Recursion

Sunday, March 11, 2018 10:36 AM

assumption

$$n! = n \cdot \boxed{(n-1)!}$$

X

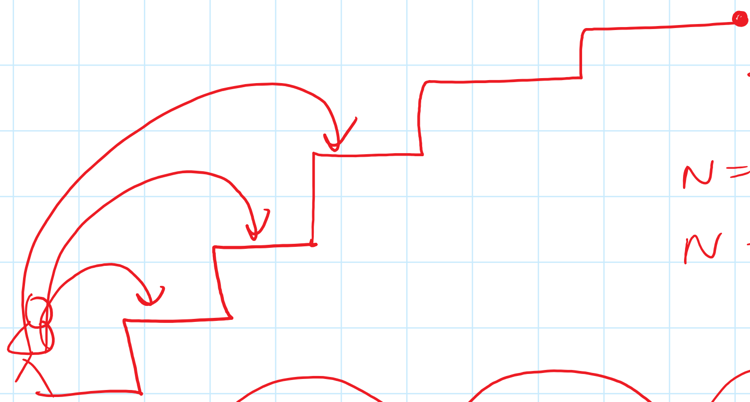
$$n! = n \cdot X$$

fact(n)

```
if (n <= 0) return 1;
ans1 = fact(n-1);
finalAns = n · ans1;
```

recurrence

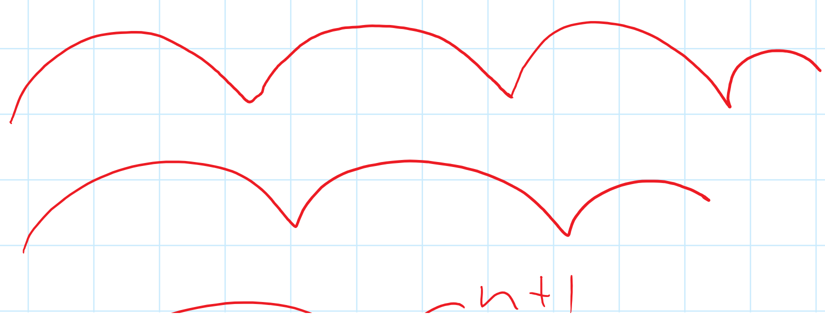
N floors



N = 9

N = 6

= 7



N = 8

n+1

$n \leftarrow 0 \begin{cases} n+1 \\ n+2 \\ n+3 \end{cases}$

$10/3 = +1$

$8/3 = 2+1 \quad 8\%3 = 2$

$$n/3 + \underbrace{(n\%3/2)}_{ans} + (ans\%2)$$

$n = 11$

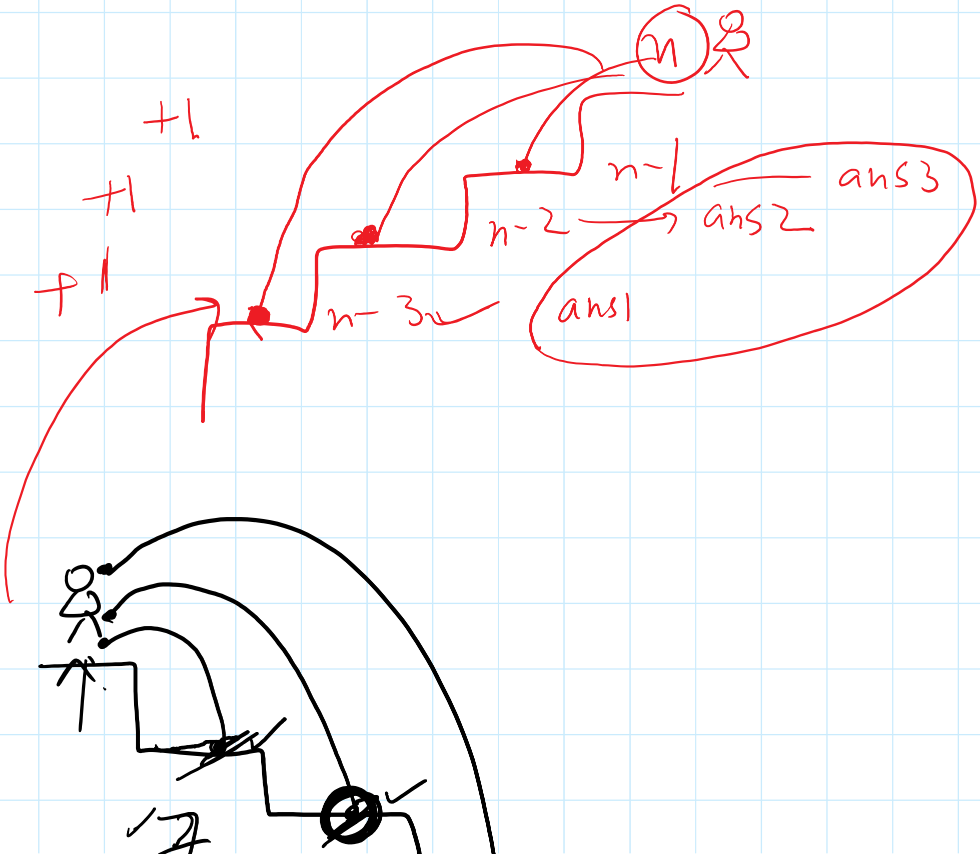
$11/3 \rightarrow 3$

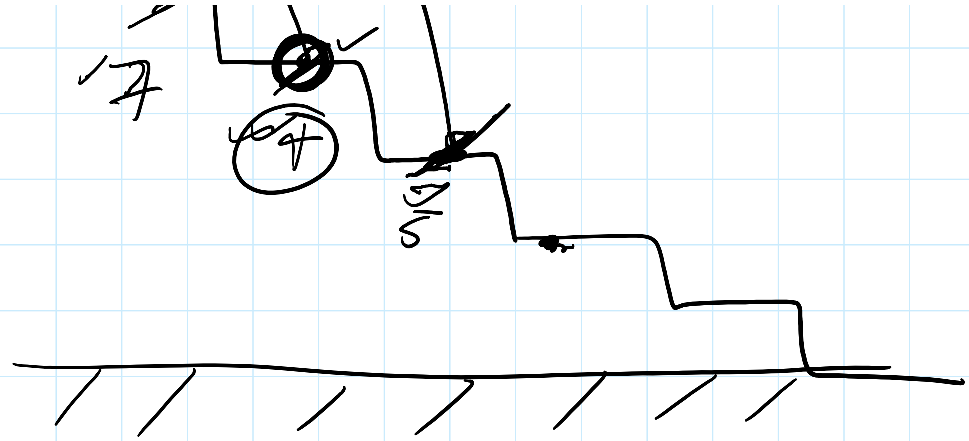
Rem $11\%3 = 2 \rightarrow 2/2 = 1$

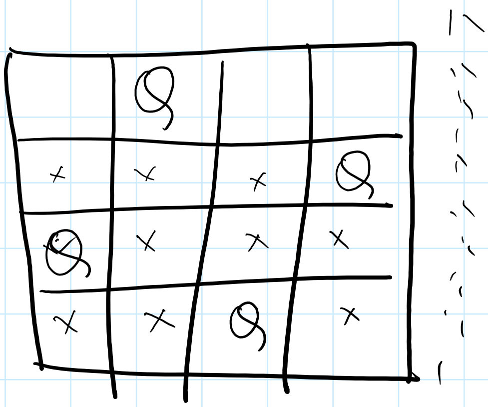
Rem $2\%2 = 0 \rightarrow 0/1 = 0$

3 2 1

n







2x2 →
6x6
8x8 ?

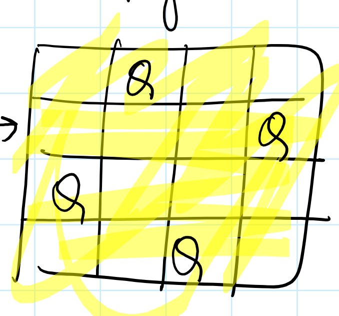
nRows / n Queen

(n-1) rows/nQueens

Pigeonhole principle

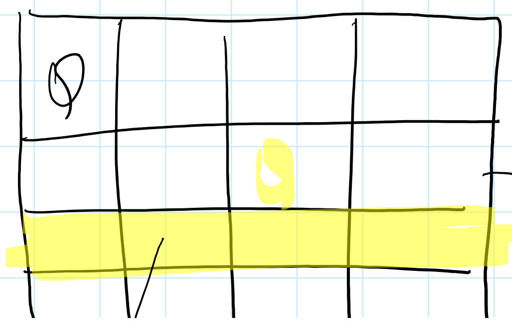
board

bool nqueen(int n, r) {

n=4, r=1 →  4x4

}

0 0
1
2



bool nQueen(n, r)

nQueen(n, 1)

if (n==r), return true;

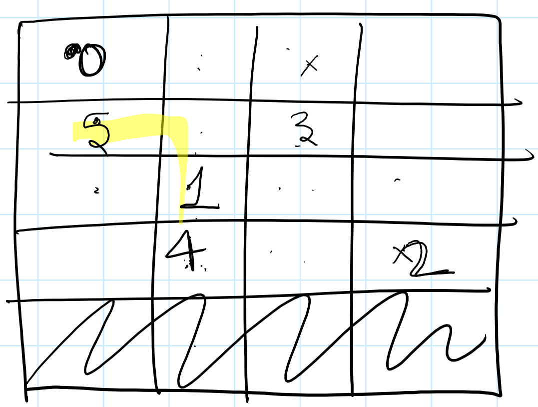
L

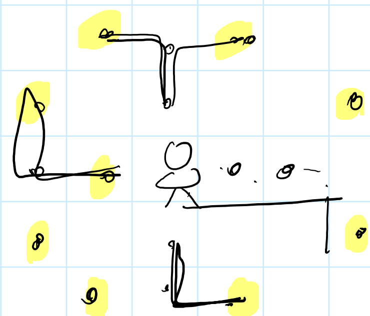
3

(x, y)

canPlace(board, n, x, y)

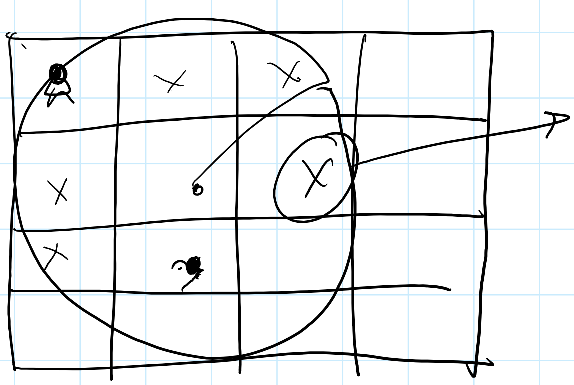
```
if (n == r) return true;
for (every col) {
    // place a queen
    if (recursion is successful)
        return true;

    // unplace a queen
}
return false;
```





16

15

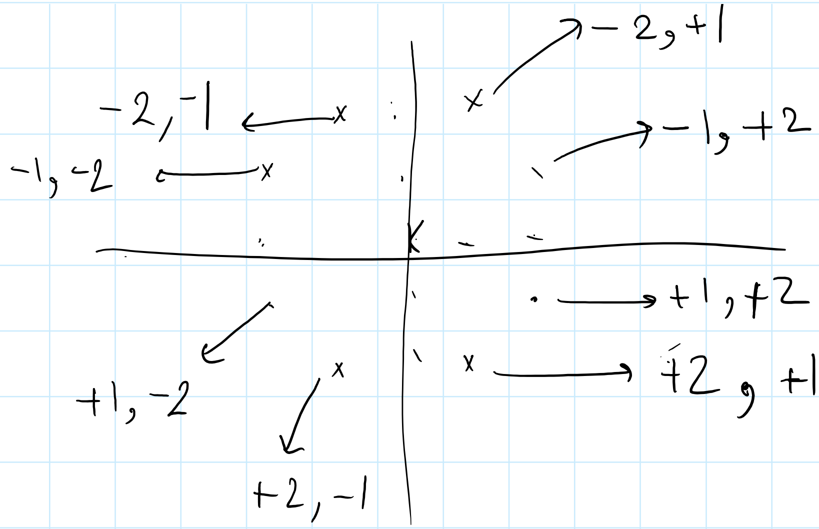


within board

44 ± = 0

n x n

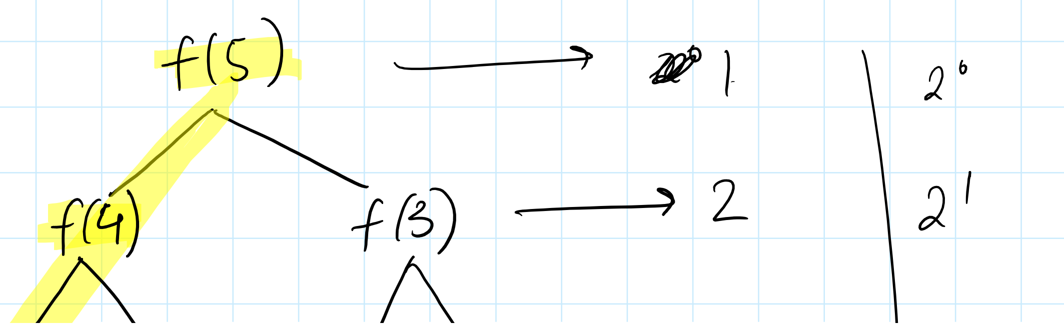
O(n·n) O(1) [ ]

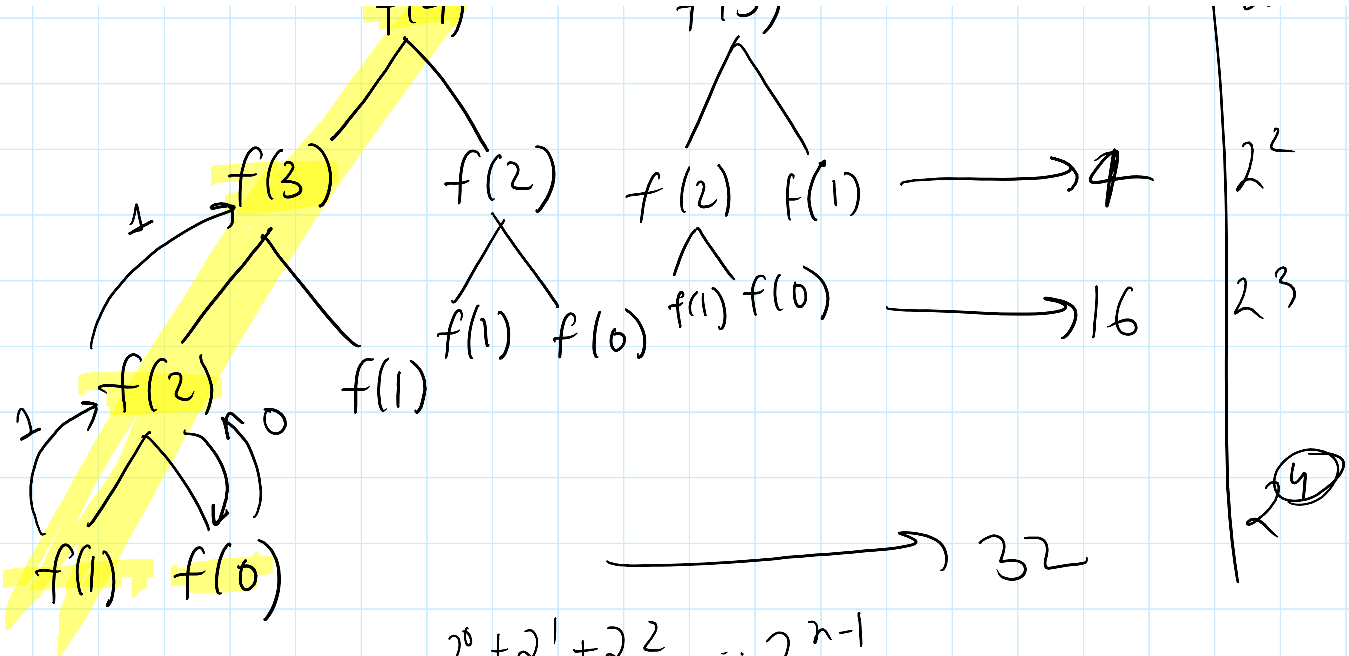


$$T(n) = k + T(n-1)$$
$$T(n-1) = k + T(n-2)$$
$$\vdots$$
$$T(2) = k + T(1)$$
$$T(1) = k + \cancel{T(0)}\ k$$

$$T(n) = nk$$
$$T(n) = O(n)$$

$$T(n) + \cancel{T(n-1) + \ldots T(1)} = \cancel{T(n-1) + T(n-2)} \ldots + nk$$





$$2^0+2^1+2^2\dots2^{n-1}$$

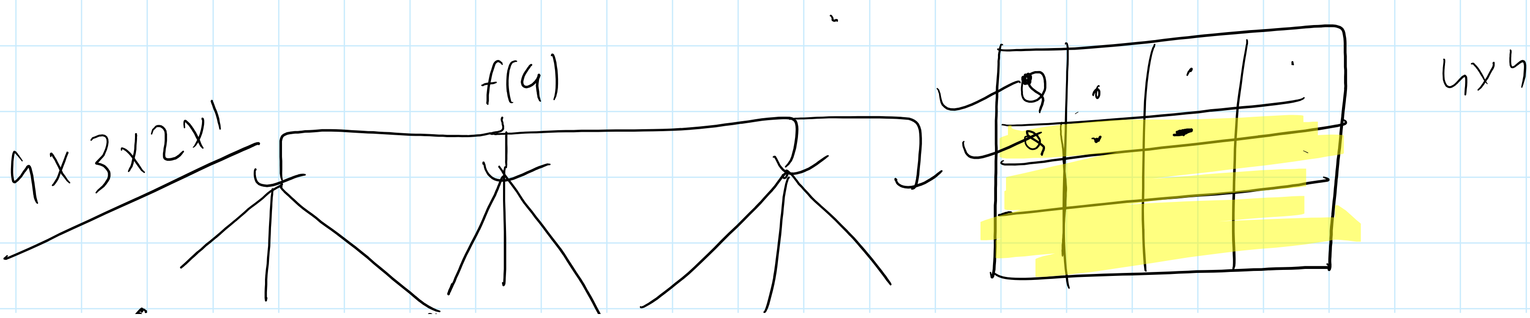
$$=\frac{1(2^n-1)}{2-1}=2^n-1$$

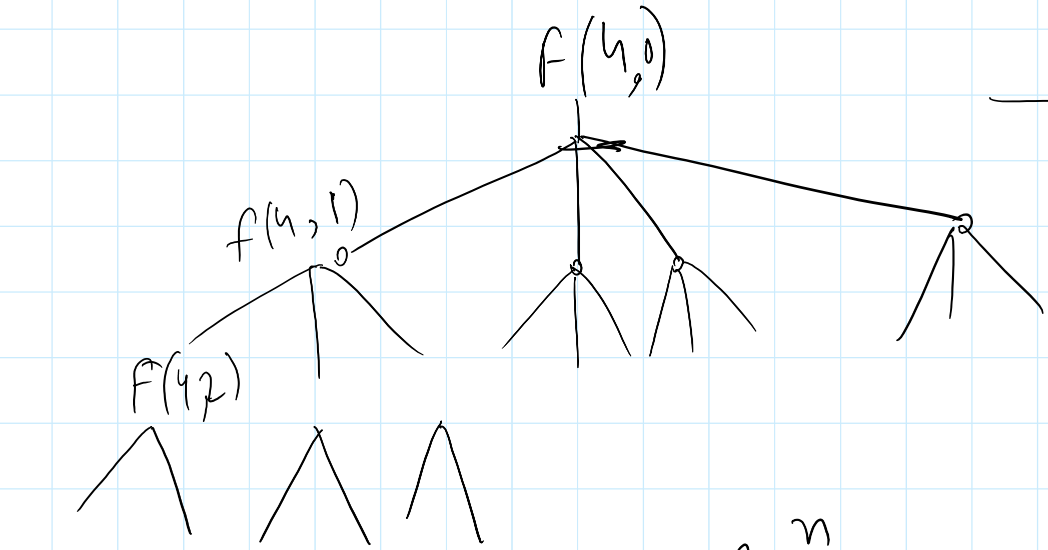
$$=2^n$$

(1) $1\,sec = 10^8$ instructions

$n = 10^8$

$\underline{n}$	$\frac{10^8}{10^8} = 1\,sec$
n^2	$\frac{(10^8)^{\cancel{2}}}{\cancel{10^8}} = 10^8\,sec = 3.17$ years
n^3	$\frac{(10^8)^3}{\cancel{10^8}} = 10^{16}$





4

4·3

4·3·2

$n!$ $n \cdot n$

4·3·2·1