

Mathematics 11

Prime or Not [2, 3, 5, 7, 11, 13, 17]

$$N = 31$$

factors are on $1 \leq N$

~~brute force~~

using for loop for 2 to $N-1$

→ efficient:

if no. factor is then ^{will be 10} $2 \rightarrow \sqrt{n}$

$$a \times b = N$$

↓

$$(2 \dots \sqrt{n})$$

$$(a \leq b)$$

$$a \times a \leq N$$

$$a \leq \sqrt{N}$$

using for loop 2 to \sqrt{N}

→ more efficient

$$N = 31$$

loop till 30 for \sqrt{N}

now, we can remove all even ~~num~~ num except 2.

remove all 3 multiple num except 3

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

pairs come after adding 6 to every first num of pair so the time complexity will be same but code will be faster

Print all divisors of N

$N = 30$

1.....N

for loop $\% == 0$ yes; \rightarrow T.C. $O(n)$ $\theta(n)$

efficient:

for loop till \sqrt{n} the multiple of one divisor for no. will also be the divisor

sorted way: make 2 loops

$i = 1$

↓

2

↓

3

↓

4

↓

5

↓

6

$i = 5$

↓

4

↓

3

↓

2

↓

1

$O(\sqrt{n})$

Sieve of Eratosthenes \rightarrow print prime no. from 1.....1000, N

① for loop and check prime

\hookrightarrow T.C. $O(n\sqrt{n}) \approx O(n^{3/2})$

$O(n \log \log n)$
 \downarrow
 $O(n)$

$N = 20$

X	1	$\frac{2}{T}$	$\frac{3}{T}$	$\frac{4}{F}$	$\frac{5}{T}$	$\frac{6}{F}$	$\frac{7}{T}$	$\frac{8}{F}$	$\frac{9}{F}$	$\frac{10}{F}$
	11	$\frac{12}{F}$	$\frac{13}{F}$	$\frac{14}{F}$	$\frac{15}{F}$	$\frac{16}{F}$	$\frac{17}{F}$	$\frac{18}{F}$	$\frac{19}{F}$	$\frac{20}{F}$

Make boolean array with init $arr = \text{True}$

until \sqrt{n} work you
 mark its True.

Fast Power, Calc Pow(a, b)

$$\text{Main: Pow}(3, 4) = 3^4 = 81$$

1. for loop b

$$O(b)$$

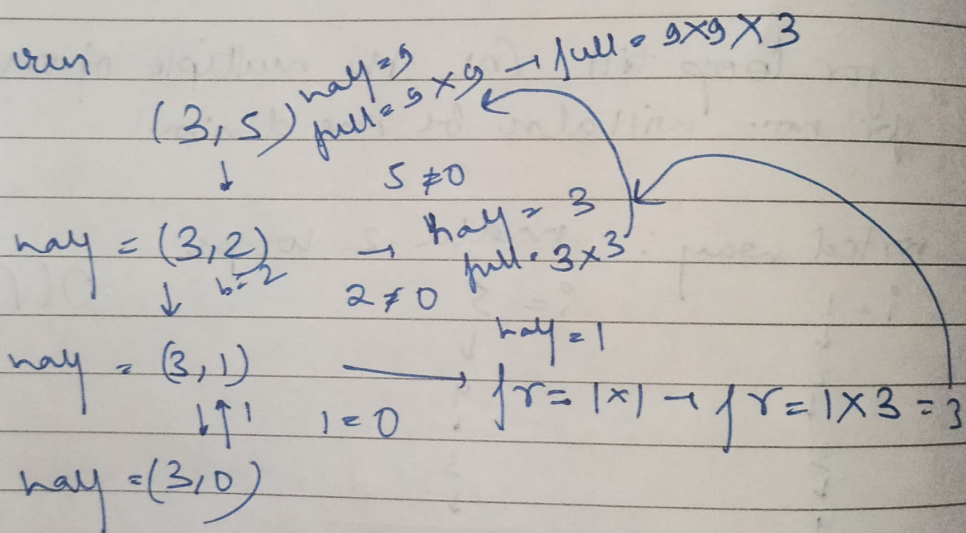
$$3 \times 3 \times 3 \times 3$$

2. $a^b \rightarrow a^{b/2} \times a^{b/2}$

even \uparrow

$$b \text{ odd} = a^{b/2} \times a^{b/2} \times a$$

Dry run



$$n \rightarrow n/2 \rightarrow n/2^2 \rightarrow \dots \text{until } n = 0$$

$$\frac{n}{2^k} = 1 \rightarrow k \text{ steps} \rightarrow$$

$$\therefore TCO(\log n)$$

$$n = 2^k$$

$$[k = \log n]$$