Introduction to Hibernate

Originals of Slides and Source Code for Examples:
http://courses.coreservlets.com/Course-Materials/hibernate.html

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- Courses developed and taught by Marty Hall
  - Java 5, Java 6, intermediate/beginning servlets/JSP, advanced servlets/JSP, Struts, JSF, Ajax, GWT, custom mix of topics
- Courses developed and taught by coreservlets.com experts (edited by Marty)
  - Spring, Hibernate/JPA, EJB3, Ruby/Rails

Contact hall@coreservlets.com for details

Topics in this Section

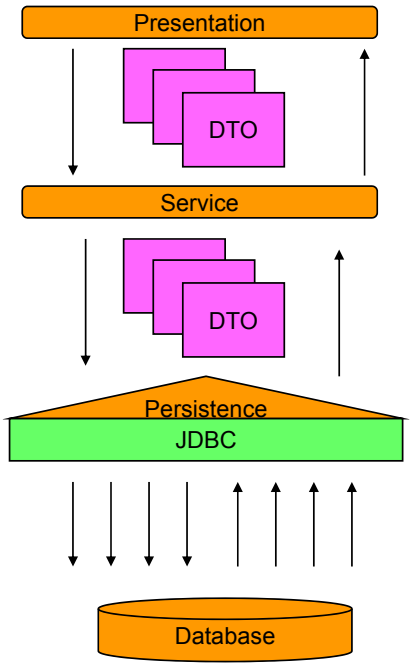
- Refresher in enterprise application architectures
- Traditional persistence
- Hibernate motivation
- Installation

Enterprise Application Architectures

N-Tier Architecture

- **Application is made up of layers or tiers**
  - Each layer encapsulates specific responsibilities
  - Enables changes in one area with minimal impact to other areas of the application
- **Common tiers**
  - Presentation
    - 'View' in model-view-controller
    - Responsible for displaying data only. No business logic
  - Service
    - Responsible for business logic
  - Persistence
    - Responsible for storing/retrieving data

N-Tier Architecture



DAO Design Pattern

- **Data Access Object**
  - Abstracts CRUD (Create, Retrieve, Update, Delete) operations
- **Benefits**
  - Allows different storage implementations to be 'plugged in' with minimal impact to the rest of the system
  - Decouples persistence layer
  - Encourages and supports code reuse

Implementing Business Logic

- **Service Layer**
  - Thin domain layer
  - Procedural service layer
  - Fowler 'Anemic Domain Model'
- **Domain Objects/Business Objects**
  - Thin service layer and complex OO domain model
  - Business logic primarily in the domain/business objects
  - Rich domain objects
- **Some combination of the two…**

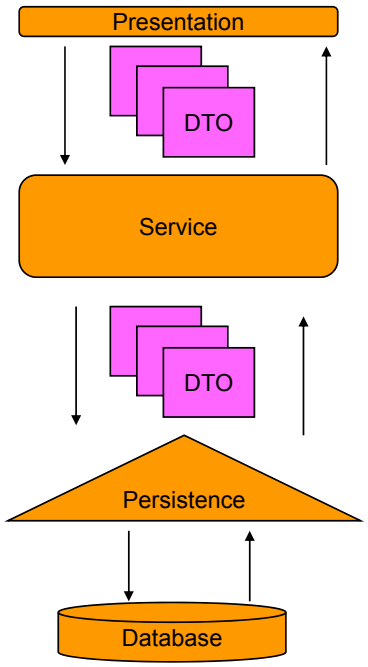
Design Approaches

- [D1] Service layer contains all business logic (no real domain model)
- [D2] Complex OO domain model/thin service layer
- [D3] Service layer contains use case logic that operates over thin or moderately complex domain model

[D1] Procedural Approach

- Service layer communicates directly to data access layer
  - No object model
  - Data access layer returns data transfer objects (DTOs) to service layer
- Leverages commonly understood core technologies
  - JDBC, JavaBeans
- Requires more low level code to persist transfer objects to the data store

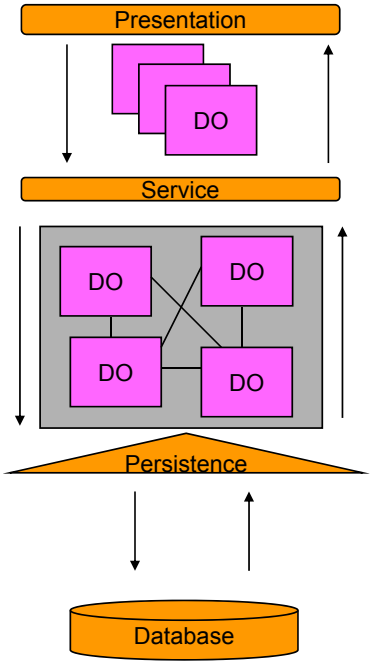
[D1] Procedural Approach



[D2] Object Oriented Approach

- **Complex OO domain model/thin service layer**
  - Rich object model utilizing standard design patterns, delegation, inheritance, etc.
  - Distinct API to domain model
- **May result in more maintainable code but updates are harder**
  - What objects have been modified and need to be saved in the database
- **Need complex Data Mapper/Data Store since domain model and database schema are likely different**
  - TopLink, JDO, Hibernate

[D2] Object Oriented Approach



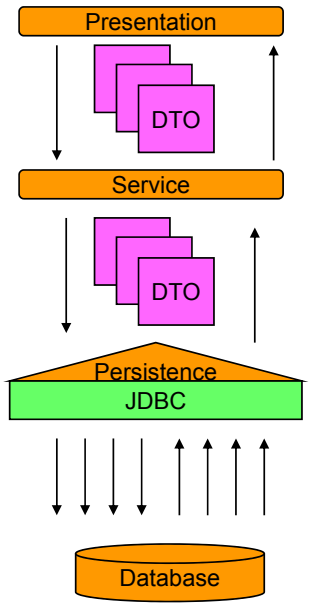
[D3] Mixed Approach

- **Object model can be basic to moderately complex**
  - Simple model is just used as a data access/ORM layer
  - Model can take on business logic
    - Common behavior for different service-layer use cases
    - Service layer performs use-case operations over a set of cooperating business objects
  - Example: Entity Beans BMP/CMP
- **Uses advantages of both extremes**
- **Difficult to remain consistent within the same application**

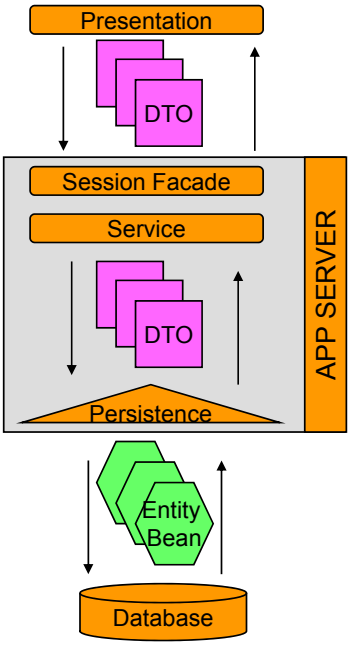
Traditional Persistence

Traditional Persistence

Persistence with JDBC



Persistence with EJB 2.x



JDBC Overview

- **JDBC API provides ability to**
  - Establish connection to a database
  - Execute SQL statements
  - Create parameterized queries
  - Iterate through results
  - Manage database transactions
- **Basic Steps to JDBC Operations**
  1. Load driver or obtain datasource
  2. Establish connection using a JDBC URL
  3. Create statement
  4. Execute statement
  5. Optionally, process results in result set
  6. Close database resources
  7. Optionally, commit/rollback transaction

JDBC Example – Create Account

```
public Account createAccount(Account account) {

  Connection connection = null;
  PreparedStatement getAccountIdStatement = null;
  PreparedStatement createAccountStatement = null;
  ResultSet resultSet = null;
  long accountId=0;

  // Load driver
  try {
    Class.forName("oracle.jdbc.driver.OracleDriver");
  catch (Exception e) {
    throw new RuntimeException(e);
  }

  try {
    //Get connection and set auto commit to false
    Connection connection =
        DriverManager.getConnection("jdbc:oracle:
        thin:lecture1/lecture1@localhost:1521:XE");
    connection.setAutoCommit(false);

    ...
```

JDBC Example – Create Account

```
...

//Get account id from sequence
getAccountIdStatement = connection
    .prepareStatement("SELECT ACCOUNT_ID_SEQ.NEXTVAL
    FROM DUAL");
resultSet = getAccountIdStatement.executeQuery();
resultSet.next();
accountId = resultSet.getLong(1);

//Create the account
createAccountStatement = connection
  .prepareStatement(AccountDAOConstants.CREATE_ACCOUNT);
createAccountStatement.setLong(1, accountId);
createAccountStatement.setString(2,
  account.getAccountType());
createAccountStatement.setDouble(3, account.getBalance());
createAccountStatement.executeUpdate();

//Commit transaction
connection.commit();
}
...
```

JDBC Example – Create Account

```
...

catch (SQLException e) {
    //In case of exception, rollback
    try{
      connection.rollback();
    }catch(SQLException e1){// log error}
    throw new RuntimeException(e);
}
finally {
  //close database resources
  try {
    if (resultSet != null)
      resultSet.close();
    if (getAccountIdStatement!= null)
      getAccountIdStatement.close();
    if (createAccountStatement!= null)
      createAccountStatement.close();
    if (connection != null)
      connection.close();
  } catch (SQLException e) {// log error}
}
}
```

EJB 2.x Overview

- **EJB API provides ability to**
  - Map object model to database tables
  - Hand off management of database connections
  - Take care of relationship management
  - Manage transactions
  - Use callback methods.
  - Search for desired objects
  - Access Control
- **Basic Steps to EJB Operations**
  1. Create your EJB
     - Home Interface
     - Remote Interface
     - Bean Class (implementation class)
  2. Setup deployment descriptors
     - ejb-jar.xml
     - Container specific EJB descriptor (<container>-ejb-jar.xml)
  3. In code, look up the EJB Home Interface
  4. Create an instance of the EJB off the Home Interface, using attributes passed in through the method call

EJB 2.x Home Interface

```
public interface SavingsAccountHome extends EJBHome {

  public SavingsAccount create(String id, String
      firstName, String lastName, BigDecimal balance)
      throws RemoteException, CreateException;

  public SavingsAccount findByPrimaryKey(String id)
      throws FinderException, RemoteException;

  public Collection findByLastName(String lastName)
      throws FinderException, RemoteException;
}
```

Source http://java.sun.com/j2ee/tutorial/1_3-fcs/doc/BMP2.html#62922

EJB 2.x Remote Interface

```
public interface SavingsAccountRemote
    extends EJBObject {

  public void debit(BigDecimal amount)
      throws RemoteException;

  public void credit(BigDecimal amount)
      throws RemoteException;

  public String getFirstName()
      throws RemoteException;

  public String getLastName()
      throws RemoteException;

  public BigDecimal getBalance()
      throws RemoteException;
}
```

Source http://java.sun.com/j2ee/tutorial/1_3-fcs/doc/BMP2.html#62922

EJB 2.x Bean Class

```
public class SavingsAccountBean {

  public String ejbCreate(String id, String firstName,
     String lastName, BigDecimal balance)
     throws CreateException {

   if (balance.signum() == -1)  {
      throw new CreateException(
        "A negative initial balance is not allowed."
      );
   }

   this.id = id;
   this.firstName = firstName;
   this.lastName = lastName;
   this.balance = balance;

   return id;
  }
  ...
```

Source http://java.sun.com/j2ee/tutorial/1_3-fcs/doc/BMP2.html#62922

EJB 2.x Bean Class

```
...
public void ejbPostCreate() {
  // The ejbPostCreate method must have the same
  // input parameters and return type as the
  // ejbCreate method.
  //
  // If you want to set up a relationship you should
  // do so in the ejbPostCreate method.
}

public void ejbRemove() {}
public void ejbLoad() {}
public void ejbStore() {}

...
```

Source http://java.sun.com/j2ee/tutorial/1_3-fcs/doc/BMP2.html#62922

EJB 2.x Bean Class

```
...
public void debit(BigDecimal amount) {
  balance = balance.subtract(amount);
}

public void credit(BigDecimal amount) {
  balance = balance.add(amount);
}

public String getFirstName() {
  return firstName;
}

public String getLastName() {
  return lastName;
}

public BigDecimal getBalance() {
  return balance;
}
...
```

Source http://java.sun.com/j2ee/tutorial/1_3-fcs/doc/BMP2.html#62922

EJB 2.x ejb-jar.xml

```
<enterprise-beans>
  <entity>
    <description> Savings Accoung Bean </description>
    <display-name> SavingsAccount </display-name>
    <ejb-name> SavingsAccount </ejb-name>
    <home>example.bean.SavingsAccountHome</home>
    <remote>example.bean.SavingsAccountRemote</remote>
    <ejb-class>example.bean.SavingsAccountBean</ejb-class>
    <persistence-type>Container</persistence-type>

    <cmp-version>1.x</cmp-version>

    <cmp-field><field-name>id</field-name></cmp-field>

    <cmp-field><field-name>firstName</field-name></cmp-field>

    <cmp-field><field-name>lastName</field-name></cmp-field>

    <cmp-field><field-name>balance</field-name></cmp-field>

    <primkey-field>id</primkey-field>
  </entity>
</enterprise-beans>
```

EJB 2.x jonas-ejb-jar.xml

```
<jonas-entity>
  <ejb-name>SavingsAccount</ejb-name>
  <jndi-name>SavingsAccount</jndi-name>
  <jdbc-mapping>
    <jndi-name>jdbc_conn1</jndi-name>
    <jdbc-table-name>SAVINGS_ACCOUNT</jdbc-table-name>

    <cmp-field-jdbc-mapping>
      <field-name>id</field-name>
      <jdbc-field-name>ID</jdbc-field-name>
    </cmp-field-jdbc-mapping>

    <cmp-field-jdbc-mapping>
      <field-name>firstName</field-name>
      <jdbc-field-name>FIRST_NAME</jdbc-field-name>
    </cmp-field-jdbc-mapping>

    <cmp-field-jdbc-mapping>
      <field-name>lastName</field-name>
      <jdbc-field-name>LAST_NAME</jdbc-field-name>
    </cmp-field-jdbc-mapping>
    ...
```

EJB 2.x jonas-ejb-jar.xml

```
    ...

    <cmp-field-jdbc-mapping>
      <field-name>balance</field-name>
      <jdbc-field-name>BALANCE</jdbc-field-name>
    </cmp-field-jdbc-mapping>

    <finder-method-jdbc-mapping>
      <jonas-method>
        <method-name>findByLastName</method-name>
      </jonas-method>
      <jdbc-where-clause>
        WHERE LAST_NAME = ?
      </jdbc-where-clause>
    </finder-method-jdbc-mapping>
  </jdbc-mapping>
</jonas-entity>
```

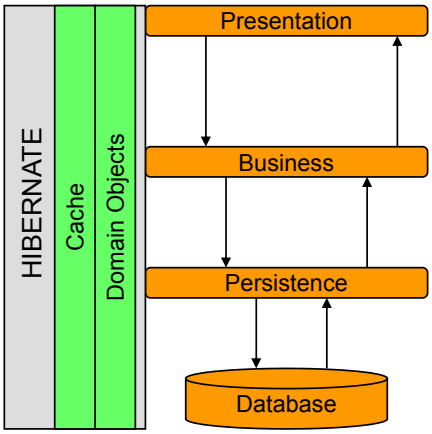
EJB 2.x Client

```
IntialContext context = new InitialContext();
SavingsAccountHome home =
    (SavingsAccountHome)context.getEJBHome();

SavingsAccount john =
    home.create("123", "Doe", "John", zeroAmount);

john.credit(new BigDecimal("88.50"));
john.debit(new BigDecimal("20.25"));
BigDecimal balance = john.getBalance();

Collection c = home.findByLastName("DOE");
```

Source http://java.sun.com/j2ee/tutorial/1_3-fcs/doc/BMP2.html#62922

Traditional Persistence vs. Hibernate

Persistence with Hibernate



Motivation

Hibernate History

- **Grass roots development (2001)**
  - Christian Bauer
  - Gavin King

- **JBoss later hired lead Hibernate developers (2003)**
  - Brought Hibernate under the Java EE specification
  - Later officially adopted as the official EJB3.0 persistence implementation for the JBoss application server.
- **EJB 3.0 Expert Group (2004)**
  - Key member which helped shape EJB3.0 and JPA
- **NHibernate**
  - .NET version release in 2005

Hibernate Goals

- **Prevent leakage of concerns**
  - Domain model should only be concerned about modeling the business process, not persistence, transaction management and authorization
  - Flaw of EJB2.x
- **Transparent and automated persistence**
  - Complete separation of concerns between domain model objects and the persistence mechanism.
  - Persistent solution does not involve writing SQL
- **Metadata in XML**
  - Object/Relational Mapping should provide human readable mapping format (not just a GUI mapping tool)
- **Reduction in LOC**
- **Importance of domain object model**

Why Hibernate?

- **Impedance mismatch**
  - Object-oriented vs. relational
- **Failure of EJB 2.x**
  - Entity Beans were extremely slow, complex
- **Java developers are not database developers**
  - Reduce the need for developers to know and fully understand database design, SQL, performance tuning
  - Increase portability across database vendors
- **Increase performance by deferring to experts**
  - Potential decrease in database calls
  - More efficient SQL statements
  - Hibernate cache usage

Why not Hibernate?

- **Overkill for small number of tables**
- **Complex legacy database schema**
- **Heavy batch processing**
- **Advanced queries / more SQL control**
- **Free, but tied to third party**
- **Complexity / ramp up / support**
- **Scaling concerns (Shards)**
- **Gavin King is somewhat opinionated ☺**

Who Uses Hibernate?

- Ubik-Ingénierie, ubik-ingenierie.com, Roubaix, France
- Fedelta POS, fedeltapos.com, Brisbane, Australia
- Skillserv, skillserv.com, San Francisco, California, USA
- Company name, Location: SoftSlate Commerce, NY, USA
- Open Source Project: Wilos - http://www.wilos-project.org/
- Company name, Location: GPI Argentina, La PLata, Buenos Aires, Argentina
- Open Source Project: itracker
- Company name, Location: TerraContact Inc., Montreal, Canada
- Company name, Location: LF Inc., Tampa, FL
- Company name, Location: Elastic Path Software, Vancouver, BC, Canada
- Company name, Location: argus Barcelona, Europe
- Company name, Location: AT&T Labs, Tampa, Florida
- Company name, Location: JTeam, Amsterdam, The Netherlands
- Company name, Location: 1Genia, Paris, France
- Company name, Location: TDC Internet, Warsaw, Poland
- Company name, Location: PriceWaterhouseCoopers, Tampa, Florida
- Company name, Location: 2Fi Business Solutions Ltd., Hong Kong
- Company name, Location: Intrasoft International, Belgium, Brussels
- Company name, Location: Burgerweeshuis, Netherlands, Deventer
- Company name, Location: Cisco Learning Institute, Phoenix, AZ USA
- Company name, Location: Open Lab S.r.l, Florence I
- Company name, Location: DriveNow, Australia
- Sony Computer Entertainment Europe, SCEE, Studio Liverpool, Liverpool, United Kingdom
- AonCHOR, http://www.aonchor.aon.com, Aon Risk Service, US
- Company name, Location: Church and People, New York
- Crank Clothing, t-shirts and apparel
- Mailvision, End-to-End SIP solutions, Israel. (http://www.mailvision.com)
- Pyromod Software Inc, Creator of BestCrosswords.com, Montreal, Canada. (http://www.pyromod.com)
- Travel Toucan Travel Site

AT&T

PriceWaterhouseCoopers

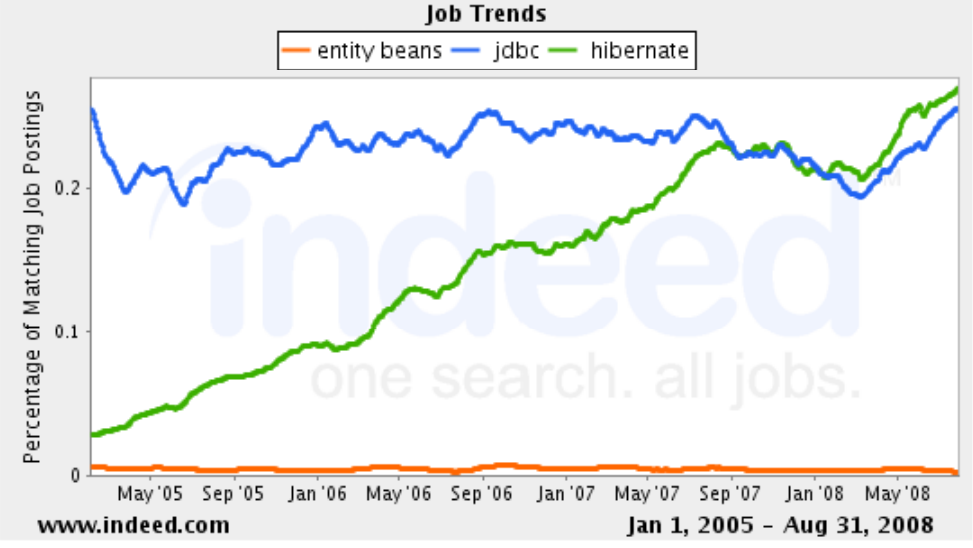
Cisco

Sony

Source hibernate.org

Hibernate Jobs (as of Aug 2008)

- **From indeed.com**
  - Claims to compile data from most major job sites



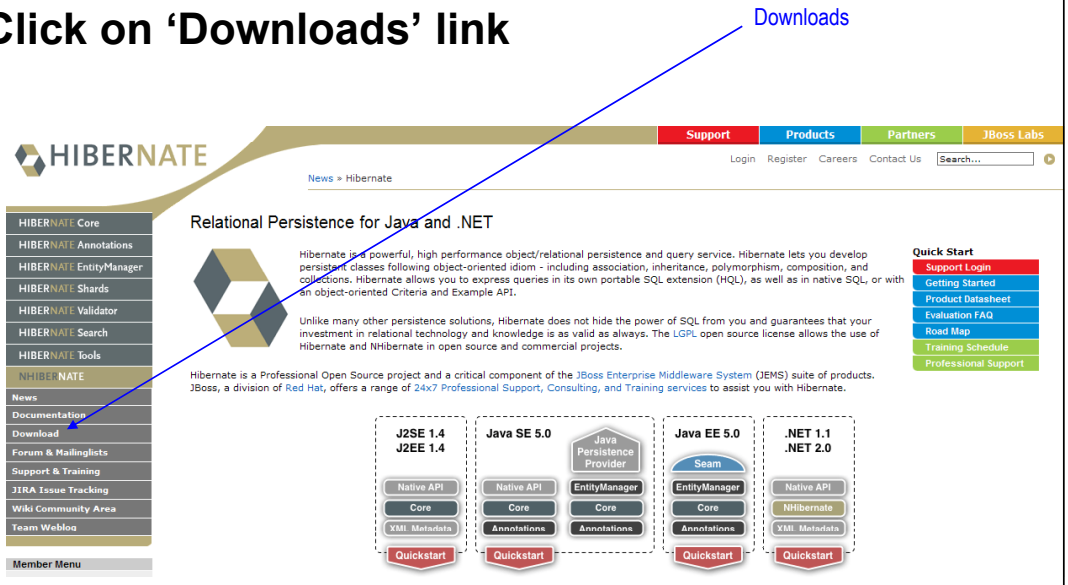
JPA Jobs (as of Aug 2008)

- **From indeed.com**
  - Claims to compile data from most major job sites

Installation

Hibernate – Step 1

- http://www.hibernate.org
- Click on 'Downloads' link



Hibernate – Step 2

- Select the core binary relase

Binary Releases

Package	Version	Release date	Category	
Hibernate Core	3.3.1.GA	11.09.2008	Production	*Download*

- Select download type

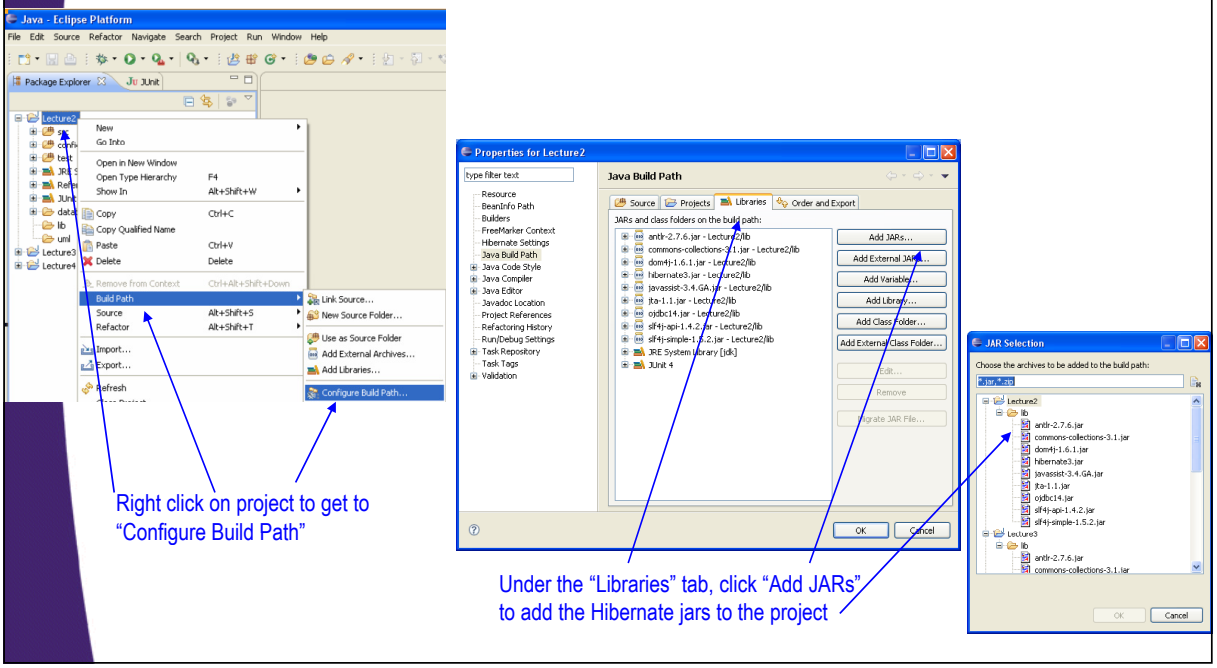
Package	Release	Filename	Size	Architecture
hibernate3				
Latest	3.3.1.GA (2008-09-11 18:54)			
		hibernate-distribution-3.3.1.GA-dist.tar.gz	28703494	Platform-Independent
		hibernate-distribution-3.3.1.GA-dist.zip	31462800	Platform-Independent
Totals:	1	2	60166294	

Hibernate – Step 3

- **Unzip the Download**
  - hibernate-distribution-3.3.1.GA-dist.zip
  - Copy jars from locations under root of zip
    - hibernate3.jar
    - hibernate-distribution-3.3.1.GA/lib/required
  - Drop the jars from into the lib directory of your project (or other location you can add to your projects classpath)
- **Obtain a Simple Logging Façade for Java (SLF4J) Implementation**
  - http://www.slf4j.org/download.html
    - slf4j-simple-1.5.3.zip
  - Unzip and copy slf4j-simple-1.5.3.jar into lib directory of your project
    - slf4j-simple-1.5.3.jar under root directory of download

Hibernate – Step 4

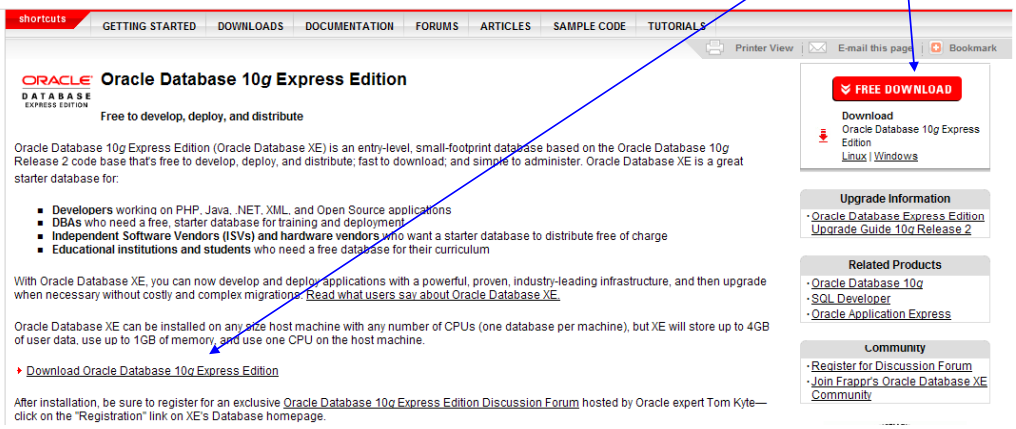
- **Within Eclipse**



Oracle Express – Step 1

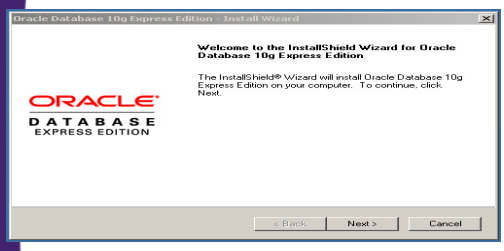
- http://www.oracle.com/technology/products/database/xe/index.html
  - Download OracleXE.exe install
  - Also available for Linux
    - Debian, Mandriva, Novell, Red Hat and Ubuntu

Download

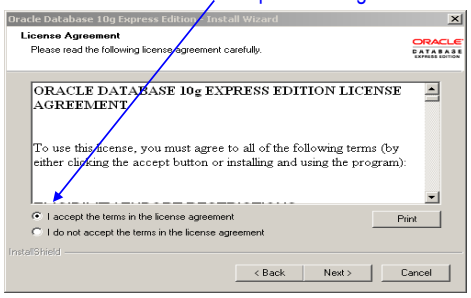


Oracle Express – Step 2

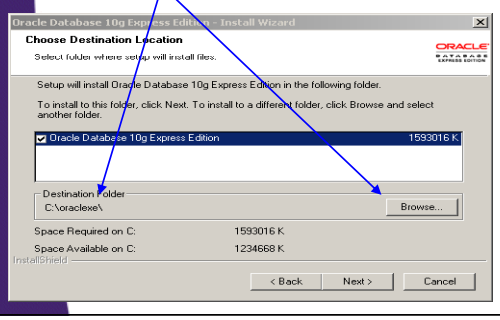
- **Run OracleXE.exe**



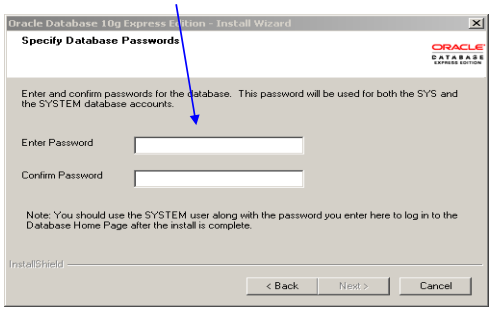
Accept license agreement



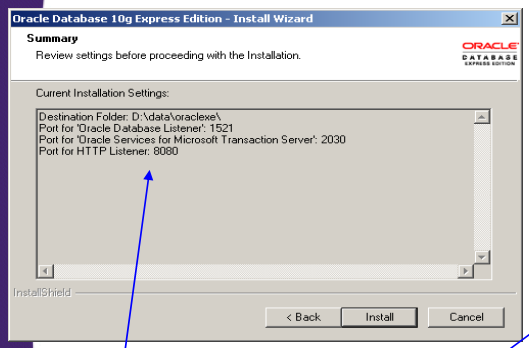
Choose install location

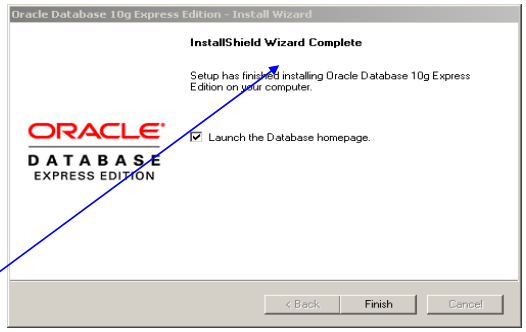


Set SYSTEM password to 'system'



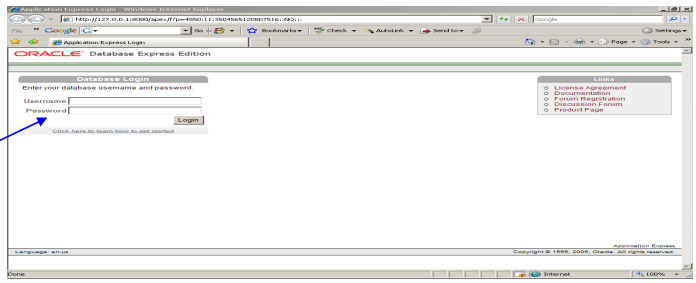
Oracle Express – Step 3





Confirm

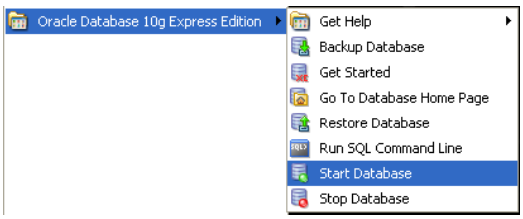
Complete



Login and test
http://127.0.0.1:8080/apex/

Starting and Stopping Oracle

- **Oracle is automatically running upon install**
- **Start and stop Oracle using the StartDB and StopDb scripts**
  - C:\oracleexe\EE\app\oracle\product\10.2.0\server\BIN\StartDB.bat
  - C:\oracleexe\EE\app\oracle\product\10.2.0\server\BIN\StopDb.bat
- **In Windows, can use Start Menu Options**

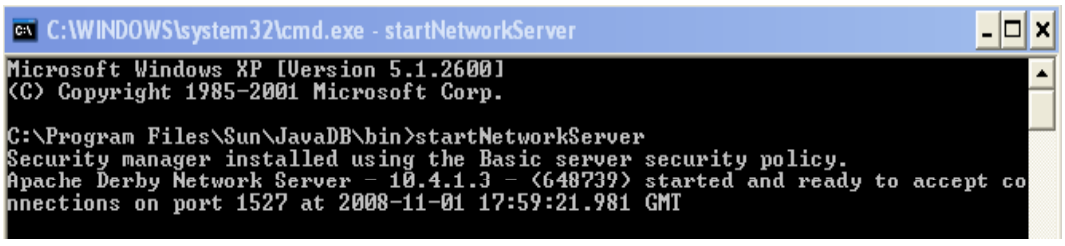


JavaDB Configuration

- **JavaDB is a version of Derby that comes packaged with Java 6**
- **Configuration – set environment variables**
  - DERBY_HOME
    - Value should be location of JavaDB root directory
    - Example: C:\Program Files\Sun\JavaDB
  - PATH
    - Append JavaDB bin directory to existing PATH variable
    - Example: C:\Program Files\Sun\JavaDB\bin

JavaDB Configuration

- **Start Server by calling startNetworkServer script**



- **Stop Server by calling stopNetworkServer script (in another window)**

Wrap-up

Preview of Next Sections

- **Walk through a simple, but full, end to end example**

Summary

- **Refresher in application architectures**
  - Service-based business logic
  - Rich domain model
  - Combination
- **Traditional persistence implementation**
  - Persistent implementations
    - Entity Beans
    - JDBC
  - JDBC example
- **Motivation**
  - Origination and history of Hibernate
  - Reasons for Hibernates development
    - Impedance mismatch
    - Failure of EJB 2.x
    - Java developers are not database developers
    - Performance benefits
- **Installation**

Questions?