What Actions Do We Have Part 2

Today

- Last time we learnt about two types of executable statements
  - Assignment statements
  - Input/output statements
- Today we will
  - Cover arithmetic statements

Arithmetic Expressions

- Arithmetic expressions manipulate numeric data
- We've already seen simple ones
- The main arithmetic operators are
  - + addition
  - - subtraction
  - * multiplication
  - / division
  - % modulus

+, -, and *

- Addition, subtraction, and multiplication behave in C++ in the same way that they behave in algebra

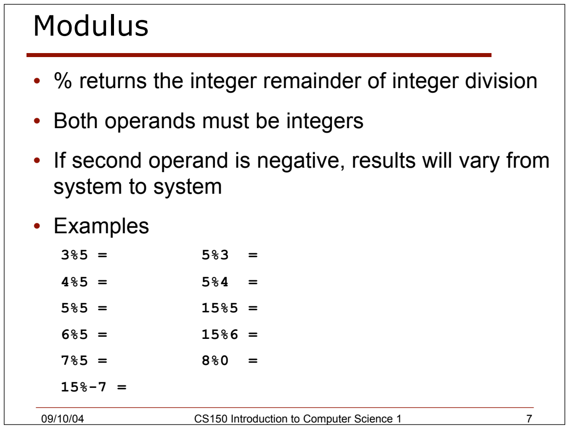
```
int num1, num2, num3, num4, sum, mul;
num1 = 3;
num2 = 5;
num3 = 2;
num4 = 6;
sum = num1 + num2;
mul = num3 * num4;
```

Division /

- The division operator can be used with both integers and doubles
- If the operands are both **`doubles`**, the result is a **`double`**
  - Example: `7.0/2.0 is 3.5`
- If the operands are both **`ints`**, the result is an **`int`**
  - Any fractional part in integer division is discarded
  - Example: `7/2 is 3`
- If mixed, the **`int`** operand is converted to a **`double`** and the result is a **`double`**
  - Example: `5/2.5 is 2.0`

Division

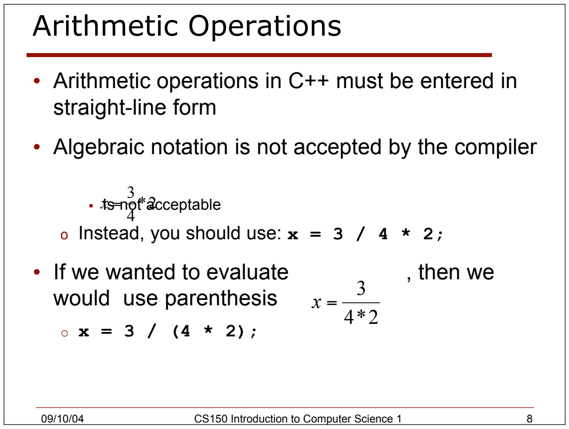
- Divisor (second operand) cannot be 0
- Division with negative integers may or may not be allowed
  - It depends on the compiler



Modulus

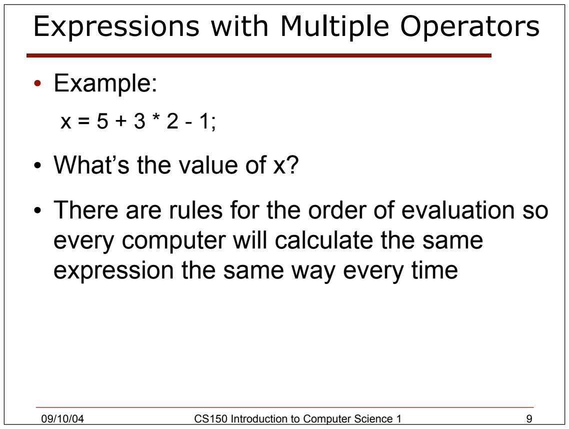
- % returns the integer remainder of integer division
- Both operands must be integers
- If second operand is negative, results will vary from system to system
- Examples

```
3%5 =          5%3  =
4%5 =          5%4  =
5%5 =          15%5 =
6%5 =          15%6 =
7%5 =          8%0  =
15%-7 =
```



Arithmetic Operations

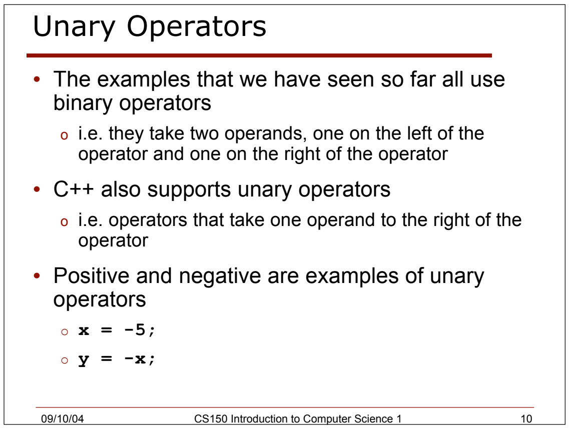
- Arithmetic operations in C++ must be entered in straight-line form
- Algebraic notation is not accepted by the compiler
  - $x = \frac{3}{4} * 2$ is not acceptable
  - Instead, you should use: **`x = 3 / 4 * 2;`**
- If we wanted to evaluate $x = \frac{3}{4*2}$, then we would use parenthesis
  - **`x = 3 / (4 * 2);`**



Expressions with Multiple Operators

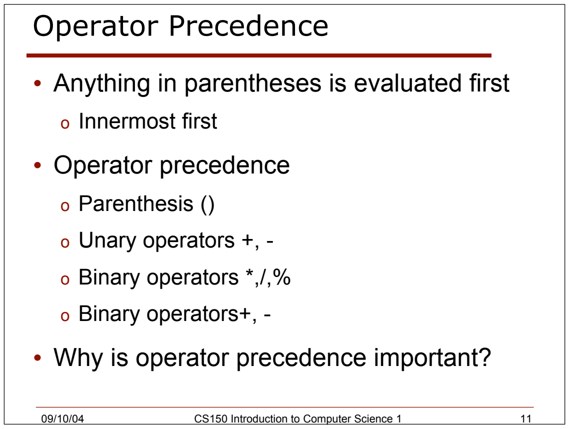
- Example:

  x = 5 + 3 * 2 - 1;
- What's the value of x?
- There are rules for the order of evaluation so every computer will calculate the same expression the same way every time



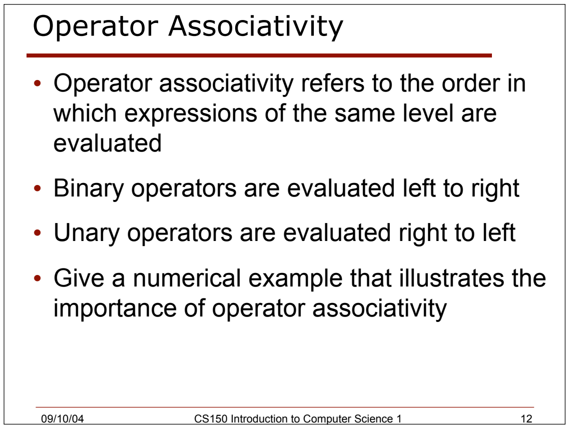
Unary Operators

- The examples that we have seen so far all use binary operators
  - i.e. they take two operands, one on the left of the operator and one on the right of the operator
- C++ also supports unary operators
  - i.e. operators that take one operand to the right of the operator
- Positive and negative are examples of unary operators
  - **`x = -5;`**
  - **`y = -x;`**



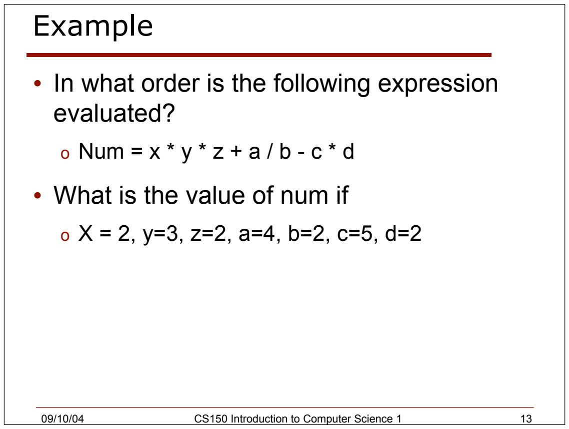
Operator Precedence

- Anything in parentheses is evaluated first
  - Innermost first
- Operator precedence
  - Parenthesis ()
  - Unary operators +, -
  - Binary operators *,/,%
  - Binary operators+, -
- Why is operator precedence important?



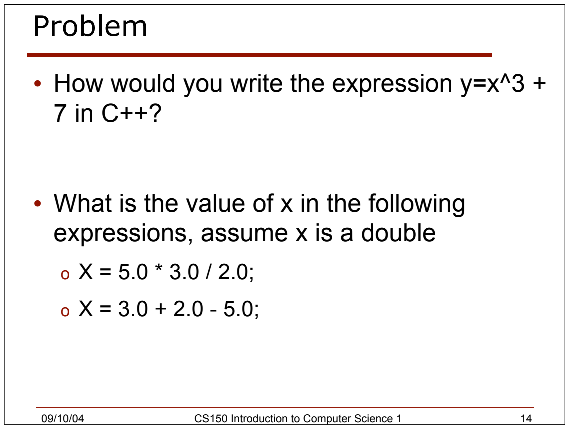
Operator Associativity

- Operator associativity refers to the order in which expressions of the same level are evaluated
- Binary operators are evaluated left to right
- Unary operators are evaluated right to left
- Give a numerical example that illustrates the importance of operator associativity



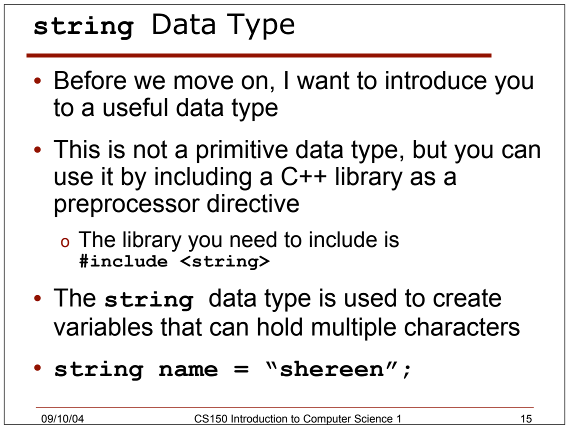
Example

- In what order is the following expression evaluated?
  - Num = x * y * z + a / b - c * d
- What is the value of num if
  - X = 2, y=3, z=2, a=4, b=2, c=5, d=2



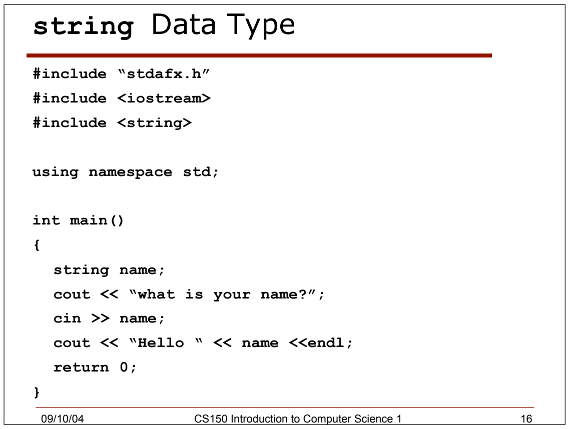
Problem

- How would you write the expression y=x^3 + 7 in C++?
- What is the value of x in the following expressions, assume x is a double
  - X = 5.0 * 3.0 / 2.0;
  - X = 3.0 + 2.0 - 5.0;



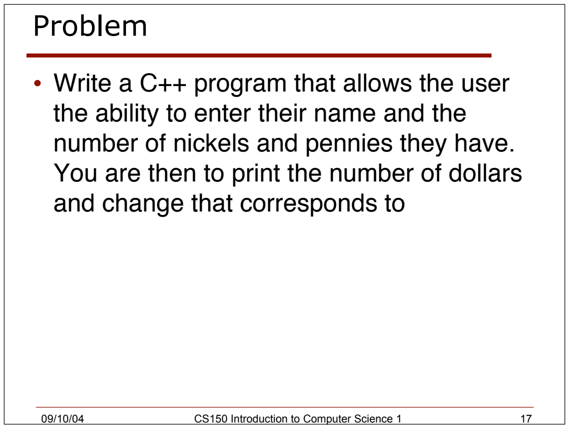
`string` Data Type

- Before we move on, I want to introduce you to a useful data type
- This is not a primitive data type, but you can use it by including a C++ library as a preprocessor directive
  - The library you need to include is **`#include <string>`**
- The **`string`** data type is used to create variables that can hold multiple characters
- **`string name = “shereen”;`**



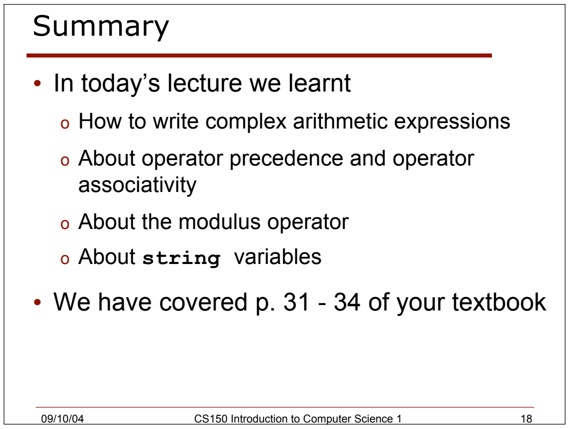
`string` Data Type

```
#include “stdafx.h”
#include <iostream>
#include <string>

using namespace std;

int main()
{
  string name;
  cout << “what is your name?”;
  cin >> name;
  cout << “Hello “ << name <<endl;
  return 0;
}
```



Problem

- Write a C++ program that allows the user the ability to enter their name and the number of nickels and pennies they have. You are then to print the number of dollars and change that corresponds to



Summary

- In today’s lecture we learnt
  - How to write complex arithmetic expressions
  - About operator precedence and operator associativity
  - About the modulus operator
  - About **`string`** variables
- We have covered p. 31 - 34 of your textbook