Object-Oriented Programming I

Java Variables and Types

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

- Variables
- Types
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**

Example

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

- **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 ➔ 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 ➔ Too short
  - theCurrentItemBeingProcessed ➔ Too long
  - currentItem ➔ 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
SchultzieVonWienerschnitzelIII

Invalid:

30DayAbs starts with a digit
2 starts with a digit
pork&beans ‘&’ is illegal
private reserved name
C-3PO ‘-’ is illegal
Primitive Data Types

- **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

Optional sign and digits (0-9): 12 -1 +234 0 1234567

Same as above, but followed by ‘L’ or ‘l’: -1394382953L

Floating-Point Types:
- double
- float

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
- 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.

```java
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: \(x \times y\), \(x/y\)
    - 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: \(x+y\), \(x-y\)

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

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

  \[(8 \times 4) + \text{“degrees”} \rightarrow \text{“32degrees”} \quad \text{and} \quad (1 + 2) + \text{“5”} \rightarrow \text{“35”}\]

- **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