🧠✨ Lecture 05 — LOGIC BUILDING

(Implementation Ready · Beginner + SDE Friendly)

🔁 LOOP CHOICE — First Principle

❓ Problem

Kab **for loop** aur kab **while loop** use karein?

🧠 Logic

Situation	Best Loop
Iterations pehle se pata	`for`
Condition ke basis par rukna	`while`
Number todna (digits)	`while`

📌 Golden Interview Line

> “Digit-based problems are condition-driven, not count-driven.”

🔢 CORE DIGIT LOGIC (EVERYTHING DEPENDS ON THIS)

❓ Problem

Number ke digits kaise nikaalein?

🧠 Logic (Real Life)

Socho ek number **right side se kat raha hai.**

🛠️ Algorithm

```
last digit = num % 10

remaining  = num / 10
```

🧠 Rule jo zindagi bhar kaam aayega

`%10 → digit nikalta hai`

`/10 → digit remove hota hai`

👉 **Agar ye clear hai, to aadhi lecture already aati hai**

➕ SUM OF DIGITS

❓ Problem

Number ke saare digits ka sum nikaalna

🧠 Logic (Soch)

- Ek box (`sum`) rakho
- Har digit nikaalo
- Box me daalte jao
- Jab number khatam → answer ready

🔁 Algorithm

```
sum = 0

while(num != 0):

    digit = num % 10

    sum = sum + digit

    num = num / 10
```

🧪 Example

Input: `345128`
Output: `23`

🧠 Code likhte waqt yaad rakho

- `sum` hamesha **0 se start**
- Loop ka kaam sirf **3 lines** ka ho

🔄 NUMBER REVERSE

❓ Problem

Number ko ulta karna

🧠 Logic (Mindset)

Purana number → **left shift**
Naya digit → **right me add**

🔑 Master Formula

```
ans = ans * 10 + digit
```

🔁 Algorithm

```
ans = 0

while(num != 0):

    digit = num % 10

    ans = ans * 10 + digit

    num = num / 10
```

🧪 Example

Input: 1234
Output: 4321

📌 Interview Tip

> Reverse problems = multiply + add pattern

🔢 DECIMAL → BINARY

❓ Problem

Decimal number ko binary me convert karna

🧠 Logic

Binary = **divide by 2 system**

🔁 Algorithm

```
place = 1

ans = 0

while(num != 0):

    rem = num % 2

    ans = ans + rem * place

    place = place * 10

    num = num / 2
```

⚡ Optimized (SDE Level)

```
rem = num & 1   // faster than %2

num = num >> 1 // faster than /2
```

🧪 Example

Input: `17`
Output: `10001`

📌 Yaad Rakho

- Binary reverse order me banta hai
- Isliye `place` use kiya

🔄 BINARY → DECIMAL

❓ Problem

Binary number ko decimal me convert karna

🧠 Logic

Har bit = **power of 2**

🔁 Algorithm

```
power = 1

ans = 0

while(num != 0):

    rem = num % 10

    ans = ans + rem * power

    power = power * 2

    num = num / 10
```

🧪 Example

Input: 11011
Output: 27

📌 Golden Rule

> Binary → multiply by powers of 2

🧮 FACTORIAL

❓ Problem

n! calculate karna

🧠 Logic

Multiplication ka neutral element = **1**

🔁 Algorithm

```
fact = 1

for i = 1 to n:

    fact = fact * i
```

⚠️ Edge Case

```
0! = 1
```

📌 **Interview Favorite Question**

🔢 ARMSTRONG NUMBER

❓ Problem

Digits ke cube ka sum = original number?

🧠 Logic

- Number todna padega → number change hoga
- Isliye **original save karna mandatory**

🔁 Algorithm

```
original = num

sum = 0

while(num != 0):

    digit = num % 10

    sum += digit³

    num = num / 10

if sum == original → Armstrong
```

🧪 Example

Input: `153`
Output: `Armstrong Number`

🔁 FIBONACCI SERIES

❓ Problem

Series generate karni

🧠 Logic

Sirf **last 2 values yaad rakho**

🔁 Algorithm

```
first = 0

second = 1

repeat:

    next = first + second

    first = second

    second = next
```

🧪 Example

Input: 7
Output: 0 1 1 2 3 5 8

📌 Space optimized solution

🔲 FLOOR SQUARE ROOT

❓ Problem

Largest integer jiska square ≤ number

🧠 Logic

Trial badhaate jao jab tak square cross na kare

🔁 Algorithm

```
ans = 0

for i = 1 while i*i <= num:

    ans = i
```

🧪 Example

Input: 10
Output: 3

🧠 ULTIMATE LOGIC CHEAT SHEET

```
Digits         → %10 /10

Reverse        → ans*10 + digit

Binary         → divide by 2

Decimal        → powers of 2

Unknown loops → while

Original data → save it
```

🏁 FINAL LINE (SDE LEVEL)

> “I first identify the pattern,
> then convert it into a loop invariant,
> and finally implement it.”

Made By Harshal Chauhan