Arithmetic Operators

Section 2.15 & 3.2
p 60-63, 81-89

Today

- Arithmetic Operators & Expressions
  - Computation
  - Precedence
  - Associativity
  - Algebra vs C++
  - Exponents

Assigning `float`s to `int`s

```
int intVariable;
intVariable = 42.7;
cout << intVariable;
```

- What do you think is the output?

Assigning `double`s to `int`s

- What is the output here?

```
int intVariable;
double doubleVariable = 78.9;
intVariable = doubleVariable;
cout << intVariable;
```

Arithmetic Expressions

Arithmetic expressions manipulate numeric data

We've already seen simple ones

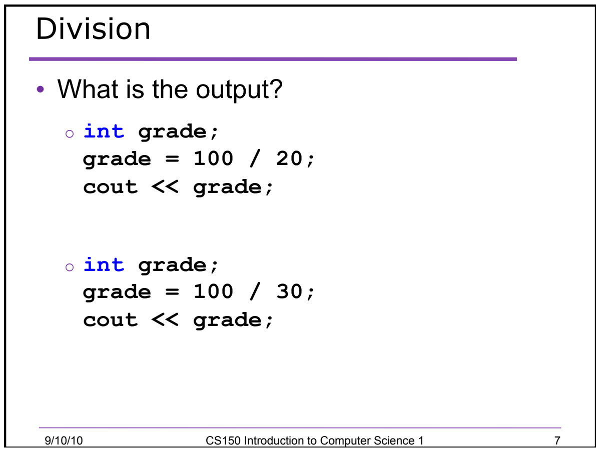
The main arithmetic operators are

+ 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;
```

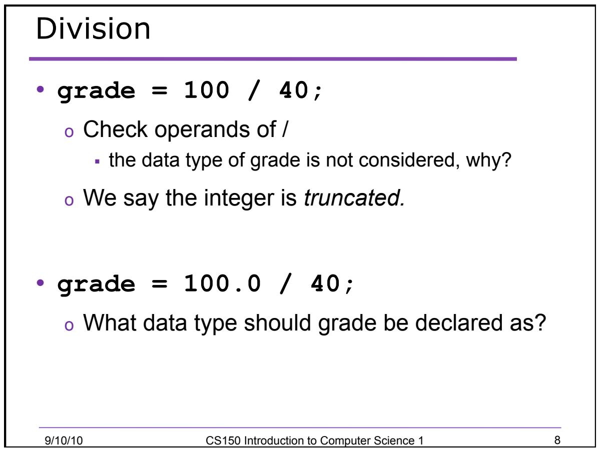


Division

- What is the output?

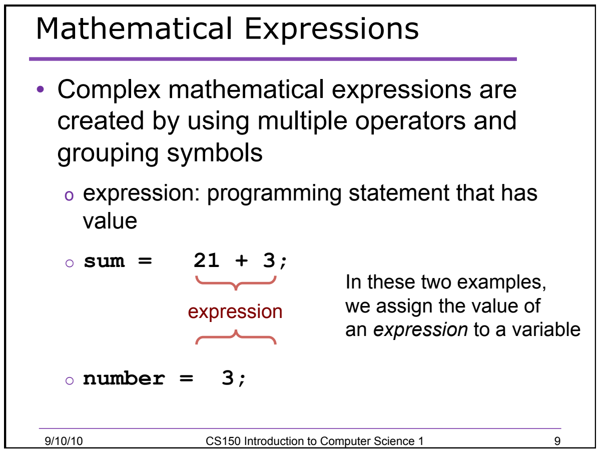
  -
    ```
    int grade;
    grade = 100 / 20;
    cout << grade;
    ```

  -
    ```
    int grade;
    grade = 100 / 30;
    cout << grade;
    ```



Division

- **`grade = 100 / 40;`**
  - Check operands of /
    - the data type of grade is not considered, why?
  - We say the integer is *truncated.*
- **`grade = 100.0 / 40;`**
  - What data type should grade be declared as?



Mathematical Expressions

- Complex mathematical expressions are created by using multiple operators and grouping symbols
  - expression: programming statement that has value
  - **sum =** $\underbrace{\texttt{21 + 3}}_{\text{expression}}$**;**
  - **number =** $\overbrace{\texttt{3}}$**;**

In these two examples, we assign the value of an *expression* to a variable

Arithmetic Operators

- Operators allow us to manipulate data
  - Unary: `operator operand`
  - Binary: `operand operator operand`
    (left hand side) (right hand side)

Operator	Meaning	Type	Example
-	Negation	Unary	`- 5`
=	Assignment	Binary	`rate = 0.05`
*	Multiplication	Binary	`cost * rate`
/	Division	Binary	`cost / 2`
%	Modulus	Binary	`cost % 2`
+	Addition	Binary	`cost + tax`
-	Subtraction	Binary	`total - tax`

Operator Precedence

- `result = 4 * 2 - 3;`
- `result = 12 + 6 / 3;`
  - `result = ?`
- Rules on how to evaluate an arithmetic expression
  - arithmetic expressions are evaluated left to right
  - do them in order of precedence
  - grouping symbols ( )

Operator Precedence

Precedence of Arithmetic Operators (Highest to Lowest)
(unary negation) -
* / %
+ -
(assignment) =

- Operator Associativity
  - If two operators have the same precedence, evaluate them from left to right as they appear in the expression

Practice

```
int x = 3;
double y = 2.5;

cout << 5 + 2 * 3;
cout << ( 10 / 2 – y );
cout << 3 + 12 * 2 - 3;
cout << 4 + 17 / 3.0 + 9;
cout << (6 – y) * 9 / x * 4 - 9;
```

If you are unsure, you can always type up and run the code in Visual Studio

Modulus

- Modulus is the remainder after integer division
- **`grade = 100 % 20;`**
  - **`grade`** = ?
- **`grade = 100 % 30;`**
  - **`grade`** = ?
- **`rem = x % n;`**
  - What are the possible values for **`rem`**?

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

- Today we have looked at:
  - Arithmetic Operators & Expressions
- Next time we will:
  - Continue looking at mathematic operators
- Completed section 2.15 & started on section 3.2