



PREPZEN · COMPUTER

Computer Awareness Notes

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Contents

01	Computer Fundamentals	3
02	Computer Generations & History	6
03	CPU, Motherboard & Ports	9
04	Input Devices	13
05	Output Devices	15
06	Computer Memory — Overview	17
07	RAM & ROM	19
08	Cache, Registers, Virtual & Buffer Memory	22
09	Secondary Storage Devices	24
10	Memory Units	26
11	Number System	28
12	Logic Gates & Boolean Algebra	31
13	Software	33
14	Operating System	36
15	Microsoft Windows	39
16	Keyboard & Shortcut Keys	42
17	MS Word	45
18	MS Excel	48
19	MS PowerPoint	51
20	MS Office Suite, Access & Outlook	53
21	Programming Languages & Translators	55
22	Database Management System (DBMS)	58
23	Computer Networks	60
24	OSI & TCP/IP Models	63
25	Internet & World Wide Web	66
26	Internet Protocols & Port Numbers	69
27	Email (Electronic Mail)	71
28	Cyber Security	74
29	File Extensions	77
30	Computer Abbreviations	80
31	Cloud Computing & Emerging Technologies	85
32	Banking & Digital Payment Technology	88



WHAT IS A COMPUTER?

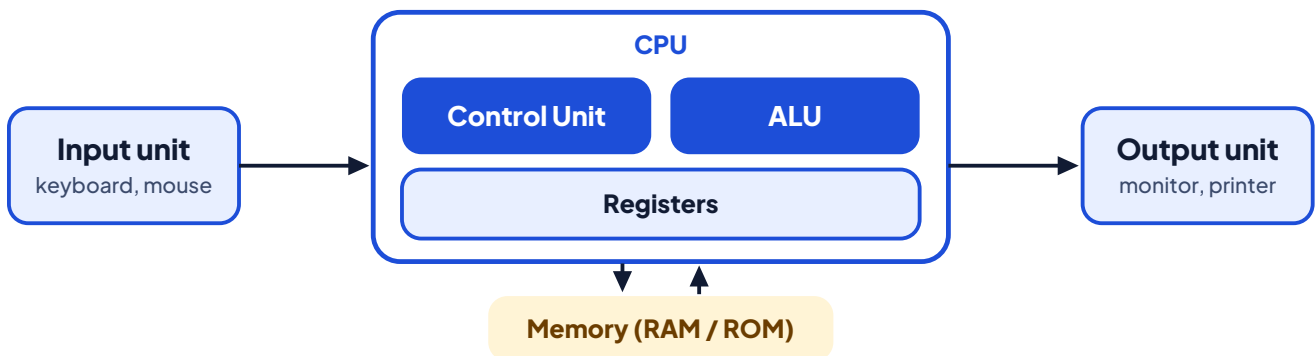
A computer is an electronic machine that accepts data (input), processes it according to a set of instructions (program), stores it, and produces useful results (output).

The word "computer" comes from the Latin word "computare", which means "to calculate".

REMEMBER FOR EXAM

Charles Babbage is called the "Father of the Computer". He designed the Difference Engine and the Analytical Engine.

DIAGRAM · BLOCK DIAGRAM OF A COMPUTER



- **1. Input** – you give data with a keyboard, mouse or scanner.
- **2. Process** – the CPU works on it: the Control Unit directs, the ALU calculates.
- **3. Store** – data and results are kept in memory (RAM) and storage.
- **4. Output** – the result is shown on a monitor or printed. This is the IPO cycle.

THE IPO CYCLE

Every computer works on the IPO cycle — Input → Process → Output — with Storage supporting every step.

Stage	What happens	Example
Input	Data and instructions enter the computer	Typing on a keyboard
Process	The CPU works on the data	Adding two numbers
Output	The result is shown or printed	Answer on the monitor
Storage	Data is saved for later use	Saving a file on SSD

DATA VS INFORMATION

- **Data:** raw facts and figures with no meaning on their own (e.g. 45, 67, 89)

- ▶ Information: processed, organised data that is meaningful (e.g. "Average marks = 67")
- ▶ GIGO: Garbage In, Garbage Out — wrong input always gives wrong output

CHARACTERISTICS OF A COMPUTER

- ▶ Speed: performs millions of instructions per second; speed is measured in MIPS, FLOPS or clock speed (GHz)
- ▶ Accuracy: results are accurate if input and program are correct
- ▶ Diligence: works for hours without tiredness or loss of concentration
- ▶ Versatility: can do many different types of work
- ▶ Storage: can store huge amounts of data permanently
- ▶ No IQ: a computer cannot think on its own; it only follows instructions
- ▶ No feelings: it cannot take decisions based on emotions

BLOCK DIAGRAM OF A COMPUTER

The basic parts of a computer are the Input Unit, the Central Processing Unit (CPU), the Memory Unit and the Output Unit.

- ▶ Input Unit: keyboard, mouse, scanner
- ▶ CPU: ALU (Arithmetic Logic Unit) + CU (Control Unit) + Registers
- ▶ Memory Unit: primary memory (RAM, ROM) and secondary storage (HDD, SSD)
- ▶ Output Unit: monitor, printer, speaker

TYPES OF COMPUTERS BY WORKING PRINCIPLE

Type	Works on	Example
Analog	Continuous physical quantities (temperature, pressure, voltage)	Speedometer, thermometer, seismograph
Digital	Discrete values — binary 0 and 1	Laptop, desktop, calculator
Hybrid	Both analog and digital	ICU patient-monitoring machines, petrol pump machines

TYPES OF COMPUTERS BY SIZE AND POWER

Type	Key facts	Examples
Supercomputer	Fastest and most powerful; speed measured in FLOPS; used for weather forecasting, research, nuclear simulation	PARAM (India), Frontier, Fugaku
Mainframe	Large; supports thousands of users at once; used by banks, railways, airlines	IBM zSeries
Minicomputer	Medium size; multi-user; used by small organisations	PDP-11
Microcomputer	Personal computer with a microprocessor; single user	Desktop, laptop, tablet, smartphone

REMEMBER FOR EXAM

PARAM 8000 (1991) was India's first supercomputer, developed by C-DAC, Pune. Vijay Bhatkar is called the father of Indian supercomputers.

TYPES OF COMPUTERS BY PURPOSE

- ▶ General purpose: can do many kinds of tasks (PCs, laptops)
- ▶ Special purpose: designed for one task (ATM machine, traffic-light controller, washing-machine controller)

HARDWARE, SOFTWARE, FIRMWARE, LIVEWARE

- ▶ Hardware: physical parts you can touch — keyboard, CPU, monitor
- ▶ Software: programs that tell the hardware what to do — Windows, MS Word
- ▶ Firmware: software permanently stored in hardware (in ROM) — BIOS
- ▶ Liveware: the people who use the computer — users, programmers

EXAM FOCUS

- ▶ The "brain" of the computer is the CPU; the "heart" of the computer is often said to be the motherboard
- ▶ Microprocessor = the whole CPU on a single chip; the first microprocessor was Intel 4004 (1971)
- ▶ Computer speed is measured in hertz (clock speed), MIPS (instructions) and FLOPS (supercomputers)
- ▶ A computer cannot work without an operating system; it cannot think without a program

ONE-LINERS ASKED IN EXAMS

1. Who is known as the "Father of the Computer" → **Charles Babbage**
2. Raw facts and figures that have not been processed are called → **Data**
3. What does GIGO stand for → **Garbage In, Garbage Out**
4. Which part of the computer is called its "brain" → **CPU**
5. The CPU consists of → **ALU and Control Unit (with registers)**



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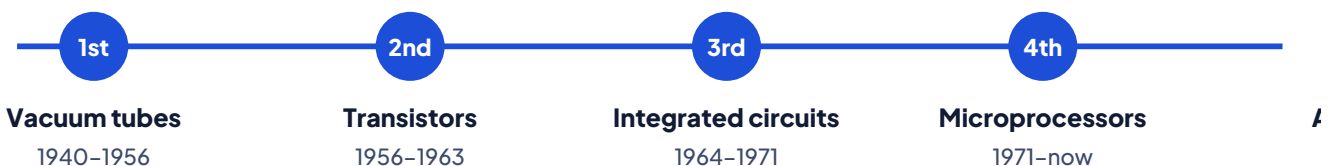
EARLY CALCULATING DEVICES

Device	Inventor	Year / Period	Key fact
Abacus	China (also Babylon)	About 3000 BC	First known calculating device; uses beads on rods
Napier's Bones	John Napier	1617	Used for multiplication and division
Slide Rule	William Oughtred	1622	Based on logarithms
Pascaline	Blaise Pascal	1642	First mechanical adding machine
Stepped Reckoner	Gottfried Leibniz	1673	Could add, subtract, multiply and divide
Jacquard Loom	Joseph Marie Jacquard	1801	Used punched cards to control weaving patterns
Difference Engine	Charles Babbage	1822	Mechanical calculator for tables
Analytical Engine	Charles Babbage	1837	First design of a general-purpose programmable computer
Tabulating Machine	Herman Hollerith	1890	Used punched cards for the US census; his company later became IBM

REMEMBER FOR EXAM

Lady Ada Lovelace wrote the first algorithm for Babbage's Analytical Engine, so she is called the world's first computer programmer.

DIAGRAM · GENERATIONS OF COMPUTERS



- Each generation is named after the main electronic part used inside it.
- **ENIAC** (1st generation) used about 18,000 vacuum tubes; the **microprocessor** (4th) put a whole CPU on one chip.

FAMOUS EARLY ELECTRONIC COMPUTERS

- **ENIAC** (1946): Electronic Numerical Integrator and Computer — first general-purpose electronic digital computer; built by J. Presper Eckert and John Mauchly; used about 18,000 vacuum tubes
- **EDVAC**: Electronic Discrete Variable Automatic Computer — based on von Neumann's stored-program idea

- ▶ EDSAC (1949): Electronic Delay Storage Automatic Calculator — one of the first practical stored-program computers
- ▶ UNIVAC I (1951): Universal Automatic Computer — first commercial computer in the USA
- ▶ Mark I (1944): electromechanical computer built by Howard Aiken with IBM

THE FIVE GENERATIONS OF COMPUTERS

Generation	Period (approx.)	Main technology	Language	Examples
First	1940–1956	Vacuum tubes	Machine language	ENIAC, EDVAC, UNIVAC I
Second	1956–1963	Transistors	Assembly language; early FORTRAN and COBOL	IBM 1401, IBM 7094
Third	1964–1971	Integrated Circuits (IC)	High-level languages	IBM 360 series
Fourth	1971–present	Microprocessor (VLSI)	High-level languages, GUI	Personal computers, Apple Macintosh
Fifth	Present and future	Artificial Intelligence (ULSI), parallel processing	AI languages, natural language	Robots, expert systems, AI assistants

KEY FACTS BY GENERATION

- ▶ First generation: very large, consumed a lot of power, produced a lot of heat; used magnetic drums for memory and punched cards for input
- ▶ Second generation: transistor invented in 1947 at Bell Labs (Shockley, Bardeen, Brattain); used magnetic-core memory
- ▶ Third generation: Integrated Circuit invented by Jack Kilby (1958) and Robert Noyce; keyboards and monitors began to be used; operating systems appeared
- ▶ Fourth generation: microprocessor — the whole CPU on one chip (Intel 4004, 1971); personal computers and networks grew
- ▶ Fifth generation: aims at computers that can learn and reason; based on AI, ULSI and parallel processing

COMPUTERS IN INDIA

- ▶ TIFRAC (1960): first computer designed and built in India, at the Tata Institute of Fundamental Research (TIFR), Mumbai
- ▶ Siddharth: first Indian-made personal/mini computer series, made by ECIL
- ▶ PARAM 8000 (1991): first Indian supercomputer, by C-DAC Pune
- ▶ National Supercomputing Mission (NSM) is building PARAM supercomputers across India

EXAM FOCUS

- ▶ Father of the computer: Charles Babbage; first programmer: Ada Lovelace

- ▶ Father of modern computer science and AI theory: Alan Turing (Turing machine, Turing test)
- ▶ Von Neumann gave the "stored program concept" — programs and data stored together in memory
- ▶ Vacuum tube → transistor → IC → microprocessor → AI: the order of generations

ONE-LINERS ASKED IN EXAMS

1. The main electronic component used in first-generation computers was → **Vacuum tube**
2. Integrated Circuits (ICs) were the main technology of which generation → **Third**
3. Who is regarded as the world's first computer programmer → **Ada Lovelace**
4. ENIAC stands for → **Electronic Numerical Integrator and Computer**
5. The first computer designed and built in India was → **TIFRAC**



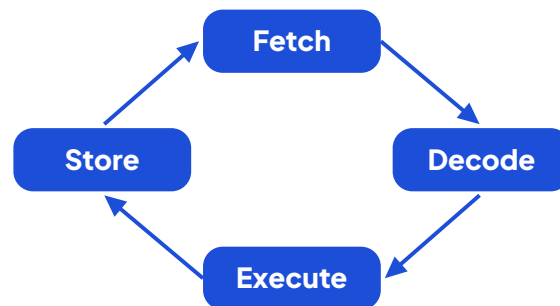
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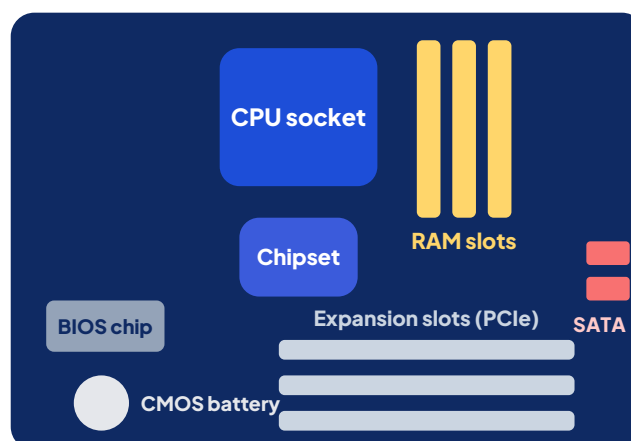
**CENTRAL PROCESSING UNIT (CPU)**

The CPU (also called the processor) carries out all instructions of a program. It is called the brain of the computer.

- ▶ **ALU (Arithmetic Logic Unit)**: does arithmetic (+, −, ×, ÷) and logical operations (AND, OR, NOT, comparisons)
- ▶ **CU (Control Unit)**: directs and coordinates all parts of the computer; fetches and decodes instructions; it does not process data itself
- ▶ **Registers**: very small, very fast storage inside the CPU

DIAGRAM · MACHINE CYCLE (INSTRUCTION CYCLE)

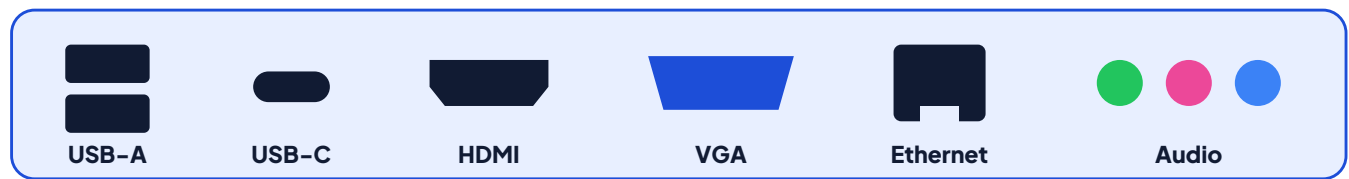
- ▶ **Fetch** the instruction from memory → **Decode** what it means → **Execute** it (the ALU works here) → **Store** the result.
- ▶ The CPU repeats these 4 steps for every instruction, billions of times a second.

DIAGRAM · PARTS OF A MOTHERBOARD

- ▶ **CPU socket** holds the processor; **RAM slots** hold memory sticks; the **chipset** controls data flow.
- ▶ **BIOS / UEFI chip** starts the computer (booting); the **CMOS battery** keeps date, time and BIOS settings.
- ▶ **Expansion slots (PCIe)** add graphics, sound or network cards; **SATA** ports connect hard disks and

SSDs.

DIAGRAM · PORTS ON THE BACK PANEL



► **USB** (Universal Serial Bus) – keyboard, mouse, pen drive; USB-C is reversible. **HDMI** – digital video + audio to a monitor or TV.

► **VGA** – older analog video, 15 pins. **Ethernet (RJ-45)** – wired internet; RJ-11 is the smaller telephone port.

► **Audio** – green = speakers / headphones, pink = microphone, blue = line-in.

MACHINE CYCLE (INSTRUCTION CYCLE)

The CPU repeats four steps for every instruction:

Step	What happens
Fetch	Get the instruction from memory
Decode	Understand what the instruction means
Execute	Carry out the instruction (ALU works here)
Store	Write the result back to memory or a register

IMPORTANT CPU REGISTERS

Register	Full form	Job
PC	Program Counter	Holds the address of the next instruction
IR	Instruction Register	Holds the instruction being executed
MAR	Memory Address Register	Holds the memory address to read or write
MBR / MDR	Memory Buffer / Data Register	Holds the data read from or written to memory
ACC	Accumulator	Holds intermediate results of the ALU

PROCESSOR SPEED AND CORES

- Clock speed: measured in hertz — today usually in GHz (gigahertz = billions of cycles per second)
- Core: an independent processing unit inside the CPU; dual-core = 2, quad-core = 4, octa-core = 8
- Word size: number of bits a CPU processes at once — 32-bit or 64-bit
- Major CPU makers: Intel (Core i3/i5/i7/i9), AMD (Ryzen), Apple (M-series), Qualcomm (Snapdragon for phones)

REMEMBER FOR EXAM

GPU (Graphics Processing Unit) handles images and video; it is also used for AI work. NVIDIA and

AMD are leading GPU makers.

MOTHERBOARD

The motherboard is the main circuit board of the computer. Every component connects to it.

- ▶ It holds the CPU socket, RAM slots, chipset, BIOS/UEFI chip, expansion slots and ports
- ▶ Other names: mainboard, system board, logic board
- ▶ A CMOS battery on the motherboard keeps the date, time and BIOS settings when the computer is off

BUSES

A bus is a set of wires that carries signals between parts of the computer.

- ▶ Data bus: carries data (two-way)
- ▶ Address bus: carries memory addresses (one-way, from CPU)
- ▶ Control bus: carries control signals such as read/write

BIOS, UEFI AND BOOTING

- ▶ BIOS: Basic Input Output System — firmware stored in ROM that starts the computer
- ▶ UEFI: Unified Extensible Firmware Interface — the modern replacement of BIOS
- ▶ POST: Power-On Self-Test — the first check BIOS runs to test hardware when the computer starts
- ▶ Booting: the process of starting a computer and loading the operating system
- ▶ Cold booting: starting the computer from power OFF; warm booting: restarting it while it is on (Ctrl + Alt + Del / Restart)

PORTS AND CONNECTORS

Port	Used for
USB (Universal Serial Bus)	Pen drives, keyboards, mice, phones; USB Type-C is reversible
HDMI	High-Definition video + audio to TV or monitor
VGA	Older analog video port for monitors
Ethernet (RJ-45)	Wired network / internet cable
RJ-11	Telephone line / DSL modem
PS/2	Older keyboard (purple) and mouse (green) port
Audio jack (3.5 mm)	Headphones, speakers, microphone
Serial port	Old modems, mouse — sends one bit at a time
Parallel port	Old printers — sends several bits at once

EXAM FOCUS

- ▶ ALU = calculations and logic; CU = control and coordination
- ▶ Program Counter holds the address of the next instruction
- ▶ POST is done by the BIOS; CMOS battery keeps the clock and BIOS settings
- ▶ USB was introduced in 1996; HDMI carries both audio and video

ONE-LINERS ASKED IN EXAMS

1. Which part of the CPU performs arithmetic and logical operations → **ALU**
2. Which unit of the CPU directs and coordinates all the operations of the computer → **Control Unit**
3. The register that holds the address of the next instruction to be executed is → **Program Counter**
4. The speed of a modern processor is usually measured in → **GHz**
5. The test a computer runs on its hardware when it is switched on is called → **POST**



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Input Devices

WHAT IS AN INPUT DEVICE?

An input device sends data and instructions into the computer. The computer converts this input into binary (0s and 1s).

KEYBOARD

- ▶ The most common input device; a standard keyboard has about 104 keys
- ▶ QWERTY layout was designed by Christopher Latham Sholes (1870s) for typewriters
- ▶ Keys: alphanumeric, function keys (F1–F12), modifier keys (Shift, Ctrl, Alt), toggle keys (Caps Lock, Num Lock, Scroll Lock), navigation keys (arrows, Home, End, Page Up, Page Down)
- ▶ F and J keys have small bumps to help touch typists find the home row

MOUSE AND POINTING DEVICES

- ▶ Mouse: invented by Douglas Engelbart (1960s); a pointing device that controls the cursor; types — mechanical (ball), optical, laser, wireless
- ▶ Mouse actions: click, double-click, right-click (shortcut menu), drag and drop, scroll
- ▶ Trackball: an upside-down mouse; the ball is rolled with the thumb
- ▶ Touchpad / trackpad: used on laptops
- ▶ Joystick: used in games, flight simulators and to control cranes and robots
- ▶ Light pen: a pen-shaped device used to draw or select directly on a screen
- ▶ Stylus: used with touch screens and graphic tablets

SCANNING AND READING DEVICES

Device	Full form	Reads / used for
Scanner	—	Converts paper documents and photos into digital images
OCR	Optical Character Recognition	Reads printed or handwritten text and converts it into editable text
OMR	Optical Mark Reader / Recognition	Reads pencil or pen marks — used for checking objective (bubble) answer sheets
MICR	Magnetic Ink Character Recognition	Reads characters printed with magnetic ink — used by banks to process cheques
BCR	Bar Code Reader	Reads bar codes on products at shop counters
QR code scanner	Quick Response code	Reads 2D codes — used for UPI payments
RFID reader	Radio Frequency Identification	Reads RFID tags — FASTag at toll plazas

REMEMBER FOR EXAM

MICR is used in banking for cheque processing. The 9-digit MICR code at the bottom of a cheque identifies the bank and branch.

OTHER INPUT DEVICES

- ▶ Microphone: audio input; used with speech-recognition software
- ▶ Webcam / digital camera: video and image input
- ▶ Touch screen: works as both input and output device
- ▶ Graphic tablet (digitizer): converts hand drawings into digital form
- ▶ Biometric devices: read fingerprints, iris, face or voice — used in Aadhaar authentication and AePS
- ▶ Sensors: temperature, motion and light sensors give input to embedded systems

DEVICES THAT ARE BOTH INPUT AND OUTPUT

- ▶ Touch screen, modem, network card, headset with microphone, multi-function printer (scan + print)

EXAM FOCUS

- ▶ MICR = banks (cheques); OMR = exams (answer sheets); OCR = converts text in images into editable text; BCR = bar codes in shops
- ▶ Douglas Engelbart invented the mouse; Christopher Latham Sholes designed QWERTY
- ▶ A touch screen is both an input and an output device

ONE-LINERS ASKED IN EXAMS

1. Which device is used by banks to read the characters printed on cheques → **MICR**
2. Which device is used to check objective-type (bubble) answer sheets in competitive exams → **OMR**
3. Software or a device that converts the text in a scanned image into editable text uses → **OCR**
4. Who invented the computer mouse → **Douglas Engelbart**
5. The QWERTY keyboard layout was designed by → **Christopher Latham Sholes**



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Output Devices

WHAT IS AN OUTPUT DEVICE?

An output device shows or delivers the result of processing to the user — as soft copy (on screen) or hard copy (on paper).

- ▶ Soft copy: output seen on a screen; it is temporary
- ▶ Hard copy: output printed on paper; it is permanent

MONITORS (VISUAL DISPLAY UNIT)

Type	Full form	Key fact
CRT	Cathode Ray Tube	Old, bulky monitors; use an electron gun
LCD	Liquid Crystal Display	Flat; needs a backlight
LED	Light Emitting Diode	LCD panel lit by LEDs; thinner and saves power
OLED	Organic LED	Each pixel makes its own light; true black; used in phones
Plasma	—	Used in older large TVs

- ▶ Pixel: the smallest dot on a screen (Picture Element)
- ▶ Resolution: number of pixels — e.g. 1920 × 1080 (Full HD), 3840 × 2160 (4K)
- ▶ Refresh rate: how many times per second the screen redraws — measured in hertz (Hz)
- ▶ Screen size is measured diagonally, in inches

PRINTERS

IMPACT PRINTERS (STRIKE THE PAPER — NOISY)

- ▶ Dot matrix printer: prints with pins striking an ink ribbon; speed measured in CPS (characters per second); used for bills and multi-part forms
- ▶ Daisy wheel printer: letter-quality text; cannot print graphics
- ▶ Line printer: prints one full line at a time; speed in LPM (lines per minute)

NON-IMPACT PRINTERS (NO STRIKING — QUIET)

- ▶ Inkjet printer: sprays tiny drops of liquid ink; good for colour photos
- ▶ Laser printer: uses a laser, a drum and toner powder; fast and sharp; speed in PPM (pages per minute)
- ▶ Thermal printer: uses heat-sensitive paper — ATM slips, bus tickets, billing receipts

REMEMBER FOR EXAM

Printer resolution (quality) is measured in DPI — Dots Per Inch.

OTHER OUTPUT DEVICES

- ▶ Plotter: prints large drawings, maps, engineering designs and banners (drum and flatbed types)
- ▶ Speaker and headphones: sound output
- ▶ Projector: shows the screen image on a large surface
- ▶ 3D printer: builds solid objects layer by layer
- ▶ Braille embosser: prints Braille for visually impaired readers

EXAM FOCUS

- ▶ Soft copy = screen; hard copy = paper
- ▶ Dot matrix is an impact printer; laser and inkjet are non-impact printers
- ▶ Speed units: CPS (dot matrix), LPM (line printer), PPM (laser); quality: DPI
- ▶ Plotters are used for large engineering drawings and maps

ONE-LINERS ASKED IN EXAMS

1. Output printed on paper is called → **Hard copy**
2. Which of these is an impact printer → **Dot matrix printer**
3. Printer resolution is measured in → **DPI**
4. The speed of a laser printer is usually measured in → **PPM**
5. Which device is used to print large engineering drawings and maps → **Plotter**



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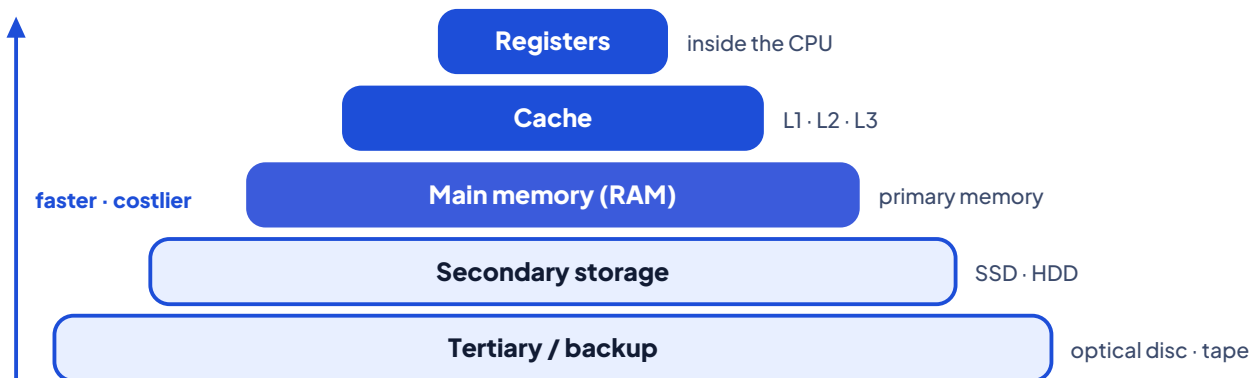
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WHAT IS MEMORY?

Memory stores data and instructions. A computer uses different types of memory, from very small and very fast (inside the CPU) to very large and slower (hard disk).

DIAGRAM · MEMORY HIERARCHY



► Higher in the pyramid = **faster and costlier** per byte but **smaller**; lower = **slower, cheaper and bigger**.

► Registers and cache sit closest to the CPU; RAM is the main (primary) memory; SSD / HDD keep data permanently.

PRIMARY VS SECONDARY MEMORY

Feature	Primary memory	Secondary memory
Also called	Main / internal memory	Auxiliary / external / backup storage
Examples	RAM, ROM, cache, registers	Hard disk, SSD, pen drive, CD/DVD, memory card
Speed	Fast	Slower
Capacity	Smaller	Much larger
Cost per GB	Higher	Lower
CPU access	CPU accesses it directly	CPU cannot access it directly; data is first loaded into RAM
Volatility	RAM is volatile; ROM is non-volatile	Non-volatile

VOLATILE VS NON-VOLATILE

► Volatile memory loses its data when power is switched off — RAM, cache, registers

► Non-volatile memory keeps data without power — ROM, hard disk, SSD, flash memory, CD/DVD

MEMORY HIERARCHY (FASTEST TO SLOWEST)

Level	Memory	Speed	Size
1	Registers	Fastest	Smallest
2	Cache (L1 → L2 → L3)	Very fast	Very small
3	RAM (main memory)	Fast	Medium
4	SSD / flash storage	Slower	Large
5	Hard disk (HDD)	Slower still	Large
6	Optical disc / magnetic tape	Slowest	Very large (tape) / small (CD)

REMEMBER FOR EXAM

Speed and cost per byte go DOWN as we move down the hierarchy; capacity goes UP.

WAYS OF ACCESSING DATA

- ▶ Random / direct access: any location can be reached directly — RAM, hard disk, SSD
- ▶ Sequential access: data is read in order, one after another — magnetic tape

SEMICONDUCTOR MEMORY

- ▶ Primary memory is built from semiconductor chips, so it is also called semiconductor memory
- ▶ Flash memory (pen drives, SSDs) is also semiconductor memory, but it is used as secondary storage

EXAM FOCUS

- ▶ Registers are the fastest memory; magnetic tape is the slowest common storage
- ▶ RAM is volatile; ROM is non-volatile
- ▶ The CPU can directly access only primary memory
- ▶ Magnetic tape uses sequential access; it is used for backups and archives

ONE-LINERS ASKED IN EXAMS

1. Which memory is the fastest in a computer → **Registers**
2. Which of these is volatile memory → **RAM**
3. Secondary memory is also called → **Auxiliary memory**
4. Which memory can the CPU access directly → **Primary memory (RAM)**
5. Magnetic tape stores and reads data by → **Sequential access**



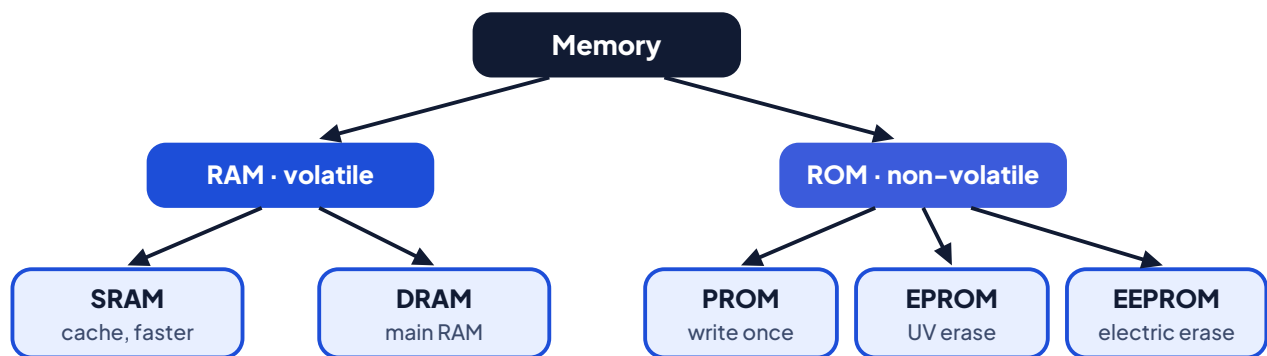
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**RAM — RANDOM ACCESS MEMORY**

RAM is the computer's working memory. It holds the programs and data being used right now. It is volatile — everything in it is lost when the power goes off.

- ▶ Read and write memory: data can be read and changed
- ▶ More RAM lets you run more programs at the same time
- ▶ RAM capacity is measured in GB; common sizes are 4 GB, 8 GB, 16 GB
- ▶ Dynamic RAM was invented by Robert H. Dennard at IBM (1966)

DIAGRAM · TYPES OF RAM AND ROM

- ▶ **RAM** loses its data when the power goes off (volatile); **ROM** keeps it (non-volatile).
- ▶ **SRAM** (static) is faster and used as cache; **DRAM** (dynamic) must be refreshed and is used as main memory.
- ▶ Flash memory (pen drives, SSDs) is a type of EEPROM.

TYPES OF RAM

Feature	SRAM (Static RAM)	DRAM (Dynamic RAM)
Built from	Flip-flops (transistors)	Capacitors (+ a transistor per bit)
Refreshing	Does not need refreshing	Must be refreshed thousands of times per second
Speed	Faster	Slower
Cost	Costlier	Cheaper
Density	Less	More (more data per chip)
Used as	Cache memory	Main memory (RAM sticks)

SDRAM AND DDR

- ▶ SDRAM: Synchronous DRAM — works in step with the system clock
- ▶ DDR SDRAM: Double Data Rate — transfers data twice per clock cycle

- Generations: DDR → DDR2 → DDR3 → DDR4 → DDR5; each is faster and uses less power
- LPDDR (Low-Power DDR) is used in mobile phones

ROM — READ ONLY MEMORY

ROM is non-volatile memory that keeps its data without power. It stores the instructions needed to start the computer.

- Stores firmware such as the BIOS / UEFI
- The process of writing data into a ROM chip is called "burning"
- ROM is used in calculators, washing machines, TVs and other embedded devices

TYPES OF ROM

Type	Full form	Can be changed?	How
MROM	Masked ROM	No	Data is written by the manufacturer during making
PROM	Programmable ROM	Once only	The user can program it one time (OTP — one-time programmable)
EPROM	Erasable Programmable ROM	Yes	Erased with ultraviolet (UV) light, then reprogrammed
EEPROM	Electrically Erasable Programmable ROM	Yes	Erased and rewritten with electric signals, byte by byte
Flash	(a type of EEPROM)	Yes	Erased electrically in blocks — pen drives, SSDs, phone storage

REMEMBER FOR EXAM

PROM was invented by Wen Tsing Chow (1956). EPROM was invented by Dov Frohman at Intel (1971).

RAM VS ROM

RAM	ROM
Volatile	Non-volatile
Read and write	Mainly read only
Temporary storage of running programs	Permanent storage of startup instructions
Larger capacity	Smaller capacity
Faster	Slower

EXAM FOCUS

- SRAM is used for cache; DRAM is used for main memory
- DRAM must be refreshed; SRAM need not be refreshed

- ▶ EPROM is erased by UV light; EEPROM is erased electrically
- ▶ BIOS is stored in ROM (flash ROM in modern PCs)

ONE-LINERS ASKED IN EXAMS

1. Which type of RAM is used to make cache memory → **SRAM**
2. Which RAM needs to be refreshed constantly → **DRAM**
3. EPROM can be erased using → **Ultraviolet light**
4. Which ROM can be erased and rewritten using electric signals → **EEPROM**
5. A PROM chip can be programmed by the user → **Only once**



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CACHE MEMORY

Cache is a very fast, small memory between the CPU and RAM. It stores data and instructions the CPU uses often, so the CPU does not wait for slower RAM.

- ▶ Made of SRAM
- ▶ Levels: L1 (inside each core, smallest and fastest), L2 (larger), L3 (shared by all cores, largest and slowest of the three)
- ▶ Cache hit: the data the CPU needs is found in cache
- ▶ Cache miss: the data is not in cache, so it is fetched from RAM

REGISTERS

- ▶ Registers are the smallest and fastest memory, inside the CPU
- ▶ They hold the data and instructions the CPU is using at this moment
- ▶ Register size equals the CPU's word size (for example 64 bits)
- ▶ A register is built from flip-flops; one flip-flop stores one bit

VIRTUAL MEMORY

Virtual memory lets a computer use part of the hard disk / SSD as if it were extra RAM.

- ▶ When RAM is full, less-used data is moved to a file on the disk (page file / swap file)
- ▶ Paging: memory is divided into fixed-size blocks called pages (in RAM, page frames)
- ▶ Thrashing: when the computer spends more time swapping pages than doing work, so it becomes very slow
- ▶ Virtual memory is slower than real RAM

BUFFER MEMORY

- ▶ A buffer is a temporary storage area that holds data while it moves between two devices working at different speeds
- ▶ Example: printer buffer (spooling), video buffering while streaming, keyboard buffer
- ▶ Spooling: Simultaneous Peripheral Operations On-Line — print jobs wait in a queue

OTHER SPECIAL MEMORIES

- ▶ Flash memory: non-volatile, electrically erasable memory used in pen drives and SSDs
- ▶ VRAM (Video RAM): memory on a graphics card for screen images
- ▶ CMOS memory: a small memory that stores BIOS settings, kept alive by the CMOS battery

EXAM FOCUS

- ▶ Cache uses SRAM; L1 is the fastest cache
- ▶ Virtual memory uses the hard disk to extend RAM; it is managed by the operating system
- ▶ Thrashing = too much paging
- ▶ Spooling is used with printers

ONE-LINERS ASKED IN EXAMS

1. Cache memory is placed between → **CPU and RAM**
2. Which level of cache is the fastest → **L1**
3. When the CPU finds the needed data in cache, it is called a → **Cache hit**
4. Virtual memory uses which device to extend RAM → **Hard disk / SSD**
5. Excessive swapping of pages between RAM and disk, which slows the computer, is called → **Thrashing**



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Secondary Storage Devices

WHAT IS SECONDARY STORAGE?

Secondary storage keeps data permanently, even when the computer is off. It is non-volatile, larger and cheaper than RAM, but slower.

MAGNETIC STORAGE

HARD DISK DRIVE (HDD)

- ▶ Stores data magnetically on spinning metal platters coated with magnetic material
- ▶ A read/write head moves over the platters on an arm
- ▶ The first hard disk was the IBM 350 (RAMAC), introduced in 1956
- ▶ Speed of spinning is measured in RPM — common speeds are 5400 and 7200 RPM
- ▶ Track: a circle on the platter; Sector: a part of a track (the smallest storage unit on the disk); Cylinder: the same track on all platters
- ▶ Seek time: time to move the head to the right track; Latency: time for the sector to rotate under the head; Access time = seek time + latency
- ▶ Formatting prepares a disk for use by creating tracks, sectors and a file system

FLOPPY DISK

- ▶ Old portable magnetic storage; the 3.5-inch floppy held 1.44 MB
- ▶ Invented by IBM (1971); now obsolete

MAGNETIC TAPE

- ▶ Sequential-access storage; very cheap per GB; used for large backups and archives

SOLID STATE STORAGE

- ▶ SSD (Solid State Drive): uses flash memory, no moving parts; much faster, quieter and more shock-proof than HDD
- ▶ NVMe SSDs connect through PCIe and are faster than SATA SSDs
- ▶ Pen drive (USB flash drive): portable flash storage
- ▶ Memory card (SD, microSD): used in phones and cameras

OPTICAL STORAGE (READ WITH A LASER)

Disc	Typical capacity	Notes
------	------------------	-------

CD (Compact Disc)	700 MB	Infrared laser; CD-ROM, CD-R (write once), CD-RW (rewritable)
DVD (Digital Versatile Disc)	4.7 GB (single layer), 8.5 GB (dual layer)	Red laser
Blu-ray Disc	25 GB (single layer), 50 GB (dual layer)	Blue-violet laser — shorter wavelength stores more

REMEMBER FOR EXAM

ROM = read only; R = Recordable once (WORM — Write Once Read Many); RW = ReWritable many times.

CLOUD STORAGE

- ▶ Data is stored on remote internet servers and accessed online
- ▶ Examples: Google Drive, OneDrive, Dropbox, iCloud, DigiLocker (Government of India)

EXAM FOCUS

- ▶ Sector is the smallest unit of storage on a disk
- ▶ HDD speed is in RPM; SSD has no moving parts
- ▶ CD 700 MB, DVD 4.7 GB, Blu-ray 25 GB (single layer)
- ▶ CD-R is a WORM medium; magnetic tape is sequential access

ONE-LINERS ASKED IN EXAMS

1. The smallest storage unit on a hard disk track is the → **Sector**
2. The rotation speed of a hard disk is measured in → **RPM**
3. Which storage device has no moving parts → **SSD**
4. The typical capacity of a standard CD is → **700 MB**
5. A single-layer DVD typically holds → **4.7 GB**



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BITS AND BYTES

- ▶ Bit (Binary Digit): the smallest unit of data — 0 or 1
- ▶ Nibble: 4 bits
- ▶ Byte: 8 bits — enough to store one character (such as "A")
- ▶ Word: the number of bits a CPU processes at once (16, 32 or 64 bits)

DIAGRAM · MEMORY UNITS LADDER



- ▶ Smallest unit: **bit** (0 or 1). **8 bits = 1 byte**, then each step up is **1024 times** bigger (2^{10}).
- ▶ After PB come EB (exabyte), ZB (zettabyte) and YB (yottabyte).

MEMORY UNIT CHART (BINARY SYSTEM — USED INSIDE COMPUTERS)

Unit	Equal to
1 Nibble	4 bits
1 Byte	8 bits
1 Kilobyte (KB)	1024 bytes
1 Megabyte (MB)	1024 KB
1 Gigabyte (GB)	1024 MB
1 Terabyte (TB)	1024 GB
1 Petabyte (PB)	1024 TB
1 Exabyte (EB)	1024 PB
1 Zettabyte (ZB)	1024 EB
1 Yottabyte (YB)	1024 ZB

REMEMBER FOR EXAM

Memory trick for the order of units — "Kids Make Great Toys, Playing Every Zone Yearly" = K, M, G, T, P, E, Z, Y.

DECIMAL VS BINARY UNITS

- ▶ Storage makers use decimal units: 1 KB = 1000 bytes, 1 GB = 10^9 bytes
- ▶ Computers use binary units: 1 KiB = 1024 bytes (2^{10})
- ▶ This is why a "1 TB" drive shows only about 931 GB in Windows
- ▶ IEC binary names: KiB (kibibyte), MiB (mebibyte), GiB (gibibyte), TiB (tebibyte)

POWERS OF 2 TO REMEMBER

Unit	Bytes as power of 2
1KB	2^{10} bytes
1MB	2^{20} bytes
1GB	2^{30} bytes
1TB	2^{40} bytes

DATA TRANSFER UNITS

- ▶ Internet speed is measured in bits per second (bps): Kbps, Mbps, Gbps
- ▶ Note: Mbps (megabits) is different from MBps (megabytes); 8 Mbps = 1 MBps

EXAM FOCUS

- ▶ 1 byte = 8 bits; 1 nibble = 4 bits
- ▶ 1 KB = 1024 bytes = 2^{10} bytes
- ▶ The largest standard unit is the yottabyte (newer ronnabyte and quettabyte were added in 2022)
- ▶ Internet speed uses bits; file size uses bytes

ONE-LINERS ASKED IN EXAMS

1. How many bits make one byte → **8**
2. 4 bits together are called a → **Nibble**
3. 1 KB is equal to → **1024 bytes**
4. 1 GB is equal to → **1024 MB**
5. Which of these is the largest → **Petabyte**



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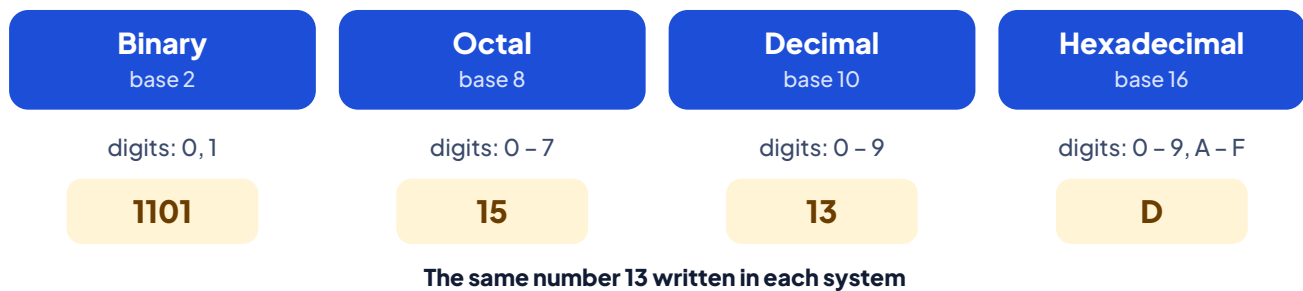
TYPES OF NUMBER SYSTEMS

System	Base	Digits used	Example
Binary	2	0, 1	$(1011)_2$
Octal	8	0 to 7	$(17)_8$
Decimal	10	0 to 9	$(25)_{10}$
Hexadecimal	16	0–9 and A–F (A=10, B=11, C=12, D=13, E=14, F=15)	$(1F)_{16}$

REMEMBER FOR EXAM

Computers understand only binary. One octal digit = 3 bits; one hexadecimal digit = 4 bits.

DIAGRAM · NUMBER SYSTEMS



► Decimal → binary: divide by 2 and read the remainders from bottom to top (13 → 1101).

► Binary → octal: group bits in 3s (001 101 → 15); binary → hex: group in 4s (1101 → D). A = 10 ... F = 15.

BINARY TO DECIMAL

Multiply each bit by 2 raised to its position (from the right, starting at 0) and add.

Example: $(1011)_2 = 1 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 1 = 11$

DECIMAL TO BINARY

Divide by 2 repeatedly and write the remainders from bottom to top.

Example: $13 \div 2 = 6 \text{ r}1$; $6 \div 2 = 3 \text{ r}0$; $3 \div 2 = 1 \text{ r}1$; $1 \div 2 = 0 \text{ r}1 \rightarrow (1101)_2$

OCTAL AND HEXADECIMAL CONVERSIONS

► Binary → octal: group bits in 3s from the right. $(110\ 101)_2 = (65)_8$

► Binary → hex: group bits in 4s from the right. $(1010\ 1111)_2 = (AF)_{16}$

► Hex → decimal: $(2A)_{16} = 2 \times 16 + 10 = 42$

► Octal → decimal: $(17)_8 = 1 \times 8 + 7 = 15$

BINARY ARITHMETIC

Addition	Result
0 + 0	0
0 + 1	1
1 + 0	1
1 + 1	10 (0, carry 1)
1 + 1 + 1	11 (1, carry 1)

1'S AND 2'S COMPLEMENT (FOR NEGATIVE NUMBERS)

- 1's complement: change every 0 to 1 and every 1 to 0. 1's complement of 1010 is 0101
- 2's complement: 1's complement + 1. 2's complement of 1010 is 0110
- Computers use 2's complement to store negative numbers and to subtract

CHARACTER CODES

Code	Full form	Bits
ASCII	American Standard Code for Information Interchange	7 bits (128 characters); extended ASCII uses 8 bits
EBCDIC	Extended Binary Coded Decimal Interchange Code	8 bits; used in IBM mainframes
Unicode	—	Up to 32 bits; covers all world scripts including Hindi and emojis
BCD	Binary Coded Decimal	4 bits per decimal digit

EXAM FOCUS

- Base: binary 2, octal 8, decimal 10, hexadecimal 16
- Hex F = 15; hex A = 10
- ASCII of "A" = 65, "a" = 97, "0" = 48
- 2's complement = 1's complement + 1

ONE-LINERS ASKED IN EXAMS

1. The base of the hexadecimal number system is → **16**
2. The binary number 1011 equals which decimal number → **11**
3. The decimal number 13 in binary is → **1101**
4. In hexadecimal, the letter F represents → **15**
5. How many bits represent one octal digit → **3**



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WHAT IS A LOGIC GATE?

A logic gate is a basic electronic circuit that takes one or more binary inputs (0 or 1) and gives one output. All digital circuits, including the CPU, are built from logic gates.

- ▶ Boolean algebra (the maths of 0 and 1) was developed by George Boole
- ▶ 1 = TRUE / ON / HIGH; 0 = FALSE / OFF / LOW

DIAGRAM · TRUTH TABLE OF ALL GATES

A	B	AND	OR	NAND	NOR	XOR	XNOR
0	0	0	0	1	1	0	1
0	1	0	1	1	0	1	0
1	0	0	1	1	0	1	0
1	1	1	1	0	0	0	1

- ▶ **AND** = 1 only if all inputs are 1. **OR** = 1 if any input is 1. **NOT** flips the input (0 → 1, 1 → 0).
- ▶ **NAND and NOR are universal gates**: any other gate can be built from them alone.
- ▶ **XOR** = 1 when the inputs are different; **XNOR** = 1 when they are the same.

BASIC GATES

Gate	Symbol in expression	Output is 1 when
AND	$A \cdot B$	All inputs are 1
OR	$A + B$	At least one input is 1
NOT	A' or $\bar{A}$	The input is 0 (it inverts the input; only one input)

DERIVED GATES

Gate	Meaning	Output is 1 when
NAND	NOT of AND	At least one input is 0
NOR	NOT of OR	All inputs are 0
XOR	Exclusive OR	Inputs are different
XNOR	Exclusive NOR	Inputs are the same

REMEMBER FOR EXAM

NAND and NOR are called Universal Gates — any other gate can be built using only NAND gates or only NOR gates.

TRUTH TABLE (TWO INPUTS A AND B)

A	B	AND	OR	NAND	NOR	XOR	XNOR
0	0	0	0	1	1	0	1
0	1	0	1	1	0	1	0
1	0	0	1	1	0	1	0
1	1	1	1	0	0	0	1

IMPORTANT BOOLEAN LAWS

- Identity: $A + 0 = A$; $A \cdot 1 = A$
- Null: $A + 1 = 1$; $A \cdot 0 = 0$
- Idempotent: $A + A = A$; $A \cdot A = A$
- Complement: $A + A' = 1$; $A \cdot A' = 0$
- Double negation: $(A')' = A$
- De Morgan's theorems: $(A \cdot B)' = A' + B'$ and $(A + B)' = A' \cdot B'$

EXAM FOCUS

- AND = multiplication; OR = addition; NOT = inversion
- Universal gates: NAND and NOR
- XOR gives 1 only when inputs differ
- A truth table with n inputs has 2^n rows

ONE-LINERS ASKED IN EXAMS

1. Which gates are called universal gates → **NAND and NOR**
2. The output of an AND gate is 1 only when → **All inputs are 1**
3. The output of an OR gate is 0 only when → **All inputs are 0**
4. Which gate has only one input → **NOT**
5. An XOR gate gives output 1 when → **The inputs are different**



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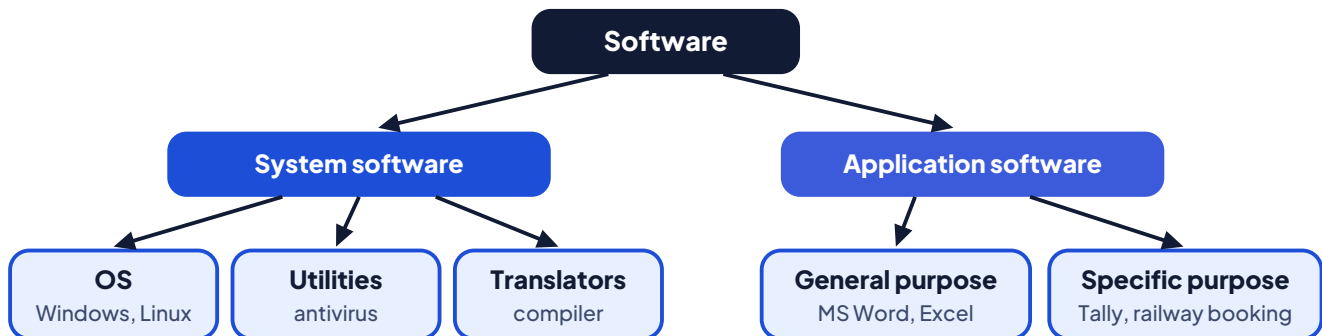
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WHAT IS SOFTWARE?

Software is a set of programs (instructions) that tells the computer what to do. Unlike hardware, software cannot be touched.

DIAGRAM · TYPES OF SOFTWARE



- **System software** runs the computer itself; **application software** does a job for the user.
- Device drivers and firmware are also system software. Freeware is free to use; open-source software also shares its code.

MAIN TYPES OF SOFTWARE

Type	Purpose	Examples
System software	Runs and manages the computer hardware	Operating systems, device drivers, BIOS, utilities
Application software	Helps the user do a specific task	MS Word, Excel, Chrome, Tally, Photoshop, WhatsApp
Utility software	Maintains and protects the computer	Antivirus, disk cleanup, defragmenter, backup, file compression (WinZip, WinRAR)
Programming / development software	Helps write programs	Compilers, interpreters, IDEs such as VS Code

SYSTEM SOFTWARE IN DETAIL

- Operating system: the main system software — Windows, Linux, macOS, Android
- Device driver: a small program that lets the OS talk to a hardware device such as a printer
- Language translators: compiler, interpreter, assembler
- Firmware: software built into hardware (BIOS)

APPLICATION SOFTWARE CATEGORIES

- ▶ Word processor: MS Word, Google Docs, LibreOffice Writer
- ▶ Spreadsheet: MS Excel, Google Sheets
- ▶ Presentation: MS PowerPoint, Google Slides
- ▶ Database: MS Access, Oracle, MySQL
- ▶ Graphics: Photoshop, CorelDRAW
- ▶ Accounting: Tally
- ▶ Web browser: Chrome, Firefox, Edge, Safari

SOFTWARE BY LICENCE AND PRICE

Type	Meaning	Example
Proprietary (closed source)	Owned by a company; source code is secret; usually paid	MS Office, Windows
Open source	Source code is free to see, change and share	Linux, Firefox, LibreOffice, Android (AOSP)
Freeware	Free to use, but source code is not shared	Adobe Acrobat Reader, Skype
Shareware	Free to try for a limited time or with limited features, then pay	WinRAR (trial)
Public domain	No copyright; anyone can use it freely	Some old programs

REMEMBER FOR EXAM

Open source ≠ freeware. Freeware is free of cost; open source means the source code is open.

SOFTWARE TERMS

- ▶ EULA: End User Licence Agreement — the terms you accept before installing software
- ▶ Patch: a small update that fixes bugs or security holes
- ▶ Version: a numbered release of software (e.g. Windows 11)
- ▶ Beta version: an early test version released to users
- ▶ Bug: an error in a program; debugging: finding and removing bugs
- ▶ Installation: copying and setting up software; uninstallation removes it
- ▶ Horizontal software is general (used by anyone); vertical software is made for one industry (hospital or bank software)

EXAM FOCUS

- ▶ Operating system = most important system software
- ▶ Antivirus, disk defragmenter and backup tools are utility software
- ▶ Linux is open source; Windows is proprietary
- ▶ Device drivers connect the OS with hardware

ONE-LINERS ASKED IN EXAMS

1. Which of these is system software → **Operating system**
2. Software whose source code is freely available to see, change and share is called → **Open-source software**
3. Software given free to try for a limited period, after which you must pay, is → **Shareware**
4. An antivirus program is an example of → **Utility software**
5. A program that allows the operating system to communicate with a printer is a → **Device driver**



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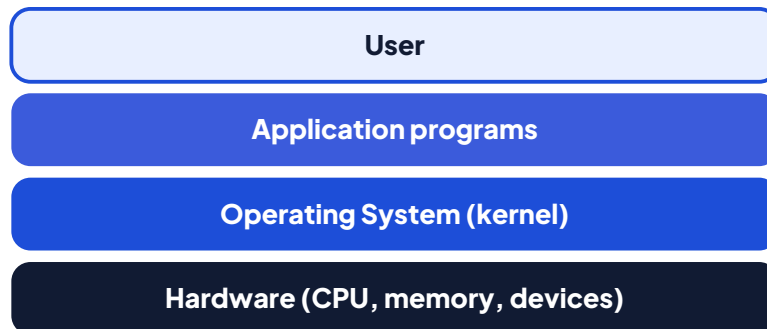
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WHAT IS AN OPERATING SYSTEM?

An operating system (OS) is system software that manages the computer's hardware and software and acts as an interface between the user and the computer. A computer cannot run without an OS.

DIAGRAM · WHERE THE OPERATING SYSTEM SITS



- ▶ The OS is the link between the user's programs and the hardware: it manages memory, processes, files and devices.
- ▶ The **kernel** is the core of the OS. Booting loads the OS from storage into RAM.

FUNCTIONS OF AN OPERATING SYSTEM

- ▶ Process management: runs programs, decides which program gets the CPU (CPU scheduling)
- ▶ Memory management: allots RAM to programs and frees it; manages virtual memory
- ▶ File management: creates, saves, deletes and organises files and folders
- ▶ Device management: controls input/output devices through drivers
- ▶ Security: user accounts, passwords and permissions
- ▶ User interface: CLI or GUI

PARTS OF AN OS

- ▶ Kernel: the core of the OS; it stays in memory and controls hardware directly
- ▶ Shell: the outer layer that takes user commands and passes them to the kernel

USER INTERFACES

Type	Full form	How you use it	Example
CLI / CUI	Command Line / Character User Interface	Typing commands	MS-DOS, Linux terminal
GUI	Graphical User Interface	Icons, windows, menus and a mouse	Windows, macOS

REMEMBER FOR EXAM

GUI was first developed at Xerox PARC. Apple's Macintosh (1984) made GUI popular; Windows 1.0 came in 1985.

TYPES OF OPERATING SYSTEMS

Type	Meaning	Example
Batch OS	Jobs with similar needs are grouped and run one after another without user interaction	Early IBM mainframes, payroll processing
Multiprogramming	Several programs are kept in memory so the CPU is never idle	—
Multitasking / time-sharing	The CPU switches quickly between tasks so each user gets a time slice	Windows, Linux, Unix
Multiprocessing	Uses two or more CPUs together	Servers
Real-time OS (RTOS)	Responds within a fixed, very short time	Air-traffic control, missile systems, ATMs, robots
Distributed OS	Many connected computers work as one system	—
Network OS	Manages computers and resources on a network	Windows Server
Mobile OS	Made for phones and tablets	Android, iOS, HarmonyOS

POPULAR OPERATING SYSTEMS

- ▶ Windows (Microsoft): most used desktop OS; first version Windows 1.0 (1985)
- ▶ macOS (Apple): for Mac computers
- ▶ Linux: open-source OS created by Linus Torvalds (1991); versions (distributions) include Ubuntu, Fedora, Red Hat, Debian
- ▶ Unix: developed at Bell Labs (1969) by Ken Thompson and Dennis Ritchie
- ▶ Android: mobile OS based on the Linux kernel, owned by Google
- ▶ iOS: Apple's mobile OS for iPhone
- ▶ MS-DOS: Microsoft Disk Operating System — single-user, single-tasking, command-line OS (1981)
- ▶ BharOS: an Indian mobile OS developed with IIT Madras support

BOOTING

- ▶ Booting: loading the OS into RAM when the computer starts
- ▶ Cold boot: starting a switched-off computer; warm boot: restarting a running computer
- ▶ Bootstrap loader: the small program in ROM that starts loading the OS
- ▶ Safe mode: starts Windows with only basic drivers to fix problems

FILE SYSTEMS

► FAT32, NTFS (Windows), exFAT (pen drives), ext4 (Linux), APFS (macOS)

EXAM FOCUS

- Kernel is the core; shell is the interface
- Linux was created by Linus Torvalds; Android is based on Linux
- Real-time OS is used where immediate response is critical
- MS-DOS is a single-user, single-tasking CLI OS

ONE-LINERS ASKED IN EXAMS

1. The core part of an operating system that controls the hardware is the → **Kernel**
2. Who created the Linux operating system → **Linus Torvalds**
3. Which type of OS is used in air-traffic control and missile systems → **Real-time OS**
4. Android is based on which kernel → **Linux**
5. A user interface that uses icons, windows and menus is called → **GUI**



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**ABOUT WINDOWS**

Windows is a GUI operating system made by Microsoft. Bill Gates and Paul Allen founded Microsoft in 1975.

Version	Year	Note
Windows 1.0	1985	First version
Windows 95	1995	Introduced the Start button and taskbar
Windows XP	2001	Very popular for many years
Windows 7	2009	—
Windows 10	2015	Introduced the Edge browser
Windows 11	2021	Centred Start menu and taskbar

PARTS OF THE WINDOWS DESKTOP

- ▶ Desktop: the main screen you see after logging in
- ▶ Icons: small pictures that stand for files, folders or programs
- ▶ Taskbar: the bar (usually at the bottom) that shows the Start button and open programs
- ▶ Start menu: opens apps, settings and the power options
- ▶ System tray / notification area: right side of the taskbar — clock, volume, network, battery
- ▶ Recycle Bin: holds deleted files until it is emptied; files can be restored from it
- ▶ Shortcut: an icon that points to a file or program; it has a small arrow on it
- ▶ File Explorer: used to browse and manage files and folders
- ▶ Control Panel / Settings: change system settings
- ▶ Task Manager: shows running programs and processes; used to end a frozen program (Ctrl + Shift + Esc)

REMEMBER FOR EXAM

Shift + Delete deletes a file permanently — it does NOT go to the Recycle Bin.

FILES AND FOLDERS

- ▶ File: a collection of data with a name and an extension (report.docx)
- ▶ Folder (directory): a container for files and other folders
- ▶ Path: the location of a file, e.g. C:\Users\Asha\Documents\report.docx
- ▶ Root directory: the top-level folder of a drive (C:\)
- ▶ File names in Windows cannot contain \ / : * ? " < > |

USEFUL WINDOWS FEATURES

- ▶ Clipboard: temporary storage for cut/copied items (Windows key + V shows its history)
- ▶ Snipping Tool: takes screenshots (Windows key + Shift + S)
- ▶ Notepad: simple text editor (.txt); WordPad: basic word processor; Paint: simple drawing program
- ▶ Disk Cleanup and Defragment: utilities to free space and arrange files
- ▶ Sleep mode keeps work in RAM using little power; Hibernate saves work to the disk and switches off

WINDOWS SHORTCUTS

Shortcut	Action
Windows key	Open the Start menu
Windows + D	Show desktop
Windows + E	Open File Explorer
Windows + L	Lock the computer
Windows + R	Open the Run box
Windows + I	Open Settings
Windows + Tab	Task View
Alt + Tab	Switch between open windows
Alt + F4	Close the active window / shut down dialog on desktop
Ctrl + Shift + Esc	Open Task Manager directly
F2	Rename the selected file
F5	Refresh

EXAM FOCUS

- ▶ Recycle Bin stores deleted files; Shift + Delete bypasses it
- ▶ Windows + L locks the PC; Windows + D shows the desktop
- ▶ Notepad saves files as .txt
- ▶ Microsoft was founded by Bill Gates and Paul Allen in 1975

ONE-LINERS ASKED IN EXAMS

1. Deleted files in Windows are stored temporarily in the → **Recycle Bin**
2. Which shortcut deletes a file permanently without sending it to the Recycle Bin → **Shift + Delete**
3. The shortcut to lock a Windows computer is → **Windows + L**
4. Which shortcut opens Task Manager directly → **Ctrl + Shift + Esc**
5. The bar at the bottom of the Windows screen showing the Start button and open programs is the → **Taskbar**



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TYPES OF KEYS

- ▶ Alphanumeric keys: letters and numbers
- ▶ Function keys: F1 to F12 at the top
- ▶ Modifier keys: Ctrl, Alt, Shift, Windows key — they work together with other keys
- ▶ Toggle keys: Caps Lock, Num Lock, Scroll Lock — they switch a mode on or off
- ▶ Navigation keys: arrow keys, Home, End, Page Up, Page Down
- ▶ Editing keys: Insert, Delete, Backspace
- ▶ Numeric keypad: on the right side; works as numbers when Num Lock is on

REMEMBER FOR EXAM

Backspace deletes the character to the LEFT of the cursor; Delete removes the character to the RIGHT of the cursor.

FUNCTION KEYS

Key	Common use
F1	Help
F2	Rename the selected file or folder
F3	Search / Find (in File Explorer and browsers)
F4	Repeat the last action (MS Word); Alt + F4 closes the window
F5	Refresh a page; start a slide show (PowerPoint)
F6	Move to the address bar (browser)
F7	Spelling and grammar check (MS Word)
F11	Full screen (browser)
F12	Save As (MS Office); developer tools (browser)

CTRL SHORTCUTS (WINDOWS AND MS OFFICE)

Shortcut	Action
Ctrl + A	Select all
Ctrl + B	Bold
Ctrl + C	Copy
Ctrl + D	Font dialog (Word); bookmark (browser)
Ctrl + E	Centre align
Ctrl + F	Find

Ctrl + G	Go To
Ctrl + H	Replace (Word); history (browser)
Ctrl + I	Italic
Ctrl + J	Justify
Ctrl + K	Insert hyperlink
Ctrl + L	Left align
Ctrl + N	New document / window
Ctrl + O	Open
Ctrl + P	Print
Ctrl + R	Right align
Ctrl + S	Save
Ctrl + U	Underline
Ctrl + V	Paste
Ctrl + W	Close document / tab
Ctrl + X	Cut
Ctrl + Y	Redo
Ctrl + Z	Undo
Ctrl + Home / Ctrl + End	Go to the beginning / end of the document

BROWSER SHORTCUTS

Shortcut	Action
Ctrl + T	New tab
Ctrl + Shift + T	Reopen the last closed tab
Ctrl + Shift + N	New incognito (private) window in Chrome
Ctrl + Tab	Next tab
Ctrl + + / Ctrl + -	Zoom in / zoom out
Ctrl + D	Bookmark the page

OTHER USEFUL COMBINATIONS

- ▶ **Ctrl + Alt + Delete**: security screen (lock, sign out, Task Manager); in old PCs it restarted the system
- ▶ **Alt + Tab**: switch between programs
- ▶ **Shift + F10**: right-click menu
- ▶ **Ctrl + Shift + Esc**: Task Manager
- ▶ **Print Screen (PrtSc)**: copies the screen image to the clipboard

EXAM FOCUS

- ▶ Ctrl + Z undo; Ctrl + Y redo
- ▶ F7 spell check; F12 Save As; Shift + F7 thesaurus in Word
- ▶ Ctrl + K hyperlink; Ctrl + J justify; Ctrl + E centre
- ▶ A standard keyboard has 12 function keys

ONE-LINERS ASKED IN EXAMS

1. Which shortcut is used to undo the last action → **Ctrl + Z**
2. Which function key opens the spelling and grammar check in MS Word → **F7**
3. Ctrl + K is used to → **Insert a hyperlink**
4. Which shortcut justifies text in MS Word → **Ctrl + J**
5. The F12 key in MS Office opens → **Save As**



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ABOUT MS WORD

MS Word is a word-processing program from Microsoft used to create, edit, format and print documents. It was first released in 1983, developed by Charles Simonyi and Richard Brodie.

FILE EXTENSIONS

Extension	Meaning
.docx	Word document (Word 2007 and later)
.doc	Word 97–2003 document
.dotx	Word template
.docm	Macro-enabled document
.rtf	Rich Text Format (opens in most word processors)
.pdf	Can be saved as PDF (File → Save As)

DEFAULT SETTINGS

- ▶ Default font: Calibri 11 pt in Office 2007–2021 (newer Microsoft 365 uses Aptos)
- ▶ Default orientation: Portrait
- ▶ Default margins: 1 inch (2.54 cm) on all sides ("Normal")
- ▶ Default paper size: A4 in India (Letter in the USA)
- ▶ Default alignment: Left
- ▶ Zoom range: 10% to 500%

RIBBON TABS AND WHAT THEY CONTAIN

Tab	Important tools
File (Backstage view)	Save, Save As, Print, Open, Share, Export
Home	Font, paragraph, styles, Format Painter, Find & Replace, clipboard
Insert	Table, pictures, shapes, SmartArt, chart, header & footer, page number, text box, WordArt, Drop Cap, symbol, equation, hyperlink
Design	Themes, watermark, page colour, page borders
Layout	Margins, orientation, size, columns, breaks, line numbers, indent, spacing
References	Table of contents, footnotes, endnotes, citations, bibliography, captions
Mailings	Mail Merge, envelopes, labels
Review	Spelling & grammar, thesaurus, word count, comments, track changes, protect document

IMPORTANT FEATURES

- ▶ Mail Merge (Mailings tab): sends the same letter to many people with different names and addresses; it needs a main document and a data source
- ▶ Format Painter (Home tab): copies formatting from one text to another; double-click to apply many times
- ▶ Drop Cap (Insert tab): a large first letter at the start of a paragraph
- ▶ Watermark (Design tab): faint text or picture behind the page text, e.g. "CONFIDENTIAL"
- ▶ Track Changes (Review tab): records every edit made to the document
- ▶ Macro: a recorded set of steps that runs with one click
- ▶ Header and footer: text at the top/bottom of every page
- ▶ Gutter margin: extra space for binding
- ▶ Thesaurus (Shift + F7): finds synonyms
- ▶ AutoCorrect: fixes common typing mistakes automatically

WORD SHORTCUTS

Shortcut	Action
Ctrl + Enter	Page break
Ctrl + 1 / 2 / 5	Single / double / 1.5 line spacing
Shift + F3	Change case (UPPER / lower / Title)
Ctrl +] or Ctrl + Shift + >	Increase font size
Ctrl + [or Ctrl + Shift + <	Decrease font size
Ctrl + =	Subscript (H ₂ O)
Ctrl + Shift + =	Superscript (x ²)
Ctrl + D	Font dialog box
Shift + F7	Thesaurus
F7	Spelling and grammar
Ctrl + M	Indent paragraph

WORD VIEWS

- ▶ Read Mode, Print Layout (default), Web Layout, Outline, Draft

EXAM FOCUS

- ▶ .docx is the default Word format; .dotx is a template
- ▶ Mail Merge is in the Mailings tab; Drop Cap is in the Insert tab; Watermark is in the Design tab
- ▶ Default orientation is Portrait; default margin 1 inch

► Ctrl + Enter inserts a page break; Shift + F3 changes case

ONE-LINERS ASKED IN EXAMS

1. The default file extension of an MS Word 2007+ document is → **.docx**
2. Mail Merge is found in which tab of MS Word → **Mailings**
3. Which feature copies formatting from one piece of text to another → **Format Painter**
4. The default page orientation in MS Word is → **Portrait**
5. Which shortcut inserts a page break in MS Word → **Ctrl + Enter**



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ABOUT MS EXCEL

MS Excel is a spreadsheet program used for calculations, data analysis, charts and tables. It was first released in 1985.

- ▶ **Workbook:** the Excel file (.xlsx); it contains worksheets
- ▶ **Worksheet:** one sheet made of rows and columns
- ▶ **Cell:** the box where a row and a column meet; named by column letter + row number, e.g. B5
- ▶ **Active cell:** the selected cell (shown in the Name Box)
- ▶ **Range:** a group of cells, e.g. A1:A10

SIZE OF A WORKSHEET (EXCEL 2007 AND LATER)

Item	Limit
Rows	1,048,576 (numbered)
Columns	16,384 (lettered, A to XFD)
Last cell	XFD1048576
New workbook	1 sheet by default (Excel 2013 and later)

FILE EXTENSIONS

Extension	Meaning
.xlsx	Excel workbook
.xls	Excel 97–2003 workbook
.xlsm	Macro-enabled workbook
.xltx	Excel template
.csv	Comma-separated values (plain text)

FORMULAS AND FUNCTIONS

Every formula starts with an equals sign (=).

Function	Use
=SUM(A1:A5)	Adds values
=AVERAGE(A1:A5)	Mean of values
=COUNT(A1:A5)	Counts cells with numbers
=COUNTA(A1:A5)	Counts non-empty cells
=MAX() / =MIN()	Largest / smallest value

=IF(A1>40,"Pass","Fail")	Checks a condition
=VLOOKUP() / =HLOOKUP()	Looks up a value vertically / horizontally
=ROUND(A1,2)	Rounds to 2 decimals
=TODAY() / =NOW()	Today's date / date and time
=CONCAT()	Joins text

CELL REFERENCES

- ▶ Relative (A1): changes when the formula is copied
- ▶ Absolute (\$A\$1): does not change when copied
- ▶ Mixed (\$A1 or A\$1): only the column or only the row is fixed
- ▶ Press F4 to switch between reference types

COMMON ERROR VALUES

Error	Meaning
#DIV/0!	Division by zero
#NAME?	Excel does not recognise a function or name
#VALUE!	Wrong type of value (e.g. text in maths)
#REF!	Invalid cell reference (a referenced cell was deleted)
#N/A	Value not available (common in VLOOKUP)
#####	Column is too narrow to show the value

IMPORTANT FEATURES

- ▶ Chart: visual display of data (column, bar, line, pie)
- ▶ Pivot Table: summarises large data quickly
- ▶ Freeze Panes (View tab): keeps headings visible while scrolling
- ▶ Conditional Formatting: changes cell colour based on rules
- ▶ Filter and Sort (Data tab); Data Validation limits what can be entered
- ▶ AutoFill: the fill handle copies a series (1, 2, 3 or Jan, Feb...)
- ▶ Name Box shows the address of the active cell; Formula Bar shows the content of the cell

EXCEL SHORTCUTS

Shortcut	Action
F2	Edit the active cell
Alt + =	AutoSum
Ctrl + ;	Insert today's date
Ctrl + Shift + ;	Insert the current time

Ctrl + Space / Shift + Space	Select whole column / whole row
Shift + F11	Insert a new worksheet
Ctrl + Page Up / Page Down	Move between sheets
F11	Create a chart on a new sheet

EXAM FOCUS

- ▶ Formulas start with =; rows are numbers, columns are letters
- ▶ 1,048,576 rows and 16,384 columns (last column XFD)
- ▶ \$A\$1 is an absolute reference; F4 toggles references
- ▶ #DIV/0! = division by zero; ##### = column too narrow

ONE-LINERS ASKED IN EXAMS

1. Every formula in MS Excel starts with → =
2. The intersection of a row and a column in Excel is called a → **Cell**
3. How many rows does an Excel 2007+ worksheet have → **1,048,576**
4. The last column in an Excel 2007+ worksheet is → **XFD**
5. Which is an absolute cell reference → **\$A\$1**



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ABOUT POWERPOINT

MS PowerPoint is presentation software used to create slide shows with text, pictures, charts, audio and video. It was created by Robert Gaskins and Dennis Austin (originally named "Presenter") and released in 1987; Microsoft bought it the same year.

- ▶ Presentation: the whole PowerPoint file
- ▶ Slide: one page of a presentation

FILE EXTENSIONS

Extension	Meaning
.pptx	PowerPoint presentation (2007 and later)
.ppt	PowerPoint 97–2003 presentation
.ppsx	PowerPoint Show — opens directly as a slide show
.potx	PowerPoint template
.pptm	Macro-enabled presentation

VIEWS IN POWERPOINT

View	Use
Normal	Default view for editing slides
Outline View	Shows only the text of slides
Slide Sorter	Shows all slides as thumbnails — to rearrange, delete or copy slides
Notes Page	Shows the slide with speaker notes below it
Reading View	Plays the show inside the PowerPoint window
Slide Show	Full-screen presentation

TRANSITIONS VS ANIMATIONS

- ▶ Transition: the effect when moving from one slide to the next (Transitions tab)
- ▶ Animation: the effect on an object (text or picture) within a slide — entrance, emphasis, exit, motion path (Animations tab)
- ▶ Animation Painter copies animation effects to another object

IMPORTANT FEATURES

- ▶ Slide Master (View tab): controls the design and layout of all slides at once

- ▶ Design themes (Design tab): ready-made colours, fonts and backgrounds
- ▶ Speaker notes: notes for the presenter that the audience does not see
- ▶ Hyperlinks and action buttons for moving between slides
- ▶ Rehearse Timings: records how long each slide is shown
- ▶ SmartArt: diagrams such as lists and processes

POWERPOINT SHORTCUTS

Shortcut	Action
F5	Start slide show from the first slide
Shift + F5	Start slide show from the current slide
Ctrl + M	Insert a new slide
Ctrl + D	Duplicate the selected slide
Esc	End the slide show
B / W (during show)	Black / white screen
N or →	Next slide; P or ← previous slide

EXAM FOCUS

- ▶ F5 starts from the beginning; Shift + F5 from the current slide
- ▶ Slide Sorter view is used to rearrange slides
- ▶ Transition = between slides; Animation = on objects inside a slide
- ▶ Slide Master controls the look of all slides; .ppsx opens directly as a show

ONE-LINERS ASKED IN EXAMS

1. Which key starts a PowerPoint slide show from the first slide → **F5**
2. Shift + F5 in PowerPoint → **Starts the show from the current slide**
3. Which view shows all slides as thumbnails for rearranging → **Slide Sorter**
4. The effect that appears when moving from one slide to the next is a → **Transition**
5. Effects applied to text or pictures within a slide are called → **Animations**



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MS OFFICE

MS Office is a suite (group) of office programs from Microsoft. The first Office suite was released in 1990 (1989 for Mac).

Program	Used for	File extension
Word	Documents	.docx
Excel	Spreadsheets	.xlsx
PowerPoint	Presentations	.pptx
Access	Databases	.accdb
Outlook	Email, calendar, contacts	.pst (data file)
OneNote	Digital notes	.one
Publisher	Desktop publishing (brochures, newsletters)	.pub
Teams	Chat, meetings, collaboration	—

- ▶ Microsoft 365 (earlier Office 365): the subscription, cloud-connected version of Office
- ▶ Alternatives: Google Workspace (Docs, Sheets, Slides), LibreOffice (Writer, Calc, Impress), Apple iWork (Pages, Numbers, Keynote), WPS Office

MS ACCESS

MS Access is a database management system (DBMS) for storing and organising data in tables.

Object	Purpose
Table	Stores data in rows (records) and columns (fields)
Query	Asks questions of the data — finds, filters and calculates
Form	A user-friendly screen to enter and view data
Report	A formatted output of data for printing
Macro	Automates tasks
Module	VBA (Visual Basic for Applications) code

- ▶ Primary key: a field that uniquely identifies each record
- ▶ File extension: .accdb (Access 2007 and later); .mdb in older versions
- ▶ Design View is used to create the structure of a table; Datasheet View shows the data

MS OUTLOOK

- ▶ An email client and Personal Information Manager (PIM)
- ▶ Manages email, calendar, contacts (People), tasks and notes

- ▶ Stores data in .pst files (Personal Storage Table) on the computer
- ▶ Outlook.com is Microsoft's free webmail (it replaced Hotmail)

OTHER OFFICE FACTS

- ▶ Clipboard in Office can hold up to 24 items
- ▶ Backstage view opens from the File tab
- ▶ Quick Access Toolbar: small toolbar for frequently used commands (Save, Undo)
- ▶ Ribbon: the strip of tabs and groups at the top of Office programs (introduced in Office 2007)
- ▶ Status bar: the bar at the bottom showing page number, word count and zoom

EXAM FOCUS

- ▶ Access objects: Table, Query, Form, Report, Macro, Module
- ▶ Primary key uniquely identifies a record; .accdb is an Access database
- ▶ Outlook = email + calendar + contacts (PIM)
- ▶ The Ribbon was introduced in Office 2007; the Office clipboard holds 24 items

ONE-LINERS ASKED IN EXAMS

1. Which MS Office program is used to create databases → **Access**
2. In MS Access, data is stored in → **Tables**
3. The Access object used to ask questions of the data and filter records is a → **Query**
4. A field that uniquely identifies each record in a table is the → **Primary key**
5. The file extension of an Access 2007+ database is → **.accdb**



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WHAT IS A PROGRAMMING LANGUAGE?

A programming language is a set of words, symbols and rules used to write instructions (programs) for a computer.

LEVELS OF PROGRAMMING LANGUAGES

Level	Description	Example
Machine language (1GL)	Written in binary (0 and 1); understood directly by the CPU; fastest but very hard to write	10110000 01100001
Assembly language (2GL)	Uses short codes called mnemonics (ADD, MOV, SUB); needs an assembler	MOV A, B
High-level language (3GL)	Close to English; easy to write; machine-independent	C, C++, Java, Python, COBOL, FORTRAN
4GL	Even closer to human language; used for databases and reports	SQL
5GL	Based on solving problems with constraints; used in AI	Prolog

REMEMBER FOR EXAM

Machine language and assembly language are low-level languages. Machine language is the only language the computer understands directly.

LANGUAGE TRANSLATORS

Translator	Converts	How
Assembler	Assembly language → machine code	—
Compiler	High-level language → machine code	Translates the whole program at once; shows all errors together; runs faster afterwards (C, C++)
Interpreter	High-level language → machine code	Translates and runs line by line; stops at the first error (Python, JavaScript, BASIC)

- ▶ Source code: the program written by the programmer
- ▶ Object code: the machine code produced by the compiler
- ▶ Linker: joins object files and libraries into one executable program
- ▶ Loader: loads the executable program into memory to run it

IMPORTANT PROGRAMMING LANGUAGES

Language	Developer	Year	Used for
----------	-----------	------	----------

FORTRAN	John Backus (IBM)	1957	Scientific calculations — first high-level language
COBOL	Grace Hopper (team)	1959	Business and banking applications
BASIC	John Kemeny and Thomas Kurtz	1964	Beginners
Pascal	Niklaus Wirth	1970	Teaching programming
C	Dennis Ritchie (Bell Labs)	1972	System programming; Unix was rewritten in C
C++	Bjarne Stroustrup	1983	Object-oriented version of C
Python	Guido van Rossum	1991	General purpose, AI and data science
Java	James Gosling (Sun Microsystems)	1995	"Write once, run anywhere"; Android apps
JavaScript	Brendan Eich (Netscape)	1995	Web pages
PHP	Rasmus Lerdorf	1995	Server-side web programming
C#	Microsoft (Anders Hejlsberg)	2000	Windows and .NET applications

WEB LANGUAGES

- ▶ **HTML:** HyperText Markup Language — structure of web pages (a markup language, not a programming language)
- ▶ **CSS:** Cascading Style Sheets — design and layout of web pages
- ▶ **XML:** eXtensible Markup Language — stores and transports data

PROGRAMMING TERMS

- ▶ **Algorithm:** step-by-step method to solve a problem; **flowchart:** a diagram of an algorithm
- ▶ **Bug:** an error; **debugging:** removing errors. The term "bug" became popular after Grace Hopper's team found a moth in the Mark II computer (1947)
- ▶ **Syntax error:** breaking the rules of the language; **logical error:** the program runs but gives a wrong result; **runtime error:** occurs while the program is running
- ▶ **OOP (Object-Oriented Programming) concepts:** class, object, inheritance, polymorphism, encapsulation, abstraction

EXAM FOCUS

- ▶ **FORTRAN** is the first high-level language; **COBOL** is for business
- ▶ **Compiler** = whole program at once; **interpreter** = line by line
- ▶ **C** was developed by Dennis Ritchie; **Java** by James Gosling; **Python** by Guido van Rossum
- ▶ **HTML** is a markup language

ONE-LINERS ASKED IN EXAMS

1. Which is the only language the computer understands directly → **Machine language**
2. A translator that converts the whole high-level program into machine code at once is a → **Compiler**

3. A translator that converts and runs a program line by line is a/an → **Interpreter**

4. An assembler converts → **Assembly language into machine code**

5. Which was the first high-level programming language → **FORTRAN**



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BASIC TERMS

- ▶ **Data:** raw facts; **Database:** an organised collection of related data
- ▶ **DBMS:** software that creates, stores, manages and retrieves data from a database — e.g. MySQL, Oracle, MS Access, SQL Server, PostgreSQL
- ▶ **RDBMS:** Relational DBMS — stores data in related tables; the relational model was given by E. F. Codd (1970)
- ▶ **Field (column / attribute):** one piece of information, such as Name
- ▶ **Record (row / tuple):** all fields about one item, such as one customer
- ▶ **Table (relation):** a set of rows and columns

KEYS IN A DATABASE

Key	Meaning
Primary key	Uniquely identifies each record; cannot be empty (NULL) or repeated
Candidate key	Any field that could be a primary key
Alternate key	A candidate key that was not chosen as the primary key
Foreign key	A field in one table that refers to the primary key of another table; links tables
Composite key	A primary key made of two or more fields
Super key	Any set of fields that can uniquely identify a record

REMEMBER FOR EXAM

Each table can have only ONE primary key, but it can have many foreign keys.

SQL (STRUCTURED QUERY LANGUAGE)

Type	Full form	Commands
DDL	Data Definition Language	CREATE, ALTER, DROP, TRUNCATE, RENAME
DML	Data Manipulation Language	INSERT, UPDATE, DELETE, SELECT
DCL	Data Control Language	GRANT, REVOKE
TCL	Transaction Control Language	COMMIT, ROLLBACK, SAVEPOINT

- ▶ **SELECT * FROM Students WHERE marks > 60;** — shows students with marks above 60
- ▶ **DELETE** removes rows (can be rolled back); **TRUNCATE** removes all rows quickly; **DROP** removes the whole table

ADVANTAGES OF DBMS

- ▶ Less data redundancy (duplication) and better consistency
- ▶ Data sharing among many users; security and access control
- ▶ Backup and recovery; data integrity

OTHER DATABASE CONCEPTS

- ▶ Normalisation: organising tables to reduce redundancy (1NF, 2NF, 3NF, BCNF)
- ▶ ACID properties of transactions: Atomicity, Consistency, Isolation, Durability
- ▶ Data warehouse: large store of historical data used for analysis; data mining: finding patterns in large data
- ▶ Schema: the structure/design of the database
- ▶ Big data: very large data sets described by Volume, Velocity and Variety

EXAM FOCUS

- ▶ E. F. Codd gave the relational model
- ▶ Primary key: unique and not NULL; foreign key links two tables
- ▶ DDL defines structure (CREATE, ALTER, DROP); DML handles data (INSERT, UPDATE, DELETE, SELECT)
- ▶ ACID = Atomicity, Consistency, Isolation, Durability

ONE-LINERS ASKED IN EXAMS

1. The relational database model was proposed by → **E. F. Codd**
2. A field that uniquely identifies each record and cannot be NULL is the → **Primary key**
3. A key in one table that refers to the primary key of another table is a → **Foreign key**
4. In a database table, a row is also called a → **Record (tuple)**
5. Which of these is a DDL command → **CREATE**



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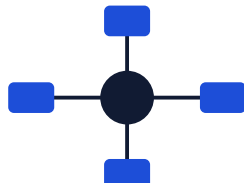
WHAT IS A NETWORK?

A computer network is two or more computers connected to share data, files, printers and the internet.

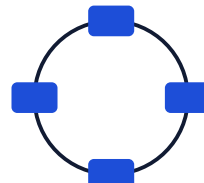
DIAGRAM · NETWORK TOPOLOGIES



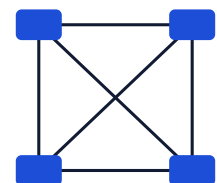
Bus



Star (hub / switch)



Ring



Mesh

► **Bus** – one main cable; a break stops the network. **Star** – every device joins a central hub or switch; the most common in offices.

► **Ring** – data travels in one circle. **Mesh** – every device links to every other: most reliable, most cables ($n(n-1)/2$ links).

TYPES OF NETWORKS BY AREA

Type	Full form	Area	Example
PAN	Personal Area Network	A few metres	Bluetooth earphones, phone hotspot
LAN	Local Area Network	A room, building or campus	Office or school network
CAN	Campus Area Network	A university campus	College network
MAN	Metropolitan Area Network	A city	Cable TV network in a city
WAN	Wide Area Network	Country or world	The Internet (the largest WAN)

► **WLAN**: Wireless LAN (Wi-Fi); **VPN**: Virtual Private Network – a secure, encrypted connection over a public network

NETWORK TOPOLOGIES (HOW DEVICES ARE ARRANGED)

Topology	Arrangement	Key point
Bus	All devices on one main cable (backbone)	Cheap; if the main cable fails, the whole network fails
Star	All devices connect to a central hub/switch	Most common; if the hub fails, the network stops
Ring	Each device connects to two others in a circle	Data travels in one direction; token passing
Mesh	Every device connects to every other	Most reliable; costly; needs $n(n-1)/2$ links

Tree	Groups of star networks joined to a bus	Hierarchical
Hybrid	Mix of two or more topologies	Flexible

NETWORK DEVICES

Device	Job
Hub	Sends incoming data to all ports (not intelligent)
Switch	Sends data only to the correct device using MAC addresses
Router	Connects different networks and finds the best path using IP addresses
Modem	MOdulator-DEModulator: converts digital signals to analog and back
Repeater	Boosts (regenerates) weak signals to extend distance
Bridge	Connects two LAN segments
Gateway	Connects networks that use different protocols
NIC	Network Interface Card — gives a computer its network connection and MAC address
Access point	Provides Wi-Fi to devices on a wired network

TRANSMISSION MEDIA

- Guided (wired): twisted-pair cable (most common in LANs), coaxial cable (cable TV), optical fibre (fastest; uses light; total internal reflection)
- Unguided (wireless): radio waves (Wi-Fi, Bluetooth), microwaves, infrared (TV remotes), satellite

DATA TRANSMISSION MODES

- Simplex: one direction only — keyboard to computer, radio broadcast
- Half-duplex: both directions, but one at a time — walkie-talkie
- Full-duplex: both directions at the same time — telephone call

OTHER TERMS

- Bandwidth: the maximum data rate of a connection, in bps
- Client-server network: central server gives services; peer-to-peer (P2P): all computers are equal
- MAC address: 48-bit physical address of a network card (hexadecimal)

EXAM FOCUS

- The Internet is the largest WAN; Bluetooth forms a PAN
- Star topology is the most common; mesh is the most reliable
- Router uses IP addresses; switch uses MAC addresses
- Optical fibre is the fastest medium; modem = modulator-demodulator

ONE-LINERS ASKED IN EXAMS

1. Which network covers the largest area → **WAN**
2. A network formed by Bluetooth devices around a person is a → **PAN**
3. In which topology are all devices connected to a central hub or switch → **Star**
4. Which topology is the most reliable but most expensive → **Mesh**
5. A device that connects different networks and chooses the best path for data is a → **Router**



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OSI MODEL

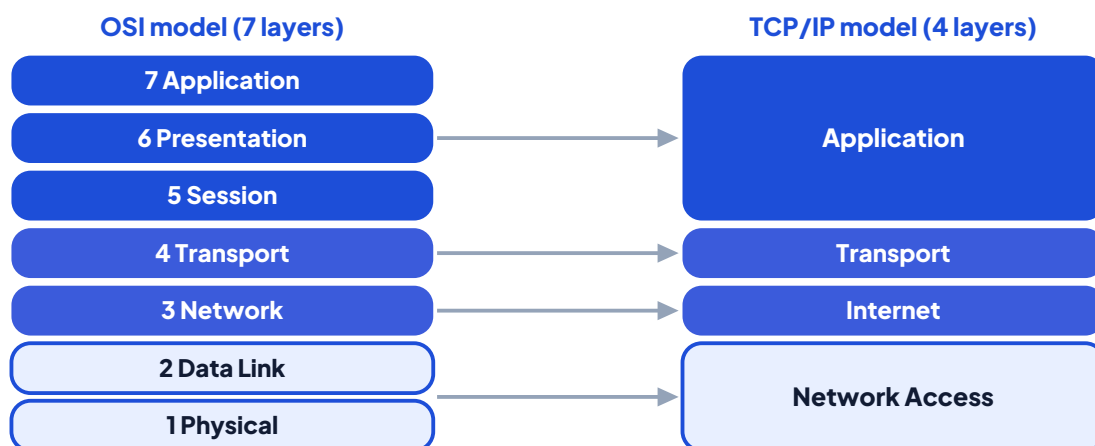
The OSI (Open Systems Interconnection) model was developed by the ISO (International Organization for Standardization) in 1984. It explains how data travels across a network in 7 layers.

Layer	Name	Job	Examples / data unit
7	Application	Services for user applications	HTTP, FTP, SMTP, DNS, Telnet
6	Presentation	Translation, encryption and compression of data	JPEG, MPEG, SSL/TLS, ASCII
5	Session	Starts, manages and ends sessions	NetBIOS, RPC
4	Transport	End-to-end delivery, error checking, segmentation	TCP, UDP — data unit: segment
3	Network	Logical addressing and routing	IP, ICMP — data unit: packet; device: router
2	Data Link	Physical (MAC) addressing, framing, error detection	Ethernet — data unit: frame; devices: switch, bridge
1	Physical	Transmits raw bits over the medium	Cables, hubs, repeaters — data unit: bit

REMEMBER FOR EXAM

Memory trick from top to bottom — "All People Seem To Need Data Processing" (Application, Presentation, Session, Transport, Network, Data Link, Physical).

DIAGRAM · OSI VS TCP/IP LAYERS



► Memory trick, top to bottom: "**All People Seem To Need Data Processing**" (Application → Physical).

► Routers work at the **Network** layer (IP address); switches at the **Data Link** layer (MAC address); hubs and cables at **Physical**.

TCP/IP MODEL

The TCP/IP model is the practical model used by the Internet. It was developed by the US Department of Defense (ARPANET); Vint Cerf and Bob Kahn are called the fathers of the Internet for designing TCP/IP.

TCP/IP layer	Matches OSI layers	Protocols
Application	Application + Presentation + Session	HTTP, HTTPS, FTP, SMTP, DNS, DHCP
Transport	Transport	TCP, UDP
Internet	Network	IP, ICMP, ARP
Network Access (Link)	Data Link + Physical	Ethernet, Wi-Fi

► The TCP/IP model has 4 layers (some books show 5, splitting Network Access into Data Link and Physical)

TCP VS UDP

TCP	UDP
Transmission Control Protocol	User Datagram Protocol
Connection-oriented (handshake first)	Connectionless
Reliable — confirms delivery and resends lost data	Not reliable — no confirmation
Slower	Faster
Web pages, email, file transfer	Video streaming, online games, voice calls, DNS queries

OTHER PROTOCOLS

- IP: Internet Protocol — gives addresses and routes packets
- ICMP: used by the "ping" command to test connections
- ARP: Address Resolution Protocol — finds the MAC address for an IP address
- DHCP: automatically gives IP addresses to devices

EXAM FOCUS

- OSI has 7 layers; TCP/IP has 4
- Router works at the Network layer; switch at the Data Link layer; hub at the Physical layer
- Encryption and compression happen at the Presentation layer
- TCP is reliable and connection-oriented; UDP is fast and connectionless

ONE-LINERS ASKED IN EXAMS

1. How many layers does the OSI model have → **7**
2. The OSI model was developed by → **ISO**
3. Which OSI layer is responsible for routing and logical (IP) addressing → **Network**

4. A router works at which OSI layer → **Network**

5. A switch mainly works at which OSI layer → **Data Link**



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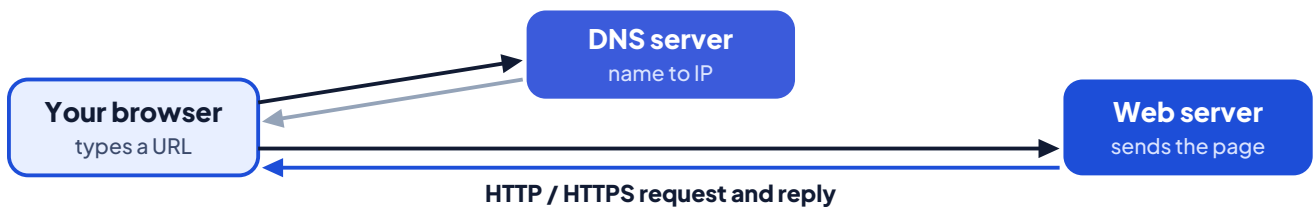


THE INTERNET

The Internet is a global network of networks that connects millions of computers using the TCP/IP protocol.

- ▶ ARPANET (1969), a US Department of Defense project, was the first network that grew into the Internet
- ▶ Vint Cerf and Bob Kahn are called the fathers of the Internet (TCP/IP)
- ▶ Internet came to India for the public on 15 August 1995 through VSNL (Videsh Sanchar Nigam Limited)
- ▶ ISP: Internet Service Provider — a company that gives internet access (Jio, Airtel, BSNL)

DIAGRAM · HOW A WEB PAGE OPENS



- ▶ **DNS** turns a name like prepzen.in into an **IP address**; then the browser asks the web server for the page over **HTTP / HTTPS**.
- ▶ A URL has parts: **https://** (protocol) · **www.prepzen.in** (domain) · **/notes** (path). HTTPS uses port 443, HTTP port 80.

WORLD WIDE WEB (WWW)

- ▶ The WWW is a system of web pages linked by hyperlinks, accessed through the Internet
- ▶ Invented by Tim Berners-Lee in 1989 at CERN (Switzerland); the first website, info.cern.ch, went live in 1991
- ▶ The Web is a service that runs on the Internet; the Internet and the Web are not the same
- ▶ W3C (World Wide Web Consortium) sets web standards; founded by Tim Berners-Lee
- ▶ First web browser: WorldWideWeb (later Nexus); Mosaic (1993) was the first popular graphical browser

WEB TERMS

Term	Meaning
Web page	A single document on the web, written in HTML
Website	A collection of related web pages
Home page	The first / main page of a website

Web browser	Software to view web pages — Chrome, Firefox, Edge, Safari
Search engine	A website that finds information — Google, Bing, DuckDuckGo
Hyperlink	Clickable text or image that opens another page
Bookmark / Favourite	Saved link to a website
Cookie	Small file a website stores in your browser to remember you
Cache (browser)	Saved copies of web pages for faster loading
Web server	A computer that stores websites and sends pages to browsers

REMEMBER FOR EXAM

Google is a search engine; Chrome is a web browser. Google was founded by Larry Page and Sergey Brin in 1998.

URL (UNIFORM RESOURCE LOCATOR)

Example: <https://www.prepzen.in/current-affairs/index.html>

- ▶ [https](https://www.prepzen.in/current-affairs/index.html) — protocol
- ▶ [www.prepzen.in](https://www.prepzen.in/current-affairs/index.html) — domain name (prepzen = second-level domain, .in = top-level domain)
- ▶ [/current-affairs/index.html](https://www.prepzen.in/current-affairs/index.html) — path to the file

DOMAIN NAMES

Domain	Used by
.com	Commercial organisations
.org	Non-profit organisations
.net	Network providers
.edu	Educational institutions
.gov / .gov.in	Government (India uses .gov.in)
.mil	US military
.in	India (country code); .uk United Kingdom; .jp Japan

IP ADDRESS AND DNS

- ▶ IP address: a unique number that identifies a device on a network
- ▶ IPv4: 32-bit address, written as four numbers 0–255 (e.g. 192.168.1.1); about 4.3 billion addresses
- ▶ IPv6: 128-bit address written in hexadecimal; created because IPv4 addresses were running out
- ▶ DNS (Domain Name System): converts domain names into IP addresses — like a phone book of the internet

TYPES OF WEB AND NETWORKS

- ▶ Intranet: a private network used only inside an organisation

- ▶ Extranet: an intranet that gives limited access to outside partners such as suppliers
- ▶ Surface web: pages found by search engines; deep web: pages not indexed (net banking, email inbox); dark web: hidden sites reached with special software like Tor
- ▶ Web 1.0: read-only static web; Web 2.0: interactive and social (YouTube, Facebook); Web 3.0: semantic, decentralised web (blockchain, AI)

EXAM FOCUS

- ▶ Tim Berners-Lee invented the WWW (1989, CERN); first website info.cern.ch
- ▶ ARPANET (1969) was the first network; VSNL brought the internet to India on 15 August 1995
- ▶ DNS converts domain names to IP addresses; IPv4 = 32 bits, IPv6 = 128 bits
- ▶ Intranet = private; extranet = private with limited outside access

ONE-LINERS ASKED IN EXAMS

1. Who invented the World Wide Web → **Tim Berners-Lee**
2. The first network that later developed into the Internet was → **ARPANET**
3. Which system converts domain names into IP addresses → **DNS**
4. An IPv4 address is made of → **32 bits**
5. An IPv6 address is made of → **128 bits**



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WHAT IS A PROTOCOL?

A protocol is a set of rules that devices follow to communicate over a network. A port number identifies a specific service on a computer.

IMPORTANT PROTOCOLS AND PORTS

Protocol	Full form	Port	Used for
HTTP	HyperText Transfer Protocol	80	Loading web pages (not encrypted)
HTTPS	HTTP Secure	443	Secure web pages; uses SSL/TLS encryption — shows a padlock
FTP	File Transfer Protocol	20 (data), 21 (control)	Uploading and downloading files
SFTP	SSH File Transfer Protocol	22	Secure file transfer
SSH	Secure Shell	22	Secure remote login
Telnet	Teletype Network	23	Remote login (not secure)
SMTP	Simple Mail Transfer Protocol	25 (587 for submission)	Sending email
DNS	Domain Name System	53	Converting domain names to IP addresses
DHCP	Dynamic Host Configuration Protocol	67 / 68	Giving IP addresses automatically
POP3	Post Office Protocol version 3	110	Downloading email to one device
IMAP	Internet Message Access Protocol	143	Reading email on the server; syncs across devices
SNMP	Simple Network Management Protocol	161	Monitoring network devices
RDP	Remote Desktop Protocol	3389	Remote desktop on Windows

REMEMBER FOR EXAM

SMTP sends mail ("S for Send"); POP3 and IMAP receive mail.

SECURITY PROTOCOLS

- ▶ **SSL**: Secure Sockets Layer; **TLS**: Transport Layer Security (the modern successor of SSL) — encrypt data between browser and server
- ▶ **HTTPS** = HTTP + SSL/TLS
- ▶ **IPsec**: secures IP traffic, used in VPNs
- ▶ **WPA2 / WPA3**: Wi-Fi security protocols

OTHER PROTOCOLS TO KNOW

- ▶ TCP and UDP: transport protocols
- ▶ IP: addressing and routing
- ▶ ARP: finds a MAC address from an IP address
- ▶ ICMP: error and "ping" messages
- ▶ NTP: Network Time Protocol — keeps clocks in sync (port 123)
- ▶ VoIP: Voice over Internet Protocol — phone calls over the internet (WhatsApp calls)

EXAM FOCUS

- ▶ HTTP 80; HTTPS 443; FTP 20/21; SSH 22; Telnet 23; SMTP 25; DNS 53; POP3 110; IMAP 143
- ▶ HTTPS uses SSL/TLS; the padlock in the address bar shows a secure site
- ▶ SMTP sends; POP3/IMAP receive; IMAP keeps mail on the server
- ▶ Telnet is insecure; SSH is its secure replacement

ONE-LINERS ASKED IN EXAMS

1. The default port number of HTTP is → **80**
2. The default port number of HTTPS is → **443**
3. Which protocol is used to send emails → **SMTP**
4. Which protocol keeps emails on the server and syncs them across devices → **IMAP**
5. FTP is used for → **Transferring files**



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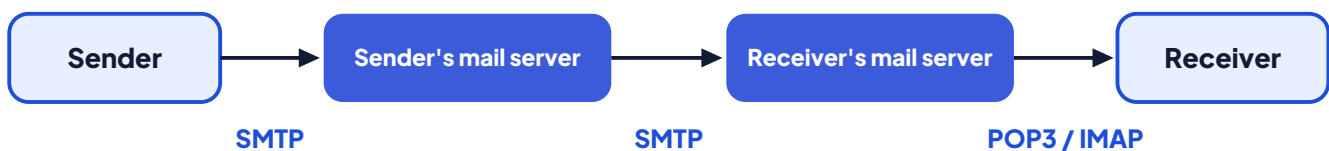


ABOUT EMAIL

Email is a way of sending messages and files electronically over the internet.

- ▶ Ray Tomlinson sent the first network email in 1971 on ARPANET and chose the "@" symbol
- ▶ Email address format: username@domain — e.g. prepzen.app@gmail.com
- ▶ An email address cannot contain spaces

DIAGRAM · HOW AN EMAIL TRAVELS



- ▶ **SMTP** sends mail (port 25 / 587); **POP3** downloads it to one device (port 110); **IMAP** keeps it in sync on all devices (port 143).
- ▶ **CC** = everyone sees the copy; **BCC** = hidden copy. The @ sign separates the user name from the domain.

PARTS OF AN EMAIL

Part	Meaning
From	Sender's email address
To	Main receiver(s)
CC	Carbon Copy — others who receive a copy; all receivers can see CC addresses
BCC	Blind Carbon Copy — receivers who get a copy secretly; other receivers cannot see BCC addresses
Subject	Short title of the email
Body	The main message
Attachment	A file sent with the email (shown with a paper-clip icon)
Signature	Text added automatically at the end — name, designation, phone

EMAIL FOLDERS AND ACTIONS

- ▶ Inbox: received emails; Outbox: emails waiting to be sent; Sent: emails already sent
- ▶ Drafts: unfinished emails saved for later
- ▶ Spam / Junk: unwanted bulk emails
- ▶ Trash / Bin: deleted emails (removed permanently after some days)

- ▶ Archive: removes an email from the inbox without deleting it
- ▶ Reply: answers only the sender; Reply All: answers the sender and all receivers; Forward: sends the email to someone new

REMEMBER FOR EXAM

Use BCC when sending one email to many people who should not see each other's addresses.

EMAIL PROTOCOLS

- ▶ SMTP: sends emails
- ▶ POP3: downloads emails to one device (usually removes them from the server)
- ▶ IMAP: keeps emails on the server and syncs all devices
- ▶ MIME: Multipurpose Internet Mail Extensions — lets emails carry attachments, images and non-English text

EMAIL SERVICES

Service	Fact
Gmail	Google's email, launched in 2004; developed by Paul Buchheit
Hotmail	Founded in 1996 by Sabeer Bhatia (Indian-origin) and Jack Smith; now Outlook.com
Yahoo Mail	Launched in 1997
Rediffmail	Indian email service

- ▶ Webmail: email used inside a browser (Gmail website); email client: a program installed on the device (MS Outlook, Thunderbird)

EMAIL SAFETY

- ▶ Spam: unsolicited bulk email; phishing emails trick users into sharing passwords or OTPs
- ▶ Never open attachments or links from unknown senders
- ▶ Spoofing: an email that pretends to come from someone else

EXAM FOCUS

- ▶ Ray Tomlinson: first email (1971) and the @ sign
- ▶ CC = visible copy; BCC = hidden copy
- ▶ SMTP sends; POP3 / IMAP receive; MIME handles attachments
- ▶ Sabeer Bhatia co-founded Hotmail

ONE-LINERS ASKED IN EXAMS

1. Who sent the first network email and introduced the "@" symbol → **Ray Tomlinson**
2. The BCC field in an email is used to → **Send a copy secretly, hiding the address from other receivers**

- 3. CC in email stands for → **Carbon Copy**
- 4. Unwanted bulk email is called → **Spam**
- 5. Emails that are written but not yet sent are saved in → **Drafts**



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**WHAT IS CYBER SECURITY?**

Cyber security is the protection of computers, networks, data and users from attacks, damage and unauthorised access.

MALWARE (MALICIOUS SOFTWARE)

Type	What it does
Virus	Attaches itself to a file or program and spreads when that file is opened; needs user action
Worm	Copies itself and spreads across networks on its own, without a host file
Trojan horse	Looks like a useful program but secretly harms the system or opens a backdoor
Ransomware	Locks or encrypts files and demands money (ransom) to unlock them — e.g. WannaCry (2017)
Spyware	Secretly collects the user's information
Keylogger	Records every key pressed to steal passwords
Adware	Shows unwanted advertisements
Rootkit	Hides deep in the system to give attackers control
Botnet	A network of infected computers ("bots/zombies") controlled by an attacker
Logic bomb	Malicious code that activates when a condition or date is reached

REMEMBER FOR EXAM

Creeper (1971) is considered the first computer virus/worm. Brain (1986) was the first virus for MS-DOS PCs.

ONLINE FRAUDS AND ATTACKS

Attack	Meaning
Phishing	Fake emails or websites that trick people into giving passwords, card or bank details
Vishing	Voice phishing — fraud phone calls (fake bank officer asking for OTP)
Smishing	SMS phishing — fraud text messages with links
Pharming	Redirecting users from a real website to a fake one
Spoofing	Pretending to be a trusted source (fake email, caller ID or website)
DoS / DDoS	(Distributed) Denial of Service — flooding a server with traffic so it stops working
Man-in-the-middle	Secretly intercepting communication between two parties
Social engineering	Tricking people psychologically into giving information

SQL injection	Inserting harmful code into a website's database query
Identity theft	Stealing someone's personal details to commit fraud
Hacking	Gaining unauthorised access; ethical (white-hat) hackers test security legally

PROTECTION METHODS

- ▶ Antivirus: detects and removes malware — e.g. Quick Heal (Indian), Norton, McAfee, Kaspersky
- ▶ Firewall: hardware or software that blocks unauthorised network traffic
- ▶ Encryption: converting readable plain text into unreadable cipher text; decryption reverses it
- ▶ Two-factor / multi-factor authentication (2FA/MFA): password + OTP or fingerprint
- ▶ Strong passwords, regular software updates (patches), backups
- ▶ CAPTCHA: test that tells humans and bots apart
- ▶ Digital signature: proves who sent a document and that it was not changed
- ▶ VPN: secure encrypted connection over public networks

CYBER SECURITY IN INDIA

- ▶ IT Act, 2000: India's main cyber law (amended in 2008); Section 66 covers computer-related offences
- ▶ CERT-In: Indian Computer Emergency Response Team — national agency for cyber incidents, under MeitY
- ▶ I4C: Indian Cyber Crime Coordination Centre — under the Ministry of Home Affairs
- ▶ Cyber crime helpline number 1930; complaints at cybercrime.gov.in
- ▶ Digital Personal Data Protection (DPDP) Act, 2023: protects personal data

EXAM FOCUS

- ▶ Virus needs a host file; worm spreads on its own; Trojan disguises itself
- ▶ Phishing = email; vishing = voice call; smishing = SMS
- ▶ Firewall blocks unauthorised access; encryption turns plain text into cipher text
- ▶ CERT-In is India's national cyber-incident agency; helpline 1930

ONE-LINERS ASKED IN EXAMS

1. Malware that spreads across networks by itself without a host file is a → **Worm**
2. Software that looks useful but secretly harms the system is a → **Trojan horse**
3. Malware that locks files and demands money to unlock them is → **Ransomware**
4. Fraud done through fake phone calls asking for OTP or bank details is called → **Vishing**
5. Fraud done through SMS text messages is called → **Smishing**



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File Extensions

WHAT IS A FILE EXTENSION?

A file extension is the part of a file name after the last dot. It tells the computer which type of file it is and which program opens it. Example: report.docx → extension .docx

DOCUMENTS AND OFFICE FILES

Extension	File type
.docx / .doc	MS Word document
.xlsx / .xls	MS Excel workbook
.pptx / .ppt	MS PowerPoint presentation
.accdb / .mdb	MS Access database
.pdf	Portable Document Format (Adobe)
.txt	Plain text (Notepad)
.rtf	Rich Text Format
.csv	Comma-Separated Values
.odt / .ods / .odp	OpenDocument text / spreadsheet / presentation (LibreOffice)

IMAGES

Extension	File type
.jpg / .jpeg	Joint Photographic Experts Group — compressed photos
.png	Portable Network Graphics — lossless, supports transparency
.gif	Graphics Interchange Format — supports simple animation
.bmp	Bitmap image (uncompressed)
.tiff / .tif	Tagged Image File Format — high-quality printing
.svg	Scalable Vector Graphics — does not blur when enlarged
.psd	Adobe Photoshop document
.webp	Web image format by Google

AUDIO AND VIDEO

Extension	File type
.mp3	MPEG-1 Audio Layer 3 — compressed audio
.wav	Waveform audio (uncompressed)
.aac / .m4a	Advanced Audio Coding

.mp4	MPEG-4 video
.avi	Audio Video Interleave (Microsoft)
.mkv	Matroska video
.mov	Apple QuickTime video
.wmv	Windows Media Video

PROGRAMS, WEB AND COMPRESSED FILES

Extension	File type
.exe	Executable program (Windows)
.bat	Batch file (Windows commands)
.dll	Dynamic Link Library
.apk	Android app package
.html / .htm	Web page
.css	Style sheet for web pages
.js	JavaScript
.php	PHP web script
.py	Python program
.java / .class	Java source / compiled class
.c / .cpp	C / C++ program
.zip / .rar / .7z	Compressed archive
.iso	Disc image
.tmp	Temporary file
.bak	Backup file
.sys	System file

REMEMBER FOR EXAM

JPG uses lossy compression (some quality lost); PNG uses lossless compression. GIF supports animation.

EXAM FOCUS

- ▶ .exe = executable program; .apk = Android app; .dll = library
- ▶ .jpg photos; .png lossless with transparency; .gif animation
- ▶ .mp3 audio; .mp4 video; .zip / .rar compressed files
- ▶ .txt Notepad; .csv comma-separated data; .pdf Adobe document

ONE-LINERS ASKED IN EXAMS

1. Which extension is used for executable program files in Windows → **.exe**

2. An Android app installation file has the extension → **.apk**
3. Which image format supports simple animation → **.gif**
4. Which image format supports transparency and uses lossless compression → **.png**
5. .mp3 is an extension for → **Audio files**



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**HARDWARE AND MEMORY**

Abbreviation	Full form
ALU	Arithmetic Logic Unit
CPU	Central Processing Unit
CU	Control Unit
GPU	Graphics Processing Unit
RAM	Random Access Memory
ROM	Read Only Memory
SRAM / DRAM	Static / Dynamic Random Access Memory
PROM	Programmable Read Only Memory
EPROM	Erasable Programmable Read Only Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
HDD	Hard Disk Drive
SSD	Solid State Drive
CD	Compact Disc
DVD	Digital Versatile Disc
USB	Universal Serial Bus
BIOS	Basic Input Output System
UEFI	Unified Extensible Firmware Interface
CMOS	Complementary Metal Oxide Semiconductor
POST	Power-On Self-Test
SMPS	Switched-Mode Power Supply
UPS	Uninterruptible Power Supply
VDU	Visual Display Unit
LCD	Liquid Crystal Display
LED	Light Emitting Diode
CRT	Cathode Ray Tube
VGA	Video Graphics Array
HDMI	High-Definition Multimedia Interface
NIC	Network Interface Card
MICR	Magnetic Ink Character Recognition
OCR	Optical Character Recognition

OMR	Optical Mark Reader / Recognition
BCR	Bar Code Reader
RFID	Radio Frequency Identification
DPI	Dots Per Inch
PPM	Pages Per Minute
CPS	Characters Per Second
RPM	Revolutions Per Minute
MIPS	Million Instructions Per Second
FLOPS	Floating Point Operations Per Second
IC	Integrated Circuit
VLSI	Very Large Scale Integration
ULSI	Ultra Large Scale Integration

SOFTWARE AND PROGRAMMING

Abbreviation	Full form
OS	Operating System
GUI	Graphical User Interface
CLI	Command Line Interface
DOS	Disk Operating System
NTFS	New Technology File System
FAT	File Allocation Table
EULA	End User Licence Agreement
HTML	HyperText Markup Language
XML	eXtensible Markup Language
CSS	Cascading Style Sheets
SQL	Structured Query Language
DBMS	Database Management System
RDBMS	Relational Database Management System
COBOL	Common Business-Oriented Language
FORTRAN	Formula Translation
BASIC	Beginner's All-purpose Symbolic Instruction Code
OOP	Object-Oriented Programming
IDE	Integrated Development Environment
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
EBCDIC	Extended Binary Coded Decimal Interchange Code

BCD	Binary Coded Decimal
PDF	Portable Document Format
JPEG	Joint Photographic Experts Group
GIF	Graphics Interchange Format
PNG	Portable Network Graphics
MPEG	Moving Picture Experts Group
VBA	Visual Basic for Applications

INTERNET AND NETWORKING

Abbreviation	Full form
WWW	World Wide Web
URL	Uniform Resource Locator
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
FTP	File Transfer Protocol
SMTP	Simple Mail Transfer Protocol
POP	Post Office Protocol
IMAP	Internet Message Access Protocol
TCP	Transmission Control Protocol
IP	Internet Protocol
UDP	User Datagram Protocol
DNS	Domain Name System
DHCP	Dynamic Host Configuration Protocol
ARP	Address Resolution Protocol
ISP	Internet Service Provider
LAN	Local Area Network
MAN	Metropolitan Area Network
WAN	Wide Area Network
PAN	Personal Area Network
VPN	Virtual Private Network
Wi-Fi	Wireless Fidelity
MAC	Media Access Control
OSI	Open Systems Interconnection
ARPANET	Advanced Research Projects Agency Network
VoIP	Voice over Internet Protocol
SSL / TLS	Secure Sockets Layer / Transport Layer Security

SSH	Secure Shell
MIME	Multipurpose Internet Mail Extensions
CC / BCC	Carbon Copy / Blind Carbon Copy
SEO	Search Engine Optimisation
W3C	World Wide Web Consortium
IoT	Internet of Things
5G	Fifth Generation (mobile network)
LTE	Long Term Evolution
GPS	Global Positioning System
NFC	Near Field Communication

SECURITY, CLOUD AND OTHERS

Abbreviation	Full form
CERT-In	Indian Computer Emergency Response Team
DDoS	Distributed Denial of Service
OTP	One-Time Password
PIN	Personal Identification Number
2FA / MFA	Two-Factor / Multi-Factor Authentication
CAPTCHA	Completely Automated Public Turing test to tell Computers and Humans Apart
AI	Artificial Intelligence
ML	Machine Learning
AR / VR	Augmented Reality / Virtual Reality
IaaS	Infrastructure as a Service
PaaS	Platform as a Service
SaaS	Software as a Service
ERP	Enterprise Resource Planning
CRM	Customer Relationship Management
ICT	Information and Communication Technology
C-DAC	Centre for Development of Advanced Computing
MeitY	Ministry of Electronics and Information Technology
NIC (Govt.)	National Informatics Centre

EXAM FOCUS

- ▶ CAPTCHA, ASCII, EBCDIC, BIOS and SMPS are frequently asked full forms
- ▶ UPS keeps a computer running during a power cut; SMPS converts AC to DC inside the cabinet
- ▶ NIC can mean Network Interface Card or National Informatics Centre (Government of India)

ONE-LINERS ASKED IN EXAMS

1. What is the full form of CAPTCHA → **Completely Automated Public Turing test to tell Computers and Humans Apart**
2. SMPS stands for → **Switched-Mode Power Supply**
3. UPS stands for → **Uninterruptible Power Supply**
4. The full form of BIOS is → **Basic Input Output System**
5. URL stands for → **Uniform Resource Locator**



20 exam questions on this chapter

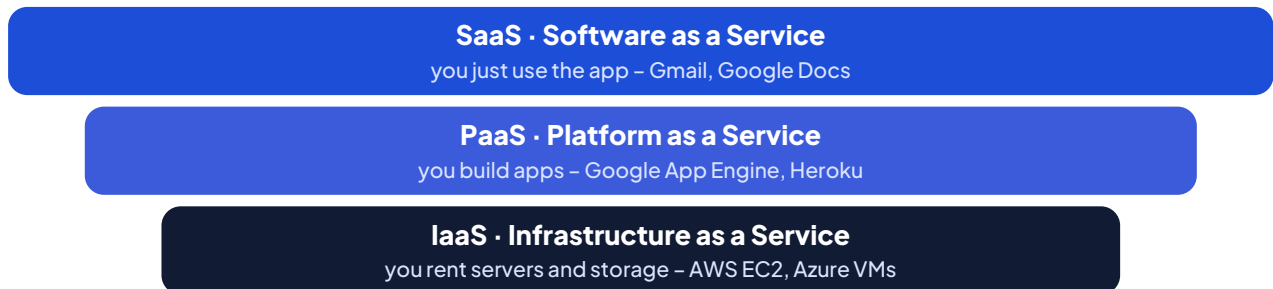
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CLOUD COMPUTING

Cloud computing means using computing services — storage, servers, software, databases — over the internet instead of on your own computer. You pay only for what you use.

DIAGRAM · CLOUD SERVICE MODELS



- ▶ Top of the stack = the provider manages the most; bottom = you manage the most.
- ▶ Deployment types: **public**, **private**, **hybrid** and **community** cloud.

SERVICE MODELS

Model	Full form	What you get	Examples
IaaS	Infrastructure as a Service	Virtual servers, storage and networks	Amazon EC2 (AWS), Microsoft Azure VMs, Google Compute Engine
PaaS	Platform as a Service	A ready platform to build and run apps	Google App Engine, Heroku
SaaS	Software as a Service	Ready-to-use software in a browser	Gmail, Google Docs, Microsoft 365, Zoom

DEPLOYMENT MODELS

- ▶ Public cloud: shared by many customers over the internet (AWS, Azure, Google Cloud)
- ▶ Private cloud: used by a single organisation
- ▶ Hybrid cloud: a mix of public and private clouds
- ▶ Community cloud: shared by organisations with common needs
- ▶ MeghRaj: the Government of India's cloud computing initiative

ARTIFICIAL INTELLIGENCE (AI)

- ▶ AI is the ability of machines to perform tasks that need human intelligence — learning, reasoning, understanding language

- ▶ The term "Artificial Intelligence" was coined by John McCarthy in 1956; he is called the father of AI
- ▶ Machine Learning (ML): systems learn from data without being explicitly programmed
- ▶ Deep Learning: ML using many-layered artificial neural networks
- ▶ Generative AI: creates new text, images or audio — e.g. ChatGPT, Gemini, Claude
- ▶ NLP (Natural Language Processing): machines understanding human language; chatbots use NLP
- ▶ IndiaAI Mission (2024): Government of India mission to build AI capacity

OTHER EMERGING TECHNOLOGIES

Technology	Key facts
Internet of Things (IoT)	Everyday devices connected to the internet (smart meters, smart watches); term coined by Kevin Ashton (1999)
Blockchain	A shared, tamper-proof digital ledger of records (blocks); basis of Bitcoin, introduced by "Satoshi Nakamoto" (2008)
Big Data	Very large data sets; described by the 3 Vs — Volume, Velocity, Variety
Augmented Reality (AR)	Adds digital objects to the real world (Pokémon Go, Snapchat filters)
Virtual Reality (VR)	A fully computer-made 3D world seen through a headset
Quantum computing	Uses qubits, which can be 0 and 1 at the same time; India's National Quantum Mission was approved in 2023
5G	Fifth-generation mobile network — very high speed and low delay; launched in India on 1 October 2022
Edge computing	Processing data near where it is produced instead of a far-away data centre
Robotics	Machines that do tasks automatically; robots in factories, surgery and delivery
Drones (UAV)	Unmanned Aerial Vehicles used for mapping, delivery and agriculture
Cryptocurrency	Digital money secured by cryptography (Bitcoin, Ethereum); not legal tender in India
CBDC	Central Bank Digital Currency — India's Digital Rupee (₹) by RBI, piloted from 2022

EXAM FOCUS

- ▶ IaaS, PaaS, SaaS: Gmail and Google Docs are SaaS
- ▶ John McCarthy coined "AI" (1956); Kevin Ashton coined "IoT" (1999)
- ▶ Blockchain is a distributed ledger; Bitcoin by Satoshi Nakamoto
- ▶ 5G launched in India on 1 October 2022; MeghRaj is the government cloud initiative

ONE-LINERS ASKED IN EXAMS

1. Gmail and Google Docs are examples of which cloud service model → **SaaS**
2. Amazon EC2, which provides virtual servers, is an example of → **IaaS**
3. Who coined the term "Artificial Intelligence" → **John McCarthy**
4. The Government of India's cloud computing initiative is called → **MeghRaj**

5. The term "Internet of Things" was coined by → **Kevin Ashton**



20 exam questions on this chapter

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**CORE BANKING SOLUTION (CBS)**

- CBS lets customers use their account from any branch of the bank, because all branches share one central database
- "CORE" is often expanded as Centralised Online Real-time Exchange
- Popular CBS software: Finacle (Infosys), Flexcube (Oracle), BaNCS (TCS)

DIAGRAM · HOW A UPI PAYMENT WORKS

Money moves bank to bank in seconds, 24x7

- **UPI** (Unified Payments Interface) is run by **NPCI** and was launched in **2016**. You pay with a VPA like name@bank and a UPI PIN.
- Other NPCI systems: **IMPS** (instant, 24 × 7), **RuPay** cards, **AePS** (Aadhaar-based), **FASTag** (NETC). **NEFT** and **RTGS** are run by RBI.

FUND TRANSFER SYSTEMS

System	Full form	Key facts
NEFT	National Electronic Funds Transfer	Settles in half-hourly batches; available 24x7 since December 2019; no minimum amount; run by RBI
RTGS	Real Time Gross Settlement	Instant, one-by-one settlement; minimum ₹2 lakh; 24x7 since December 2020; run by RBI
IMPS	Immediate Payment Service	Instant transfer 24x7 using account + IFSC or mobile number + MMID; run by NPCI
UPI	Unified Payments Interface	Instant mobile payments using a virtual payment address (UPI ID) or QR code; launched by NPCI in 2016

REMEMBER FOR EXAM

NEFT and RTGS are operated by the RBI; IMPS, UPI, RuPay, NACH, AePS and BHIM are run by NPCI (National Payments Corporation of India, set up in 2008, Mumbai).

NPCI PRODUCTS

- **UPI**: launched in April 2016; UPI Lite for small payments; UPI 123PAY for feature phones without internet
- **BHIM**: Bharat Interface for Money — UPI app launched in December 2016

- ▶ RuPay: India's own card payment network (launched 2012)
- ▶ NACH: National Automated Clearing House — bulk payments such as salaries, EMIs, subsidies
- ▶ AePS: Aadhaar Enabled Payment System — banking with Aadhaar number and fingerprint at micro-ATMs
- ▶ NETC FASTag: electronic toll collection using RFID
- ▶ BBPS: Bharat Bill Payment System — paying electricity, water and phone bills

BANK CODES

Code	Length	Use
IFSC	11 characters (alphanumeric)	Identifies a bank branch for NEFT, RTGS, IMPS; first 4 letters = bank, 5th character = 0, last 6 = branch
MICR	9 digits	Printed on cheques; identifies city, bank and branch for cheque clearing
SWIFT / BIC	8 or 11 characters	International bank transfers

CHEQUES AND CLEARING

- ▶ CTS: Cheque Truncation System — cheque images are sent electronically instead of moving the paper cheque
- ▶ Cheques are read by MICR machines; CTS-2010 is the standard cheque format
- ▶ Positive Pay System: the customer confirms the details of a high-value cheque in advance to prevent fraud

ATMS, CARDS AND DIGITAL CHANNELS

- ▶ ATM: Automated Teller Machine; White Label ATMs are run by non-bank companies authorised by RBI; Brown Label ATMs are owned by a service provider but carry a bank's brand
- ▶ Micro-ATM: handheld device used by banking correspondents in villages
- ▶ POS: Point of Sale terminal for card payments in shops; NFC enables tap-to-pay
- ▶ Card security: PIN (4 or 6 digits), CVV (3 digits on the back), EMV chip
- ▶ Net banking, mobile banking and Internet banking let customers bank online
- ▶ e-RUPI: prepaid digital voucher for specific purposes, launched in 2021
- ▶ Digital Rupee (e₹): RBI's Central Bank Digital Currency, piloted from 2022

EXAM FOCUS

- ▶ RTGS minimum ₹2 lakh; NEFT has no minimum; both 24×7
- ▶ NPCI runs UPI, IMPS, RuPay, NACH, AePS, BHIM, FASTag (NETC)
- ▶ IFSC = 11 characters; MICR = 9 digits
- ▶ CTS sends cheque images electronically; Finacle is Infosys's CBS software

ONE-LINERS ASKED IN EXAMS

1. The minimum amount for an RTGS transfer is → **₹2 lakh**
2. Which payment system is NOT operated by NPCI → **NEFT**
3. How many characters are there in an IFSC code → **11**
4. The MICR code on a cheque has how many digits → **9**
5. UPI was launched by NPCI in → **2016**



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