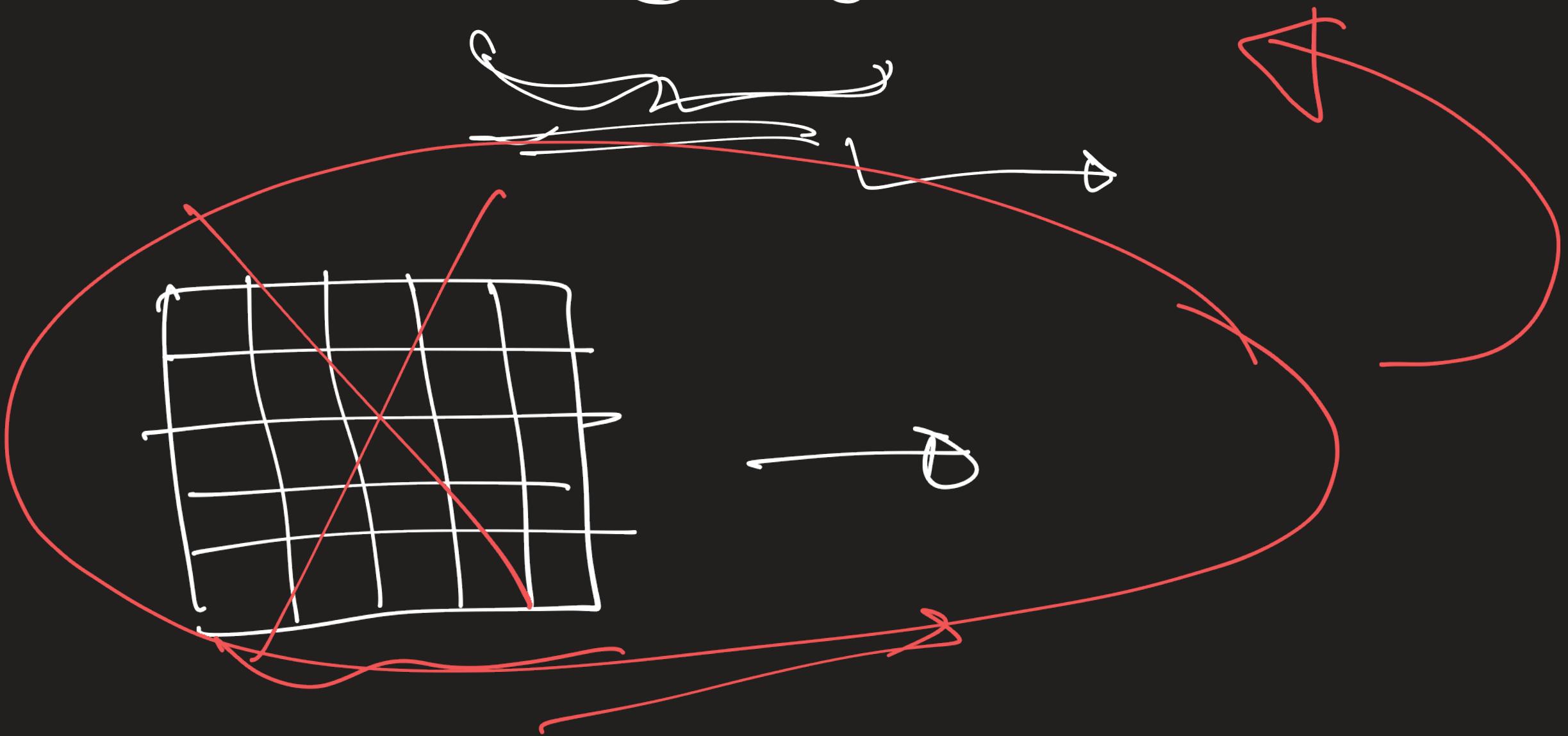
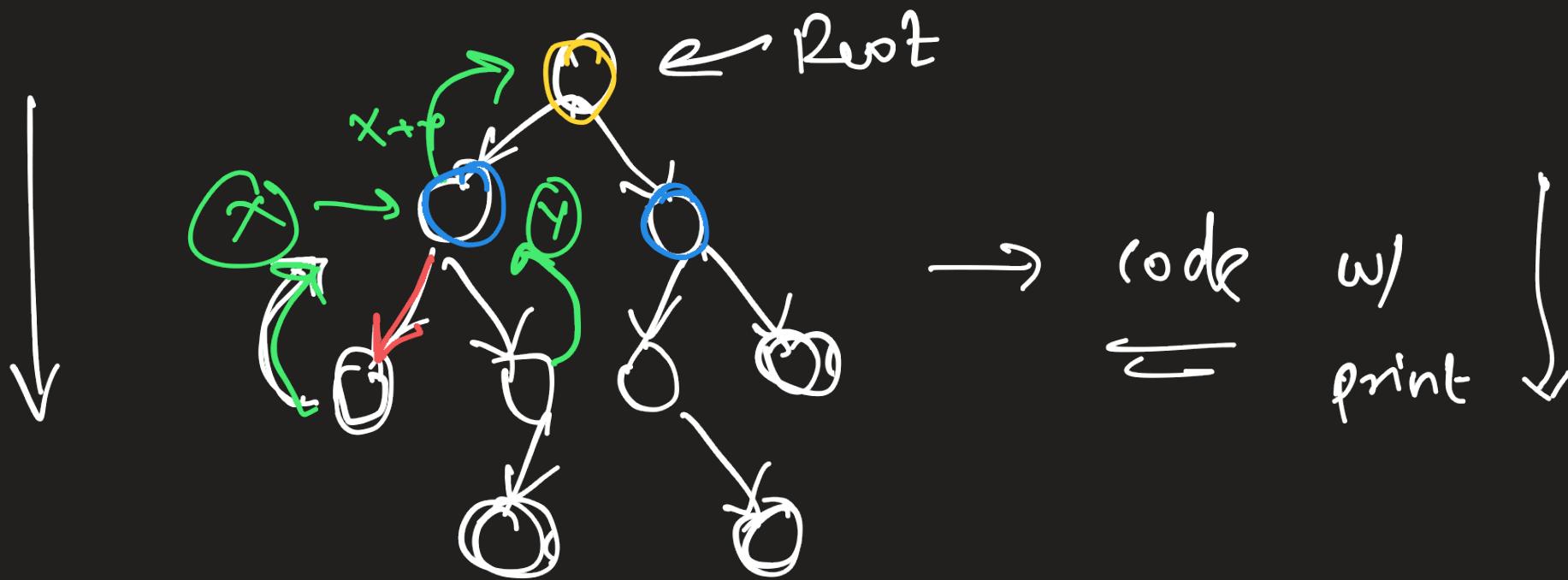
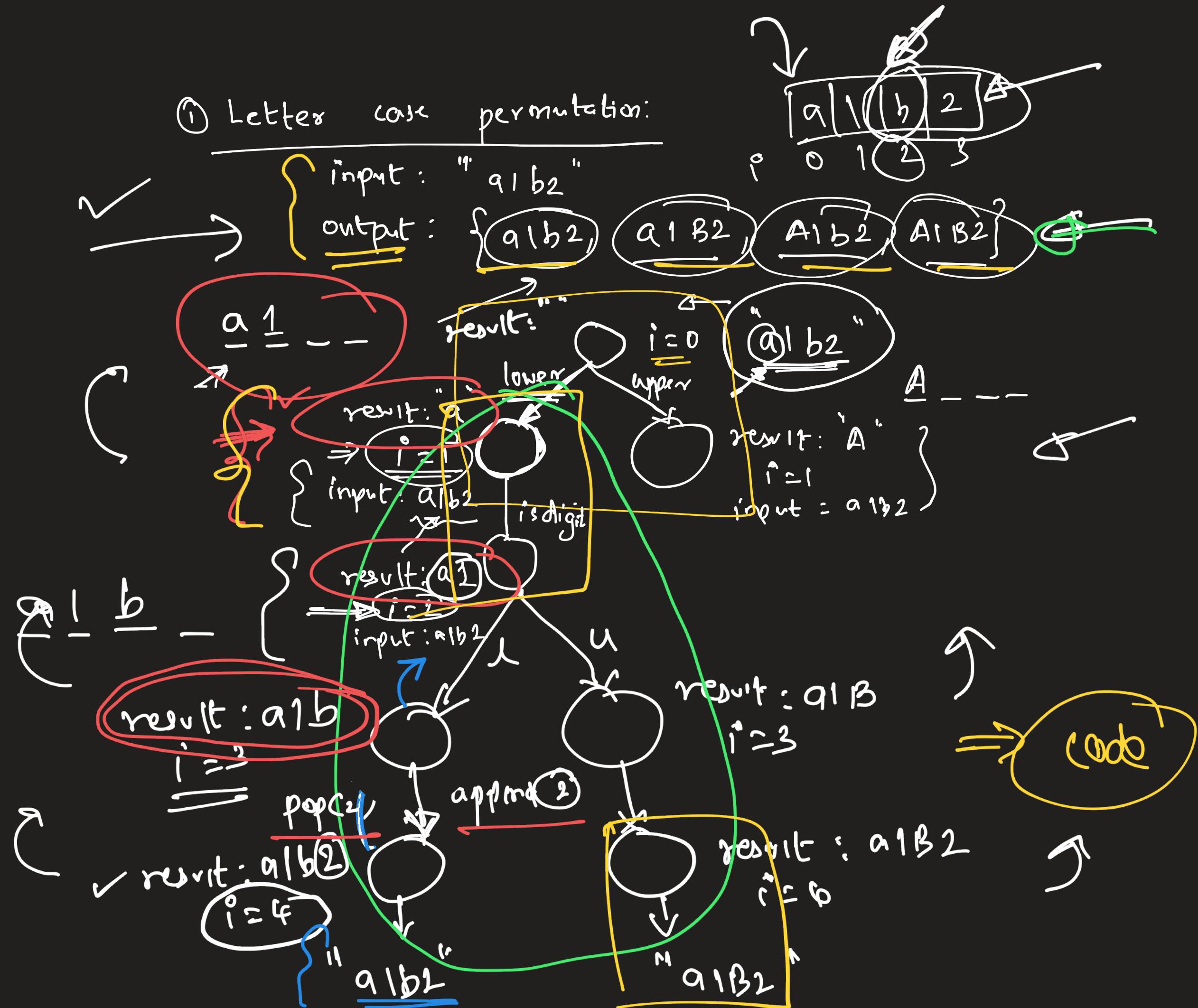


Recursion :-



① Letter case permutation:



$s[n]$

for ($i : 0 \dots n$) $\leftarrow O(1)$

$s = s + "f"; \cancel{O(n)}$



$O(n)$ time

PT

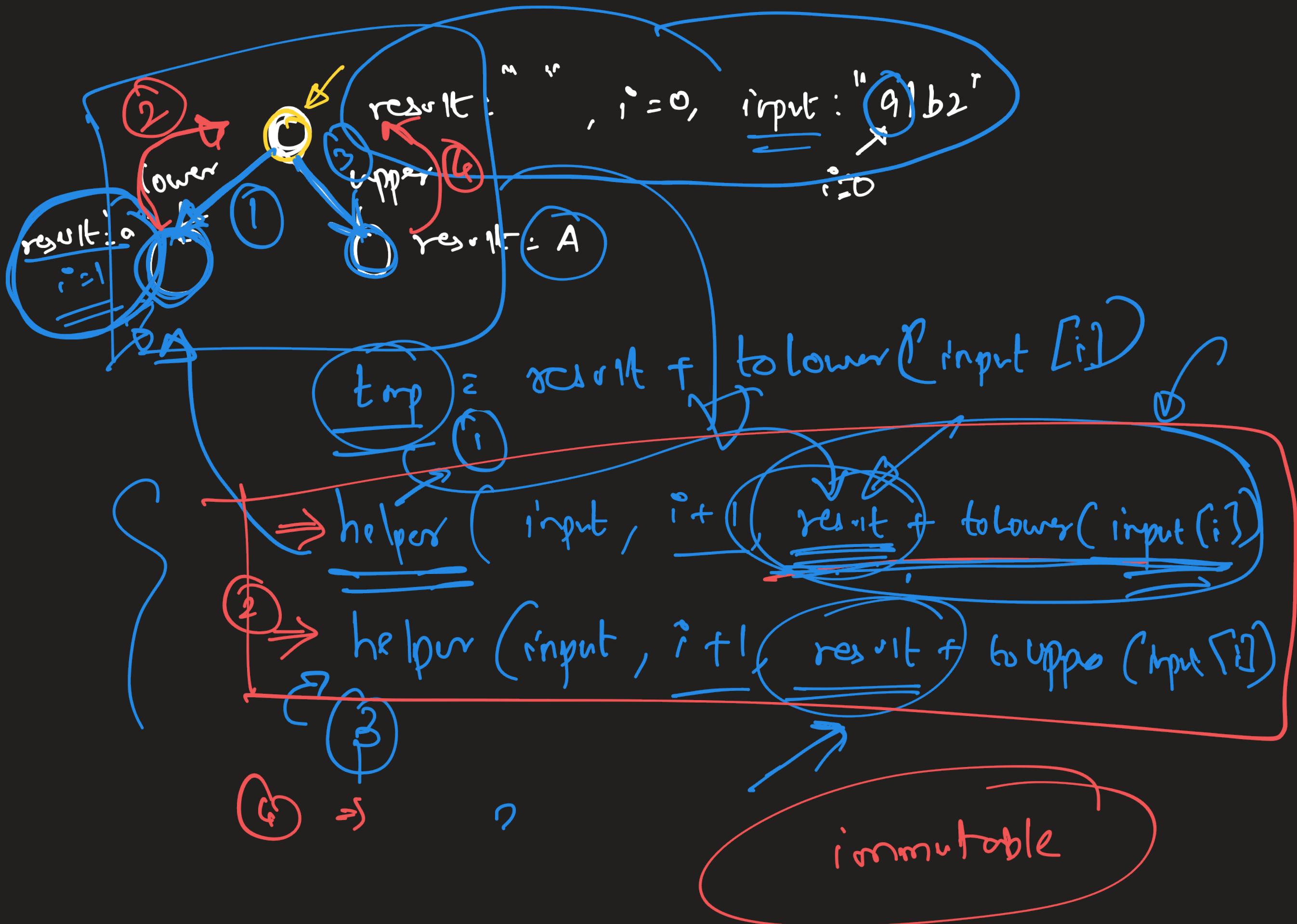
$\rightarrow O(N)$

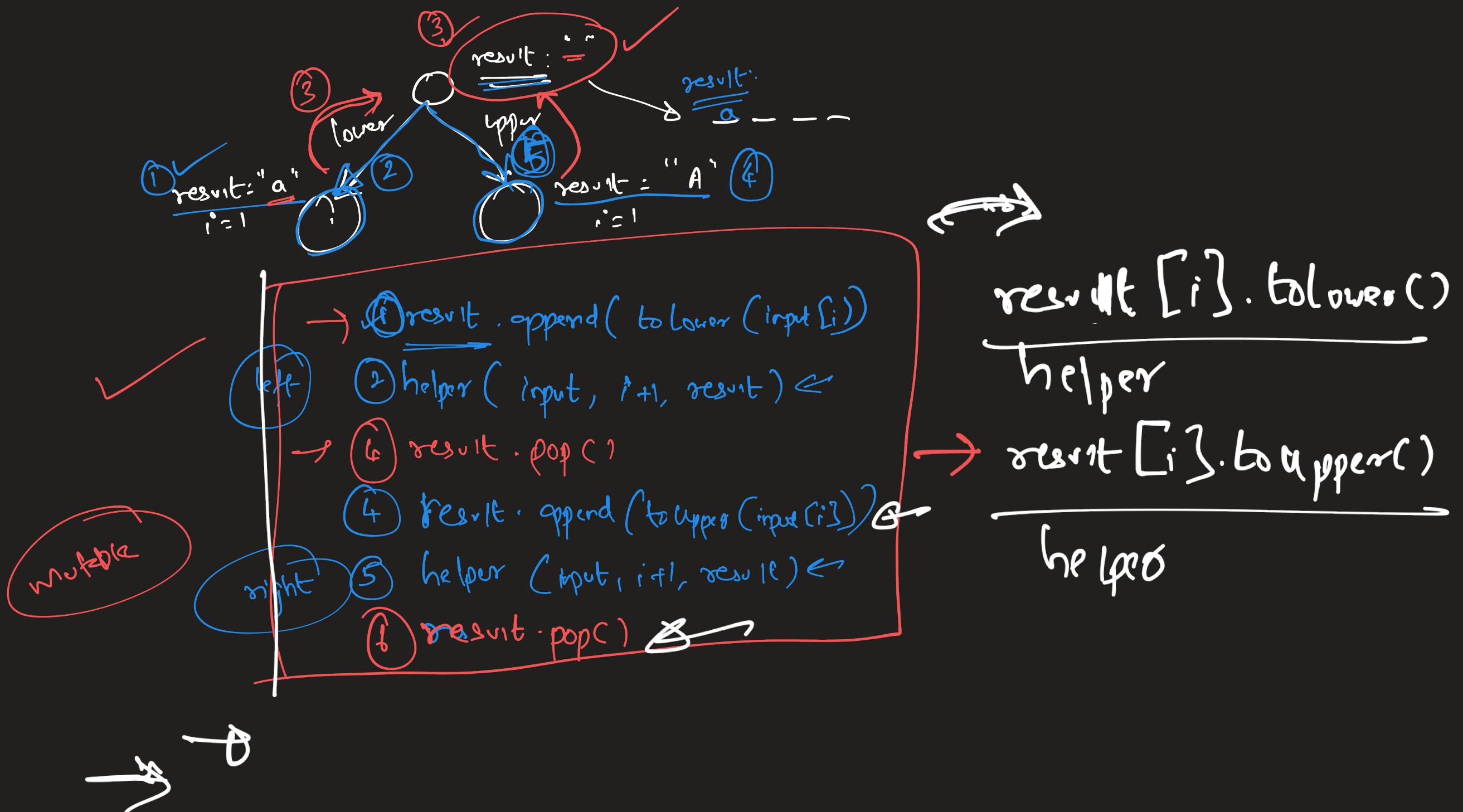
$\rightarrow O(N^2)$

```

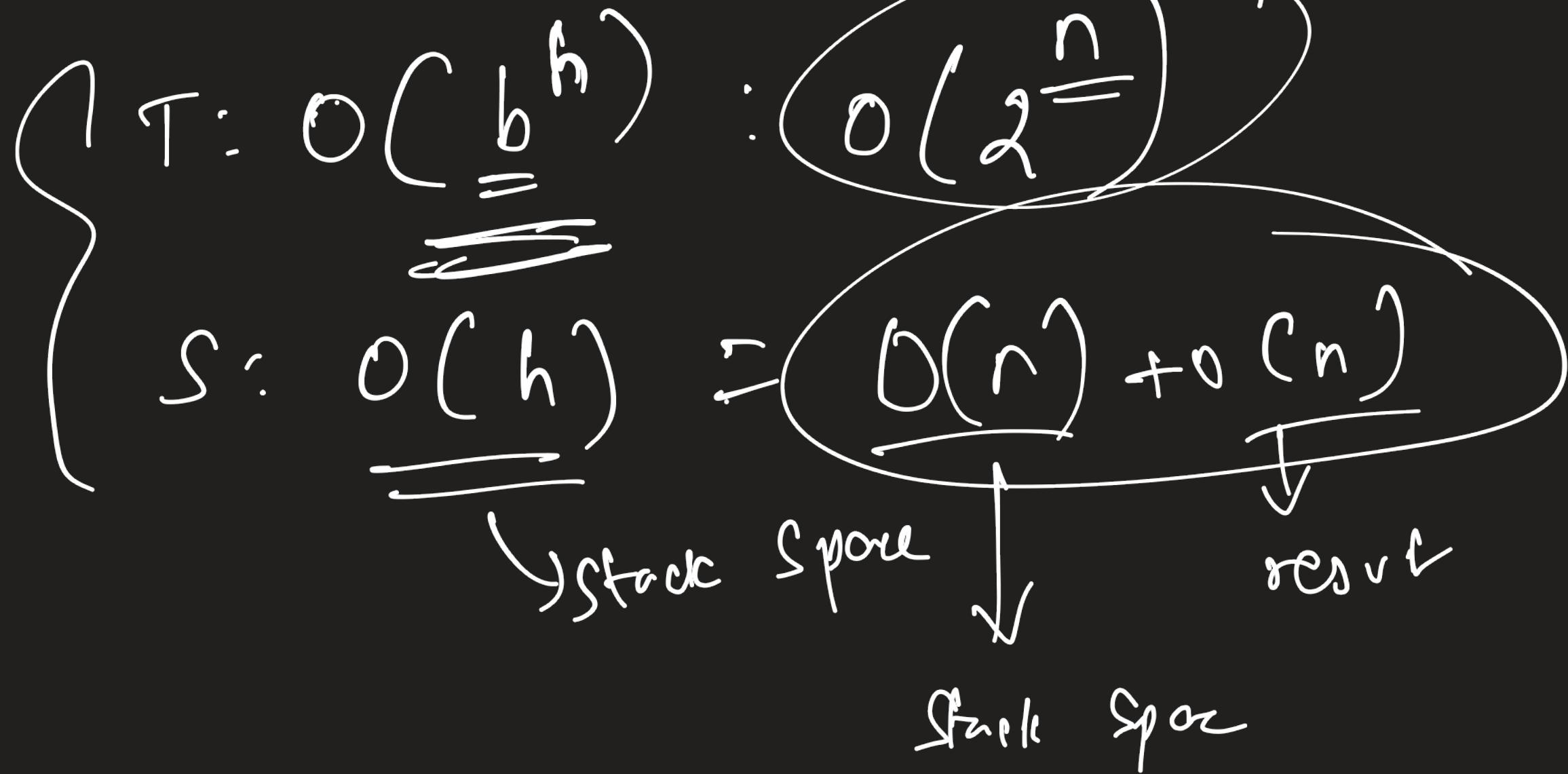
    | lepermute( string input) {
    |     return helper( input, 0, "" );
    |
    |     void helper( string input, int i, string result), vector<string>
    |     results ) {
    |         if( i == input.length() ) {
    |             print( result ); → results.append( result )
    |             return ;
    |
    |         } if( isdigit( input[i] ) )
    |             helper( input, i+1, result + input[i] )
    |         else {
    |             left ← helper( input, i+1, result + toLower( input[i] ) )
    |             right ← helper( input, i+1, result + toUpper( input[i] ) )
    |
    |         }
    |
    |     }

```





Rec: / ^{other case}
permutation



②

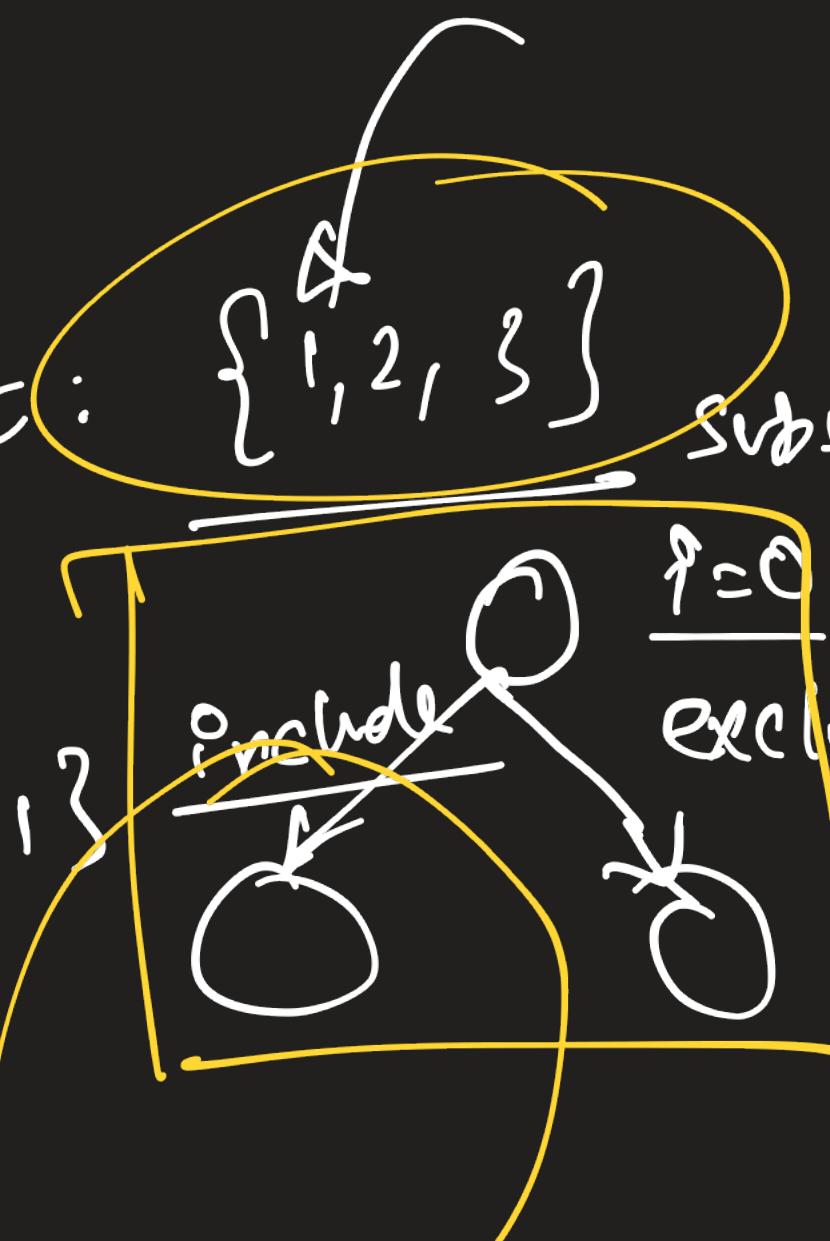
Subset:

input:

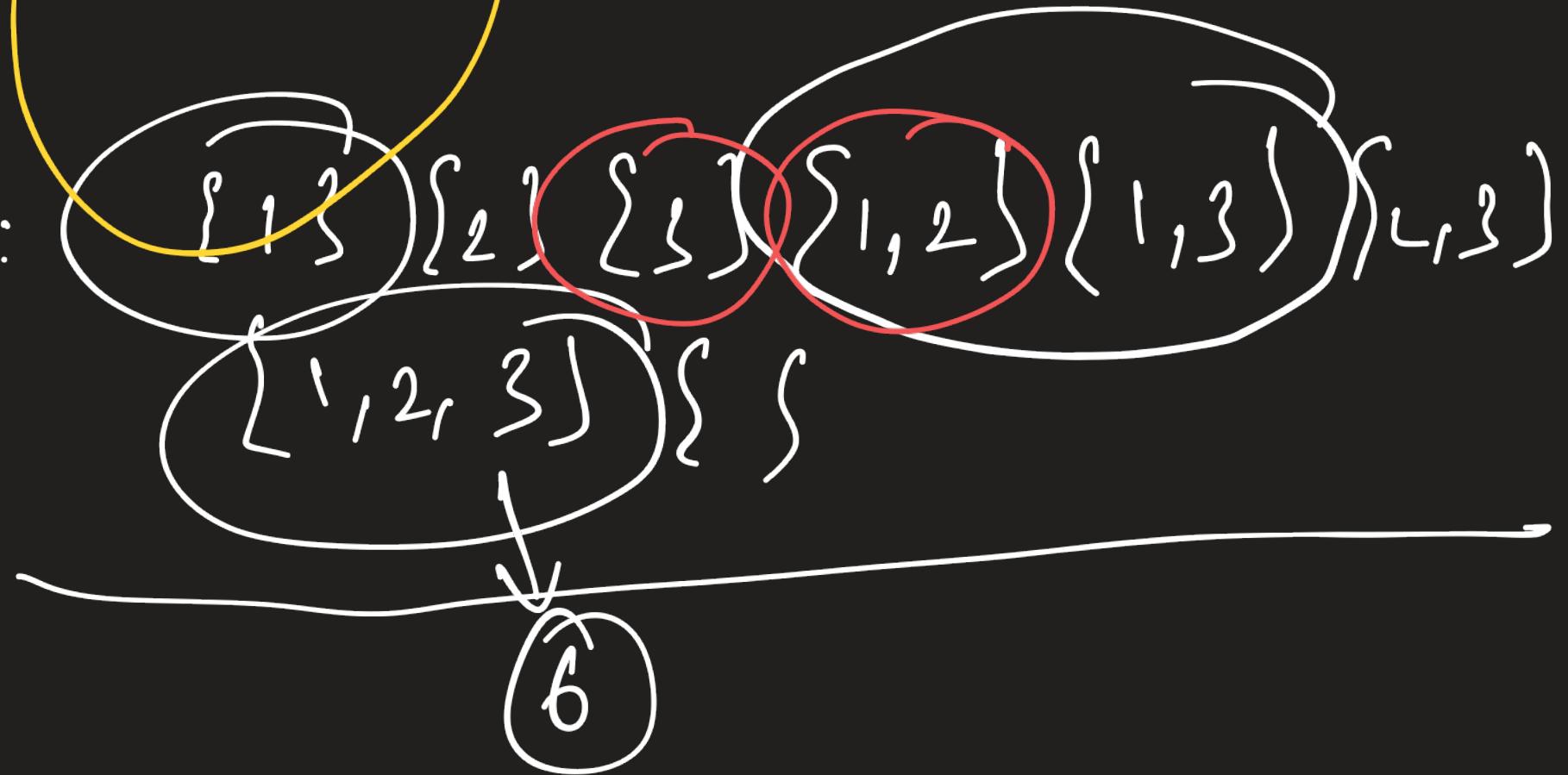
{1, 2, 3}

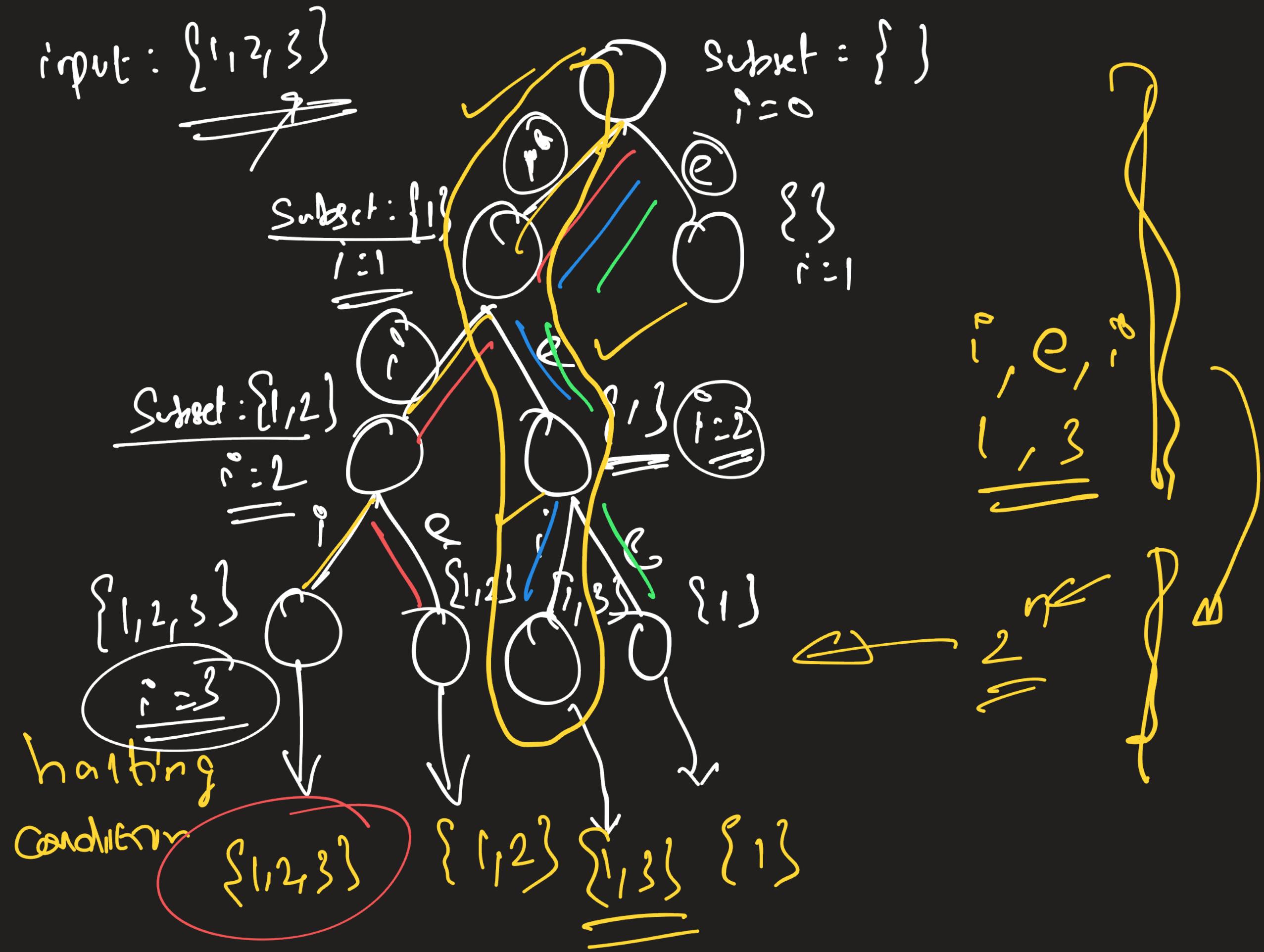
Subset: {3}

Subset:
 \checkmark $i=1$
input:



Output:





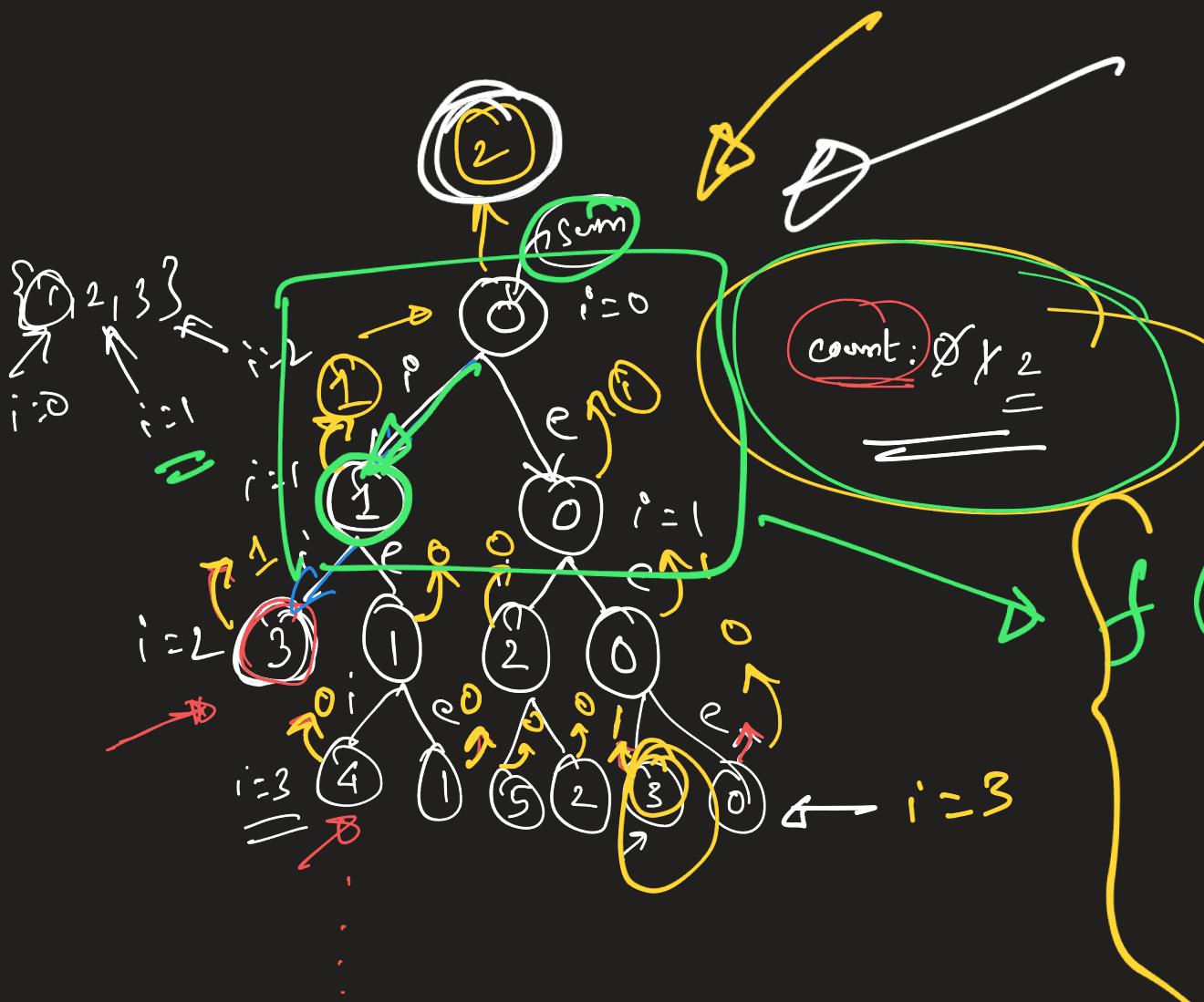
3

Subset Sum :- (Counting Subsets)

Input : $\{1, 2, 3\}$ ↗

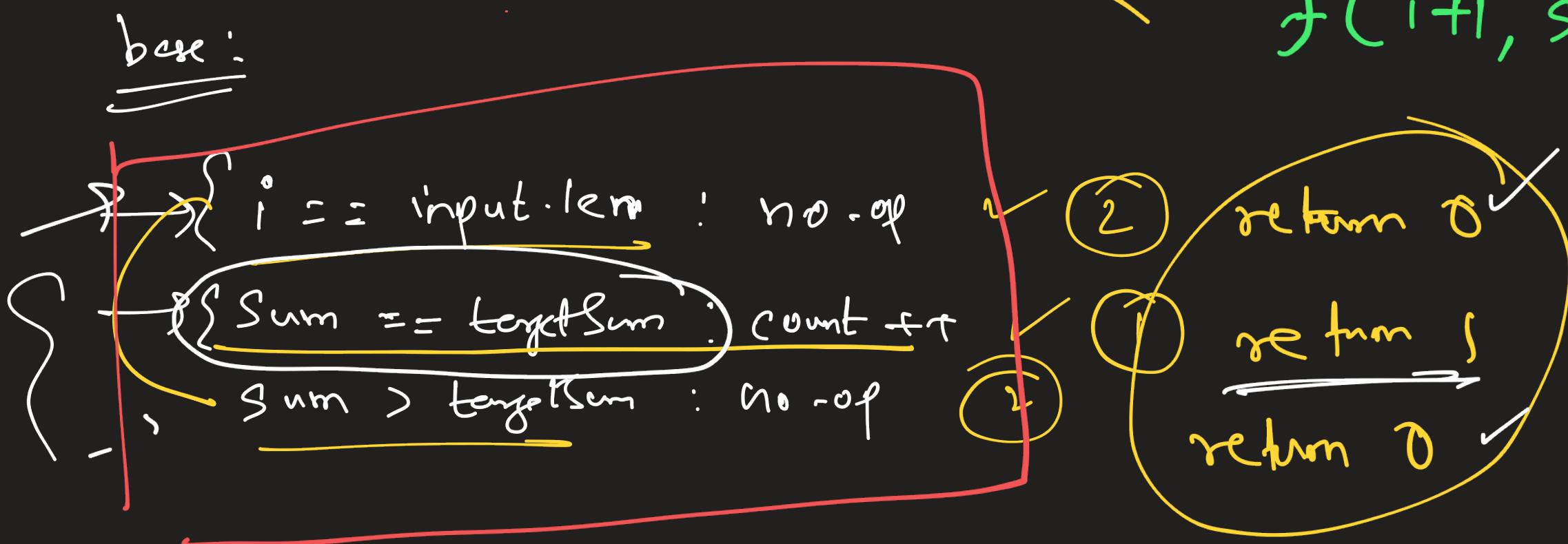
target-Sum : $\begin{array}{c} 3 \\ = \end{array}$ ↙

result : $2 \rightarrow \{1, 2\} \quad \{3\}$



✓

$f(i, \text{sum}) = f(i+1, \text{sum} + \text{input}[i]) + f(i+1, \text{sum})$



```
int countSubset( vector<int> input, int  
                targetSum ) {  
    return helper( input, targetSum, 0, 0 );  
}
```

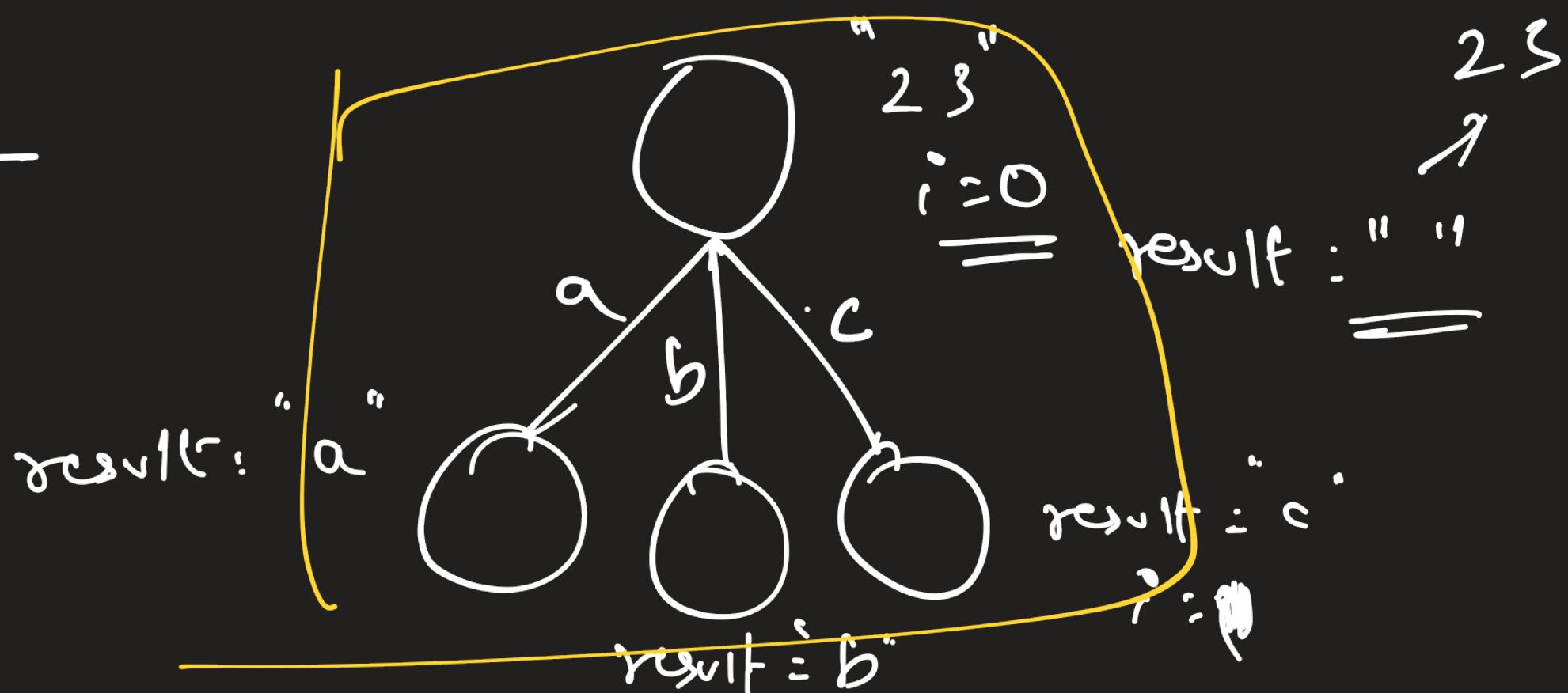
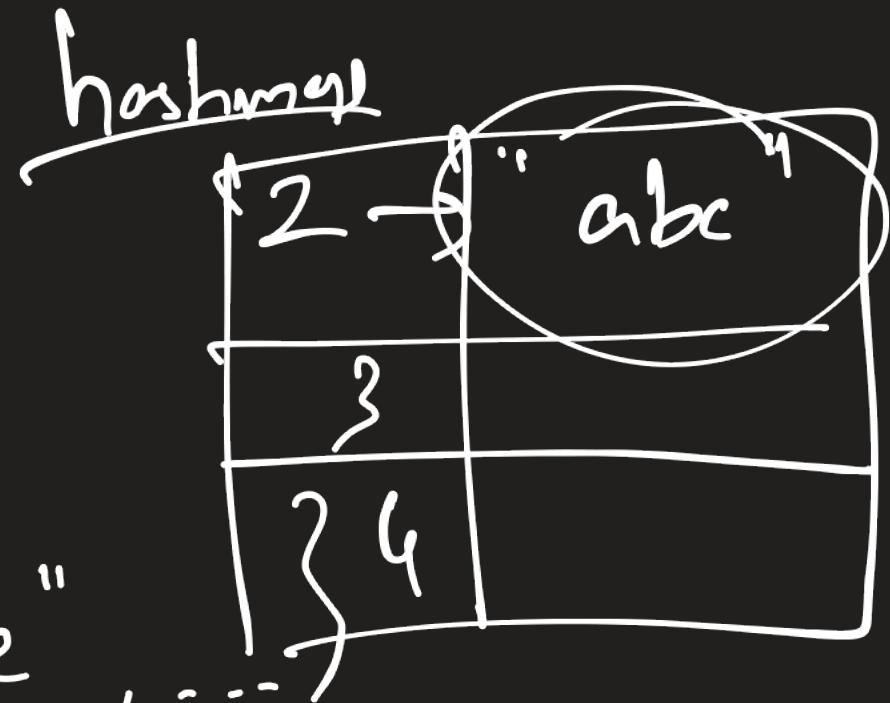
```
int helper( vector<int> input, int targetSum,  
            int i, int sum ) {  
  
    base = {  
        if ( sum == targetSum ) return 1; // base case  
        if ( sum > targetSum || i >= input.length() ) return 0;  
    };  
  
    return helper( input, targetSum, i+1, sum + input[i] )  
          + helper( input, targetSum, i+1, sum );  
}
```

④ Dial pad

input = "23"

output = { "ad", "ae", ... }

c
b
a
—



5

Generate parenthesis

$n = 3$ pairs

✓ ((()))

~~((x))~~

✓ ()()()

~~(c)(x)~~

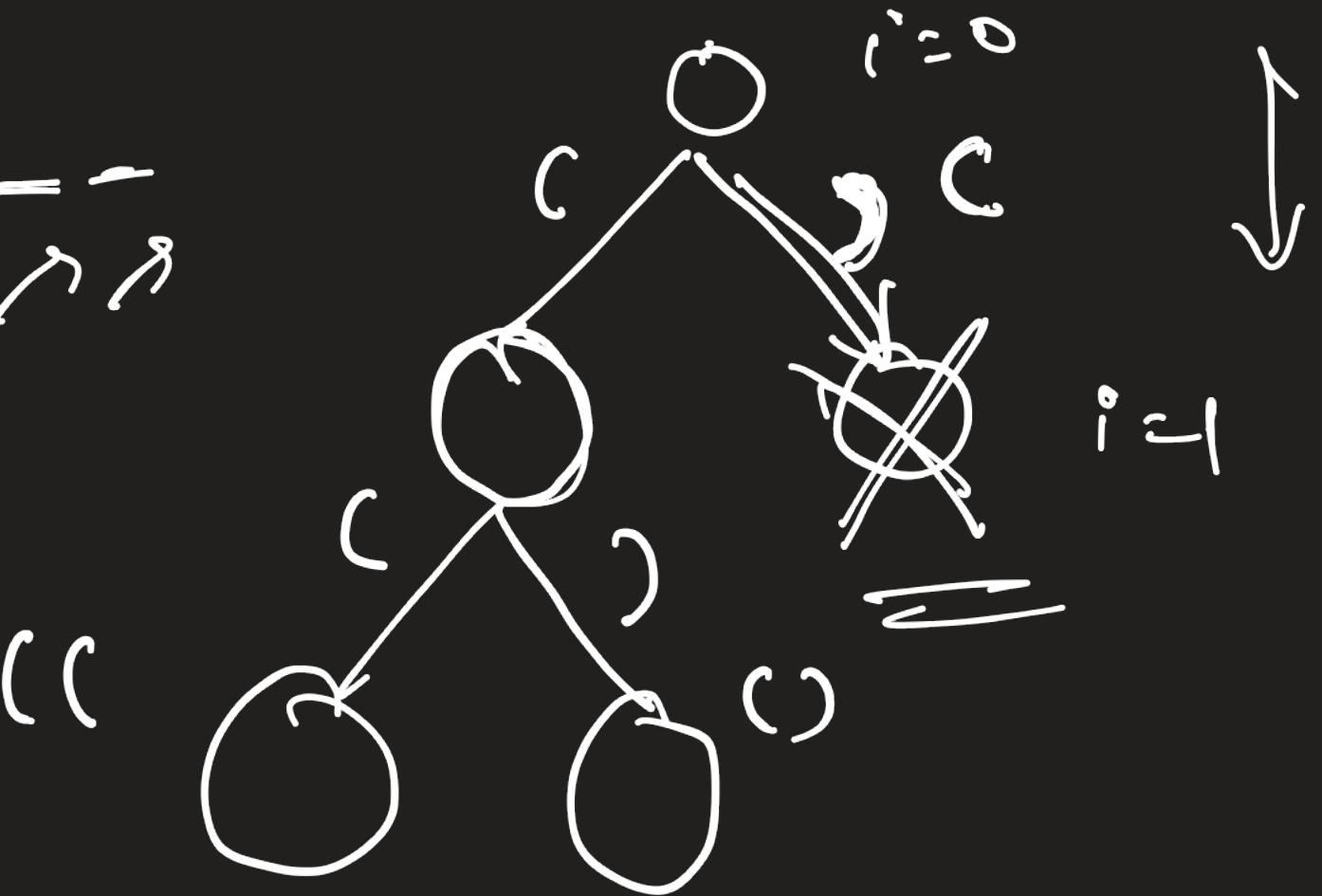
✓ (())()

✓ ()(())

.

X)
((

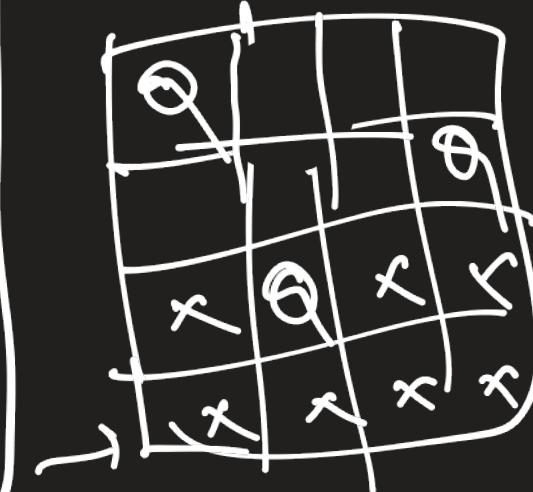
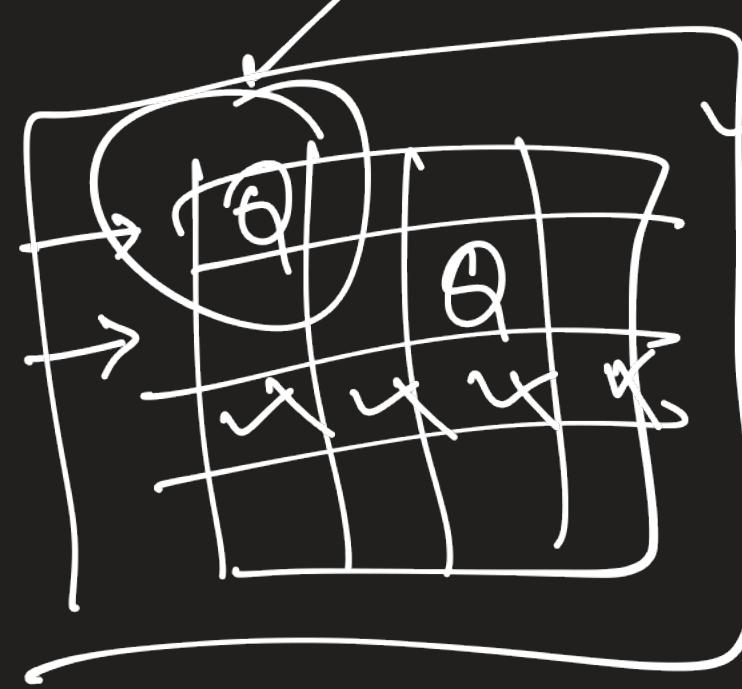
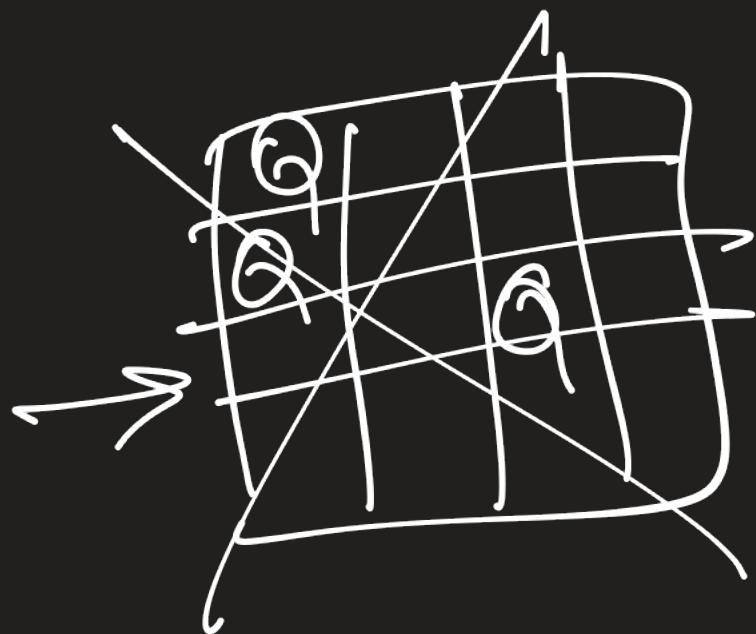
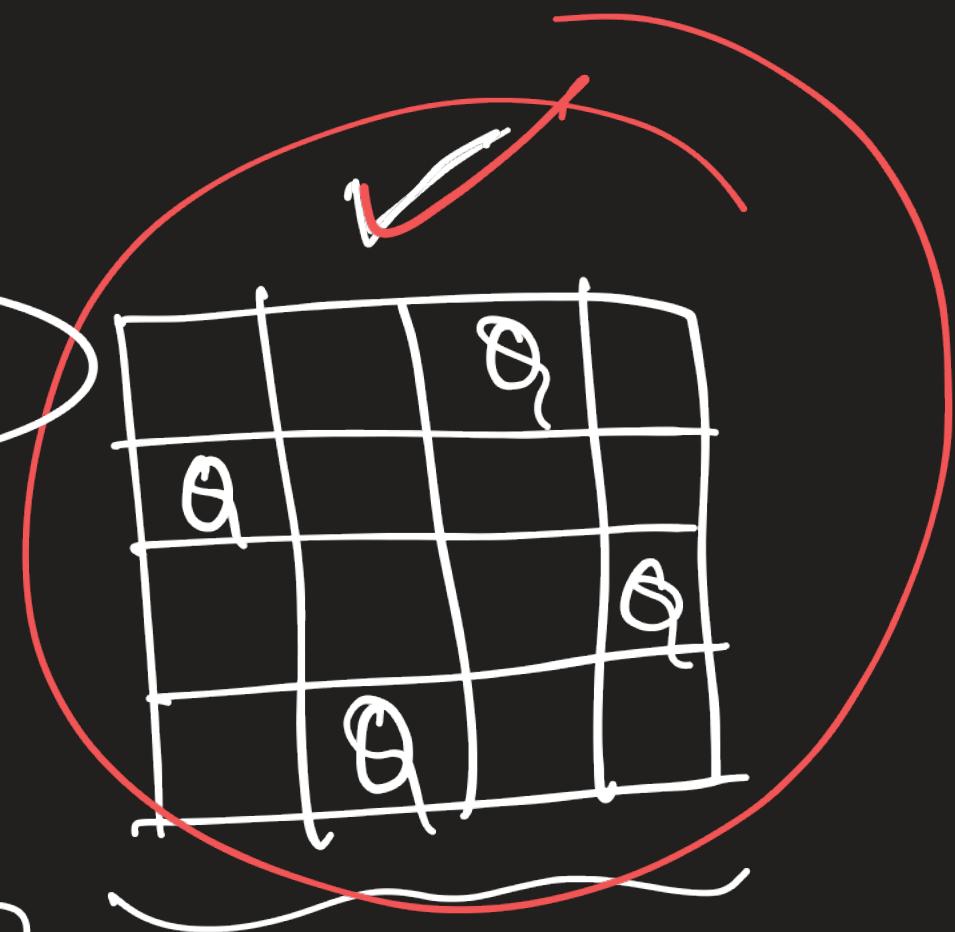
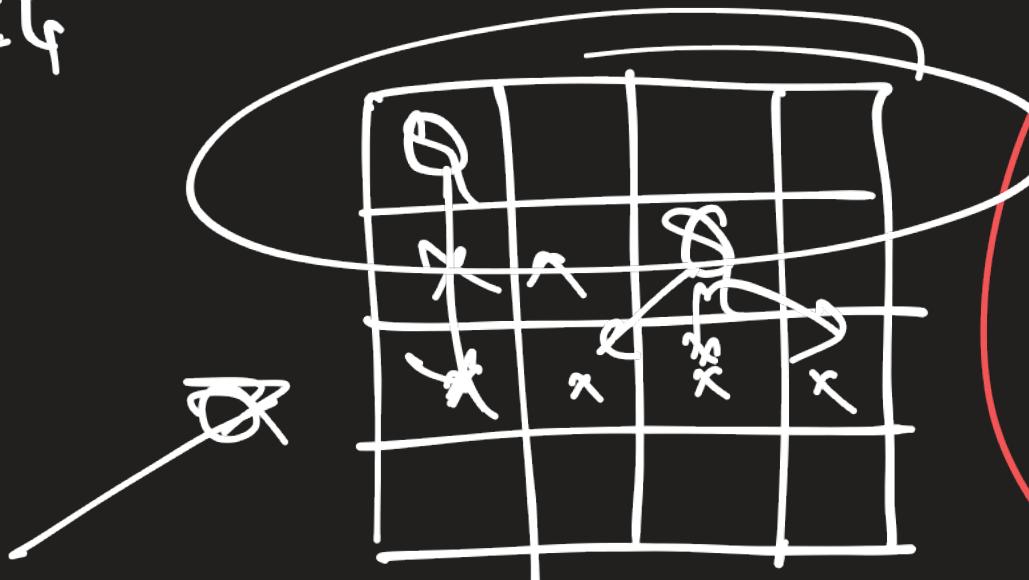
— — — — —
↗ ↗ ↗ ↗ ↗

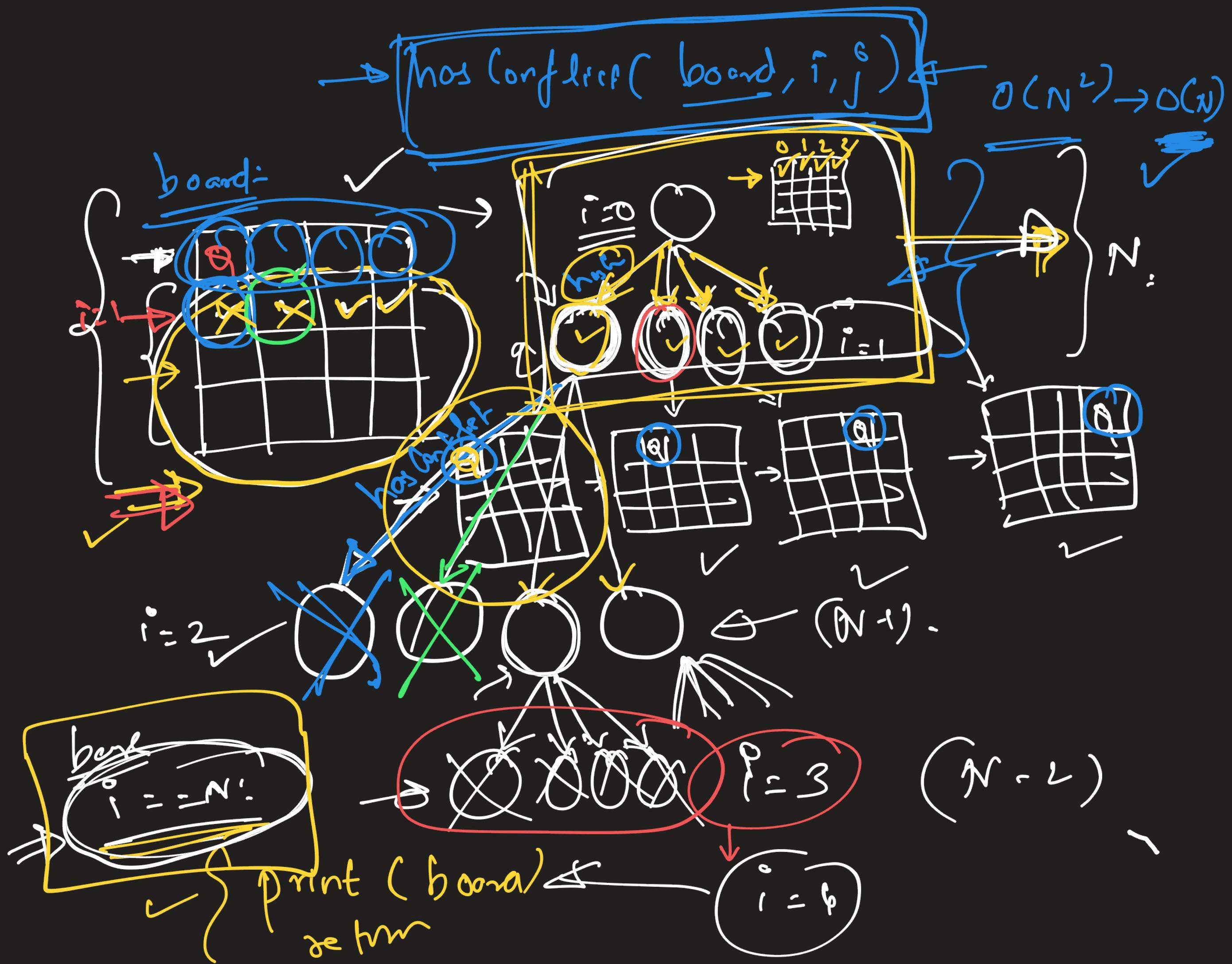


6 N-Queens: ✓

chess board : $N \times N$

$N=4$





```
void NO(int N) {  
    int board[N]; ✓  
    helper(N, board, 0); ✓  
}
```

hash:

row

column

	K	V
1	0	2
2	3	0
3	1	3

2-d array

0	1	2	3
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0

col

2	0	3	1
---	---	---	---

$i = 0 \quad 1 \quad 2 \quad 3 \quad 4$

\rightarrow (row)

