

Recursion

Consider the Problem

There are **N** people in a room. What will be the total number of handshakes if each person shakes hand with everyone else in the room once?



A



B



C



D

.....



N

Let's solve a simpler problem first !!

What if we had only 2 persons in the room?

Let's solve a simpler problem first !!

What if we had only 2 persons in the room?



A

Let's solve a simpler problem first !!

What if we had only 2 persons in the room?



A



B

Let's solve a simpler problem first !!

What if we had only 2 persons in the room?

1 Hand Shake



A



B

With 3 persons in the room !!

What if we had 3 persons in the room?



A

With 3 persons in the room !!

What if we had 3 persons in the room?



A



B

With 3 persons in the room !!

What if we had 3 persons in the room?



A



B



C

With 3 persons in the room !!

What if we had 3 persons in the room?

3 Hand Shakes



A



B



A



C



B



C

With 4 persons in the room !!

What if we had 4 persons in the room?



A

With 4 persons in the room !!

What if we had 4 persons in the room?



A



B

With 4 persons in the room !!

What if we had 4 persons in the room?



A



B



C

With 4 persons in the room !!

What if we had 4 persons in the room?



A



B



C

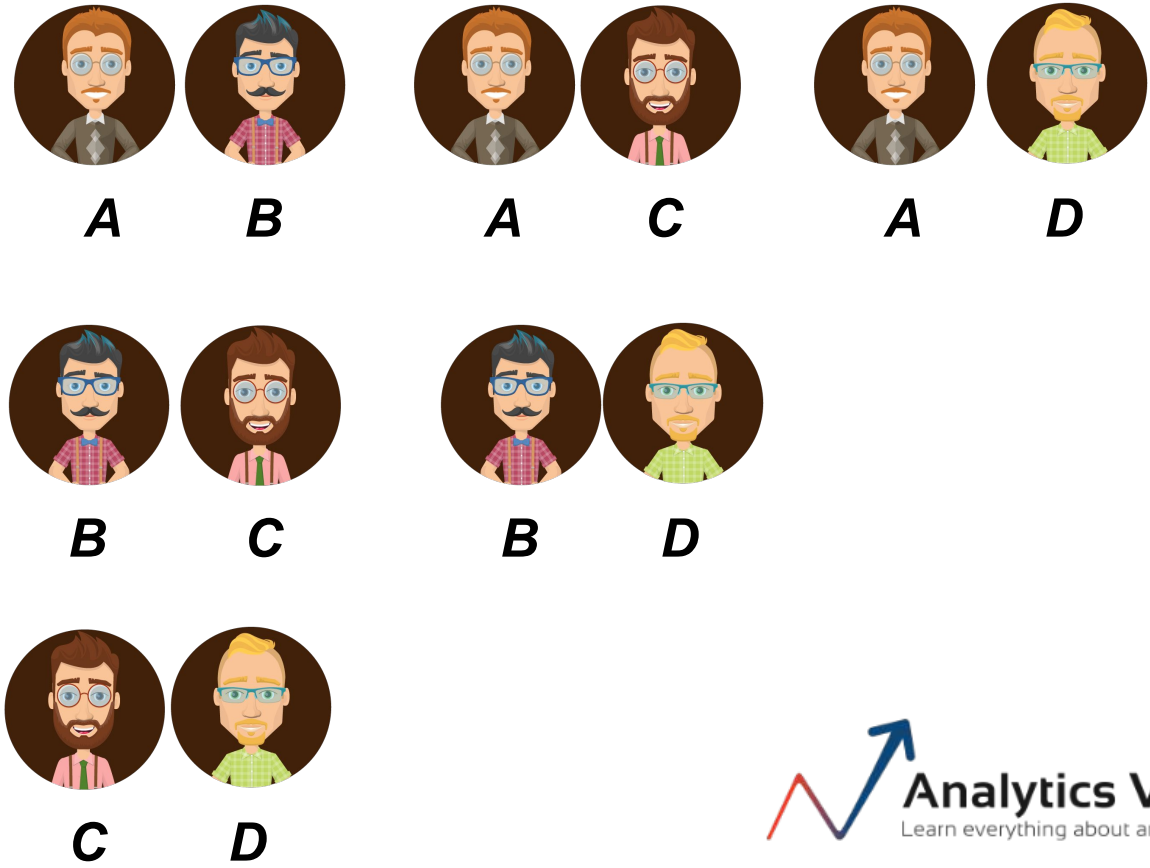


D

With 4 persons in the room !!

What if we had 4 persons in the room?

6 Hand Shakes



With 5 persons in the room !!

What if we had 5 persons in the room?



A

With 5 persons in the room !!

What if we had 5 persons in the room?



A



B

With 5 persons in the room !!

What if we had 5 persons in the room?



A



B



C

With 5 persons in the room !!

What if we had 5 persons in the room?



A



B



C



D

With 5 persons in the room !!

What if we had 5 persons in the room?



A



B



C



D

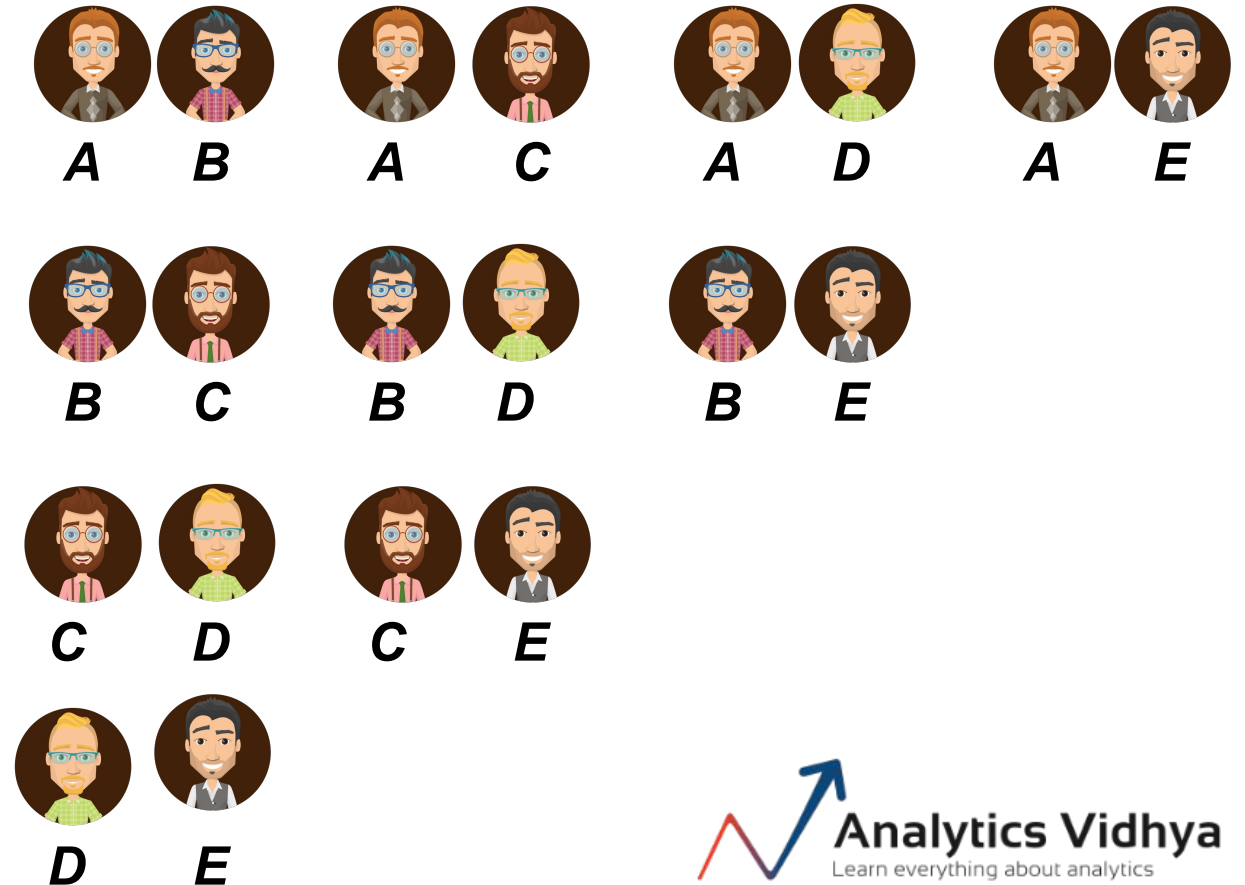


E

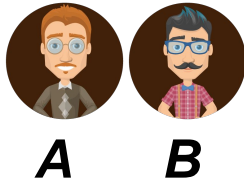
With 5 persons in the room !!

What if we had 5 persons in the room?

10 Hand Shakes



Look at the results



$F(2) = 1$ Hand Shake

Look at the results



A

B

$F(2) = 1$ Hand Shake



A

B

C

$F(3) = 3$ Hand Shakes

Look at the results



A

B

$F(2) = 1$ Hand Shake



A

B

C

$F(3) = 3$ Hand Shakes



A

B

C

D

$F(4) = 6$ Hand Shakes

Look at the results



A

B

$F(2) = 1$ Hand Shake



A

B

C

$F(3) = 3$ Hand Shakes



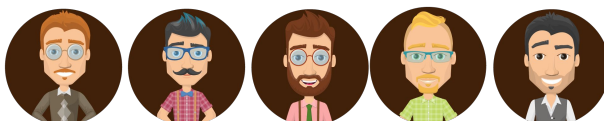
A

B

C

D

$F(4) = 6$ Hand Shakes



A

B

C

D

E

$F(5) = 10$ Hand Shakes

Did you observe the pattern in the results ?

Look at the results



A

B

$$F(2) = 1$$



A

B

C

$$F(3) = 3$$

$$F(3) = F(2) + 2$$



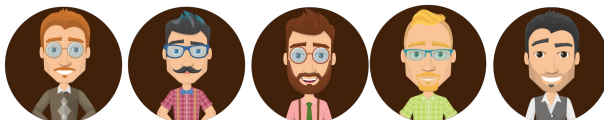
A

B

C

D

$$F(4) = 6$$



A

B

C

D

E

$$F(5) = 10$$

Look at the results



A

B

$$F(2) = 1$$



A

B

C

$$F(3) = 3$$

$$F(3) = F(2) + 2$$



A

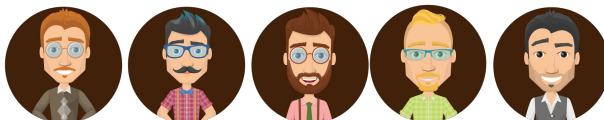
B

C

D

$$F(4) = 6$$

$$F(4) = F(3) + 3$$



A

B

C

D

E

$$F(5) = 10$$

Look at the results



A

B

$$F(2) = 1$$



A

B

C

$$F(3) = 3$$

$$F(3) = F(2) + 2$$



A

B

C

D

$$F(4) = 6$$

$$F(4) = F(3) + 3$$



A

B

C

D

E

$$F(5) = 10$$

$$F(5) = F(4) + 4$$

$$F(N) = F(N-1) + (N-1)$$

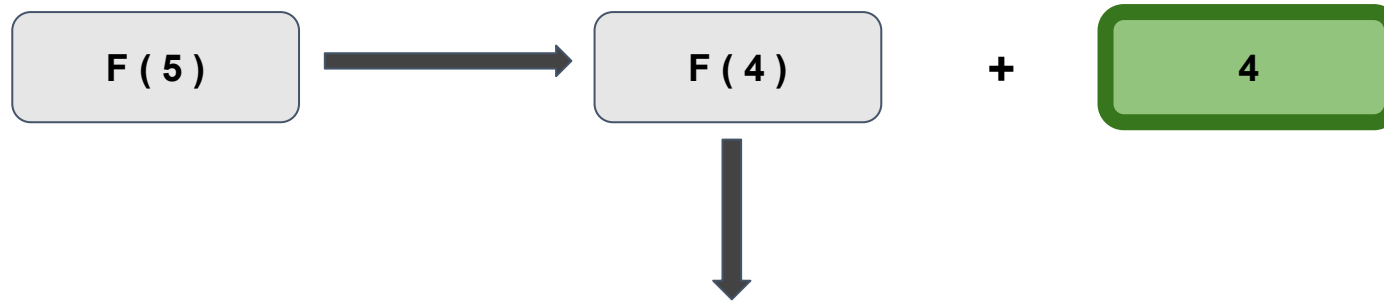
F (5)

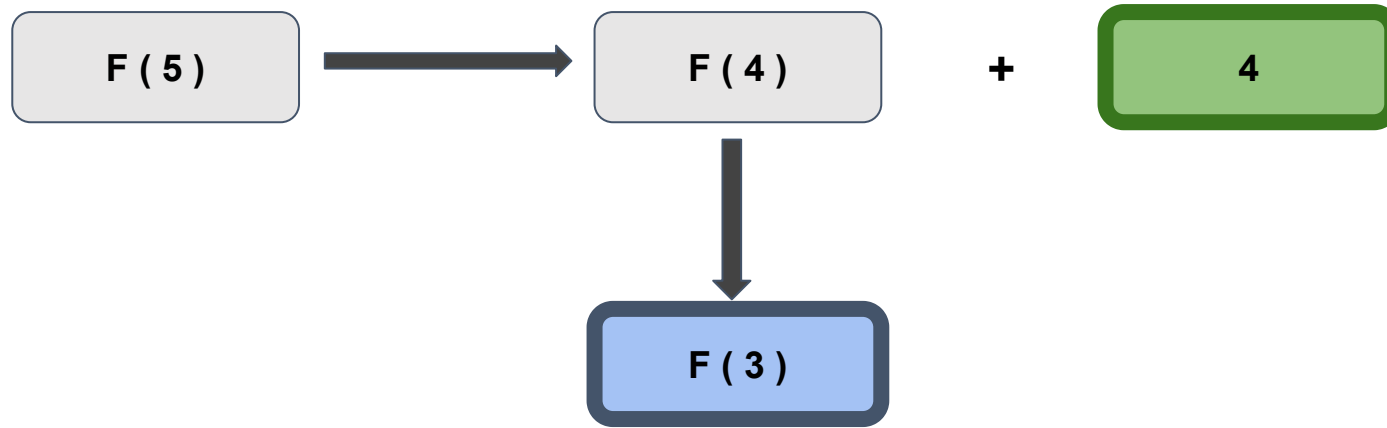
F (5)

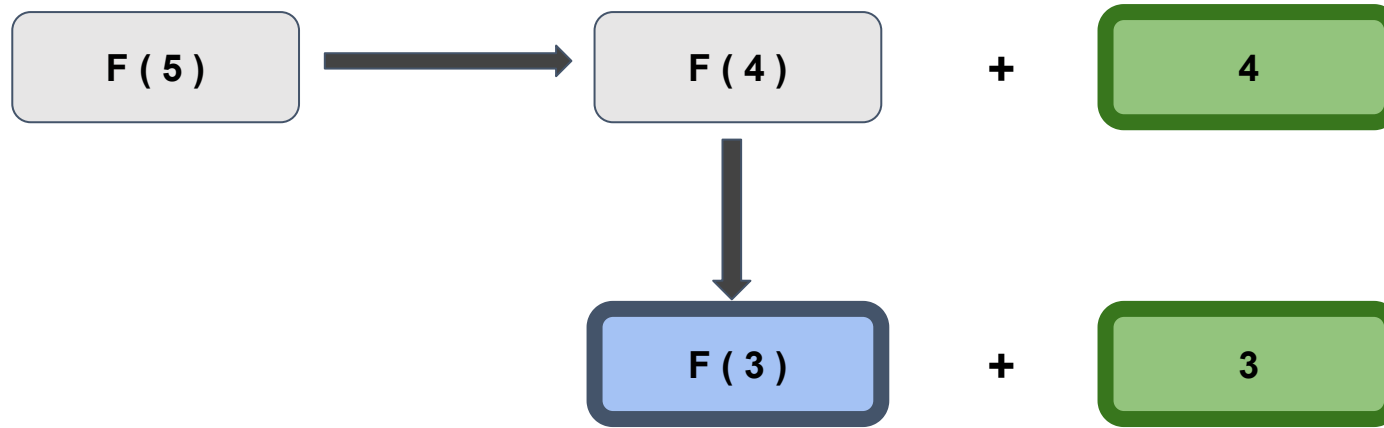


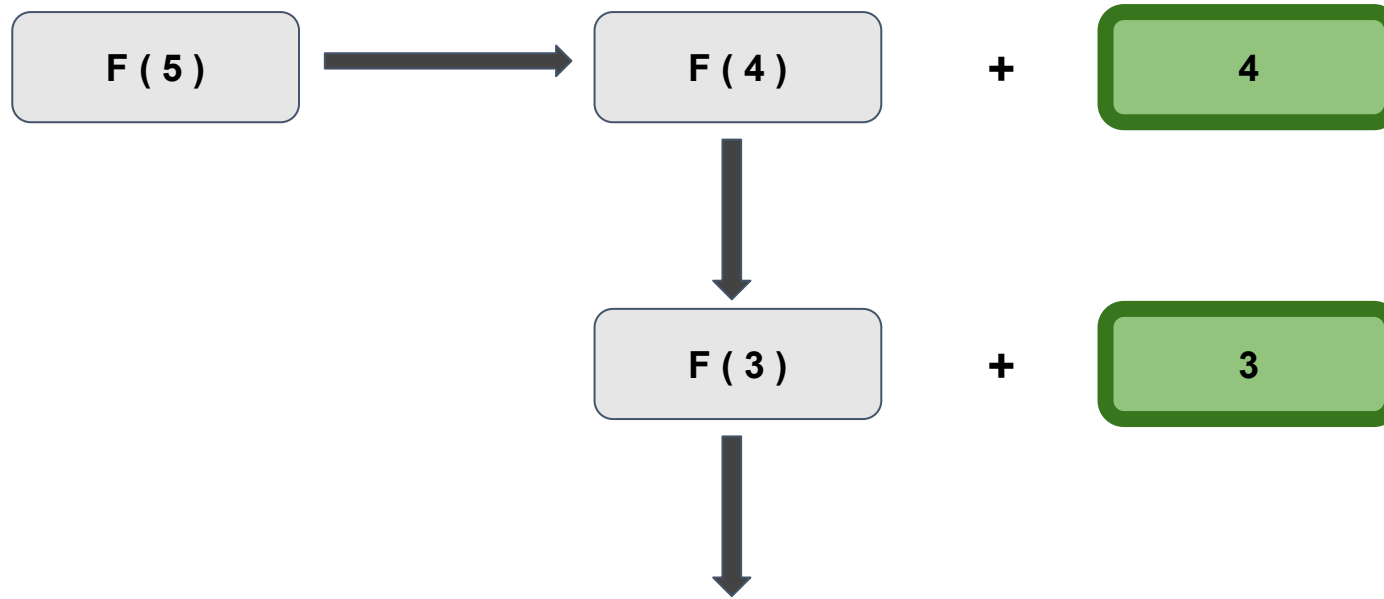


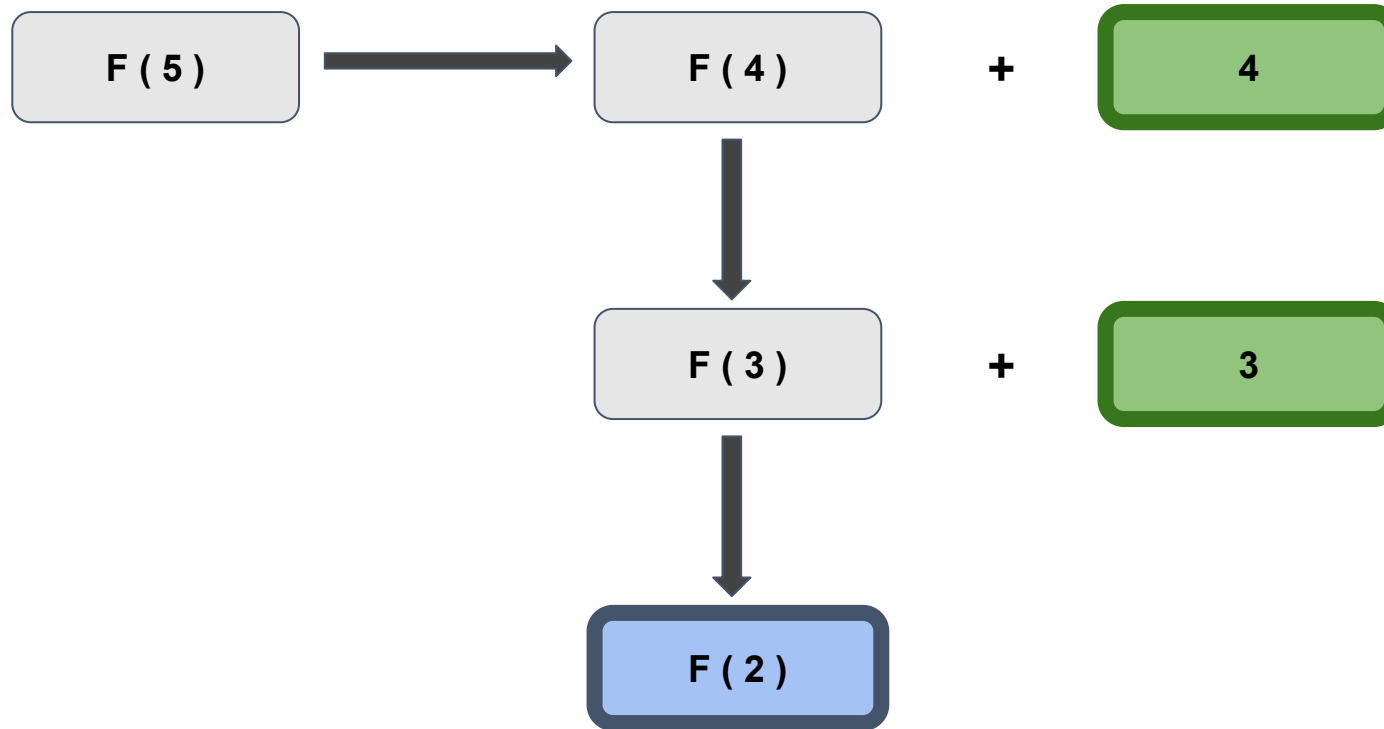


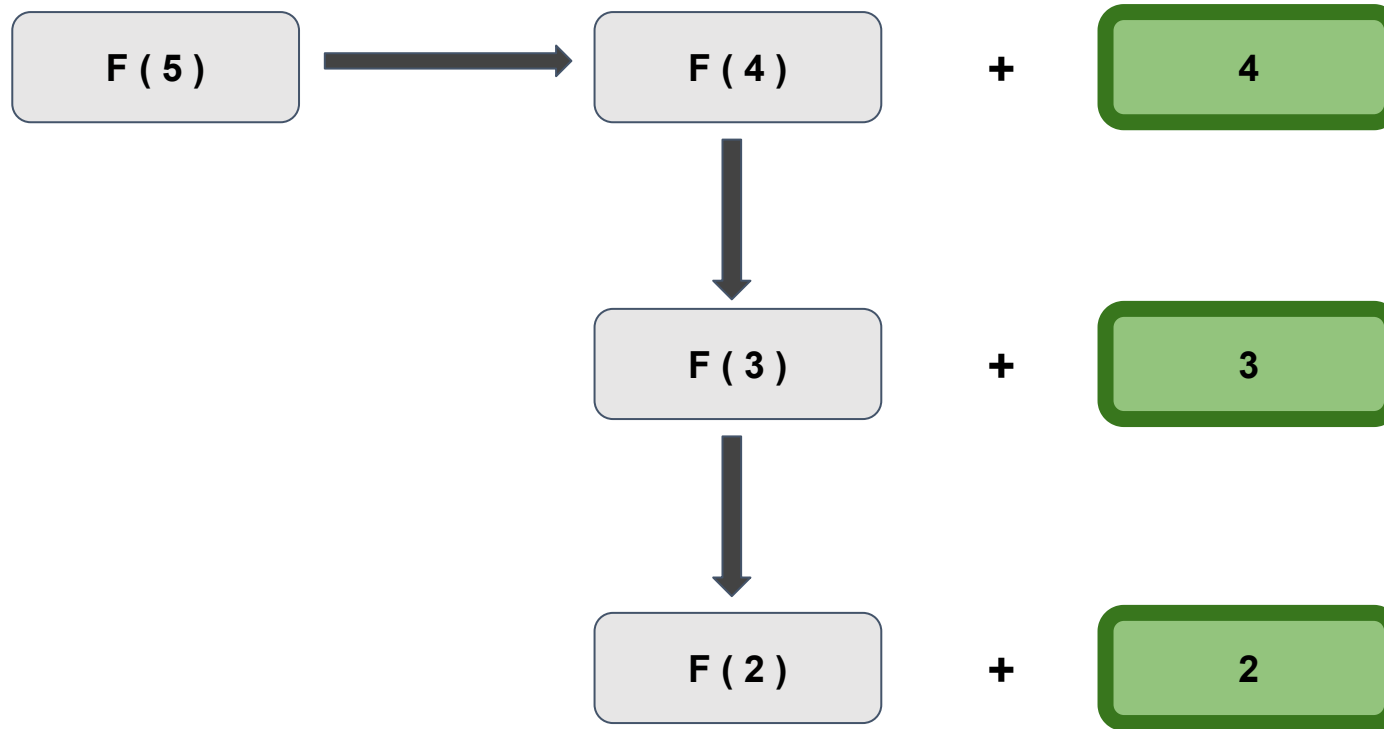


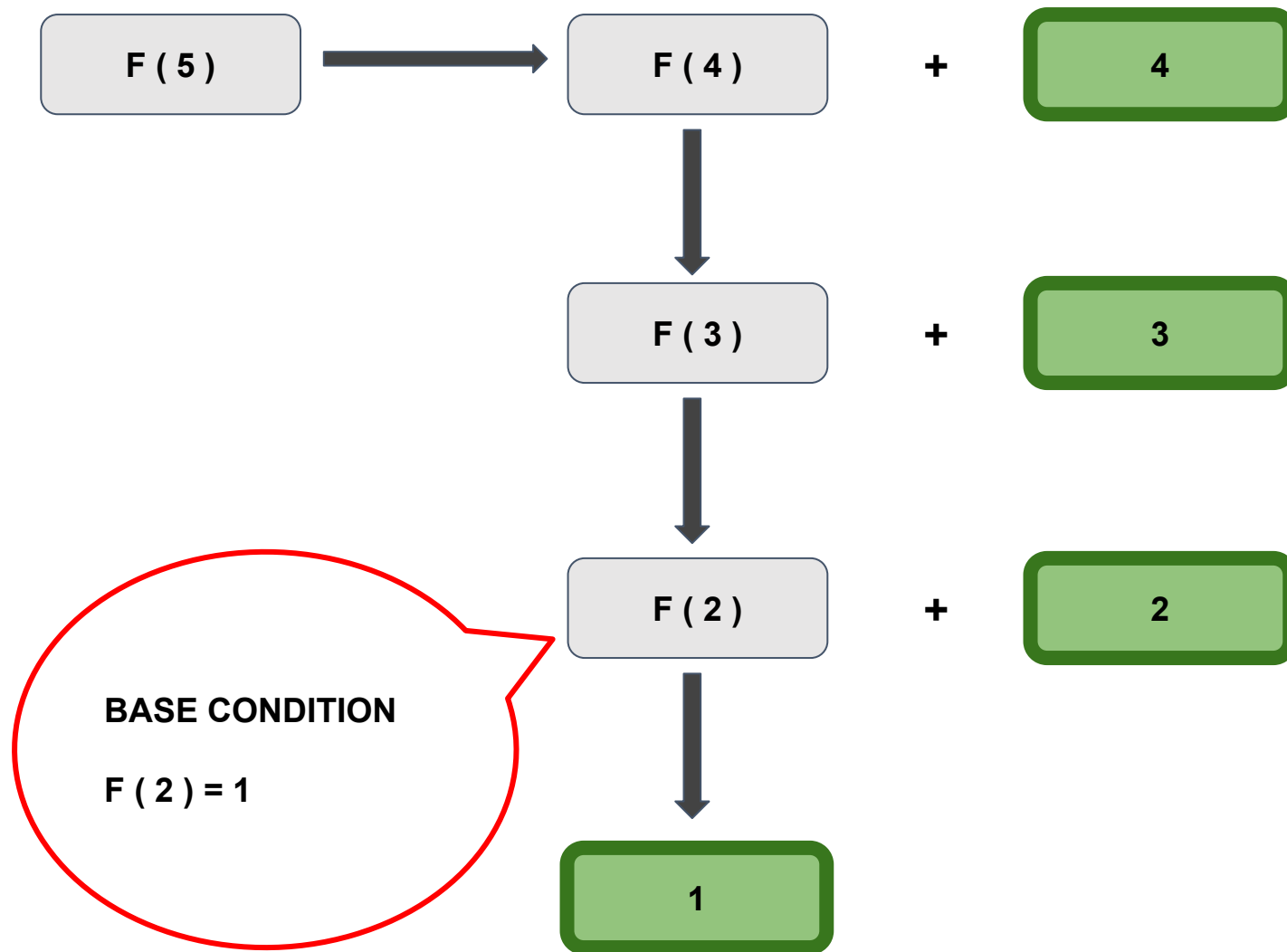


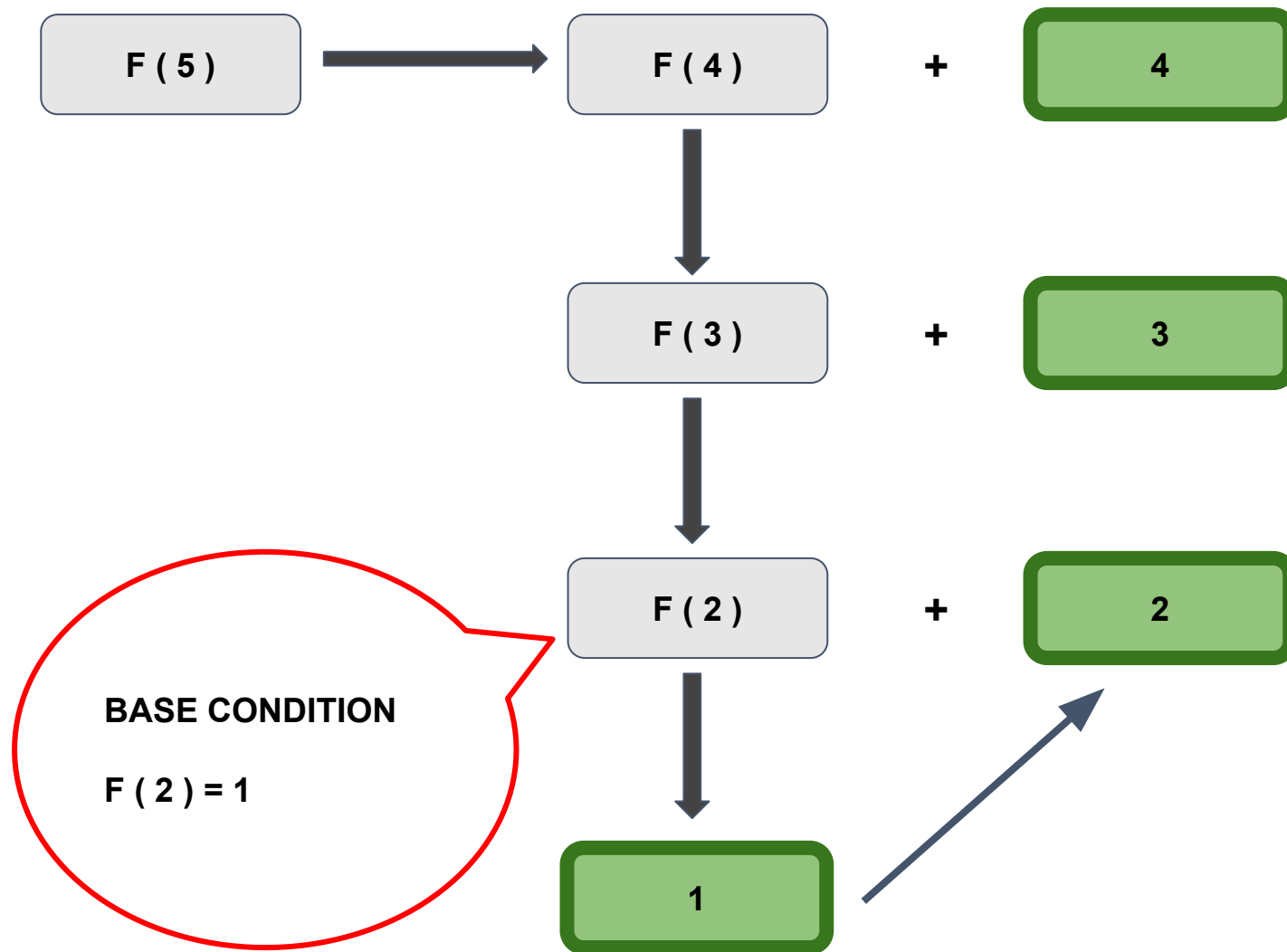


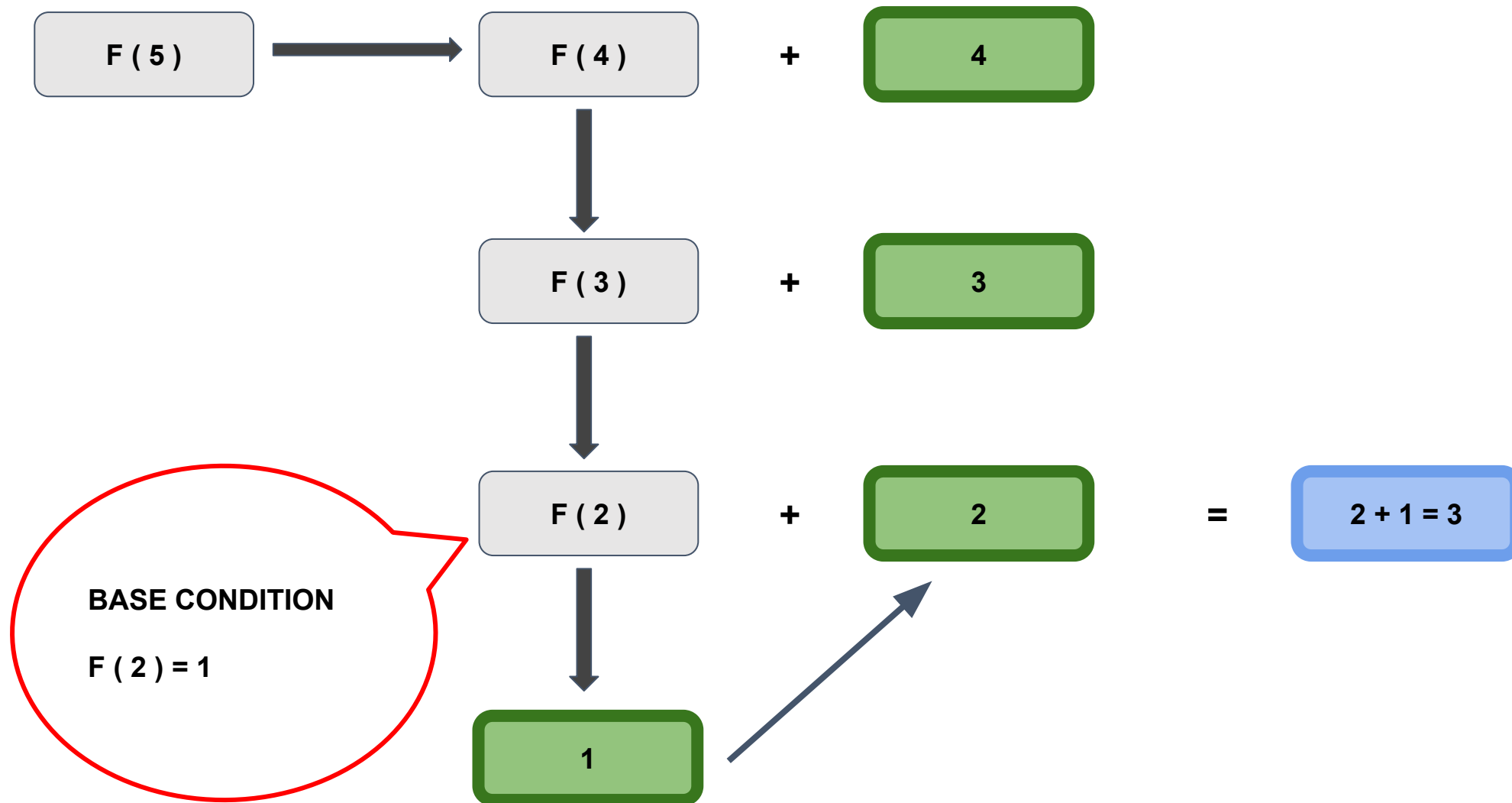


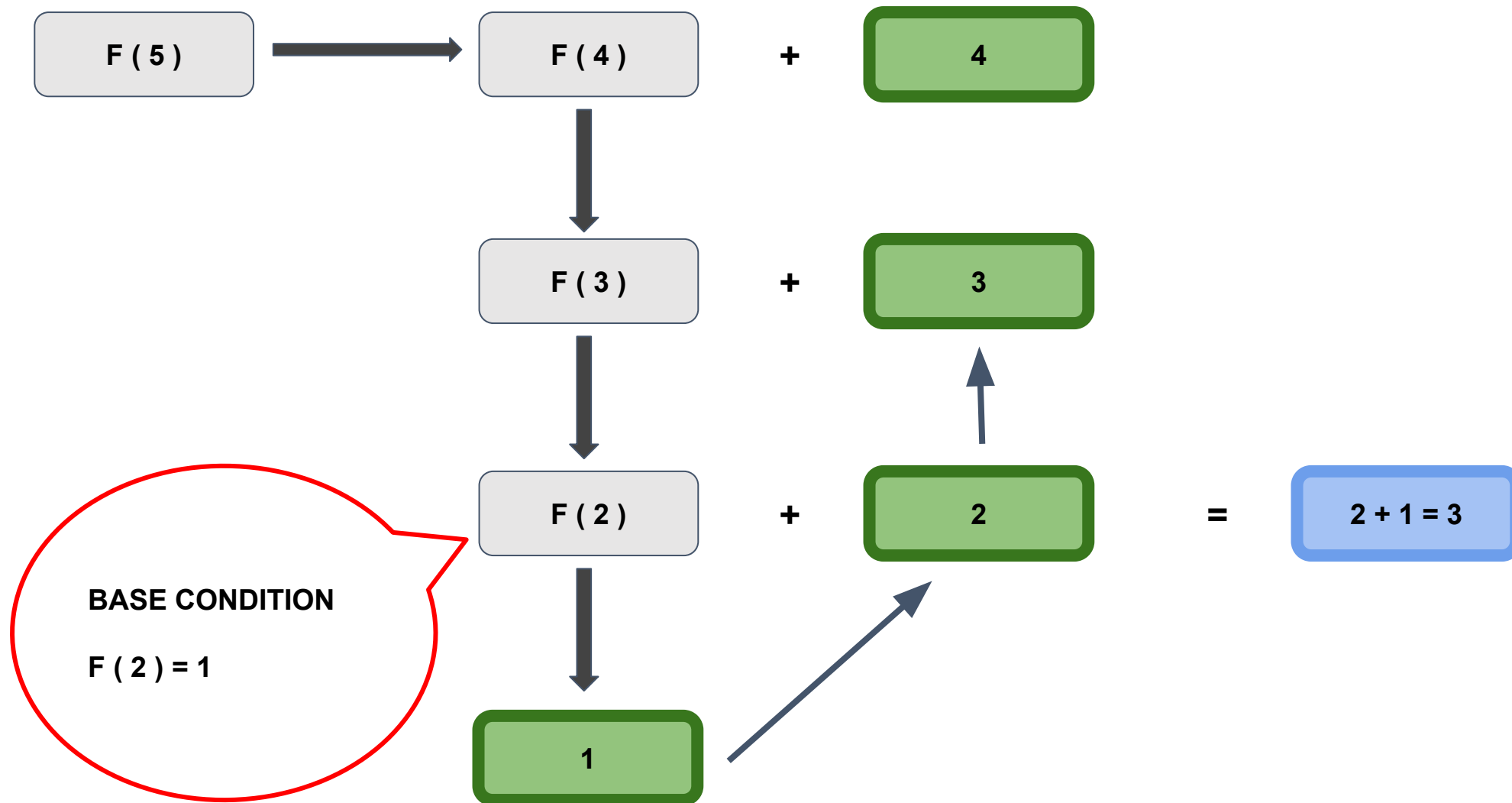


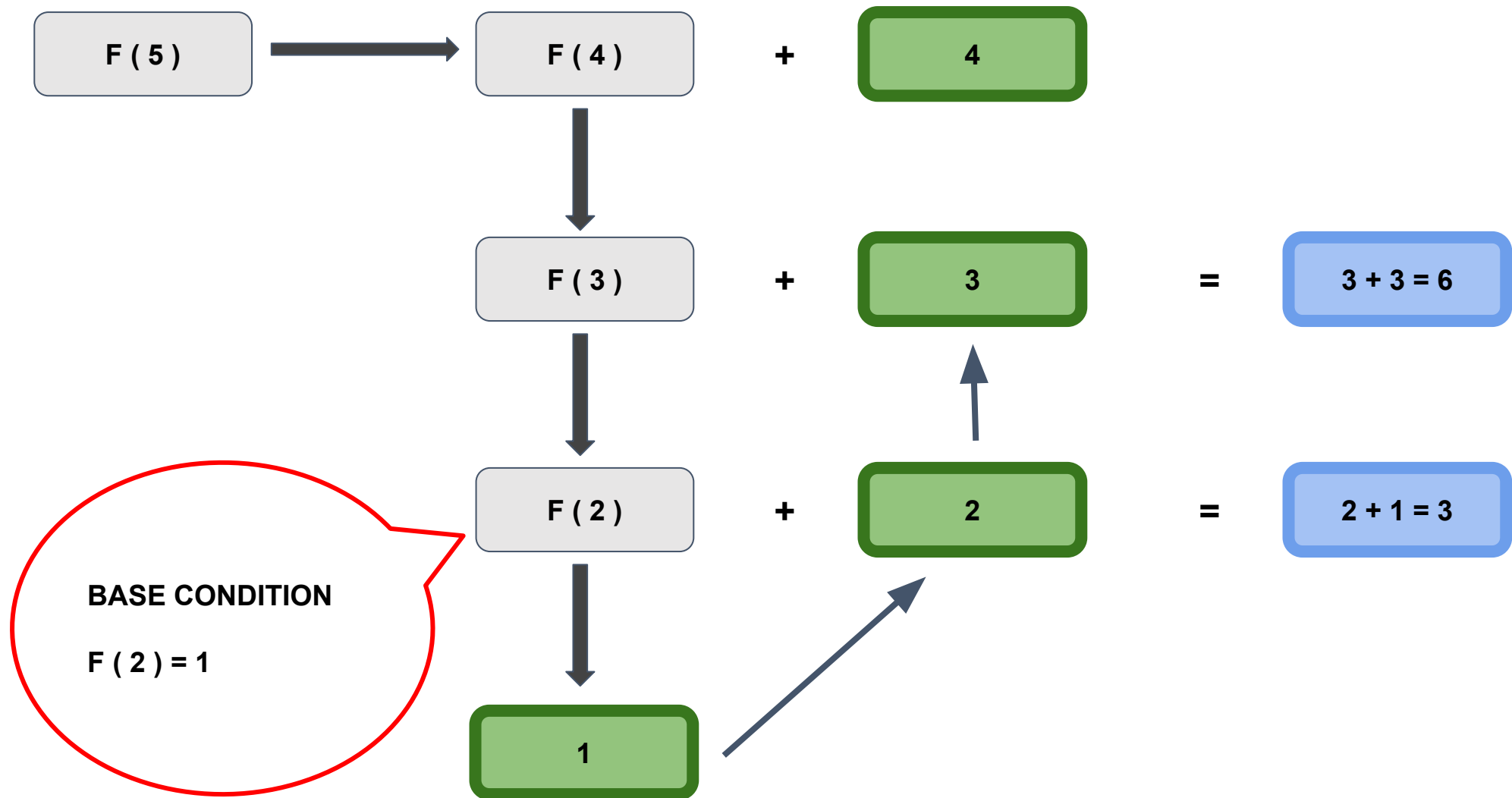


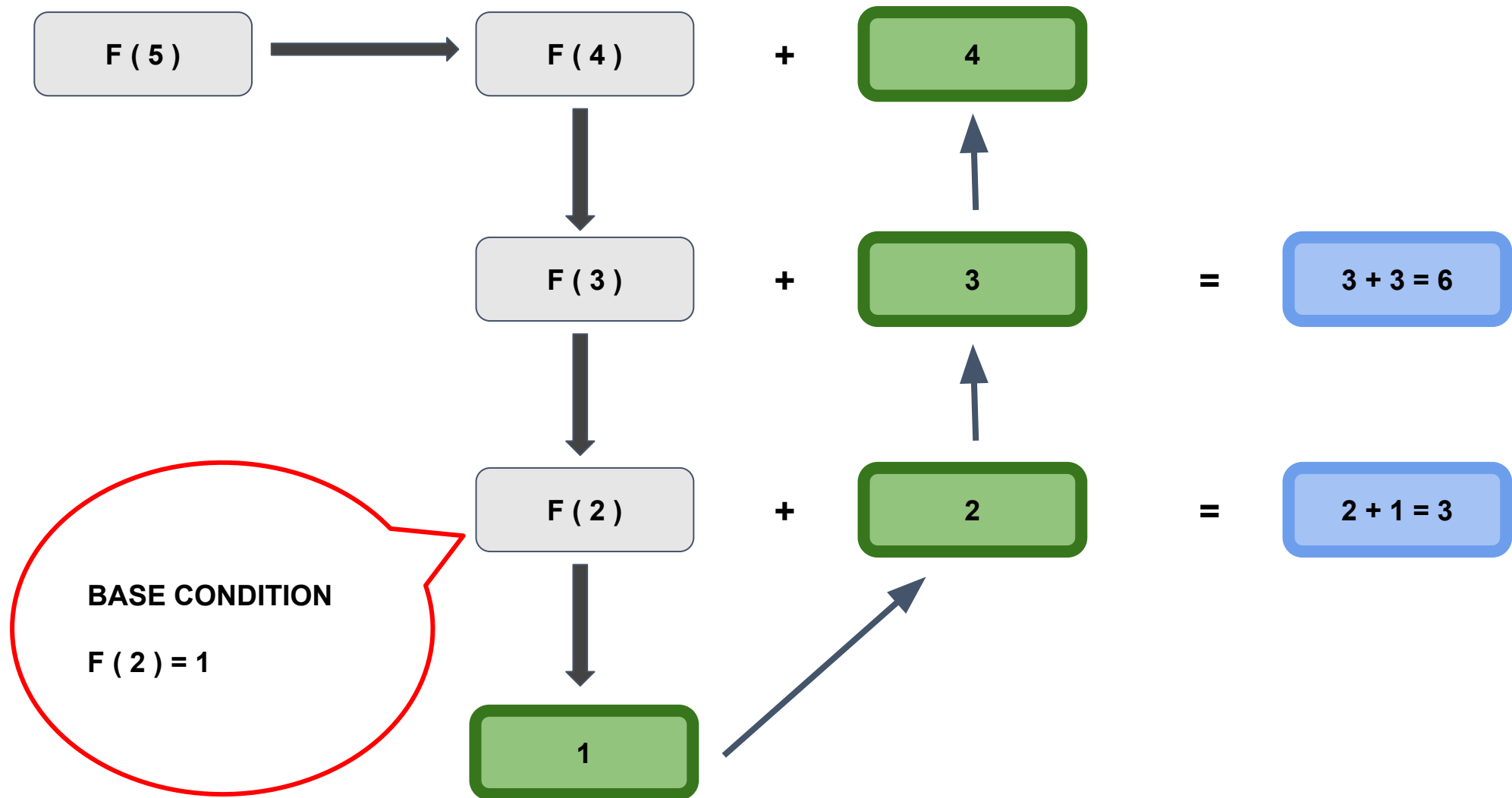


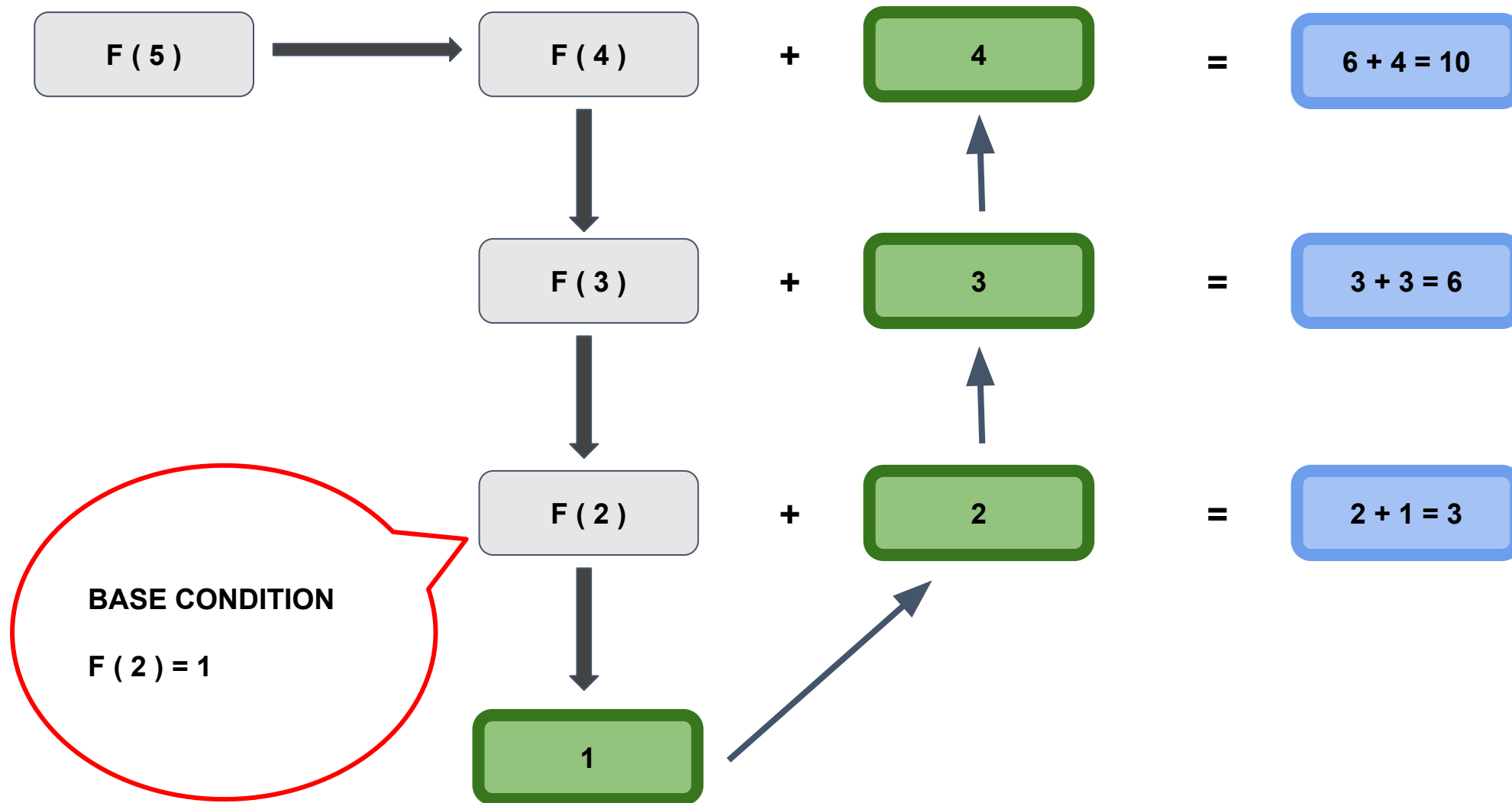


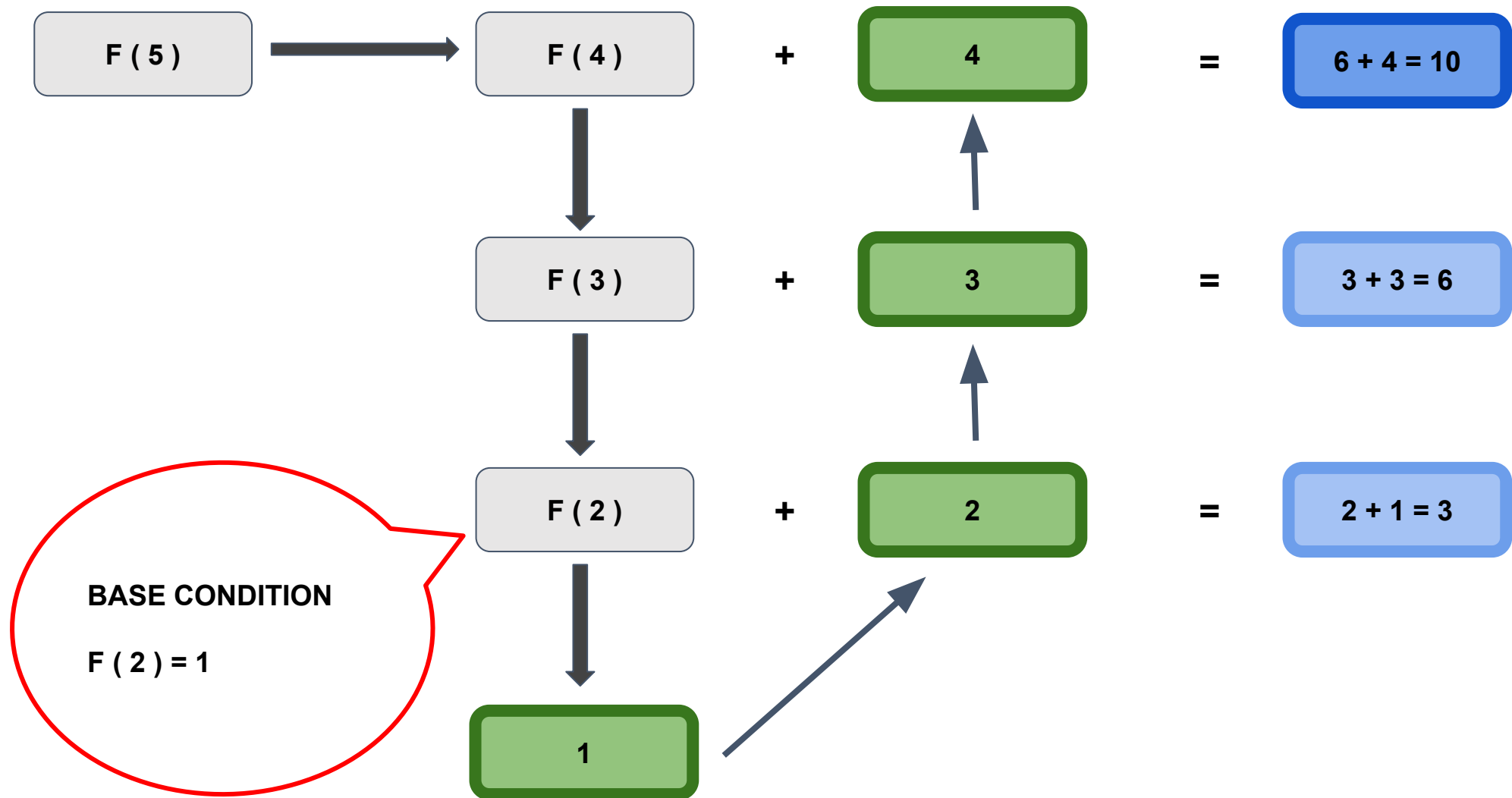












**START THE
RECURSIVE
FUNCTION**

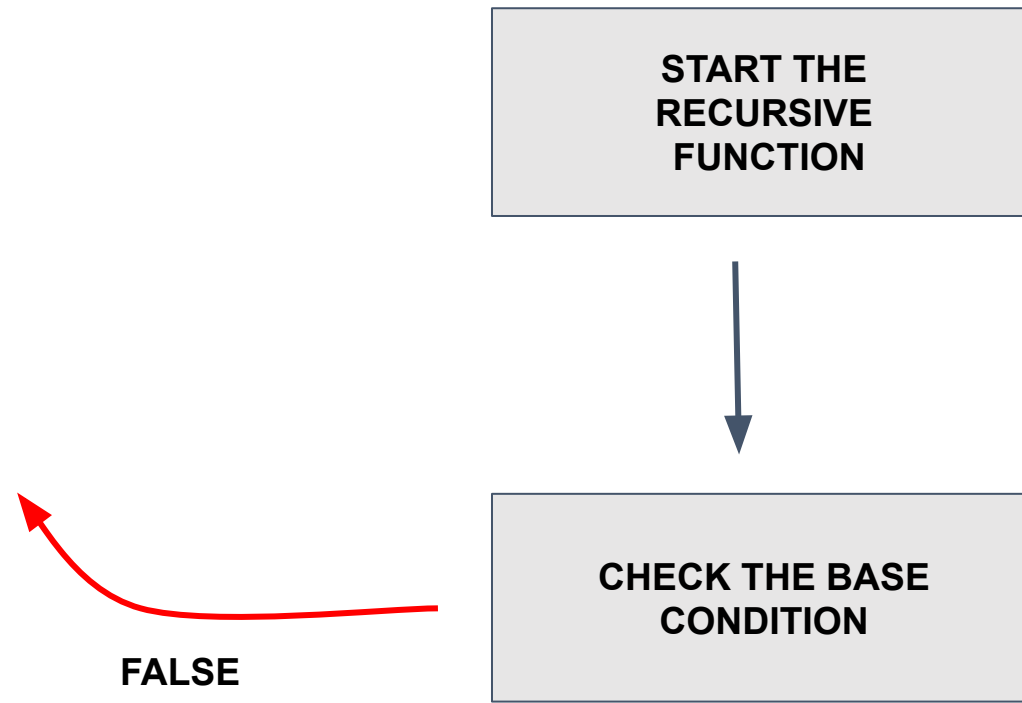
**START THE
RECURSIVE
FUNCTION**

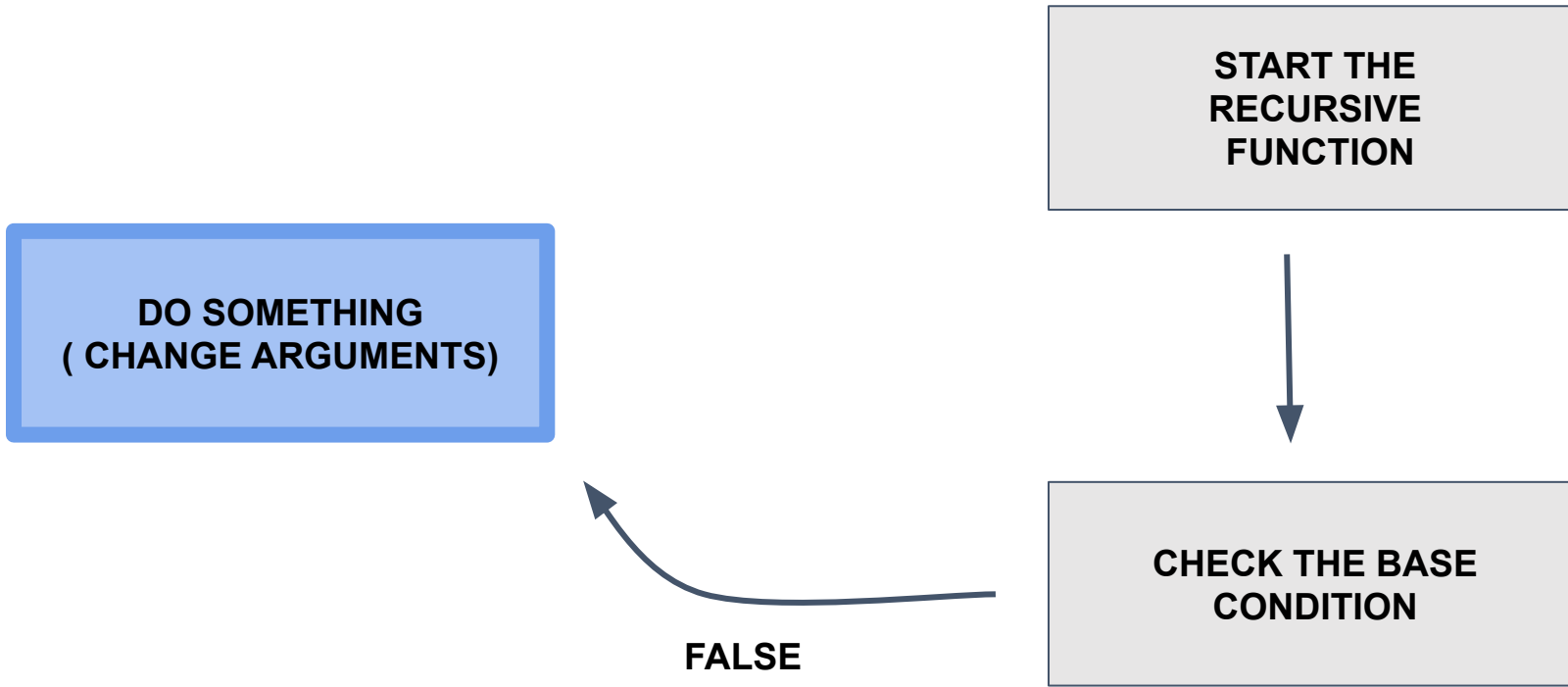


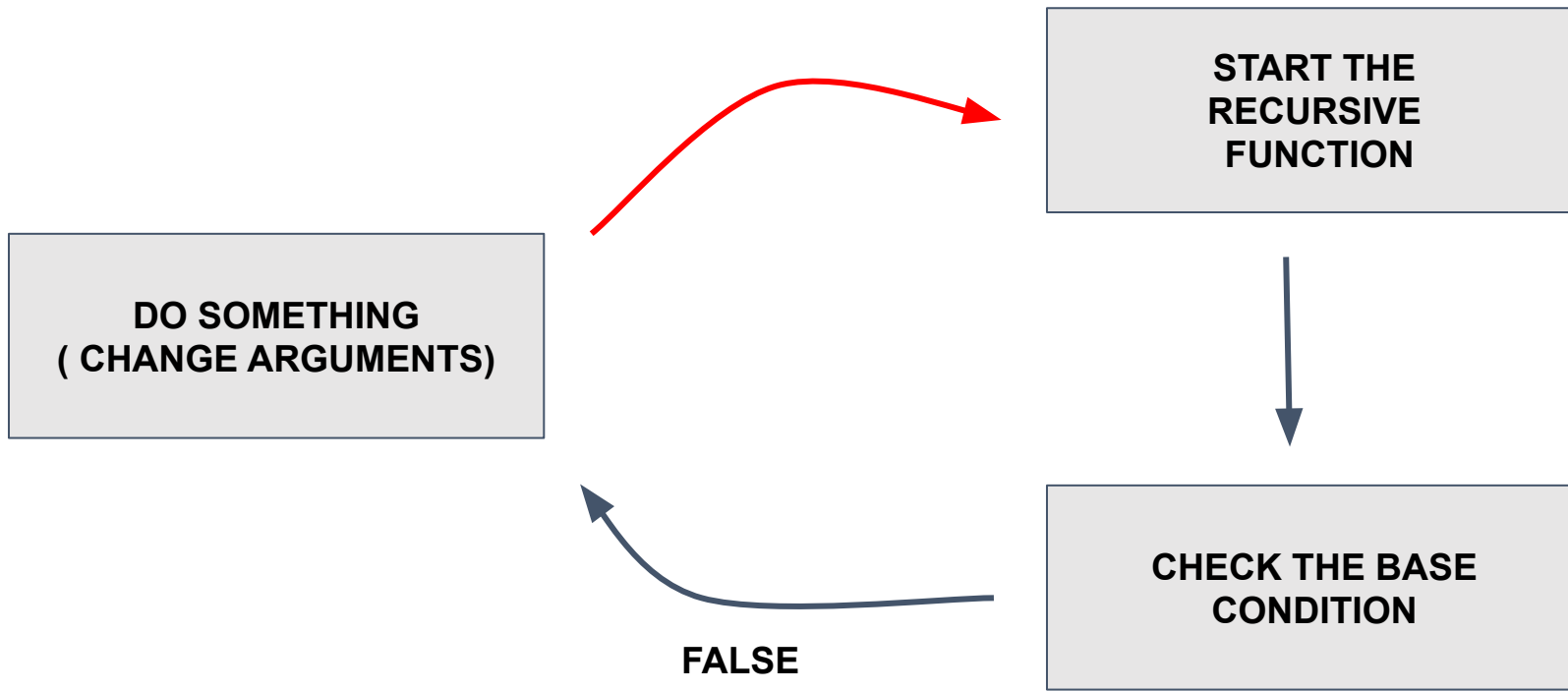
**START THE
RECURSIVE
FUNCTION**

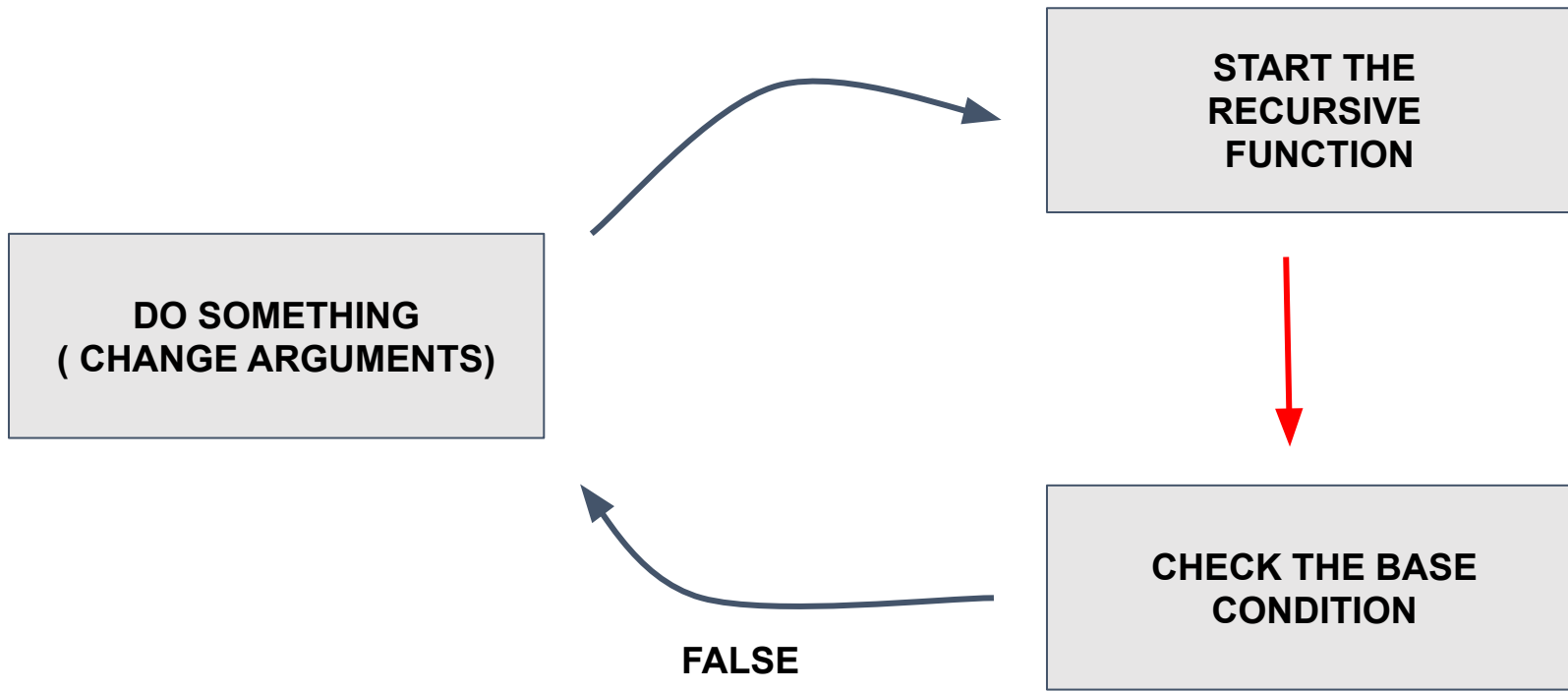


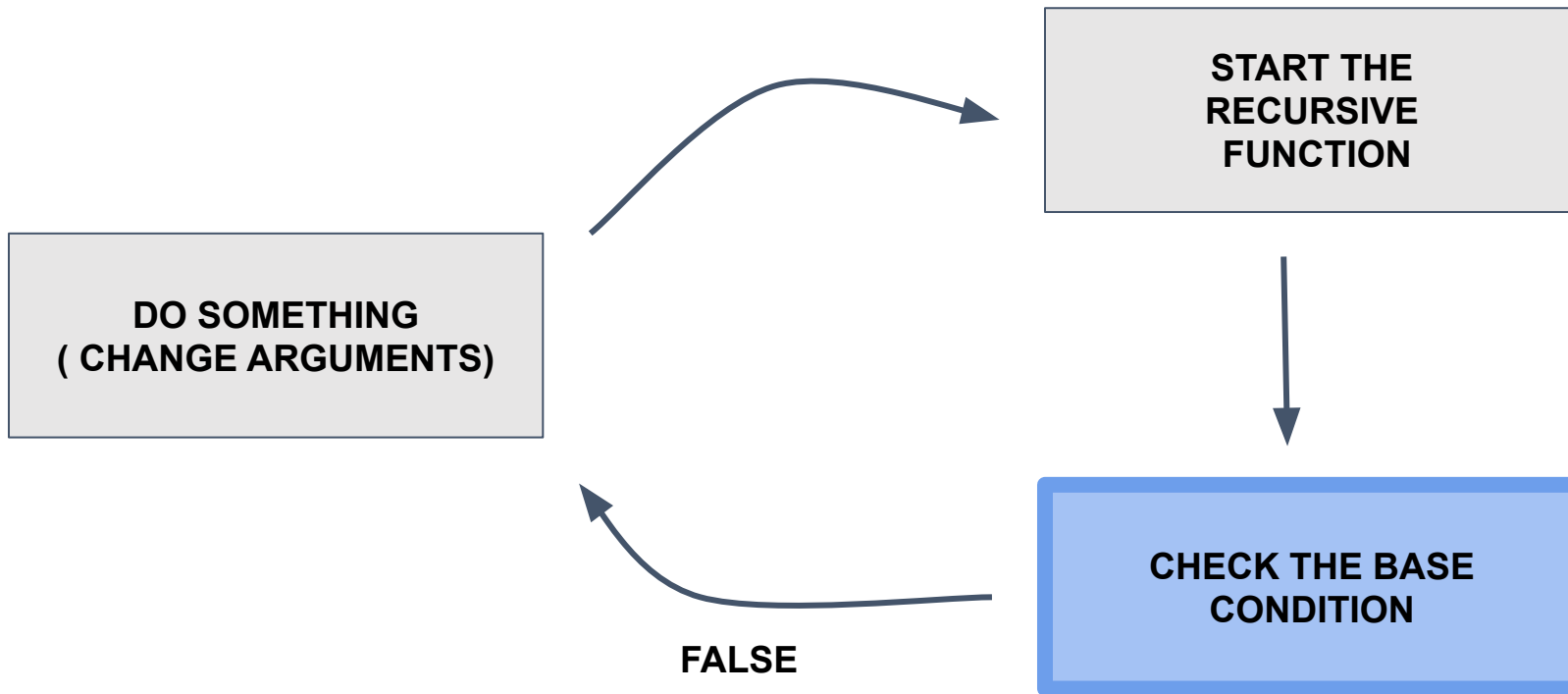
**CHECK THE BASE
CONDITION**

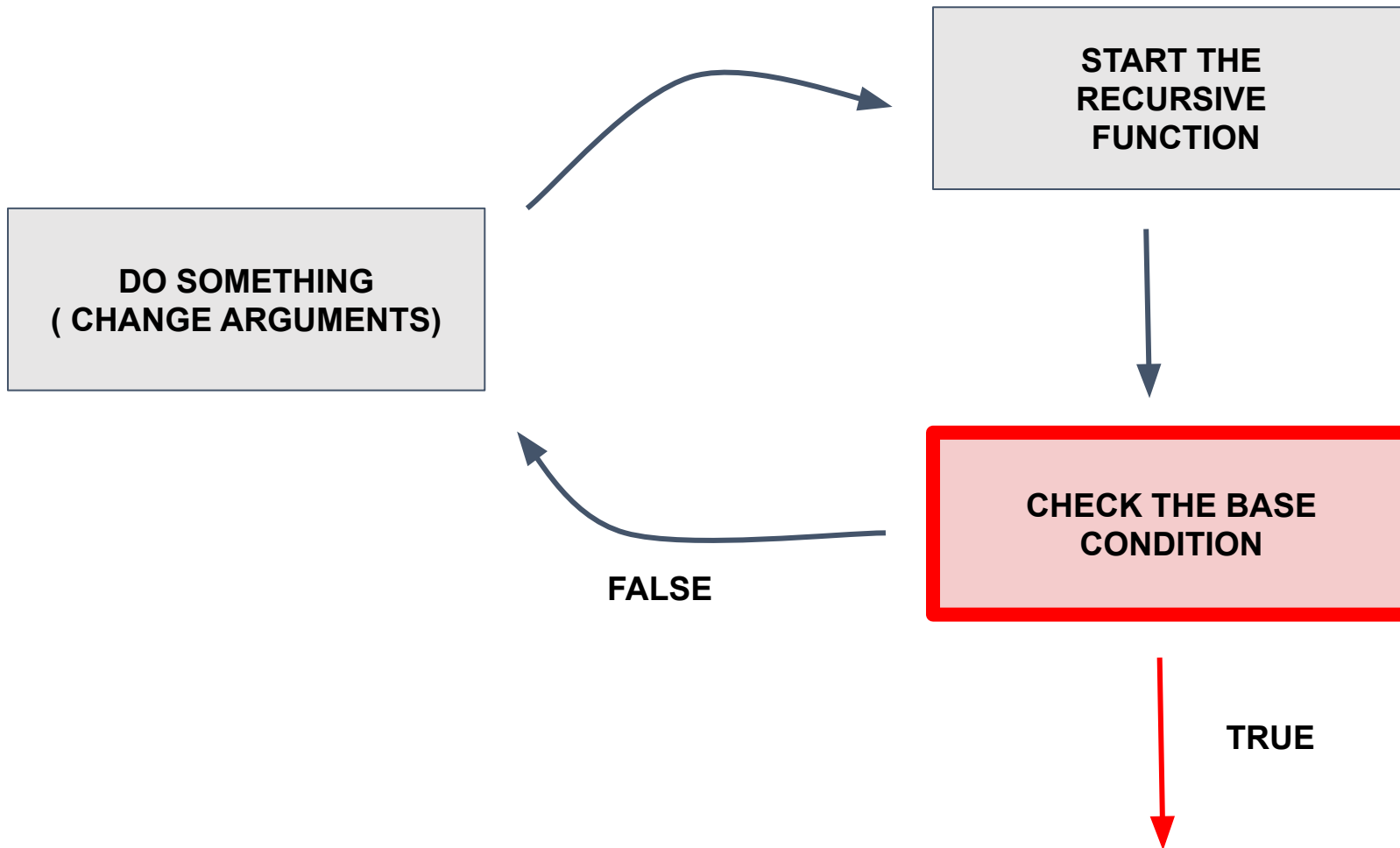


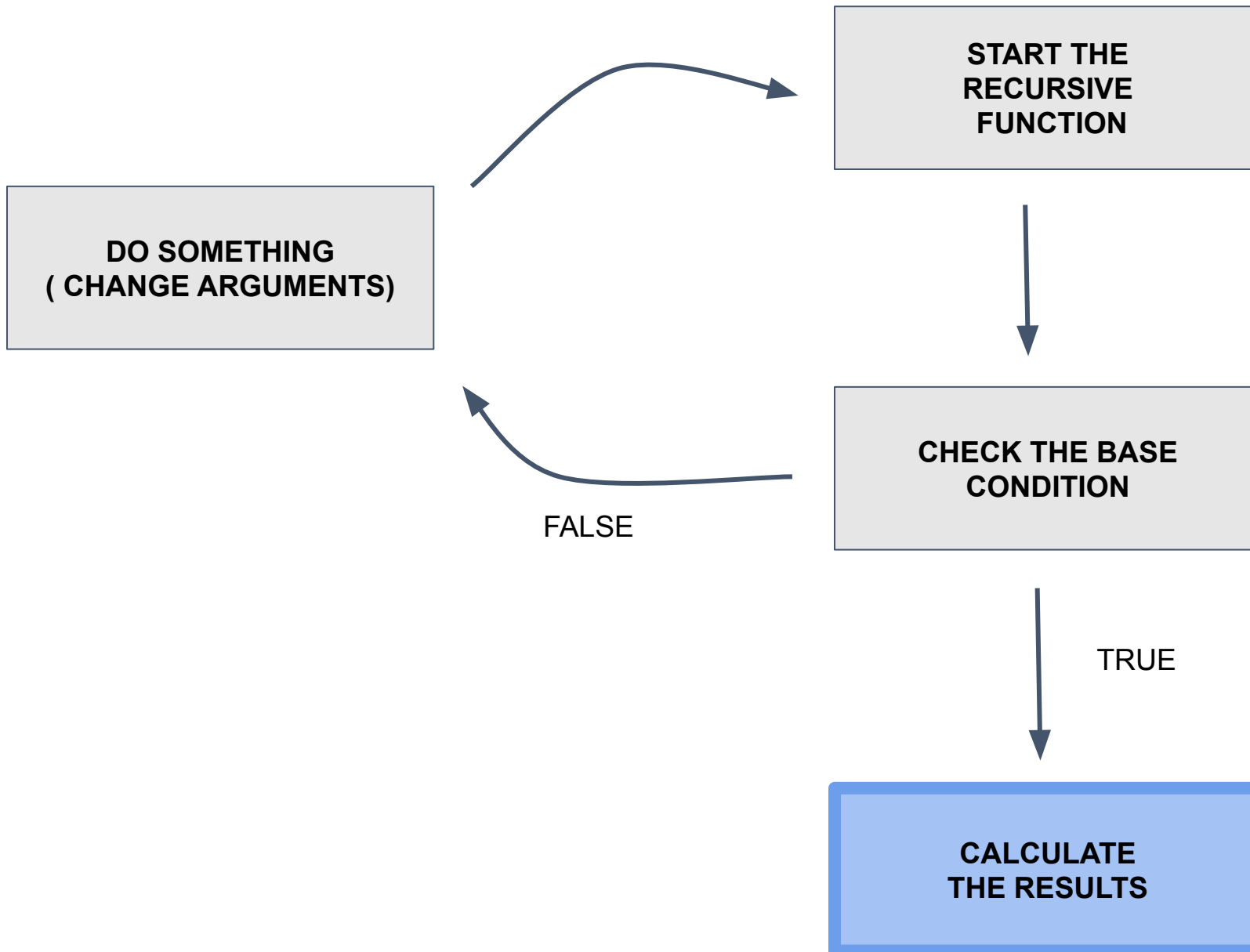


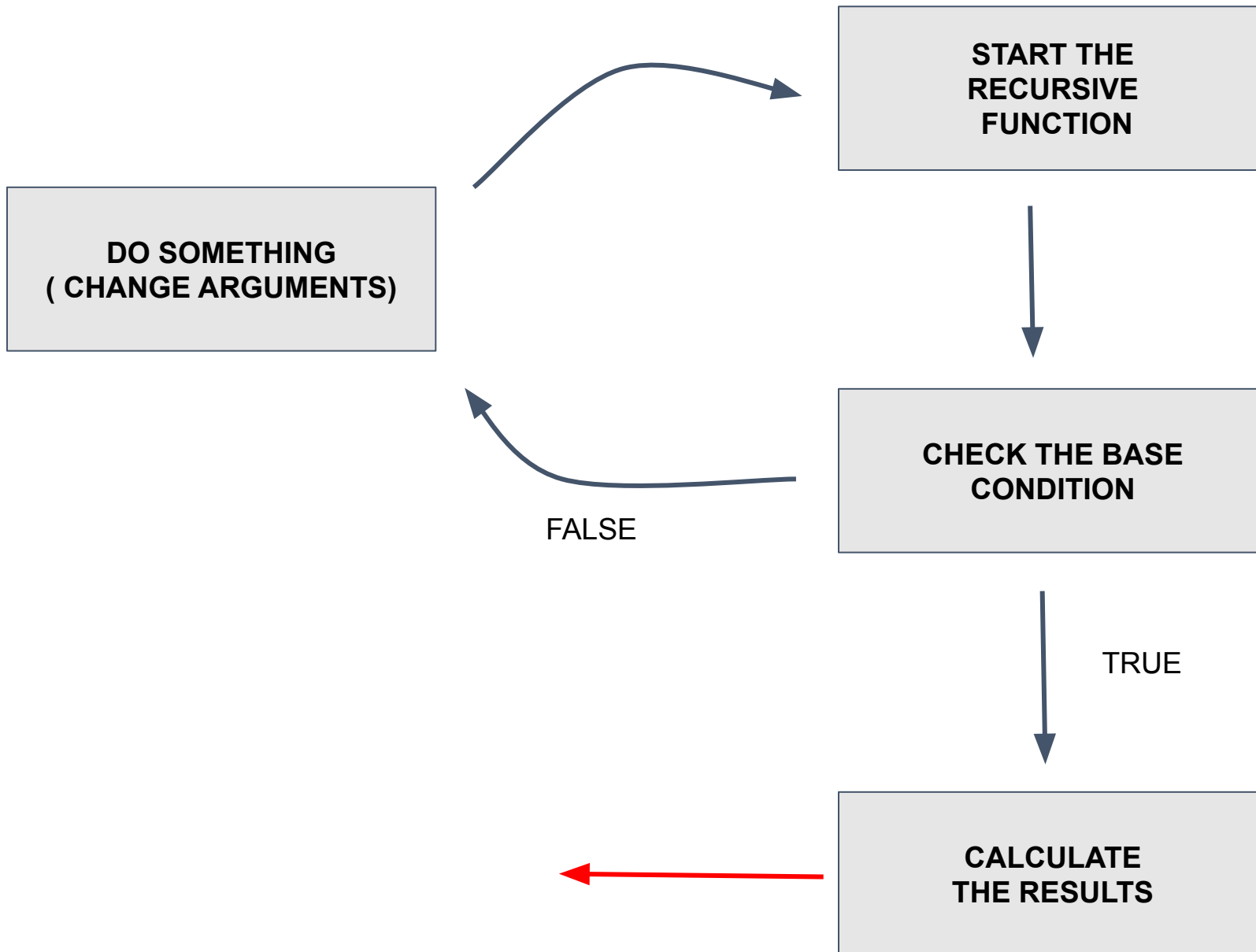


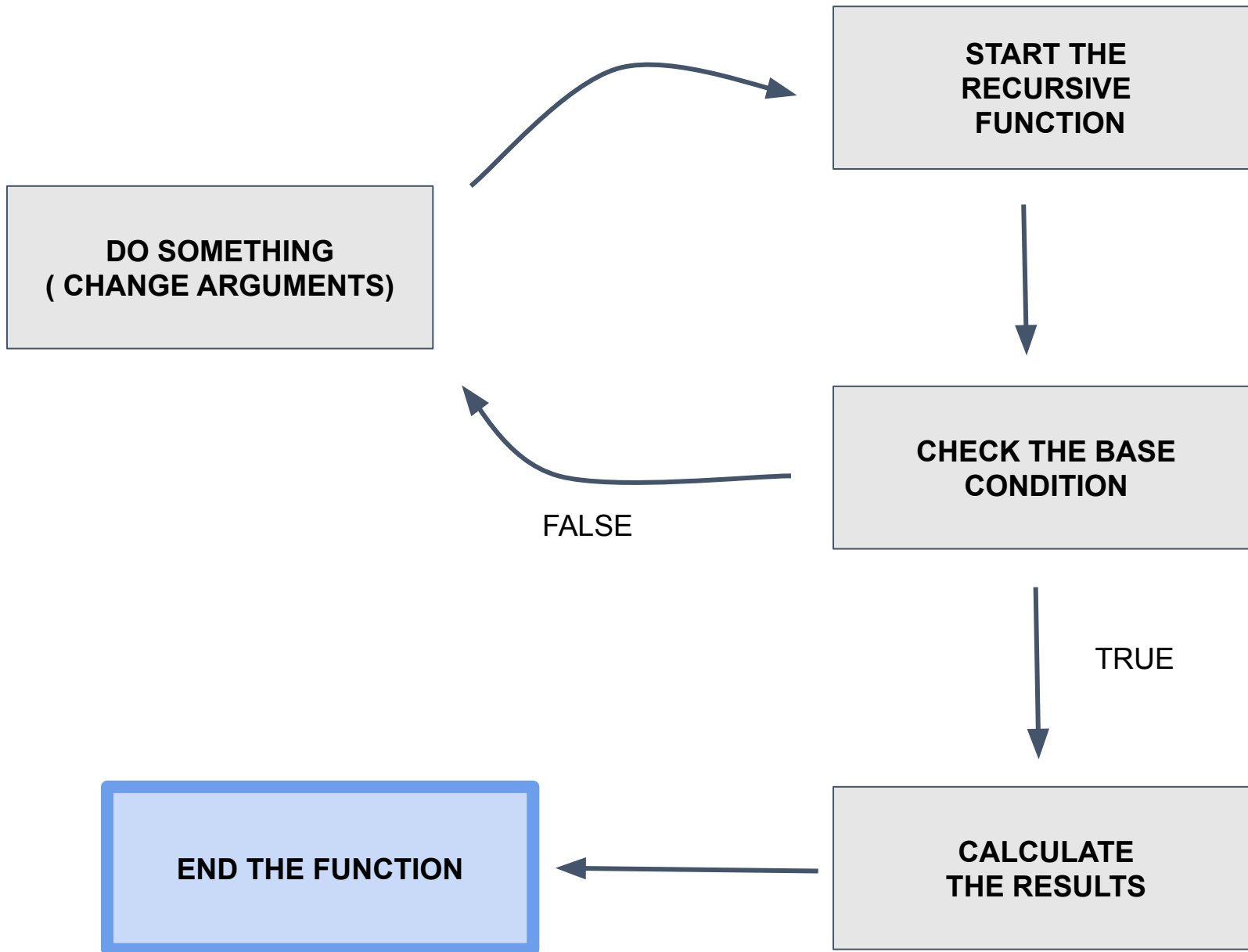












Python Code

```
# define recursive function to count handshakes
```

```
def count_hand_shakes(total_persons_in_room):
```

```
    # Base Condition: When number of persons is 2 (One Handshake)
```

```
    if total_persons_in_room == 2:
```

```
        return 1
```

```
    else:
```

```
        #  $F(N) = F(N-1) + (N-1)$ 
```

```
        return count_hand_shakes(total_persons_in_room - 1) + (total_persons_in_room - 1)
```

Thank You

Advantages of Recursion

- Reduce Unnecessary Calling of Function
- Reduces length of code
- Iteration can be complex sometimes, when we have several possible random cases.

Disadvantages of Recursion

- It uses more memory.
- Time complexity is increases, can be slow if not implemented correctly.
- Difficult to debug.