١

$Sum = 0 \quad O(1)$

$for(i=0; i<n; i++) \rightarrow O(n)$

$O(n) \leftarrow \begin{cases} for(j=0; j<i; j++) \\ \quad for(k=0; k<r; k++) \{ \\ \qquad Sum++; \quad O(1) \end{cases} \quad n \times n = n^2$

٢

$int \ f(int \ n) \rightarrow T(n)$

$\{ if(n==1)\}_{O(1)}$
$return \ 1,$
$return \ f(n-1) + f(n-1); \rightarrow 2(T(n-1))$
$\qquad\quad T(n-1) \quad T(n-1)$
$\}$

$T(n) = 2 T(n-1) + O(1)$

$T(1) = 1$

$T(2) = 2 T(1) + 1 = 2 + 1 \qquad\qquad T(3) = 2T(2) + 1 = 2(2+1) + 1 = 2^2 + 2^1 + 2^0$

$T(4) = 2 + 2^2 + 1 = 2(2^2 + 2^1 + 2^0) + 1 = 2^3 + 2^2 + 2^1 + 2^0$

$T(n) = 2^{n-1} + 2^{n-2} + 2^{n-3} + \cdots + 2^0 = 0 \qquad\qquad$ حاصل جمع است

$\dfrac{1 - 2^0 \times 2^n}{1-2} = 2^n - 1 = O(2^n)$

MICRO

$$T(n) = \begin{cases} 0 & \text{if } n=1 \\ 2T(\frac{n}{2}) + \frac{1}{2}n & \text{if } n>1 \end{cases}$$

$$2T(\frac{n}{2}) + \frac{1}{2}n \longrightarrow 2T(\frac{n}{2}) + 2n$$

$$\longrightarrow 2T(\frac{n}{4}) + \frac{3}{2}n$$

$$\longrightarrow 2\left(2T(\frac{n}{4}) + 2n\right) + \frac{1}{2}n \Rightarrow \boxed{2^2 T(\frac{n}{4}) + 11n}$$

$$\longrightarrow 2^2\left(2T(\frac{n}{8}) + \frac{3}{2}n\right) + 11n \Rightarrow \boxed{2^3 T(\frac{n}{2^3}) + 18n} \quad 2T(\frac{n}{2}) + \frac{3}{2}n$$

$$\longrightarrow 2^3\left(2T(\frac{n}{2^4}) + \frac{3}{2}n\right) + 18n \Rightarrow \boxed{2^4 T(\frac{n}{2^4}) + K(\frac{1}{2}n)} \longrightarrow$$

$$\longrightarrow \boxed{2^0 T(\frac{n}{2^0}) + 0(\frac{1}{2}n)} \longrightarrow 2^5 T(\frac{n}{2^5}) + 5(\frac{1}{2}n)$$

نفترض أن

$$\frac{n}{2^\pi} = 1 \Rightarrow 2^\pi = n$$

$$\pi = \lg n$$

$$2^{\lg n} T(\frac{n}{2^{\lg n}}) + \lg n(\frac{1}{2}n) \Rightarrow n + \lg^n(\frac{1}{2}n) \Rightarrow$$

$$\Rightarrow n + \frac{1}{2}n\lg^n \Rightarrow n\lg^n$$

void Hanoi (n, start, goal, help)   (n=٣)   5 ⊛

if (n=1) {

~~ ~~
~~ ~~

}
}
                                              2

Hanoi (n-1, start, help, goal) ⟹ (٢, start, help, goal) // (n=٢)   3

                                                         (1, sd, hg)

print (___)   5   4 (1, hg, s)

Hanoi (n-1, help, goal, start) ⟹ (٢, h, g, s) ⟹ | ٢ن   6

                                                         ⊛ (1, s, h, g)

        ٠٤٧   (1 (h, g, s)   7

$$\lg^p n < n < n \log^n < n \lg^n < (r^{\lg n} < (n^r < (\tfrac{e}{r})^n) < (r^n < (n^r)^n < (r^{rn} < n!$$