lost when power turned off

Non-volatile = not lost when power turned off

IMPORTANT!

Comparing RAM and ROM

RAM	ROM
Volatile - data lost when power turned off	**Non-volatile** - data NOT lost when power turned off
Data stored in it can be changed - flexible and reusable	Data can't be changed - only one use
Stores data and programs currently being used	Stores bootstrap loader and BIOS used at startup
Data and programs moved to it from secondary storage when they are needed	
More RAM can be added to DIMM slots	Integral part of the motherboard
	Slower and cheaper