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Recursion Complexity

- $\boxed{MD1}$ sasta & tikau
- $\boxed{MD2}$ recurrence rel^n

$\boxed{MD1}$ $\sum^{f^n}$ work in each function frame $= \sum^{f^n}$ no of operation in each function frame

i.e. approx = operation $\times$ f^n frame } andar ki baat

$\boxed{MD2}$ find a relation and solve it to ~~find~~ remove other variable except n. i.e. find a relation in 'n'

a^b MD0 $\rightarrow$ $sp = a^{b/2}$ f^n frame $= \log n$

return $sp \cdot sp$ $O(\log n)$

MD0 $\rightarrow$ a^b

a^{b-1} $O(n)$

return $sp \cdot a$

MD2 $\rightarrow$

$$f(n) = f(n/2) + 1$$
$$f(n/2) = f(n/2^2) + 1$$
$$\underbrace{f(n/2^k)}_{=1} = \underbrace{f\left(\frac{n}{2^{k+1}}\right)}_{=0} + 1$$

$$\frac{n}{2^{k+1}} = 1 \qquad \therefore k = \log_2 b$$

Smallest problem is always 0 or 1

$f(n) = 1 + 1 + \dots + k$ times $= K = \log_2 b$

fibonacci

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

MD1 operation $= 2 \times n$ $O(n)$

MD2
$$f(n) = f(n-1) + f(n-2)$$
$$f(n-1) = f(n-2) + f(n-3)$$
$$f(n-2) = f(n-3) + f(n-4)$$
$$\vdots$$
$$n-k = (n-k+1) + (n-k+2)$$
$$\rightarrow k = n+3 \qquad O(n)$$

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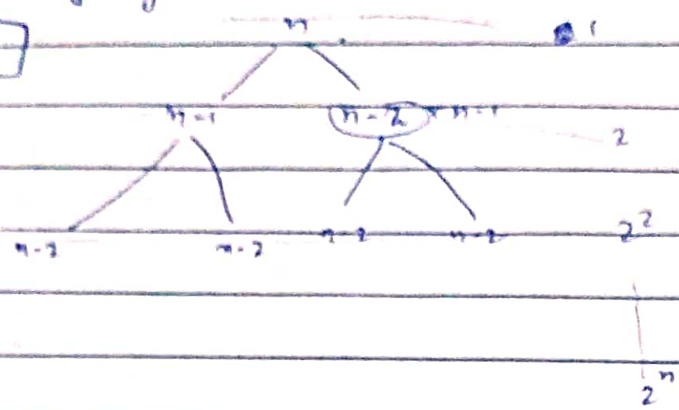
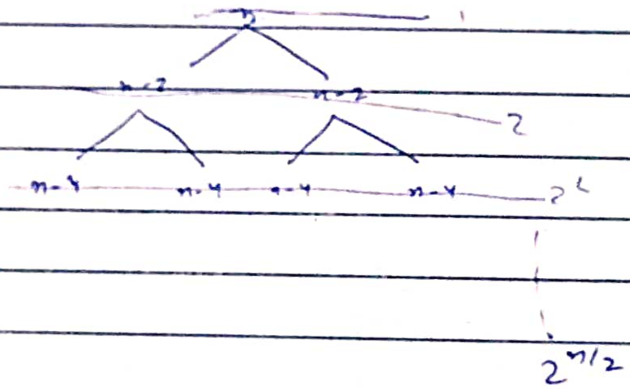
aap soch rhe honge ki sahi hai per
ye galat hai

$\boxed{MD1}$



$(1+2+2^2+\cdots+2^n) = 2^n$ $\quad\therefore\quad 2^n$



operations $= 2^{n/2} \cdot K$

$$\boxed{2^{n/2} \ldots 2^n}$$

$\boxed{MD2}$ $\quad f(n) = f(n-1) + f(n-2) + 1$

$f(n-2) \le f(n-1)$

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

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

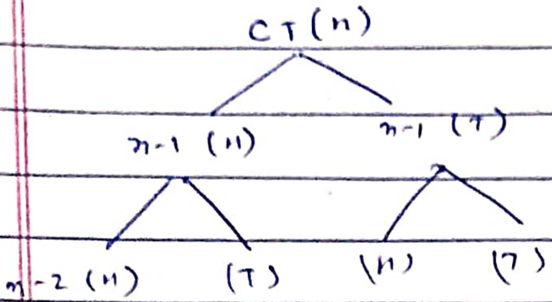
$2f(n-2) = 2f(n-3) + 1$

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

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

$\boxed{f(n) = 2^n}$

coin toss



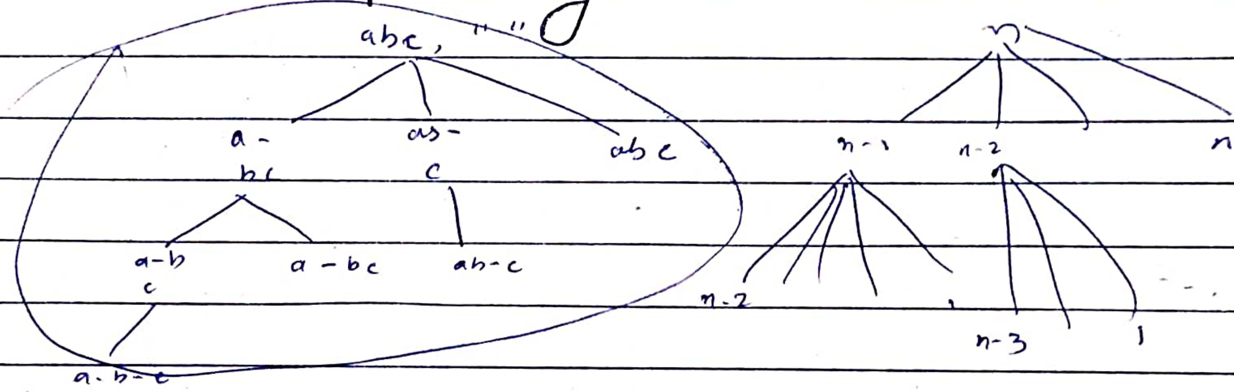
2^n f^n frame

$O(n \cdot 2^n)$
coz 2 string concatenation
(= = har baar naya string bnata hai)

* if k branches or k recursive call $O(n \cdot k^n)$

* $f(n) = k(n-1) + nk$ $O(nk \cdot k^n)$

Palindrome partioning



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

$\therefore f(n) = f(n-1) + f(n-1) + k$
$f(n) = 2f(n-1) + k$

$\therefore 1 + n + n(n-1) + n(n-1)(n-2) \cdots n!$
$\therefore \boxed{O(n!)}$