

Contents

Component 01 — Computer Systems

Section One — Components of a Computer System

Computer Systems.....	1
The CPU.....	2
<i>Warm-Up and Worked Exam Questions</i>	4
<i>Exam Questions</i>	5
Memory.....	6
CPU and System Performance	7
Secondary Storage.....	8
<i>Warm-Up and Worked Exam Questions</i>	10
<i>Exam Questions</i>	11
Systems Software — The OS	12
Systems Software — Utilities	15
<i>Warm-Up and Worked Exam Questions</i>	16
<i>Exam Questions</i>	17
Revision Questions for Section One	18

Section Two — Data Representation

Units	19
Binary Numbers	20
Hexadecimal Numbers.....	23
<i>Warm-Up and Worked Exam Questions</i>	25
<i>Exam Questions</i>	26
Characters	27
Storing Images.....	28
Storing Sound.....	29
Compression	30
<i>Warm-Up and Worked Exam Questions</i>	31
<i>Exam Questions</i>	32
Revision Questions for Section Two	33

Section Three — Networks

Networks — LANs and WANs.....	34
Networks — Hardware.....	35
Wireless Networks.....	36
Client-server and Peer-to-Peer Networks.....	37
Network Topologies.....	38
<i>Warm-Up and Worked Exam Questions</i>	39
<i>Exam Questions</i>	40
Network Protocols.....	41
Networks — The Internet.....	43
Network Security Threats.....	44
<i>Warm-Up and Worked Exam Questions</i>	47
<i>Exam Questions</i>	48
Revision Questions for Section Three.....	50

Section Four — Issues

Ethical and Cultural Issues.....	51
<i>Warm-Up and Worked Exam Questions</i>	56
<i>Exam Questions</i>	57
Environmental Issues	58
Computer Legislation.....	59
Open Source and Proprietary Software	60
<i>Warm-Up and Worked Exam Questions</i>	61
<i>Exam Questions</i>	62
Revision Questions for Section Four	63

Contents

Component 02 — Computational Thinking, Algorithms and Programming

Section Five — Algorithms

Computational Thinking	64
Writing Algorithms — Pseudocode	65
Writing Algorithms — Flowcharts	66
<i>Warm-Up and Worked Exam Questions</i>	67
<i>Exam Questions</i>	68
Search Algorithms	69
Sorting Algorithms	70
<i>Warm-Up and Worked Exam Questions</i>	73
<i>Exam Questions</i>	74
Revision Questions for Section Five	75

Section Six — Programming

Programming Basics — Data Types	76
Programming Basics — Casting and Operators	77
Programming Basics — Operators	78
Constants and Variables	79
Strings	80
<i>Warm-Up and Worked Exam Questions</i>	81
<i>Exam Questions</i>	82
Program Flow	83
<i>Warm-Up and Worked Exam Questions</i>	86
<i>Exam Questions</i>	87
Boolean Logic	88
Random Number Generation	91
<i>Warm-Up and Worked Exam Questions</i>	92
<i>Exam Questions</i>	93
Arrays	94
File Handling	96
Storing Data	97
Searching Data	98
Sub Programs	99
<i>Warm-Up and Worked Exam Questions</i>	101
<i>Exam Questions</i>	102
Revision Questions for Section Six	104

Section Seven — Design, Testing and IDEs

Structured Programming	105
Defensive Design	106
Testing	107
<i>Warm-Up and Worked Exam Questions</i>	109
<i>Exam Questions</i>	110
Trace Tables	111
Translators	112
Integrated Development Environments	113
<i>Warm-Up and Worked Exam Questions</i>	114
<i>Exam Questions</i>	115
Revision Questions for Section Seven	116

Practice Paper 1	117
Practice Paper 2	127
Answers	138
Glossary & Index	152

Computer Systems

As it's the first page I'll start simple. Computer Science is all about computers. What, you already knew that?

A Computer is a Machine that Processes Data

- 1) The purpose of a computer is to take **data**, **process** it, then **output** it.
Computers were created to help process data and complete tasks **more efficiently** than humans.
- 2) A **computer system** consists of **hardware** and **software** that work together to process data/complete tasks.
 - Hardware is the **physical** stuff that makes up your computer system, like the CPU, motherboard, monitor and printer.
 - Software is the **programs** or **applications** that a computer system runs e.g. an operating system, a word processor or video game.
- 3) There are **many types** of computer system. These range from small devices like calculators and watches, up to large **supercomputers** used by banks or for scientific applications. Computers may be **general purpose** (designed to perform **many tasks**, e.g. PCs and tablets) or **dedicated systems** (designed for **one particular** function, e.g. controlling traffic lights or an aeroplane).

External pieces of hardware like the keyboard, mouse and printer are called peripherals.

Embedded Systems are Computers inside a Larger System

- 1) **Embedded systems** are computers **built into other devices**, like dishwashers, microwaves and TVs. They are usually dedicated systems.
- 2) Embedded systems are often used as **control systems** — they **monitor** and **control** machinery in order to achieve a desired result. E.g. In a **dishwasher** the embedded system could control the water pumps and water release mechanisms, manage the various dishwasher cycles and control the thermostat to keep the water at an appropriate temperature.
- 3) As they're **dedicated** to a single task, embedded systems are usually easier to **design**, cheaper to **produce**, and more **efficient** at doing their task than a general purpose computer.

Computers contain Components which Work Together

This section is all about the main hardware components of a computer.
As a warm-up, let's take a look inside a **typical desktop PC**.

Power supply — supplies power to motherboard, optical and hard drives, and other hardware.

Case cooling fan — extracts hot air from the computer case.

CPU heat sink and cooling fan — keeps the CPU at a steady temperature (CPUs generate a lot of heat).

CPU (hidden under the heat sink) — the most important component. Does all the processing (see p.2-3).



Optical drive — for read/writing of optical discs (see p.9).

RAM sticks (computer memory) slot in here (see p.6-7).

Motherboard — The main circuit board in the computer, where the hardware is connected.

Hard Disk Drive — Internal secondary storage (see p.8).

The **graphics card** slots in here (see p.7).

If you know your computer, you need not fear defeat...

There's a lot to take in on this first page. You should make sure you're comfortable with the components on this page before going any further, as they'll crop up a lot throughout this section.

The CPU

The CPU is very important — it's the main component of a computer, so here are two whole pages about it.

The CPU is the Central Processing Unit

- 1) The CPU is the brain of the computer system.
- 2) It processes all of the data and instructions that make the system work.
- 3) The processing power of a CPU depends on different characteristics, like its clock speed, number of cores and cache size — there's lots about this on p.7.
- 4) The CPU architecture describes the main components of the CPU, how they interact with each other, and with other parts of the computer system. Von Neumann and Harvard are the two main types of architecture. You will need to know about Von Neumann — see next page.



CPUs contain 1000s of gold pins — some of these transmit data, others supply power to the CPU.

The CPU has Three Main Parts

The Control Unit (CU)

- The control unit is in overall control of the CPU. Its main job is to manage the fetching, decoding and execution of program instructions by following the fetch-execute cycle (see next page).
- It controls the flow of data inside the CPU (to registers, ALU, cache — see below) and outside the CPU (to main memory and input/output devices).

The Arithmetic Logic Unit (ALU)

- The ALU basically does all the calculations.
- It completes simple addition and subtraction, compares the size of numbers and can do multiplications and divisions using repeated addition and subtraction.
- It performs logic operations such as AND, OR and NOT (see p.88) and binary shifts (see p.22) — remember, computers process binary data.
- It contains the accumulator register — see next page.

The Cache

- The cache is very fast memory in the CPU. It's slower than the registers (see below), but faster than RAM (see p.6).
- It stores regularly used data so that the CPU can access it quickly the next time it's needed. When the CPU requests data, it checks the cache first to see if the data is there. If not, it will fetch it from RAM.
- Caches have a very low capacity and are expensive compared to RAM and secondary storage.
- There are different levels of cache memory — L1, L2 and L3. L1 is quickest but has the lowest capacity. L2 is slower than L1 but can hold more. L3 is slower than L2 but can hold more.

The CPU contains various registers which temporarily hold tiny bits of data needed by the CPU. They are super-quick to read/write to, much quicker than any other form of memory. You need to know about the program counter, memory address register (MAR), memory data register (MDR) and the accumulator (see next page).

That's a lot to remember, for something so small...

It's important that you know all about the CU, ALU and cache. Try learning everything you can about each one, then cover up the page and write down as many notes as you can remember.

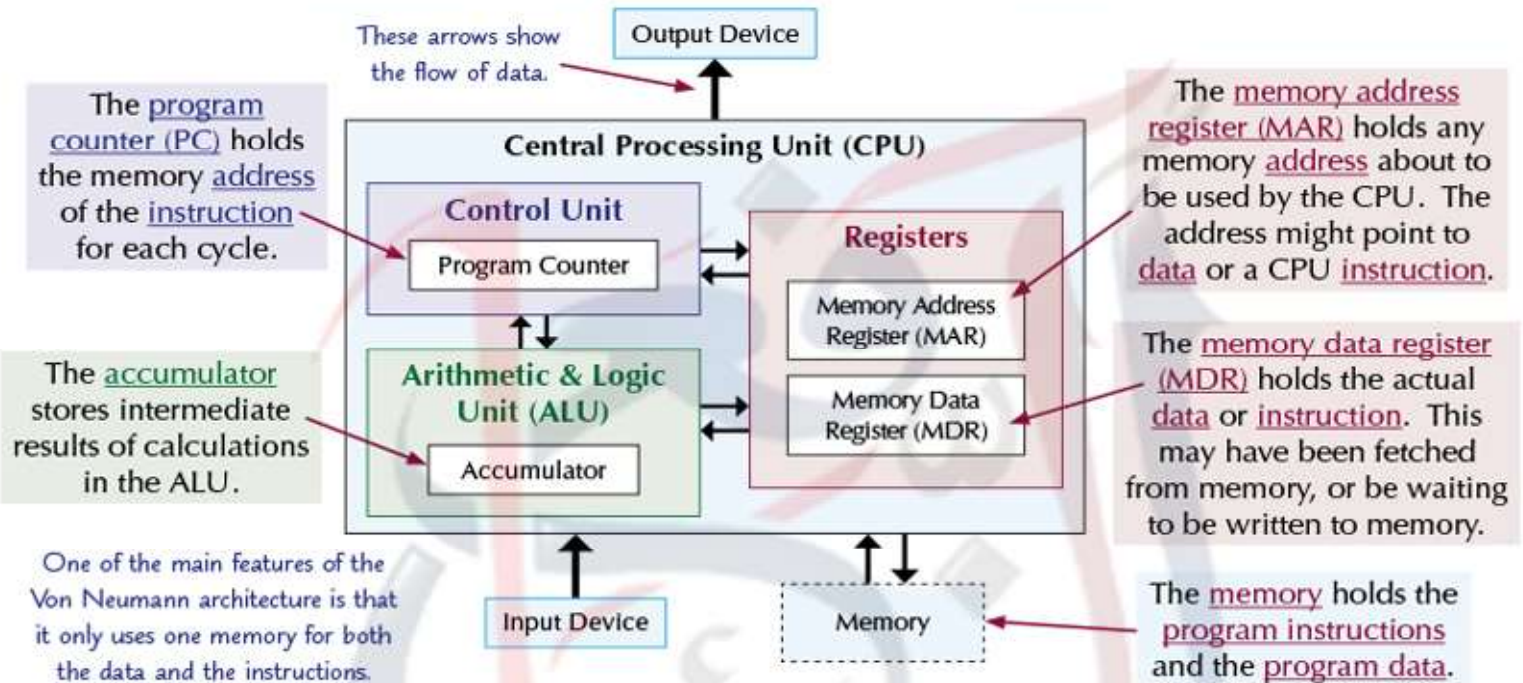


The CPU

Now let's look at the Von Neumann architecture and what the registers do in a bit more detail. Von Neumann came up with his design in 1945 and it still describes how most computers work today.

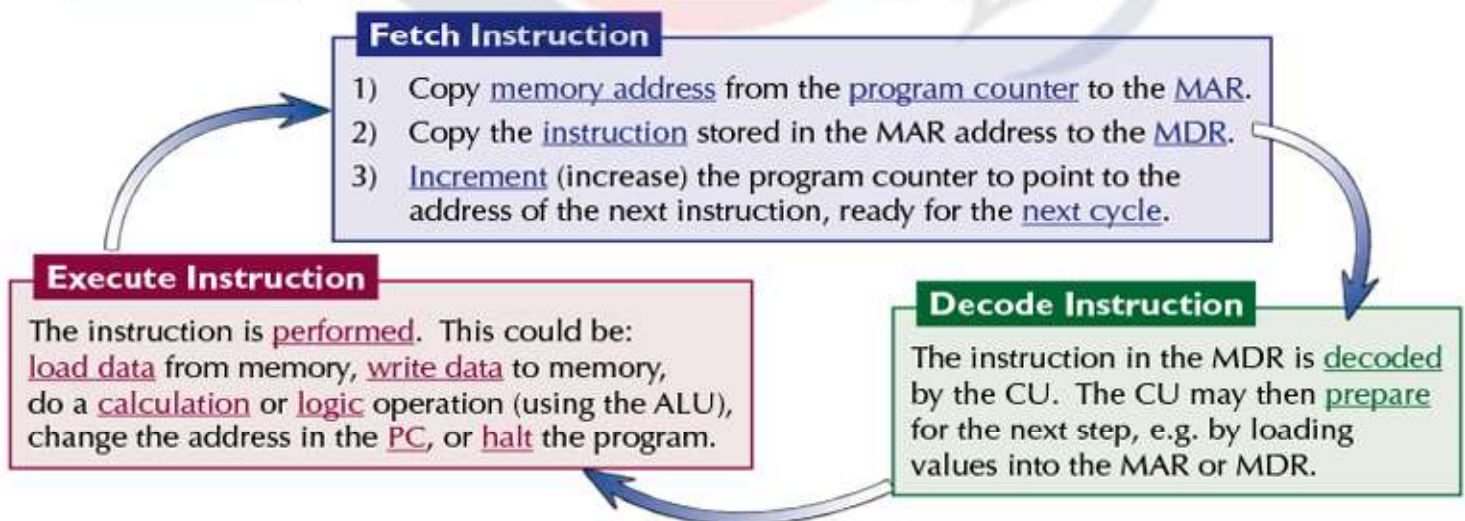
Von Neumann's Design Revolutionised Computing

The Von Neumann architecture describes a system where the CPU runs programs stored in memory. Programs consist of instructions and data which are stored in memory addresses.



CPU's follow the Fetch-Execute Cycle

Essentially, all a CPU does is carry out instructions, one after another, billions of times a second. The Fetch-Execute cycle (also called the Fetch-Decode-Execute cycle) describes how it does it.



Learn this with the Revise-Assess-Review cycle...

To remember what each register does, look at its name to see if it stores an address or data. If you're confused about the difference between the PC and MAR, remember: the program counter just starts off the cycle by pointing to the instruction. The MAR is far busier — all addresses (data or instruction) being used must go into the MAR, meaning its value might change several times each cycle.