Object-Oriented Programming I

Java Variables and Types

Dept of Computer Science
University of Maryland College Park

This material is based on material provided by Ben Bederson, Bonnie Dorr, Fawzi Emad, David Mount, Jan Plane
Overview

- Variables
- Types
Variables

- **What is a variable?**
  - The name of some **location of memory** used to hold a data value.
  - **Different types** of data require **different amounts** of memory. The compiler’s job is to reserve sufficient memory.
  - Variables need to be declared once
  - Variables are **assigned** values, and these values may be changed later
  - Each variable has a type, and **operations can only be performed between compatible types**
  - Java’s primitive types:

- **Example**

  ```java
  int width = 3;
  int height = 4;
  int area = width * height;
  
  width = 6;
  area = width * height;
  ```

<table>
<thead>
<tr>
<th>width</th>
<th>height</th>
<th>area</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>24</td>
</tr>
</tbody>
</table>
Valid Variable Names: These rules apply to all Java names, or identifiers, including methods and class names

- **Starts with:** a letter (a-z or A-Z), dollar sign ($), or underscore (_)
- **Followed by:** zero or more letters, dollar signs, underscores, or digits (0-9).
- Uppercase and lowercase are different (total ≠ Total ≠ TOTAL)
- Cannot be any of the reserved names. These are special names (keywords) reserved for the compiler. Examples:
  
  class, float, int, if, then, else, do, public, private, void, ...
Good Variable Names

- **Choosing Good Names** \(\rightarrow\) Not all valid variable names are good variable names.
- Some guidelines:
  - Do not use `\$` (it is reserved for special system names.)
  - Avoid names that are identical other than differences in case (total, Total, and TOTAL).
  - Use meaningful names, but avoid excessive length.
    - `crItm` \(\rightarrow\) Too short
    - `theCurrentItemBeingProcessed` \(\rightarrow\) Too long
    - `currentItem` \(\rightarrow\) Just right
- **Camel case** capitalization style
- In Java we use camel case
  - Variables and methods start with lower case
    - `dataList2` `myFavoriteMartian` `showMeTheMoney`
  - Classes start with uppercase
    - `String` `JOptionPane` `MyFavoriteClass`
Valid/Invalid Identifiers

Valid:
- $$
- R2D2
- INT okay. “int” is reserved, but case is different here
- _dogma_95_
- riteOnThru
- SchultzVonWienerschnitzelIII

Invalid:
- 30DayAbs starts with a digit
- 2 starts with a digit
- pork&beans `&’ is illegal
- private reserved name
- C-3PO `-' is illegal
Java’s basic data types:

Integer Types:
- byte 1 byte Range: -128 to +127
- short 2 bytes Range: roughly -32 thousand to +32 thousand
- int 4 bytes Range: roughly -2 billion to +2 billion
- long 8 bytes Range: Huge!

Floating-Point Types (for real numbers)
- float 4 bytes Roughly 7 digits of precision
- double 8 bytes Roughly 15 digits of precision

Other types:
- boolean 1 byte {true, false} (Used in logic expressions and conditions)
- Char 2 bytes A single (Unicode) character

String is not a primitive data type (they are objects)
Specifying constants: (also called literals) for primitive data types.

Integer Types:

- **byte**
- **short**
- **int**
- **long** (Same as above, but followed by ‘L’ or ‘l’: -1394382953L)

Floating-Point Types:

- **double** (Two allowable forms:)
  - Decimal notation: 3.14159  -234.421  0.0042  -43.0
  - Scientific notation: (use E or e for base 10 exponent)
    
    \[
    3.145E5 = 3.145 \times 10^5 = 314500.0
    \]
    
    \[
    1834.23e-6 = 1834.23 \times 10^{-6} = 0.00183423
    \]

- **float** (Same as double, but followed by ‘f’ or ‘F’)
  - 3.14159F  -43.2f

Note: By default, integer constants are **int**, unless ‘L’/‘l’ is used to indicate they are **long**. Floating constants are **double**, unless ‘F’/‘f’ is used to indicate they are **float**.
Character and String Constants

- **char constants**: Single character enclosed in single quotes (‘...’) including:
  - punctuation symbols: ‘*’, ‘#’, ‘@’, ‘$’ (except single quote and backslash ‘\’)
  - escape sequences: (see below)

- **String constants**: Zero or more characters enclosed in double quotes (“...”) (same as above, but may not include a double quote or backslash)

- **Escape sequences**: Allows us to include single/double quotes and other special characters:
  - " double quote
  - \n new-line character (start a new line)
  - ‘ single quote
  - \t tab character
  - \ \ backslash

Examples: char x = ‘\’’ → (x contains a single quote)

  "\\"Hi there!\\"" → "Hi there!"

  "C:\\WINDOWS" → C: \WINDOWS

System.out.println( "Line 1\nLine 2" ) prints

```
Line 1
Line 2
```
Data Types and Variables

- **Java → Strongly-type language**
- **Strong Type Checking →** Java checks that all expressions involve compatible types.

```
int x, y;  // x and y are integer variables
double d; // d is a double variable
String s;  // s is a string variable
boolean b; // b is a boolean variable
char c;    // c is a character variable
```

```
x = 7;     // legal (assigns the value 7 to x)
b = true;  // legal (assigns the value true to b)
c = ‘#’;   // legal (assigns character # to c)
s = “cat” + “bert”; // legal (assigns the value “catbert” to s)
d = x - 3; // legal (assigns the integer value 7 - 3 = 4 to double d)
```

```
b = 5;     // illegal! (cannot assign int to boolean)
y = x + b; // illegal! (cannot add int and boolean)
c = x;    // illegal! (cannot assign int to char)
```
Numeric Operators

- **Arithmetic Operators:**
  - Unary negation: \(-x\)
  - Multiplication/Division: \(x \times y \quad x/y\)
    - Division between integer types **truncates** to integer: \(23/4 \rightarrow 5\)
    - \(x \% y\) returns the **remainder** of \(x\) divided by \(y\): \(23\%4 \rightarrow 3\)
    - Division with real types yields a real result: \(23.0/4.0 \rightarrow 5.75\)
  - Addition/Subtraction: \(x+y \quad x-y\)

- **Comparison Operators:**
  - Equality/Inequality: \(x == y \quad x != y\)
  - Less than/Greater than: \(x < y \quad x > y\)
  - Less than or equal/Greater than or equal: \(x <= y \quad x >= y\)

These comparison operators return a **boolean** value: **true** or **false**.
Common String Operators

- **String Concatenation**: The `+` operator **concatenates** (joins) two strings.
  - “von” + “Wienerschnitzel” → “vonWienerschnitzel”
  - When a string is concatenated with another type, the other type is first evaluated and **converted** into its string representation.
    - (8*4) + “degrees” → “32degrees”
    - (1 + 2) + “5” → “35”

- **String Comparison**: Strings should not be compared using the above operators (==, <=, <, etc). Let s and t be strings.
  - s.equals(t) → returns true if s equals t
  - s.length() → returns length
  - s.compareTo(t) → compares strings **lexicographically** (dictionary order)
    - result < 0 → if s is less than t
    - result == 0 → if s is equal to t
    - result > 0 → if s is greater than t

Note: Concatenation does not add any space.
Examples

- Let’s take a look at some examples
- See code distribution