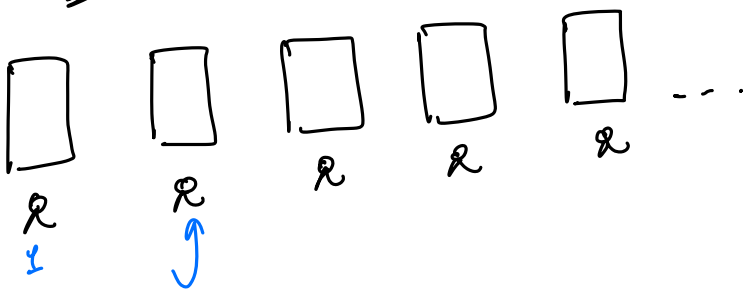
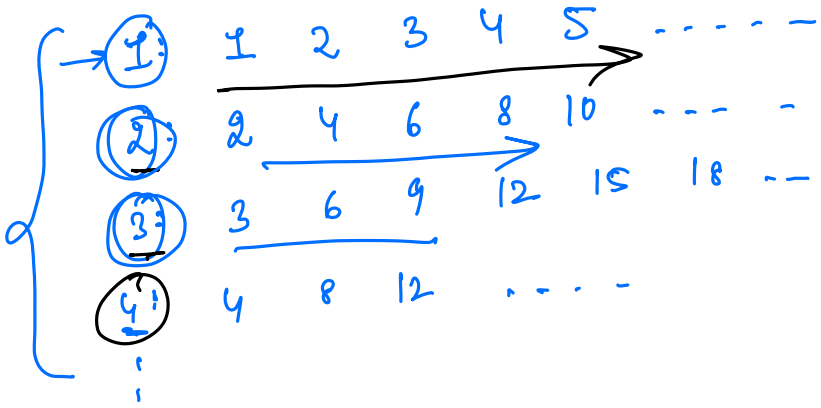
① N doors.

All doors are closed

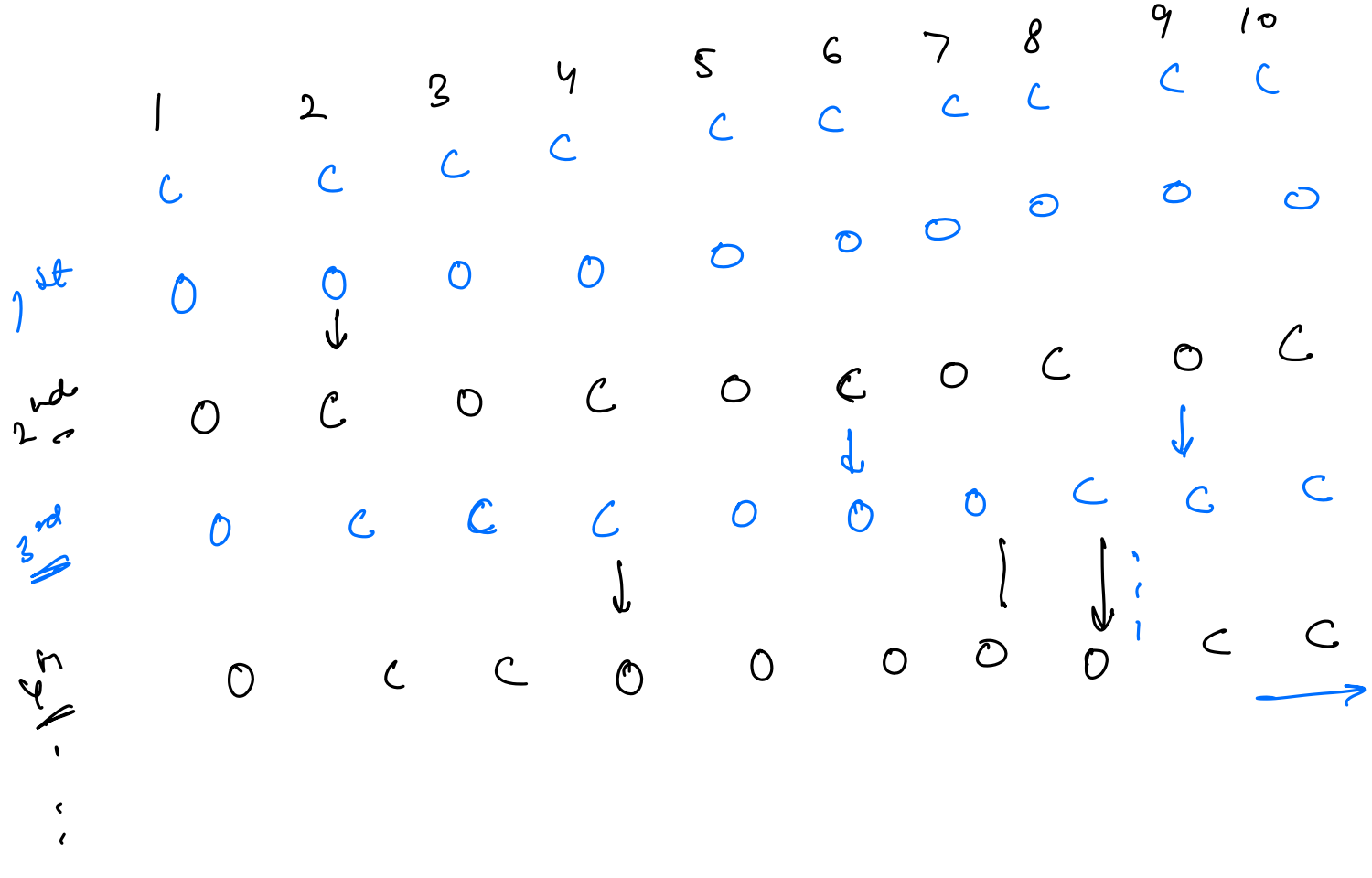


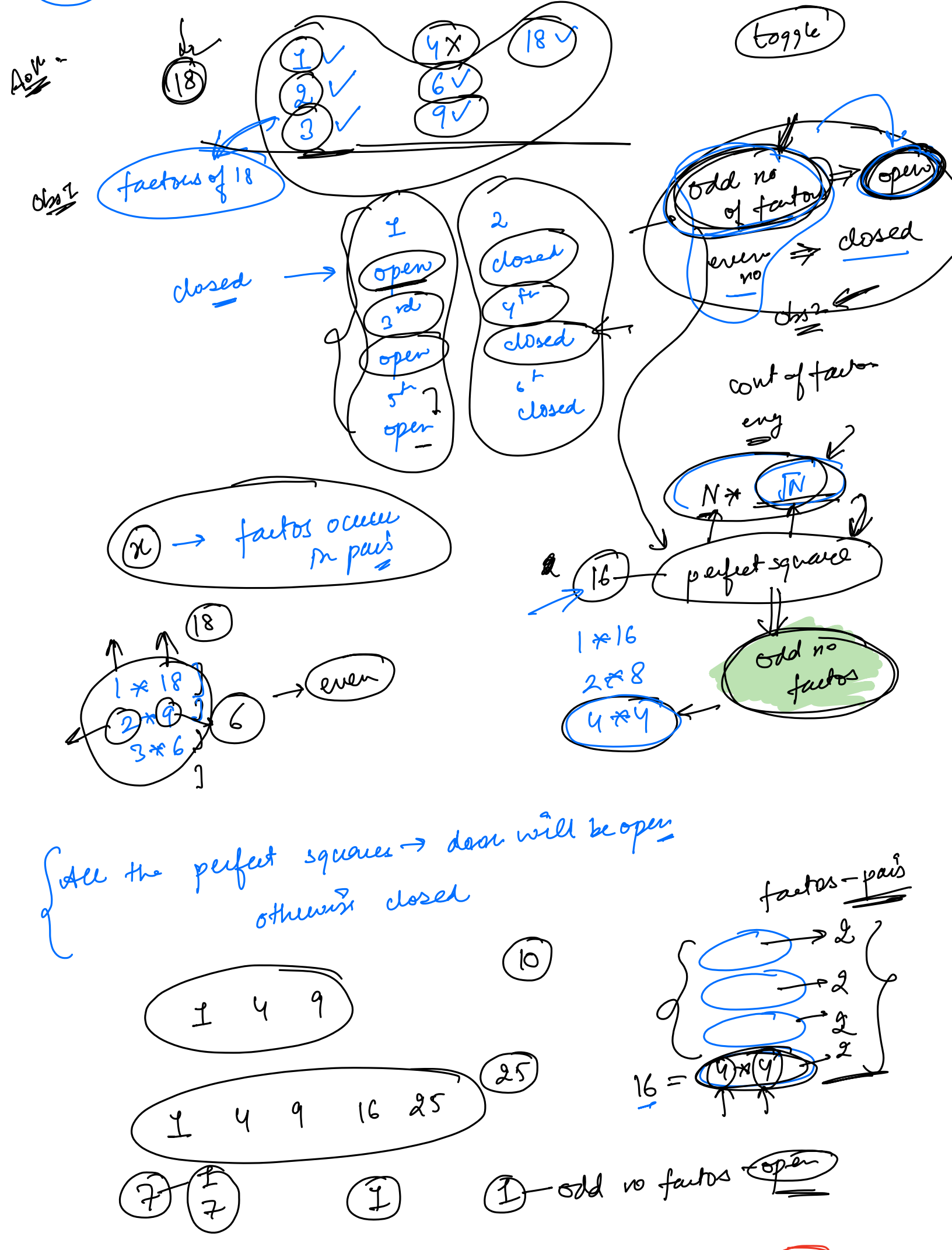
toggle



N-door problem

Q → Which all doors will be open at last?




Toggle
AoW -
18
1 ✓
2 ✓
3 ✓
4 ✗
6 ✓
9 ✓
18 ✓
factors of 18
Obs 1
1
open
3rd
open
5th
open
2
closed
4th
closed
6th
closed
closed
odd no of factors
open
even no
closed
Obs 2
count of factors
eng
N*
√N
perfect squares
16
1*16
2*8
4*4
odd no factors
x → factors occur in pairs
18
1*18
2*9
3*6
6
even
All the perfect squares → door will be open
otherwise closed
10
1 4 9
25
1 4 9 16 25
factors - pairs
2
2
2
2
16 =
4*4
7
1
7
1
1 - odd no factors
open

(2) p → prime number

$p^2 - 1$ is divisible by 24

$a^2 - b^2 = (a-b)(a+b)$

$(p-1)(p+1) \;\%\; 24 = 0$

$24 = 2 \times 3 \times 4$

3 < p <= 10 ← string

1000 10^{18}

"123"

even

p → prime?

p-1 | p | p+1

even | even | even

2 | 2 | 2

$2 \times 2 \times -x-$

4

$2 \times \frac{2}{2} \times -x-$

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Obs 2 → out of 2 consecutive even no- one has to be divisible by 4

3 4 5 6 7 8 9 10 11 12

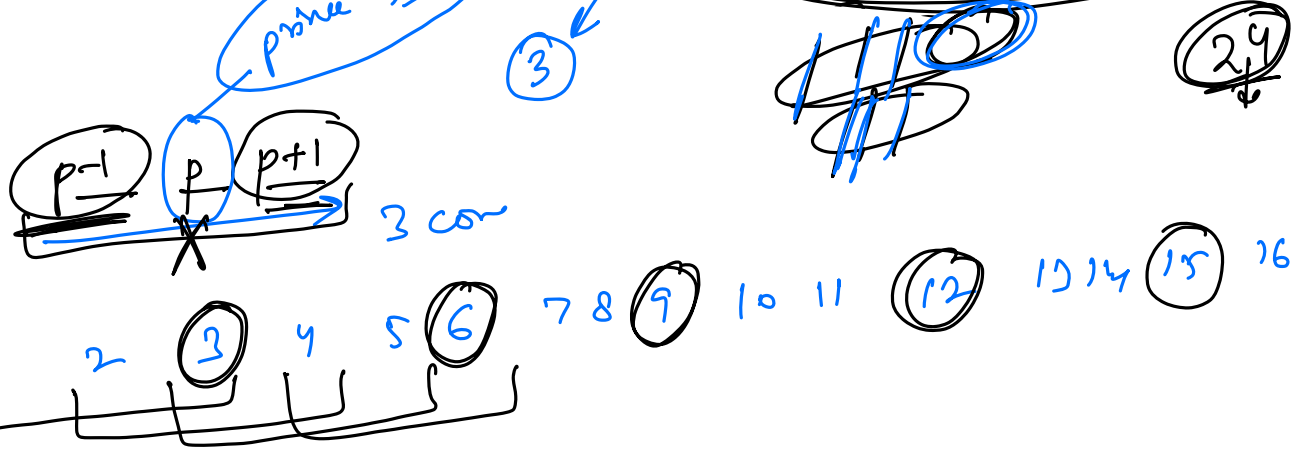
0 1 2 0 1 2 0 1 2 ...

p-1 | p | p+1 — not div by 3

I will always get a 3

$p^2 - 1$ %24 == 0

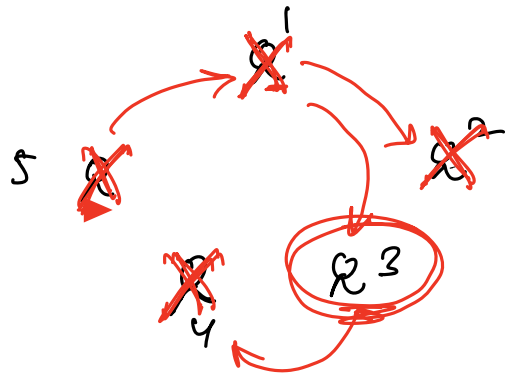
return true;



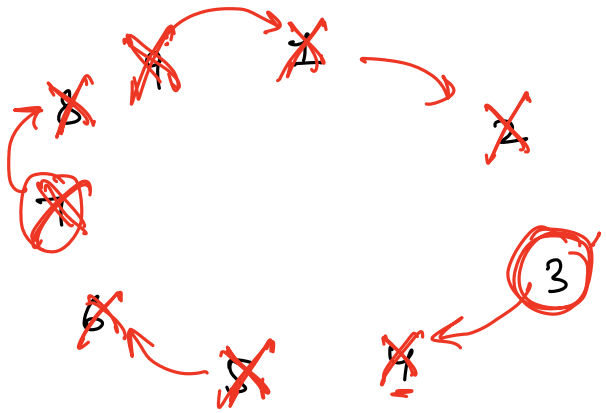
3 Josephus problem

Q There are N people stand ^ a circle. Every person has a sword and kill the next person (clockwise) on there chance. We start from 1'st person. Who will survive?

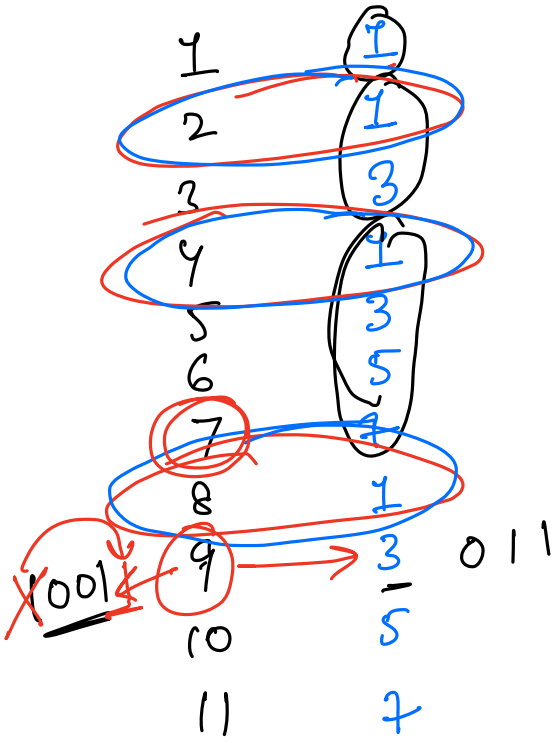
5

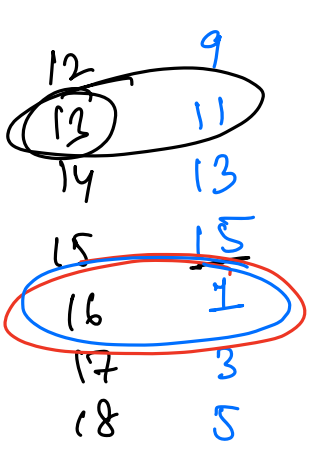


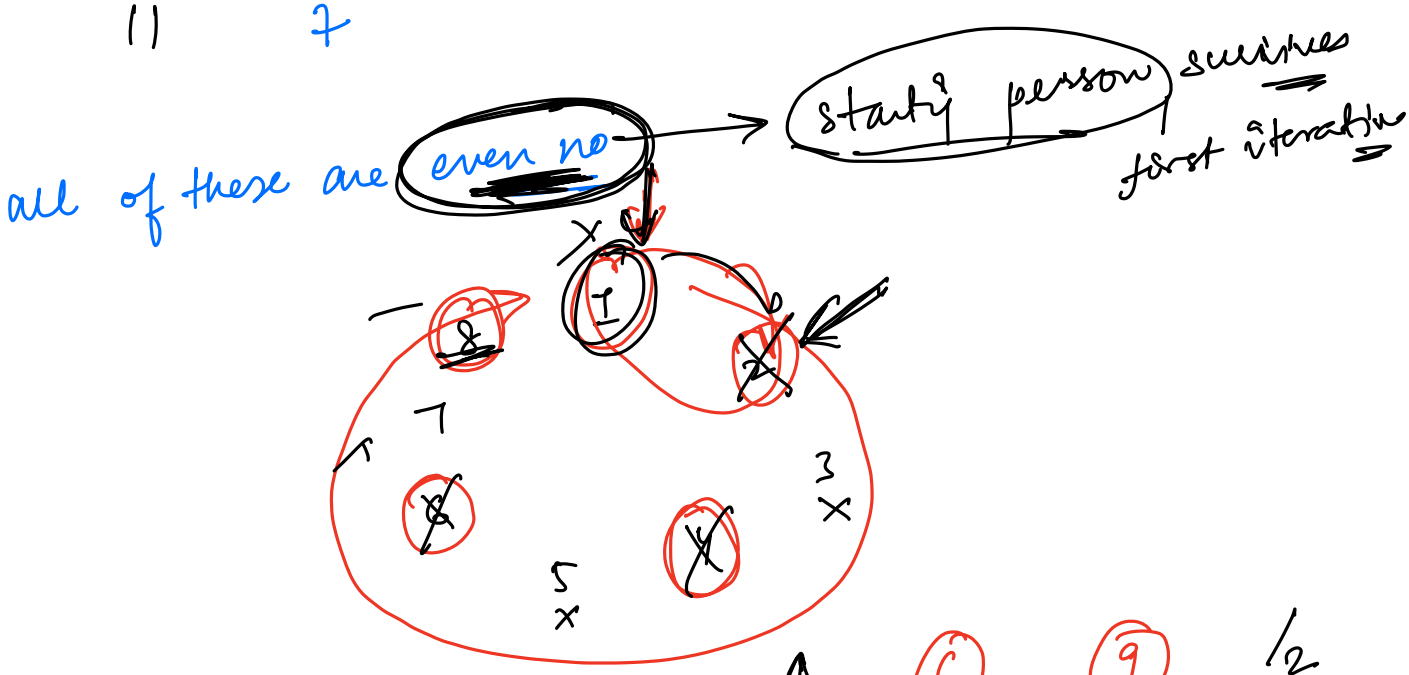
9

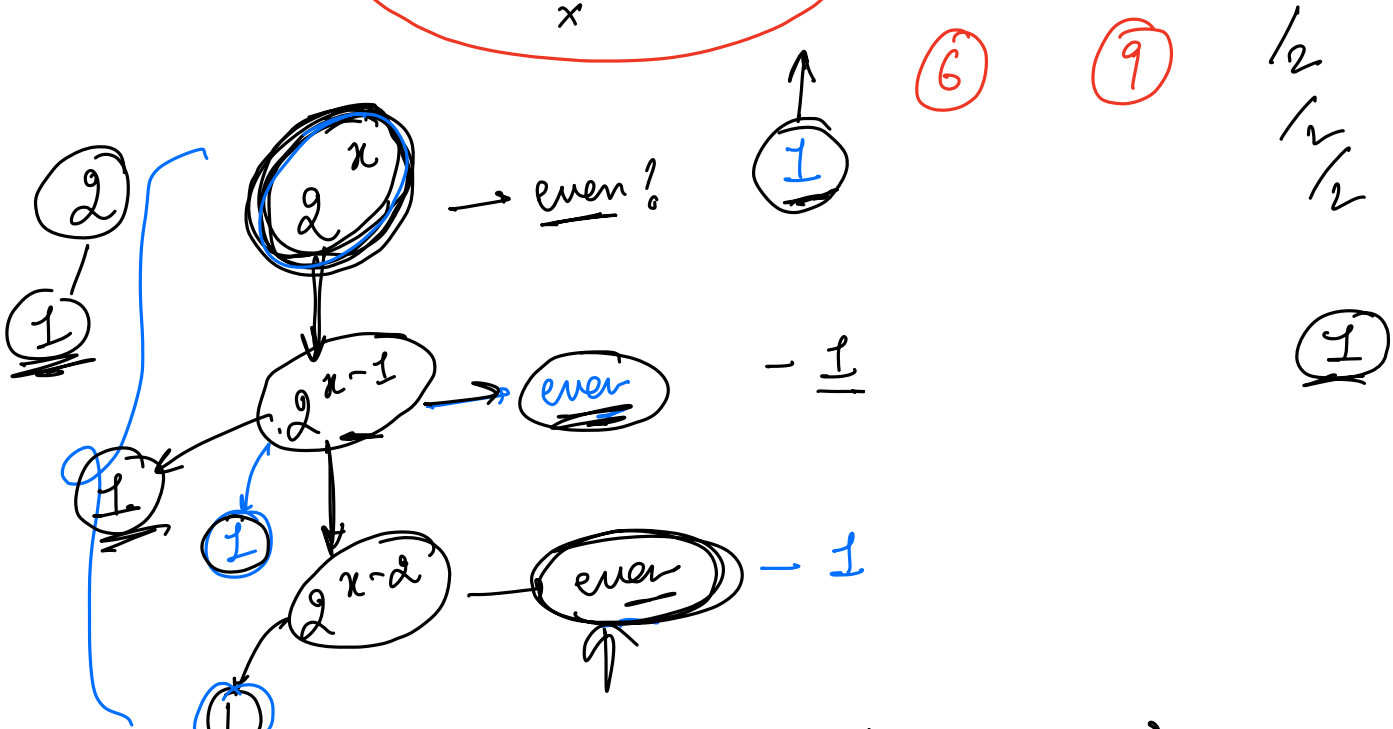


11 → 7









If N is power of 2, the sunny person will be the stanly one!

$13 = 8 + 5$

nearest pow of 2

$N = 2^x + t$

x → nearest pow of 2

$2t + 1$

$12 = 8 + 4$

12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3

$N = 2^x + t$

$2t+1$

$\log_2 12 = [3 \ldots]$

2^3

$\lfloor \log_2 N \rfloor$

$2^{\lfloor \log_2 N \rfloor}$

$1735 = 1024 + 711$

$2 \times 711 + 1$

$N = 1735 \rightarrow 1024$

$1735 = 1024 + 711$

t

$2t+1 \rightarrow 1423$

$\log_a b$

$a^{\_} = b$

$\log_2 1735 = 2^{\_} = 1735$

$2^x = 1735$

$x \log_2 2 = \log_2 1735$

$x = \log_2 1735$

$2^{10\ldots} = 1735$

int x = log2N

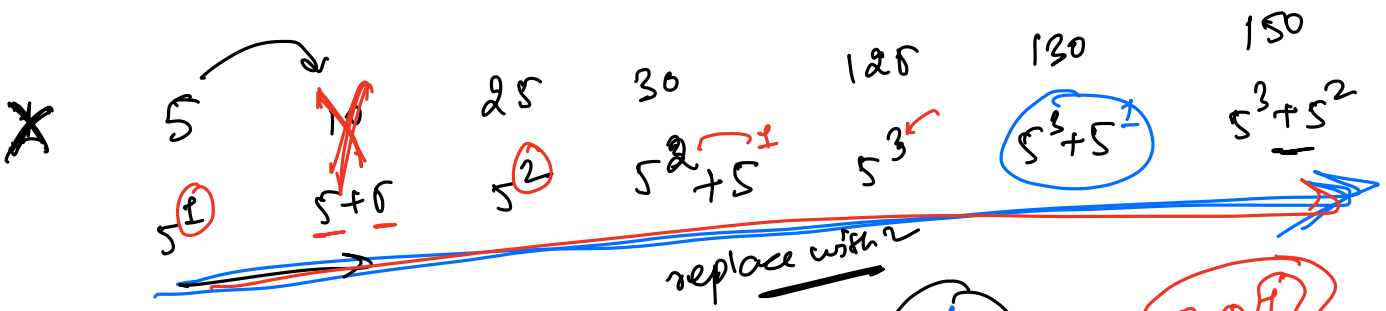
```
int t = N - 2^n
cout << 2t+1;
```

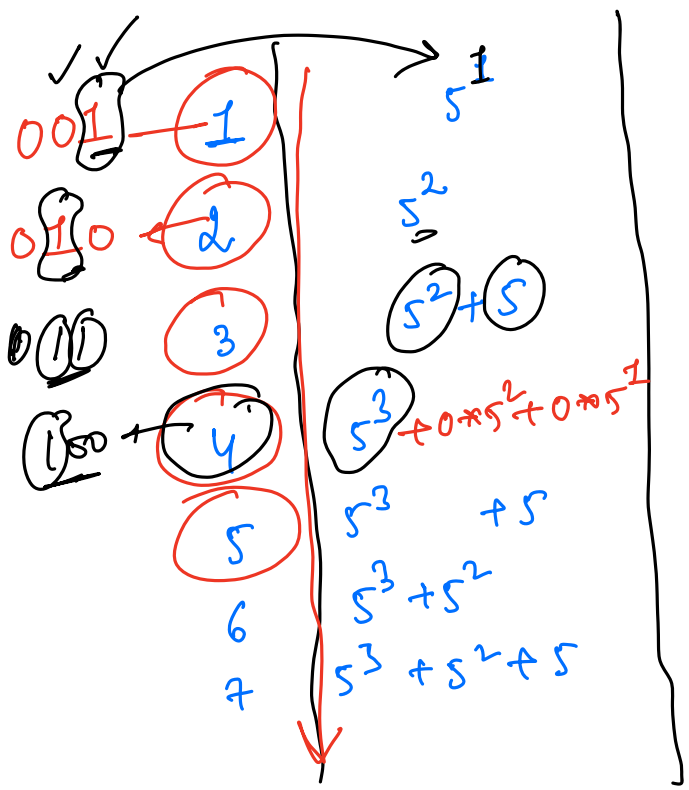
Q4 N^th Magical number

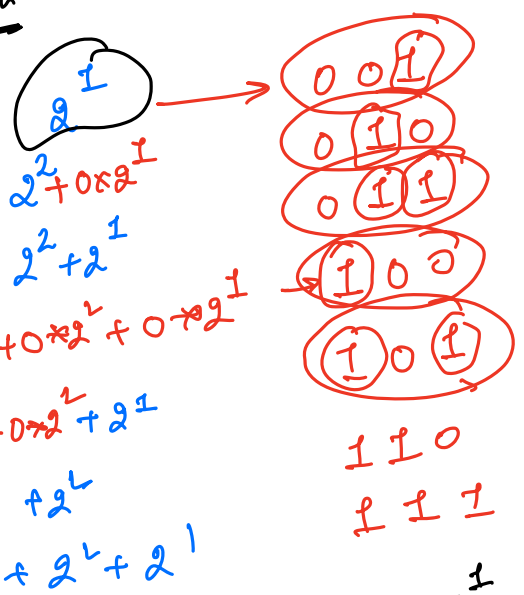
number which can be expressed as a sum of unique power of 5

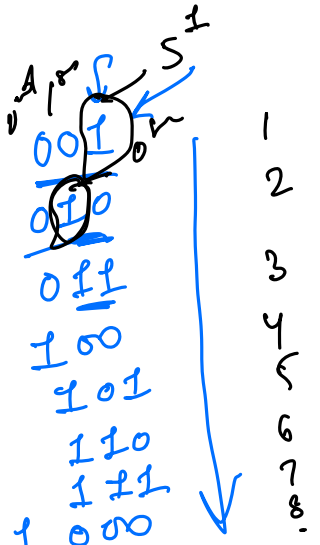
or

power of 5









N → bit representation

5^(i+1)

0th bit

273

2	273	1
2	136	0
2	68	0
2	34	0
2	17	1
2	8	0
2	4	0
2	2	0
2	1	

100010001

5^9 5^5 5^0 0 5^1

x & (1 << i)

ans += 5^(i+1)

Q5 Rearrange the Array !

N integers

arr[i]

arr[arr[i]]

index 0 1 2 3

arr → 3 2 0 1

arr[i] 3

arr[arr[0]] arr[2]

Extra space

O(1)

0 1 2 3

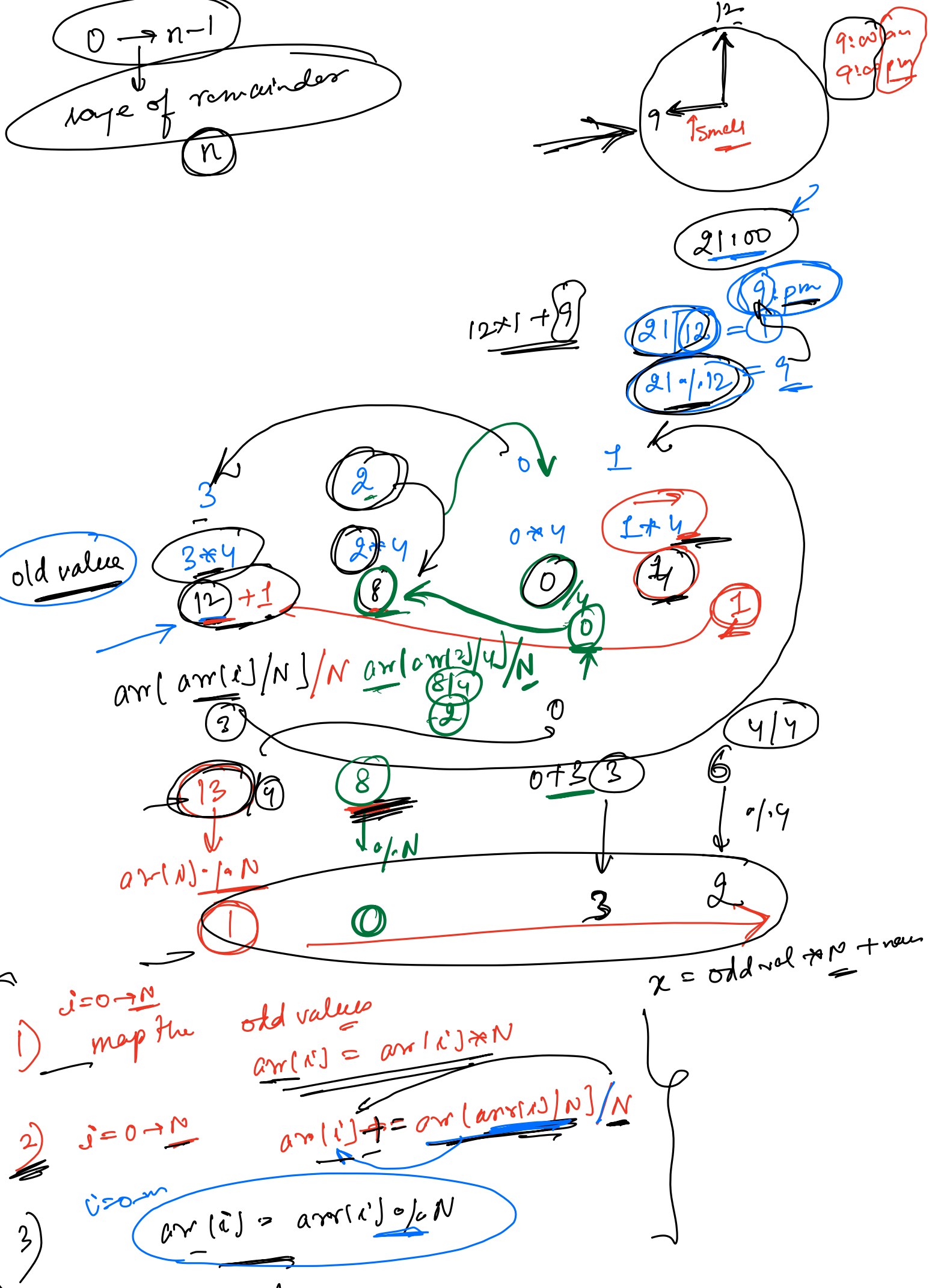
arr[i]

0 - n-1

q = p * q + r

odd value → factor

new value → remainder



1) $i = 0 \to N$ map the old values

$arr[i] = arr[i] * N$

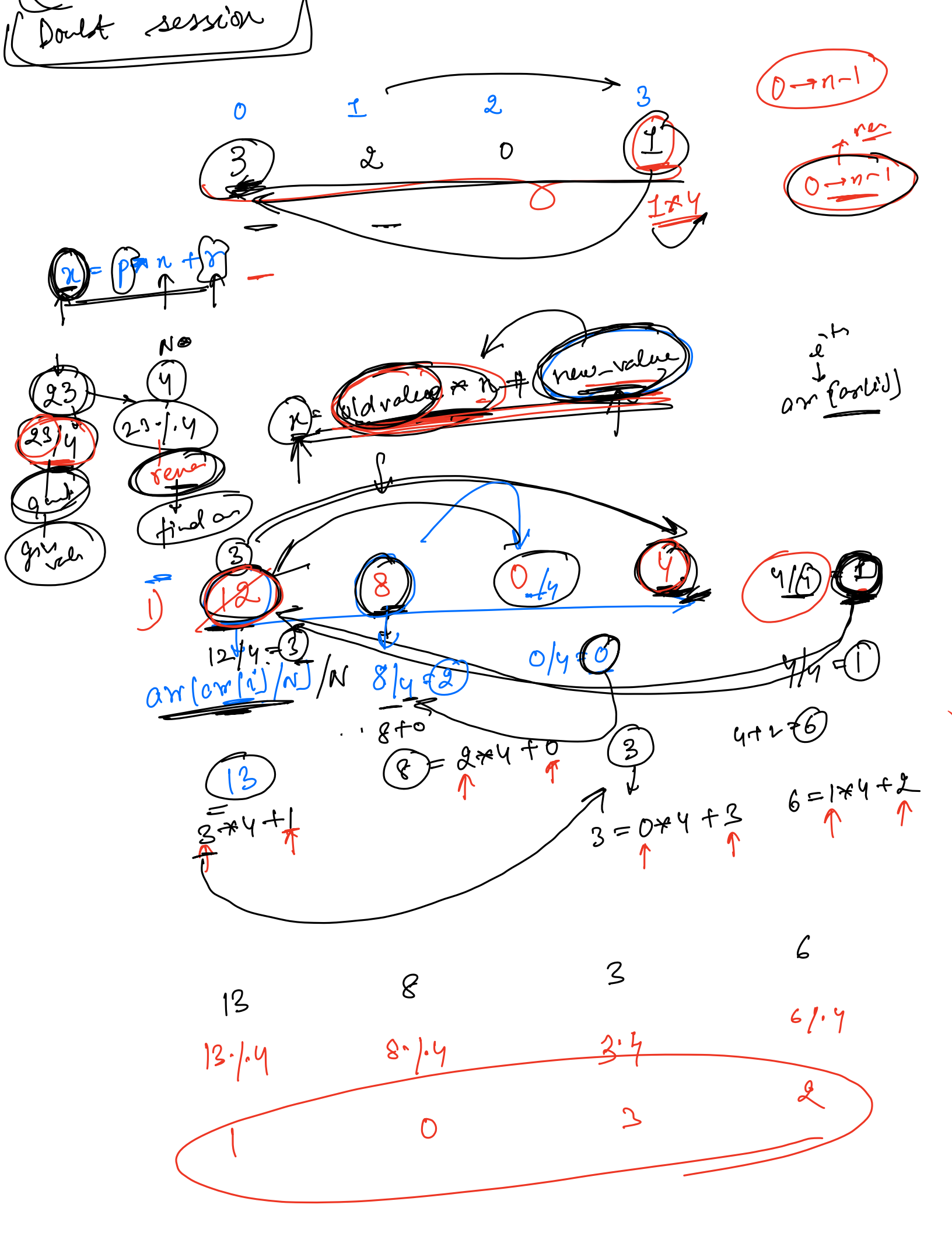
2) $i = 0 \to N$

$arr[i] += arr[arr[i]/N]/N$

3) $i = 0 \to N$

$arr[i] = arr[i] \% N$

Doubt session



log

$2^x = N$

$\log_2 2^x = \log_2 N$

$x \log_2 2 = \log_2 N$

$x = \log_2 N$

$N = 2^x + t$

$2^x <= N$

$x <= \log_2 N$