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Introduction to Java

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1. Overview

In 1995, Java language burst onto the Internet scene. The growth in the popularity of the Internet, and of the World Wide Web, has created entire new worlds of programming possibilities. The Internet and corporate Intranets have been posted client/server programming and active content. In the pre-Java world of the Web, you could not consider on your users having a specific browser configuration. Java can solve the problem of passive content and browser dependence. We can say that Java is nearly ideal language for programming the World Wide Web.

Java, developed by Sun Microsystems, was designed for creating applets and application for Internet, Intranet, and any other heterogeneous, distributed network. As a computer language, it offers some powerful features such as simple, object-oriented, distributed, portable, dynamic and etc. It can make your programs better and requires less effort than other languages. One obvious advantage is a run time library that provides platform independence. No matter what your platform is, Java program can run. In addition, Java has a similar syntax with C++, which some programmers are already familiar with. But, some difficult features such as pointers in C++ are omitted in Java.
2. Introduction

The abilities of Java can make not only an active and dynamic content web page, but also client/server programming. The most common Java programs are application and applet. Application is standalone program. Applet is similar to application, but it run within a Java-compatible browser. Here are the capabilities of Java comparing with C++ programming language and advantages of Java.

2.1. Comparing with C++

i) Simple
Java started out as C++, but some of most difficult aspects of C++ programming such as memory management and pointers are removed. Actually, using pointer in the program, it will contain memory leaks that will cause the system to run out of memory. Therefore, why Java removes this feature is to avoid this problem occurring. And, the syntax of Java is also pretty simple.

ii) Object-Oriented
Nowadays, object orientation is very useful for writing large programs. Java and C++ also support object orientation, but Java does not include the multiple inheritance. In Java, multiple interfaces replaced multiple inheritances. It reduces the complexity. There is no global function in Java. All function is invoked through an object.

iii) Distributed
Networking capabilities of Java is strong and easy to use. Writing a network program in Java is much easier and simpler than other languages such as C++.

iv) Multithreaded
Multithreading is the ability for one program to do more than one thing at the same time. It is built directly into the Java language and runtime environment. If you have tried to do multithreading in C++, you will find that how easy it is in Java.

v) Secure
Java has a great deal of control over the code that exists within the Java environment because Java does not use pointers to directly reference memory locations.

2.2. Advantages of Java

1) It provides platform independence that you can use the same code on Window, Solaris, UNIX and so on.
2) It has a similar syntax to that of C++, so some of the terms used in Java you are familiar with.
3) It cannot perform manual memory allocation and deallocation.
4) It has fully object oriented.
3. Java Virtual Machine

Virtual machine is, developed by Sun Microsystems (developers of the Java programming language and runtime environment) a software that acts as an interface between compiled Java binary code and the microprocessor that actually performs the program's instructions. Once a Java virtual machine is installed in a computer, any Java program (which, after compilation, is called byte code) can run on that platform. Java was designed to allow application programs to be built that could be run on any platform without having to be rewritten or recompiled by the programmer for each separate platform. Java's virtual machine makes this possible to provide platform independence.

The output of "compiling" a Java source program (a set of Java language statements) is called **byte code**. A Java virtual machine can either interpret the byte code one instruction at a time (mapping it to a real microprocessor instruction) or the byte code can be compiled further for the real microprocessor using what is called a just-in-time (JIT) compiler.

Java code is really small, ideal for transmission over the network and designed for virtual machine. The advantage of using a virtual machine is that you can design it as simple as you want. Then implementing interpreters for several machines you can run the same code over different platforms.
4. Java Programming
A Java program is executed as either an application which runs stand-alone from the command line or an applet that runs under a Web browser. Applications and applets start program execution in different ways; an application has a `main()` method and an applet has a `init()` method initialised by the browser.

4.1. Java Application
The source code of a Java application is stored in file with the suffix ".java". The source code is compiled into bytecode and stored in a file with the suffix ".class". Here is a sample code of application.

```java
Line 1  public class JavaApplication {
Line 2     public static void main(String[] args){
Line 3         System.out.println("Welcome to Java Online Course!");
Line 4     }
Line 5  }
```

This is a simple example to illustrate Java application program. It will print a "HelloWorld" message in the console.

Once the code is compiled, you can execute the application using the java virtual machine. To do so, you type the following in the same directory:

```
java JavaApplication
```

4.2. Java Applet
An applet is also a Java program that can operate only within a compatible Web browser, such as Netscape Navigator or Microsoft Internet Explorer. It is a little application program. On the Web, an applet is a small program that can be sent along with a Web page to a user. Java applets can perform interactive animations, immediate calculations, or other simple tasks without having to send a user request back to the server.

Here is a sample code of applet.

```java
Line 1  import java.awt.*;
Line 2  import java.applet.Applet;
Line 3  public class JavaApplet extends Applet{
Line 4     public void paint(Graphics g) {
Line 5         g.drawString("HelloWorld",25,50);
Line 6     }
Line 7  }
```

This program is as same as the previous program. It will also display the "HelloWorld" message, but displays on the browser.
The source code of a Java applet is also stored in file with the suffix ".java". The source code is compiled into bytecode and stored in a file with the suffix ".class". The ".class" file is included in the HTML document using the applet tag. Here is an example of the applet tag used by the JavaApplet applet:

```html
<APPLET CODE="JavaApplet.class" WIDTH=200 HEIGHT=200>
```

A Java applet is executed by a Web browser when the browser loads an HTML document that contains an applet tag. The JavaApplet applet source code is stored in “JavaApplet.java”. Its bytecode is stored in “JavaApplet.class”. It is included in the test.html document. The applet tag defines the width and height of the applet window within the HTML document. The applet tag has numerous attributes to enhance its placement within the HTML document.
5. Java 2 Enterprise Edition

In mid of 1999, Sun released its Java 2 Enterprise Edition (J2EE) specification which provided a comprehensive view of the Java middle tier (Presentation Layer and Business Logic Layer) solution. Presentation layer generates web pages, including dynamic content. It interprets web pages submitted from the client. Business Logic Layer performs validations and handles interaction with the database.

J2EE implements the Presentation Layer with Servlets and, more recently Java provides the option to generate web pages with dynamic content using JavaServer Pages (JSP). Servlets/JSP generate web pages with dynamic content. They can also parse web pages submitted from the client and pass them to Enterprise JavaBeans for handling. Servlets and JSPs run inside a Web Server.

J2EE implements the Business Logic layer with Enterprise JavaBeans (EJB). Enterprise JavaBeans are responsible for logic like validation and calculations as well as provided data access (e.g. database I/O) for the application. Enterprise JavaBeans run inside an Application Sever.

In addition, J2EE provides for access by non-web clients to the business logic layer. A standalone Java application (IIOP client) can access an EJB directly using J2EE's Remote Method Invocation (RMI) API.
6. Java Servlets

Common Gateway Interface (CGI) was one of the first things for creating dynamic content of web pages. CGI is a standard for external gateway programs to interface with information servers such as Hyper Text Transfer Protocol (HTTP) or Web servers. Since a CGI program is executed in real-time by the web server, it can output dynamic information to the user. Nowadays, CGI can be written in any languages (C, C++, Perl, ASP and etc).

In 1997, Sun introduced Servlets to create web pages with dynamic content. Servlets are used within a web server and run inside the Java Virtual Machine (JVM) on the server. Unlike applets, they do not require support for Java in the web browser. Servlets can be run on all major web servers (either directly or via widely available third-party plug-ins).

In creating web pages with dynamic content, Servlets also provide an infrastructure to parse/decode the user-submitted HTML form, handle cookies, etc. Therefore, the Servlet can manage all the presentation aspects of the web application. Servlets are 100% pure Java server-side modules.

Moreover, Servlets can access database directly or Servlets can derive their dynamic content via Enterprise Java Beans which run on an application server.

Since Servlets follow the standard Sun-defined API, Servlet application code is also portable across web servers. Servlets can also access to the entire family of Java APIs, including the JDBC to access enterprise database.

The following Servlet code sample generates a webpage that displays “Hello World”.

```java
import java.io.*;
import java.text.*;
import java.util.*;
import javax.servlet.*;
import javax.servlet.http.*;

public class HelloWorldExample extends HttpServlet {
    ResourceBundle rb = ResourceBundle.getBundle("LocalStrings");

    public void doGet(HttpServletRequest request, HttpServletResponse response) throws IOException, ServletException {
        response.setContentType("text/html");
        PrintWriter out = response.getWriter();

        out.println("<html>");
        out.println("<body>");
        out.println("<head>");
        out.println("<title>Hello World!</title>");
    }
}
```

out.println("</head>");
out.println("<body>");
out.println("<h1>Hello World!</h1>");
out.println("</body>");
out.println("</html>");
}
7. **JavaServer Pages (JSP)**

While Servlets provided a Java-based solution for generating dynamic webpages, many find Servlets troublesome to develop. Needing to write line-after-line of `out.println()` is both troublesome and it obscures the resulting HTML.

In apparent admiration of Microsoft's cleaner Active Server Pages (ASP) solution for dynamic webpages, Sun introduced JavaServer Pages (JSP) in 1999. JSP allows you to mix static HTML with server-side scripting to produce dynamic output. JSP uses XML-like tags and scriptlets written in the Java programming language to encapsulate the logic that generates the content for the page.

```
%@ page session=false %>
<%
String title = "Hello, world!";
%>
<head>
<title>%title</title>
</head>
<body bgcolor=white>
<h1>%title</h1>
</body>
```

As you can see in the code sample, JSP dynamic directives are surrounded by `<% %>` while the standard HTML is simply written in `< >`. JSP provides a number of server-side tags that allow developers to perform most dynamic content operations without ever writing a single line of Java code.

JSP is an extension of the Java Servlet. The Web Server translates the JSP into a Servlet. The advantage is that the programmer only needs to put together the simpler JSP page and let the web server do the translation to Servlet code.

In the basic model, a request is sent directly to a JSP page. The picture as below illustrates the flow of information in JSP model. JSP code can control interactions with JavaBeans components for business and data logic processing, and then displays the results in dynamically generated HTML mixed with static HTML code.

Sun has stated that "JSPs are the norm" while Servlets will be the exception in terms of developing dynamic webpages. In other words, Servlets would only be used for creating dynamic webpages in those unusual situations where JSPs cannot effectively do the job.
8. **Java Editor**

a) **Sun**

Sun has three editions for Java.

**Java Enterprise Edition (J2EE):** which addresses using Java in the middle tier of large Enterprise Web applications

**Java Standard Edition (J2SE):** The essential Java 2 SDK, tools, runtimes, and API for developers writing, deploying, and running applets and applications in the Java programming language.

**Java Micro Edition (J2ME):** It became necessary to define a smaller edition with the "key" language features that was suitable for running on small or embedded consumer products, including pagers, cellular phones, screenphones, digital set-top boxes and car navigation systems.

b) **Microsoft**

Microsoft Visual J++ 6.0 is an integrated windows-hosted development tool for Java programming. It introduces the Windows Foundation Class for Java (WFC). This is a new application framework accesses the Microsoft Windows API. It allows you to write full-featured Windows application with the Java programming language.
9. Resources

a) Resources for development
   i) Java 2D Graph Package
      Facilitate plotting data using Java applets.
      http://www.sci.usq.edu.au/staff/leighb/graph/
   
   ii) JARS - The Java Applet Rating Service
      Rates Java based applets and applications and other Internet related software.
      http://www.jars.com/
   
   iii) Java Boutique
      Contain a lot of interesting applets. They also feature Java technology news, reviews, and a developer forum.
      http://javaboutique.internet.com/
   
   iv) Intel Web Applets
      Add interactivity to your Web pages with new applets. You can use these applets to complement your site with your own images.
      http://www.intel.com/home/funstuff/webapplets/
   
   v) Java Resources - The complete webmaster
      Have some simple examples that show the tools and technology that you use everyday.
      http://abiglime.com/webmaster/articles/java.htm
   
   vi) Java CodeGuru: Applet
      Share the piece of code with others, provide useful techniques when writing applets and contains applets with source code.
      http://www.codeguru.com/java/Applet/index.shtml
   
   vii) JPowered.com
      Have high quality Java applet that make your pages look more professional than just HTML alone.
      http://www.jpowered.com/
   
   viii) ET Applets
      Collect small and fast Java applets to make your web page more attractive. The applets can be customized by the user in all fonts and colors.
      http://www.entanke.se/
   
   ix) CadViewer
      Have a java based viewer for AutoCad or other CAD drawings saved using the dwf file format.
      http://www.cadviewer.com/

b) Educational resources writing in Java
   i) Interactive Physics and Math with Java
      Contains 23 educational Java applets illustrating physics concepts.
Molecular Dynamics Simulation with Java
Generate interactive computer graphics to represent intermolecular interaction “from the molecular point of view”.
http://ws05.pc.chemie.tu-darmstadt.de/research/molcad/java/

Constructive and Destructive Wave Interference
Adjust the wavelength and amplitude of the two upper waves by clicking and dragging on the grey ball.
http://ciu.ic.polyu.edu.hk/course/offline/Wave%20Interference.htm

Refraction of Light
http://ciu.ic.polyu.edu.hk/course/offline/Refraction%20of%20Light.htm

c) Game writing in Java

Maze in 3D
http://users.nbn.net/%7Emr_g/java/Maze3D/arcade/maze/maze.htm

Snapple Good Fruit! Bad Fruit
http://www.snapple.com/play/fruit.html