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C++ Programming
Recursion

Recursion

A function that calls itself is known as recursive function.

This technique is known as recursion.

Example 1: Factorial of a Number Using Recursion

Factorial function: f(n) = n*f(n-1)

Lets say we want to find out the factorial of 5 which means n =5

f(5) = 5* f(5-1) = 5* f(4)

5* 4* f(4-1) = 20* f(3)

20*3* f(3-1) = 60* f(2)

60* 2* f(2-1) = 120* f(1)

120*1* f(1-1) = 120*f(0)

120*1=120

```cpp
// Factorial of n = 1*2*3*...*n

#include <iostream>

using namespace std;

int factorial(int n)
{
    if (n > 1)
    {
        return n*factorial(n-1);
    }
    else
    {
        return 1;
    }
}

int main()
{
    int n;

    cout<<"Enter a number to find factorial: ";
    cin >> n;

    cout << "Factorial of " << n <<" = " << factorial(n);

    return 0;
}
```

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Example 2: Calculate Sum of Natural numbers using Recursion

The positive numbers 1, 2, 3... are known as natural numbers. The program below takes a positive integer from the user and calculates the sum up to the given number.

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

int sum(int n)
{
    if(n != 0)
    {
        return n + sum(n - 1);
    }
    return 0;
}

int main()
{
    int n;

    cout << "Enter a positive integer: ";
    cin >> n;

    cout << "Sum =  " << sum(n);

    return 0;
}
```

Output

```
Enter an positive integer: 10
Sum = 55
```

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Example 3: Calculate G.C.F. using Recursion

The Greatest Common Factor (G.C.F.) is the greatest number that is a factor of two (or more) other numbers.

When we find all the factors of two or more numbers, and some factors are the same ("common"), then the largest of those common factors is the Greatest Common Factor.

Source: https://www.mathsisfun.com/definitions/greatest-common-factor.html

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

int gcf(int n1, int n2)
{
    if (n2 != 0)
    {
        return gcf(n2, n1 % n2);
    }
    else
    {
        return n1;
    }
}

int main()
{
    int n1, n2;

    cout << "Enter two positive integers: ";
    cin >> n1 >> n2;

    cout << "G.C.F of " << n1 << " & " <<  n2 << " is: " << gcf(n1, n2);

    return 0;
}
```

Example 4: Recursive Bubble Sort

For another example of a recursive function, refer to the booklet entitled "Sorting" on my website.