

Factorial

Introduction

The factorial (denoted or represented as $n!$) for a positive number or integer (which is denoted by n) is the product of preceding or equivalent to n (the positive integer).

The factorial function can be found in various areas of mathematics, including algebra, mathematical analysis, and combinatorics.

Starting in the 1200s, factorials were used to count permutations. The notation for a factorial ($n!$) was introduced in the early 1800s by Christian Kramp, a French mathematician.

The factorial formula can be seen below:

$$n! = n \times (n - 1) \times \dots \times 3 \times 2 \times 1$$

factorial of 0 i.e. $0! = 1$ and factorial of 1 i.e. $1! = 1$.

Such as:

$$5! = 1 \times 2 \times 3 \times 4 \times 5 = 120$$

That is we can represent this with forloop we get:

```
// Factorial using for loop
#include <iostream>
using namespace std;

int fact(int n)
{
    int factorial = 1;
    if(n==0)
    {
        return 1;
    }
    for (int i = 1; i <= n; i++)
    {
        factorial = factorial * i;
    }
    return factorial;
}

int main()
{
    cout << fact(5) << endl;
    return 0;
}
```

Here i runs from 1 to 5 i.e. n = 5 , we get:

$factorial = 1 \times 1 = 1$, when $i = 1$

$factorial = 1 \times 2 = 2$, when $i = 2$

$factorial = 2 \times 3 = 6$, when $i = 3$

$factorial = 6 \times 4 = 24$, when $i = 4$

$factorial = 24 \times 5 = 120$, when $i = 5$

The same can be achieved by recursion :

```
//Factorial using recursion
#include <iostream>
using namespace std;

int factorial(int n)
{
    if (n == 0 || n==1)
    {
        return 1;
    }
    else
    {
        return n * factorial(n - 1);
    }
}

int main()
{

    cout << "Factorial of 5 is " <<
    factorial(5);
    return 0;
}
```

$$\mathbf{\textit{factorial}(5) = 5 \times 4! \quad (4! = 4 \times 3 \times 2 \times 1)}$$

$$\Rightarrow \mathbf{5 \times 4 \times 3! \quad (3! = 3 \times 2 \times 1)}$$

$$\Rightarrow \mathbf{5 \times 4 \times 3 \times 2! \quad (2! = 2 \times 1)}$$

$$\Rightarrow \mathbf{5 \times 4 \times 3 \times 2 \times 1 = 120}$$
