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Prelude to Java SE9 (online resource)
Sachin Malhotra
Saurabh Choudhary

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Chapter 2

Getting started with Java

Objective

- Know the Java Features and its Runtime Environment
- Get familiar with new releases in Java
- Understand the basic structure of a Java program
- Get into the details about JDK Installation
- Know about the various constituents of JDK and its development environments

Introduction

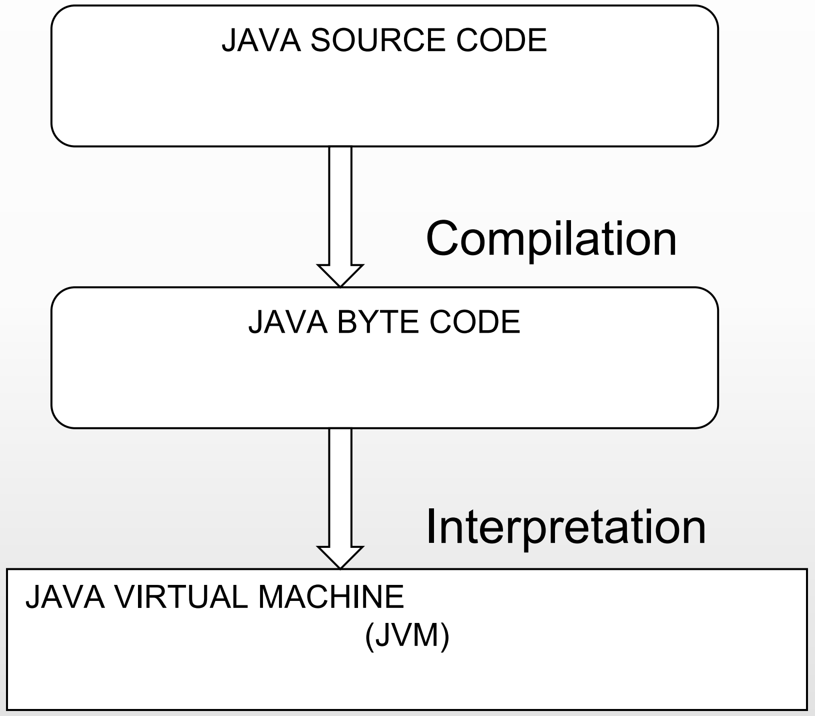
- Java is a programming language developed by James Gosling and others in 1994.
- Originally named Oak ,was developed as a part of the Green project at Sun Microsystems.
- Java 9 is latest stable release.

Java Essentials

- A high level language
- Java Bytecode – intermediate code
- Java Virtual Machine (JVM) – interpreter for bytecode

Java Runtime

Java Runtime Environment includes JVM, class libraries and other supporting files.



Java Approach

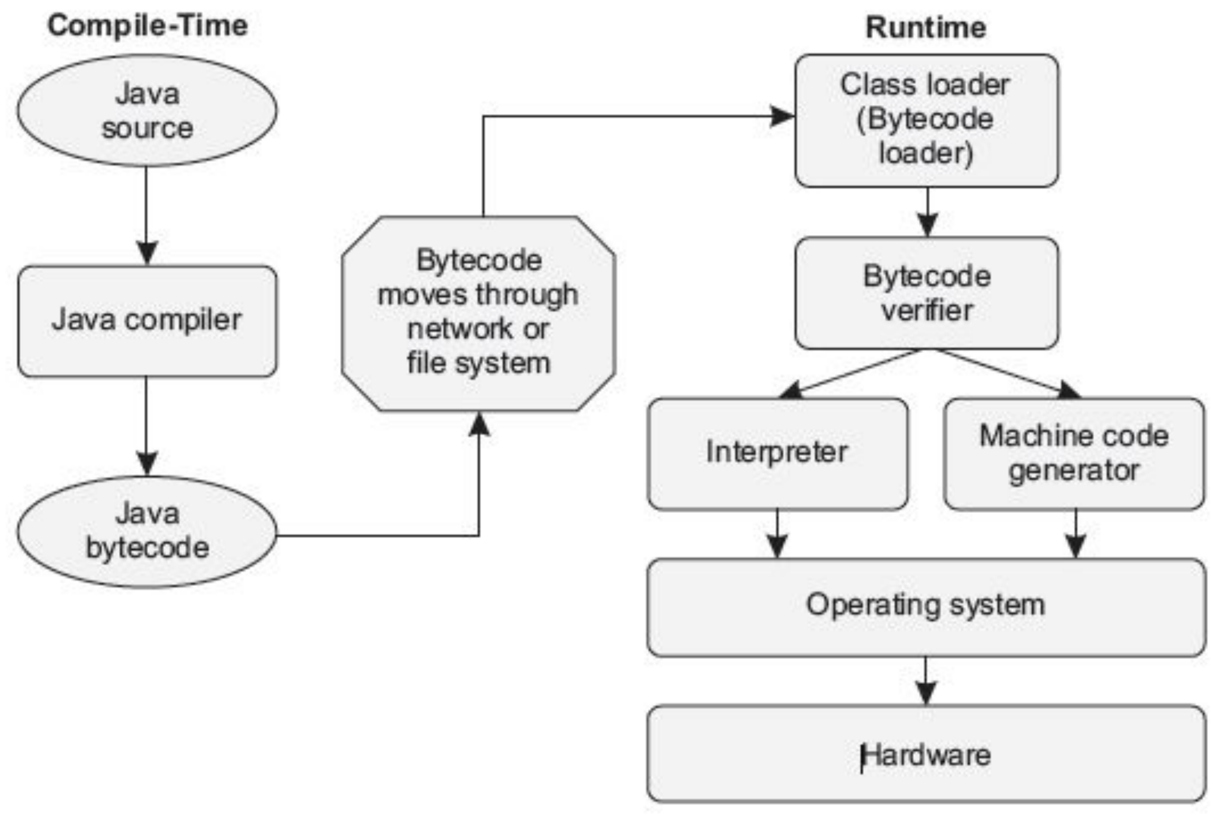


Fig. 2.6 Compilation and Interpretation in Java

Java Features

- Platform Independence
- Object oriented
- Compiled and interpreted
- Robust
- Security
    - Strictly typed language
    - Lack of pointers
    - Garbage collection
    - Strict compile time checking
    - Sandbox security

Java Features

- Multithreaded
- Dynamic binding
- Performance
- Networking
- No pointers
- No global variables
- Automatic Garbage collection

Java 5 New Features

- Autoboxing and unboxing
- Enhanced For loop
- Metadata
- Variable arguments
- Static import
- Graphics enhancemnets
- Generics
- Enum
- StringBuilder class

Java 6 New Features

- Enhancements in Collections API
- Console class
- Jar and Zip enhancements
- Enhancements to Network Interface
- Enhancements in Java web start and plug in

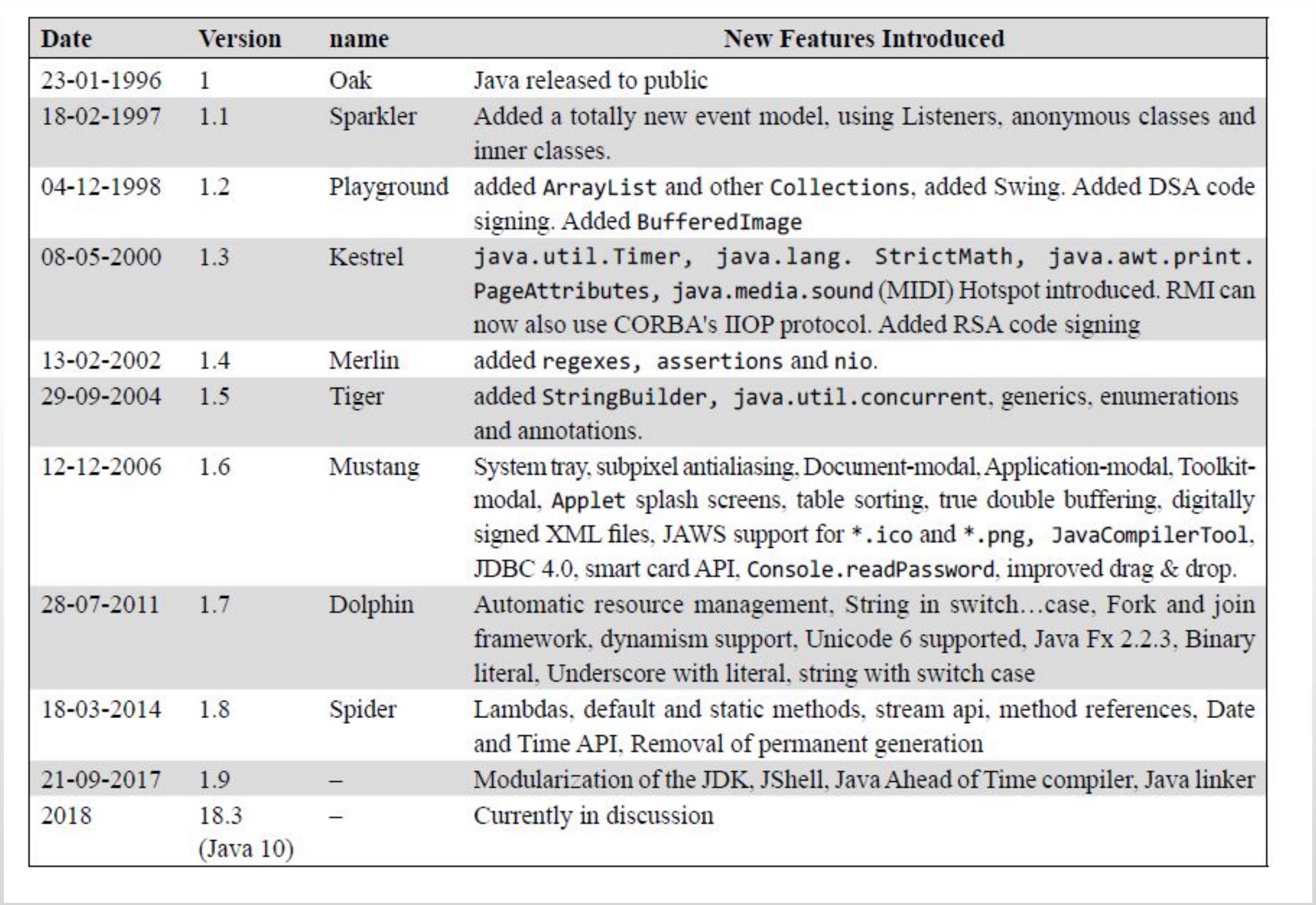
Java 7 New Features

- String in switch…case Statement
- Unicode 6.0.0 Support
- Binary Literals and Numeric Literals (with Underscores)
- Automatic Resource Management
- Improved Exception Handling
- nio 2.0 (Non-blocking I/O)—New File System API

Java 7 Features (contd.)

- Fork and Join for parallel processing
- Supporting Dynamism using invoke dynamic to let JVM resolve type info at runtime
- No need of Diamond Operator <> on right side of the expression
- Swing Enhancements
- Java FX 2.2.3 provides the new GUI toolkit for creating rich cross platform user interfaces

Comparison of Java Versions



Date	Version	name	New Features Introduced
23-01-1996	1	Oak	Java released to public
18-02-1997	1.1	Sparkler	Added a totally new event model, using Listeners, anonymous classes and inner classes.
04-12-1998	1.2	Playground	added `ArrayList` and other `Collections`, added Swing. Added DSA code signing. Added `BufferedImage`
08-05-2000	1.3	Kestrel	`java.util.Timer, java.lang. StrictMath, java.awt.print. PageAttributes, java.media.sound` (MIDI) Hotspot introduced. RMI can now also use CORBA's IIOP protocol. Added RSA code signing
13-02-2002	1.4	Merlin	added `regexes, assertions` and `nio`.
29-09-2004	1.5	Tiger	added `StringBuilder, java.util.concurrent`, generics, enumerations and annotations.
12-12-2006	1.6	Mustang	System tray, subpixel antialiasing, Document-modal, Application-modal, Toolkit-modal, `Applet` splash screens, table sorting, true double buffering, digitally signed XML files, JAWS support for `*.ico` and `*.png, JavaCompilerTool`, JDBC 4.0, smart card API, `Console.readPassword`, improved drag & drop.
28-07-2011	1.7	Dolphin	Automatic resource management, String in switch…case, Fork and join framework, dynamism support, Unicode 6 supported, Java Fx 2.2.3, Binary literal, Underscore with literal, string with switch case
18-03-2014	1.8	Spider	Lambdas, default and static methods, stream api, method references, Date and Time API, Removal of permanent generation
21-09-2017	1.9	–	Modularization of the JDK, JShell, Java Ahead of Time compiler, Java linker
2018	18.3 (Java 10)	–	Currently in discussion

Differences between C++ and Java

- **Multiple Inheritance not allowed**
    - Multi-level inheritance is enforced, which makes the design clearer. Multiple inheritance among classes is not supported in java. Interfaces are used for supporting multiple inheritance.
- **Common parent**
    - All classes are *single-rooted*. The class Object is the parent of all the classes in java.
- **Packages**
    - The concept of *packages* is used, i.e. a large, *hierarchical namespace* is provided. This prevents naming ambiguities in libraries.
- **In-source documentation**
    - *In-source code documentation* comments are provided. Documentation keywords are provided for example: @author, @version, etc.
- **All code inside class**
    - All code resides inside a class. Global data declaration outside the class is not allowed. However, static data within classes is supported.

Differences between C++ and Java

- **Operator overloading**
  - Operator overloading is not supported in java but there are few operators which are already overloaded by java, e.g. '+'. Programmers do not have the option of overloading operators.
- **Explicit boolean type**
  - boolean is an explicit type, different from int. Only two boolean literals are provided i.e. true and false. These cannot be compared with integers 0 and 1 as used in some other languages.
- **Array length accessible**
  - All array objects in java have a length variable associated with them to determine the length of the array.

Differences between C++ and Java

- **goto**
  - Instead of goto, break and continue are supported.
- **Pointers**
  - There are no pointers in java.
- **null pointers reasonably caught**
  - Null pointers are caught by a NullPointerException.
- **Memory management**
  - Explicit destructor is not needed. The use of *garbage collection* prevents memory leaks and referencing freed memory.
- **Automatic variable initialization**
  - Variables are automatically initialized except local variables.
- **Runtime container bounds checks**
  - The bounds of containers (arrays, strings, etc.) are checked at runtime and an IndexOutOfBoundsException is thrown if necessary.

Differences between C++ and Java

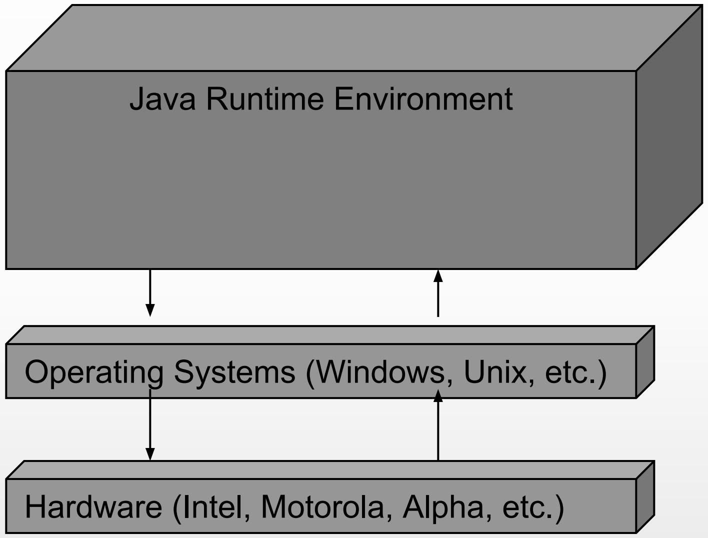
- **All definitions are well defined**
  - Methods and fields carry explicitly one of the access modifiers.
- **Sizes of the integer types defined**
  - The sizes of the integer type's byte, short, int and long are defined to be 1, 2, 4 and 8 bytes.
- **Unicode provided**
  - Unicode represents character in most of the languages, e.g. Japanese, Latin etc.
- **String class**
  - An explicit predefined String class is provided along with StringBuffer and new StringBuilder class.

Differences between C++ and Java

- **Extended utility class libraries: *package java.util***
  - Supported among others: Enumeration (an *Iterator* interface), Hashtable, Vector.
- **Multithreading support with synchronization**
  - Java supports multithreading with synchronization among them.
- **Default access specifier added**
  - By default, in java all variables, methods and classes have default privileges which are different from private access specifier. Private is the default access specifier in C++.

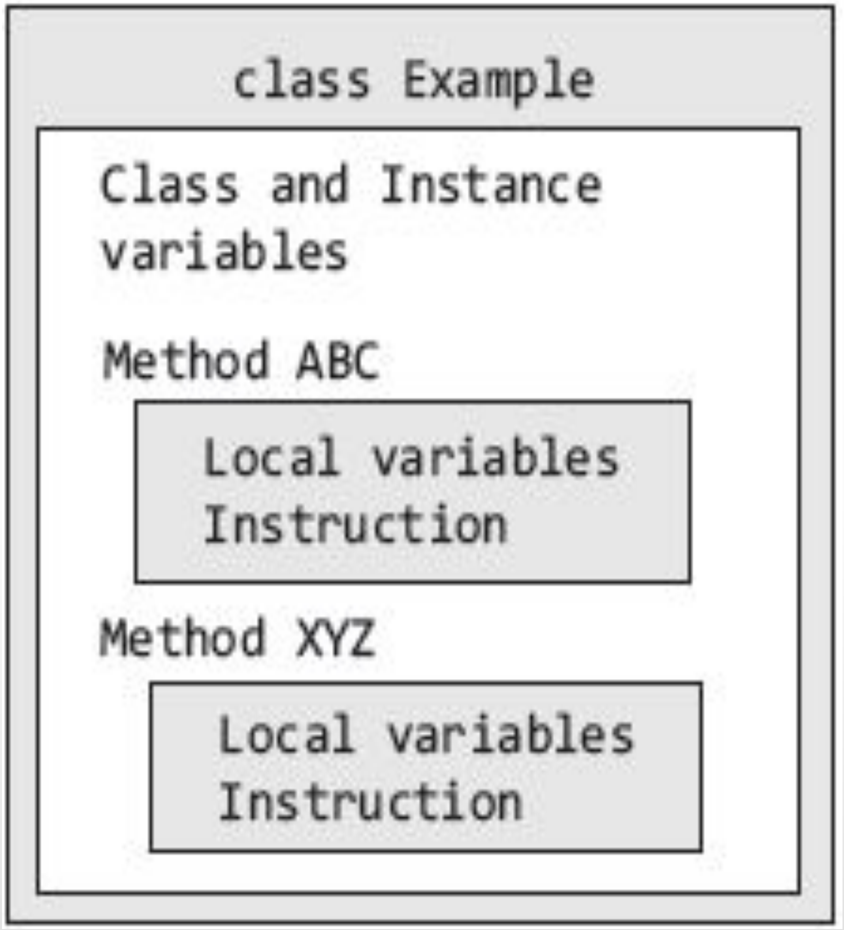
JVM and JRE

- JVM is a part of JRE


Java Runtime Environment
Operating Systems (Windows, Unix, etc.)
Hardware (Intel, Motorola, Alpha, etc.)

Program Structure

- A Java Application consists of a collection of classes.
- A class is a template containing methods and variables.



First Java Program

```
/* Call this file “Example.java”.*/

class Example {

//your program starts execution with a call to //main()

public static void main(String args[ ]){

System.out.println(“This is a simple Java program”);

}

}
```

Executing Java Program

- **Entering the source code:** text editor like notepad or any IDE
- **Saving the source code:**
  - Select File | Save As from the notepad menu.
  - In the ‘File name’ field, type “Example.java” within the double quotes.
  - In the ‘Save as type’ field select All Files (*.*).
  - Click enter to save the file.
- **Compiling & running the source**
  - type *cmd* at the run prompt.
  - move to the folder that contains the saved Example.java file.
  - compile the program using javac,
  - C:\javaeg\>javac Example.java

Executing Java Program

- Compilation creates a file called **Example.class**
- This class contains bytecode which is interpreted by JVM.
- To execute the program type the following command at the dos prompt:
  - C:\javaeg\>java Example
- The output of the program is shown below:
  - This is a simple Java program

Why save as Example.java?

- The name of the .class file will match exactly with the name of the source file.
- That is why it is a good idea to give the Java source files the same name as that of the class they contain.
- Java is case-sensitive.
- So example and Example are two different class names.

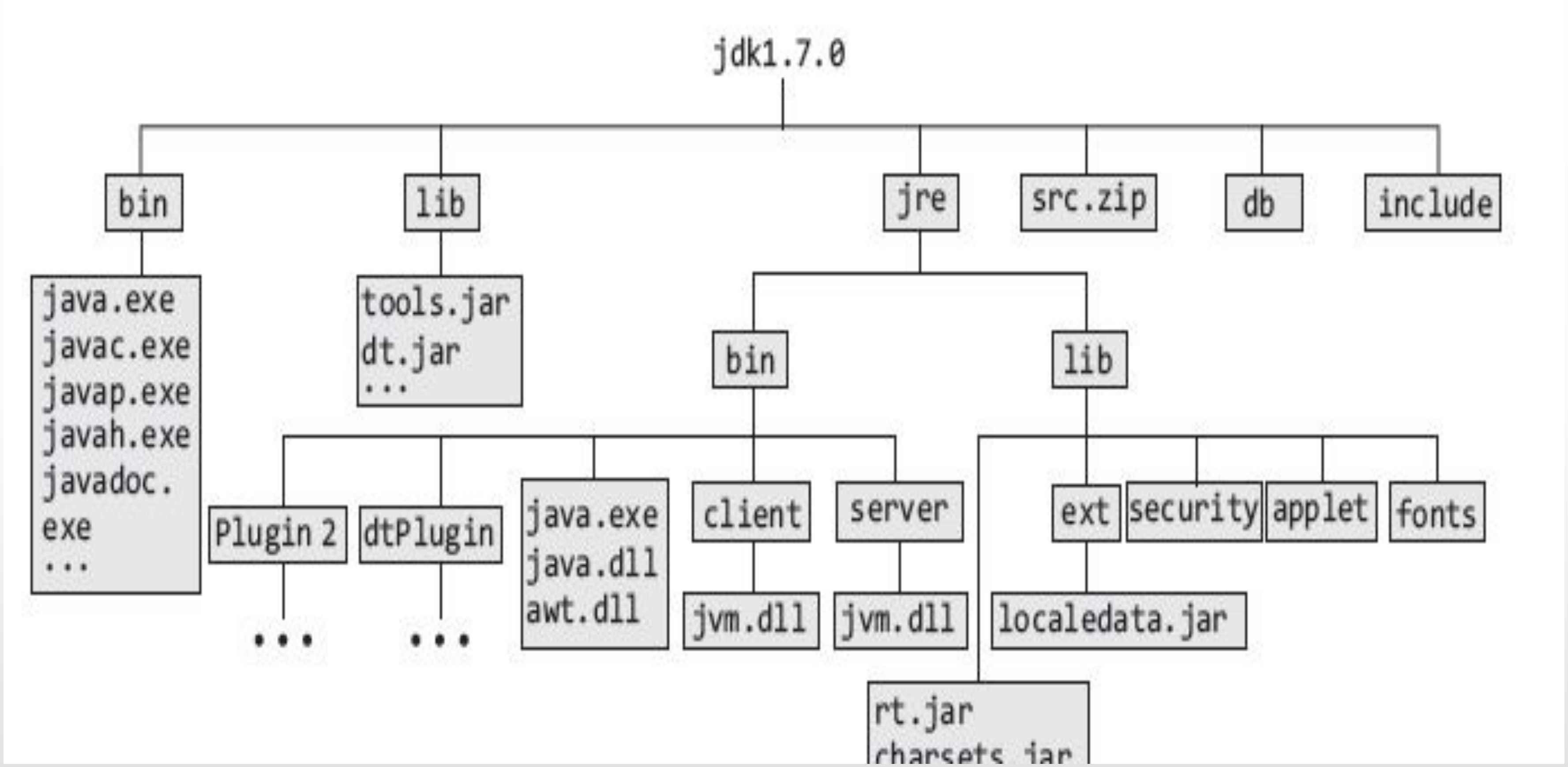
Your Turn

- Let us revise the concepts
  - What is platform independence?
  - What is the relation between JVM and JRE?
  - Differences between C++ and Java?
  - Why the source file is named after the class name in java?

Installation of Java

- Download the JDK installer.
- Run the JDK installer.
- Update PATH Environment variables.
- Test the installation – run javac and java on command prompt.

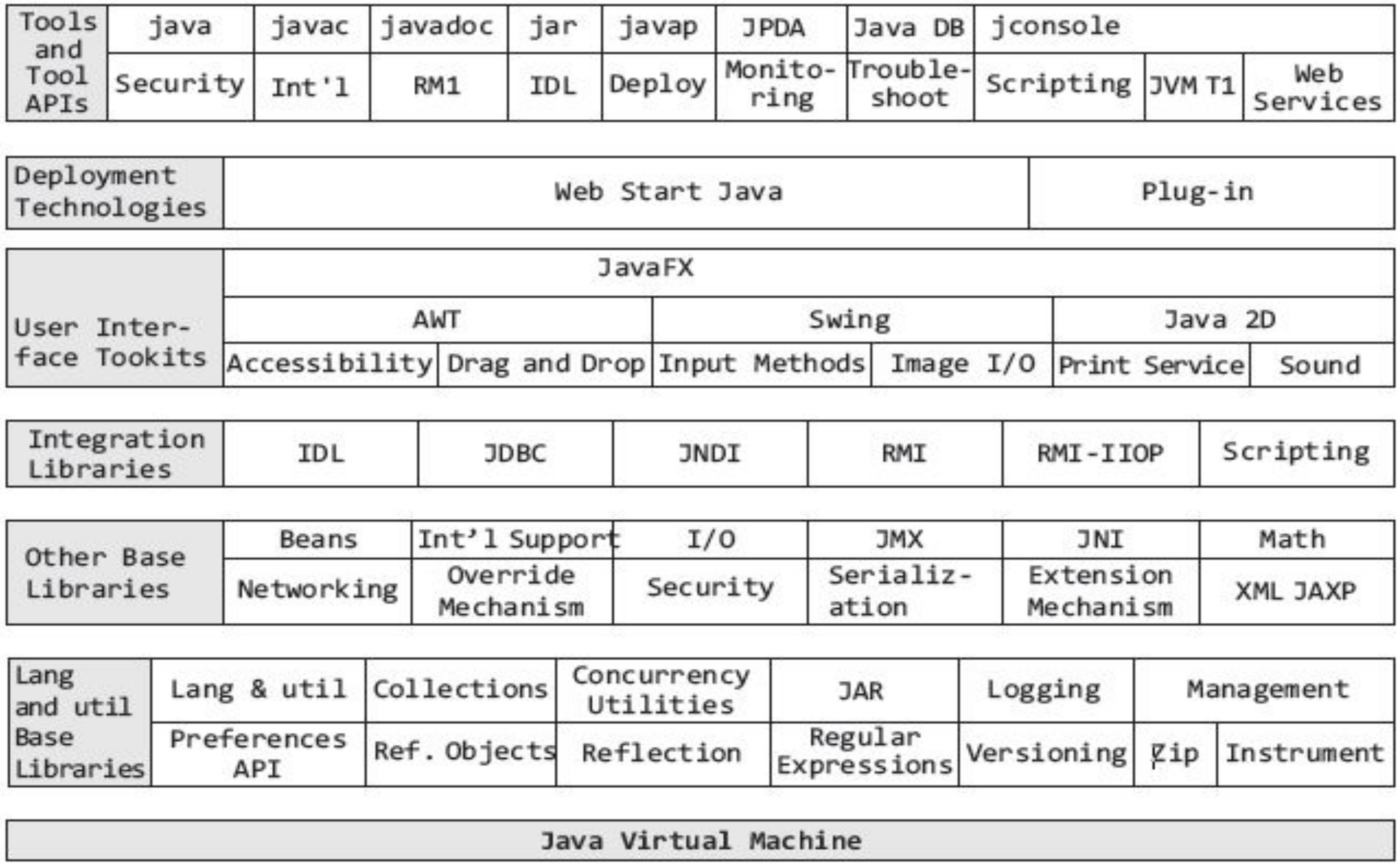
Installed Directory Structure



Installed Directory Structure

- **src.zip file** contains all the core class binaries, and is used by JDK in this form.
- **include\** directory contains a set of C and C++ header files for interacting with C and C++.
- **lib\** directory contains non-core classes like **dt.jar** and **tools.jar** used by tools and utilities in JDK.
- **bin\** The bin directory contains the binary executables for Java. For example, Java Compiler (Java), Java Interpreter (Java) , rmicompiler, (rmic) etc.
- **jre\** is the root directory for the Java runtime environment.
- **db\** contains java database.

Exploring the JDK



Tools and Tool APIs	java	javac	javadoc	jar	javap	JPDA	Java DB	jconsole		
	Security	Int'l	RM1	IDL	Deploy	Monito-ring	Trouble-shoot	Scripting	JVM T1	Web Services

Deployment Technologies	Web Start Java	Plug-in

User Inter-face Tookits	JavaFX					
	AWT		Swing		Java 2D	
	Accessibility	Drag and Drop	Input Methods	Image I/O	Print Service	Sound

Integration Libraries	IDL	JDBC	JNDI	RMI	RMI-IIOP	Scripting

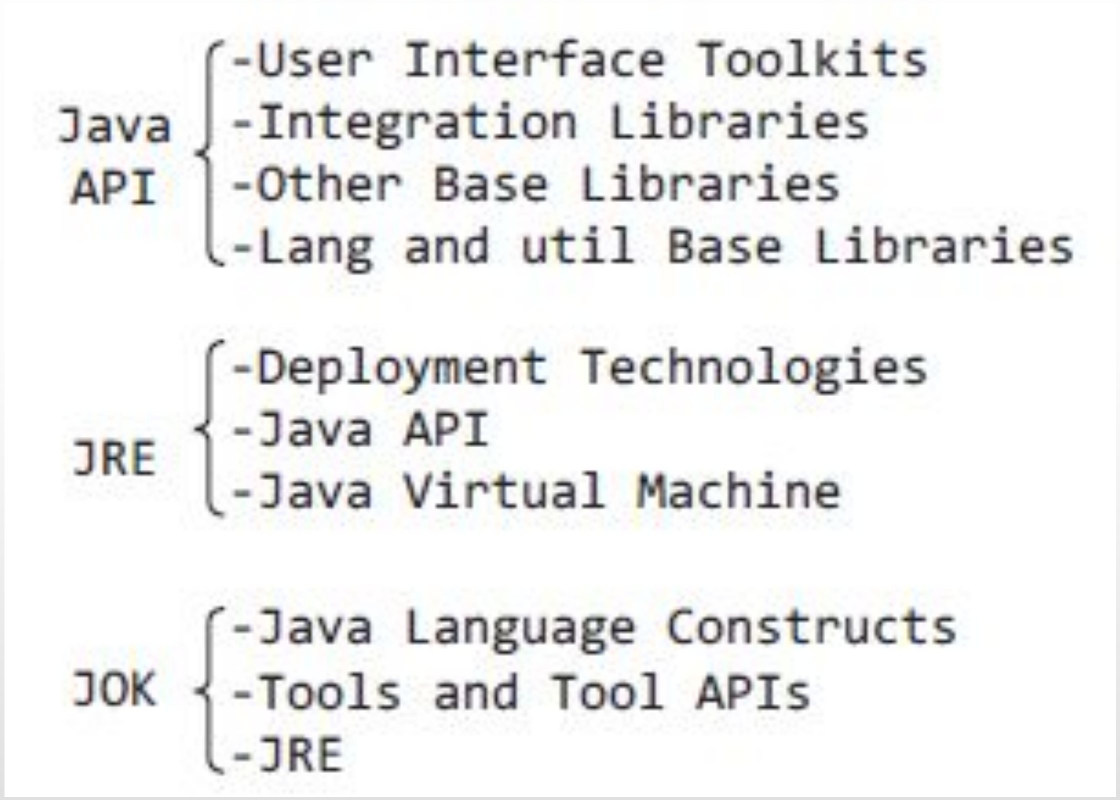
Other Base Libraries	Beans	Int'l Support	I/O	JMX	JNI	Math
	Networking	Override Mechanism	Security	Serializ-ation	Extension Mechanism	XML JAXP

Lang and util Base Libraries	Lang & util	Collections	Concurrency Utilities	JAR	Logging	Management	
	Preferences API	Ref. Objects	Reflection	Regular Expressions	Versioning	Zip	Instrument

Java Virtual Machine

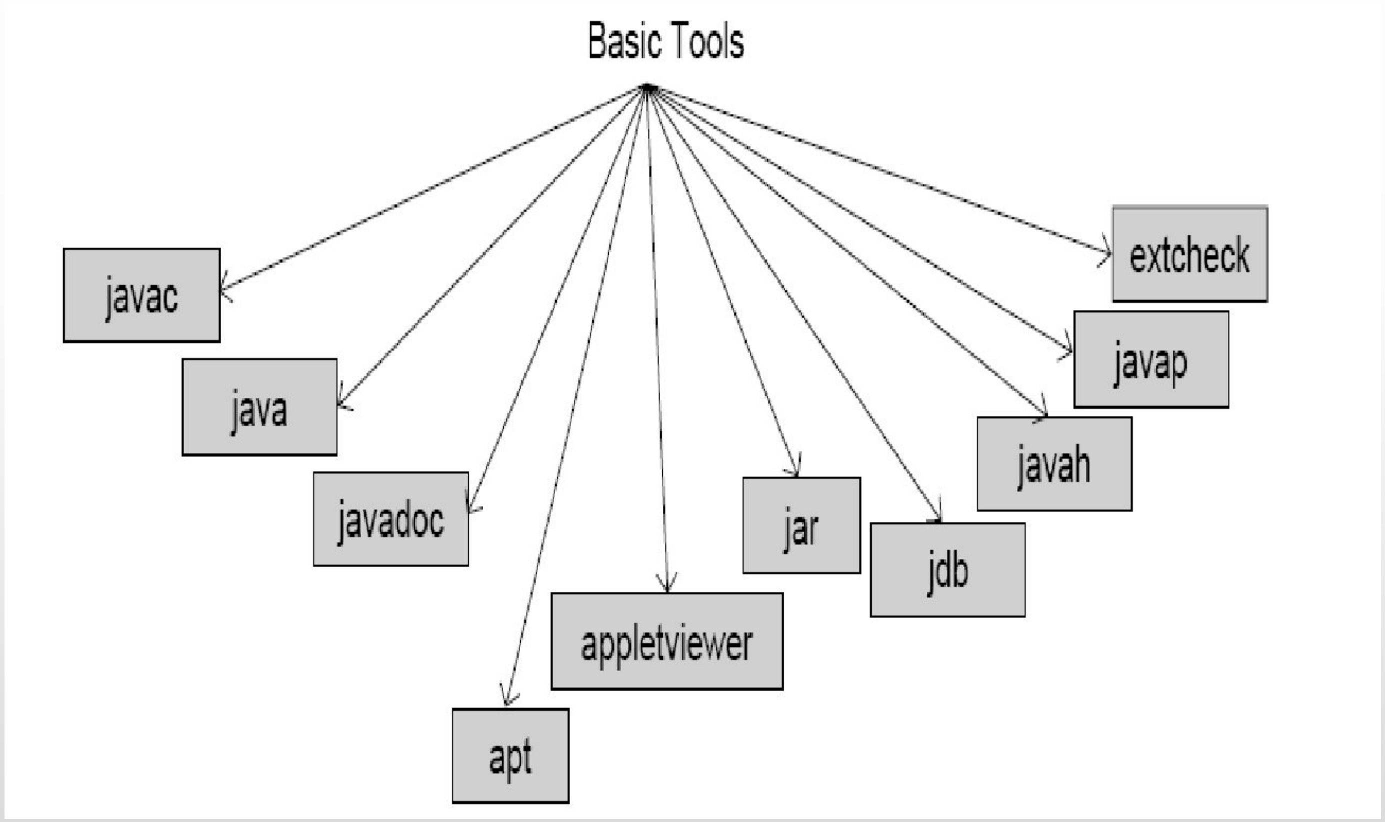
Exploring the JDK

JDK=JRE + JAVA API



Tools in JDK

- Basic Tools in Java



IDE

- Tools specifically designed for writing Java code.
- Tools offer a GUI environment to compile and debug your Java program easily from the editor environment, as well as browse through your classes etc.
- Popular IDEs
    - Eclipse
    - Netbeans
    - Kawa
    - JCreator

Summary

- Java is an object-oriented language.
- Java is designed to be platform independent, so it can run on multiple platforms.
- Every Java program consists of one or more classes.
- A class is nothing but a template for creating objects.
- In Java, code resides inside a class.
- Java bytecode executes on a special type of microprocessor.
- As there was not a hardware implementation of this microprocessor available when Java was first released, the complete processor architecture was emulated by a software known as *virtual machine*. (popularly known as JVM).