

# Understanding Computers

## Year 8 Computer Systems & Binary Representation

### 8.1 • Knowledge Organiser

#### Computer System Components

- **Hardware:** Physical components you can touch (CPU, RAM, keyboard, monitor)
- **Software:** Programs and applications that run on hardware
- **Input Devices:** Keyboard, mouse, microphone, camera, touchscreen
- **Output Devices:** Monitor, speakers, printer, projector
- **Storage Devices:** Hard drive, SSD, USB stick, DVD
- **Processing:** CPU performs calculations and executes instructions

<b>Input</b> Data enters the system	<b>Processing</b> CPU processes data
<b>Output</b> Results displayed/printed	<b>Storage</b> Data saved permanently

#### CPU & Memory Systems

- **CPU:** Central Processing Unit - computer's "brain"
- **RAM:** Temporary storage for running programs
- **Fetch-Decode-Execute:** CPU cycle for processing
- **Clock Speed:** How fast CPU works (measured in Hz)
- **Volatile Memory:** RAM loses data when power off
- **Non-volatile:** Hard drives keep data permanently

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FETCH: Get instruction from memory
DECODE: Understand what to do
EXECUTE: Perform the instruction
REPEAT: Start cycle again
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**Speed:** 1 Hz = 1 cycle/second • 1 GHz = 1 billion cycles/second

#### Binary Number System

- **Binary:** Base-2 system using only 0s and 1s
- **Why Binary:** Computers use electrical switches (on/off)
- **Bit:** Single binary digit (0 or 1)
- **Place Values:** 128, 64, 32, 16, 8, 4, 2, 1
- **Conversion:** Add place values where there's a 1

Binary	Decimal	Binary	Decimal
0001	1	0110	6
0010	2	0111	7
0011	3	1000	8
0100	4	1001	9
0101	5	1010	10

**Tip:** Binary numbers ending in 1 are odd, ending in 0 are even

#### Storage Technologies

- **Magnetic Storage:** HDDs use magnetic fields
- **Solid State:** SSDs use electronic circuits, faster than HDDs
- **Optical Storage:** CDs, DVDs, Blu-ray use laser light
- **Pits and Lands:** Data stored as bumps and flat areas
- **Laser Reading:** Light reflects differently from pits vs lands

**Capacity:** CD (700MB) → DVD (4.7GB) → Blu-ray (25GB)

**How It Works:** Laser bounces off pits (0) and lands (1) to read binary data

#### ASCII & Character Encoding

- **ASCII:** Standard code for text characters
- **Character Codes:** Each letter/symbol has a unique number
- **7-bit System:** 128 different characters (0-127)
- **Common Codes:** A=65, a=97, 0=48, space=32
- **Storage:** Each character stored as 8 bits

Char	ASCII	Binary
A	65	01000001
a	97	01100001
1	49	00110001
!	33	00100001

#### Technology Evolution & Moore's Law

- **Moore's Law:** Computing power doubles every 2 years
- **Convergence:** Separate devices combined into one
- **Evolution:** Telegraph → Telephone → Internet
- **Mobile:** 1G → 2G → 3G → 4G → 5G
- **Integration:** Phone + Camera + Computer + GPS

**Example:** Smartphones combine telephone, camera, computer, GPS, music player, and internet

#### Data Units & Conversions

- **Bit:** Single binary digit (0 or 1)
- **Byte:** 8 bits (stores 1 character)
- **Kilobyte (KB):** 1,024 bytes
- **Megabyte (MB):** 1,024 KB
- **Gigabyte (GB):** 1,024 MB
- **Terabyte (TB):** 1,024 GB

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1 TB = 1,024 GB
1 GB = 1,024 MB
1 MB = 1,024 KB
1 KB = 1,024 bytes
1 byte = 8 bits
```

**Examples:** Text (KB) • Photo (MB) • Video (GB) • Game (tens of GB)

#### Emerging Technologies

- **Artificial Intelligence:** Computers that learn and make decisions
- **Robotics:** Machines that move and perform tasks
- **3D Printing:** Creating physical objects from digital designs
- **Virtual Reality:** Immersive computer-generated environments
- **Internet of Things:** Everyday objects connected to internet

**Future Impact:** These technologies will transform industries, jobs, and daily life