C++ Functions

A function is a block of code that performs a specific task.

Suppose we need to create a program to create a circle and color it. We can create two functions to solve this problem:

- a function to draw the circle
- a function to color the circle

Dividing a complex problem into smaller chunks makes our program easy to understand and reusable.

There are two types of function:

1. **Standard Library Functions:** Predefined in C++
2. **User-defined Function:** Created by users

C++ User-defined Function

C++ allows the programmer to define their own function.

A user-defined function groups code to perform a specific task and that group of code is given a name (identifier).

When the function is invoked from any part of the program, it all executes the codes defined in the body of the function.

C++ Function Declaration

The syntax to declare a function is:

```
returnType functionName (parameter1, parameter2,...) {
   // function body
}
```

Here's an example of a function declaration.

```
// function declaration
void greet() {
   cout << "Hello World";
}
```

Here,

- the name of the function is `greet()`
- the return type of the function is `void, (this type will not return any value)`
- the empty parentheses mean it doesn't have any parameters
- the function body is written inside `{}`

Calling a Function

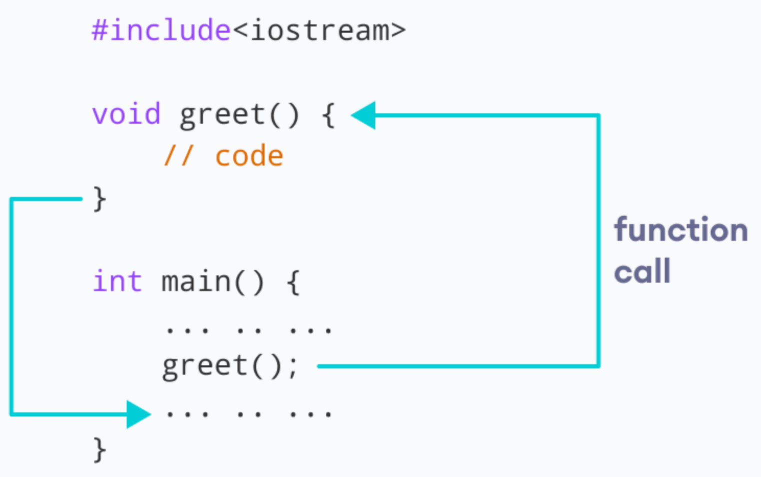
In the above program, we have declared a function named `greet()`. To use the `greet()` function, we need to call it.

Here's how we can call the above `greet()` function.

```
int main() {

   // calling a function
   greet();

}
```



```
#include<iostream>

void greet() {
    // code
}

int main() {
    ... .. ...
    greet();
    ... .. ...
}
```

Example 1: Display a Text

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

// declaring a function
void greet() {
  cout << "Hello there!";
}

int main() {
  // calling the function
  greet();
  return 0;
}
```

Output

```
Hello there!
```

Function Parameters

As mentioned above, a function can be declared with parameters (arguments). A parameter is a value that is passed when declaring a function.

For example, let us consider the function below:

```
void printNum(int num) {
   cout << num;
}
```

Here, the `int` variable `num` is the function parameter.

We pass a value to the function parameter while calling the function.

```
int main() {
   int n = 7;

   // calling the function
   // n is passed to the function as argument
   printNum(n);

   return 0;
}
```

Example 2: Function with Parameters

```
// program to print a text

#include <iostream>
using namespace std;

// display a number
void displayNum(int n1, double n2) {
   cout << "The int number is " << n1;
   cout << "\n The double number is " << n2;
}

int main() {

    int num1 = 5;
    double num2 = 5.5;

   // calling the function
   displayNum(num1, num2);

   return 0;
}
```

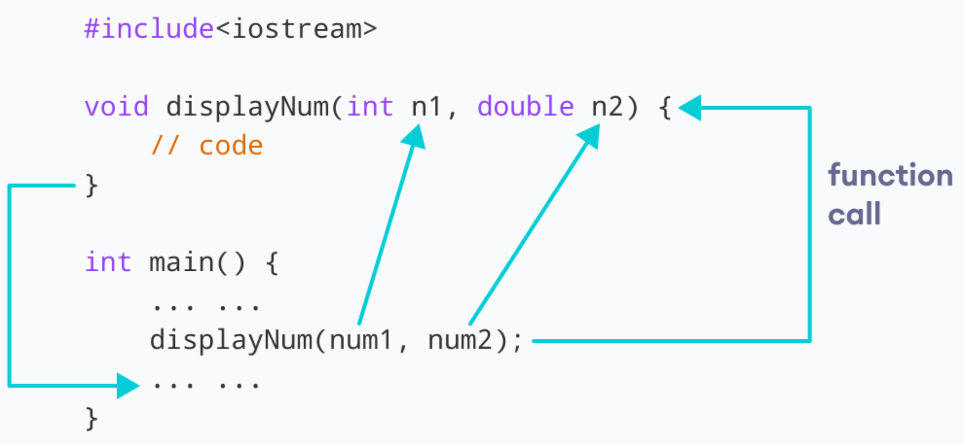
Output

```
The int number is 5

The double number is 5.5
```

In the above program, we have used a function that has one `int` parameter and one `double` parameter.

We then pass `num1` and `num2` as arguments. These values are stored by the function parameters `n1` and `n2` respectively.



```
#include<iostream>

void displayNum(int n1, double n2) {
    // code
}

int main() {
    ... ...
    displayNum(num1, num2);
    ... ...
}
```

Note: The type of the arguments passed while calling the function must match with the corresponding parameters defined in the function declaration.

Return Statement

In the above programs, we have used void in the function declaration. For example,

```
void displayNumber() {
   // code
}
```

This means the function is not returning any value.

It's also possible to return a value from a function. For this, we need to specify the `returnType` of the function during function declaration. Then, the `return` statement can be used to return a value from a function.

For example,

```
int add (int a, int b) {
  int c = a + b;
  return (c);
}
```

Here, we have the data type `int` instead of `void`. This means that the function returns an `int` value.

The code `return (c);` returns the sum of the two parameters as the function value.

The `return` statement denotes that the function has ended. Any code after `return` inside the function is not executed.

Example 3: Add Two Numbers

```
// program to add two numbers using a function
#include <iostream>
using namespace std;

// declaring a function
int add(int a, int b) {
   return (a+b);
}

int main() {
   int sum;

   // calling the function and storing
   // the returned value in sum
   sum = add(100, 78);

   cout << "100 + 78 = " << sum << endl;
   return 0;
}
```

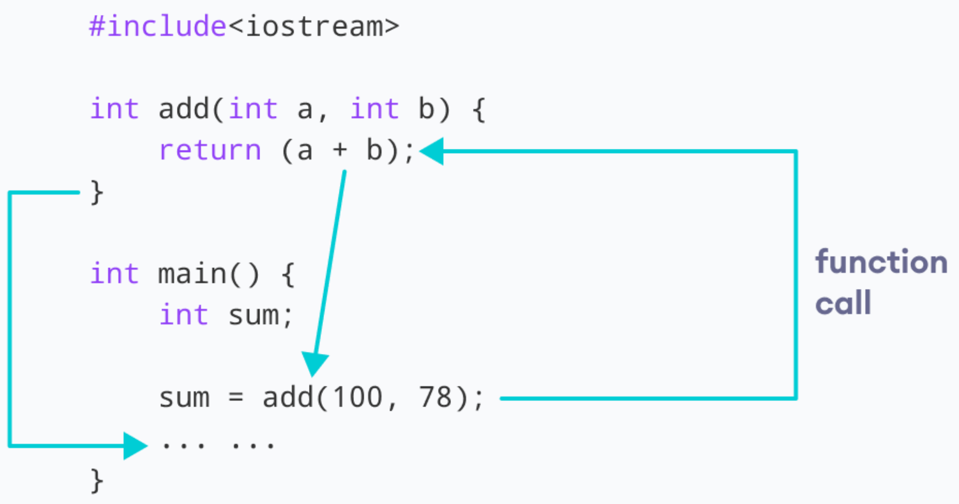
Output

```
100 + 78 = 178
```

In the above program, the `add()` function is used to find the sum of two numbers.

We pass two `int` literals `100` and `78` while calling the function.

We store the returned value of the function in the variable `sum`, and then we print it.



```
#include<iostream>

int add(int a, int b) {
    return (a + b);
}

int main() {
    int sum;

    sum = add(100, 78);
    ... ...
}
```

Notice that `sum` is a variable of `int` type. This is because the return value of `add()` is of `int` type.

Function Prototype

In C++, the code of function declaration should be before the function call. However, if we want to define a function after the function call, we need to use the function prototype. For example,

```
// function prototype
void add(int, int);

int main() {
   // calling the function before declaration.
   add(5, 3);
   return 0;
}

// function definition
void add(int a, int b) {
   cout << (a + b);
}
```

In the above code, the function prototype is:

```
void add(int, int);
```

This provides the compiler with information about the function name and its parameters. That's why we can use the code to call a function before the function has been defined.

The syntax of a function prototype is:

```
returnType   functionName(dataType1, dataType2, ...);
```

Example 4: C++ Function Prototype

```
// using function definition after main() function
// function prototype is declared before main()
#include <iostream>
using namespace std;

// function prototype
int add(int, int);

int main() {
   int sum;

   // calling the function and storing
   // the returned value in sum
   sum = add(100, 78);

   cout << "100 + 78 = " << sum << endl;

   return 0;
}

// function definition
int add(int a, int b) {
   int c = a +b;
   return (c);
}
```

Output

```
100 + 78 = 178
```

The above program is nearly identical to **Example 3**. The only difference is that here, the function is defined **after** the function call.

That's why we have used a function prototype in this example.

Benefits of Using User-Defined Functions

- Functions make the code reusable. We can declare them once and use them multiple times.
- Functions make the program easier as each small task is divided into a function.
- Functions increase readability.

C++ Library Functions

Library functions are the built-in functions in C++ programming.

Programmers can use library functions by invoking the functions directly; they don't need to write the functions themselves.

Some common library functions in C++ are `sqrt()`, `abs()`, `isdigit()`, etc.
In order to use library functions, we usually need to include the header file in which these library functions are defined.

For instance, in order to use mathematical functions such as `sqrt()` and `abs()`, we need to include the header file `cmath`.

Example 5: C++ Program to Find the Square Root of a Number

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

int main() {
   double number, squareRoot;

   number = 25.0;

   // sqrt() is a library function to calculate the square root
   squareRoot = sqrt(number);

   cout << "Square root of " << number << " = " << squareRoot;

   return 0;
}
```

Output

```
Square root of 25 = 5
```

In this program, the `sqrt()` library function is used to calculate the square root of a number.

The function declaration of `sqrt()` is defined in the `cmath` header file. That's why we need to use the code `#include <cmath>` to use the `sqrt()` function.