

Lecture Set 4: More About Methods and More About Operators

- More arithmetic operators
- Operator Side effects
- Operator Precedence
- Short-circuiting
- Methods
 - Definitions
 - Invocations



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Expressions

- Java “expressions” that yield values
e.g.
`x`
`x + 1 - y`
`x == y && z == 0`
`foo.equals (“cat”)`
- Expressions have values of a specific type (int, boolean, etc.)
- Expressions can be assigned to variables, appear inside other expressions, etc.



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Expressions and Side Effects

- Some expressions can also alter the values of variables
e.g. `x=1`
- `x=1` is an expression?
 - Yes!
 - Value is result of evaluation right-hand side of `=`
 - It also alters the value of `x`
- Such alterations are called **side effects**

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Are the Following Legal?

- `int x, y;`
`x = y = 1;`
Yes. Result assigns 1 to `x` and to `y`
- `int x = 0, y = 1;`
`boolean b = false;`
`if (b = (x <= y)) {`
 `x = y;`
`}`
Yes. Result assigns `true` to `b` and 1 to `x`

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Other Expressions with Side Effects



- Java includes abbreviations for common forms of assignment
- Example: **increment** operations (Basically equivalent to $x = x + 1$)
 - $++x$ "Pre-increment"
 - Increments x , returns the new value of x
 - $x++$ "Post-increment"
 - Increments x , returns the old value of x
- Same or Different
 - $x == x++$ always true
 - $x == ++x$ never true
- Compare
 - $x++ * y++$
 - $++x * ++y$
 - $++x * y++$
 - $x++ * ++y$

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Other Assignment Operators



- Example: **decrement** operations (Basically equivalent to $x = x - 1$)
 - $--x$ "Pre-decrement"
 - Decrements x , returns the new value of x
 - $x--$ "Post-decrement"
 - Decrements x , returns the old value of x
- General modification by constant
 - General form: **<var> <op with=> <constant>**
 - Examples

$x += 2$	equivalent to	$x = x + 2$
$x -= 2$	equivalent to	$x = x - 2$
$x *= 2$	equivalent to	$x = x * 2$
$x /= 2$	equivalent to	$x = x / 2$

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Precedence

- Explains how to evaluate expressions
 - What is value of $1 - 2 + 3 * 4$?
 - **Precedence rules** answer this question
 - Higher-precedence operators evaluated first
 - Example from math: “Please, Excuse my Dear Aunt Sally” or PEMDAS

Multiple and divide (higher precedence) before you add and subtract (lower precedence)
- Java follows “Aunt Sally’s Rules” ... but what about other operators?

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Java Precedence Rules

- parentheses: ()
- unary ops: $+x$ $-x$ $++x$ $--x$ $x++$ $x--$ $!x$
- multiply/divide: $*$ $/$ $\%$
- add/subtract: $+$ $-$
- comparisons: $<$ $>$ $<=$ $>=$
- equality: $==$ $!=$
- logical and: $\&\&$
- logical or: $||$
- assignments: $=$ $+=$ $*=$ $/=$ $\%=$ (only these are right to left associative)

increasing precedence

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Examples



- $x * y + -z$

Equivalent to $(x * y) + (-z)$

- $(x \leq y \ \&\& \ y \leq z \ || \ w > z)$

Equivalent to $((x \leq y) \ \&\& \ (y \leq z)) \ || \ (w > z)$

- What is value of $1 - 2 + 3 * 4$?

$1 - 2 + 3 * 4$
 $= (1 - 2) + (3 * 4)$
 $= (1 - 2) + 12$
 $= -1 + 12$
 $= 11$

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Should You Rely on Precedence?



- No!
- The only ones people can remember are
 - "Please Excuse My Dear Aunt Sally"
 - PEMDAS
- Bad
if $(2 * x++ < 5 * z + 3 \ \&\& \ -w != x / 2)$
- Better
if $(2 * (x++) < ((5 * z) + 3)) \ \&\& \ ((-w) != (x / 2))$

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Short-circuiting

- As soon as Java knows an answer – it quits evaluating the expression.
- What does Java print?

```
int x = 0, y = 1;
if ((y > 1) && (++x == 0)) {
    --y;
}
System.out.println (x);
```

- 0
- Why?
 - $y > 1$ is false
 - The result of $\&\&$ will be false, regardless of second expression
 - Java therefore does not evaluate second expression of $\&\&$
- This treatment of $\&\&$, $\|\|$ is called **short-circuiting**
 - Subexpressions evaluated from left to right
 - Evaluation stops when value of over-all expression is determined



Examples

- What does Java print?

```
int x = 0, y = 1;
if ((y >= 1) && (++x == 0)) {
    --y;
}
```

```
System.out.println (x);
```

- 1
- What does Java print?

```
int x = 0, y = 1;
if ( ((y > 1) && (++x == 0))
    ||
    ((y == 1) && (x++ == 0)) ) {
    --y;
}
System.out.println (y);
System.out.println (x);
```

- 0
- 1



Examples (cont.)

- What does Java print?

```
int x = 0, y = 0;
while (x++ <= 4) {
    y += x;
}
System.out.println (y);
```

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Programming with Side-Effects

Generally:

- Side effects in conditions are hard to understand
- Good programming practice
 - Conditions should be side-effect-free
 - Side effects should be in “stand-alone statements”
- Major Goal: Strive to create the most readable and maintainable code.

Primitive Types and their Hierarchy



- double
- float
- long
- int
- short
- byte

int x = 7.2;

double y = 6;

- Changing to something else Further Up this list is acceptable
 - called “Widening Conversion”
- Changing to Something else Further Down this list is not acceptable
 - called “Narrowing Conversion”
- Explicit casting needed for when you want to go lower in the list

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Type Casting



Which of the following are legal?

- int x = 3.5;
Illegal: 3.5 is not an int
- float x = 3;
Legal: 3 is an int, which is also a float
- long i = 3;
Legal: 3 is an int, which is also a long
- byte x = 155;
Illegal: 155 is too big to be a byte (> 127)
- double d = 3.14159F;
Legal: 3.14159F is a float, which is also a double

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Mixed Expressions

- What is result of
`float x = 3 / 4;`
 - x assigned value 0.0F
 - Why?
 - 3, 4 are ints
 - So integer / operation is used, yielding 0, before upcasting is performed
- To get floating point result, use explicit casting
`float x = (float) 3 / (float) 4;`
 - Assigns x the value 0.75F
- Can also do following
`float x = (float) 3 / 4;`
 - Why?
 - `(float) 3` returns a value type float (3.0F)
 - 4 is an int
 - In this case, Java compiler uses widening conversion on “lower” type (here, int) to obtain values in same type before computing operation

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main method

```
public static void main(String args[]){  
    // statements here  
}
```

- All projects and examples have defined this method
- No explicit call needed
- Parts of the line
 - Name = main
 - Parameter List = args
 - Return type = void
 - Access = public -- more on this later
 - Modifier = static

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Other public static methods



- A static method is associated with a class
 - not an individual instance (object)
- Must have all of the same parts as the main

```
public static returnType name(argList){  
    body  
}
```

- For example – defining a method to print a number of stars

```
public static void printStars(int count){  
    for (int curr = 0; curr < count; curr++){  
        System.out.print("*");  
    }  
}
```

- For example – defining a method to print a number of stars

```
printStars(3)  
System.out.println();  
printStars(77);
```

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method information: parameters and arguments



- parameter list
 - type name for each item in the list
 - e.g. (MyGrid grid, char where)
- argument list
 - expression for each item in the list
 - e.g. (grid, 't')
- Matched between the arguments and the parameters based on position in the list

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Non-main static public methods: defining, invoking and commenting



- Defined based on a name and a list of parameters

```
public static void name(parameterlist){  
    body  
}
```

- Invoked by stating its name and giving an argument for each element of the parameter list

```
name(argumentlist);
```

- Each method must have a well defined purpose
 - That information goes into a comment before the method definition
 - Each parameter's purpose should be explained
 - Return value's purpose should be explained

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