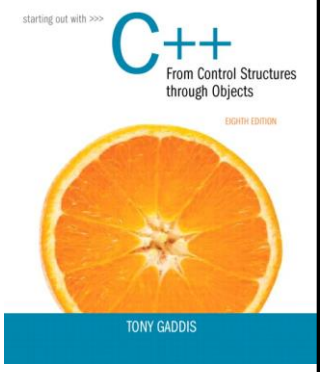
Chapter 6:

Functions

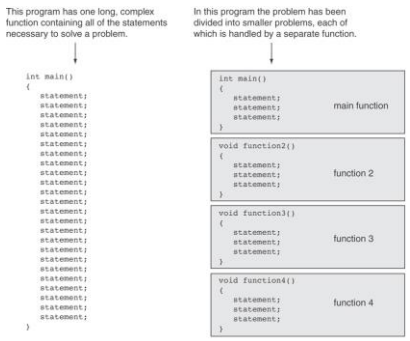


6.1

Modular Programming

Modular Programming

- Modular programming: breaking a program up into smaller, manageable functions or modules
- Function: a collection of statements to perform a task
- Motivation for modular programming:
  - Improves maintainability of programs
  - Simplifies the process of writing programs



6.2

Defining and Calling Functions

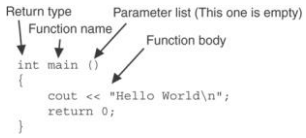
Defining and Calling Functions

- Function call: statement causes a function to execute
- Function definition: statements that make up a function

Function Definition

- Definition includes:
  - return type: data type of the value that function returns to the part of the program that called it
  - name: name of the function. Function names follow same rules as variables
  - parameter list: variables containing values passed to the function
  - body: statements that perform the function's task, enclosed in `{}`

Function Definition



Note: The line that reads `int main()` is the *function header*.

Function Return Type

- If a function returns a value, the type of the value must be indicated:

```
int main()
```

- If a function does not return a value, its return type is `void`:

```
void printHeading()
{
      cout << "Monthly Sales\n";
}
```


Calling a Function

- To call a function, use the function name followed by `()` and `;`

```
printHeading();
```

- When called, program executes the body of the called function
- After the function terminates, execution resumes in the calling function at point of call.

Functions in Program 6-1

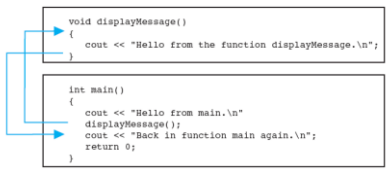
Program 6-1

```
// This program has two functions: main and displayMessage
#include <iostream>
using namespace std;

//*****************************************
// Definition of function displayMessage  *
// This function displays a greeting.     *
//*****************************************

void displayMessage()
{
   cout << "Hello from the function displayMessage.\n";
}

//*****************************************
// Function main                          *
//*****************************************

int main()
{
   cout << "Hello from main.\n";
   displayMessage();
   cout << "Back in function main again.\n";
   return 0;
}
```

Program Output

```
Hello from main.
Hello from the function displayMessage.
Back in function main again.
```


Flow of Control in Program 6-1



Calling Functions

- `main` can call any number of functions
- Functions can call other functions
- Compiler must know the following about a function before it is called:
  - name
  - return type
  - number of parameters
  - data type of each parameter

6.3

Function Prototypes

Function Prototypes

- Ways to notify the compiler about a function before a call to the function:
  - Place function definition before calling function's definition
  - Use a function prototype (function declaration) – like the function definition without the body
    - Header: `void printHeading()`
    - Prototype: `void printHeading();`

Function Prototypes in Program 6-5

Program 6-5

```
1  // This program has three functions: main, First, and Second.
2  #include <iostream>
3  using namespace std;
4
5  // Function Prototypes
6  void first();
7  void second();
8
9  int main()
10 {
11    cout << "I am starting in function main.\n";
12    first();    // Call function first
13    second();   // Call function second
14    cout << "Back in function main again.\n";
15    return 0;
16 }
17
```

(Program Continues)

Function Prototypes in Program 6-5

```
18 //***************************************
19 // Definition of function first.        *
20 // This function displays a message.    *
21 //***************************************
22
23 void first()
24 {
25    cout << "I am now inside the function first.\n";
26 }
27
28 //***************************************
29 // Definition of function second.       *
30 // This function displays a message.    *
31 //***************************************
32
33 void second()
34 {
35    cout << "I am now inside the function second.\n";
36 }
```


Prototype Notes

- Place prototypes near top of program
- Program must include either prototype or full function definition before any call to the function – compiler error otherwise
- When using prototypes, can place function definitions in any order in source file

6.4

Sending Data into a Function

Sending Data into a Function

- Can pass values into a function at time of call:

```
c = pow(a, b);
```

- Values passed to function are arguments
- Variables in a function that hold the values passed as arguments are parameters

A Function with a Parameter Variable

```
void displayValue(int num)
{
   cout << "The value is " << num << endl;
}
```

The integer variable `num` is a parameter.
It accepts any integer value passed to the function.

Function with a Parameter in Program 6-6

Program 6-6

```
1  // This program demonstrates a function with a parameter.
2  #include <iostream>
3  using namespace std;
4
5  // Function Prototype
6  void displayValue(int);
7
8  int main()
9  {
10    cout << "I am passing 5 to displayValue.\n";
11    displayValue(5);  // Call displayValue with argument 5
12    cout << "Now I am back in main.\n";
13    return 0;
14 }
15
```

(Program Continues)

Function with a Parameter in Program 6-6

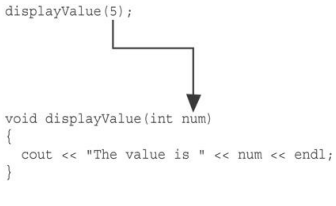
Program 6-6 *(continued)*

```
16 //*************************************************************
17 // Definition of function displayValue.                       *
18 // It uses an integer parameter whose value is displayed.     *
19 //*************************************************************
20
21 void displayValue(int num)
22 {
23    cout << "The value is " << num << endl;
24 }
```

Program Output

```
I am passing 5 to displayValue.
The value is 5
Now I am back in main.
```


Function with a Parameter in Program 6-6



The function call in line 11 passes the value 5 as an argument to the function.

Other Parameter Terminology

- A parameter can also be called a formal parameter or a formal argument
- An argument can also be called an actual parameter or an actual argument

Parameters, Prototypes, and Function Headers

- For each function argument,
  - the prototype must include the data type of each parameter inside its parentheses
  - the header must include a declaration for each parameter in its ()

```
void evenOrOdd(int);  //prototype
void evenOrOdd(int num) //header
evenOrOdd(val);       //call
```


Function Call Notes

- Value of argument is copied into parameter when the function is called
- A parameter's scope is the function which uses it
- Function can have multiple parameters
- There must be a data type listed in the prototype () and an argument declaration in the function header () for each parameter
- Arguments will be promoted/demoted as necessary to match parameters

Passing Multiple Arguments

When calling a function and passing multiple arguments:

- the number of arguments in the call must match the prototype and definition
- the first argument will be used to initialize the first parameter, the second argument to initialize the second parameter, etc.

Passing Multiple Arguments in Program 6-8

Program 6-8

```
1  // This program demonstrates a function with three parameters.
2  #include <iostream>
3  using namespace std;
4
5  // Function Prototype
6  void showSum(int, int, int);
7
8  int main()
9  {
10    int value1, value2, value3;
11
12    // Get three integers.
13    cout << "Enter three integers and I will display ";
14    cout << "their sum: ";
15    cin >> value1 >> value2 >> value3;
16
17    // Call showSum passing three arguments.
18    showSum(value1, value2, value3);
19    return 0;
20 }
21
```

(Program Continues)

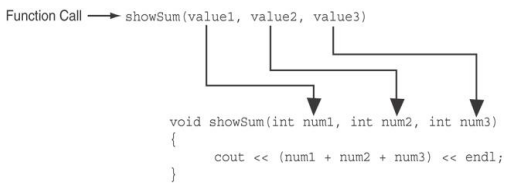
Passing Multiple Arguments in Program 6-8

```
22 //*************************************************************
23 // Definition of function showSum.                            *
24 // It uses three integer parameters. Their sum is displayed. *
25 //*************************************************************
26
27 void showSum(int num1, int num2, int num3)
28 {
29    cout << (num1 + num2 + num3) << endl;
30 }
```

Program Output with Example Input Shown in Bold

```
Enter three integers and I will display their sum: 4 8 7 [Enter]
19
```

Passing Multiple Arguments in Program 6-8



The function call in line 18 passes value1, value2, and value3 as a arguments to the function.

6.5

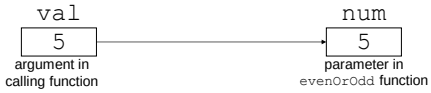
Passing Data by Value

Passing Data by Value

- Pass by value: when an argument is passed to a function, its value is copied into the parameter.
- Changes to the parameter in the function do not affect the value of the argument

Passing Information to Parameters by Value

- Example: `int val=5;`
  `evenOrOdd(val);`



- `evenOrOdd` can change variable `num`, but it will have no effect on variable `val`

6.6

Using Functions in Menu-Driven Programs

Using Functions in Menu-Driven Programs

- Functions can be used
  - to implement user choices from menu
  - to implement general-purpose tasks:
    - Higher-level functions can call general-purpose functions, minimizing the total number of functions and speeding program development time
- *See Program 6-10 in the book*

6.7

The `return` Statement

The `return` Statement

- Used to end execution of a function
- Can be placed anywhere in a function
  - Statements that follow the `return` statement will not be executed
- Can be used to prevent abnormal termination of program
- In a `void` function without a `return` statement, the function ends at its last `}`

Performing Division in Program 6-11

Program 6-11

```
1  // This program uses a function to perform division. If division
2  // by zero is detected, the function returns.
3  #include <iostream>
4  using namespace std;
5
6  // Function prototype.
7  void divide(double, double);
8
9  int main()
10 {
11    double num1, num2;
12
13    cout << "Enter two numbers and I will divide the first\n";
14    cout << "number by the second number: ";
15    cin >> num1 >> num2;
16    divide(num1, num2);
17    return 0;
18 }
```

(Program Continues)

Performing Division in Program 6-11

```
20 //*************************************************************
21 // Definition of function divide.                             *
22 // Uses two parameters: arg1 and arg2. The function divides arg1*
23 // by arg2 and shows the result. If arg2 is zero, however, the  *
24 // function returns.                                          *
25 //*************************************************************
26
27 void divide(double arg1, double arg2)
28 {
29    if (arg2 == 0.0)
30    {
31       cout << "Sorry, I cannot divide by zero.\n";
32       return;
33    }
34    cout << "The quotient is " << (arg1 / arg2) << endl;
35 }
```

Program Output with Example Input Shown in Bold

```
Enter two numbers and I will divide the first
number by the second number: 12 0 [Enter]
Sorry, I cannot divide by zero.
```


6.8

Returning a Value From a Function

Returning a Value From a Function

- A function can return a value back to the statement that called the function.
- You've already seen the `pow` function, which returns a value:

```
double x;
x = pow(2.0, 10.0);
```

Returning a Value From a Function

- In a value-returning function, the `return` statement can be used to return a value from function to the point of call. Example:

```
int sum(int num1, int num2)
{
  double result;
  result = num1 + num2;
  return result;
}
```


A Value-Returning Function

Return Type

```
int sum(int num1, int num2)
{
   double result;
   result = num1 + num2;
   return result;
}
```

Value Being Returned

A Value-Returning Function

```
int sum(int num1, int num2)
{
   return num1 + num2;
}
```

Functions can return the values of expressions, such as `num1 + num2`

Function Returning a Value in Program 6-12

Program 6-12

```
1  // This program uses a function that returns a value.
2  #include <iostream>
3  using namespace std;
4
5  // Function prototype
6  int sum(int, int);
7
8  int main()
9  {
10    int value1 = 20,   // The first value
11        value2 = 40,   // The second value
12        total;         // To hold the total
13
14    // Call the sum function, passing the contents of
15    // value1 and value2 as arguments. Assign the return
16    // value to the total variable.
17    total = sum(value1, value2);
18
19    // Display the sum of the values.
20    cout << "The sum of " << value1 << " and "
21         << value2 << " is " << total << endl;
22    return 0;
23 }
```

(Program Continues)

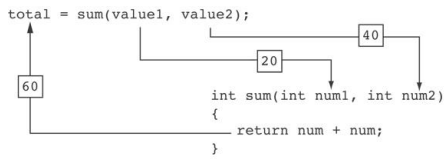
Function Returning a Value in Program 6-12

```
24
25 //*********************************************************
26 // Definition of function sum. This function returns     *
27 // the sum of its two parameters.                         *
28 //*********************************************************
29
30 int sum(int num1, int num2)
31 {
32    return num1 + num2;
33 }
```

Program Output

```
The sum of 20 and 40 is 60
```

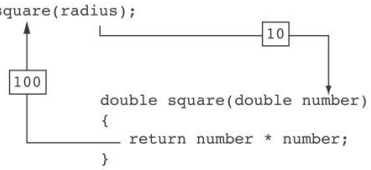

Function Returning a Value in Program 6-12



The statement in line 17 calls the sum function, passing `value1` and `value2` as arguments. The return value is assigned to the `total` variable.

Another Example from Program 6-13

```
area = PI * square(radius);
```



Returning a Value From a Function

- The prototype and the definition must indicate the data type of return value (not `void`)
- Calling function should use return value:
  - assign it to a variable
  - send it to `cout`
  - use it in an expression

6.9

Returning a Boolean Value

Returning a Boolean Value

- Function can return `true` or `false`
- Declare return type in function prototype and heading as `bool`
- Function body must contain `return` statement(s) that return `true` or `false`
- Calling function can use return value in a relational expression

Returning a Boolean Value in Program 6-15

Program 6-15

```
1  // This program uses a function that returns true or false.
2  #include <iostream>
3  using namespace std;
4
5  // Function prototype
6  bool isEven(int);
7
8  int main()
9  {
10    int val;
11
12    // Get a number from the user.
13    cout << "Enter an integer and I will tell you ";
14    cout << "if it is even or odd: ";
15    cin >> val;
16
17    // Indicate whether it is even or odd.
18    if (isEven(val))
19       cout << val << " is even.\n";
20    else
21       cout << val << " is odd.\n";
22    return 0;
23 }
24
```

(Program Continues)

Returning a Boolean Value in Program 6-15

```
25 //*************************************************************
26 // Definition of function isEven. This function accepts an    *
27 // integer argument and tests it to be even or odd. The function *
28 // returns true if the argument is even or false if the argument *
29 // is odd. The return value is a bool.                        *
30 //*************************************************************
31
32 bool isEven(int number)
33 {
34    bool status;
35
36    if (number % 2 == 0)
37       status = true;  // The number is even if there is no remainder.
38    else
39       status = false; // Otherwise, the number is odd.
40    return status;
41 }
```

Program Output with Example Input Shown in Bold

```
Enter an integer and I will tell you if it is even or odd: 5 [Enter]
5 is odd.
```

6.10

Local and Global Variables

Local and Global Variables

- Variables defined inside a function are *local* to that function. They are hidden from the statements in other functions, which normally cannot access them.
- Because the variables defined in a function are hidden, other functions may have separate, distinct variables with the same name.

Local Variables in Program 6-16

Program 6-16

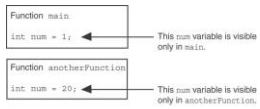
```
1  // This program shows that variables defined in a function
2  // are hidden from other functions.
3  #include <iostream>
4  using namespace std;
5
6  void anotherFunction(); // Function prototype
7
8  int main()
9  {
10    int num = 1;  // Local variable
11
12    cout << "In main, num is " << num << endl;
13    anotherFunction();
14    cout << "Back in main, num is " << num << endl;
15    return 0;
16 }
17
18 //*********************************************************
19 // Definition of anotherFunction                          *
20 // It has a local variable, num, whose initial value      *
21 // is displayed.                                          *
22 //*********************************************************
23
24 void anotherFunction()
25 {
26    int num = 20;  // Local variable
27
28    cout << "In anotherFunction, num is " << num << endl;
29 }
```


Local Variables in Program 6-16

Program Output

```
In main, num is 1
In anotherFunction, num is 20
Back in main, num is 1
```

When the program is executing in `main`, the `num` variable defined in `main` is visible. When `anotherFunction` is called, however, only variables defined inside it are visible, so the `num` variable in `main` is hidden.



Local Variable Lifetime

- A function's local variables exist only while the function is executing. This is known as the *lifetime* of a local variable.
- When the function begins, its local variables and its parameter variables are created in memory, and when the function ends, the local variables and parameter variables are destroyed.
- This means that any value stored in a local variable is lost between calls to the function in which the variable is declared.

Global Variables and Global Constants

- A global variable is any variable defined outside all the functions in a program.
- The scope of a global variable is the portion of the program from the variable definition to the end.
- This means that a global variable can be accessed by *all* functions that are defined after the global variable is defined.

Global Variables and Global Constants

- You should avoid using global variables because they make programs difficult to debug.
- Any global that you create should be *global constants*.

Global Constants in Program 6-19

Program 6-19

Global constants defined for values that do not change throughout the program's execution.

```
1  // This program calculates gross pay.
2  #include <iostream>
3  #include <iomanip>
4  using namespace std;
5
6  // Global constants
7  const double PAY_RATE = 22.55;    // Hourly pay rate
8  const double BASE_HOURS = 40.0;   // Max non-overtime hours
9  const double OT_MULTIPLIER = 1.5; // Overtime multiplier
10
11 // Function prototypes
12 double getBasePay(double);
13 double getOvertimePay(double);
14
15 int main()
16 {
17    double hours,           // Hours worked
18           basePay,         // Base pay
19           overtime = 0.0,  // Overtime pay
20           totalPay;        // Total pay
```


Global Constants in Program 6-19

The constants are then used for those values throughout the program.

```
29     // Get overtime pay, if any.
30     if (hours > BASE_HOURS)
31        overtime = getOvertimePay(hours);

56  // Determine base pay.
57  if (hoursWorked > BASE_HOURS)
58     basePay = BASE_HOURS * PAY_RATE;
59  else
60     basePay = hoursWorked * PAY_RATE;

75     // Determine overtime pay.
76     if (hoursWorked > BASE_HOURS)
77     {
78        overtimePay = (hoursWorked - BASE_HOURS) *
79                      PAY_RATE * OT_MULTIPLIER;
```


Initializing Local and Global Variables

- Local variables are not automatically initialized. They must be initialized by programmer.
- Global variables (not constants) are automatically initialized to `0` (numeric) or `NULL` (character) when the variable is defined.

6.11

Static Local Variables

Static Local Variables

- Local variables only exist while the function is executing. When the function terminates, the contents of local variables are lost.
- `static` local variables retain their contents between function calls.
- `static` local variables are defined and initialized only the first time the function is executed. `0` is the default initialization value.

Local Variables Do Not Retain Values Between Function calls in Program 6-21

Program 6-21

```
1  // This program shows that local variables do not retain
2  // their values between function calls.
3  #include <iostream>
4  using namespace std;
5
6  // Function prototype
7  void showLocal();
8
9  int main()
10 {
11    showLocal();
12    showLocal();
13    return 0;
14 }
15
```

(Program Continues)

Local Variables Do Not Retain Values Between Function calls in Program 6-21

Program 6-21 *(continued)*

```
16 //*************************************************************
17 // Definition of function showLocal.                          *
18 // The initial value of localNum, which is 5, is displayed.  *
19 // The value of localNum is then changed to 99 before the     *
20 // function returns.                                         *
21 //*************************************************************
22
23 void showLocal()
24 {
25    int localNum = 5; // Local variable
26
27    cout << "localNum is " << localNum << endl;
28    localNum = 99;
29 }
```

Program Output

```
localNum is 5
localNum is 5
```

In this program, each time `showLocal` is called, the `localNum` variable is re-created and initialized with the value 5.

A Different Approach, Using a Static Variable in Program 6-22

Program 6-22

```
1  // This program uses a static local variable.
2  #include <iostream>
3  using namespace std;
4
5  void showStatic(); // Function prototype
6
7  int main()
8  {
9     // Call the showStatic function five times.
10    for (int count = 0; count < 5; count++)
11       showStatic();
12    return 0;
13 }
14
```

(Program Continues)

A Different Approach, Using a Static Variable in Program 6-22

Program 6-22 *(continued)*

```
15 //*************************************************************
16 // Definition of function showStatic.                         *
17 // statNum is a static local variable. Its value is displayed *
18 // and then incremented just before the function returns.     *
19 //*************************************************************
20
21 void showStatic()
22 {
23    static int statNum;
24
25    cout << "statNum is " << statNum << endl;
26    statNum++;
27 }
```

Program Output

```
statNum is 0
statNum is 1
statNum is 2
statNum is 3
statNum is 4
```

`statNum` is automatically initialized to 0. Notice that it retains its value between function calls.

If you do initialize a local static variable, the initialization only happens once. See Program 6-23.

```
16 //*************************************************************
17 // Definition of function showStatic.                         *
18 // statNum is a static local variable. Its value is displayed *
19 // and then incremented just before the function returns.     *
20 //*************************************************************
21
22 void showStatic()
23 {
24    static int statNum = 5;
25
26    cout << "statNum is " << statNum << endl;
27    statNum++;
28 }
```

Program Output

```
statNum is 5
statNum is 6
statNum is 7
statNum is 8
statNum is 9
```


6.12

Default Arguments

Default Arguments

A Default argument is an argument that is passed automatically to a parameter if the argument is missing on the function call.

- Must be a constant declared in prototype:
  ```
  void evenOrOdd(int = 0);
  ```
- Can be declared in header if no prototype
- Multi-parameter functions may have default arguments for some or all of them:
  ```
  int getSum(int, int=0, int=0);
  ```


Default Arguments in Program 6-24

Default arguments specified in the prototype

Program 6-24

```
1  // This program demonstrates default function arguments.
2  #include <iostream>
3  using namespace std;
4
5  // Function prototype with default arguments
6  void displayStars(int = 10, int = 1);
7
8  int main()
9  {
10    displayStars();      // Use default values for cols and rows.
11    cout << endl;
12    displayStars(5);     // Use default value for rows.
13    cout << endl;
14    displayStars(7, 3);  // Use 7 for cols and 3 for rows.
15    return 0;
16 }
```

(Program Continues)

Default Arguments in Program 6-24

```
18 //*********************************************************
19 // Definition of function displayStars.                   *
20 // The default argument for cols is 10 and for rows is 1.*
21 // This function displays a square made of asterisks.     *
22 //*********************************************************
23
24 void displayStars(int cols, int rows)
25 {
26    // Nested loop. The outer loop controls the rows
27    // and the inner loop controls the columns.
28    for (int down = 0; down < rows; down++)
29    {
30       for (int across = 0; across < cols; across++)
31          cout << "*";
32       cout << endl;
33    }
34 }
```

Program Output

```
**********

*****

*******
*******
*******
```


Default Arguments

- If not all parameters to a function have default values, the defaultless ones are declared first in the parameter list:
  ```
  int getSum(int, int=0, int=0);// OK
  int getSum(int, int=0, int);  // NO
  ```
- When an argument is omitted from a function call, all arguments after it must also be omitted:
  ```
  sum = getSum(num1, num2);     // OK
  sum = getSum(num1, , num3);   // NO
  ```


6.13

Using Reference Variables as Parameters

Using Reference Variables as Parameters

- A mechanism that allows a function to work with the original argument from the function call, not a copy of the argument
- Allows the function to modify values stored in the calling environment
- Provides a way for the function to 'return' more than one value

Passing by Reference

- A reference variable is an alias for another variable
- Defined with an ampersand (&)

```
void getDimensions(int&, int&);
```

- Changes to a reference variable are made to the variable it refers to
- Use reference variables to implement passing parameters *by reference*

Passing a Variable By Reference in Program 6-25

Program 6-25

The & here in the prototype indicates that the parameter is a reference variable.

Here we are passing value by reference.

```
1  // This program uses a reference variable as a function
2  // parameter.
3  #include <iostream>
4  using namespace std;
5
6  // Function prototype. The parameter is a reference variable.
7  void doubleNum(int &);
8
9  int main()
10 {
11    int value = 4;
12
13    cout << "In main, value is " << value << endl;
14    cout << "Now calling doubleNum..." << endl;
15    doubleNum(value);
16    cout << "Now back in main. value is " << value << endl;
17    return 0;
18 }
19
```

(Program Continues)

Passing a Variable By Reference in Program 6-25

The & also appears here in the function header.

```
20 //*************************************************************
21 // Definition of doubleNum.                                   *
22 // The parameter refVar is a reference variable. The value    *
23 // in refVar is doubled.                                      *
24 //*************************************************************
25
26 void doubleNum (int &refVar)
27 {
28    refVar *= 2;
29 }
```

Program Output

```
In main, value is 4
Now calling doubleNum...
Now back in main. value is 8
```


Reference Variable Notes

- Each reference parameter must contain &
- Space between type and & is unimportant
- Must use & in both prototype and header
- Argument passed to reference parameter must be a variable – cannot be an expression or constant
- Use when appropriate – don't use when argument should not be changed by function, or if function needs to return only 1 value

6.14

Overloading Functions

Overloading Functions

- Overloaded functions have the same name but different parameter lists
- Can be used to create functions that perform the same task but take different parameter types or different number of parameters
- Compiler will determine which version of function to call by argument and parameter lists

Function Overloading Examples

Using these overloaded functions,

```
void getDimensions(int);              // 1
void getDimensions(int, int);         // 2
void getDimensions(int, double);      // 3
void getDimensions(double, double);// 4
```

the compiler will use them as follows:

```
int length, width;
double base, height;
getDimensions(length);              // 1
getDimensions(length, width);       // 2
getDimensions(length, height);      // 3
getDimensions(height, base);        // 4
```


Function Overloading in Program 6-27

Program 6-27

```
1  // This program uses overloaded functions.
2  #include <iostream>
3  #include <iomanip>
4  using namespace std;
5
6  // Function prototypes
7  int square(int);
8  double square(double);
9
10 int main()
11 {
12    int userInt;
13    double userFloat;
14
15    // Get an int and a double.
16    cout << fixed << showpoint << setprecision(2);
17    cout << "Enter an integer and a floating-point value: ";
18    cin >> userInt >> userFloat;
19
20    // Display their squares.
21    cout << "Here are their squares: ";
22    cout << square(userInt) << " and " << square(userFloat);
23    return 0;
24 }
```

The overloaded functions have different parameter lists

Passing a `double`

Passing an `int`

(Program Continues)

Function Overloading in Program 6-27

```
26 //*****************************************************************
27 // Definition of overloaded function square.                      *
28 // This function uses an int parameter, number. It returns the    *
29 // square of number as an int.                                    *
30 //*****************************************************************
31
32 int square(int number)
33 {
34    return number * number;
35 }
36
37 //*****************************************************************
38 // Definition of overloaded function square.                      *
39 // This function uses a double parameter, number. It returns      *
40 // the square of number as a double.                              *
41 //*****************************************************************
42
43 double square(double number)
44 {
45    return number * number;
46 }
```

Program Output with Example Input Shown in Bold

```
Enter an integer and a floating-point value: 12 4.2 [Enter]
Here are their squares: 144 and 17.64
```


6.15

The `exit()` Function

The `exit()` Function

- Terminates the execution of a program
- Can be called from any function
- Can pass an `int` value to operating system to indicate status of program termination
- Usually used for abnormal termination of program
- Requires `cstdlib` header file

The `exit()` Function

- Example:

```
exit(0);
```

- The `cstdlib` header defines two constants that are commonly passed, to indicate success or failure:

```
exit(EXIT_SUCCESS);
exit(EXIT_FAILURE);
```

6.16

Stubs and Drivers

Stubs and Drivers

- Useful for testing and debugging program and function logic and design
- Stub: A dummy function used in place of an actual function
  - Usually displays a message indicating it was called. May also display parameters
- Driver: A function that tests another function by calling it
  - Various arguments are passed and return values are tested