



CMSC 131

Object-Oriented Programming I

Java Variables and Types

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Overview

- ▶ Variables
- ▶ Types

Variables

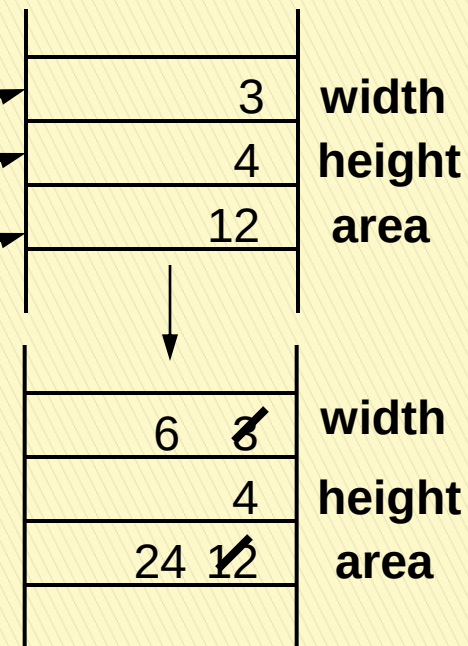
► What is a variable?

- 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**

◦ Example

```
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)

Numeric Constants (Literals)

- **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 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

Avoid this lowercase L. It looks too much like the digit '1'

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:
 - **letters and digits:** 'A', 'B', 'C', ..., 'a', 'b', 'c', ..., '0', '1', ..., '9'
 - **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

\ ' single quote

\\ backslash

\n new-line character (start a new line)

\t tab character

- ▶ **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: $x * y$ 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"

Note: Concatenation does not add any space

- When a string is concatenated with another type, the other type is first evaluated and **converted** into its string representation

$(8*4) + \text{"degrees"} \rightarrow \text{"32degrees"}$

$(1 + 2) + \text{"5"} \rightarrow \text{"35"}$

- ▶ **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

Examples

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