

Thread Title

Developing Web Databases Using Java Technology: A Tutorial

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Session: Developing Web Databases Using Java Technology:
A Tutorial
Session ID: I11

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Developing Web Databases Using Java Technology: A Tutorial

ABSTRACT

This tutorial presents technologies and architectures needed for developing JDBC-based Web-enabled Databases.

Developing Web Databases Using Java Technology: A Tutorial

- Distributed Enterprise Computing Architectures
- Java Applets, Java Servlets, and JSP
- HTML page and Java Servlets Interactions and Architecture
- JDBC (Java Database Connectivity) and Web Database
- Integrated Development Environment - VisualAge for Java, and IBM WebSphere Application Server

Distributed Computing Frameworks and Architectures

- Distributed Computing Frameworks support:
 - Web applications and connection to legacy systems
 - XML for exchange data among different components
 - Common services are partitioned into tiers and reusable components
 - Software choices from multiple vendors on multiple operating systems
 - Development of contemporary scalable distributed object computing

Java Applets

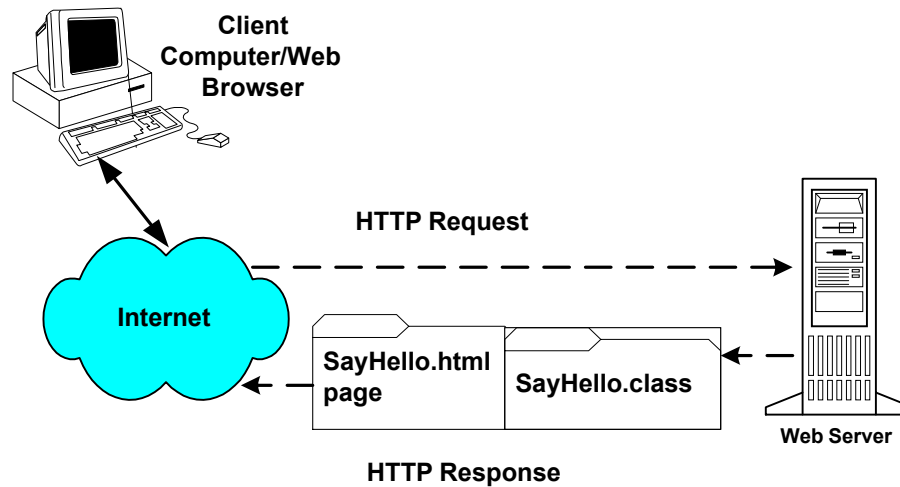
- Applets are programs written in Java for including in an HTML page and executed by the browser or an Appletviewer
- It can perform the following functions on the client side: computation, animation, and sound.
- Java has the following two class packages for Applet applications:
 - `java.Applet`
 - `javax.swing.JApplet`

Preparing and Using an Applet

- For example, an applet called `SayHello.java` is created and compiled into the class file: `SayHello.class`; and is saved in a Web server for use
- A HTML page called `SayHello.html` for using this `SayHello.class` may include the following tag and code for this applet to be downloaded and executed within the browser:

```
<APPLET CODE="SayHello.class" WIDTH=700  
HEIGHT=50> </APPLET>
```

Accessing an Applet



What are Java Servlets?

- **Java™ Servlet** provides Web developers with a simple, consistent mechanism for extending the functionality of a Web server and for accessing existing business systems.
- Servlets provide a component-based, platform-independent method for building Web-based applications, without the performance limitations of CGI programs.

What are Java Servlets? (Continued)

- Servlets have access to the entire family of Java APIs, including the JDBC API to access enterprise databases.
- Servlets can also access a library of HTTP-specific calls and receive all the benefits of the matured Java language, including portability, performance, reusability, and crash protection.
- IBM WebSphere Application server has a Servlet container or engine for executing Servlets

Java Sever Pages (JSPs)

- JavaServer Pages™ (JSP™) technology uses XML-like tags and scriptlets written in Java to separate presentation from the content generation.
- JSPs are normally considered dynamic Web pages which mix regular, static HTML with dynamic generated content from Servlets.

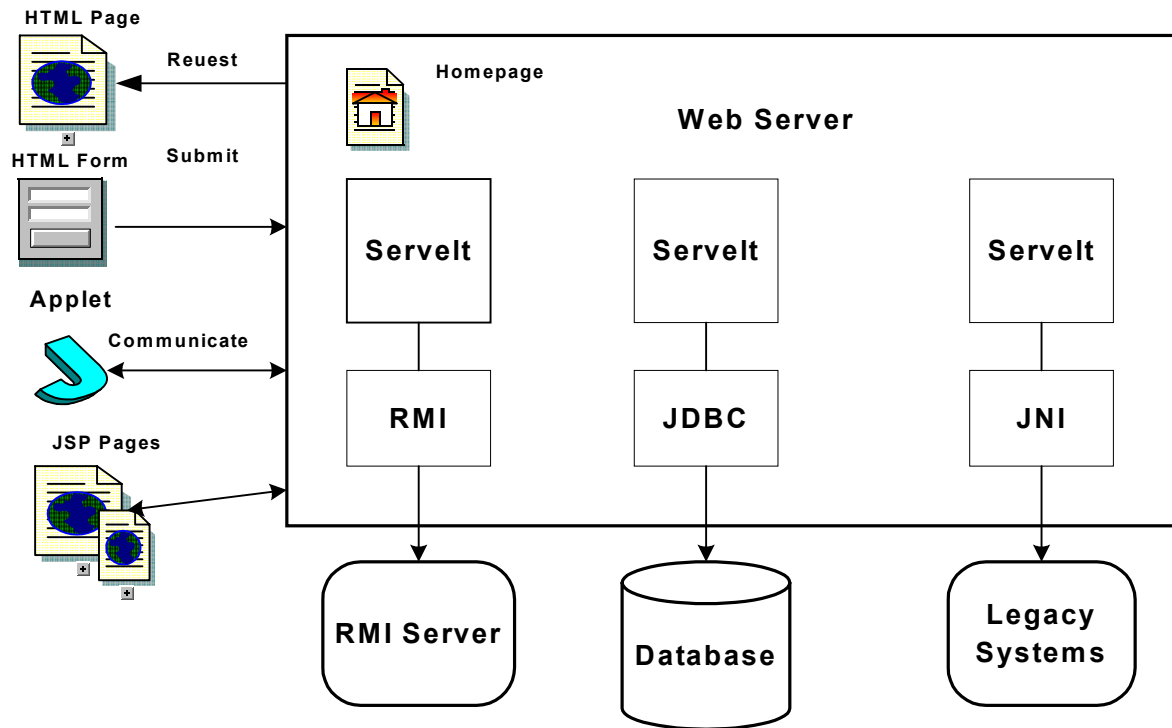
HTML Page and Servlets Interactions

- The request-response model of communication is the foundation for Java Servlets.
- The Servlets communicate between clients and the servers via the HTTP protocol of the World Wide Web.
- A client HTML page using GET and/or POST method in the FORM to sends a HTTP request to the server.

HTML Page and Servlets Interactions (Continued)

- The server receives the request and directs it to be processed by an appropriate Servlet.
- The Servlet process its task processing (which often includes interacting with a database).
- Then return their results to the browser in the form of HTML documents.

Servlet Architecture



Java Database Connectivity (JDBC) Basics

- Java Database Connectivity (JDBC) API allows Java programs to manipulate enterprise-level relational database management systems (RDBMS) without using vendor-specific or platform-specific APIs
- JDBC 3.0 is implemented with the packages:
 - Java.sql
 - Javax.sql
- There are four JDBC driver types

JDBC Driver Types

Driver Type	Driver Name	Technology	Applications
Type 1	JDBC-ODBC Bridge plus ODBC	C/C++; no Java	Two-tier applications running in a LAN; no applets
Type 2	Native API Partly Java	Native C/C++ and Java	Within RMI servers or Java Servlets; for 3-tier applications
Type 3	JDBC-Network Pure Java	No native code; Java Client	Suited for use within both applets and 3-tier Java applications
Type 4	Native Protocol Pure Java	Pure Java	Within RMI, CORBA server or Servlet

JDBC Supporting Classes

- The JDBC Classes for Creating a Connection
 - `java.sql.Driver`
 - `java.sql.DriverManager`
 - `java.sql.Connection`
- Database Access
 - `java.sql.Statement`
 - `// executeQuery() to execute SQL query`
 - `// executeUpdate()`
 - `java.sql.ResultSet`
 - `// one or more rows of data returned from a database query`

JDBC Supporting Classes (Continued)

- Other classes

java.sql.SQLException

java.sql.SQLWarning

java.sql.DataTruncation

java.sql.Date

java.sql.Time

java.sql.Timestamp

SQL Datatypes and Java Datatypes Mappings

Procedures for Using JDBC to Access Database

- Install Java 2 Enterprise Edition, and JDBC API packages (java.sql and javax.sql)
- Install an appropriate JDBC driver
- Load database driver class
- Connect to a database
- Create statements to query
- Query database
- Process returned data results
- Close statement and connection
- Setup GUI and display result

Web-Enabled Database Architectures

- The four-layer Internet architecture consists:
 - Presentation
 - Content
 - Application
 - Data and Service layers.
- Three-tier Web-enabled database architecture:
 - A Client Tier
 - A Middle Tier
 - A Data Tier

Three-Tier Web-Enabled Database Architecture

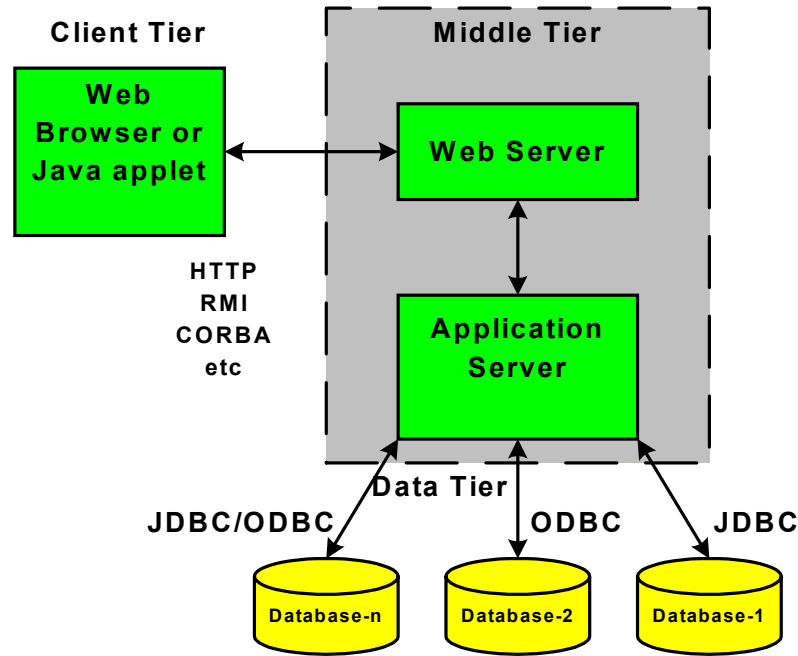
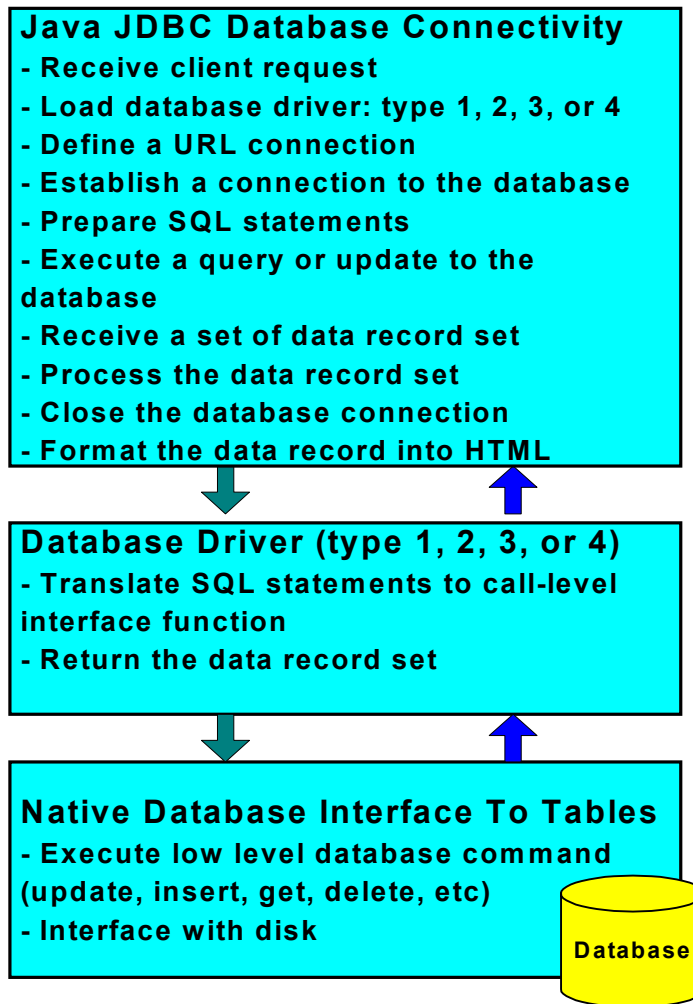


Figure 1. Three-Tier Web-Enabled Database Architecture

Web-Enabled Databases Design Using JDBC Drivers



Querying a JDBC Data Source with a GUI Client

```
//ShowSupplier.java
import java.sql.*;
import java.awt.*
import java.util.*;
import javax.swing.*
public class ShowSupplier extends JFrame {
// Constructor
public ShowSupplier(){
try{
String jdbcDriver =
"com.ibm.db2.jdbc.app.DB2Driver";
```

Querying a JDBC Data Source with a GUI Client (continue)

```
String dataBaseURL = "jdbc:db2:PARTS_SUPPLIER";  
// 1. Load database driver class  
Class.forName(ibmJDBCdriver);  
// 2. Connect to a Database through the DriverManager  
Connection aConnection =  
DriverManager.getConnection(dataBaseURL);  
// 3. Craete Statement for query database  
// Standard SQL Interface  
Statement aStatement =  
db2Connection.createStatement();
```

Querying a JDBC Data Source with a GUI Client (continue)

```
// or use PreparedStatement for accepting input parameters;  
// set INPUT parameters  
// or use CallableStatement for accepting input and output  
// parameters; set INPUT and //OUTPUT parameters  
//4. Run Query Statement  
ResultSet aResultSet =  
    aStatement.executeQuery( "SELECT * FROM suppliers"  
    );  
//5. Process query results  
StringBuffer aResults = new StringBuffer();  
ResultSetMetaData aMetaData =  
    aResultSet.getMetaData();
```

Querying a JDBC Data Source with a GUI Client (Continued)

```
int numOfColumns = aMetaData.getColumnCount();  
    // Process data here  
// Close statement and connection  
    aStatement.close();    aConnection.close();  
// Set up GUI and display window  
}  
// Catch database interfacing problems  
catch (SQLException dbSQLException)  
    { // Show message }  
    System,.exit(1);  
}
```

Querying a JDBC Data Source with a GUI Client (Continued)

```
// Catch database driver loading problems
catch (ClassNotFoundException classNotFound)
    { // Show message }
    System.exit(1);
}
} // end of ShowSupplier() constructor
public static void main(String args[])
{
    ShowSupplier jdbcDbTest = new ShowSuppliers();
}
} end of class ShowSuppliers
```

Database Connection Pool

- Setting a pool of connections to a data source so that the connection can be drawn and reuse
- The advantages:
 - Minimizing the substantial overhead (time and resources) required to physically connecting to a database
 - Allowing many concurrent database connections (such as Web shopping-cart application)
- Using DataSource object not DriverManager class to get an connection
- Registered with a JNDI (Java Naming and Directory Interface)

IBM VisualAge for Java (Enterprise Edition)

- VisualAge Developer Domain
(www.software.ibm.com/vadd)
- The Java IDE with visual programming support for creating applets and Swing beans
- Team program support to share and maintain source code in a single repository
- JavaDoc output support
- Enterprise Toolkit for AS/400 and workstation, Java compilers and a remote Java debugger

IBM VisualAge for Java (Enterprise Edition)

- Enterprise Access Builder for SAP R/3, JDBC, C++, and RMI
- IBM Java Implementation - com.ibm.uvm.* package
- Create class, applet, interface, servlet, application, method, instance field, package
- Help: code assist
- WebSphere Test Environment (WTE)

IBM WebSphere Application Servers

- Standard, Advanced and Enterprise editions
- a middleware, built on open standards-based technology, enables development, deployment and integration of next-generation e-business applications
- Product information can be found at IBM WebSphere Developer Web Site
<http://www7b.boulder.ibm.com/wsdd/>

IBM WebSphere Application Servers (Continued)

- Advanced Edition: Includes a high performance Enterprise Java Bean component server. It is the premier server for integrating enterprise data and transactions and deploying them in a complex e-business environment on multiple, distributed machines.
- Advanced Single Server Edition: Supports all of the J2EE APIs (including support for EJBs) in an entry-level, single server environment.

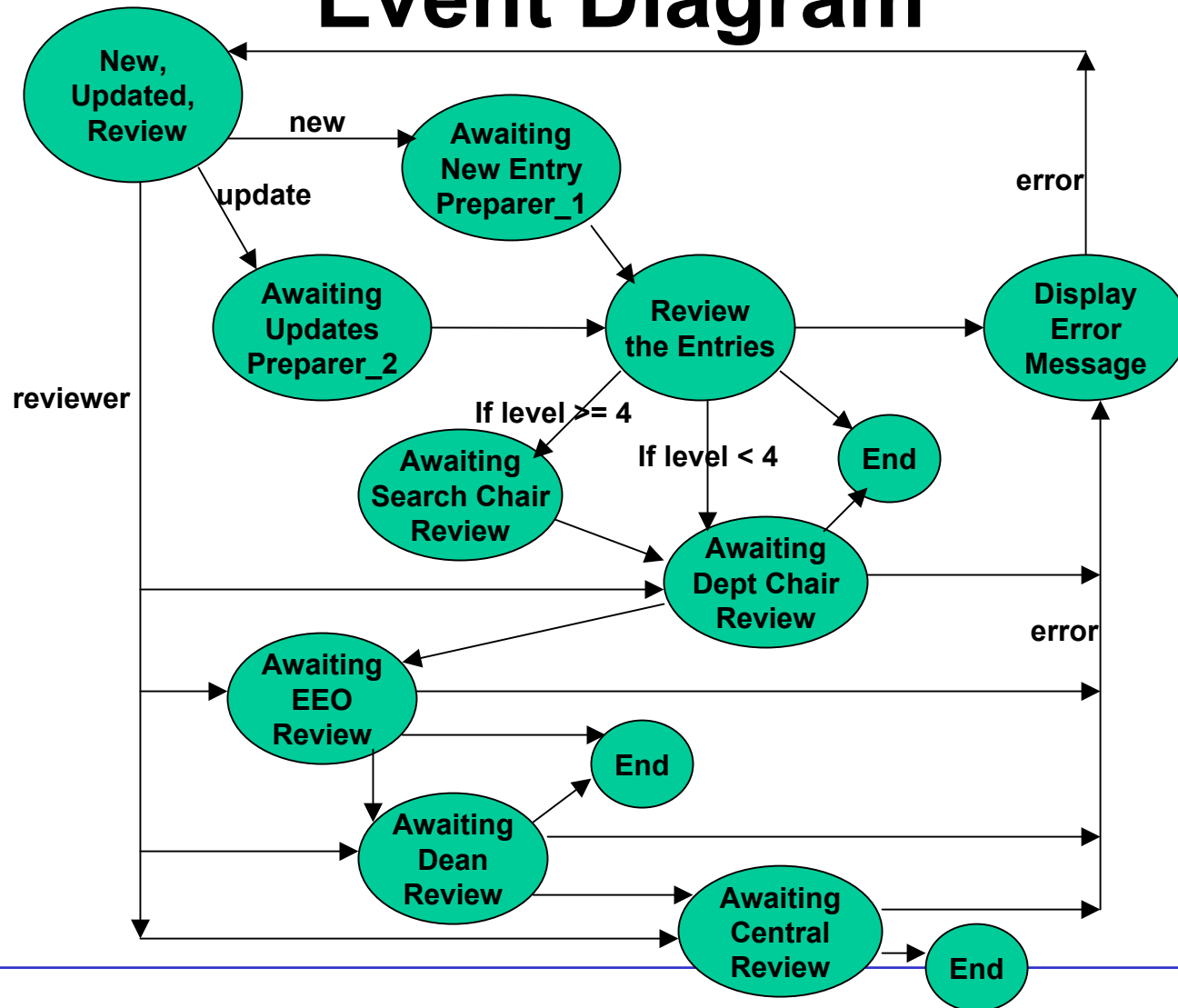
IBM WebSphere Application Servers (Continued)

- Enterprise Edition: Builds highly transactional, high-volume e-business applications, integrating EJB and CORBA technologies.
- Standard Edition: Quickly transforms static Web sites into vital sources of Web content by using Servlets, JavaServer Pages, and XML. “

An Example: Position Filled Announcement

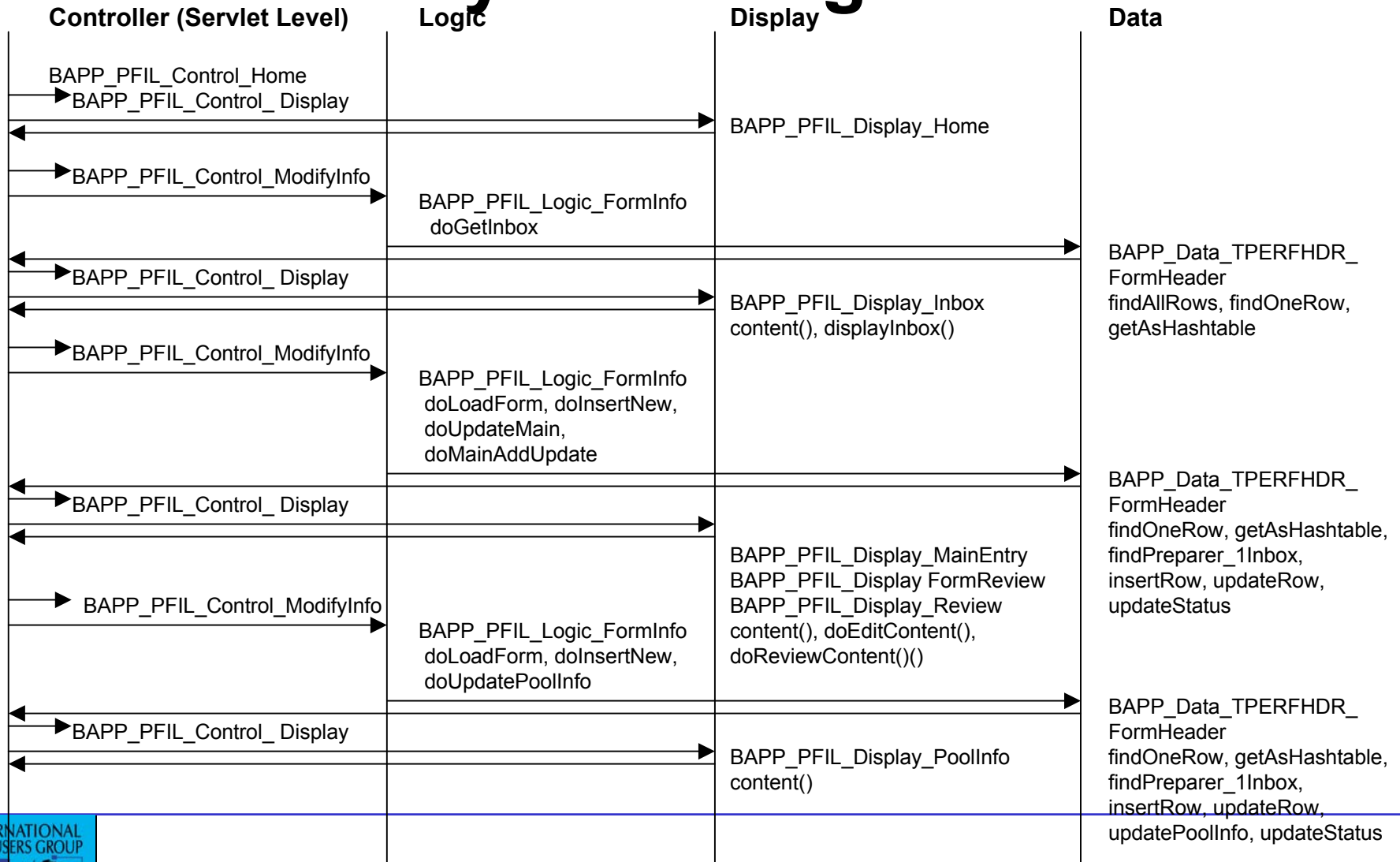
- Give a high level block diagram (is there any database here), using Vision to show
- Classes _???????
- Event Diagram

Ex: Position Filled Announcement Event Diagram



Ex: Position Filled Announcement

System Diagram



Ex: Position Filled Announcement Web Page

Position Filled Announcement: Home - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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Address Go Links >>

 **Position Filled Announcement: Home** 

[Home](#) [In-Box](#) [Logoff](#)

Position Filled Announcement

Position Number:

Listing Number:



Done

Start | Workbench | WebSphere... | Console | C:\ISProje... | Position Fi... | C:\melissa\... | Microsoft P... | Local intranet | 9:47 AM

Ex: Position Filled Announcement Review Page

Position Filled Announcement: Form Review - Microsoft Internet Explorer

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**Position Filled Announcement: Form Review**

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General Information

Position: 829970	Listing: 2002A00002
Title: COORDINATOR, COMPUTER APPLICATIONS	Applicant Selected From: Inside
Name: Billy Bob	SSN: 123456789
Effective Date of Employment: 2002-02-02	Tenure Earning: Yes
Race: Black (non-Hispanic)	Handicapped: Yes
Gender: Male	Date of Acceptance: 2002-02-02

Applicant Pool Information

Qualified Applicants:	Male	Female
African-American	1	2
Asian-American	3	4
Caucasian	7	6
Hispanic-American	0	0
Native-American	0	0
Other	0	0
Total:		69
No Information Provided Total:		2

Interviewed Applicants:	Male	Female
African-American	1	2

Done

Start Workbench WebSphere Console C:\ISProje... Position Fi... C:\melissa\... Microsoft P... Local intranet 9:48 AM

Ex: Position Filled Announcement Main Entry Page

Position Filled Announcement: Main Entry - Microsoft Internet Explorer

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 **Position Filled Announcement: Main Entry** 

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Position Filled Announcement

Legislative Position No.: 829970
Listing No.: 2002A00002
Title: COORDINATOR, COMPUTER APPLICATIONS

Name:	Billy Bob	Applicant Selected From:	☒ Inside ☐ Outside
Social Security No.:	123456789	Tenure Earning Position:	☒ Yes ☐ No
Race:	Black (non-Hispanic)	Effective Date Of Employment:	2002-02-02
Gender:	☒ Male ☐ Female	Salary: \$	69000.00
Handicapped:	☒ Yes ☐ No	Date Of Acceptance:	2002-02-02



Done Local intranet

Start Workbench WebSph... Console C:\ISPro... C:\melis... Microsof... Position... 10:09 AM

Ex: Position Filled Announcement Applicant Pool Info

Position Filled Announcement: List Of Five - Microsoft Internet Explorer

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Address Go Links >>


Position Filled Announcement: List Of Five


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Legislative Position No.: 829970
Listing No.: 2002A00002
Title: COORDINATOR, COMPUTER APPLICATIONS

Name	Title	Institution
List below "External Experts" chosen to identify minority candidates		
Regina Fillangi	cook	uf
Willy Rechstiener		
List below "External Experts" chosen to identify female candidates		
sssss	eeeeeeeeeeee	oooooooooooo
dddddddddd	uuuuuuuuuuuu	
List below "List of Five" identified minority candidates		
sssss	ss	ssssssssss

Done

Start Workbench WebSph... Console C:\ISPro... C:\mellis... Microsof... Position... Local intranet 10:15 AM

Ex: Position Filled Announcement Rank of Applicants

Position Filled Announcement: Rank of 3-5 Applicants - Microsoft Internet Explorer

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Address

 **Position Filled Announcement: Rank of 3-5 Applicants**  UNIVERSITY OF FLORIDA

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Legislative Position No.: 829970
Listing No.: 2002A00002
Title: COORDINATOR, COMPUTER APPLICATIONS

☐	Name: Billy Bob	Explanation: he was the best (You may enter up to 125 characters.)
☐	Race: White (non-Hispanic)	
☐	Gender: Male ☒ Female ☐	
☐	Name: Joe Blow	Explanation: not good (You may enter up to 125 characters.)
☐	Race: Black (non-Hispanic)	
☐	Gender: Male ☒ Female ☐	
☐	Name: Jane Thomas	Explanation: good (You may enter up to 125 characters.)
☐	Race: White (non-Hispanic)	
☐	Gender: Male ☐ Female ☒	
☐	Name:	Explanation:
☐	Race:	

Done

Start Workbench WebSph... Console C:\ISPro... C:\mellis... Microsof... Position... Local intranet 10:12 AM

Ex: Position Filled Announcement List of Five

Position Filled Announcement: List Of Five - Microsoft Internet Explorer

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**Position Filled Announcement: List Of Five** UNIVERSITY OF FLORIDA

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Legislative Position No.: 829970
Listing No.: 2002A00002
Title: COORDINATOR, COMPUTER APPLICATIONS

Name	Title	Institution
List below "External Experts" chosen to identify minority candidates		
Regina Fillangi	cook	uf
Willy Rechstiener		
List below "External Experts" chosen to identify female candidates		
sssss	eeeeeeeeeeee	oooooooooooo
ddddddddd	uuuuuuuuuuu	
List below "List of Five" identified minority candidates		
sssss	ss	ssssssssss

Done

Start | Workbench | WebSph... | Console | C:\ISPro... | C:\melis... | Microsof... | Position... | Local intranet | 10:15 AM

Summary

- We have presented Web-enabled database architectures and some popular Java technologies and tools for developing JDBC-based Web enabled databases. These Java technologies include
 - Java Applets
 - Java Servlets
 - Java Server Pages (JSPs)
 - JDBC
- The development tools and application servers are IBM VisualAge and WebSphere Servers

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