Optimization

Prime No →

T	T		T		T	T	T		—		T	T	F
0	1	2	3	4	5						22	23	24

$2 \rightarrow$ 4, 6, 8, 10, 12, 18, 20, 22, 24, 2̶6̶

$3 \rightarrow$ 6, 9, 12, 15, 18, 21, 24, 27

$4 \rightarrow$ Non Prime

$5 \rightarrow$ 10, 15, 20, 25

① → optimization < 1 (Inner Loop)

$i \rightarrow ②\times 2 = 4$ $i = 3 \times 2 = 6$
$2 \times 3 = 6$ $\times 3 = 9$
$2 \times 4 = 8$ $\times 4 = 12$
$2 \times 5 = 10$

$i \rightarrow$ Pehle Toh start $\rightarrow i \times i$

ex> $2 \times 2 = 4$, 6, 8, 10, 12, 14, 16, — —
$3 = 3 \times 3 = 9$

ab 3 se phele jo bhi 3×2 vo aagye

Spiral
logo

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$5 \times 5 = 25$

1) sese phele $\to 10 \to 5 \times 2$, $15 \to 5 \times 3$, 20

$5 \times ④$

$\downarrow$

$\swarrow \times 2$

so, Start from $i * i$

② → Optimization-2 (Outer Loop)

inner loop ⇒ int, $j = i * i$

while $(j \leq N)$ {

    $arr[j] = false$

    $j += i;$

already mark hogaye

$y = 7, 14, 21, ---- 49$

$7 \to i * i = 49$ se

best while $(49 \leq N)$

→ Outer loop extra chal rha hh
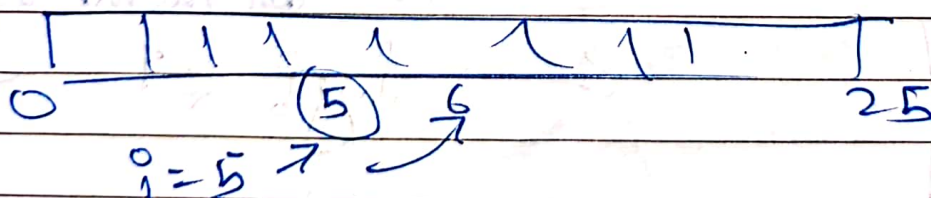
ab $i = 0 \longrightarrow \sqrt{n} \to$ why?

$n = 25$, $\sqrt{n} = 5$

0 ⑤ 6 25 so $\sqrt{n}$ tak

$i = 5$ loop chalo

inner loop $j = 5 \times 5 = ㉕$

$i = 6$

inner loop $j = 6 \times 6 = ㊱ \to$ out of

Worst | $TC \approx n \log(\log n)$

Same hogi

$\hookrightarrow$ but Avg achi ho jayegi

$\rightarrow L, R$

$L = 13056$ $R \Rightarrow 198935$

No of Primes

0 | T | T | F | . . . . $\boxed{}$ _____ 19835
           $\downarrow$ $\underbrace{}$
        13056   Count krlugaa

But if $L = 13056$ $\boxed{R = 10^9}$

                        Cannot allocate
                        10^9 on memory

Stack $\leftarrow$ Why? $\leftarrow$ 4
  $\downarrow$

  $\uparrow$ fun ()f
                        int ce [1000]
Heap $\downarrow$
data   4   cone man size
Text
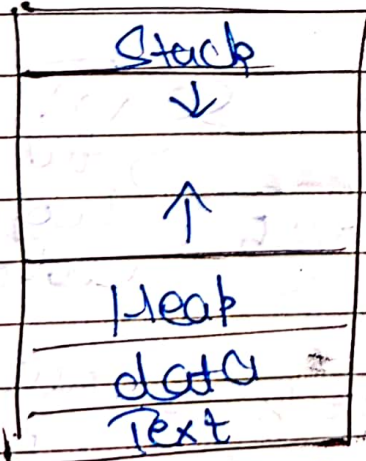
$\hookrightarrow$ Memory   Spiral

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int, double, char→array, max Size→10^6

bool array →10^7

Global → int, double, char →10^7 bool →10^8

   ↳ Diff for diff Computer Antecture

for Online Contest

⇒ $1 \leq (L, R) \leq 10^9$

     ↳ $(R - L + 1) \leq 10^6$

EX) L=110   R-L+1=21   R=130

110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Segmented Sieve

Steps→ i) Generate all primes responsible to mark seg sieve

    or → find all the prime No from 0 to √R

       ↳ using Normal sieve

Sieve → $\sqrt{N} = 11$ | | | | | | | ← Prime

These prime will help to mark in Segmented Sieve Spiral

(8-2) → Base prime = {2, 3, 5, 7, 11}

find first index to start marking

→ index 0 ——→ Resembles 110

index 20 ——→ Resembles 130

start → first Multiple
low.

$prime = 2$　　　$\dfrac{110}{2} \times 2 = 110$
　　　　　　　　　　　　　　↓
　　　　　　　　　　start
　　　　　　　　　marking
　　　　　　　　　with
　　　　　　　　　this

$prime = 3$　→　$\dfrac{110}{3} \times 3 = (36.6) \times 3$
　　　　　　　　　　　　　　↓
　　　　　　　　　　　　　int
　　　　　　　　　　　　　↓
　　　　　　　　　→ $36 \times 3 = 108$

If (value < low)

first Multiple + prime

$108 + 3 = 111$

First Multiple = $\left(\dfrac{k}{prime}\right) \times prime$

int j = max(first Multiple, prime $\times$ prime)
　　　　　　　　　　　　　　　　　　Spiral

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$i=3$ first mul = (111) ⎤
                        ⎬ →main

$i * i = 9$

but for $i = 11$ first mul $= 110 * 11 = (110)$
                                         $\overline{11}$ alrealy
                                           Markeed

        $i * i = 121$
               ↳ Take this

     seg. Sieve $[j - L] = $ false
         $j += $ pame

why Not $j = 111 - L = 110 = $ ① → Index
           but array is from 0 to $R - L + 1$

Ans → $1 1 3 1 2 7$