C++ How to Program 10th edition Deitel Solutions Manual

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Introduction to C++ Programming, Input/Output and Operators

2



Objectives

In this chapter you'll:

- Write basic computer programs in C++.
- Write input and output statements.
- Use fundamental types.
- Learn computer memory concepts.
- Use arithmetic operators.
- Understand the precedence of arithmetic operators.
- Write decision-making statements.

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Self-Review Exercises

2.1 Fill in the blanks in each of the following.

a) Every C++ program begins execution at the function _____.

ANS: `main`.

b) A(n) _____ begins the body of every function and a(n) _____ ends the body.

ANS: left brace (`{`), right brace (`}`).

c) Most C++ statements end with a(n) _____.

ANS: semicolon.

d) The escape sequence `\n` represents the _____ character, which causes the cursor to position to the beginning of the next line on the screen.

ANS: newline.

e) The _____ statement is used to make decisions.

ANS: `if`.

2.2 State whether each of the following is *true* or *false*. If *false*, explain why. Assume the statement `using std::cout;` is used.

a) Comments cause the computer to print the text after the `//` on the screen when the program is executed.

ANS: *False*. Comments do not cause any action to be performed when the program is executed. They're used to document programs and improve their readability.

b) The escape sequence `\n`, when output with `cout` and the stream insertion operator, causes the cursor to position to the beginning of the next line on the screen.

ANS: *True*.

c) All variables must be declared before they're used.

ANS: *True*.

d) All variables must be given a type when they're declared.

ANS: *True*.

e) C++ considers the variables `number` and `NuMbEr` to be identical.

ANS: *False*. C++ is case sensitive, so these variables are different.

f) Declarations can appear almost anywhere in the body of a C++ function.

ANS: *True*.

g) The remainder operator (`%`) can be used only with integer operands.

ANS: *True*.

h) The arithmetic operators `*`, `/`, `%`, `+` and `–` all have the same level of precedence.

ANS: *False*. The operators `*`, `/` and `%` have the same precedence, and the operators `+` and `-` have a lower precedence.

i) A C++ program that prints three lines of output must contain three statements using `cout` and the stream insertion operator.

ANS: *False*. One statement with `cout` and multiple `\n` escape sequences can print several lines.

2.3 Write a single C++ statement to accomplish each of the following (assume that neither `using` declarations nor a `using` directive have been used):

a) Declare the variables `c`, `thisIsAVariable`, `q76354` and `number` to be of type `int` (in one statement) and initialize each to `0`.

ANS:
```
int c{0}, thisIsAVariable{0}, q76354{0}, number{0};
```

b) Prompt the user to enter an integer. End your prompting message with a colon (`:`) followed by a space and leave the cursor positioned after the space.

ANS:
```
std::cout << "Enter an integer: ";
```

c) Read an integer from the user at the keyboard and store it in integer variable `age`.

ANS:
```
std::cin >> age;
```

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d) If the variable `number` is not equal to `7`, print `"The variable number is not equal to 7"`.

ANS:
```
if (number != 7) {
   std::cout << "The variable number is not equal to 7\n";
}
```

e) Print the message `"This is a C++ program"` on one line.

ANS:
```
std::cout << "This is a C++ program\n";
```

f) Print the message `"This is a C++ program"` on two lines. End the first line with `C++`.

ANS:
```
std::cout << "This is a C++\nprogram\n";
```

g) Print the message `"This is a C++ program"` with each word on a separate line.

ANS:
```
std::cout << "This\nis\na\nC++\nprogram\n";
```

h) Print the message `"This is a C++ program"`. Separate each word from the next by a tab.

ANS:
```
std::cout << "This\tis\ta\tC++\tprogram\n";
```

2.4 Write a statement (or comment) to accomplish each of the following (assume that `using` declarations have been used for `cin`, `cout` and `endl`):

a) Document that a program calculates the product of three integers.

ANS:
```
// Calculate the product of three integers
```

b) Declare the variables `x`, `y`, `z` and `result` to be of type `int` (in separate statements) and initialize each to 0.

ANS:
```
int x{0};
int y{0};
int z{0};
int result{0};
```

c) Prompt the user to enter three integers.

ANS:
```
cout << "Enter three integers: ";
```

d) Read three integers from the keyboard and store them in the variables `x`, `y` and `z`.

ANS:
```
cin >> x >> y >> z;
```

e) Compute the product of the three integers contained in variables `x`, `y` and `z`, and assign the result to the variable `result`.

ANS:
```
result = x * y * z;
```

f) Print `"The product is "` followed by the value of the variable `result`.

ANS:
```
cout << "The product is " << result << endl;
```

g) Return a value from `main` indicating that the program terminated successfully.

ANS:
```
return 0;
```

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2.5 Using the statements you wrote in Exercise 2.4, write a complete program that calculates and displays the product of three integers. Add comments to the code where appropriate. [*Note:* You'll need to write the necessary `using` declarations or directive.]

ANS: (See program below.)

```
// Calculate the product of three integers
#include <iostream> // enables program to perform input and output
using namespace std; // program uses names from the std namespace

// function main begins program execution
int main() {
   int x{0}; // first integer to multiply
   int y{0}; // second integer to multiply
   int z{0}; // third integer to multiply
   int result{0}; // the product of the three integers

   cout << "Enter three integers: "; // prompt user for data
   cin >> x >> y >> z; // read three integers from user
   result = x * y * z; // multiply the three integers; store result
   cout << "The product is " << result << endl; // print result; end line
} // end function main
```

2.6 Identify and correct the errors in each of the following statements (assume that the statement `using std::cout;` is used):

a)
```
if (c < 7); {
      cout << "c is less than 7\n";
   }
```

ANS: *Error:* Semicolon after the right parenthesis of the condition in the `if` statement.
Correction: Remove the semicolon after the right parenthesis. [*Note:* The result of this error is that the output statement executes whether or not the condition in the `if` statement is true.] The semicolon after the right parenthesis is an empty statement that does nothing. We'll say more about the empty statement in Chapter 4.

b)
```
if (c => 7) {
      cout << "c is equal to or greater than 7\n";
   }
```

ANS: *Error:* The incorrect relational operator =>.
Correction: Change => to >=, and you may want to change "equal to or greater than" to "greater than or equal to" as well.

Exercises

NOTE: Solutions to the programming exercises are located in the `ch02solutions` folder.

2.7 Discuss the meaning of each of the following objects:

a) `std::cin`

ANS: This object refers to the standard input device that is normally connected to the keyboard.

b) `std::cout`

ANS: This object refers to the standard output device that is normally connected to the screen.

2.8 Fill in the blanks in each of the following:

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a) _____ are used to document a program and improve its readability.
ANS: Comments
b) The object used to print information on the screen is _____.
ANS: `std::cout`
c) A C++ statement that makes a decision is _____.
ANS: `if`
d) Most calculations are normally performed by _____ statements.
ANS: assignment
e) The _____ object inputs values from the keyboard.
ANS: `std::cin`

2.9 Write a single C++ statement or line that accomplishes each of the following:
a) Print the message `"Enter two numbers"`.
ANS:
```
cout << "Enter two numbers";
```
b) Assign the product of variables `b` and `c` to variable `a`.
ANS:
```
a = b * c;
```
c) State that a program performs a payroll calculation (i.e., use text that helps to document a program).
ANS:
```
// Payroll calculation program
```
d) Input three integer values from the keyboard into integer variables `a`, `b` and `c`.
ANS:
```
cin >> a >> b >> c;
```

2.10 State which of the following are *true* and which are *false*. If *false*, explain your answers.
a) All operators are evaluated from left to right.
ANS: False. Some operators are evaluated from left to right, while other operators are evaluated right to left.
b) The following are all valid variable names: `_under_bar_`, `m928134`, `t5`, `j7`, `her_sales`, `his_account_total`, `a`, `b`, `c`, `z`, `z2`.
ANS: True.
c) The statement `cout << "a = 5;";` is a typical example of an assignment statement.
ANS: False. The statement is an output statement. The text `a = 5;` is output to the screen.
d) A valid arithmetic expression with no parentheses is evaluated from left to right.
ANS: False. Arithmetic operators can appear in any order in an expression, so the expression is `a = b + c * d;` actually evaluates from right to left because of the rules of operator precedence.
e) The following are all invalid variable names: `3g`, `87`, `67h2`, `h22`, `2h`.
ANS: False. `h22` is a valid variable name. The others are invalid because they each begin with a digit.

2.11 Fill in the blanks in each of the following:
a) What arithmetic operations are on the same level of precedence as multiplication? _____.
ANS: division and modulus.
b) When parentheses are nested, which set of parentheses is evaluated first in an arithmetic expression? _____.
ANS: innermost.
c) A location in the computer's memory that may contain different values at various times throughout the execution of a program is called a(n) _____.
ANS: variable.

2.12 What, if anything, prints when each of the following statements is performed? If nothing prints, then answer "nothing." Assume `x = 2` and `y = 3`.
a)
```
cout << x;
```

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b) `cout << x + x;`
ANS: `4`
c) `cout << "x=";`
ANS: `x=`
d) `cout << "x = " << x;`
ANS: `x = 2`
e) `cout << x + y << " = " << y + x;`
ANS: `5 = 5`
f) `z = x + y;`
ANS: nothing.
g) `cin >> x >> y;`
ANS: nothing.
h) `// cout << "x + y = " << x + y;`
ANS: nothing (because it is a comment).
i) `cout << "\n";`
ANS: A newline is output which positions the cursor at the beginning of the next line on the screen.

2.13 Which of the following statements contain variables whose values are replaced?
a) `cin >> b >> c >> d >> e >> f;`
b) `p = i + j + k + 7;`
c) `cout << "variables whose values are replaced";`
d) `cout << "a = 5";`
ANS: (a) and (b)

2.14 Given the algebraic equation $y = ax^3 + 7$, which of the following, if any, are correct C++ statements for this equation?
a) `y = a * x * x * x + 7;`
b) `y = a * x * x * (x + 7);`
c) `y = (a * x) * x * (x + 7);`
d) `y = (a * x) * x * x + 7;`
e) `y = a * (x * x * x) + 7;`
f) `y = a * x * (x * x + 7);`
ANS: (a), (d), (e)

2.15 ***(Order of Evaluation)*** State the order of evaluation of the operators in each of the following C++ statements and show the value of x after each statement is performed.
a) `x = 7 + 3 * 6 / 2 - 1;`
ANS: `*, /, +, -, =, 15`
b) `x = 2 % 2 + 2 * 2 - 2 / 2;`
ANS: `%, *, /, +, -, =, 3`
c) `x = (3 * 9 * (3 + (9 * 3 / (3))));`
ANS: innermost parentheses around `3, *, /, +, *, *, 324`

2.22 What does the following code print?

```
cout << "*\n**\n***\n****\n*****" << endl;
```

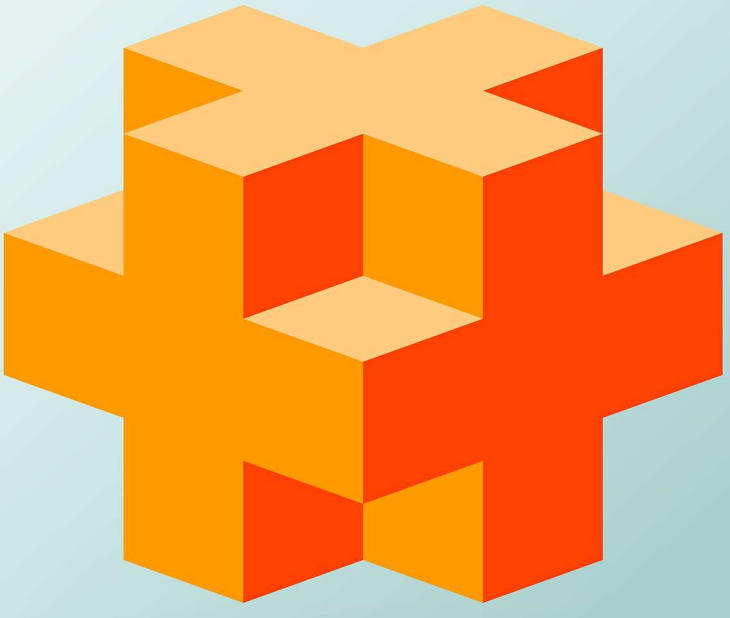
ANS:

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

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2.1 Fill in the blanks in each of the following.

a) Every C++ program begins execution at the function _____.

ANS: `main`.

b) A(n) _____ begins the body of every function and a(n) _____ ends the body.

ANS: left brace (`{`), right brace (`}`).

c) Most C++ statements end with a(n) _____.

ANS: semicolon.

d) The escape sequence `\n` represents the _____ character, which causes the cursor to position to the beginning of the next line on the screen.

ANS: newline.

e) The _____ statement is used to make decisions.

ANS: `if`.

2.2 State whether each of the following is *true* or *false*. If *false*, explain why. Assume the statement `using std::cout;` is used.

a) Comments cause the computer to print the text after the `//` on the screen when the program is executed.

ANS: *False*. Comments do not cause any action to be performed when the program is executed. They're used to document programs and improve their readability.

b) The escape sequence `\n`, when output with `cout` and the stream insertion operator, causes the cursor to position to the beginning of the next line on the screen.

ANS: *True*.

c) All variables must be declared before they're used.

ANS: *True*.

d) All variables must be given a type when they're declared.

ANS: *True*.

e) C++ considers the variables `number` and `NuMbEr` to be identical.

ANS: *False*. C++ is case sensitive, so these variables are different.

f) Declarations can appear almost anywhere in the body of a C++ function.

ANS: *True*.

g) The remainder operator (`%`) can be used only with integer operands.

ANS: *True*.

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ANS: *False*. The operators `*`, `/` and `%` have the same precedence, and the operators `+` and `-` have a lower precedence.

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ANS: *False*. One statement with `cout` and multiple `\n` escape sequences can print several lines.

2.3 Write a single C++ statement to accomplish each of the following (assume that neither `using` declarations nor a `using` directive have been used):

a) Declare the variables `c`, `thisIsAVariable`, `q76354` and `number` to be of type `int` (in one statement) and initialize each to `0`.

ANS:
```
int c{0}, thisIsAVariable{0}, q76354{0}, number{0};
```

b) Prompt the user to enter an integer. End your prompting message with a colon (`:`) followed by a space and leave the cursor positioned after the space.

ANS:
```
std::cout << "Enter an integer: ";
```

c) Read an integer from the user at the keyboard and store it in integer variable `age`.

ANS:
```
std::cin >> age;
```

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d) If the variable `number` is not equal to `7`, print `"The variable number is not equal to 7"`.

ANS:
```
if (number != 7) {
   std::cout << "The variable number is not equal to 7\n";
}
```

e) Print the message `"This is a C++ program"` on one line.

ANS:
```
std::cout << "This is a C++ program\n";
```

f) Print the message `"This is a C++ program"` on two lines. End the first line with `C++`.

ANS:
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std::cout << "This is a C++\nprogram\n";
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ANS:
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h) Print the message `"This is a C++ program"`. Separate each word from the next by a tab.

ANS:
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std::cout << "This\tis\ta\tC++\tprogram\n";
```

2.4 Write a statement (or comment) to accomplish each of the following (assume that `using` declarations have been used for `cin`, `cout` and `endl`):

a) Document that a program calculates the product of three integers.

ANS:
```
// Calculate the product of three integers
```

b) Declare the variables `x`, `y`, `z` and `result` to be of type `int` (in separate statements) and initialize each to 0.

ANS:
```
int x{0};
int y{0};
int z{0};
int result{0};
```

c) Prompt the user to enter three integers.

ANS:
```
cout << "Enter three integers: ";
```

d) Read three integers from the keyboard and store them in the variables `x`, `y` and `z`.

ANS:
```
cin >> x >> y >> z;
```

e) Compute the product of the three integers contained in variables `x`, `y` and `z`, and assign the result to the variable `result`.

ANS:
```
result = x * y * z;
```

f) Print `"The product is "` followed by the value of the variable `result`.

ANS:
```
cout << "The product is " << result << endl;
```

g) Return a value from `main` indicating that the program terminated successfully.

ANS:
```
return 0;
```

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2.5 Using the statements you wrote in Exercise 2.4, write a complete program that calculates and displays the product of three integers. Add comments to the code where appropriate. [*Note:* You'll need to write the necessary `using` declarations or directive.]

ANS: (See program below.)

```
// Calculate the product of three integers
#include <iostream> // enables program to perform input and output
using namespace std; // program uses names from the std namespace

// function main begins program execution
int main() {
   int x{0}; // first integer to multiply
   int y{0}; // second integer to multiply
   int z{0}; // third integer to multiply
   int result{0}; // the product of the three integers

   cout << "Enter three integers: "; // prompt user for data
   cin >> x >> y >> z; // read three integers from user
   result = x * y * z; // multiply the three integers; store result
   cout << "The product is " << result << endl; // print result; end line
} // end function main
```

2.6 Identify and correct the errors in each of the following statements (assume that the statement `using std::cout;` is used):

a)
```
if (c < 7); {
      cout << "c is less than 7\n";
   }
```

ANS: *Error:* Semicolon after the right parenthesis of the condition in the `if` statement.
Correction: Remove the semicolon after the right parenthesis. [*Note:* The result of this error is that the output statement executes whether or not the condition in the `if` statement is true.] The semicolon after the right parenthesis is an empty statement that does nothing. We'll say more about the empty statement in Chapter 4.

b)
```
if (c => 7) {
      cout << "c is equal to or greater than 7\n";
   }
```

ANS: *Error:* The incorrect relational operator =>.
Correction: Change => to >=, and you may want to change "equal to or greater than" to "greater than or equal to" as well.

Exercises

NOTE: Solutions to the programming exercises are located in the ***ch02solutions*** *folder.*

2.7 Discuss the meaning of each of the following objects:

a) `std::cin`

ANS: This object refers to the standard input device that is normally connected to the keyboard.

b) `std::cout`

ANS: This object refers to the standard output device that is normally connected to the screen.

2.8 Fill in the blanks in each of the following:

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a) _____ are used to document a program and improve its readability.
ANS: Comments
b) The object used to print information on the screen is _____.
ANS: `std::cout`
c) A C++ statement that makes a decision is _____.
ANS: `if`
d) Most calculations are normally performed by _____ statements.
ANS: assignment
e) The _____ object inputs values from the keyboard.
ANS: `std::cin`

2.9 Write a single C++ statement or line that accomplishes each of the following:
a) Print the message `"Enter two numbers"`.
ANS:
```
cout << "Enter two numbers";
```
b) Assign the product of variables `b` and `c` to variable `a`.
ANS:
```
a = b * c;
```
c) State that a program performs a payroll calculation (i.e., use text that helps to document a program).
ANS:
```
// Payroll calculation program
```
d) Input three integer values from the keyboard into integer variables `a`, `b` and `c`.
ANS:
```
cin >> a >> b >> c;
```

2.10 State which of the following are *true* and which are *false*. If *false*, explain your answers.
a) All operators are evaluated from left to right.
ANS: False. Some operators are evaluated from left to right, while other operators are evaluated right to left.
b) The following are all valid variable names: `_under_bar_`, `m928134`, `t5`, `j7`, `her_sales`, `his_account_total`, `a`, `b`, `c`, `z`, `z2`.
ANS: True.
c) The statement `cout << "a = 5;";` is a typical example of an assignment statement.
ANS: False. The statement is an output statement. The text `a = 5;` is output to the screen.
d) A valid arithmetic expression with no parentheses is evaluated from left to right.
ANS: False. Arithmetic operators can appear in any order in an expression, so the expression is `a = b + c * d;` actually evaluates from right to left because of the rules of operator precedence.
e) The following are all invalid variable names: `3g`, `87`, `67h2`, `h22`, `2h`.
ANS: False. `h22` is a valid variable name. The others are invalid because they each begin with a digit.

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a) What arithmetic operations are on the same level of precedence as multiplication? _____.
ANS: division and modulus.
b) When parentheses are nested, which set of parentheses is evaluated first in an arithmetic expression? _____.
ANS: innermost.
c) A location in the computer's memory that may contain different values at various times throughout the execution of a program is called a(n) _____.
ANS: variable.

2.12 What, if anything, prints when each of the following statements is performed? If nothing prints, then answer "nothing." Assume `x = 2` and `y = 3`.
a)
```
cout << x;
```

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b) `cout << x + x;`

ANS: `4`

c) `cout << "x=";`

ANS: `x=`

d) `cout << "x = " << x;`

ANS: `x = 2`

e) `cout << x + y << " = " << y + x;`

ANS: `5 = 5`

f) `z = x + y;`

ANS: nothing.

g) `cin >> x >> y;`

ANS: nothing.

h) `// cout << "x + y = " << x + y;`

ANS: nothing (because it is a comment).

i) `cout << "\n";`

ANS: A newline is output which positions the cursor at the beginning of the next line on the screen.

2.13 Which of the following statements contain variables whose values are replaced?

a) `cin >> b >> c >> d >> e >> f;`

b) `p = i + j + k + 7;`

c) `cout << "variables whose values are replaced";`

d) `cout << "a = 5";`

ANS: (a) and (b)

2.14 Given the algebraic equation $y = ax^3 + 7$, which of the following, if any, are correct C++ statements for this equation?

a) `y = a * x * x * x + 7;`

b) `y = a * x * x * (x + 7);`

c) `y = (a * x) * x * (x + 7);`

d) `y = (a * x) * x * x + 7;`

e) `y = a * (x * x * x) + 7;`

f) `y = a * x * (x * x + 7);`

ANS: (a), (d), (e)

2.15 ***(Order of Evaluation)*** State the order of evaluation of the operators in each of the following C++ statements and show the value of `x` after each statement is performed.

a) `x = 7 + 3 * 6 / 2 - 1;`

ANS: `*, /, +, -, =, 15`

b) `x = 2 % 2 + 2 * 2 - 2 / 2;`

ANS: `%, *, /, +, -, =, 3`

c) `x = (3 * 9 * (3 + (9 * 3 / (3))));`

ANS: innermost parentheses around `3`, `*`, `/`, `+`, `*`, `*`, `324`

2.22 What does the following code print?

```
cout << "*\n**\n***\n****\n*****" << endl;
```

ANS:

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

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