Ath Magical No.

Q Given an integer A, B & C

find Ath magical no.

Magical no. : Divisible by B or C or both.

Eg A=8, B=2, C=3

~~1~~, 2, 3, 4, ~~5~~, 6, ~~7~~, 8, 9, 10, ~~11~~, 12, ~~13~~ ....

1 2 3 4 5 6 7 8

Soln > Brute force

⇒ Iterate from 1 till you find the Ath magical no.

Code

```
int findAthMagicalNo(A, B, C) {

    count = 0;
```

```
int i = 1;
while (count < A) {
    if ( (i % B == 0) || (i % C == 0) ) {
        count ++;
    }
    i++;
}
return i;
}
```

$$T.C. = O(\min(B, C) \times A)$$

$A = 8, \quad B = 2, \quad C = 3$

8th no. divisible by 2 $\Rightarrow$ 2, 4, 6, 8 .... $8 \times 2 = 16$

8th no. divisible by 3 $\Rightarrow$ 3, 6, 9 .... 8×3

$A = 8 \quad B = 2, \quad C = 2$ ~~3~~

2 $\Rightarrow$ 2, 4, 6, 8, 10, 12, 14, 16

Ans = multiple of 2 (8th)

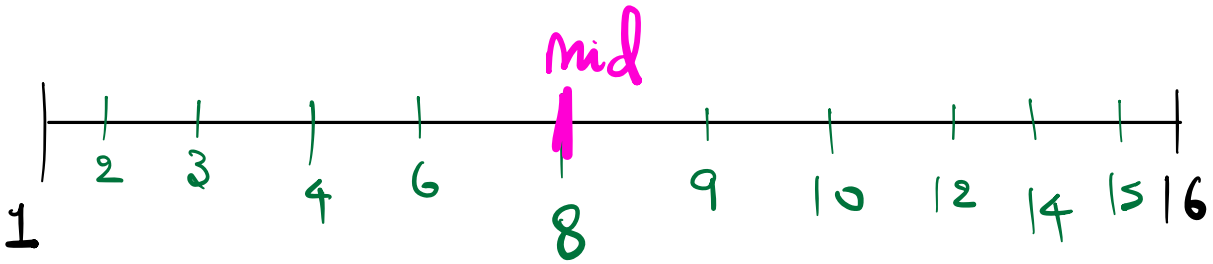
20 $\Rightarrow$ 20, 40, 60 160

Ans ⇒ $[1, \min(B, C) \times A]$

↓ Optimise

Answer space ??

A = 8, B = 2, C = 3

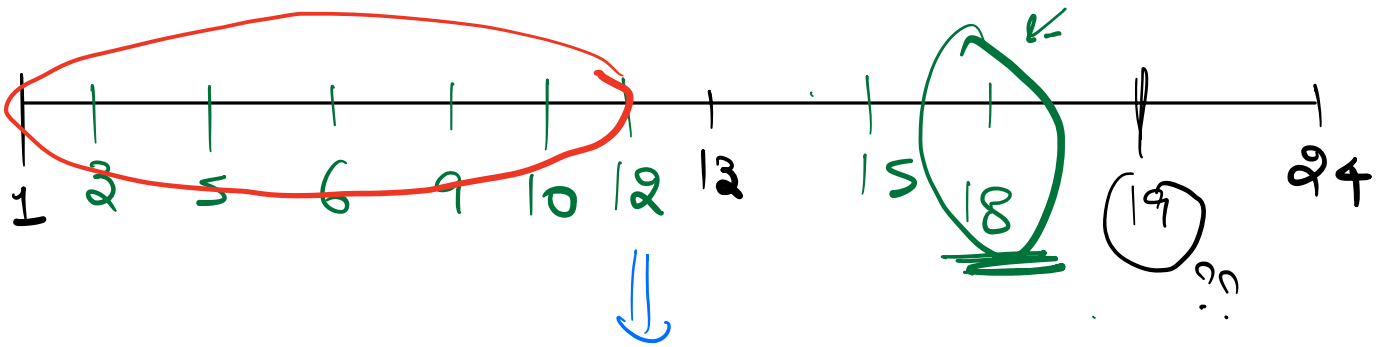


⇓

Count of Ngid no's ≤ 8

(5) = (A)

A = 8, B = 3, C = 5



⇓

6 Ngid no ≤ 12

Given B & C

Q Count of magical no's from [1 to X]

X = 50, B = 2, C = 5

Count of no's divisible by 2 or 5 or both from 1 to 50.

1) Count of no's divisible by 2 from 1 to 50 ⇒ 25 ?? ⇒ 50/2

2) Count of no's divisible by 5 from 1 to 50 ⇒ 10 ⇒ 50/5

2 ⇒ 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50

5 ⇒ 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Ans = $X/B + X/C$ − Duplicate ?!

$X = 24 \quad B = 6, \quad C = 4$

$[1, 24]$

$12 \rightarrow LCM(6, 4)$

4, 6, 8, 12, 16, 18, 20, 24 $\Rightarrow$ 8

↳ Multiples of 12 $\Rightarrow$ $B \times C$

$6 \Rightarrow 24/6 = 4$

$4 \Rightarrow 24/4 = 6$

$+$

10

$6 \times 4 = 24$

− Duplicates (2)

Count of no's divisible by B or C or both for $[1, X]$ $\Rightarrow$ $X/B + X/C - \frac{X}{lcm(B,C)}$

Code

```
int AthMajicalNo (A, B, C) {
    int x = lcm(B, C);
    s = 1;
    e = min(B, C) * A;
```

```
while (s<=e) {
    mid = s + (e-s)/2;
    count = (mid/B + mid/C - mid/x );
    if (count == A) {
        if (mid%B==0 || mid%C==0) {
            return mid;
        } else {  // Go to L
            e = mid-1;
        }
    } else if (count > A) {  // Go to L
        e = mid-1;
    } else {  // Go to R
        s = mid+1;
    }
}
}
```

$$T.C. = O(\log(\min(B,C) \times A))$$

$$LCM(A,B) = \frac{A \times B}{GCD(A,B)}$$

$\log(\min(A,B))$

Painter's partition

Given N Boards with their lengths.

$$A = [L_0, L_1, L_2, L_3 \ldots\ldots L_{N-1}]$$

Given K painters & Each painters takes 1 unit of time to paint 1 unit length of board.

Board (Length = 4) ⇒ 4 units of times

Calculate the min amount of time in which all the boards can be painted.

Constr: 1) Two painters cannot share a board to paint.

2) A painter will only paint contiguous boards.

P_1 P_2

$[B_1, B_2, B_3, \cancel{B_4}, B_5, B_6]$

P_1 P_1 $\cancel{P_1}$

Eg $N = 15$, (# Boards) $K = 3$ (# Painters)

$A = [\underset{0}{3}, \underset{1}{5}, \underset{2}{1}, \underset{3}{7}, \underset{4}{8}, \underset{5}{2}, \underset{6}{5}, \underset{7}{3}, \underset{8}{10}, \underset{9}{1}, \underset{10}{4}, \underset{11}{7}, \underset{12}{5}, \underset{13}{4}, \underset{14}{6}]$

31 | 25 | 15

$A = [\underset{0}{3}, \underset{1}{5}, \underset{2}{1}, \underset{3}{7}, \underset{4}{8}, \underset{5}{2}, \underset{6}{5}, \underset{7}{3}, \underset{8}{10}, \underset{9}{1}, \underset{10}{4}, \underset{11}{7}, \underset{12}{5}, \underset{13}{4}, \underset{14}{6}]$

26 | 23 | 22

$A = [\underset{0}{3}, \underset{1}{5}, \underset{2}{1}, \underset{3}{7}, \underset{4}{8}, \underset{5}{2}, \underset{6}{5}, \underset{7}{3}, \underset{8}{10}, \underset{9}{1}, \underset{10}{4}, \underset{11}{7}, \underset{12}{5}, \underset{13}{4}, \underset{14}{6}]$

24 | 25 | 22

Eg $A = [\underset{0}{10}, \underset{1}{20}, \underset{2}{30}, \underset{3}{40}]$ $K = 2$

P1	P2
10 (10)	20, 30, 40 (90) ⇒ 90
10, 20 (30)	30, 40 (70) ⇒ 70
10, 20, 30 (60)	40 (40) ⇒ 60

Soln) Greedy

$$\frac{(\text{Sum of all lengths})}{(\#\text{painters})}$$

$A = [1, 2, 3, 4, 100]$ $K = 2$

~~Sum = $\frac{110}{2}$ = 55~~ ??

Min amount of time = Max Length of a board.

Max amount of time = Sum of lengths of all boards. (#painters = 1)

[max Length , Sum of all length]

$K = 4$

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	5	1	7	8	9	5	3	10	1	4	7	5	4	6

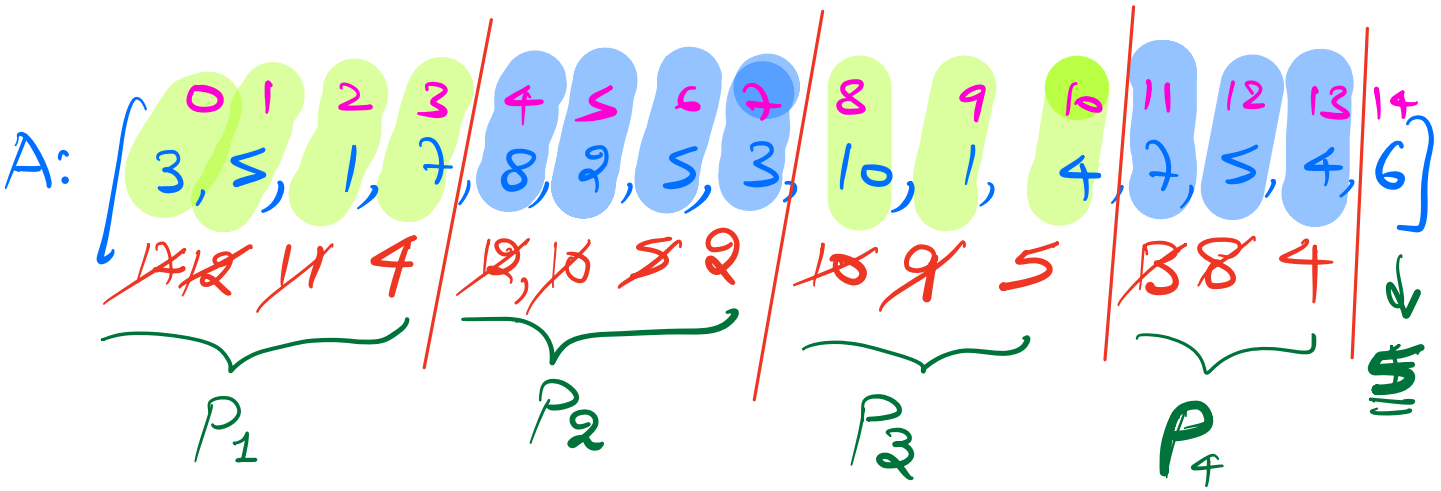
A: [3, 5, 1, 7, 8, 9, 5, 3, 10, 1, 4, 7, 5, 4, 6]

Min = 10

Max = 71

Time = 20 units

Q Is it possible to paint all the boards in 20 units of time with 4 painters ??



Code

```
bool check (A, T, K) {

    curr_time = T;
    count = 1;

    for (i = 0; i < N; i++) {

        if ((A[i]) <= curr_time) {
            curr_time -= A[i];
        } else {
```

```
        count++;
        curr_time = T;
    }
    if (count > K) {
        return false;
    }
}
return true;
}
```

K = 4

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A:	3,	5,	1,	7,	8,	9,	5,	3,	10,	1,	4,	7,	5,	4,	6
	P_1				P_2				P_3			P_4			P_5

Min = 10

Max = 71

s	e	mid	
10	71	40	⇒ check(A, 40, 4) ⇒ true
			check(A, 39, 4) ⇒ true
10	39	24	⇒ check(A, 24, 4) ⇒ true
			check(A, 23, 4) ⇒ true
10	23	16	⇒ check(A, 16, 4) ⇒ false
17	23	20	⇒ check(A, 20, 4) ⇒ false
21	23	22	⇒ check(A, 22, 4) ⇒ true
			check(A, 21, 4) ⇒ false

Ans

Code

```
int minTime(A, K) {
    s = max(A[i]);
    e = Σ(A[i]);

    while (s<=e) {
        mid = s + (e-s)/2;

        if (check(A, mid, K)) {
            if (check(A, mid-1, K)) {
                e = mid-1;
            } else {
                return mid;
            }
        } else {
            s = mid + 1;
        }
    }
}
```

T.C. = O(log(Range of ans space) × N)

T.C. = log(Σ(A[i]) − Max(A[i])) × N;

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1 Ques ⇒ Aggressive Cows

Recording ⇐ ⇓

⇓

(Archived) → (2nd Jan 9:00PM)

2nd ⇓ 2nd Night

- Holiday ⇒ 5 Ass. Ques
- Non Holiday ⇒ Attend 2 Ass. Ques

10 days ✗

Yes ⇒

⇓

Sat & Sunday (23 & 24) ⇒ R2 C2

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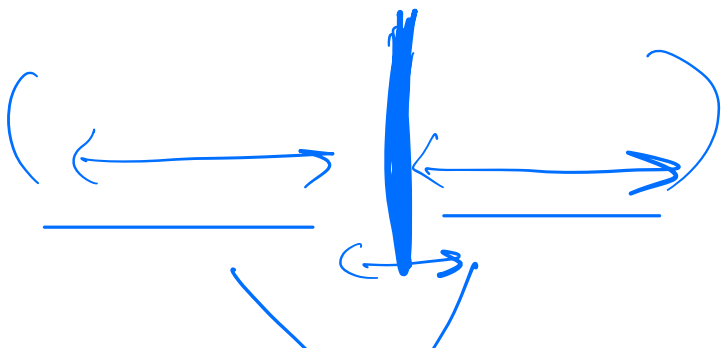
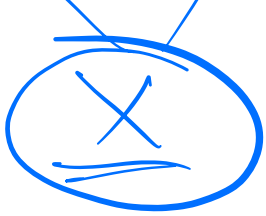
3 loops





$1 \le A[i] \le 10^8$ > Triplet

3×10^8

$[1, 3 \times 10^8] \Rightarrow$ mid

Bf

$O(N^3)$

Count of Triplets where sum $\le$ mid

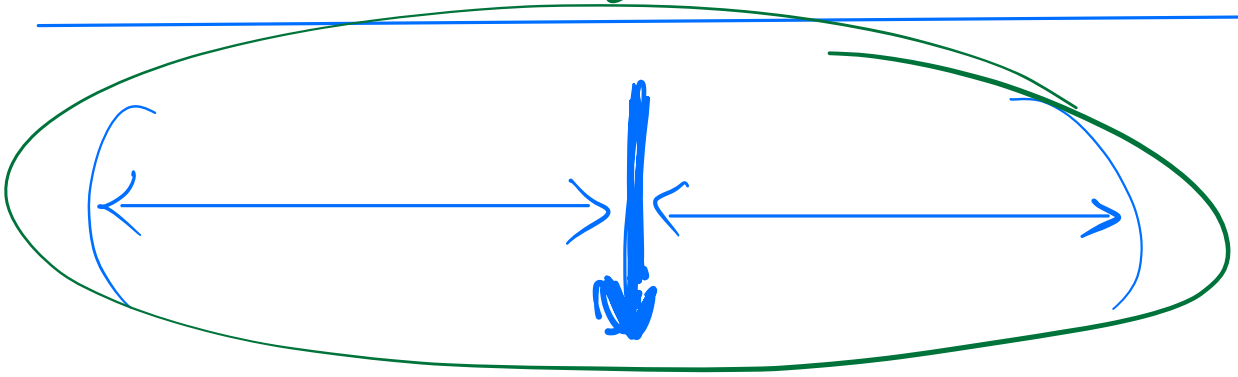
$< B$

Go to Right

B

$> B$

Left



2 pointer $\Rightarrow$ $O(N^2)$