

## Recursion - 4

Lecture-30

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


# Finding subarrays - vo subsequence jo ki continuous faishim me ho

Find out all the subarrays of an array.

```
SKILLS
```







### Palindrome using recursion

Find out whether a given string is palindrome or not using recursion

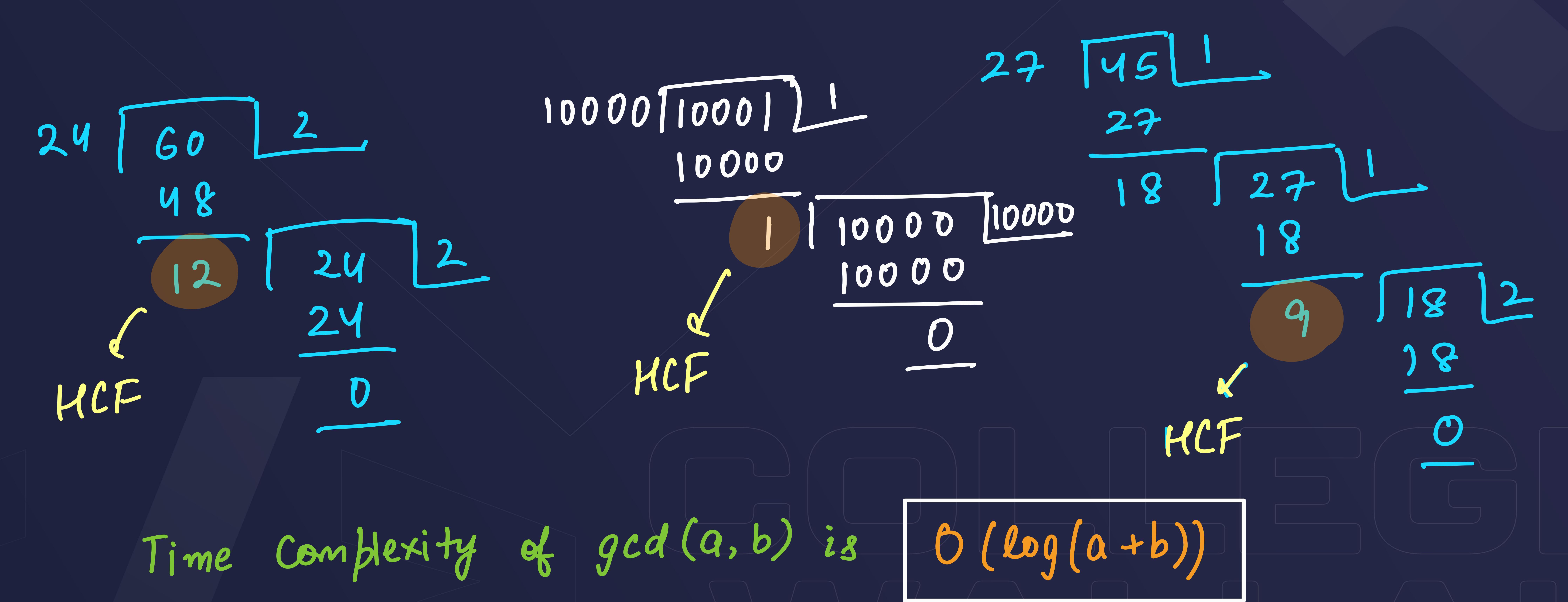
mom
aba
aba
abacacba
racecar

#### Greatest Common Divisor

Calculate Greatest Common Divisor of two numbers.

$$hcf(24,60) = 12$$
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
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 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i = 24; i = 2; i - )$ 
 $for(int i$ 

## Euclid's Division Algo (long division method)



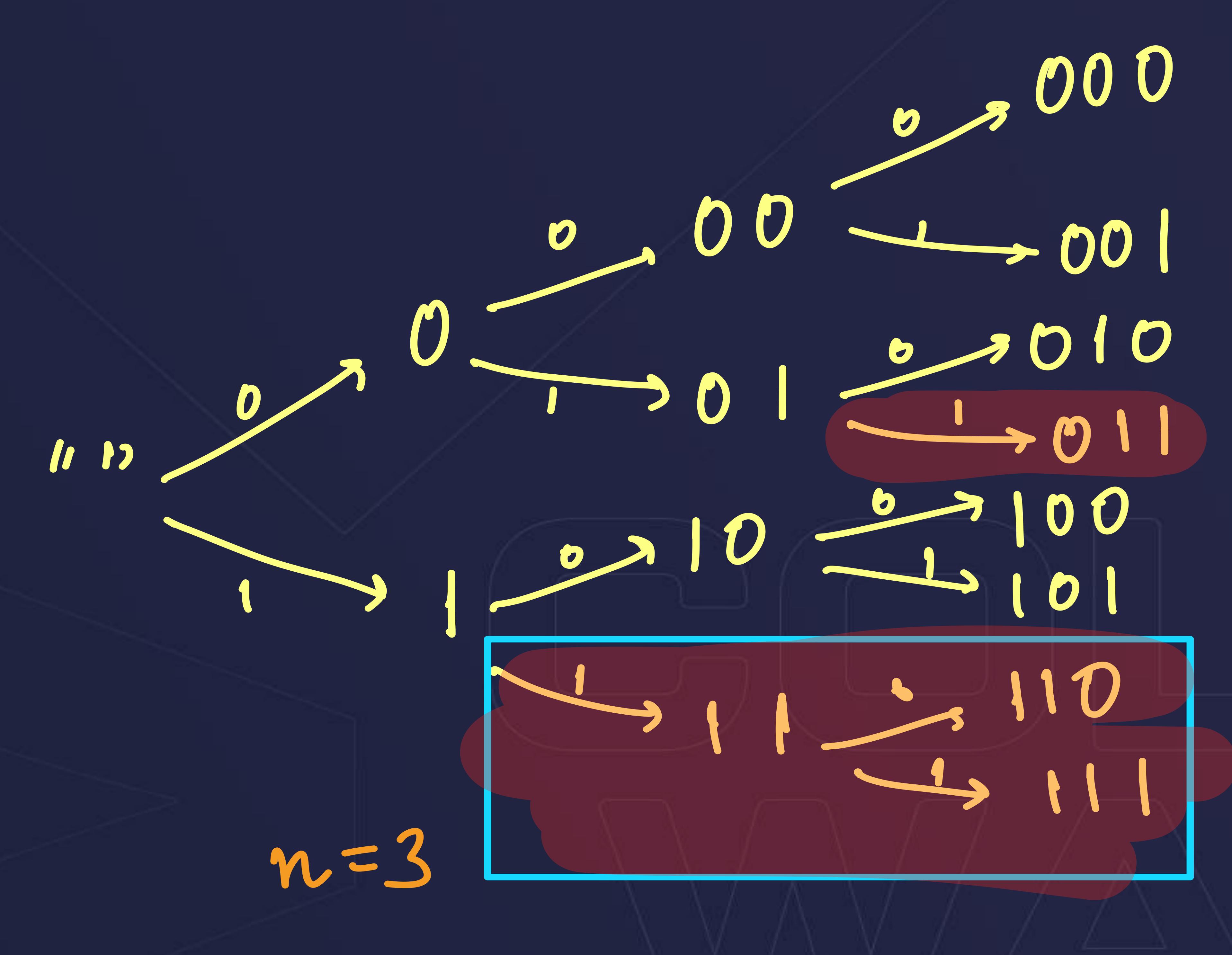
```
HCF -> 27 & 45
 gcd (27, 45)
 gcd (45%27, 27) = gcd (18,27)
                    gcd(27\%18, 18) = gcd(9, 18)
 gcd(45,27) = gcd(27,45)
a b
```

27% 45



#### Practice

Generate all binary strings of length n without consecutive I's



#### Ques: Combination Sum

#### [Leetcode - 39]

$$\{3, \{2,3,5\}, 8\}$$
 $\{23, \{2,3,5\}, 6\}$ 
 $\{23, \{2,3,5\}, 6\}$ 
 $\{23, \{2,3,5\}, 5\}$ 
 $\{53, \{1,2,3\}, 3\}$ 
 $\{2,2,2\}, 1$ 
 $\{2,2,3\}, 1$ 
 $\{2,2,3\}, 1$ 
 $\{2,2,3\}, 1$ 
 $\{2,2,3\}, 1$ 
 $\{2,2,3\}, 1$ 

#### Ques: Generate Parentheses

#### Leetcode - 22

```
Input: n = 3
Output: ["((()))","(()())","(())()","()(())","()(())"]
```

```
WIMP Observations
 at every instant,
no. of opening bkts >=
 no at closing batts.
```

$$n=1 \rightarrow ()$$
 $n=2 \rightarrow ()(), (())$ 
 $n=3 \rightarrow ()()(), (()()), (()()), ((())), ((()))$ 



#### Ques: Generate Parentheses str op cl n Leetcode - 22]

"", 0, 0, 3  $n=3 \rightarrow (((,(,),),),)$ 6,1,0,3 CC, 2, 0, 3 ()(,2,1,3 ((), 2, 1, 3 (((,3,0,3) d = (1,3,1,3) (1,3,1,3) (1,3,1,3) (1,3,1,3) (1,3,1,3) (1,3,1,3)

#### Ques: Generate Parentheses

#### Leetcode - 22]

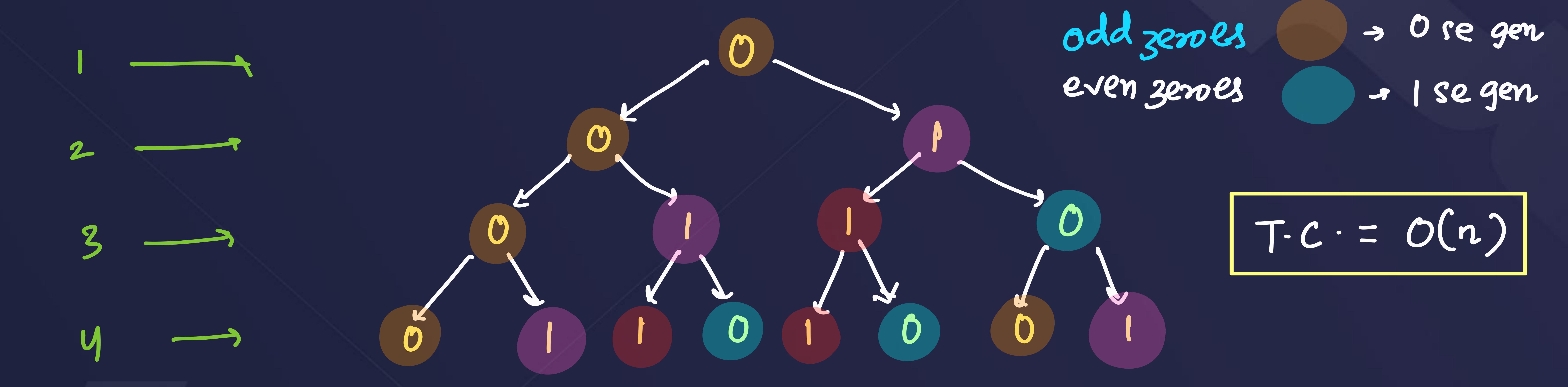
```
((1),3,1,3) ((1)(1,3,1,3) ((1)(1,2,2,3) ((1)(1,3,1,3) ((1)(1,2,2,3) ((1)(1,3,2,3) ((1)(1,3,2,3) ((1)(1,3,2,3) ((1)(1,3,2,3) ((1)(1,3,2,3) ((1)(1,3,3,3) ((1)(1,3,3,3) ((1)(1,3,3,3) ((1)(1,3,3,3) ((1)(1,3,3,3) ((1)(1,3,3,3) ((1)(1,3,3,3) ((1)(1,3,3,3)
```

```
Input: n = 3
Output: ["((()))","(()())","()(())","()(())"]
```



#### Ques: Kth Symbol in Grammar

#### [Leetcode - 779]



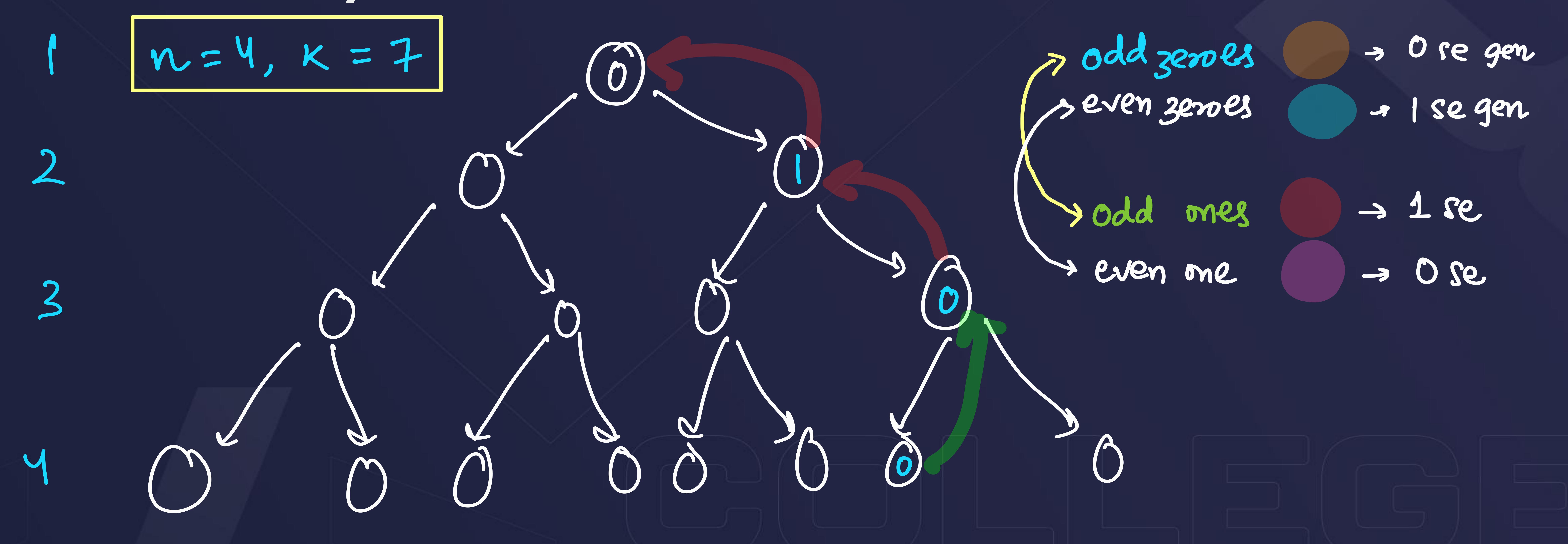
$$n = U, K = $65$$
 $0 \rightarrow 01$ 
 $0 \rightarrow 01$ 
 $0 \rightarrow 01$ 
 $0 \rightarrow 00$ 
 $0 \rightarrow 00$ 

$$kth(n,k) \rightarrow if(k\%2==0) \rightarrow kth(n-1, \frac{k}{2})$$

$$kth(n,k) \rightarrow if(k\%2!=0) \rightarrow kth(n-1, \frac{k}{2}+1)$$

#### Ques: Kth Symbol in Grammar

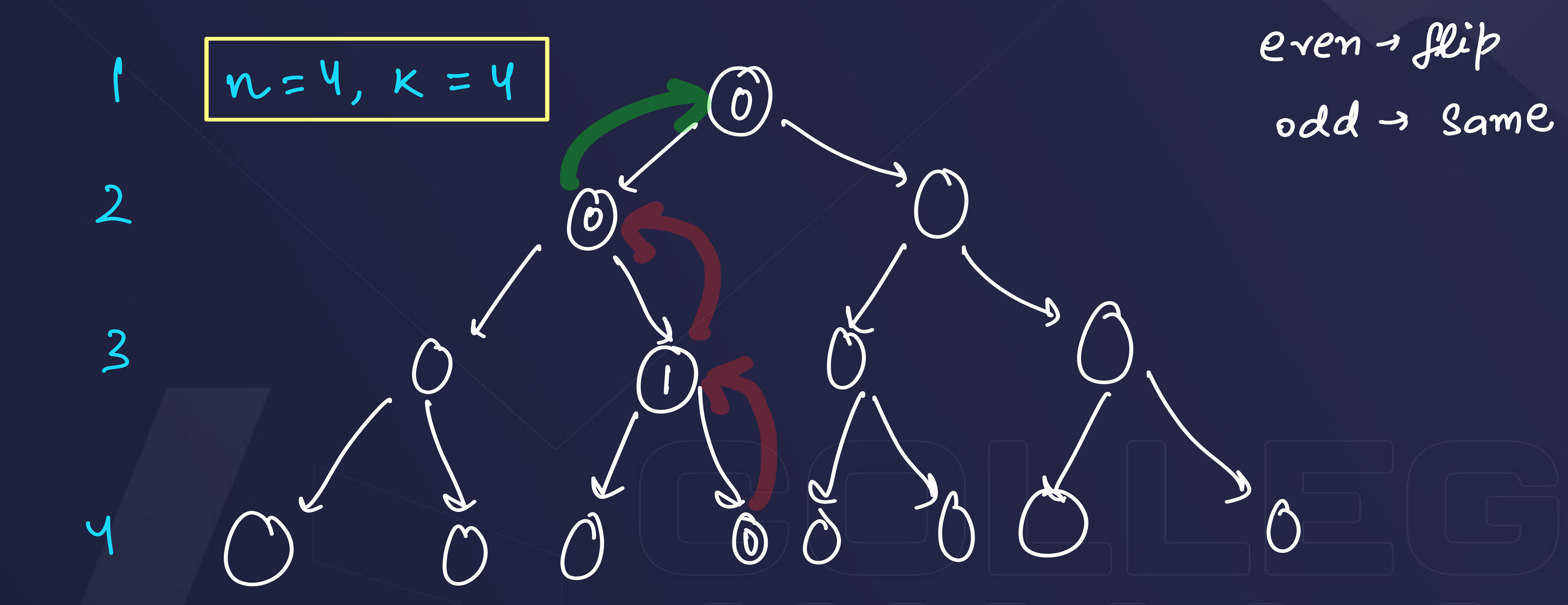
#### [Leetcode - 779]



$$kth(n,k) \rightarrow if(k\%2==0) \rightarrow kth(n-1, \frac{k}{2})$$
  
 $kth(n,k) \rightarrow if(k\%2!=0) \rightarrow kth(n-1, \frac{k}{2}+1)$ 



## Leetcode – 779



#### Ques: Count and Say

#### Leetcode - 38

```
cas(n) = the way you would speak cas(n-1)
                        cas(7) = "13112221
 Cas(1) = "1";
                      cas (8) = "1113213211"
cas(2) = one \rightarrow 
 cas(3) = taoo | = | (2) |
  cas (M) = "1211"
 cas(5) = "111221"
cas(6) = "312211"
```

# "3322251" two 3's, three 2's, one 5, and one 1 2 3 + 3 2 + 1 5 + 1 1 "23321511"

# Ques: Permutation Sequence n=4 -> 4! = 24 permutations () "1234", 4, "", 0, 9

134,3,2,3

-3 14, 23,

$$n=9$$
 $K=18$   $\rightarrow$  fact = $(n-1)!$  =  $3!=6$ 

$$str$$
 n K ans  
 $\rightarrow 1234$  4 18 ""  
 $\rightarrow 124$  3 fact 3  
 $fact = (4-1)! = 6$   
 $idx = \frac{18}{6} - 1 = \frac{2}{2}$ 

2314
2314
2314
2314
2413
2413
2413
2431
24213
$$ib(K\% fact = 0) idx = K/fact;$$
 $ib(K\% fact = 0) idx = K/foot$ 

$$n=4$$
 $K=14$  —  $fact=(m-1)!=3!=6$ 

```
    1234
    3124

    1243
    3142

    1324
    3214

    1342
    3241

    1423
    3412

      1432
     2134
                                    4123
     2143
      2314
```

$$str$$
 n K ans  
 $\rightarrow 1234$  4 17 ""  
 $\rightarrow 124$  3 5 3  
 $fact = 6$   
 $idx = 17 = 2$  K-fact  
 $796 = 5$ 

2314
2314
2314
2314
2317
2413
2413
2431
2431
4213
$$ib(K\% fact = 0) idx = K/fact;$$
 $ib(K\% fact = 0) idx = K/fact;$ 

$$n=4$$
 $K=4$ 
 $fact=(n-1)!=3!=6$ 

```
      1234
      3124

      1243
      3142

      1324
      3214

      1342
      3241

                   3412
    122
   1432
                   3421
   2134
   2143
    2314
                         4213
    2341
    2413
    243
```

$$M = 3$$
 $K = 3$ 
 $123$ 
 $132$ 
 $213$ 
 $231$ 
 $312$ 

fact = 6  

$$idx$$
 = 2 = 0  
 $q = 1$ ;  
 $ib(x\%)$  fact == 0)  $q = fact$   
 $ele(x\%)$  fact == 0)  $q = x\%$  fact





#### Next Lecture

#### Advanced Sorting Algorithms





# THANKYOU