

Principles and Techniques of DBMS 8

Object-Relation Mapping II

Haopeng Chen

***RE**liable, **IN**telligent and **SC**alable Systems Group (**REINS**)*

Shanghai Jiao Tong University

Shanghai, China

<http://reins.se.sjtu.edu.cn/~chenhp>

e-mail: chen-hp@sjtu.edu.cn

- O/R mapping
 - Inheritance strategy
 - Work with object

- Single table per class hierarchy strategy

```
public class Plane {
    private Long id;
    private String type;
    private String manufacturer;

    public Plane() {}

    public Long getId() { return id; }
    private void setId(Long id) { this.id = id; }

    public String getType() { return type; }
    public void setType(String type) { this.type = type; }

    public String getManufacturer() { return manufacturer; }
    public void setManufacturer(String manufacturer) {
        this.manufacturer = manufacturer;
    }
}
```

- Single table per class hierarchy strategy

```
public class Airbus extends Plane{
    private String capacity;

    public Airbus() {}

    public String getCapacity() { return capacity; }
    private void setCapacity(String capacity) { this.capacity = capacity; }
}
```

```
public class Boeing extends Plane{
    private String comfort;

    public Boeing() {}

    public String getComfort() { return comfort; }
    private void setComfort(String comfort) { this.comfort = comfort; }
}
```

- Single table per class hierarchy strategy

```
<hibernate-mapping package="Sample.Entity"
                    discriminator-value="0" >
  <class name="Plane" table="planes">
    <id name="id" column="ID">
      <generator class="native"/>
    </id>
    <discriminator column="DISC" type="string"/>
    <property name="type"/>
    <property name="manufacturer"/>

    <subclass name="Airbus" discriminator-value="1">
      <property name="capacity" />
    </subclass>
    <subclass name="Boeing" discriminator-value="2">
      <property name="comfort" />
    </subclass>
  </class>
</hibernate-mapping>
```

- Single table per class hierarchy strategy

```
String manufacturer = (String) request.getParameter("manufacturer");
```

```
Session session =
```

```
    HibernateUtil.getSessionFactory().getCurrentSession();
```

```
session.beginTransaction();
```

```
List planes = session.createQuery(
```

```
    "from Plane as p where p.manufacturer = :manu").
```

```
    setParameter("manu", manufacturer).list();
```

```
session.getTransaction().commit();
```

```
for (int i = 0; i < planes.size(); i++) {
```

```
    Plane thePlane = (Plane) planes.get(i);
```

```
    out.println("id: " + thePlane.getId() + "<br>" +
```

```
        "type: " + thePlane.getType() + "<br>" +
```

```
        "manufacturer: " + thePlane.getManufacturer() +
```

```
        "<br><br>");
```

```
}
```

- Single table per class hierarchy strategy

```
Airbus airbus = new Airbus();  
airbus.setManufacturer("Airbus");  
airbus.setType("320");  
airbus.setCapacity("320");  
session.save(airbus);
```

```
Boeing boeing = new Boeing();  
boeing.setManufacturer("Boeing");  
boeing.setType("777");  
boeing.setComfort("Great");  
session.save(boeing);
```

```
Plane plane = new Plane();  
plane.setManufacturer("I1");  
plane.setType("78");  
session.save(plane);
```

- Joined subclass strategy

```
public class Cat {  
  
    private Long uid;  
    private Date birthday;  
    private String color;  
    private String sex;  
    private int weight;  
  
    public Cat() {}  
  
    public Long getUid() { return uid; }  
    private void setUid(Long uid) { this.uid = uid; }  
  
    public Date getBirthday() { return birthday; }  
    public void setBirthday(Date birthday) { this.birthday = birthday; }  
  
    public String getColor() { return color; }  
    public void setColor(String color) { this.color = color; }  
  
    public String getSex() { return sex; }  
    public void setSex(String sex) { this.sex = sex; }  
  
    public int getWeight() { return weight; }  
    public void setWeight(int weight) { this.weight = weight; }  
  
}
```


- Joined subclass strategy

```
public class DomesticCat extends Cat {  
    private String name;  
  
    public DomesticCat() {}  
  
    public String getName() { return name; }  
    public void setName(String name) { this.name = name; }  
}
```

- Joined subclass strategy

```
<hibernate-mapping package="Sample.Entity">
  <class name="Cat" table="CATS">
    <id name="uid" column="UID">
      <generator class="native"/>
    </id>
    <property name="birthday" type="date"/>
    <property name="color"/>
    <property name="sex"/>
    <property name="weight"/>
    <joined-subclass name="DomesticCat" table="DOMESTIC_CATS">
      <key column="CAT"/>
      <property name="name" type="string"/>
    </joined-subclass>
  </class>
</hibernate-mapping>
```

- Joined subclass strategy

```
Session session = HibernateUtil.getSessionFactory().getCurrentSession();
session.beginTransaction();
List cats = session.createQuery("from Cat").list();
session.getTransaction().commit();

for (int i = 0; i < cats.size(); i++) {
    Cat theCat = (Cat)cats.get(i);
    out.println("id: " + theCat.getUid() + "<br>" +
        "birthday: " + theCat.getBirthday() + "<br>" +
        "color: " + theCat.getColor() + "<br>" +
        "weight: " + theCat.getWeight() + "<br>");
    if (theCat instanceof DomesticCat) {
        DomesticCat aCat = (DomesticCat)theCat;
        out.println("name: " + aCat.getName() + "<br>");
    }
    out.println("<br>");
}
```

- Joined subclass strategy

```
Session session = HibernateUtil.getSessionFactory().getCurrentSession();
    session.beginTransaction();
List cats = session.createQuery("from Cat").list();
DomesticCat domesticCat = new DomesticCat();
Date birthday = new Date();
domesticCat.setUid(new Long(3));
domesticCat.setBirthday(birthday);
domesticCat.setColor("blue");
domesticCat.setName("Doraemon");
domesticCat.setSex("male");
domesticCat.setWeight(20);
session.save(domesticCat);
session.getTransaction().commit();
```

- Table per class strategy

```
public class Fruit {
    private Long uid;
    private String shape;
    private String flavor;
    private String color;

    public Fruit() {}

    public Long getUid() { return uid; }
    public void setUid(Long uid) { this.uid = uid; }

    public String getShape() { return shape; }
    public void setShape(String shape) { this.shape = shape; }

    public String getFlavor() { return flavor; }
    public void setFlavor(String flavor) { this.flavor = flavor; }

    public String getColor() { return color; }
    public void setColor(String color) { this.color = color; }
}
```

- Table per class strategy

```
public class Apple extends Fruit {
```

```
    private int weight;
```

```
    public Apple() {}
```

```
    public int getWeight() { return weight; }
```

```
    public void setWeight(int weight) { this.weight = weight; }
```

```
}
```

- Table per class strategy

```
<hibernate-mapping package="Sample.Entity">
  <class name="Fruit" table="FRUITS">
    <id name="uid" column="UID"> </id>
    <property name="shape"/>
    <property name="flavor"/>
    <property name="color"/>
    <union-subclass name="Apple" table="APPLES">
      <property name="weight"/>
    </union-subclass>
  </class>
</hibernate-mapping>
```

- Table per class strategy

```
@WebServlet("/FruitServlet")
```

```
public class FruitServlet extends HttpServlet {
```

```
    protected void processRequest(HttpServletRequest request,  
        HttpServletResponse response)
```

```
        throws ServletException, IOException {
```

```
        .....
```

```
        Session session = HibernateUtil.getSessionFactory().getCurrentSession();  
        session.beginTransaction();
```

```
        Apple apple = new Apple();
```

```
        apple.setUid(new Long(5));
```

```
        apple.setShape("round");
```

```
        apple.setFlavor("so-so");
```

```
        apple.setColor("yellow");
```

```
        apple.setWeight(9);
```

```
        session.save(apple);
```


- Table per class strategy

```
@WebServlet("/FruitServlet")
public class FruitServlet extends HttpServlet {
    protected void processRequest(HttpServletRequest request,
                                HttpServletResponse response)
        throws ServletException, IOException {
        .....
        List fruits = session.createQuery("from Fruit").list();
        session.getTransaction().commit();

        for (int i = 0; i < fruits.size(); i++) {
            Fruit theFruit = (Fruit)fruits.get(i);
            out.println("id: " + theFruit.getUid() + "<br>" +
                .....
            if (theFruit instanceof Apple) {
                Apple aFruit = (Apple)theFruit;
                out.println("weight: " + aFruit.getWeight() + "<br>");
            }
        }
    }
}
```

- A data model does not support modeling inheritance in a direct way
- Three Strategies
 - table per subclass
 - table per concrete class
 - table per class hierarchy

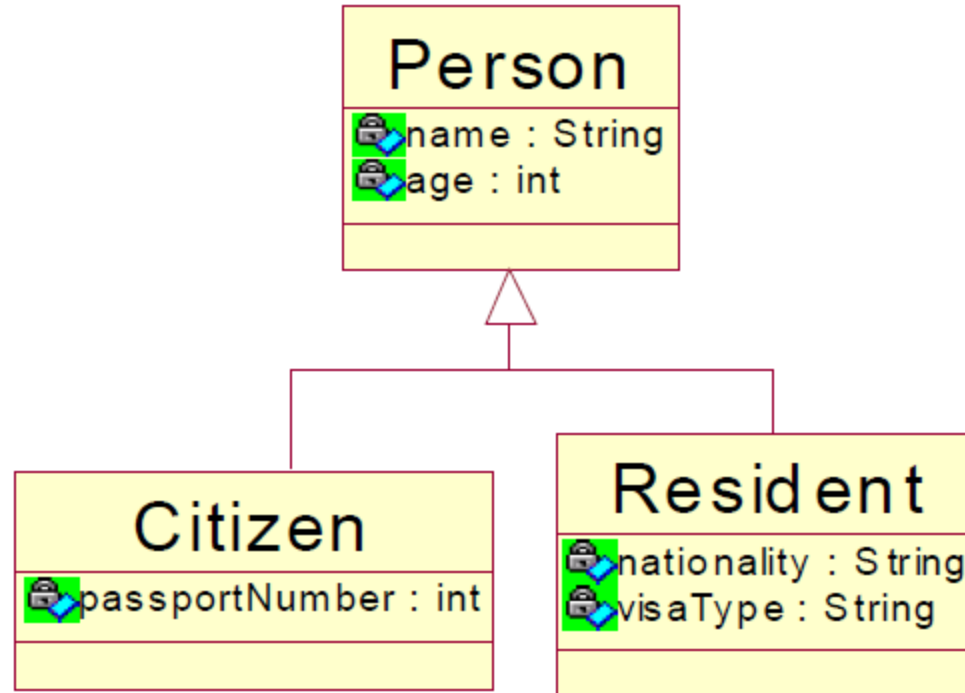
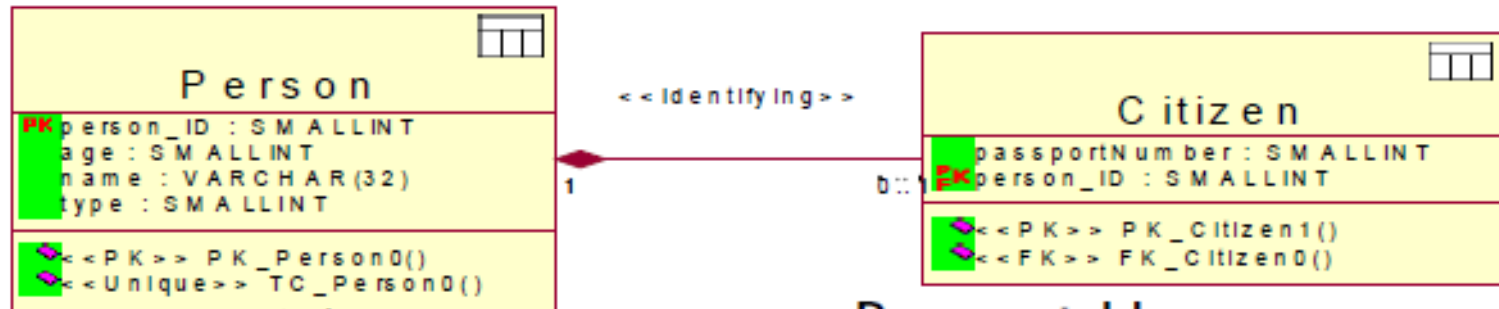


Table per subclass



Person table

| person_ID | type | name | age |
|-----------|----------|-------|-----|
| 1 | citizen | John | 19 |
| 2 | resident | Mike | 73 |
| 3 | person | Julie | 20 |

Resident table

| person_ID | nationality | visaType |
|-----------|-------------|----------|
| 2 | China | H-1 |

Citizen table

| person_ID | passportNumber |
|-----------|----------------|
| 1 | 123-456 |

Table per concrete class

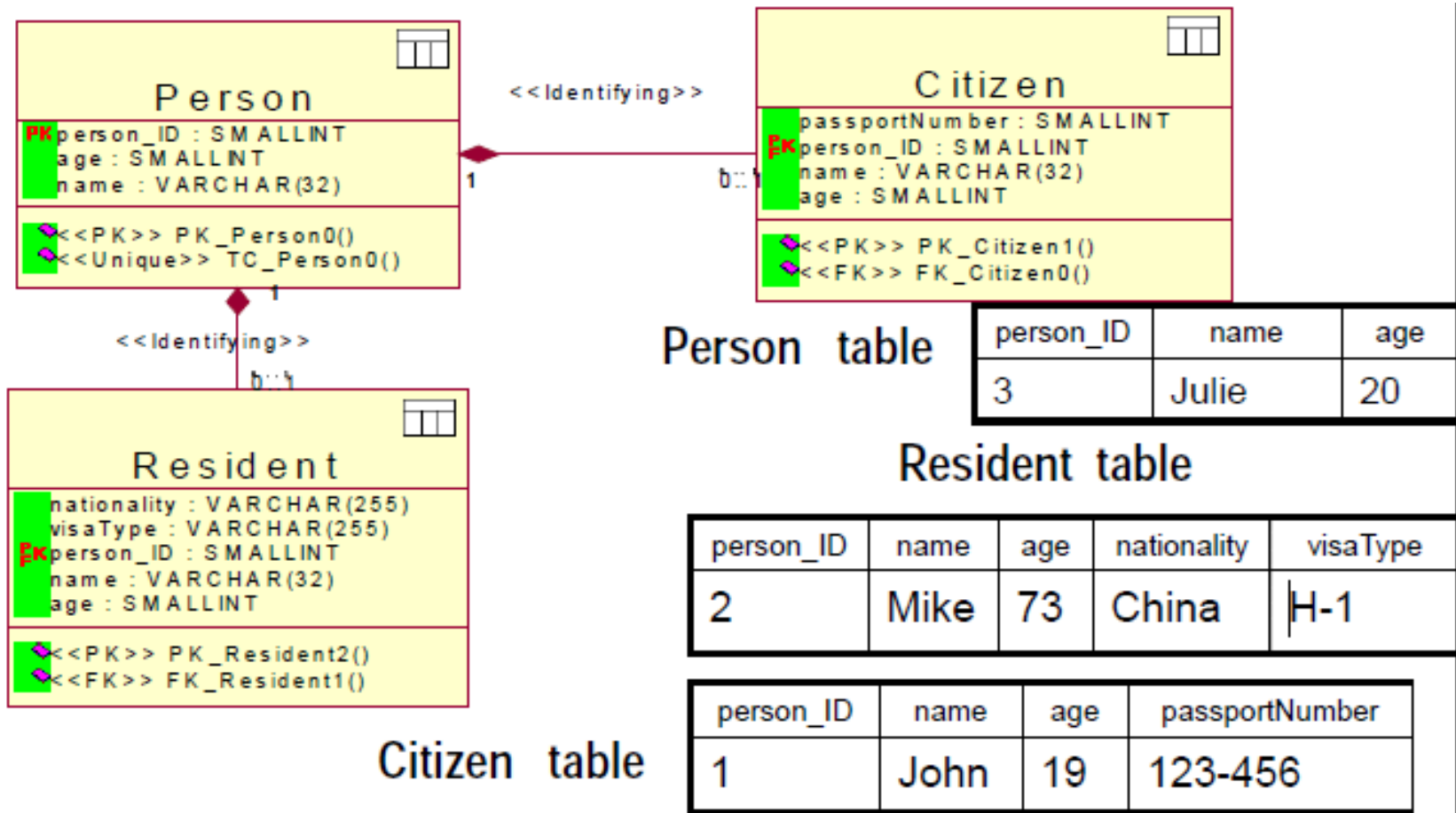





Table per class hierarchy

Person 

PK person_ID : SMALLINT
age : SMALLINT
name : VARCHAR(32)
type : SMALLINT
passportNumber : SMALLINT
nationality : VARCHAR(255)
visaType : VARCHAR(255)

 <<PK>> PK_Person0()
 <<Unique>> TC_Person0()

Person table

| person_ID | type | name | age | passportNumber | nationality | visaType |
|-----------|----------|-------|-----|----------------|-------------|----------|
| 1 | citizen | John | 19 | 123-456 | | |
| 2 | resident | Mike | 73 | | China | H-1 |
| 3 | person | Julie | 20 | | | |

- Hibernate defines and supports the following object states:
 - *Transient*
 - an object is transient if it has just been instantiated using the new operator, and it is not associated with a Hibernate Session.
 - *Persistent*
 - a persistent instance has a representation in the database and an identifier value.
 - *Detached*
 - a detached instance is an object that has been persistent, but its Session has been closed.

Making objects persistent

```
DomesticCat fritz = new DomesticCat();
fritz.setColor(Color.GINGER);
fritz.setSex('M');
fritz.setName("Fritz");
Long generatedId = (Long) sess.save(fritz);
```

```
DomesticCat pk = new DomesticCat();
pk.setColor(Color.TABBY);
pk.setSex('F');
pk.setName("PK");
pk.setKittens( new HashSet() );
pk.addKitten(fritz);
sess.save( pk, new Long(1234) );
```

Or

```
sess.persist( pk, new Long(1234) );
```



```
Cat fritz = (Cat) sess.load(Cat.class, generatedId);

// you need to wrap primitive identifiers
long id = 1234;
DomesticCat pk = (DomesticCat) sess.load( DomesticCat.class, new Long(id) );

Cat cat = new DomesticCat();
// load pk's state into cat
sess.load( cat, new Long(pkId) );
Set kittens = cat.getKittens();

Cat cat = (Cat) sess.get(Cat.class, id);
if (cat==null) {
    cat = new Cat();
    sess.save(cat, id);
}
return cat;

sess.save(cat);
sess.flush(); //force the SQL INSERT
sess.refresh(cat); //re-read the state (after the trigger executes)
```

```
List cats = session.createQuery(
    "from Cat as cat where cat.birthdate < ?")
    .setDate(0, date)
    .list();
List mothers = session.createQuery(
    "select mother from Cat as cat join cat.mother
        as mother where cat.name = ?")
    .setString(0, name)
    .list();
List kittens = session.createQuery(
    "from Cat as cat where cat.mother = ?")
    .setEntity(0, pk)
    .list();
Cat mother = (Cat) session.createQuery(
    "select cat.mother from Cat as cat where cat = ?")
    .setEntity(0, izi)
    .uniqueResult();
Query mothersWithKittens = (Cat) session.createQuery(
    "select mother from Cat as mother left join fetch mother.kittens");
Set uniqueMothers = new HashSet(mothersWithKittens.list());
```

```
Iterator kittensAndMothers = sess.createQuery(
    "select kitten, mother from Cat kitten join kitten.mother mother")
    .list()
    .iterator();
while ( kittensAndMothers.hasNext() ) {
    Object[] tuple = (Object[]) kittensAndMothers.next();
    Cat kitten = (Cat) tuple[0];
    Cat mother = (Cat) tuple[1];
    ....
}
```

```
Iterator results = sess.createQuery(
    "select cat.color, min(cat.birthdate), count(cat) from Cat cat " + "group by cat.color")
    .list()
    .iterator();
while ( results.hasNext() ) {
    Object[] row = (Object[]) results.next();
    Color type = (Color) row[0];
    Date oldest = (Date) row[1];
    Integer count = (Integer) row[2];
    .....
}
```

```
//named parameter (preferred)
```

```
Query q = sess.createQuery("from DomesticCat cat  
                           where cat.name = :name");
```

```
q.setString("name", "Fritz");
```

```
Iterator cats = q.iterate();
```

```
//positional parameter
```

```
Query q = sess.createQuery("from DomesticCat cat  
                           where cat.name = ?");
```

```
q.setString(0, "Izi");
```

```
Iterator cats = q.iterate();
```

```
//named parameter list
```

```
List names = new ArrayList();
```

```
names.add("Izi");
```

```
names.add("Fritz");
```

```
Query q = sess.createQuery("from DomesticCat cat  
                           where cat.name in (:namesList)");
```

```
q.setParameterList("namesList", names);
```

```
List cats = q.list();
```

Pagination and Scrollable iteration



REliable, INtelligent & Scalable Systems

```
Query q = sess.createQuery("from DomesticCat cat");
q.setFirstResult(20);
q.setMaxResults(10);
List cats = q.list();
```

```
Query q = sess.createQuery("select cat.name, cat from DomesticCat cat " + "order
by cat.name");
ScrollableResults cats = q.scroll();
if ( cats.first() ) {
    // find the first name on each page of an alphabetical list of cats by name
    firstNamesOfPages = new ArrayList();
    do {
        String name = cats.getString(0);
        firstNamesOfPages.add(name);
    } while ( cats.scroll(PAGE_SIZE) );
    // Now get the first page of cats
    pageOfCats = new ArrayList();
    cats.beforeFirst();
    int i=0;
    while( ( PAGE_SIZE > i++ ) && cats.next() )
        pageOfCats.add( cats.get(1) );
}
cats.close();
```

```
Criteria crit = session.createCriteria(Cat.class);
crit.add( Restrictions.eq( "color", eg.Color.BLACK ) );
crit.setMaxResults(10);
List cats = crit.list();
```

```
List cats = session.createQuery("SELECT {cat.*} FROM CAT
{cat} WHERE ROWNUM<10")
    .addEntity("cat", Cat.class)
    .list();
```

```
List cats = session.createQuery(
    "SELECT {cat}.ID AS {cat.id}, {cat}.SEX AS {cat.sex}, " +
    "{cat}.MATE AS {cat.mate}, {cat}.SUBCLASS AS
{cat.class}, ... " +
    "FROM CAT {cat} WHERE ROWNUM<10")
    .addEntity("cat", Cat.class)
    .list();
```

```
DomesticCat cat = (DomesticCat) sess.load( Cat.class, new Long(69) );  
cat.setName("PK");  
sess.flush(); // changes to cat are automatically detected and persisted
```

```
// in the first session
```

```
Cat cat = (Cat) firstSession.load(Cat.class, catId);  
Cat potentialMate = new Cat();  
firstSession.save(potentialMate);
```

```
// in a higher layer of the application  
cat.setMate(potentialMate);
```

```
// later, in a new session  
secondSession.update(cat); // update cat  
secondSession.update(mate); // update mate
```

```
or  
secondSession.merge(cat); // merge cat  
secondSession.merge(mate); // merge mate
```

```
// in the first session
```

```
Cat cat = (Cat) firstSession.load(Cat.class, catID);
```

```
// in a higher tier of the application
```

```
Cat mate = new Cat();
```

```
cat.setMate(mate);
```

```
// later, in a new session
```

```
secondSession.saveOrUpdate(cat);
```

```
// update existing state (cat has a non-null id)
```

```
secondSession.saveOrUpdate(mate);
```

```
// save the new instance (mate has a null id)
```


Deleting persistent objects

```
sess.delete(cat);
```

```
//retrieve a cat from one database
```

```
Session session1 = factory1.openSession();  
Transaction tx1 = session1.beginTransaction();  
Cat cat = session1.get(Cat.class, catId);  
tx1.commit();  
session1.close();
```

```
//reconcile with a second database
```

```
Session session2 = factory2.openSession();  
Transaction tx2 = session2.beginTransaction();  
session2.replicate(cat, ReplicationMode.LATEST_VERSION);  
tx2.commit();  
session2.close();
```

- ReplicationMode:
 - IGNORE
 - OVERWRITE
 - EXCEPTION
 - LATEST_VERSION

- *flush*, occurs by default at the following points:
 - before some query executions
 - from `org.hibernate.Transaction.commit()`
 - from `Session.flush()`
- The SQL statements are issued in the following order:
 - all entity insertions in the same order the corresponding objects were saved using `Session.save()`
 - all entity updates
 - all collection deletions
 - all collection element deletions, updates and insertions
 - all collection insertions
 - all entity deletions in the same order the corresponding objects were deleted using `Session.delete()`

```
sess = sf.openSession();
Transaction tx = sess.beginTransaction();
sess.setFlushMode(FlushMode.COMMIT);
// allow queries to return stale state

Cat izi = (Cat) sess.load(Cat.class, id);
izi.setName(iznizi);

// might return stale data
sess.find("from Cat as cat left outer join cat.kittens kitten");

// change to izi is not flushed!
...
tx.commit(); // flush occurs
sess.close();
```

- For each basic operation of the Hibernate session there is a corresponding cascade style
- including `persist()`, `merge()`, `saveOrUpdate()`, `delete()`, `lock()`, `refresh()`, `evict()`, `replicate()`
 - `CascadeType.PERSIST`
 - `CascadeType.MERGE`
 - `CascadeType.REMOVE`
 - `CascadeType.REFRESH`
 - `CascadeType.DETACH`
 - `CascadeType.ALL`

```
@Entity
public class Customer {
    private Set<Order> orders;
    @OneToMany(cascade=CascadeType.ALL, orphanRemoval=true)
    public Set<Order> getOrders() { return orders; }
    public void setOrders(Set<Order> orders) {
        this.orders = orders;
    }
    ...
}
```

```
@Entity
public class Order { ... }
```

```
Customer customer = em.find(Customer.class, 11);
Order order = em.find(Order.class, 11);
customer.getOrders().remove(order);
//order will be deleted by cascade
```

- HIBERNATE - Relational Persistence for Idiomatic Java,
 - http://docs.jboss.org/hibernate/orm/4.1/manual/en-US/html_single/#preface



Thank You!