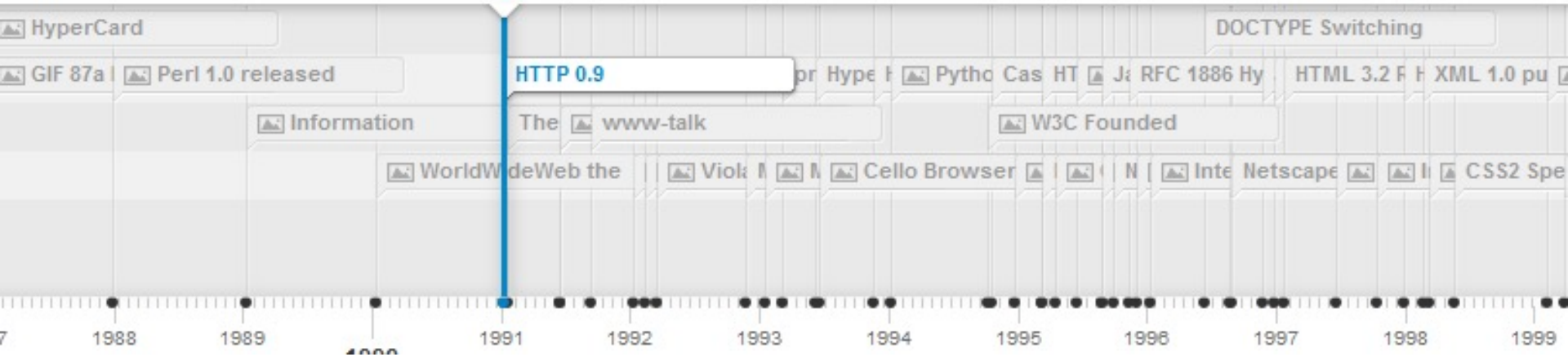
Introduction to Java Web Application Fundamentals

Home of All the Laws of Nature

History of the Web

1991milestones HTTP; HTML



http://www.webdirections.org/history/

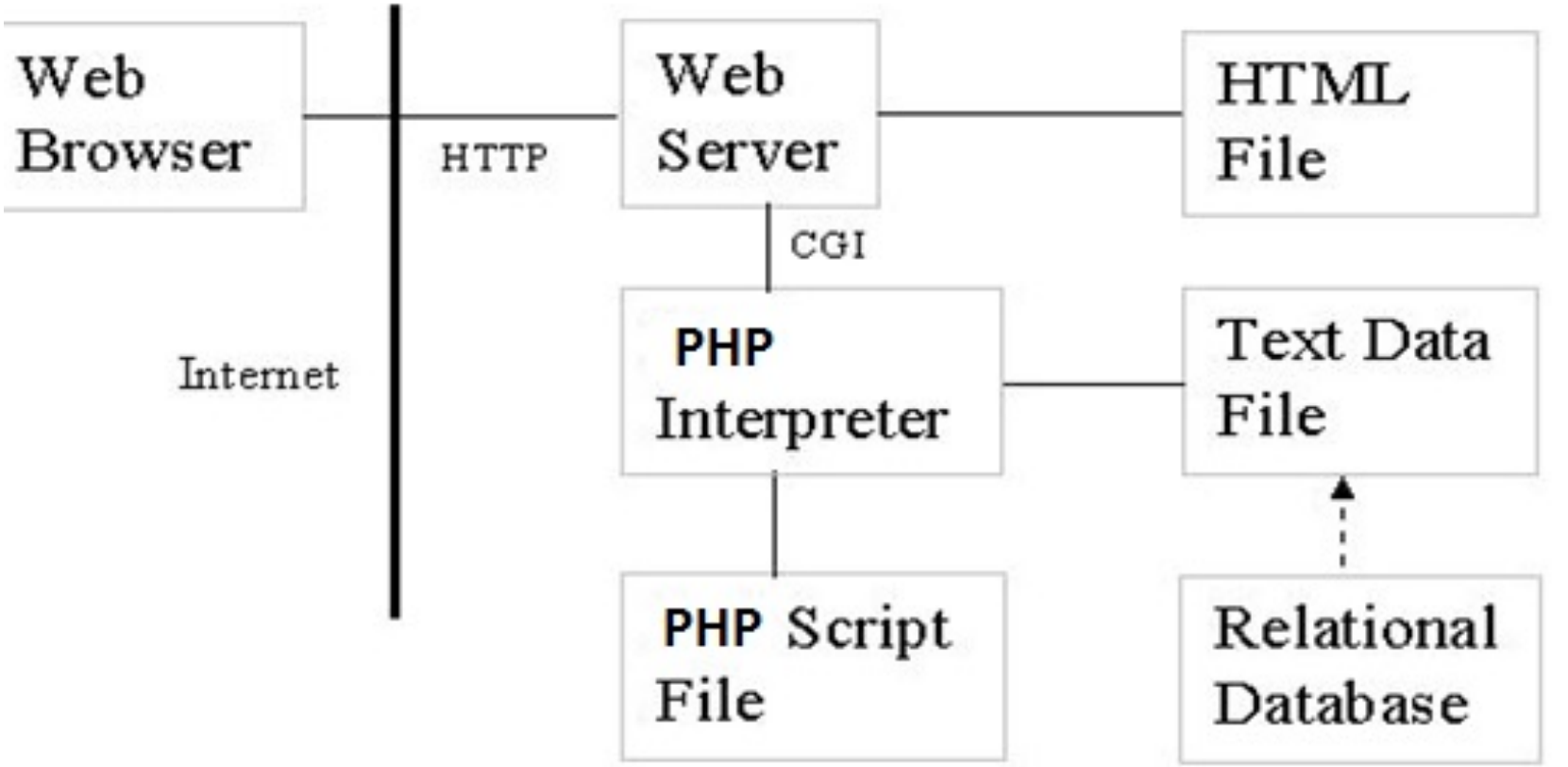
The oldest extant web page

The oldest web page continually served was last modified on Tuesday November 13 1990.

HTML & HTML

- Hypertext is structured text that uses logical links (hyperlinks) between nodes containing text.
  - You can go to any place on the Internet whenever you want by clicking on links — there is no set order to do things in.
- HTTP[Hyper Text Transfer Protocol] is the protocol to exchange or transfer hypertext.
- HTML[Hyper Text Markup Language] is a *Language*, as it has code-words and syntax like any other language.
  - Markup is what **HTML tags** do to the text inside them. They mark it as a certain type of text (*italicised* text, for example).

CGI Platform



Common Gateway Interface (CGI) is a standard method used to generate dynamic content on Web pages and Web applications.

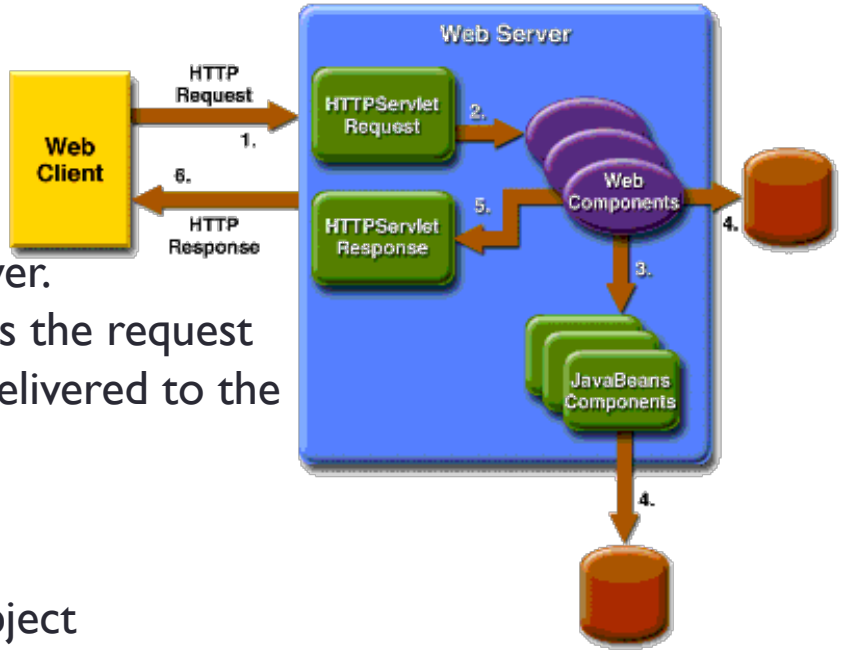
Servlets – An Efficient Technology

- A servlet is server-side java code that can handle http requests and return dynamic content.
- Servlets are managed by a *servlet engine* or *container*.
- Each request that comes in results in the spawning of a new thread that runs a servlet.

(eliminating the cost of creating a new process every time).

Java Web Applications

- In the Java 2 platform, web components provide dynamic extension capabilities for a web server. Servlets, JSPs and JSFs are web components.

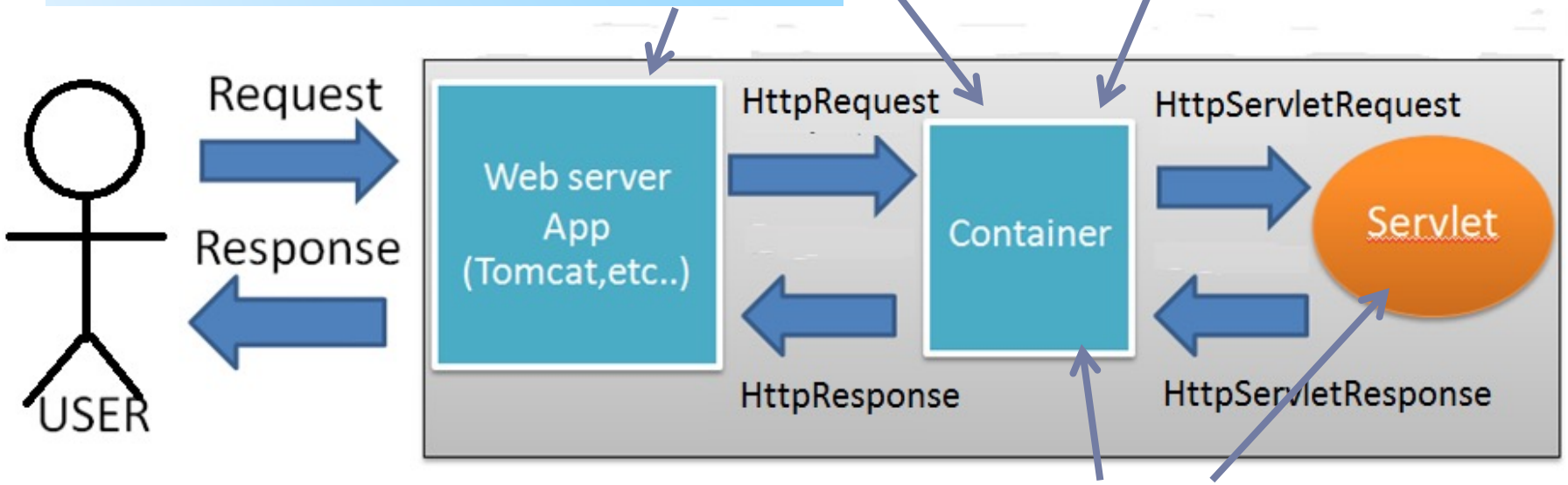


1. Client sends an HTTP request to the web server.
2. Web server [**via Servlet container**] converts the request into an HTTPServletRequest object which is delivered to the Servlet
3. Servlet interacts with JavaBeans components
4. or a database to generate dynamic content
5. Servlet generates an HTTPServletResponse object
6. Web server [**via Servlet container**] converts this object to an HTTP response and returns it to the client

Servlet Container

When a request comes to the web server, if the server sees the request is for a servlet, it passes the request data to the servlet container.

Servers that support servlets have as a helper app: *servlet container.*

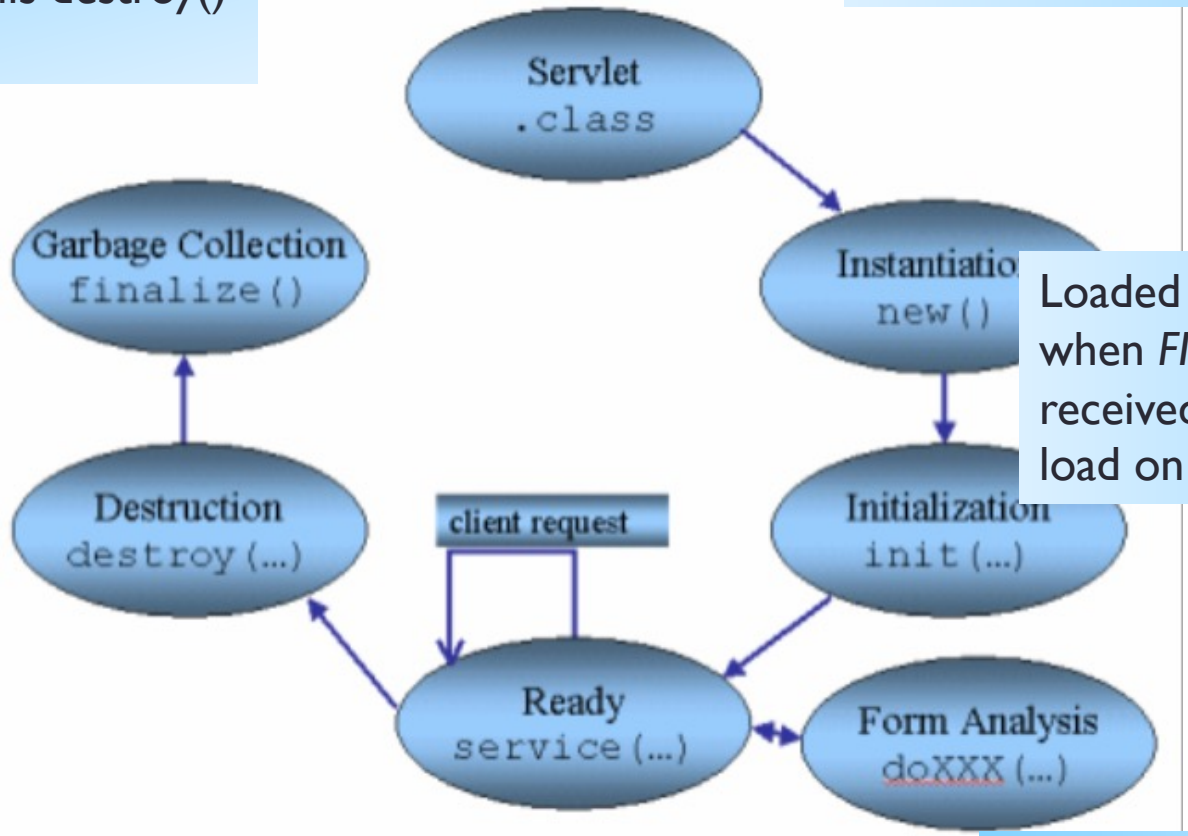


The servlet container locates the servlet, creates **SERVLET** request and response objects and passes them to the servlet, and returns to the web server the response stream that the servlet produces.

Servlet Lifecy

tion termination or Servlet
ner shutdown calls destroy()
d

HelloWorldServlet- compiled & deployed when "Run As" was invoked

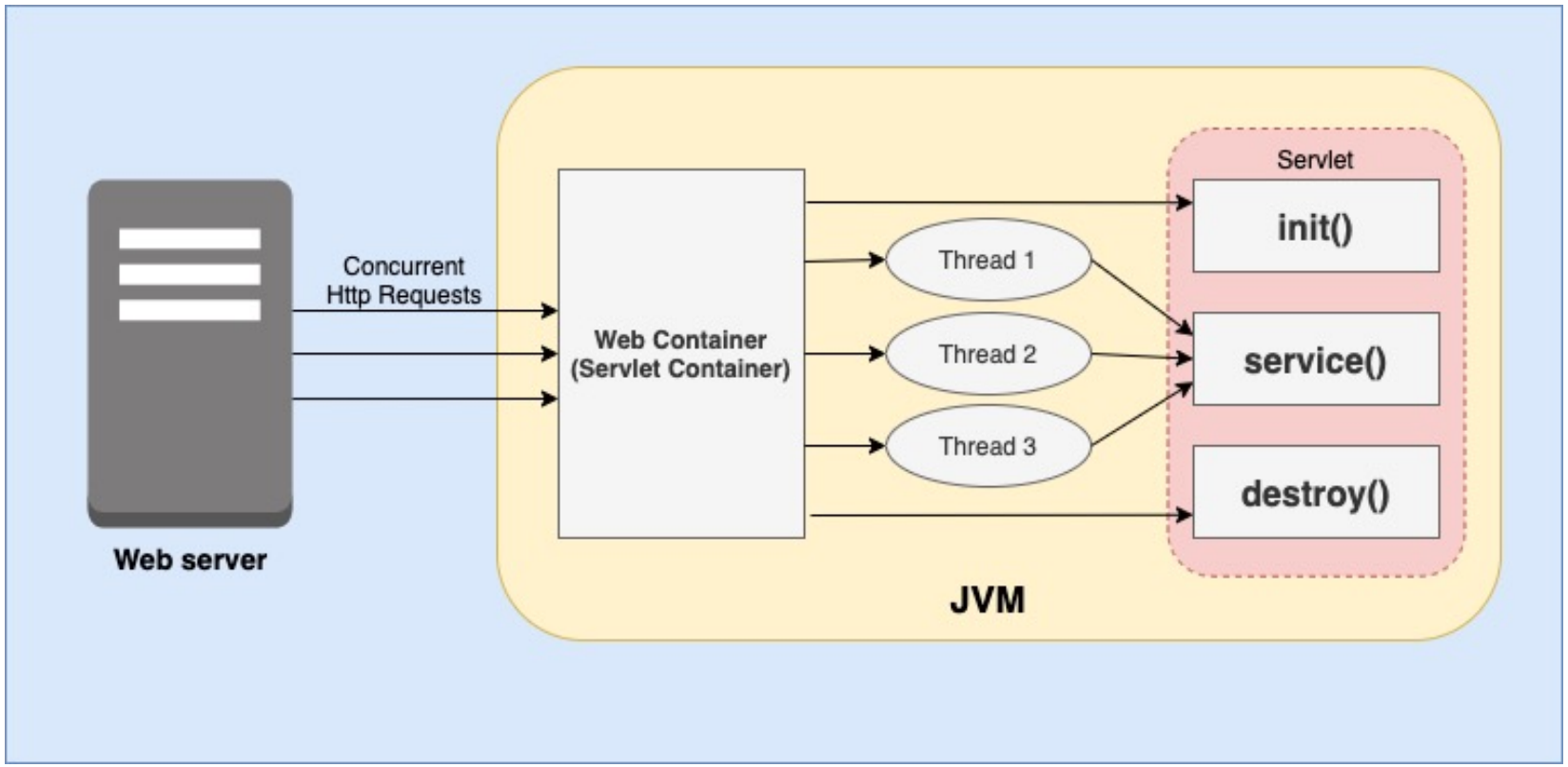


Loaded [new()] & init'ed when *FIRST* request is received [or configured to load on startup]

HttpServlet service() method calls doGet,doPost,etc.

Request is forwarded to the Servlet's service() method.

Servlet


Concurrent
Http Requests
Web server
Web Container
(Servlet Container)
Thread 1
Thread 2
Thread 3
Servlet
init()
service()
destroy()
JVM

A Simple Order Form

Servlet Code doGet Example

```
response.setContentType("text/html");
 PrintWriter writer = response.getWriter();
 writer.println("<html>");
 writer.println("<head>");
 writer.println("<title>" + TITLE + "</title></head>");
 writer.println("<body><h1>" + TITLE + "</h1>");
 writer.println("<form method='post'>");
 writer.println("<table>");
 writer.println("<tr>");
 writer.println("<td>Name:</td>");
 writer.println("<td><input name='name'/></td>");
 writer.println("</tr>");
 writer.println("<tr>");
 writer.println("<td>Address:</td>");
 writer.println("<td><textarea name='address' "
         + "cols='40' rows='5'></textarea></td>");
 writer.println("</tr>");
```

Continued

```
    writer.println("<tr>");
       writer.println("<td>Country:</td>");
       writer.println("<td><select name='country'>");
       writer.println("<option>United States</option>");
       writer.println("<option>Canada</option>");
       writer.println("</select></td>");
       writer.println("</tr>");
       writer.println("<tr>");
       writer.println("<td>Delivery Method:</td>");
       writer.println("<td><input type='radio' " +
               "name='deliveryMethod'"
               + " value='First Class'/>First Class");
       writer.println("<input type='radio' " +
               "name='deliveryMethod' "
               + "value='Second Class'/>Second Class</td>");
       writer.println("</tr>");
       writer.println("<tr>");
       writer.println("<td>Shipping Instructions:</td>");
writer.println("<td><textarea name='instruction' "
               + "cols='40' rows='5'></textarea></td>");
       writer.println("</tr>");
```

And More

```
writer.println("<tr>");
        writer.println("<td> </td>");
        writer.println("<td><textarea name='instruction' "
                + "cols='40' rows='5'></textarea></td>");
        writer.println("</tr>");
        writer.println("<tr>");
        writer.println("<td>Please send me the latest " +
                "product catalog:</td>");
        writer.println("<td><input type='checkbox' " +
                "name='catalogRequest'/></td>");
        writer.println("</tr>");
        writer.println("<tr>");
        writer.println("<td> </td>");
        writer.println("<td><input type='reset'/>" +
                "<input type='submit'/></td>");
        writer.println("</tr>");
        writer.println("</table>");
        writer.println("</form>");
        writer.println("</body>");
        writer.println("</html>");
```

Main Point

Servlets are the basis of dynamic web applications. Servlets process information from a request object and generate new information in a response object. *For every action in nature there is always a reaction.*

Web Application Deployment Descriptor (web.xml)

- Defines everything about your Java Web Application that a server needs to know:
  - Servlets
  - Initialization parameters
  - Listeners
  - Filters
  - Error pages
  - Welcome pages

Three Names of a Servlet [web.xml]

```
<servlet>
        <servlet-name>hello</servlet-name>
        <servlet-class>mum.Hello</servlet-class>
</servlet>

<servlet-mapping>
        <servlet-name>hello</servlet-name>
        <url-pattern>/hello</url-pattern>
</servlet-mapping>
```

"servlet-name" is the internal name of the servlet

"url-pattern" is the way the servlet is specified in the browser http:localhost:8080/HelloWorld/hello *and the* **HTML form <form action="*hello*" *method*="get">**

“special” URL Patterns

Default Servlet Mapping:

<url-pattern>/</url-pattern> matches a request if no other pattern matches.

<url-pattern>/*</url-pattern> overrides all other servlets. Whatever request you fire, it will end up in that servlet.

Error-Page (web.xml)

```
<error-page>
  <error-code>404</error-code>
  <location>/page-not-found.html</location>
</error-page>
```

Welcome List [web.xml]

```
<welcome-file-list>
   <welcome-file>index.html</welcome-file>
 </welcome-file-list>
```

ServletConfig & ServletContext

- ServletConfig is a configuration object PER servlet to pass initialization information to a servlet during servlet init().
- ServletContext holds parameters that are initialization information for the entire application(i.e, every servlet in the application). ServletContext is also used during the application for application state management.

```
<web-app>
        <servlet>
                <servlet-name>order</servlet-name>
                <servletclass>mum.edu.cs.Order</servlet-class>
                <init-param>
                        <param-name>servletName</param-name>
                        <param-value>MVC2</param-value>
                </init-param>
        </servlet>
        <context-param>
                <param-name>applicationName</param-name>
                <param-value>Order Form</param-value>
        </context-param>
         <listener>
                 <listener-class>mum.edu.listener.OrderContextListener </listener-class>
         </listener>
</web-app>
```

OrderFormStartup Demo

Override Servlet init() – to process the Servlet init-param FROM web.xml:

```
<init-param>
        <param-name>servletName</param-name>
        <param-value>MVC2</param-value>
</init-param>
```

```
public class Order extends HttpServlet {
  // Store servlet init-param here
  String servletName;
  @Override
  public void init( ) throws ServletException {
      servletName =
  getServletConfig().getInitParameter("servletName");
}
```

OrderFormStartup Demo [Cont.]

Implement Listener to process Application Context context-param [web.xml]:

```
<context-param>
        <param-name>applicationName</param-name>
        <param-value>Order Form</param-value>
</context-param>

<listener>
        <listener-class>mum.edu.listener.OrderContextListener </listener-class>
</listener>
```

```
public class OrderContextListener implements ServletContextListener{
   public void contextInitialized(ServletContextEvent event){
     ServletContext servletContext = event.getServletContext();
       String applicationName =
                    servletContext.getInitParameter("applicationName");
     servletContext.setAttribute("applicationName", applicationName);
   }
```

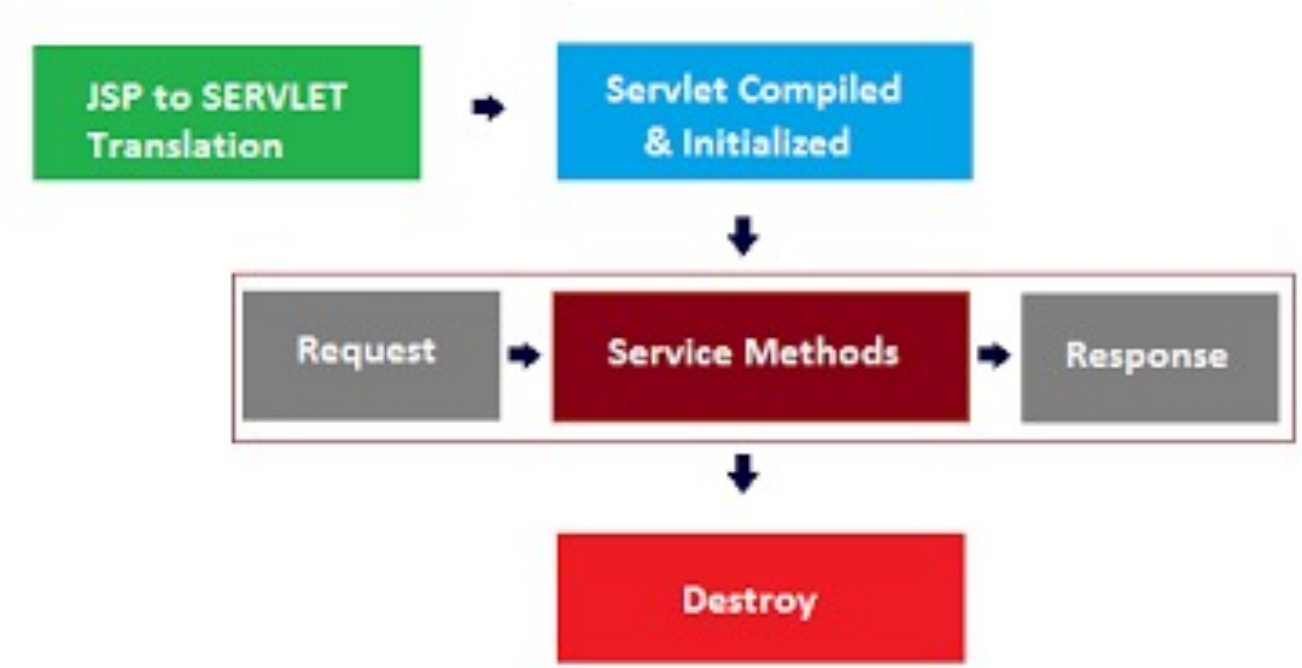
Main Point

- Web containers manage the life cycle of servlets. *The unified field manages the entire universe.*

Java Server Pages

- Architecturally, a Java Server Page is a high-level abstraction of Java servlets.
- It is a type of Java servlet that is designed to fulfill the role of a user interface for a Java web application.
- Developers write JSPs as text files that combine HTML or XHTML code, XML elements, and embedded JSP actions and commands.

JSP Lifecycle



A Simple Order Form “DEMO”

```
public void _jspService(final javax.servlet.http.HttpServletRequest request, final
   javax.servlet.http.HttpServletResponse response)
 try {
    response.setContentType("text/html");
    pageContext = _jspxFactory.getPageContext(this, request, response, null, true, 8192, true);
    _jspx_page_context = pageContext;
    application = pageContext.getServletContext();
    config = pageContext.getServletConfig();
    session = pageContext.getSession();
    out = pageContext.getOut();
    _jspx_out = out;
    out.write("<!DOCTYPE html>\r\n");
    out.write("<html>\r\n");
    out.write("<head>\r\n");
    out.write("<link rel=\"stylesheet\" type=\"text/css\" href=\"resources/mystyle.css\">\r\n");
    out.write("<meta charset=\"ISO-8859-1\">\r\n");
    out.write("<h4>Order</h4>\r\n");
    out.write("</head>\r\n");
    out.write("<body>\r\n");
    out.write("\t<form  method=\"post\">\r\n");
   …
```

Expression Language versus Scriptlet

- Example: We have a person object stored as a request attribute. A person has an address and an address has a zip. How to retrieve zip?

- Scripting approach:

```
<%((pkg.Person)request.getAttribute("person")).
getAddress().getZip() %>
```

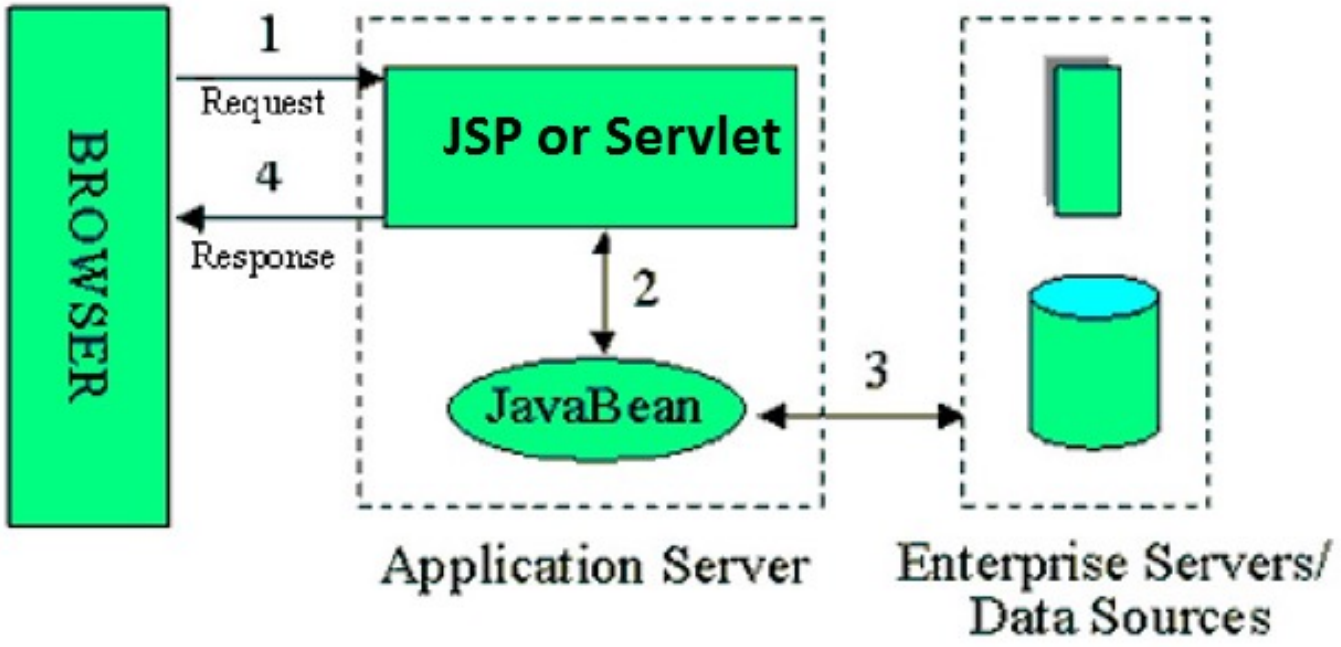
- EL approach:

```
${person.address.zip}
```

MVC: Model-View-Controller

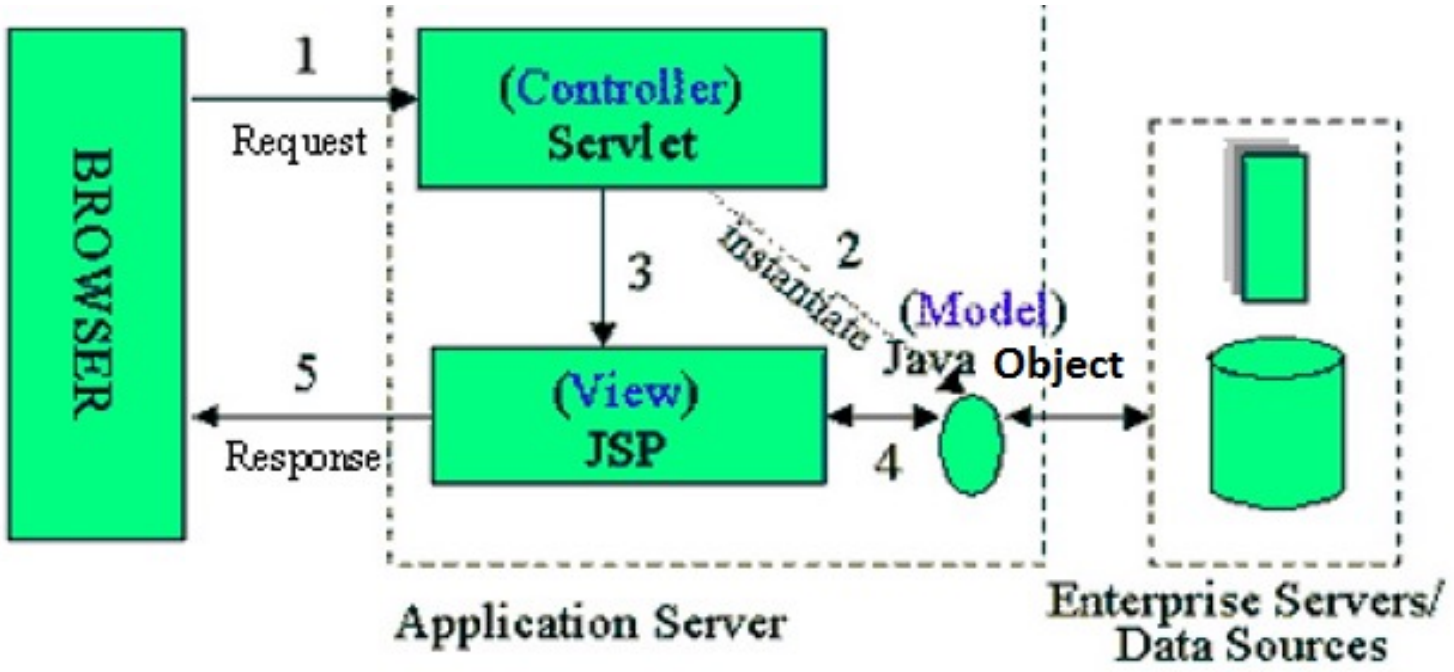
- **Separation of Concerns**
  - Separates the modeling of the domain, the presentation, and the actions based on user input into three separate classes
- **Model**
  - Maintains the data[i.e. state] of the application domain
- **View**
  - Manages the display of information.
- **Controller**
  - Manages user input triggering the model and/or the view to change as appropriate.

Model 1 Architecture



Model 1 mixes view and business logic inside each handling servlet (or JSP). This makes it more difficult to change the view independently of that logic, and difficult to change business logic without changing the view.

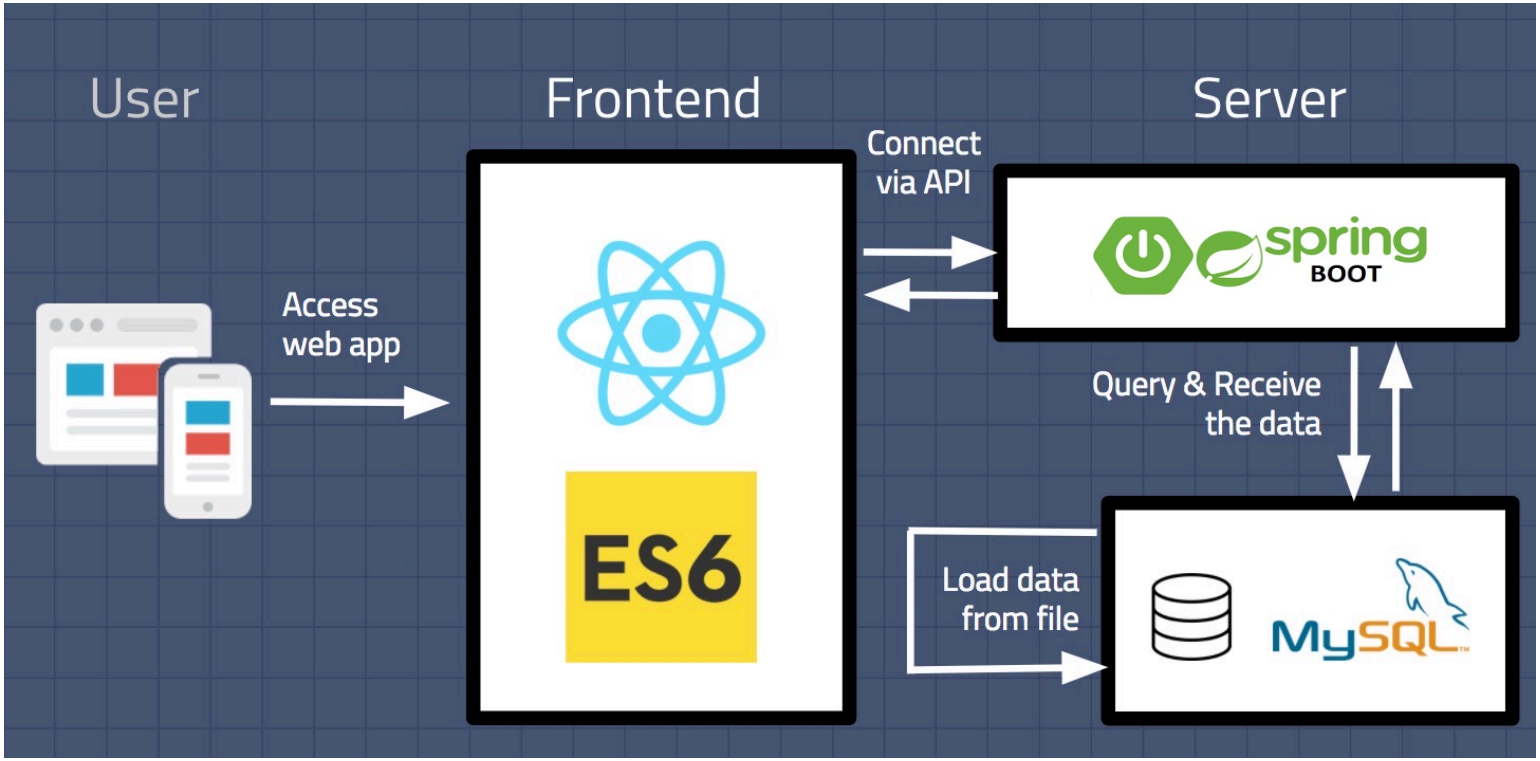
Model 2 Architecture



Model II cleanly separates business data and logic from the view, and the two are connected through a controller servlet. The model allows for multiple controllers/servlets, [e.g., one per GET/POST pair].

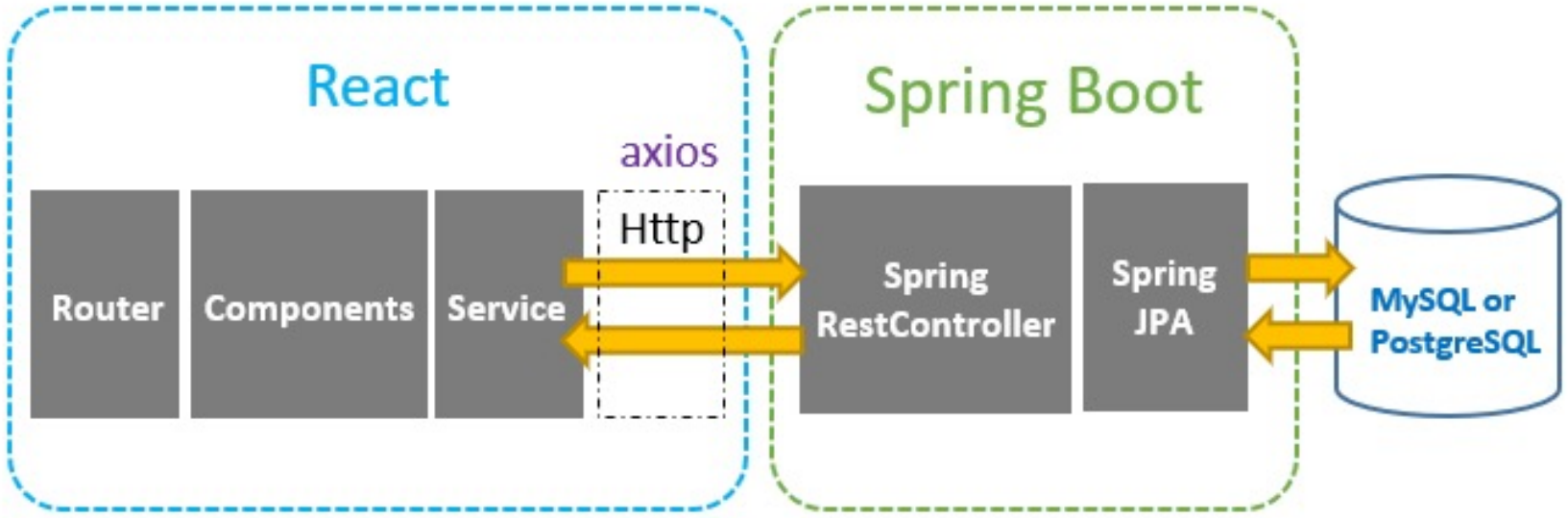
Typical MVC Framework implementations have just **one controller servlet** which centralizes common tasks.

Model 3 Architecture

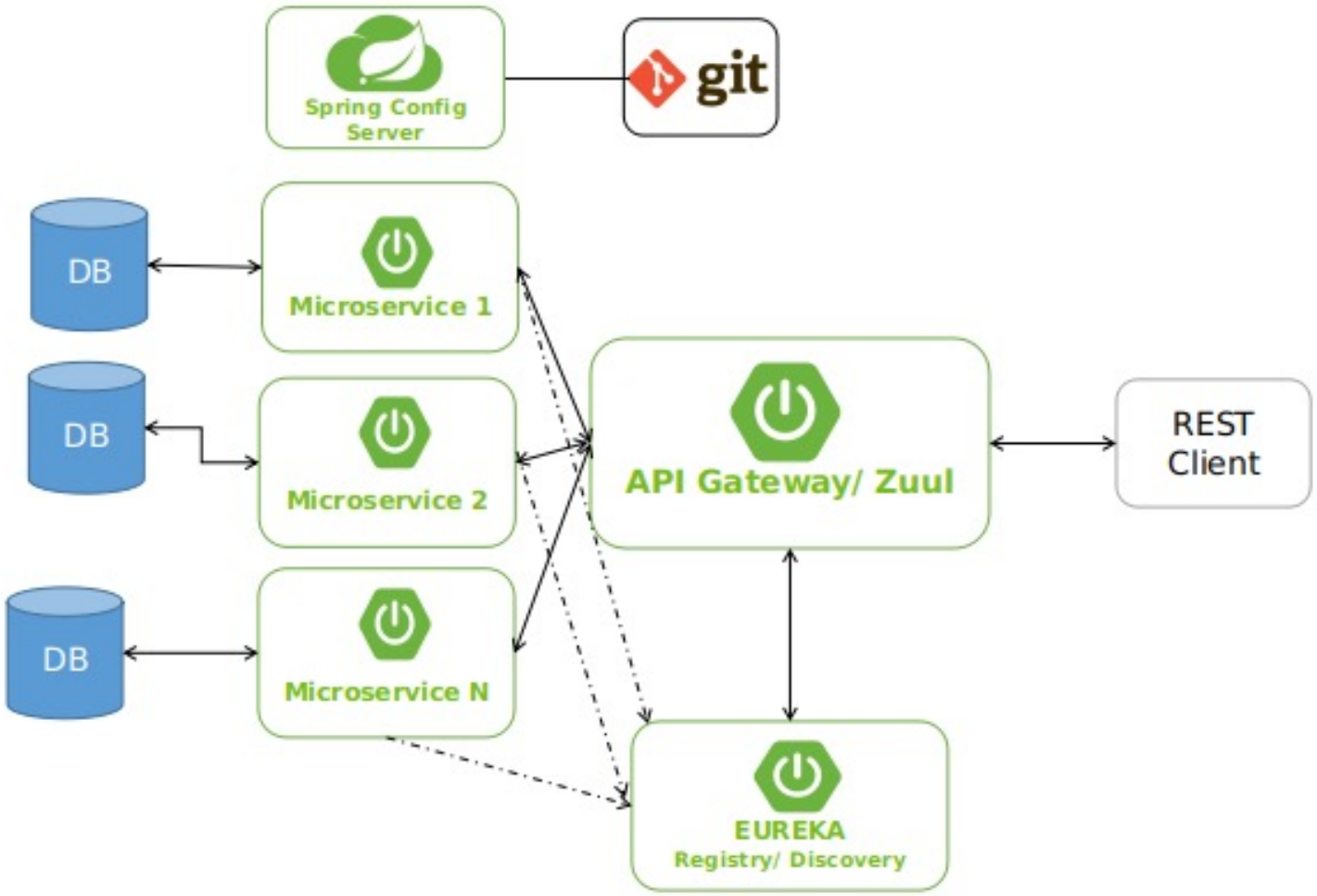


Architecture built in this course

- This course emphasizes on building a modern architecture separating the view from the server-side.
- This is more efficient, scalable and widely applied in today's industrial market for several reasons explained within course



Microservices Architecture



Main Point

When you use JSP pages according to a Model 2 architecture, there is a servlet that acts as a controller (**process of knowing**) that sets attribute values based on computations and results from a business model (**knower**), then dispatches the request to the servlet generated by the JSP page (**known**). The JSP servlet then retrieves the attribute values and inserts them into the designated places in the HTML being sent to the browser.