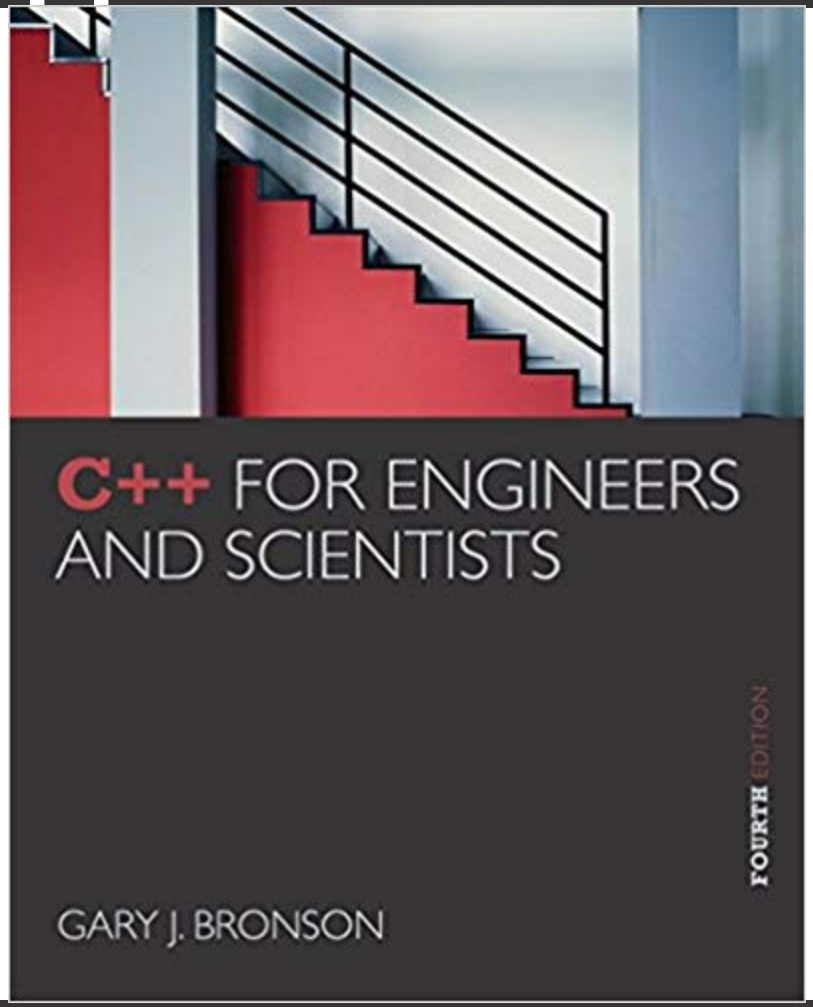
ELEG 1043
Computer Applications in Engineering



Chapter 4:
Selection Structures

Acknowledgement

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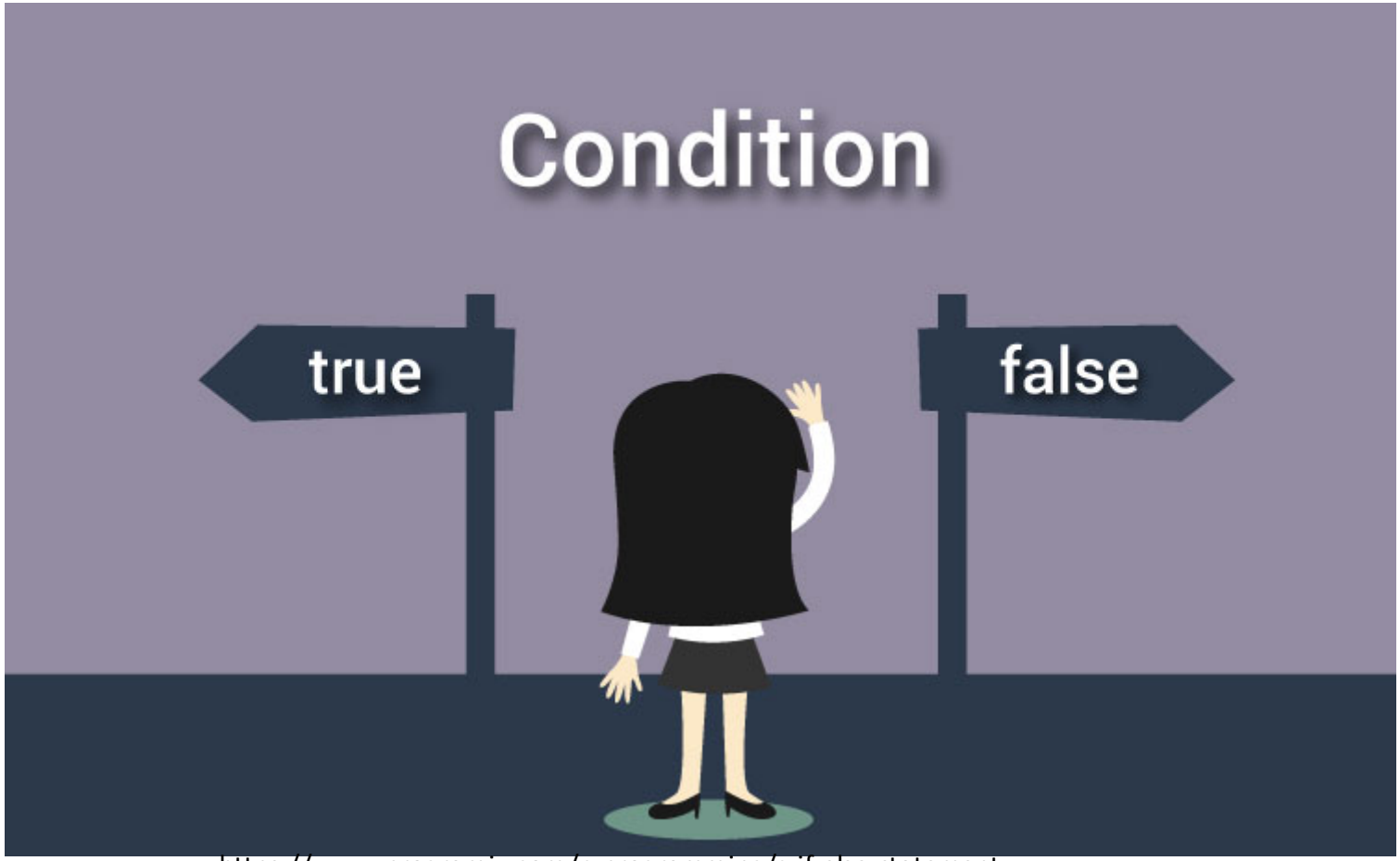
Objectives

- In this chapter, you will learn about:
  - Selection criteria
  - The **`if-else`** statement
  - Nested **`if`** statements
  - The **`switch`** statement
  - Program testing
  - Common programming errors

Selection Criteria



https://www.programiz.com/c-programming/c-if-else-statement

Selection Criteria

- **`if-else`** statement: Implements a decision structure for two alternatives

  Syntax:

  if (condition)

  statement executed if condition is true;

  else

  statement executed if condition is false;

Selection Criteria (continued)

- The condition is evaluated to its numerical value:
  - A non-zero value is considered to be **true**
  - A zero value is considered to be **false**
- The **`else`** portion is optional
  - **Executed only if the condition is false**

Logical Operators

- AND (`&&`): Condition is true only if both expressions are true
- OR (`||`): Condition is true if either one or both of the expressions is true
- NOT (`!`): Changes an expression to its opposite state; true becomes false, false becomes true

Logical Operators

- A && B -> True when both A and B are True, Otherwise False
- A || B -> False when both A and B are False, Otherwise True

Exercise 1

1. (**Practice**) Determine the value of the following expressions, assuming `a = 5`, `b = 2`, `c = 4`, `d = 6`, and `e = 3`:

   a. `a > b`

   b. `a != b`

   c. `d % b == c % b`

   d. `a * c != d * b`

   e. `d * b == c * e`

   f. `!(a * b)`

   g. `!(a % b * c)`

   h. `!(c % b * a)`

   i. `b % c * a`

Exercise 1

2. (**Practice**) Using parentheses, rewrite the following expressions to indicate their order of evaluation correctly. Then evaluate each expression, assuming `a` = 5, `b` = 2, and `c` = 4.

a. `a % b * c && c % b * a`

b. `a % b * c || c % b * a`

c. `b % c * a && a % c * b`

d. `b % c * a || a % c * b`

One-Way Selection

- **One-way selection:** An **`if`** statement without the optional **`else`** portion

```
int a = 1;
if(a > 0)
{
    cout<<a;
}
```

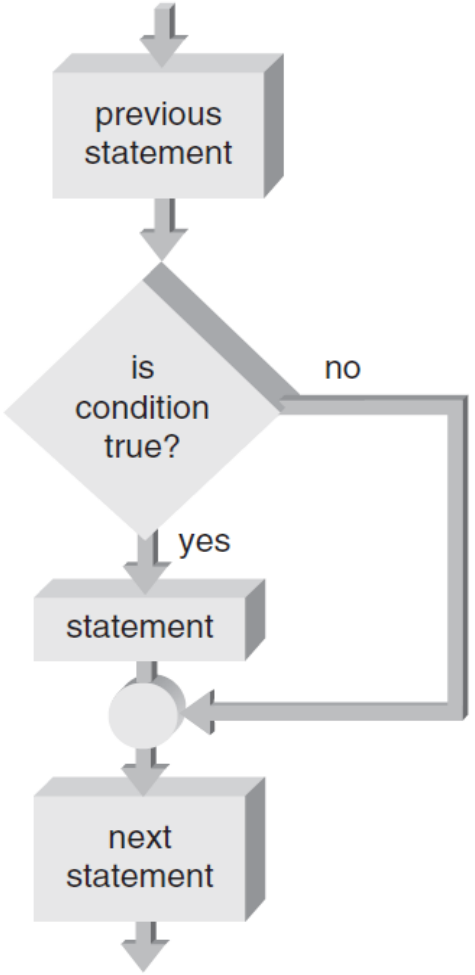


Figure 4.3 A one-way selection **`if`** statement

Nested `if` Statements

- **`if-else`** statement can contain any valid C++ statement, including another **`if-else`**
- Nested **`if`** statement: an **`if-else`** statement completely contained within another **`if-else`**
- Use braces to block code, especially when inner **`if`** statement does not have its own **`else`**

Exercise 2

Write a program that is to judge whether the number is an even number or an odd number, where the number is input from keyboard.

Example

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

int main()
{
    int number;
    cout<<"Enter an integer: \n";
    cin>>number;

    // True if remainder is 0
    if( number%2 == 0 )
        cout<<number<<“  is an even integer.\n";
    else
        cout<<number<<“  is an odd integer.\n";

    return 0;

}
```

Exercise 3

- **Write a program that is to judge if the number falls in the range (-10, 0), where the number is received from keyboard.**

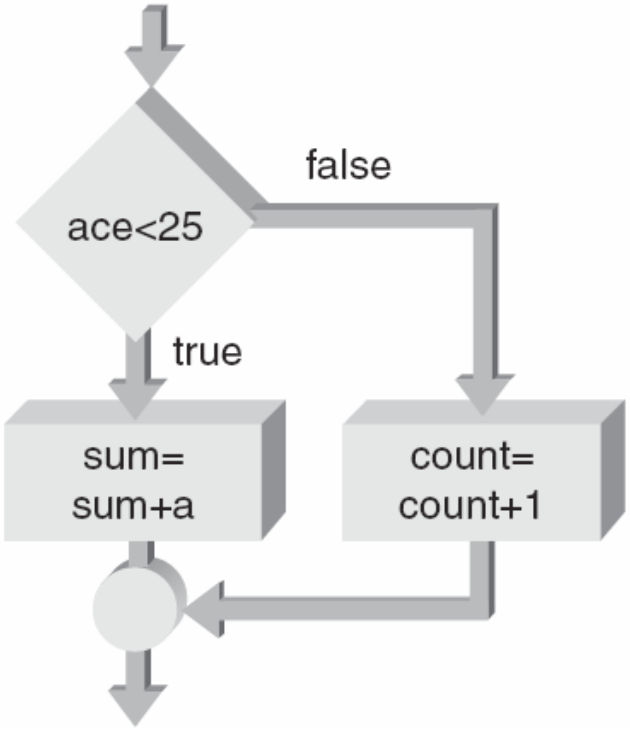
Answer

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

int main()
{
    int number;
    cout<<"Enter an integer: \n";
    cin>>number;

    // Test expression is true if number is less than 0
    if (number < 0)
    {
        if (number > -10)
            cout<<number<<“ in the range (-10, 0)\n”;
    }

    return 0;
}
```

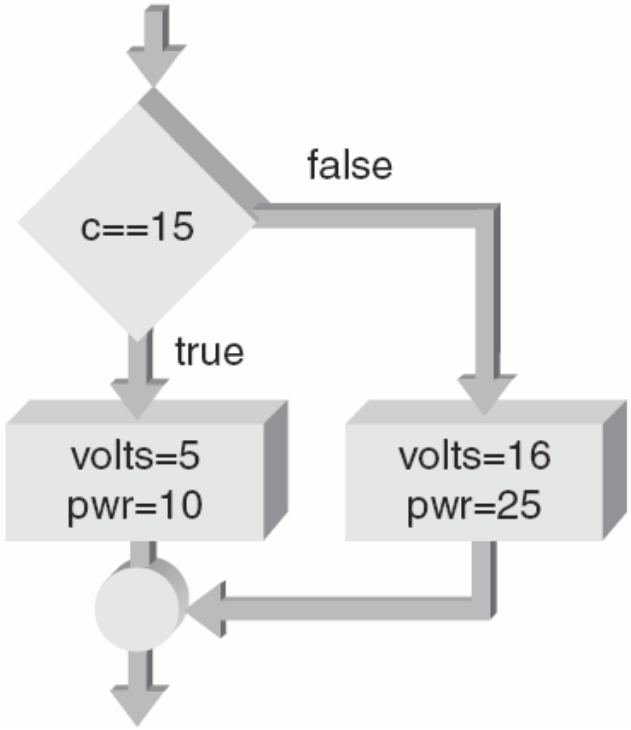
Exercise 4

(**Practice**) Write `if` statements corresponding to the conditions illustrated in the following flowcharts:

a.



b.



Answer

```
a.
if(a  < 25)
{
    sum = sum + a;
}
else
{
    count = count + 1;
}
b.
if(c == 15)
{
    volt = 5; power = 10;
}
else
{
     volt = 16; power = 25;
}
```

Chapter 5:
Repetition Statements

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Objectives

In this chapter, you will learn about:

- Basic loop structures
- **`while`** loops
- Interactive **`while`** loops
- **`for`** loops
- Loop programming techniques

Objectives (continued)

- Nested loops
- **`do while`** loops
- Common programming errors

Basic Loop Structures

- Repetition structure has four required elements:
  - Repetition statement
  - Condition to be changed
  - Initial value for the condition
  - Loop termination
- Repetition statements include:
  - **`while`**
  - **`for`**
  - **`do while`**

Example

(a) Repetition statement

(b) Condition to be changed

(c) Initial value for the condition

(d) Loop termination

(c) (d) (b)

```
for(int i = 0; i < 10; i++)
{ cout<<i<<endl; (a)
}
```

Basic Loop Structures (continued)

- The condition can be tested
  - At the beginning: **Pretest** or **entrance-controlled** loop
  - At the end: **Posttest** or **exit-controlled** loop
- Something in the loop body must cause the condition to change, to avoid an **infinite loop**, which never terminates

while Loops

`while` Loops

- **`while` statement** is used to create a `while` loop
  - Syntax:

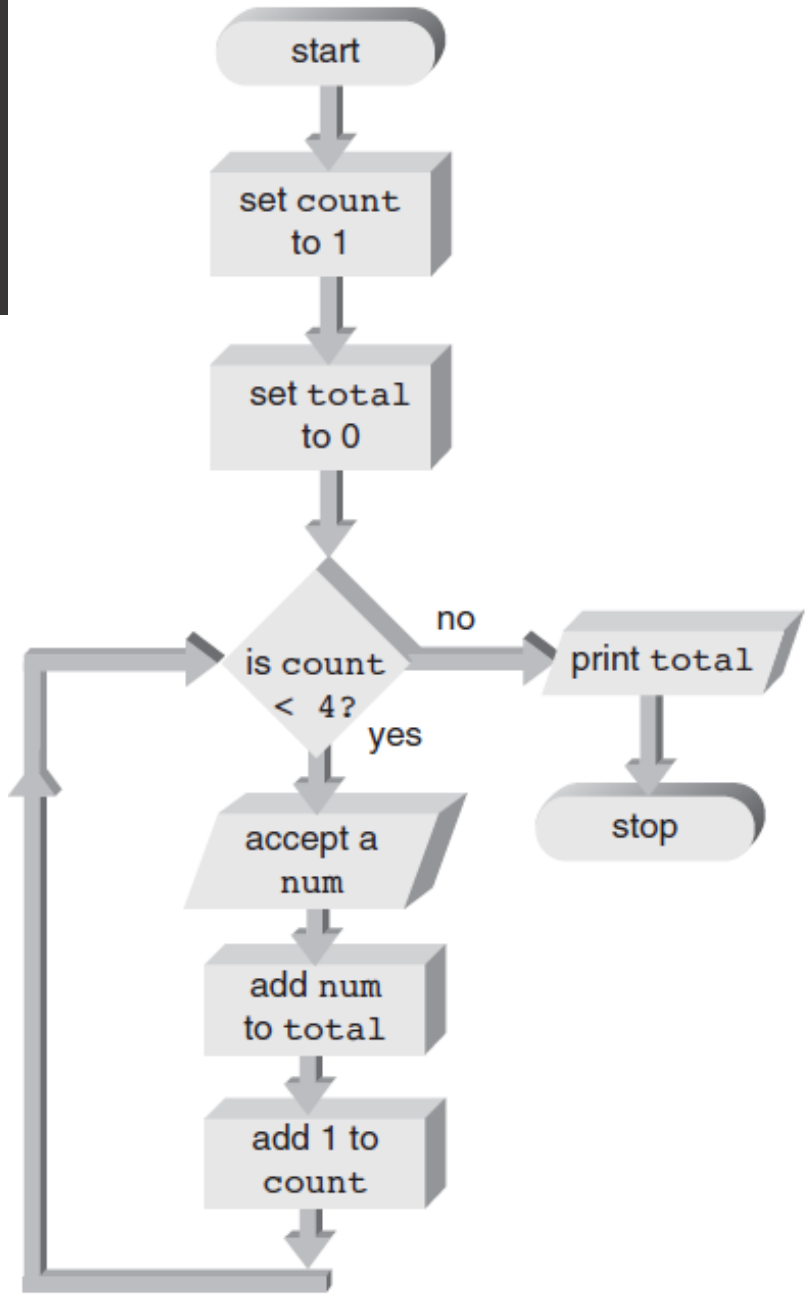
while (expression)
statement;

- Statements following the expressions are executed as long as the expression condition remains true (evaluates to a non-zero value)

Interactive `while` Loops

- Combining interactive data entry with the **`while`** statement provides for repetitive entry and accumulation of totals

Interactive `while` Loops (cont'd)



Interactive `while` Loops (cont'd)

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

int main()
{
    int count = 0, total = 0;

    while(count < 4)
    {
        int num;
        cout<<"Enter a num \n";
        cin>>num;
        total = total + num;
        count = count + 1
    }

    cout<<"The total is "<<total;
    return 0;
}
```

`break` and `continue` Statements

- **`break`** statement
  - Forces an immediate break, or exit, from **`switch`**, **`while`**, **`for`**, and **`do-while`** statements
  - Useful for breaking out of loops when an unusual condition is detected

`break` and `continue` Statements (cont'd)

- Example of a `break` statement:

```
while (count <= 10)
{
  cout << "Enter a number: ";
  cin  >> num;
  if (num > 76)
  {
    cout << "You lose!\n";
    break;        // break out of the loop
  }
  else
    cout << "Keep on trucking!\n";
  count++;
}
// break jumps to here
```

Exercise 4

- **Write a Program to print the numbers from 1 to 10 in increments of 3. The output of your program should be the following:**

  1 4 7 10

Answer

```
#include <stream>
using namespace std;
int main(){
int num = 1;
while(num < 11){
    cout<<num<<“ ”;
    num = num + 3;}
    return 0;
}
```

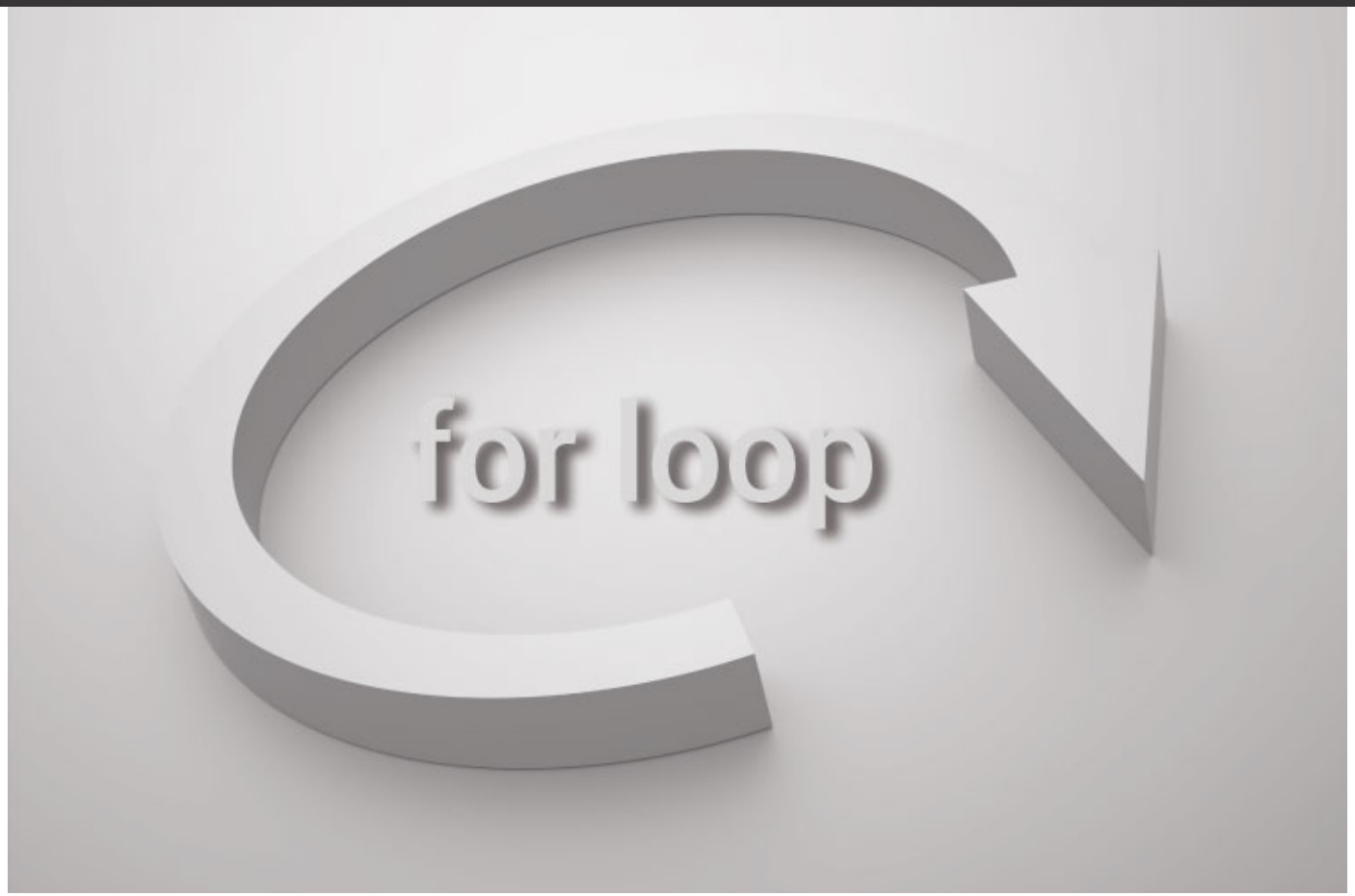
Exercise 5

- **Write a Program that is to produce a table starting at a Celsius value of 2 and ending with a Celsius value of 60, in increments of 10 degrees.**

Answer

```
#include <stream>
using namespace std;
int main(){
int celsiusValue= 2;
while(celsiusValue < 61){
    cout<< celsiusValue <<“ ”;
     celsiusValue = celsiusValue + 10;}
    return 0;
}
```

for Loops



`for` Loops

- **`for`** statement: A loop with a fixed count condition that handles alteration of the condition
  - Syntax:

for (initializing list; expression; altering list)

statement;

- **Initializing list:** Sets the starting value of a counter
- **Expression:** Contains the maximum or minimum value the counter can have; determines when the loop is finished

Exercise 6

(Desk check) Determine the value in `total` after each of the following loops is executed:

a.
```
total = 0;
for (i = 1; i <= 10; i = i + 1)
  total = total + 1;
```

b.
```
total = 1;
for (count = 1; count <= 10; count = count + 1)
  total = total * 2;
```

c.
```
total = 0;
for (i = 10; i <= 15; i = i + 1)
  total = total + i;
```

d.
```
total = 50;
for (i = 1; i <=10; i = i + 1)
  total = total - i;
```

Answer

a. total = 0 + 1*10 = 10

b. total = 1*2*2*2*2*2*2*2*2*2*2 = 1,024

c. total = 0 + 10 + 11 + 12 + 13 + 14 + 15 = 75

d. total = 50 - 1 - 2 - 3- 4 - 5 - 6 - 7- 8 - 9 -10= -5

Chapter 6:
Modularity Using Functions

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Defining a Function

- Every C++ function consists of two parts:
  - **Function header**
  - **Function body**
- Function header's purpose:
  - Identify data type of value function returns, provide function with name, and specify number, order, and type of arguments function expects
- Function body's purpose:
  - To operate on passed data and return, at most, one value directly back to the calling function

Exercise 7

1. (**Practice**) For the following function headers, determine the number, type, and order (sequence) of the values that must be passed to the function:
   a. `void factorial(int n)`
   b. `void volts(int res, double induct, double cap)`
   c. `void power(int type, double induct, double cap)`
   d. `void flag(char type, double current, double time)`
   e. `void total(double amount, double rate)`

Answer

a. Require one int value

b. Require three values in this order: an int, a double, and a double

c. Require three values in this order: an int, a double, and a double

d. Require three values in this order: a char, a double, and a double

e. Require two values in this order: a double, and a double

Exercise 8

4. (Statics) A beam's second moment of inertia, also known as its area moment of inertia, is used to determine its resistance to bending and deflection. For a rectangular beam (see Figure 6.6), the second moment of inertia is given by this formula:

$I = b \times h^3 / 12$

I is the second moment of inertia (m^4).

b is the base (m).

h is the height (m).

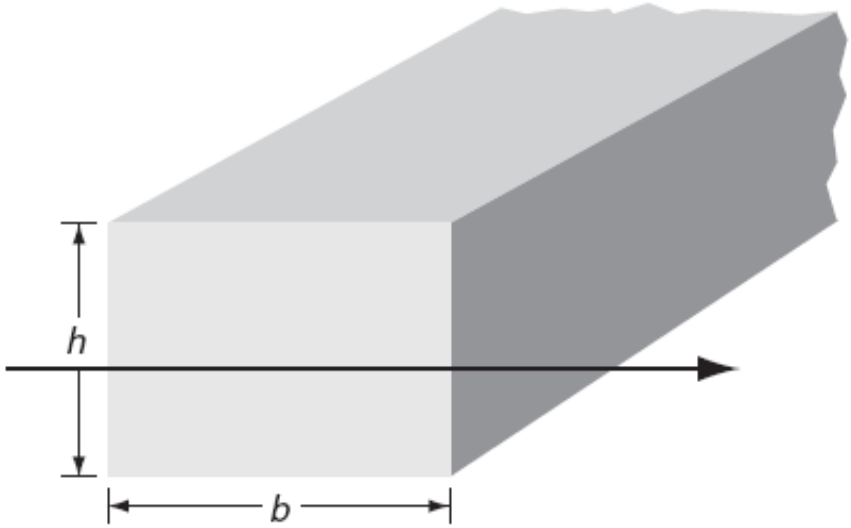

Figure 6.6 Calculating a beam's second moment of inertia

a. Using this formula, write a function called `beamMoment()` that accepts two double-precision numbers as parameters (one for the base and one for the height), calculates the corresponding second moment of inertia, and displays the result.

Answer

```
double beamMoment(double b, double h)
{
    double I = (b*h*h*h)/12.0;
    cout<<“The second moment is ”<<I<<endl;
    return I;
}
int main(){
double b = 0.2, h = 1.2;
double I = beamMonment(b,h);
return 0;}
```

Exercise 9

3. (Practice) Write function headers for the following:

a. A function named `check()` that has three parameters. The first parameter should accept an integer number, and the second and third parameters should accept a double-precision number. The function returns no value.

b. A function named `findAbs()` that accepts a double-precision number passed to it and returns its absolute value.

c. A function named `mult()` that accepts two floating-point numbers as parameters, multiplies these two numbers, and returns the result.

d. A function named `sqrIt()` that computes and returns the square of the integer value passed to it.

e. A function named `powfun()` that raises an integer number passed to it (as an argument) to a positive integer power and returns the result as an integer.

f. A function that produces a table of the numbers from 1 to 10, their squares, and their cubes. No arguments are to be passed to the function, and the function returns no value.

Answer

a. void check(int a, double b, double c);

b. double findAbs(double num);

c. float mult(float num1, float num2);

d. int sqrlt(int num);

e. int powfun(int num, int power);

f. void displayTable(void);