Intro to Java

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Overview

- 1991: James Gosling at Sun Microsystems developed first version of Java
- intended for embedded systems (home appliances e.g. washing machines, TVs).
  - complex: various processors make it difficult to make portable, and manufacturers wouldn't want to develop expensive compilers
  - used two-step translation:

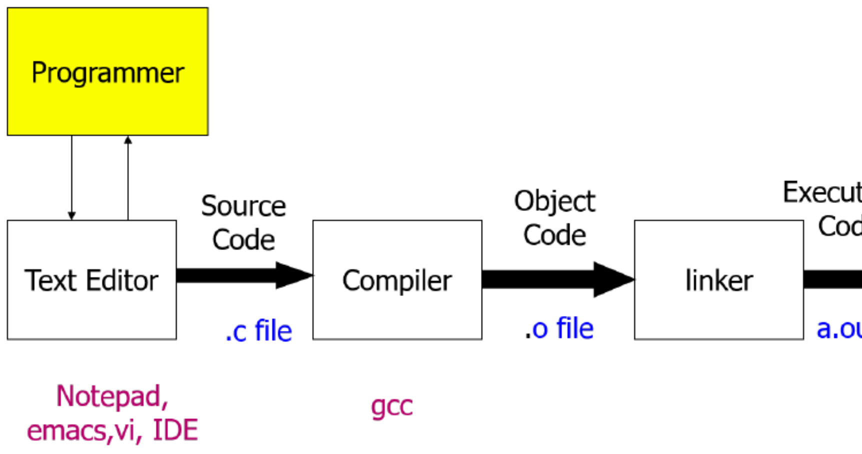
        * translate to an intermediate language, *Java byte-code* which is the same for all appliances
        * small, easy-to-write interpreter converts to machine language

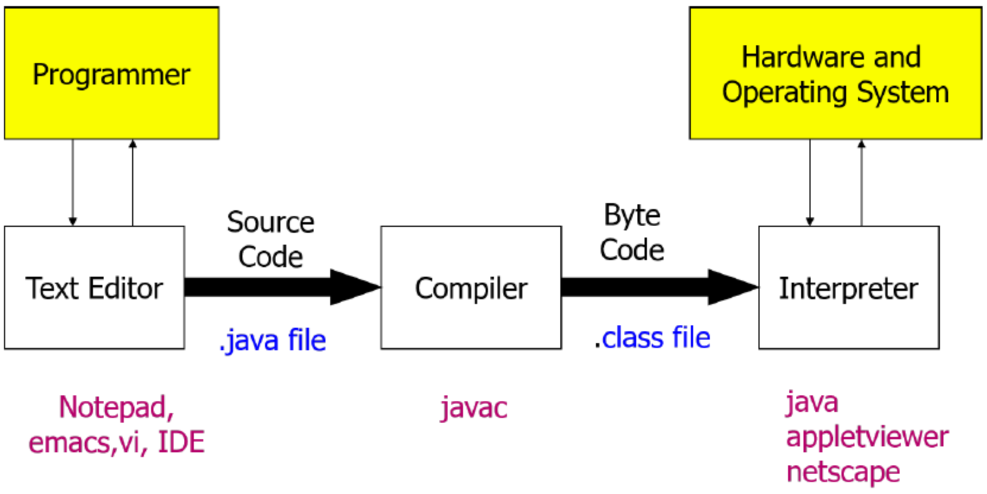
- Oracle now owns Java
- *byte code*: computer-readable program
- *object-oriented programming*: Java is an OOP language
    - objects
    - methods: actions an object can take
    - class: collects objects of the same type
- *Java application program*: class with a `main` method
- *application*: meant to be run by computer, c.f. applet
    - has a `main` method
    - can be invoked from command line using Java interpreter
- *applets*: little Java application;
    - no `main` method
    - program embedded in a web page
    - run by Java-enabled web browser
    - always use a window interface

Java Features

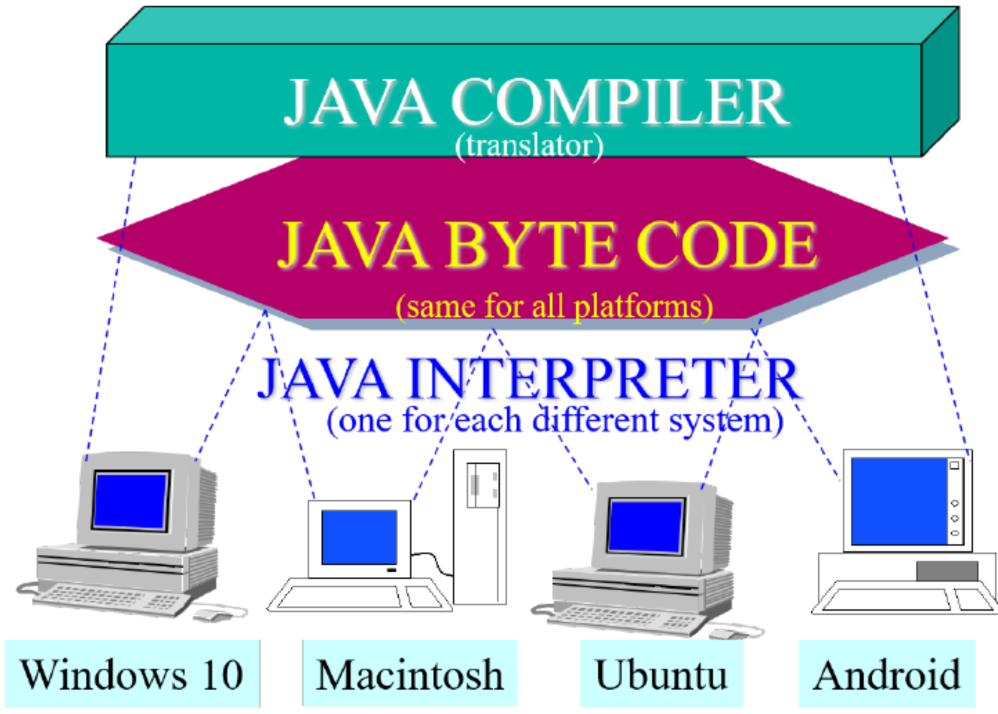
1. Compiled and interpreted

    - Compiled language (e.g. C)





- Java
- Java is compiled to bytecode, then interpreted to machine code
- porting Java to a new system involves writing an interpreter



2. Platform independent
3. Object oriented

Hello world!

```java
// HelloWorld.java: Display "Hello World!" on the screen
import java.lang.*;              // imports java.lang.* package; optional
public class HelloWorld{         // name of class must be same as filename
    public static void main(String args[]) {    // standalone program must have main defined
        // args[] contain command-line arguments

        System.out.println("Hello World!");     // out is an object
        return;                                 // optional; usually excluded
    }
}
```

Compiling and running

```
# compile
javac HelloWorld.java
# run
java HelloWorld
```

Comments

- `/* */`: multi-line comments
- `//`: single line comments
- `/** */`: documentation comments

Command Line args

- accessed by `args[]`

Java vs C

- Java: oop language; C: procedural language
- Java:
    - no **`goto`**, `sizeof`, `typedef`
    - no structures, unions
    - no explicit pointer type

- no preprocessor: (#`define`, #`include`, #`indef`)
- safe, well-define: memory is managed by VM not programmer

identifiers

- *rules*:
  - must not start with a digit
  - all charactes must in {letters, digits, underscore}
  - can theoretically be of any length
  - are case-sensitive
- *conventions*:
  - `camelCase`:
    * variables, methods, objects: start with lower case, word boundaries uppercase, remaining characters are digits and lower case letters
  - classes: start with upper case letter; otherwise camelCase
- *keywords, reserved words*: cannot be used as identifiers
  - e.g. **`public`**, **`class`**, **`void`**, **`static`**
- *pre-defined identifiers*: defined in libraries required by Java standard packages e.g. `System`, `String`, `println`
  - can be redefined but can be confusing/dangerous

Data types

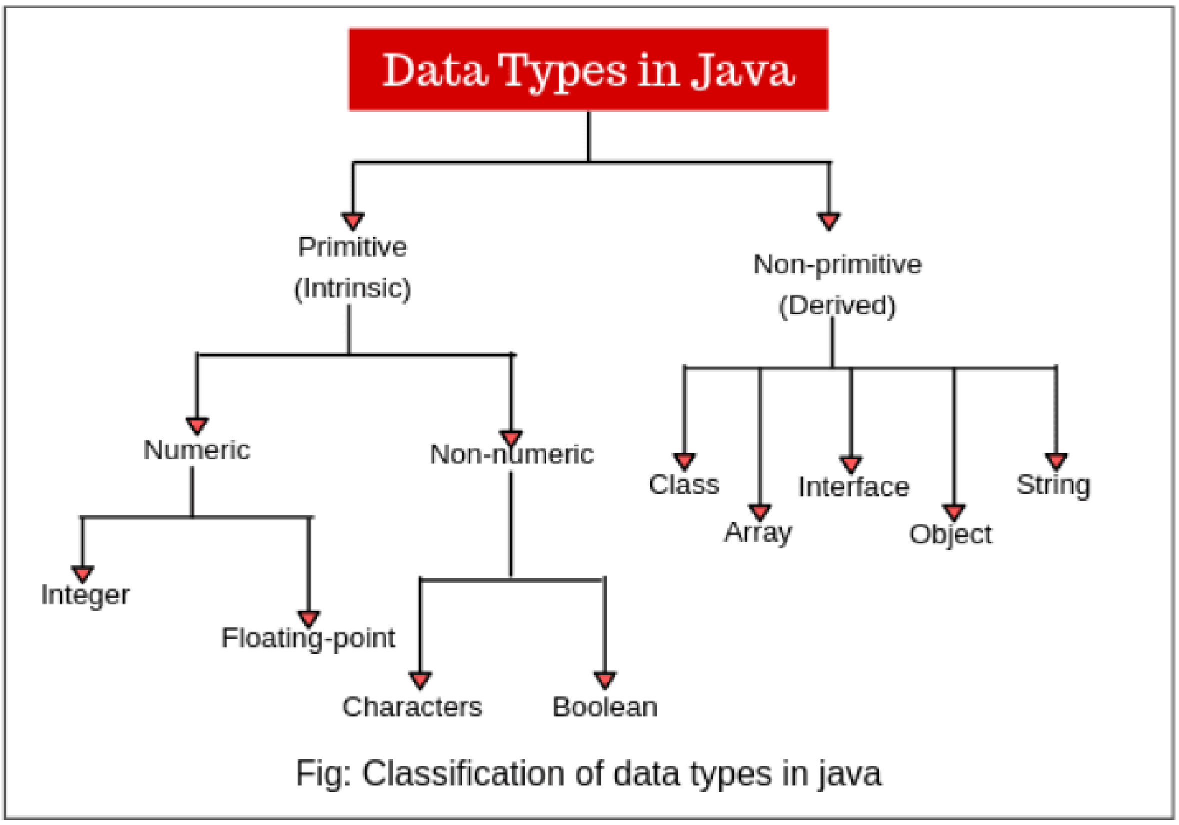


Figure 1: java_data_types

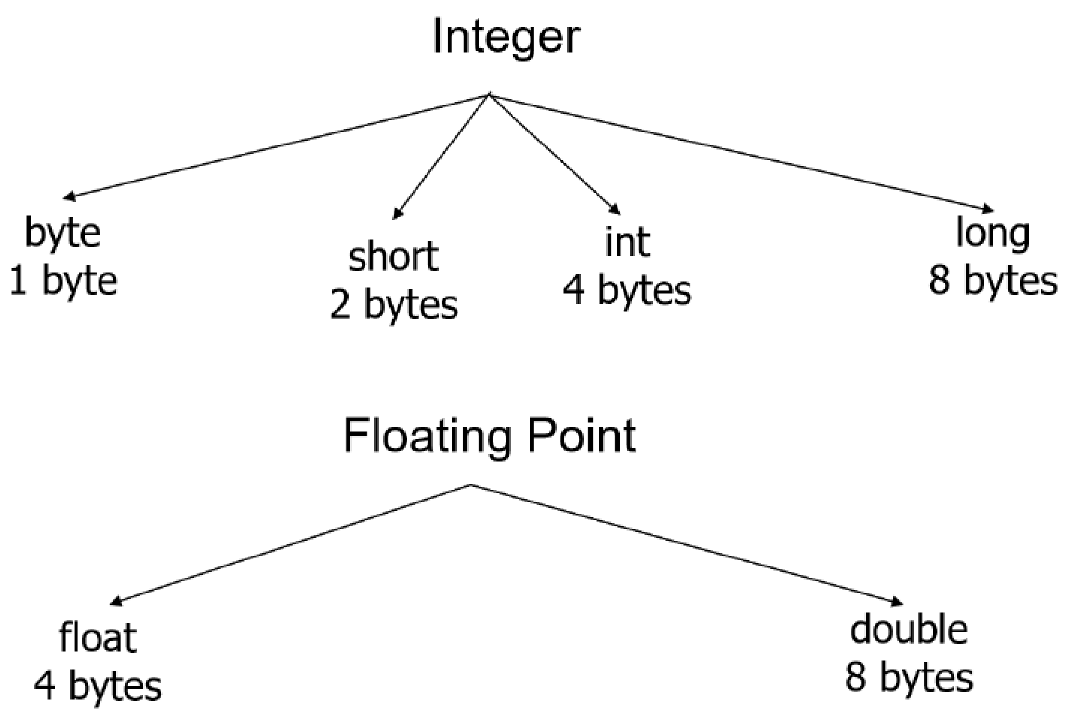


Figure 2: java_numeric_data_types

- floating point numbers are treated as double-precision unless forced by appending `f` or `F` to the number e.g. `float a = 2.3F;`
- `boolean` type: `true, false`

Variables

- must be *declared* and *initialised* before use:

```
<type> <variable name> = <initial value>;
```

- a value of any type in the list can be assigned to a variable to its right:

```
byte -> short -> int -> long -> float -> double
char -> int
```

- explicit *type cast* required to assign a value of one type to variable whose type appears to left on above list (e.g. `double` to `int`)

```java
int x = 2.99; // invalid assignment
int y = (int)2.99; // valid assignment; x will be 2
```

- `int` variable cannot be assigned to `boolean` variable or vice-versa

Variable classes

1. *instance*
2. *static* (or *class*)
3. *local*: define in a Java method

Constants

- read only values; do not change during execution
- declared with `final` keyword
- convention: upper case letters with words separated by `_`
- data type need to be explicitly specified

```java
final int MAX_LENGTH = 420;
```

Operators

Arithmetic

Operator	Meaning
`+`	addition, unary plus
`-`	subtraction, unary minus
`*`	multiplication
`/`	division
`%`	modulo division

- *mixed-mode arithmetic expression*: if one operand is real and other is integer
  - integer operand converted to real, real arithmetic performed

Relational

Operator	Meaning
<	Is less than
<=	Is less than or equal to
>	
>=	Is greater than or equal to
==	Is equal to
!=	Is not equal to

- result of relational operator is **`boolean`**

Logical

Operator	Meaning
&&	AND
||	OR
!	NOT

Bitwise

operator	Meaning
&	bitwise AND
!	bitwise OR
^	bitwise exclusive OR
~	one’s compliment
<<	shift Left
>>	shift Right

operator	Meaning
`>>>`	shift Right with zero fill

Other operators

- increment: `++`
- decrement: `--`
- conditional: `exp1 ? exp2: exp3`

Mathematical functions

- `Math` class in `java.lang` package defines mathemtical functions via: `Math.method_name();`
  - e.g. `sin, cos, log`

Control flow

Branching

- **`if-else`**:

```java
if (boolean_expression) {
  // statements
} else if (boolean_expression_2) {
  // statements
} else {
  // otherwise statements
}
```

- **`switch`**

```java
switch (control expression)
{
    case Case_Label_1:
        Statement_Sequence_1
        break;
    case Case_Label_2:
        Statement_Sequence_2
        break;
    case Case_Label_n:
        Statement_sequence_n
        break;
    default:
        Default_Statement_Sequence
        break;
}
```

- two way decision expression: `expression ? value_true : value_false`

Loops

- **`while`**

```
while (condition) {
    // statements to execute
}
```

- **`do-while`**

```
do {
    // statements to execute
} while (expression)
```

}- **`for`**

```
for (initialise_expr; terminate_expr; update_expr) {
    // statements to execute
}
```

- **`break`**: exits **`while`**, **`do`**, **`for`** loop
- **`continue`**: skips rest of statements in loop