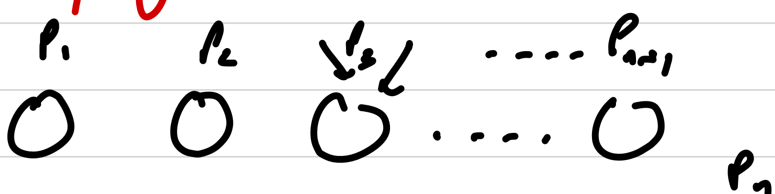
Pigeonhole Principle

The principle states that,

if you've p holes and $p+1$ pigeons, then there will be atleast one hole that contains more than one pigeon.



In India → 10,00,000 people ~~guns~~

a person has atmost 10 cars

yes

which 2 persons in delhi have same no. of cars or not

Gray Similar Code → Codechef

→ gray code

$a_1 \quad a_2 \; \text{----} \; a_n$

$a_i - a_{i+1}$ → differs by 1 bit

000, 001, 011

$\boxed{a_i \,\hat{}\, a_j \,\hat{}\, a_k \,\hat{}\, a_l = 0}$ ← find

1	0	2	3	7

001, 000, 010, 011, 111

$\longrightarrow$ gen

$\boxed{\text{gray code}}$

→ number consist of 64 bits max

xor xor → gray codes list

$a_1 \ a_2 \ a_3 \ a_4 \ \ldots \ a_K$

000...1...0 0...1...0

K=130

K/2 pairs

65 pairs

pigeon

num → exact one bit set

0^*10^*

regex

≥130 number ↔ Yes

129 → Bruteforce

TC? $O(n^4)$

64 → holes

_ _ _ _

0010

0010

0100

0001

1000

⋮

0000....01 → 1

00.......10 → 1

00.....100 → 1

⋮

1

64 pairs

63 of them

$a_m \wedge a_n \leftarrow \varphi_i \quad \wedge \quad \varphi_j \rightarrow a_p a_q$

$$0^* 1 0^* \quad = = \quad 0^* 1^*$$

$$\boxed{a_m \wedge a_n \wedge a_p \wedge a_q} \rightarrow \underline{\underline{0}}$$

130

a_1 a_2 a_3 a_{65}

00.....01 00.....10 00.....100

p.q.r

$a_i \to$ 1 bit is set

$\boxed{p_i \wedge p_j = 0}$

$\boxed{a_m \wedge a_n \wedge a_p \wedge a_q = 0}$

$\to$ 400

64 $\to$ hole

$[\ \ ]_{130}$ 2

$a \wedge b \wedge c \wedge d = 0$

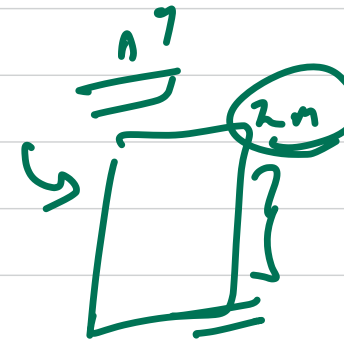
$\boxed{d = a \wedge b \wedge c}$

for ( ) $\rightarrow a$

for ( ) $\rightarrow b$

for ( ) $\rightarrow c$

$a \wedge b \wedge c$



$O(n^3)$

d

yes

Q Given a pair $P = (e_1, e_2)$. find the smallest whole number x such that

$$x \% e_1 > x \% (e_1+1) > \dots\dots x \% (e_2-1) > x \% (e_2)$$

if x doesn't exist, print $\underline{-1}$

$T \le 10^5$

$e_1, e_2 \le 10^6$

Ex $T \to 1$

$\underline{4, 6} \longrightarrow$ ans $\underline{6}$

$6 \% 4 > 6 \% 5 > 6 \% 6$

$\boxed{2 > 1 > 0}$

$$\underbrace{N\phi_{0L}}_{\text{greatest}} > N\phi_{0(L+1)} > N\phi_{0(L+2)} \cdots > \underbrace{N\phi_{0R}}_{\text{smallest}}$$

$$N\phi_{0L} \in [0, L-1]$$

at max L distinct values

Biggest value for $N\phi_{0L} \rightarrow L-1$

In worst case we can have L distinct values.

$[L, R] \rightarrow \underbrace{\text{Total values}} \rightarrow R - L + 1 \rightarrow r - l + 1$

$\underset{\text{\# of values}}{R - L + 1} > L \rightarrow$ ans never exist

$\Downarrow$

$\boxed{R \geq 2L}$ no answer

$\boxed{\text{L holes}}$

$9 \% 10 \to 9$
$5 \% 11 \to 5$
$5 \% 12 \to 5$

$\boxed{R < 2d}$

$N \to [0, d)$ XX $\underline{\underline{3}}$

$\underline{\underline{a}}$

$\underline{\underline{N \% d}}$

3

$N \% (d+1)$ - - - - (equal) $\underline{\underline{WA}}$

3

$\underline{\underline{[L, R)}}$

$\boxed{a \% b \to a}$

$a < b$ $\underline{b > a}$

$\boxed{[d, R}$

$\underline{\underline{b \geq d}}$

$\boxed{a \% b \to a}$

$\underline{\underline{NO}}$

$[L, R) \rightarrow N$

$[5, 11) \rightarrow 6$

$N \% L = x$

$x > y > z \dots\dots 0 \rightarrow N$

$N \% (L+1) = y$

NO

⋮

⋮

min value 2 ?

$N \% N = 0$

$[R, \infty)$

$N \% (N+1) = N$

R Ans

Q→ Given an array of length N, find the count of subarrays whose sum of elements is divisible by N.

T → testcases

$T \le 10$

$N \le 10^5$

[5, 5, 5, 5, 5] $N = 5$ → 15

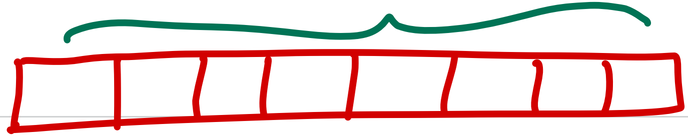
5 10 15 20 25

0 0 0 0 0

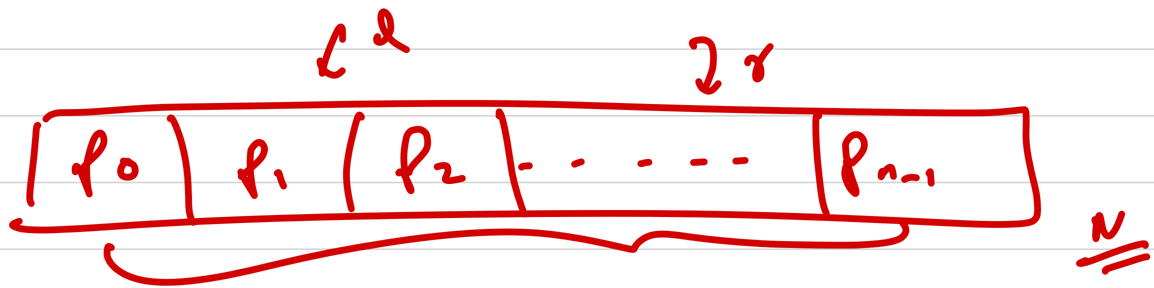
$0 \to 5$

${}^5C_2 \to \frac{5 \times 4}{2} \to 10$

$\left[f_i C_2 + f_{i+1} C_2 \dots \right] + f_0$



prefix → $sum(l, r) = sum(0, r) - sum(0, l-1)$



$(P_r - P_{l-1}) \% N = 0$

$$\boxed{P_r \% N = P_{l-1} \% N}$$

$[f_0 f_0 N,\ f_1 f_1 N,\ f_2 f_0 N\ \text{------}\ f_{n-1} f_0 N]$

$\downarrow$

$[x_0,\ x_1\ x_2\ \text{------}\ x_{n-2},\ x_{n-1}]$

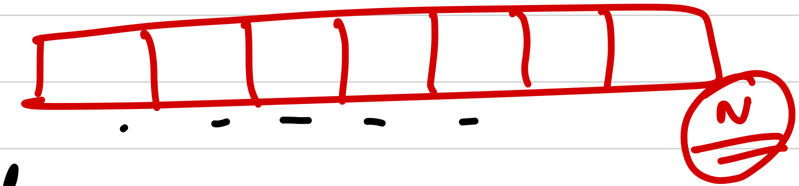
$\boxed{x_i \in [0, N-1]}$ $\qquad$ $x_i == x_j$

$\boxed{f: C_2} \rightarrow ans+$

$\underbrace{3 \quad\quad}\ \underbrace{3 \quad\quad}\ 3$

· Subarray ⊂ Powerset

% N == 0



S % N

↓

[0, N-1]

[1, N-1]

↓

Pigeonhole

N-1 holes

Prefix.

13, 1, 3, 2

13, 14, 17, 19

1, 2, 1, 3

N

4, 6, 10

4, 10, 20

$\boxed{1, 1,}$ 2