Object-Oriented Programming I

Java Variables and Types

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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

• Example

```java
int width = 3;
int height = 4;
int area = width * height;
width = 6;
textarea = 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, ...
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
  • crltm ➔ 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)
Numeric Constants (Literals)

- **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: \(x \cdot y \quad x/y\)
    - 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
Examples

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