Enterprise Application Development

An Introduction to Java Enterprise Edition

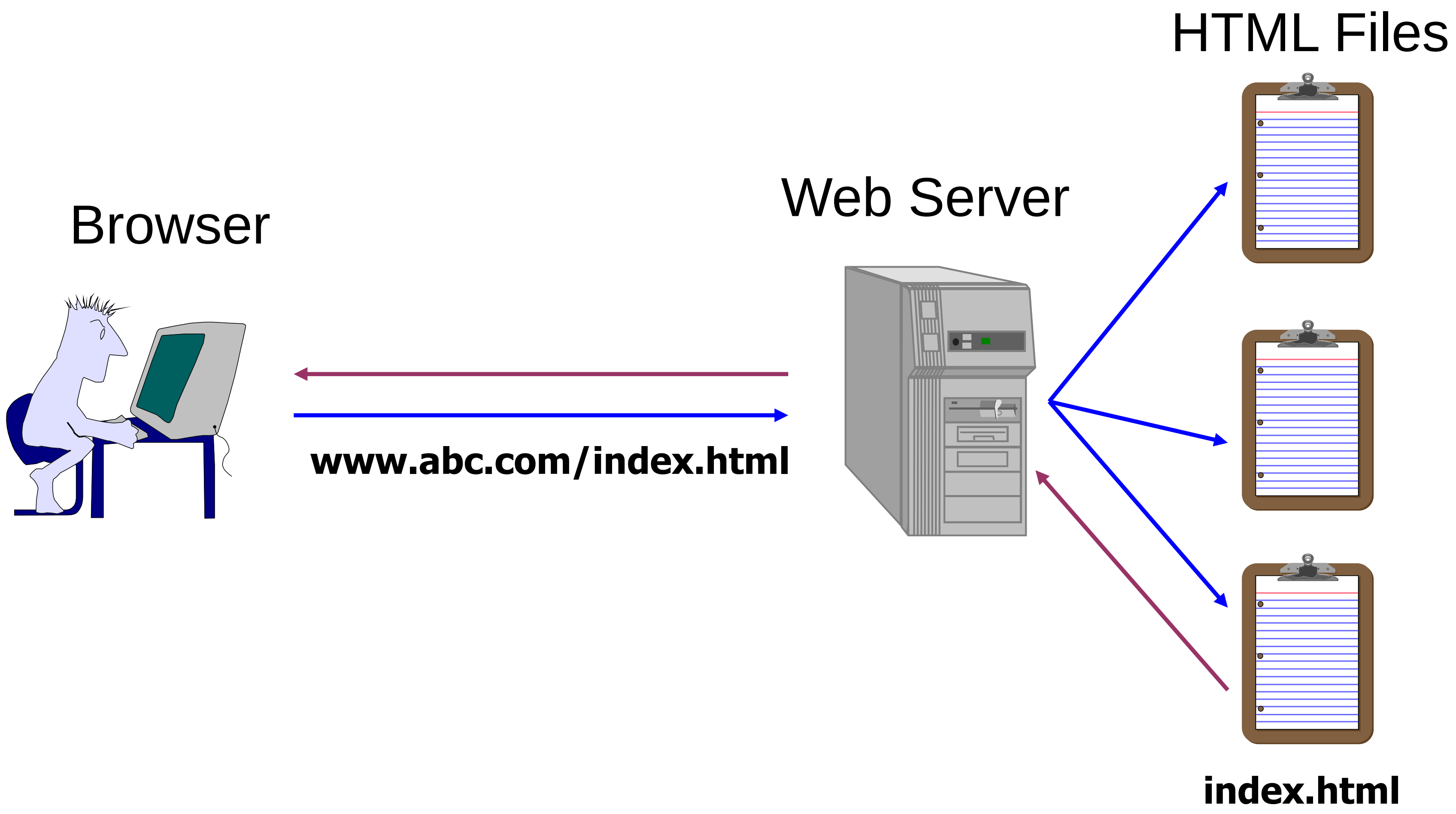
Shahid Beheshti University

Sadegh Aliakbary

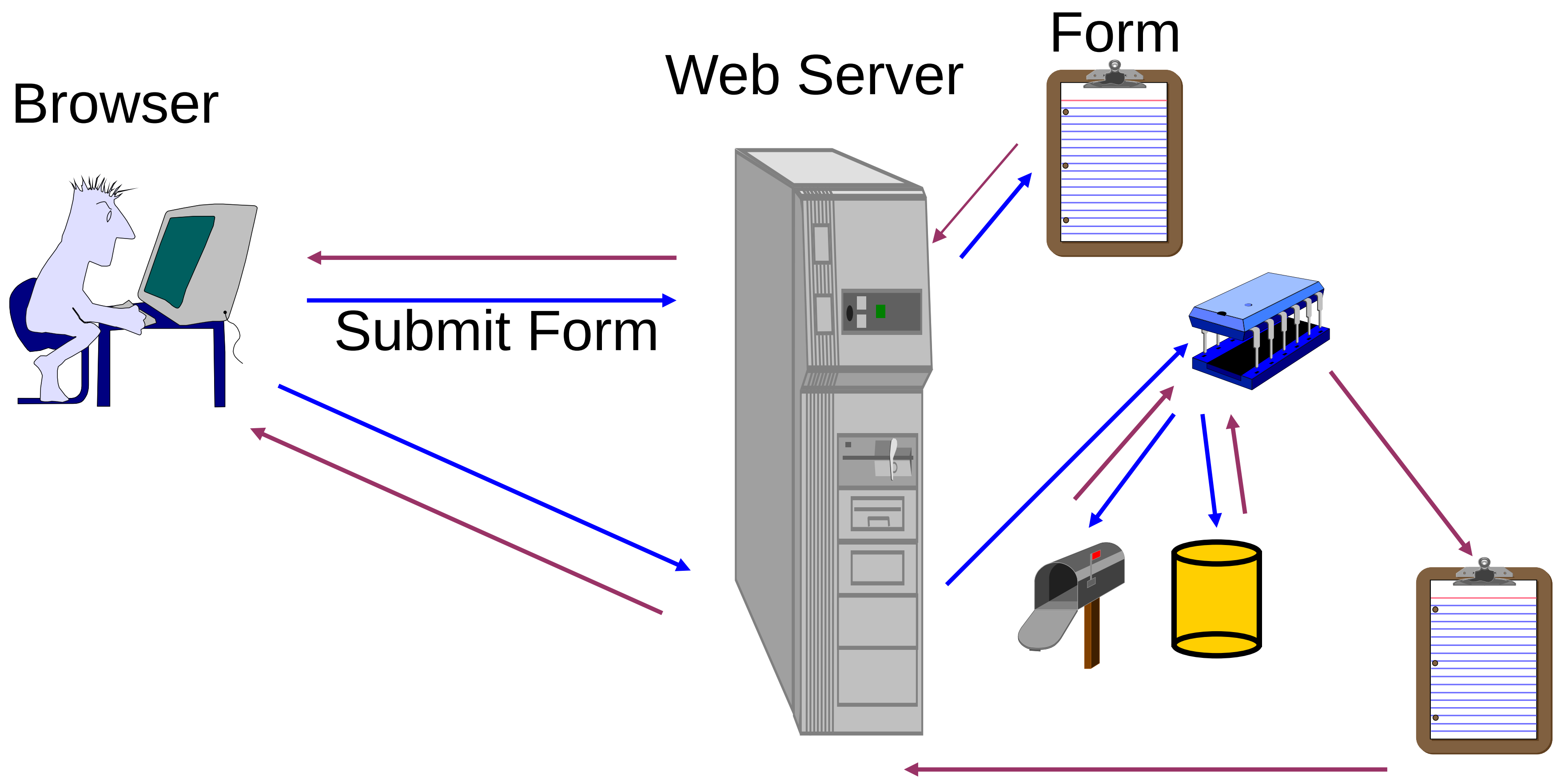
Outline

- Enterprise Application Development
- Web Programming
- Java Enterprise Edition
  - Architectures
  - Patterns
  - Standards
  - Technologies

Static Web Pages



Dynamic Web Pages



Web Application

- Definition: *A web application is an application delivered to users from a web server over a network such as the Internet*
- Only needs a web browser to use the application (Thin Client)
  - Software application that is coded in a browser-supported language
- Common web applications, e.g., webmail, Google Docs, Portals, …

Web Applications Layers

- Logical Partitioning → Layering
- Common layering in web applications
  - Presentation Layer
  - Business logic Layer
  - Data (management/source) Layer
- These layers are purely abstractions
- These layers may not correspond to physical distribution (tiers)

Presentation Layer

- Handling the interactions between the user and the software
  - GUI
  - HTML based browser
- The user interface of the application
  - Can be made up client side & server side codes
- It communicates with other layers by outputting results to the browser/client software and all other layers

- What is this layer in Facebook?

Business Logic Layer

- The work that the application needs to do for the domain
- It controls an application's functionality by performing detailed processing
  - Validation of the data from the presentation
  - Processing/Computing/Calculations
  - Dispatching data source logic
  - …
- What does this layer do in Facebook?

Data Layer

- Communicating with other systems that carry out tasks (typically data retrieval) on behalf of the application
- Database server
- Files
- Transaction monitor

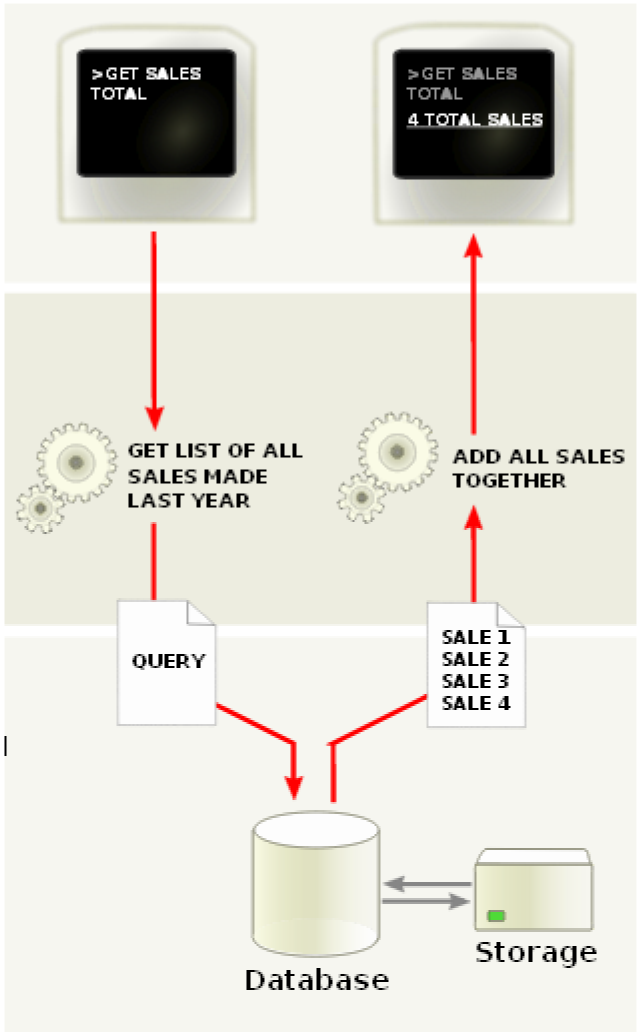
- What is this layer in Facebook?

Multilayer Architecture

Presentation Layer

Business logic Layer

Data Layer



Data Layer Trends

- New Patterns and technologies in data layer:

- Object Databases
- ORM
- NoSQL
- CQRS
  - Command Query Responsibility Segregation
- Data-warehousing

Client-Server Architecture

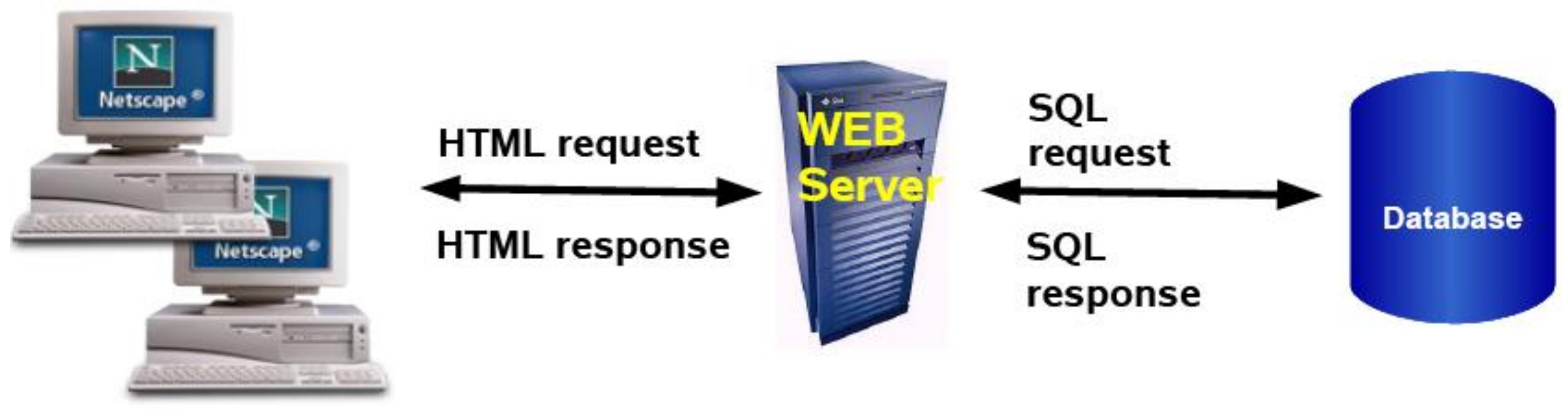
- Client-Server: The traditional architecture for distributed computing (including web)
- Client: Active (master), Sends requests, Awaits response
- Server: passive (slave), waits for requests, serves requests and sends a response
- Thin client (Pros and Cons?)
  - function is mainly presentational
    - e.g. standard browser functionality
  - All significant processing done by server
- Fat client (Pros and Cons?)
  - Significant processing on client
    - e.g. Java applet, Flash
  - less server load

Multitier Architecture

- Physical separation of these layers is another story
  - Tiers: the physical separation of layers
- Three-tier Architecture:
- N-tire Architecture:

Three-Tier (Web Server)

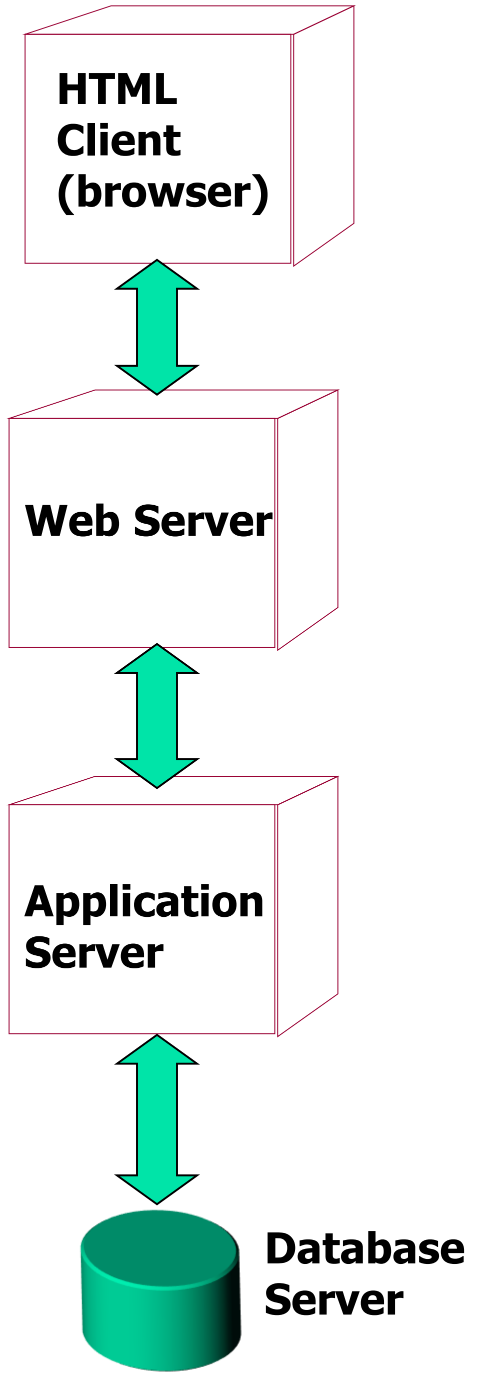
- Browser handles presentation logic
- Browser talks to Web server via HTTP protocol
- Business logic and data model are handled by "dynamic contents generation" technologies (CGI, Servlet/JSP, ASP)



N-Tier Architecture

- In N-tier deployments, presentation layer, business logic layer, and data layer are separated into respective physical tiers
  - 3 tier: client + server + data base
- Presentation layer is implemented by parts in both client & server sides
  - E.g., dynamic web page using AJAX + PHP
  - 4 tier: Browser + Web server + Application Server + Database server
- Complicated Bussing logic layer itself can be distributed multitier application → N-tier

Typical Web Application N-tier Architecture



N-Tier Architecture Characteristics

- Migration costs are low
  - Business logic application migration
  - Database switching
  - Web server switch
  - OS upgrade
  - Each tier can be upgraded independently
- Communication performance suffers
- Maintenance costs are high

Application servers

- Many common requirements in applications
  - Transaction, Logging and audit, Security, and much more
- These are not implemented by neither OS nor Application developer
  - They are called middleware
- Application servers provide middleware services
  - Application components live inside application servers

Application Servers

- Existing technologies can be classified into three broad categories
- Java based platform (Java Enterprise Edition)
- .NET Framework
- Other web application development frameworks
  - PHP frameworks: Zend, …
  - Ruby on Rail
  - …

Java Enterprise Edition

The Enterprise Today

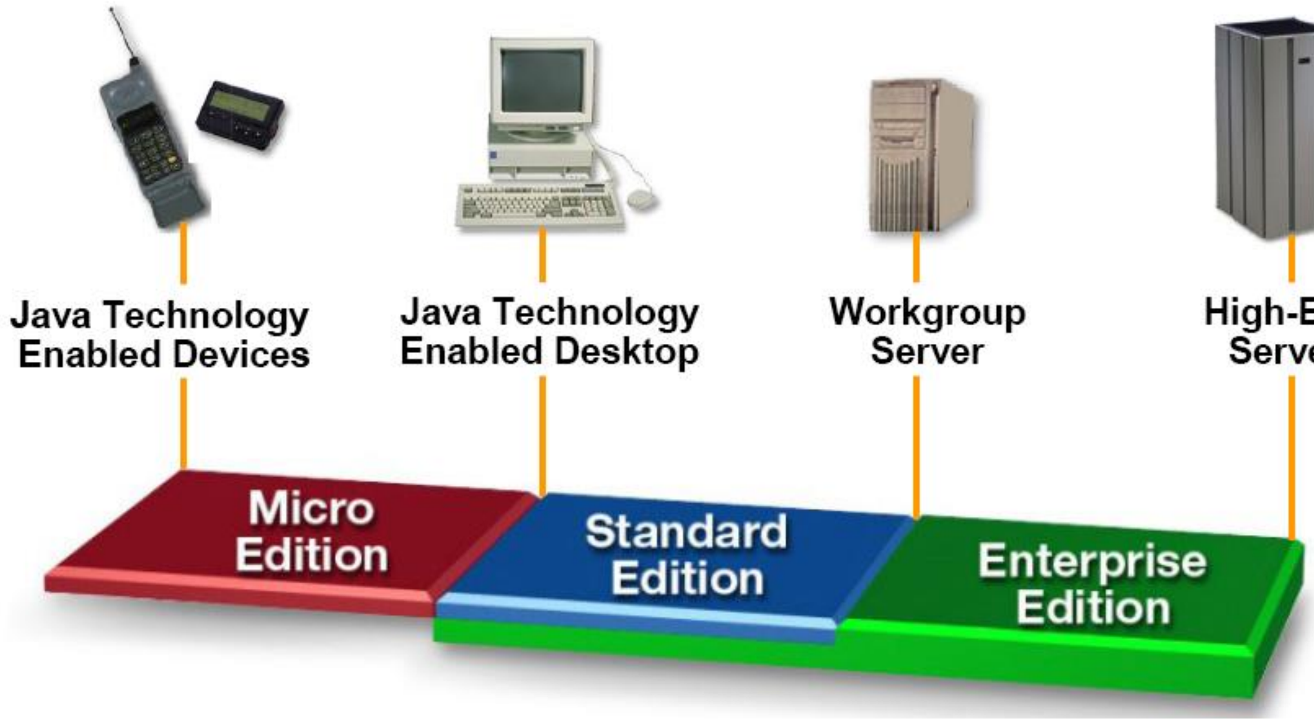
- Availability 7×24
- Performance
- Extensibility
- Security
- Scalability
- Integration

Eenterprise

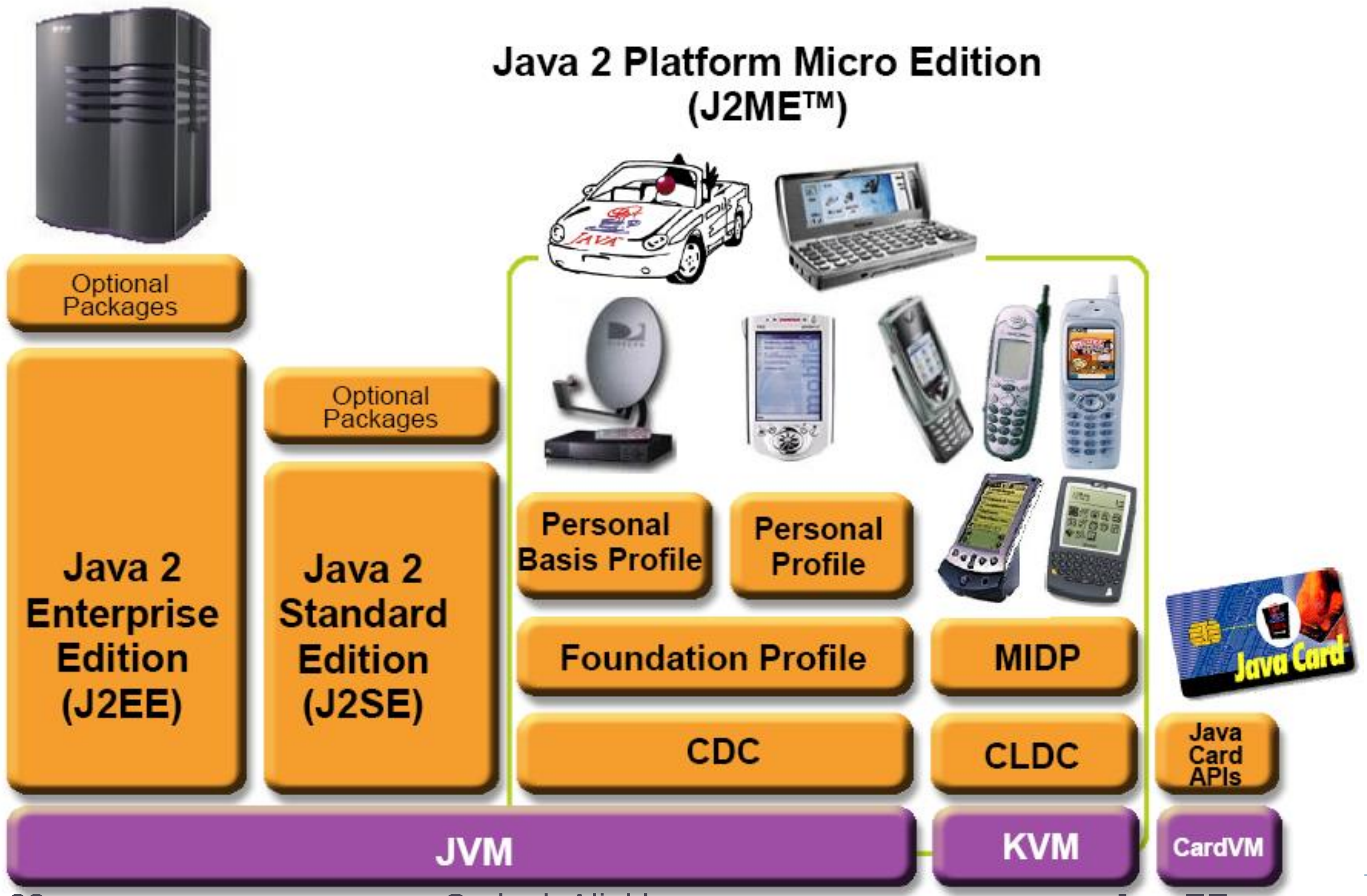
- a project, typically one that is difficult or requires effort.

- a business or company.

The Java™ Platform



The Java™ Platform



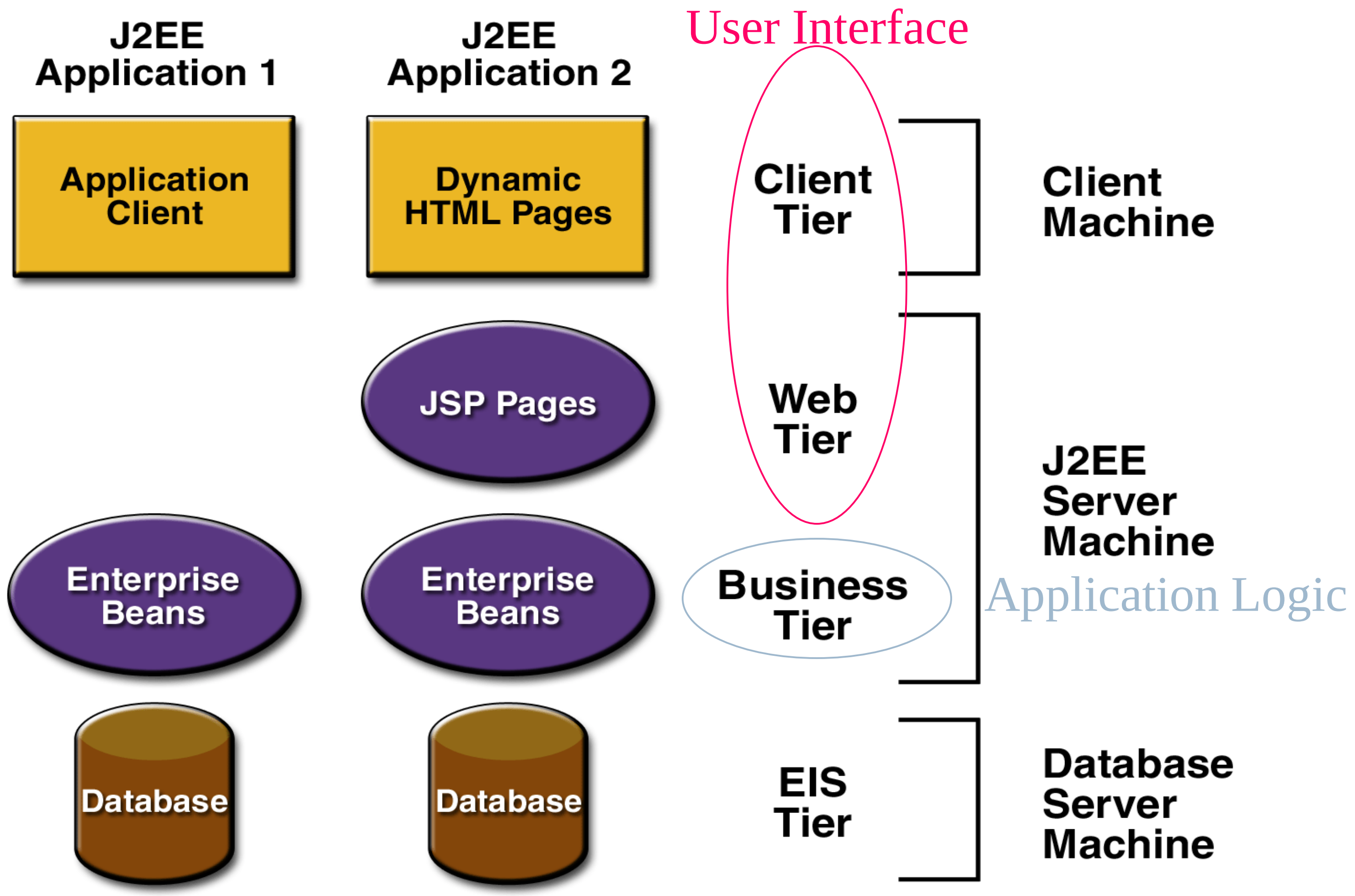
Java EE

- Java Platforms
  - Java Card: Smart card version
  - Java ME (Micro Edition): Embedded systems, e.g. Mobile handheld
  - Java SE (Standard Edition): Desktop application development
  - Java EE (Enterprise Edition): Enterprise distributed application software
- Java EE add standards and libraries to SE for fault-tolerant, distributed, multi-tier based components
  - Until java 5, it has been called J2EE

JavaEE

- JavaEE platform is a simple, unified **standard** for distributed applications through a **component-based** application model
- Provides a component-based approach to the design, development, assembly, and deployment of enterprise applications
- It’s based on **3^+-tier** Application Architecture

JavaEE Application Architecture



J2EE Components

- J2EE Client
  - Web Client(DHTML,HTML,XML,...)
  - Applet
  - Application Client
- J2EE Server
  - Web Component
  - Business Component
- Enterprise Information System (EIS)
  - DBMS,…

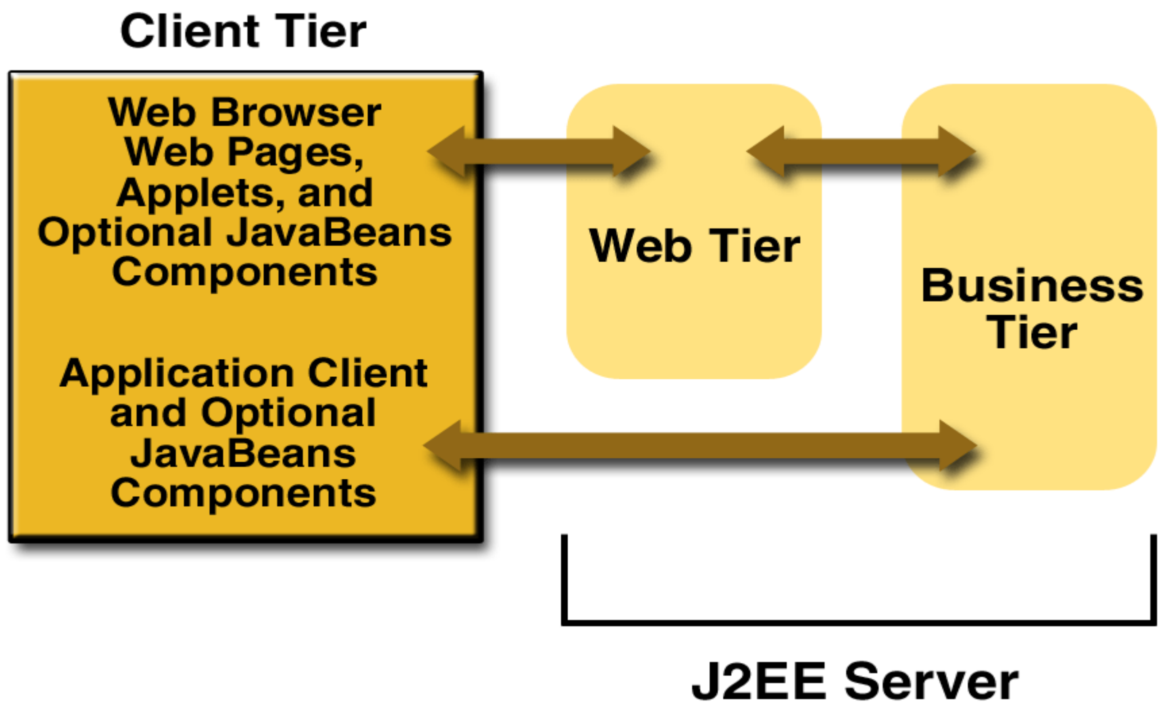
Web Client

- Web pages containing various types of markup language *(e.g. HTML, XML)*, which are generated by web components running in the web tier
- Web Browser
- is called thin client

Application Client

- It typically has a graphical user interface(GUI) created from Swing or AWT APIs, but a command-line interface is certainly possible.
- Application clients directly access enterprise beans running in the business tier
- is called thick client

J2EE Server


Client Tier
Web Browser
Web Pages,
Applets, and
Optional JavaBeans
Components
Application Client
and Optional
JavaBeans
Components
Web Tier
Business
Tier
J2EE Server

Java EE

- Java EE provides technologies (libraries) for enterprise level applications
- Java EE technologies for web applications
  - Servlet
  - JavaServer Pages
  - JavaServer Faces
  - Java Enterprise Beans
- Many other required libraries
  - Remote method invocation, Security, Database connectors, XML, …

Java EE Standards and Technologies

- Java API for RESTful Web Services (JAX-RS)
- Web Services
- Java API for XML-Based Web Services (JAX-WS)
- Java Architecture for XML Binding (JAXB)
- Java API for XML-based RPC (JAX-RPC)
- Java APIs for XML Messaging (JAXM)
- Java **Servlet**
- JavaServer Faces (**JSF**)
- JavaServer Pages (**JSP**)
- JavaServer Pages Standard Tag Library (JSTL)
- Enterprise JavaBeans (**EJB**)
- Java Persistence API (**JPA**)
- Java EE Connector Architecture
- Java Message Service API (**JMS**)
- Java Transaction API (**JTA**)
- **JavaMail** API
- Java Authentication Service Provider Interface for Containers (JASPIC)
- Java Authorization Service Provider Contract for Containers (JACC)

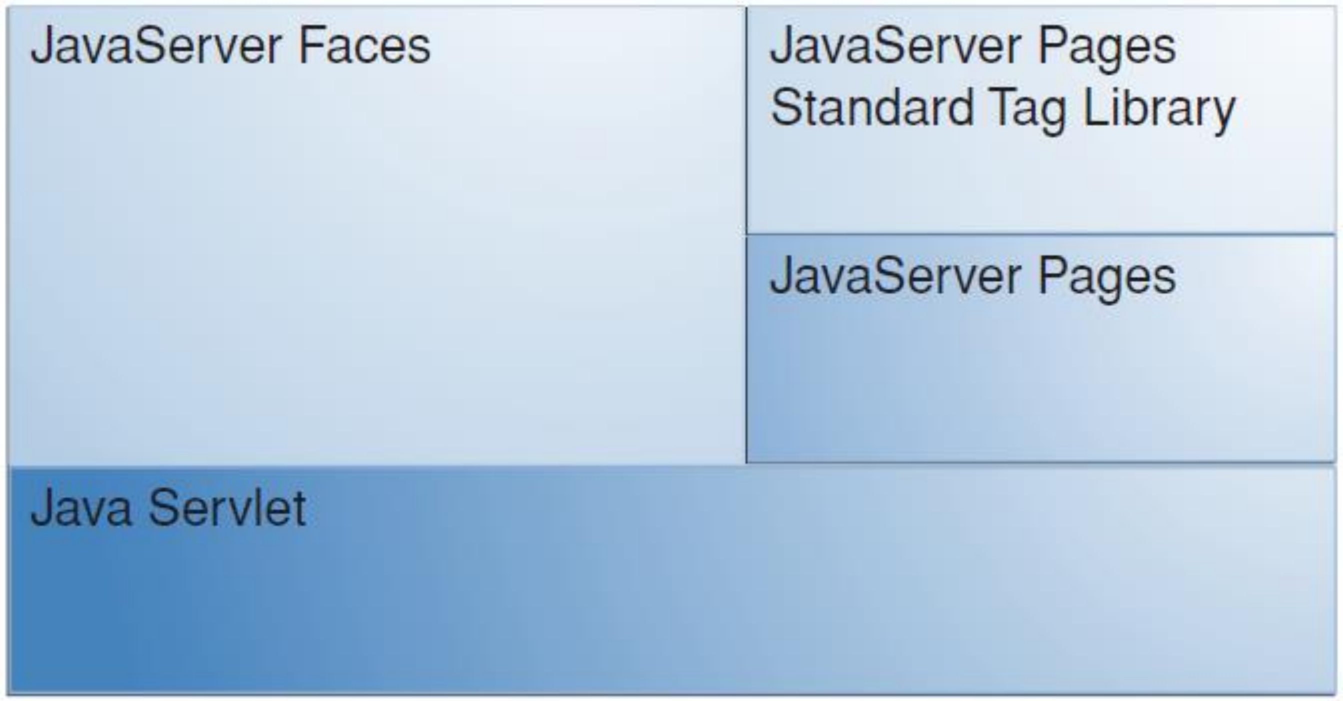
Containers

- Containers provide the runtime support for Java EE applications components
- Containers provide a view of the underlying Java EE API to the application components
- Java EE application components never interact directly with each other
  - They use the protocol and methods of the container for interacting
  - Remote Procedure Invocation (RMI)

Java EE Presentation Tier Components

- Client side
  - Client can use HTML, Java Applet, Java Application, …
- Server side
  - Servlets are special classes to realize the request-response model (get, post of HTTP)
    - External server side code
  - JSP is a developer-friendly wrapper over the servlet classes
    - Embed server side code
  - Faces & Facelets similar to JSP but uses custom tags which can be converted to anything

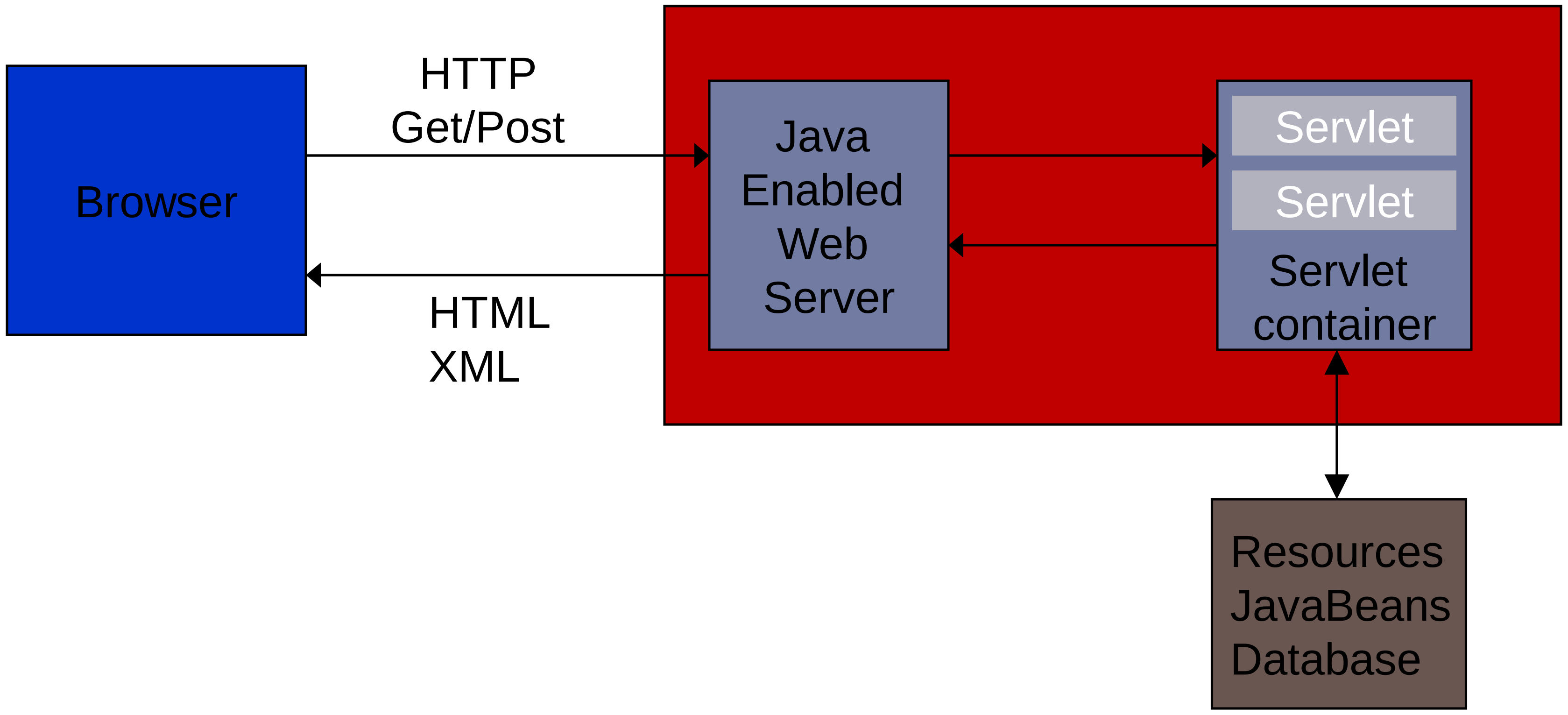
Java EE Presentation Tier Components



Servlet

- A Java application run on the web server in response to HTTP GET or POST requests
- Servlet is used to generate dynamic content to return to browser: HTML, XML, …
- Servlet is a Java program that runs as separated thread inside servlet container
- Servlet container is part of web server
  - It interacts with web client using the request/ response paradigm

The Servlet Model



Servlet (cont'd)

- Servlet container runs servlets and send back their output to web client
  - HTML page is produced by print statements

  out.println("<html>"); …
- Loaded into memory once and then called many times
  - Performance enhancement
- Provides APIs for session management, access to GET/POST data, …

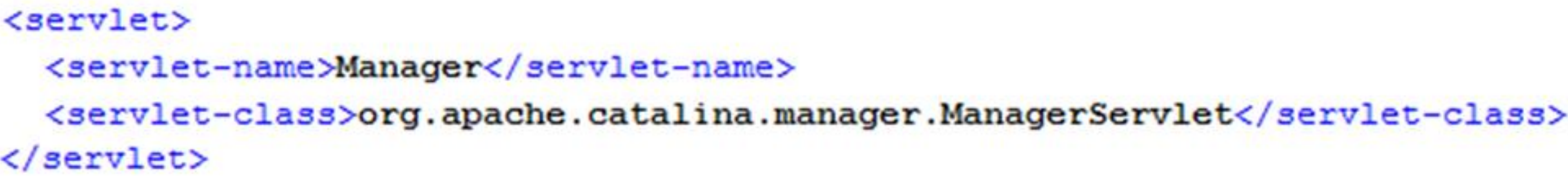
Servlet Implementation

- Servlet container provides API for session & request management through implicit objects
  - Session object: Session management
  - Request object : Access to request fields: headers, cookies, …
  - Response object: The response object is used to build the HTTP response
- When a request for the servlet is received, the servlet engine spawns a new thread and calls appropriate service method
  - `doGet`: Process HTTP GET requests
  - `doPost`: Process HTTP POST requests
  - `doDelete`, `doPut`, …
- `destroy()` is called by to destroy the servlet
  - On web application shutdown or to release some resources
  - By default, servlets are kept alive as long as possible

The Hello World Servlet

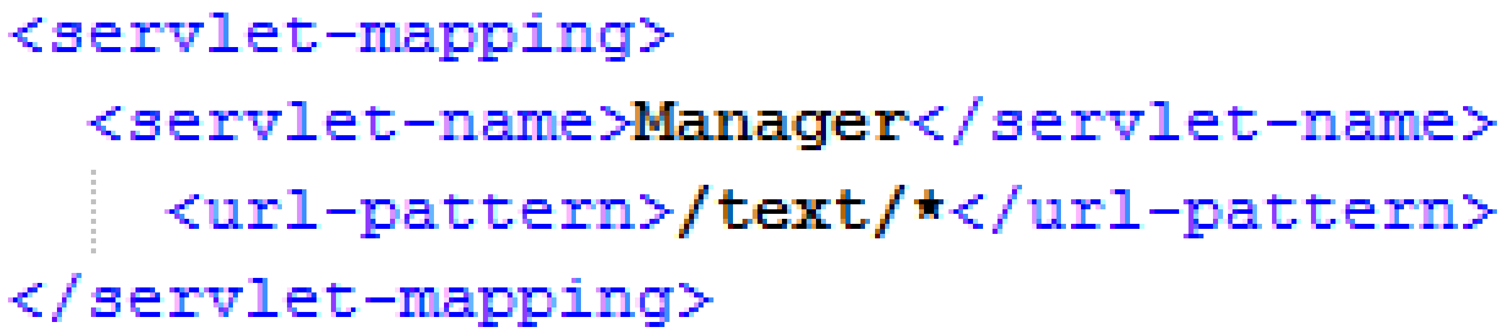
```
public class HelloServlet extends HttpServlet {
  public void doGet(HttpServletRequest request,
   HttpServletResponse response)
          throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    out.println("<HTML>\n" +
                "<HEAD><TITLE>Hello</TITLE></HEAD>\n" +
                "<BODY>\n" +
                "<H1>Hello World</H1>\n" +
                "</BODY></HTML>");
  }
}
```

web.xml => servlet



```
<servlet>
  <servlet-name>Manager</servlet-name>
  <servlet-class>org.apache.catalina.manager.ManagerServlet</servlet-class>
</servlet>
```

web.xml => servlet-mapping



```
<servlet-mapping>
    <servlet-name>Manager</servlet-name>
        <url-pattern>/text/*</url-pattern>
</servlet-mapping>
```

Servlets vs. CGI Scripts

- Advantages:
  - Running a servlet doesn’t require creating a separate process each time
  - A servlet stays in memory, so it doesn’t have to be reloaded each time
  - Untrusted servlets can be run in a “sandbox”
    - A secured environment
- Disadvantage:
  - Servlets must be in Java
  - CGI scripts can be in any language

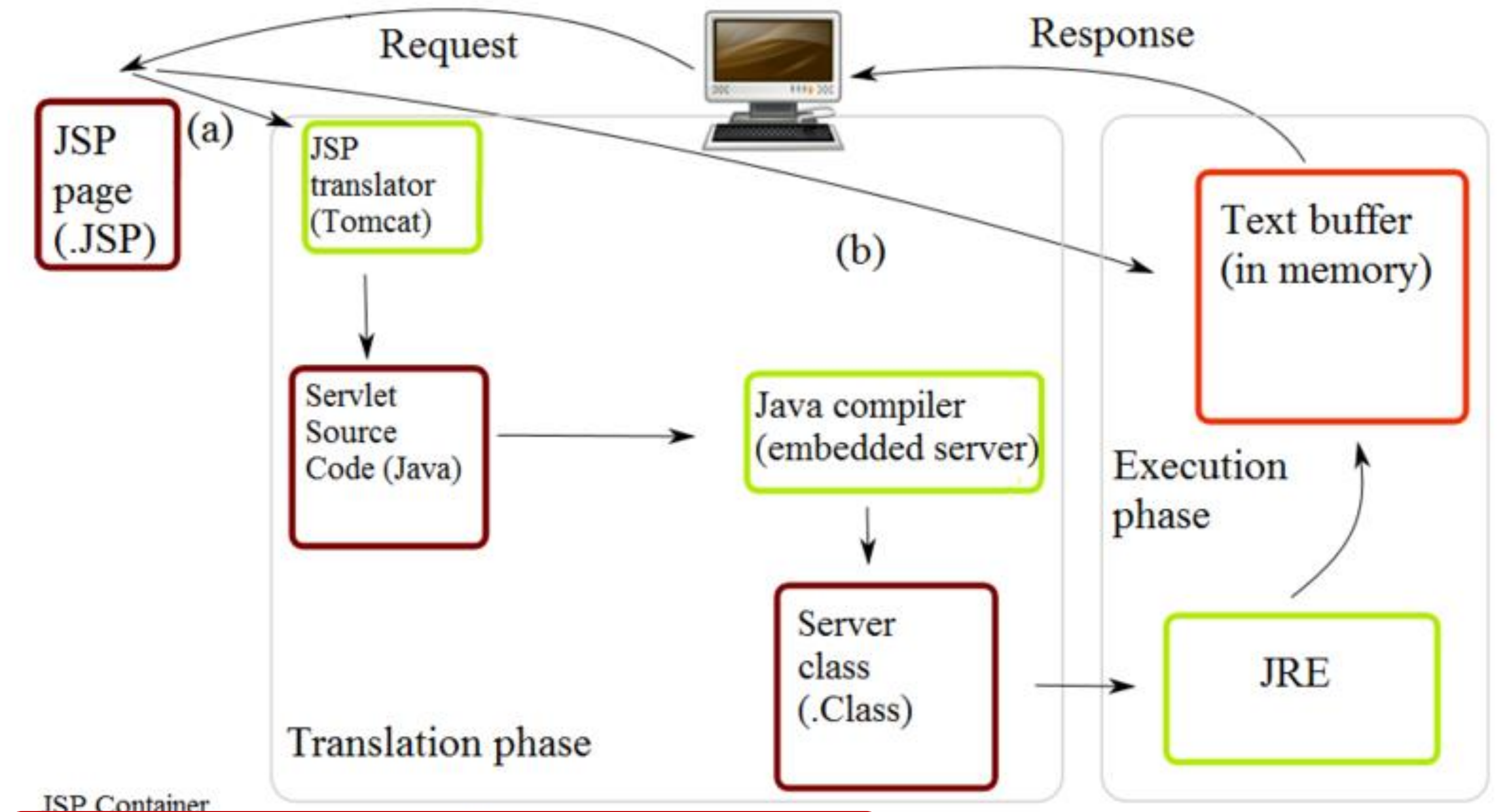
JavaServer Pages (JSP)

- JavaServer Pages technology is an extension of servlet
  - It is the embed version of servlet in HTML
    - JSPs are easier to develop than servlets
  - It runs on the web server tier
- Contains some static HTML and some JSP tags in .jsp file, Java code inside the tags creates dynamic content (similar to PHP)
- When JSP is run, it creates a servlet

JSP Example

```
<html xmlns = "http://www.w3.org/1999/xhtml">
<head> <title>Processing "get" requests with data</title> </head>
 <body>
      <% // begin scriptlet
         String name = request.getParameter("firstName");
         if ( name != null ) {
      %>
          <h1> Hello <%= name %>, <br /> Welcome to JavaServer Pages! <h1>
      <% // continue scriptlet
         }
         else {
      %>
            <form action = "welcome.jsp" method = "get">
               <p> Type your first name and press Submit</p>
               <p><input type = "text" name = "firstName" />
                  <input type = "submit" value = "Submit" />
               </p>
            </form>
      <% // continue scriptlet
      }  // end else
      %>
   </body>
</html>
```

JSP Invocation



(a) Translation occurs at this point, if JSP has been changed or is new.
(b) If not, translation is skipped.

JSP Advantages

- Performance
  - Runtime characteristics of servlet
  - Server side complex processing
- Programming
  - Easier to develop
  - Automatic recompilation of modified pages
  - More natural way to dynamic web pages

JSP in Summary

- In comparison to interpreted scripts (e.g., PHP)
  - JSP is compiled
    - More safety & better performance
  - Compiled servlet is in memory
    - Better performance
  - Converted to Servlet (a complete Java program)
    - Full OOP!!
    - More complex logic implementation

JavaServer Faces

- A user interface framework for building web applications
- JavaServer Faces Components
  - A GUI component framework
    - A set of custom markup tags `<h:form>`, `<h:head>`
  - A flexible model for rendering components in different kinds of HTML or different markup
    - A Renderer object generates the markup to render the component & view its data
  - A standard RenderKit for generating HTML/4.01

JavaServer Faces Components

- Backing beans
  - The logic of application
    - Java classes using Java EE beans
- Facelet
  - The view of application
    - XHTML file using component tags
- Application configuration & description
  - Mapping between Facelets & Beans
  - File organization, …

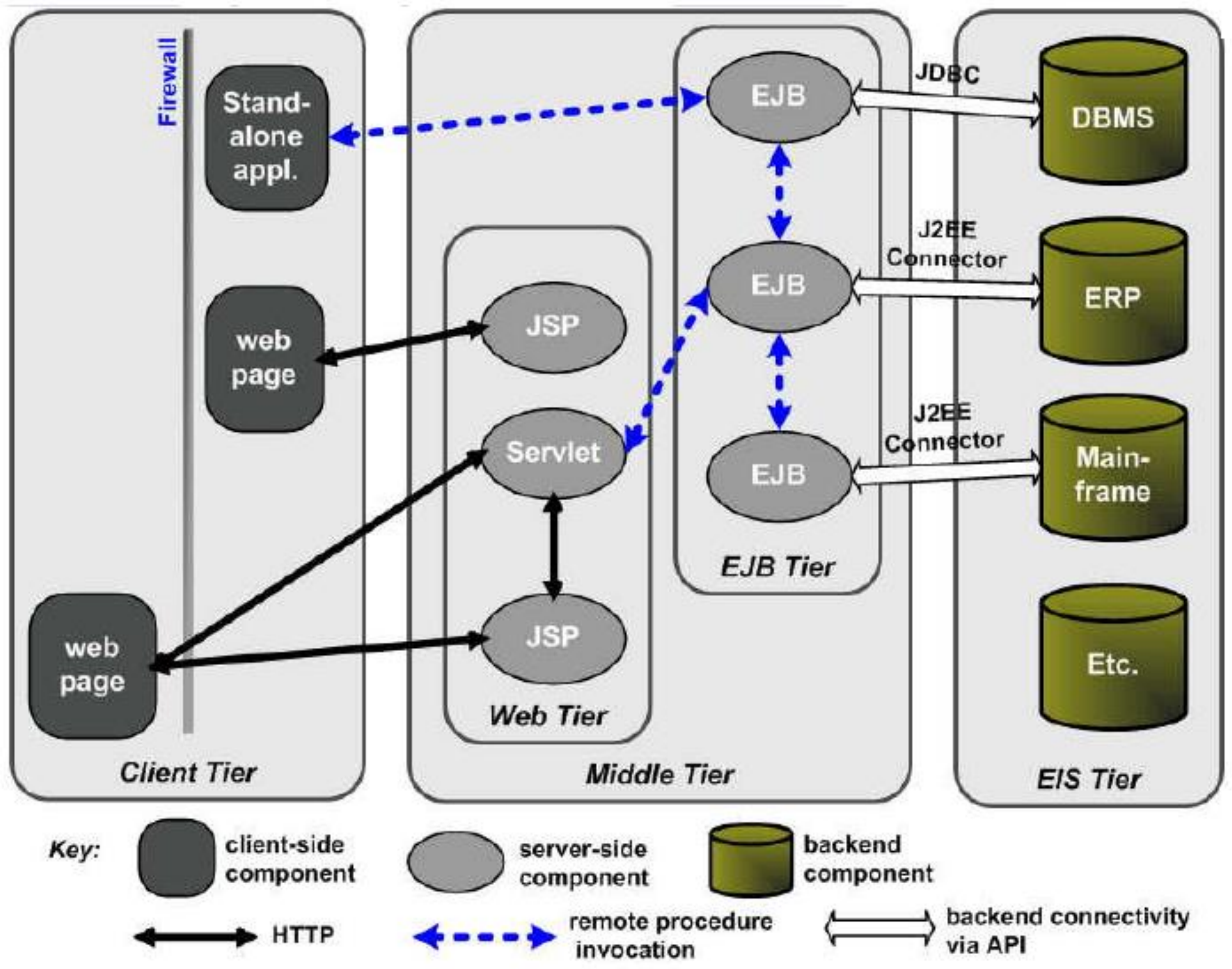
EJB

- EJBs are *distributed components* used to implement business logic (no UI)
- Developer concentrates on business logic
  - Availability, scalability, security, interoperability and … handled by the J2EE server
- Client of EJBs can be JSPs, servlets, other EJBs and external applications
- Clients see *interfaces*

EJB Types

- Session Beans
  - *Synchronous Action*: Process oriented service providers
  - Example: Credit Authorization
- Entity Beans
  - *Data*: Represent data
  - Example: Customer, Account
- Message-Driven
  - *Asynchronous Action*: Never called directly, only receive messages
  - JMS
  - Example: Transaction logging

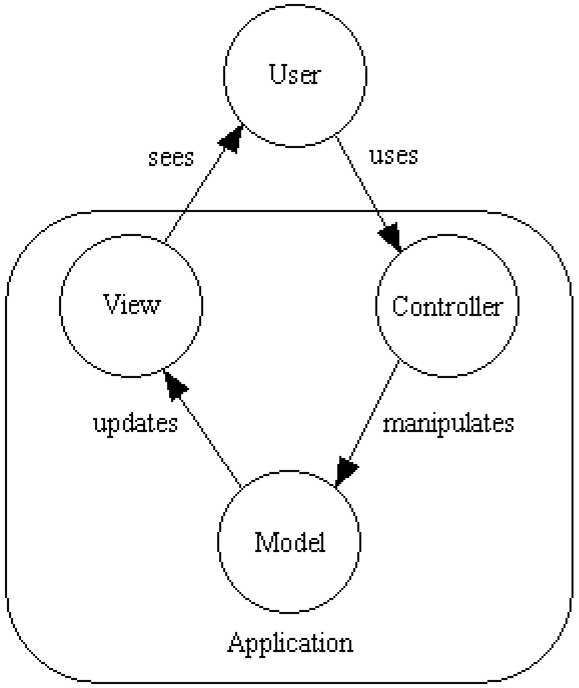
Java EE Summary

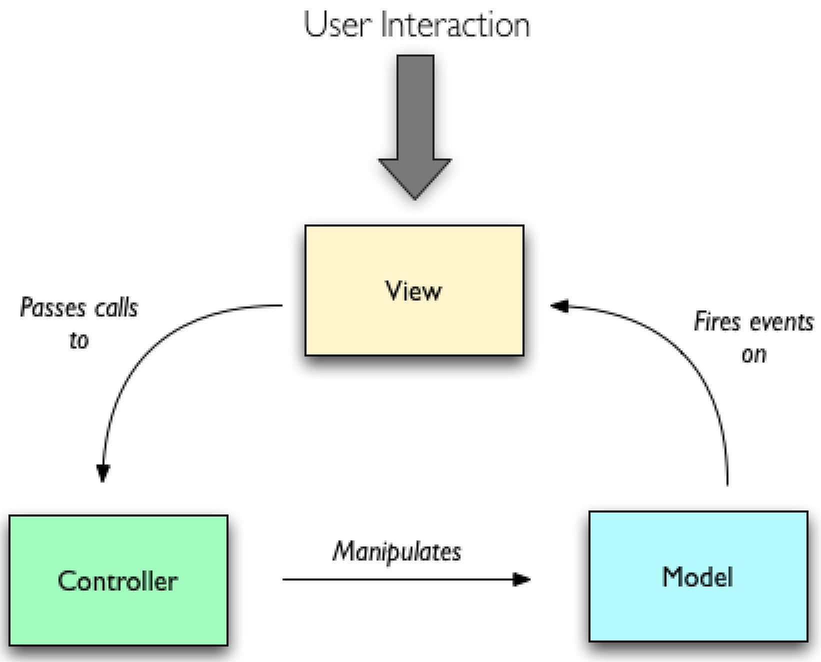


MVC

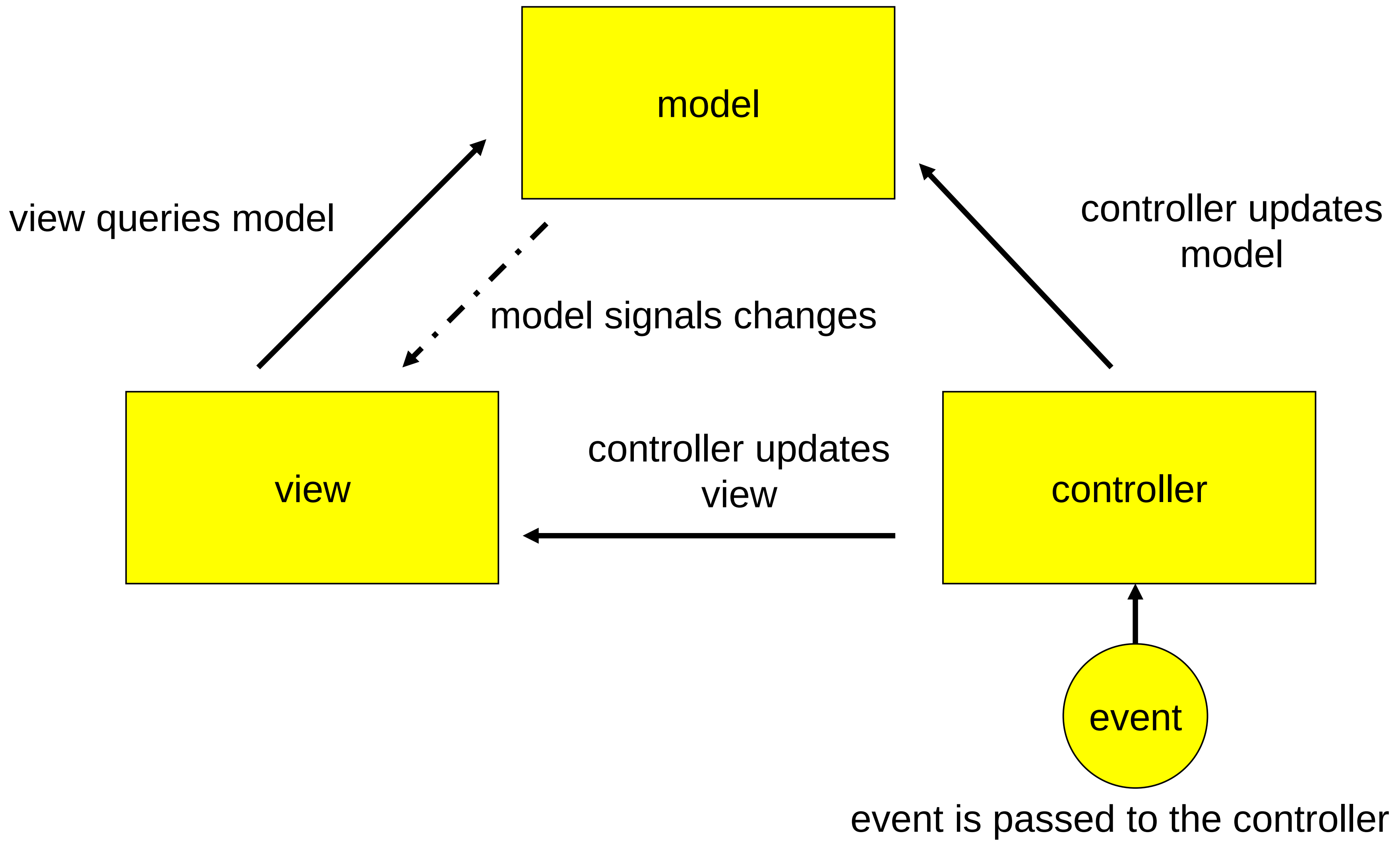
- What is design pattern?
  - Designing complex SW system is really difficult
  - Design patterns help us to design in methodological manner
- Model-View-Controller (MVC)
  - Model
    - Contains data, system state, and logic
  - View
    - Presents data and system state
  - Controller
    - Handles events/requests affecting model or view

MVC?!


User
sees
uses
View
Controller
updates
manipulates
Model
Application


User Interaction
View
Passes calls to
Fires events on
Controller
Manipulates
Model

MVC Interactions (cont'd)



MVC in Web Applications

- Model consists of data and system state
- Database tables
    - Persistent data
- Current system state data
- Business logic (eCommerce)
    - Rules governing the transaction

MVC in Web Applications (cont'd)

- View gives a presentation of the model
- Client-side presentation in a browser window
  - (D)HTML
  - CSS style-sheets
  - Server-side templates
- Administrative information
  - Server output logs

MVC in Web Applications (cont'd)

- Controller handles events
- User-generated events
  - Client-side scripting
  - HTTP request processing
  - Redirection
  - Pre-processing

MVC in Java EE: Approach 1

- The pure JSP approach
- Separate JSP pages are used for the controller and the view
- Beans being used for the model part
- This is a good approach when the development is heavy in graphic designers and light in Java programmers
- Relatively complex applications can be constructed with the use of only JSP
  - Is also well suited for prototyping Web applications

MVC in Java EE: Approach 2

- A combination of servlets, JSP, and beans
- A servlet accepts requests and implement business logic
  - The servlet that receives requests can use other servlets to handle various kinds of requests
- Beans store and perform basic data manipulation
- JSP implements the user views of results of requests
- Conclude:
  - Use servlets to implement the controller
  - JSP to implement the view

Application Server vs. Servlet Container

- A servlet-container supports only the servlet API
  - including JSP, JSTL
  - e.g. Apache Tomcat

- An application server supports the whole JavaEE
  - EJB, JMS, JTA, Servlets, etc.
  - E.g. JBoss

Servlet Containers

- Apache Tomcat

- Jetty
  - Eclipse foundation

Application Servers

- Apache Geronimo
  - Tomcat or Jetty as the servlet container
- JBoss
  - An embedded Apache Tomcat
  - JBoss, Red Hat
- WebLogic
  - BEA => Oracle
- GlassGish
  - Sun => Oracle
  - The reference implementation of Java EE
  - A derivative of Apache Tomcat as the servlet container
- Websphere
  - IBM

Oracle, BEA, Sun, …

A closer look at JSP and Servlet (more practical)

JSP Scripting Elements

- There are four types of scripting elements defined
  - Declaration
  - Expression
  - Scriptlets
  - Comments

Declaration

Declares a variable or method valid in the scripting language used in the JSP page

JSP Syntax

```
<%! declaration; [ declaration; ]+ ... %>
```

Examples

```
<%! int i = 0; %>
<%! int a, b, c; %>
<%! Circle a = new Circle(2.0); %>
```

Expression

JSP Syntax

<%= *expression* %>

Description

An expression that is converted to a String

Example

Welcome, <%=userName%>

Output:

Welcome, James

Expression

```
<%= new java.util.Date()%>
```

The resulting servlet code will probably look like this:

```
out.print(new java.util.Date());
```

Script lets

- Contains a code fragment valid in the page scripting language
- Scriptlets allows you to include a series of java statements
- you must terminate them with semicolon.

JSP Syntax

<% *code fragment* %>

Scriptlets

- **Examples**

```
<%   String name = null;
      if (request.getParameter("name") == null) { %>
          <%@ include file="error.html" %>
<%   }
     else {
     userObject.setName(request.getParameter("name"));

  }
%>
```

Comments

To denote any lines you want to be completely ignored by the JSP translation process.

Example

```
<%-- Author: James Gosling --%>
```

taglib directive

- The taglib directive
- Declares that the JSP page uses custom tags
- Names the tag library that defines them
- and specifies their tag prefix.
- Defines a tag library and prefix for the custom tags used in the JSP page.

JSP Syntax

<%@ taglib {uri="*URI*" | tagdir="/WEB-INF/tags[/*subdir*]+"} prefix="*tagPrefix*" %>

Examples

<%@ taglib uri="http://www.jspcentral.com/tags" prefix="public" %>

<public:loop> ... </public:loop>

JSP Implicit objects

- Implicit objects are being created by JSP mechanism automatically.
- They are accessible from the JSP pages :
- **request** – represents the HTTP request, which is being serviced by the JSP page; it is an instance of a class, implementing *javax.servlet.http.httpServletRequest* interface;
  - **getParameter (only strings)**
  - **getAttribute & setAttribute (any objects)**
- **response** – represents the HTTP response, receiving by the JSP page; it is an instance of a class, implementing *javax.servlet.http.httpServletResponse* interface;

JSP Implicit objects *(cont.)*

- **session** – an instance of javax.servlet.http.HttpSession, representint an HTTP session;
  - getAttribute & setAttribute (any objects)
- **application** – represents the **servlet context** for the Web application; it is instance of *javax.servlet.ServletContext* class;
  - **getAttribute & setAttribute (any objects)**
- **out** – instance of *javax.servlet.jsp.JspWriter* class, which is being used to write content in the JSP output;

Example

```
<%
Integer userviews =
(Integer)session.getAttribute("userviews");
if(userviews==null)
		userviews = 0;
session.setAttribute("userviews",++userviews);
%>

<HTML> <BODY>

Number of User Views:
<%=userviews%>

</BODY></HTML>
```

Example

```
<%
Integer usersview =
(Integer)application.getAttribute("usersview");
if(usersview==null)
		usersview = 0;
application.setAttribute("usersview",++usersview);
%>

<HTML><BODY>

Number of Users Views:   <%=usersview%>

</BODY></HTML>
```

Example

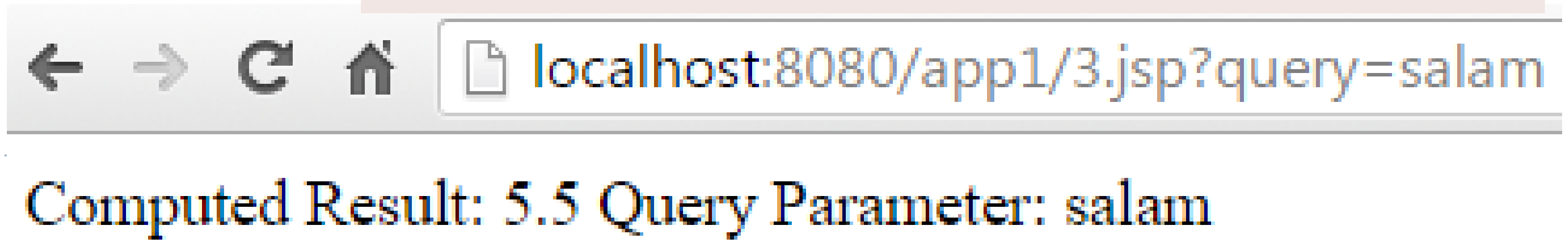
3.jsp

```
<%
request.setAttribute("result",new Double(5.5));
%>
<jsp:forward page="display.jsp" />
```

display.jsp

```
<%
Double number = (Double)request.getAttribute("result");
String param = request.getParameter("query");
%>
<HTML> <BODY>
Computed Result: <%=number%>
Query Parameter: <%=param%>
</BODY> </HTML>
```

Entering:
http://localhost:8080/app1/3.jsp?query=sala
Results:



```
localhost:8080/app1/3.jsp?query=salam
```

```
Computed Result: 5.5 Query Parameter: salam
```

Example

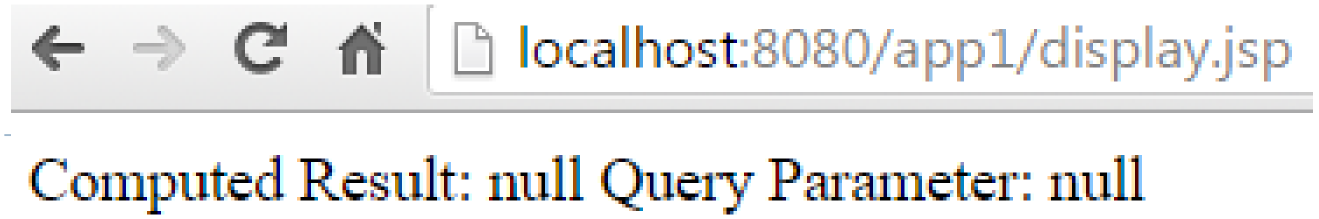
```
<%
request.setAttribute("result",new Double(5.5));
response.sendRedirect("display.jsp");
%>
```

4.jsp

display.jsp

```
<%
Double number = (Double)request.getAttribute("result");
String param = request.getParameter("query");
%>
<HTML> <BODY>
Computed Result: <%=number%>
Query Parameter: <%=param%>
</BODY> </HTML>
```

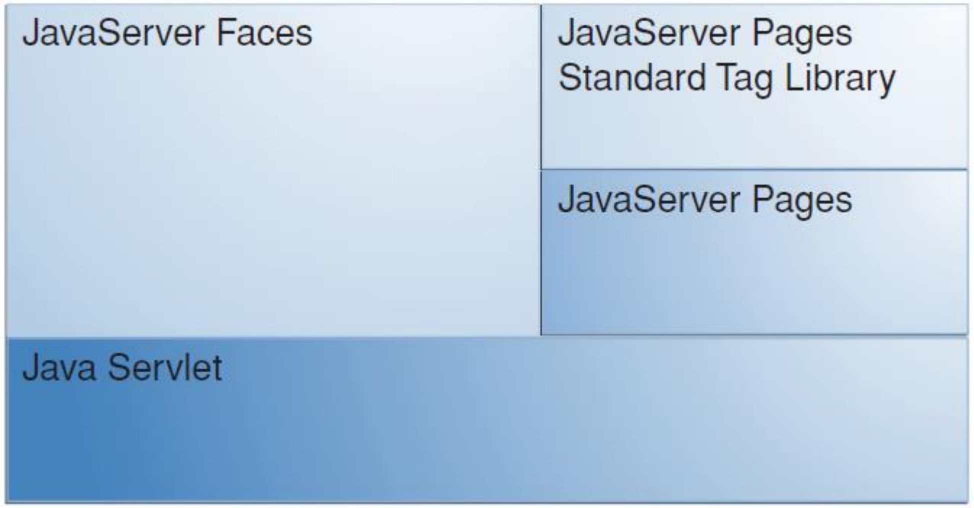
Entering:
http://localhost:8080/app1/4.jsp?query=sal
Results:


localhost:8080/app1/display.jsp

```
Computed Result: null Query Parameter: null
```

New Presentation-layer Technologies

- Nowadays, enterprise applications usually use other technologies in presentation layer
- JSF, GWT, Wicket, SpringMVC, Vaadin, …
- But we should know the architecture of JSP/Servlets
- Many technologies are built on servlet
- Servlet concepts are still important and useful



Exercise

- Write a simple JSP file
- Deploy it on Tomcat
- See how it works
- See the translated Servlet
- See the tomcat folders and files

Review some concepts

- Request/Response
  - request.getParameter()
  - request.getAttribute()
  - request.setAttribute()
    - Why?!
    - Forwarding requests
- Session/Application (ServletContext)
  - Share variables
  - getAttribute/setAttribute
- Redirect/Forward

Getting Information From Requests

- Parameters
  - used to convey information between clients and servlets
  - String bookId = request.getParameter("Add");
- Object-valued attributes
  - used to pass information between the servlet container and a servlet or between collaborating servlets
  - request.setAttribute(“id”,theObject);
  - Object identifier = request.getAttribute(“id”);

Getting Information From Requests *(cont)*

- Information about
  - the protocol
  - The method (get, put, …)
  - Request path
  - Headers
  - **Query String**
  - …

Constructing Responses

- Indicate the content type
  - response.setContentType("text/html");
- Indicate whether to buffer output
  - By default, any content written to the output stream is immediately sent to the client
  - response.setBufferSize(8192);
- Retrieve an output stream
  - To send character data, use the PrintWriter returned by the response's **getWriter** method
  - To send binary data in a MIME body response, use the ServletOutputStream returned by **getOutputStream**
- Using Output stream
  - output.println("<html>“);

Invoking Other Web Resources

- To invoke a resource available on the server that is running a web component, you must first obtain a RequestDispatcher using the getRequestDispatcher("URL") method
- To include another resource, invoke the include method of a RequestDispatcher:
  - **include(request, response);**
- To forward to another resource, invoke the forward:
  - **forward(request, response);**

Example: Transferring Control to Another Web Component

```
public class Dispatcher extends HttpServlet {
 public void doGet(HttpServletRequest request,
  HttpServletResponse response) {
  ...
  request.setAttribute("avg", new Double(18.5));
  RequestDispatcher dispatcher = request.
  getRequestDispatcher("/template.jsp");
  if (dispatcher != null)
    dispatcher.forward(request, response);
 }
 public void doPost(HttpServletRequest request,
   ...
}
```

Web Context

- The **application** object in JSP is called the **ServletContext** object in a servlet
- The context in which web components execute is an object that implements the ServletContext interface
- We can retrieve the web context with the getServletContext() method

```
public class MyServlet extends HttpServlet{
    private ServletContext ctx = null;
    @Override
    public void init(ServletConfig config) throws ServletException {
        ctx = config.getServletContext();
    }
…
```

Session: Maintaining Client State

- Sessions are represented by an HttpSession object
- You can access a session by calling the getSession() method of a **request** object

```
HttpSession session =
request.getSession();
session.setAttribute("object", obj);
```

Servlet Container Folder Structure

- bin
  - startup
- conf
  - server.xml
- lib
- logs
- temp
- webapps
- work

War files

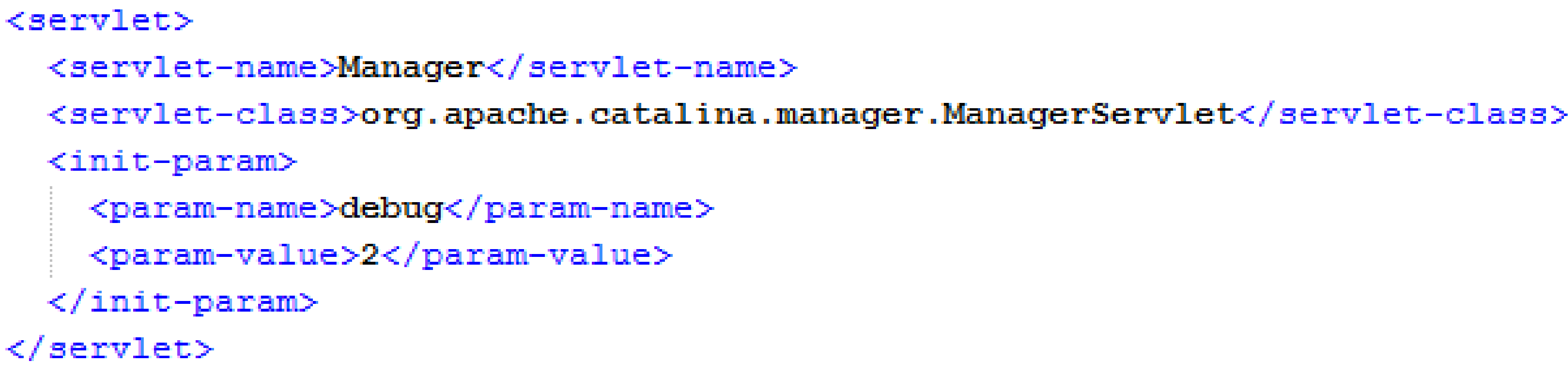
A web-app Structure

- Html, css, js, JSPs
- WEB-INF
  - web.xml
  - classes
  - lib

web.xml

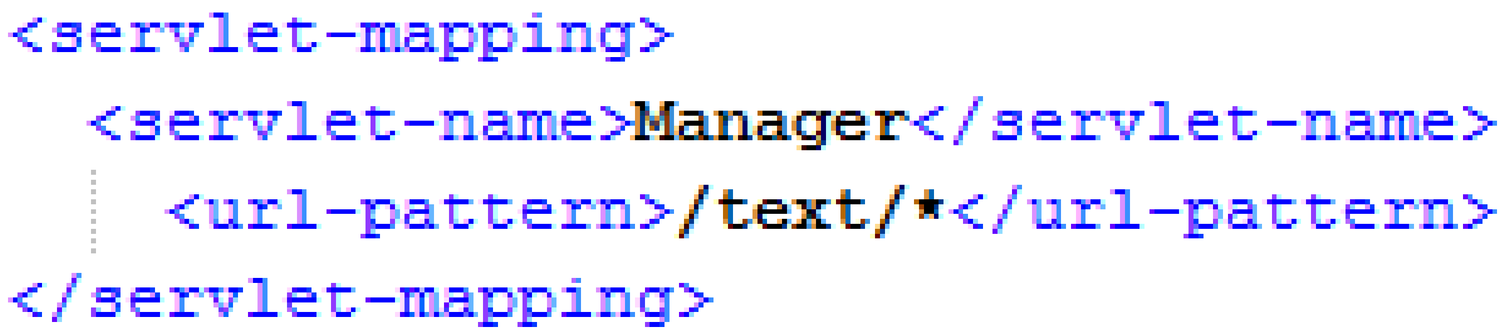
- An xml file
- Contains
  - Servlet definitions
  - Servlet-mappings
  - Filter definitions
  - Filter-mappings
  - Error-pages
  - …

web.xml => servlet



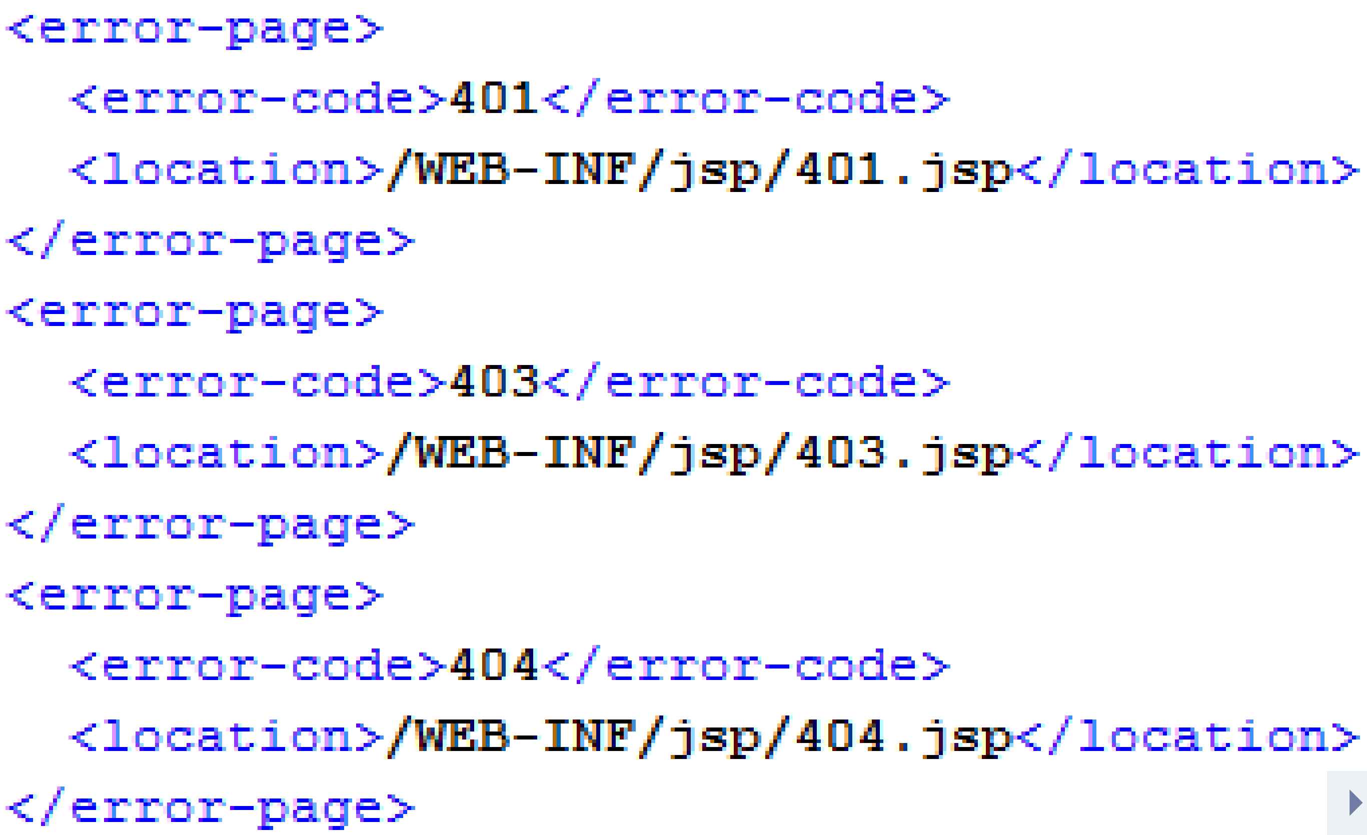
```xml
<servlet>
  <servlet-name>Manager</servlet-name>
  <servlet-class>org.apache.catalina.manager.ManagerServlet</servlet-class>
  <init-param>
    <param-name>debug</param-name>
    <param-value>2</param-value>
  </init-param>
</servlet>
```

web.xml => servlet-mapping



```
<servlet-mapping>
  <servlet-name>Manager</servlet-name>
    <url-pattern>/text/*</url-pattern>
</servlet-mapping>
```

web.xml =>error pages



```
<error-page>
  <error-code>401</error-code>
  <location>/WEB-INF/jsp/401.jsp</location>
</error-page>
<error-page>
  <error-code>403</error-code>
  <location>/WEB-INF/jsp/403.jsp</location>
</error-page>
<error-page>
  <error-code>404</error-code>
  <location>/WEB-INF/jsp/404.jsp</location>
</error-page>
```

- 200 OK
- 401 Unauthorized
- 403 Forbidden
- 404 Not Found

Import in JSP

- Import in Java
  - Import classes: includes the mentioned class in the program
  - Example:
    - import java.util.ArrayList;
    - import java.sql.Connection;
- Import in JSP:
  - <%@ page import=“CLASS_NAME" %>
  - Example:
    - <%@ page import="java.util.List" %>

Filter

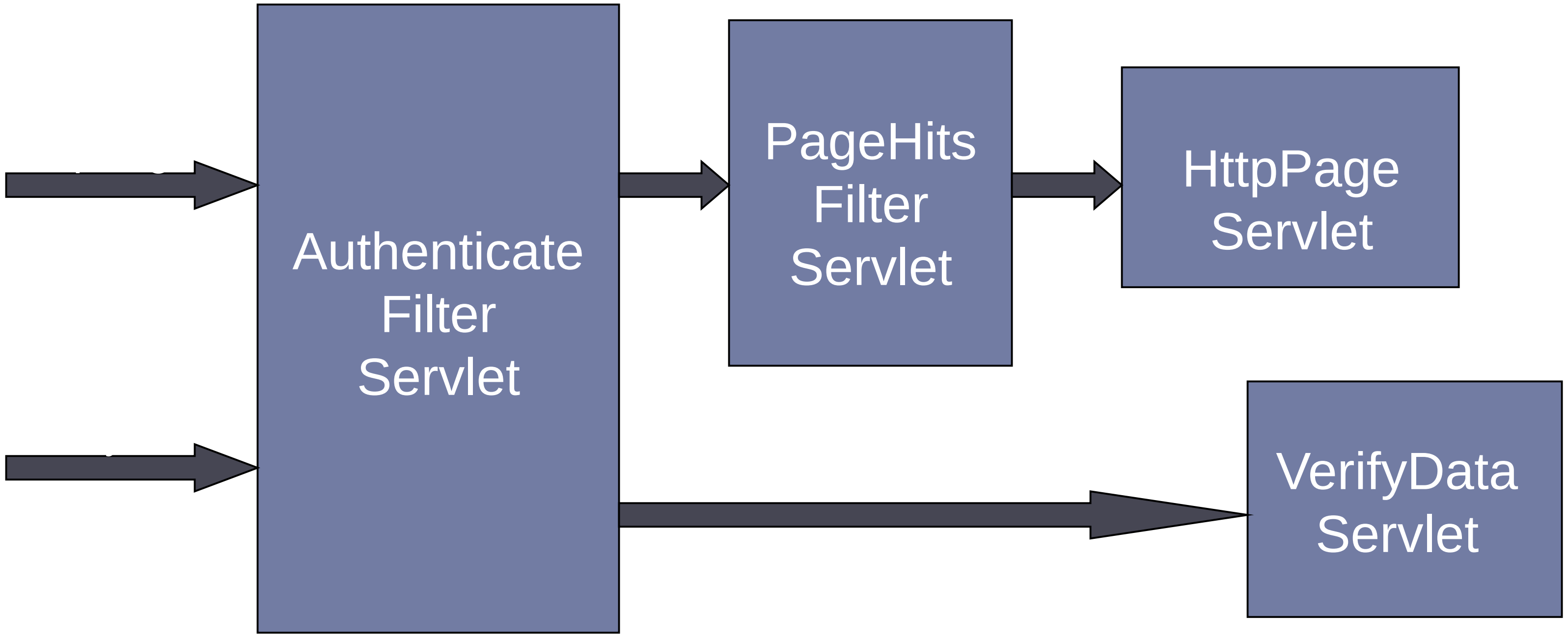
- Acts as preprocessor to request/response for target servlet
- Extracts common scenario among different servlets
- Applications?
  - Authentication
    - SSO
  - Statistics
  - Log
  - …

web.xml => filter

```xml
<filter>
  <filter-name>SetCharacterEncoding</filter-name>
  <filter-class>org.apache.catalina.filters.SetCharacterEncodingFilter</filter-class>
  <init-param>
    <param-name>encoding</param-name>
    <param-value>UTF-8</param-value>
  </init-param>
</filter>

<filter-mapping>
  <filter-name>SetCharacterEncoding</filter-name>
  <url-pattern>/*</url-pattern>
</filter-mapping>
```

Filter Servlets



Filter Servlet

```
Import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
publc class PageHits extends HttpServlet implements Filter
{
    private FilterConfig filterConfig = null;

  public void init(FilterConfig filterConfig) throws ServletException
   {
       this.filterConfig = filterConfig;
   }

   public void destroy(
   {
       this.filterConfig = null;
   }
```

implement
Filter Interface

override init. method

override destroy method

Filter Servlet (cont.)

```
public void doFilter(ServletRequest request, ServletResponse response,
                                 FilterChain chain) throws IOException, ServletException
{
  if (filterConfig == null)
      return;

      Integer counter =(Integer) filterConfig.getServletContext().getAttribute("Counter");

      if (counter == null)
            counter = new Integer(0);
      counter = new Integer(counter.intValue()+1);
      filterConfig.getServletContext().log("Number of hits is " + counter);
      filterConfig.getServletContext().setAttribute("Counter", counter);


  chain.doFilter(req, resp)
}
```

Must override doFilter method

Modify Deployment Descriptor

```
<web-app>
…

    <filter>
        <filter-name>PageHits</filter-name>
        <filter-class>ir.ac.sbu.PageHits</filter-class>
    </filter>
    <filter-mapping>
         <filter-name>PageHits</filter-name>
         <url-pattern>/payment/*</url-pattern>
    </filter-mapping>

</web-app>
```

Listener Servlet

- Servlet is automatically executed when some external event occurs
- Event Listeners

HTTPSessionActivationListener	Session is activated/passivated
HTTPSessionAttributeListener	Session attribute is added/removed
HTTPSessionListener	Session attribute is created/destroyed
ServletContextAttributeListener	Servlet contextattribute is added/removed
ServletContextListener	Servlet context changes

What Events to Listen?

- ServletContextListener
  - contextInitialized
  - contextDestroyed
- HttpSessionListener
  - sessionCreated
  - sessionDestroyed
- HttpSessionAttributeListener
  - attributeAdded
  - attributeRemoved
  - attributeReplaced
- ServletRequestAttributeListener
  - attributeAdded
  - attributeRemoved
  - attributeReplaced
- ServletContextAttributeListener
  - attributeAdded
  - attributeRemoved
  - attributeReplaced

Example

```
public class MyListener implements
      HttpSessionListener,HttpSessionAttributeListener,
      HttpSessionActivationListener{

@Override public void sessionDidActivate(HttpSessionEvent p) {}
@Override public void sessionWillPassivate(HttpSessionEvent p) {}
@Override public void attributeAdded(HttpSessionBindingEvent p) {}
@Override public void attributeRemoved(HttpSessionBindingEvent p) {}
@Override public void attributeReplaced(HttpSessionBindingEvent p) {}
@Override public void sessionCreated(HttpSessionEvent p) {}
@Override public void sessionDestroyed(HttpSessionEvent p) {}

}
```

Create Listener Servlet

```
Import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
publc class Listener extends HttpServlet implements ServletContextListener
{
    private ServletContext context = null;

  public void contextIntialized(ServletContextEvent  event)

  {
         context = event.getServerContext();
         Integer counter = new Integer(0);
         context.setAttribute(“Counter”, counter);
         context.log(“Created Counter”);

   }

   public void contextDestroyed(ServletContextEvent  event)

   {
         event.getServletContext().removeAttribute(“Counter”);
   }

}
```

Must implement Listner Interface

Must override contextInitialized method

Must override contextDestroyed method

Web.xml

```
<web-app>
    <servlet>
…

    </servlet>
   <servlet-mapping>
…

    </servlet-mapping>
    <filter>
…

    </filter>
    <filter-mapping>
…

    </filter-mapping>
     <listener>
         < listener-class>Listener</ listener -class>
     </listener>
</web-app>
```

Modify Filter Servlet

```
public void doFilter(ServletRequest request, ServletResponse response,
                     FilterChain chain) throws IOException, ServletException
{
    if (filterConfig == null)
        return;
    synchronized (this)
    {
        Integer counter =( Integer) filterConfig.getServletContext().getAttribute("Counter");
        if (counter = null)
            counter = new Integer(1);        ← No longer needed
        counter = new Integer(counter.intValue()+1);
        filterConfig.getServletContext().log("Number of hits is " + counter);
        filterConfig.getServletContext().setAttribute("Counter", counter); counter);

    }
    chain.doFilter(request, response);
}
}
```

Modified Filter Servlet

```
    public void doFilter(ServletRequest request, ServletResponse response,
                                    FilterChain chain) throws IOException, ServletException
    {
        if (filterConfig == null)
            return;
        synchronized (this)
        {
            Integer counter =( Integer) filterConfig.getServletContext().getAttribute(“Counter”);
            counter = new Integer(counter.intValue()+1);
            filterConfig.getServletContext().log(“Number of hits is “ + counter);
            filterConfig.getServletContext().setAttribute(“Counter”, counter); counter);

        }

        chain.doFilter(request, response);
    }

}
```

Conclusion

Conclusion

- Tiers and Layers
- MVC
- JavaEE
  - Java Editions
  - JSP
  - Servlet
  - JSF
  - EJB
  - Listener
  - Filter
  - Servlet container file/folder structure

Which layer?
Client side or Server side?
Need container or App server?

- JSP
- JPA
- JSF
- Servlet
- Hibernate
- EJB
- Spring
- SpringMVC
- Web Service
- CSS
- HTML
- Applet
- Flash
- Struts
- JDBC
- Logging
- GWT
- Javascript
- JavaFX
- Silverlight
- AJAX

Exercise

- Write a JSP/Servlet application
- Contact List app
  - User login form
  - Data Entry
  - List
  - Add MVC pattern
- Use an IDE for development
  - NetBeans
  - Eclipse JavaEE IDE (Formerly named WTP)
  - IntelliJ IDEA

References and Material

- The Java EE 6Tutorial, Oracle
  http://docs.oracle.com/javaee/6/tutorial/doc/javaeetutorial6.pdf
- JavaCup Exercise (www.javacup.ir)
- J2EE Workshops, Seyyed Jamaleddin Pishvayi
  http://asta.ir
- Internet Engineering course, Amirkabir University of Technology, Dr. Bahador Bakhshi
  http://ceit.aut.ac.ir/~bakhshis/

Any questions?