

Definitions and Concepts for AQA Computer Science A-level

Topic 7: Fundamentals of Computer Organisation and Architecture

7.1 Internal Hardware Components of a Computer

Addressable Memory: The concept of storing data and instructions in a memory with discrete, unique addresses.

Address Bus: A bus that carries the memory location address of the register the data is being carried to or from.

Control Bus: A part of the CPU that controls and manages the execution of instructions. It sends control signals to coordinate execution and controls Fetch-Decode-Execute cycles and buses.

Data Bus: A bi-directional bus for carrying data and instructions between the processor and memory.

Harvard Architecture: A computer architecture that stores data and instructions in separate memories to allow the next instruction to be read while data is currently being read or written.

I/O Controllers: An interface that allows the processor to communicate with Input/Output devices connected to the computer.

Main Memory: A data store for instructions for the processor that can be directly addressed by the processor.

Processors: A complex chip of transistors capable of executing programs, computing data to outputs, and supervising the operation of a computer system.

Von Neumann Architecture: A computer architecture where a single control unit manages program control via a linear sequence of fetch-execute-decode cycles. Data and instructions are held in the same memory.

7.2 The Stored Program Concept

Stored Program Concept: Machine code instructions stored in main memory are fetched and executed serially by a processor that performs arithmetic and logical operations. †

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7.3 Structure and Role of the Processor and its Components

7.3.1 The Processor and its Components

Arithmetic and Logic Unit (ALU): A part of the processor that performs arithmetic calculations and logical operations on data for the computer programs.

Clock: A timing device connected to the processor that periodically generates a signal to synchronise fetch, decode execute cycle runs and other components of the computer.

Control Unit: A part of the processor that controls and manages the execution of instructions. It sends control signals to coordinate execution and controls Fetch-Decode-Execute cycles and buses.

Current Instruction Register: A dedicated register that stores the address of the instruction that is being executed in the processor.

Dedicated Register: A register reserved for a specific purpose or role essential to the running of the processor.

General Purpose Registers: Special memory cells in the processor that can be accessed quickly. They temporarily store data and control information.

Memory Address Register: A special register that stores the memory address of the next instruction to load or data to use.

Memory Buffer Register: A special register that temporarily stores data to be read from or written to the computer's memory.

Program Counter: A dedicated register that stores the address of the next instruction to execute.

Status Register: A dedicated register containing information about the intermediate states or outcomes of various processes in the processor.

7.3.2 The Fetch-Execute Cycle and the Role of Registers within it

Fetch-Decode-Execute Cycles: The process of fetching from memory (supplying the address and retrieving the instruction from memory), decoding (interpreting the instruction and then reading and retrieving the the required data from their addresses) and executing the instruction (CPU carries out the required actions).

7.3.3 The Processor Instruction Set

Instruction Set: A set of sequenced operations in machine code that can be recognised by a particular processor as the execution of a command.



Opcode: The part of an instruction that explains what action the instruction performs.

Operand: The part of an instruction with a value, memory address or register that the instruction will act on during its execution.

7.3.4 Addressing Modes

Direct Addressing: A form of addressing an instruction such that the operand is the address of the required datum (singular of data). †

Immediate Addressing: A form of addressing an instruction such that the operand is the required datum (singular of data). †

7.3.5 Machine-Code/Assembly Language Operations

Add: An machine code instruction that adds a given value to the value in a register, and stores the sum in the specified destination memory address.

Branch: A set of machine code instructions that allow you to move to another part of the program either always (unconditional branching) or if a particular condition is met (conditional branching).

Halt: A machine code instruction that stops the execution of the program.

Load: A machine code instruction that loads the value stored in the memory address specified in the instruction.

Logical Bitwise Operators: A set of machine code instructions designed to perform a specified logical operation (OR, AND, NOT etc.) on the value in a register value and a value given in the instruction, storing the result in the specified destination memory address.

Logical Shift: A machine code instruction that can shift the value stored in a given register by a number of bits (also given in the instruction) left or right, and stores the result in the specified destination memory address.

Store: A machine code instruction that stores the value in a given register to a the specified destination memory address.

Subtract: A machine code instruction that subtracts a given value from the value in a register, and stores the difference in the specified destination memory address.

7.3.6 Interrupts

Interrupt: A signal sent by a program to request the processor for attention from the current task(s).

Interrupt Service Routine (ISR): A block of code used by the processor to appropriately



handle and deal with an interrupt if it chooses to accept it.

7.4 External Hardware Devices

7.4.1 Input and Output Devices

Input Devices: Peripheral devices that allow the user communicate and to pass readable data into a computer, decode it and send it to the CPU.

Output Devices: Peripheral devices that take convert signals from a computer into a human-readable form.

7.4.2 Secondary Storage Devices

Hard Disk: A secondary storage device consisting of circular magnetic discs. Data is stored magnetically in concentric circles on each disc, and is accessed by moving parts.

Optical Disk: A secondary storage device consisting of a single disc that stores data as pits and lands on the disc's surface, which can be read using a laser.

Solid State Disk: A secondary storage device consisting of NAND flash memory and a controller that stores data electronically with no moving parts.

Definitions with a '+' taken from [AQA AS and A-level Computer Science specification version 1.5](#)

