Variable & Types

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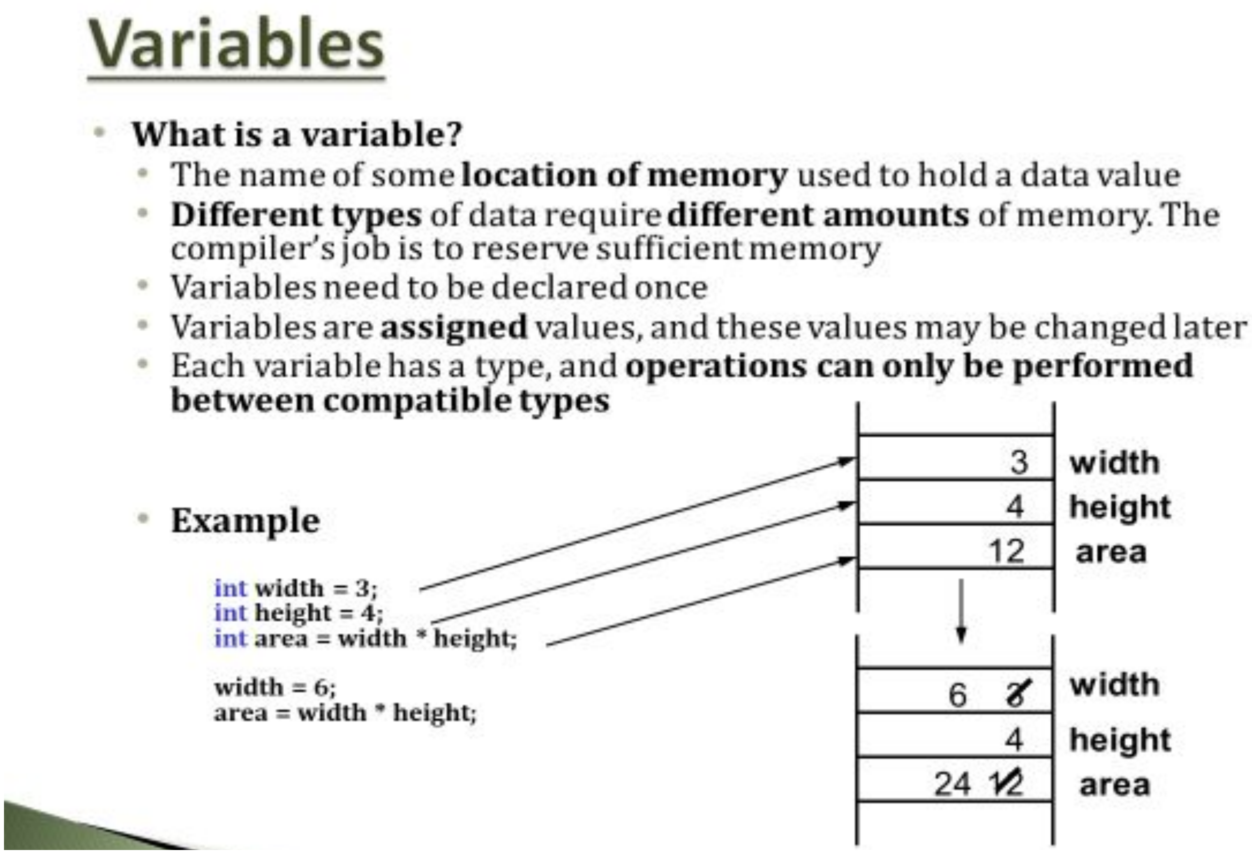
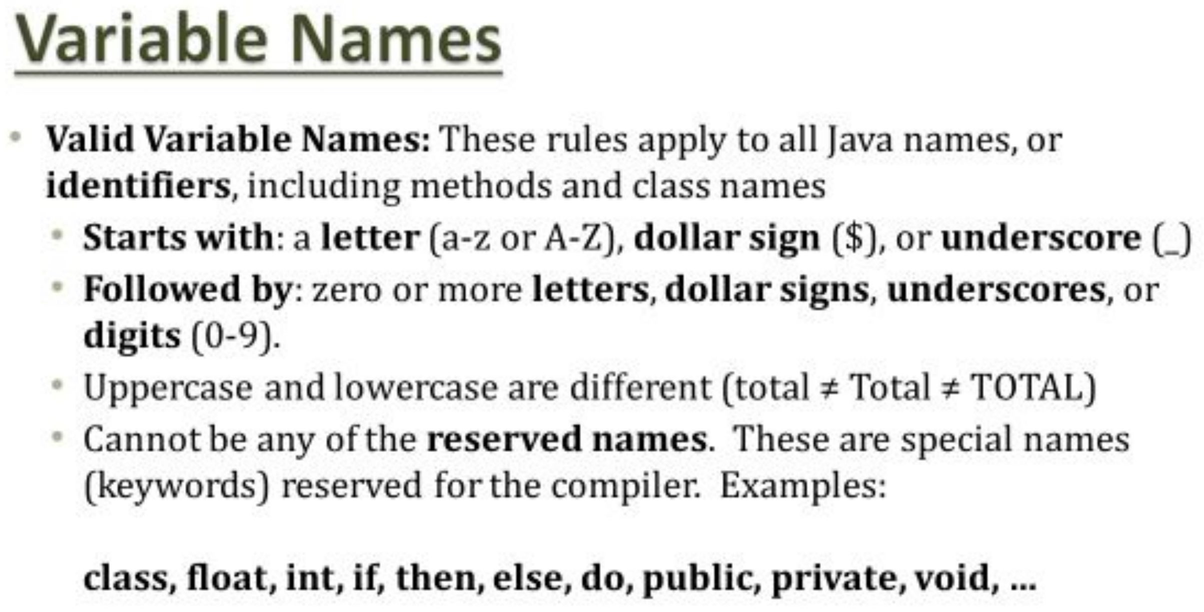


Variables

- **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**

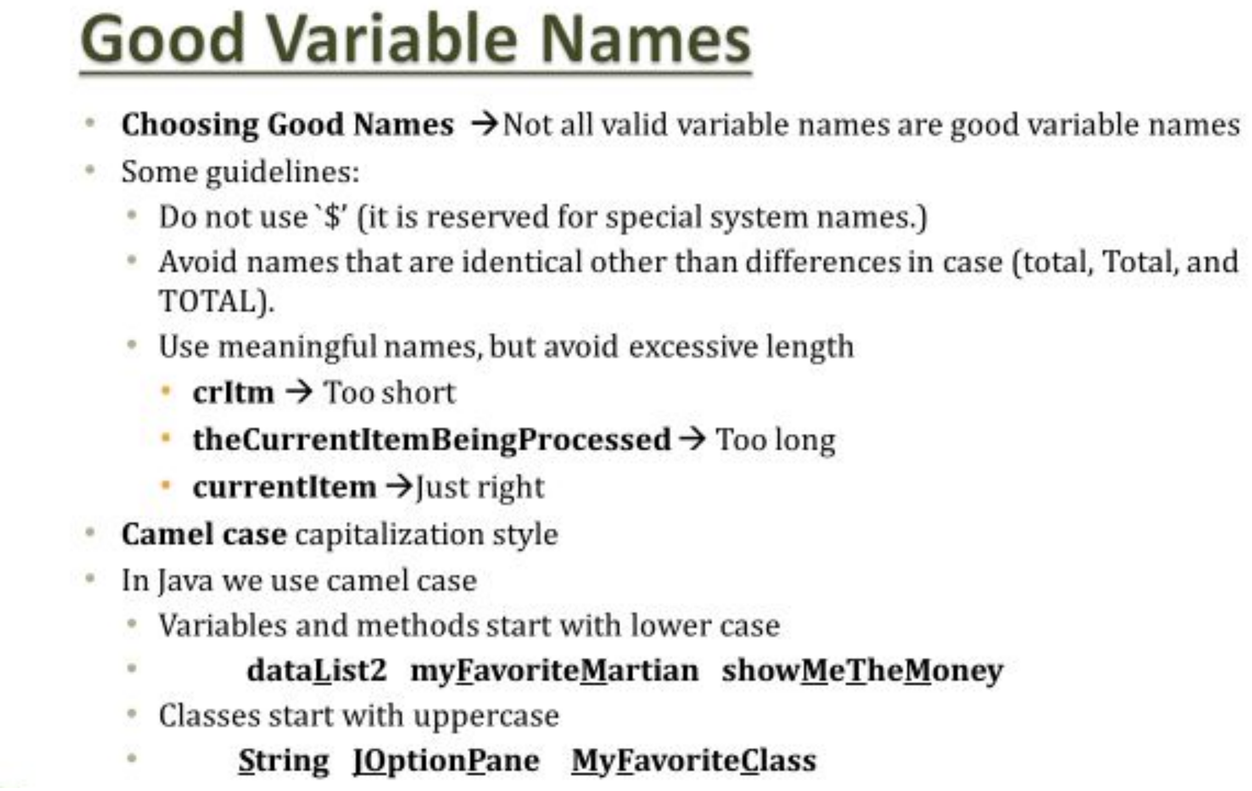
```
int width = 3;
int height = 4;
int area = width * height;

width = 6;
area = width * height;
```



Variable Names

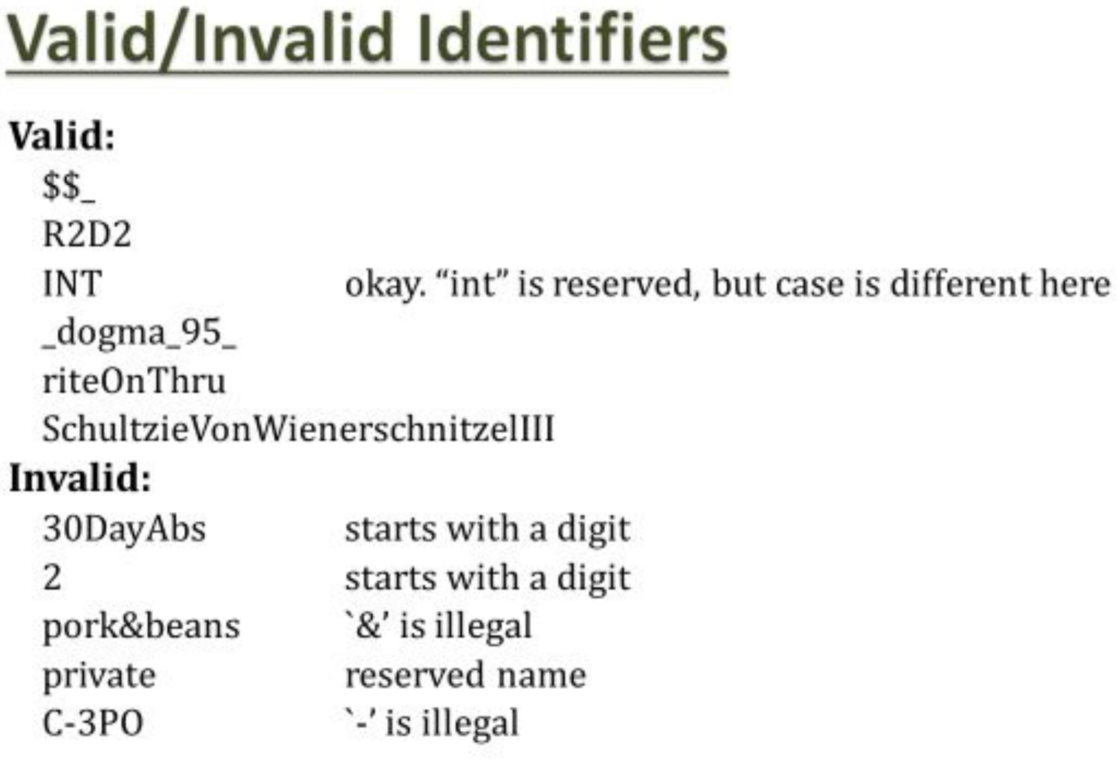
- **Valid Variable Names:** These rules apply to all Java names, or **identifiers**, including methods and class names
  - **Starts with**: a **letter** (a-z or A-Z), **dollar sign** ($), or **underscore** (_)
  - **Followed by**: zero or more **letters**, **dollar signs**, **underscores**, or **digits** (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**



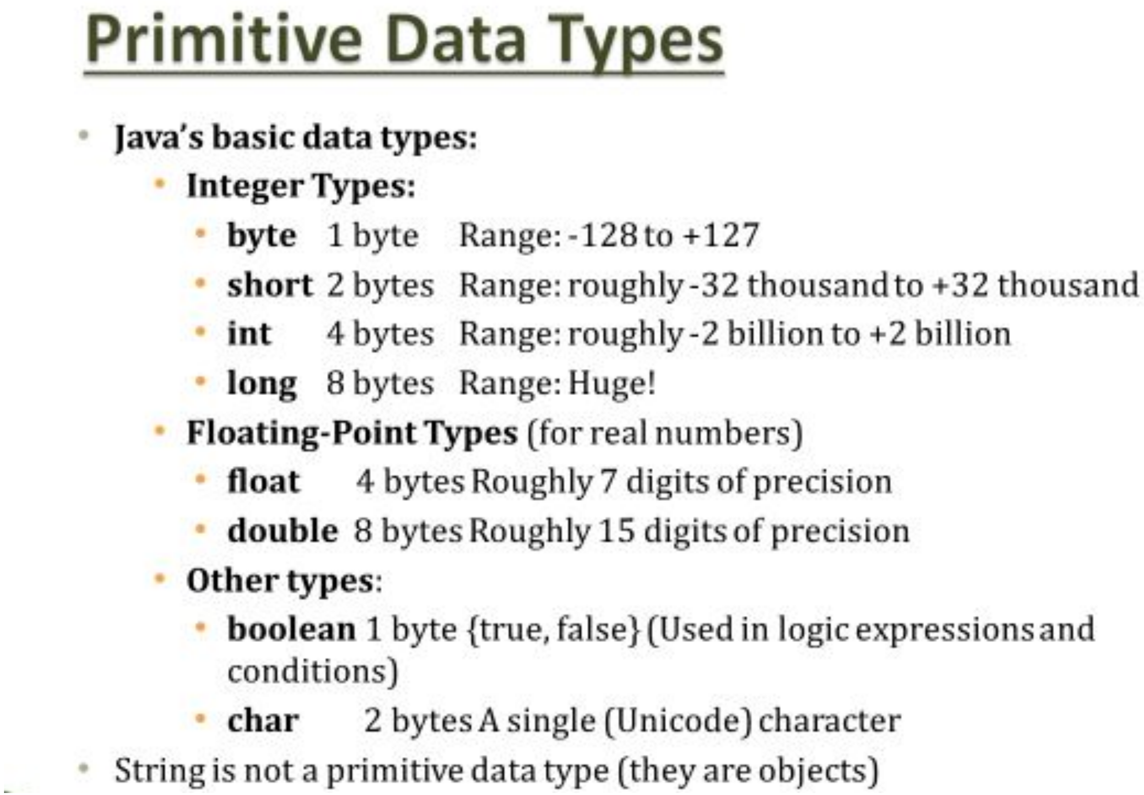
Valid/Invalid Identifiers

Valid:

$$_	
R2D2	
INT	okay. “int” is reserved, but case is different here
_dogma_95_	
riteOnThru	
SchultzieVonWienerschnitzelIII	

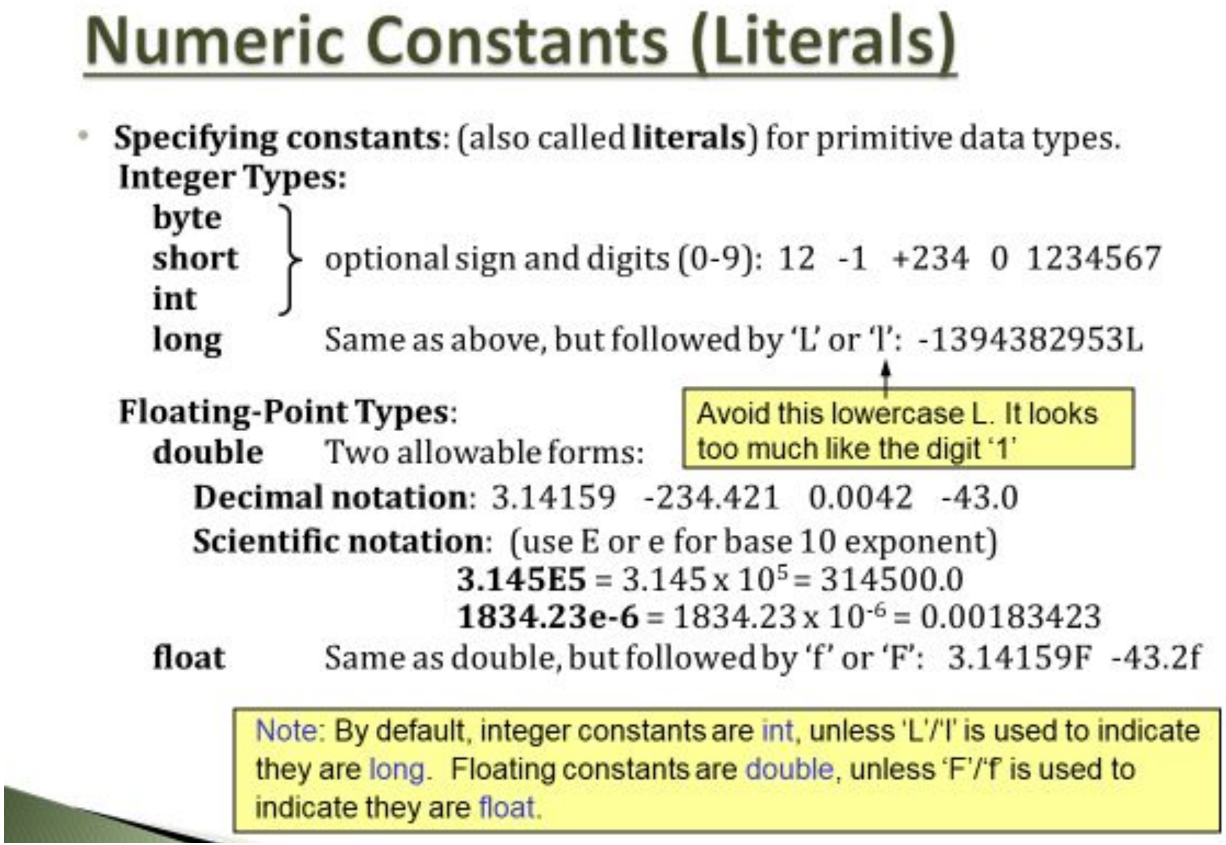
Invalid:

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

long Same as above, but followed by 'L' or 'l': -1394382953L

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

Floating-Point Types:

double Two allowable forms:

Decimal notation: 3.14159 -234.421 0.0042 -43.0

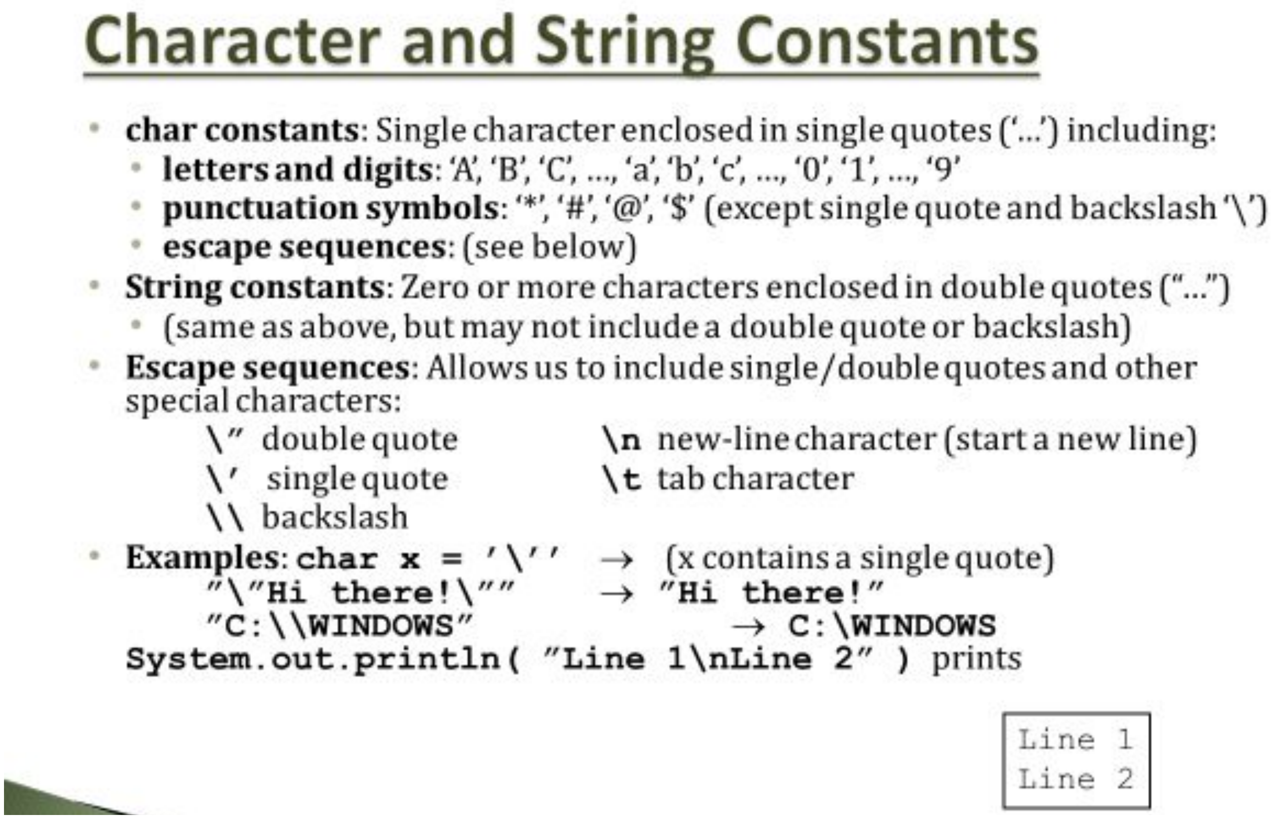
Scientific notation: (use E or e for base 10 exponent)

3.145E5 = 3.145 x 10^5 = 314500.0

1834.23e-6 = 1834.23 x 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

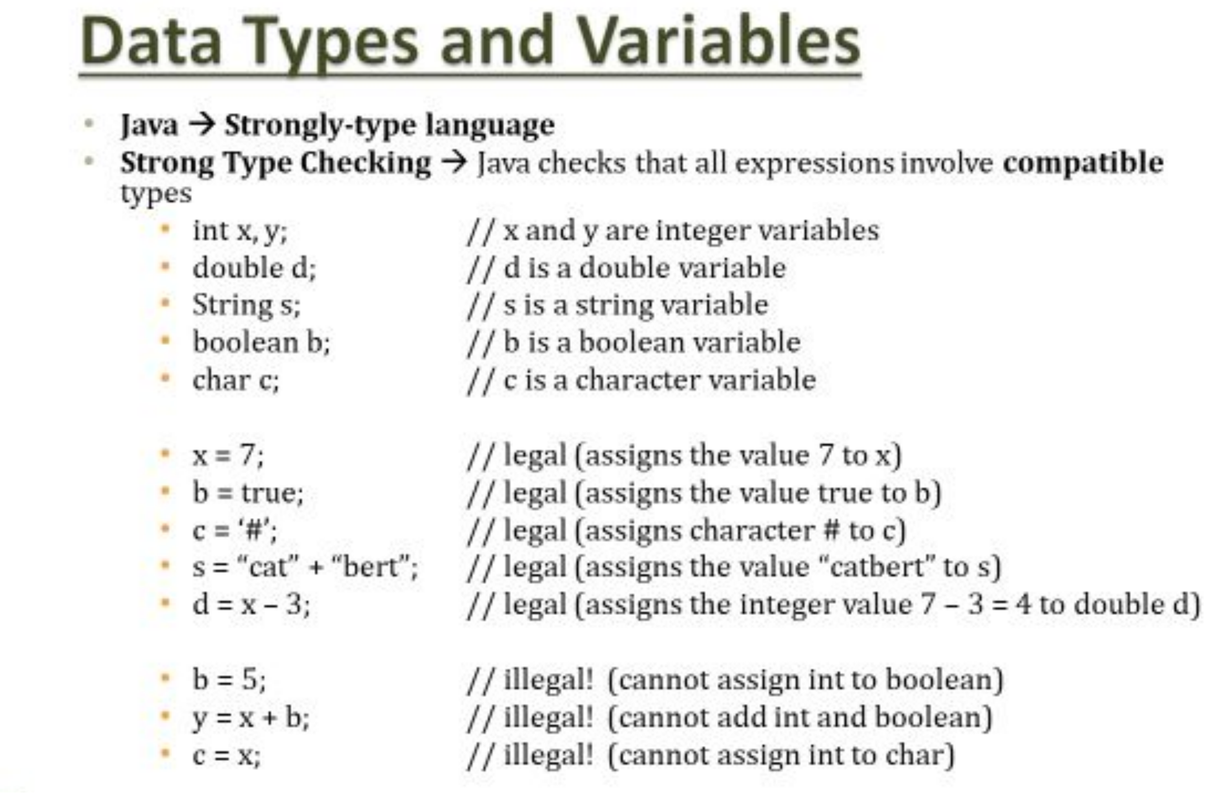
- **char constants**: Single character enclosed in single quotes (‘…’) including:
  - **letters and digits**: ‘A’, ‘B’, ‘C’, …, ‘a’, ‘b’, ‘c’, …, ‘0’, ‘1’, …, ‘9’
  - **punctuation symbols**: ‘*’, ‘#’, ‘@’, ‘$’ (except single quote and backslash ‘\’)
  - **escape sequences**: (see below)
- **String constants**: 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	`\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
```

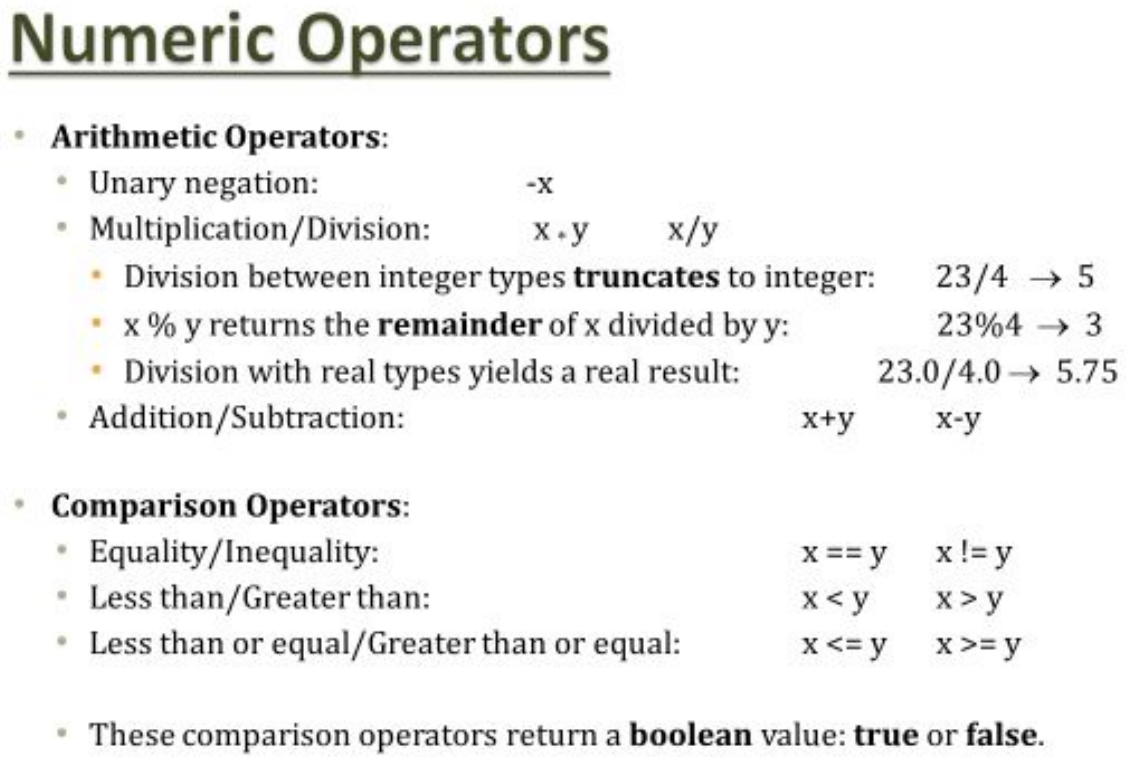


Data Types and Variables

- **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)

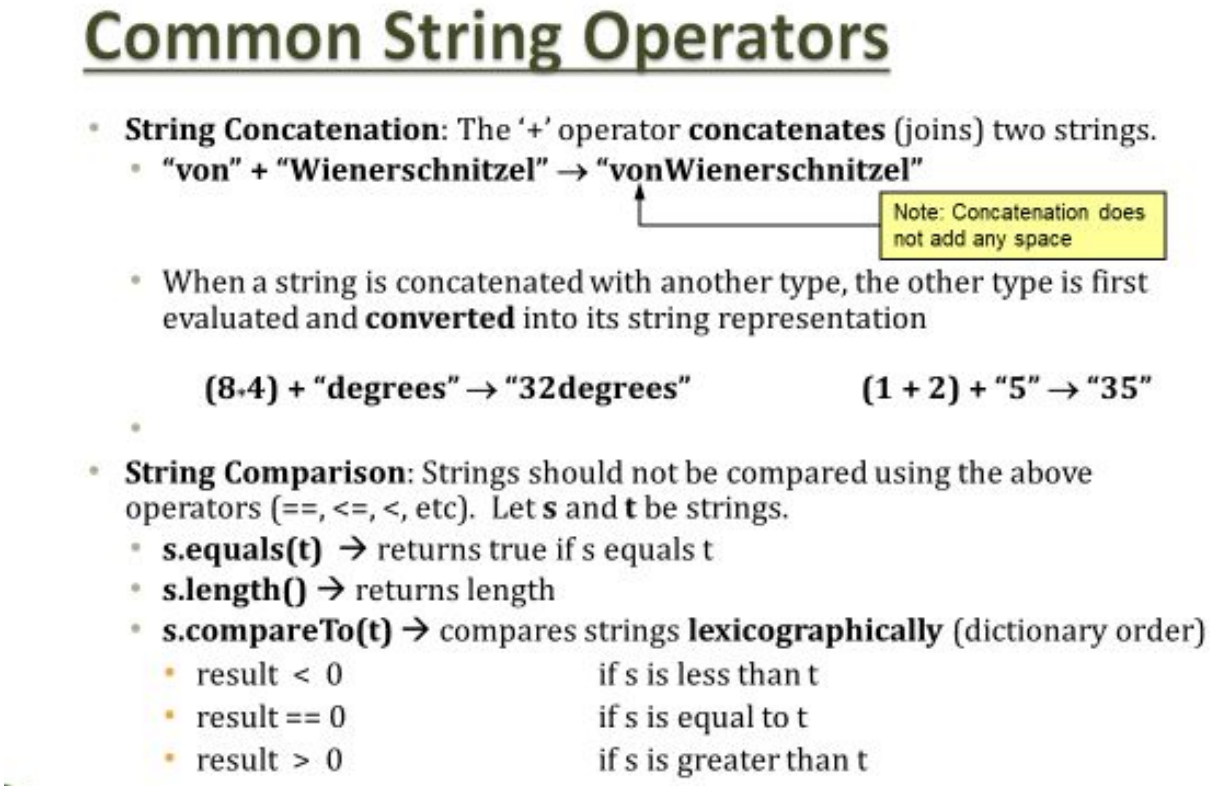


Numeric Operators

- **Arithmetic Operators**:
  - Unary negation: -x
  - Multiplication/Division: x * y x/y
    - Division between integer types **truncates** to integer: 23/4 → 5
    - x % y returns the **remainder** of x divided by y: 23%4 → 3
    - Division with real types yields a real result: 23.0/4.0 → 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) + "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

References

- This material is based on material provided by Ben Bederson, Bonnie Dorr, Fawzi Emad, David Mount, Jan Plane, Dept of Computer Science, University of Maryland College Park

Be strong, you
never know who
you are inspiring