N Queens - Branch and Bound

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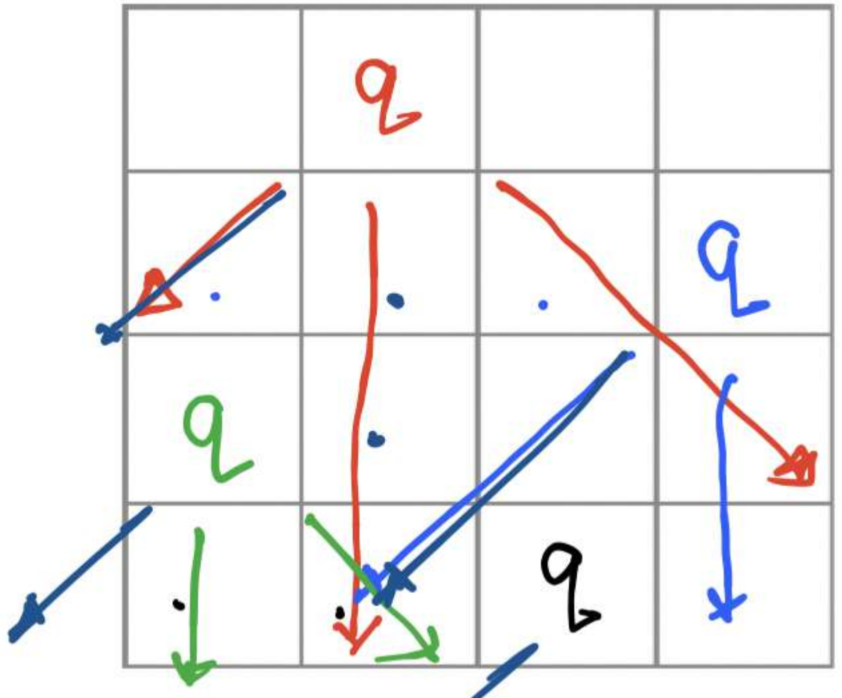
4x4



→ row==n] nxn → n placed

place queen and stop column and diagonals for future queen, this logic is called branch and bound.

In a single row, we can place exactly one queen

① How to Block a column so that we can make a check of safety in O(1)

② Reduce Safety check of diagonal 1 in O(1)

③ Reduce safety check of diagonal 2 in O(1)

→ ocupy space and reduce time complexity

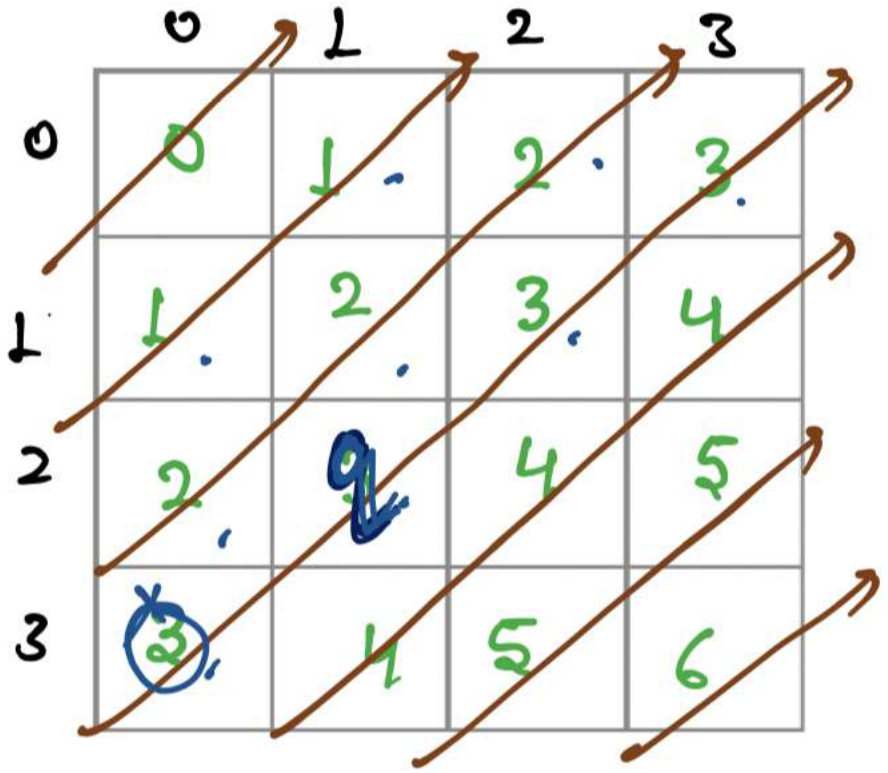
① How to ensure safety of column

Booleam

0	1	2	3
	T		

col[c] = True

② How to ensure safety of normal diagonals



	0	1	2	3
0	0	1	2	3
1	1	2	3	4
2	2	3	4	5
3	3	4	5	6

Bottom left to top Right (Direction)

this is for observation

place → row + col

normal diagonal

Size of diagonal array

↪ 2*n-1 = 2×4-1 = 7

0	1	2	3	4	5	6
			T			

Booleam array

ndiagonal[r+c] = True

r=3

c=0

nd[3+0] → True

→ False

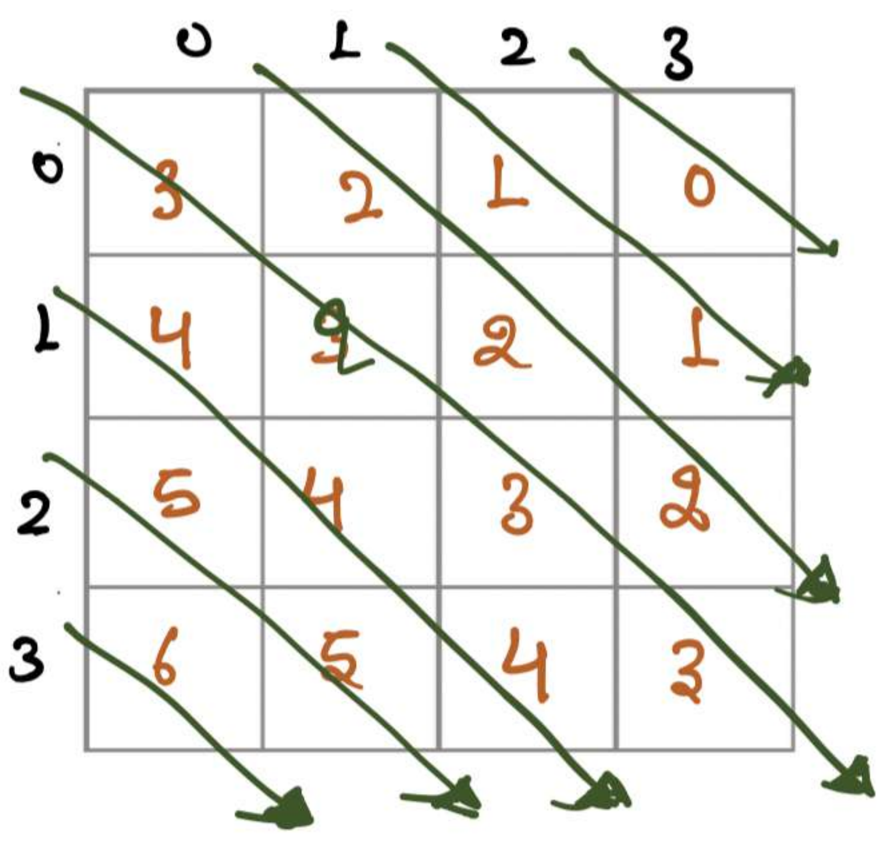
r → 2

c → 1

diagonal NO = r+c = ③

③ How to ensure safety of reverse diagonal (diagonal 2)

↳ top left → Bottom Right (Direction)



	0	1	2	3
0	3	2	1	0
1	4	3	2	1
2	5	4	3	2
3	6	5	4	3

$$\text{place} \rightarrow \underline{\text{row} -} \text{ col} + (\underbrace{\text{board.length}}_{n} - 1)$$

$$\text{place} \rightarrow (\text{row} - \text{col}) + (n-1)$$

boolean array of reverse diagonal - of size → $\underbrace{2*n-1}$

$r = 1$

$c = 1$

rd ⇒

0	1	2	3	4	5	6
			T			

$$\underline{\text{Index}} \Rightarrow \underbrace{(r-c) + (n-1)}$$

$$= 1-1 + 4-1$$

$$0 + 3 = \boxed{3}$$

$$\text{rd[indx]} = \underline{\text{True}}$$

→ N- queen

1. level → Row
2. option → cols.
    - ↳ is safe to place

Static Boolean array {
- ↳ column[]
- ↳ normal_diagonal[]
- ↳ reverse_diagonal[]

→ check Safety

place } → marking

unplace } ↔ unmarking

Josephus Problem

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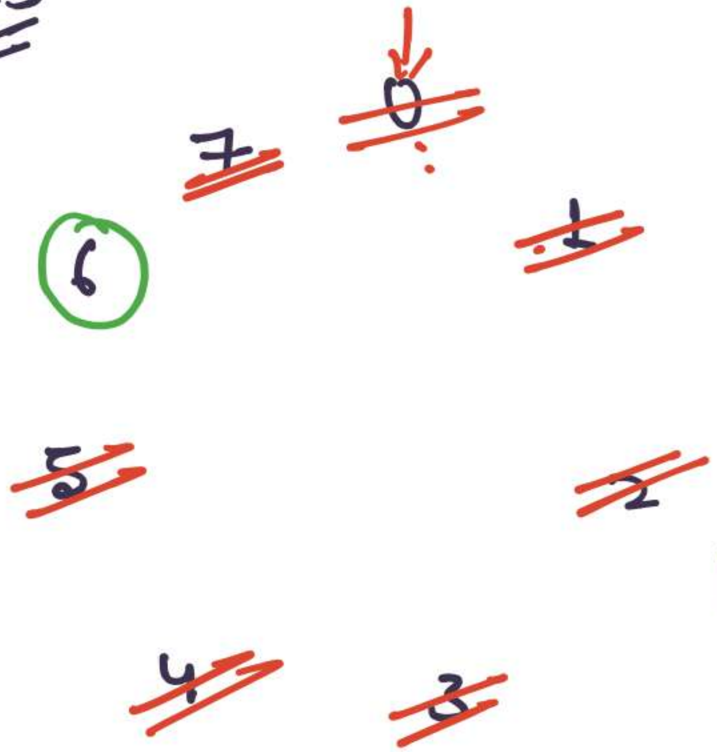
Integer → n , k ← kill Every kth people

↑ no. of people

↳ place n people in circular form

n=8

k=3

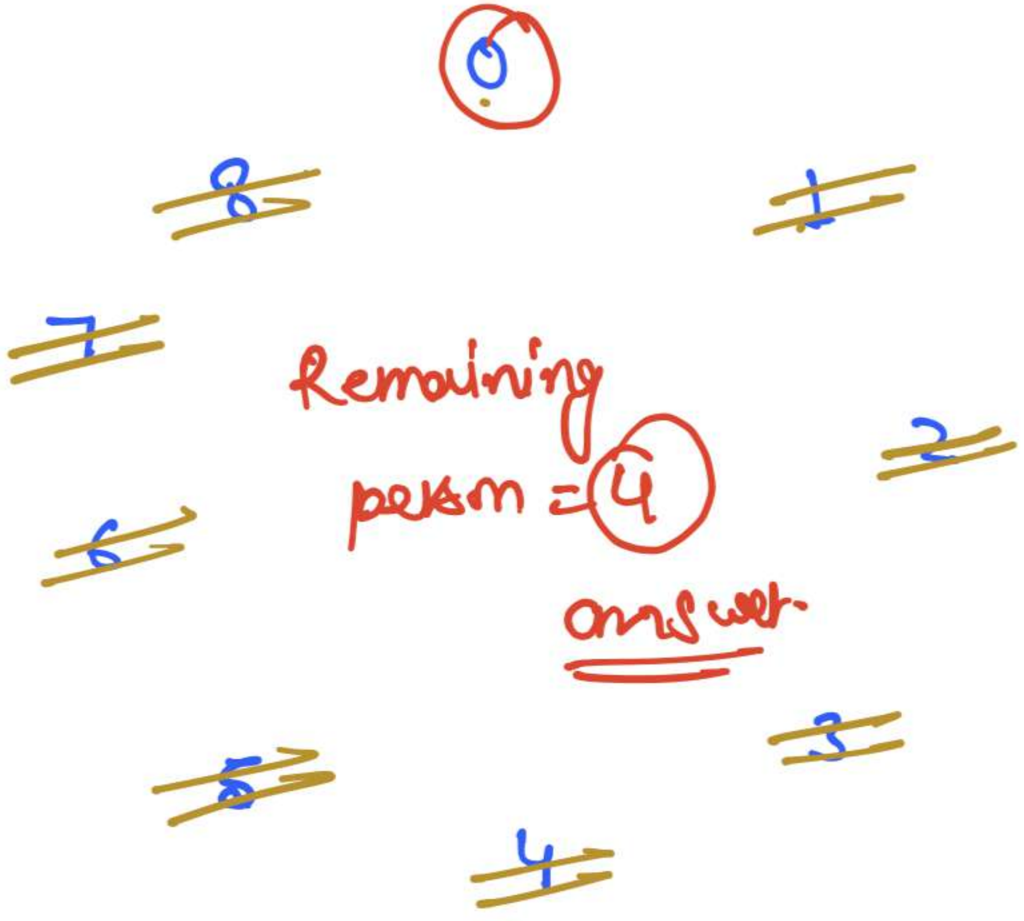


Remaining person = 6

answer.

n= 9

k= 4



Remaining person = 4

answer.

n=7, k= 4

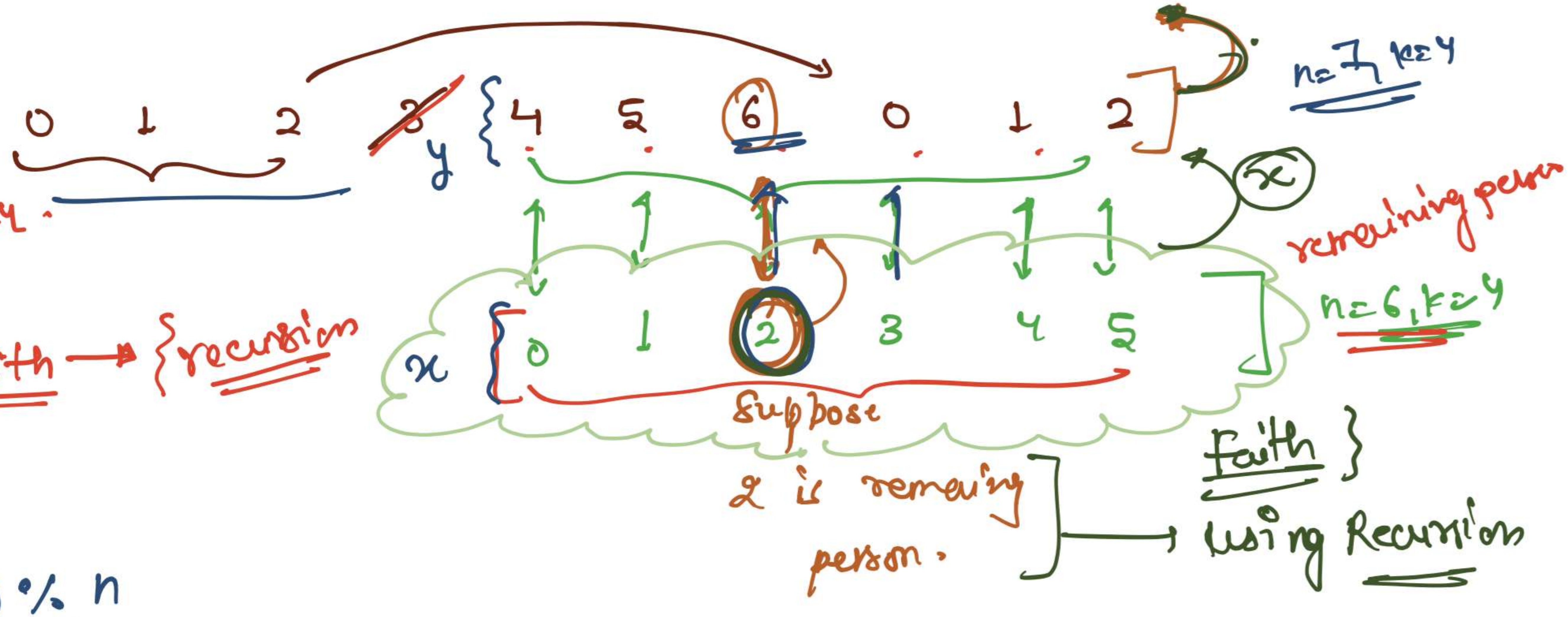
→ ~~0~~ 1 ~~2~~ ~~3~~ ~~4~~ ~~5~~ ~~6~~

↳ remaing → 1

n=7 k=4

n=7, k=4.

faith → {recursion



$$y = \underbrace{(x + k) \% n}$$

x=2

$$y = (2+4) \% 7$$

$$= 6 \% 7 = \boxed{6}$$

How to find mapping.

$$\boxed{y = (x+k) \% n}$$

n=8 , k=3

Expectation

problem (n, k) → remaining person.

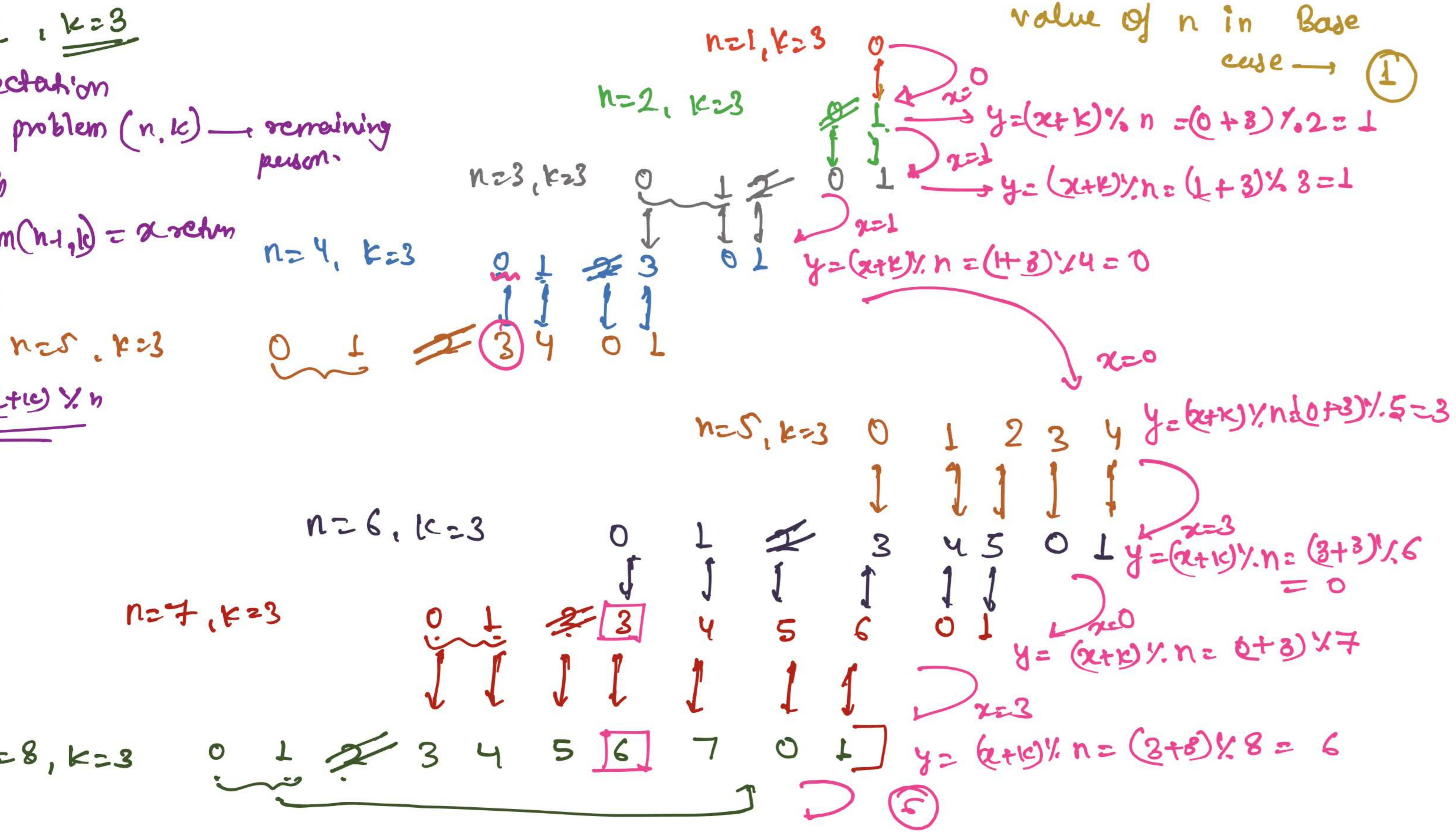
faith

problem(n-1, k) = x return

merging

$y = (x+k) \% n$

return



Lexicographical Numbers

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Dictionary order

a
b
c
d
da
db
dc
|
dca
dcb
⋮

1
2
3
4
41
42
43
441
442
⋮

n=1000

1
10
100
1000
101
102
103
104
105
106
107
108
109

11
110
111
112
113
114
115
116
117
118
119

12
120
121
⋮
129

13 --- 19
130 --- 190
131 --- 191
⋮
139 --- 199

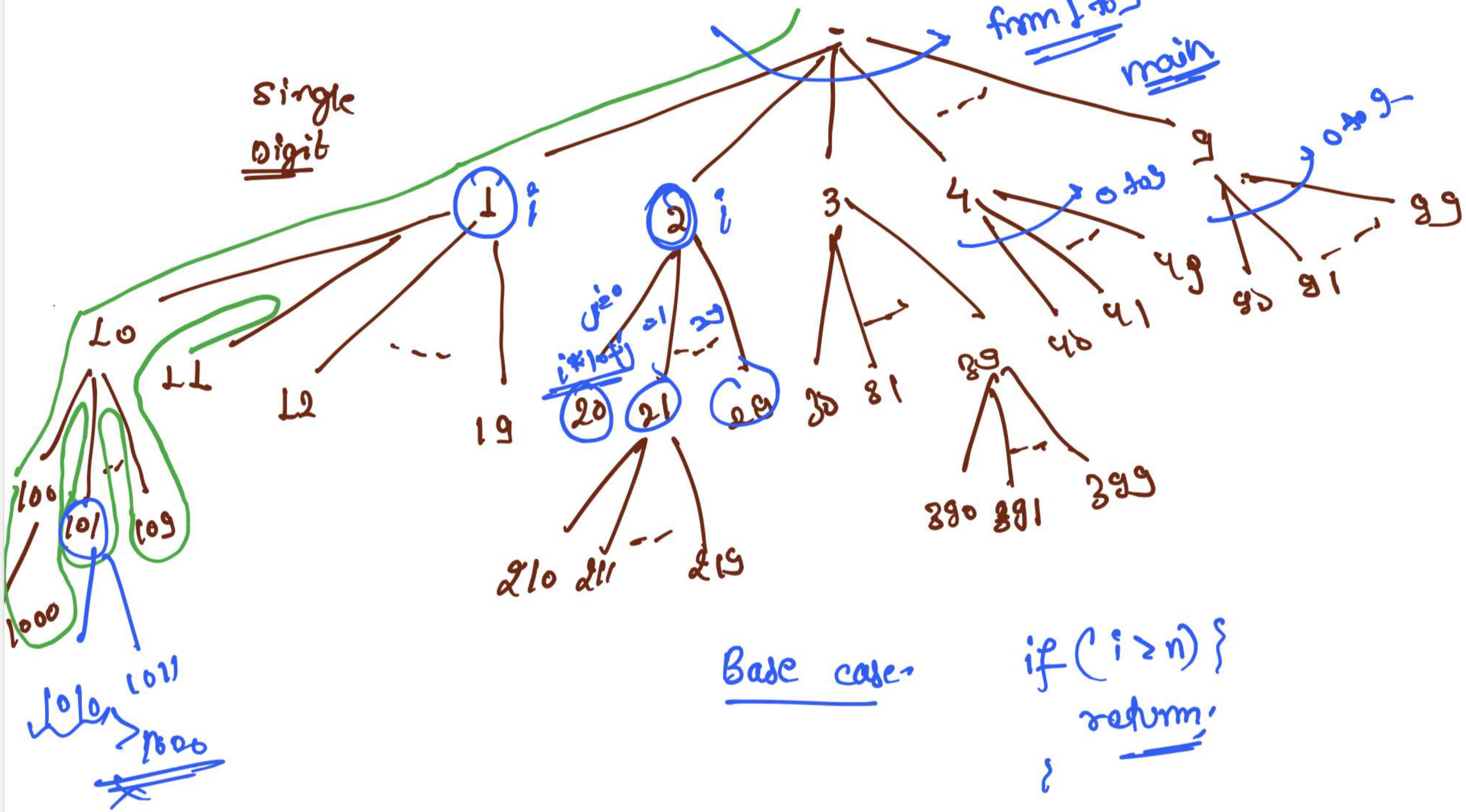
2
20
200
201
202
⋮
209

21
210
211
⋮
219

9
290
291
⋮
299

3
30
300
301
302
303
⋮
309

9
90
900
901
902
⋮
909
⋮
1000



Base case-

```
if (i>n){
   return;
}
```

1   11

10

100

1000

101

102

:

109

Gold Mine - 2

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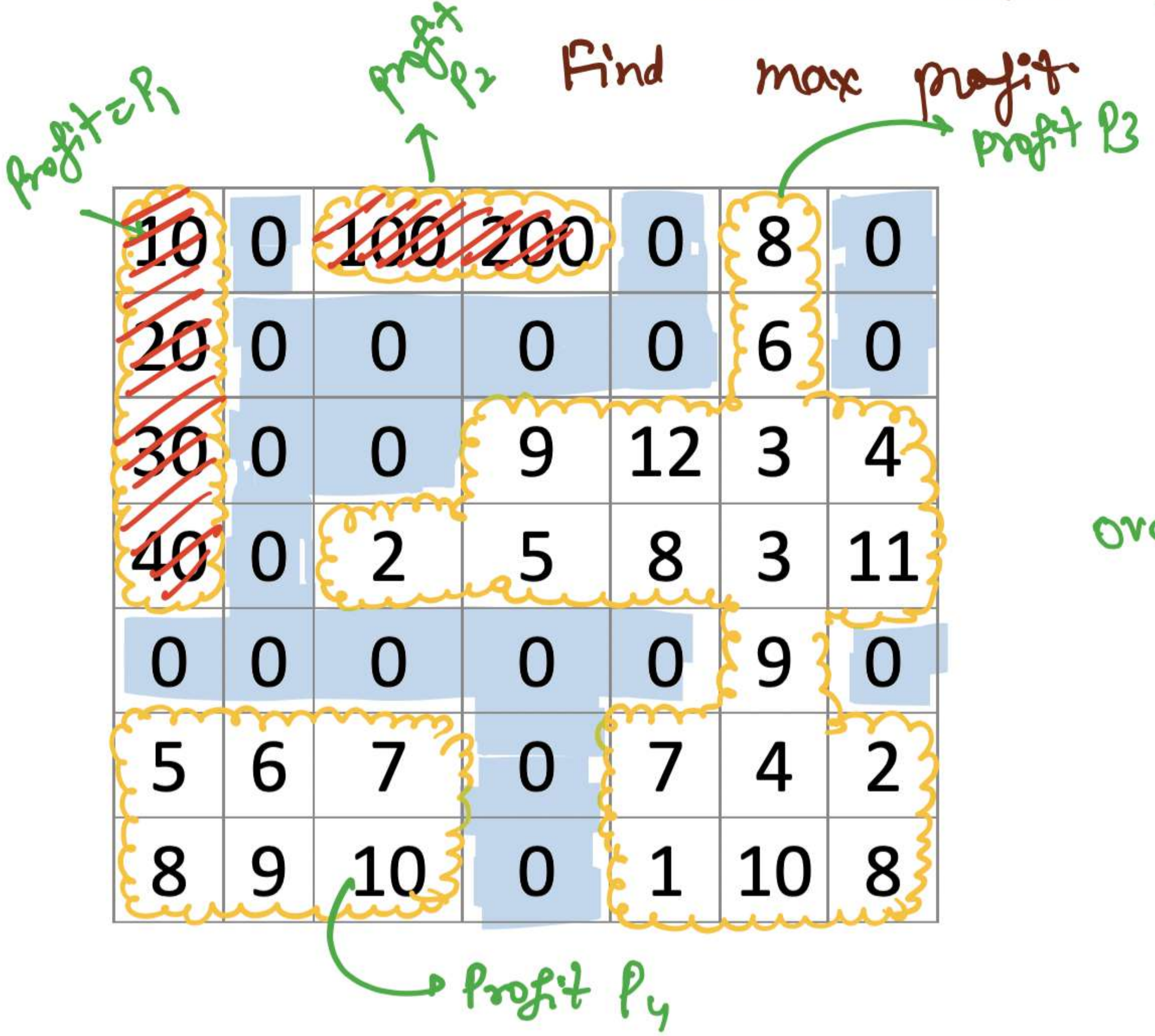
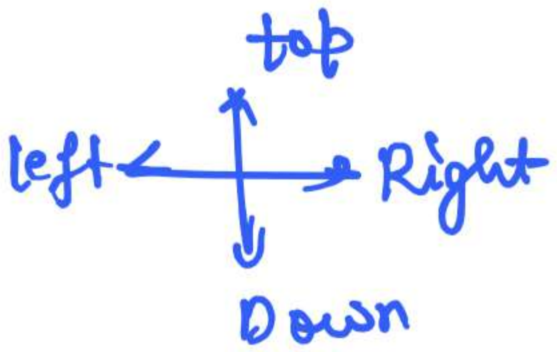
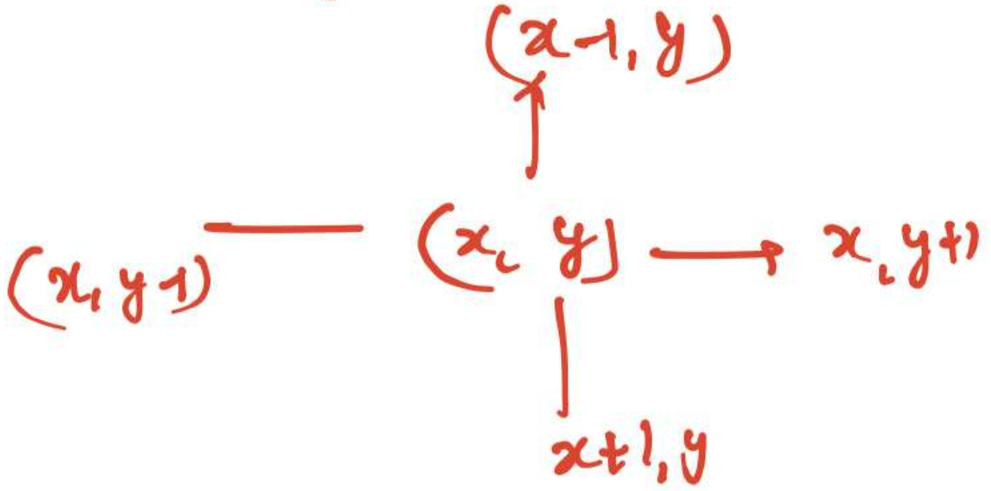
Given a grid, in which if grid[i][j]==0, then this is barrier i.e. we can't visit that cell, rest all is profit with Gold, Find max profit



~~10~~	0	~~100~~	~~200~~	0	8	0
~~20~~	0	0	0	0	6	0
~~30~~	0	0	9	12	3	4
~~40~~	0	2	5	8	3	11
0	0	0	0	0	9	0
5	6	7	0	7	4	2
8	9	10	0	1	10	8





overall Max overall = $\underbrace{\text{Math.max}(P_1, P_2, P_3, P_4)}_{\text{Result}}$

{-1,0}, {0,-1}, {1,0} {0,1}

→ Base of problem is

BFS

DFS] Recommended

Solve Sudoku

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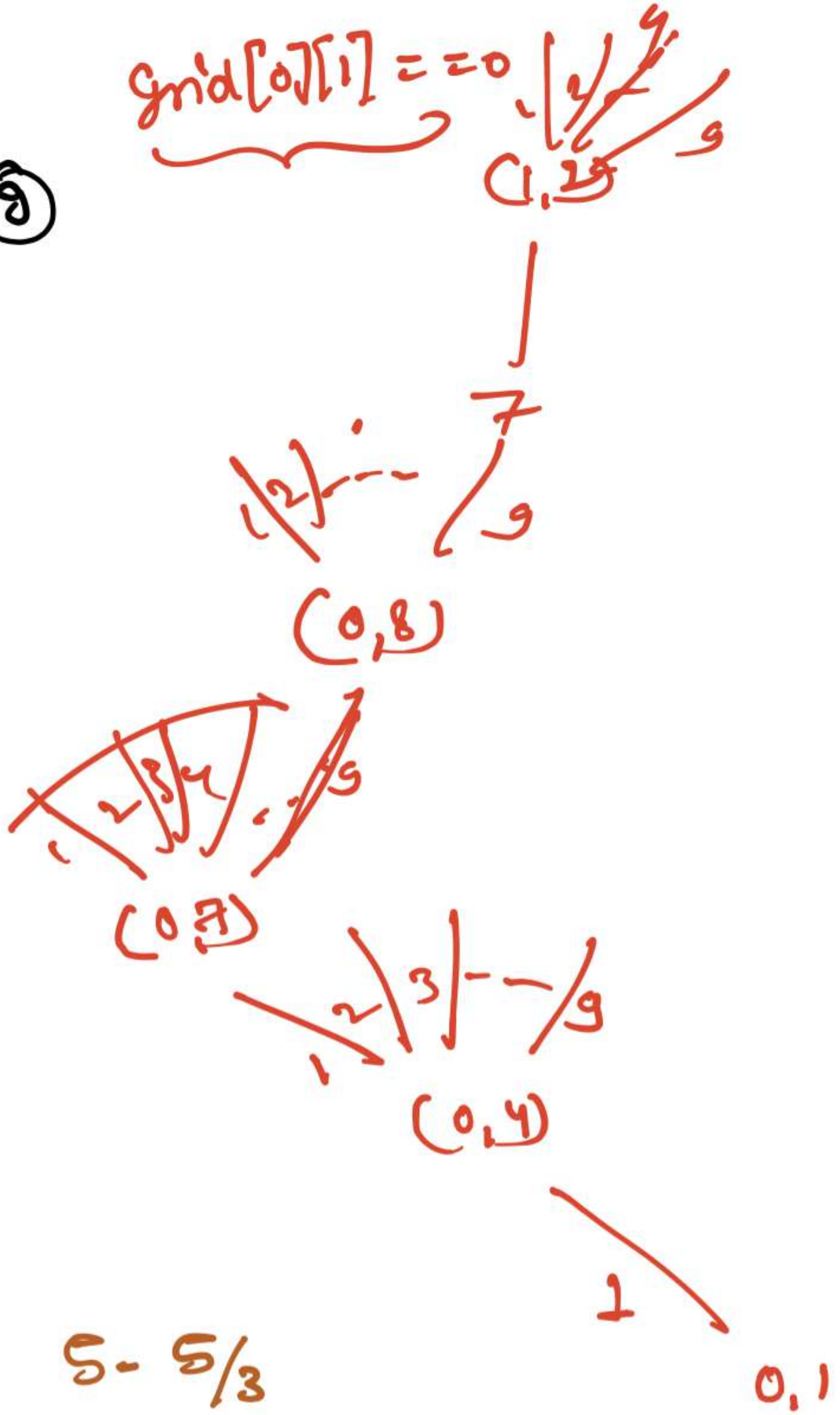
	0	1	2	3	4	5	6	7	8
0	3	0	6	5	0	8	4	0	0
1	5	2	0	0	0	0	0	0	0
2	0	8	7	0	0	0	0	3	1
3	0	0	3	0	1	0	0	8	0
4	9	0	0	8	6	3	0	0	5
5	0	5	0	0	9	0	6	0	0
6	1	3	0	0	0	0	2	5	0
7	0	0	0	0	0	0	0	7	4
8	0	0	5	2	0	6	3	0	0

9



5 - 5/3

5 - 1 = 4

starting point of submatrix

row = r - r%3 } starting pt of submatrix

col = c - c%3

level → cells

option → Digits from 1 to 9

is safe to place

① → col ||→

② → Row ||→

③ → submatrix

4 - 4%3 = 4-1=3

5 - 5%3 = 5-2=3

Cryptarithmatic

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string s1 → SEND

string s2 → MORE

string s3 → MONEY

find string of unique character from $\underbrace{s1+s2+s3}$ = SENDMORY

S E N D M O R Y

2 ... 2**

level → characters
option → Digits (from 0-9)

→ Digit will uniquely provide to character → verify mapping.

SEND → integer n1
MORE → int n2
MONEY → int n3
n1+n2 == n3 → valid mapping

```
   SEND        9567
+  MORE        1085
  MONEY       10652
```

Requirement

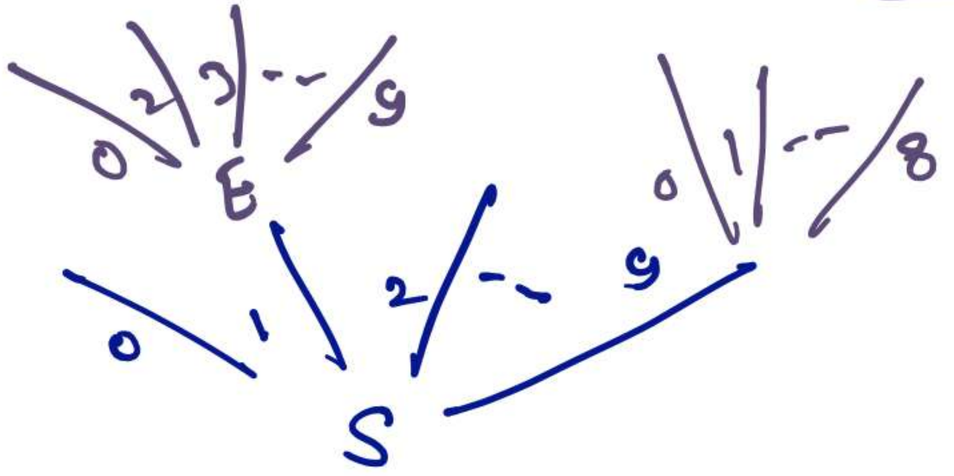
① unique string + index

② s1, s2, s3

④ booleed[] digitused → 10 size

⑤ HashMap character → digit(integer)

Y
⋮
D
N
E
S



print all possible mapping

print mapping of character in sorted order → D. E→, M. N, O, R, S, Y string → SEND

S →	2
E →	4
N →	3
D →	7

How to find integer associated with string

```
for(int i=0; i< str.length(); i++){
    ans = ans*10 + map.get(str.chartAt(i));

}
```

ans=0 S → 0×10 + 2 = 2

=2 E → 2×10 + 4 = 24

=24 N → 24×10+3 = 243

=243 D → 243×10+7 = 2437

return ans;

~~a~~
~~b~~
~~c~~
~~d~~
⋮
z

sorted order

```
for(int i=0; i<26; i++){
    char ch = (char)(i+'a');
    if(map.containsKey(ch)){
        syso(ch+"->"+map.get(ch));
    }
}
```