
Logical Operators and if/else statement

Floating Point and Relational Operators

- Floating point math may not work out as you expect because of round off errors.
- In Math
 - $6 * 2/3 = 4$
- In C++, where 0.66666 is equivalent to $2/3$
 - $6.0 * 0.66666 =$
 - $6.0 * 0.66667 =$
 - $6.0 * 0.666666 =$
 - $6.0 * (2.0 / 3.0) =$

Q.1 Example

```
double result;

result = 6.0 * 0.666666;


if(result == 4.0)
{
    cout << "result == 4.0" << endl;
}

cout << setprecision(6) << fixed;
cout << result << endl;
cout << setprecision(2) << result;
cout << endl;
```

Example

```
#include "stdafx.h"
#include <iostream>
#include <iomanip>
using namespace std;

int _tmain(int argc, _TCHAR* argv[])
{
    double result;
    result = 6.0 * 0.666666;
    if( result == 4.0 )
    {
        cout << " TRUE, result does equal 4.0" << endl;
    }
    cout << setprecision(6) << fixed << result << endl;
    cout << setprecision(2) << fixed << result << endl;
    return 0;
}
```



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If Statement

- We may want to execute some code if an expression is **true**, and execute *some other code* when the expression is **false**.
- This can be done with two if statements...

```
if( value >= LIMIT )
{
    // do something
}
if( value < LIMIT )
{
    // do something else
}
```

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If/Else (4.3)

- C++ provides a shortcut to combine two if statements:
 - The statements in the else clause are executed only when the expression is false.
- ```
if(expression)
{
 // do stuff
}
else
{
 // do other stuff
}
```

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## Q.2 Example

```
int number;
cout << "Enter a number, I'll tell you";
cout << " if it is odd: ";
cin >> number;

// use an if/else statement here
```

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## If/Else: Syntax and Formatting

```
if(expression)
{
 // do stuff
}
else
{
 // do other stuff
}
```

- Note the braces with the `else` keyword and the alignment of the `else` under the `if` on its own line

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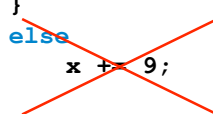
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## If/Else: Braces

```
if(expression)
{
 // do stuff
}
else
 x += 9;
```



- Always use braces with the `else`!

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## If/Else: Commenting

```
// the expression I'm using here
// checks for . . .
if(expression)
{
 // if the expression is true
 // I need to ...
}
else
{
 // if the expression is false
 // I need to ...
}
```

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## Q.3 Practice

- Turn this code into an if/else statement:

```
int x, y;
if(x > y)
{
 x += y;
}
if(y <= x)
{
 y += x;
}
```

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## Q.4 Practice

- Are these two code snippets equivalent?

|                                                                                |                                                                        |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------|
| <pre>int x, y; if(x &gt; y) {     x += y; } if(y &lt; x) {     y += x; }</pre> | <pre>int x, y; if(x &gt; y) {     x += y; } else {     y += x; }</pre> |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------|

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## if/else/if statements (4.4)

- What if there are more than two alternatives?

```
if(expression1)
{
 statement1;
}
else if(expression2)
{
 statement2;
}
else
{
 default statement;
}
```

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## Q.5 Problem

- Write a C++ program segment that allows the user the ability to input an integer from the keyboard. If the integer is positive, increment a variable `poscount` by 1. If the integer is **negative**, increment a variable `negcount` by 1. If neither, increment `zerocount` by 1

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## Q.6 Problem

- Write a program that displays a letter grade corresponding to an exam score

90 - 100 A

80 - 89 B

70 - 79 C

60 - 69 D

0 - 59 F

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## Nested if Statements (4.6)

- The second if is only executed if the first if conditional is `false`

```
if(x > y)
{
}
else
{
}
```
- Note the indentation of the inner if

```
if(x == 9)
{
}
```
- There may be code between the { with the first else and the second `if`

```
else
{
}
if
}
```

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## Q.7 Example

- Write nested if statements that perform the following test:
  - If amount1 is greater than 10 and amount2 is less than 100, display the greater of the two
- Can you write the solution to the above problem without nested if statements?

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## Using nested ifs

- Write a snippet of code that will do all of the following, where x and y are integers:
  - add y to x if `x == y`
  - add x to y if `y > x`
  - add 1 to x if `(2 * y) == x`

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## Logical Operators (4.7)

- If we want to check for more than one condition then we need to use logical operators
- These combine logical expressions (i.e. expressions that have a true/false value)
- There are three logical operators
  - `&&`      and
  - `||`      or
  - `!`      Not

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## Q.8 Examples of Logical Operators

- `if((x > 7) && (x < 20))`
- `if((temp > 90.0) && (humidity > 0.9))`
- `if((salary < minSalary) || (dependents > 5))`

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## Evaluating Expressions: And &&

- `(expr1) && (expr2)`
- For the complete expression to be true, both `expr1` and `expr2` have to be true
- Example:
  - `(temp > 90.0) && (humidity > 0.9)`
    - These are unbearable heat and humidity conditions
    - Both must be true for the entire expression to be true

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## Evaluating Expressions: Or ||

- `(expr1 || expr2)`
- The complete expression is true if either `expr1` or `expr2` is true
- Examples:
  - `(salary < minSalary) || (dependents > 5)`
  - To qualify for financial aid, salary has to be less than some minimum salary or the number of dependents is greater than 5
  - Only one condition has to be true

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## Evaluating Expressions: Not !

- `!expr`
- Unary operator
- Examples:
  - `!(salary < minSalary) && (dependents > 5)`
  - What makes this true? False?

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## Q.9 Example

- Your local bookstore has asked you to write a program to help them determine the cost of shipping of customers orders. If the order is \$30 or less then shipping will cost \$5, if the order is over \$30 then shipping will be \$3

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## Q.10 Problem

- The bookstore has now changed its shipping policy so that
  - If the order is \$30 or less, shipping is \$5
  - If the order is over \$30 but less than \$50, shipping is \$3
  - If the order is over \$50 then shipping is \$2

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## Operator Precedence

- We have now added relational, equality and logical operators to the mathematical operators that were introduced last week
- Where do the new operators fit in the precedence table?

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## Precedence

| Precedence Operators (Highest to Lowest) |
|------------------------------------------|
| - (unary negation), ! (Logical NOT)      |
| * / %<br>- +                             |
| <= > > <<br>== !=                        |
| &&<br>                                   |
| = += -= *= /= %=                         |

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## Q.11 Expression Evaluation

- According to the operator precedence and associativity rules given on the previous slide, how will the following expressions be evaluated?
  - `x < min + max`
  - `min <= x && x <= max`
  - `!x == y + 2`
  - `x = a + b % 7 * 2`

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## `exit()`

- To terminate a program we can use the `exit(int status)` function
  - This is a *function*, not part of the language
    - `#include<stdlib.h>`
  - The `status` is returned to the operating system to denote program success or failure
    - Success: 0
    - Failure: non-zero

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## Q.12 Practice

- Write a complete program that will ask the user for two integers. Display both integers to the screen if they are each greater than 1000 and terminate the program with `exit()` otherwise. Use exactly one `if/else`

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