CS1001

Lecture 13

Overview

- Java Programming

Goals

- Understand the basics of Java programming

Assignments

- Brookshear: Ch 4, Ch 5 (Read)
- Read linked documents on these slides (slides will be posted in courseworks)

Objectives:

- Learn to distinguish the required syntax from the conventional style
- Learn when to use comments and how to mark them
- Review reserved words and standard names
- Learn the proper style for naming classes, methods, and variables
- Learn to space and indent blocks of code

Comments

- Comments are notes in plain English inserted in the source code.
- Comments are used to:
  - document the program's purpose, author, revision history, copyright notices, etc.
  - describe fields, constructors, and methods
  - explain obscure or unusual places in the code
  - temporarily "comment out" fragments of code

Formats for Comments

- A "block" comment is placed between /* and */ marks:

```
/*  Exercise 5-2  for Java Methods
    Author: Miss Brace
    Date: 3/5/2010
    Rev. 1.0                    */
```

- A single-line comment goes from // to the end of the line:

```
wt *= 2.2046;          //  Convert to kilograms
```

Reserved Words

- In Java a number of words are reserved for a special purpose.
- Reserved words use only lowercase letters.
- Reserved words include:
  - primitive data types: int, double, char, boolean, etc.
  - storage modifiers: public, private, static, final, etc.
  - control statements: if, else, switch, while, for, etc.
  - built-in constants: true, false, null
- There are about 50 reserved words total.

Programmer-Defined Names

- In addition to reserved words, Java uses standard names for library packages and classes:

  String, Graphics, javax.swing, JApplet, JButton, ActionListener, java.awt

- The programmer gives names to his or her classes, methods, fields, and variables.

Names (cont'd)

- Syntax: A name can include:
  - upper- and lowercase letters
  - digits
  - underscore characters
- Syntax: A name cannot begin with a digit.
- Style: Names should be descriptive to improve readability.

Names (cont'd)

- Programmers follow strict style conventions.
- Style: Names of classes begin with an uppercase letter, subsequent words are capitalized:

```
public class FallingCube
```

- Style: Names of methods, fields, and variables begin with a lowercase letter, subsequent words are capitalized.

```
private final int delay = 30;
public void dropCube()
```

Names (cont'd)

- Method names often sound like verbs:
  setBackground, getText, dropCube, start
- Field names often sound like nouns:
  cube, delay, button, whiteboard
- Constants sometimes use all caps:
  PI, CUBESIZE
- It is OK to use standard short names for temporary "throwaway" variables:
  i, k, x, y, str

Syntax vs. Style

- Syntax is part of the language. The compiler checks it.
- Style is a convention widely adopted by software professionals.
- The main purpose of style is to improve the **readability of programs**.

Syntax

- The compiler catches syntax errors and generates error messages.
- Text in comments and literal strings within double quotes are excluded from syntax checking.
- Before compiling, carefully read your code a couple of times to check for syntax and logic errors.

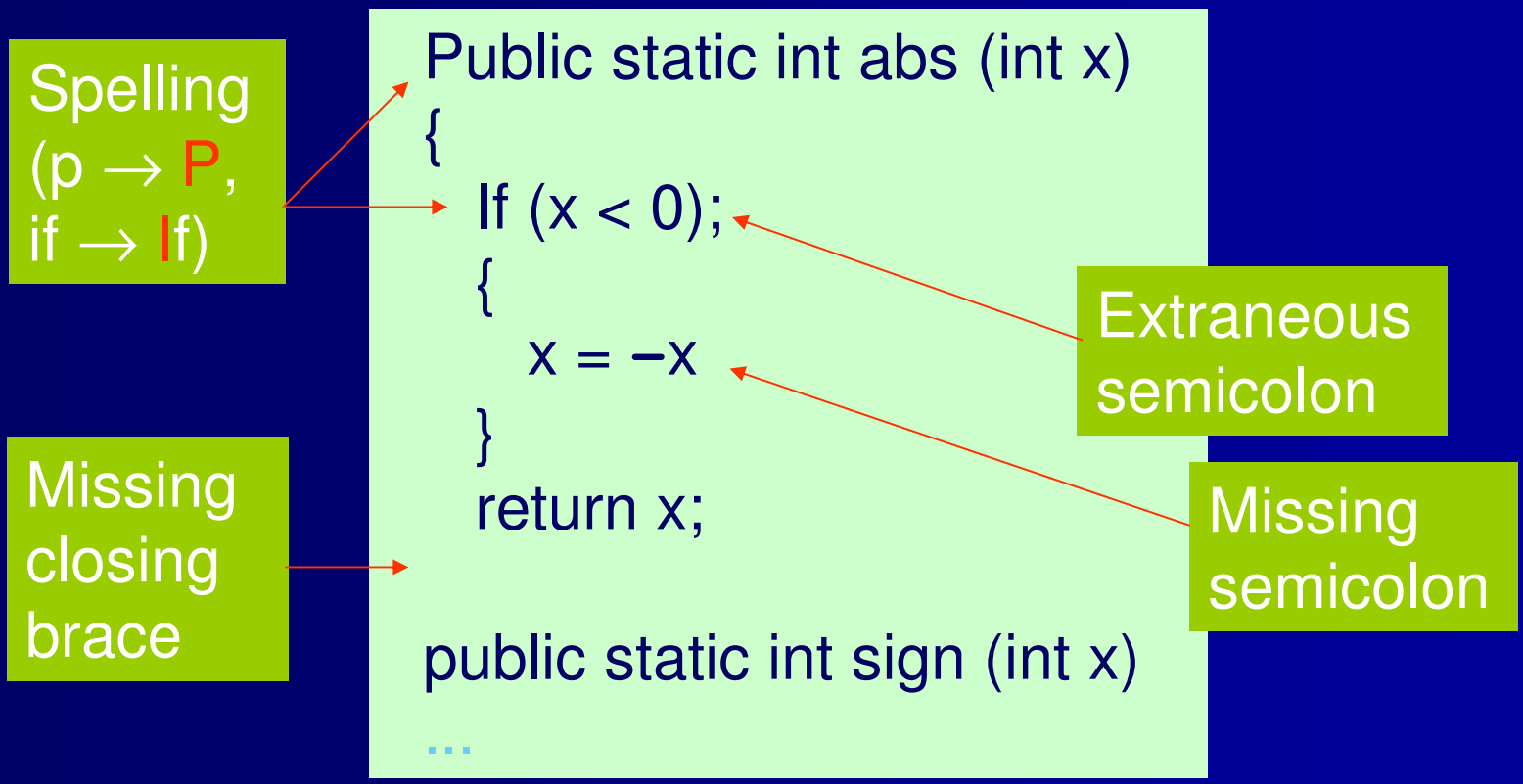
Syntax (cont'd)

- Pay attention to and check for:
  - matching braces { }, parentheses ( ), and brackets [ ]
  - missing and extraneous semicolons
  - correct symbols for operators

    +, -, =, <, <=, ==, ++, &&, etc.
  - correct spelling of reserved words, library names and programmer-defined names, including case

Syntax (cont'd)

- Common syntax errors:



Style

- Arrange code on separate lines; insert blank lines between fragments of code.
- Use comments.
- Indent blocks within braces.

Style (cont'd)

Before:

```
public boolean
moveDown(){if
(cubeY<6*cubeX)
{cubeY+=yStep;
return true;}else
return false;}
```

Compiles fine!

After:

```
public boolean moveDown()
{
    if (cubeY < 6 * cubeX)
    {
        cubeY += yStep;
        return true;
    }
    else
    {
        return false;
    }
}
```

Style (cont'd)

```
public void fill (char ch)
{
    int rows = grid.length, cols = grid[0].length;
    int r, c;

    for (r = 0; r < rows; r++)
    {
        for (c = 0; c < cols; c++)
        {
            grid[r][c] = ch;
        }
    }
}
```

Add blank lines for readability

Add spaces around operators and after semicolons

Blocks, Indentation

- Java code consists mainly of declarations and control statements.
- Declarations describe objects and methods.
- Control statement describe actions.
- Declarations and control statements end with a semicolon.
- No semicolon is used after a closing brace (except certain array declarations).

Blocks, Indentation (cont'd)

- Braces divide code into nested blocks.
- A block in braces indicates a number of statements that form one ***compound*** statement.
- Statements inside a block are indented, usually by two spaces or one tab.

Blocks, Indentation (cont'd)

```
public void fill (char ch)
{
   int rows = grid.length, cols = grid[0].length;
   int r, c;

   for (r = 0; r < rows; r++)
   {
      for (c = 0; c < cols; c++)
      {
         grid[r][c] = ch;
      }
   }
}
```

Review:

- Name as many uses of comments as you can.
- Explain the difference between syntax and style.
- Why is style important?
- Roughly how many reserved words does Java have?

Review (cont'd):

- Explain the convention for naming classes, methods and variables.
- Which of the following are syntactically valid names for variables: C, _denom_, my.num, AvgScore? Which of them are in good style?
- What can happen if you put an extra semicolon in your program?
- What are braces used for in Java?
- Is indentation required by Java syntax or style?

Objectives:

- Review primitive data types
- Learn how to declare fields and local variables
- Learn about arithmetic operators, compound assignment operators, and increment / decrement operators
- Learn how to avoid common mistakes in arithmetic

Variables

- A variable is a "named container" that holds a value.

- `q = 100 - q;`

  means:

  1. Read the current value of `q`
  2. Subtract it from 100
  3. Move the result back into `q`

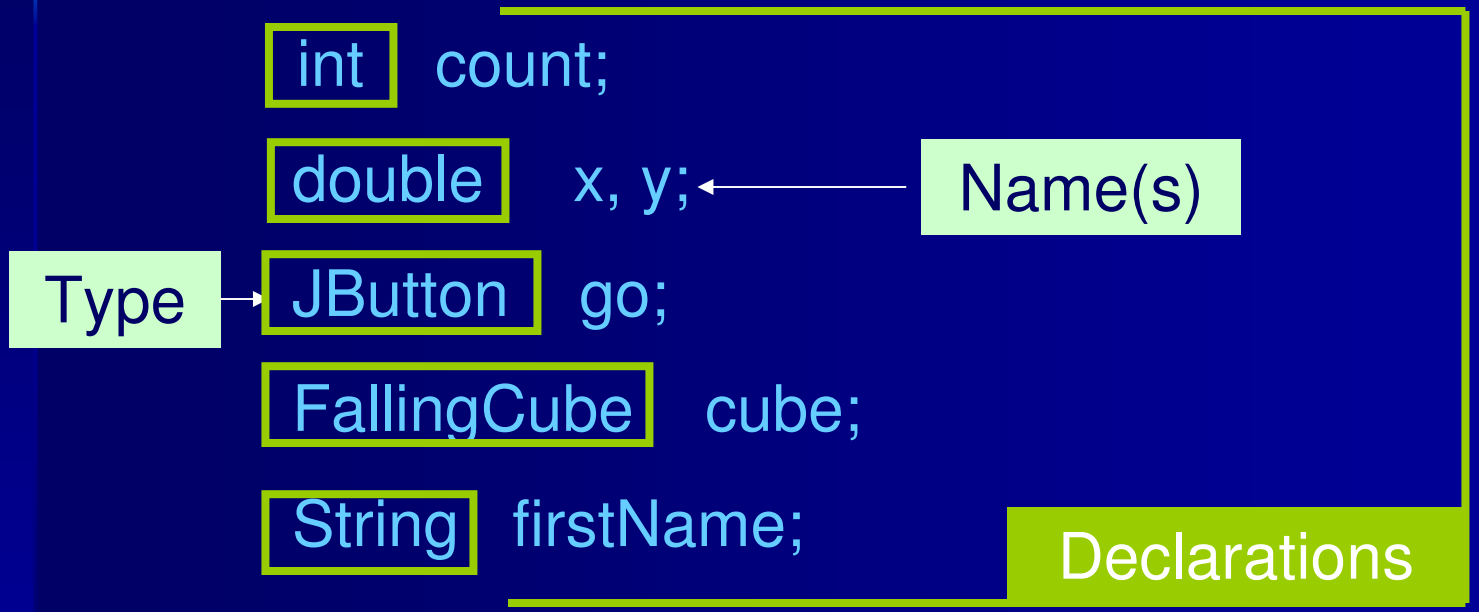
```
mov ax,q
mov bx,100
sub bx,ax
mov q,bx
```

Variables (cont'd)

- Variables can be of different data types: int, char, double, boolean, etc.
- Variables can hold objects; then the type is the class of the object.
- The programmer gives names to variables.
- Names usually start with a lowercase letter.

Variables (cont'd)

- A variable must be declared before it can be used:



Variables (cont'd)

- The assignment operator = sets the variable's value:

```
count = 5;
x = 0;
go = new JButton("Go");
firstName = args[0];
```

Assignments

- A variable can be initialized in its declaration:

```
int count = 5;
JButton go = new JButton("Go");
String firstName = args[0];
```

Declarations with initialization

Variables (cont'd)

- Each variable has a *scope* — the area in the source code where it is "visible."
- If you use a variable outside its scope, the compiler reports a syntax error.
- Variables can have the same name. **Caution:** use only when their scopes do not intersect.

```
{
   int  k;
   ...
}
```

```
{
   int  k;
   ...
}
```

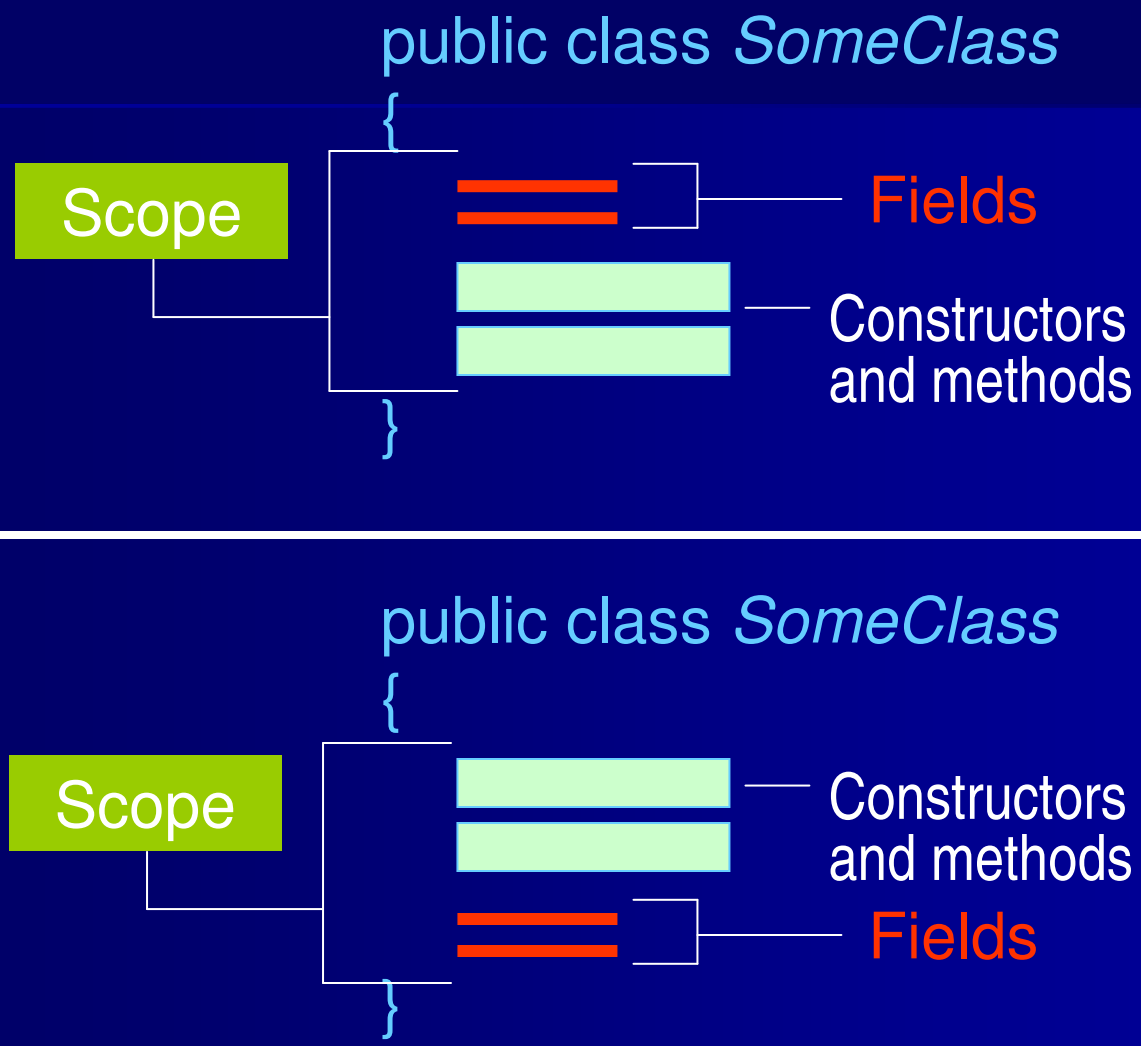
Fields vs. Local Variables

- Fields are declared outside all constructors and methods.
- Local variables are declared inside a constructor or a method.

Fields vs. Local Variables (cont'd)

- Fields are usually grouped together, either at the top or at the bottom of the class.
- The scope of a field is the whole class.

Fields


public class *SomeClass*
{
Scope
Fields
Constructors
and methods
}
public class *SomeClass*
{
Scope
Constructors
and methods
Fields
}

Variables (cont'd)

- Common mistakes:

```
public void SomeMethod (...)
{
   int x;
   ...
   int   x = 5;   // should be:  x = 5;
   ...
```

Variable declared twice — syntax error

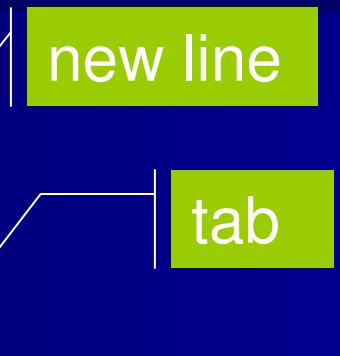
Primitive Data Types

- **int**
- **double**
- **char**
- **boolean**

- byte
- short
- long
- float

Used in
Java Methods

Constants




```
'A', '+', '\n', '\t'          // char
–99, 2010, 0                  // int
0.75, –12.3, 8., .5           // double
```

Constants (cont'd)

- Symbolic constants are initialized **final** variables:

```
private final int delay = 30;

private final double aspectRatio = 0.7;
```

Constants (cont'd)

- Why use symbolic constants?
  - easier to change the value throughout, if necessary
  - easy to change into a variable
  - more readable, self-documenting code
  - additional data type checking

Arithmetic

- Operators: **+**, **−**, **/**, *****, **%**
- The precedence of operators and parentheses work the same way as in algebra.
- **m % n** means the remainder when **m** is divided by **n** (e.g. 17 % 5 is 2).
- **%** has the same rank as **/** and *****
- Same-rank binary operators are performed in order from left to right.

Arithmetic (cont'd)

- The type of the result is determined by the types of the operands, not their values; this rule applies to all intermediate results in expressions.
- If one operand is an int and another is a double, the result is a double; if both operands are ints, the result is an int.

Arithmetic (cont'd)

- Caution: if a and b are ints, then a / b is truncated to an int...

```
17 / 5  gives 3
 3 / 4  gives 0
```

- ...even if you assign the result to a double:

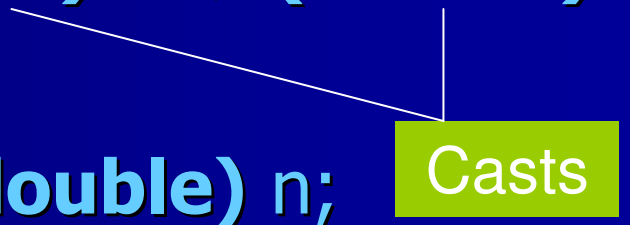
```
double ratio = 2 / 3;
```

The double type of the result doesn't help: ratio still gets the value 0.0.

Arithmetic (cont'd)

- To get the correct double result, use double constants or the *cast* operator:

```
double ratio = 2.0 / 3;

double ratio = 2 / 3.0;

double factor = (double) m / (double) n;

double factor = m / (double) n;

double r2 = k / 2.0;

double r2 = (double) k / 2;
```



Arithmetic (cont'd)

- Caution: the range for ints is from -2^{31} to $2^{31}-1$ (about $-2 \cdot 10^9$ to $2 \cdot 10^9$)
- Overflow is not detected by the Java compiler or interpreter

```
n =  8   10^n =  1000000000   n! =       40320
n =  9   10^n = 10000000000   n! =      362880
n = 10   10^n = 1410065408    n! =     3628800
n = 11   10^n = 1215752192    n! =    39916800
n = 12   10^n = -727379968    n! =   479001600
n = 13   10^n = 1316134912    n! =  1932053504
n = 14   10^n =  276447232    n! =  1278945280
```

Arithmetic (cont'd)

- Use compound assignment operators:

```
a = a + b;  ⟶ a += b;
a = a - b;  ⟶ a -= b;
a = a * b;  ⟶ a *= b;
a = a / b;  ⟶ a /= b;
a = a % b;  ⟶ a %= b;
```

- Use increment and decrement operators:

```
a = a + 1;  ⟶ a++;
a = a - 1;  ⟶ a--;
```

Do not use these in larger expressions

Review:

- What is a variable?
- What is the type of variable that holds an object?

Review (cont'd):

- What is the range for ints?
- When is a cast to double used?
- Given

```
double dF = 68.0;
double dC = 5 /  9 * (dF – 32);
```

  what is the value of dC?
- When is a cast to int used?
- Should compound assignment operators be avoided?