

# Chapter 5 – Using Functions

As in mathematics, there are functions in C++ that perform specific actions. In Chapter 3, functions were used to control output. In Chapter 1, functions were used to pause the program until a key was pressed. There are two general types of functions in C++. First are *member functions*, which are part of a *class*. If an object of a class exists in a program, the member functions of the class may be used. The second type of functions are *free functions*, which do not belong to a class. They are usually located in a file that must be imported into a program via the *#include* instruction to the pre-compiler.

To invoke or call (i.e. use) a member function, the following form must be used:

*object.function-name ( argument-list )*

*cout* is an object of class *ostream* that is declared in *iostream*. Once *iostream* is included in a program, *cout* and all of the *member functions* of *ostream* are available for use within the program. Here is a listing of the *ostream* member functions that we have used:

*cout.width(integer)* – sets the minimum width of the *cout* output, width by default is 0

*cout.fill(char)* – sets the fill character for spaces to be used by *cout* when the width of output exceeds the actual width of the value to be output

*cout.flush()* – removes the contents of the output buffer created by the operating system when the program was run, *cout.flush()* should be used before input and output functions other than *cin* and *cout*

*cout.setf()* – sets internal state information in *cout*

*cout.precision(integer)* – regulates decimal precision

One other function that has been used before in example programs is *getch()* (from *conio.h*), which is an example of a *free function*. It retrieves a character from the keyboard. In the previous examples of its use, the character typed in by the user was ignored. The following is an example program that makes use of the character typed by the user.

```
#include <iostream>
#include <conio.h>
using namespace std;

void main() {
    cout << "Press any key: ";
    cout.flush();
    char k = getch();
    cout << "\n" << k << endl;
}
```

If the user presses shifted-J during a run of this example program, the run will look like this:

```
Press any key:
J
```

*getch()* waits until the user presses a key, does not echo the key pressed to the screen, and does not wait for the Enter key to be pressed. The key pressed is returned as the value of the expression in the assignment statement, *k = getch()*, assigning the value 'J' to *char* object *k*.

C++ functions that do not return a value are called *void functions*. *cout.width()*, *cout.flush()*, *cout.fill()*, *cout.setf()*, and *cout.precision()* are all examples of *void functions*. C++ functions that return a value are called *non-void functions*. *getch()* is an example of a *non-void function*. Both member functions and free functions may be void or non-void functions. Void functions are called in the form of a statement. Non-void functions may be called in the form of a statement, but are intended to be called from inside of an expression, such as the expression of an assignment statement.

Most students first use functions by way of a calculator. C++ has a standard library of non-void mathematical free functions similar to the standard ones found on calculators that is accessible by directing the pre-compiler to include the file *cmath*. Here are some of these functions: (see next page)

## Short List of Functions in cmath

Function	description
double pow(double, double)	Returns the first argument raised to the power given by the first argument
double sin(double)	Returns the sine of the argument, the argument must be expressed in radians
double cos(double)	Returns the cosine of the argument, the argument must be expressed in radians
double fabs(double)	Returns the absolute value of the argument
double sqrt(double)	Returns the square root of the argument
double ceil(double)	Returns the nearest integer that is equal to or larger than the argument
double floor(double)	Returns the nearest integer that is smaller than or equal to the argument

The following is an example program of using the functions in the previous list.

```
#include <iostream>
#include <cmath>           // may need to be written <math.h>
using namespace std;

void main()
{
    cout << pow(2, 5) << endl
         << sqrt(16) << endl
         << sin(1.5) << endl
         << cos(1.5) << endl
         << fabs(-33.7) << endl
         << ceil(-33.7) << endl
         << floor(-33.7) << endl;
}
```

When run, the above example program will produce output that looks like this:

```
32
4
0.997495
0.0707372
33.7
-33
-34
```

**Exercises**

1. What is a void function?
2. What is a non-void function?

**Programming Assignment 5.1**

Write a program to input the values for a, b, and c, then compute and output the result of the results of the quadratic formula. Use the program to find a valid set of values for a, b and c.

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

**Programming Assignment 5.2**

Ballistic objects, such as the shell fired from a large gun, are propelled only at the very start of their flight. The distance a ballistic object will travel over level ground is given by the following formula:

$$d = \frac{V^2}{g} \sin \left[ \frac{2.0 * r * 3.14}{180.0} \right]$$

where d is distance traveled by the ballistic object

V is the velocity (meters per second) of the ballistic object at the start of its journey

g is the downward acceleration imposed by gravity (9.8 meters per second)

r is angle of travel of the ballistic object at the start of its journey (in degrees)

Write a program to calculate the distance that a ballistic object started at 25 meters per second will travel. The angle will be determined by user input (in degrees from 0 to 90). Output should be limited to 1 decimal place.

**Programming Assignment 5.3**

The amount of potential energy in an ocean wave can be calculated by the following formula:

$$E_p = 0.0329 \cdot H^2 \sqrt{D (1 - 4.935 (H^2/D^2))}$$

where  $E_p$  is the energy potential  
H is the wave height in feet  
D is distance between successive wave crests

Write a program to calculate the energy potential of an ocean wave when the user inputs the wave height and distance between successive wave crests. Output should be limited to 5 decimal places.