

Recursion

$$5! = 5 \times \boxed{4 \times 3 \times 2 \times 1} = 5 \times 4!$$

$$4! = 4 \times 3 \times 2 \times 1$$

$$\rightarrow \text{fact}(n) = n \times \text{fact}(n-1)$$

$$\boxed{\text{fact}(0) = 1} \leftarrow \text{base case}$$

Ex: 2

| | | | | |
|---|---|---|---|------------------------------|
| 0 | 1 | 2 | 3 | |
| 0 | 1 | 1 | 2 | 3, 5, 8, 13, 21, 34, 55, ... |

$$\boxed{\text{fib}(n) = \text{fib}(n-1) + \text{fib}(n-2)}$$

$$\text{fib}(3) = \boxed{1} + 1 = 2$$

$$\text{fib}(2) = 1$$

Ex-3 palindrone?

| | | | | |
|---|---|---|---|---|
| a | b | c | b | a |
| 0 | 1 | 2 | 3 | 4 |

$$\text{isPal}(0,4) = (s[0] == s[4]) \text{ and } (\text{isPal}(1,3))$$

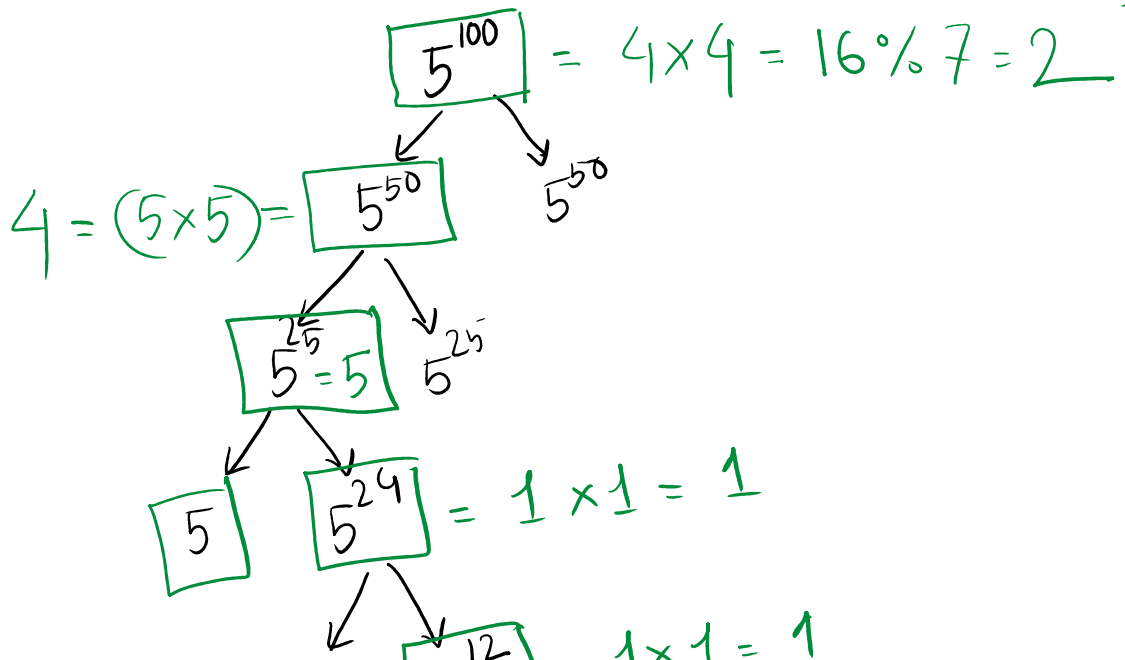
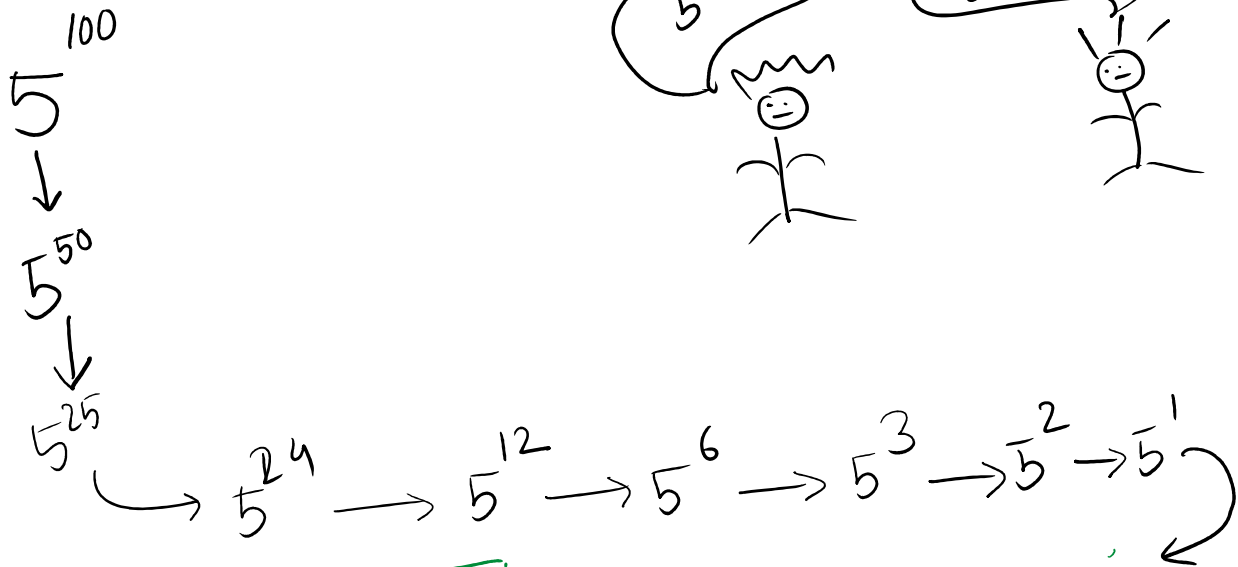
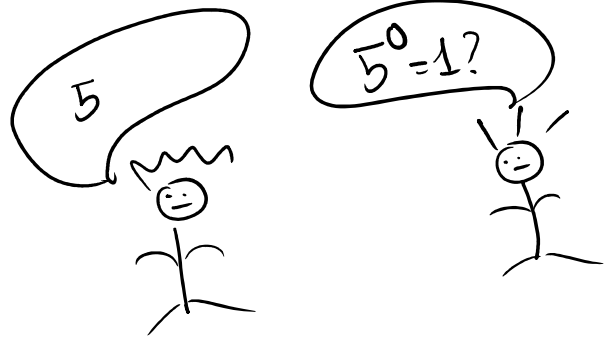
$isPal(0,4) = (s[0] == s[4])$ and (w/o (---))

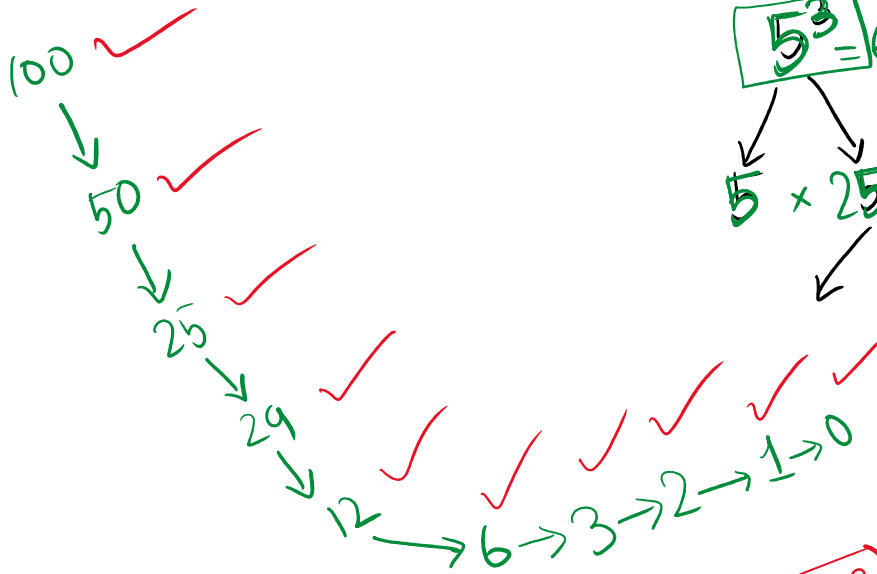
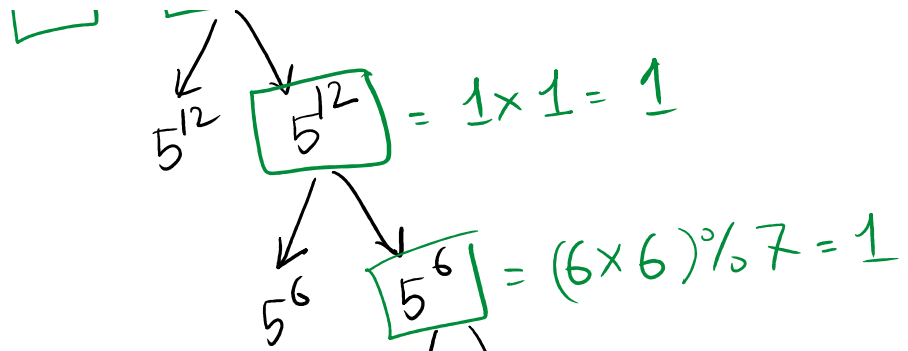
↓ ↓ ↓ ↓ ↓ ↓ ↓
a b c d e f g h i

Ex-4

$a^b \bmod M$

$0 \leq a, b, M \leq 10^9$





| | | |
|--------|---|--|
| 100 | ~ | 7 |
| 1000 | ~ | 10 |
| 10000 | ~ | 13 |
| 100000 | ~ | 17 |
| 10^6 | ~ | 20 |
| 10^7 | ~ | 24 |
| 10^8 | ~ | 27 |
| 10^9 | ~ | 29 |

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$a^b \bmod M$

$b = 10$

$\log_2 b \approx 60$

$$\text{expo}(a, b) = \begin{cases} (\text{expo}(a, b/2))^2 & ; \text{if } b \text{ is even} \\ (\text{expo}(a, b-1) \times a) & ; \text{if } b \text{ is odd} \\ 1 & ; \text{if } b = 0 \end{cases}$$

a^b

$\text{expo}(a, b) \rightarrow \{$

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if $(b == 0)$ return 1;

if $(b \% 2 == 0) \rightarrow$

auto half_expo = $\text{expo}(a, b/2)$;

return half_expo * half_expo;

return $(a \times \text{expo}(a, b-1))$;

