Expressions

GEEN163 Introduction to Computer Programming

“Beauty without expression is boring.”

Ralph Waldo Emerson

Textbook

"Java Illuminated", 3rd edition, Brief edition by Anderson and Franceschi,

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The full edition is compatible
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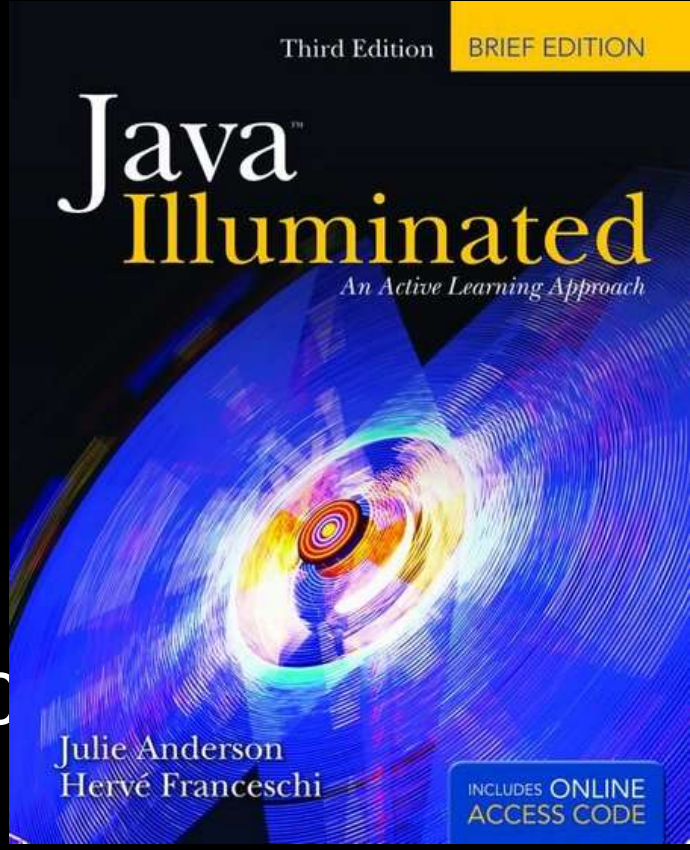


Available at the Bookstore, from online bookstores and other students

MyCodeLab

- Do 25 out of the 68 possible questions in sections 2.1 and 2.2 of MyCodeLab on the www.turingscraft.com website
- You will earn 4 points for each correct answer up to a maximum of 100 points
- You can retry incorrect answers
- Due by midnight on Wednesday, January 22

Simple Data Types

- **int** – integer whole numbers
- **double** – numbers with decimal points

- **char** – single characters
- **boolean** – ***true*** or ***false***

A Not-So-Simple Data Type

- **String** – A string of characters.
- A **String** can contain any character on the keyboard *(and more*)
- **String** is a Java class. *(Note the first letter is capitalized.)* We will talk more about classes and complex data types later.

Declaring Variables

- All variables must be declared before they are used in the program
- A variable is declared by writing the data type followed by the variable name
- More than one variable may be declared on the same line as the same type by separating the variable names by commas

Example Declarations

```
double  interestRate;
int     numPenguins;
String  myName;
boolean doit;
int     first, second;
```

Which declaration is incorrect?

A. double dog;
B. int cat
C. String cow, bull;
D. double dog2;

Which declaration is incorrect?

A. double dog;
B. int cat *(no semicolon)*
C. String cow, bull;
D. double dog2;

Assigning Values

- You can set a variable to a value during execution by putting the name of variable, an equals sign followed by a value and semicolon

```
numPenguins = 6;
first = 3;
interestRate = 4.75;
```

- The type of the variable and the value must match.

Not All Are Equal

- The equals sign is used to set a variable to a value. It does not mean equal in the mathematical sense.

```
int  cat, dog;
cat = 3;
dog = 5;
cat = dog;      // cat has the value 5
```

- An old computer language used the arrow character to indicate assignment.

cat ← 3; dog ← 5; cat ← dog ; // not Java

Sequential Execution

- Java programs are executed sequentially one line at a time

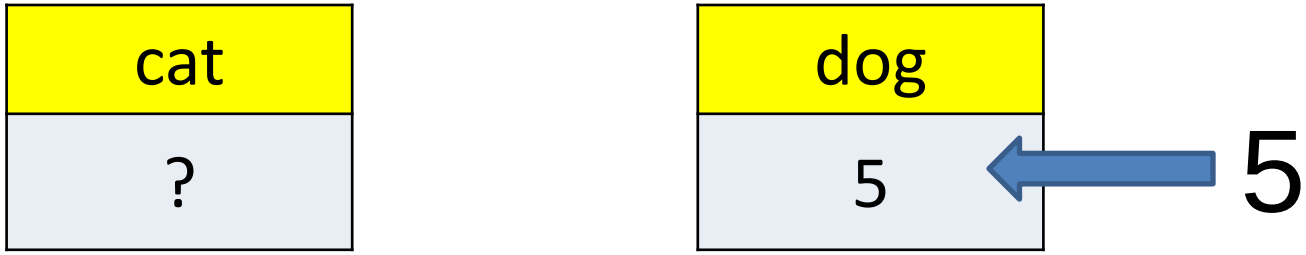
```
int  cat, dog;
dog = 5;
cat = dog;      // cat has the value 5
dog = 7;
```

- cat still has the value 5 while dog now has the value 7

Moving Data

- When you first create a variable, it has an undefined value

Moving Data

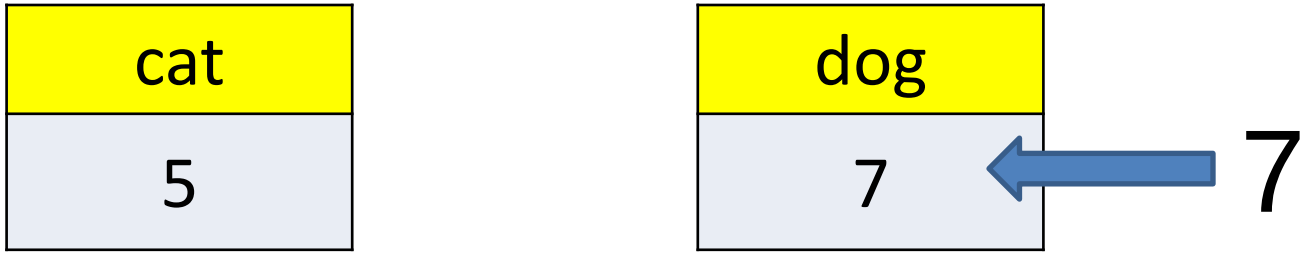



```
dog = 5;
```

Moving Data


```
cat = dog;
```

Moving Data




```
dog = 7;
```

Equations in Java

- A Java expression or equation is a valid arrangement of variables, constants, and operators.
- In Java each expression is written on the line with normal keyboard characters
- the value of the expression

  9.0 * 4.0 is 36.0

Operators can be

binary	involving 2 operands	2 + 3
unary	involving 1 operand	- 3
ternary	involving 3 operands	*later*

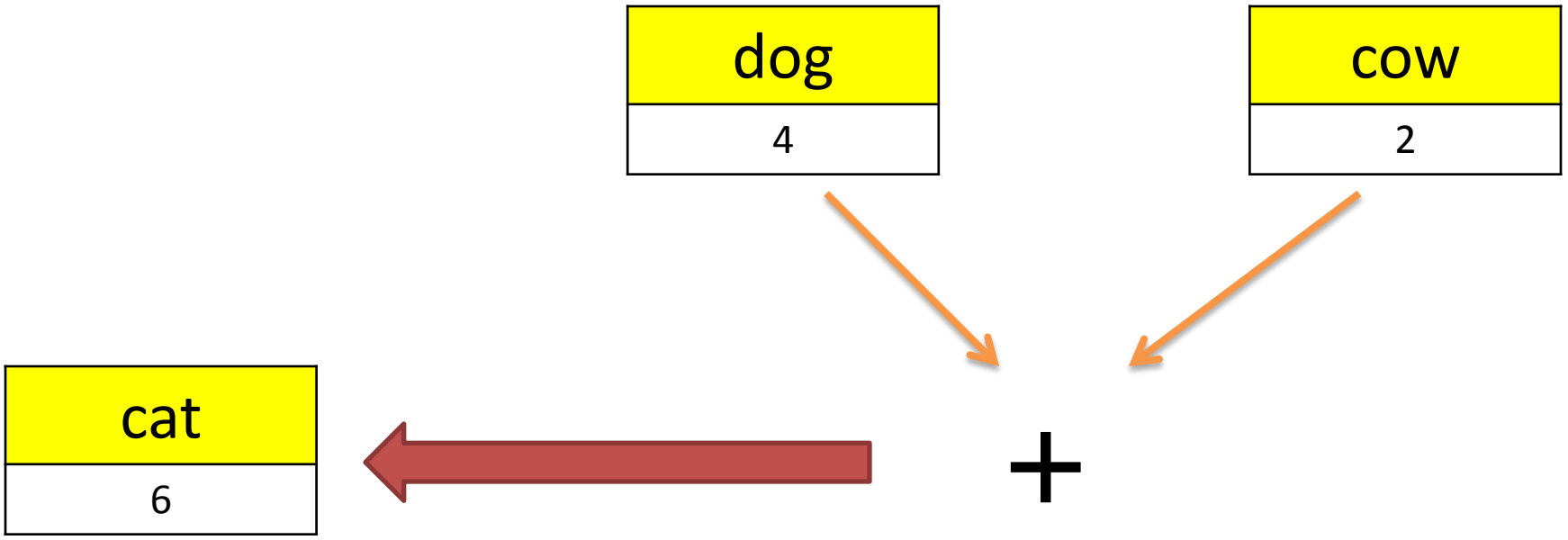
Some Java Arithmetic Operators

12 + 3	addition
12 - 3	subtraction
12 * 3	multiplication
12 / 3	division
12 % 3	modulus or remainder
-12	negative
+12	positive *(pointless, do not use)*

Example Java Expressions

```
int cow, dog, goat, cat;
cow = 2;
dog = 4;
goat = 7;
cat = cow + 3;                  // cat is 5
cat = cow + dog;                // cat is 6
cat = dog / cow + goat;         // cat is 9
cat = cow * goat – dog;         // cat is 10
```

Execution of an Equation



cat = cow + dog;

What is goat?

```
int  cat;
int  goat,  dog;
cat = 3;
dog = 5;
goat = dog * cat;
```

A. 3
B. 5
C. 15
D. "goat"

Honor's Contract

- Please see your instructor if you are in the University Honor's program

Modulus Operator

- the modulus operator % can only be used with integer type operands and always has an integer type result
- its result is the integer type remainder of an integer division

EXAMPLE

11 % 4 has value 3 because

$$4 \overline{)\ 11} \quad R = 3$$

Integer Division

- Integers can only hold whole numbers
- If division results in a fractional part, the fraction is dropped and the result is just the whole number.

8/2 is 4 7 / 3 is 2

1 / 2 is 0 -5 / 4 is -1

Example Java Expressions

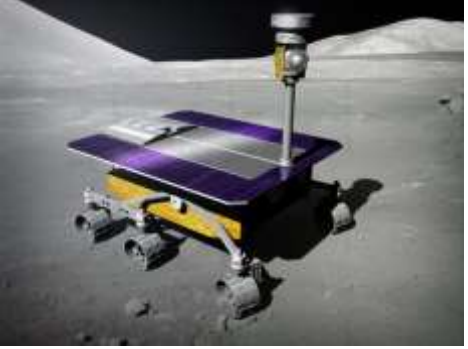
```
int cow = 2, dog = 4, goat = 7, cat;

cat = goat % dog;              // cat is 3
cat = goat / dog;              // cat is 1
cat = dog * goat / cow;        // cat is 14
cat = cow / 3;                 // cat is 0
```

What is mouse?

```
int rat, gerbil, mouse;
mouse = 7;
rat = 6;
gerbil = 4;
mouse = rat / gerbil + 2;
```

A. 2
B. 3
C. 3.5
D. 6
E. 7



White Space

- In Java you can put “white space” anywhere between operators and variables
- Whitespace can be blanks, tabs or new lines

```
dog=cat+cow-5.0;

dog = cat + cow – 5.0;

        dog             =cat+         cow-5.0;

dog = cat  +
              cow - 5.0;
```

- You cannot put whitespace in names

```
dog =  c   a   t  + cow    - 5   .  0;       // invalid
```

Operator Priority

- When an expression has multiple operators the high priority operations are done first
- When operators are of equal priority, they are executed left to right
- High priority operators are: *** / %**
- Lower priority operators are: **+ -**
- Multiplication and division are done before addition and subtraction

Example Java Expressions

```
double cow = 2, dog = 4, goat = 6, cat;

cat = goat / cow + dog;          // cat is 7.0
cat = dog + goat / cow;          // cat is 7.0
cat = cow + goat / cow +dog;     // cat is 9.0
```

What is aardvark?

```
int cat = 5, dog = 3, aardvark = 7;
aardvark = 1 + cat / dog;
```

A. 2

B. 2.666667

C. 3

D. 7

What is aardvark?

```
int cat = 5, dog = 3, aardvark = 7;
aardvark = 1 + cat / dog;
```

A. 2 cat / dog is 1

B. 2.666667

C. 3

D. 7

(Parentheses)

- Parentheses can be used to change the order in which an expression is evaluated
- Parts of an expression that are inside parentheses are done before outer parts
- If there is more than one parenthesized expression, they are evaluated left to right
- The most nested parenthesized expressions are done first

Evaluating Expressions

2 * 3 + 1	equals 7
1 + 2 * 3	equals 7
(1 + 2) * 3	equals 9
3 + 7 / 2 + 1	equals 7
(3 + 7) / 2 + 1	equals 6
(3 + 7) / (2 + 1)	equals 3

What is aardvark?

```
int cat = 5, dog = 3, aardvark = 7;
aardvark = (1 + cat) / dog;
```

A. 2

B. 2.666667

C. 3

D. 7

What is aardvark?

```
int cat = 5, dog = 3, aardvark = 7;
aardvark = (1 + cat) / dog;
```

A. 2
B. 2.666667
C. 3
D. 7

Evaluating Expressions

7 * 10 - 5 % 3 * 4 + 9

means (7 * 10) - 5 % 3 * 4 + 9

70 - 5 % 3 * 4 + 9

70 - (5 % 3) * 4 + 9

70 - 2 * 4 + 9

70 - (2 * 4) + 9

70 - 8 + 9

(70 - 8) + 9

62 + 9

71

Parentheses

- parentheses can be used to change the usual order
- parts in ( ) are evaluated first
- evaluate **(5 * (11 - 9) + 3) * 2 + 9**

(5 * 2 + 3) * 2 + 9

(10 + 3) * 2 + 9

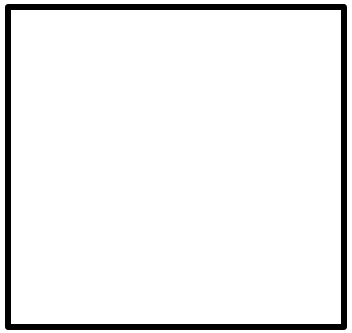
13 * 2 + 9

26 + 9

35

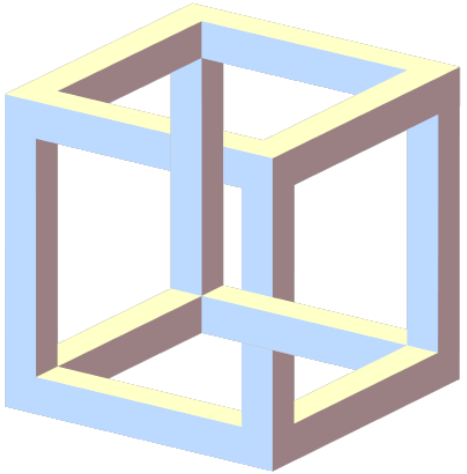
Squares and Cubes

- Java has a method for raising a number to a power, such as x^n
- If you are just squaring a number, x^2 or cubing it, x^3, then it is easiest to just multiply the number by itself



goat^2 *is* goat * goat;

fish^3 *is* fish * fish * fish;



Operator Priority

Precedence	Operator	Description
Higher	( )	Parenthesis
	-	unary Negative
	*	Multiplication
	/	Division
	%	Modulus (remainder)
	+	Addition
	-	Subtraction
Lower	=	Assignment

Expression Evaluation

- Higher precedence determines which operator is applied first in an expression having several operators
- An expression is evaluated by performing the operations in precedence order
- Operations of equal precedence are performed left to right
- Expressions inside parenthesis are evaluated first

Math to Java

$$cat = \frac{cow + dog}{goat}$$

```
cat = (cow + dog) / goat;
```

$$cat = \frac{cow * dog}{cat * goat}$$

```
cat = (cow * dog) / (cat * goat);
```

Write the equation for Java

double cat = 1, dog = 2, cow = 3;

$$cat = \frac{10}{dog + cow}$$

Write the equation for Java

double cat = 1, dog = 2, cow = 3;

$$cat = \frac{10}{dog + cow}$$

```
cat = 10.0 / (dog + cow);   // 2
```

incorrect

```
cat = 10.0 / dog + cow;     // 5
```

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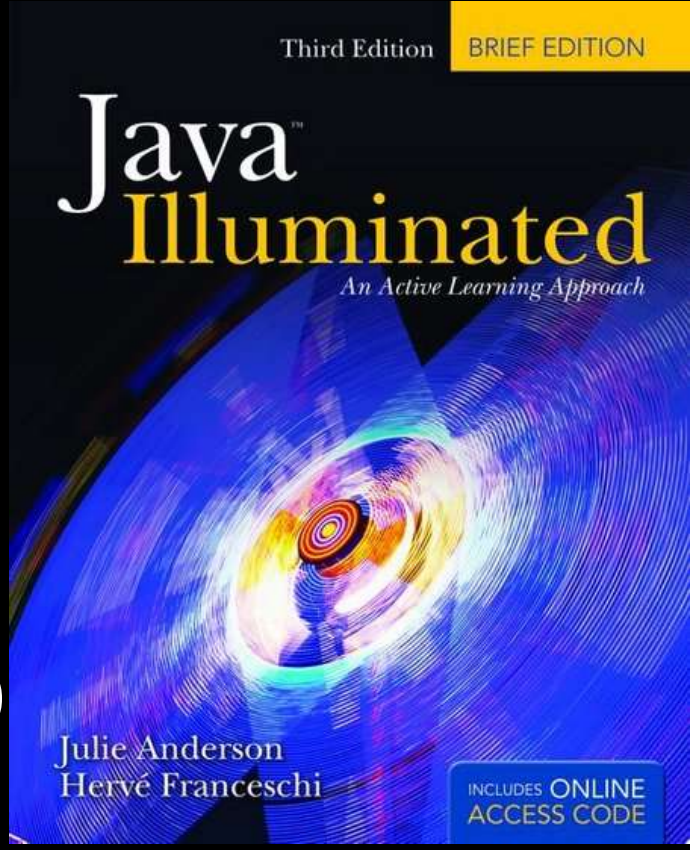

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MLK Holiday

There are no classes on Monday, January 20