Computer Network 💻

✅ 1. What is a Computer Network?

A **Computer Network** is when two or more computers are connected to share data, resources, or communication.

> 📦 Real Life Example: WhatsApp and Instagram work because millions of devices (phones, servers) are connected via networks.

Benefits of Networking:

- File sharing
- Internet access
- Communication (chat, email)
- Resource sharing (printers, servers)

✅ 2. Types of Networks

Type	Full Form	Range	Example
LAN	Local Area Network	Within a building or room	Home Wi-Fi
MAN	Metropolitan Area Network	City-wide	College Campus Wi-Fi
WAN	Wide Area Network	Country or world-wide	The Internet
PAN	Personal Area Network	Very short range	Bluetooth, Hotspot

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✅ 3. Network Topologies

Topology = How devices are connected

Topology	Description	Pros	Cons
Bus	All devices in a line	Easy setup	One failure affects all
Star	All connect to a central hub	Easy to manage	Hub failure affects all
Ring	Devices in a circle	Predictable	If one breaks, all fail
Mesh	All devices connected to all others	Very reliable	Expensive
Hybrid	Mix of all	Flexible	Complex

🌐 Day 1: OSI Model – The Backbone of Networking

🤔 What is the OSI Model?

OSI stands for **Open Systems Interconnection**.

It's a **conceptual framework** that shows how data travels from one computer to another over a network. It divides the process into **7 layers**, each with a specific role.

🧱 7 Layers of the OSI Model (Top to Bottom)

Layer	Layer Name	What It Does (Simple)	Example
7	Application	Interface for the user	WhatsApp, Gmail
6	Presentation	Converts data formats (encrypt, compress)	JPEG ↔ PNG, Encryption
5	Session	Manages sessions (start, end communication)	Logging in to a server
4	Transport	Ensures reliable delivery (TCP/UDP)	Splits data into chunks
3	Network	Routes data using IP addresses	Google.com → IP
2	Data Link	Transfers frames between two directly connected devices	MAC Address
1	Physical	Actual hardware and transmission (cables, signals)	Ethernet cable, Wi-Fi

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📦 Real-Life Analogy: Sending a Parcel

Imagine sending a parcel:

1. **Application** – You write the letter.
2. **Presentation** – You translate it (e.g., Hindi to English).
3. **Session** – You call the post office to schedule pickup.
4. **Transport** – They pack and label it.
5. **Network** – They choose the best route (road, air).
6. **Data Link** – Truck loads it and drives it locally.
7. **Physical** – The wheels move the parcel physically.

💡 Remember Like This (Mnemonic):

> **"All People Seem To Need Data Processing"**
> (A = Application, P = Presentation, S = Session, T = Transport, N = Network, D = Data Link, P = Physical)

🌐 Daily CN Lesson – Day 2: TCP/IP Model

> 📦 The real-world version of the OSI model, used by the internet today.

📘 What is the TCP/IP Model?

TCP/IP stands for **Transmission Control Protocol / Internet Protocol**.

It is the **practical model** that the internet and most modern networks use to communicate. While the OSI model is a reference framework, **TCP/IP is the actual implementation**.

🧱 Layers of the TCP/IP Model (4 Layers Only!)

Layer	OSI Equivalent	Role (Simple)	Example
4. Application	OSI Layer 5–7	Provides services to user	HTTP, FTP, SMTP
3. Transport	OSI Layer 4	Ensures reliable or fast delivery	TCP, UDP
2. Internet	OSI Layer 3	Handles addressing & routing	IP, ICMP
1. Network Access	OSI Layer 1–2	Sends bits physically	Ethernet, Wi-Fi

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🧠 Key Differences: OSI vs TCP/IP

Feature	OSI Model	TCP/IP Model
Layers	7	4
Use	Conceptual	Practical (used in real world)
Developed By	ISO	DARPA (U.S. Dept. of Defense)
Popularity	Learning/Exams	Real-world Networking

📦 Real-Life Analogy:

Let's say you want to send a message using WhatsApp:

1. **Application Layer** → You type the message.
2. **Transport Layer** → The message is broken into packets.
3. **Internet Layer** → The address of the destination is added.
4. **Network Access Layer** → Message physically sent via Wi-Fi.

📌 Common Protocols in TCP/IP

Layer	Protocols
Application	HTTP, HTTPS, FTP, SMTP, DNS
Transport	TCP, UDP
Internet	IP (IPv4, IPv6), ICMP
Network Access	Ethernet, Wi-Fi, ARP

🌐 Daily CN Lesson – Day 3: IP Addressing + Subnetting Basics

🧠 What is an IP Address?

An **IP (Internet Protocol) address** is a **unique identifier** for every device on a network — like a phone number for your computer.

It helps:

- **Identify** a device on the internet or network
- **Send and receive** data to/from the right place

📦 Types of IP Addresses

Type	Description	Example
IPv4	32-bit address, widely used	`192.168.1.1`
IPv6	128-bit address, newer, more space	`2001:0db8:85a3:0000:0000:8a2e:0370:7334`

📌 IPv4 Format

- 32 bits (divided into 4 sections or *octets*)
- Written in **dotted decimal** form: `192.168.0.1`
- Each section (octet) ranges from **0 to 255**

🔢 Example:
`11000000.10101000.00000000.00000001` = `192.168.0.1`

🏠 Public vs Private IP Addresses

Type	Used Where?	Example
Private	Inside home or office network	`192.168.x.x`, `10.x.x.x`, `172.16.x.x`
Public	Globally on the internet	Your mobile/ISP-assigned IP

🔒 Private IPs can't be accessed directly from outside the network.

🧮 What is Subnetting?

Subnetting = Breaking a large network into smaller **sub-networks (subnets)**.

Why?

- Helps in **efficient IP allocation**
- **Improves performance** and **security**
- Reduces **broadcast traffic**

🧠 Subnet Mask

A **subnet mask** defines which part of the IP address is the **network** and which part is the **host**.

Common example:

- IP: `192.168.1.10`
- Subnet Mask: `255.255.255.0`

That means:

- `192.168.1` = Network part
- `.10` = Host (device) part

🎯 CIDR Notation

Instead of writing the whole mask:

- `192.168.1.10/24` → Means **first 24 bits** are for the network.

🌐 Daily CN Lesson – Day 4: IP Address Classes + Default Subnets + Practice

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🧠 Why IP Address Classes?

Back in early networking days, the internet needed a way to organize IP addresses for different **sizes of networks**. That's how **IP Classes** were introduced.

IPv4 addresses are divided into **5 classes** based on their **starting bits and range**.

📊 IP Address Classes (A to E)

Class	Starting Bit(s)	Range (1st Octet)	Default Subnet Mask	Use
A	0xxxxxxx	1 – 126	255.0.0.0 (/8)	Large networks
B	10xxxxxx	128 – 191	255.255.0.0 (/16)	Medium networks
C	110xxxxx	192 – 223	255.255.255.0 (/24)	Small networks
D	1110xxxx	224 – 239	N/A	Multicast
E	1111xxxx	240 – 255	N/A	Research only (Experimental)

> Note: `127.x.x.x` is reserved for **loopback (localhost)**

🎯 Default Subnet Masks

Class	Subnet Mask	CIDR Notation	Usable Hosts
A	255.0.0.0	`/8`	~16 million
B	255.255.0.0	`/16`	~65,000
C	255.255.255.0	`/24`	254

> Usable hosts = $2^n - 2$
> (`n` = number of host bits)

🌐 Day 5: Static vs Dynamic IP + DHCP + DNS + Real-World Workflow

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🔁 1. Static vs Dynamic IP

Type	Description	Example Use Case
Static IP	Manually assigned IP that never changes	Servers, printers
Dynamic IP	Automatically assigned by DHCP	Home Wi-Fi, mobile data

🧠 Key Differences

Feature	Static IP	Dynamic IP
Assigned by	Admin manually	DHCP server automatically
Changes?	Never (unless manually changed)	Yes, can change any time
Cost	Usually paid	Free
Example	`192.168.1.10`	`192.168.1.100` (changes)

> ⚠️ If you're hosting a website or game server, **static IP** is better.

⚙️ 2. What is DHCP (Dynamic Host Configuration Protocol)?

DHCP automatically assigns:

- **IP address**
- **Subnet mask**
- **Gateway**
- **DNS**

> 👷 Without DHCP, every device must be configured **manually**.

🧭 DHCP Workflow (Real World Example):

1. **Device joins network**
   (e.g., You connect your phone to Wi-Fi)
2. Device sends a **DHCPDISCOVER**
3. DHCP server replies with **DHCPOFFER**
4. Device sends **DHCPREQUEST**
5. Server confirms with **DHCPACK**

✅ Your phone now has an IP and can access the internet!

🌍 3. What is DNS (Domain Name System)?

DNS = Phonebook of the internet

It **converts domain names to IP addresses**.

> 📦 Example:
> You type `www.google.com` → DNS says: "Its IP is `142.250.195.36`" → Browser connects to that

> server

🔗 DNS Resolution Flow (Simplified)

1. You type `www.example.com`
2. Your device asks a **DNS Resolver**
3. Resolver checks:
   - Local Cache
   - Root Server → TLD Server → Authoritative Server
4. Gets IP address → sends it to your browser
5. Browser connects to server via IP

🔁 Real-Life Network Flow Summary

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You → Connect to Wi-Fi
→ DHCP assigns IP, DNS
→ You open google.com
→ DNS translates domain to IP
→ Browser connects via IP
→ Server sends response
→ You see Google homepage
```
