Java™ Crash Course

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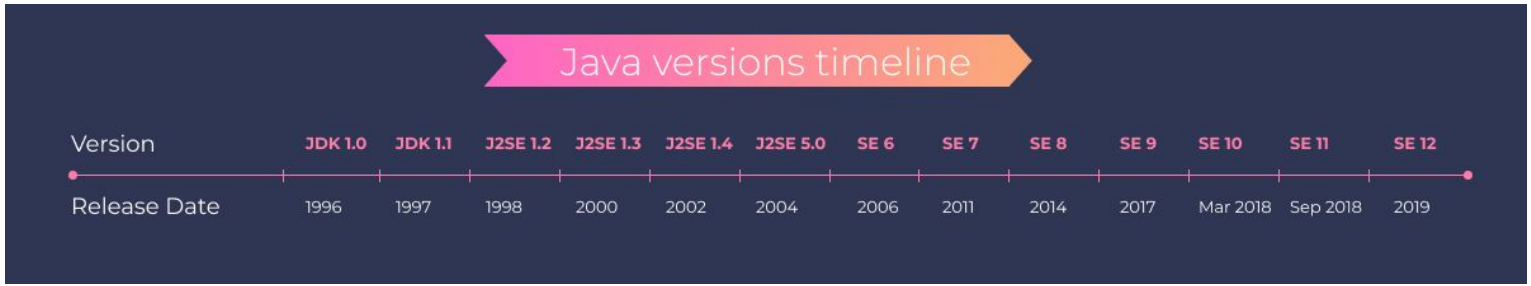
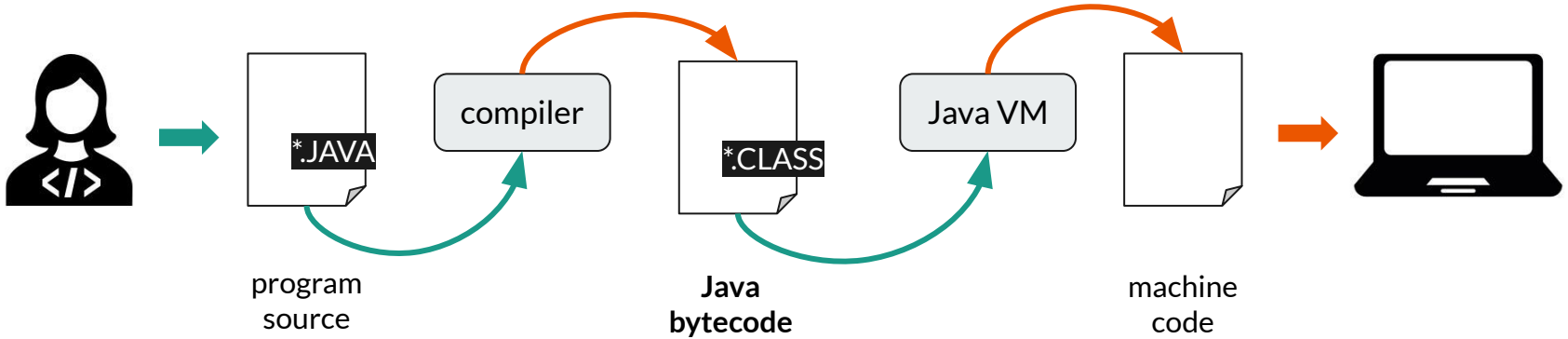
Part 1: Java ecosystem

Java is...

- a programming language
- an environment to run applications written in this language



WORA: Write Once Run Anywhere

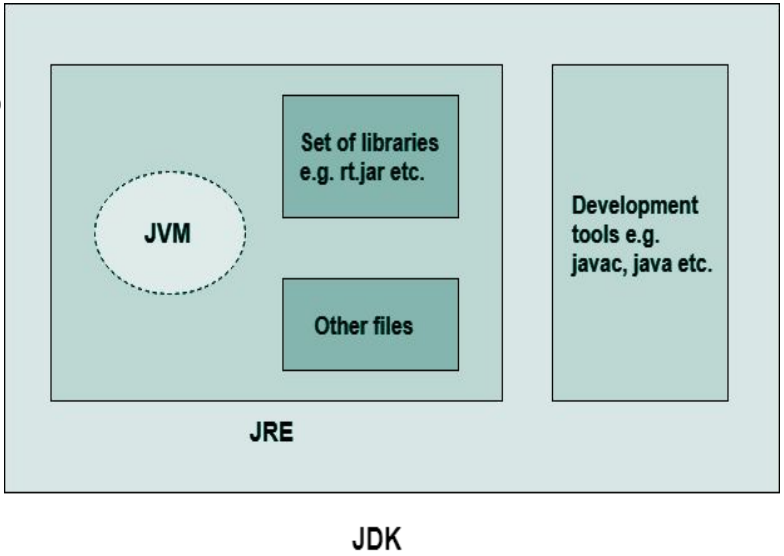


Java bytecode:

- intermediate representation interpreted by the Java Virtual Machine (JVM)
- does not depend on exact hardware architecture (= run anywhere)

Java lingo

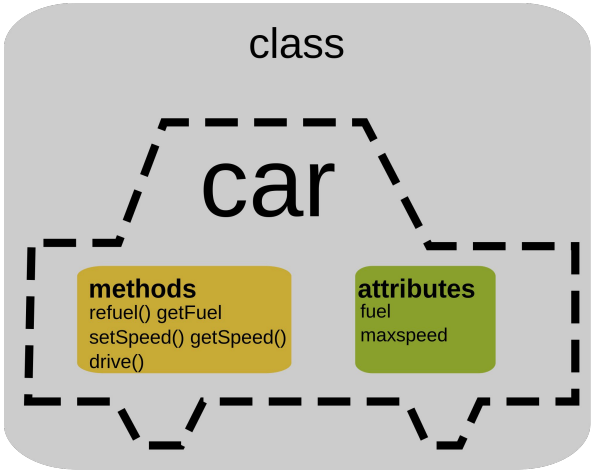
- **Java SE/EE/ME**: Java *Standard*/Enterprise/Micro platform
  - collections of **tools** to develop Java programs and the environment to run Java programs
- **JDK**: Java Development Kit
  - an implementation of one of the platforms (differ by sets of **tools**)
  - we will use some in this course: **java**, **javac**, **javadoc**, **jar**
- **JRE**: Java Runtime Environment
- **JVM**: Java Virtual Machine



Part 2: Java syntax

Java programming language

- **object-oriented**
  - (almost) everything is an object of a class
  - classes describe how the data is represented (via *attributes*) and manipulated (via *methods*)
- imperative
  - programmer specifies computational steps



Hello, World!

everything is an object of a **class**

`main()` *method* - application entry point

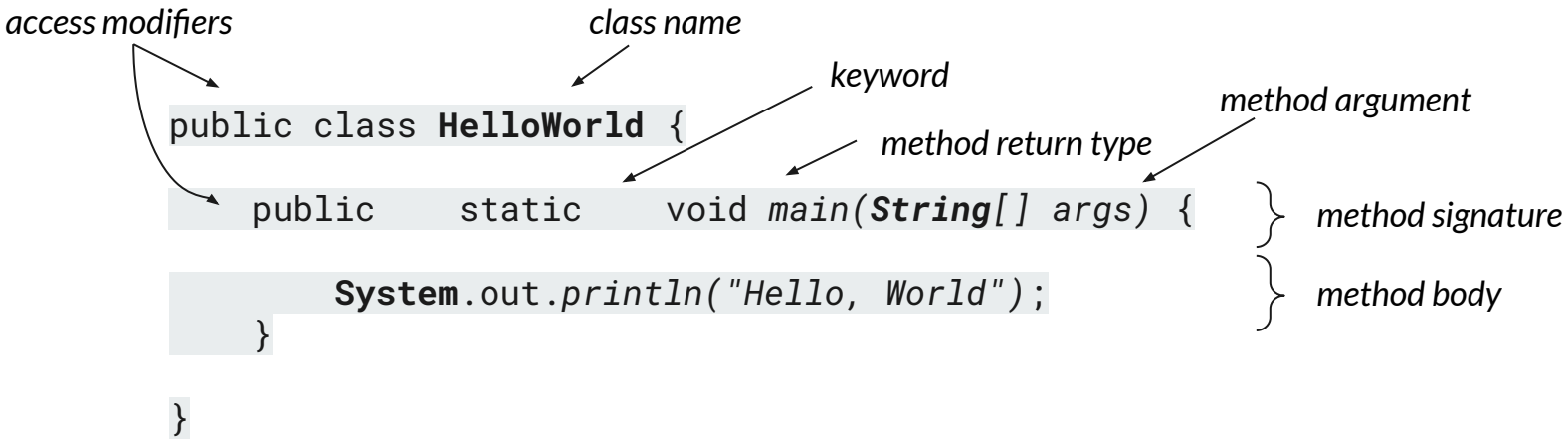
```
public class HelloWorld {

    public static void main(String[] args) {

        System.out.println("Hello, World");
    }
}
```

The `main()` is the starting point for JVM to start execution of a Java program. Without the `main()` method, JVM will not execute the program.

Hello, World! (anatomy)



Primitive and reference types

- Primitive data types (hold values)
  - `byte` < `short` < `char` < `int` < `long` < `float` < `double`
  - `boolean`
- All other types are reference types (hold references to objects)
- `null` - special reference, does not refer to anything, “empty” reference

Operators

For primitive types:

- Assignment: `=`
- Arithmetic: `+`, `-`, `*`, `/`, `%` (integer division)
- Comparison: `>`, `>=`, `<`, `<=`, `==` (equality) , `!=` (inequality)
- Conditional: `&&` (AND), `||` (OR), `!` (NOT)

Different in reference types:

- Reference equality: `==`
- Contents equality: `.equals(...)`

Operators can be **overloaded** - given new meaning - in reference types.

For example, `+` is used for concatenation in Strings:

```
String s1 = “Hel” + “lo”;
String s2 = “Hello”;

System.out.println(
      s1.equals(s2));
```

Conditionals

Executing different code depending on some logical (=`boolean`-valued) conditions:

```
if (CONDITION1) {
    ...

} else if (CONDITION2) {
    ...

} else {
    ...

}
```

Executing different code depending on fixed values of a variable:

```
switch (VARIABLE) {
    case VALUE1:
        ...
        break;
    case VALUE2:
        ...
        break;
    default:
        ...
        break;
}
```

Loops

Java has 3 kinds of loops...

- `for (i = 0; i < N; i++) { code }`
- `while (condition) { code }`
- `do {code} while (condition)`

...and two special loop statements

- `continue` - start next loop iteration
- `break` - exit the loop

prints numbers 0-5

```
for (int i = 0; i < 5; i++) {
    System.out.println(i);
}
```

prints number 1

```
for (int i = 0; i < 5; i++) {

    if (i % 2 == 0) continue;

    if (i == 3) break;

    System.out.println(i);
}
```

skip even numbers

stops reaching 3

Exceptions

```
public void myMethod() throws IOException{
      ...
      throw new IOException();
}
```

If a method does not handle an exception, the method must declare it using the throws keyword at the end of a method's signature.

```
public void myMethod(double foo) throws IOException{
      ...
     myOtherMethod();
}
```

this method actually throws an exception

Handling **unexpected behavior**:

```
try {
  ...code that might throw an exception

} catch (ExceptionType1 e1) {
  ...process exception

} catch (ExceptionType2 e2) {
  ...

} finally {
  ...code that always executes.
}
```

IO: Input and Output

```
public class HelloWorld {

    public static void main(String[] args) {

        System.out.println("Hello, World");
    }

}
```

Program input:
- CLI **arguments** (here)
- **`System.in`**

Program output:
- **`System.out`** (here)
- **`System.err`**

Stream IO

Reading from input stream:

The code on the right:

1. **creates** a `Scanner` object
2. **uses** it to read a `String` and an `int`
3. prints to the output stream, and
4. **closes** the `Scanner` object because there is no more input to read

Hint: always close the input stream!

```
Scanner scanner = new Scanner(System.in);

String myString = scanner.next();
int myInt = scanner.nextInt();
System.out.println("myString is: " + myString);
System.out.println("myInt is: " + myInt);

scanner.close();
```

File IO

Reading a line from a text file

```
File myFile = new File("PATH/test.txt");
Scanner myReader = new Scanner(myFile);

String textLine = myReader.nextLine();
System.out.println(textLine);

myReader.close();
```

Writing a line to a text file

```
FileWriter myWriter = new FileWriter("PATH/test.txt");

myWriter.write("Hello, world!");

myWriter.close();
```

You might need to **close the file stream** explicitly in many cases

Comments

```
/** This is a class-level doc comment.
 */
public class HelloWorld {

    /** This is a method-level doc comment. This is free-text comment part.
     *  @param args This is tagged comment part
     */
    public static void main(String[] args) {

        // this is an inline comment
        System.out.println("Hello, World");
    }
      /* this is a
         multi-line block comment */
}
```

Part 3: Java applications

Compiling and running

Java code is usually organized as a **project**.

Project file hierarchy:

- project (collection of packages)
  - package (collection of classes)
    - class

3 options to produce an executable program:

- **CLI:** text editor + `java`, `javac`, jar
- **IDE**: Eclipse, NetBeans, IntelliJ, VisualStudio Code,...
- Build systems: Maven, Gradle

No-IDE compilation

Make a folder with the following structure:

- your-program-name
  - Main.java
  - other *.java files
  - MANIFEST.MF

The manifest file should specify main class:

```
Main-Class: Hello
```

Option 1:

```
$ javac *.java
$ java Main
```

Option 2:

```
$ javac *.java
$ jar cfm main.jar MANIFEST.MF *.class
$ java -jar hello.jar
```

Coding conventions: why?

80% of the lifetime cost of a piece of software goes to maintenance.

Hardly any software is maintained for its whole life by the original author.

Code conventions improve the readability of the software, allowing engineers to understand new code more quickly and thoroughly.

- Code Conventions for the Java™ Programming Language

Coding conventions: which?

Code Conventions for the Java™ Programming Language

Google Java Style Guide

- most IDEs have support for project-level style set up
- styles can differ between projects, so **agree with collaborators**

Unit testing

```
public class MyUnit {
    public String concatenate(String one, String two){
        return one + two;
    }
}
```

unit of code under test: method `concatenate()`

```
public class MyUnitTest {
      @Test
      public void testConcatenate() {

          MyUnit myUnit = new MyUnit();
          String result = myUnit.concatenate("one", "two");

          assertEquals("onetwo", result);

      }
}
```

unit test for the method `concatenate()`

Part 4: practice

Exercises

- The simplest program: Hello, world!
- The unit test example program: string concatenation
- A printer program that: reads a number N, if it is even prints N characters ‘-’ to the standard output stream, if it is odd - prints N characters ‘=’ to the standard error stream.
    - Stream IO, conditionals, operators, loops, comments, [exceptions]
- A program that copies text files: reads a line from one file and writes it to another file
    - File IO, conditionals, operators, loops, comments, exceptions, unit tests

Further resources* on Java

** section added on 18.09.2020*

General Java tutorials

Online crash courses

Udemy: Java Beginners Program - A crash course

University of California, Berkeley: A Java Crash Course

Tutorial sites

https://www.javatpoint.com/java-tutorial

https://www.tutorialspoint.com/java/index.htm

https://www.w3schools.com/java/default.asp

https://howtodoinjava.com/

Thematic resources

- Code examples collection of basic Java concepts
- StackOverflow - programming community Question/Answer website
- Maven in 5 minutes
- Unit testing with JUnit:
  - https://www.tutorialspoint.com/junit/junit_test_framework.htm
  - https://www.vogella.com/tutorials/JUnit/article.html
- Codility - a website with programming challenges