AQA Computer Science A-Level
4.7.1 Internal hardware components of a computer
Concise 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
- Executes program instructions in order to run applications
- Is covered in much more detail in the notes for *4.7.3 structure and role of the processor and its components*

Main memory
- Includes RAM (random access memory) and ROM (read only memory)
- Stores program instructions and frequently used data
- Usually much faster than secondary storage

Buses
- A bus is a series of parallel wires that connects internal components of a computer system, allowing signals to be passed between them
- The number of parallel wires in a bus is called its width
- A bus' width and has a direct relationship to the number of bits it can transfer simultaneously

Address bus
- Used to transport memory addresses
- Specifies where in memory data is to be sent to or retrieved from
- Increasing the width increases the range of addresses that can be specified
- Adding a single wire doubles the number of addressable memory locations

Data bus
- Sends data and instructions to and from the different components of the computer system
- Increasing the width increases the volume of data that can be transferred at any one time

Control bus
- Used to carry control signals that regulate the operation of the computer system
- Also carries the computer's clock signal

I/O Controllers
- 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

- Two different ways of setting up a processor's access to main memory

Harvard architecture
- The processor uses two separate main memory locations
- One is used for instructions and the other for data
- Each piece of main memory can be given different characteristics
  - Memory used for instructions could be made read-only so that instructions cannot be altered
- Extensively used in embedded systems such as digital signal processing

Von Neumann architecture
- Both instructions and data are stored together in the same memory
- The same buses have to be shared for fetching both instructions and data
- Therefore, systems based on von Neumann architecture often perform worse than those based on Harvard architecture
- Used in everyday general-purpose computer systems like laptops and smartphones