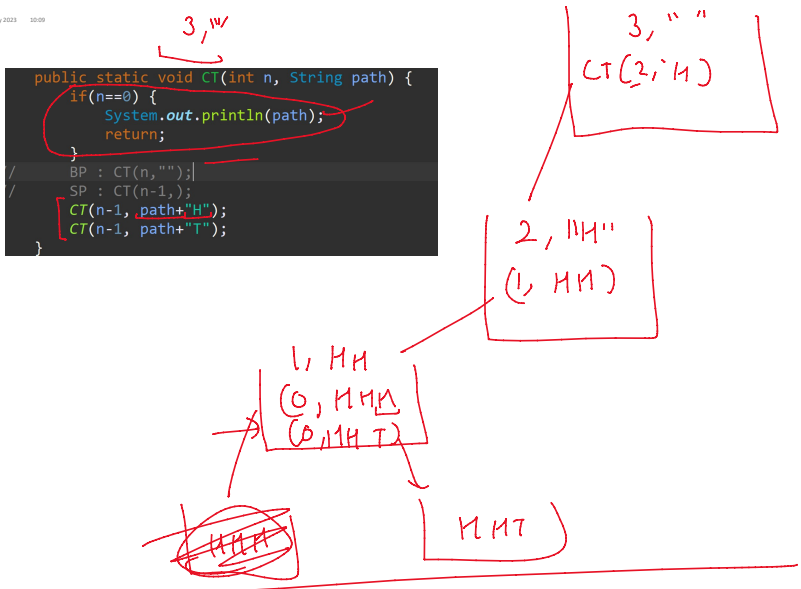
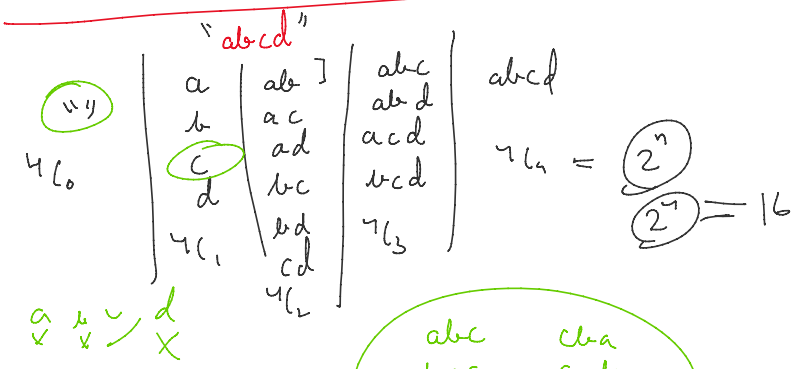
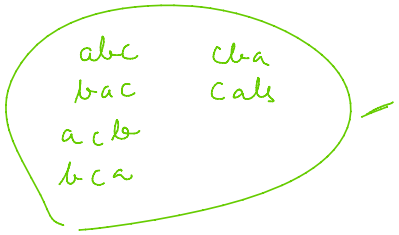
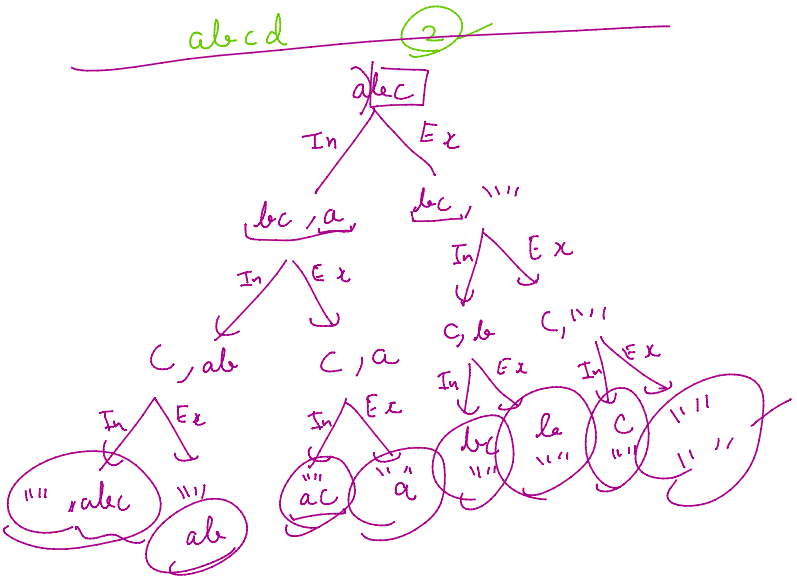
25 May 2023 10:09

```java
public static void CT(int n, String path) {
    if(n==0) {
        System.out.println(path);
        return;
    }
//      BP : CT(n,"");
//      SP : CT(n-1,);
    CT(n-1, path+"H");
    CT(n-1, path+"T");
}
```

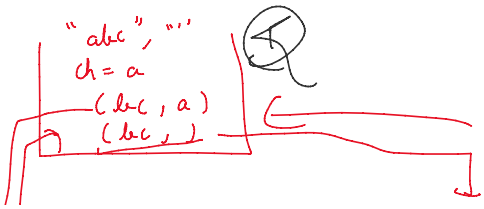




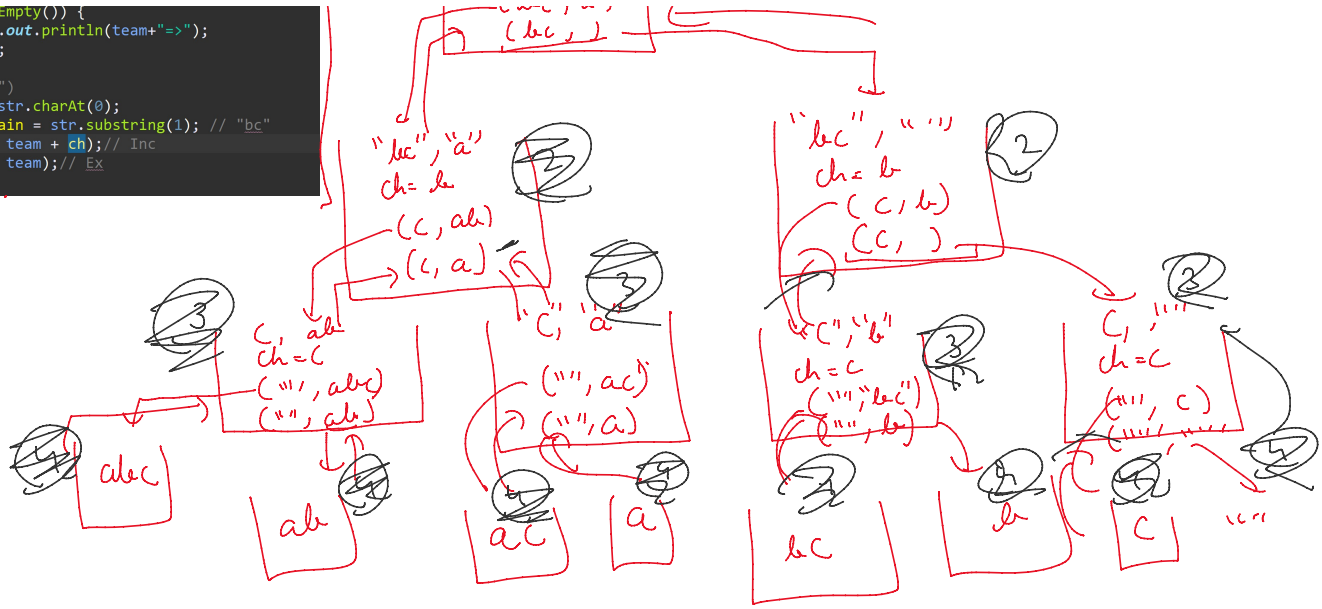


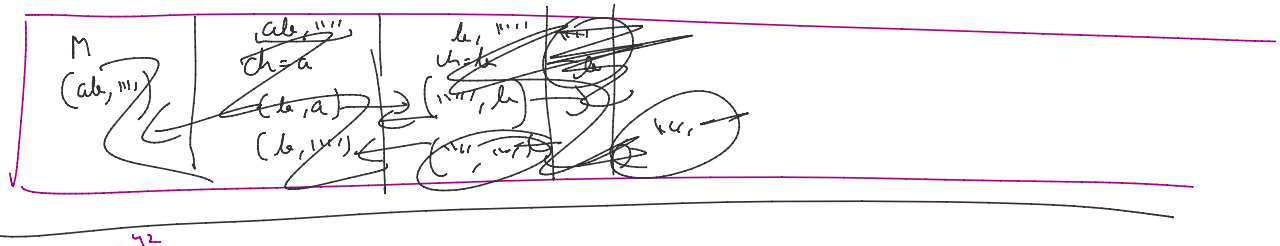



```java
public static void SS(String str, String team) {
    if (str.isEmpty()) {
        System.out.println(team+"=>");
        return;
    }
    SS("abc","")
```

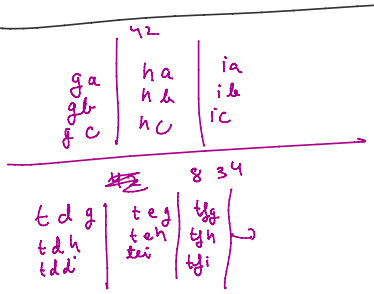


```
    if (str.isEmpty()) {
        System.out.println(team+"=>");
        return;
    }
    SS("abc","")
    char ch = str.charAt(0);
    String remain = str.substring(1); // "bc"
    SS(remain, team + ch);// Inc
    SS(remain, team);// Ex
}
```



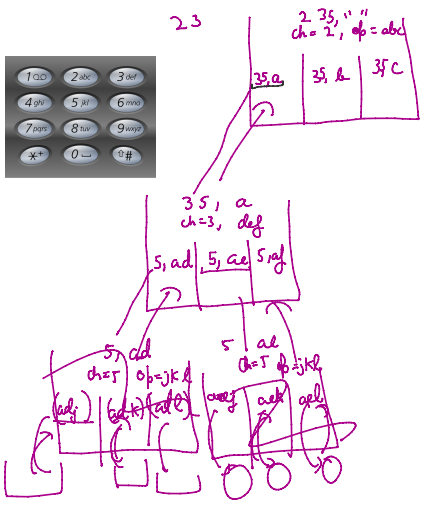


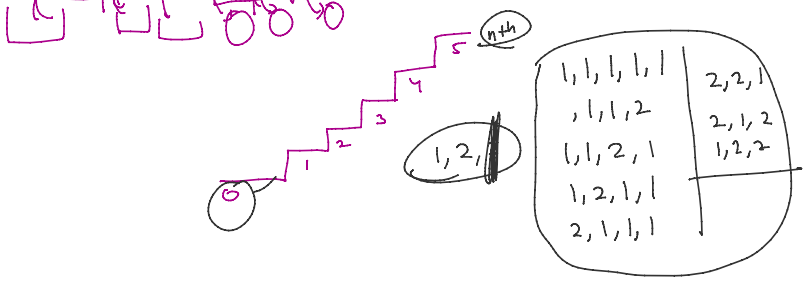
4 → ghi
5 → def
8 → tuv

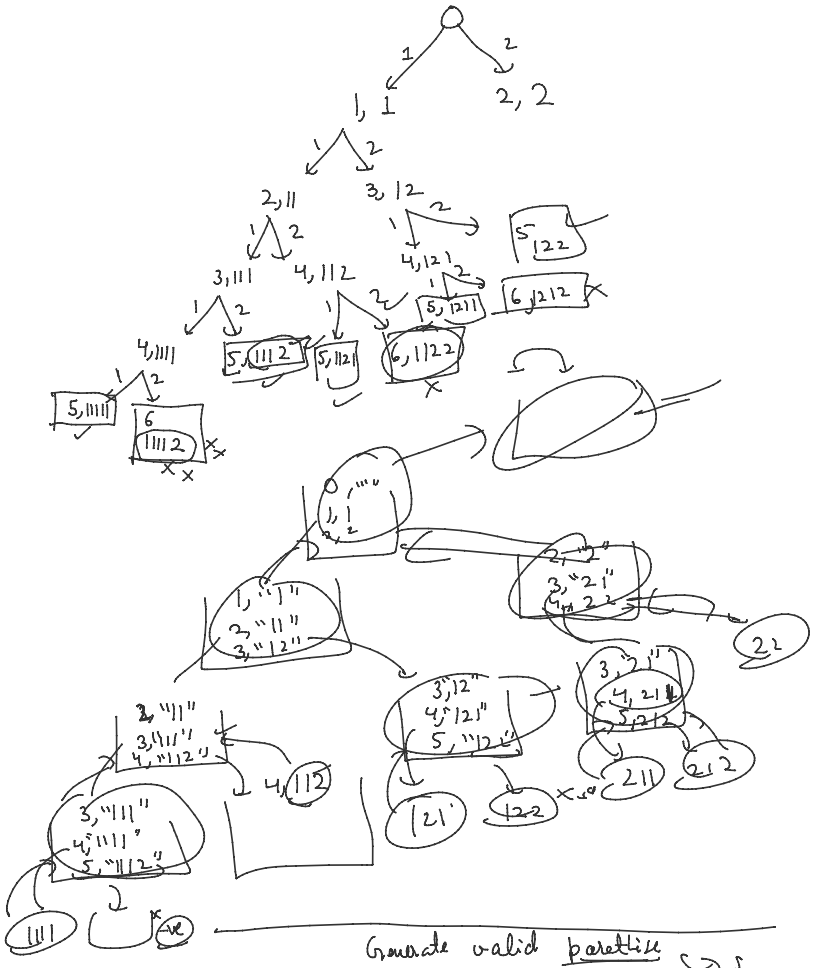



```
public static void LetterKC(String digits, String ans)
    if(digits.isEmpty()) {
        System.out.println(ans);
        return ;
    }
    digits = "352";
    char ch = digits.charAt(0); //'3'
    String remain = digits.substring(1); // "52"
    String options = Options(ch); //def
    for(int idx =0;idx<options.length();idx++) {
        LetterKC(remain, ans+options.charAt(idx));
    }
```

```
        letterRC(remain, ans+options.charAt(idx));
    }
```





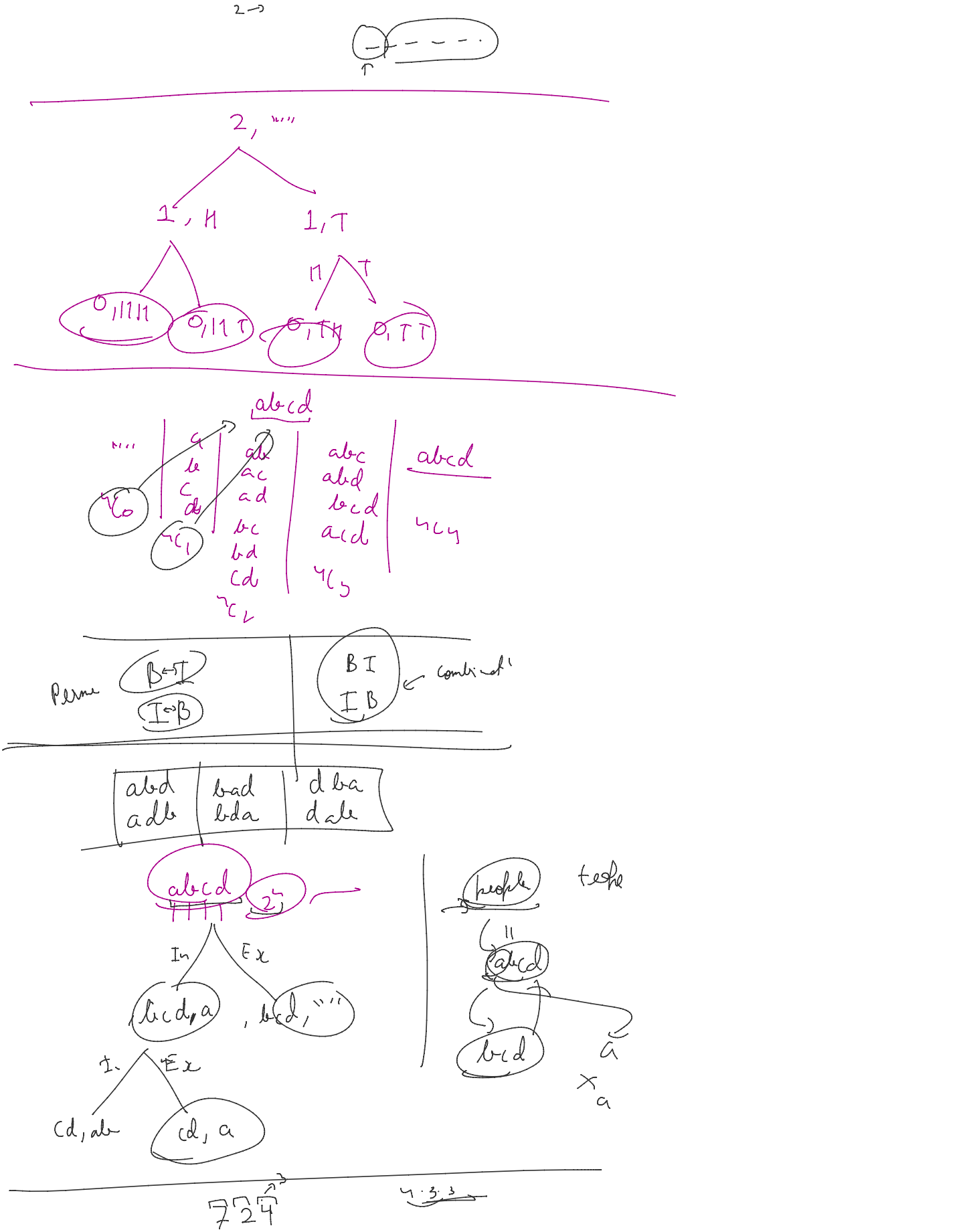


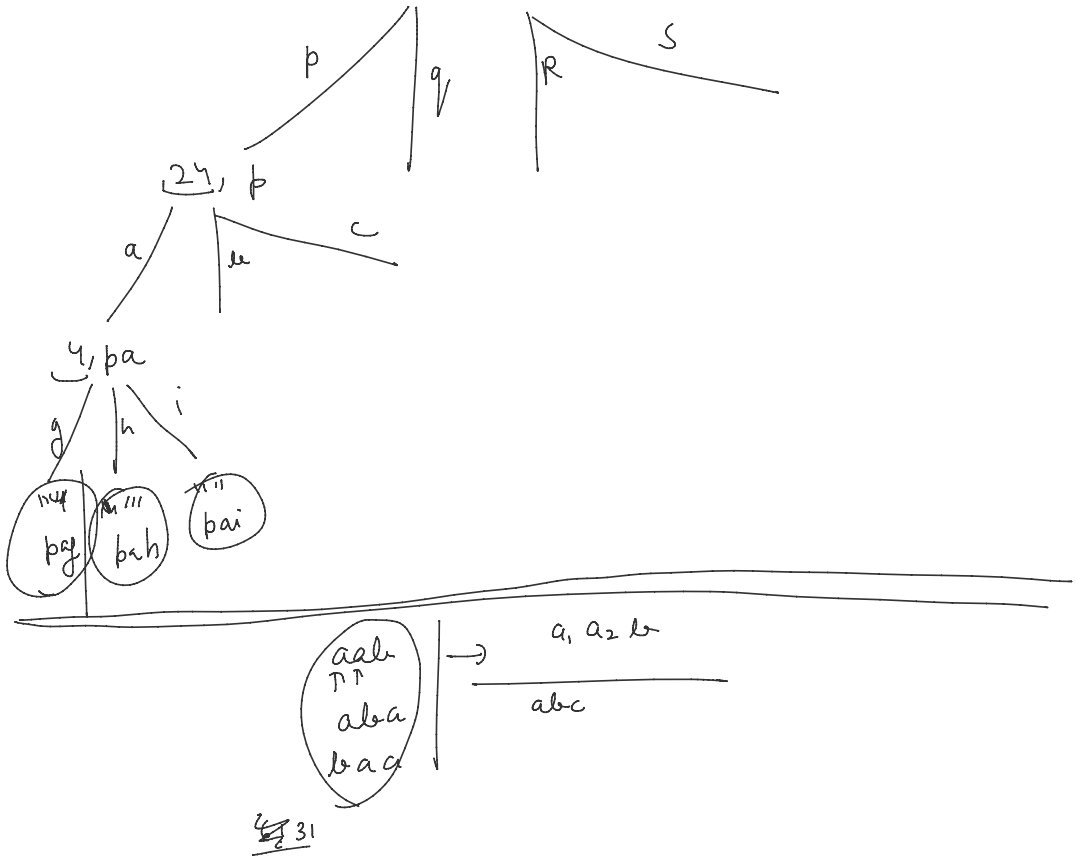
Generate valid parethis

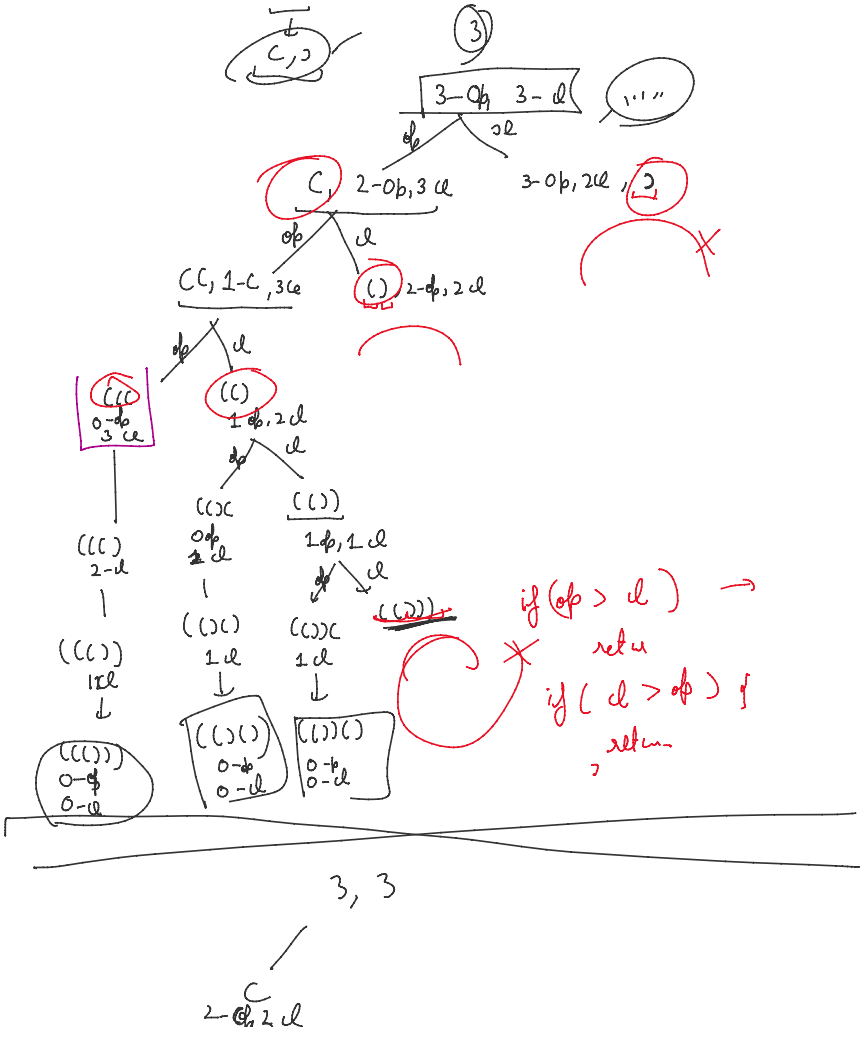
3 → {{{ , 3 → }}}

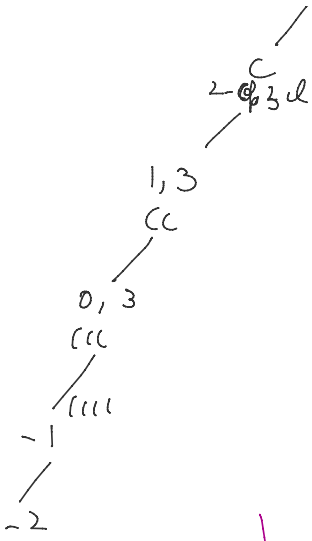
n → 3

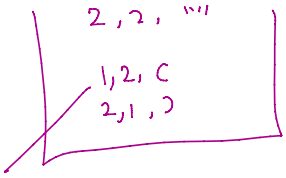
6

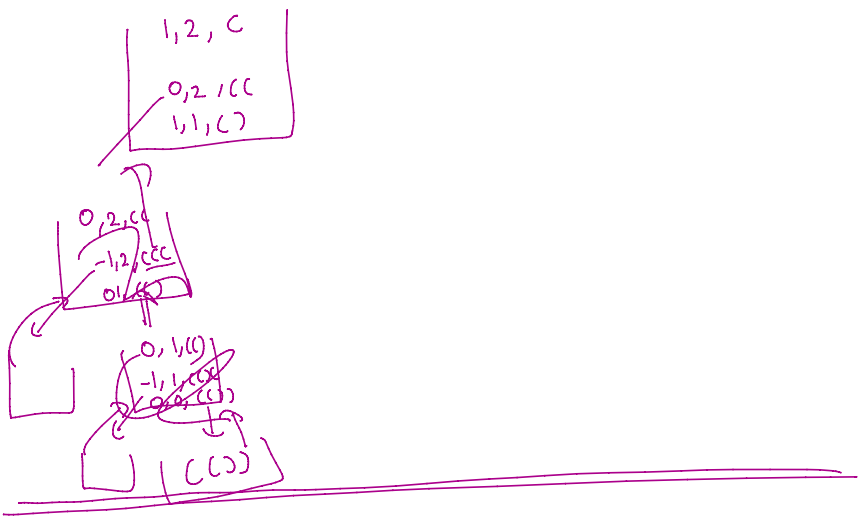

abcd
abc
abd
bcd
acd
ab
ac
ad
bc
bd
cd
abcd
Permu
B I
I B
combinat°
abd
adb
bad
bda
dba
dab
abcd
In
Ex
people
temple
abcd
bcd
a
cd, ab
cd, a


p
q
R
S
a
b
c
g
h
i
pg
pah
pai
aab
aba
baa
a1 a2 b
abc
31

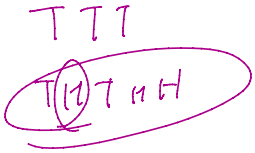

C, 0
3
3-0p 3-cl
2-0p, 3 cl
3-0p, 2cl
CC, 1-C, 3cl
(), 2-0p, 2 cl
CCC
0-0p
3 cl
(()
1 0p, 2 cl
((()
2-cl
(()()
1cl
(())
1 0p, 1 cl
((()))
1cl
(()())
1 cl
((()))
0-0p
0-cl
(()())
0-0p
0-cl
(())()
0-0p
0-cl
if (op > cl) →
retu
if (cl > op) {
retur
3, 3
C
2-0p, 2 cl

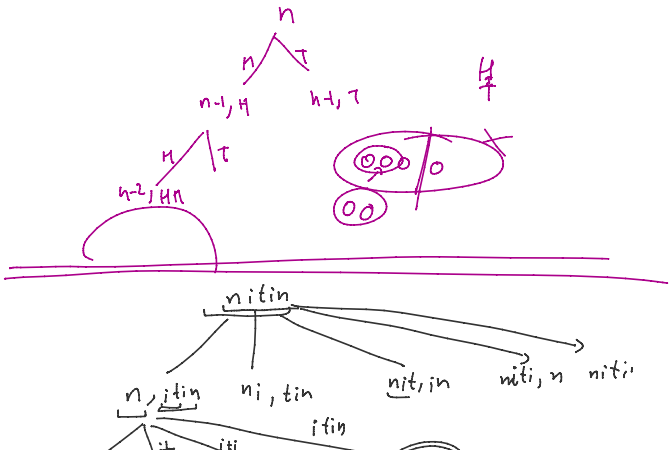


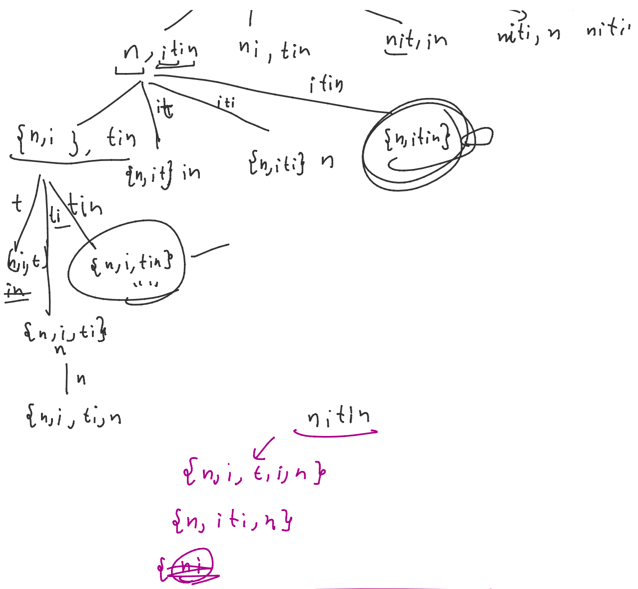


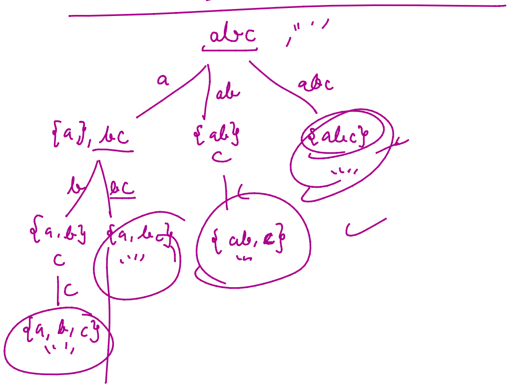


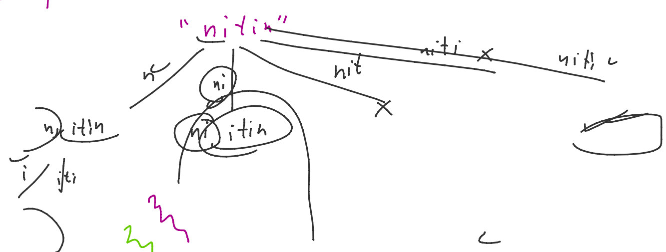
N = 3
~~THH~~
~~HHT~~
HTH
HTT
~~THH~~
THT
TTH
TTT

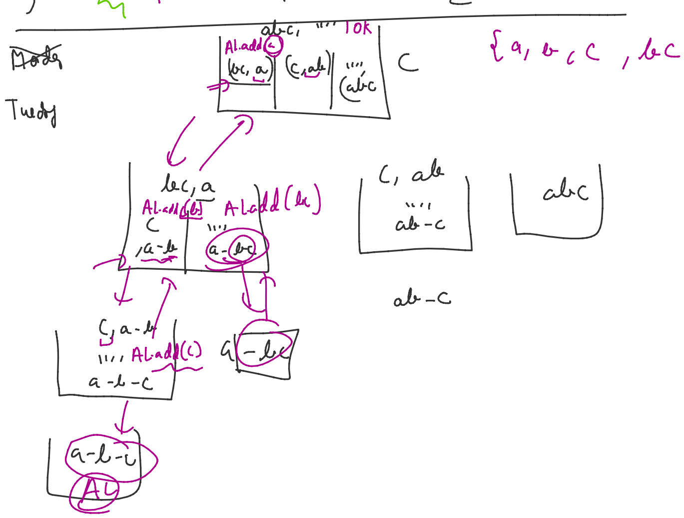


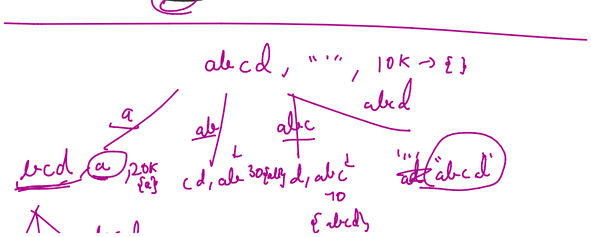


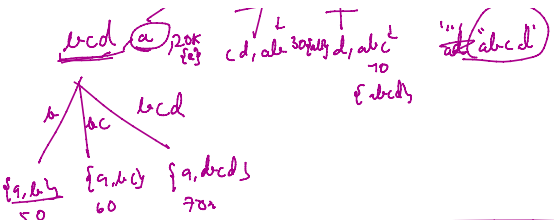

n, itin
ni, tin
nit, in
niti, n
{n, i, t, i, n}
{n, iti, n}


abc
{a}, bc
{ab}
{abc}
{a, b}
{a, bc}
{ab, c}
{a, b, c}

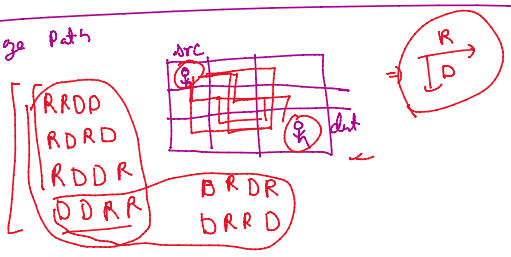

"nitin"

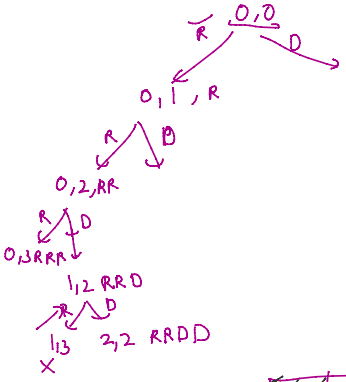

abc, "", 10K
bc, a
c, ab
abc
a-b-c
AL

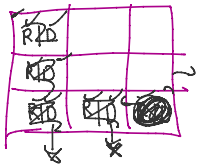

abcd, "", 10K → { }
abcd



Maze Path







RR D D

RDRD

RDDR

DRRD

DRDR

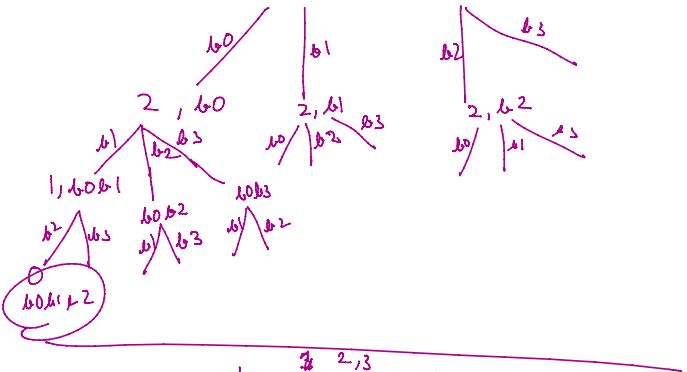
DDRR

Permutation

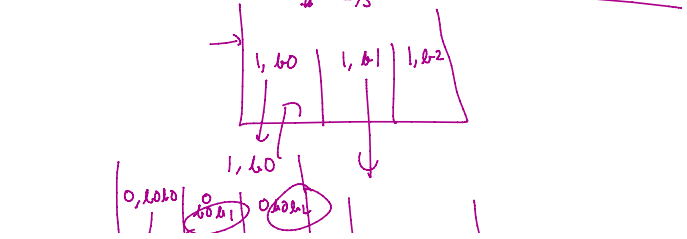
3 boxes out of 4 such that arrangement matter.

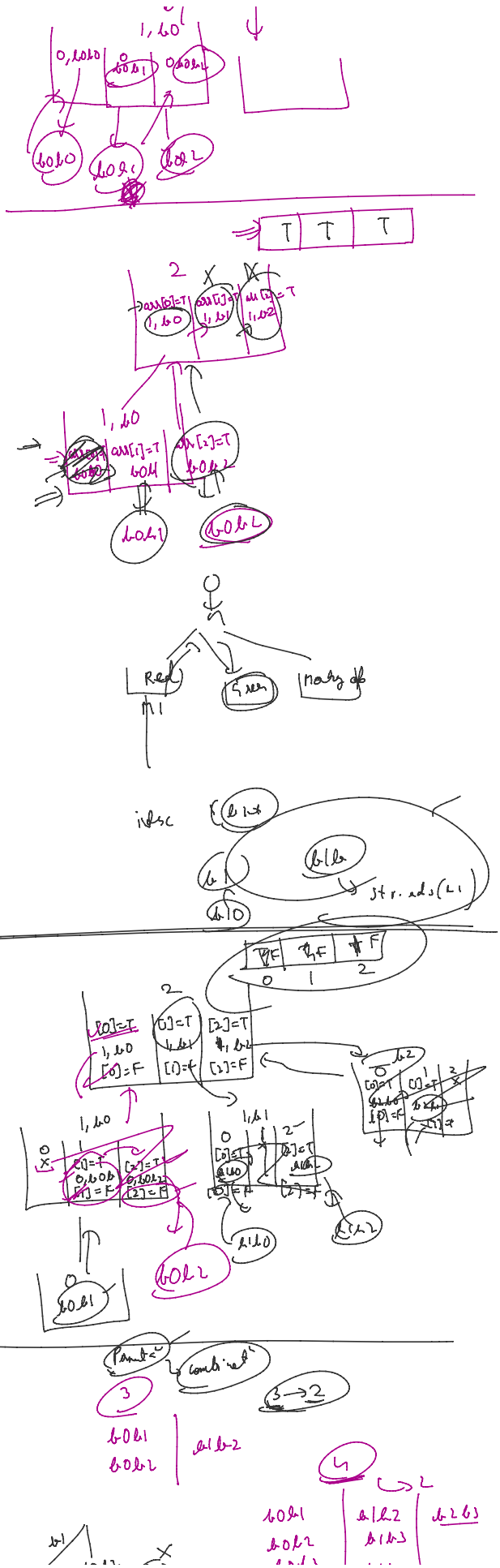
b0 b1	b1 b0	b3 b0
b0 b2	b1 b2	b3 b1
b0 b3	b1 b3	b3 b2

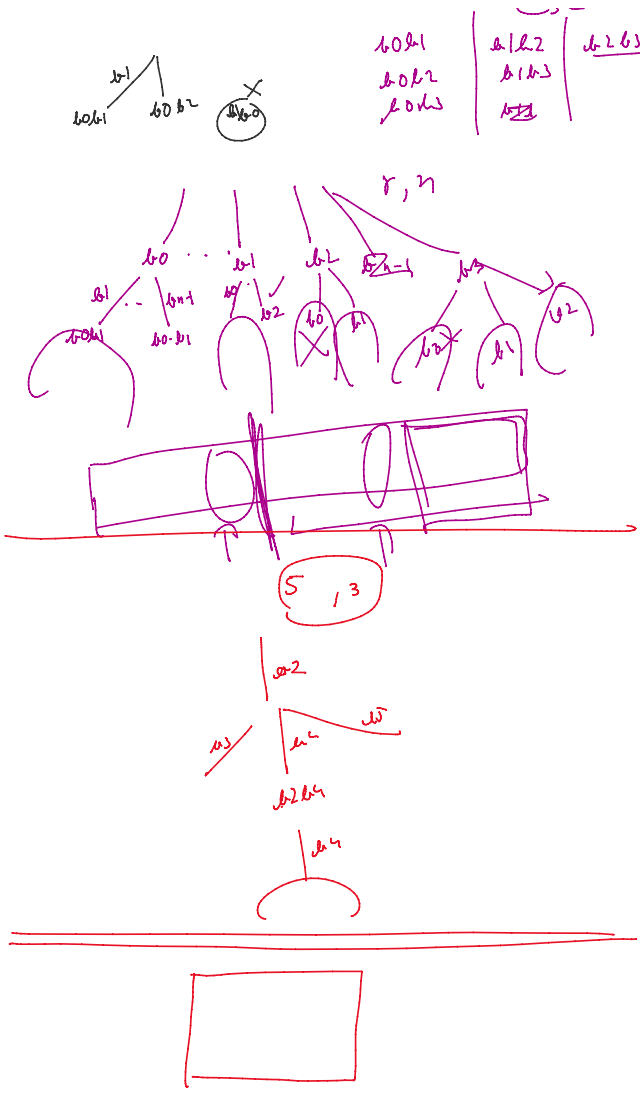
3



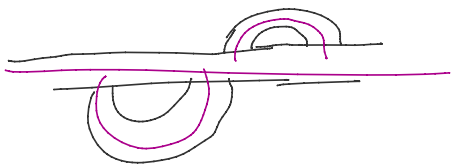
3 2,3



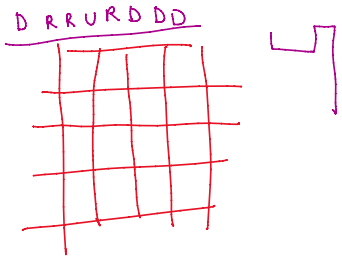


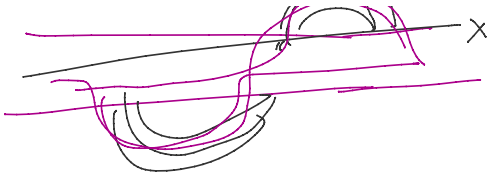


- {{0,1,0,0},
- {0,0,0,0},
- {0,1,0,0}
- {0,0,1,0}}



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





$f(b) = f(b-1) + 1$ Recurrence relationship

$f(b-1) = f(b-2) + 1$

$f(b-2) = f(b-3) + 1$

$\vdots$

$b(b-(b-1)) = f(0) + 1$

$f(b) = 1+1+1+1+1+\cdots = b$ (b terms)

$f(n) = f(n-1) + f(n-2) + 1$

$f(n)$ → Fac(n)

$f(n-2)$ ↑ V1

$f(n-1) + f(n-1) + 1 \geq f(n)$ ↑1

$2f(n-1) + 1 \geq f(n) \geq 2f(n-2) + 1$

$f(n) = 2f(n-1) + 1$

$+$

$2 \cdot f(n-1) = 2^2 f(n-2) + 1 \cdot 2$

$2^2 f(n-2) = 2^3 f(n-3) + 1 \cdot 2^2$

$2^3 f(n-3) = 2^4 f(n-4) + 1$

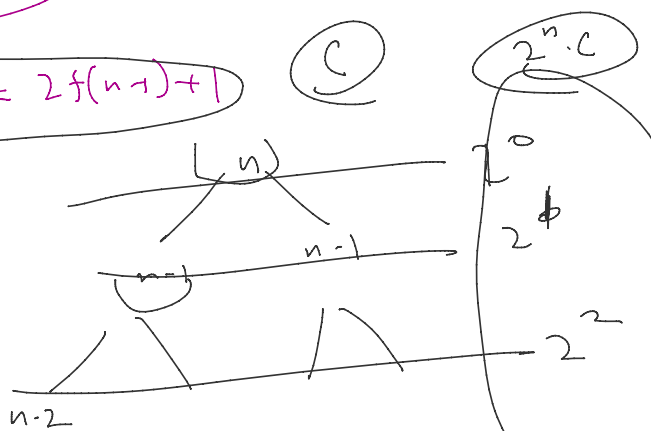
$2^{n-1} f(n-(n-1)) = 2^n f(0) + 1 \cdot 2^{n-1}$

$f(1)$

$f(n) = 1 + 2 + 2^2 + 2^3 + \cdots + 2^{n-1}$

$f(n) = 2^n$

$f(n) = 2f(n-1) + 1$



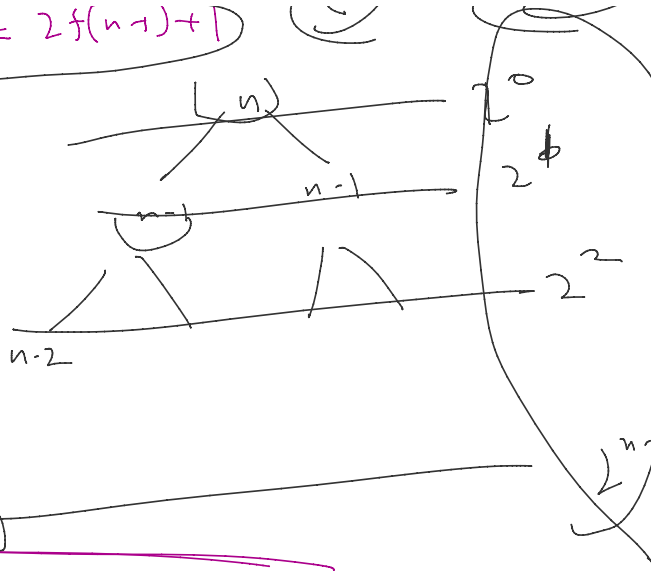
$2^2 f(n-2) = 2 \cdot f(n-3) + 1 \cdot 2$

$2^3 f(n-3) = 2^4 \cdot f(n-4) + 1$

$2^{n-1} f(n-(n-1)) = 2^n \cdot f(0) + 1 \cdot 2^{n-1}$

$f(1)$

$f(n) = 2f(n-1) + 1$



$f(n) = 2 \cdot f(n-1) + 2n$

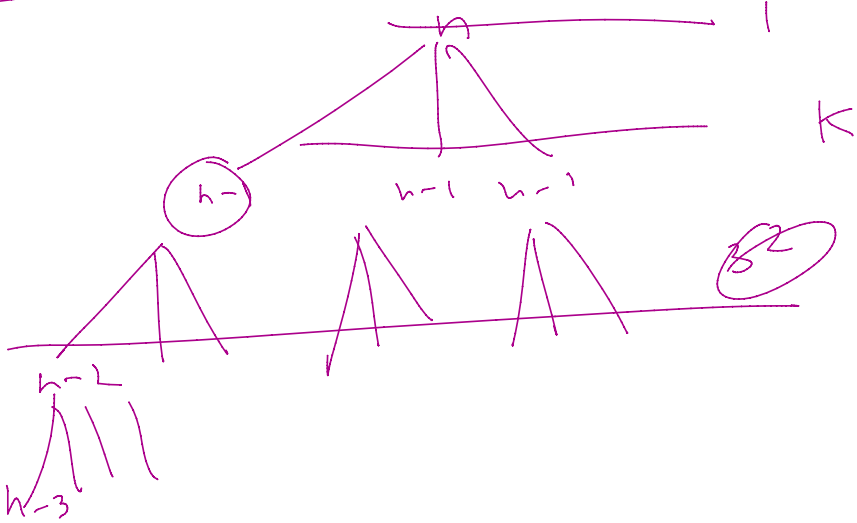
$f(n-1) = 2 \cdot f(n-2) + 2n$

$f(n-2) = 2f(n-3) + 2n$

1
2
3
n

n/4

$2n(2^n) = n2^n$



$n-(n-1)$ k^{n-1}

$k^0 + k^1 + k^2 + k^3 + \dots k^{n-1} = k^n$

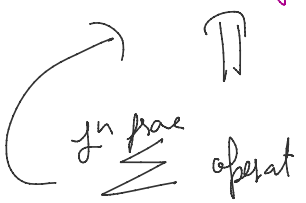
$n + kn \approx kn$

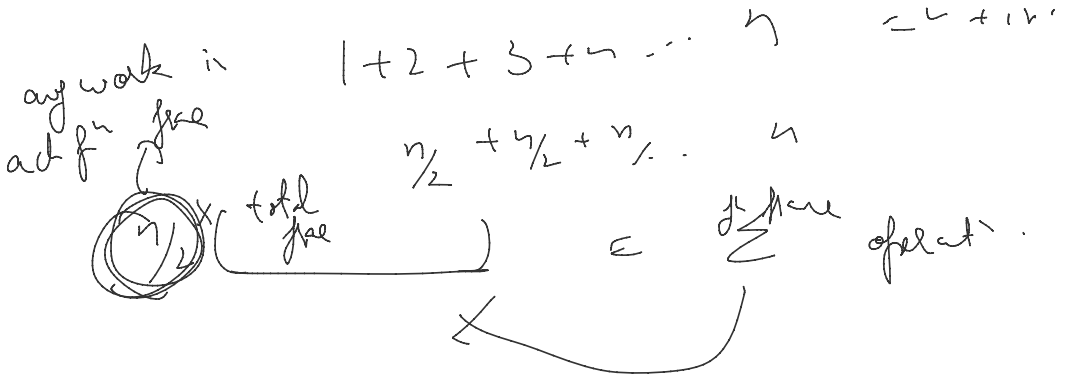
$k^n \cdot k \cdot n = k^{n+1} \cdot n \Rightarrow O(k^n \cdot n)$

$4^{10} \cdot 10$ $n=10$

$2^{20} \cdot 10 \Rightarrow = 10^6 \mid 10^7$

Shortcut → count no. of f^n frame × work in each f^n frame





$f(n) = n + kf(n-1) + k \cdot n$

$f(n) = kf(n-1) + kn$

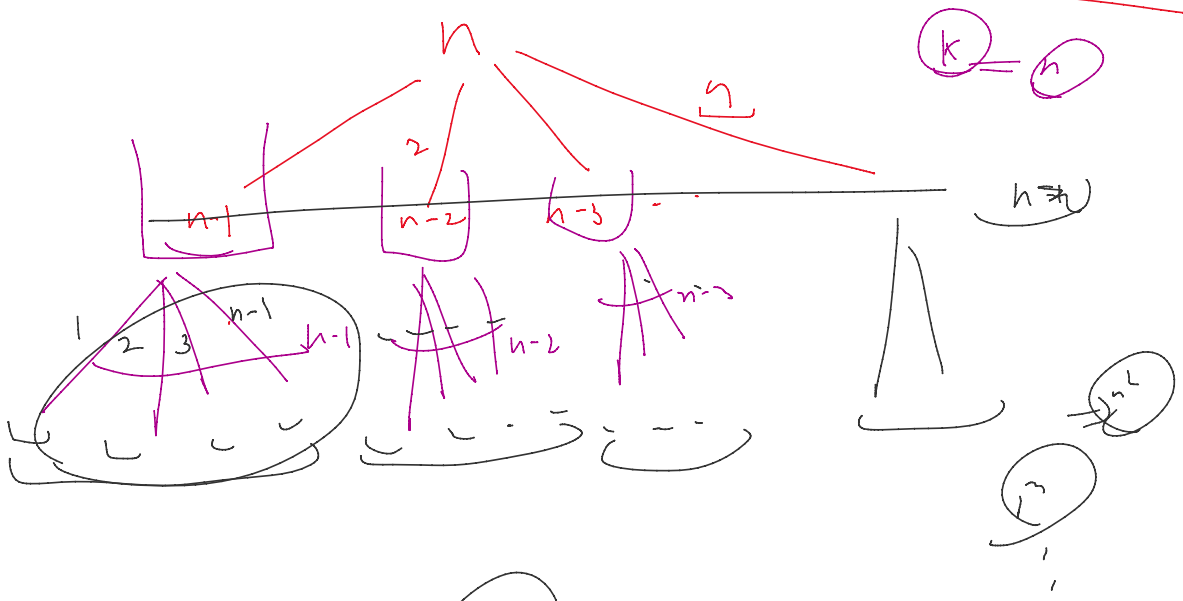
$kf(n-1) = kf(n-2) + k \cdot n \cdot k$

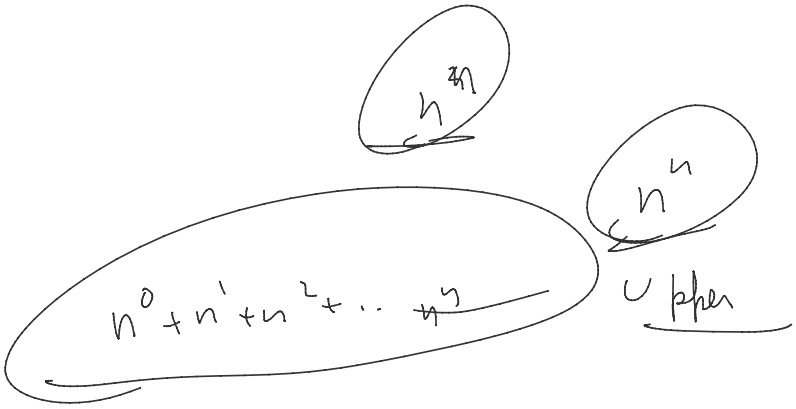
k^2

$k(1 + k + k^2 + \dots k^{n-1})$

$k(1+k+k^2+\cdots k^{n-1})$

$k^n \cdot k^y = k^{n \cdot y}$ ⟸ O

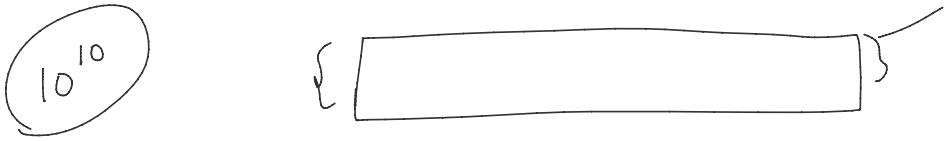




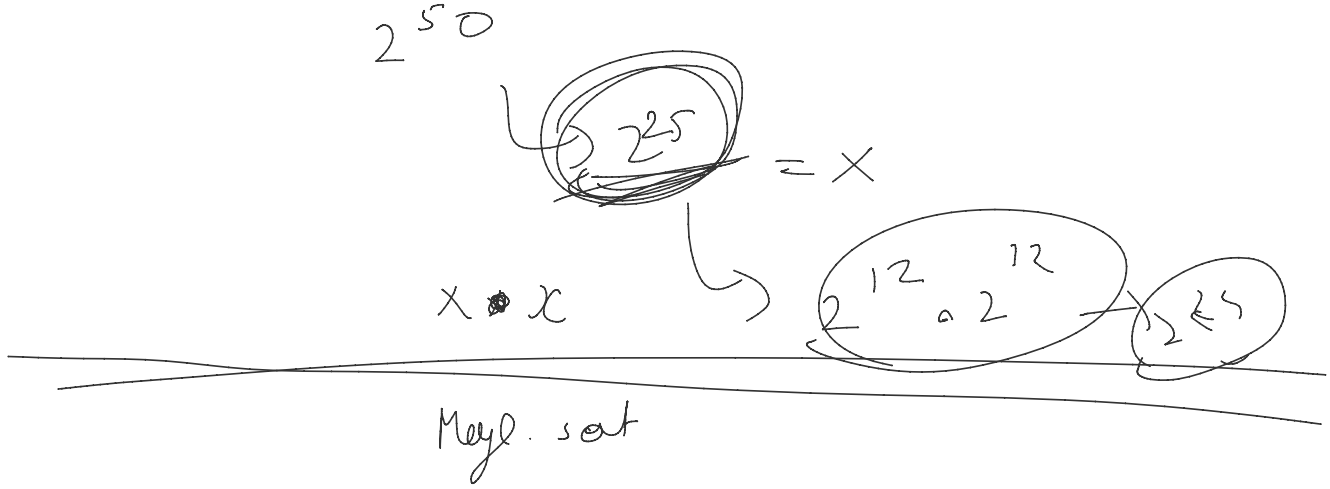
$f(n) = f(n-1) + f(n-2) + f(n-3) + \cdots f(0) + 1$

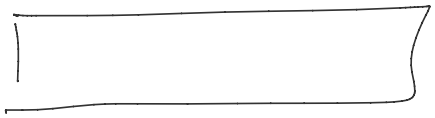
$f(n-1) = f(n-2) + f(n-3) \cdots f(0) + 1$

$f(n) = 2f(n-1) + 1$ $\quad 2^n$ ✓



$a^b \rightarrow O(\log n)$

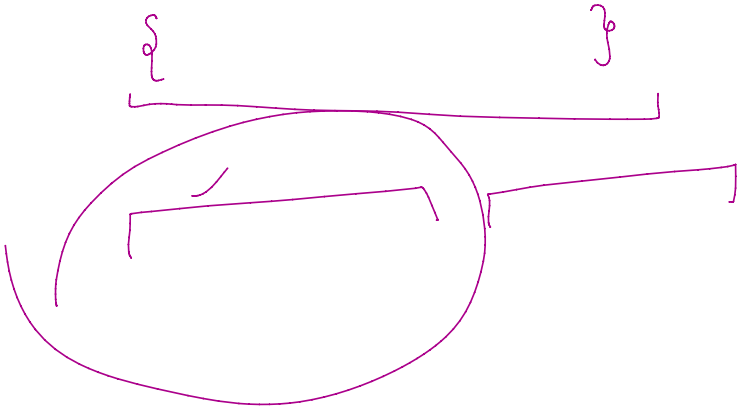




{5, 10, 15, 20}

{7, 12, 14, ...

{5 7, 10 12, 14, 15, 20, ...



{ 50, 40, 30, 20, 10 }

11.

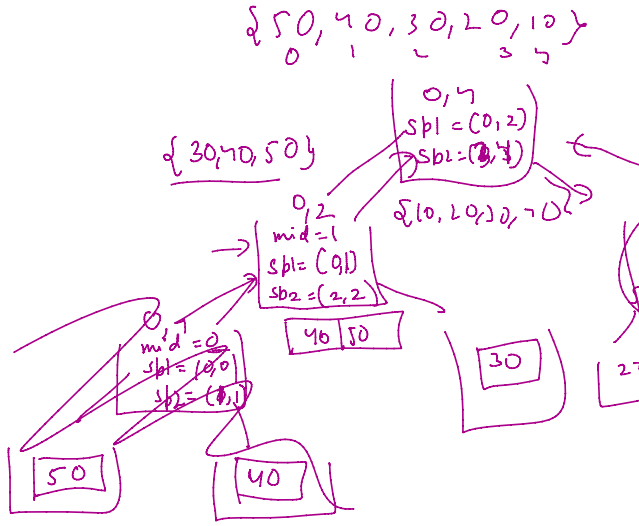
40

{50, 40, 30, 20, 10}

80,607

150,60

```java
public static int[] soort(int[] arr, int s, int e) {
    if(s==e) {
        int[] ans = new int[1];
        ans[0] = arr[s];
        return ans;
    }
    int mid = (s + e) / 2;
    int[] sp1 = soort(arr, s, mid);
    int[] sp2 = soort(arr, mid + 1, e);
    return merge(sp1, sp2);
}
```



Space.

Q1 → O(n) extra 2 arrays

out place

Time complexity

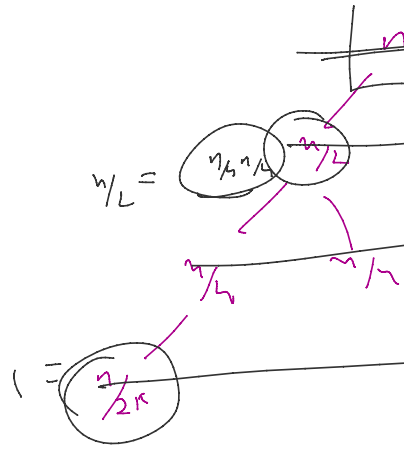
$f(n) = 2f(n/2) + n$

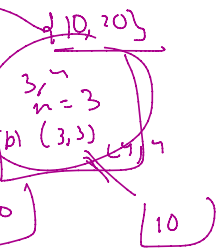
$2 \cdot f(n/2) = 2^2 \cdot f(n/2^2) + n/2$

$2^2 \cdot f(n/2^2) = 2^3 \cdot f(n/2^3) + \dots$

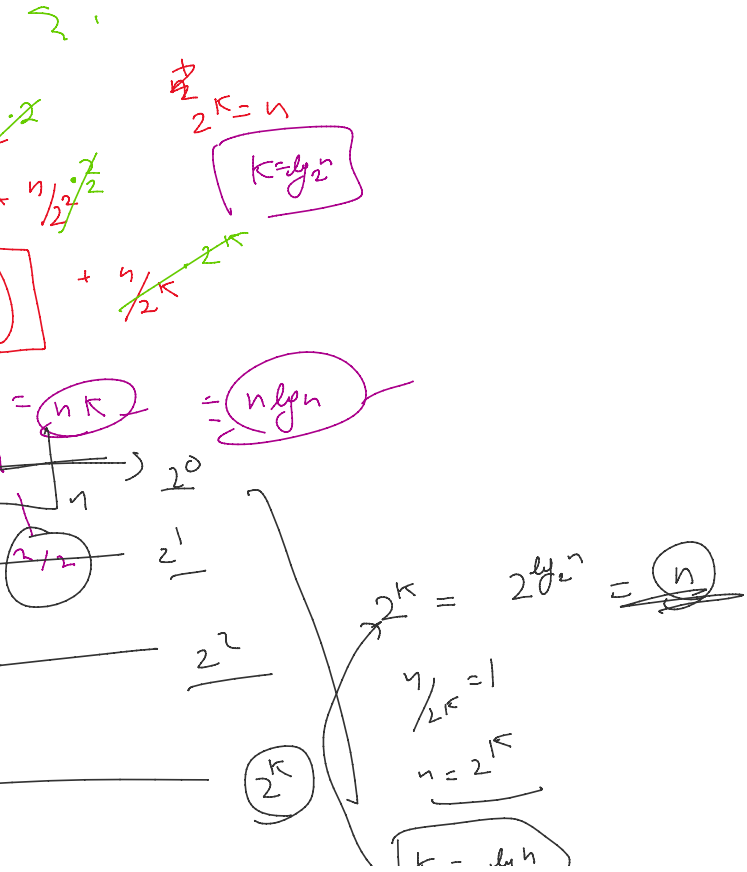
$2^K \cdot f(n/2^K) = 2 \cdot f(n/2^{K+1})$

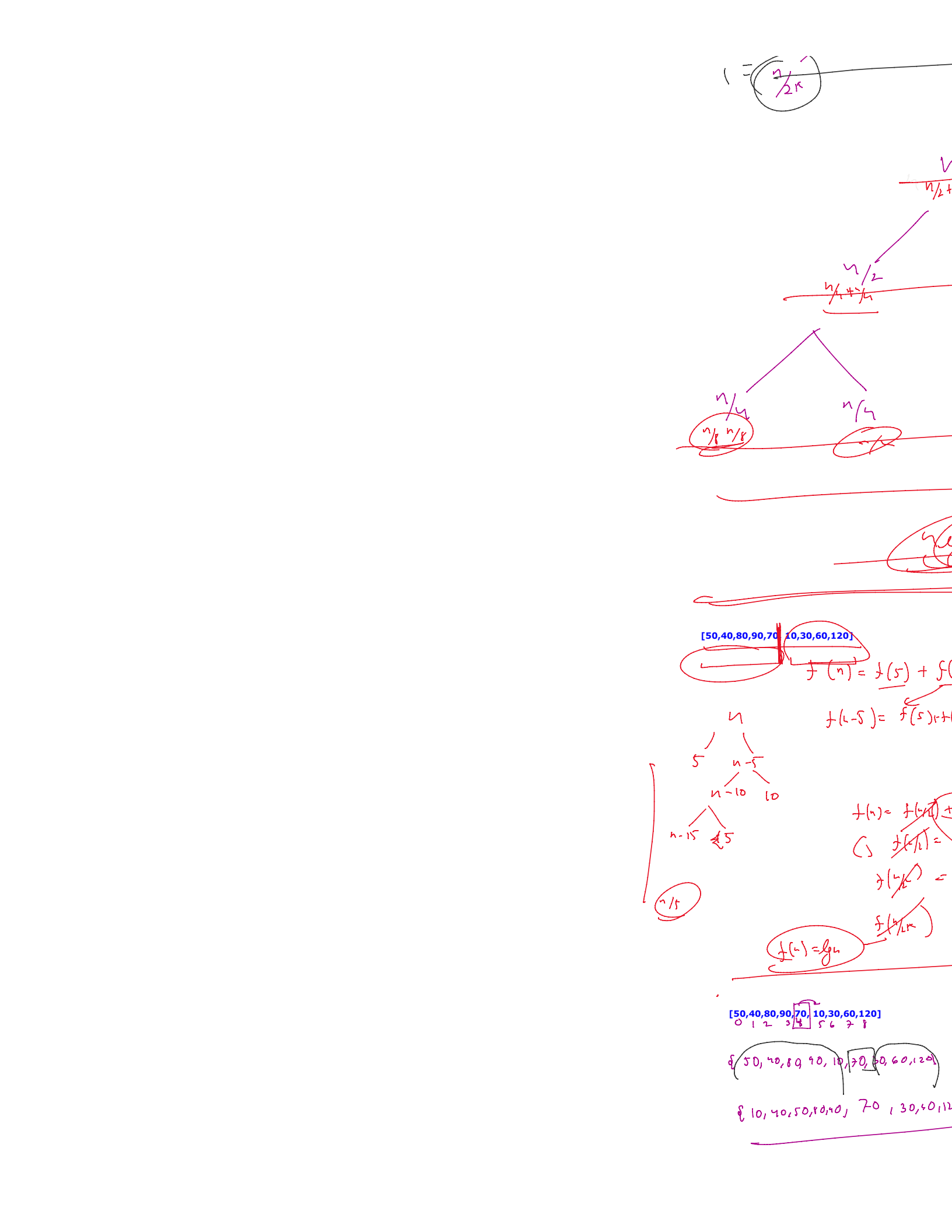
$f(n) = n + n + n + n + \dots$

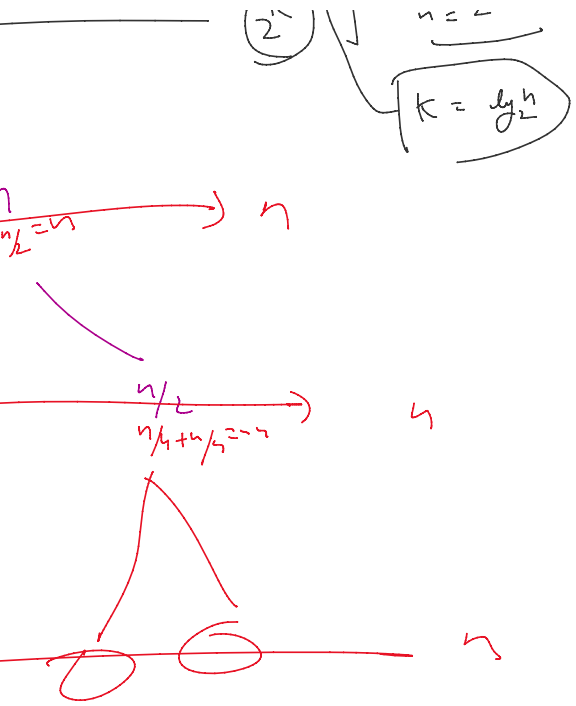


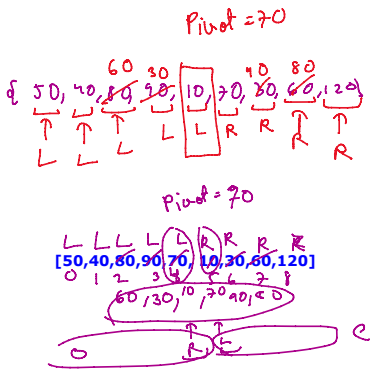


Q2) Can you merge 2 sorted arrs without extra space




[50,40,80,90,70,10,30,60,120]
[50,40,80,90,70,10,30,60,120]
0 1 2 3 4 5 6 7 8




Pivot = 70
[50,40,80,90,70,10,30,60,120]
0 1 2 3 4 5 6 7 8