Maths for DSA

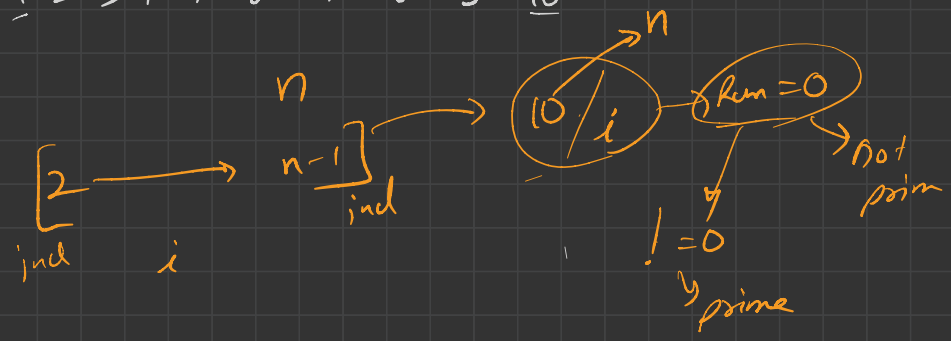
(1) Prime numbers:-

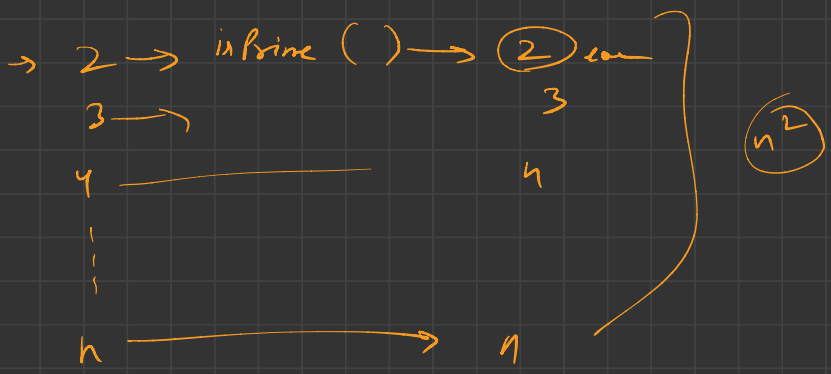
i/p → n

o/p → is Prime or not

n → 10

1 2 3 4 5 6 7 8 9 10





→ Sieve of Eratosthenes :-

n = 40 → o/p - 12

~~1~~	(2)	(3)	~~4~~	(5)	~~6~~	(7)	~~8~~	~~9~~	~~10~~
(11)	~~12~~	(13)	~~14~~	~~15~~	~~16~~	(17)	~~18~~	(19)	~~20~~
~~21~~	~~22~~	(23)	~~24~~	~~25~~	~~26~~	~~27~~	~~28~~	(29)	~~30~~
(31)	~~32~~	~~33~~	~~34~~	~~35~~	~~36~~	(37)	~~38~~	~~39~~	~~40~~

App:

① Mark every no as a Prime Number

② Table ke across jo usko non prime mark kardo

→ Complexity

↪ n → total

$$\left(\frac{n}{2} + \frac{n}{3} + \frac{n}{5} + \frac{n}{7} + \frac{n}{11} - - - \right)$$

$$n \times \left(\frac{1}{2} + \frac{1}{3} + \frac{1}{5} + \frac{1}{7} + \frac{1}{11} - - - \right)$$

⇓

H.P → prime no)

⇓

$O(n * \log(\log n))$ → T.C

Homework → Segmented Sieve

GCD / HCF :-

a & b

24 , 72

2	24
2	12
2	6
3	3
	1

2	72
2	36
2	18
3	9
3	3
	1

24 :- 2×2×2×3

72 :- 2×2×2×3×

2×2×2×3

4×6

= 24

$$gcd(a, b) = gcd(a-b, b)$$

$$\Downarrow$$

$$gcd(a\%b, b)$$

Ex. $gcd(72, 24) = gcd(48, 24)$

$= gcd(24, 24)$

$= gcd(0, 24)$

24

$$lcm(a,b) * gcd(a,b) = a * b$$

Relation

$a \% n \longrightarrow [0 \longrightarrow (n-1)]$

ind ind

Q → Print ans modulo 10^9+7

ind

$(a+b) \% m = a \% m + b \% m$

$a \% m - b \% m = (a-b) \% m$

$a \% m * b \% m = (a*b) \% m$

Fast Exponentiation:-

a^b $\quad a^b$

```
ans = 1;
for (b times)
{
    ans = ans * a;
}
```

→ O(b) T.C

a^b $\quad 2^{10} \quad 2^{11}$

$a^b \rightarrow (a^{b/2})^2$ → if b is even

$(a^{b/2})^2 \times a$ → if b is odd

$2^{10} \rightarrow (2^5)^2$, $2^{11} \rightarrow (2^5)^2 \times 2$

$= 2^{10} \times 2 = 2^{10+1} = 2^{11}$

x, n, m

$(x^n) \% m$

$O(n)$

$O(\log n) \rightarrow T.C$

→ Sieve of Eratos — / Segmented Sieve

→ GCD / LCM → Code → Article

→ Fast Power → Code → (Modular Arithmetic)
↓
Article

Homeworks

- Pigeonhole Principle
- Catalan number
- Inc-Excl Principle

Q - Factorial of no

$212! \% m$

$m = 10^9 + 7$

- CRT
- Lucas
- FL
- P