Recursion

→ function is calling itself

① Divide & conquer

② Dynamic Programming

Recursion

factorial of given number

$5! = 5 \times 4 \times 3 \times 2 \times 1$

$= 120$

Base case condition

$1! = 1$

$0! = 1$

Recursion

$6! = 6 * 5!$

$5 * 4!$

$4 * 3!$

$3 * 2!$

$2 * 1!$

① Recursive code

$T(n)$

```
fact(n) {
    if(n==0 OR n==1)        // Base case condition
        return 1;
    else
        n * fact(n-1);      // Recursive call
}
```

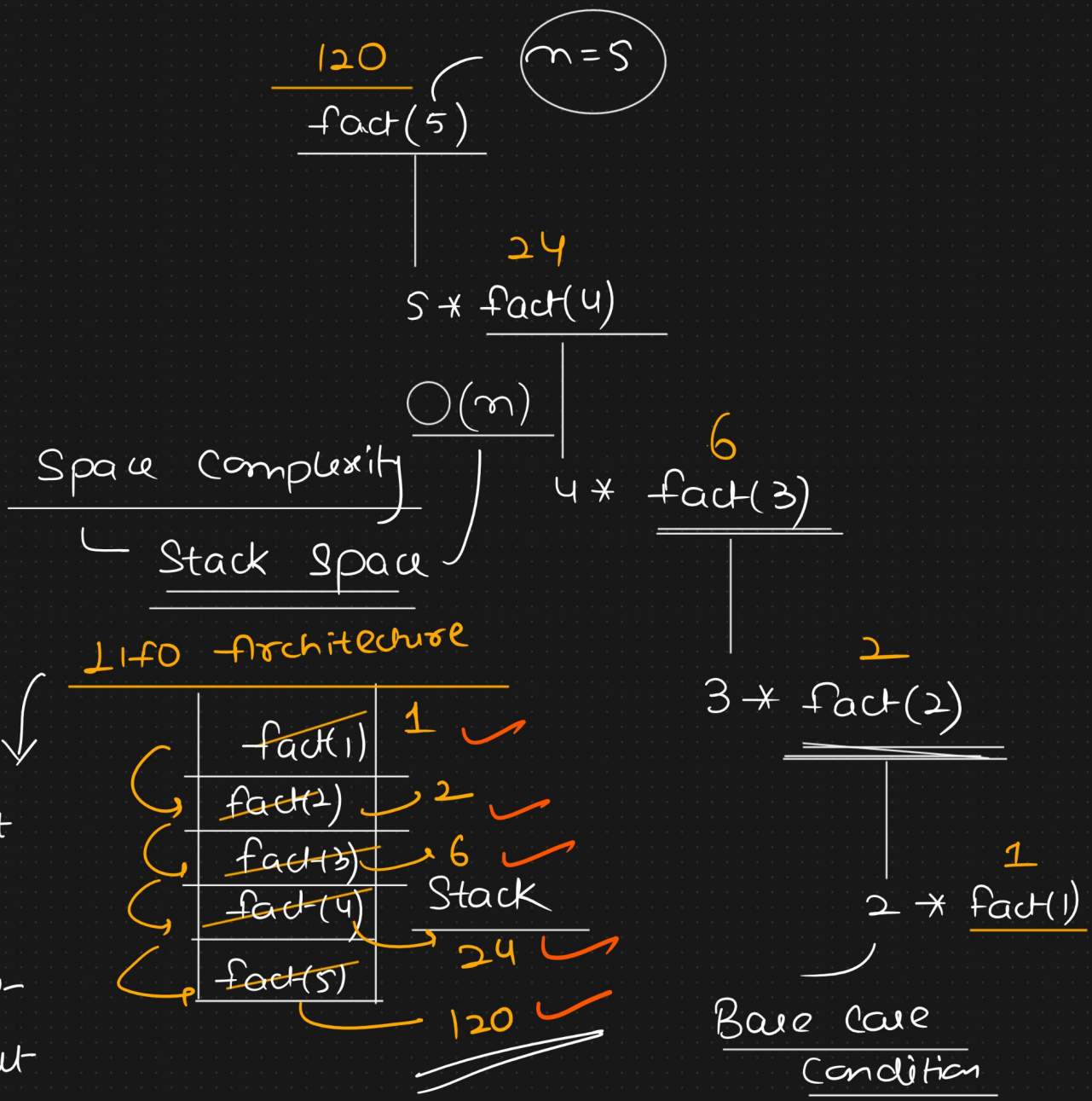
$T(n-1)+c$

Recurrence Relation

↓

Complete DSA in Python

$$T(n) = T(n-1)+c$$
$$= O(n)$$



Repetitive task

Recursion

Calling the same function again

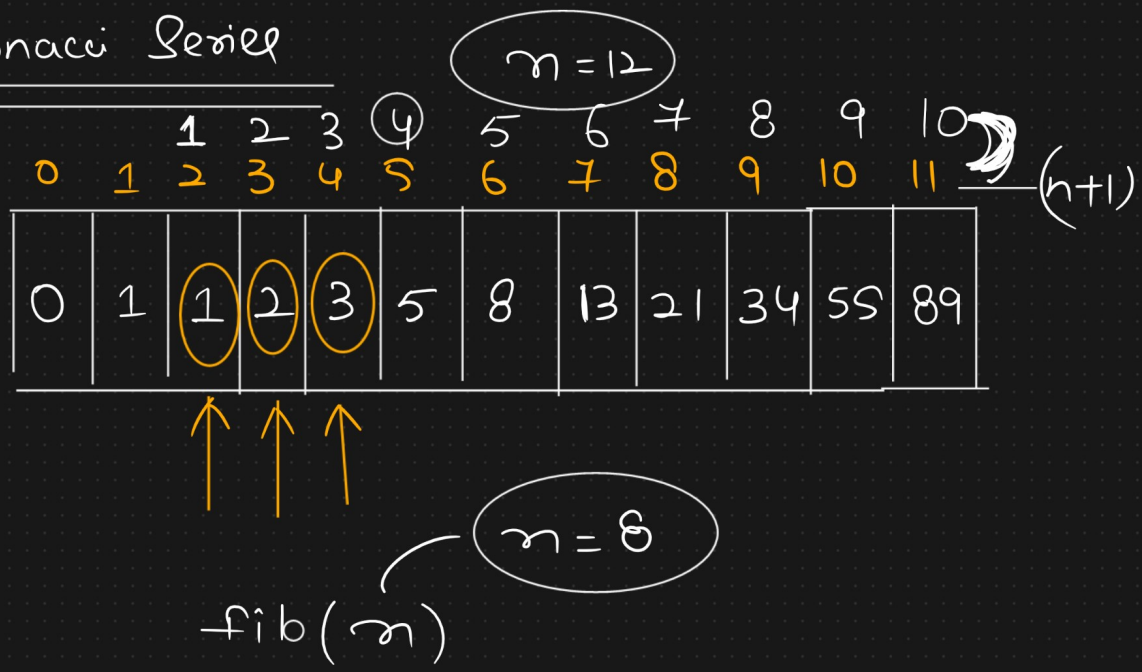
→ different set of parameters

Iterative

→ for, while, do-while

- Easy to understand
- Lesser line of code

(2) fibonacci Series



C

```
if (n==0 OR n==1){
    return n;
}
else {
    return fib(n-1) + fib(n-2);
}
```

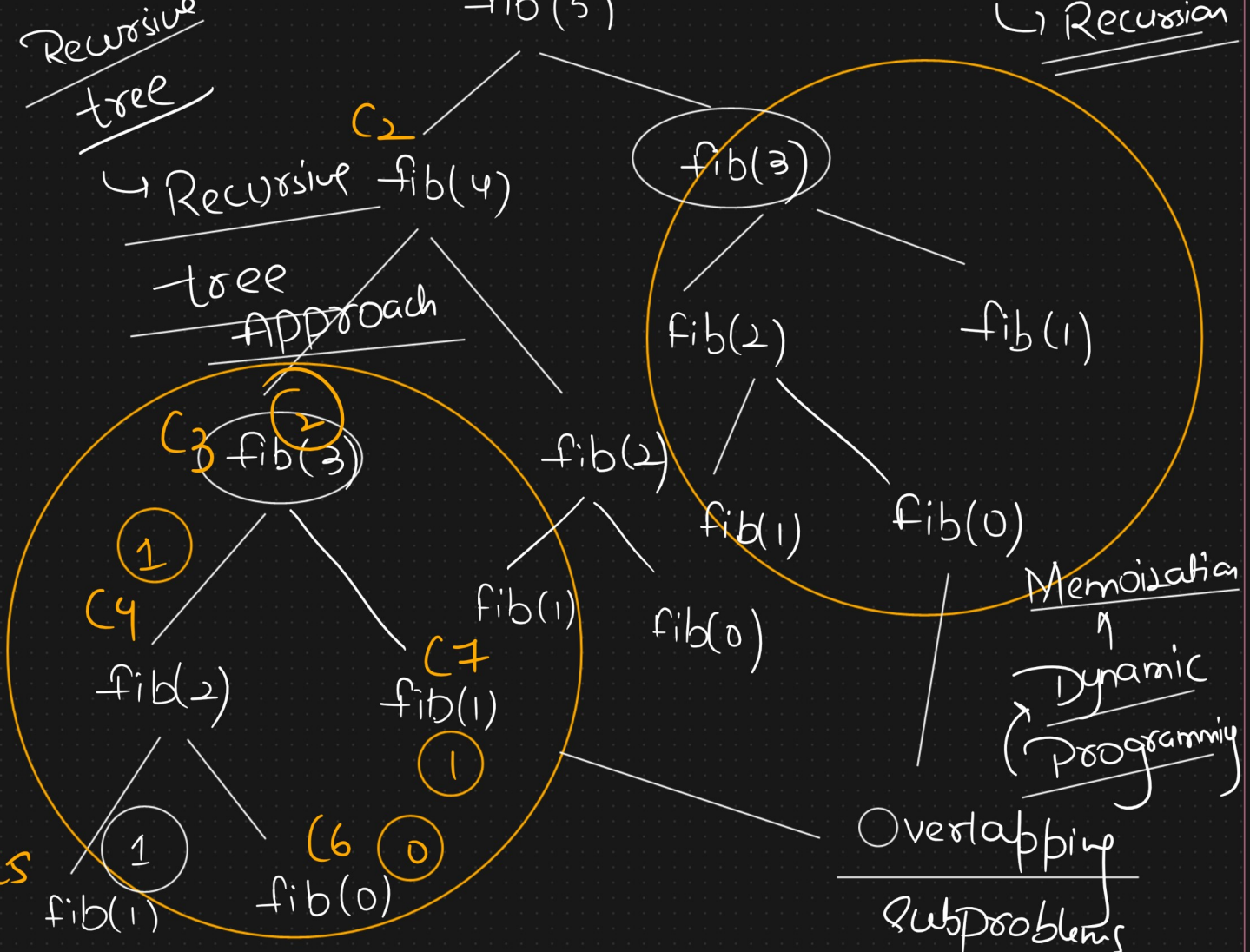
$T(n-1) + T(n-2)$

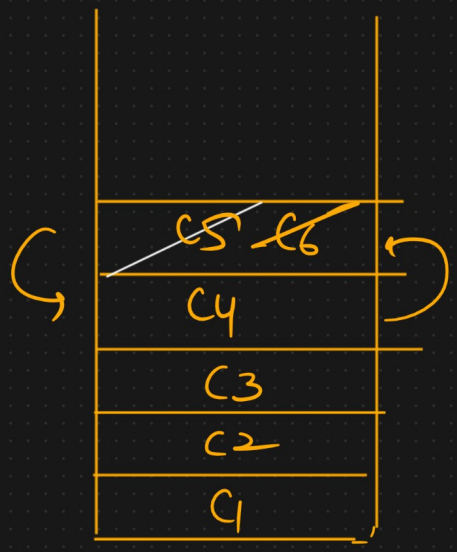
Recursive Approach

$O(2^n)$

Time limit Exceeded

↳ Recursion





Trade off b/w time & space complexity

$$T(n) = \begin{cases} c & n = 1 \\ T(n-1) + T(n-2) & n > 1 \end{cases}$$

Exponential

$O(2^n)$

DP

$O(n)$

Linear

$n = 4$

1. $1+1+1+1$
2. $1+2+1$
3. $2+1+1$
4. $1+1+2$
5. $2+2$

1 2 3 4 5 6 7 8 9 10

num1 num2 5 8

num1 = 1

num2 = 2

num1 num2 num3

for (i = 3 to n) {

i = 3

num3 = num1 + num2;

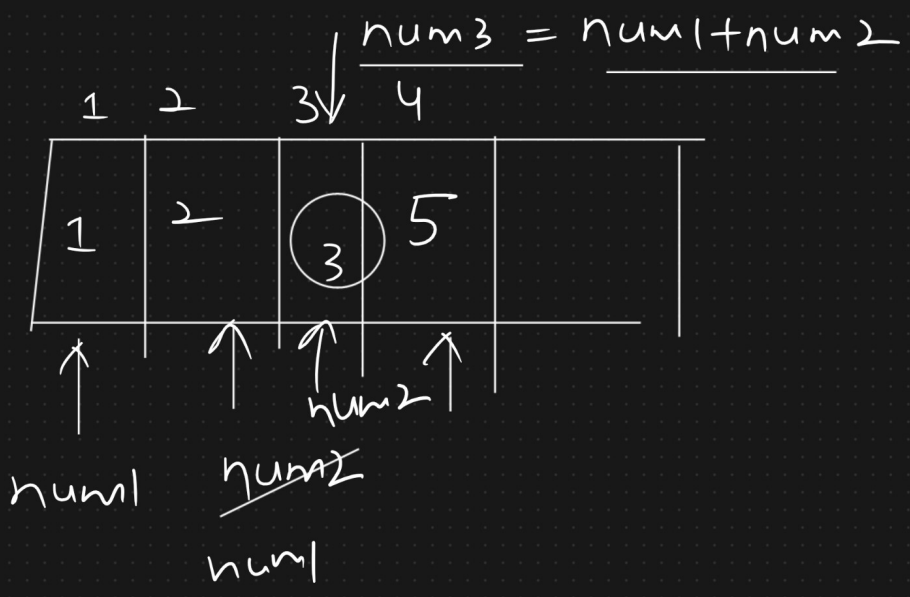
num1 = num2

num2 = num3

return num2;

}

O(n)



Application of Divide & Conquer

No problem of Overlapping Subproblem

- MergeSort
- QuickSort
- Binary Search

Sum of Digits

Interview Question

num = 1234

Output = 1 + 2 + 3 + 4

= 10

num/10

Remainder

num % 10 = 1234 % 10 = 4

```
SumofDigits(int n)
    n==0
      ↳ 0
```

n = 1234

return (n%10) + sumofDigits(n/10)

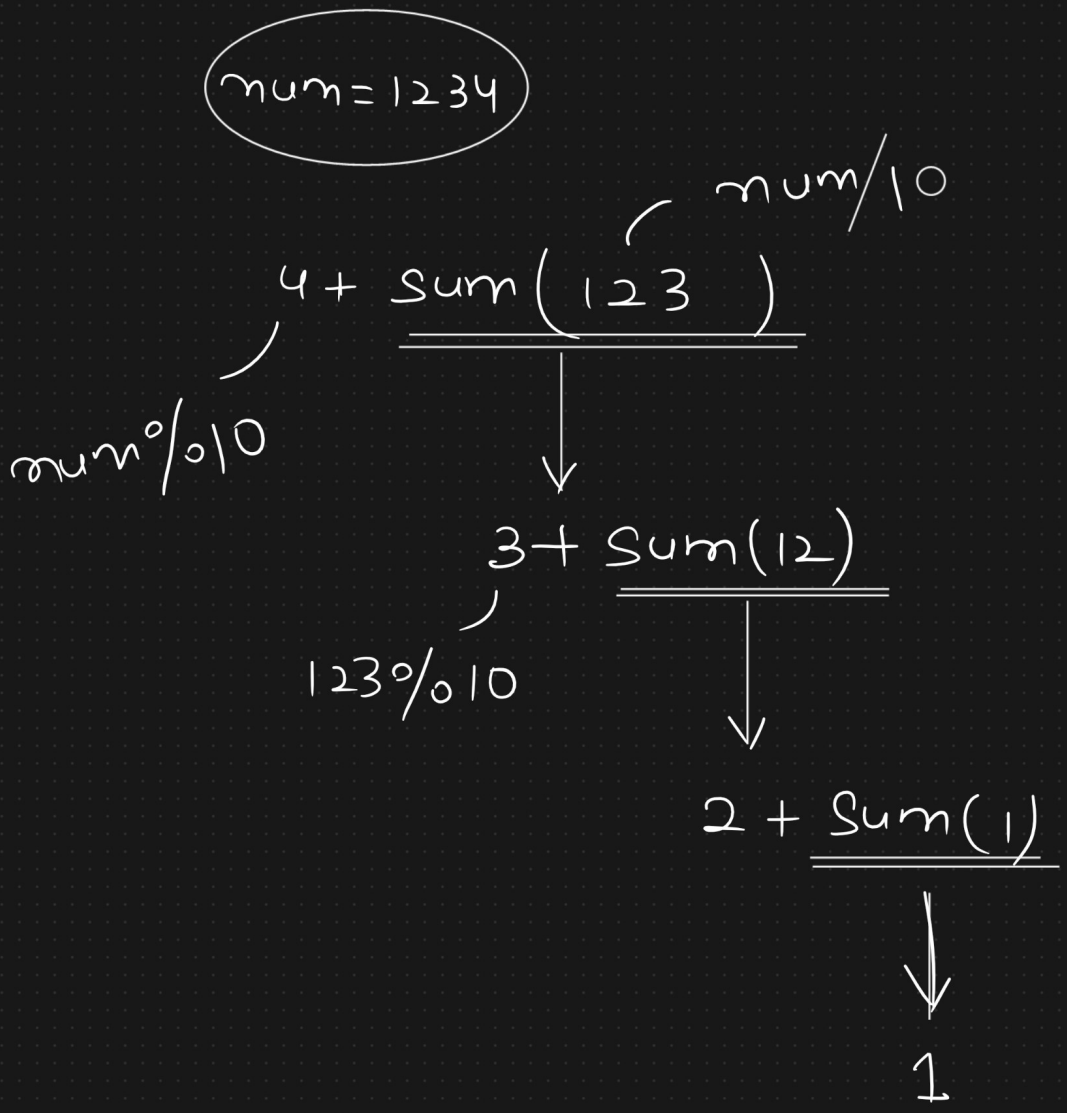
4 + Sum(123)

3 + Sum(12)

2 + Sum(1)

1

10



(1) Add digits

Assignment

num = 38

3 + 8 = 11

1 + 1 = 2 → Return the answer as 2.

Alternating Digit Sum

Question 2

num = 15

Alternate sign manner

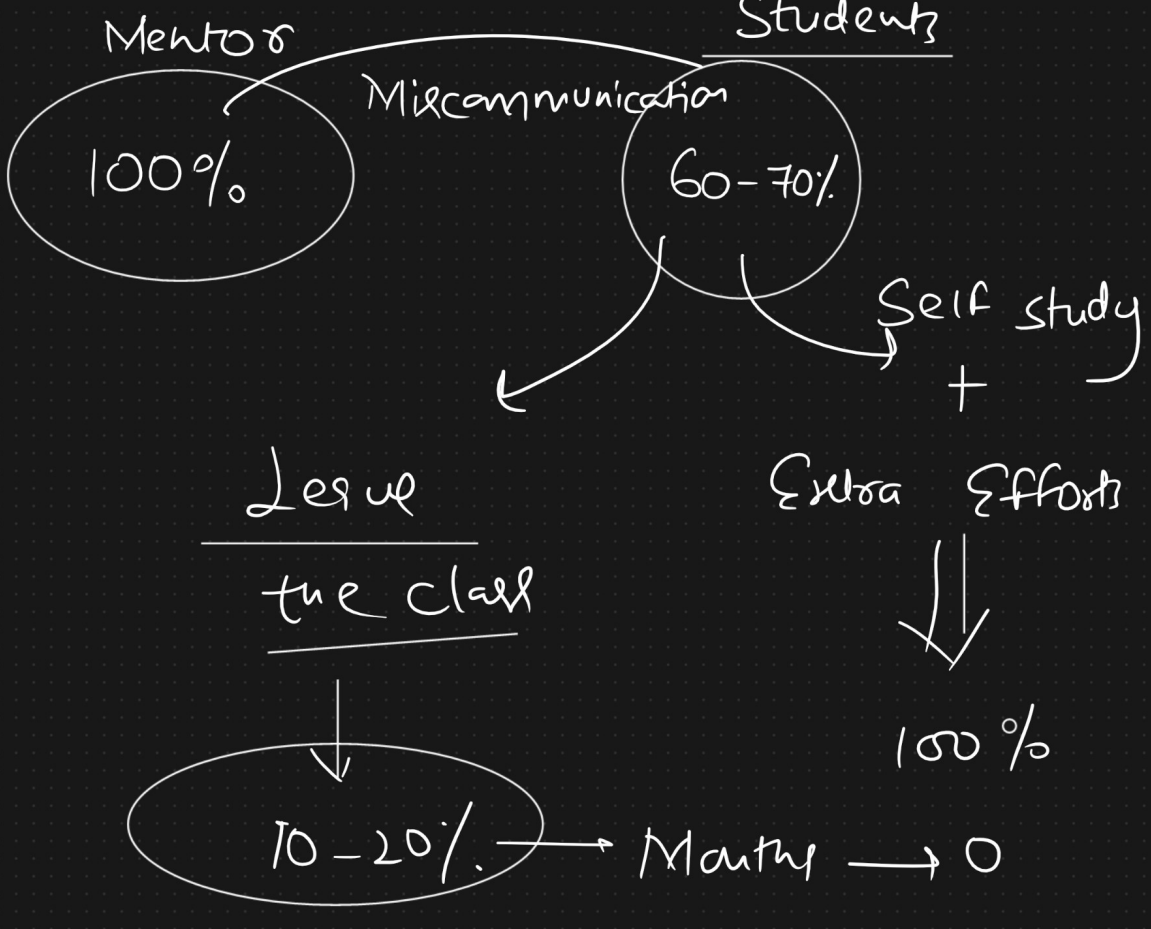
$15 - 14 + 13 - 12 + 11 - 10 + 9 - 8 + 7$

$- 6 + 5 - 4 + 3 - 2 + 1$

Recursion

{ Even → -ve

Odd → +ve



Hashing — 17th July