Server Side Internet Programming

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  - mapping and configuration
  - compilation and execution

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- JSP
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- JSP Expression Language (EL)

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- The basics of servlets
  - mapping and configuration
  - compilation and execution
- Cookies and sessions
- Request and session attributes
- JSP
  - execution, examples
- JSP Expression Language (EL)
- Databases:
  - SQL (Structured Query Language)
  - JDBC (Java Data Base Connectivity)

Dynamic web content

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But what are servlets?

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Servlets are programs that run on the server side. They work like CGI programs but are partial Java programs following a special recipe and they are run by a container application program

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A servlet reads data from the client, generates an answer – by communicating with files, databases or other programs – and sends back the answer to the client

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- There are many application servers that work as servlet containers.
- Resin, Jetty (is a combined http, java servlet and application server), JOnAS, BEA WebLogic, SIP Servlet Application Server, iPlanet, et.c. see: `http://en.wikipedia.org/wiki/List_of_Servlet_containers` for a more actual (accurate) list

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- If you run Tomcat you can test your servlets by submitting a form or by simply starting it without any form parameters.

Servlet structure

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import java.io.*;
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      // e.g. cookies and query data from HTML forms
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   public void doGet(HttpServletRequest request,
                     HttpServletResponse response)
   throws ServletException, IOException {
      // Use "request" to read incoming HTTP headers
      // e.g. cookies and query data from HTML forms
      // Use "response" to specify HTTP response status
      // code and headers, e.g. content type and cookies
      PrintWriter out = response.getWriter();
      // Use "out" to send the content to the browser
   }
}
```

Simple text generating servlet

Simple text generating servlet

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
public class HelloWorld extends HttpServlet {
   public void doGet(HttpServletRequest request,
                     HttpServletResponse response)
   throws ServletException, IOException {
```

Simple text generating servlet

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
public class HelloWorld extends HttpServlet {
   public void doGet(HttpServletRequest request,
                     HttpServletResponse response)
   throws ServletException, IOException {
      // container takes care of headers but
      // we change headers:
      response.setContentType("text/plain");
```

Simple text generating servlet

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import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
public class HelloWorld extends HttpServlet {
   public void doGet(HttpServletRequest request,
                     HttpServletResponse response)
   throws ServletException, IOException {
      // container takes care of headers but
      // we change headers:
      response.setContentType("text/plain");
      // and now the content
      PrintWriter out = response.getWriter();
      out.println("Hello World");
   }
}
```

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In Windows, add to CLASSPATH:

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In Windows, add to CLASSPATH:

```
%CATALINA_HOME%\common\lib\servlet.jar
```

and compile with javac. If CLASSPATH is not defined, it's OK to add a classpath value when calling javac:

```
javac -classpath %CATALINA_HOME%\common\lib\servlet.jar myServlet.java
```

Manage Tomcat with ant

If you use ant to install Tomcat all environment variables are set and it works in Solaris, Linux, MacOSX and Windows (all variants, haven't tested windows 7).

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In Solaris you do as follows:

```
~> mkdir test
~> cd test
~/test> module add ant
~/test> cp -r /info/DD1335/localTomcat .
~/test> cd localTomcat
```

If the default port is occupied you need to choose another port. Make the change in conf/server.xml

Manage Tomcat with ant . . .

```
localTomcat> ant install
localTomcat> ant compile
localTomcat> ant tomcat
localTomcat> ant stopTomcat
```

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```

When you have modified a servlet you need to restart tomcat. The fastest way is to use the manager web application.
`http://localhost:8080/manager/reload?path=/labbar`
username: `student`, password: `NADA`

Standard Web Application (webapp) Directories

```
webapps/                                  (servlet contexts)
  ROOT/                                   http://host:port/
    examples/                             http://host:port/examples
      WEB-INF/...                         (not visible by http)
    labbar/                               http://host:port/labbar
      test.html, test.jsp foo/bar.html    http://host:port/labbar/test.html
      WEB-INF/...                         (not visible by http)
        web.xml                           someJSPTagLibrary.tld
        classes/
            HelloWoldServlet.java HelloWorldServlet.class
            somepackage/AClassInThePackage
        lib/
            someLibrary.jar
```

A servlet that generates HTML

```
import java.io.*;
import javax.servlet.http.*;
import javax.servlet.*;
public class HelloWWW extends HttpServlet {
  public void doGet(HttpServletRequest  request,
                    HttpServletResponse response)
  throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String docType = "<!DOCTYPE HTML PUBLIC \"-//W3C//DTD HTML 4.0 " +
                     "Transitional//EN\">\n";
    out.println(docType + "<HTML>\n" +
                "<HEAD><TITLE>Hello WWW</TITLE></HEAD>\n" +
                "<BODY>\n" + "<H1>Hello WWW</H1>\n" +
                "</BODY></HTML>");
  }
}
```

A utility class generating HTML header

```
public class ServletUtilities {
   public static final String DOCTYPE =
      "<!DOCTYPE HTML PUBLIC \"-//W3C//DTD HTML 4.0 " +
      "Transitional//EN\">";
   public static String headWithTitle(String title) {
      return(DOCTYPE +
             "\n" + "<HTML>\n" +
             "<HEAD><TITLE>" +
             title + "</TITLE>\n</HEAD>\n");
   }
}
```

A servlet using our utility class

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
public class SimplerHelloWWW extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
  throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    out.println(ServletUtilities.headWithTitle ("Hello WWW") +
                "<BODY>\n" +
                "<H1>Hello WWW</H1>\n" +
                "</BODY></HTML>");
  }
}
```

Mapping a servlet to a path in web.xml

Normally you can access a servlet like

`http://server:port/webapp/servlet/servletName` e.g.

`http://localhost:8080/labbar/servlet/SimplerHelloWWW`

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We can configure further mappings in labbar/WEB-INF/web.xml

We can make the servlet accessible from

`http://localhost:8080/labbar/bla.abc`

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We can make the servlet accessible from

`http://localhost:8080/labbar/bla.abc`

or why not `http://localhost:8080/labbar/<anything>.abc` ?

(where `<anything>` may be substituted with just anything.

and `http://localhost:8080/labbar/world/<anything>`

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```
<?xml version="1.0" encoding="ISO-8859-1"?>
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```
<?xml version="1.0" encoding="ISO-8859-1"?>
<web-app xmlns="http://java.sun.com/xml/ns/j2ee"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee/web-app_2_4.xsd"
   version="2.4">
```

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   <servlet>
      <servlet-name>hello</servlet-name>
      <servlet-class>SimplerHelloWWW</servlet-class>
   </servlet>
```

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   version="2.4">
   <servlet>
      <servlet-name>hello</servlet-name>
      <servlet-class>SimplerHelloWWW</servlet-class>
   </servlet>
   <servlet-mapping>
      <servlet-name>hello</servlet-name>
      <url-pattern>*.abc</url-pattern>
   </servlet-mapping>
   <servlet-mapping>
      <servlet-name>hello</servlet-name>
      <url-pattern>/world</url-pattern>
   </servlet-mapping>
</web-app>
```

Calling a servlet from a form

```
<html>
  <body>









  </body>
</html>
```

Calling a servlet from a form

```
<html>
  <body>
    <form action="/servlet/ThreeParams">




    </form>
  </body>
</html>
```

Calling a servlet from a form

```
<html>
  <body>
    <form action="/servlet/ThreeParams">
      First Parameter: <input type="text" name="param1"><br />
      Second Parameter: <input type="text" name="param2"><br />
      Third Parameter: <input type="text" name="param3"><br />



    </form>
  </body>
</html>
```

Calling a servlet from a form

```
<html>
  <body>
    <form action="/servlet/ThreeParams">
      First Parameter: <input type="text" name="param1"><br />
      Second Parameter: <input type="text" name="param2"><br />
      Third Parameter: <input type="text" name="param3"><br />
      <center>
        <input type="submit">
      </center>
    </form>
  </body>
</html>
```

Responding to the form

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
public class ThreeParams extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
  throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String title = "Reading Three Request Parameters";
    out.println(ServletUtilities.headWithTitle(title) +
       "<body bgcolor=\"#fdf5e6\">\n" +
       "<h1 align=\"center\">" + title +
       "</h1>\n" + "<ul>\n" + " <li><b>param1</b>: " +
       request.getParameter("param1") + "\n" +
       " <li><b>param2</b>: " + request.getParameter("param2") +
       "\n" + " <li><b>param3</b>: " +
       request.getParameter("param3") + "\n" + "</ul>\n" +
       "</body>\n</html>");
   }
}
```

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`javax.servlet.http.HttpServletRequest`

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- Beware, some of the `HttpServletRequest` methods are declared in its superinterface `javax.servlet.ServletRequest`.
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  - `getMethod()`
  - `getProtocol()`
  - `getQueryString()`

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  - `String getParameter(String name)` returns one parameter
  - `String[] getParameterValues()` returns all values of a parameter
  - `Map getParameterMap()` returns all parameters

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- The query string is already broken down into parameters
  - `String getParameter(String name)` returns one parameter
  - `String[] getParameterValues()` returns all values of a parameter
  - `Map getParameterMap()` returns all parameters
- TCP information (like CGI)
  - Local: `getServerPort()`, `getServerName()`
  - Remote: `getRemoteHost()`, `getRemoteAddr()`

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  - `Enumeration getHeaderNames()`
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  - `getContentType()`
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- Unlike CGI, you can read *any* HTTP header
  - `getHeader(String name)`
  - `Enumeration getHeaderNames()`
  - `getIntHeader(String name)`
- You can get the POST content by invoking
  - `getInputStream()`
  - `getReader()`

Request printing example

```
public class ShowRequestHeaders extends HttpServlet {
   public void doGet(HttpServletRequest request,
                     HttpServletResponse response)
   throws ServletException, IOException {
      response.setContentType("text/html");
      PrintWriter out = response.getWriter();
      String title = "Servlet Example: Showing Request Headers";
      out.println(ServletUtilities.headWithTitle(title) +
         "<body bgcolor=\"#fdf5e6\">\n" + "<h1 align=\"center\">" +
         title + "</h1>\n" +
         "<b>Request Method: </b>" +
         request.getMethod() + "<br />\n" +
         "<b>Request URI: </b>" +
         request.getRequestURI() + "<br />\n" +
         "<b>Request Protocol: </b>" +
         request.getProtocol() + "<br /><br />\n");
```

Request printing example . . .

```
        out.println("<table border=\"1\" align=\"center\">\n" +
            "<tr bgcolor=\"#ffad00\">\n" +
            "<th>Header Name<th>Header Value");
        Enumeration headerNames = request.getHeaderNames();
        while(headerNames.hasMoreElements()) {
            String headerName = (String)headerNames.nextElement();
            out.println("<tr><td>" + headerName);
            out.println(" <td>" + request.getHeader(headerName));
        }
        out.println("</table>\n</body></html>");
    }
    public void doPost(HttpServletRequest request,
                       HttpServletResponse response)
    throws ServletException, IOException {
        doGet(request, response);   /* doPost() do as doGet(). */
    }
}
```

Servlet lifecycle

- init(ServletConfig) is called when the servlet is created. Called once!

```
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   // initialize the servlet
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- `init(ServletConfig)` calls `init()` with no parameters
- `destroy()` is called just before the server goes down, or when the web application is reloaded
- `destroyservice(ServletRequest, ServletResponse)` is called for each access
- `doGet()`, `doPost()` and `doXxx`
  `service()` will call one of these, depending on the HTTP method

Servlet configuration parameters

```
public class ShowMessage extends HttpServlet {
  private String message;
  private String defaultMessage = "No message.";
  private int repeats = 1;
  public void init() throws ServletException {
    ServletConfig config = getServletConfig();
    message = config.getInitParameter("message");
    if (message == null) { message = defaultMessage; }
    try {
      String repeatString = config.getInitParameter("repeats");
      repeats = Integer.parseInt(repeatString);
    }
    catch(NumberFormatException nfe) {
    /* NumberFormatException handles case where repeatString is null
      *and* case where it is in an illegal format. */
    }
  }
```

Servlet configuration parameters . . .

```
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
  throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String title = "The ShowMessage Servlet";
    out.println(ServletUtilities.headWithTitle(title) +
                "<body bgcolor=\"#fdf5e6\">\n" +
                "<h1 align=\"center\">" +
                title + "</h1>");
    for(int i = 0; i < repeats; i++) {
      out.println("<b>" + message + "</b><br />");
    }
    out.println("</body></html>");
  }
}
```

Setting configuration parameters in web.xml

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<web-app
   xmlns="http://java.sun.com/xml/ns/j2ee"
   xmlns:xsi="http://www.w3.or g/2001/XMLSchema-instance"
   xsi:schemaLocation=
     "http://java.sun.com/xml/ns/j2ee/web-app_2_4.xsd"
   version="2.4">
   <servlet>
      <servlet-name>Show Msg</servlet-name>
      <servlet-class>ShowMess age</servlet-class>
      <init-param>
         <param-name>message</param-name>
         <param-value>Shibboleth</param-value>
      </init-param>
      <init-param>
         <param-name>repeats</param-name>
         <param-value>5</param-value>
      </init-param>
   </servlet>
</web-app>
```

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  - shopping basket, etc
- The cookie is created by the server and sent to the browser with the response

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- The rest is not important for the course see

`http://java.sun.com/javaee/5/docs/api/javax/servlet/http/Cookie.html`
`http://java.sun.com/javaee/5/docs/api/javax/servlet/http/`↩
`HttpServletResponse.html#addCookie(javax.servlet.http.Cookie)`

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- A session expires if there is no access from the browser for a certain period (typically 15 minutes)
- You may associate attributes with the session.
  The attributes, like the session, will be accessible when responding to all HTTP requests made from the same browser, until the session expires

Session example

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
import java.util.Date;
public class ShowSession extends HttpServlet {
  public void doGet(HttpServletRequest request,
  HttpServletResponse response)
    throws ServletException, IOException {
      response.setContentType("text/html");
      PrintWriter out = response.getWriter();
      String title = "Session Tracking Example";
      HttpSession session = request.getSession(true);
      String heading;
      Integer accessCount =
        (Integer)session.getAttribute("accessCount");
      if (accessCount == null) {
        accessCount = new Integer(0);
        heading = "Welcome, Newcomer";
      } else {
        heading = "Welcome Back";
        accessCount = new Integer(accessCount.intValue() + 1);
      }
```

Session example . . .

```
    session.setAttribute("accessCount", accessCount);
    out.println(ServletUtilities.headWithTitle(title));
    out.println("<body bgcolor=\"#fdf5e6\">");
    out.println("<h1 align=\"center\">" + heading + "</h1>");
    out.println("<h2>Information on Your Session:</h2>");
    out.println("<table border=\"1\" align=\"center\">");
    out.println("<tr bgcolor=\"#ffad00\">");
    out.println("<th>Info Type</th><th>Value</th></tr>\n");
    out.println("<tr>\n<td>ID</td>");
    out.println("<td>" + session.getId() + "</td>\n</tr>");
    out.println("<tr>\n<td>Creation Time</td>\n<td>");
    out.println(new Date(session.getCreationTime()) + "</td>\n</tr>");
    out.println("<tr>\n<td>Time of Last Access</td>\n<td>");
    out.println(new Date(session.getLastAccessedTime())");
    out.println("</td>\n</tr>");
    out.println("<tr><td>Number of Previous Accesses</td>\n<td>");
    out.println(accessCount + "</td>\n</tr>\n</table>");
    out.println("</body></html>");
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  - `pageContext: javax.servlet.jsp.PageContext`
  - `out: javax.servlet.jsp.JspWriter`
  - `application: javax.servlet.ServletContext` (the webapp)
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- JSP 2.0 doc
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- With JSP, you do not need to restart Tomcat or reload the servlet context when you change something. It will be re-translated to Java and recompiled for you automatically

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- Java Server Faces (JSF) is a more GUI-style web programming and is hard to combine with JSP

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  - If you know your page will produce a lot of content, it may be important to work on these

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  - This will be translated into something like:

```
public class myJsp extends HttpServlet{
  private int accessCount = 0;
  public void service(HttpSerletRequest req,
                      HttpServletResponse resp)
  throws IOException, ServletException{
    ServletOutputStream out= req.getOutputStream();
    out.print("Accesses to page since server reboot:");
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- Request, session or application attributes can be used to communicate between the page and the pages/servlets it includes or those that included it

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- HTTP cookies: `cookie`

Custom JSP tag libraries. JSTL

The @taglib directive

```
<%@ taglib uri="http://www.sometaglibprovider.com/name"
           prefix="special" %>
<html><body>
...
<special:makeBold>this text will become bold
</special:makeBold>
<special:timeOfDay format="hh:MM:ss" />
</body>
</html>
```

Such libraries are implemented using `javax.servlet.jsp.tagext.*`
The most important tag library is the Java Standard Tag Library (JSTL)
The normal JSP page does not normally need the whole power of Java, no need to create classes

Custom JSP tag libraries. JSTL . . .

```
<%@ taglib uri="http://java.sun.com/jstl/core_rt"
           prefix="c" %>
<c:set var="count" value="34" />
 ${count} <%-- Will print 34 --%>
<c:forEach items="${orders}" var="order">
   <c:out value="${order.id}"/>
</c:forEach>
```

`c:forEach` can iterate in any `java.util.Collection`, `Iterator`, `Enumeration`, etc (see Lecture 2)

It can even iterate in arrays!

```
<c:if expr="${empty(param.x)}">
  The x parameter was not specified</c:if>
```

The JSTL/EL version of header printing

```
<%@page contentType="text/html" %>
<%@ taglib uri="http://java.sun.com/jstl/core_rt" prefix="c" %>
<html>
 <head><title>Welcome!</title></head>
<body>
  You are connecting from ${pageContext.request.remoteHost}<br />
  <table border="1">
  <c:forEach items="${pageContext.request.headerNames}"
             var="headerName">
    <tr><td>${headerName}</td><td>${header[headerName]}</td></tr>
  </c:forEach>
  </table>
  <dl><%-- bonus --%>
  <c:forEach items="${paramValues}" var="p">
    <dt>${p.key}</dt>
    <dd><c:forEach items="${p.value}" var="q">${q}
        </c:forEach></dd>
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</body>
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Comments on JSTL/EL version of header printing

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- `${p.key}` results into a call to `p.getKey()`
- `${p.value}` results into a call to `p.getValue()` which in this case returns a `String[]` so we can `<c:forEach >` through it

Three-tier systems

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- Data storage layer, e.g. a database management system (SQL)
- Today, most advanced CGI systems (including servlet/JSP) work with a database where they store the data that they display and change

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  - `DELETE FROM course WHERE name='DD1335'`

Simple SQL queries

Q How many credits does course DD1335 have?

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- Make a table with students
  - `CREATE TABLE student(id integer, name varchar(255), startyear integer)`
- A table with course attendance: a many-to-many relationship
  - ```
    CREATE TABLE course_attendance (
      student_id integer, course_id integer,
      lab1 integer, lab2 integer, project integer,
      PRIMARY KEY (student_id, course_id)
    )
    ```
    ```

Simple SQL queries . . .

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```
SELECT s.name
FROM course c, course_attendance ca, student s
WHERE ca.student_id=s.id
AND c.id=ca.course_id and c.name='DD1335'
```

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```
SELECT count(ca.student_id)
FROM course c, course_attendance ca
WHERE c.id=ca.course_id and c.name='DD1335'
```

Java as SQL client: JDBC

```
import java.sql.*;
public class JDBCCode{
   public static void main(String args[]){
      try {
        Class.forName("org.postgresql.Driver" ); // load driver
      } catch (ClassNotFoundException cfn){
        System.out.println("Problem loading driver");
        System.exit(1);
      }
      try{//Establish a connection to the database, second
         //argument is the name of the user and the third
         //argument is a password (blank)
         Connection con = DriverManager.getConnection(
           "jdbc:postgresql://nestor.nada.kth.se:5432/dbname",
           "username", "userPassword");
         //Create a statement object
         Statement selectStatement = con.createStatement();
```

Java as SQL client: JDBC . . .

```
      //Execute the SQL select statement
      ResultSet rs =
        selectStatement.executeQuery (
          "SELECT name, startyear FROM " +
          "student WHERE name like 'John%'");
      while(rs.next())
        System.out.println ("Name = "+ rs.getString(1) +
                            "Salary = "+ rs.getInt(2));
      selectStatement.close();
      con.close();
      rs.close();
    } catch(Exception e) {
      System.out.println("Problems with access to database");
      e.printStackTrace();
      System.exit(2);
    }
  }
}
```

JDBC: changing data

```
try {
  Class.forName(driverName);
}
catch (ClassNotFoundException cfn) {
  //Problem with driver, error message and return
  //to operating system with status value 1
  System.out.println("Problem loading driver");
  System.exit(1);
}
try {
  Connection con = DriverManager.getConnection(
           "jdbc:postgresql://nestor.nada.kth.se:5432/dbname",
           "username", "userPassword");
  Statement updateStatement = con.createStatement();
  String studentName ="...", startYear = "...";
```

JDBC: changing data . . .

```
  int noOfRows =
    updateStatement.executeUpdate (
      "INSERT INTO student (name, startYear)" +
      "VALUES(" + "'" + studentName + "'," + startYear);
     //Execute the SQL insert statement
} catch(SQLException sqe) {
      System.out.println("Problem updating database");
}
```

JDBC . . .

Sun's JDBC tutorial

`http://java.sun.com/docs/books/tutorial/jdbc/index.html`

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More info on the net

`http://www.javaworld.com/javaworld/jw-051996/jw-05-shah.html`
`http://www.javaworld.com/channel_content/jwjdbc-index.shtml`