

GATE 2013 • C PROGRAMMING • QUESTION 42

Recursion • Pass by Reference • Pass by Value

Question

GATE 2013 – Question 42

What is the return value of $f(p,p)$, if the value of p is initialized to 5 before the call?
The first parameter is passed by reference, whereas the second parameter is passed by value.

Given Function

```
int f (int &x, int c) {  
    c = c - 1;  
    if (c==0) return 1;  
    x = x + 1;  
    return f(x,c) * x;  
}
```

Function Call

```
int p = 5;  
f(p,p);
```

Parameter Passing

- x is passed by reference using $\text{int } \&x$. Therefore, changes to x change the original variable p .
- c is passed by value. Each recursive call receives its own copy of c .

Initial Values

Before the first call: $p = 5$
Therefore: x refers to $p \rightarrow x = 5$
and c receives a copy $\rightarrow c = 5$

Recursive Calls

Call 1: $f(x,5)$

$c = 5 - 1 = 4$
 $c \neq 0$, so $x = x + 1 \rightarrow p = 6$
Return: $f(x,4) \times x$

Call 2: $f(x,4)$

$$c = 4 - 1 = 3$$

$$x = x + 1 \rightarrow p = 7$$

$$\text{Return: } f(x,3) \times x$$

Call 3: $f(x,3)$

$$c = 3 - 1 = 2$$

$$x = x + 1 \rightarrow p = 8$$

$$\text{Return: } f(x,2) \times x$$

Call 4: $f(x,2)$

$$c = 2 - 1 = 1$$

$$x = x + 1 \rightarrow p = 9$$

$$\text{Return: } f(x,1) \times x$$

Call 5: $f(x,1)$

$$c = 1 - 1 = 0$$

Now $c == 0$, so the function returns 1.

This is the base case; x remains 9.



Unwinding the Recursion

Base case returns 1

At this point $x = 9$ and $p = 9$. The recursive calls now return in reverse order.



Call 4 returns

$$1 \times 9 = 9$$



Call 3 returns

$$9 \times 9 = 81$$



Call 2 returns

$$81 \times 9 = 729$$



Call 1 returns

$$729 \times 9 = 6561$$

Final Answer

(B) 6561

★ Quick Revision

Reference parameter x changes the original p.

Value parameter c is copied for each call.

The recursion stops when c becomes 0.

During unwinding, x has the final value 9.

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