

4.7 Logical Operators

CONCEPT: Logical operators connect two or more relational expressions into one or reverse the logic of an expression.

In the previous section you saw how a program tests two conditions with two `if` statements. In this section you will see how to use logical operators to combine two or more relational expressions into one. Table 4-6 lists C++’s logical operators.

Table 4-6 Logical Operators

Operator	Meaning	Effect
<code>&&</code>	AND	Connects two expressions into one. Both expressions must be true for the overall expression to be true.
<code> </code>	OR	Connects two expressions into one. One or both expressions must be true for the overall expression to be true. It is only necessary for one to be true, and it does not matter which.
<code>!</code>	NOT	Reverses the “truth” of an expression. It makes a true expression false, and a false expression true.

Ejemplo:

```
if ((temperature < 20) && (minutes > 12))
    cout << "The temperature is in the danger zone.";
```

temp	min	&&		temp	!temp
0	0	0	0	0	1
0	1	0	1	1	0
1	0	0	1		
1	1	1	1		

Table 4-7 Logical AND

Expression	Value of the Expression
<code>false && false</code>	false (0)
<code>false && true</code>	false (0)
<code>true && false</code>	false (0)
<code>true && true</code>	true (1)

Table 4-8 Logical OR

Expression	Value of the Expression
false false	false (0)
false true	true (1)
true false	true (1)
true true	true (1)

Table 4-9 Logical NOT

Expression	Value of the Expression
!false	true (1)
!true	false (0)

Ejemplos de código:

Program 4-12

```

1 // This program determines whether a loan applicant qualifies for
2 // a special loan interest rate. It uses the && logical operator.
3 #include <iostream>
4 using namespace std;
5
6 int main()
7 {
8     char    employed,        // Currently employed? (Y or N)
9           recentGrad;      // Recent college graduate? (Y or N)
10
11     // Is the applicant employed and a recent college graduate?
12     cout << "Answer the following questions\n";
13     cout << "with either Y for Yes or N for No.\n";
14
15     cout << "Are you employed? ";
16     cin  >> employed;
17     cout << "Have you graduated from college in the past two years? ";
18     cin  >> recentGrad;
19

```

(program continues)

Program 4-12 *(continued)*

```

20     // Determine the applicant's loan qualifications
21     if ((employed == 'Y') && (recentGrad == 'Y')) // Uses logical AND
22         cout << "\nYou qualify for the special interest rate.\n";
23     else
24     { cout << "\nYou must be employed and have graduated\n";
25       cout << "from college in the past two years to qualify\n";
26       cout << "for the special interest rate.\n";
27     }
28     return 0;
29 }

```

Program 4-13

```
1 // This program determines whether or not an applicant qualifies
2 // for a loan. To qualify they must make at least $35,000 a year
3 // or have been at their current job for more than 5 years.
4 // It uses the logical || operator.
5 #include <iostream>
6 using namespace std;
7
8 int main()
9 {
10     double income;        // Annual income
11     int years;           // Years at the current job
12
13     // Get annual income and years on the job
14     cout << "What is your annual income? ";
15     cin  >> income;
16     cout << "How many years have you worked at your current job? ";
17     cin  >> years;
18
```

(program continues)

Program 4-13 *(continued)*

```
19     // Determine if the applicant qualifies for a loan
20     if ((income >= 35000) || (years > 5)) // Uses logical OR
21         cout << "You qualify for a loan.\n";
22     else
23     { cout << "You must earn at least $35,000 or have been employed\n";
24       cout << "for more than 5 years to qualify for a loan.\n";
25     }
26     return 0;
27 }
```

Program 4-14

```
1 // This program determines whether or not an applicant qualifies
2 // for a loan. To qualify they must make at least $35,000 a year
3 // or have been at their current job for more than 5 years. It uses
4 // the ! logical operator to reverse the logic of the if statement.
5 #include <iostream>
6 using namespace std;
7
8 int main()
9 {
10     double income;        // Annual income
11     int years;           // Years at the current job
12
13     // Get annual income and years on the job
14     cout << "What is your annual income? ";
15     cin >> income;
16     cout << "How many years have you worked at your current job? ";
17     cin >> years;
18
19     // Determine if the applicant qualifies for a loan
20     if (!((income >= 35000) || (years > 5))) // Uses logical NOT
21     {
22         cout << "You must earn at least $35,000 or have been employed\n";
23         cout << "for more than 5 years to qualify for a loan.\n";
24     }
25     else
```