ORM
Concurrency

Enterprise Applications

- We want to create Enterprise Applications with Spring and Hibernate
  - The vast majority of these also use a web container

- Let's first review Java Web Containers and web dev.
  - And relate it to what we've learned so far

Web Containers

- We’ll first discuss :
  - Web Container IoC
  - Servlets (beans)
  - Filters (interceptors)
- Then we’ll look at JSP for view:
  - JSPs are all XML
  - JSTL tags for program control
  - EL inside statements and to print

Containers so Far

- We saw that Spring is a container:
  - IoC (creates objects)
  - DI (connects them)
  - AOP (proxies for extra functionality, discuss laater)

- Hibernate is also a container:
  - Creates Objects (IoC)
  - Connects objects based on associations (DI)
  - Proxies to provide lazy loading (AOP)

Web Container

- We will see that a web container:
  - Creates Objects (IoC)
  - Can add proxies for extra functionality (Filters)
  - Does not connect objects together (no DI)

- Main difference, web containers work with:
  - Incoming Request objects
  - Outgoing Response objects

Not POJOs

- Another big difference is that the objects managed by web containers are not POJOs
  - To be a Servlet or Filter you have to extend or implement a Technology related class / interface
  - Web containers design is old
  - Before Rod Johnson’s book about POJO containers

Comparing Terminology

- Servlet:
  - Object that the container creates and manages
  - What Spring called a Bean
- Web.xml
  - Configuration file that configures the container
  - What spring called applicationContext.xml
- Filter
  - Proxy for a Servlet
  - Somewhat similar to Interceptor in Spring MVC

web.xml

Inside project's /WEB-INF/

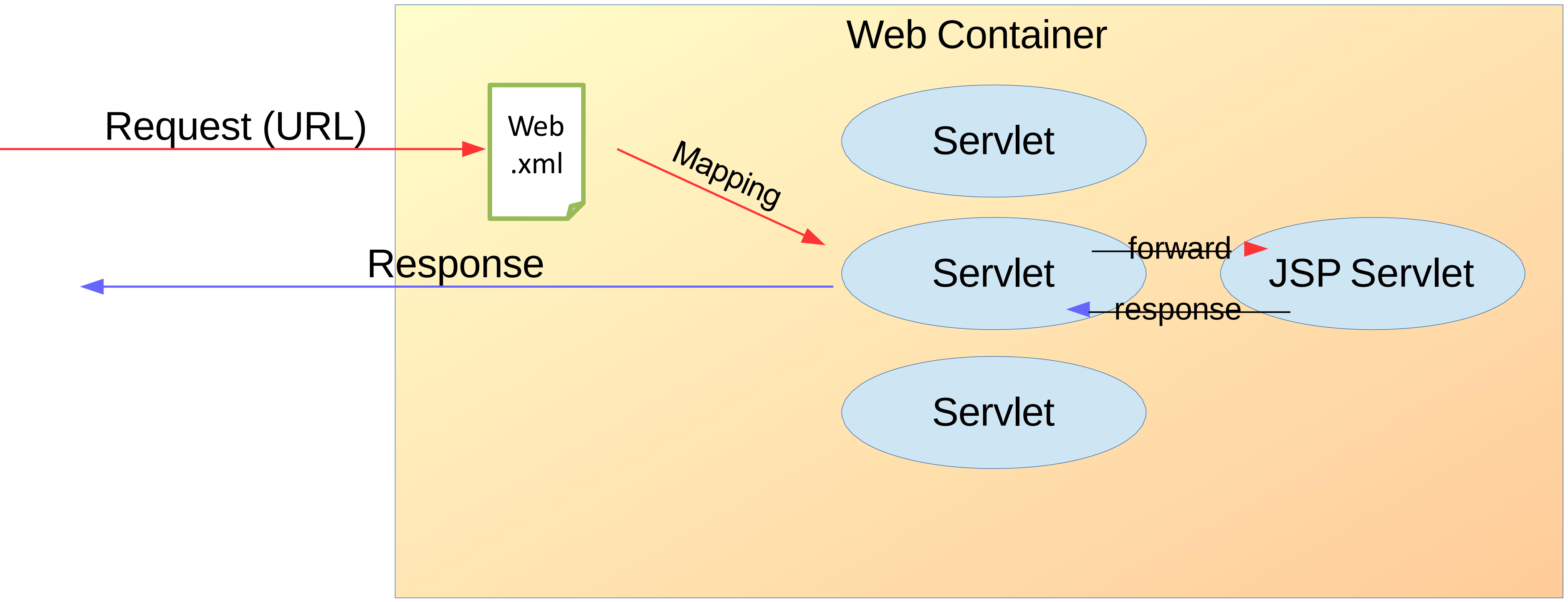
```
<?xml version="1.0" encoding="UTF-8"?>
<web-app version="2.4" xmlns="http://java.sun.com/xml/ns/j2ee"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee
http://java.sun.com/xml/ns/j2ee/web-app_2_4.xsd">

  <servlet>
    <servlet-name>Servlet Demo</servlet-name>
    <servlet-class>demo.ServletDemo</servlet-class>
  </servlet>

  <servlet-mapping>
    <servlet-name>Servlet Demo</servlet-name>
    <url-pattern>/servlet</url-pattern>
  </servlet-mapping>
</web-app>
```

Can also be done
@WebServlet

Request / Response

- The container receives a request for a URL
  - Looks at Servlet-Mappings to find a matching pattern
  - Passes request and a empty response to servlet
    - Request may contain additional key/value params
  - Servlet reads request, and fills in response
    - Optionally forwarding req/resp to other servlet for more
  - Response (text output) then printed to user

Visually


Web Container
Request (URL)
Web .xml
Mapping
Servlet
Servlet
forward
JSP Servlet
response
Response
Servlet

Requests

- HTTP (web) Requests have a type:
  - GET or POST for HTML
- May have key / value pair parameters:
  - GET in URL, POST as ‘post data’
- Often also a Session ID cookie
  - Allows the server to find storage for this user

Servlet

```
@WebServlet(name = "Hello", urlPatterns = { "/Hello" })
public class Hello extends HttpServlet {
        private static final long serialVersionUID = 1L;

        @Override
        protected void doGet(HttpServletRequest request, HttpServletResponse response)
                        throws ServletException, IOException {

                request.setAttribute("now", new Date());
                request.setAttribute("one", 1);
                request.setAttribute("two", 2);

                ServletContext context = this.getServletContext();
                String jsp = "/Hello.jsp";
                RequestDispatcher dispatcher = context.getRequestDispatcher(jsp);
                dispatcher.forward(request, response);
        }
}
```

Not a POJO
Extends HttpServlet

Method on HttpServlet
Lets you get container
(Context)

Filter

```
@WebFilter(filterName = "OpenEntityManagerInView", urlPatterns = "/*")
public class EntityManagerInterceptor implements Filter {
        @Override
        public void destroy() { }
        @Override
        public void init(FilterConfig fc) throws ServletException { }
        @Override
        public void doFilter(ServletRequest req, ServletResponse res, FilterChain chain)
                        throws IOException, ServletException {

                EntityManager em = EntityManagerHelper.getCurrent();
                try {
                        em.getTransaction().begin();
                        chain.doFilter(req, res);
                        em.getTransaction().commit();
                } catch (RuntimeException e) {

                        if (em != null && em.isOpen())
                                em.getTransaction().rollback();
                        throw e;

                } finally {
                        em.close();
                }
        }
}
```

Not a POJO
Implements Filter

Web.xml for Filter

```
<?xml version="1.0" encoding="UTF-8"?>
<web-app version="2.4" 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
http://java.sun.com/xml/ns/j2ee/web-app_2_4.xsd">

 ...

  <filter>
    <filter-name>OpenEntityManagerInView</filter-name>
    <filter-class>example.filter.OpenEntityManagerInView</filter-class>
  </filter>

  <filter-mapping>
    <filter-name>OpenEntityManagerInView</filter-name>
    <url-pattern>/*</url-pattern>
  </filter-mapping>

 ...


</web-app>
```

Can also be done with @WebFilter

Applications

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Web: JSP with EL & JSTL

View Technology

- JSP is a type of Servlet written in XML
  - Java's oldest web based view technology

Pre-compiler transforms XML into Java

- Write logic with XML tags (for loops etc)
  - JSTL: Java Standard Tag Library

Originally JSP had you write Java code inside HTML

This is now considered a bad practice. Deprecated!

Model View Control

- Best practice:
  - Controller receives request
  - Gets data from Service layer
  - Forwards data to (JSP) View

We'll connect with Service layer later

Servlet Controller

```
@WebServlet(name = "Hello", urlPatterns = { "/Hello" })
public class Hello extends HttpServlet {
        private static final long serialVersionUID = 1L;

        @Override
        protected void doGet(HttpServletRequest request, HttpServletResponse response)
                        throws ServletException, IOException {

                request.setAttribute("now", new Date());
                request.setAttribute("one", 1);
                request.setAttribute("two", 2);

                ServletContext context = this.getServletContext();
                String jsp = "/Hello.jsp";
                RequestDispatcher dispatcher = context.getRequestDispatcher(jsp);
                dispatcher.forward(request, response);
        }
}
```

Instead of retrieving data we'll just create some here and store inside request

Then forward to Hello.jsp

Hello.jsp with JSTL and EL

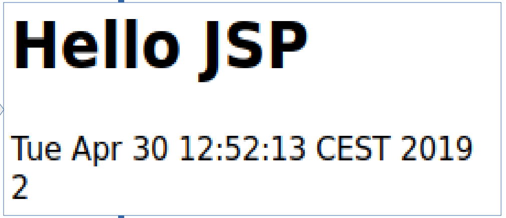
```
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>

<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<html>
   <head>
      <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
      <title>JSP Page</title>
   </head>
   <body>
      <h1>Hello JSP</h1>
      ${now}

      <div>
                <c:if test="${two gt one}">
                      ${two}
                </c:if>
      </div>

   </body>
</html>
```

EL can be used to print or used in statement tag

Uses **now, one, two** stored in request

<c:if> to create if statement

Browser shows:



Hello JSP

Tue Apr 30 12:52:13 CEST 2019
2

Expression Language

Easier for
non-Java people?

- ${expression}
- ${object.value}

Uses .getValue()
method

- Supported Operators
  - Arithmetic: +, -, *, / (div), % (mod)
  - Relational: == (eq), != (ne), < (lt), > (gt), <= (lte), >= (gte)
  - Logical: && (and), || (or), ! (not)
  - Other: (), empty, []

EL Scopes

- When using a variable in EL it uses the name as a key to find a value in the following scopes:
  - Page scope
  - Request scope
  - Session scope
  - Application scope

First to Last

What we used in our example, and what you should mostly use

JSTL

Other libs can also be loaded

- Example JTSL core tags:

```
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
```

  - Import the core tag lib with the prefix “c”

```
<c:if test="${two gt one}"> ... </c:if>
```

  - Use the <c:if> tag to make an if statement

```
<c:forEach items="${customers}" var="customer"> ... </c:forEach>
```

  - Use the <c:forEach> tag to make a loop

JSTL Core Tags

Tag	Description
<c:out>	Output result of evaluating an expression
<c:set>	Sets a key in one of the scopes
<c:remove>	Removes a key in one of the scopes
<c:catch>	Catches any java.lang.Throwable inside it
<c:if>	Executes content if test is true
<c:choose>	For a multi condition if (if/else)
<c:when>	Specify one (or more) conditions inside a <c:choose>
<c:otherwise>	Specify what should happen if none of the <c:when> are true
<c:import>	Ability to import data from a url (does http request)
<c:forEach>	Basic Foreach
<c:forTokens>	Iterates over tokens separated by the supplied delimiter
<c:redirect>	Redirects to a URL (HTTP 3xx)
<c:url>	Encodes a URL with optional parameters
<c:param>	To provide parameters to the url and import tags

Formatting Tags

```
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt"  %>
```

Tag	Description
<fmt:message>	Gets message from bundle (for internationalization)
<fmt:param>	To give parameter to <fmt:message>
<fmt:bundle>	Specify a resource bundle to use
<fmt:setLocale>	Sets the locale
<fmt:requestEncoding>	Sets the request's character encoding
<fmt:timeZone>	Specifies the timezone for formatting
<fmt:setTimeZone>	Stores the specified timezone into a variable
<fmt:formatNumber>	Format a number based on the set locale
<fmt:parseNumber>	Parses a string of a (number, percentage, currency)
<fmt:formatDate>	Formats dates and times in a locale sensitive way
<fmt:parseDate>	Parses string representations of times and dates

Java is Deprecated inside JSP

- There were several ways to write Java in JSP
  - Pure Java code inside JSP (scriptlets)

- And elements that let you use Java:
  - JSP Expressions: **<%= user.getName() %>**
  - JSP Declarations: **<%! int a = 5 %>**

- These are all depricated (**don’t use them**)

Summary

- The web container is another container
  - Servlets (beans) take request and make response
  - Filters (like AOP) can intercept request / response

- JSP is type of Servlet written in XML
  - Uses JSTL tags for (if / loop) statements
  - Uses EL expressions inside statements or to print

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Hibernate Web Applications

Hibernate Web Applications

- **Hibernate is generally only used in combination with Spring or a J2EE Server**
  - To provide a deeper understanding of how it’s integrated into an application
  - We’re first going to **manually provide** some of the things Hibernate needs to run

Single Entity Manager Factory

- The Entity Manager Factory should start **once**
  - **Only one** for the entire application
  - Starts when the app starts
  - Closes when the app closes
- Good way to do this:
  - Make a **singleton** for it

Entity Manager & DAOs

- Repositories (DAOs) need to be able to get the ‘**current entityManager**’
  - If each DAO method makes it’s own EntityManager
  - We need multiple per web request
  - Each EntityManager has:
    - Its own DB connection, transaction, entity cache
    - All of which should be used for multiple operations!

EntityManager per Operation Anti-Pattern

- Using a EntityManager per operation is so bad it's considered an Anti-Pattern

- Also known as:

  "SessionPerOperation" Anti-Pattern

```java
public class BadCustomerDao {
        private EntityManagerFactory emf;
        public CustomerDao() {
                EntityManagerFactory emf = EMF.get();
        }

        public Customer load(Long id) {
                EntityManager em = emf.createEntityManager();
                Customer c = em.find(Customer.class, id);
                em.close();
                return c;
        }
        public void save(Customer c) {
                EntityManager em = emf.createEntityManager();
                em.persist(c);
                em.close();
        }
        public void update(Customer c) {
                EntityManager em = emf.createEntityManager();
                em.merge(c);
                em.close();
        }
```

Never write a DAO like this!

Entity Manager per Request

- We want one Entity Manager per (web) Request
  - Create it in the controller and pass it around as param?
  - 😒 Messy solution
- **Store it in the current thread**
  - Available to every method running in the thread
  - Known as “ThreadLocal”

EntityManager Helper

```
public class EntityManagerHelper {
    private static final EntityManagerFactory emf;
    private static final ThreadLocal<EntityManager> threadLocal;

    static {
        emf = Persistence.createEntityManagerFactory("cs544");
        threadLocal = new ThreadLocal<EntityManager>();
    }

    public static EntityManager getCurrent() {
        EntityManager em = threadLocal.get();
        if (em == null) {
            em = emf.createEntityManager();
            threadLocal.set(em);
        }
        return em;
    }

    public static void closeEntityManagerFactory() {
        emf.close();
    }
}
```

EntityManagerHelper provides:

- **Singleton** EntityManagerFactory
- **ThreadLocal**<EntityManager>
- getCurrent() method that can be called from any method

Based on: https://stackoverflow.com/questions/15071238/entitymanager-threadlocal-pattern-with-jpa-in-jse

EntityManager per Request DAO

- DAO’s become thin wrappers:
  - Gets current EntityManager
  - Calls method

```
public class CustomerDao {

        public Customer load(Long id) {
                EntityManager em = EntityManagerHelper.getCurrent();
                return em.find(Customer.class, id);
        }

        public void save(Customer c) {
                EntityManager em = EntityManagerHelper.getCurrent();
                em.persist(c);
        }

        public void update(Customer c) {
                EntityManager em = EntityManagerHelper.getCurrent();
                em.merge(c);
        }
}
```

Transaction

- Each **service method** should be **one transaction**

- Many Thread Local implementations close the EntityManager when the transaction commits
  - Means that all managed objects become detached
  - And automatic loading of related objects no longer works

Service Method

- Before an object is returned from a Service method:
  - Load any related objects needed by the recipient
    - Either have the DAO load all object into EM cache with query
    - Or have the Service follow references to 'force lazy loading'

```
public class CustomerService {
        ...
        public Customer getCustomer(Long id) {
                EntityManager em = EntityManagerHelper.getCurrent();
                em.getTransaction().begin();
                Customer c = customerDao.load(id);
                // follow references to ensure related objects are loaded
                c.getAddress().getCity();
                c.getCreditCard().getAddress().getCity();
                // Then commit (may close entity manager)
                em.getTransaction().commit();
                // and return the 'object structure'
                return c;
        }
}
```

Starts and stops the Transaction

Makes sure related objects are loaded

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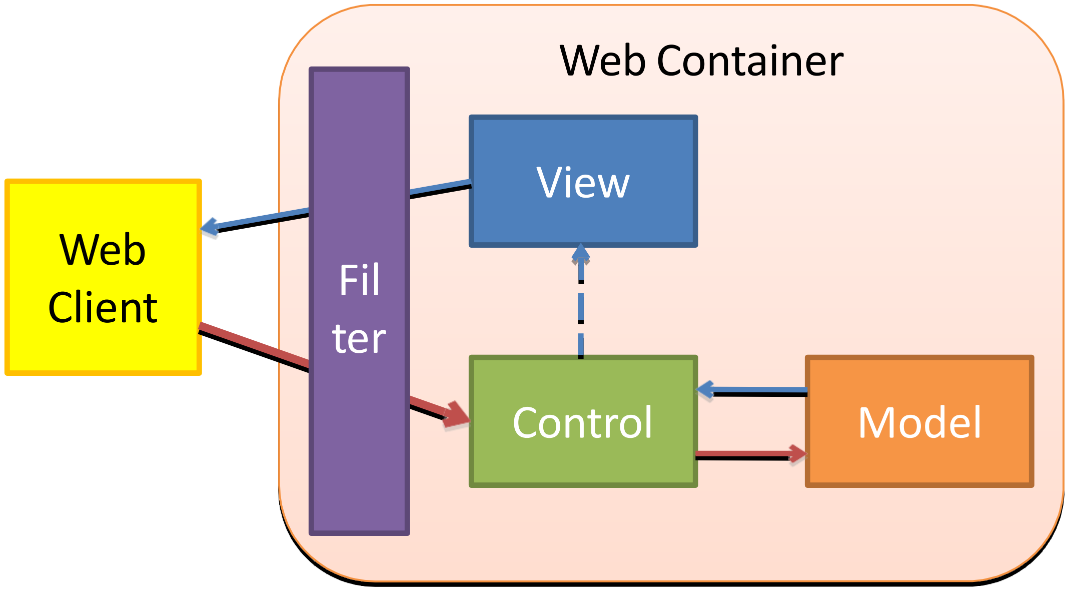
Hibernate Web: Open EntityManager in View

View

- Loading having all the entity objects loaded before they reach the view is a **best practice**
- Nevertheless, people find it frustrating that they cannot do lazy loading in the view
  - Solution: **OpenEntityManagerInView** pattern
  - Very popular / but some see it as an anti-pattern

OpenEntityManagerInView

- Uses a filter to open TX before controller
  - Closes TX after view is done



Open in View Filter

```
@WebFilter(filterName = "OpenEntityManagerInView", urlPatterns = "/*")
public class EntityManagerInterceptor implements Filter {
		@Override
		public void destroy() { }
		@Override
		public void init(FilterConfig fc) throws ServletException { }
		@Override
		public void doFilter(ServletRequest req, ServletResponse res, FilterChain chain)
						throws IOException, ServletException {

				EntityManager em = EntityManagerHelper.getCurrent();
				try {
						em.getTransaction().begin();
						chain.doFilter(req, res);
						em.getTransaction().commit();
				} catch (RuntimeException e) {

						if (em != null && em.isOpen())
								em.getTransaction().rollback();
						throw e;

				} finally {
						em.close();
				}
		}
}
```

Wraps all Servlets
(controller and view)
In one big transaction

Service Method

- **Just load first object**
  - Any related objects can be loaded by view

```
public class CustomerService {
                    ...
                    public Customer getCustomer(Long id) {
                                        return customerDao.load(id);
                    }
}
```

No longer has Transaction code (TX inside Filter)

No longer loads related data (view can do so)

Criticism

No console app
or JavaFX app

- **Ties the Service Layer to Web Environment**
  - Only a web environment can lazy load (with filter)
- Can create Transaction that is too big
  - But each request usually calls only one service method
- Database activity happens during view
  - Some consider it a violation of layers
  - But it's not seen in code (just happens)

Hibernate App Summary

- The EMF should be a singleton
  - EM per operation is bad (for TX, cache, DB conn)
  - ThreadLocal used to give each request its own EM

- Load all related data before service method returns
  - Best practice, but there is a alternate option:
  - OpenEntityManagerInView filter so view can lazy load

Applications

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Concurrency

Concurrency

- Concurrent means '**at the same time**'
  - Enterprise Apps need have many users (same time)
  - Concurrency problems center around Shared data
  - Data (state) only gets stored in DB
    - @Controller, @Service, and @Repository are stateless

Transactions

- The DB manages concurrency with Transactions
- A Transactions is a **unit of work** that is:
  - **ATOMIC**: The transaction is considered a single unit, either the entire transaction completes, or the entire transaction fails.
  - **CONSISTENT**: A transaction transforms the database from one consistent state to another consistent state
  - **ISOLATED**: Data inside a transaction can not be changed by another concurrent processes until the transaction has been committed
  - **DURABLE**: Once committed, the changes made by a transaction are persistent

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Concurrency: Isolation Level

Isolation Levels

- Proper isolation is expensive (takes lots of time) to produce in a multi-user environment
  - Isolation is often relaxed to increase DB speed
  - ANSI SQL defines 4 isolation levels

Read Uncommitted, Read Committed, Repeatable Read, Serializable

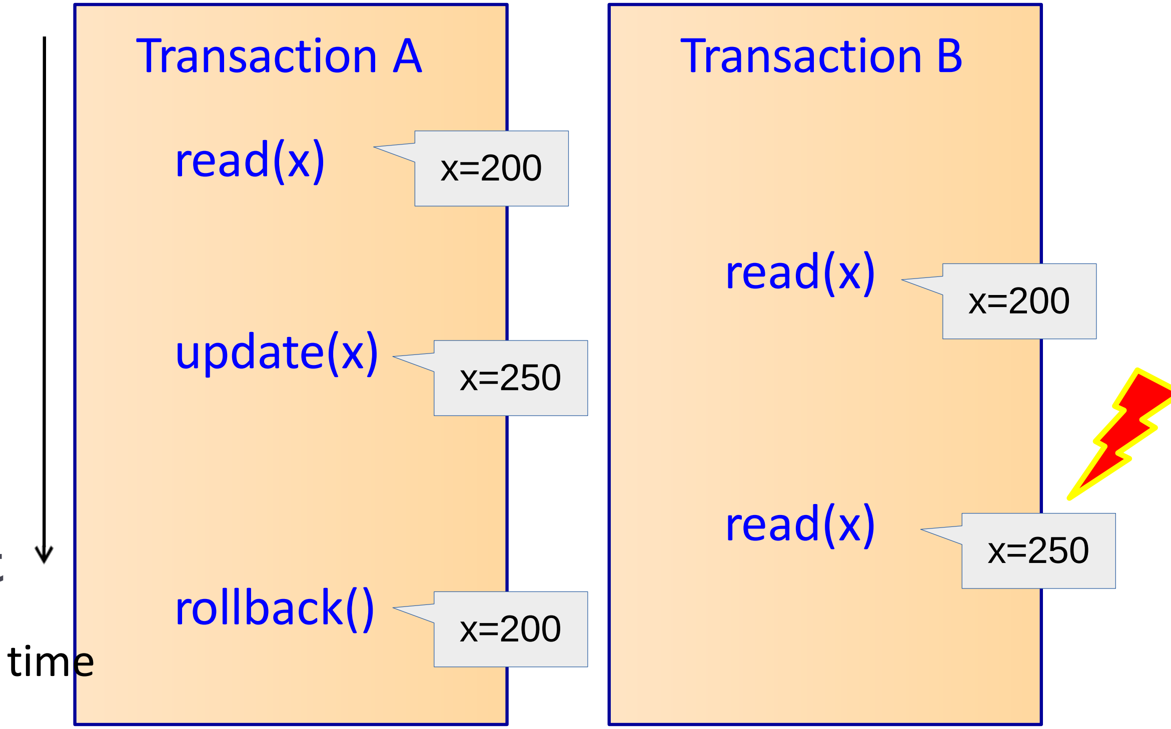
$\longrightarrow$

Weaker and Faster to Stronger and Slower

- Most Dbs default to Read Committed isolation
  - Only Serializable fully isolates a transaction from all concurrency issues

Read Uncommitted

- TX A can read TX B's uncommitted updates
  - No locks at all
  - **Violates ACID**
  - Not in Oracle
  - Don't use in concurrent env!



Read Uncommitted

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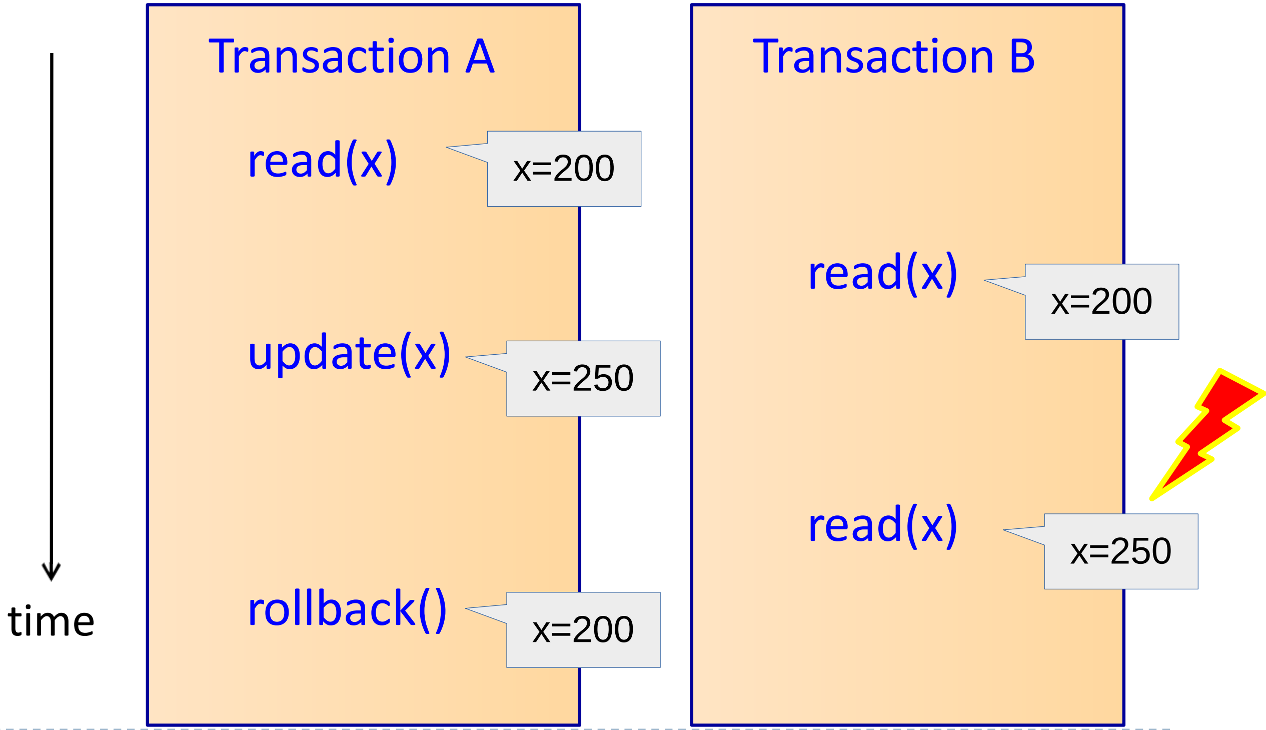
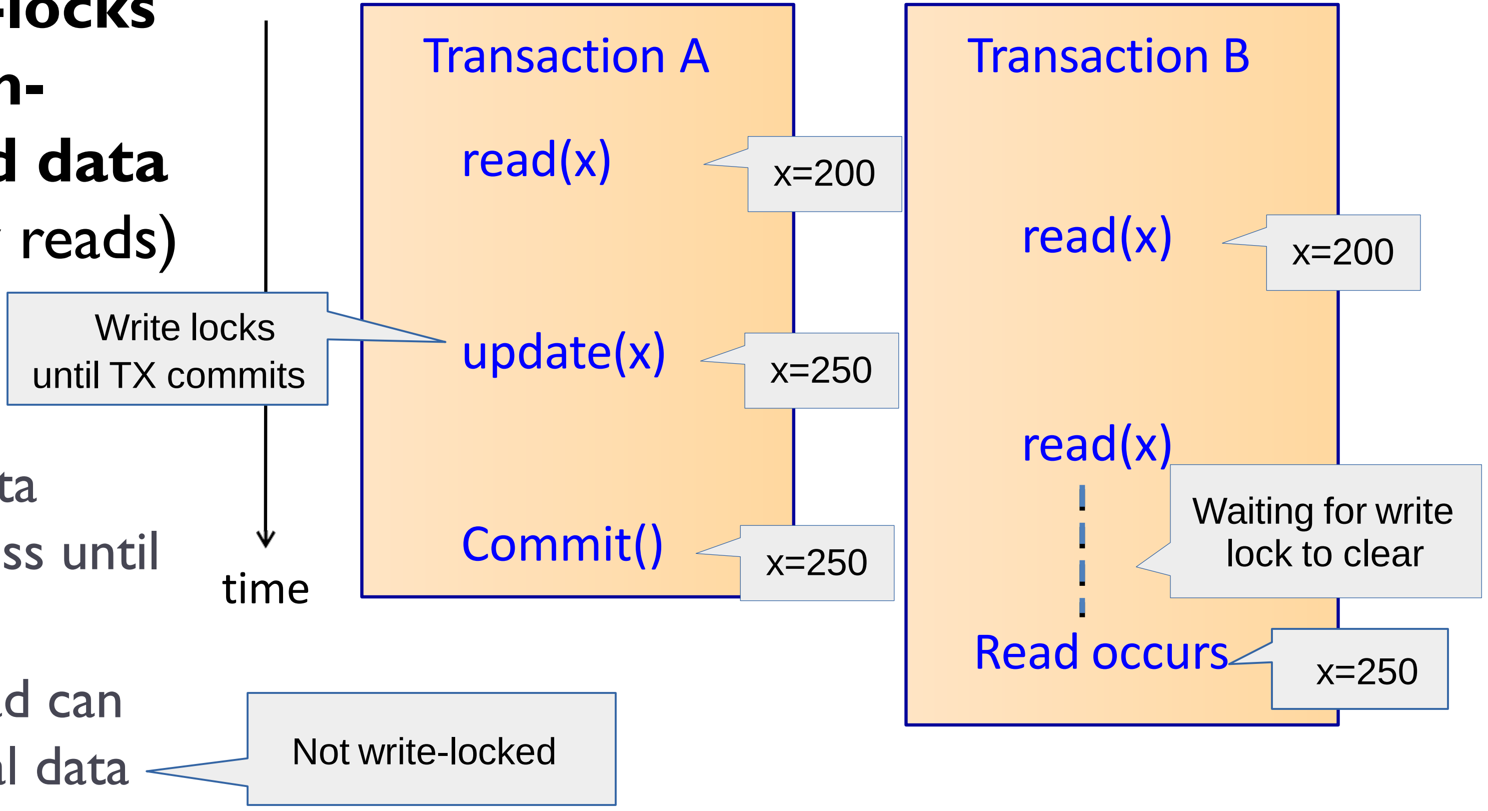


Concurrency Issues

- **Dirty reads**: a TX can read data that may never even get committed (useless)
- **Non-repeatable read**: a TX can read the same row twice and get two different values
- **Lost updates**: an update made by one TX silently disappears / overwritten (more on this later)
- **Phantom Read**: executing the same select twice may return more or less rows the second time

Read Committed

- Uses **write-locks to hide non-committed data** (solves dirty reads)
  - Written data blocks access until commit
  - Every thread can read normal data



Concurrency Issues

Not MySQL
it defaults to
Repeatable Read

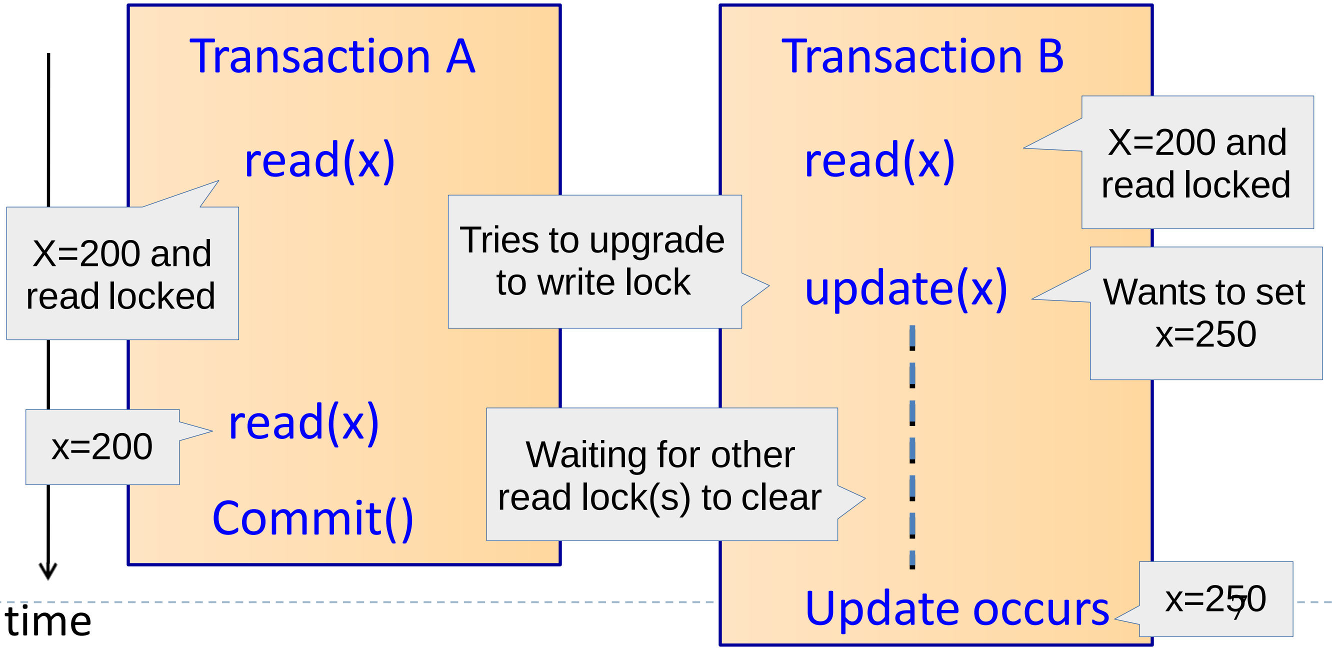
- Read Committed is the **Default for many Dbs**
  - Write locks cause some delays, but not significant
  - **Speed more important** than fixing concurrency issues

- Do provide other ways of solving them:
  - Pessimistic locking (provided by most Dbs)
  - Optimistic concurrency (provided by JPA)

Not MySQL

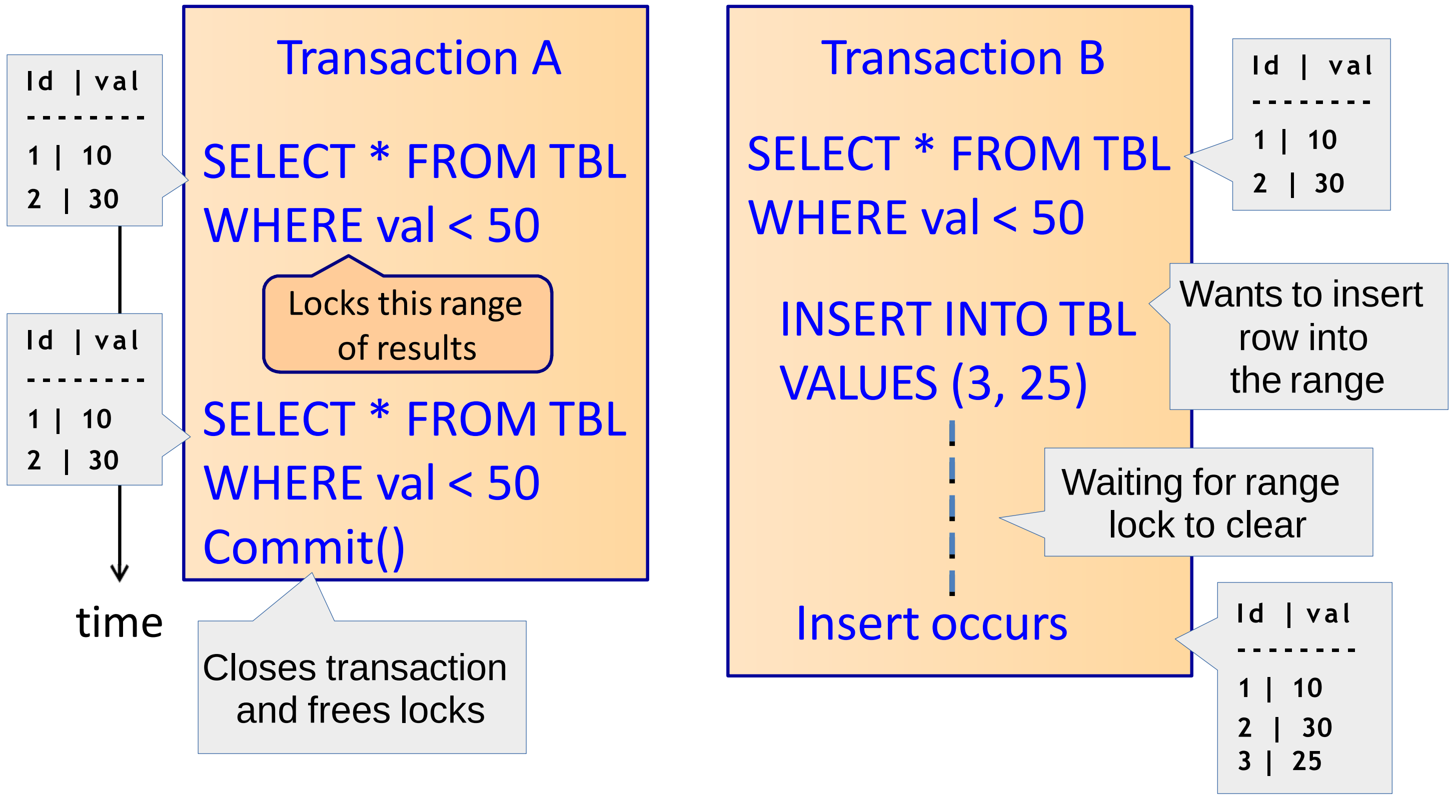
Repeatable Read

- **Uses read and write locks to solve** non-repeatable read and lost update problems
  - Once read all future reads same value



Serializable

- Sets **range locks** to solve phantom read
  - Lots of locks
  - Slow
  - Functionally similar to executing one after the other



Transaction A

```
SELECT * FROM TBL
WHERE val < 50
```

```
Id  | val
--------
1 |  10
2  |  30
```

```
SELECT * FROM TBL
WHERE val < 50
Commit()
```

```
Id  | val
--------
1 |  10
2  |  30
```

Transaction B

```
SELECT * FROM TBL
WHERE val < 50
```

```
Id  |  val
--------
1 |  10
2  |  30
```

```
INSERT INTO TBL
VALUES (3, 25)
```

Insert occurs

```
Id  | val
--------
1 |  10
2  |  30
3 |  25
```

Locks this range of results
Closes transaction and frees locks
time
Wants to insert row into the range
Waiting for range lock to clear

Changing the default

- You can raise the default isolation level
  - **Everything will be slower**, less scalable
  - Even for transactions that don't need it

Not Recommended

- Inside persistence.xml:

```
<property name="hibernate.connection.isolation" value="8" />
```

1 – Read Uncommitted
2 – Read Committed
4 – Repeatable Read
8 – Serializable

Using read-committed

- Because **speed is usually more important** most databases use read-committed
- This leaves DBs open to:
  - Non-repeatable reads
  - Phantom reads
  - Lost update

Biggest Problem!

- We'll look at some ways to mitigate lost-update

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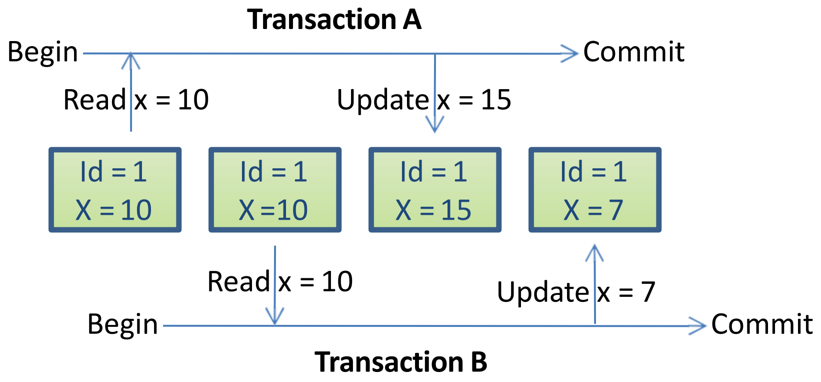
Concurrency: Optimistic Concurrency

Optimistic Concurrency

- Optimistic concurrency assumes that lost update conflicts **generally don’t occur**
  - But keeps versions# so that it knows when they do
  - Uses read committed transaction level
  - Guarantees best performance and scalability
  - The default way to deal with concurrency

Lost Update Problem

- Read Committed Allows:
  - **Last update to commit wins**
  - First update lost

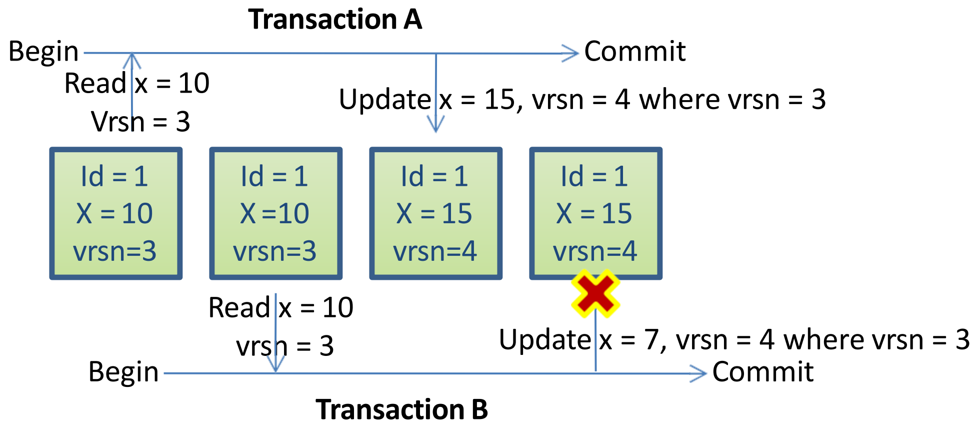


- Timeline:
  - Transactions A and B read id=1, x=10
  - Transaction A changes x to x=15 (increment by 5)
  - Transaction B wants to decrement by 3, sets X=7
  - Neither A or B is aware that data was lost!

Believing X = 10

Versioning – First Update Wins

- Optimistic concurrency adds **a version column**
  - To track updates



- **Last update fails**
  - UPDATE table SET x=15 WHERE id=1 AND vrsn=3
  - If other tx changed version, update does nothing
  - JPA throws OptimisticLockException (in last TX)

OptimisticLockException

- When a version conflict occurs, JPA implementations throw a OptimisticLockException
  - Catching this exception allows you to **notify the user** about the conflict
  - The user can then reload the data and apply their updates against the latest data

Merging Conflicts

- If you have the time:
  - You can create a conflict merging page
  - Showing their the updates the other TX made
  - Showing the updates the user wanted to make
  - Allowing easy resolution
    - User may not always remember all details on error

Version Column

- The best way to enable versioning is with an additional **integer property** / column
  - Should have no semantic value (no meaning)
  - Should be updated by all apps using the table!

```
@Entity
public class Customer {
  @Id
  @GeneratedValue
  private int id;
  private String firstname;
  private String lastname;

  @Version
  private int version;

  ...
```

Uses @Version
no need for
getter / setter

Timestamp Column

- JPA also supports a **Timestamp column**
  - Not as good: may have business logic (can change)
  - Not every computer's time is exactly the same
    - But usually set by DB
    - Otherwise could give interesting bugs in finding who is first

```
@Entity
public class Customer {
  @Id
  @GeneratedValue
  private int id;
  private String firstname;
  private String lastname;

  @Version
  private Date timestamp;

  ...
```

@Version on
Date or Calendar
or LocalDateTime

Without a column

- **Hibernate extension** – only works for objects that have not been detached
  - Checks if attributes are the same as when retrieved

```
@Entity
@org.hibernate.annotations.Entity(
  optimisticLock=OptimisticLockType.ALL,
  dynamicUpdate=true
)
public class Customer {
  @Id
  @GeneratedValue
  private int id;
  private String firstname;
  private String lastname;

  …
```

Hibernate's version of @Entity

CS544 EA

Concurrency: Application Transactions

Application Transactions

- Application Transactions are longer running conversations
  - Can be seen as a Unit of Work from the User Perspective
  - Spanning two or more screens

- The user expects these units of work to be
  - Atomic, Consistent, Isolated, and Durable
  - Submitting data after each screen would not allow us to roll back the entire unit of work (not Atomic)
  - Nor should you use a single database transaction across multiple screens
    - Keeping locks open during user think time

Checkout

- An online checkout is generally an Application Tx
  - Multiple screens (items, shipping, payment, etc)
  - Needs to be: Atomic, Consistent, Isolated, Durable

- Can be implemented with **optimistic concurrency**
  - Detach objects after first screen, store in session
  - Update objects on subsequent screens
  - Re-attach objects after final screen
    - Exception will be thrown if changes happened outside App TX

Pessimistic Locking

- For certain operations optimistic concurrency might not be enough
- Stricter isolation might be required to prevent the unrepeatable reads problem
- Hibernate can **request explicit database level locks** to provide increased isolation
- These locks will be released on commit

SELECT FOR UPDATE on DBs that support it

```
Customer cust = (Customer)session.get(Customer.class, 1);
em.lock(cust, LockModeType.OPTIMISTIC);
```

```
Customer cust = em.find(Customer.class, 1, LockModeType.OPTIMISTIC);
```

LockModeType

Lock Mode	Description
None	Nothing
OPTIMISTIC	Performs a version column check
OPTIMISTIC_FORCE_INCREMENT	Ensures an increment on the version column before the transactions sommits
PESSIMISTIC_FORCE_INCREMENT	Forces and increment on the version column right away and tries to get a write lock
PESSIMISTIC_READ	Tries to get a read lock in the DB
PESSIMISTIC_WRITE	Tries to get a write lock in the DB
READ	Synonym of OPTIMISTIC
WRITE	Synonym of OPTIMISTIC_FORCE_INCREMENT

Throws PersistenceException on objects without version

Newer apps should use OPTIMISTIC versions Not READ / Write

Concurrency Summary

- Databases often run in weaker isolation modes
- Optimistic concurrency uses a version column to prevent the Lost Update problem
- Pessimistic Locking can be used to force database locks or version column updates
- Application Transactions can be implemented using detached objects and version columns