Module 1

Getting Started

Objectives

- Describe the key features of Java technology
- Write, compile, and run a simple Java technology application
- Describe the function of the Java Virtual Machine (JVM™)
- Define garbage collection
- List the three tasks performed by the Java platform that handle code security

NOTE: The terms "Java Virtual Machine" and "JVM" mean a Virtual Machine for the Java™ platform.

Relevance

- Is the Java programming language a complete language or is it useful only for writing programs for the Web?
- Why do you need another programming language?
- How does the Java technology platform improve on other language platforms?

What Is the Java™ Technology?

- Java technology is:
  - A programming language
  - A development environment
  - An application environment
  - A deployment environment
- It is similar in syntax to C++.
- It is used for developing both *applets* and *applications*.

Primary Goals of the Java Technology

- Provides an easy-to-use language by:
  - Avoiding many pitfalls of other languages
  - Being object-oriented
  - Enabling users to create streamlined and clear code
- Provides an interpreted environment for:
  - Improved speed of development
  - Code portability

Primary Goals of the Java Technology

- Enables users to run more than one thread of activity
- Loads classes dynamically; that is, at the time they are actually needed
- Supports changing programs dynamically during runtime by loading classes from disparate sources
- Furnishes better security

Primary Goals of the Java Technology

The following features fulfill these goals:

- The Java Virtual Machine (JVM™)[1]
- Garbage collection
- The Java Runtime Environment (JRE)
- JVM tool interface

The Java Virtual Machine

- Provides hardware platform specifications
- Reads compiled byte codes that are platform-independent
- Is implemented as software or hardware
- Is implemented in a Java technology development tool or a Web browser

The Java Virtual Machine

JVM provides definitions for the:

- Instruction set (central processing unit [CPU])
- Register set
- Class file format
- Stack
- Garbage-collected heap
- Memory area
- Fatal error reporting
- High-precision timing support

The Java Virtual Machine

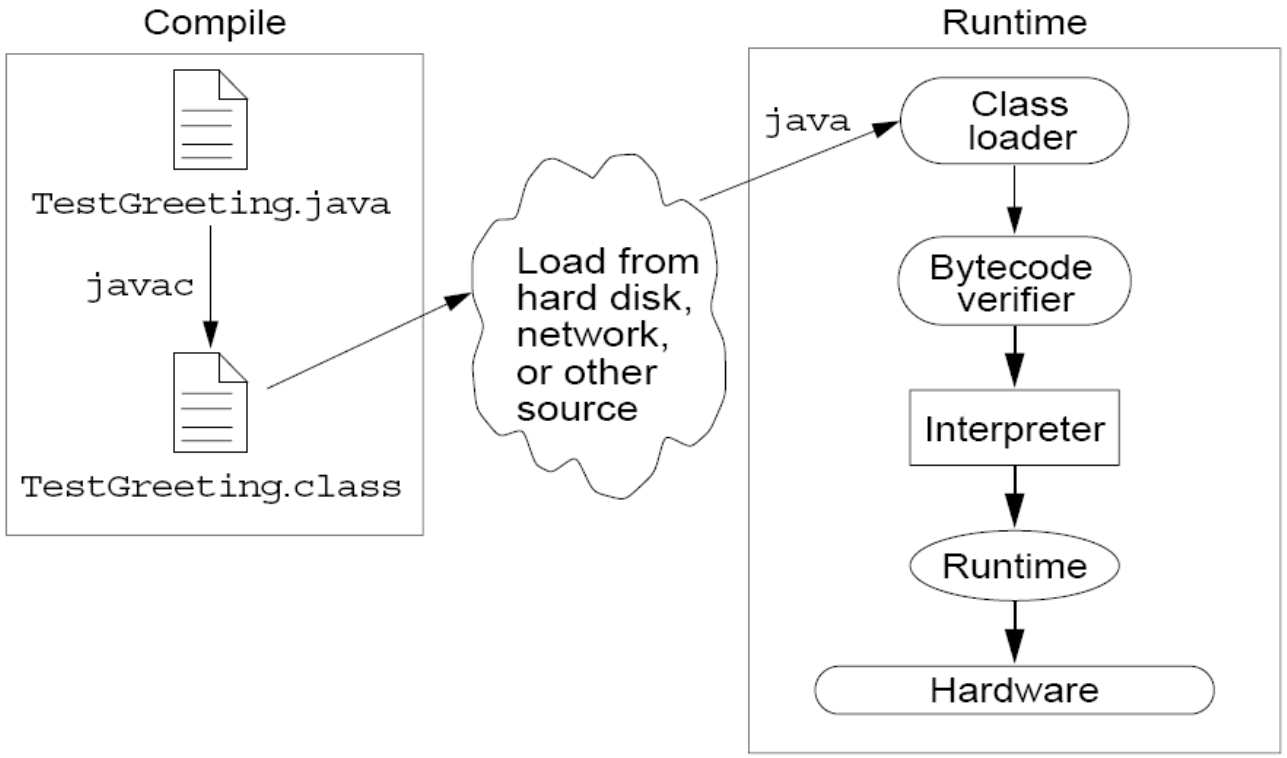
- The majority of type checking is done when the code is compiled.
- Implementation of the JVM approved by Sun Microsystems must be able to run any compliant class file.
- The JVM executes on multiple operating environments.

Garbage Collection

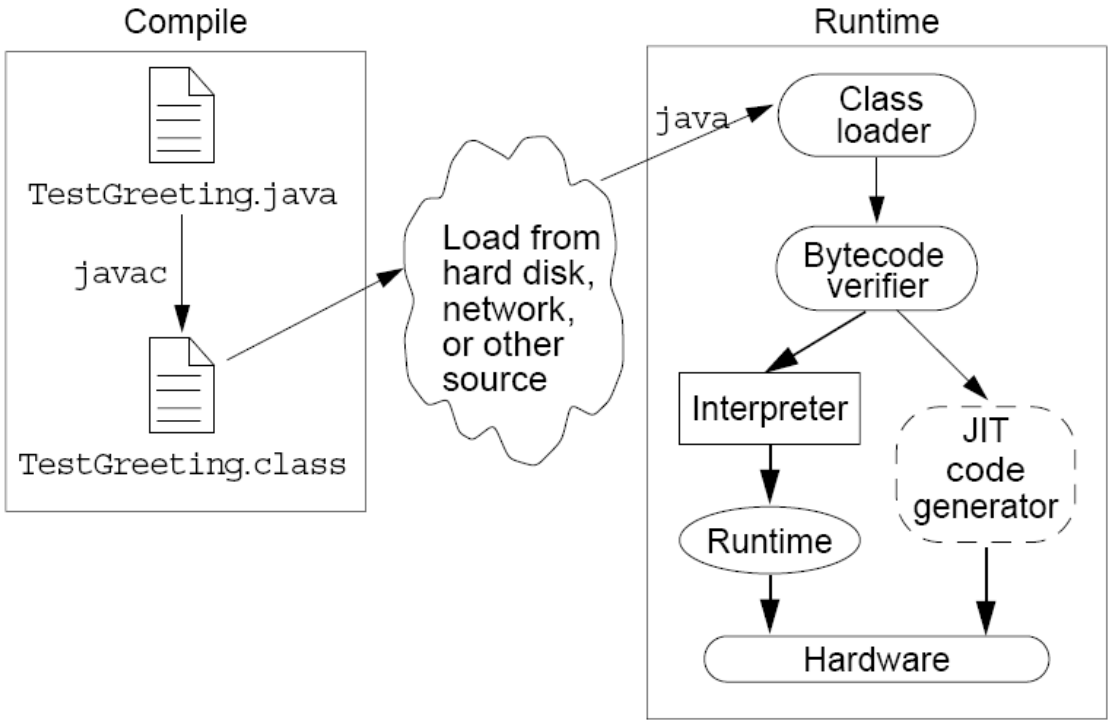
- Allocated memory that is no longer needed should be deallocated.
- In other languages, deallocation is the programmer's responsibility.
- The Java programming language provides a system-level thread to track memory allocation.
- Garbage collection has the following characteristics:
  - Checks for and frees memory no longer needed
  - Is done automatically
  - Can vary dramatically across JVM implementations

The Java Runtime Environment

The Java application environment performs as follows:



Operation of the JRE With a Just-In-Time (JIT) Compiler



JVM™ Tasks

The JVM performs three main tasks:

- Loads code
- Verifies code
- Executes code

The Class Loader

- Loads all classes necessary for the execution of a program
- Maintains classes of the local file system in separate *namespaces*
- Prevents spoofing

The Bytecode Verifier

Ensures that:

- The code adheres to the JVM specification.
- The code does not violate system integrity.
- The code causes no operand stack overflows or underflows.
- The parameter types for all operational code are correct.
- No illegal data conversions (the conversion of integers to pointers) have occurred.

A Simple Java Application

The `TestGreeting.java` Application

```
1   //
2   // Sample "Hello World" application
3   //
4   public class TestGreeting{
5     public static void main (String[] args) {
6       Greeting hello = new Greeting();
7       hello.greet();
8     }
9   }
```

The `Greeting.java` Class

```
1   public class Greeting {
2     public void greet() {
3       System.out.println("hi");
4     }
5   }
```

The `TestGreeting` Application

- Comment lines
- Class declaration
- The `main` method
- Method body

The `Greeting` Class

- Class declaration
- The `greet` method

Compiling and Running the `TestGreeting` Program

- Compile `TestGreeting.java`:

  ```
  javac TestGreeting.java
  ```

- The `Greeting.java` is compiled automatically.
- Run the application by using the following command:

  ```
  java TestGreeting
  ```

- Locate common compile and runtime errors.

Compile-Time Errors

- `javac: Command not found`
- ```
  Greeting.java:4: cannot resolve symbol
  symbol  : method printl  (java.lang.String)
  location: class java.io.PrintStream
  System.out.printl("hi");
            ^
  ```
- ```
  TestGreet.java:4: Public class TestGreeting
  must be defined in a file called
  "TestGreeting.java".
  ```

Runtime Errors

- `Can't find class TestGreeting`
- `Exception in thread "main" java.lang.NoSuchMethodError: main`

Java Technology Runtime Environment