

Computer Science I

Chapter III - Expressions and Interactivity

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October 29, 2025



Slide contents are mainly based on the following documents:

- Tony Gaddis, Starting out with C++, Six Edition, Pearson, 2009
- Tony Gaddis, Power Points Slides:
<https://www.ums1.edu/~antognolij/gaddis.html>



Relational Operators

- Used to compare numbers to determine relative order

>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to
==	Equal to
!=	Equal to



Relational Expressions

- Boolean expressions - true or false

- Examples:

`12 > 5` is true

`7 <= 5` is false

if `x` is 10, then

`x == 10` is true,

`x != 8` is true, and

`x == 8` is false



Relational Expressions

- Can be assigned to a variable:
`result = x <= y;`
- Assigns 0 for false, 1 for true
- Do not confuse = and ==



Relational Expressions

Program 4-1

```
1 // This program displays the values of true and false states.
2 #include <iostream>
3 using namespace std;
4
5 int main()
6 {
7     bool trueValue, falseValue;
8     int x = 5, y = 10;
9
10    trueValue = x < y;
11    falseValue = y == x;
12
13    cout << "True is " << trueValue << endl;
14    cout << "False is " << falseValue << endl;
15    return 0;
16 }
```

Program Output

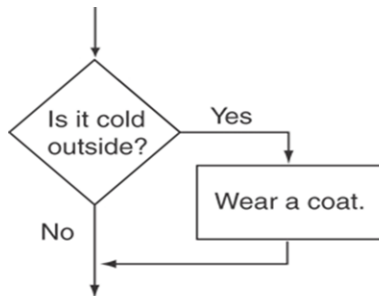
```
True is 1
False is 0
```



The if statement

- Allows statements to be conditionally executed or skipped over
- Models the way we mentally evaluate situations:
 - "If it is raining, take an umbrella."
 - "If it is cold outside, wear a coat."

Flowchart for Evaluating a Decision



The if statement

- General Format:
 `if (expression)`
 `statement;`
- If the expression is true, then statement is executed.
- If the expression is false, then statement is skipped.



Flowchart for Evaluating a Decision

Program 4-2

```
1 // This program averages three test scores
2 #include <iostream>
3 #include <iomanip>
4 using namespace std;
5
6 int main()
7 {
8     const int HIGH_SCORE = 95; // A high score is 95 or greater
9     int score1, score2, score3; // To hold three test scores
10    double average;             // TO hold the average score
11
12    // Get the three test scores.
13    cout << "Enter 3 test scores and I will average them: ";
14    cin >> score1 >> score2 >> score3;
15
16    // Calculate and display the average score.
17    average = (score1 + score2 + score3) / 3.0;
18    cout << fixed << showpoint << setprecision(1);
19    cout << "Your average is " << average << endl;
20
21    // If the average is a high score, congratulate the user.
22    if (average > HIGH_SCORE)
23        cout << "Congratulations! That's a high score!\n";
24    return 0;
25 }
```

Program Output with Example Input Shown in Bold

Enter 3 test scores and I will average them: **80 90 70** [Enter]
Your average is 80.0

Program Output with Different Example Input Shown in Bold

Enter 3 test scores and I will average them: **100 100 100** [Enter]
Your average is 100.0
Congratulations! That's a high score!



The if statement

- Do not place ; after (expression)
- Place statement; on a separate line after (expression), indented:

```
if (score > 90)  
    grade = 'A';
```
- Be careful testing floats and doubles for equality
- 0 is false; any other value is true



Expanding the if Statement

- To execute more than one statement as part of an if statement, enclose them in { }:

```
if (score > 90)
{
    grade = 'A';
    cout << "Good Job!  \n";
}
```

- { } creates a block of code



The if/else Statement

- Provides two possible paths of execution
- Performs one statement or block if the expression is true, otherwise performs another statement or block.
- General Format:

```
if (expression)
    statement1; // or block
else
    statement2; // or block
```



The if/else Statement

- If the expression is true, then
statement1 is executed and statement2 is skipped.
- If the expression is false, then
statement1 is skipped and statement2 is executed.



The if/else Statement

Program 4-8

```
1  // This program uses the modulus operator to determine
2  // if a number is odd or even. If the number is evenly divisible
3  // by 2, it is an even number. A remainder indicates it is odd.
4  #include <iostream>
5  using namespace std;
6
7  int main()
8  {
9      int number;
10
11      cout << "Enter an integer and I will tell you if it\n";
12      cout << "is odd or even. ";
13      cin >> number;
14      if (number % 2 == 0)
15          cout << number << " is even.\n";
16      else
17          cout << number << " is odd.\n";
18      return 0;
19  }
```

Program Output with Example Input Shown in Bold

Enter an integer and I will tell you if it
is odd or even. **17 [Enter]**
17 is odd.



The if/else Statement

Program 4-9

```
1 // This program asks the user for two numbers, num1 and num2.
2 // num1 is divided by num2 and the result is displayed.
3 // Before the division operation, however, num2 is tested
4 // for the value 0. If it contains 0, the division does not
5 // take place.
6 #include <iostream>
7 using namespace std;
8
9 int main()
10 {
11     double num1, num2, quotient;
12
13     // Get the first number.
14     cout << "Enter a number: ";
15     cin >> num1;
16
17     // Get the second number.
18     cout << "Enter another number: ";
```



The if/else Statement

```
19     cin >> num2;
20
21     // If num2 is not zero, perform the division.
22     if (num2 == 0)
23     {
24         cout << "Division by zero is not possible.\n";
25         cout << "Please run the program again and enter\n";
26         cout << "a number other than zero.\n";
27     }
28     else
29     {
30         quotient = num1 / num2;
31         cout << "The quotient of " << num1 << " divided by ";
32         cout << num2 << " is " << quotient << ".\n";
33     }
34     return 0;
35 }
```

Program Output with Example Input Shown in Bold

Enter a number: **10** [Enter]
Enter another number: **0** [Enter]
Division by zero is not possible.
Please run the program again and enter
a number other than zero.

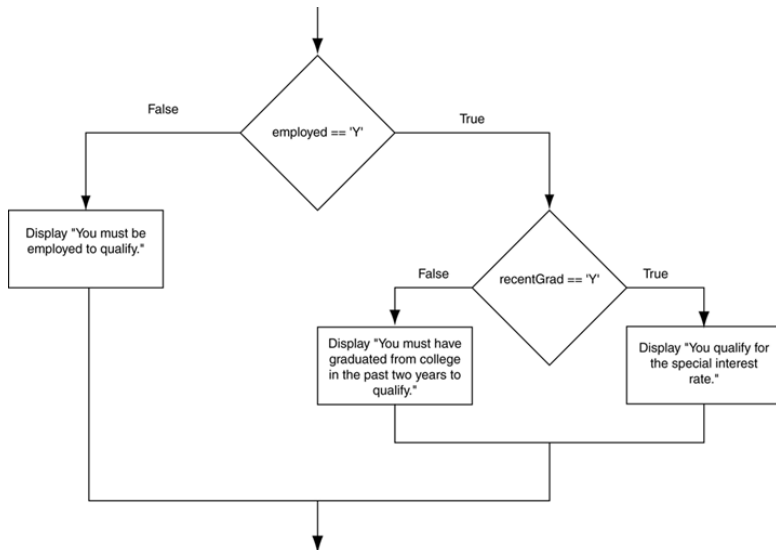


Nested if Statements

- An if statement that is nested inside another if statement
- Nested if statements can be used to test more than one condition



Nested if Statements



Nested if Statements

```
20      // Determine the user's loan qualifications.
21      if (employed == 'Y')
22      {
23          if (recentGrad == 'Y') //Nested if
24          {
25              cout << "You qualify for the special ";
26              cout << "interest rate.\n";
27          }
28      }
```

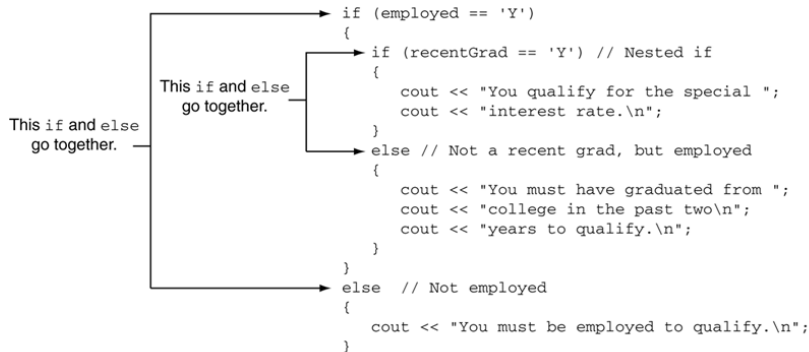


Nested if Statements

```
20      // Determine the user's loan qualifications.
21      if (employed == 'Y')
22      {
23          if (recentGrad == 'Y') // Nested if
24          {
25              cout << "You qualify for the special ";
26              cout << "interest rate.\n";
27          }
28          else // Not a recent grad, but employed
29          {
30              cout << "You must have graduated from ";
31              cout << "college in the past two\n";
32              cout << "years to qualify.\n";
33          }
34      }
35      else // Not employed
36      {
37          cout << "You must be employed to qualify.\n";
38      }
```



Nested if Statements



Nested if Statements

```
if (employed == 'Y')
{
if (recentGrad == 'Y') // Nested if
{
cout << "You qualify for the special ";
cout << "interest rate.\n";
}
else // Not a recent grad, but employed
{
cout << "You must have graduated from ";
cout << "college in the past two\n";
cout << "years to qualify.\n";
}
}
else // Not employed
{
cout << "You must be employed to qualify.\n";
}
```

*Don't write code
like this!*



The if/else if Statement

- Tests a series of conditions until one is found to be true
- Often simpler than using nested if/else statements
- Can be used to model thought processes such as:
"If it is raining, take an umbrella,
else, if it is windy, take a hat,
else, take sunglasses"



if/else if Format

- `if (expression)`
 `statement1; // or block`
`else if (expression)`
 `statement2; // or block`
 .
 . `// other else ifs`
 .
`else if (expression)`
 `statementn; // or block`



Nested if Statements

```
21    // Determine the letter grade.
22    if (testScore >= A_SCORE)
23        cout << "Your grade is A.\n";
24    else if (testScore >= B_SCORE)
25        cout << "Your grade is B.\n";
26    else if (testScore >= C_SCORE)
27        cout << "Your grade is C.\n";
28    else if (testScore >= D_SCORE)
29        cout << "Your grade is D.\n";
30    else
31        cout << "Your grade is F.\n";
```



Exercise

- Programming Challenges: 1, 3, 4, 7, 10, 12
- Write a C++ program to find x (real number) such that $ax + b = 0$ where a, b are input from the keyboard.
- Write a C++ program to find x (real number) such that $ax^2 + bx + c = 0$ where a, b, c are input from the keyboard.
- Write a C++ program to check whether three input numbers can form a triangle or not.
- Write a C++ program that asks the user to enter three numbers and prints them in ascending order.

