01 Zero & One

Unit 7: Computers

Programming & AI, 1st secondary (Introduction to ICT)



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7-1 Computer Configuration

- **Hardware and peripheral devices**: **Hardware:** is everything you can touch: the main computer unit and the devices connected to it.
- **The five major components**
  - **Control unit:** executes the computer's instructions and issues commands to every part
  - **Arithmetic unit:** performs the calculations.
  - **Memory unit:** holds programs and data.
  - **Input unit:** brings information in from outside, such as the keyboard, mouse and scanner.
  - **Output unit:** sends information out of the computer, such as the display and printer.
- **Two kinds of storage**
  - **Main memory:** stores programs and data **temporarily** and exchanges data **directly** with the CPU
  - **Secondary memory:** for **long-term** storage of large amounts of data
- **Flow of control and flow of data**: The **flow of control** goes out from the **control unit** to every device, because it is the one giving the commands.
- **Interface**
  - **USB:** the most widely used interface for peripherals
  - **HDMI:** a standard that carries video, audio and other data through **one cable**
  - **Ethernet:** a communication standard for **wired** LANs at home and in the office
- **Kinds of memory and the motherboard**
  - **RAM (Random Access Memory):** the main memory we read from and write to
  - **ROM (Read-Only Memory):** its contents are **fixed and not lost** when the device is turned off
  - **Cache memory:** a small, **very fast** memory inside or next to the processor that keeps the data the CPU uses often, so it does not wait for the slower main memory
  - **Motherboard:** the main electronic board on which the processor and memory are mounted and to which storage units and ports connect, so it **links the computer's components together**.
  - **Bus:** a set of **wires (paths)** that carries data and commands between the processor, memory and the other parts.
  - An **SSD** stores data on electronic chips and has no moving mechanical parts, so it is faster than an ordinary hard disk.

Hardware	The physical parts of a computer, such as the main unit and peripheral devices.
Peripheral devices	Devices that are connected to a computer in order to use them, such as a keyboard or printer.
Control unit	The part of the CPU that executes instructions and issues commands to every part.
Arithmetic unit	The part of the CPU that performs calculations.
CPU	Central processing unit: the control unit and the arithmetic unit together.

Main memory	Temporary storage for programs and data that exchanges data directly with the CPU.
Secondary memory	Long-term storage for large amounts of data, such as a hard disk, SSD or USB memory.
Interface	A component that mediates information exchange between the computer and peripheral devices.
HDMI	A standard that carries video and audio through a single cable.
Ethernet	A communication standard for wired local area networks.
RAM	Random access memory: read-and-write main memory that loses its contents when the power is cut.
ROM	Read-only memory: permanent memory that holds the start-up instructions such as the BIOS.
Cache memory	A small, very fast memory near the CPU that keeps frequently used data.
Motherboard	The main circuit board that connects the CPU, memory, storage and ports.
Bus	A set of wires (paths) that carries data and signals between the CPU and other parts.

7-2 Computer Software

- **Hardware and software**: **Hardware:** the physical parts, such as the CPU, memory and storage.
- **Types of software**
  - **System software:** the software needed to operate the hardware itself.
  - **Operating system (OS):** a type of system software responsible for the basic functions of a computer
  - **Application software:** runs **on top of** system software and does a specific task, such as word processing or spreadsheets.
- **What does an OS do?**: An OS has management functions: **task management** (which job runs when), **memory management** (how much space each program gets) and **file management** (saving, opening and organising).
- **Device driver**: A program that controls the communication between a **connected device** (such as a printer) and the **software** on the computer
- **Stack them in layers**
  - Top: **application software** (Word, Excel, a game).
  - Below them: **system software** (the OS + device drivers).
  - At the bottom: **hardware** (CPU, memory, printer).
  - That is why **application software cannot run without system software**.
- **Utility software, programming languages and open source**
  - **Utility software:** programs that protect and maintain the computer, such as **antivirus** software, **disk clean-up**, backup and file compression
  - **Machine language:** 0s and 1s, the **only language the processor understands directly**
  - **Compilers:** translate the **whole program at once** into machine language before it runs
  - **Proprietary software:** only the company can see and change the code, such as Windows and macOS

Software	The programs and data that run on hardware.
System software	Software needed to operate the hardware, including the operating system.

Operating system (OS)	System software responsible for basic functions such as task, memory and file management.
Application software	Software that runs on top of system software to do a specific task.
Device driver	A program that controls communication between a connected device and the software.
Task management	An OS function that decides which job runs and when.
File management	An OS function for saving, opening and organising files.
Utility software	Programs that protect and maintain the computer, such as antivirus and disk clean-up tools.
Machine language	Code made of 0s and 1s: the only language the CPU understands directly.
High-level language	A programming language close to human language, such as Python.
Compiler	A program that translates a whole program into machine language before it runs.
Interpreter	A program that translates and executes code one line at a time.
Open-source software	Software whose source code anyone may view, change and share, such as Linux.
Proprietary software	Software whose source code only its owner can see and change.

7-3 Logic Circuits

- **Logical operations**: **Logical operations:** work on combinations of 0 and 1
- **The three gates**
  - **AND gate (logical conjunction circuit):** output is 1 **only when all inputs are 1**
  - **OR gate (logical disjunction circuit):** output is 1 if **at least one input** is 1
  - **NOT circuit (inverter circuit):** one input, and it outputs the **opposite**: 0 → 1 and 1 → 0.
- **Truth tables in numbers**
  - **AND:** 00→0, 01→0, 10→0, 11→1
  - **OR:** 00→0, 01→1, 10→1, 11→1
  - **NOT:** 0→1, 1→0
- **Half adder circuit**: It adds two binary numbers of **one digit (bit)** each, and is built from AND, OR and NOT gates
- **Full adder circuit**: It takes into account the **carry from the lower digit (Cin)** and the **carry to the higher digit (Cout)**, so it has 3 inputs: A, B and Cin.

Logical operations	Operations on combinations of 0 and 1, where 1 is true and 0 is false.
Logic circuit	A circuit designed to perform logical operations.
Truth table	A table showing every possible input combination of a logic circuit and its output.
AND gate	A circuit that outputs 1 only when all of its inputs are 1.
OR gate	A circuit that outputs 1 if at least one of its inputs is 1.
NOT circuit	A circuit (inverter) that outputs the opposite of its input.
Half adder circuit	A circuit that adds two one-bit numbers and gives a sum S and a carry C.

Full adder circuit	A circuit that adds two bits plus the carry from the lower bit and gives the carry to the higher bit.
Carry	The digit moved to the next higher position during binary addition.

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