1. IP Address Classes

Classes	Range	Usage	Bits	N/H Portions	Default Mask
A	1 - 126	Unicast Broadcast communication	0	8/24	255.0.0.0
B	128 - 191		10	16/16	255.255.0.0
C	192 - 223		110	24/8	255.255.255.0
D	224 - 239	Multicast	1110	N/A	N/A
E	240 - 255	Research and Development	1111	N/A	N/A

- **Important Notes:**
  - **i.** Classes **D and E** cannot be assigned to end-users.
  - **ii.** Class **E** is reserved by **IANA** for research purposes.
  - **iii.** Class **A, B, and C** are assignable to hosts.
  - **iv.** **127.x.x.x** is reserved for **loopback (localhost)**.

2. Identifying Class from Decimal

- **Example: 10.170.200.235**
  - **i.** First octet = **10** → Falls in **1–126** → **Class A**.

3. Identifying Class from Binary

To find the class in **binary format**, we check the **first few bits of the first octet**

- Class A: 0xxxxxxx → first bit is 0
- Class B: 10xxxxxx → starts with 10
- Class C: 110xxxxx → starts with 110
- Class D: 1110xxxx → starts with 1110
- Class E: 1111xxxx → starts with 1111

128	64	32	16	8	4	2	1		
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		
0	0	0	0	0	0	0	0	Off	0
1	1	1	1	1	1	1	1	On	255

- **OFF (0)** → no value added
- **ON (1)** → value included

- **Example Conversion: 10.170.200.235**

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**		
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		
0	0	0	0	0	0	0	0	Off	0
1	1	1	1	1	1	1	1	On	255

For 10:

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
0	**0**	**0**	**0**	**1**	**0**	**1**	**0**

For 170:

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
1	**0**	**1**	**0**	**1**	**0**	**1**	**0**

For 200:

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
1	**1**	**0**	**0**	**1**	**0**	**0**	**0**

For 235:

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
1	**1**	**1**	**0**	**1**	**0**	**1**	**1**

So the IP in binary is:

- 00001010**.**10101010**.**11001000**.**11101011
- Below its done in Hand Written format

Lets convert this IP to binary

IP : 10.170.200.234

This Ip belongs to class A because if we look at the first octet we see 10 which lies between 1 – 126 and class A addresses are also from 1 – 126.

So we know in binary there are two possibilities either 0 or 1.
0 meaning off and 1 meaning on.

So: 10.170.200.235 in binary for that lets do.

So for 10 what bits should be on to make 10.

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	0	0	0	1	0	1	0

since $2^3 = 8$ and $2^1 = 2$. $8+2 = 10$.

now for 170. which bits should be on to make 170

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	1	0	1	0	1	0

$128+32=160$. $8+2=10$. $160+10=170$

for 200.

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	0	0	1	0	0	0

$128+64+8 = 200$.

for 235.

$128+64+32+8+2+1 = 235$

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	0	1	0	1	1

4. Network ID

- In **Network ID** the **Host portion is all 0**

Example:

- A: 10.170.200.255 → Network ID: 10.0.0.0
- B: 190.16.10.10 → Network ID: 190.16.0.0
- C: 192.168.0.1 → Network ID: 192.168.0.0

5. Broad Cast ID

- In **Broad Cast ID** the **Host portion is all 1**

Example:

- A: 10.170.200.255 → Broadcast ID: 10.255.255.255
- B: 190.16.10.10 → Broadcast ID: 190.16.255.255
- C: 192.168.0.1 → Broadcast ID: 192.168.0.255

6. Usable Host Addresses

Formula: **2^n – 2**, where n = number of host bits.

- **Class A:** 2^24 – 2 = **16,777,214** hosts
- **Class B:** 2^16 – 2 = **65,534** hosts
- **Class C:** 2^8 – 2 = **254** hosts

(-2 because Network ID and Broadcast ID are not usable by hosts.)

7. Subnet Masks

Subnet mask = **network portion ON (1), host portion OFF (0).**

- **Class A:** 255.0.0.0 (/8)
- **Class B:** 255.255.0.0 (/16)
- **Class C:** 255.255.255.0 (/24)

Examples (given IPs):

- 10.170.200.255 → Subnet mask: 255.0.0.0
- 171.16.0.0 → Subnet mask: 255.255.0.0

- 171.16.0.0 → Subnet mask: 255.255.0.0

8. Private vs Public Addresses

- **Public IPs:** Used on internet.
- **Private IPs:** Used inside local networks; require NAT (Network Address Translation) to connect to internet.

Private IP Ranges:

- **Class A:** 10.0.0.0 – 10.255.255.255
- **Class B:** 172.16.0.0 – 172.31.255.255 (16 private networks)
- **Class C:** 192.168.0.0 – 192.168.255.255 (256 private networks)

9. IPv6 vs IPv4

- IPv4: 32-bit (≈ 4.3 billion addresses)
- IPv6: 128-bit (almost unlimited addresses)

⚠ Note: IPv6 is **many times larger** (2^128 addresses).