

5-10



Atcoder DP problem series

next week



20 dp problem solving

→ Basics of DP

→ How to get started in CP week C++

graph

↳ Brute force → To iterate on each no. in the range $[a, b]$ and calc sum of digits

1 → 3 7 8 2

$f(x) \rightarrow$ sum of digits of numbers $\rightarrow [1, x]$
 \downarrow
defn \hookrightarrow

$$\underline{\underline{f(b) - f(a-1)}}$$

\Leftarrow sum of digits
of no. $\rightarrow \underline{\underline{[a, b]}}$

f(3782)

[1, 3782]

< 1000

< 2000

< 3000

n digits → 4 digit
[_ _ _ _]
2

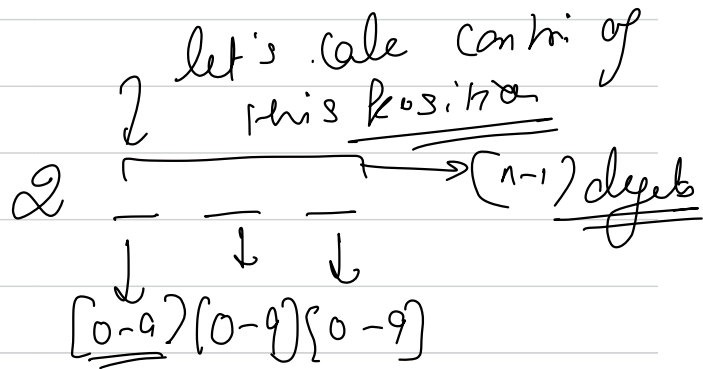
[1000, 1999]

Any digit at any place will contribute how much
to Sum.

2 → 10ⁿ⁻¹

2000
2001
2002
⋮
⋮
2999 } 1000

$$\text{Sum} = \underline{\underline{2 \times 1000}} + 1 \boxed{x} + 1 \times 1000 + 1 \boxed{x} + 0 \times 1000 + \boxed{x}$$



handle 3 separately

$$\frac{10^{n-1}}{10} \times (0 + 1 + 2 + 3 + \dots + 9)$$

$$\underline{\underline{x = 10^{n-2} \times (45) \times (n-1)}}$$

$$f(\overline{3782}) \rightarrow \underline{0 \times 1000 + 2 + 1 \times 100 + 2 + 2 \times 10 + 2} \\ + \underline{\underline{3 \times (101000 + 1)}} + f(782)$$

3000

3001

3002

⋮

3782

$$f(d) = f(d-1) + \underline{\underline{\text{const}}}$$

no. of digits

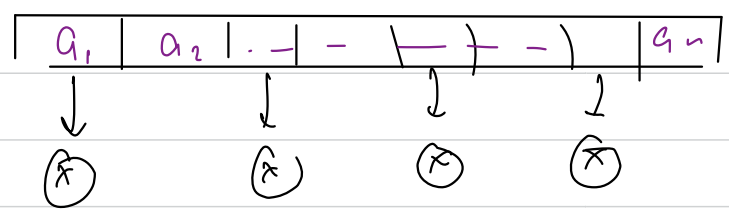
≡

$O(d)$

d → no. of
digit

10^9

Q. 2



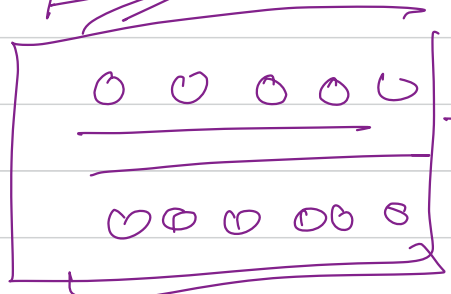
1 sec

K times

$1/c \log n$ \rightarrow TLF

$K \leq 10^5$
 $n \leq \dots$

10^3



$\leq 10^3$

$\approx 1024 \approx 2^{10}$

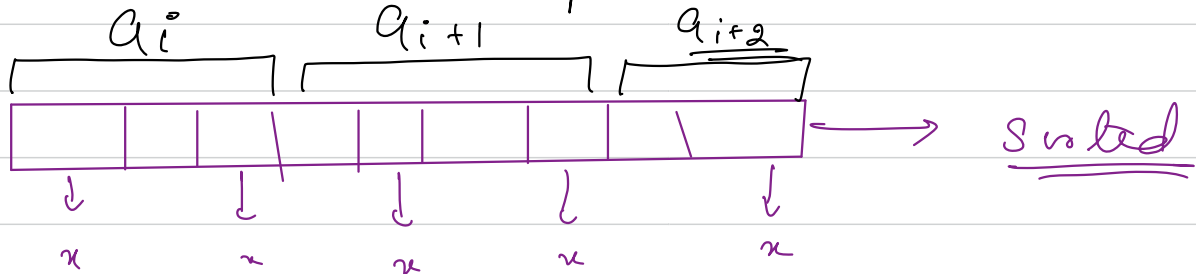
$\otimes \otimes \otimes \otimes \otimes \otimes$

$a_i \wedge x \rightarrow y \leq 10^3$

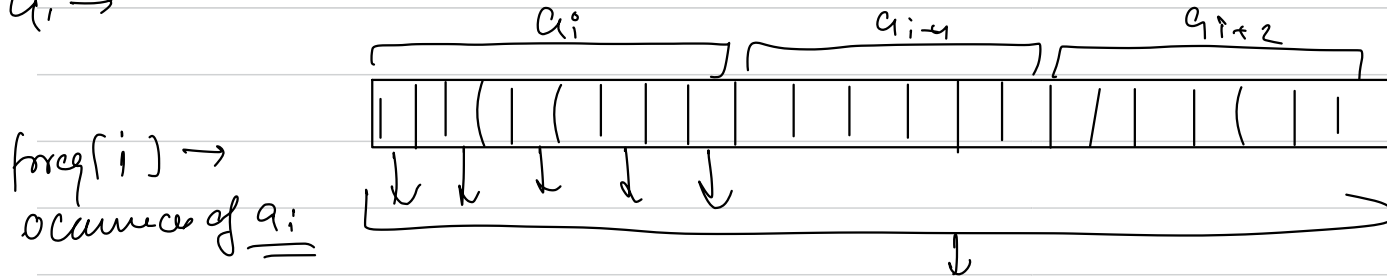
array \rightarrow size $\rightarrow 10^5$

\downarrow
 $a_i \leq 10^3$

\rightarrow repeated elements

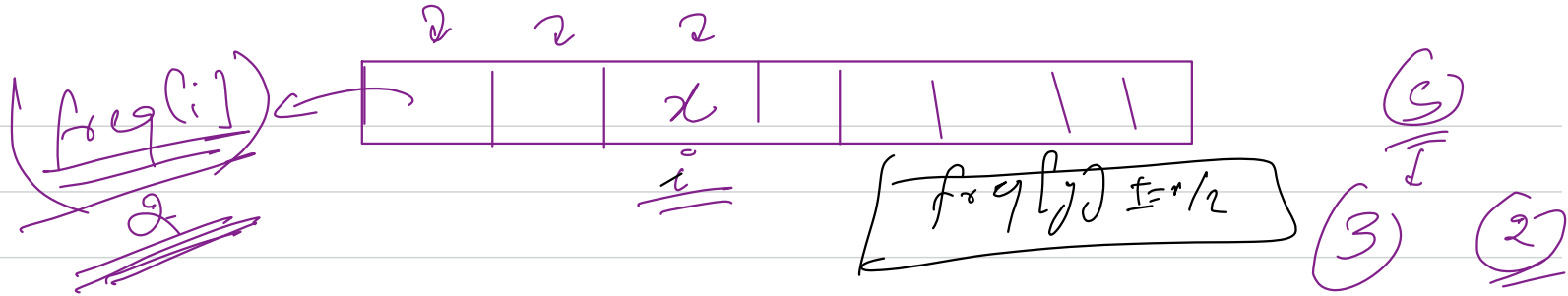


$a_i \rightarrow$



$freq[i] \rightarrow$
occurrence of a_i





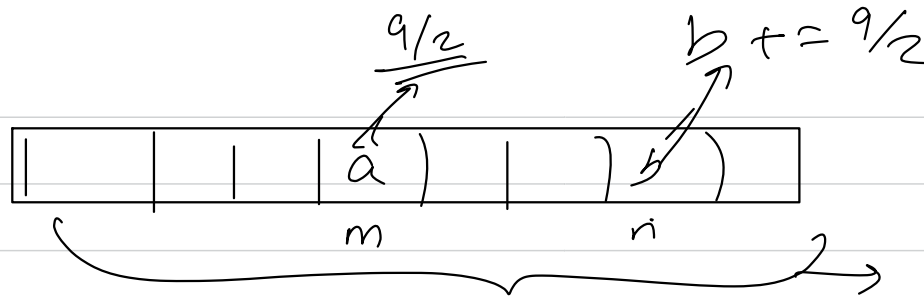
$$\text{freq}[i] = n$$

$$\boxed{\text{freq}[i] \neq x} \rightarrow \boxed{y} \rightarrow \underline{\underline{n/2}}$$

$$\boxed{n/2} \rightarrow \text{not}$$

$$n/2 \rightarrow \underline{\underline{\text{not not}}}$$

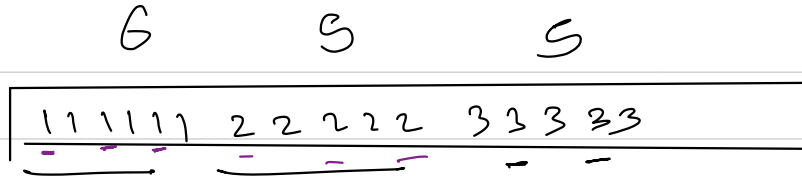
$$\boxed{\text{freq}[i] = n/2}$$



$$\begin{aligned}
 & \frac{a}{2} \uparrow \quad \downarrow \quad m \quad x = \underline{\underline{n}} \\
 & \frac{\lfloor \log(m) \rfloor}{2} \rightarrow \underline{\text{ared}} \\
 & \frac{\lfloor \log(m) \rfloor}{2} \rightarrow \text{not } \underline{\text{ared}}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{10^3}{2} \times K \\
 & K \sim 10^5 \\
 & 10^3 \times 10^5 \\
 & \approx 10^8 \\
 & \checkmark
 \end{aligned}$$

parity $\rightarrow 0 \rightarrow \text{even}$
 $1 \rightarrow \text{odd}$



parity $\rightarrow \frac{0}{1}$
 of the array
til now

$$\left\lfloor \frac{n}{2} \right\rfloor + 1$$

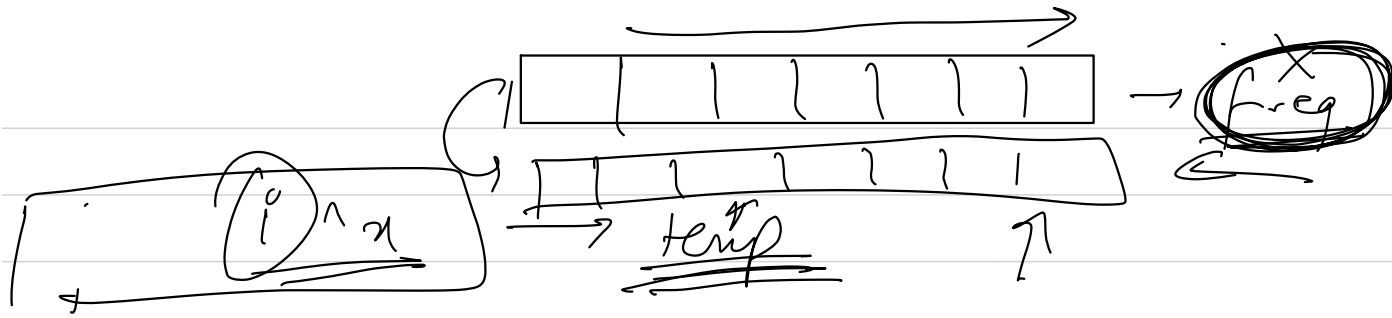
$$\left\lfloor \frac{n}{2} \right\rfloor$$



0	1	1
even	+ odd	\rightarrow odd
even	+ even	\rightarrow even
odd	+ odd	\rightarrow even
odd	+ even	\rightarrow odd

xor2

xor



$\text{freq}[i] \rightarrow \text{no. of occurrences of } i$

$i < \text{temp}$

$\text{temp}++$