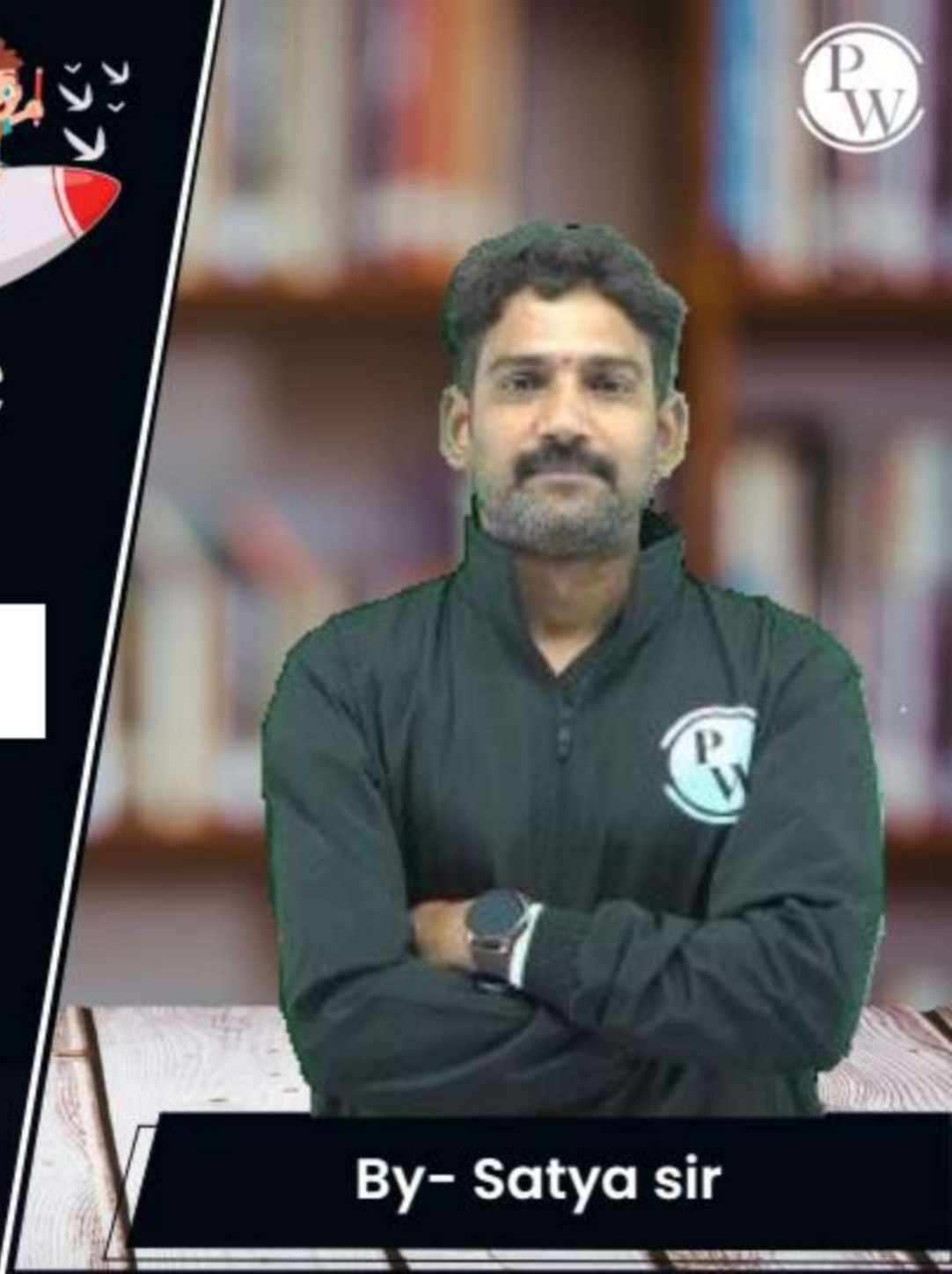
Data Science & Artificial Intelligence

Python For Data Science

Functions

Lecture No.- 02



By- Satya sir

Recap of Previous Lecture

- Set methods | Operations
- Dictionaries
- Functions
  - Recursion

Topics to be Covered

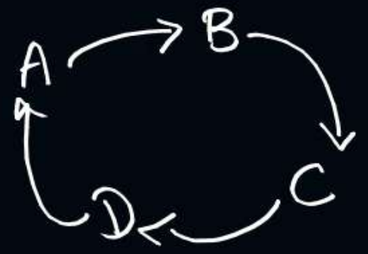
- Types of Recursion
- Examples

Topic : Functions - 2

Types of Recursion :

1) Direct Recursion

2) Indirect Recursion



Types of Direct Recursion :

1. Head Recursion
2. Tail Recursion
3. Tree Recursion
4. Nested Recursion

Topic : Functions - 2

Head Recursion :

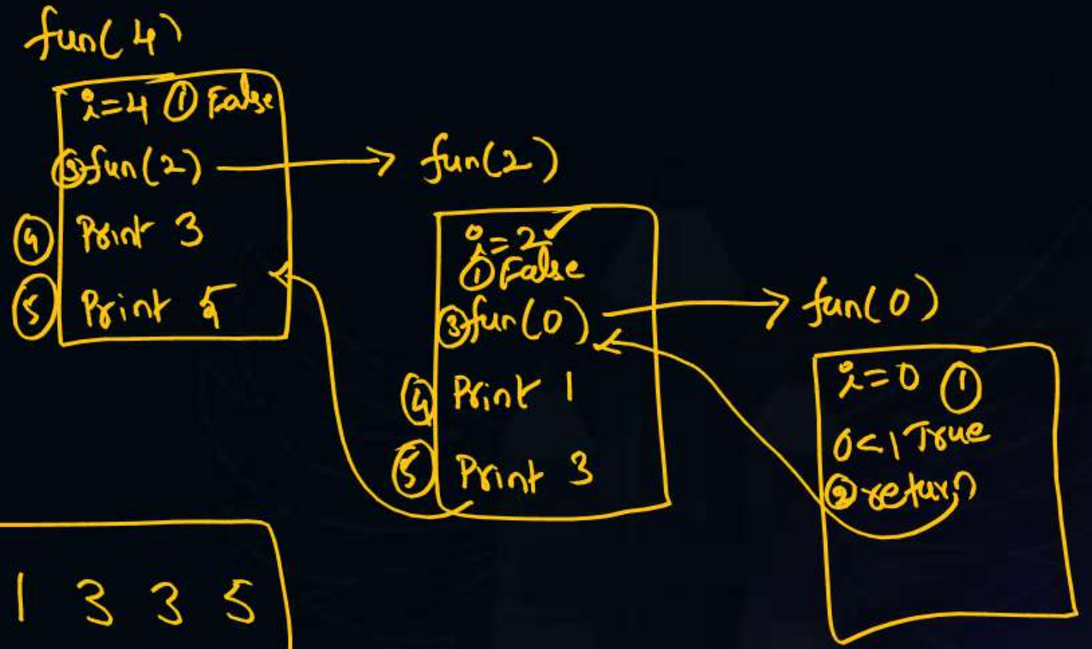
If after calling Function Recursively, body of the function still Exists [Statements there Execute].

o/p = _____

Ex:

```
def fun(i):
1.  if i<1:
2.      return
3.  fun(i-2) # Recursive calling
4.  Print(i-1, end=' ')
5.  Print(i+1, end=' ')

fun(4)
```



o/p: 1 3 3 5

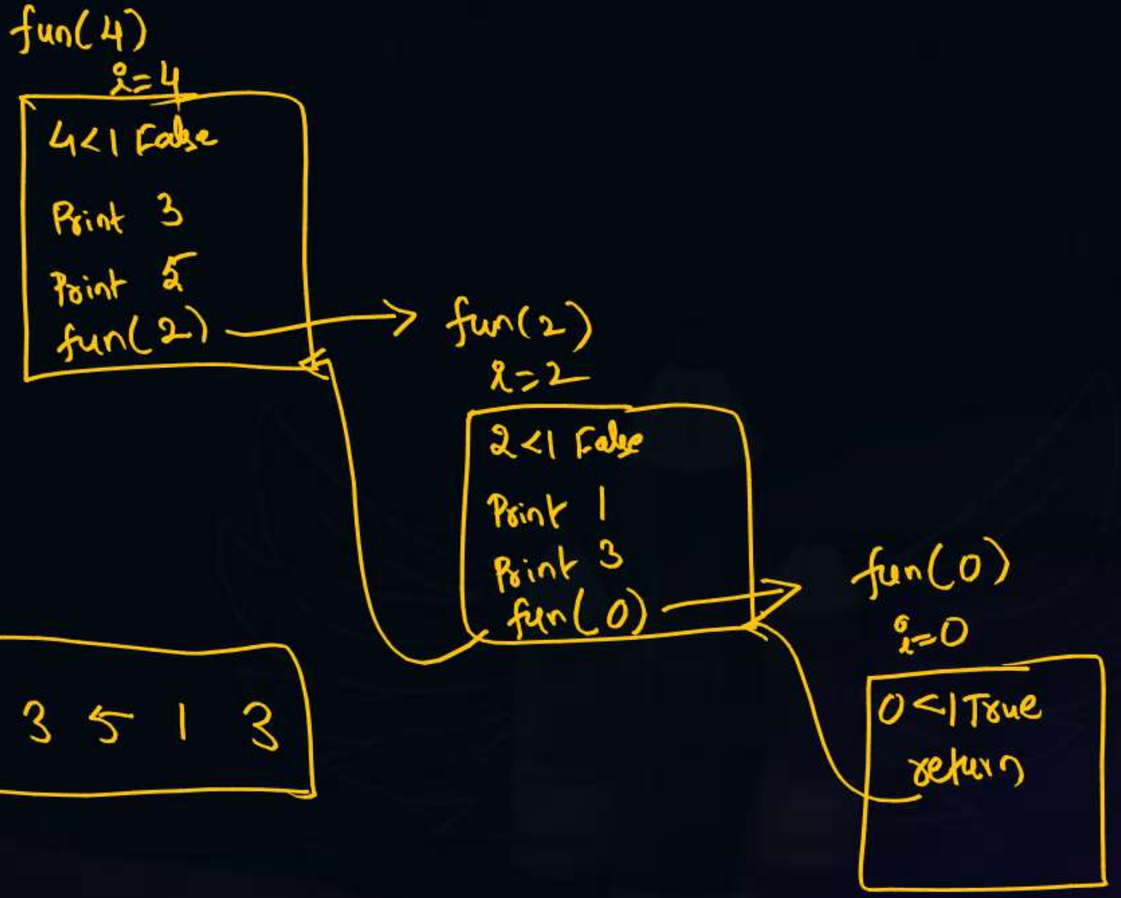
Topic : Functions - 2

Tail Recursion : If Recursive calling is the last statement in a Recursive function body.

Ex:

```
def fun(i):
    if i<1:
        return
    print(i-1, end=' ')
    print(i+1, end=' ')
    fun(i-2)  # Recursive Calling
```

→ fun(4)



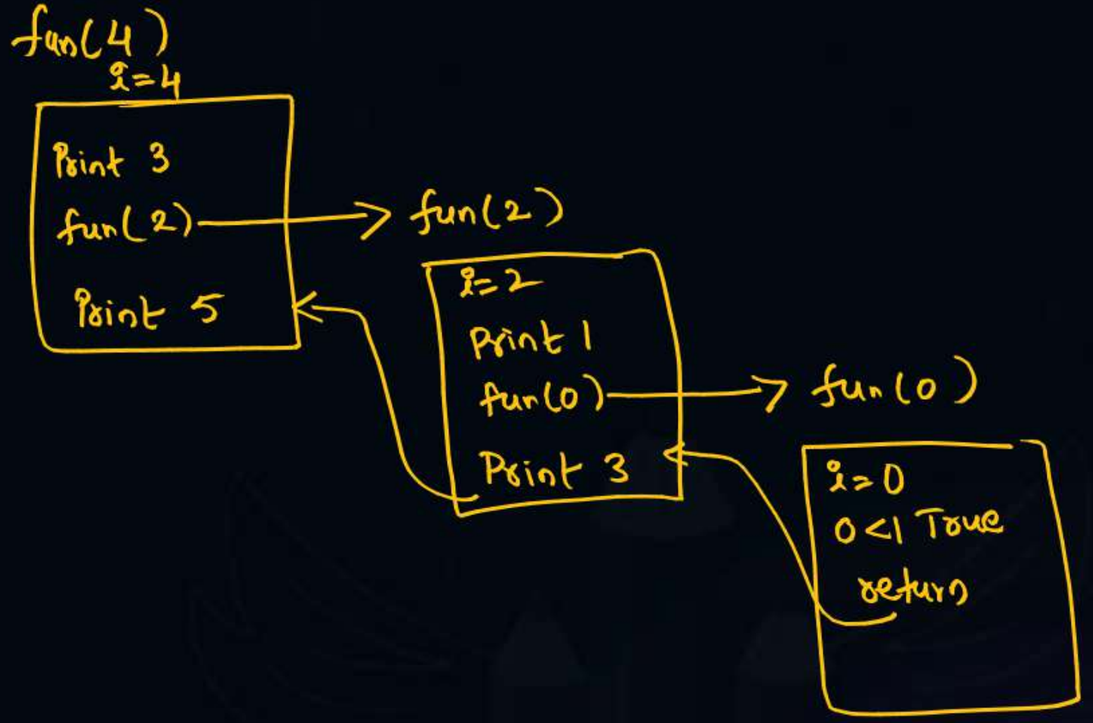
o/p : 3 5 1 3

Topic : Functions - 2

Ex:

```
def fun(i):
    if i<1:
        return
    print(i-1, end=' ')
    fun(i-2)
    print(i+1, end=' ')
fun(4)
```

o/p: 3 1 3 5

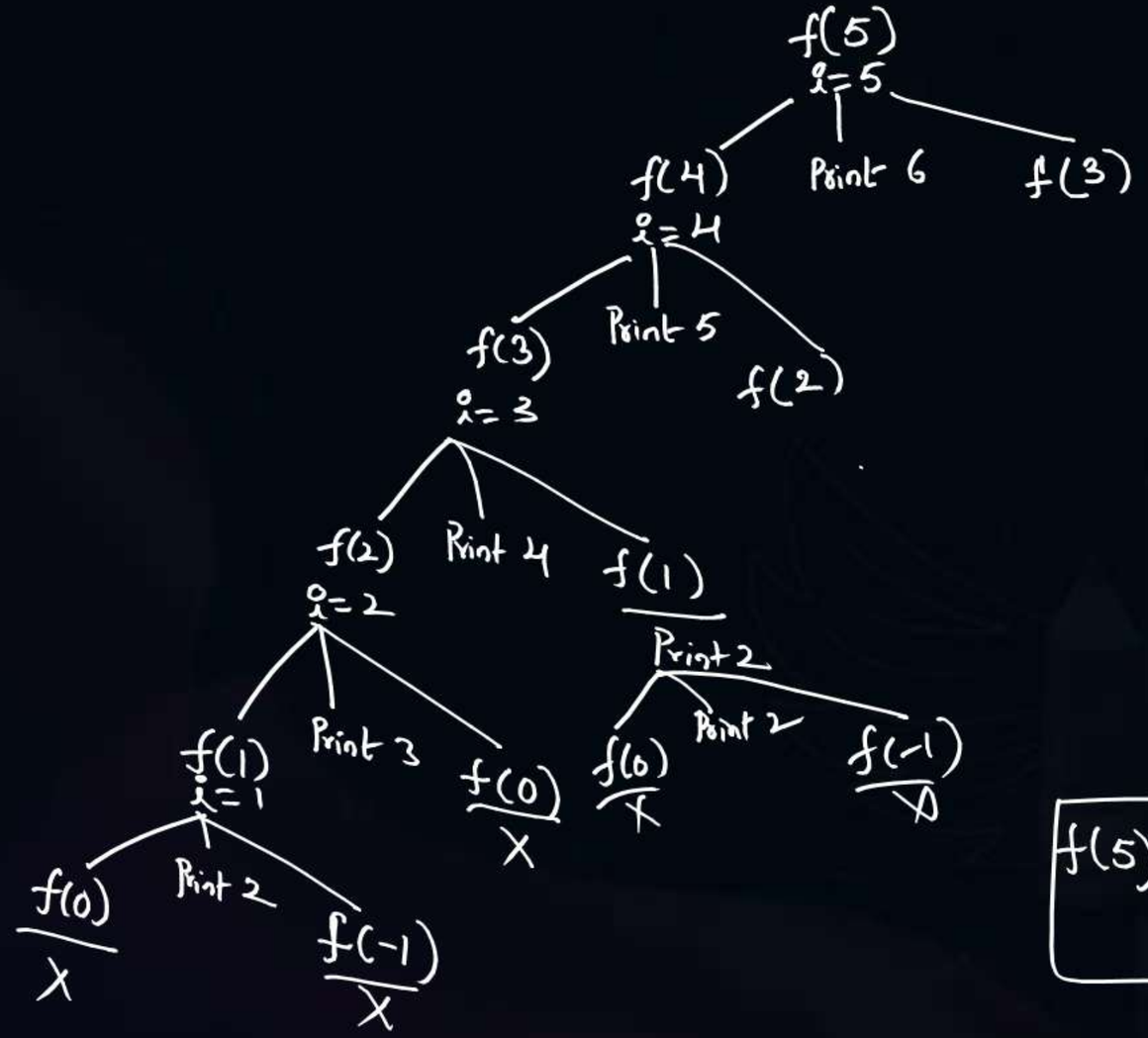


Topic : Functions - 2

Tree Recursion : If a function is called Recursively, more than one time in a single call.

Example

```
def f(i):
    if i<1:
        return
    f(i-1)
    Print(i+1)
    f(i-2)
f(5)
```



f(1) : Print 2

f(2) : Print 2 3

f(3) : 2 3 4 2

f(4) : 2 3 4 2 5 2 3

f(5) : 2 3 4 2 5 2 3 6 2 3 4 2

Topic : Functions - 2

Nested Recursion : If, in one Recursive call, another recursive call is made.

Example

```
def f(x):
    if x<=1:
        return x
    return x+f(f(x-2))
print(f(7))
```

o/p:

f(7)
x=7
7+f(f(5))
11
=7+f(11)

f(11)
11+f(f(9))

f(9)=9+f(f(7))

f(7)=7+f(f(5))
=7+f(11)

Infinite Recursion

f(5)
x=5
5+f(f(3))
5+f(4)
5+6
=11

f(3)
3+f(f(1))
=3+f(1)
=3+1
=4

f(1)
1<=1 true
return 1

f(4)
4+f(f(2))
2
=4+f(2)
=4+2
=6

f(2)
2+f(f(0))
0
0
=2+0
=return 2

Topic : Functions - 2

Example-2

```
def f(i):
    if i<=1:
        return i
    return i - f(f(i-1))
print(f(4))
```

O/p: 3

f(4)
i=4
4 - f(f(3))

4 - f(2)

4 - 1

= 3

f(3)
3 - f(f(2))

3 - f(1)

= 3 - 1

= 2

f(2)
2 - f(f(1))

= 2 - f(1)

= 2 - 1

= 1

f(1)
return 1

Topic : Functions - 2

Examples

①
```
def func(i, j):
    if i==j:
        return i+j
    return i + func(i-1, j+1)
Print(func(7,1))
```

o/p: 26

i j
func(7,1)
7 + func(6,2)
6 + func(5,3)
5 + func(4,4)
4+4

= 7+6+5+4+4

= 26

Topic : Functions - 2

(2)

```
def f(x):
    if x<=1:
        return x+3
    elif x<=3:
        return x-2
    elif x<=7:
        return x - f(x-2)
    else:
        return x+ f(x-1)
Print(f(9))
```

o/p: 20

f(9)

9+f(8)

8+f(7)

7-f(5)

5-f(3)

1

= 9+8+7-(5-1)

= 9+8+7-4

= 9+8+3

= 20

Topic : Functions - 2

③
```
def f(i):
    if i<0:
        return i
    return i + f(i-1) + f(i-3)

print(f(7))
```

o/p: -3

f(7)

7 + f(6) + f(4)

= 7 + (-4) + (-6)

= 7 - 10 = -3

6 + f(5) + f(3)

6 + (-5) + (-5) = -4

5 + f(4) + f(2)

= 5 + (-6) + (-4)

= -5

3 + f(2) + f(0)

= 3 + (-4) + (-4) = -5

0 + f(-1) + f(-3)

-1 -3

= -4

4 + f(3) + f(1)

= 4 + (-5) + (-5) = -6

2 + f(1) + f(-1)

-1

= 2 + (-5) + (-1)

= 2 - 6 = -4

1 + f(0) + f(-2)

-2

= 1 + (-4) + (-2) = -5

f(0) = -4

f(1) = -5

f(2) = -4

f(3) = -5

f(4) = -6

f(5) = -5

f(6) = -4

2 mins Summary

H/w

④

```
def fun(x):
    if x<=1:
        Print(x)
    Print(x-1)
    fun(x-1)
    Print(x+1)

fun(5)
```

The Total Number of times Print statements Executed is _____

THANK - YOU