

AQA Computer Science A-Level
**4.7.1 Internal hardware components of a
computer**
Intermediate Notes



Specification:

4.7.1.1 Internal hardware components of a computer:

Have an understanding and knowledge of the basic internal components of a computer system.

Understand the role of the following components and how they relate to each other:

- processor
- main memory
- address bus
- data bus
- control bus
- I/O controllers

Understand the need for, and means of, communication between components. In particular, understand the concept of a bus and how address, data and control buses are used.

Be able to explain the difference between von Neumann and Harvard architectures and describe where each is typically used

Understand the concept of addressable memory.



Components of a computer

The processor

A computer's processor **executes program instructions** in order to run applications. The internal components of the processor are covered in much more detail in the notes for 4.7.3 structure and role of the processor and its components.

Main memory

A computer uses its **main memory** to store **instructions** and **frequently used data**. Main memory is usually much faster than **secondary storage** so storing frequently used data in main memory helps the processor to **execute instructions quickly**.

Synoptic Link

Types of **secondary storage** include **hard disk drives, solid state drives and optical disks**.

Secondary storage devices are covered under **external hardware devices**.

Buses

A number of **buses** can be found inside a computer. A bus is a series of **parallel wires** that **connects internal components** of a computer system, allowing signals to be passed between them.

Synoptic Link

Buses transmit data using **parallel data transmission**.

Parallel data transmission is covered under **communication in fundamentals of communication and networking**.

The number of parallel wires in a bus is called its **width** and has a **direct relationship** to the number of bits can be transferred **simultaneously** by the bus.

The three buses that you need to know about are the address bus, the data bus and the control bus.

Address bus

The address bus is used to **transport memory addresses**, specifying where data is to be sent to or retrieved from. Increasing the width of the address bus **increases the range of addresses** that it can specify, hence increasing the computer's amount of **addressable memory**.

Number of parallel wires in address bus	Number of addressable memory locations
1	$2^1 = 2$
2	$2^2 = 4$
3	$2^3 = 8$

An addressable memory location is a portion of memory that can be **accessed by its address**.

If there are not enough addresses available, some portions memory may go **unused**.



Data bus

A computer's data bus sends **data and instructions** to and from the different components of the computer system. Increasing the width of the data bus **increases the volume of data that can be transferred over the bus at any one time**.

Control bus

The control bus is used to carry **control signals** that regulate the operation of the computer system. The control bus also carries the computer's **clock signal**.

I/O Controllers

I/O controllers (input/output controllers) are pieces of **hardware** that control the **communication of data** between the processor and **external hardware devices** such as keyboards, mice and monitors.

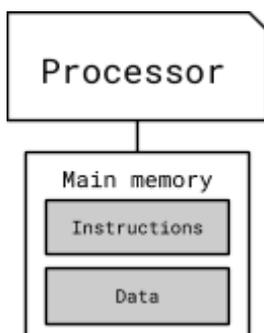
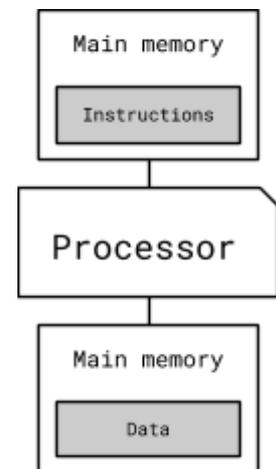
Von Neumann and Harvard architectures

Harvard architecture and **von Neumann** architecture are two different ways of setting up a processor's access to **main memory**.

Harvard architecture

If a computer system is set up to use Harvard architecture, the processor will use **two separate pieces of main memory**. One for **instructions** and another for **data**.

Harvard architecture is extensively used in **embedded systems** such as **digital signal processing** because it allows for instructions and data to be fetched from main memory simultaneously.



Von Neumann architecture

In von Neumann architecture, both instructions and data are stored together in the **same memory**. Because of this, systems based on von Neumann architecture often **perform worse** than those based on Harvard architecture as instructions and data can't be fetched from main memory simultaneously.

Von Neumann architecture is used in **everyday** computer systems like laptops and smartphones.

