C++ Programming

Recursive Functions 2

Mostafa S. Ibrahim
Teaching, Training and Coaching since more than a decade!

Artificial Intelligence & Computer Vision Researcher
PhD from Simon Fraser University - Canada
Bachelor / Msc from Cairo University - Egypt
Ex-(Software Engineer / ICPC World Finalist)

Factorial: A recursive function

15_3.cpp

```cpp
#include<iostream>
using namespace std;

int factorial(int n) {
    cout<<"Function Call: factorial: n="<<n<<"\n";

    if (n == 1)
        return 1;
    return factorial(n-1) * n;
}

int main() {
    cout << factorial(6) << "\n";
    return 0;
}
```

- A recursive function: Function that calls itself with smaller input (supproblem) till reaches baseline

```
Function Call: factorial: n=6
Function Call: factorial: n=5
Function Call: factorial: n=4
Function Call: factorial: n=3
Function Call: factorial: n=2
Function Call: factorial: n=1
720
```

Let’s trace it

- Call **Factorial**(6)
  - If 6 == 1? False
  - Call **Factorial** (5) and multiply results with 6
    - If 5 == 1? False
    - Call **Factorial** (4) and multiply results with 5
      - If 4 == 1? False
      - Call **Factorial** (3) and multiply results with 4
        - If 3 == 1? False
        - Call **Factorial** (2) and multiply results with 3
          - If 2 == 1? False
          - Call **Factorial** (1) and multiply results with 2
            - If 1 == 1? True
              - Return 1

```
int factorial(int n) {
    if (n == 1)
        return 1;
    return factorial(n-1) * n;
}
```

Let’s trace it

Main: factorial(6)

Let’s trace it

factorial(6)
    Return factorial(5) * 6

Main: factorial(6)

Let’s trace it

factorial(5)
    Return factorial(4) * 5

factorial(6)
    Return factorial(5) * 6

Main: factorial(6)

Let’s trace it

factorial(4)
    Return factorial(3) * 4

factorial(5)
    Return factorial(4) * 5

factorial(6)
    Return factorial(5) * 6

Main: factorial(6)

Let’s trace it

factorial(3)
    Return factorial(2) * 3

factorial(4)
    Return factorial(3) * 4

factorial(5)
    Return factorial(4) * 5

factorial(6)
    Return factorial(5) * 6

Main: factorial(6)

Let’s trace it

factorial(3)
Return factorial(2) * 3

factorial(4)
Return factorial(3) * 4

factorial(5)
Return factorial(4) * 5

factorial(6)
Return factorial(5) * 6

Main: factorial(6)

factorial(2)
Return factorial(1) * 2

Let’s trace it

factorial(3)
Return factorial(2) * 3

factorial(4)
Return factorial(3) * 4

factorial(5)
Return factorial(4) * 5

factorial(6)
Return factorial(5) * 6

Main: factorial(6)

factorial(1)
Return 1

factorial(2)
Return factorial(1) * 2

Let’s trace it

factorial(3)
Return factorial(2) * 3

factorial(4)
Return factorial(3) * 4

factorial(5)
Return factorial(4) * 5

factorial(6)
Return factorial(5) * 6

Main: factorial(6)

factorial(2)
Return 1 * 2 ⇒ 2

Let’s trace it

factorial(3)
    Return 2 * 3 ⇒ 6

factorial(4)
    Return factorial(3) * 4

factorial(5)
    Return factorial(4) * 5

factorial(6)
    Return factorial(5) * 6

Main: factorial(6)

Let’s trace it

factorial(4)
Return 6 * 4 ⇒ 24

factorial(5)
Return factorial(4) * 5

factorial(6)
Return factorial(5) * 6

Main: factorial(6)

Let’s trace it

factorial(5)
Return 24 * 5 ⇒ 120

factorial(6)
Return factorial(5) * 6

Main: factorial(6)

Let’s trace it

factorial(6)
Return 120 * 6 ⇒ 720

Main: factorial(6)

Let’s trace it

Main: factorial(6) ⇒ 720

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."