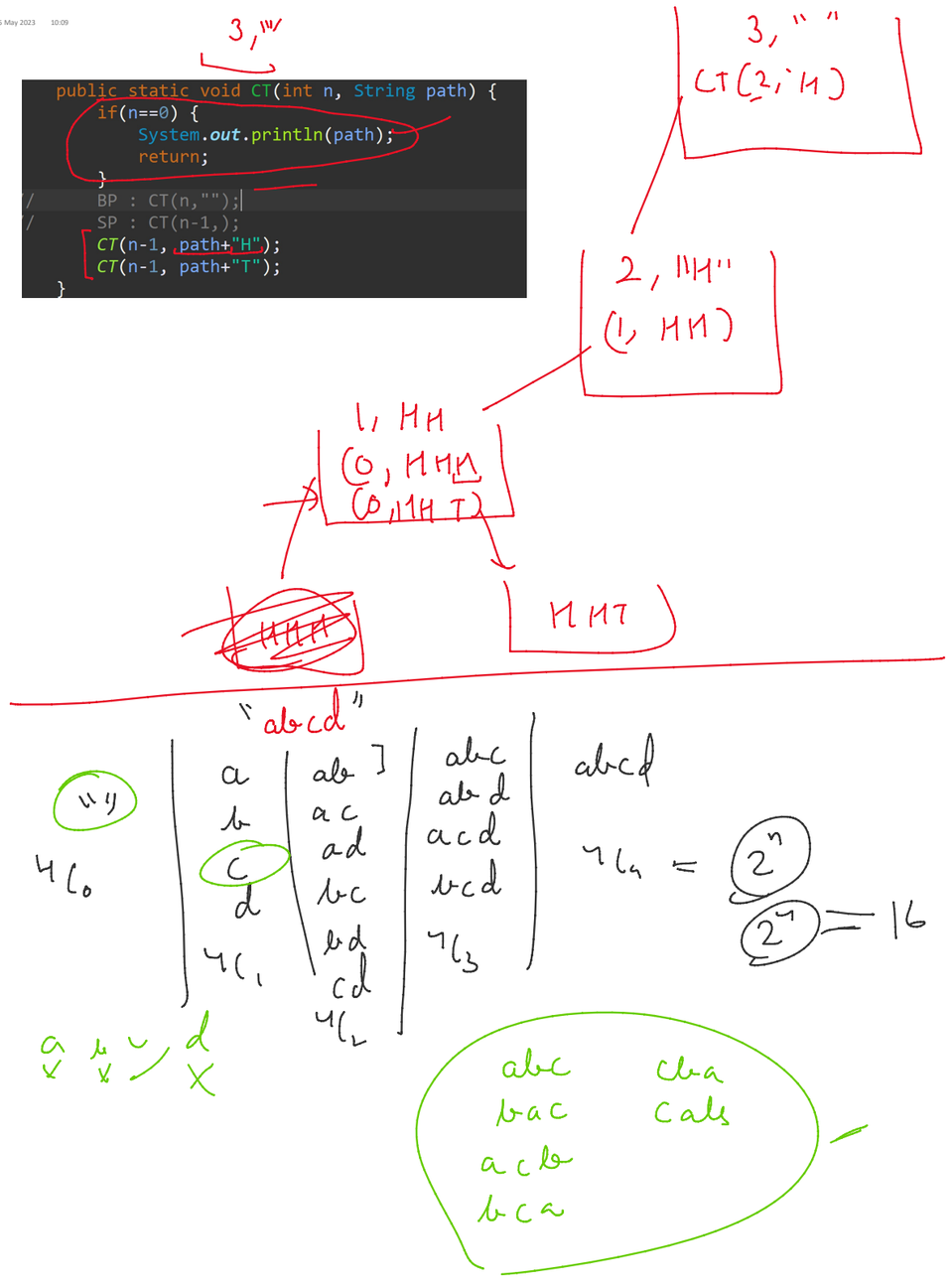
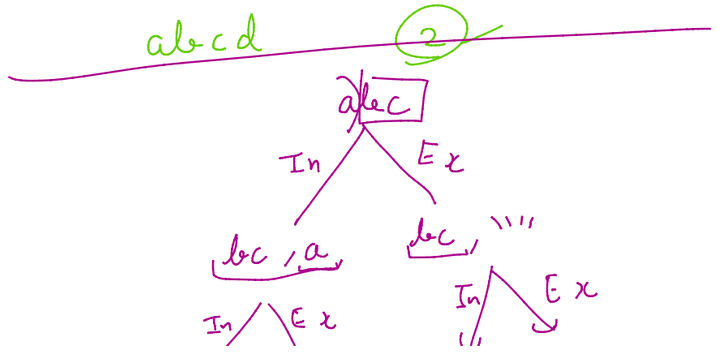
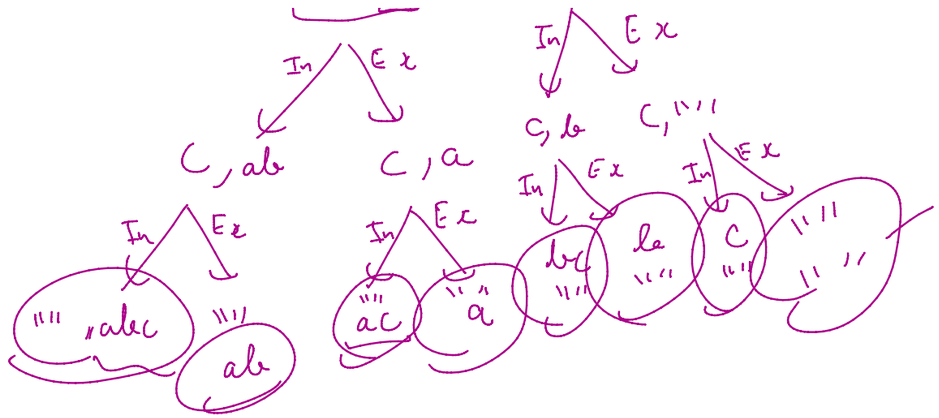
25 May 2023 10:09

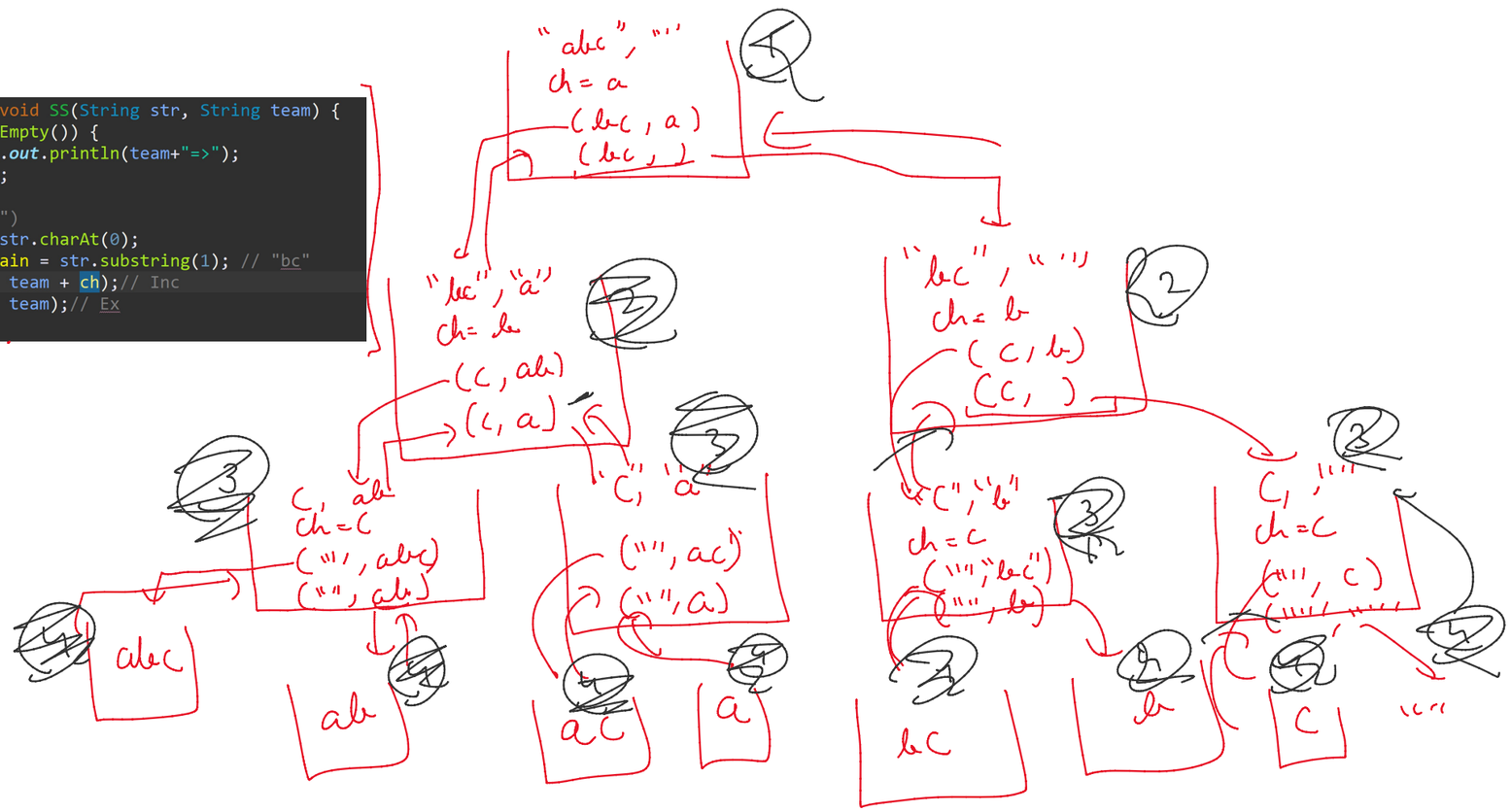
```java
public static void CT(int n, String path) {
    if(n==0) {
        System.out.println(path);
        return;
    }
//  BP : CT(n,"");
//  SP : CT(n-1,);
    CT(n-1, path+"H");
    CT(n-1, path+"T");
}
```

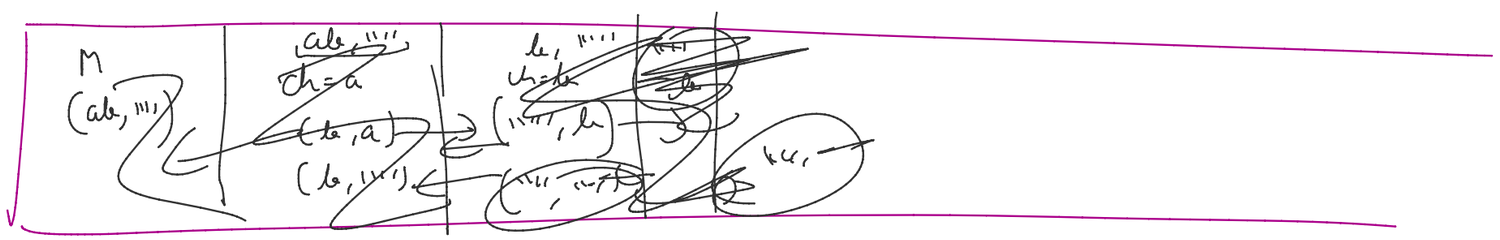




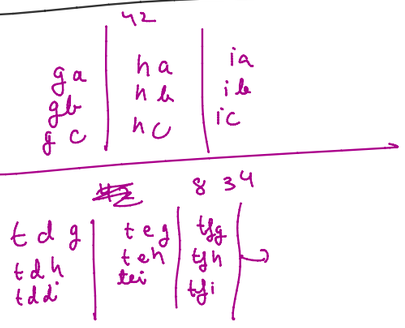



```java
public static void SS(String str, String team) {
    if (str.isEmpty()) {
        System.out.println(team+"=>");
        return;
    }
    SS("abc","")
    char ch = str.charAt(0);
    String remain = str.substring(1); // "bc"
    SS(remain, team + ch);// Inc
    SS(remain, team);// Ex
}
```

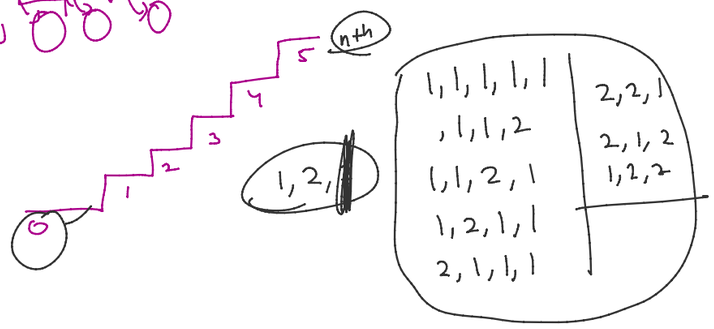


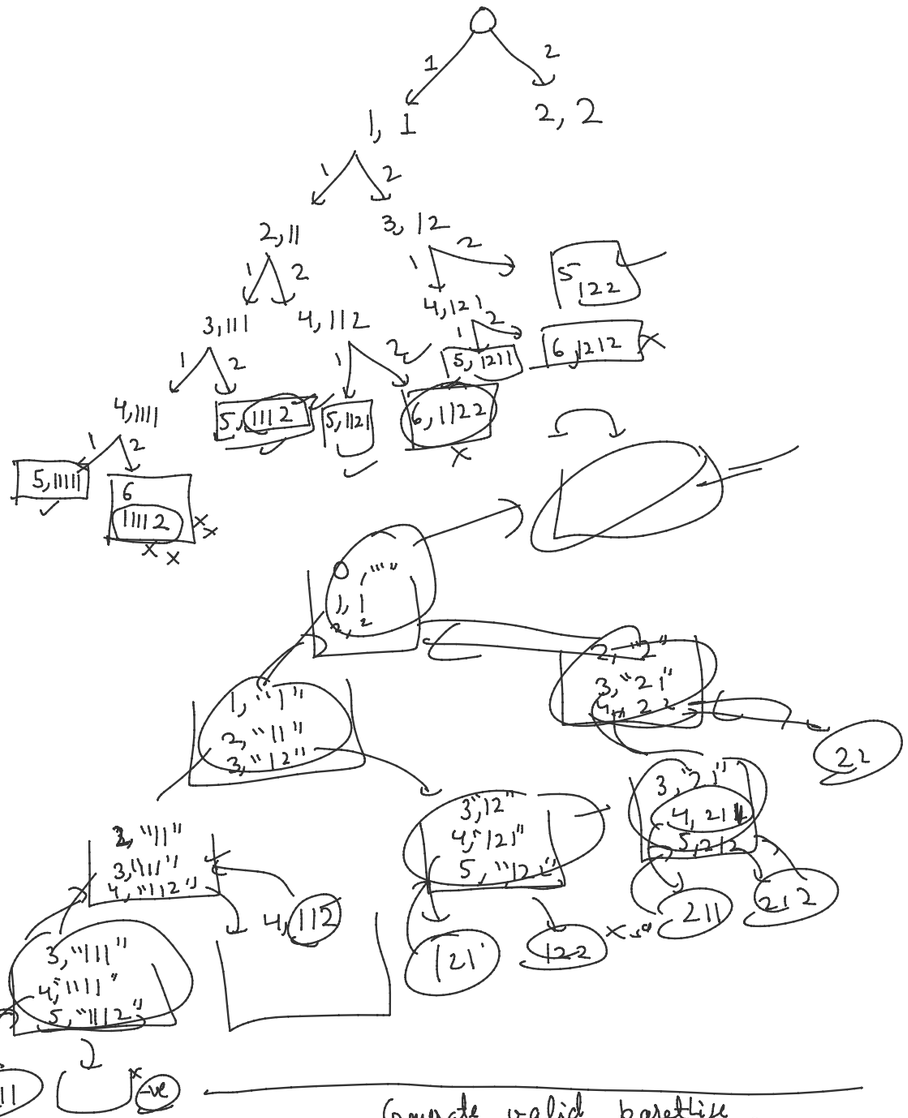


4 → ghi
3 → def
8 → tuv




```
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));
    }
```





Generate valid parethesis

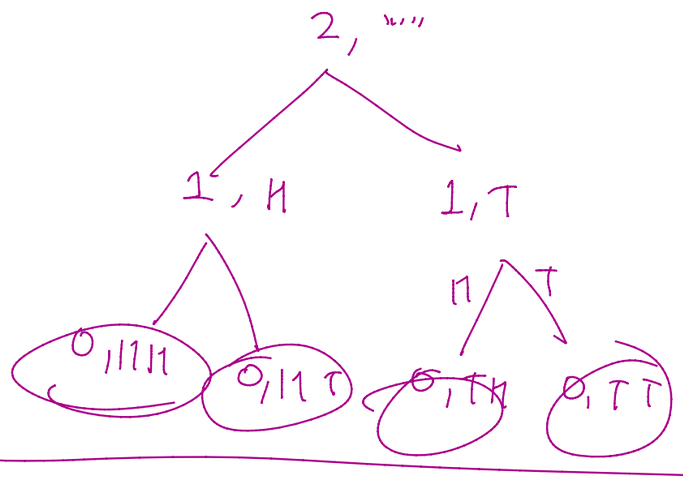
3 → { { { , 3 → } } }

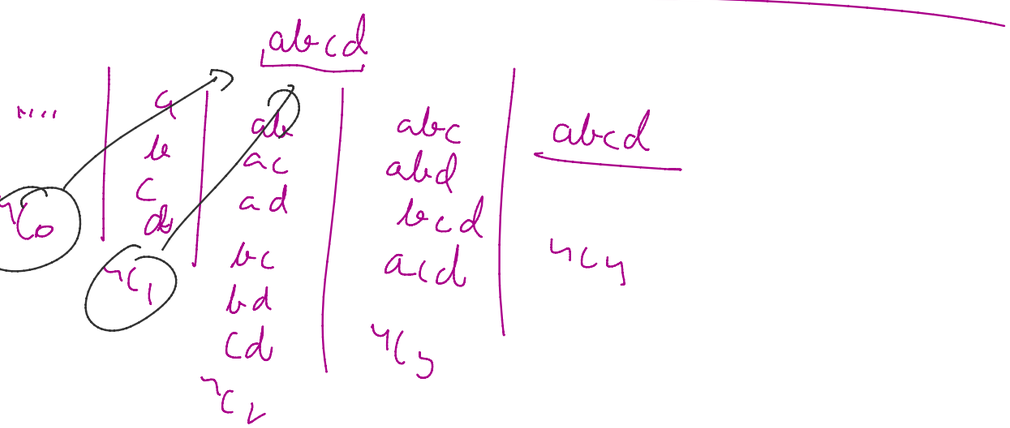
3 → {{{ , 3 → }}}

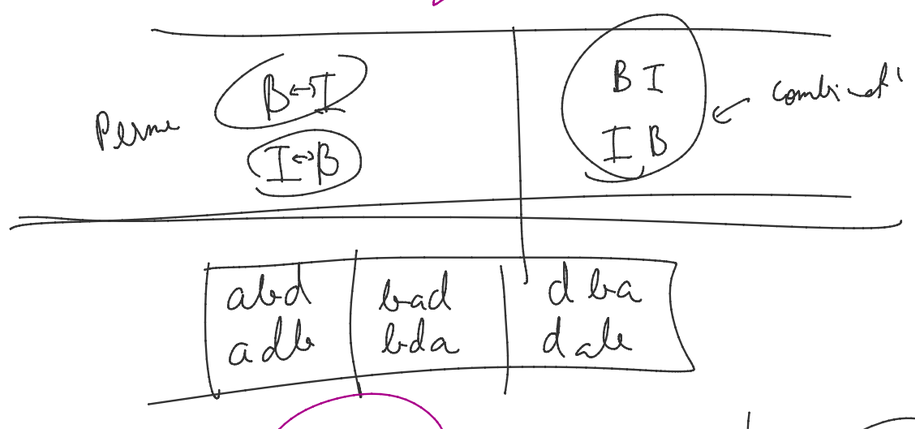
n → 3

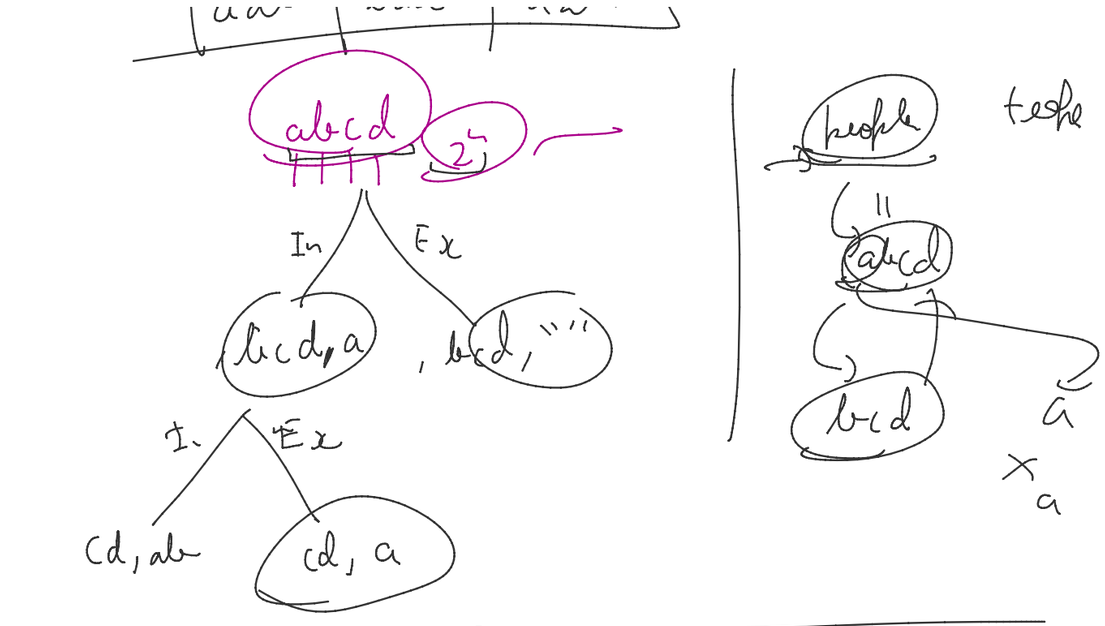
6

2 →

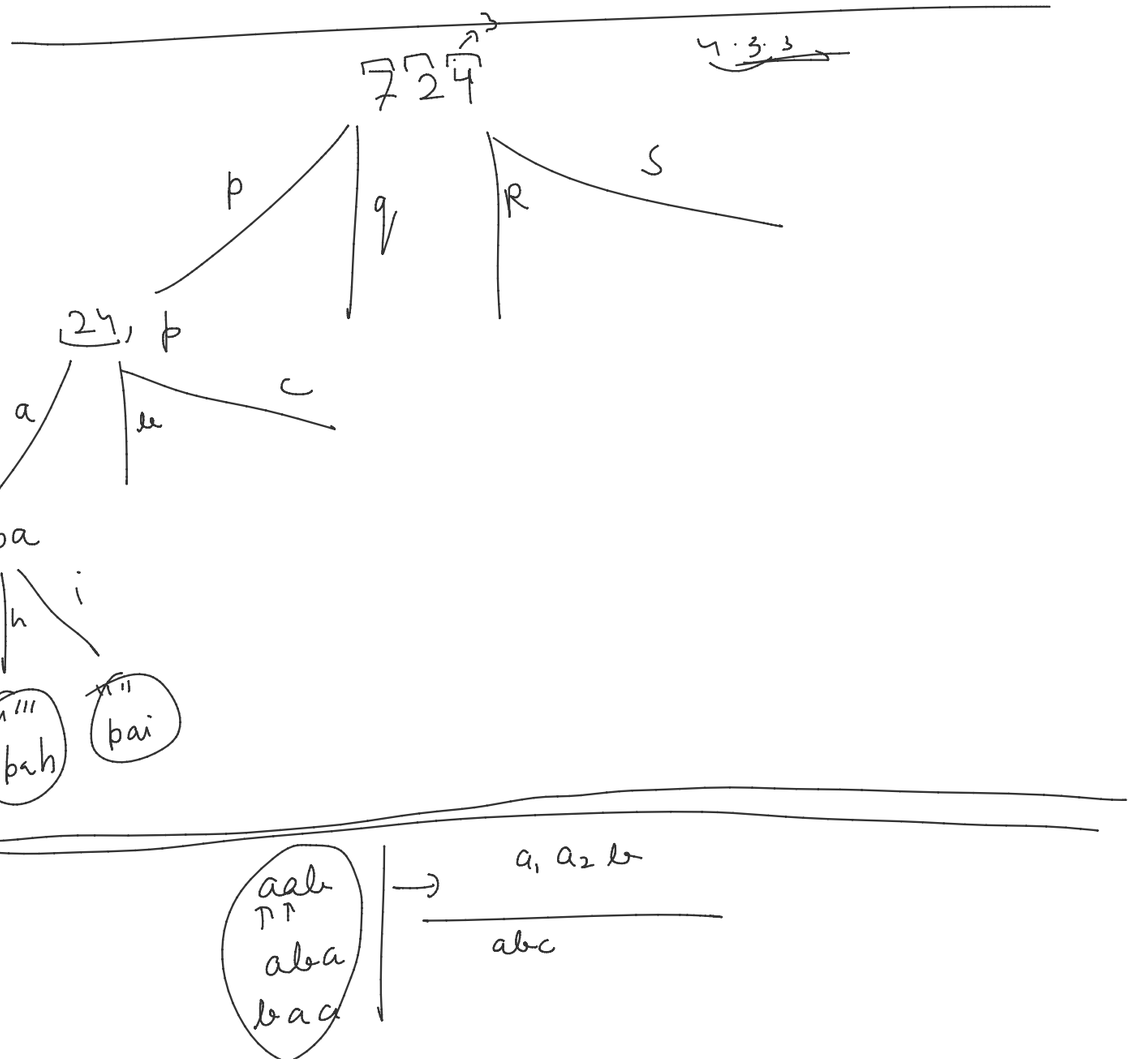







abcd
2
In
Ex
bcd, a
bcd, ...
I.
Ex
cd, ab
cd, a

people
tespe
abcd
bcd
a
a


724
4·3·3
p
q
R
S
24, p
a
b
c
4, pa
g
h
i
pag
pah
pai
aab
aba
baa
a1 a2 b
abc

aab
aba
baa

$a_1\ a_2\ b$

abc

31

C, 0

3

3-op 3-cl

2-op, 3 cl

3-op, 2cl

CC, 1-C, 3cl

() 2-op, 2 cl

CCC
0-op
3 cl

(()
1 op, 2 cl

((()
2-cl

(()()
1 cl

(()())
0-op
0-cl

((()(
0 op
1 cl

(()())
0-op
0-cl

(())
1 op, 1 cl

((()))
0-op
0-cl

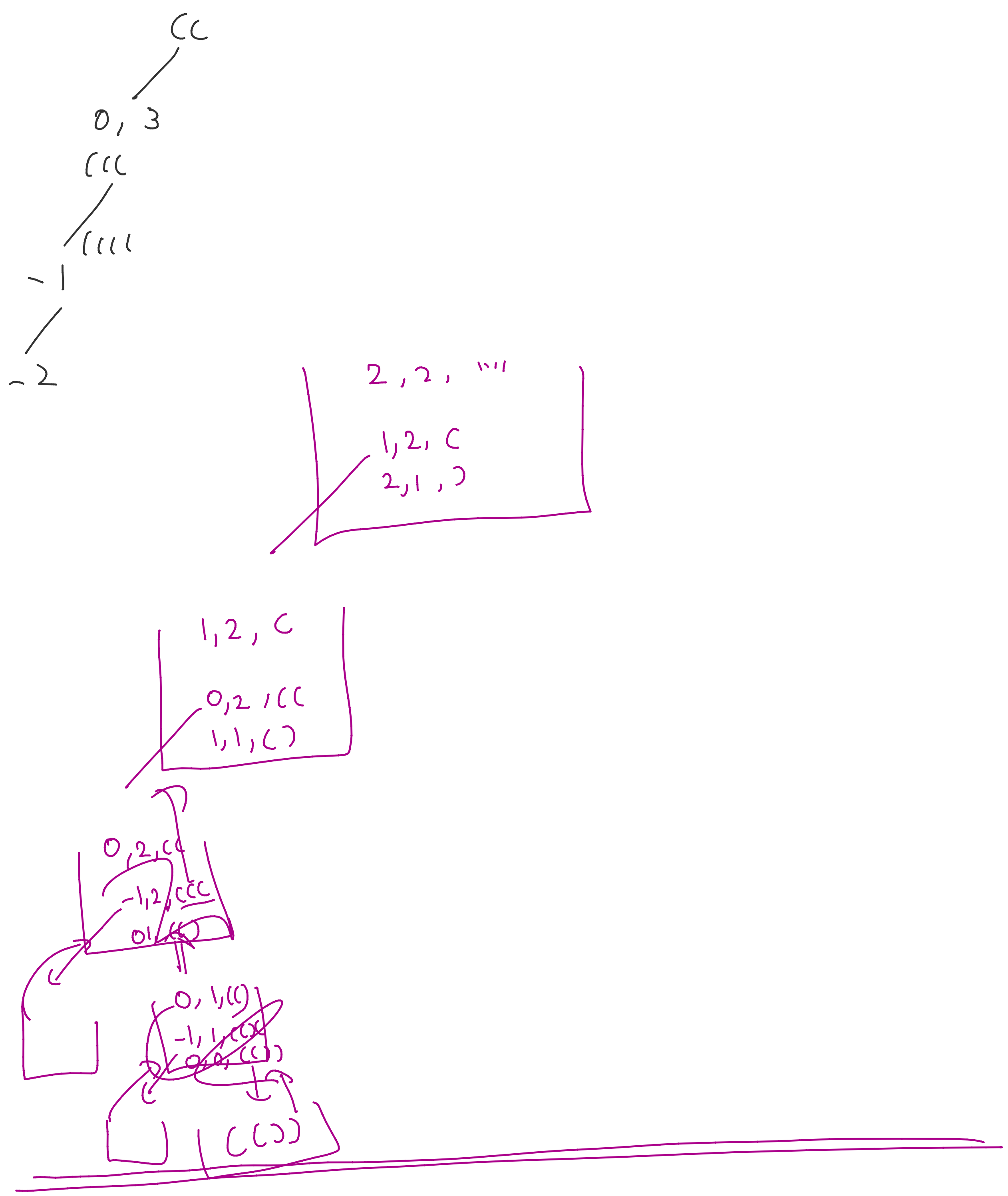
((())()
0-op
0-cl

if (op > cl) →
retu
if (cl > op) {
retu
}

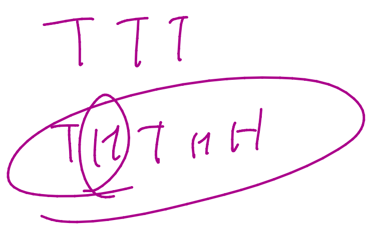
3, 3

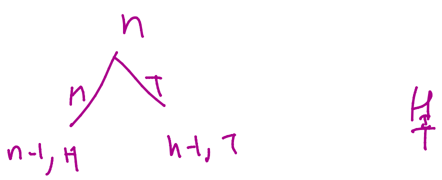
C
2-op 3 cl

1, 3

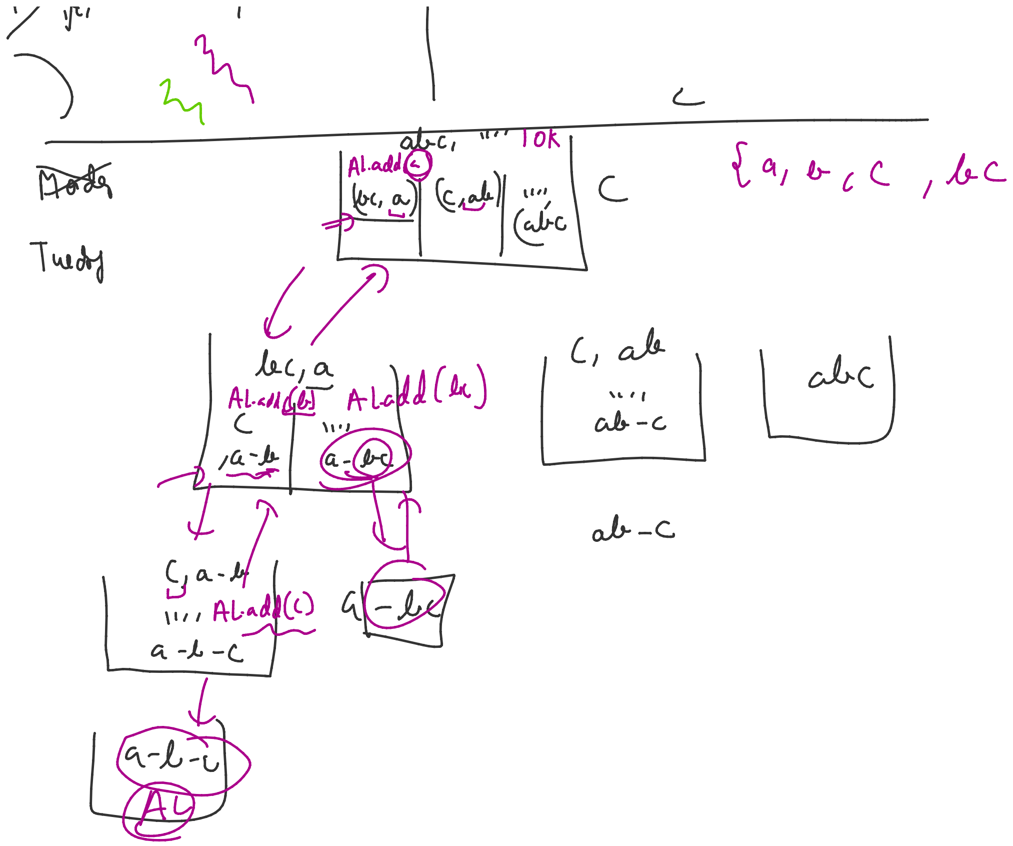


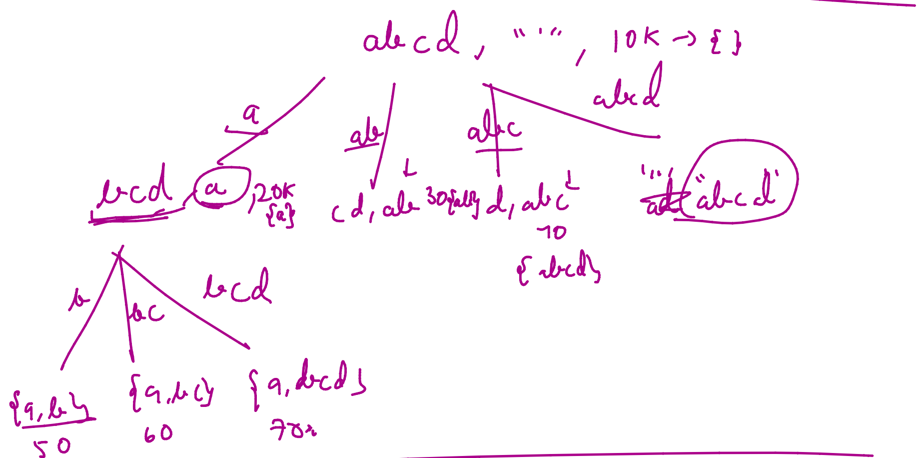
N = 3
~~HHH~~
~~HHT~~
HTH
HTT
~~THH~~
THT
TTH
TTT



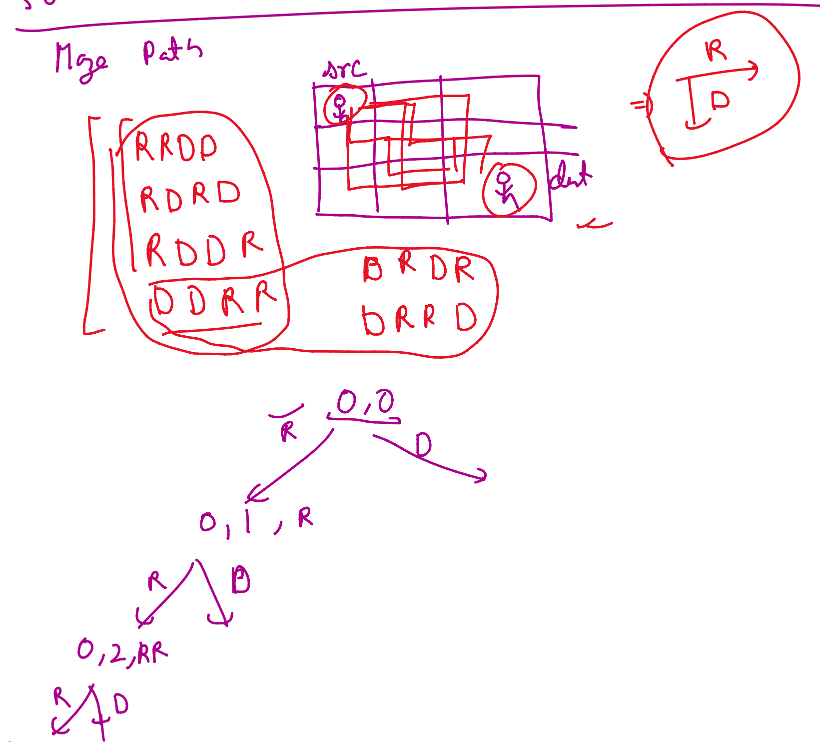


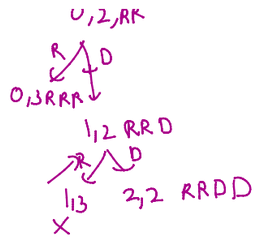
n-2, HH
n itin
n, itin
ni, tin
nit, in
niti, n
itin
{n, i}, tin
{n, it} in
{n, iti} n
{n, itin}
t
ti
tin
{n, i, tin}
{n, i, ti}
n
{n, i, t, i, n}
n, itin
{n, iti, n}
abc
a
ab
abc
{a}, bc
{ab}
{abc}
b
bc
c
{a, b}
{a, bc}
{ab, c}
{a, b, c}
"nitin"
niti
nit
ni
itin
i
iti

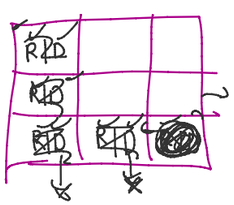

Tuesday
{a, b, c, bc
AL.add(c)
(bc, a)
(c, ab)
(abc
bc, a
AL.add(bc)
(c, ab
ab-c
abc
c, a-b
AL.add(c)
a-b-c
a-b-c
AL


abcd, 10K → {}
a
ab
abc
abcd
bcd
a
,20K
cd, ab
d, abc
"abcd"
b
bc
bcd
{a, b}
{a, bc}
{a, bcd}
50
60
70

Maze Path


src
dest
R
D
RRDD
RDRD
RDDR
DDRR
DRDR
DRRD
0,0
R
D
0,1, R
R
D
0,2, RR
R
D





RR D D

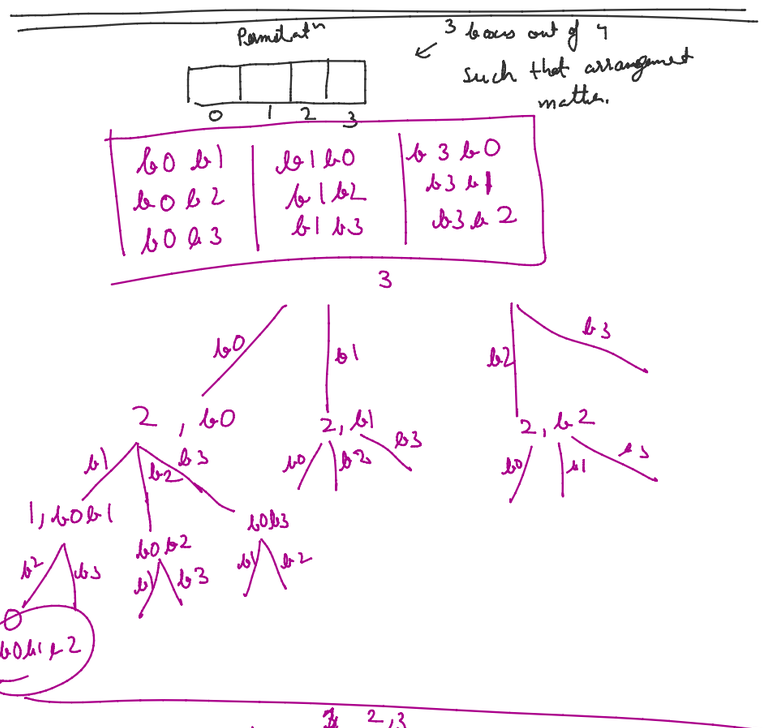
R D R D

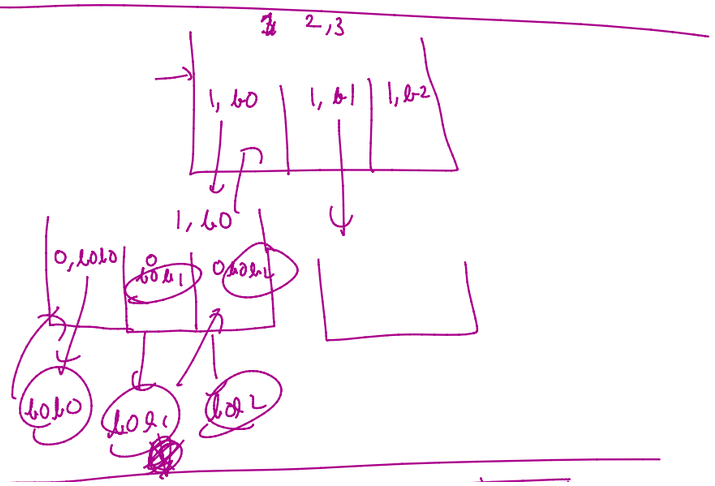
R D D R

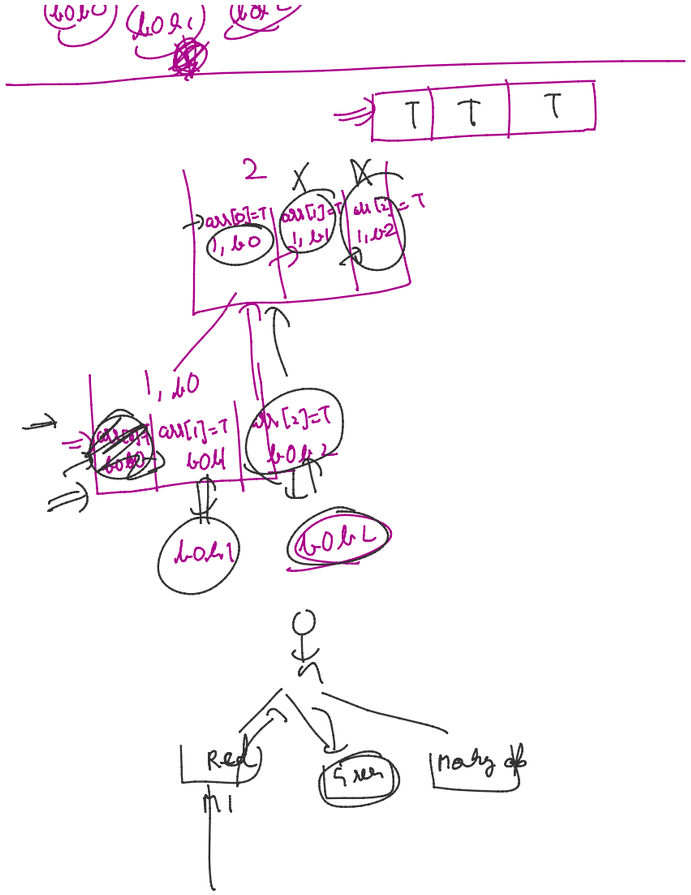
D R R D

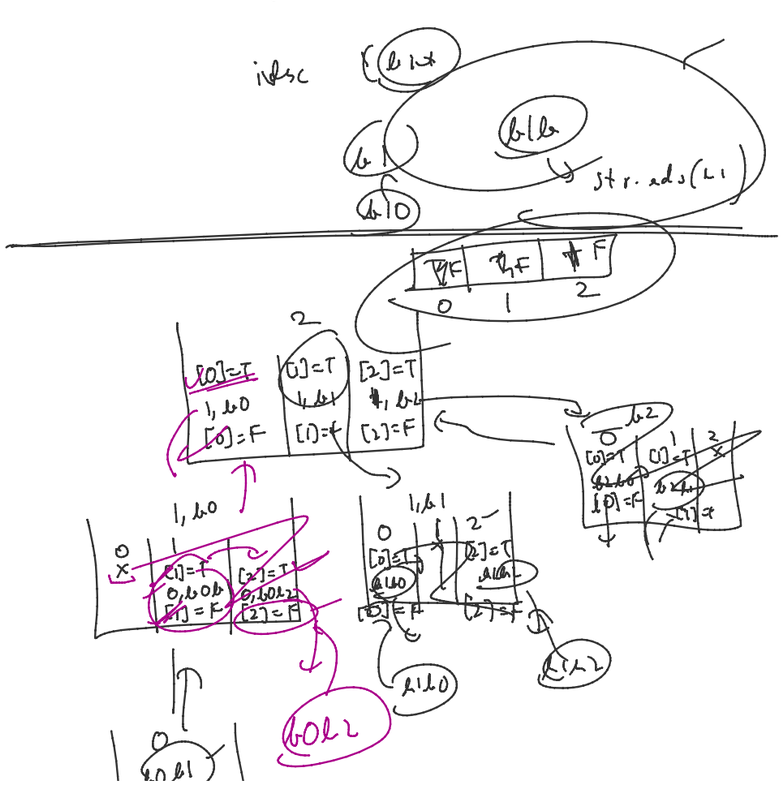
D R D R

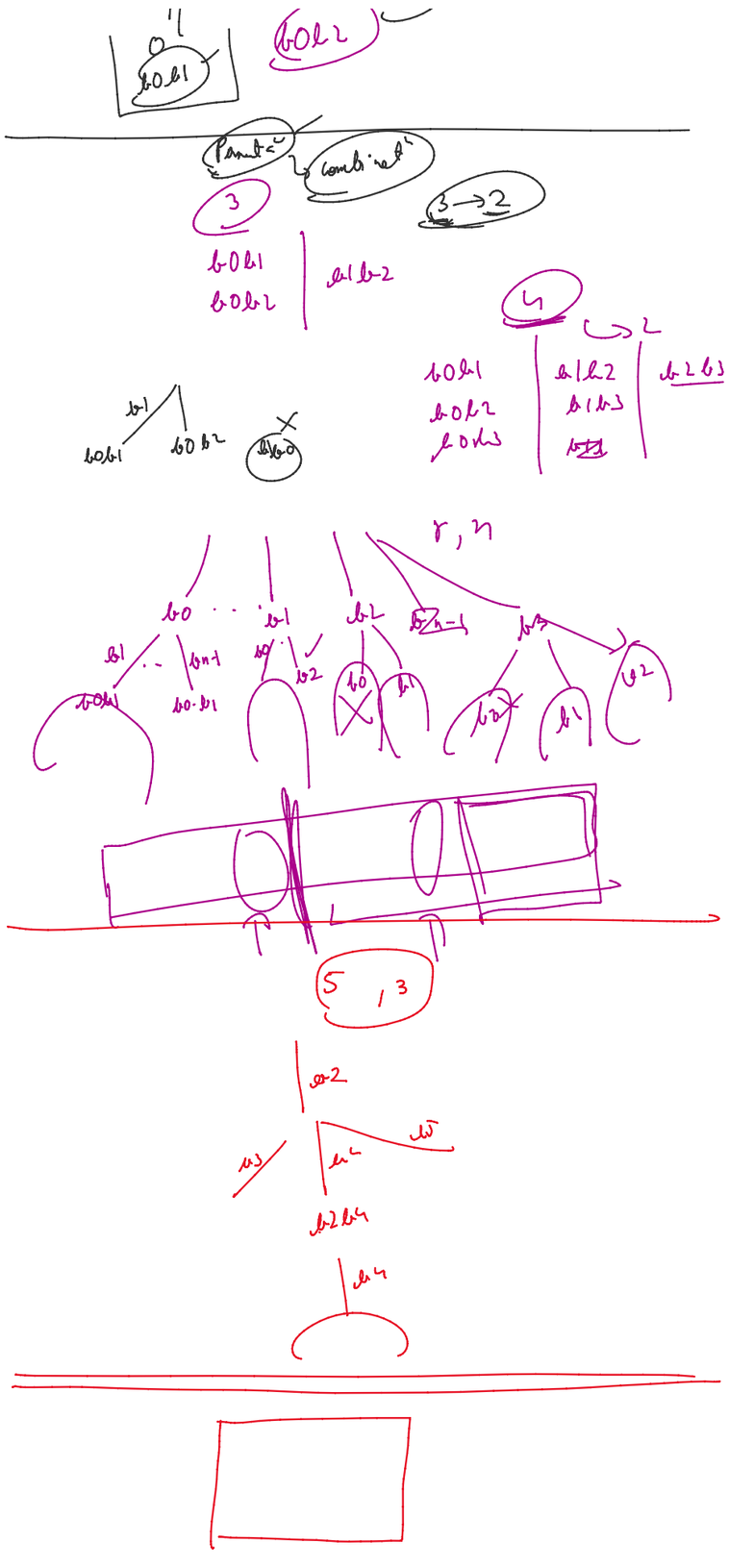
D D R R



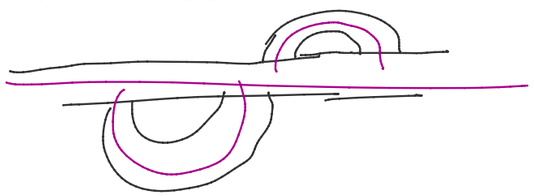



T
T
T
2
1, b0
1, b1
1, b2
Red
Green
many

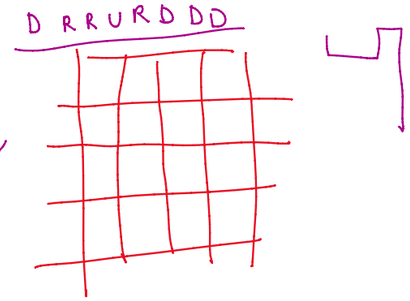

int
str.add(L1)
T
T
T
0
1
2
1, b0
1, b1
0
1
2

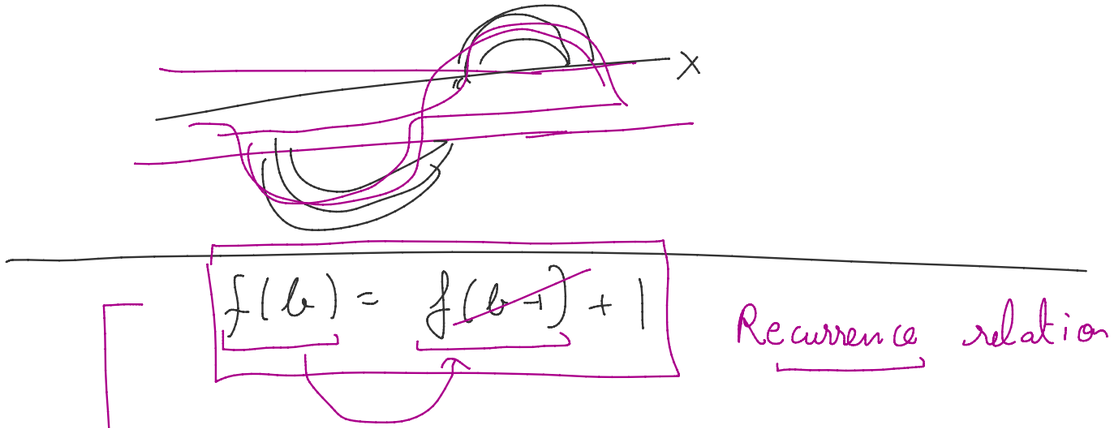


- {{0,1,0,0},
- {0,0,0,0},
- {0,1,0,0}
- {0,0,1,0}}



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





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

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

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

$\vdots$

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

$f(h) = \underbrace{1+1+1+1+1\cdots}_{h} = h$

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

Fac(n)

$f(n-2)$

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

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

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

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

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

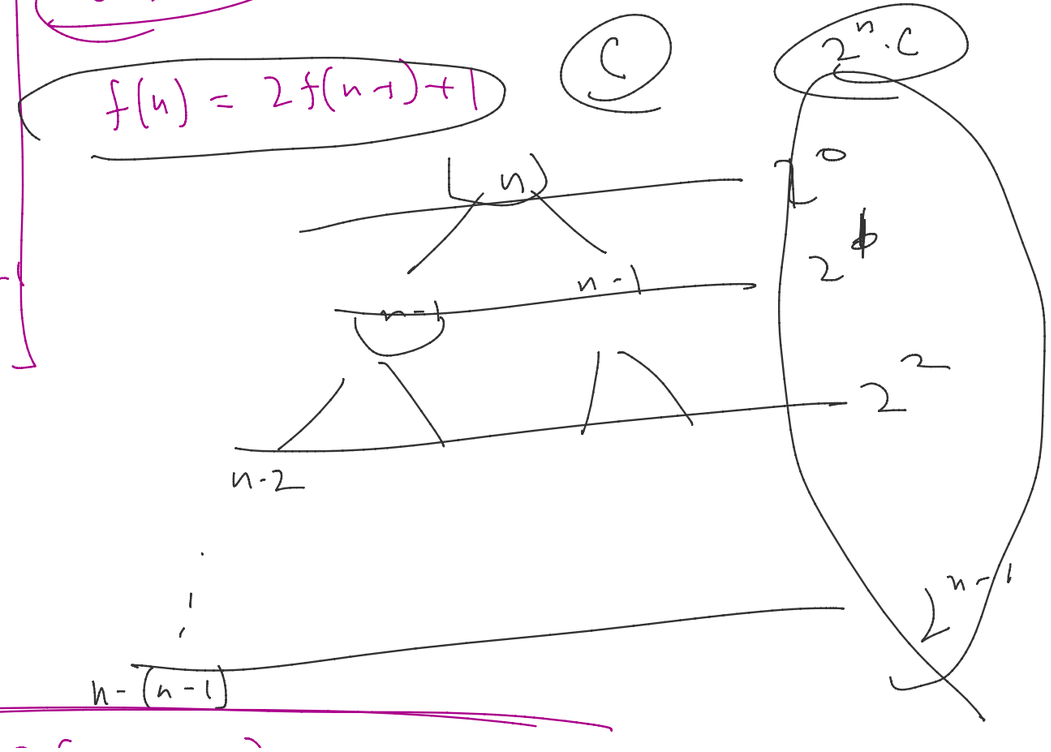
$2^2 f(n-2) = 2^3 f(n-3) + 1 \cdot 2^2$

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

$f(1)$

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

$f(n) = 2^n$



$n-(n-1)$

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

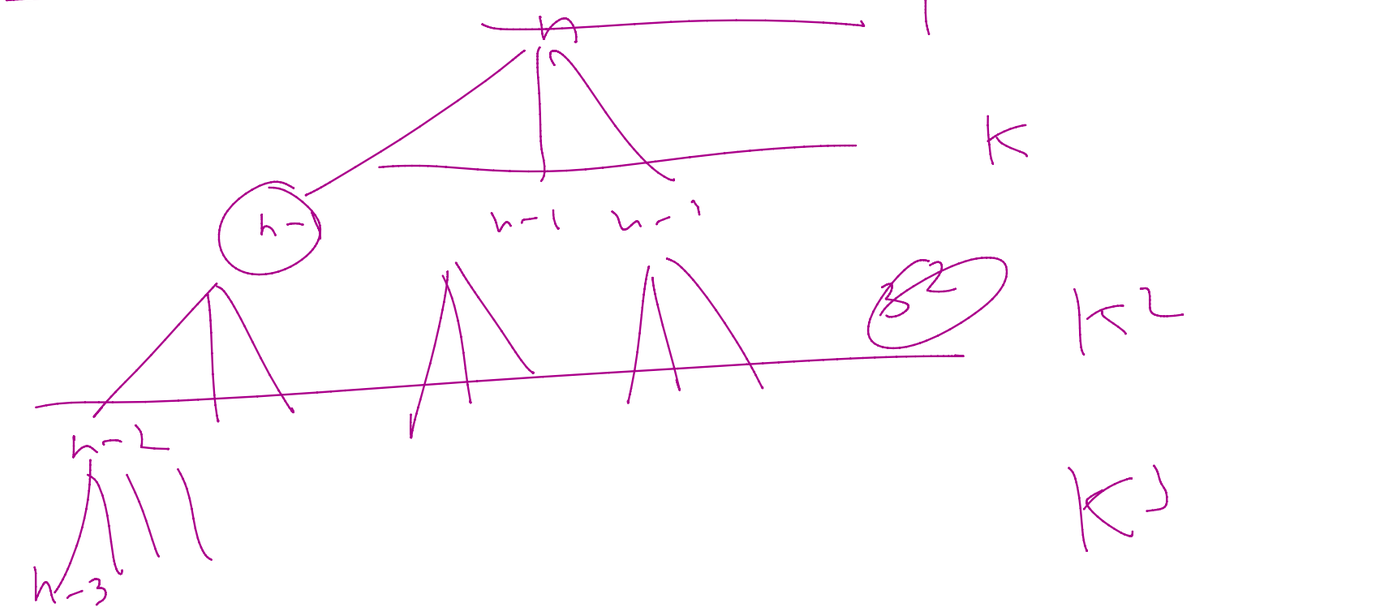
$f(n-1) = 2 \cdot f(n-2) + 2cn$

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

1
2
3
n

$n/4$

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



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

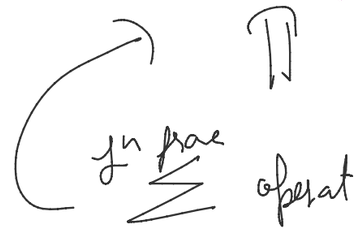
$n + kn \approx kn$

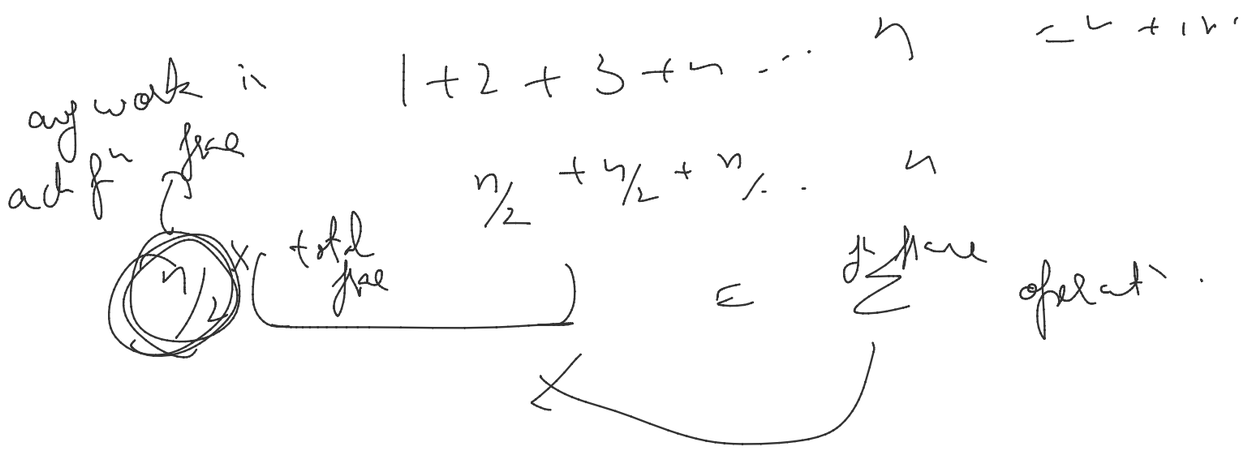
$k^n \cdot k \cdot n = k^{n+1} \cdot n \Rightarrow O(k^n \cdot n)$

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

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

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

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

$$k^n \cdot k^n = k^n \cdot y \Leftarrow 0$$

n^n

$n^0 + n^1 + n^2 + \dots + n^n$ ∪ phen

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

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

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

10^{10} { }

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

2^{50}

$2^{25} = x$

$x * x$

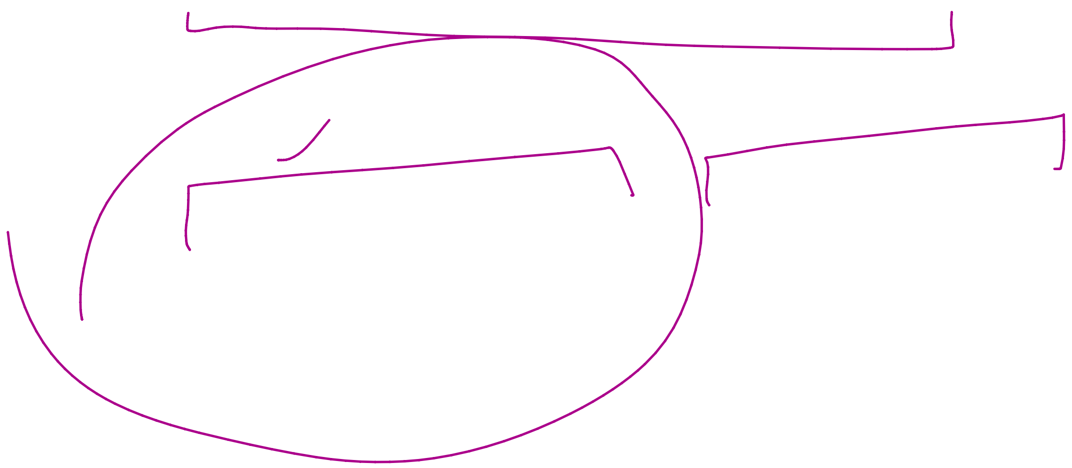
$2^{12} * 2^{12} \rightarrow 2^{24}$

Merge sort

{5, 10, 15, 20}

{7, 12, 14, 50, 60}

{5 7, 10 12, 14, 15, 20, 50, 60}



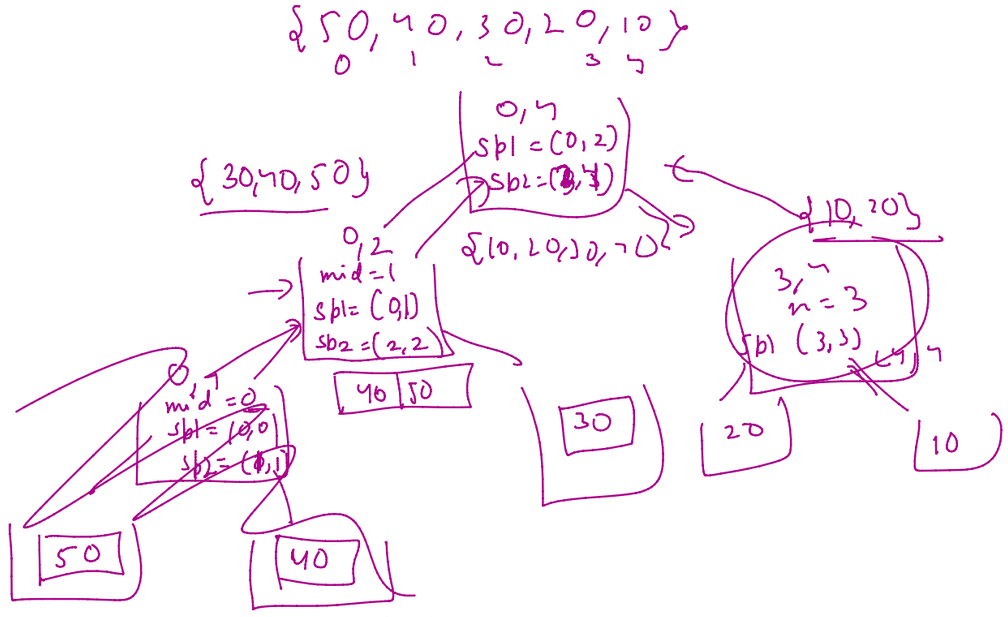
{50, 40, 30, 20, 10}

11

42

{50, 40, 30, 20, 10}

```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);
}
```



Q1 → O(n) extra 2 array] Q2) can you merge 2 sated array without extra space with this

Spare.

out place

Time complexity

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

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

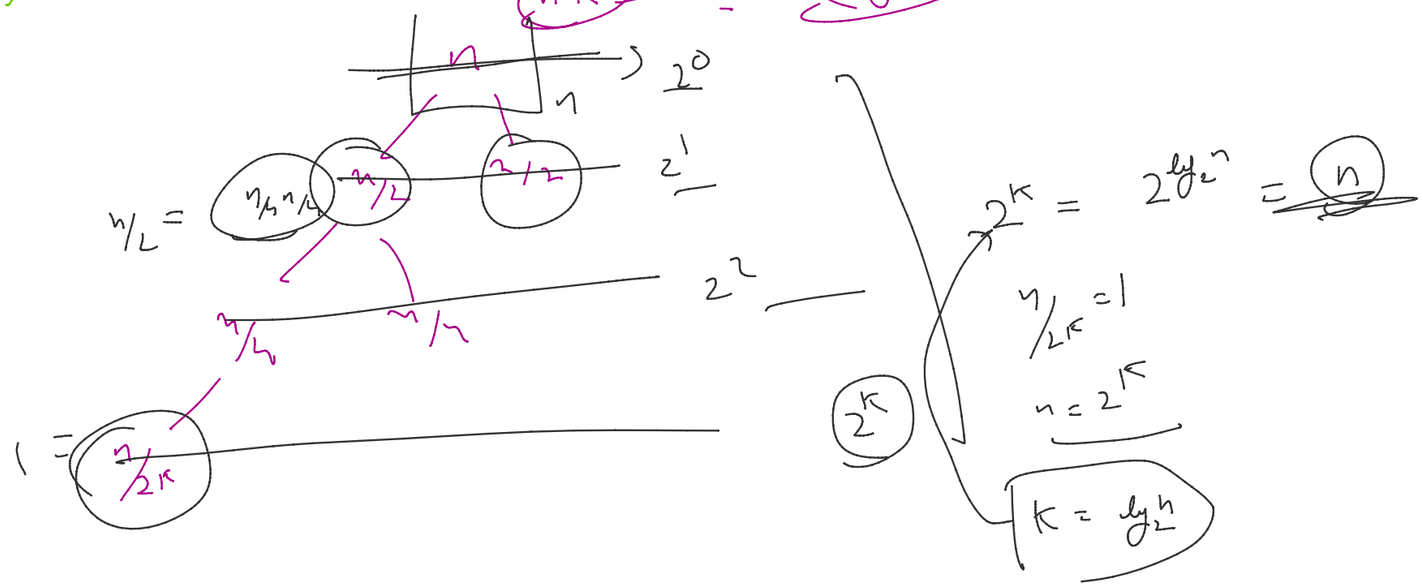
$2^2 \cdot f(n/2^2) = 2^3 \cdot f(n/2^3) + n/2^2 \cdot 2^2$

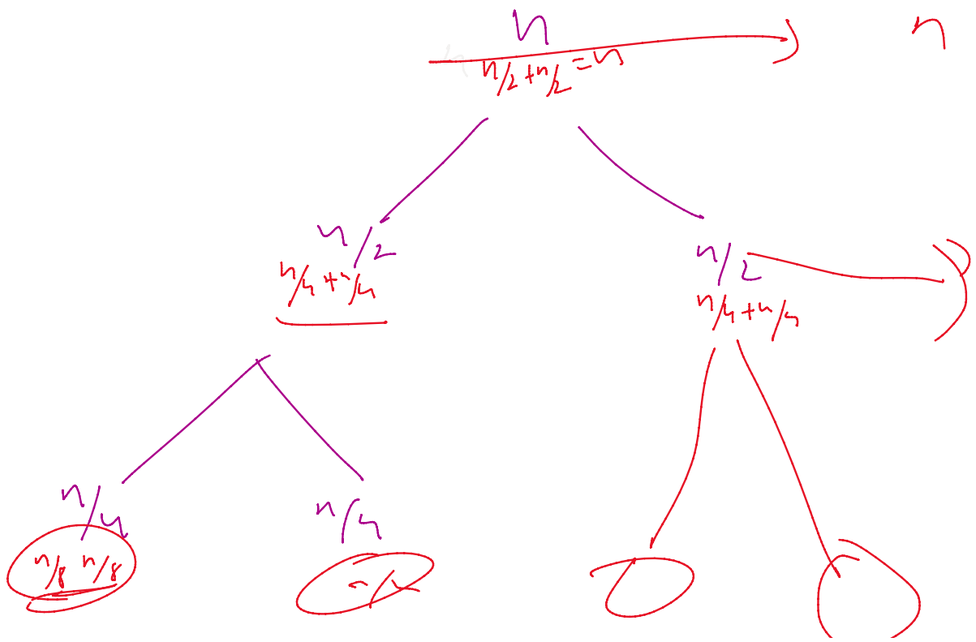
$2^k \cdot f(n/2^k) = 2 \cdot f\left(\frac{n}{2^{k+1}}\right) + n/2^k \cdot 2^1$

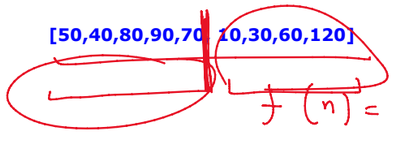
$2^k = n$

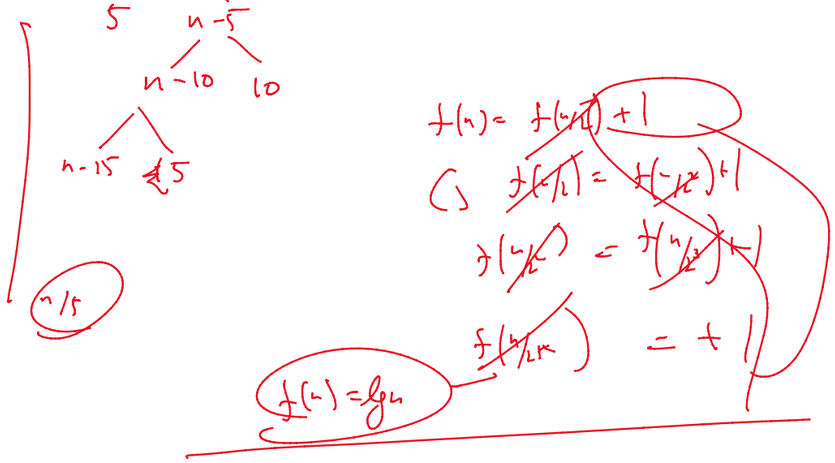
$k = \lg_2 n$

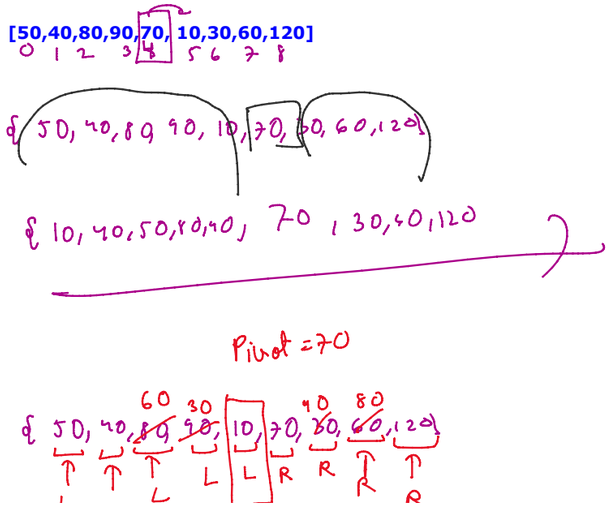
$f(n) = n + n + n + n + n = nk = n \lg n$

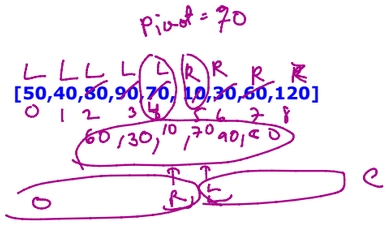





[50,40,80,90,70, 10,30,60,120]
f(n) = f(5) + f(n-5) + n
f(n-5) = f(5) + f(n-10)
n
5
n-5
n-10
10
n-15
5


n/5
f(n) = f(n/2) + 1
f(n/2) = f(n/4) + 1
f(n/4) = f(n/8) + 1
f(n/2^k) = + 1
f(n) = log n


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


pivot = 70
[50,40,80,90,70,10,30,60,120]

[50,40,80,90,70,10,30,60,120]
pivot = 70
pivot = 60
pivot = 30
pivot = 70
a
n-a
n
a ⇒ pivot sorted position
f(n) = f(a) + f(n-a) + n
c1) a = 0 or a = n-1 → pivot min or max value
f(n) = f(n-1) + n → O(n²)
f(n-1) = f(n-2) + n-1

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

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

$n + (n-1) + (n-2) + \dots + 1$

(2) $a = n/2$ → median

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

$f(n) = 2f(n/2) + n$ → $n \log n$

Q1) Quick sort vs Merge sort

Q2) Arrays.sort() ?

Q3) apna sorting algo?

unstable → same values ka original order destroy hogaya

Algo	W.C	B.C	Space
Quick (pivot: Quick sort → $n \log n$)	n^2	$n \log n$	$O(1)$
Merge → $n \log n$	$n \log n$	$n \log n$	$O(n)$ → out
Bubble	n^2	$n^2 \to n$	$O(1)$
Select	n^2	n^2	$O(1)$ → in
Insert	n^2	n	$O(1)$

Stability

non-primitive →

80	70	80	80
S1	S2	S3	S4

S1, S3, S4, S2

{ 5, 2, 5, 5 }

primitive → stable, unstable ✗

non-primitive → ✓ matters.

100	100
S1	S2

L > R ✗

L > R

L ≥ R

{ 10, 20, 30, 40, 50, 60 }

{ 10, 20, 30, 40, 50, 60 }

n+3

C ⟶ C++ ??

OOPs

C++ ⟶ Java

Platform Independance ⟶ compiled file

High level ⟶ .exe

compiler.

Machine level. 0110 11 ⟶ compiled file

• Java

Hlp.

compiler

• class.

platform independent

Byte code

J.V.M Java virtual

machine

slower

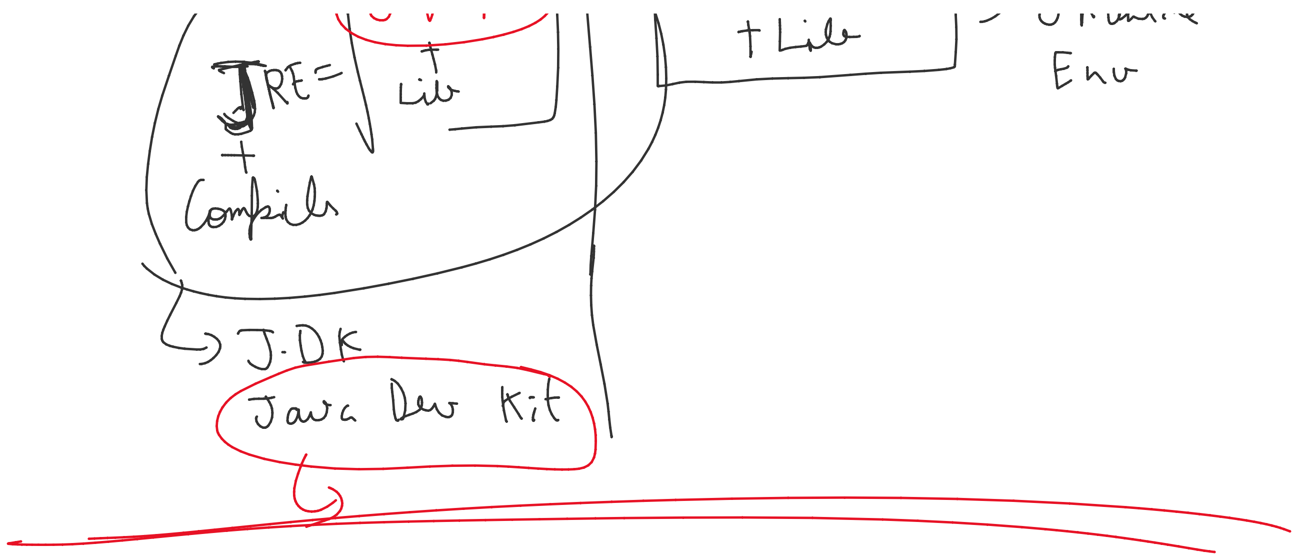
J.V.P

SD | Client

J.V.M + Lib

JRE = J.V.M + Lib ⟹ J. Runtime Env

Machine



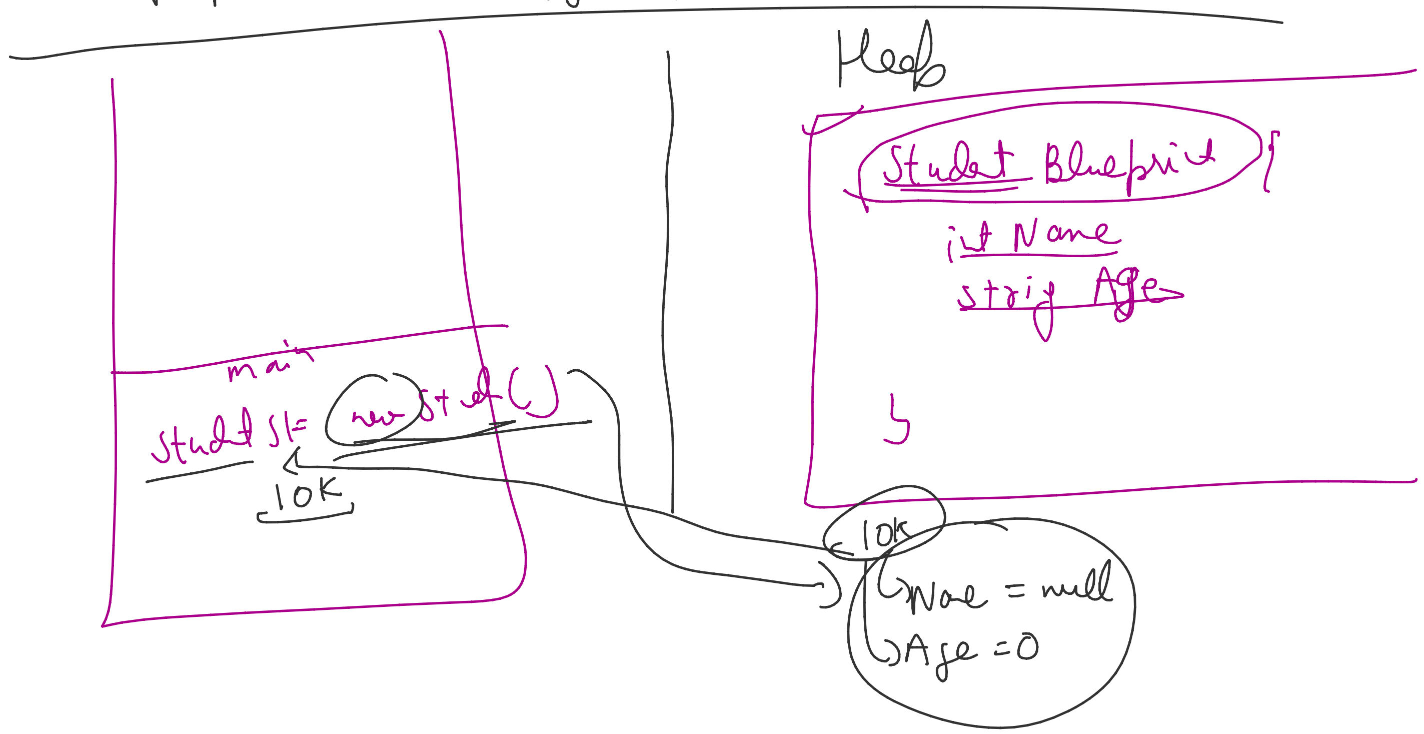
OOPs

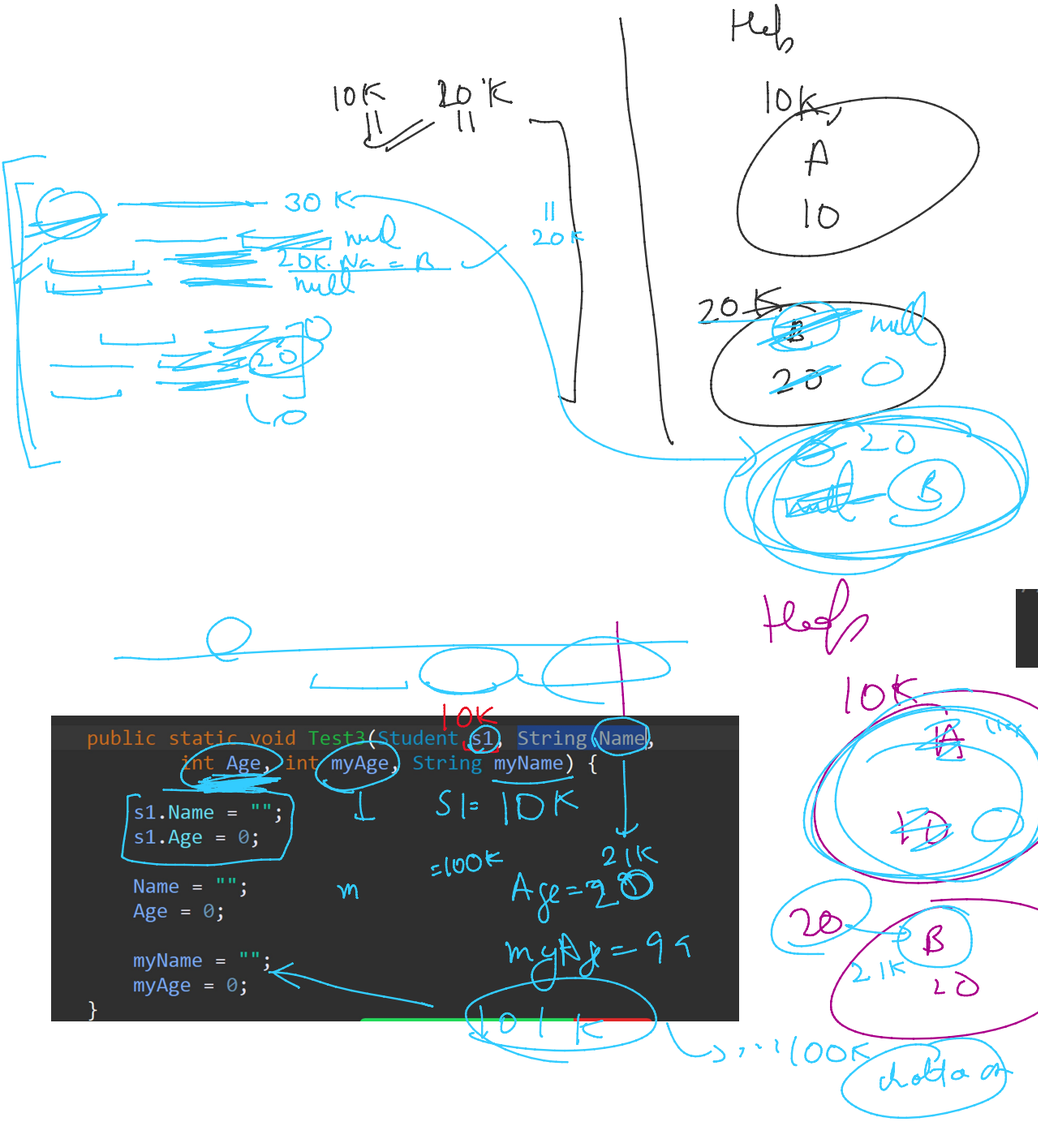
A) S1. clapse(S2)

B) slaps(S1.Head, S1.St)

noun → class

proper noun → object / Instance






```java
public static void Test2(Student s1, Student s2) {
    s1 = new Student();
    String temp_s = s1.Name;
    s1.Name = s2.Name;
    s2.Name = temp_s;

    int temp_i = s1.Age;
    s1.Age = s2.Age;
    s2.Age = temp_i;
}
```

```java
int myAge = 99; String myName = "chotto doon";
Test3(s1, s2.Name, s2.Age, myAge, myName);
```

```java
public static void Test3(Student s1, String Name,
        int Age, int myAge, String myName) {
    s1.Name = "";
    s1.Age = 0;

    Name = "";
    Age = 0;

    myName = "";
    myAge = 0;
}
```