📊 Bit Manipulation Cheat Sheet

🧠 Topic	📖 Meaning	🧩 Real-Life Analogy	💻 Example
AND (&)	1 if both bits are 1	Checking if two switches are *both ON* 🔌	5 & 3 → 1 (0101 & 0011 = 0001)
OR (|)	1 if *either* bit is 1	Turning on a room light from two switches 💡	5 | 3 → 7 (0101 | 0011 = 0111)
XOR (^)	1 if bits are *different*	Door with two switches – toggle state 🔄	5 ^ 3 → 6 (0101 ^ 0011 = 0110)
NOT (~)	Flips all bits	Mirror image reflection 🪞	~5 → -6 (in 2's complement)
Left Shift (<<)	Shifts bits left (×2 each shift)	Moving digits left in math ➡️	5 << 1 → 10 (0101 → 1010)
Right Shift (>>)	Shifts bits right (÷2 each shift)	Moving digits right ➡️	5 >> 1 → 2 (0101 → 0010)
Check ith Bit	(Num >> i) & 1	Zooming in on 1 bit 🔍	2nd bit of 5: (5 >> 2) & 1 → 1
Set ith Bit	Num | (1 << i)	Turning a specific light ON 💡	Set 1st bit of 5: 5 | (1<<1) → 7
Clear ith Bit	Num & ~(1 << i)	Turning a specific light OFF 🚫	Clear 0th bit of 5: 5 & ~(1<<0) → 4
Toggle ith Bit	Num ^ (1 << i)	Flip a specific switch 🔄	Toggle 0th bit of 5: 5 ^ (1<<0) → 4
Count Set Bits	bin(Num).count('1')	Count ON switches in a panel 🔢	bin(5) → '101' → 2 bits set