Principles and Techniques of DBMS Object-Relation Mapping II

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Overview

- O/R mapping
  - Basic O/R Mapping
  - Working with Objects
  - Transactions and Concurrency
  - Improving Performance

Session and transaction scopes

- A SessionFactory is an expensive-to-create, thread-safe object, intended to be shared by all application threads.
  - It is created once, usually on application startup, from a Configuration instance.

- A Session is an inexpensive, non-thread-safe object that should be used once and then discarded for: a single request, a conversation or a single unit of work.
  - A Session will not obtain a JDBC Connection, or a Datasource, unless it is needed. It will not consume any resources until used.

Unit of work

- A unit of work is a design pattern described by Martin Fowler as
  - "[maintaining] a list of objects affected by a business transaction and coordinates the writing out of changes and the resolution of concurrency problems. "
- In other words, its a series of operations we wish to carry out against the database together.
  - Basically, it is a transaction, though fulfilling a unit of work will often span multiple physical database transactions
- Do not use the *session-per-operation* anti-pattern:
  - do not open and close a Session for every simple database call in a single thread.

Long conversations

- In web and enterprise applications, it is not acceptable for a database transaction to span a user interaction.

- Hibernate's features:
  - *Automatic Versioning*.
  - *Detached Objects*.
  - *Extended (or Long) Session*

- Session span
  - *session-per-operation*
  - *session-per-request*
  - *session-per-conversation*

Considering object identity

- An application can concurrently access the same persistent state in two different Sessions.
  - However, an instance of a persistent class is never shared between two Session instances

- Database Identity
  - foo.getId().equals(bar.getId())
- JVM Identity
  - foo==bar

- The developer has to override the equals() and hashCode() methods in persistent classes and implement their own notion of object equality.
  - There is one caveat: never use the database identifier to implement equality.

Database transaction demarcation

- No communication with the database can occur outside of a database transaction
  - this seems to confuse many developers who are used to the auto-commit mode

- Ending a Session usually involves four distinct phases:
  - flush the session
  - commit the transaction
  - close the session
  - handle exceptions

Non-managed environment


```
// Non-managed environment idiom
Session sess = factory.openSession();
Transaction tx = null;
try {
  tx = sess.beginTransaction();
  // do some work ...
  tx.commit();
}
catch (RuntimeException e) {
  if (tx != null)
     tx.rollback();
  throw e; // or display error message
}
finally {
  sess.close();
}
```

Non-managed environment


```
// Non-managed environment idiom with getCurrentSession()
try {
  factory.getCurrentSession().beginTransaction();
  // do some work ...
  factory.getCurrentSession().getTransaction().commit();
}
catch (RuntimeException e) {
  factory.getCurrentSession().getTransaction().rollback();
  throw e;   // or display error message
}
```

Using JTA


```
// BMT idiom
Transaction tx = null;
try {
  UserTransaction tx = (UserTransaction)new
                       InitialContext() .lookup("java:comp/UserTransaction");
  // do some work ...
  tx.commit();
}
catch (RuntimeException e) {
  if (tx != null) tx.rollback();
  throw e;
  // or display error message
}
finally {
  sess.close();
}
```

Using JTA


```
// BMT idiom with getCurrentSession()
try {
  UserTransaction tx = (UserTransaction)new
                    InitialContext() .lookup("java:comp/UserTransaction");
  tx.begin();
  // Do some work on Session bound to transaction
  factory.getCurrentSession().load(...);
  factory.getCurrentSession().persist(...);
  tx.commit();
}
catch (RuntimeException e) {
  tx.rollback();
  throw e;
  // or display error message
}
```

Using JTA

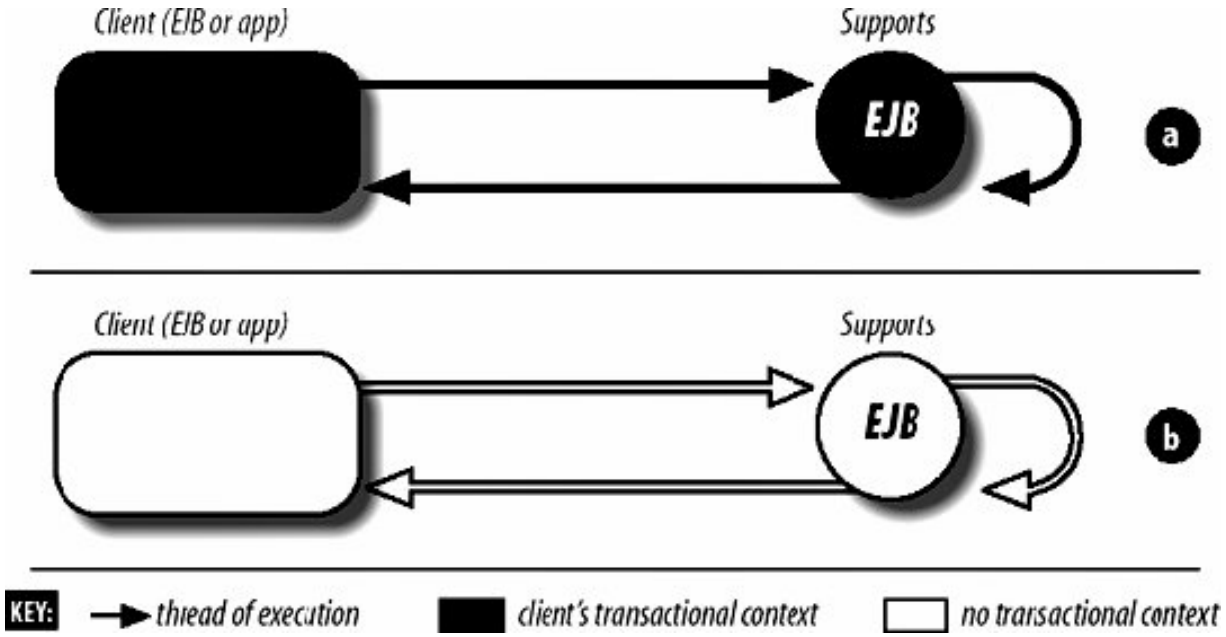

```
// CMT idiom
Session sess = factory.getCurrentSession();
// do some work ...

 import static TransactionAttributeType.*;
    @Stateless
    @TransactionAttribute(NOT_SUPPORTED)
    public class TravelAgentBean implements TravelAgentRemote {
        public void setCustomer(Customer cust) {...}

        @TransactionAttribute(REQUIRED)
        public TicketDO bookPassage(CreditCardDO card, double price)
        { ... }
    }
```

Transaction attributes defined

- NotSupported
  - Invoking a method on an EJB with this transaction attribute suspends the transaction until the method is completed.

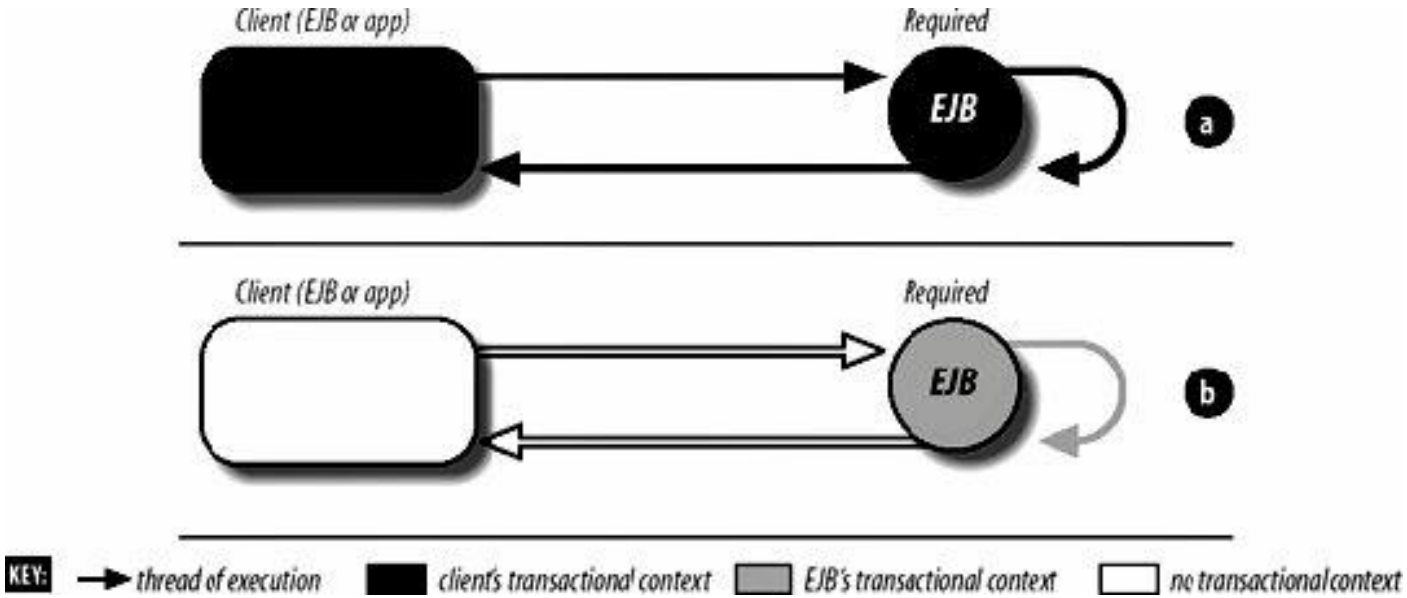
Transaction attributes defined

- Supports
  - This attribute means that the enterprise bean method will be included in the transaction scope if it is invoked within a transaction.



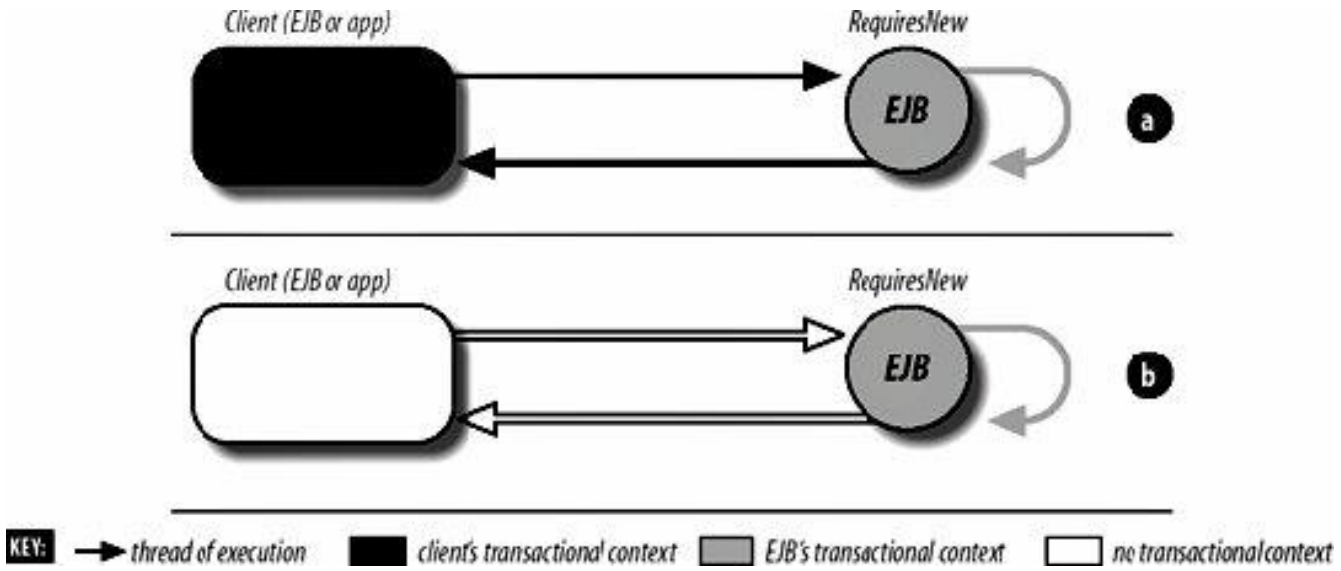
Transaction attributes defined

- Required
  - This attribute means that the enterprise bean method must be invoked within the scope of a transaction.



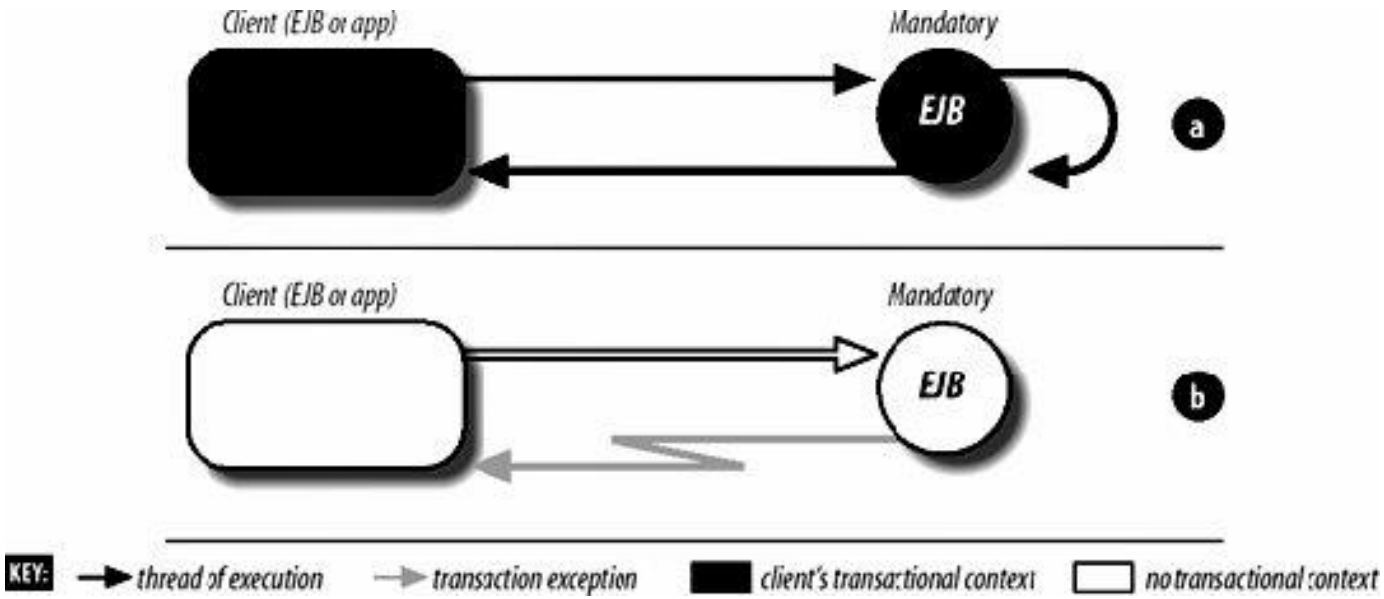
Transaction attributes defined

- RequiresNew
  - This attribute means that a new transaction is always started.



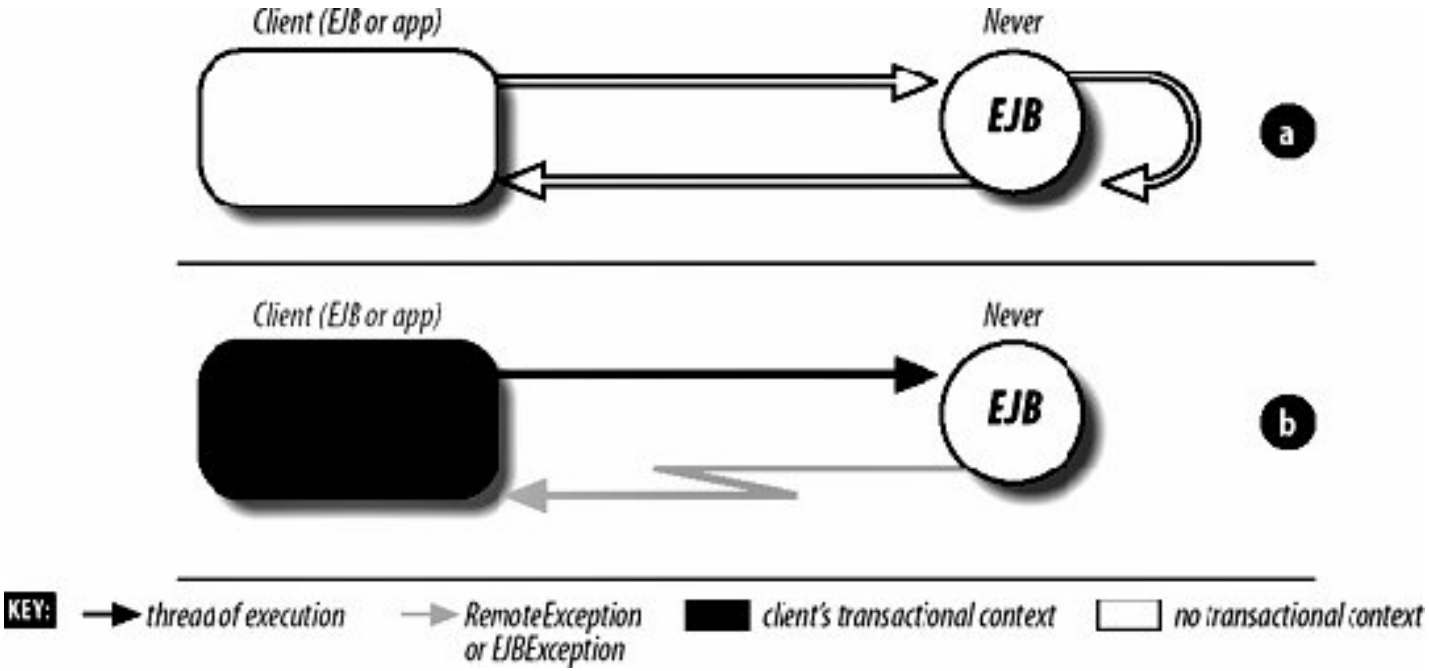
Transaction attributes defined

- Mandatory
  - This attribute means that the enterprise bean method must always be made part of the transaction scope of the calling client.



Transaction attributes defined

- Never
  - This attribute means that the enterprise bean method must not be invoked within the scope of a transaction.



Transaction attributes defined

TRANSACTION ATTRIBUTE	CLIENT'S TRANSACTION	BEAN'S TRANSACTION
Required	None	T2
	T1	T1
RequiresNew	None	T2
	T1	T2
Supports	None	None
	T1	T1
Mandatory	None	Error
	T1	T1
NotSupported	none	None
	T1	None
Never	none	None
	T1	Error

Transaction Timeout


```
Session sess = factory.openSession();
try {
  //set transaction timeout to 3 seconds
  sess.getTransaction().setTimeout(3);
  sess.getTransaction().begin();
  // do some work ...
  sess.getTransaction().commit()
}
catch (RuntimeException e) {
  sess.getTransaction().rollback();
  throw e; // or display error message
}
finally {
  sess.close();
}
```

Optimistic concurrency control

- The only approach that is consistent with high concurrency and high scalability, is optimistic concurrency control with versioning.
  - Version checking uses version numbers, or timestamps, to detect conflicting updates and to prevent lost updates.

Application version checking


```
// foo is an instance loaded by a previous Session
session = factory.openSession();
Transaction t = session.beginTransaction();
int oldVersion = foo.getVersion();
session.load( foo, foo.getKey() ); // load the current state
if ( oldVersion != foo.getVersion() )
   throw new StaleObjectStateException();
foo.setProperty("bar");
t.commit();
session.close();
```

Extended session and automatic versioning


```
// foo is an instance loaded earlier by the old session
Transaction t = session.beginTransaction();
// Obtain a new JDBC connection, start transaction

foo.setProperty("bar");
session.flush();  // Only for last transaction in conversation
t.commit();       // Also return JDBC connection
session.close(); // Only for last transaction in conversation
```

Detached objects and automatic versioning


```
// foo is an instance loaded by a previous Session
foo.setProperty("bar");
session = factory.openSession();
Transaction t = session.beginTransaction();
session.saveOrUpdate(foo);
// Use merge() if "foo" might have been loaded already
t.commit();
session.close();
```

Pessimistic locking

- The LockMode class defines the different lock levels that can be acquired by Hibernate.
  - LockMode.WRITE
  - LockMode.UPGRADE
  - LockMode.UPGRADE_NOWAIT
  - LockMode.READ
  - LockMode.NONE

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Fetching strategies

- Hibernate3 defines the following fetching strategies:
  - *Join fetching*
  - *Select fetching*
  - *Subselect fetching*
  - *Batch fetching*
- Hibernate also distinguishes between:
  - *Immediate fetching*
  - *Lazy collection fetching*
  - *"Extra-lazy" collection fetching*
  - *Proxy fetching*
  - *"No-proxy" fetching*
  - *Lazy attribute fetching*

Working with lazy associations

- hibernate.default_batch_fetch_size

```
s = sessions.openSession();
Transaction tx = s.beginTransaction();
User u = (User) s.createQuery("from User u where u.name=:userName")
  .setString("userName", userName).uniqueResult();
Map permissions = u.getPermissions();
tx.commit();
s.close();
Integer accessLevel = (Integer) permissions.get("accounts");
// Error!
```

- Hibernate does not support lazy initialization for detached objects.

The second level cache

- specify the name of a class that implements org.hibernate.cache.spi.CacheProvider using the property hibernate.cache.provider_class.

Cache	Provider class	Type	Cluster Safe	Query Cache Supported
ConcurrentHashMap (only for testing purpose, in hibernate-testing module)	org.hibernate.testing.cache.CachingRegionFactory	memory		yes
EHCache	org.hibernate.cache.ehcache.EhCacheRegionFactory	memory, disk, transactional, clustered	yes	yes
Infinispan	org.hibernate.cache.infinispan.InfinispanRegionFactory	clustered (ip multicast), transactional	yes (replication or invalidation)	yes (clock sync req.)

Cache mappings

- shared-cache-mode element in your persistence.xmlfile or the javax.persistence.sharedCache.mode property in your configuration:
  - ENABLE_SELECTIVE (Default and recommended value)
  - DISABLE_SELECTIVE
  - ALL
  - NONE

- hibernate.cache.default_cache_concurrency_strategy:
  - read-only
  - read-write
  - nonstrict-read-write
  - transactional

Cache mappings

- **Definition of cache concurrency strategy via @Cache**

```
@Entity
@Cacheable
@Cache(usage = CacheConcurrencyStrategy.NONSTRICT_READ_WRITE)
public class Forest { ... }
```

- **Caching collections using annotations**

```
@OneToMany(cascade=CascadeType.ALL, fetch=FetchType.EAGER)
@JoinColumn(name="CUST_ID")
@Cache(usage = CacheConcurrencyStrategy.NONSTRICT_READ_WRITE)
public SortedSet<Ticket> getTickets() {
   return tickets;
}
```

Cache mappings

- **Cache Concurrency Strategy Support**

Cache	read-only	nonstrict-read-write	read-write	transactional
ConcurrentHashMap (not intended for production use)	yes	yes	yes	
EHCache	yes	yes	yes	yes
Infinispan	yes			yes

Managing the caches

- **Explcitly evicting a cached instance from the first level cache using Session.evict()**

```
ScrollableResult cats = sess.createQuery("from Cat as cat").scroll();
//a huge result set
while ( cats.next() ) {
  Cat cat = (Cat) cats.get(0);
  doSomethingWithACat(cat);
  sess.evict(cat);
}
```

- **Second-level cache eviction via SessionFactoty.evict() andSessionFacyory.evictCollection()**

```
sessionFactory.evict(Cat.class, catId); //evict a particular Cat
sessionFactory.evict(Cat.class); //evict all Cats
sessionFactory.evictCollection("Cat.kittens", catId);
//evict a particular collection of kittens
sessionFactory.evictCollection("Cat.kittens"); //evict all kitten collections
```

Managing the caches

- **Browsing the second-level cache entries via the Statistics API**

```
Map cacheEntries = sessionFactory.getStatistics()
    .getSecondLevelCacheStatistics(regionName)
    .getEntries();
```

- **Enabling Hibernate statistics**

```
hibernate.generate_statistics true
hibernate.cache.use_structured_entries true
```

Query cache regions

- If you require fine-grained control over query cache expiration policies, you can specify a named cache region for a particular query by calling Query.setCacheRegion().

```
List blogs = sess.createQuery
  ("from Blog blog where blog.blogger = :blogger")
 .setEntity("blogger", blogger)
 .setMaxResults(15)
 .setCacheable(true)
 .setCacheRegion("frontpages")
 .list();
```

Monitoring a SessionFactory


```
// MBean service registration for a specific SessionFactory
Hashtable tb = new Hashtable();
tb.put("type", "statistics");
tb.put("sessionFactory", "myFinancialApp");
ObjectName on = new ObjectName("hibernate", tb); // MBean object name
StatisticsService stats = new StatisticsService(); // MBean implementation
stats.setSessionFactory(sessionFactory); // Bind the stats to a SessionFactory
server.registerMBean(stats, on); // Register the Mbean on the server

// MBean service registration for all SessionFactory's
Hashtable tb = new Hashtable();
tb.put("type", "statistics");
tb.put("sessionFactory", "all");
ObjectName on = new ObjectName("hibernate", tb); // MBean object name
StatisticsService stats = new StatisticsService(); // MBean implementation
server.registerMBean(stats, on); // Register the MBean on the server
```

Metrics


```
Statistics stats = HibernateUtil.sessionFactory.getStatistics();
double queryCacheHitCount = stats.getQueryCacheHitCount();
double queryCacheMissCount = stats.getQueryCacheMissCount();
double queryCacheHitRatio = queryCacheHitCount /
                (queryCacheHitCount + queryCacheMissCount);

log.info("Query Hit ratio:" + queryCacheHitRatio);

EntityStatistics entityStats =
stats.getEntityStatistics( Cat.class.getName() );
long changes =
    entityStats.getInsertCount()
    + entityStats.getUpdateCount()
    + entityStats.getDeleteCount();
log.info(Cat.class.getName() + " changed " + changes + "times" );
```

References

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

Thank You!