Using Comments

While comments may seem like a minor element to the many lines of code that combine to make a game, application or even an entire operating system, in actual fact they're probably one of the most important factors.

THE IMPORTANCE OF COMMENTING

Comments inside code are basically human readable descriptions that detail what the code is doing at that particular point. They don't sound especially important but code without comments is one of the many frustrating areas of programming, regardless of whether you're a professional or just starting out.

In short, all code should be commented in such a manner as to effectively describe the purpose of a line, section, or individual elements. You should get in to the habit of commenting as much as possible, by imagining that someone who doesn't know anything about programming can pick up your code and understand what it's going to do simply by reading your comments.

In a professional environment, comments are vital to the success of the code and ultimately, the company. In an organisation, many programmers work in teams alongside engineers, other developers, hardware analysts and so on. If you're a part of the team that's writing a bespoke piece of software for the company, then your comments help save a lot of time should something go wrong, and another team member has to pick up and follow the trail to pinpoint the issue.

Place yourself in the shoes of someone whose job it is to find out what's wrong with a program. The program has in excess of 800,000 lines of code, spread across several different modules. You can soon appreciate the need for a little help from the original programmers in the form of a good comment.

The best comments are always concise and link the code logically, detailing what happens when the program hits this line or section. You don't need to comment on every line. Something along the lines of: if x==0 doesn't require you to comment that if x equals zero then do something; that's going to be obvious to the reader. However, if x equalling zero is something that drastically changes the program for the user, such as, they've run out of lives, then it certainly needs to commented on.

Even if the code is your own, you should write comments as if you were going to publicly share it with others. This way you can return to that code and always understand what it was you did or where it was you went wrong or what worked brilliantly.

Comments are good practise and once you understand how to add a comment where needed, you soon do it as if it's second nature.

```
        DEFB    26h,30h,32h,26h,30h,32h,0,0,32h,72h,73h,32h,72h,73h,32h
        DEFB    60h,61h,32h,4Ch,4Dh,32h,4Ch,99h,32h,4Ch,4Dh,32h,4Ch,4Dh
        DEFB    32h,4Ch,99h,32h,5Bh,5Ch,32h,56h,57h,32h,33h,0CDh,32h,33h
        DEFB    34h,32h,33h,34h,32h,33h,0CDh,32h,40h,41h,32h,66h,67h,64h
        DEFB    66h,67h,32h,72h,73h,64h,4Ch,4Dh,32h,56h,57h,32h,80h,0CBh
        DEFB    19h,80h,0,19h,80h,81h,32h,80h,0CBh,0FFh
T858C:
        DEFB    80h,72h,66h,60h,56h,66h,56h,56h,51h,60h,51h,51h,56h,66h
        DEFB    56h,56h,80h,72h,66h,60h,56h,66h,56h,56h,51h,60h,51h,51h
        DEFB    56h,56h,56h,56h,80h,72h,66h,60h,56h,66h,56h,56h,51h,60h
        DEFB    51h,51h,56h,66h,56h,56h,80h,72h,66h,60h,56h,66h,56h,40h
        DEFB    56h,66h,80h,66h,56h,56h,56h,56h
;
; Game restart point
;
START:  XOR     A
        LD      (SHEET),A
        LD      (KEMP),A
        LD      (DEMO),A
        LD      (B845B),A
        LD      (B8458),A
        LD      A,2             ;Initial lives count
        LD      (NOMEN),A
        LD      HL,T845C
        SET     0,(HL)
        LD      HL,SCREEN
        LD      DE,SCREEN+1
        LD      BC,17FFh        ;Clear screen image
        LD      (HL),0
        LDIR
        LD      HL,0A000h       ;Title screen bitmap
        LD      DE,SCREEN
        LD      BC,4096
        LDIR
        LD      HL,SCREEN + 800h + 1*32 + 29
        LD      DE,MANDAT+64
        LD      C,0
        CALL    DRWFIX
        LD      HL,0FC00h       ;Attributes for the last room
        LD      DE,ATTR         ;(top third)
        LD      BC,256
        LDIR
        LD      HL,09E00h       ;Attributes for title screen
        LD      BC,512          ;(bottom two-thirds)
        LDIR
        LD      BC,31
        DI
        XOR     A
R8621:
        IN      E,(C)
        OR      E
        DJNZ    R8621   ;$-03
        AND     20h
        JR      NZ,R862F ;$+07
        LD      A,1
        LD      (KEMP),A
R862F:
        LD      IY,T846E
        CALL    C92DC
        JP      NZ,L8684
        XOR     A
        LD      (EUGHGT),A
```

C++ COMMENTS

Commenting in C++ involves using a double forward slash '/', or a forward slash and an asterisk, '/*'. You've already seen some brief examples but this is how they work.

STEP 1 Using the Hello World code as an example, you can easily comment on different sections of the code using the double forward slash:

```
//My first C++ program
cout << "Hello, world!\n";
```

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

int main()
{
    //My first C++ program
    cout << "Hello, world!\n";


}
```

STEP 2 However, you can also add comments to the end of a line of code, to describe in a better way what's going on:

```
cout << "Hello, world!\n"; //This line outputs the words 'Hello, world!'. The \n denotes a new line.
```

Note, you don't have to put a semicolon at the end of a comment. This is because it's a line in the code that's ignored by the compiler.

```
Start here | *helloworld.cpp
#include <iostream>
using namespace std;

int main()
{
    //My first C++ program
    cout << "Hello, world!\n"; //This line outputs the words 'Hello, world!'. The /


}
```

STEP 3 You can comment out several lines by using the forward slash and asterisk:

```
/* This comment can
     cover several lines
     without the need to add more slashes */
```

Just remember to finish the block comment with the opposite asterisk and forward slash.

```
int main()
{
    //My first C++ program
    cout << "Hello, world!\n";
    cout << "And greetings from C++";

    /* This comment can
       cover several lines
       without the need to add more slashes */


}
```

STEP 4 Be careful when commenting, especially with block comments. It's very easy to forget to add the closing asterisk and forward slash and thus negate any code that falls inside the comment block.

```
Start here | *helloworld.cpp
#include <iostream>
using namespace std;

int main()
{
    //My first C++ program
    cout << "Hello, world!\n";
    cout << "And greetings from C++";

    /* This comment can
      cover several lines
      without the need to add more slashes

    cout << "This line is now being ignored by the compiler!";


}
```

STEP 5 Obviously if you try and build and execute the code it errors out, complaining of a missing curly bracket '}' to finish off the block of code. If you've made the error a few times, then it can be time consuming to go back and rectify. Thankfully, the colour coding in Code::Blocks helps identify comments from code.

```
Start here | helloworld.cpp
#include <iostream>
using namespace std;

int main()
{
    //My first C++ program
    cout << "Hello, world!\n";
    cout << "And greetings from C++";

    /* This comment can
      cover several lines
      without the need to add more slashes

    cout << "This line is now being ignored by the compiler!";


}
```

STEP 6 If you're using block comments, it's good practise in C++ to add an asterisk to each new line of the comment block. This also helps you to remember to close the comment block off before continuing with the code:

```
/* This comment can
 *    cover several lines
 *    without the need to add more slashes */
```

```
int main()
{
    //My first C++ program
    cout << "Hello, world!\n";
    cout << "And greetings from C++\n";

   /* This comment can
    *    cover several lines
    *    without the need to add more slashes */


    cout << "This line is now being ignored by the compiler!\n";


}
```

Variables

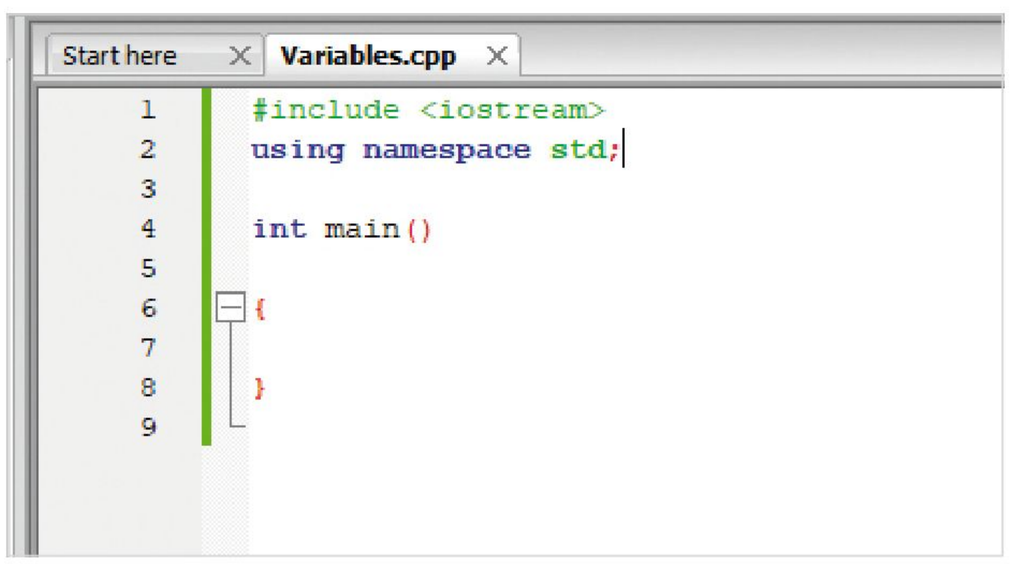
Variables differ slightly when using C++ as opposed to Python. In Python, you can simply state that 'a' equals 10 and a variable is assigned. However, in C++ a variable has to be declared with its type before it can be used.

THE DECLARATION OF VARIABLES

You can declare a C++ variable by using statements within the code. There are several distinct types of variables you can declare. Here's how it works.

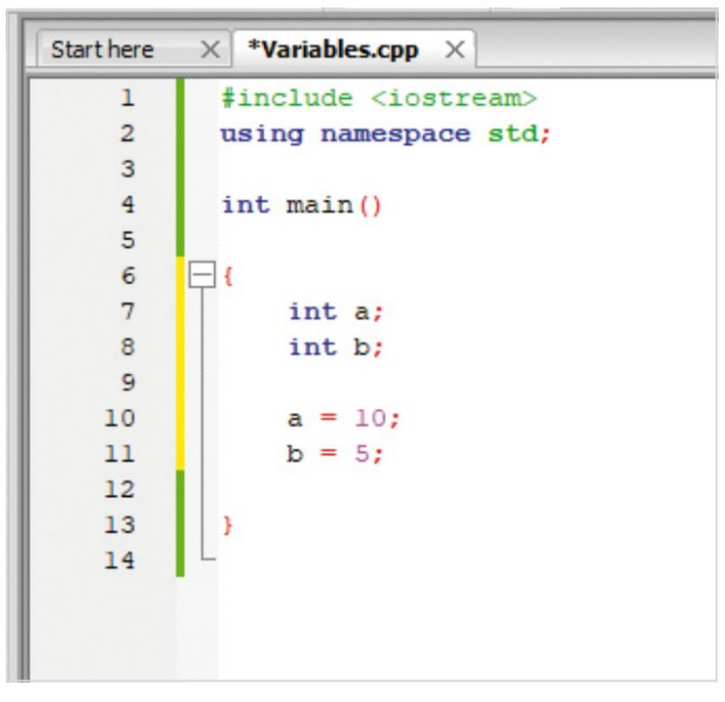
STEP 1 Open up a new, blank C++ file and enter the usual code headers:

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

int main()
{

}
```



STEP 2 Start simple by creating two variables, a and b, with one having a value of 10 and the other 5. You can use the data type int to declare these variables. Within the curly brackets, enter:

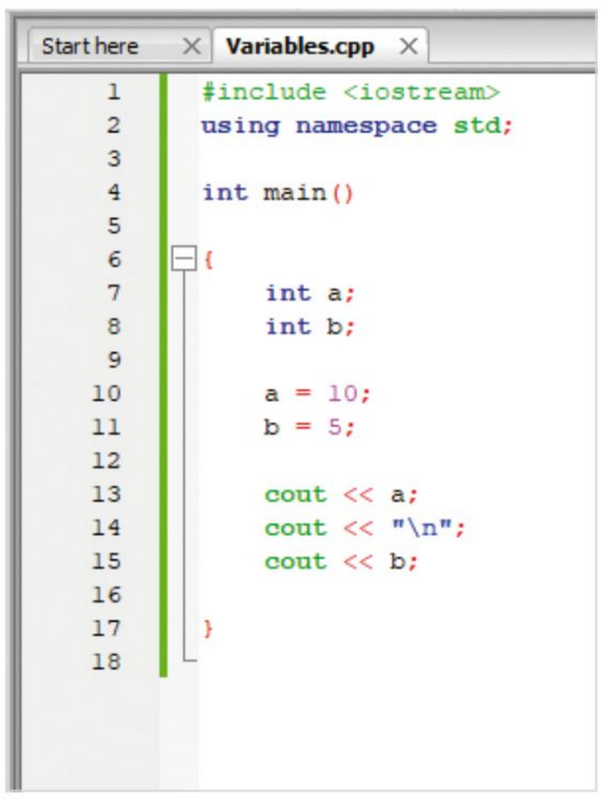
```
int a;
int b;

a = 10;
b = 5;
```



STEP 3 You can build and run the code but it won't do much, other than store the values 10 and 5 to the integers a and b. To output the contents of the variables, add:

```
cout << a;
cout << "\n";
cout << b;
```

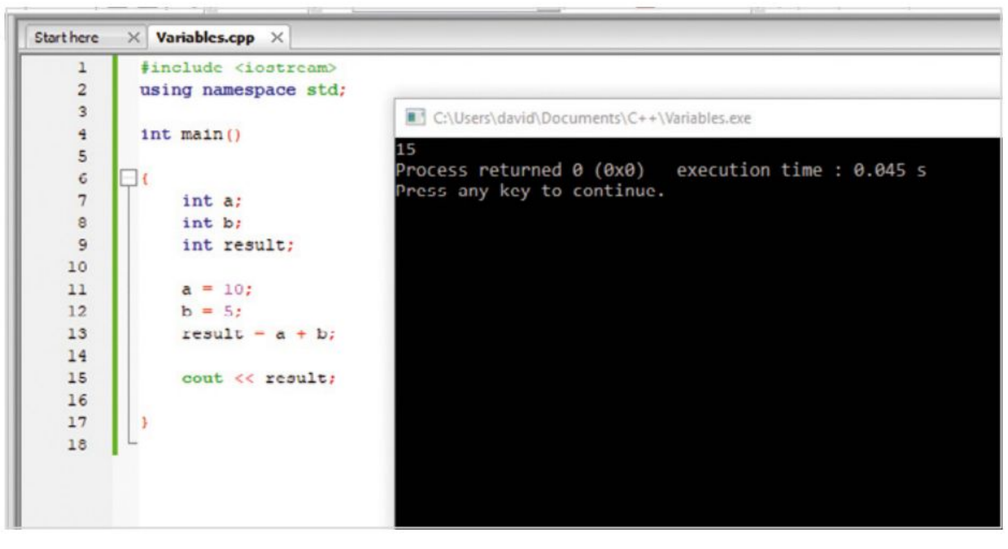
The cout << "\n"; part simply places a new line between the output of 10 and 5.



STEP 4 Naturally you can declare a new variable, call it result and output some simple arithmetic:

```
int result;

result = a + b;
cout << result;
```

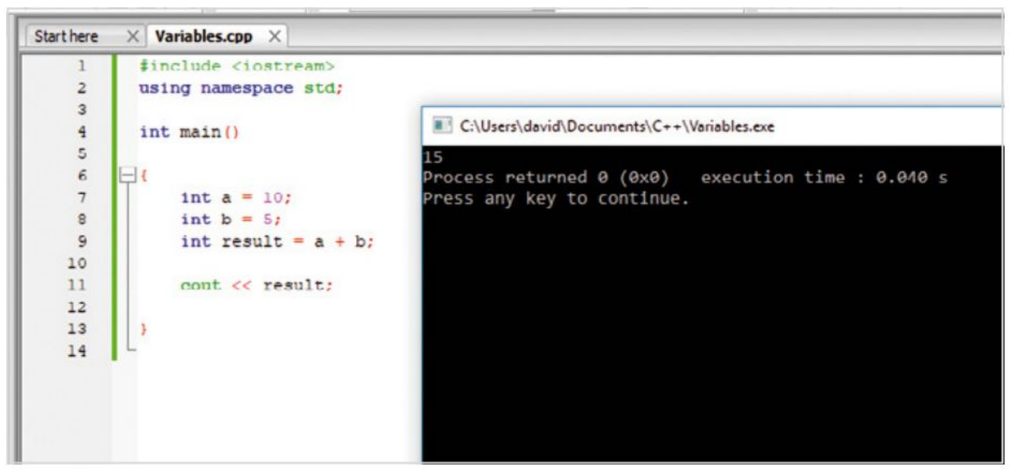
Insert the above into the code as per the screenshot.



STEP 5

You can assign a value to a variable as soon as you declare it. The code you've typed in could look like this, instead:

```
int a = 10;
int b = 5;
int result = a + b;

cout << result;
```



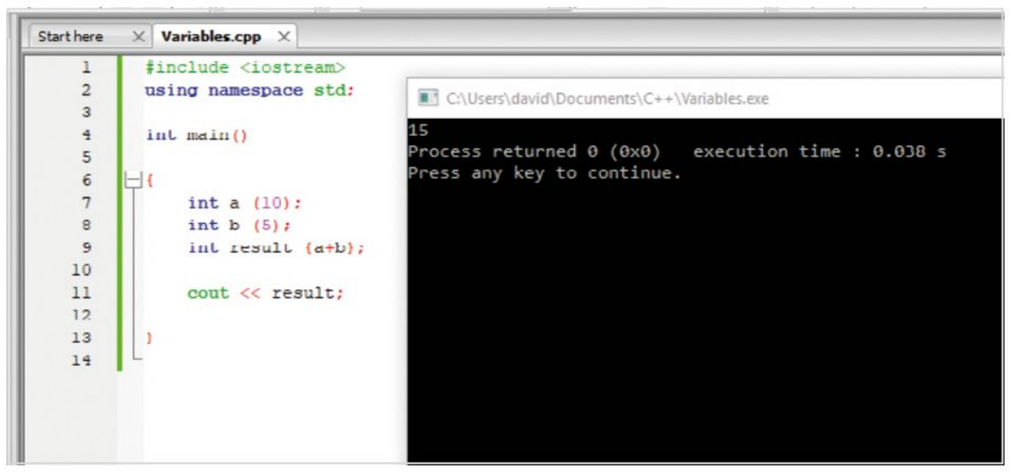
STEP 6

Specific to C++, you can also use the following to assign values to a variable as soon as you declare them:

```
int a (10);
int b (5);
```

Then, from the C++ 2011 standard, using curly brackets:

```
int result {a+b};
```



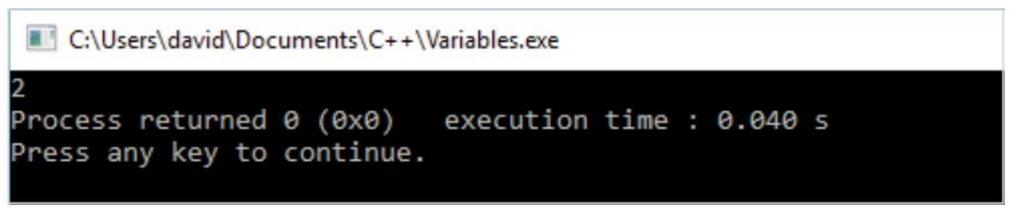
STEP 7

You can create global variables, which are variables that are declared outside any function and used in any function within the entire code. What you've used so far are local variables: variables used inside the function. For example:

```
#include <iostream>
using namespace std;
int StartLives = 3;

int main ()

{
      startLives = StartLives - 1;
      cout << StartLives;
}
```

STEP 8

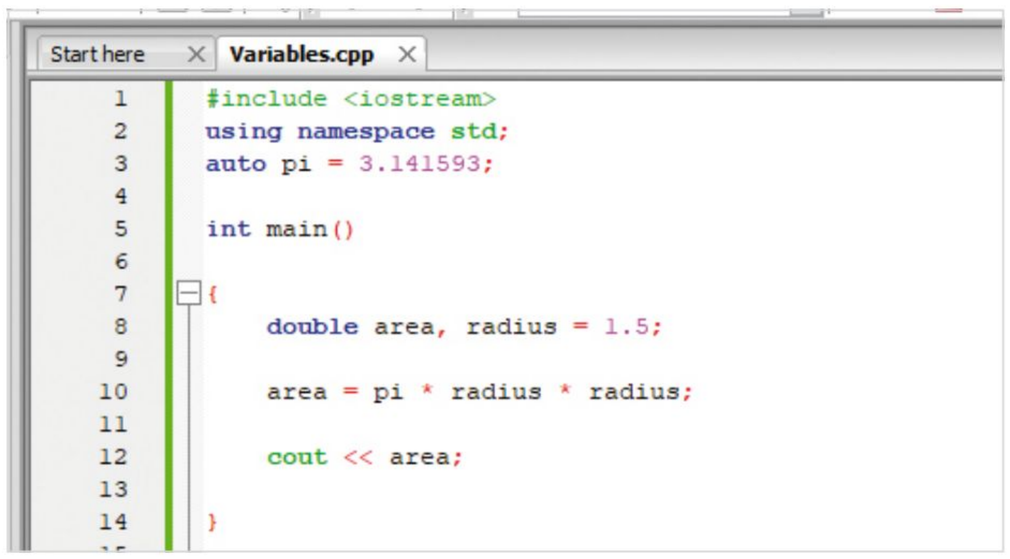
The previous step creates the variable StartLives, which is a global variable. In a game, for example, a player's lives go up or down depending on how well or how bad they're doing. When the player restarts the game, the StartLives returns to its default state: 3. Here we've assigned 3 lives, then subtracted 1, leaving 2 lives left.



STEP 9

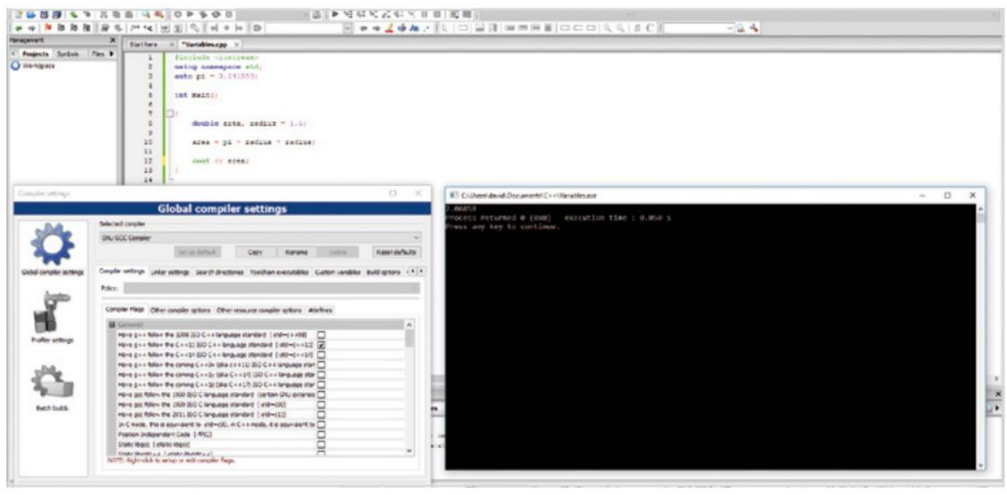
The modern C++ compiler is far more intelligent than most programmers give it credit. While there are numerous data types you can declare for variables, you can in fact use the auto feature:

```
#include <iostream>
using namespace std;
auto pi = 3.141593;

int main()

{
    double area, radius = 1.5;

    area = pi * radius * radius;

    cout << area;

}
```



STEP 10

A couple of new elements here: first, auto won't work unless you go to Settings > Compiler and tick the box labelled 'Have G++ follow the C++11 ISO C++ Language Standard [-std=c++1]'. Then, the new data type, double, which means double-precision floating point value. Enable C++11, then build and run the code. The result should be 7.06858.



Data Types

Variables, as we've seen, store information that the programmer can then later call up, and manipulate if required. Variables are simply reserved memory locations that store the values the programmer assigns, depending on the data type used.

THE VALUE OF DATA

There are many different data types available for the programmer in C++, such as an integer, floating point, Boolean, character and so on. It's widely accepted that there are seven basic data types, often called Primitive Built-in Types; however, you can create your own data types should the need ever arise within your code.

The seven basic data types are:

TYPE	COMMAND
Integer	`Integer`
Floating Point	`float`
Character	`char`
Boolean	`bool`
Double Floating Point	`double`
Wide Character	`wchar_t`
No Value	`void`

These basic types can also be extended using the following modifiers: Long, Short, Signed and Unsigned. Basically this means the modifiers can expand the minimum and maximum range values for each data type. For example, the int data type has a default value range of -2147483648 to 2147483647, a fair value, you would agree.

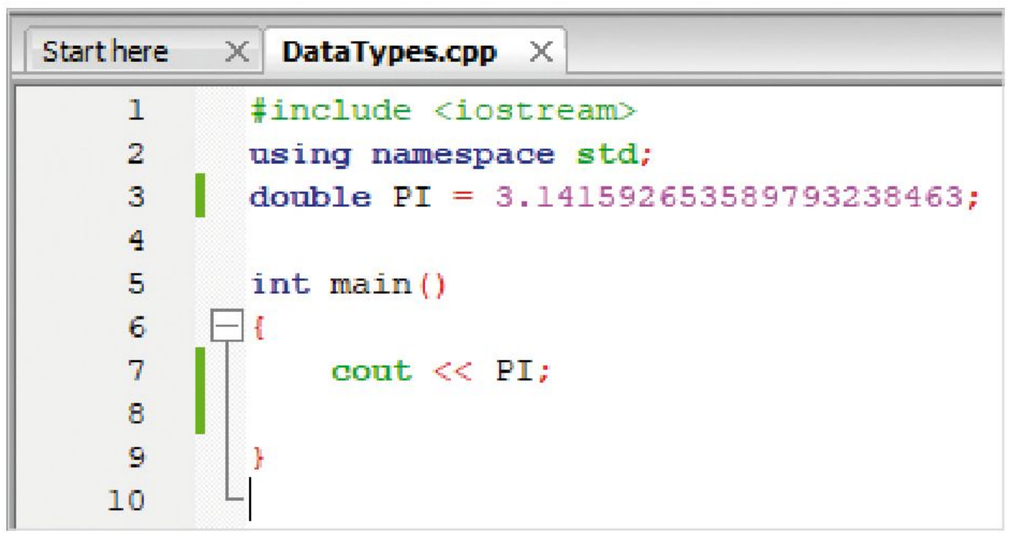
Now, if you were to use one of the modifiers, the range alters:

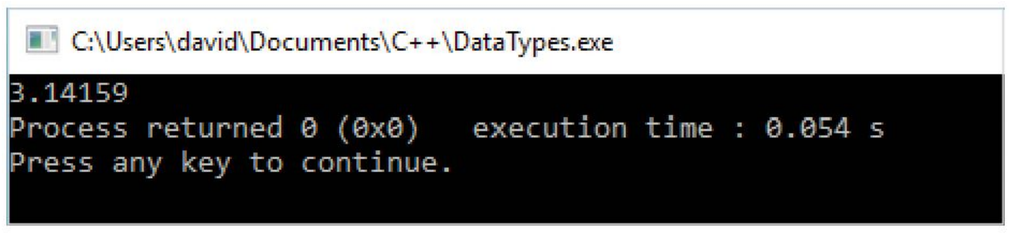
Unsigned int = 0 to 4294967295
Signed int = -2147483648 to 2147483647
Short int = -32768 to 32767
Unsigned Short int = 0 to 65,535
Signed Short int = -32768 to 32767
Long int = -2147483647 to 2147483647
Signed Long int = -2147483647 to 2147483647
Unsigned Long int = 0 to 4294967295

Naturally you can get away with using the basic type without the modifier, as there's plenty of range provided with each data type. However, it's considered good C++ programming practise to use the modifiers when possible.

There are issues when using the modifiers though. Double represents a double-floating point value, which you can use for incredibly accurate numbers but those numbers are only accurate up to the fifteenth decimal place. There's also the problem when displaying such numbers in C++ using the cout function, in that cout by default only outputs the first five decimal places. You can combat that by adding a cout.precision () function and adding a value inside the brackets, but even then you're still limited by the accuracy of the double data type. For example, try this code:

```
#include <iostream>
using namespace std;
double PI = 3.141592653589793238463;

int main()
{
    cout << PI;
}
```



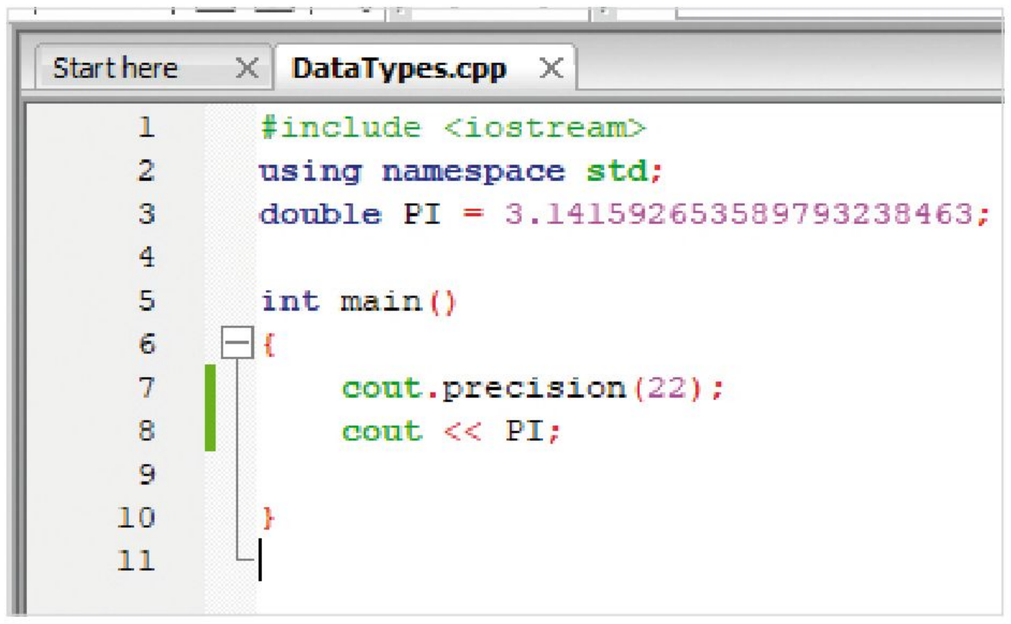


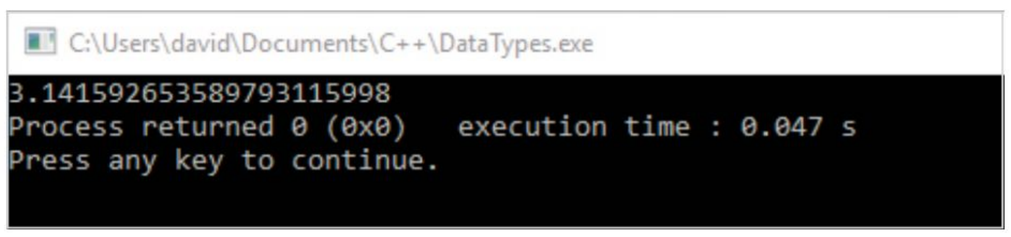
Build and run the code and as you can see the output is only 3.14159, representing cout's limitations in this example.

You can alter the code including the aforementioned cout.precision function, for greater accuracy. Take precision all the way up to 22 decimal places, with the following code:

```
#include <iostream>
using namespace std;
double PI = 3.141592653589793238463;

int main()
{
```

```
    cout.precision(22);
    cout << PI;

}
```



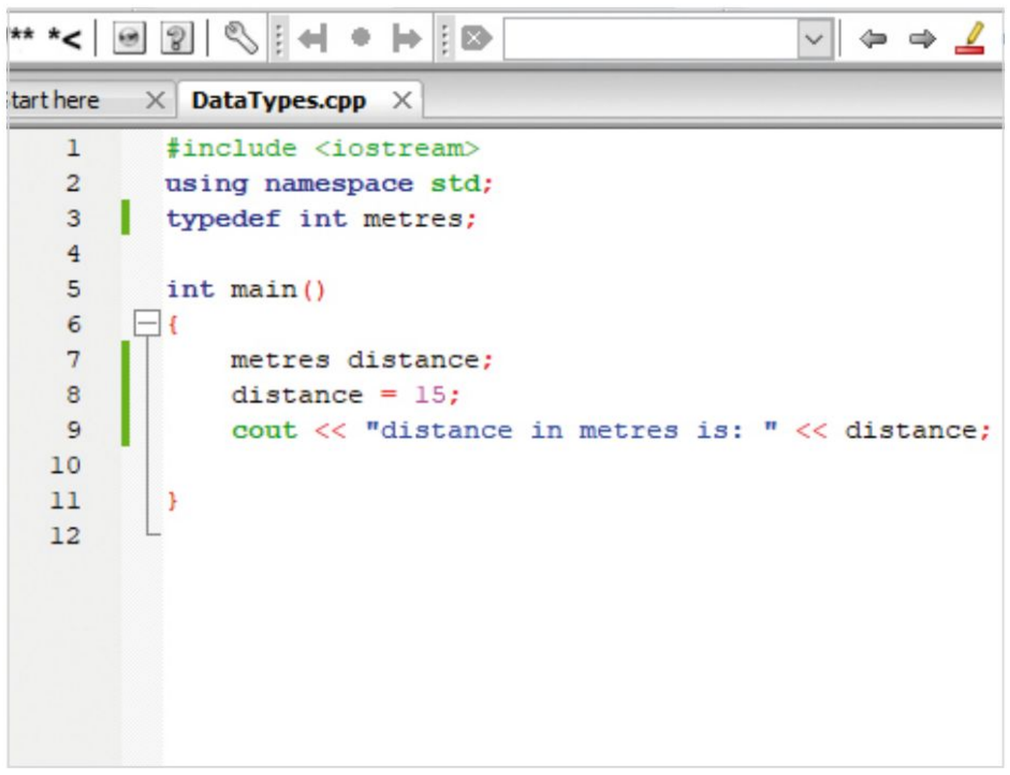


Again, build and run the code; as you can see from the command line window, the number represented by the variable PI is different to the number you've told C++ to use in the variable. The output reads the value of PI as 3.1415926535897931159, with the numbers going awry from the fifteenth decimal place.

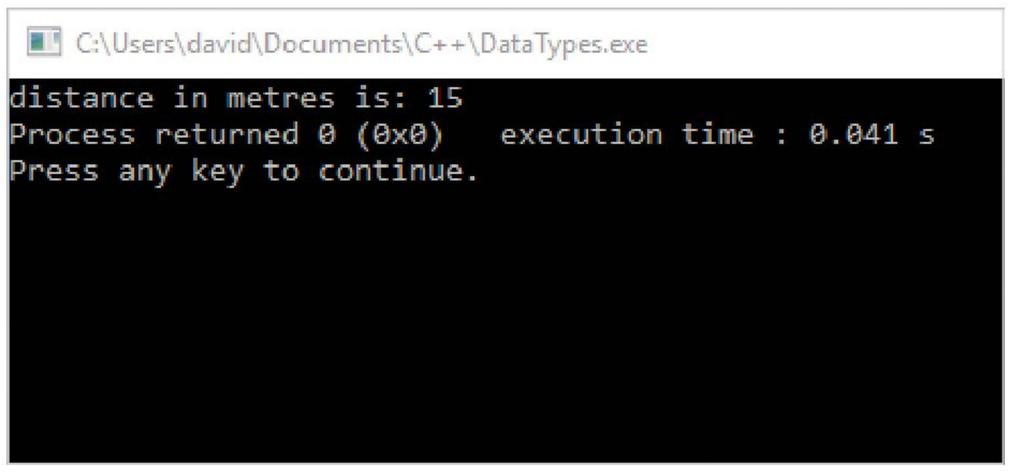
This is mainly due to the conversion from binary in the compiler and that the IEEE 754 double precision standard occupies 64-bits of data, of which 52-bits are dedicated to the significant (the significant digits in a floating-point number) and roughly 3.5-bits are taken holding the values 0 to 9. If you divide 53 by 3.5, then you arrive at 15.142857 recurring, which is 15-digits of precision.

To be honest, if you're creating code that needs to be accurate to more than fifteen decimal places, then you wouldn't be using C++, you would use some scientific specific language with C++ as the connective tissue between the two languages.

You can create your own data types, using an alias-like system called typedef. For example:




```
#include <iostream>
using namespace std;
typedef int metres;

int main()
{
    metres distance;
    distance = 15;
    cout << “distance in metres is: “ << distance;

}
```



This code when executed creates a new int data type called metres. Then, in the main code block, there's a new variable called distance, which is an integer; so you're basically telling the compiler that there's another name for int. We assigned the value 15 to distance and displayed the output: distance in metres is 15.

It might sound a little confusing to begin with but the more you use C++ and create your own code, the easier it becomes.

Strings

Strings are objects that represent and hold sequences of characters. For example, you could have a universal greeting in your code ‘Welcome’ and assign that as a string to be called up wherever you like in the program.

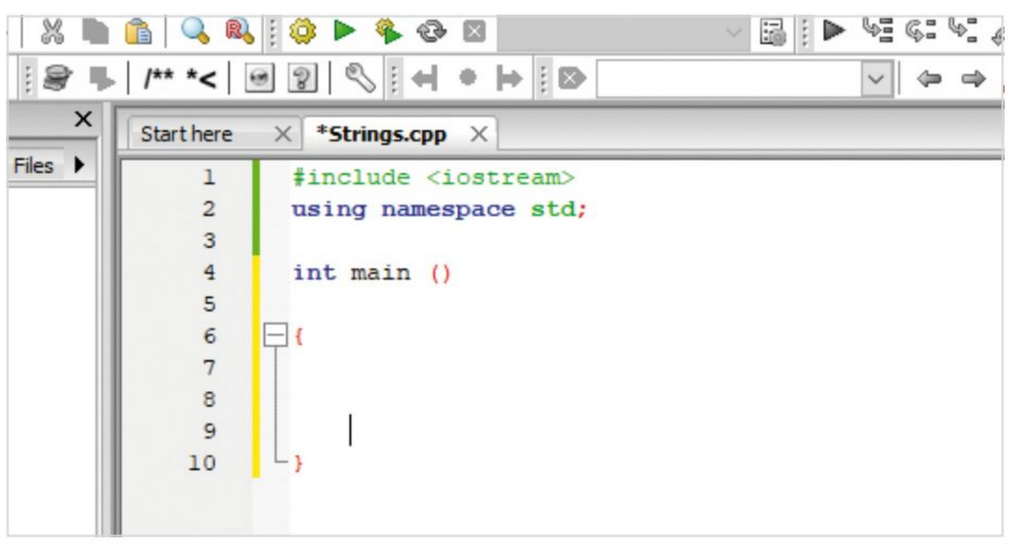
STRING THEORY

There are different ways in which you can create a string of characters, which historically are all carried over from the original C language, and are still supported by C++.

STEP 1

To create a string you use the char function. Open a new C++ file and begin with the usual header:

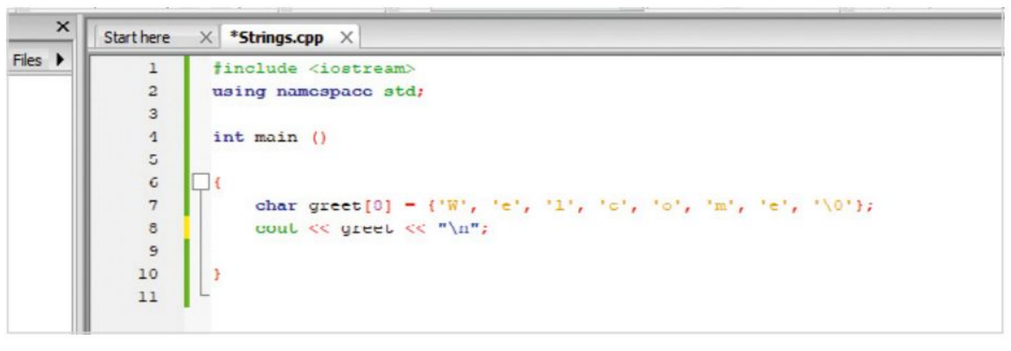
```
#include <iostream>
using namespace std;

int main ()

{

}
```



STEP 2

It’s easy to confuse a string with an array. Here’s an array, which can be terminated with a null character:

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

int main ()

{
    char greet[8] = {‘W’, ‘e’, ‘l’, ‘c’, ‘o’, ‘m’,
‘e’, ‘\0’};
    cout << greet << “\n”;

}
```



STEP 3

Build and run the code, and ‘Welcome’ appears on the screen. While this is perfectly fine, it’s not a string. A string is a class, which defines objects that can be represented as a stream of characters and doesn’t need to be terminated like an array. The code can therefore be represented as:

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

int main ()

{
    char greet[] = “Welcome”;
    cout << greet << “\n”;

}
```

STEP 4

In C++ there’s also a string function, which works in much the same way. Using the greeting code again, you can enter:

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

int main ()

{
    string greet = “Welcome”;
    cout << greet << “\n”;

}
```

STEP 5 There are also many different operations that you can apply with the string function. For instance, to get the length of a string you can use:

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

int main ()

{
    string greet = “Welcome”;
    cout << “The length of the string is: “;
    cout << greet.size() << “\n”;

}
```

```
1   #include <iostream>
2   using namespace std;
3
4   int main ()
5
6   {
7       string greet = "Welcome";
8       cout << "The length of the string is: ";
9       cout << greet.size() << "\n";
10
11  }
12
```

STEP 6 You can see that we used greet.size() to output the length, the number of characters there are, of the contents of the string. Naturally, if you call your string something other than greet, then you need to change the command to reflect this. It’s always stringname.operation. Build and run the code to see the results.

```
C:\Users\david\Documents\C++\Strings.exe
The length of the string is: 7

Process returned 0 (0x0)   execution time : 0.044 s
Press any key to continue.
```

STEP 7 You can of course add strings together, or rather combine them to form longer strings:

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

int main ()

{
    string greet1 = “Hello”;
    string greet2 = “, world!”;
    string greet3 = greet1 + greet2;

    cout << greet3 << “\n”;

}
```

```
Start here | Strings.cpp
Files
1   #include <iostream>
2   using namespace std;
3
4   int main ()
5
6   {
7       string greet1 = "Hello";
8       string greet2 = ", world!";
9       string greet3 = greet1 + greet2;
10
11      cout << greet3 << "\n";
12
13  }
14
```

STEP 8 Just as you might expect, you can mix in an integer and store something to do with the string. In this example, we created int length, which stores the result of string. size() and outputs it to the user:

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

int main ()

{
    int length;
    string greet1 = “Hello”;
    string greet2 = “, world!”;
    string greet3 = greet1 + greet2;
    length = greet3.size();

    cout << “The length of the combined strings
is: “ << length << “\n”;

}
```

STEP 9 Using the available operations that come with the string function, you can manipulate the contents of a string. For example, to remove characters from a string you could use:

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

int main ()

{
  string strg (“Here is a long sentence in a
string.”);
  cout << strg << ‘\n’;

  strg.erase (10,5);
  cout << strg << ‘\n’;

  strg.erase (strg.begin()+8);
  cout << strg << ‘\n’;

  strg.erase (strg.begin()+9, strg.end()-9);
  cout << strg << ‘\n’;

}
```

STEP 10 It’s worth spending some time playing around with the numbers, which are the character positions in the string. Occasionally, it can be hit and miss whether you get it right, so practice makes perfect. Take a look at the screenshot to see the result of the code.

```
C:\Users\david\Documents\C++\Strings.exe
Here is a long sentence in a string.
Here is a sentence in a string.
Here is  sentence in a string.
Here is  a string.

Process returned 0 (0x0)   execution time : 0.051 s
Press any key to continue.
```

C++ Maths

Programming is mathematical in nature and as you might expect, there's plenty of built-in scope for some quite intense maths. C++ has a lot to offer someone who's implementing mathematical models into their code. It can be extremely complex or relatively simple.

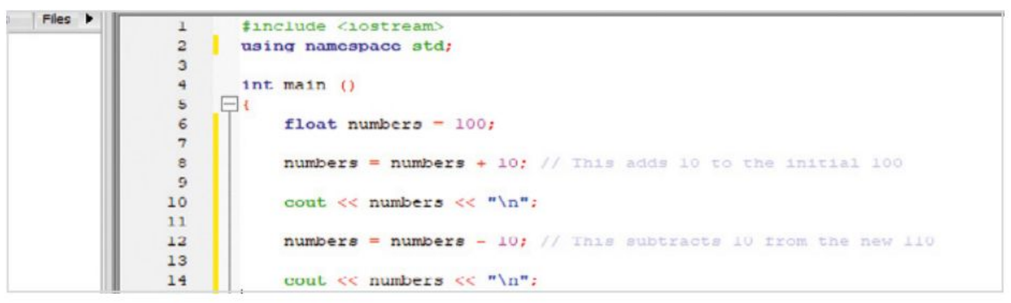
C++ = MC^2

The basic mathematical symbols apply in C++ as they do in most other programming languages. However, by using the C++ Math Library, you can also calculate square roots, powers, trig and more.

STEP 1

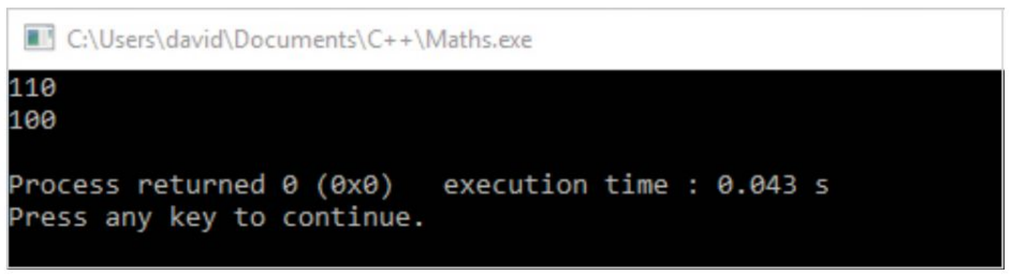
C++'s mathematical operations follow the same patterns as those taught in school, in that multiplication and division take precedence over addition and subtraction. You can alter that though. For now, create a new file and enter:

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

int main ()
{
    float numbers = 100;

    numbers = numbers + 10; // This adds 10 to the initial 100

    cout << numbers << "\n";

    numbers = numbers - 10; // This subtracts 10 from the new 110

    cout << numbers << "\n";

}
```



STEP 2

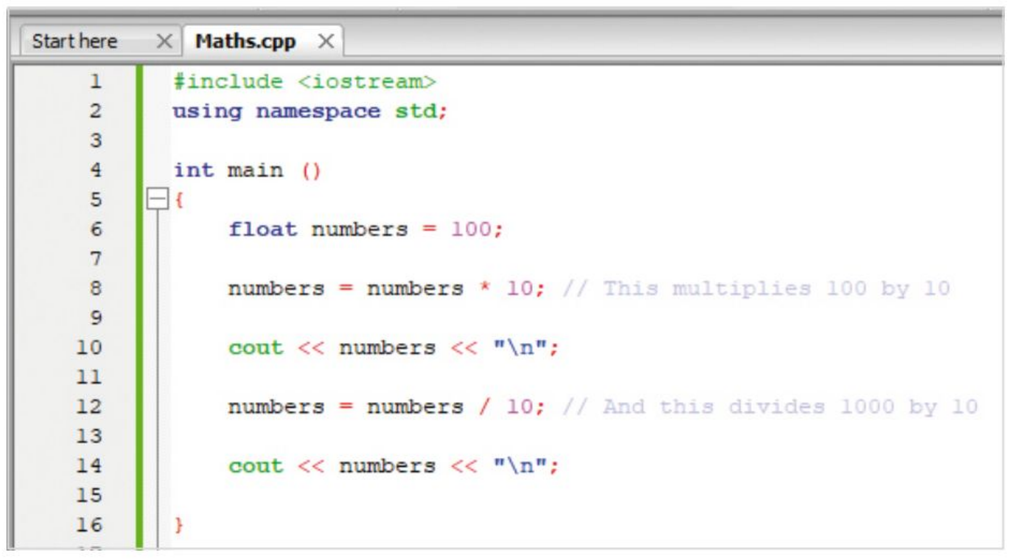
While simple, it does get the old maths muscle warmed up. Note that we used a float for the numbers variable. While you can happily use an integer, if you suddenly started to use decimals, you would need to change to a float or a double, depending on the accuracy needed. Run the code and see the results.



STEP 3

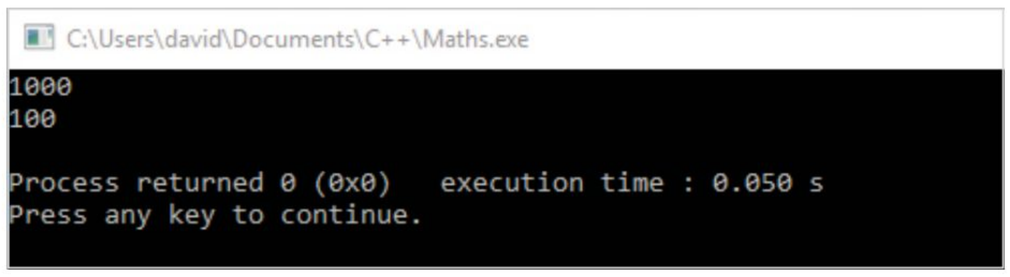
Multiplication and division can be applied as such:

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

int main ()
{
    float numbers = 100;

    numbers = numbers * 10; // This multiplies 100 by 10

    cout << numbers << "\n";

    numbers = numbers / 10; // And this divides 1000 by 10

    cout << numbers << "\n";

}
```



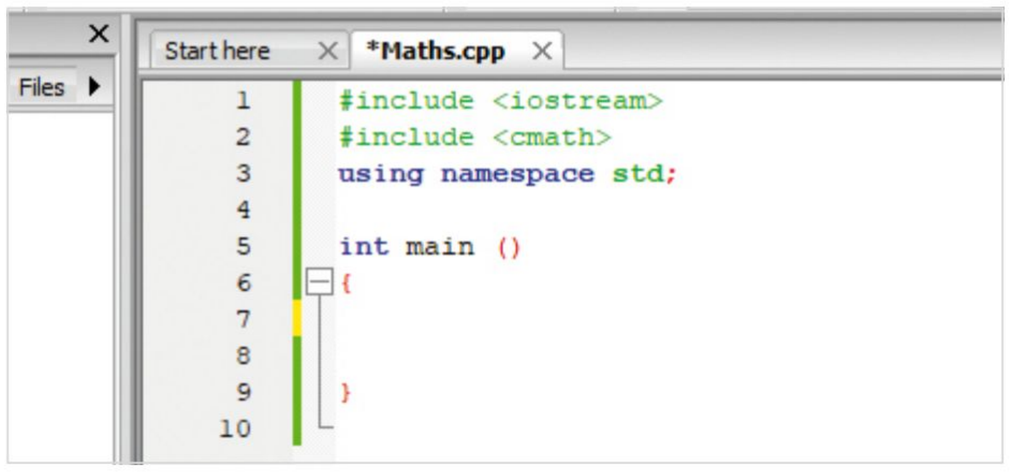
STEP 4

Again, execute the simple code and see the results. While not particularly interesting, it's a start into C++ maths. We used a float here, so you can play around with the code and multiply by decimal places, as well as divide, add and subtract.



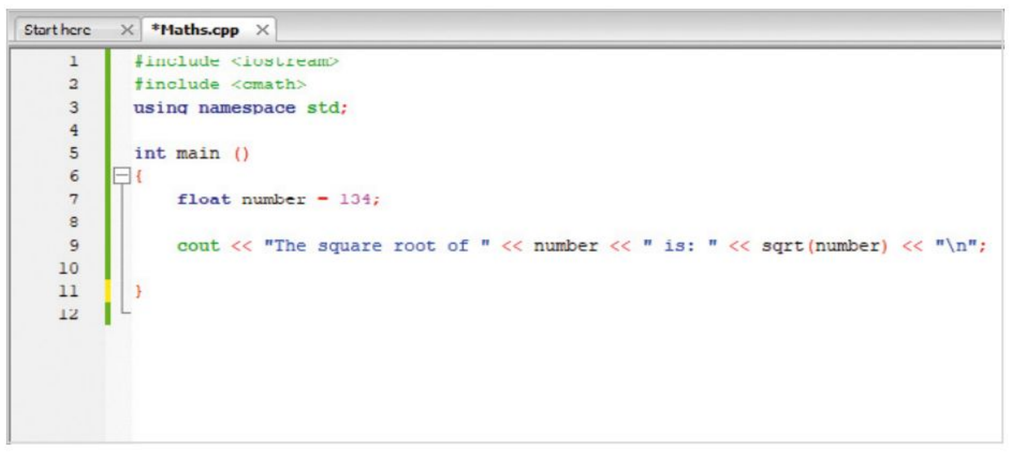
STEP 5 The interesting maths content comes when you call upon the C++ Math Library. Within this header are dozens of mathematical functions along with further operations. Everything from computing cosine to arc tangent with two parameters, to the value of PI. You can call the header with:

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

int main ()
{

}
```

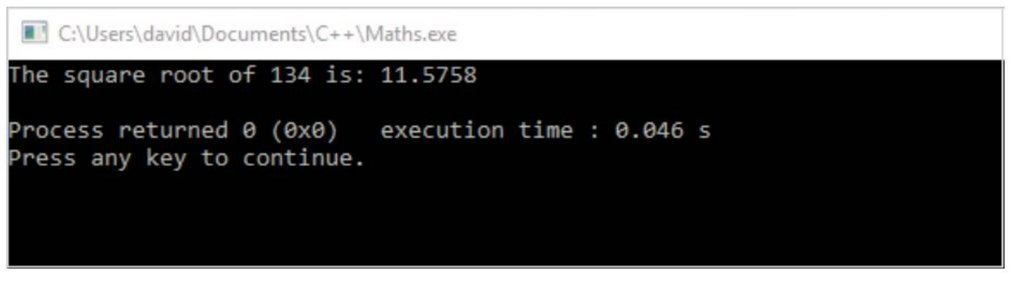


STEP 6 Start by getting the square root of a number:

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

int main ()
{
    float number = 134;

    cout << “The square root of “ << number << “ is: “ << sqrt(number) << “\n”;

}
```

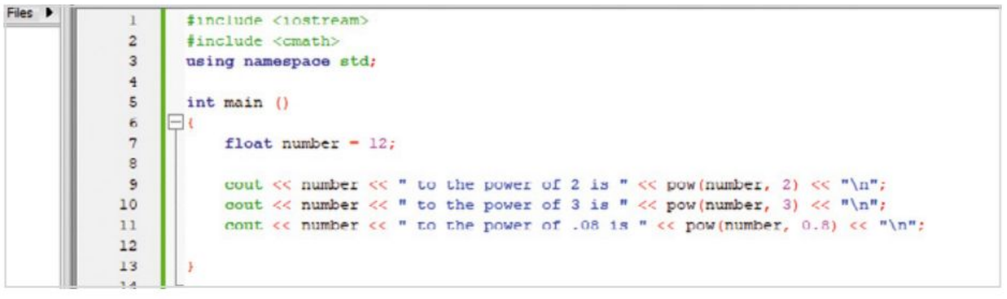


STEP 7 Here we created a new float called number and used the sqrt(number) function to display the square root of 134, the value of the variable, number. Build and run the code, and your answer reads 11.5758.

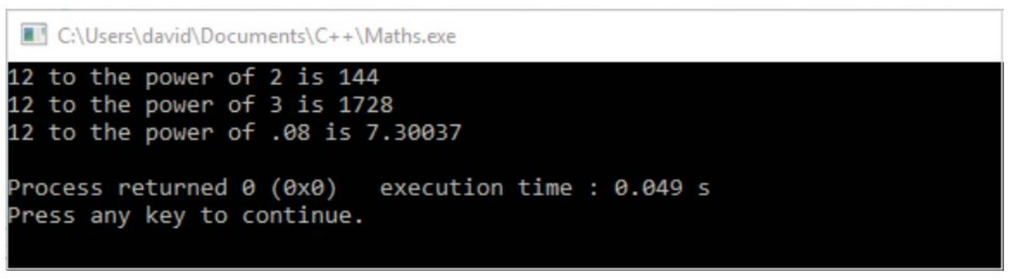


STEP 8 Calculating powers of numbers can be done with:

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

int main ()
{
    float number = 12;

    cout << number << “ to the power of 2 is “ << pow(number, 2) << “\n”;
    cout << number << “ to the power of 3 is “ << pow(number, 3) << “\n”;
    cout << number << “ to the power of .08 is “ << pow(number, 0.8) << “\n”;

}
```



STEP 9 Here we created a float called number with the value of 12, and the pow(variable, power) is where the calculation happens. Of course, you can calculate powers and square roots without using variables. For example, pow (12, 2) outputs the same value as the first cout line in the code.



STEP 10 The value of Pi is also stored in the cmath header library. It can be called up with the M_PI function. Enter cout << M_PI; into the code and you get 3.14159; or you can use it to calculate:

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

int main ()
{
    double area, radius = 1.5;

    area = M_PI * radius * radius;

    cout << area << “\n”;

}
```