Operations

Making Things Happen

(Chap. 3)

Expressions

Our Temperature Code

```
/* Temperature.java converts Celsius
 *                          heit.
                                  02
                                  & Keyboard classes
                                  c
{
  public static voi       tring [] args)
  {
    Screen theScreen =       creen();
    theScreen.print("We       to the temperature converter!\n" +
            "Please enter       temperature in Celsius: ");

    Keyboard theKeyboard = n    Keyboard();
    double celsius = theKeyboa rd.readDouble();

    double fahrenheit = ((9.0/5.0)*celsius) + 32;

    theScreen.print(celsius + " degrees Celsius is " +
            fahrenheit + " degrees Fahrenheit.\n" +
            "It's been a pleasure!\n");
  }
}
```

We've looked at statements that declare objects (variables) and constants) and assignment statements. Now we look at the operations that can be applied to objects to produce expressions.

Expressions

- As we noted in the last chapter, any sequence of *objects* and *operations* that combine to produce a value is called an *expression*.
- Example:

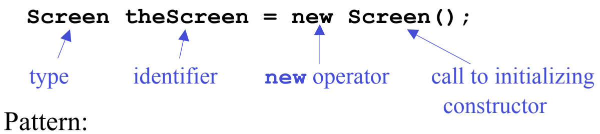
```
    double fahrenheit =
                  ((9.0/5.0)*celsius) + 32;
```

- Now we focus on C++ *operations*
- But first, a little more about types.

Constructors

Sec. 3.2

- Primitive types use literals built into the compiler for their values.
- Reference types must use the **new** operation:



```
Screen theScreen = new Screen();
```

type

identifier

new operator

call to initializing constructor

- Pattern:

```
  ClassName identifier =
              new ClassName(arguments);
```

- The **String** class is an exception; e.g.,

```
    String myName = "John Q. Doe";
```

Primitive vs Reference Types

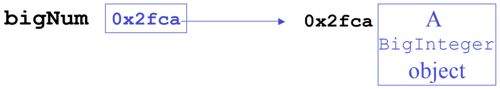
All variables refer to memory locations:

– for primitive types, the locations store the value:

```
int age = 18;
```

– for reference types, the locations store an *address:*

```
BigInteger bigNum = new BigInteger();
```



Wrapper Classes

- *Wrapper classes* are reference types that add capabilities to the primitive types:

  ```
  Byte Short Integer Long Float
  Double Boolean Character
  ```

- Examples:
  - Constants:

    ```
    Integer.MAX_VALUE
    Integer.MIN_VALUE
    ```

  - Methods:

    ```
    String digits = Integer.toString(intVal)
    ```

Numeric Expressions

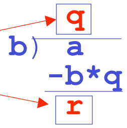
Sec. 3.3

- Java provides four familiar arithmetic operators: **+**, **-**, *****, **/**.
- They can be used with both reals and integers, but division (/) behaves differently:

  3/4 □ 0 3.0/4.0 □ 0.75

  3.0/4 □ 0.75 3/4.0 □ 0.75

- If `a` and `b` are integers:
  a / b returns the ***quotient***
  a % b returns the ***remainder***



The "guzinta" (goes-into) operation

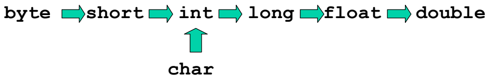
Implicit Type Conversion

- When types are mixed in an expression, the "narrower" type is "widened" to the larger type;. e.g.,

  ```
  (9.0/5.0)*celsius + 32;

  (9.0/5.0)*celsius + 32.0;
  ```

- These is known as promotion.
  Legal promotions are:



Explicit Type Conversion

- Using type casting:

```
double dubVar = (double)intVar * dubValue;
```

- Using methods in wrapper classes:

```
Integer intVarObject =  new Integer(intVar);
double dubVar =
           intVarObject.doubleValue() * dubValue;
```

The **`Math`** Class

See Tables 3.2 & 3.3

- Contains *static constants,* e.g.:

```
PI = 3.14159 …
E = 2.71828 …
```

- Contains *static methods,* e.g.:

```
abs(x)          sqrt(x)
pow(x,y)        max(x,y)
e(x)            log(x)
```

- To use these, attach **`Math.`** as a prefix; e.g., **`Math.sqrt(x)`**

Precedence/Priority

- **Question:** Is the value of the expression:

  `2 + 3 * 4`

  `(2 + 3) * 4` □ **`20`** or **`2 + (3 * 4)`** □ **`14`**?
- Operator *precedence (or priority)* governs the evaluation order of operations in an expression. `*` has *higher precedence* than `+`, so it is applied first, making the answer 14.
- Parentheses can be used to override default precedence; e.g., **`(2 + 3) * 4`**

Operator Precedence

HIGHER

`( )`

`+` (positive), `-` (negative), `!` (NOT)

`*`, `/`, `%`

`+`, `-`

`<`, `<=`, `>`, `>=`

`==`, `!=`

`&&`

`||`

LOWER

See Appendix C for a complete list.

Associativity

- **Question:** Is the value of the expression `8 - 4 - 2` `(8 - 4) - 2 □ 2` or `8 - (4 - 2) □ 6`?
- *Associativity* governs the order of execution of operators that have equal precedence.
  `–` is *left-associative*, so the left `–` is evaluated first
- Again, we can use parentheses to override the default; e.g., `8 - (4 - 2)`.
- Most (but not all) C++ operators associate left.

  See Appendix C for a complete list.

Assignment Expressions

Sec. 3.4

Assignment is an operation; an expression

```
variable = expr
```

1. Assigns the value of `expr` to `variable` (side effect), and
2. Produces this value assigned to `variable` as the value of this expression

Appending a semicolon produces an *assignment statement*.

Assignment Chaining

The assignment operator is *right-associative*, which supports expressions like

```
    int w, x, y, z;
    w = x = y = z = 0;
```

which is evaluated as

```
    w = (x = (y = (z = 0)));
```

The rightmost = is applied first, assigning 0 to **`z`** and producing 0; the next = thus assigns `y` the value of `z` (0) and produces 0; then `x` is assigned the value of `y` (0), and finally `w` is assigned the value of `x` (0).

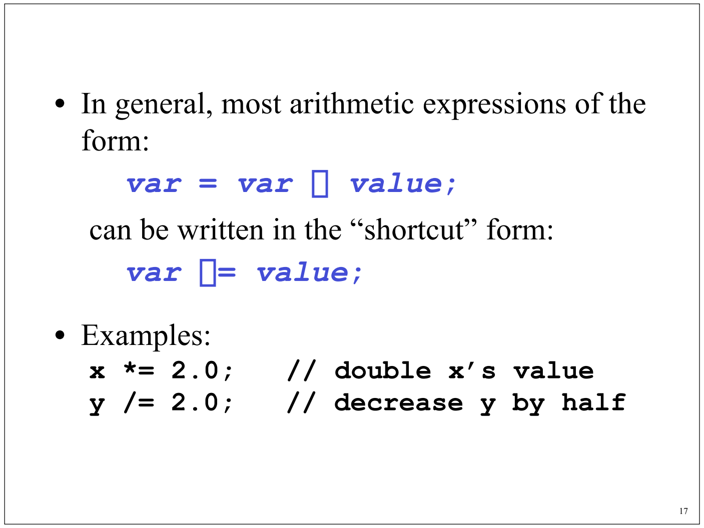
Assignment Shortcuts

- Some assignments are so common,

```
    var = var + x;  // add x to var
    var = var - y;  // sub y from var
```

that Java provides shortcuts for them:

```
    var += x;  // add x to var
    var -= y;  // sub y from var
```



- In general, most arithmetic expressions of the form:

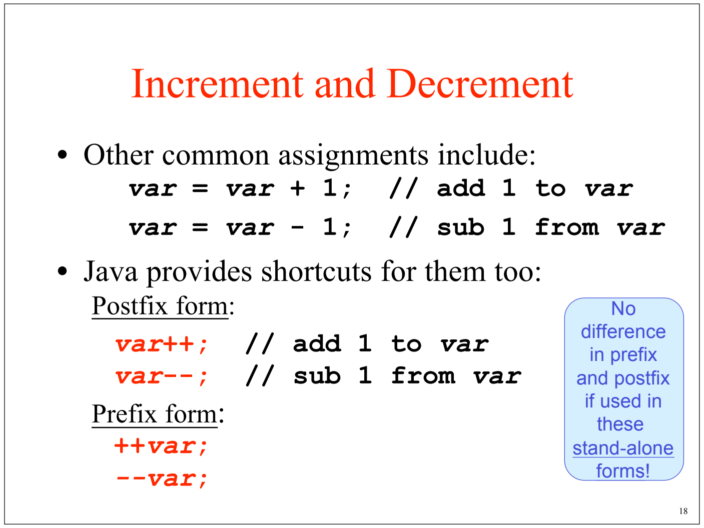
  `var = var □ value;`

  can be written in the “shortcut” form:

  `var □= value;`

- Examples:

```
x *= 2.0;    // double x’s value
y /= 2.0;    // decrease y by half
```



Increment and Decrement

- Other common assignments include:

```
var = var + 1;  // add 1 to var
var = var - 1;  // sub 1 from var
```

- Java provides shortcuts for them too:

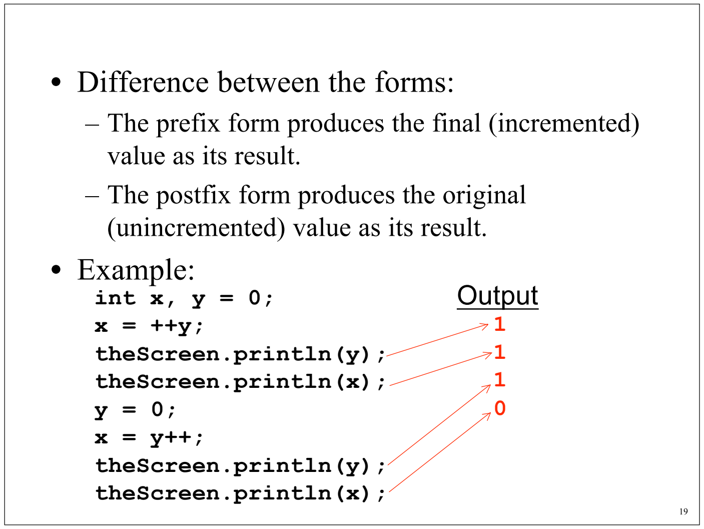
Postfix form:

```
var++;  // add 1 to var
var--;  // sub 1 from var
```

Prefix form:

```
++var;
--var;
```

No difference in prefix and postfix if used in these stand-alone forms!

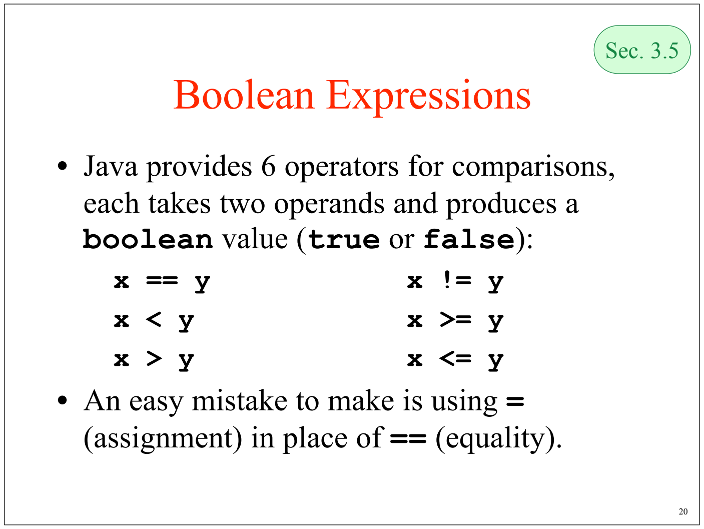


- Difference between the forms:
  - The prefix form produces the final (incremented) value as its result.
  - The postfix form produces the original (unincremented) value as its result.
- Example:

```
int x, y = 0;
x = ++y;
theScreen.println(y);
theScreen.println(x);
y = 0;
x = y++;
theScreen.println(y);
theScreen.println(x);
```

Output

```
1
1
1
0
```



Sec. 3.5

Boolean Expressions

- Java provides 6 operators for comparisons, each takes two operands and produces a **`boolean`** value (**`true`** or **`false`**):

```
x == y          x != y
x < y           x >= y
x > y           x <= y
```

- An easy mistake to make is using **`=`** (assignment) in place of **`==`** (equality).

- More complex boolean expressions can be built using the logical operators:

```
a && b   // true iff a,b are both true
a || b   // true iff a or b is true
!a       // true iff a is false
```

- Examples:

```
 (0 <= score) && (score <= 100)
 done || (count > 1000)
```

- *Short-circuit evaluation*: Second operand isn't evaluated unless necessary (e.g., if `score` is negative; if `done` is true.) This is useful in guarding potentially unsafe operation; e.g.,

```
  (x >= 0) && (Math.sqrt(x) < 10)
```

Character Expressions

Sec. 3.6

- **`char`** objects can be used in comparisons:

```
'A' < 'B'
('a' <= letter) && (letter <= 'z')
```

- They are compared using their numeric (Unicode) codes:

```
'A' < 'B' // true because 65 < 66
```

- The **`Character`** wrapper class provides additional methods, including:

```
digit(ch, b)          isLetter(ch)
getNumericValue(ch)   isUpperCase(ch)
```

See Table 3.7

String Expressions

- Concatenation:

```
"Jo " + "Doe" □ "Jo Doe”
```

- Strings are made up of individual characters:

```
String name = "Jo Doe";
```

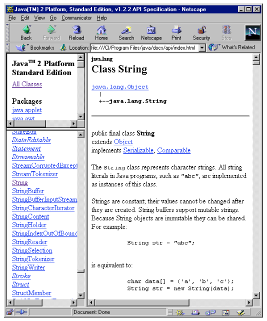
name

J	o		D	o	e	\0
0	1	2	3	4	5	6

– `name.charAt(3)` results in `'D'`

Java's API Documentation

You'll never remember all the features of these reference types; e.g., **`String`**. *Use Java's online reference manual instead.*


Java(TM) 2 Platform, Standard Edition, v1.2.2 API Specification - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Stop
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What's Related
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All Classes

Packages

java.applet
java.awt

StateEdit
StateEditable
Statement
Streamable
StreamCorruptedExcept
StreamTokenizer
String
StringBuffer
StringBufferInputStream
StringCharacterIterator
StringContent
StringHolder
StringIndexOutOfBounc
StringReader
StringSelection
StringTokenizer
StringWriter
Stroke
Struct
StructMember

java.lang
Class String

```
java.lang.Object
  |
  +--java.lang.String
```

public final class **String**
extends Object
implements Serializable, Comparable

The `String` class represents character strings. All string literals in Java programs, such as `"abc"`, are implemented as instances of this class.

Strings are constant; their values cannot be changed after they are created. String buffers support mutable strings. Because String objects are immutable they can be shared. For example:

```
     String str = "abc";
```

is equivalent to:

```
     char data[] = {'a', 'b', 'c'};
     String str = new String(data);
```

http://java.sun.com/j2se/1.4.1/docs/api