# Recursion

•••

Who answers when you call yourself ?

# But first, what is recursion ?

It is a method of solving problems that uses a function that calls itself from inside.

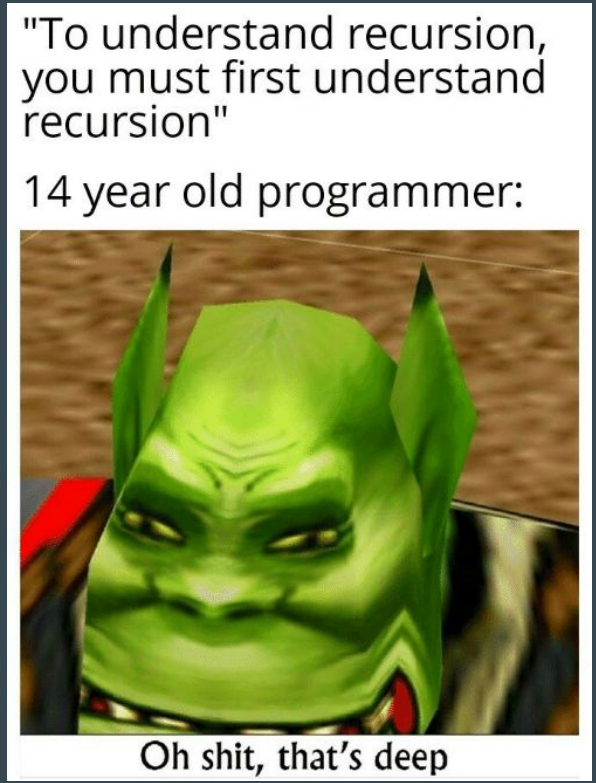
It looks something like that:

```
def myRecursiveFunction():

       return myRecursiveFunction()

print(myRecursiveFunction())
```

Warning : this code might show what recursion looks like, but it has several problems, can you spot it ?



# So, what is wrong with it ?

```
def myRecursiveFunction():

        return myRecursiveFunction()

print(myRecursiveFunction())
```

1. The function has no parameters =>
    i. The function calls an identical version of itself
    ii. It is impossible to change the behaviour of the function
2. There is no base cases => what do we return when we hit the end of the loop

```
def myRecursiveFunction(n):
        if n==0:
                return 1
        return myRecursiveFunction(n-1)*n

print(myRecursiveFunction(9))
```

# When to use it ?

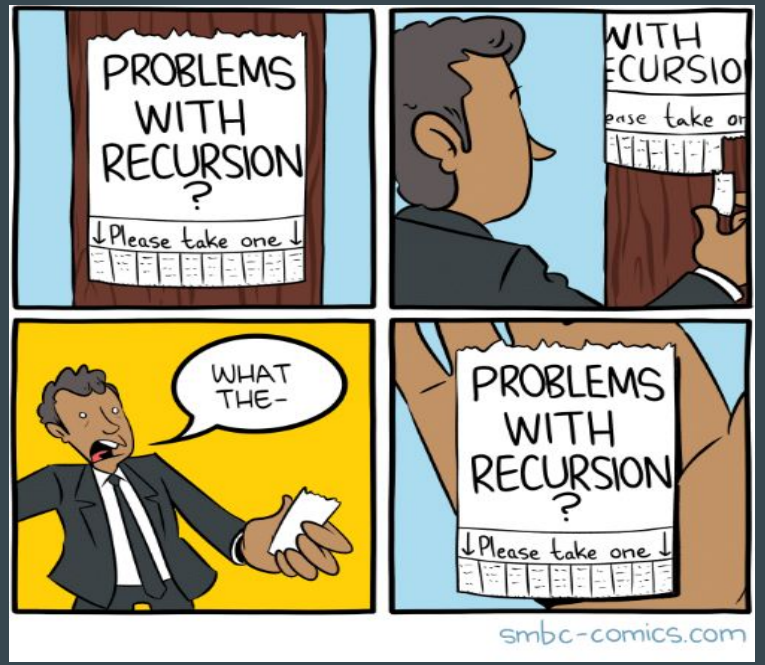
-Main problem is divisible in similar smaller problems

-We could use it almost everywhere :

Iteration ⇔ Recursion

*So why use recursion at all ?*

-Combine MULTIPLE sub-problems to get the final solution



# Some examples

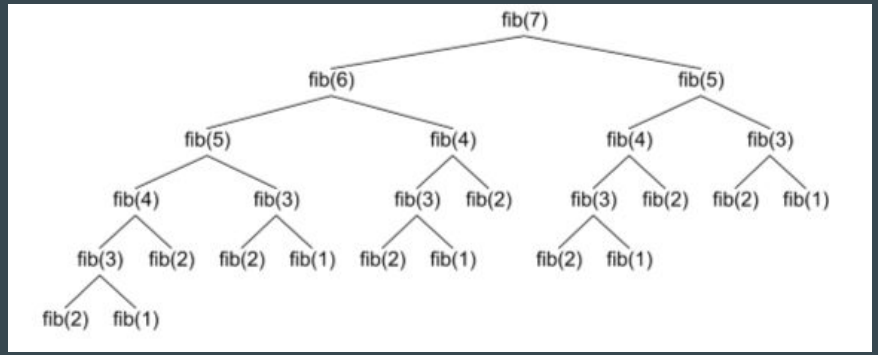
Fibonacci sequence : $F_0 = 0$ | $F_1 = 1$ | $F_n = F_{n-1} + F_{n-2}$

What we see: To know $F_n$ we must first know the two termes before.

In summary, $F_n$ is divisible in the same problems but smaller => Let's use recursion

```
def fibonacci(n):
      if n==0: return 0
      if n==1: return 1
      return fibonacci(n-1)+fibonacci(n-2)

print(fibonacci(7))
```




Works but be careful of the complexity !

Complexity : $O(2^n)$

# Some examples

We have a family tree, and want to count the number of descendants of one person.

=> it is the sum of each child of this person and the number of descendants of each child

We can write numDesc(person) = numChild + sum(numDesc(child) for each child)

```
def numDesc(person):
	childs = person.childs
	numD = len(person.childs)
	for(child in childs):
		numD += numDesc(child)
	return numD
```

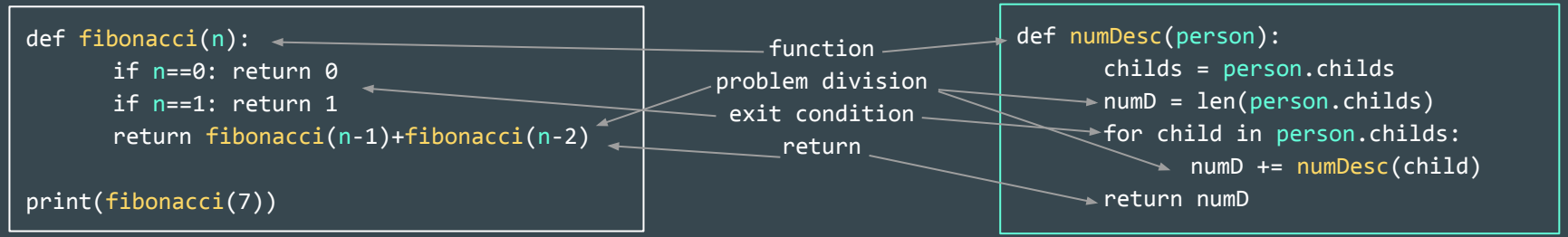
# How to make it ?

-Create a function (python syntax : `def myFunction(param):` )

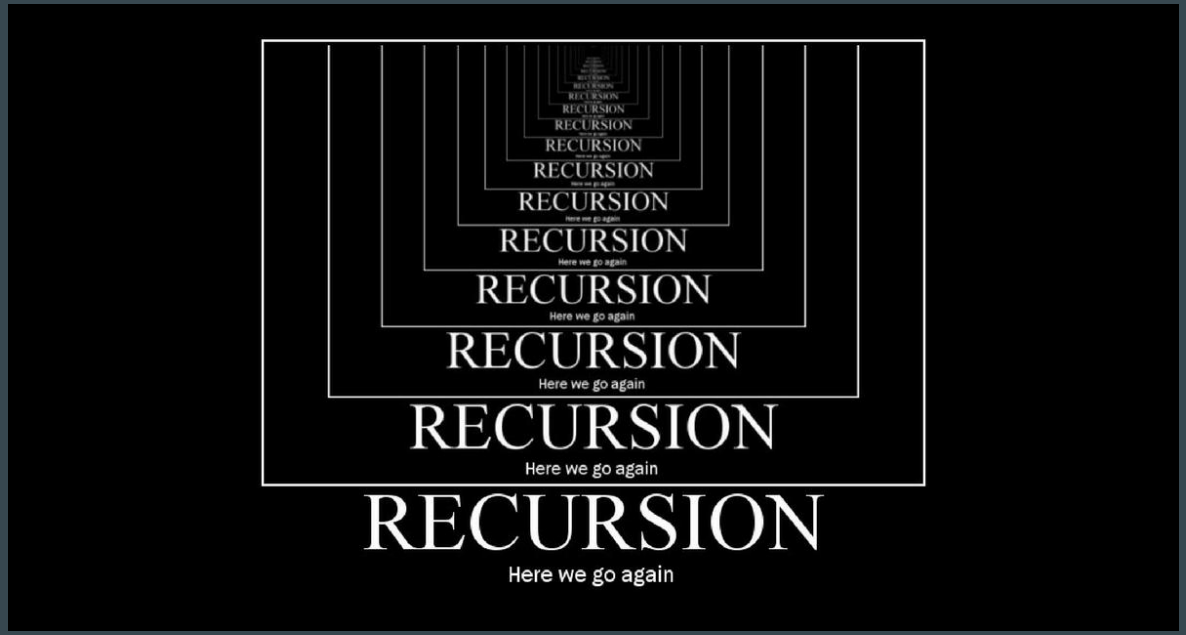
-Divide the main problem in smaller problem (find the equation between problems)

-Identify how to stop the loop (base cases/no more parsing possible)

-Remember to return a result



# Question ?


RECURSION
Here we go again
RECURSION
Here we go again
RECURSION
Here we go again
RECURSION
Here we go again
RECURSION
Here we go again
RECURSION
Here we go again
RECURSION
Here we go again
RECURSION
Here we go again
RECURSION
Here we go again