Arithmetic Operators

Topics

- Arithmetic Operators
- Operator Precedence
- Evaluating Arithmetic Expressio
- In-class Project
- Incremental Programming

Reading

- Section 2.5

Arithmetic Operators in C

Name	Operator	Example
Addition	+	num1 + num2
Subtraction	-	initial - spent
Multiplication	*	fathoms * 6
Division	/	sum / count
Modulus	%	m % n

Division

- If both operands of a division expression are integers, you will get an integer answer. The fractional portion is thrown away.
- Examples : 17 / 5 = 3
  4 / 3 = 1
  35 / 9 = 3

Division (con't)

- Division where at least one operand is a floating point number will produce a floating point answer.

- Examples : 17.0 / 5 = 3.4
  4 / 3.2 = 1.25
  35.2 / 9.1 = 3.86813
- What happens? The integer operand is temporarily converted to a floating point, then the division is performed.

Division By Zero

- Division by zero is mathematically undefined.
- If you allow division by zero in a program, it will cause a **fatal error**. Your program will terminate execution and give an error message.
- **Non-fatal errors** do not cause program termination, just produce incorrect results.

Modulus

- The expression **m % n** yields the integer remainder after **m** is divided by **n**.
- Modulus is an integer operation -- both operands MUST be integers.
- Examples : 17 % 5 = 2
  6 % 3 = 0
  9 % 2 = 1
  5 % 8 = 5

Uses for Modulus

- Used to determine if an integer value is even or odd

  5 % 2 = 1 → odd   4 % 2 = 0 → even

  If you take the modulus by 2 of an integer, a result of 1 means the number is odd and a result of 0 means the number is even.
- The Euclid's GCD Algorithm (done earlier)

Arithmetic Operators Rules of Operator Precedence

Operator(s)	Precedence & Associativity
( )	Evaluated first. If **nested (embedded)**, innermost first. If on same level, left to right.
* / %	Evaluated second. If there are several, evaluated left to right
+ -	Evaluated third. If there are several, evaluated left to right.
=	Evaluated last, right to left.

Using Parentheses

- Use parentheses to change the order in which an expression is evaluated.
- a + b * c   Would multiply b * c first, then add a to the result.
- If you really want the sum of a and b to be multiplied by c, use parentheses to force the evaluation to be done in the order you want.

  (a + b) * c
- Also use parentheses to clarify a complex expression.

Practice With Evaluating Expressions

Given integer variables a, b, c, d, and e,
where a = 1, b = 2, c = 3, d = 4,
evaluate the following expressions:

a + b - c + d
a * b / c
1 + a * b % c
a + d % b - c
e = b = d + c / b - a

A Sample Project

- Let's write a program that computes and displays the volume and surface area of a cube.
- Procedure:
  - Use the pseudocode that we developed in "Algorithms, Part 3 of 3"
  - Convert the algorithm to code
  - Clean up the code (spacing, indentation, commenting)

The Box - Pseudocode

```
Display "Enter the height:  "
Read <height>
While (<height>  <=  0 )
    Display "The height must be > 0"
    Display "Enter the height:  "
    Read <height>
End_while
```

The Box - Pseudocode (con't)

```
Display "Enter the width: "
Read <width>
While (<width>  <=  0 )
    Display "The width must be > 0"
    Display "Enter the width: "
    Read <width>
End_while
```

The Box - Pseudocode (con't)

```
Display "Enter the depth: "
Read <depth>
While (<depth>  <=  0 )
    Display "The depth must be > 0"
    Display "Enter the depth: "
    Read <depth>
End_while
```

The Box - Pseudocode (con't)

```
<volume> = <height>  X  <width>  X  <depth>

<surface1> = <height>  X  <width>
<surface2> = <width>  X  <depth>
<surface3> = <height>  X  <depth>
<surface area> =  2  X  (<surface1>  +  <surface2> +  <surface3>)
```

The Box - Pseudocode (con't)

Display "Height = ", <height>

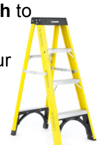
Display "Width = ", <width>

Display "Depth = ", <depth>

Display "Volume = ", <volume>

Display "Surface Area = ", <surface area>

Good Programming Practice



- It is best not to take the **"big bang" approach** to coding.
- Use an **incremental approach** by writing your code in incomplete, yet working, pieces.
- For example, for your projects,
  - Don't write the whole program at once.
  - Just write enough to display the user prompt on the screen.
  - Get that part working first (compile and run).
  - Next, write the part that gets the value from the user, and then just print it out.

Good Programming Practice

- Get that working (compile and run).
- Next, change the code so that you use the value in a calculation and print out the answer.
- Get that working (compile and run).
- Continue this process until you have the final version.
- Get the final version working.

Always have a working version of your program!

Using the Incremental Approach

- Let's think about how we could have developed the volume and surface area program incrementally.