Introduction to Java and the SDK Tools

Qiuyan Huo 霍秋艳
Software Engineering Institute
qyhuo@mail.xidian.edu.cn

计算机事业发展的下一个浪潮就是 Java，并且将很快会发生的。

Tim Berners-Lee

James Gosling

May 19, 1955

'father of Java'

History of Java

一切从C++开始！

History of Java

Oak:窗外的一棵老橡树！

History of Java

Oak → Java

History of Java

太平洋上一个盛产咖啡的岛屿

History of Java

WWW → WebRunner

History of Java

1995.5.23 HotJava

History of Java

Internet上的世界语！

History of Java

Web era

Java for websites

- **Popular sites using Java**
  - Linkedin.com
  - Msn.com
  - Ebay.com
  - 163.com
  - Paypal.com
  - Sohu.com
  - Odnoklassniki.ru
  - Mywebsearch.com
  - Aol.com
  - Ebay.de
- **Random selection of sites using Java**
- **Sites using Java only recently**
  - Mobile.de
  - 12306.cn
  - Marktplaats.nl
  - Caixa.gov.br
  - Brainyquote.com

History of Java

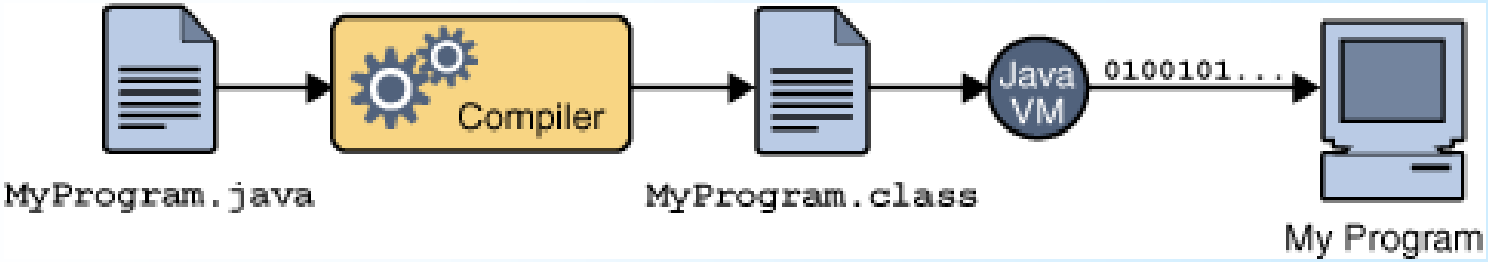
- Java technology was created as a programming tool in a small, closed-door project initiated by Patrick Naughton, Mike Sheridan, and James Gosling of Sun in 1991. But creating a new language wasn't even the point of "the Green Project."
- The TV set-top box and video-on-demand industries (Demo)
- 1994: Change of direction – The Internet. By March 1995, there were still only seven or eight binary copies of what they called "1.0a" outside of Sun. The team was getting ready to post a "full public" alpha version ("1.0a2") of the Java source code on the Internet.
- 13 November 2006 ~ 8 May 2007, Sun released all of Java's core code free and open-source, aside from a small portion of code to which Sun did not hold the copyright.
- 2009, Oracle收购Sun~ 20 October 2010, 完成了合并
- 2011 Java 7
- 2014 Java 8
- 2017 Java 9

What's Java?

- 一种编程语言→programming
- 一种开发环境→developing
- 一种应用环境→application
- 一种发布环境→deployment
- Java是一种高级编程语言

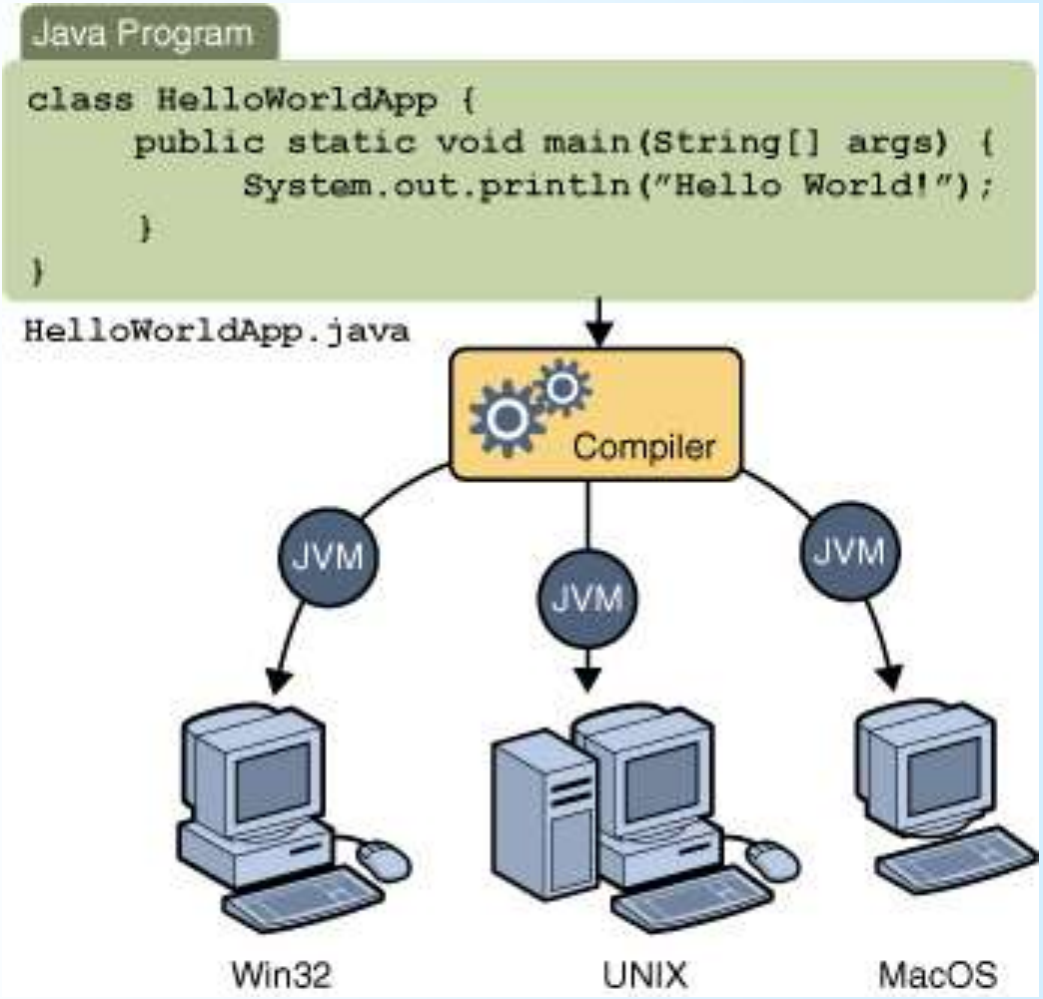
What's Java?

Java虚拟机(JVM)和Java字节码(ByteCode):



What's Java?

"*Write once, Run anywhere*"



Why Java?

- 避免其它语言的缺点（指针，内存管理）
- 更快的开发
- 更好的编写
- 更少的代码
- 一次编写，到处执行
- 更容易的发布

Java (How?)

- Java虚拟机 — JVM
  - Operating System independence.
  - Safe, well defined, operating environment.
  - Portability
  - Performance Issues
- Garbage Collection
  - 内存的分配 —— 指针 —— 释放
  - 不用再释放内存
  - C&C++ 程序员的责任 —— memory leak
  - 使用系统层次的线程追踪内存的分配
  - 自动运行
  - 同JVM同步
- 代码的安全 — Security

JRE: Java运行时环境

- 装载 —— load
  - 隔离——名字空间(namespace)——private
  - local & network—— 调用
  - 完全装载——内存分配——搜索表
  - 都在执行前
- 认证 —— verify
  - 代码的专一性
  - 对系统完整性的破坏
  - 堆栈的上溢和下溢
  - 参数、数据类型、对象的引用
  - 无非法数据转换
- 执行 —— execute

Objects, Objects, Objects

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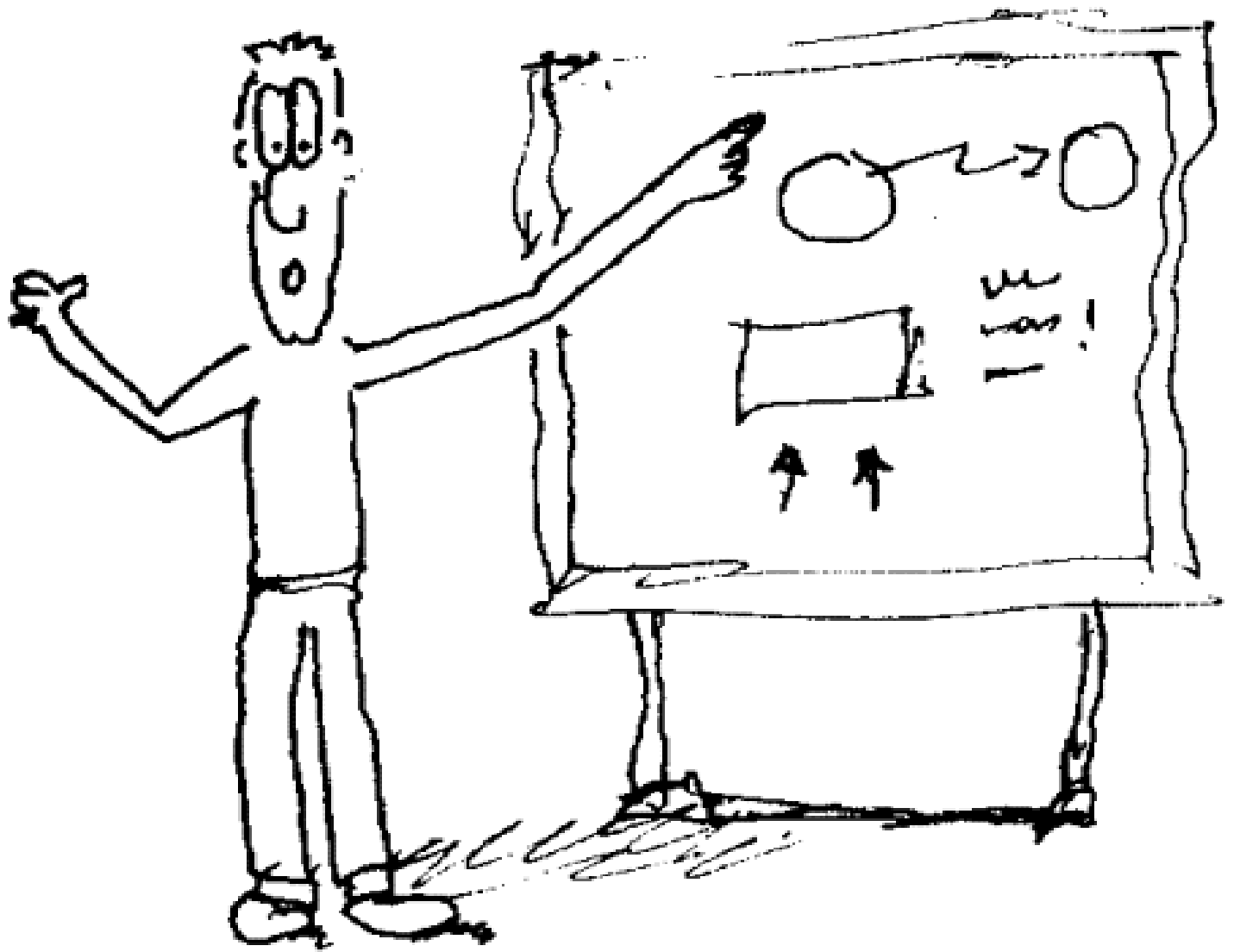
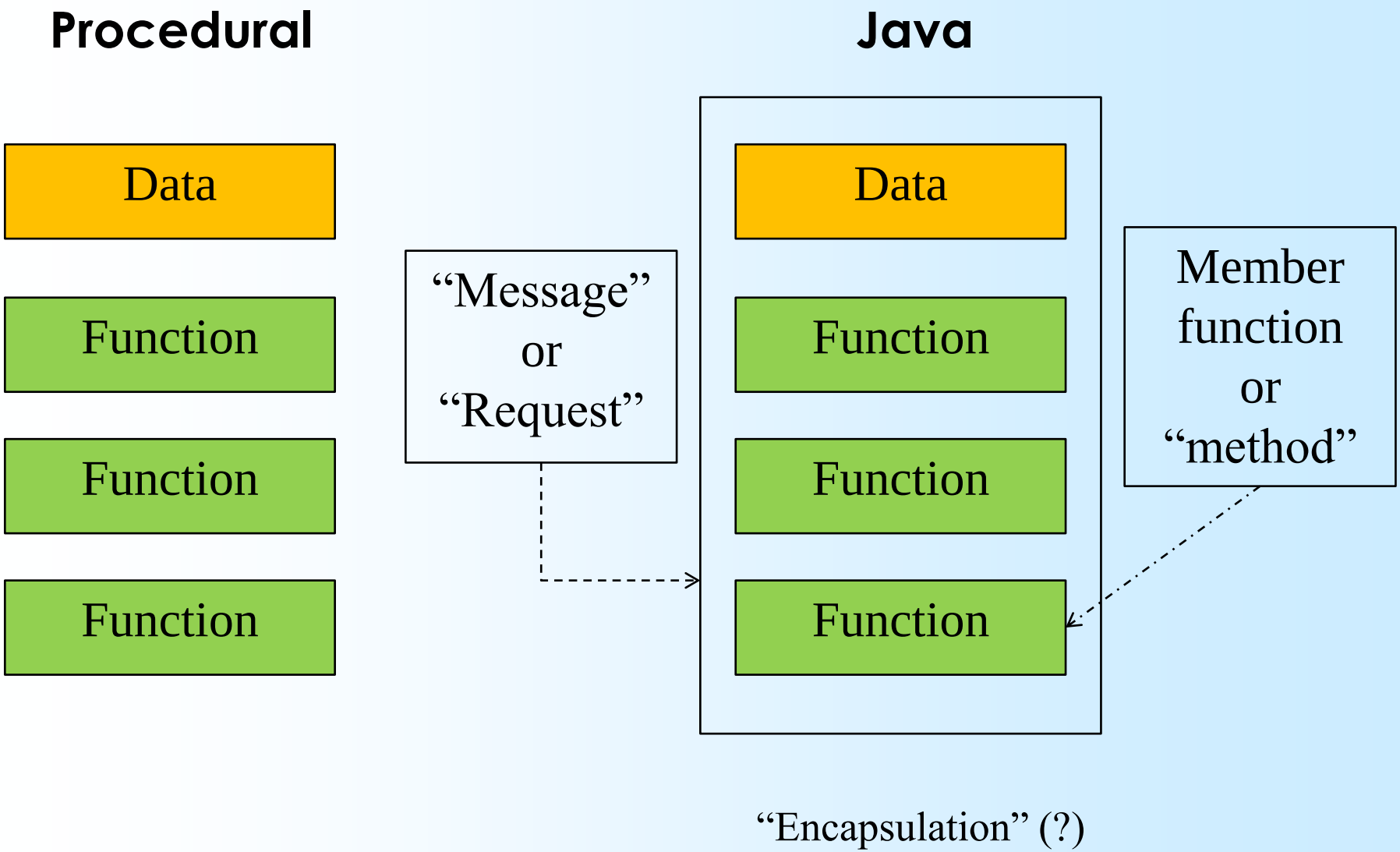


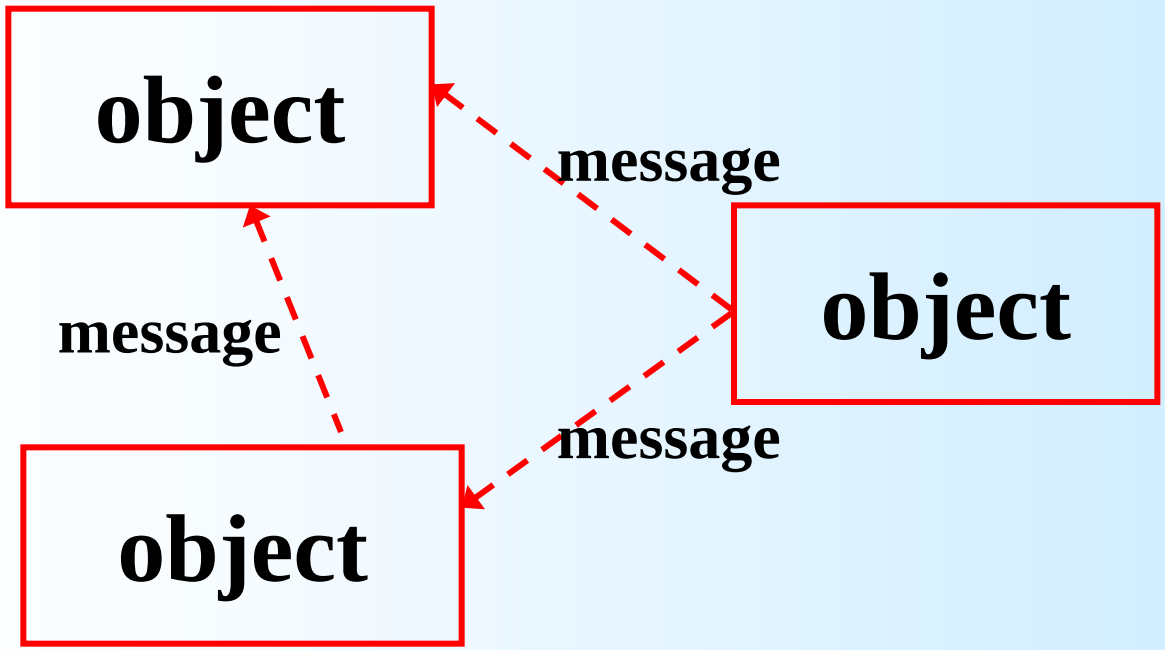
ile.

Procedural vs. Java



"Encapsulation" (?)

Object-Oriented programs



- Made up of objects sending messages to each other's interfaces

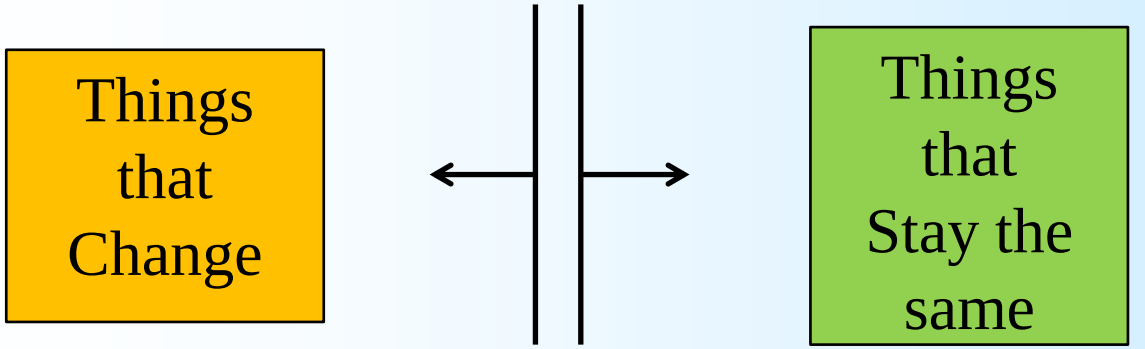
面相对象编程描述的是对象之间的相互作用

OOP Development

- Object-Oriented *Components*
  - Formalized in Java EE - Java Beans
- Incremental Development
- Unified Modeling Language (UML)

OOP Design

- Most designs can be simplified by adding another level of indirection/abstraction



- In the design
- At compile-time
- At run-time
- In the environment
- Etc

- Hard part decomposing system into objects
- What interfaces do you need?

Features & Benefits

- Platform Independence
- High Performance
- Easy to Learn
- Standards-Based
- Worldwide Prevalence
- Consistent Runtime Environments
- Optimized for Embedded
- High-performance, Portable Applications
- Proven Security Model
- Java Platform, Enterprise Edition

Java vs. C++

- Similar syntax/control structures.
- No preprocessor or include files.
- No pointers
- No global variables
- No **`struct`** or **`union`** types.
- All primitive types have well defined size.

More Java vs. C++

- No operator overloading.
- Single inheritance only
  - there is another approach used - interfaces.
- Error handling is well defined (and somewhat enforced!).
- No memory leaks!

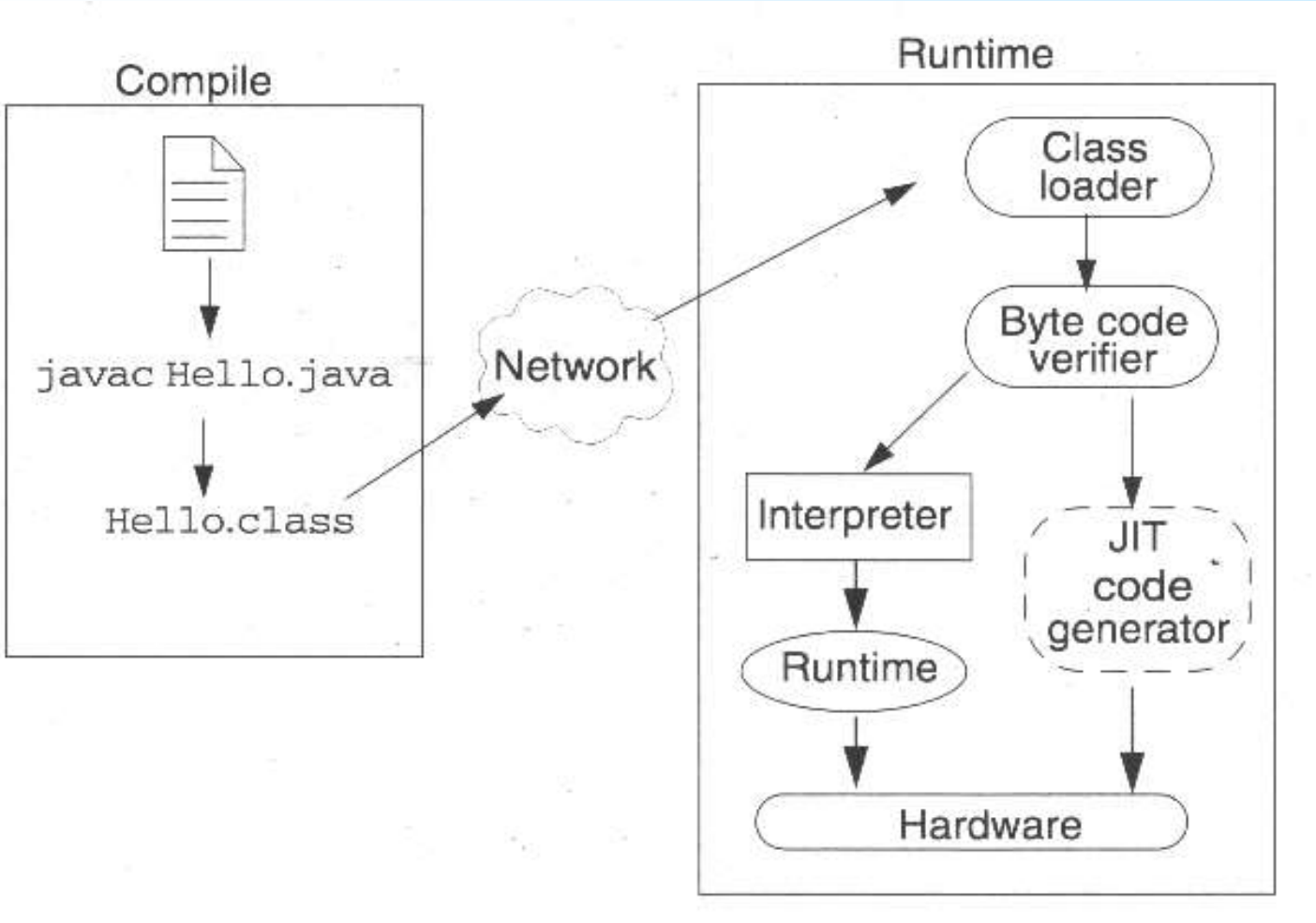
and more…

- Safety designed into the language and VM
  - bytecode verification
  - array access bounds checking
  - security manager/ security policies

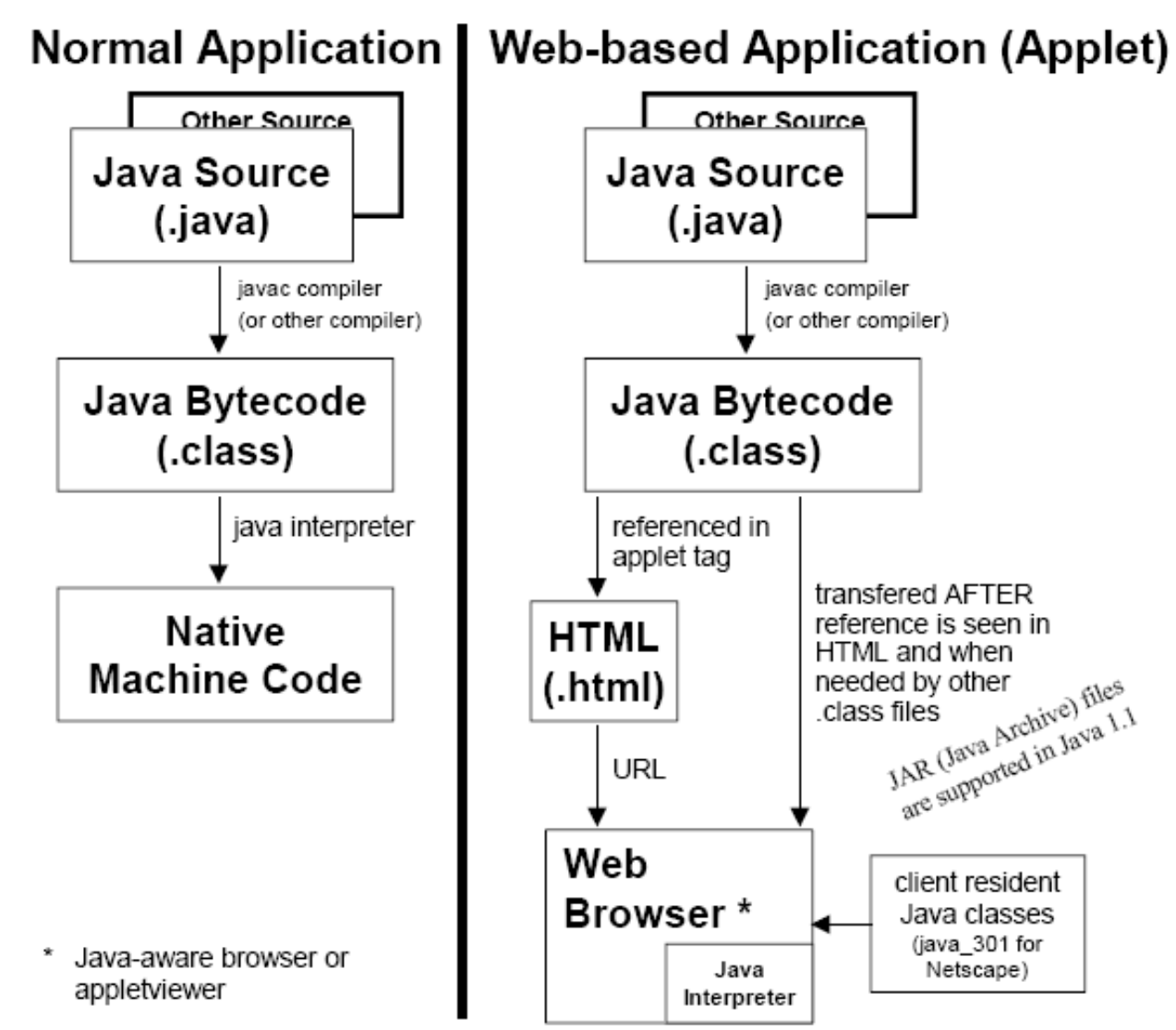
Performance Issues

- Using a VM is slower than compiling to *native* instructions.
  - JIT compilers convert Java Bytecode to machine language.
- Safety/Security slow things down
  - all array accesses require bounds check
  - Many I/O operations require security checks

The big picture



The big picture (cont.)



Java Strengths

- Simplicity (the language itself)
- Networking
- Object model
  - Graphical User Interface (GUI) programming
  - Large and Very Large systems.
  - Portable libraries

SDK Tools

- **`javac`**: the Java compiler.
  - Reads source code and generates bytecode.
- **`java`**: the Java interpreter
  - Runs bytecode.
- **`jar`**: Java Archive utility
- **`javadoc`**: create documentation from code.
- **`jdb`**: Java debugger (command line).
- There are others…**`appletviewer, javah, javap, extcheck,`**…

The Java Compiler

- Usage: **`javac filename.java`**
  - You can also do: **`javac *.java`**
  - Creates **`filename.class`** (if things work)

  - Use "-g" to compile for use with the debugger.

The Java Interpreter

- Usage: **`java classname`**
  - You tell the interpreter a class to run, not a file to run!
    - It uses the CLASSPATH to find the named class.
    - The named class should have a method with prototype like:
      - **`public static void main()`**

jar

- Like Unix tar command.
- Used to create (and extract from) an archive file:
  - collection of files.
  - compressed.
- Java can find classes (bytecode) that are stored in jar files.

jar usage

- To extract files:

```
jar xf filename.jar
```

- To list files:

```
jar tf filename.jar
```

- To create and archive:

```
jar cf filename.jar file1 file2 dir1 dir2 …
```

javadoc

- Creates documentation from properly commented Java source code.
- The output of javadoc includes HTML files in the same format as the Java SDK documentation.
  - we all need to get used to this format…
  - learning to find and understand the documentation on classes/methods is 1/2 of learning Java!

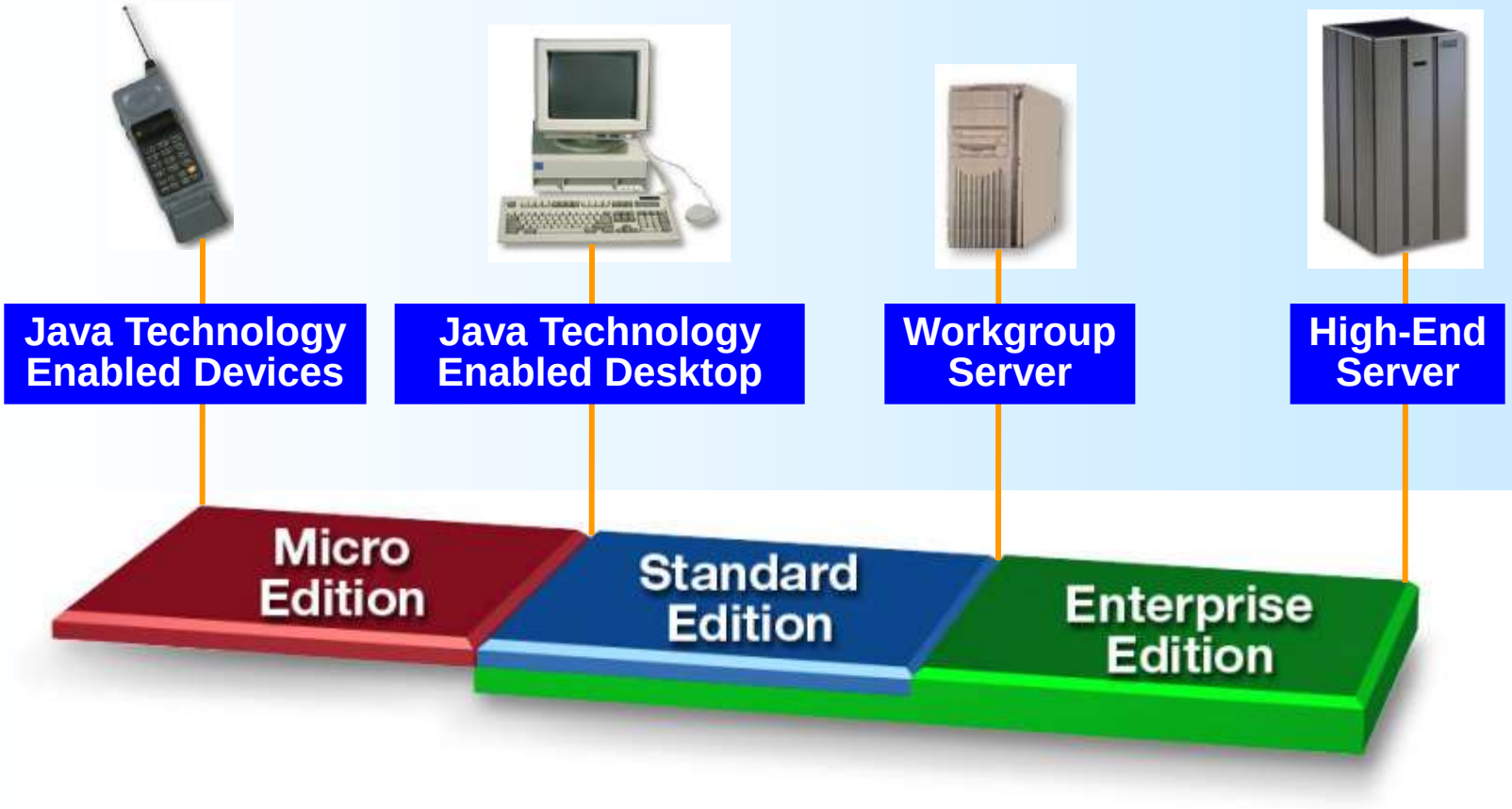
Using the tools

- We will look at these and other tools in more detail later…
- For now (HW1) we just need to be able to compile and execute a simple Java class.

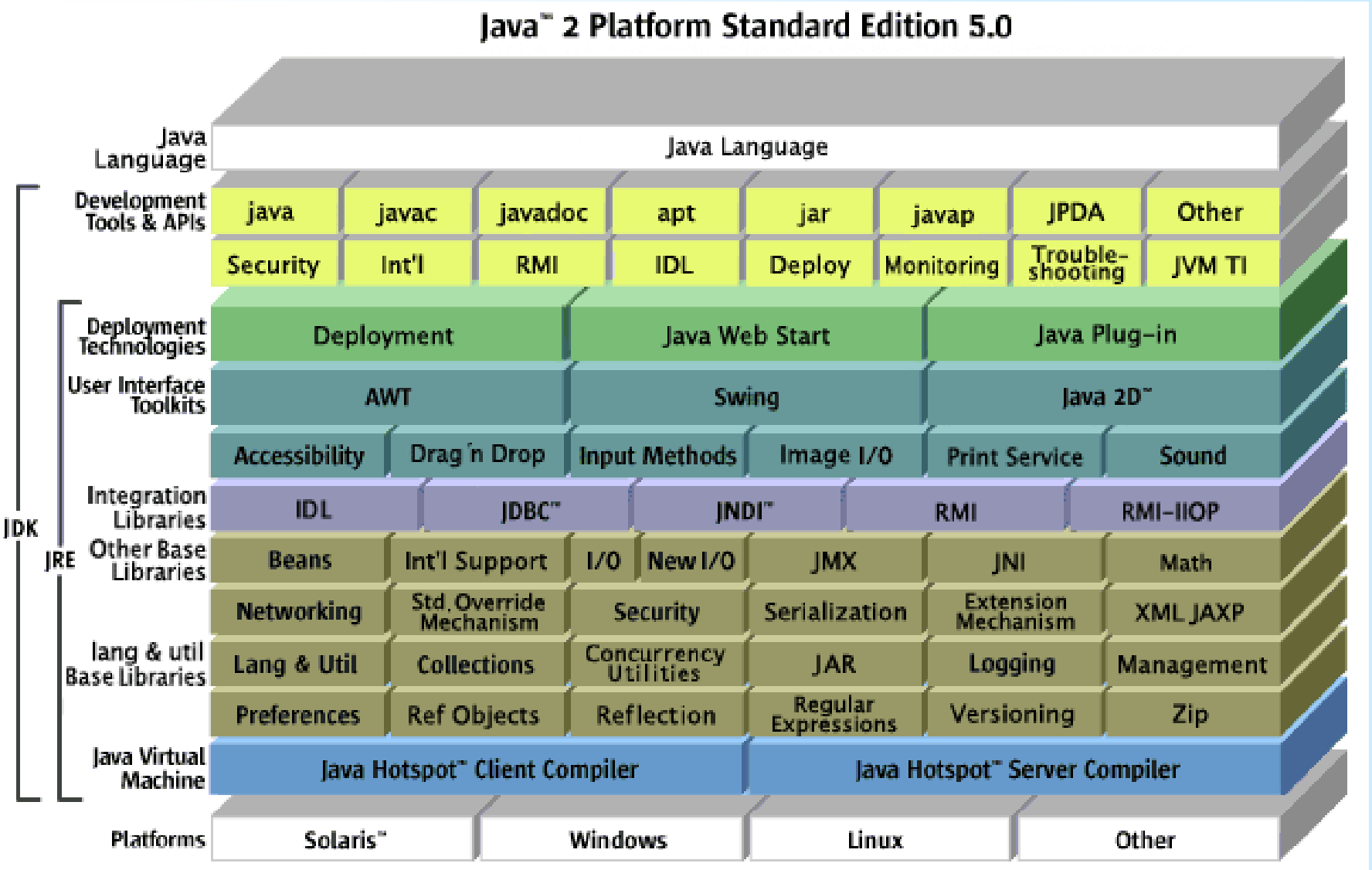
Java Versions

- **Java™ Platform, Standard Edition (Java SE)**
- **Java™ Platform, Enterprise Edition (Java EE)**
- **Java™ Platform, Micro Edition (Java ME)**

The Java™ Platform



Java™ SE 5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Java Language
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Int'l
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Drag 'n Drop
Input Methods
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Integration Libraries
IDL
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JNDI™
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Other Base Libraries
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Lang & Util
Collections
Concurrency Utilities
JAR
Logging
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Versioning
Zip
Java Virtual Machine
Java Hotspot™ Client Compiler
Java Hotspot™ Server Compiler
Platforms
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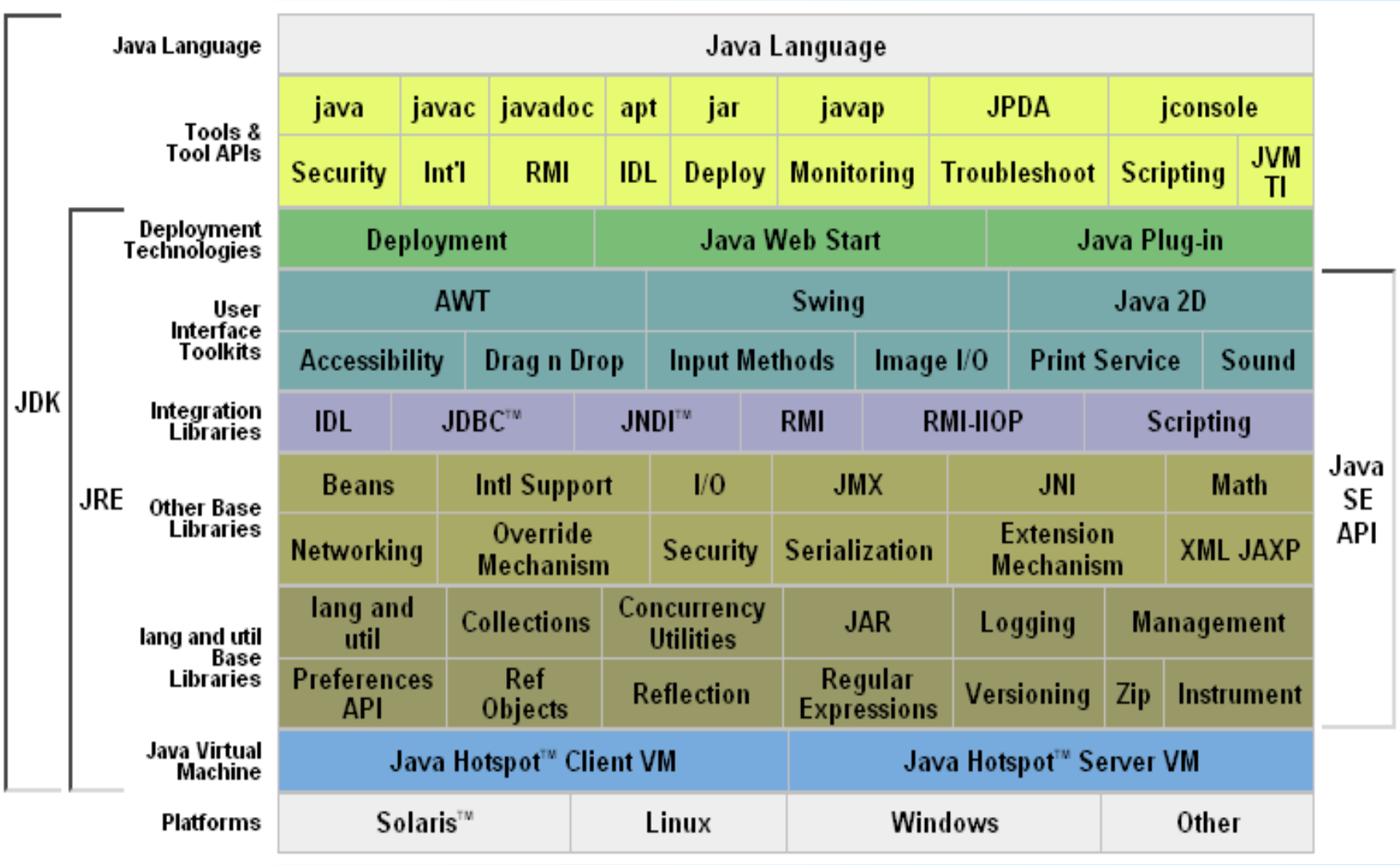
Other
JDK
JRE

Java™ SE 6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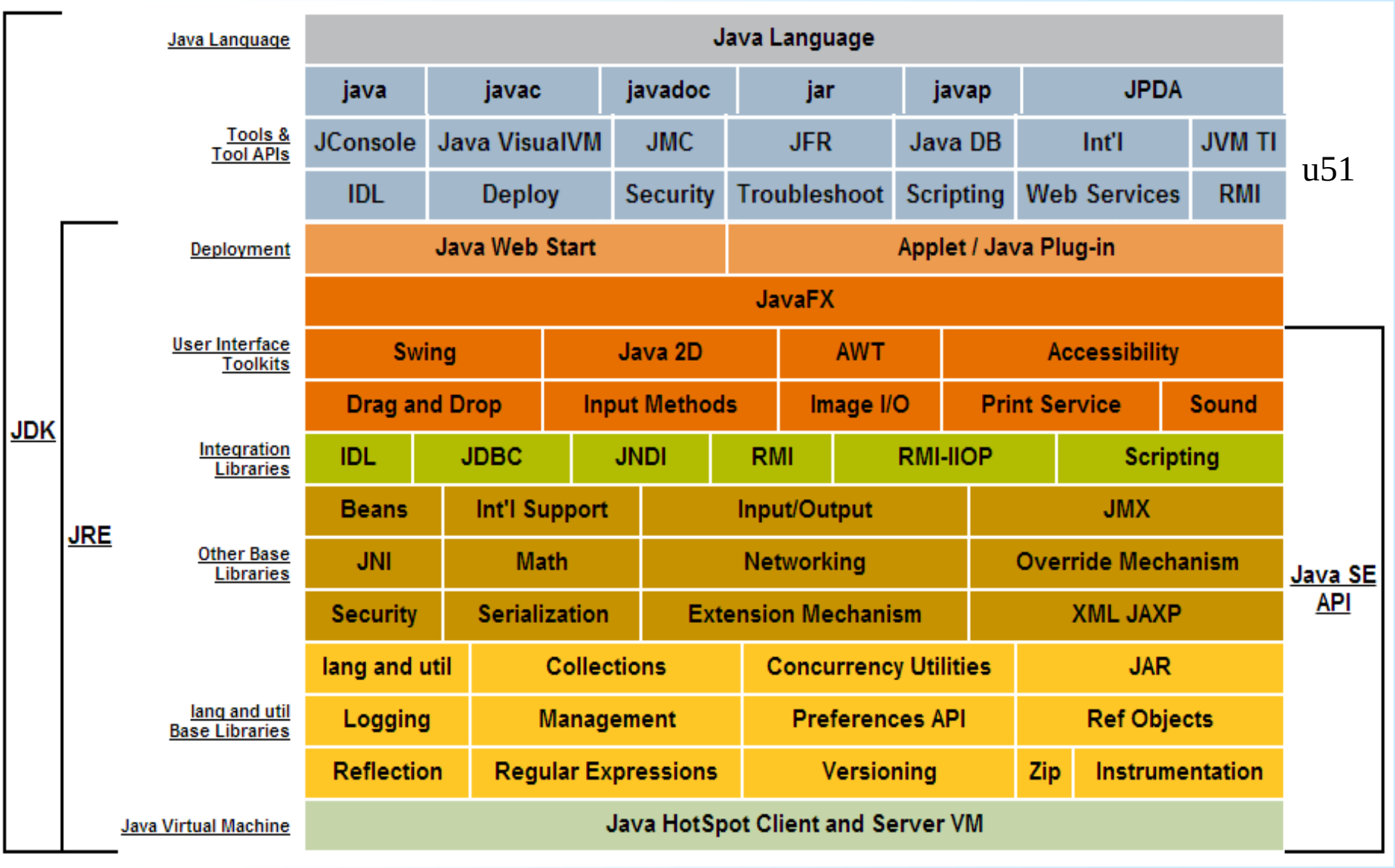
Java SE API

Java™ SE 7 –u01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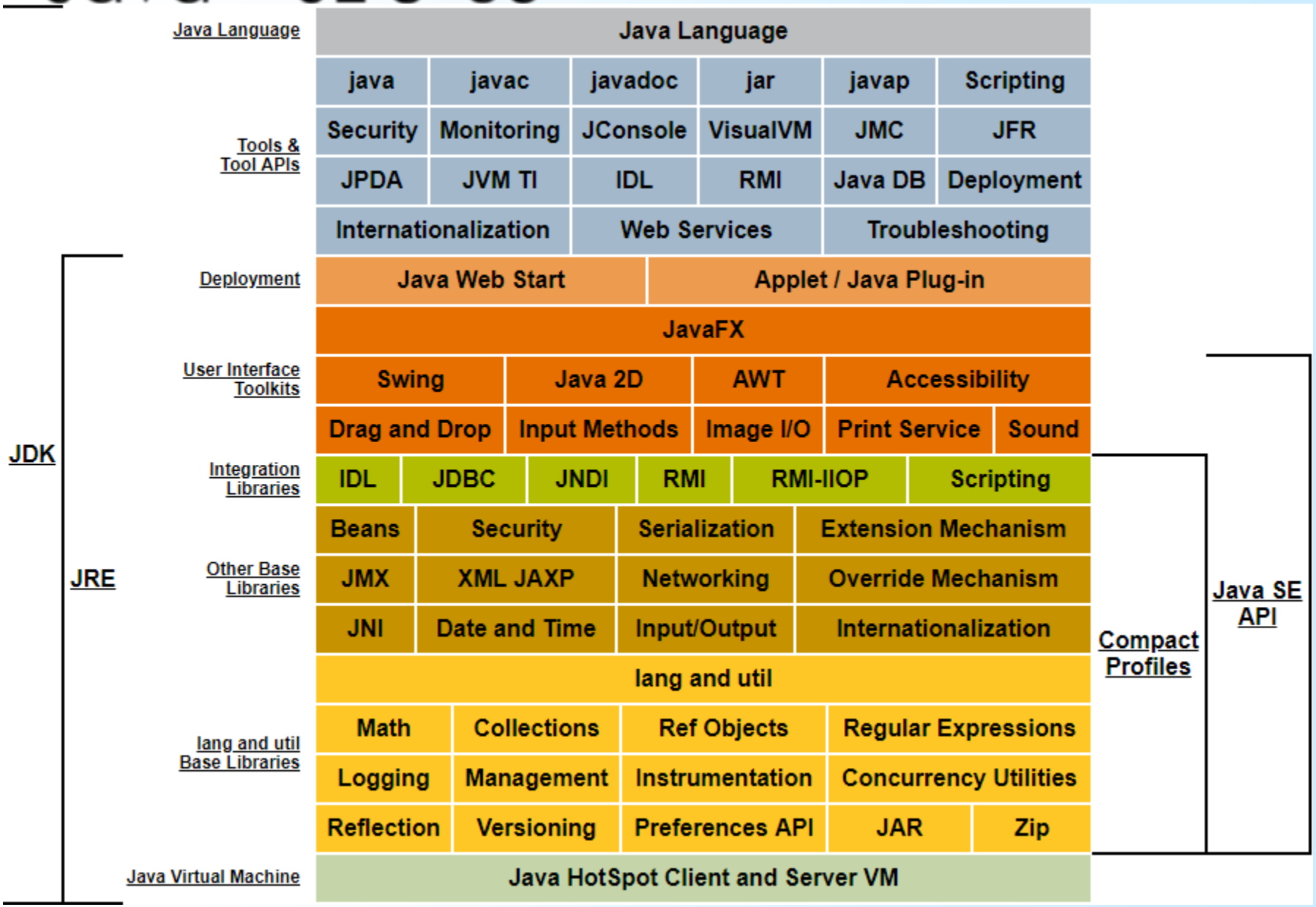
Java™ SE 8–u5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Compact Profiles
Java SE API

Getting, installing and testing the Java SDK

Installing SDK

- Make sure you have room! (150MB).
- Download the appropriate file from java.sun.com:
  - JDK Standard Edition 1.5.0 (or higher)
- Run the file (start the installation). Install somewhere easy to access, I liked **`D:\Java\jdk1.7.0_51`**, but now I just use the default directory.
- Download and install documentation
  - Java™ SDK Standard Edition documentation.
  - HTML files.

PATH Environment Variable

- To run the tools (compiler, JVM, etc) from the DOS command line you need to add the location of the tools to your PATH.
  - Follow the instructions found in the documentation at:
    `http://docs.oracle.com/javase/7/docs/webnotes/install/windows/jdk-installation-windows.html`

http://docs.oracle.com/javase/7/docs/webnotes/install/index.html

CLASSPATH environment variable

- The Java compiler and VM use the CLASSPATH environment variable to decide where to look for class definitions (Java code).
- For now it's enough the Java will look in the "current working directory".
- If your CLASSPATH is already set to something, you may need to add "." to it.

  ("." is *the* ***current directory***).
- Different directories is separated by "**;**"

Testing things

- Probably you need to reboot to have any changes to the PATH take effect. (Win2k, WinXP, Win7 do not need to reboot)
- Open a MS-DOS prompt window (command prompt for Win2K and up).
- Type "**`java -version`**". If you get "unknown command" or something like that, your PATH is not right…

Testing a Java Program

- In general, you do the following:
  - create a folder to hold the java code.
  - use an editor (notepad will work, but other editors will work better – check out editplus at www.editplus.com) to create a Java program.
  - compile the program (using **`javac`**)
  - run the program (using **`java`**)

Sun "first cup of Java" tutorial

- on the web at:
  http://download.oracle.com/javase/tutorial/getStarted/cupojava/win32.html

- Goes through all the steps, explains how to resolve common problems

First Cup of Coffee

```
class HelloWorld {
  public static void main(String[] args)
  {  //display "HelloWorld!"
   System.out.println("Hello World!");
  }
}
```

Be Careful When You Type 

Type all code, commands, and file names exactly as shown. Both the compiler (javac) and launcher tool (java) are *case-sensitive*, so you must capitalize consistently.

HelloWorld ≠ helloworld

Naming Conventions(协定)

Part of JavaSoft programming standard

- Words run together, no underscores
- Intermediate words capitalized
- Classes: first letter capitalized
- Methods and variables (including references): first letter lowercase
- Constants: all caps with underscores to separate words (like C).

Homework

- Get JDK installed and working.
- Modify a simple sample program.
- Use tag @author follows your name, Student No. and Email address.
- Compile and run the program.
- No need to submit.

Next

- Introduction to Objects
- Everything is an Object

- Language Basics