HIBERNATE - Relational Persistence for Idiomatic Java

1

Hibernate Reference Documentation

3.5.4-Final

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and thanks to James Cobb (Graphic Design) und Cheyenne Weaver (Graphic Design)

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Vorwort

Die Arbeit mit objektorientierter Software und einer relationalen Datenbank kann sich in Unternehmensumgebungen heutzutage als mühsam und zeitaufwendig erweisen. Bei Hibernate handelt es sich um ein objekt/relationales Mapping-Tool für Java Umgebungen. Der Begriff objekt/relationales Mapping (ORM) bezieht sich auf die Technik des Mappens einer Datenrepräsentation von einem Objektmodell zu einem relationalen Datenmodell mit SQL-basiertem Schema.

Hibernate not only takes care of the mapping from Java classes to database tables (and from Java data types to SQL data types), but also provides data query and retrieval facilities. It can also significantly reduce development time otherwise spent with manual data handling in SQL and JDBC.

Hibernate's goal is to relieve the developer from 95 percent of common data persistence related programming tasks. Hibernate may not be the best solution for data-centric applications that only use stored-procedures to implement the business logic in the database, it is most useful with object-oriented domain models and business logic in the Java-based middle-tier. However, Hibernate can certainly help you to remove or encapsulate vendor-specific SQL code and will help with the common task of result set translation from a tabular representation to a graph of objects.

Falls Ihnen Hibernate und Objekt/Relationales Mapping oder sogar Java neu sind, orientieren Sie sich bitte an folgenden Schritten:

1. Read *Kapitel 1, Tutorial* for a tutorial with step-by-step instructions. The source code for the tutorial is included in the distribution in the `doc/reference/tutorial/` directory.
2. Read *Kapitel 2, Architektur* to understand the environments where Hibernate can be used.
3. View the `eg/` directory in the Hibernate distribution. It contains a simple standalone application. Copy your JDBC driver to the `lib/` directory and edit `etc/hibernate.properties`, specifying correct values for your database. From a command prompt in the distribution directory, type `ant eg` (using Ant), or under Windows, type `build eg`.
4. Use this reference documentation as your primary source of information. Consider reading [*JPwH*] if you need more help with application design, or if you prefer a step-by-step tutorial. Also visit *http://caveatemptor.hibernate.org* and download the example application from [*JPwH*].
5. Antworten auf häufig gestellte Fragen (FAQs) finden Sie auf der Website von Hibernate.
6. Auf der Hibernate Website befinden sich auch Demos, Beispiele und Anleitungen Dritter.
7. Bei Fragen wenden Sie sich an das Benutzerforum, das mit der Hibernate Website verlinkt ist. Wir bieten auch ein JIRA-Problemverfolgungssystem für Fehlerberichte und Feature-Anfragen. Falls Sie an der Entwicklung von Hibernate interessiert sind, registrieren Sie sich bei der Mailing-Liste für Entwickler. Falls Sie diese Dokumentation in Ihre Sprache übersetzen möchten, setzen Sie sich mittels der Mailing-Liste für Entwickler mit uns in Verbindung.

If you have questions, use the user forum linked on the Hibernate website. We also provide a JIRA issue tracking system for bug reports and feature requests. If you are interested in the

development of Hibernate, join the developer mailing list. If you are interested in translating this documentation into your language, contact us on the developer mailing list.

Commercial development support, production support, and training for Hibernate is available through JBoss Inc. (see http://www.hibernate.org/SupportTraining/). Hibernate is a Professional Open Source project and a critical component of the JBoss Enterprise Middleware System (JEMS) suite of products.

Tutorial

Intended for new users, this chapter provides an step-by-step introduction to Hibernate, starting with a simple application using an in-memory database. The tutorial is based on an earlier tutorial developed by Michael Gloegl. All code is contained in the `tutorials/web` directory of the project source.

Wichtig

This tutorial expects the user have knowledge of both Java and SQL. If you have a limited knowledge of JAVA or SQL, it is advised that you start with a good introduction to that technology prior to attempting to learn Hibernate.

Anmerkung

The distribution contains another example application under the `tutorial/eg` project source directory.

1.1. Teil 1 - Die erste Hibernate Anwendung

For this example, we will set up a small database application that can store events we want to attend and information about the host(s) of these events.

Anmerkung

Although you can use whatever database you feel comfortable using, we will use *HSQLDB* [http://hsqldb.org/] (an in-memory, Java database) to avoid describing installation/setup of any particular database servers.

1.1.1. Setup

The first thing we need to do is to set up the development environment. We will be using the "standard layout" advocated by alot of build tools such as *Maven* [http://maven.org]. Maven, in particular, has a good resource describing this *layout* [http://maven.apache.org/guides/introduction/introduction-to-the-standard-directory-layout.html]. As this tutorial is to be a web application, we will be creating and making use of `src/main/java`, `src/main/resources` and `src/main/webapp` directories.

We will be using Maven in this tutorial, taking advantage of its transitive dependency management capabilities as well as the ability of many IDEs to automatically set up a project for us based on the maven descriptor.

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
            xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/
maven-4.0.0.xsd">

    <modelVersion
>4.0.0</modelVersion>

    <groupId
>org.hibernate.tutorials</groupId>
    <artifactId
>hibernate-tutorial</artifactId>
    <version
>1.0.0-SNAPSHOT</version>
    <name
>First Hibernate Tutorial</name>

    <build>
         <!-- we dont want the version to be part of the generated war file name -->
         <finalName
>${artifactId}</finalName>
    </build>

    <dependencies>
        <dependency>
            <groupId
>org.hibernate</groupId>
            <artifactId
>hibernate-core</artifactId>
        </dependency>

        <!-- Because this is a web app, we also have a dependency on the servlet api. -->
        <dependency>
            <groupId
>javax.servlet</groupId>
            <artifactId
>servlet-api</artifactId>
        </dependency>

        <!-- Hibernate uses slf4j for logging, for our purposes here use the simple backend -->
        <dependency>
            <groupId
>org.slf4j</groupId>
            <artifactId
>slf4j-simple</artifactId>
        </dependency>

        <!-- Hibernate gives you a choice of bytecode providers between cglib and javassist -->
        <dependency>
            <groupId
>javassist</groupId>
            <artifactId
>javassist</artifactId>
        </dependency>
    </dependencies>

</project
```

```
>
```

Tipp

It is not a requirement to use Maven. If you wish to use something else to build this tutorial (such as Ant), the layout will remain the same. The only change is that you will need to manually account for all the needed dependencies. If you use something like *Ivy* [http://ant.apache.org/ivy/] providing transitive dependency management you would still use the dependencies mentioned below. Otherwise, you'd need to grab *all* dependencies, both explicit and transitive, and add them to the project's classpath. If working from the Hibernate distribution bundle, this would mean `hibernate3.jar`, all artifacts in the `lib/required` directory and all files from either the `lib/bytecode/cglib` or `lib/bytecode/javassist` directory; additionally you will need both the servlet-api jar and one of the slf4j logging backends.

Save this file as `pom.xml` in the project root directory.

1.1.2. Die erste Klasse

Next, we create a class that represents the event we want to store in the database; it is a simple JavaBean class with some properties:

```
package org.hibernate.tutorial.domain;

import java.util.Date;

public class Event {
    private Long id;

    private String title;
    private Date date;

    public Event() {}

    public Long getId() {
        return id;
    }

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

    public Date getDate() {
        return date;
    }

    public void setDate(Date date) {
        this.date = date;
```

```
    }

    public String getTitle() {
        return title;
    }

    public void setTitle(String title) {
        this.title = title;
    }
}
```

This class uses standard JavaBean naming conventions for property getter and setter methods, as well as private visibility for the fields. Although this is the recommended design, it is not required. Hibernate can also access fields directly, the benefit of accessor methods is robustness for refactoring.

The `id` property holds a unique identifier value for a particular event. All persistent entity classes (there are less important dependent classes as well) will need such an identifier property if we want to use the full feature set of Hibernate. In fact, most applications, especially web applications, need to distinguish objects by identifier, so you should consider this a feature rather than a limitation. However, we usually do not manipulate the identity of an object, hence the setter method should be private. Only Hibernate will assign identifiers when an object is saved. Hibernate can access public, private, and protected accessor methods, as well as public, private and protected fields directly. The choice is up to you and you can match it to fit your application design.

The no-argument constructor is a requirement for all persistent classes; Hibernate has to create objects for you, using Java Reflection. The constructor can be private, however package or public visibility is required for runtime proxy generation and efficient data retrieval without bytecode instrumentation.

Save this file to the `src/main/java/org/hibernate/tutorial/domain` directory.

1.1.3. Die Mapping-Datei

Hibernate muss darüber informiert werden, wie Objekte der persistenten Klasse geladen und gespeichert werden sollen. Hier wird die "Mapping"-Datei von Hibernate benötigt. Diese Datei informiert Hibernate darüber, auf welche Tabelle in der Datenbank zugegriffen werden soll und welche Spalten dieser Tabelle verwendet werden sollen.

Die Grundstruktur einer Mapping-Datei sieht wie folgt aus:

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC
        "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
        "http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">

<hibernate-mapping package="org.hibernate.tutorial.domain">
[...]
</hibernate-mapping
```

```
>
```

Hibernate DTD is sophisticated. You can use it for auto-completion of XML mapping elements and attributes in your editor or IDE. Opening up the DTD file in your text editor is the easiest way to get an overview of all elements and attributes, and to view the defaults, as well as some comments. Hibernate will not load the DTD file from the web, but first look it up from the classpath of the application. The DTD file is included in `hibernate-core.jar` (it is also included in the `hibernate3.jar`, if using the distribution bundle).

Wichtig

We will omit the DTD declaration in future examples to shorten the code. It is, of course, not optional.

Between the two `hibernate-mapping` tags, include a `class` element. All persistent entity classes (again, there might be dependent classes later on, which are not first-class entities) need a mapping to a table in the SQL database:

```
<hibernate-mapping package="org.hibernate.tutorial.domain">

    <class name="Event" table="EVENTS">

    </class>

</hibernate-mapping
>
```

So far we have told Hibernate how to persist and load object of class `Event` to the table `EVENTS`. Each instance is now represented by a row in that table. Now we can continue by mapping the unique identifier property to the tables primary key. As we do not want to care about handling this identifier, we configure Hibernate's identifier generation strategy for a surrogate primary key column:

```
<hibernate-mapping package="org.hibernate.tutorial.domain">

    <class name="Event" table="EVENTS">
        <id name="id" column="EVENT_ID">
            <generator class="native"/>
        </id>
    </class>

</hibernate-mapping
>
```

The `id` element is the declaration of the identifier property. The `name="id"` mapping attribute declares the name of the JavaBean property and tells Hibernate to use the `getId()` and `setId()` methods to access the property. The column attribute tells Hibernate which column of the `EVENTS` table holds the primary key value.

The nested `generator` element specifies the identifier generation strategy (aka how are identifier values generated?). In this case we choose `native`, which offers a level of portability depending on the configured database dialect. Hibernate supports database generated, globally unique, as well as application assigned, identifiers. Identifier value generation is also one of Hibernate's many extension points and you can plugin in your own strategy.

Tipp

`native` is no longer consider the best strategy in terms of portability. for further discussion, see *Abschnitt 26.4, „Identifier generation“*

Lastly, we need to tell Hibernate about the remaining entity class properties. By default, no properties of the class are considered persistent:

```
<hibernate-mapping package="org.hibernate.tutorial.domain">

    <class name="Event" table="EVENTS">
        <id name="id" column="EVENT_ID">
            <generator class="native"/>
        </id>
        <property name="date" type="timestamp" column="EVENT_DATE"/>
        <property name="title"/>
    </class>

</hibernate-mapping
>
```

Similar to the `id` element, the `name` attribute of the `property` element tells Hibernate which getter and setter methods to use. In this case, Hibernate will search for `getDate()`, `setDate()`, `getTitle()` and `setTitle()` methods.

Anmerkung

Why does the `date` property mapping include the `column` attribute, but the `title` does not? Without the `column` attribute, Hibernate by default uses the property name as the column name. This works for `title`, however, `date` is a reserved keyword in most databases so you will need to map it to a different name.

The `title` mapping also lacks a `type` attribute. The types declared and used in the mapping files are not Java data types; they are not SQL database types either. These types are called *Hibernate mapping types*, converters which can translate from Java to SQL data types and vice versa. Again, Hibernate will try to determine the correct conversion and mapping type itself if the `type` attribute is not present in the mapping. In some cases this automatic detection using Reflection on the Java class might not have the default you expect or need. This is the case with the `date` property. Hibernate cannot know if the property, which is of `java.util.Date`, should map to a SQL `date`, `timestamp`, or `time` column. Full date and time information is preserved by mapping the property with a `timestamp` converter.

Tipp

Hibernate makes this mapping type determination using reflection when the mapping files are processed. This can take time and resources, so if startup performance is important you should consider explicitly defining the type to use.

Save this mapping file as `src/main/resources/org/hibernate/tutorial/domain/Event.hbm.xml`.

1.1.4. Die Konfiguration von Hibernate

At this point, you should have the persistent class and its mapping file in place. It is now time to configure Hibernate. First let's set up HSQLDB to run in "server mode"

Anmerkung

We do this do that the data remains between runs.

We will utilize the Maven exec plugin to launch the HSQLDB server by running: `mvn exec:java -Dexec.mainClass="org.hsqldb.Server" -Dexec.args="-database.0 file:target/data/tutorial"` You will see it start up and bind to a TCP/IP socket; this is where our application will connect later. If you want to start with a fresh database during this tutorial, shutdown HSQLDB, delete all files in the `target/data` directory, and start HSQLDB again.

Hibernate will be connecting to the database on behalf of your application, so it needs to know how to obtain connections. For this tutorial we will be using a standalone connection pool (as opposed to a `javax.sql.DataSource`). Hibernate comes with support for two third-party open source JDBC connection pools: *c3p0* [https://sourceforge.net/projects/c3p0] and *proxool* [http://proxool.sourceforge.net/]. However, we will be using the Hibernate built-in connection pool for this tutorial.

Achtung

The built-in Hibernate connection pool is in no way intended for production use. It lacks several features found on any decent connection pool.

For Hibernate's configuration, we can use a simple `hibernate.properties` file, a more sophisticated `hibernate.cfg.xml` file, or even complete programmatic setup. Most users prefer the XML configuration file:

```
<?xml version='1.0' encoding='utf-8'?>
<!DOCTYPE hibernate-configuration PUBLIC
        "-//Hibernate/Hibernate Configuration DTD 3.0//EN"
        "http://hibernate.sourceforge.net/hibernate-configuration-3.0.dtd">

<hibernate-configuration>

    <session-factory>

        <!-- Database connection settings -->
        <property name="connection.driver_class"
>org.hsqldb.jdbcDriver</property>
        <property name="connection.url"
>jdbc:hsqldb:hsql://localhost</property>
        <property name="connection.username"
>sa</property>
        <property name="connection.password"
></property>

        <!-- JDBC connection pool (use the built-in) -->
        <property name="connection.pool_size"
>1</property>

        <!-- SQL dialect -->
        <property name="dialect"
>org.hibernate.dialect.HSQLDialect</property>

        <!-- Enable Hibernate's automatic session context management -->
        <property name="current_session_context_class"
>thread</property>

        <!-- Disable the second-level cache  -->
        <property name="cache.provider_class"
>org.hibernate.cache.NoCacheProvider</property>

        <!-- Echo all executed SQL to stdout -->
        <property name="show_sql"
>true</property>

        <!-- Drop and re-create the database schema on startup -->
        <property name="hbm2ddl.auto"
>update</property>

        <mapping resource="org/hibernate/tutorial/domain/Event.hbm.xml"/>
```

```
    </session-factory>

</hibernate-configuration
>
```

Anmerkung

Notice that this configuration file specifies a different DTD

You configure Hibernate's `SessionFactory`. SessionFactory is a global factory responsible for a particular database. If you have several databases, for easier startup you should use several `<session-factory>` configurations in several configuration files.

The first four `property` elements contain the necessary configuration for the JDBC connection. The dialect `property` element specifies the particular SQL variant Hibernate generates.

Tipp

In most cases, Hibernate is able to properly determine which dialect to use. See *Abschnitt 26.3, „Dialect resolution“* for more information.

Hibernate's automatic session management for persistence contexts is particularly useful in this context. The `hbm2ddl.auto` option turns on automatic generation of database schemas directly into the database. This can also be turned off by removing the configuration option, or redirected to a file with the help of the `SchemaExport` Ant task. Finally, add the mapping file(s) for persistent classes to the configuration.

Save this file as `hibernate.cfg.xml` into the `src/main/resources` directory.

1.1.5. Building with Maven

We will now build the tutorial with Maven. You will need to have Maven installed; it is available from the *Maven download page* [http://maven.apache.org/download.html]. Maven will read the `/pom.xml` file we created earlier and know how to perform some basic project tasks. First, lets run the `compile` goal to make sure we can compile everything so far:

```
[hibernateTutorial]$ mvn compile
[INFO] Scanning for projects...
[INFO] ------------------------------------------------------------------------
[INFO] Building First Hibernate Tutorial
[INFO]    task-segment: [compile]
[INFO] ------------------------------------------------------------------------
[INFO] [resources:resources]
[INFO] Using default encoding to copy filtered resources.
[INFO] [compiler:compile]
```

```
[INFO] Compiling 1 source file to /home/steve/projects/sandbox/hibernateTutorial/target/classes
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESSFUL
[INFO] ------------------------------------------------------------------------
[INFO] Total time: 2 seconds
[INFO] Finished at: Tue Jun 09 12:25:25 CDT 2009
[INFO] Final Memory: 5M/547M
[INFO] ------------------------------------------------------------------------
```

1.1.6. Inbetriebnahme und Helfer

It is time to load and store some `Event` objects, but first you have to complete the setup with some infrastructure code. You have to startup Hibernate by building a global `org.hibernate.SessionFactory` object and storing it somewhere for easy access in application code. A `org.hibernate.SessionFactory` is used to obtain `org.hibernate.Session` instances. A `org.hibernate.Session` represents a single-threaded unit of work. The `org.hibernate.SessionFactory` is a thread-safe global object that is instantiated once.

We will create a `HibernateUtil` helper class that takes care of startup and makes accessing the `org.hibernate.SessionFactory` more convenient.

```
package org.hibernate.tutorial.util;

import org.hibernate.SessionFactory;
import org.hibernate.cfg.Configuration;

public class HibernateUtil {

    private static final SessionFactory sessionFactory = buildSessionFactory();

    private static SessionFactory buildSessionFactory() {
        try {
            // Create the SessionFactory from hibernate.cfg.xml
            return new Configuration().configure().buildSessionFactory();
        }
        catch (Throwable ex) {
            // Make sure you log the exception, as it might be swallowed
            System.err.println("Initial SessionFactory creation failed." + ex);
            throw new ExceptionInInitializerError(ex);
        }
    }

    public static SessionFactory getSessionFactory() {
        return sessionFactory;
    }

}
```

Save this code as `src/main/java/org/hibernate/tutorial/util/HibernateUtil.java`

This class not only produces the global `org.hibernate.SessionFactory` reference in its static initializer; it also hides the fact that it uses a static singleton. We might just as well have looked up

the `org.hibernate.SessionFactory` reference from JNDI in an application server or any other location for that matter.

If you give the `org.hibernate.SessionFactory` a name in your configuration, Hibernate will try to bind it to JNDI under that name after it has been built. Another, better option is to use a JMX deployment and let the JMX-capable container instantiate and bind a `HibernateService` to JNDI. Such advanced options are discussed later.

You now need to configure a logging system. Hibernate uses commons logging and provides two choices: Log4j and JDK 1.4 logging. Most developers prefer Log4j: copy `log4j.properties` from the Hibernate distribution in the `etc/` directory to your `src` directory, next to `hibernate.cfg.xml`. If you prefer to have more verbose output than that provided in the example configuration, you can change the settings. By default, only the Hibernate startup message is shown on stdout.

The tutorial infrastructure is complete and you are now ready to do some real work with Hibernate.

1.1.7. Das Laden und Speichern von Objekten

We are now ready to start doing some real work with Hibernate. Let's start by writing an `EventManager` class with a `main()` method:

```
package org.hibernate.tutorial;

import org.hibernate.Session;

import java.util.*;

import org.hibernate.tutorial.domain.Event;
import org.hibernate.tutorial.util.HibernateUtil;

public class EventManager {

    public static void main(String[] args) {
        EventManager mgr = new EventManager();

        if (args[0].equals("store")) {
            mgr.createAndStoreEvent("My Event", new Date());
        }

        HibernateUtil.getSessionFactory().close();
    }

    private void createAndStoreEvent(String title, Date theDate) {
        Session session = HibernateUtil.getSessionFactory().getCurrentSession();
        session.beginTransaction();

        Event theEvent = new Event();
        theEvent.setTitle(title);
        theEvent.setDate(theDate);
        session.save(theEvent);

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

```
}
```

In `createAndStoreEvent()` we created a new `Event` object and handed it over to Hibernate. At that point, Hibernate takes care of the SQL and executes an `INSERT` on the database.

A org.hibernate.Session is designed to represent a single unit of work (a single atomic piece of work to be performed). For now we will keep things simple and assume a one-to-one granularity between a Hibernate org.hibernate.Session and a database transaction. To shield our code from the actual underlying transaction system we use the Hibernate `org.hibernate.Transaction` API. In this particular case we are using JDBC-based transactional semantics, but it could also run with JTA.

What does `sessionFactory.getCurrentSession()` do? First, you can call it as many times and anywhere you like once you get hold of your `org.hibernate.SessionFactory`. The `getCurrentSession()` method always returns the "current" unit of work. Remember that we switched the configuration option for this mechanism to "thread" in our `src/main/resources/hibernate.cfg.xml`? Due to that setting, the context of a current unit of work is bound to the current Java thread that executes the application.

Wichtig

Hibernate offers three methods of current session tracking. The "thread" based method is not intended for production use; it is merely useful for prototyping and tutorials such as this one. Current session tracking is discussed in more detail later on.

A org.hibernate.Session begins when the first call to `getCurrentSession()` is made for the current thread. It is then bound by Hibernate to the current thread. When the transaction ends, either through commit or rollback, Hibernate automatically unbinds the org.hibernate.Session from the thread and closes it for you. If you call `getCurrentSession()` again, you get a new org.hibernate.Session and can start a new unit of work.

Related to the unit of work scope, should the Hibernate org.hibernate.Session be used to execute one or several database operations? The above example uses one org.hibernate.Session for one operation. However this is pure coincidence; the example is just not complex enough to show any other approach. The scope of a Hibernate org.hibernate.Session is flexible but you should never design your application to use a new Hibernate org.hibernate.Session for *every* database operation. Even though it is used in the following examples, consider *session-per-operation* an anti-pattern. A real web application is shown later in the tutorial which will help illustrate this.

See *Kapitel 12, Transactions and Concurrency* for more information about transaction handling and demarcation. The previous example also skipped any error handling and rollback.

To run this, we will make use of the Maven exec plugin to call our class with the necessary classpath setup: `mvn exec:java -Dexec.mainClass="org.hibernate.tutorial.EventManager" -Dexec.args="store"`

Anmerkung

You may need to perform `mvn compile` first.

You should see Hibernate starting up and, depending on your configuration, lots of log output. Towards the end, the following line will be displayed:

```
[java] Hibernate: insert into EVENTS (EVENT_DATE, title, EVENT_ID) values (?, ?, ?)
```

This is the `INSERT` executed by Hibernate.

To list stored events an option is added to the main method:

```
        if (args[0].equals("store")) {
            mgr.createAndStoreEvent("My Event", new Date());
        }
        else if (args[0].equals("list")) {
            List events = mgr.listEvents();
            for (int i = 0; i < events.size(); i++) {
                Event theEvent = (Event) events.get(i);
                System.out.println(
                        "Event: " + theEvent.getTitle() + " Time: " + theEvent.getDate()
                );
            }
        }
```

A new `listEvents() method is also added`:

```
    private List listEvents() {
        Session session = HibernateUtil.getSessionFactory().getCurrentSession();
        session.beginTransaction();
        List result = session.createQuery("from Event").list();
        session.getTransaction().commit();
        return result;
    }
```

Here, we are using a Hibernate Query Language (HQL) query to load all existing `Event` objects from the database. Hibernate will generate the appropriate SQL, send it to the database and populate `Event` objects with the data. You can create more complex queries with HQL. See *Kapitel 15, HQL: Die "Hibernate Query Language"* for more information.

Now we can call our new functionality, again using the Maven exec plugin: `mvn exec:java -Dexec.mainClass="org.hibernate.tutorial.EventManager" -Dexec.args="list"`

1.2. Teil 2 - Mapping-Assoziationen

So far we have mapped a single persistent entity class to a table in isolation. Let's expand on that a bit and add some class associations. We will add people to the application and store a list of events in which they participate.

1.2.1. Das Mappen der Personenklasse

The first cut of the `Person` class looks like this:

```
package org.hibernate.tutorial.domain;

public class Person {

    private Long id;
    private int age;
    private String firstname;
    private String lastname;

    public Person() {}

    // Accessor methods for all properties, private setter for 'id'

}
```

Save this to a file named `src/main/java/org/hibernate/tutorial/domain/Person.java`

Next, create the new mapping file as `src/main/resources/org/hibernate/tutorial/domain/Person.hbm.xml`

```
<hibernate-mapping package="org.hibernate.tutorial.domain">

    <class name="Person" table="PERSON">
        <id name="id" column="PERSON_ID">
            <generator class="native"/>
        </id>
        <property name="age"/>
        <property name="firstname"/>
        <property name="lastname"/>
    </class>

</hibernate-mapping
>
```

Anschließend fügen Sie dann das neue Mapping der Konfiguration von Hibernate hinzu:

```
<mapping resource="events/Event.hbm.xml"/>
<mapping resource="events/Person.hbm.xml"/>
```

Create an association between these two entities. Persons can participate in events, and events have participants. The design questions you have to deal with are: directionality, multiplicity, and collection behavior.

1.2.2. Eine unidirektionale "Set"-basierte Assoziation

By adding a collection of events to the `Person` class, you can easily navigate to the events for a particular person, without executing an explicit query - by calling `Person#getEvents`. Multi-valued associations are represented in Hibernate by one of the Java Collection Framework contracts; here we choose a `java.util.Set` because the collection will not contain duplicate elements and the ordering is not relevant to our examples:

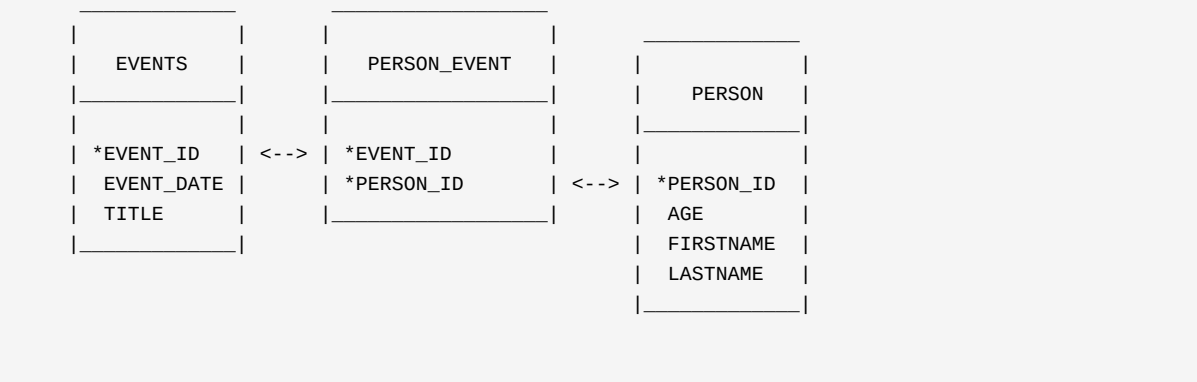
```
public class Person {

    private Set events = new HashSet();

    public Set getEvents() {
        return events;
    }

    public void setEvents(Set events) {
        this.events = events;
    }
}
```

Before mapping this association, let's consider the other side. We could just keep this unidirectional or create another collection on the `Event`, if we wanted to be able to navigate it from both directions. This is not necessary, from a functional perspective. You can always execute an explicit query to retrieve the participants for a particular event. This is a design choice left to you, but what is clear from this discussion is the multiplicity of the association: "many" valued on both sides is called a *many-to-many* association. Hence, we use Hibernate's many-to-many mapping:

```
<class name="Person" table="PERSON">
    <id name="id" column="PERSON_ID">
        <generator class="native"/>
    </id>
    <property name="age"/>
    <property name="firstname"/>
    <property name="lastname"/>

    <set name="events" table="PERSON_EVENT">
        <key column="PERSON_ID"/>
        <many-to-many column="EVENT_ID" class="Event"/>
    </set>

</class
>
```

Hibernate supports a broad range of collection mappings, a `set` being most common. For a many-to-many association, or *n:m* entity relationship, an association table is required. Each row in this table represents a link between a person and an event. The table name is decalred using the `table` attribute of the `set` element. The identifier column name in the association, for the person side, is defined with the `key` element, the column name for the event's side with the `column` attribute of the `many-to-many`. You also have to tell Hibernate the class of the objects in your collection (the class on the other side of the collection of references).

Das Datenbankschema für dieses Mapping lautet daher:



1.2.3. Das Bearbeiten der Assoziation

Now we will bring some people and events together in a new method in `EventManager`:

```
private void addPersonToEvent(Long personId, Long eventId) {
    Session session = HibernateUtil.getSessionFactory().getCurrentSession();
    session.beginTransaction();

    Person aPerson = (Person) session.load(Person.class, personId);
    Event anEvent = (Event) session.load(Event.class, eventId);
    aPerson.getEvents().add(anEvent);

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

After loading a `Person` and an `Event`, simply modify the collection using the normal collection methods. There is no explicit call to `update()` or `save()`; Hibernate automatically detects that the collection has been modified and needs to be updated. This is called *automatic dirty checking*. You can also try it by modifying the name or the date property of any of your objects. As long as they are in *persistent* state, that is, bound to a particular Hibernate `org.hibernate.Session`, Hibernate monitors any changes and executes SQL in a write-behind fashion. The process of synchronizing the memory state with the database, usually only at the end of a unit of work, is called *flushing*. In our code, the unit of work ends with a commit, or rollback, of the database transaction.

You can load person and event in different units of work. Or you can modify an object outside of a `org.hibernate.Session`, when it is not in persistent state (if it was persistent before, this state is called *detached*). You can even modify a collection when it is detached:

```
    private void addPersonToEvent(Long personId, Long eventId) {
        Session session = HibernateUtil.getSessionFactory().getCurrentSession();
        session.beginTransaction();

        Person aPerson = (Person) session
               .createQuery("select p from Person p left join fetch p.events where p.id = :pid")
                .setParameter("pid", personId)
                .uniqueResult(); // Eager fetch the collection so we can use it detached
        Event anEvent = (Event) session.load(Event.class, eventId);

        session.getTransaction().commit();

        // End of first unit of work

        aPerson.getEvents().add(anEvent); // aPerson (and its collection) is detached

        // Begin second unit of work

        Session session2 = HibernateUtil.getSessionFactory().getCurrentSession();
        session2.beginTransaction();
        session2.update(aPerson); // Reattachment of aPerson

        session2.getTransaction().commit();
    }
```

The call to `update` makes a detached object persistent again by binding it to a new unit of work, so any modifications you made to it while detached can be saved to the database. This includes any modifications (additions/deletions) you made to a collection of that entity object.

This is not much use in our example, but it is an important concept you can incorporate into your own application. Complete this exercise by adding a new action to the main method of the `EventManager` and call it from the command line. If you need the identifiers of a person and an event - the `save()` method returns it (you might have to modify some of the previous methods to return that identifier):

```
        else if (args[0].equals("addpersontoevent")) {
            Long eventId = mgr.createAndStoreEvent("My Event", new Date());
            Long personId = mgr.createAndStorePerson("Foo", "Bar");
            mgr.addPersonToEvent(personId, eventId);
            System.out.println("Added person " + personId + " to event " + eventId);
        }
```

This is an example of an association between two equally important classes : two entities. As mentioned earlier, there are other classes and types in a typical model, usually "less important". Some you have already seen, like an `int` or a `java.lang.String`. We call these classes *value types*, and their instances *depend* on a particular entity. Instances of these types do not have

their own identity, nor are they shared between entities. Two persons do not reference the same `firstname` object, even if they have the same first name. Value types cannot only be found in the JDK , but you can also write dependent classes yourself such as an `Address` or `MonetaryAmount` class. In fact, in a Hibernate application all JDK classes are considered value types.

You can also design a collection of value types. This is conceptually different from a collection of references to other entities, but looks almost the same in Java.

1.2.4. Collection von Werten

Let's add a collection of email addresses to the `Person` entity. This will be represented as a `java.util.Set` of `java.lang.String` instances:

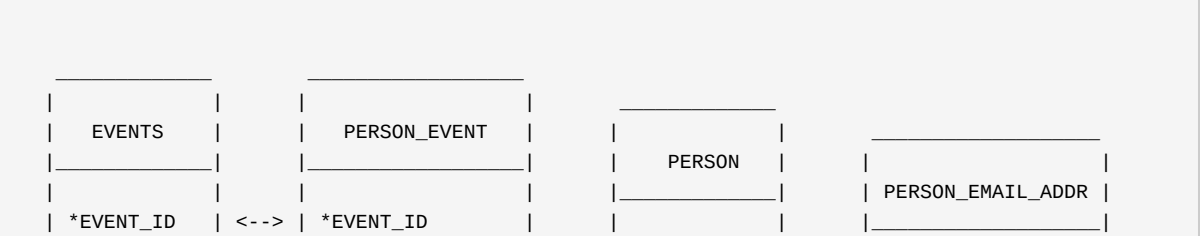
```
    private Set emailAddresses = new HashSet();

    public Set getEmailAddresses() {
        return emailAddresses;
    }

    public void setEmailAddresses(Set emailAddresses) {
        this.emailAddresses = emailAddresses;
    }
```

The mapping of this `Set` is as follows:

```
        <set name="emailAddresses" table="PERSON_EMAIL_ADDR">
            <key column="PERSON_ID"/>
            <element type="string" column="EMAIL_ADDR"/>
        </set
>
```

The difference compared with the earlier mapping is the use of the `element` part which tells Hibernate that the collection does not contain references to another entity, but is rather a collection whose elements are values types, here specifically of type `string`. The lowercase name tells you it is a Hibernate mapping type/converter. Again the `table` attribute of the `set` element determines the table name for the collection. The `key` element defines the foreign-key column name in the collection table. The `column` attribute in the `element` element defines the column name where the email address values will actually be stored.

Here is the updated schema:



```
|  EVENT_DATE |      | *PERSON_ID       | <--> | *PERSON_ID  | <--> |  *PERSON_ID       |
|  TITLE      |      |__________________|      |  AGE        |      |  *EMAIL_ADDR      |
|_____________|                                |  FIRSTNAME  |      |___________________|
                                               |  LASTNAME   |
                                               |_____________|
```

You can see that the primary key of the collection table is in fact a composite key that uses both columns. This also implies that there cannot be duplicate email addresses per person, which is exactly the semantics we need for a set in Java.

You can now try to add elements to this collection, just like we did before by linking persons and events. It is the same code in Java:

```
    private void addEmailToPerson(Long personId, String emailAddress) {
        Session session = HibernateUtil.getSessionFactory().getCurrentSession();
        session.beginTransaction();

        Person aPerson = (Person) session.load(Person.class, personId);
        // adding to the emailAddress collection might trigger a lazy load of the collection
        aPerson.getEmailAddresses().add(emailAddress);

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

This time we did not use a *fetch* query to initialize the collection. Monitor the SQL log and try to optimize this with an eager fetch.

1.2.5. Bidirektionale Assoziationen

Next you will map a bi-directional association. You will make the association between person and event work from both sides in Java. The database schema does not change, so you will still have many-to-many multiplicity.

Anmerkung

A relational database is more flexible than a network programming language, in that it does not need a navigation direction; data can be viewed and retrieved in any possible way.

First, add a collection of participants to the `Event` class:

```
    private Set participants = new HashSet();

    public Set getParticipants() {
        return participants;
    }
```

```
    public void setParticipants(Set participants) {
        this.participants = participants;
    }
```

Now map this side of the association in `Event.hbm.xml`.

```
        <set name="participants" table="PERSON_EVENT" inverse="true">
            <key column="EVENT_ID"/>
            <many-to-many column="PERSON_ID" class="events.Person"/>
        </set
>
```

These are normal `set` mappings in both mapping documents. Notice that the column names in `key` and `many-to-many` swap in both mapping documents. The most important addition here is the `inverse="true"` attribute in the `set` element of the `Event`'s collection mapping.

What this means is that Hibernate should take the other side, the `Person` class, when it needs to find out information about the link between the two. This will be a lot easier to understand once you see how the bi-directional link between our two entities is created.

1.2.6. Die Bearbeitung bidirektionaler Verbindungen

First, keep in mind that Hibernate does not affect normal Java semantics. How did we create a link between a `Person` and an `Event` in the unidirectional example? You add an instance of `Event` to the collection of event references, of an instance of `Person`. If you want to make this link bi-directional, you have to do the same on the other side by adding a `Person` reference to the collection in an `Event`. This process of "setting the link on both sides" is absolutely necessary with bi-directional links.

Many developers program defensively and create link management methods to correctly set both sides (for example, in `Person`):

```
    protected Set getEvents() {
        return events;
    }

    protected void setEvents(Set events) {
        this.events = events;
    }

    public void addToEvent(Event event) {
        this.getEvents().add(event);
        event.getParticipants().add(this);
    }

    public void removeFromEvent(Event event) {
        this.getEvents().remove(event);
        event.getParticipants().remove(this);
    }
```

The get and set methods for the collection are now protected. This allows classes in the same package and subclasses to still access the methods, but prevents everybody else from altering the collections directly. Repeat the steps for the collection on the other side.

What about the `inverse` mapping attribute? For you, and for Java, a bi-directional link is simply a matter of setting the references on both sides correctly. Hibernate, however, does not have enough information to correctly arrange SQL `INSERT` and `UPDATE` statements (to avoid constraint violations). Making one side of the association `inverse` tells Hibernate to consider it a *mirror* of the other side. That is all that is necessary for Hibernate to resolve any issues that arise when transforming a directional navigation model to a SQL database schema. The rules are straightforward: all bi-directional associations need one side as `inverse`. In a one-to-many association it has to be the many-side, and in many-to-many association you can select either side.

1.3. Teil 3 - Die EventManager-Webanwendung

A Hibernate web application uses `Session` and `Transaction` almost like a standalone application. However, some common patterns are useful. You can now write an `EventManagerServlet`. This servlet can list all events stored in the database, and it provides an HTML form to enter new events.

1.3.1. Das Schreiben des Grundservlets

First we need create our basic processing servlet. Since our servlet only handles HTTP `GET` requests, we will only implement the `doGet()` method:

```
package org.hibernate.tutorial.web;

// Imports

public class EventManagerServlet extends HttpServlet {

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

        SimpleDateFormat dateFormatter = new SimpleDateFormat( "dd.MM.yyyy" );

        try {
            // Begin unit of work
            HibernateUtil.getSessionFactory().getCurrentSession().beginTransaction();

            // Process request and render page...

            // End unit of work
            HibernateUtil.getSessionFactory().getCurrentSession().getTransaction().commit();
        }
        catch (Exception ex) {
            HibernateUtil.getSessionFactory().getCurrentSession().getTransaction().rollback();
            if ( ServletException.class.isInstance( ex ) ) {
                throw ( ServletException ) ex;
            }
            else {
                throw new ServletException( ex );
```

```
            }
        }
    }

}
```

Save this servlet as `src/main/java/org/hibernate/tutorial/web/EventManagerServlet.java`

The pattern applied here is called *session-per-request*. When a request hits the servlet, a new Hibernate `Session` is opened through the first call to `getCurrentSession()` on the `SessionFactory`. A database transaction is then started. All data access occurs inside a transaction irrespective of whether the data is read or written. Do not use the auto-commit mode in applications.

Verwenden Sie *keine* neue Hibernate `Session` für jeden Datenbankvorgang. Verwenden Sie eine Hibernate `Session`, die die gesamte Anfrage umfasst. Verwenden Sie `getCurrentSession()`, damit diese automatisch an den aktuellen Java-Thread gebunden wird.

Next, the possible actions of the request are processed and the response HTML is rendered. We will get to that part soon.

Finally, the unit of work ends when processing and rendering are complete. If any problems occurred during processing or rendering, an exception will be thrown and the database transaction rolled back. This completes the `session-per-request` pattern. Instead of the transaction demarcation code in every servlet, you could also write a servlet filter. See the Hibernate website and Wiki for more information about this pattern called *Open Session in View*. You will need it as soon as you consider rendering your view in JSP, not in a servlet.

1.3.2. Bearbeitung und Rendering

Now you can implement the processing of the request and the rendering of the page.

```
        // Write HTML header
        PrintWriter out = response.getWriter();
        out.println("<html
><head
><title
>Event Manager</title
></head
><body
>");

        // Handle actions
        if ( "store".equals(request.getParameter("action")) ) {

            String eventTitle = request.getParameter("eventTitle");
            String eventDate = request.getParameter("eventDate");

            if ( "".equals(eventTitle) || "".equals(eventDate) ) {
                out.println("<b
```

```
><i
>Please enter event title and date.</i
></b
>");
            }
            else {
                createAndStoreEvent(eventTitle, dateFormatter.parse(eventDate));
                out.println("<b
><i
>Added event.</i
></b
>");
            }
        }

        // Print page
       printEventForm(out);
       listEvents(out, dateFormatter);

       // Write HTML footer
       out.println("</body
></html
>");
       out.flush();
       out.close();
```

This coding style, with a mix of Java and HTML, would not scale in a more complex application-keep in mind that we are only illustrating basic Hibernate concepts in this tutorial. The code prints an HTML header and a footer. Inside this page, an HTML form for event entry and a list of all events in the database are printed. The first method is trivial and only outputs HTML:

```
    private void printEventForm(PrintWriter out) {
        out.println("<h2
>Add new event:</h2
>");
        out.println("<form
>");
        out.println("Title: <input name='eventTitle' length='50'/><br/>");
        out.println("Date (e.g. 24.12.2009): <input name='eventDate' length='10'/><br/>");
        out.println("<input type='submit' name='action' value='store'/>");
        out.println("</form
>");
    }
```

Die `listEvents()` Methode verwendet die an den aktuellen Thread gebundene Hibernate `Session` bei der Ausführung einer Abfrage:

```
    private void listEvents(PrintWriter out, SimpleDateFormat dateFormatter) {

        List result = HibernateUtil.getSessionFactory()
                .getCurrentSession().createCriteria(Event.class).list();
        if (result.size()
```

```
> 0) {
            out.println("<h2
>Events in database:</h2
>");
            out.println("<table border='1'
>");
            out.println("<tr
>");
            out.println("<th
>Event title</th
>");
            out.println("<th
>Event date</th
>");
            out.println("</tr
>");
            Iterator it = result.iterator();
            while (it.hasNext()) {
                Event event = (Event) it.next();
                out.println("<tr
>");
                out.println("<td
>" + event.getTitle() + "</td
>");
                out.println("<td
>" + dateFormatter.format(event.getDate()) + "</td
>");
                out.println("</tr
>");
            }
            out.println("</table
>");
        }
    }
```

Zuletzt wird die `store`-Vorgang zur `createAndStoreEvent()`-Methode gesendet, die ebenfalls die `Session` des aktuellen Threads verwendet:

```
    protected void createAndStoreEvent(String title, Date theDate) {
        Event theEvent = new Event();
        theEvent.setTitle(title);
        theEvent.setDate(theDate);

        HibernateUtil.getSessionFactory()
                .getCurrentSession().save(theEvent);
    }
```

The servlet is now complete. A request to the servlet will be processed in a single `Session` and `Transaction`. As earlier in the standalone application, Hibernate can automatically bind these objects to the current thread of execution. This gives you the freedom to layer your code and access the `SessionFactory` in any way you like. Usually you would use a more sophisticated design and move the data access code into data access objects (the DAO pattern). See the Hibernate Wiki for more examples.

1.3.3. Deployment und Test

To deploy this application for testing we must create a Web ARchive (WAR). First we must define the WAR descriptor as `src/main/webapp/WEB-INF/web.xml`

```
<?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
>Event Manager</servlet-name>
        <servlet-class
>org.hibernate.tutorial.web.EventManagerServlet</servlet-class>
    </servlet>

    <servlet-mapping>
        <servlet-name
>Event Manager</servlet-name>
        <url-pattern
>/eventmanager</url-pattern>
    </servlet-mapping>
</web-app
>
```

To build and deploy call `mvn package` in your project directory and copy the `hibernate-tutorial.war` file into your Tomcat `webapps` directory.

Anmerkung

If you do not have Tomcat installed, download it from *http://tomcat.apache.org/* and follow the installation instructions. Our application requires no changes to the standard Tomcat configuration.

Wenn das Deployment erfolgt ist und Tomcat ausgeführt wird, greifen Sie mittels `http://localhost:8080/hibernate-tutorial/eventmanager` auf die Anwendung zu. Sehen Sie im Protokoll von Tomcat nach, ob Hibernate initialisiert wird, wenn die erste Anfrage bei Ihrem Servlet eingeht (das statische Initialisierungsprogramm in `HibernateUtil` wird aufgerufen), und prüfen Sie die detaillierte Ausgabe nach Ausnahmen.

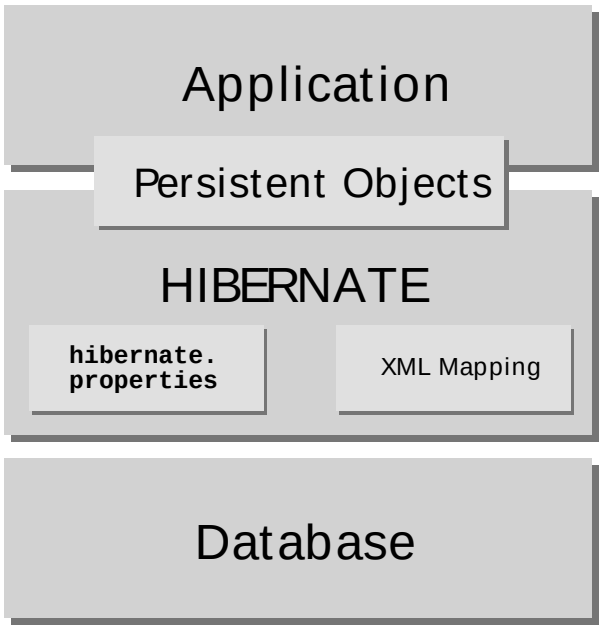
1.4. Zusammenfassung

This tutorial covered the basics of writing a simple standalone Hibernate application and a small web application. More tutorials are available from the Hibernate *website* [http://hibernate.org].

Architektur

2.1. Übersicht

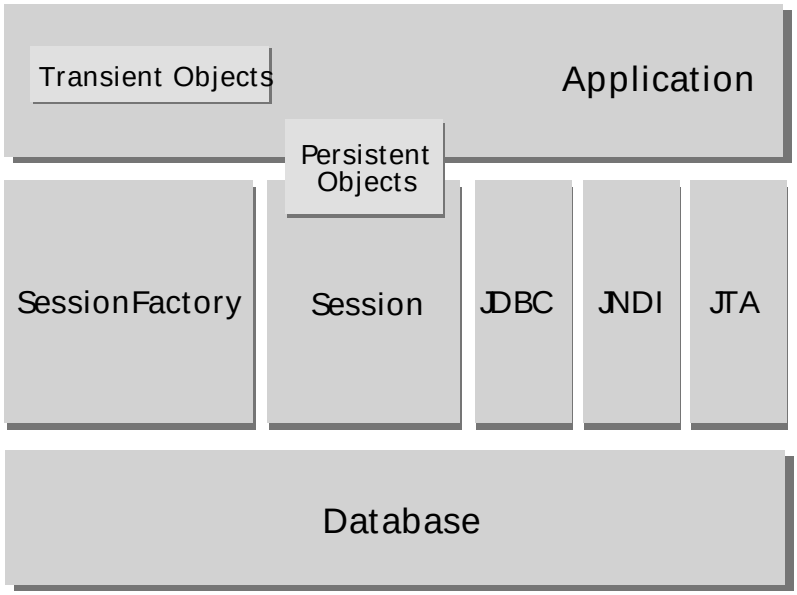
The diagram below provides a high-level view of the Hibernate architecture:



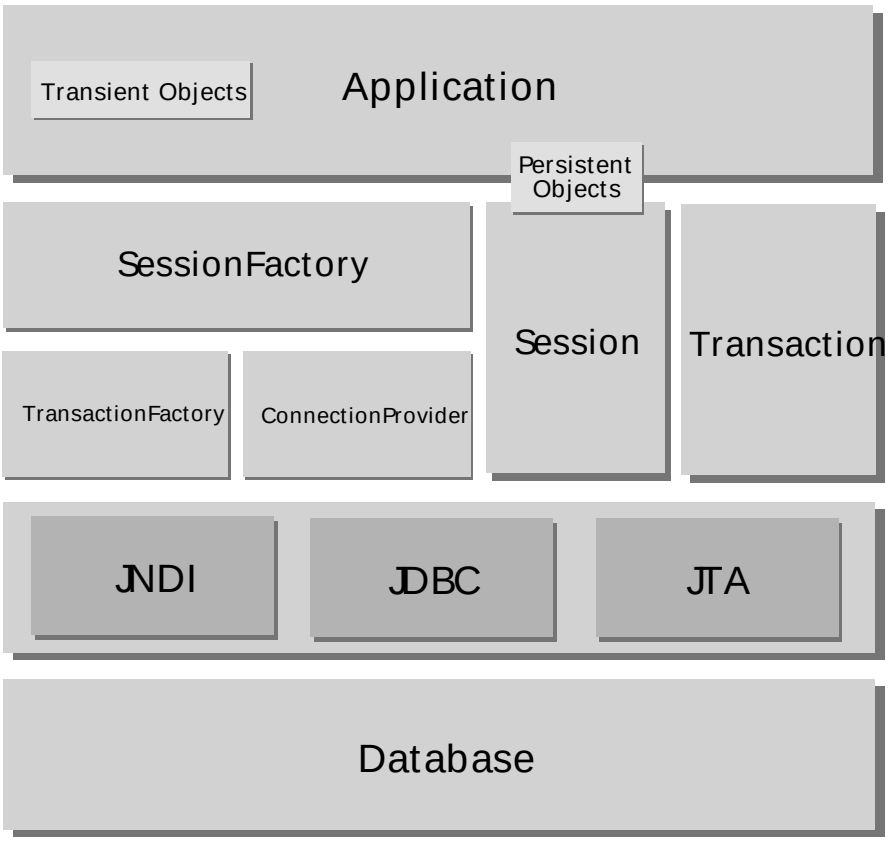
We do not have the scope in this document to provide a more detailed view of all the runtime architectures available; Hibernate is flexible and supports several different approaches. We will, however, show the two extremes: "minimal" architecture and "comprehensive" architecture.

This next diagram illustrates how Hibernate utilizes database and configuration data to provide persistence services, and persistent objects, to the application.

The "minimal" architecture has the application provide its own JDBC connections and manage its own transactions. This approach uses a minimal subset of Hibernate's APIs:



The "comprehensive" architecture abstracts the application away from the underlying JDBC/JTA APIs and allows Hibernate to manage the details.



Here are some definitions of the objects depicted in the diagrams:

SessionFactory (`org.hibernate.SessionFactory`)
: A threadsafe, immutable cache of compiled mappings for a single database. A factory for `Session` and a client of `ConnectionProvider`, `SessionFactory` can hold an optional (second-level) cache of data that is reusable between transactions at a process, or cluster, level.

Session (`org.hibernate.Session`)
: A single-threaded, short-lived object representing a conversation between the application and the persistent store. It wraps a JDBC connection and is a factory for `Transaction`. `Session` holds a mandatory first-level cache of persistent objects that are used when navigating the object graph or looking up objects by identifier.

Persistente Objekte und Collections
: Short-lived, single threaded objects containing persistent state and business function. These can be ordinary JavaBeans/POJOs. They are associated with exactly one `Session`. Once the `Session` is closed, they will be detached and free to use in any application layer (for example, directly as data transfer objects to and from presentation).

Temporäre und abgesetzte Objekte und Collections
: Instances of persistent classes that are not currently associated with a `Session`. They may have been instantiated by the application and not yet persisted, or they may have been instantiated by a closed `Session`.

Transaktion (`org.hibernate.Transaction`)
: (Optional) A single-threaded, short-lived object used by the application to specify atomic units of work. It abstracts the application from the underlying JDBC, JTA or CORBA transaction. A `Session` might span several `Transaction`s in some cases. However, transaction demarcation, either using the underlying API or `Transaction`, is never optional.

ConnectionProvider (`org.hibernate.connection.ConnectionProvider`)
: (Optional) A factory for, and pool of, JDBC connections. It abstracts the application from underlying `Datasource` or `DriverManager`. It is not exposed to application, but it can be extended and/or implemented by the developer.

TransactionFactory (`org.hibernate.TransactionFactory`)
: (Optional) A factory for `Transaction` instances. It is not exposed to the application, but it can be extended and/or implemented by the developer.

Extension Interfaces
: Hibernate offers a range of optional extension interfaces you can implement to customize the behavior of your persistence layer. See the API documentation for details.

Given a "minimal" architecture, the application bypasses the `Transaction`/`TransactionFactory` and/or `ConnectionProvider` APIs to communicate with JTA or JDBC directly.

2.2. Instanzstatus

An instance of a persistent class can be in one of three different states. These states are defined in relation to a *persistence context*. The Hibernate `Session` object is the persistence context. The three different states are as follows:

transient
: The instance is not associated with any persistence context. It has no persistent identity or primary key value.

persistent
: The instance is currently associated with a persistence context. It has a persistent identity (primary key value) and can have a corresponding row in the database. For a particular persistence context, Hibernate *guarantees* that persistent identity is equivalent to Java identity in relation to the in-memory location of the object.

detached ("abgesetzt")
: The instance was once associated with a persistence context, but that context was closed, or the instance was serialized to another process. It has a persistent identity and can have a corresponding row in the database. For detached instances, Hibernate does not guarantee the relationship between persistent identity and Java identity.

2.3. JMX-Integration

JMX is the J2EE standard for the management of Java components. Hibernate can be managed via a JMX standard service. AN MBean implementation is provided in the distribution: `org.hibernate.jmx.HibernateService`.

For an example of how to deploy Hibernate as a JMX service on the JBoss Application Server, please see the JBoss User Guide. JBoss AS also provides these benefits if you deploy using JMX:

- *Session Management*: the Hibernate `Session`'s life cycle can be automatically bound to the scope of a JTA transaction. This means that you no longer have to manually open and close the `Session`; this becomes the job of a JBoss EJB interceptor. You also do not have to worry about transaction demarcation in your code (if you would like to write a portable persistence layer use the optional Hibernate `Transaction` API for this). You call the `HibernateContext` to access a `Session`.
- *HAR deployment*: the Hibernate JMX service is deployed using a JBoss service deployment descriptor in an EAR and/or SAR file, as it supports all the usual configuration options of a Hibernate `SessionFactory`. However, you still need to name all your mapping files in the deployment descriptor. If you use the optional HAR deployment, JBoss will automatically detect all mapping files in your HAR file.

Weitere Informationen zu diesen Optionen finden Sie im JBoss AS Benutzerhandbuch.

Another feature available as a JMX service is runtime Hibernate statistics. See *Abschnitt 3.4.6, „Die Hibernate Statistik“* for more information.

2.4. JCA-Support

Hibernate can also be configured as a JCA connector. Please see the website for more information. Please note, however, that at this stage Hibernate JCA support is under development.

2.5. Contextual sessions

Most applications using Hibernate need some form of "contextual" session, where a given session is in effect throughout the scope of a given context. However, across applications the definition of what constitutes a context is typically different; different contexts define different scopes to the notion of current. Applications using Hibernate prior to version 3.0 tended to utilize either home-grown `ThreadLocal`-based contextual sessions, helper classes such as `HibernateUtil`, or utilized third-party frameworks, such as Spring or Pico, which provided proxy/interception-based contextual sessions.

Starting with version 3.0.1, Hibernate added the `SessionFactory.getCurrentSession()` method. Initially, this assumed usage of `JTA` transactions, where the `JTA` transaction defined both the scope and context of a current session. Given the maturity of the numerous stand-alone `JTA TransactionManager` implementations, most, if not all, applications should be using `JTA` transaction management, whether or not they are deployed into a `J2EE` container. Based on that, the `JTA`-based contextual sessions are all you need to use.

However, as of version 3.1, the processing behind `SessionFactory.getCurrentSession()` is now pluggable. To that end, a new extension interface, `org.hibernate.context.CurrentSessionContext`, and a new configuration parameter, `hibernate.current_session_context_class`, have been added to allow pluggability of the scope and context of defining current sessions.

See the Javadocs for the `org.hibernate.context.CurrentSessionContext` interface for a detailed discussion of its contract. It defines a single method, `currentSession()`, by which the implementation is responsible for tracking the current contextual session. Out-of-the-box, Hibernate comes with three implementations of this interface:

- `org.hibernate.context.JTASessionContext`: current sessions are tracked and scoped by a `JTA` transaction. The processing here is exactly the same as in the older JTA-only approach. See the Javadocs for details.
- `org.hibernate.context.ThreadLocalSessionContext`:current sessions are tracked by thread of execution. See the Javadocs for details.
- `org.hibernate.context.ManagedSessionContext`: current sessions are tracked by thread of execution. However, you are responsible to bind and unbind a `Session` instance with static methods on this class: it does not open, flush, or close a `Session`.

The first two implementations provide a "one session - one database transaction" programming model. This is also known and used as *session-per-request*. The beginning and end of a Hibernate session is defined by the duration of a database transaction. If you use programmatic transaction demarcation in plain JSE without JTA, you are advised to use the Hibernate `Transaction` API to hide the underlying transaction system from your code. If you use JTA, you can utilize the JTA interfaces to demarcate transactions. If you execute in an EJB container that supports CMT, transaction boundaries are defined declaratively and you do not need any transaction or session demarcation operations in your code. Refer to *Kapitel 12, Transactions and Concurrency* for more information and code examples.

The `hibernate.current_session_context_class` configuration parameter defines which `org.hibernate.context.CurrentSessionContext` implementation should be used. For backwards compatibility, if this configuration parameter is not set but a `org.hibernate.transaction.TransactionManagerLookup` is configured, Hibernate will use the `org.hibernate.context.JTASessionContext`. Typically, the value of this parameter would just name the implementation class to use. For the three out-of-the-box implementations, however, there are three corresponding short names: "jta", "thread", and "managed".

Konfiguration

Hibernate is designed to operate in many different environments and, as such, there is a broad range of configuration parameters. Fortunately, most have sensible default values and Hibernate is distributed with an example `hibernate.properties` file in `etc/` that displays the various options. Simply put the example file in your classpath and customize it to suit your needs.

3.1. Programmatische Konfiguration

An instance of `org.hibernate.cfg.Configuration` represents an entire set of mappings of an application's Java types to an SQL database. The `org.hibernate.cfg.Configuration` is used to build an immutable `org.hibernate.SessionFactory`. The mappings are compiled from various XML mapping files.

You can obtain a `org.hibernate.cfg.Configuration` instance by instantiating it directly and specifying XML mapping documents. If the mapping files are in the classpath, use `addResource()`. For example:

```
Configuration cfg = new Configuration()
    .addResource("Item.hbm.xml")
    .addResource("Bid.hbm.xml");
```

An alternative way is to specify the mapped class and allow Hibernate to find the mapping document for you:

```
Configuration cfg = new Configuration()
    .addClass(org.hibernate.auction.Item.class)
    .addClass(org.hibernate.auction.Bid.class);
```

Hibernate will then search for mapping files named `/org/hibernate/auction/Item.hbm.xml` and `/org/hibernate/auction/Bid.hbm.xml` in the classpath. This approach eliminates any hardcoded filenames.

A `org.hibernate.cfg.Configuration` also allows you to specify configuration properties. For example:

```
Configuration cfg = new Configuration()
    .addClass(org.hibernate.auction.Item.class)
    .addClass(org.hibernate.auction.Bid.class)
    .setProperty("hibernate.dialect", "org.hibernate.dialect.MySQLInnoDBDialect")
    .setProperty("hibernate.connection.datasource", "java:comp/env/jdbc/test")
    .setProperty("hibernate.order_updates", "true");
```

This is not the only way to pass configuration properties to Hibernate. Some alternative options include:

1. Pass an instance of `java.util.Properties` to `Configuration.setProperties()`.
2. Place a file named `hibernate.properties` in a root directory of the classpath.
3. Stellen Sie die `System`-Properties mittels `java -Dproperty=value` ein.
4. Include `<property>` elements in `hibernate.cfg.xml` (this is discussed later).

If you want to get started quickly`hibernate.properties` is the easiest approach.

The `org.hibernate.cfg.Configuration` is intended as a startup-time object that will be discarded once a `SessionFactory` is created.

3.2. Erstellung einer SessionFactory

When all mappings have been parsed by the `org.hibernate.cfg.Configuration`, the application must obtain a factory for `org.hibernate.Session` instances. This factory is intended to be shared by all application threads:

```
SessionFactory sessions = cfg.buildSessionFactory();
```

Hibernate does allow your application to instantiate more than one `org.hibernate.SessionFactory`. This is useful if you are using more than one database.

3.3. JDBC-Verbindungen

It is advisable to have the `org.hibernate.SessionFactory` create and pool JDBC connections for you. If you take this approach, opening a `org.hibernate.Session` is as simple as:

```
Session session = sessions.openSession(); // open a new Session
```

Once you start a task that requires access to the database, a JDBC connection will be obtained from the pool.

Before you can do this, you first need to pass some JDBC connection properties to Hibernate. All Hibernate property names and semantics are defined on the class `org.hibernate.cfg.Environment`. The most important settings for JDBC connection configuration are outlined below.

Hibernate will obtain and pool connections using `java.sql.DriverManager` if you set the following properties:

Tabelle 3.1. Hibernate JDBC-Properties

Property-Name	Zweck
hibernate.connection.driver_class	*JDBC driver class*
hibernate.connection.url	*JDBC URL*
hibernate.connection.username	*database user*
hibernate.connection.password	*database user password*
hibernate.connection.pool_size	*maximum number of pooled connections*

Hibernate's own connection pooling algorithm is, however, quite rudimentary. It is intended to help you get started and is *not intended for use in a production system*, or even for performance testing. You should use a third party pool for best performance and stability. Just replace the hibernate.connection.pool_size property with connection pool specific settings. This will turn off Hibernate's internal pool. For example, you might like to use c3p0.

C3P0 is an open source JDBC connection pool distributed along with Hibernate in the `lib` directory. Hibernate will use its `org.hibernate.connection.C3P0ConnectionProvider` for connection pooling if you set hibernate.c3p0.* properties. If you would like to use Proxool, refer to the packaged `hibernate.properties` and the Hibernate web site for more information.

The following is an example `hibernate.properties` file for c3p0:

```
hibernate.connection.driver_class = org.postgresql.Driver
hibernate.connection.url = jdbc:postgresql://localhost/mydatabase
hibernate.connection.username = myuser
hibernate.connection.password = secret
hibernate.c3p0.min_size=5
hibernate.c3p0.max_size=20
hibernate.c3p0.timeout=1800
hibernate.c3p0.max_statements=50
hibernate.dialect = org.hibernate.dialect.PostgreSQLDialect
```

For use inside an application server, you should almost always configure Hibernate to obtain connections from an application server `javax.sql.Datasource` registered in JNDI. You will need to set at least one of the following properties:

Tabelle 3.2. Properties der Hibernate Datenquelle ("Datasource")

Property-Name	Zweck
hibernate.connection.datasource	*datasource JNDI name*
hibernate.jndi.url	*URL des JNDI-Providers* (optional)
hibernate.jndi.class	*Klasse der JNDI-`InitialContextFactory`* (optional)
hibernate.connection.username	*Datenbankbenutzer* (optional)
hibernate.connection.password	*Passwort des Datenbankbenutzers* (optional)

Here is an example `hibernate.properties` file for an application server provided JNDI datasource:

```
hibernate.connection.datasource = java:/comp/env/jdbc/test
hibernate.transaction.factory_class = \
    org.hibernate.transaction.JTATransactionFactory
hibernate.transaction.manager_lookup_class = \
    org.hibernate.transaction.JBossTransactionManagerLookup
hibernate.dialect = org.hibernate.dialect.PostgreSQLDialect
```

Von einer JNDI-Datenquelle erhaltene JDBC-Verbindungen nehmen automatisch an den vom Container verwalteten Transaktionen des Applikationsservers teil.

Arbitrary connection properties can be given by prepending "`hibernate.connection`" to the connection property name. For example, you can specify a charSet connection property using hibernate.connection.charSet.

You can define your own plugin strategy for obtaining JDBC connections by implementing the interface `org.hibernate.connection.ConnectionProvider`, and specifying your custom implementation via the hibernate.connection.provider_class property.

3.4. Optionale Properties der Konfiguration

There are a number of other properties that control the behavior of Hibernate at runtime. All are optional and have reasonable default values.

Warnung

Some of these properties are "system-level" only. System-level properties can be set only via `java -Dproperty=value` or `hibernate.properties`. They *cannot* be set by the other techniques described above.

Tabelle 3.3. Konfigurationseigenschaften von Hibernate

Property-Name	Zweck
hibernate.dialect	The classname of a Hibernate `org.hibernate.dialect.Dialect` which allows Hibernate to generate SQL optimized for a particular relational database. **e.g.** `full.classname.of.Dialect` In most cases Hibernate will actually be able to choose the correct `org.hibernate.dialect.Dialect`

Property-Name	Zweck
	implementation based on the `JDBC metadata` returned by the JDBC driver.
hibernate.show_sql	Schreiben Sie alle SQL-Anweisungen in die Konsole. Es handelt sich dabei um eine Alternative für die Einstellung der Protokollkategorie `org.hibernate.SQL` auf `debug`. **e.g.** `true` | `false`
hibernate.format_sql	SQL in Protokoll und Konsole lesbar ausgeben. **e.g.** `true` | `false`
hibernate.default_schema	Qualify unqualified table names with the given schema/tablespace in generated SQL. **e.g.** `SCHEMA_NAME`
hibernate.default_catalog	Qualifies unqualified table names with the given catalog in generated SQL. **e.g.** `CATALOG_NAME`
hibernate.session_factory_name	The `org.hibernate.SessionFactory` will be automatically bound to this name in JNDI after it has been created. **e.g.** `jndi/composite/name`
hibernate.max_fetch_depth	Sets a maximum "depth" for the outer join fetch tree for single-ended associations (one-to-one, many-to-one). A `0` disables default outer join fetching. **e.g.** recommended values between `0` and `3`
hibernate.default_batch_fetch_size	Sets a default size for Hibernate batch fetching of associations. **e.g.** recommended values `4`, `8`, `16`
hibernate.default_entity_mode	Sets a default mode for entity representation for all sessions opened from this `SessionFactory` `dynamic-map`, `dom4j`, `pojo`
hibernate.order_updates	Forces Hibernate to order SQL updates by the primary key value of the items being updated.

Property-Name	Zweck
	This will result in fewer transaction deadlocks in highly concurrent systems. **e.g.** `true` | `false`
hibernate.generate_statistics	Falls aktiviert, so sammelt Hibernate Statistiken, die bei der Feinabstimmung der Performance von Nutzen sind. **e.g.** `true` | `false`
hibernate.use_identifier_rollback	Falls aktiviert, so werden die generierten Bezeichner-Properties auf die Standardwerte zurückgesetzt, wenn Objekte gelöscht werden. **e.g.** `true` | `false`
hibernate.use_sql_comments	Falls eingeschaltet, generiert Hibernate Kommentare innerhalb der SQL, für eine vereinfachte Fehlersuche. Die Standardeinstellung lautet `false`. **e.g.** `true` | `false`

Tabelle 3.4. Hibernate JDBC- und Connection-Properties

Property-Name	Zweck
hibernate.jdbc.fetch_size	Ein Wert ungleich Null bestimmt die Anzahl der JDBC-Datensätze, den so genannten "Fetch Size" (ruft `Statement.setFetchSize()` auf).
hibernate.jdbc.batch_size	Ein Wert von ungleich Null aktiviert die Verwendung von JDBC2-Stapelaktualisierungen (sog. "Batch Updates") durch Hibernate. **e.g.** recommended values between `5` and `30`
hibernate.jdbc.batch_versioned_data	Set this property to `true` if your JDBC driver returns correct row counts from `executeBatch()`. It is usually safe to turn this option on. Hibernate will then use batched DML for automatically versioned data. Defaults to `false`. **e.g.** `true` | `false`
hibernate.jdbc.factory_class	Select a custom `org.hibernate.jdbc.Batcher`. Most

Property-Name	Zweck
	applications will not need this configuration property. **e.g.** `classname.of.BatcherFactory`
hibernate.jdbc.use_scrollable_resultset	Enables use of JDBC2 scrollable resultsets by Hibernate. This property is only necessary when using user-supplied JDBC connections. Hibernate uses connection metadata otherwise. **e.g.** `true` | `false`
hibernate.jdbc.use_streams_for_binary	Use streams when writing/reading `binary` or `serializable` types to/from JDBC. **system-level property** **e.g.** `true` | `false`
hibernate.jdbc.use_get_generated_keys	Enables use of JDBC3 `PreparedStatement.getGeneratedKeys()` to retrieve natively generated keys after insert. Requires JDBC3+ driver and JRE1.4+, set to false if your driver has problems with the Hibernate identifier generators. By default, it tries to determine the driver capabilities using connection metadata. **e.g.** `true`|`false`
hibernate.connection.provider_class	The classname of a custom `org.hibernate.connection.ConnectionProvider` which provides JDBC connections to Hibernate. **e.g.** `classname.of.ConnectionProvider`
hibernate.connection.isolation	Sets the JDBC transaction isolation level. Check `java.sql.Connection` for meaningful values, but note that most databases do not support all isolation levels and some define additional, non-standard isolations. **e.g.** `1, 2, 4, 8`
hibernate.connection.autocommit	Enables autocommit for JDBC pooled connections (it is not recommended). **e.g.** `true` | `false`

Property-Name	Zweck
hibernate.connection.release_mode	Specifies when Hibernate should release JDBC connections. By default, a JDBC connection is held until the session is explicitly closed or disconnected. For an application server JTA datasource, use `after_statement` to aggressively release connections after every JDBC call. For a non-JTA connection, it often makes sense to release the connection at the end of each transaction, by using `after_transaction`. `auto` will choose `after_statement` for the JTA and CMT transaction strategies and `after_transaction` for the JDBC transaction strategy. **e.g.** `auto` (default) | `on_close` | `after_transaction` | `after_statement` This setting only affects `Session`s returned from `SessionFactory.openSession`. For `Session`s obtained through `SessionFactory.getCurrentSession`, the `CurrentSessionContext` implementation configured for use controls the connection release mode for those `Session`s. See *Abschnitt 2.5, „Contextual sessions“*
hibernate.connection.<*propertyName*>	Pass the JDBC property <*propertyName*> to `DriverManager.getConnection()`.
hibernate.jndi.<*propertyName*>	Pass the property <*propertyName*> to the JNDI `InitialContextFactory`.

Tabelle 3.5. Hibernate Cache-Properties

Property-Name	Zweck
`hibernate.cache.provider_class`	Der Klassenname eines anwenderdefinierten `CacheProvider`. **e.g.** `classname.of.CacheProvider`
`hibernate.cache.use_minimal_puts`	Optimizes second-level cache operation to minimize writes, at the cost of more frequent reads. This setting is most useful for clustered caches and, in Hibernate3, is enabled by default for clustered cache implementations.

Property-Name	Zweck
	e.g. `true|false`
`hibernate.cache.use_query_cache`	Enables the query cache. Individual queries still have to be set cachable. **e.g.** `true|false`
`hibernate.cache.use_second_level_cache`	Can be used to completely disable the second level cache, which is enabled by default for classes which specify a `<cache>` mapping. **e.g.** `true|false`
`hibernate.cache.query_cache_factory`	Der Klassenname eines anwenderdefinierten `QueryCache`-Interface, Standard ist das eingebaute `StandardQueryCache`. **e.g.** `classname.of.QueryCache`
`hibernate.cache.region_prefix`	Ein für Cache-Bereiche der zweiten Ebene zu verwendender Präfix. **e.g.** `prefix`
`hibernate.cache.use_structured_entries`	Bringt Hibernate dazu, Daten im Cachespeicher der zweiten Ebene in einer für den Benutzer freundlicheren Art zu speichern. **e.g.** `true|false`

Tabelle 3.6. Hibernate Transaktions-Properties

Property-Name	Zweck
`hibernate.transaction.factory_class`	Der Klassenname einer `TransactionFactory`, der mit der Hibernate `Transaction` API (Anwenderprogrammierschnittstelle) zu verwenden ist (standardmäßig `JDBCTransactionFactory`). **e.g.** `classname.of.TransactionFactory`
`jta.UserTransaction`	Ein von der `JTATransactionFactory` zum Erhalt der JTA `UserTransaction` vom Applikationsserver verwendeter JNDI-Name. **e.g.** `jndi/composite/name`
`hibernate.transaction.manager_lookup_class`	The classname of a `TransactionManagerLookup`. It is required when JVM-level caching is enabled or when using hilo generator in a JTA environment.

Property-Name	Zweck
	e.g. `classname.of.TransactionManagerLookup`
`hibernate.transaction.flush_before_completion`	If enabled, the session will be automatically flushed during the before completion phase of the transaction. Built-in and automatic session context management is preferred, see *Abschnitt 2.5, „Contextual sessions“*. **e.g.** `true` | `false`
`hibernate.transaction.auto_close_session`	If enabled, the session will be automatically closed during the after completion phase of the transaction. Built-in and automatic session context management is preferred, see *Abschnitt 2.5, „Contextual sessions“*. **e.g.** `true` | `false`

Tabelle 3.7. Verschiedene Properties

Property-Name	Zweck
`hibernate.current_session_context_class`	Supply a custom strategy for the scoping of the "current" `Session`. See *Abschnitt 2.5, „Contextual sessions“* for more information about the built-in strategies. **e.g.** `jta` | `thread` | `managed` | `custom.Class`
`hibernate.query.factory_class`	Wählt die Implemetierung des HQL-Parsers (Analysealgorithmus). **e.g.** `org.hibernate.hql.ast.ASTQueryTranslatorFactory` or `org.hibernate.hql.classic.ClassicQueryTranslatorFactory`
`hibernate.query.substitutions`	Is used to map from tokens in Hibernate queries to SQL tokens (tokens might be function or literal names, for example). **e.g.** `hqlLiteral=SQL_LITERAL, hqlFunction=SQLFUNC`
`hibernate.hbm2ddl.auto`	Automatically validates or exports schema DDL to the database when the `SessionFactory` is created. With `create-drop`, the database schema will be dropped when the `SessionFactory` is closed explicitly.

Property-Name	Zweck
	e.g. `validate` | `update` | `create` | `create-drop`
`hibernate.cglib.use_reflection_optimizer`	Enables the use of CGLIB instead of runtime reflection (System-level property). Reflection can sometimes be useful when troubleshooting. Hibernate always requires CGLIB even if you turn off the optimizer. You cannot set this property in `hibernate.cfg.xml`. **e.g.** `true` | `false`

3.4.1. SQL-Dialekte

Always set the `hibernate.dialect` property to the correct `org.hibernate.dialect.Dialect` subclass for your database. If you specify a dialect, Hibernate will use sensible defaults for some of the other properties listed above. This means that you will not have to specify them manually.

Tabelle 3.8. Hibernate SQL-Dialekte (`hibernate.dialect`)

RDBMS	Dialekt
DB2	`org.hibernate.dialect.DB2Dialect`
DB2 AS/400	`org.hibernate.dialect.DB2400Dialect`
DB2 OS390	`org.hibernate.dialect.DB2390Dialect`
PostgreSQL	`org.hibernate.dialect.PostgreSQLDialect`
MySQL	`org.hibernate.dialect.MySQLDialect`
MySQL mit InnoDB	`org.hibernate.dialect.MySQLInnoDBDialect`
MySQL mit MyISAM	`org.hibernate.dialect.MySQLMyISAMDialect`
Oracle (alle Versionen)	`org.hibernate.dialect.OracleDialect`
Oracle 9i	`org.hibernate.dialect.Oracle9iDialect`
Oracle 10g	`org.hibernate.dialect.Oracle10gDialect`
Sybase	`org.hibernate.dialect.SybaseDialect`
Sybase Anywhere	`org.hibernate.dialect.SybaseAnywhereDialect`
Microsoft SQL-Server	`org.hibernate.dialect.SQLServerDialect`
SAP DB	`org.hibernate.dialect.SAPDBDialect`
Informix	`org.hibernate.dialect.InformixDialect`
HypersonicSQL	`org.hibernate.dialect.HSQLDialect`
Ingres	`org.hibernate.dialect.IngresDialect`
Progress	`org.hibernate.dialect.ProgressDialect`

RDBMS	Dialekt
Mckoi SQL	`org.hibernate.dialect.MckoiDialect`
Interbase	`org.hibernate.dialect.InterbaseDialect`
Pointbase	`org.hibernate.dialect.PointbaseDialect`
FrontBase	`org.hibernate.dialect.FrontbaseDialect`
Firebird	`org.hibernate.dialect.FirebirdDialect`

3.4.2. "Outer-Join-Fetching"

If your database supports ANSI, Oracle or Sybase style outer joins, *outer join fetching* will often increase performance by limiting the number of round trips to and from the database. This is, however, at the cost of possibly more work performed by the database itself. Outer join fetching allows a whole graph of objects connected by many-to-one, one-to-many, many-to-many and one-to-one associations to be retrieved in a single SQL `SELECT`.

Outer join fetching can be disabled *globally* by setting the property `hibernate.max_fetch_depth` to `0`. A setting of `1` or higher enables outer join fetching for one-to-one and many-to-one associations that have been mapped with `fetch="join"`.

See *Abschnitt 20.1, „Abrufstrategien“* for more information.

3.4.3. Binäre Datenströme

Oracle limits the size of `byte` arrays that can be passed to and/or from its JDBC driver. If you wish to use large instances of `binary` or `serializable` type, you should enable `hibernate.jdbc.use_streams_for_binary`. *This is a system-level setting only.*

3.4.4. Zweite Ebene und Anfragen-Cache

The properties prefixed by `hibernate.cache` allow you to use a process or cluster scoped second-level cache system with Hibernate. See the *Abschnitt 20.2, „Das Cache der zweiten Ebene“* for more information.

3.4.5. "Query Language Substitution"

You can define new Hibernate query tokens using `hibernate.query.substitutions`. For example:

```
hibernate.query.substitutions true=1, false=0
```

This would cause the tokens `true` and `false` to be translated to integer literals in the generated SQL.

```
hibernate.query.substitutions toLowercase=LOWER
```

This would allow you to rename the SQL `LOWER` function.

3.4.6. Die Hibernate Statistik

If you enable `hibernate.generate_statistics`, Hibernate exposes a number of metrics that are useful when tuning a running system via `SessionFactory.getStatistics()`. Hibernate can even be configured to expose these statistics via JMX. Read the Javadoc of the interfaces in `org.hibernate.stats` for more information.

3.5. Protokollierung

Hibernate utilizes *Simple Logging Facade for Java* [http://www.slf4j.org/] (SLF4J) in order to log various system events. SLF4J can direct your logging output to several logging frameworks (NOP, Simple, log4j version 1.2, JDK 1.4 logging, JCL or logback) depending on your chosen binding. In order to setup logging you will need `slf4j-api.jar` in your classpath together with the jar file for your preferred binding - `slf4j-log4j12.jar` in the case of Log4J. See the SLF4J *documentation* [http://www.slf4j.org/manual.html] for more detail. To use Log4j you will also need to place a `log4j.properties` file in your classpath. An example properties file is distributed with Hibernate in the `src/` directory.

It is recommended that you familiarize yourself with Hibernate's log messages. A lot of work has been put into making the Hibernate log as detailed as possible, without making it unreadable. It is an essential troubleshooting device. The most interesting log categories are the following:

Tabelle 3.9. Die Protokollkategorien von Hibernate

Kategorie	Funktion
`org.hibernate.SQL`	Protokollierung aller SQL DML-Anweisungen bei deren Ausführung
`org.hibernate.type`	Protokollierung aller JDBC-Parameter
`org.hibernate.tool.hbm2ddl`	Protokollierung aller SQL DDL-Anweisungen bei deren Ausführung
`org.hibernate.pretty`	Protokollierung des Status aller Entities (max. 20 Entities) die zum Räumungzeitpunkt mit der Session assoziiert werden.
`org.hibernate.cache`	Protokollierung aller Cache-Vorgänge der zweiten Ebene
`org.hibernate.transaction`	Protokollierung von transaktionsbezogenen Vorgänge
`org.hibernate.jdbc`	Protokollierung sämtlicher JDBC-Ressourcen-Erfassungen
`org.hibernate.hql.ast.AST`	Protokollierung von HQL und SQL ASTs während Abfragen-Parsing
`org.hibernate.secure`	Protokollierung aller JAAS-Authentifizierungsanfragen
`org.hibernate`	Log everything. This is a lot of information but it is useful for troubleshooting

Bei der Entwicklung von Anwendungen mit Hibernate sollten Sie fast ausschließlich mit der aktivierten `debug`-Einstellung für die Kategorie `org.hibernate.SQL` arbeiten oder alternativ mit der aktivierten Property `hibernate.show_sql`.

3.6. Implementing a `NamingStrategy`

Das Interface `org.hibernate.cfg.NamingStrategy` ermöglicht es Ihnen einen Namensgebungsstandard (sog. "naming standard") für Datenbankobjekte und Schema-Elemente zu bestimmen.

You can provide rules for automatically generating database identifiers from Java identifiers or for processing "logical" column and table names given in the mapping file into "physical" table and column names. This feature helps reduce the verbosity of the mapping document, eliminating repetitive noise (`TBL_` prefixes, for example). The default strategy used by Hibernate is quite minimal.

You can specify a different strategy by calling `Configuration.setNamingStrategy()` before adding mappings:

```
SessionFactory sf = new Configuration()
    .setNamingStrategy(ImprovedNamingStrategy.INSTANCE)
    .addFile("Item.hbm.xml")
    .addFile("Bid.hbm.xml")
    .buildSessionFactory();
```

Bei `org.hibernate.cfg.ImprovedNamingStrategy` handelt es sich um eine eingebaute Strategie, die beim Startpunkt einiger Anwendungen von Nutzen sein kann.

3.7. XML-Konfigurationsdatei

Eine andere Konfigurationsmöglichkeit ist die Spezifizierung einer vollständigen Konfigurationsdatei mit dem Namen `hibernate.cfg.xml`. Diese Datei kann als Ersatz für die `hibernate.properties`-Datei dienen oder - falls beide vorhanden sind - Properties außer Kraft setzen.

The XML configuration file is by default expected to be in the root of your `CLASSPATH`. Here is an example:

```
<?xml version='1.0' encoding='utf-8'?>
<!DOCTYPE hibernate-configuration PUBLIC
    "-//Hibernate/Hibernate Configuration DTD//EN"
    "http://hibernate.sourceforge.net/hibernate-configuration-3.0.dtd">

<hibernate-configuration>

    <!-- a SessionFactory instance listed as /jndi/name -->
    <session-factory
        name="java:hibernate/SessionFactory">
```

```
        <!-- properties -->
        <property name="connection.datasource"
>java:/comp/env/jdbc/MyDB</property>
        <property name="dialect"
>org.hibernate.dialect.MySQLDialect</property>
        <property name="show_sql"
>false</property>
        <property name="transaction.factory_class">
            org.hibernate.transaction.JTATransactionFactory
        </property>
        <property name="jta.UserTransaction"
>java:comp/UserTransaction</property>

        <!-- mapping files -->
        <mapping resource="org/hibernate/auction/Item.hbm.xml"/>
        <mapping resource="org/hibernate/auction/Bid.hbm.xml"/>

        <!-- cache settings -->
        <class-cache class="org.hibernate.auction.Item" usage="read-write"/>
        <class-cache class="org.hibernate.auction.Bid" usage="read-only"/>
        <collection-cache collection="org.hibernate.auction.Item.bids" usage="read-write"/>

    </session-factory>

</hibernate-configuration
>
```

The advantage of this approach is the externalization of the mapping file names to configuration. The `hibernate.cfg.xml` is also more convenient once you have to tune the Hibernate cache. It is your choice to use either `hibernate.properties` or `hibernate.cfg.xml`. Both are equivalent, except for the above mentioned benefits of using the XML syntax.

With the XML configuration, starting Hibernate is then as simple as:

```
SessionFactory sf = new Configuration().configure().buildSessionFactory();
```

You can select a different XML configuration file using:

```
SessionFactory sf = new Configuration()
    .configure("catdb.cfg.xml")
    .buildSessionFactory();
```

3.8. Integration des J2EE-Applikationsservers

Hibernate besitzt die folgenden Intergrationspunkte für die J2EE Infrastruktur:

- *Container-managed datasources*: Hibernate can use JDBC connections managed by the container and provided through JNDI. Usually, a JTA compatible `TransactionManager` and

a `ResourceManager` take care of transaction management (CMT), especially distributed transaction handling across several datasources. You can also demarcate transaction boundaries programmatically (BMT), or you might want to use the optional Hibernate `Transaction` API for this to keep your code portable.

- *Automatisches JNDI-Binding*: Hibernate kann seine `SessionFactory` nach dem Startup an JNDI binden.

- *JTA Session binding:* the Hibernate `Session` can be automatically bound to the scope of JTA transactions. Simply lookup the `SessionFactory` from JNDI and get the current `Session`. Let Hibernate manage flushing and closing the `Session` when your JTA transaction completes. Transaction demarcation is either declarative (CMT) or programmatic (BMT/UserTransaction).

- *JMX deployment:* if you have a JMX capable application server (e.g. JBoss AS), you can choose to deploy Hibernate as a managed MBean. This saves you the one line startup code to build your `SessionFactory` from a `Configuration`. The container will startup your `HibernateService` and also take care of service dependencies (datasource has to be available before Hibernate starts, etc).

Je nach Ihrer Umgebung müssen Sie möglicherweise die Konfigurationsoption `hibernate.connection.aggressive_release` auf "true" setzen, falls Ihr Server "Connection Containment"-Ausnahmen (d.h. Verbindungseinschränkungen) anzeigt.

3.8.1. Konfiguration der Transaktionsstrategie

The Hibernate `Session` API is independent of any transaction demarcation system in your architecture. If you let Hibernate use JDBC directly through a connection pool, you can begin and end your transactions by calling the JDBC API. If you run in a J2EE application server, you might want to use bean-managed transactions and call the JTA API and `UserTransaction` when needed.

Um Ihren Code zwischen diesen beiden (und anderen) Umgebungen übertragbar zu halten, empfehlen wir das optionale Hibernate `Transaction`-API, welches das zu Grunde liegende System wrappt und verbirgt. Sie müssen eine Factory-Klasse für `Transaction`-Instanzen bestimmen, indem Sie die Hibernate Konfigurationseigenschaft `hibernate.transaction.factory_class` einstellen.

There are three standard, or built-in, choices:

`org.hibernate.transaction.JDBCTransactionFactory`
: delegiert an die Datenbank (JDBC) Transaktionen (default)

`org.hibernate.transaction.JTATransactionFactory`
: delegates to container-managed transactions if an existing transaction is underway in this context (for example, EJB session bean method). Otherwise, a new transaction is started and bean-managed transactions are used.

`org.hibernate.transaction.CMTTransactionFactory`
: delegiert an containerverwaltete JTA-Transaktionen

You can also define your own transaction strategies (for a CORBA transaction service, for example).

Some features in Hibernate (i.e., the second level cache, Contextual Sessions with JTA, etc.) require access to the JTA `TransactionManager` in a managed environment. In an application server, since J2EE does not standardize a single mechanism, you have to specify how Hibernate should obtain a reference to the `TransactionManager`:

Tabelle 3.10. JTA-TransactionManagers

Transaction-Factory	Applikationsserver
`org.hibernate.transaction.JBossTransactionManagerLookup`	JBoss
`org.hibernate.transaction.WeblogicTransactionManagerLookup`	Weblogic
`org.hibernate.transaction.WebSphereTransactionManagerLookup`	WebSphere
`org.hibernate.transaction.WebSphereExtendedJTATransactionLookup`	WebSphere 6
`org.hibernate.transaction.OrionTransactionManagerLookup`	Orion
`org.hibernate.transaction.ResinTransactionManagerLookup`	Resin
`org.hibernate.transaction.JOTMTransactionManagerLookup`	JOTM
`org.hibernate.transaction.JOnASTransactionManagerLookup`	JOnAS
`org.hibernate.transaction.JRun4TransactionManagerLookup`	JRun4
`org.hibernate.transaction.BESTransactionManagerLookup`	Borland ES

3.8.2. JNDI-bound `SessionFactory`

A JNDI-bound Hibernate `SessionFactory` can simplify the lookup function of the factory and create new `Session`s. This is not, however, related to a JNDI bound `Datasource`; both simply use the same registry.

If you wish to have the `SessionFactory` bound to a JNDI namespace, specify a name (e.g. `java:hibernate/SessionFactory`) using the property `hibernate.session_factory_name`. If this property is omitted, the `SessionFactory` will not be bound to JNDI. This is especially useful in environments with a read-only JNDI default implementation (in Tomcat, for example).

Beim Binden der `SessionFactory` an JNDI, wird Hibernate die Werte von `hibernate.jndi.url`, `hibernate.jndi.class` verwenden, um einen Anfangskontext zu initiieren. Werden diese nicht festgelegt, so wird der Standard `InitialContext` verwendet.

Hibernate will automatically place the `SessionFactory` in JNDI after you call `cfg.buildSessionFactory()`. This means you will have this call in some startup code, or utility class in your application, unless you use JMX deployment with the `HibernateService` (this is discussed later in greater detail).

If you use a JNDI `SessionFactory`, an EJB or any other class, you can obtain the `SessionFactory` using a JNDI lookup.

It is recommended that you bind the `SessionFactory` to JNDI in a managed environment and use a `static` singleton otherwise. To shield your application code from these details, we also recommend to hide the actual lookup code for a `SessionFactory` in a helper class, such as `HibernateUtil.getSessionFactory()`. Note that such a class is also a convenient way to startup Hibernate—see chapter 1.

3.8.3. Aktuelles Management des Sessionkontexts mit JTA

The easiest way to handle `Sessions` and transactions is Hibernate's automatic "current" `Session` management. For a discussion of contextual sessions see *Abschnitt 2.5, „Contextual sessions“*. Using the `"jta"` session context, if there is no Hibernate `Session` associated with the current JTA transaction, one will be started and associated with that JTA transaction the first time you call `sessionFactory.getCurrentSession()`. The `Sessions` retrieved via `getCurrentSession()` in the `"jta"` context are set to automatically flush before the transaction completes, close after the transaction completes, and aggressively release JDBC connections after each statement. This allows the `Sessions` to be managed by the life cycle of the JTA transaction to which it is associated, keeping user code clean of such management concerns. Your code can either use JTA programmatically through `UserTransaction`, or (recommended for portable code) use the Hibernate `Transaction` API to set transaction boundaries. If you run in an EJB container, declarative transaction demarcation with CMT is preferred.

3.8.4. JMX-Deployment

The line `cfg.buildSessionFactory()` still has to be executed somewhere to get a `SessionFactory` into JNDI. You can do this either in a `static` initializer block, like the one in `HibernateUtil`, or you can deploy Hibernate as a *managed service*.

Hibernate is distributed with `org.hibernate.jmx.HibernateService` for deployment on an application server with JMX capabilities, such as JBoss AS. The actual deployment and configuration is vendor-specific. Here is an example `jboss-service.xml` for JBoss 4.0.x:

```
<?xml version="1.0"?>
<server>

<mbean code="org.hibernate.jmx.HibernateService"
    name="jboss.jca:service=HibernateFactory,name=HibernateFactory">

    <!-- Required services -->
    <depends
>jboss.jca:service=RARDeployer</depends>
    <depends
>jboss.jca:service=LocalTxCM,name=HsqlDS</depends>

    <!-- Bind the Hibernate service to JNDI -->
    <attribute name="JndiName"
>java:/hibernate/SessionFactory</attribute>
```

```
    <!-- Datasource settings -->
    <attribute name="Datasource"
>java:HsqlDS</attribute>
    <attribute name="Dialect"
>org.hibernate.dialect.HSQLDialect</attribute>

    <!-- Transaction integration -->
    <attribute name="TransactionStrategy">
        org.hibernate.transaction.JTATransactionFactory</attribute>
    <attribute name="TransactionManagerLookupStrategy">
        org.hibernate.transaction.JBossTransactionManagerLookup</attribute>
    <attribute name="FlushBeforeCompletionEnabled"
>true</attribute>
    <attribute name="AutoCloseSessionEnabled"
>true</attribute>

    <!-- Fetching options -->
    <attribute name="MaximumFetchDepth"
>5</attribute>

    <!-- Second-level caching -->
    <attribute name="SecondLevelCacheEnabled"
>true</attribute>
    <attribute name="CacheProviderClass"
>org.hibernate.cache.EhCacheProvider</attribute>
    <attribute name="QueryCacheEnabled"
>true</attribute>

    <!-- Logging -->
    <attribute name="ShowSqlEnabled"
>true</attribute>

    <!-- Mapping files -->
    <attribute name="MapResources"
>auction/Item.hbm.xml,auction/Category.hbm.xml</attribute>

</mbean>

</server
>
```

This file is deployed in a directory called `META-INF` and packaged in a JAR file with the extension `.sar` (service archive). You also need to package Hibernate, its required third-party libraries, your compiled persistent classes, as well as your mapping files in the same archive. Your enterprise beans (usually session beans) can be kept in their own JAR file, but you can include this EJB JAR file in the main service archive to get a single (hot-)deployable unit. Consult the JBoss AS documentation for more information about JMX service and EJB deployment.

Persistente Klassen

Persistent classes are classes in an application that implement the entities of the business problem (e.g. Customer and Order in an E-commerce application). Not all instances of a persistent class are considered to be in the persistent state. For example, an instance can instead be transient or detached.

Hibernate works best if these classes follow some simple rules, also known as the Plain Old Java Object (POJO) programming model. However, none of these rules are hard requirements. Indeed, Hibernate3 assumes very little about the nature of your persistent objects. You can express a domain model in other ways (using trees of `Map` instances, for example).

4.1. Ein einfaches POJO-Beispiel

Most Java applications require a persistent class representing felines. For example:

```
package eg;
import java.util.Set;
import java.util.Date;

public class Cat {
    private Long id; // identifier

    private Date birthdate;
    private Color color;
    private char sex;
    private float weight;
    private int litterId;

    private Cat mother;
    private Set kittens = new HashSet();

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

    void setBirthdate(Date date) {
        birthdate = date;
    }
    public Date getBirthdate() {
        return birthdate;
    }

    void setWeight(float weight) {
        this.weight = weight;
    }
    public float getWeight() {
        return weight;
    }
```

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

    void setSex(char sex) {
        this.sex=sex;
    }
    public char getSex() {
        return sex;
    }

    void setLitterId(int id) {
        this.litterId = id;
    }
    public int getLitterId() {
        return litterId;
    }

    void setMother(Cat mother) {
        this.mother = mother;
    }
    public Cat getMother() {
        return mother;
    }
    void setKittens(Set kittens) {
        this.kittens = kittens;
    }
    public Set getKittens() {
        return kittens;
    }

    // addKitten not needed by Hibernate
    public void addKitten(Cat kitten) {
            kitten.setMother(this);
        kitten.setLitterId( kittens.size() );
        kittens.add(kitten);
    }
}
```

The four main rules of persistent classes are explored in more detail in the following sections.

4.1.1. Implementierung eines "No-Argument"-Konstruktors

`Cat` has a no-argument constructor. All persistent classes must have a default constructor (which can be non-public) so that Hibernate can instantiate them using `Constructor.newInstance()`. It is recommended that you have a default constructor with at least *package* visibility for runtime proxy generation in Hibernate.

4.1.2. Bereitstellung einer Bezeichner-Property (optional)

`Cat` has a property called `id`. This property maps to the primary key column of a database table. The property might have been called anything, and its type might have been any primitive type,

any primitive "wrapper" type, `java.lang.String` or `java.util.Date`. If your legacy database table has composite keys, you can use a user-defined class with properties of these types (see the section on composite identifiers later in the chapter.)

Die Bezeichner-Property ist völlig optional. Sie können sie ausgeschaltet lassen und Hibernate verfolgt die Objektbezeichner intern. Allerdings empfehlen wir diese Einstellung nicht.

In fact, some functionality is available only to classes that declare an identifier property:

- Transitive reattachment for detached objects (cascade update or cascade merge) - see *Abschnitt 10.11, „Transitive Persistenz“*
- `Session.saveOrUpdate()`
- `Session.merge()`

We recommend that you declare consistently-named identifier properties on persistent classes and that you use a nullable (i.e., non-primitive) type.

4.1.3. Bevorzugung nicht-finaler Klassen (optional)

Ein zentrales Feature von Hibernate, *Proxies*, hängt davon ab, ob die persistente Klasse entweder nicht-final oder der alle Methoden als öffentlich erklärenden Implemetierung eines Interface.

You can persist `final` classes that do not implement an interface with Hibernate. You will not, however, be able to use proxies for lazy association fetching which will ultimately limit your options for performance tuning.

You should also avoid declaring `public final` methods on the non-final classes. If you want to use a class with a `public final` method, you must explicitly disable proxying by setting `lazy="false"`.

4.1.4. Zugriffsberechtigte und Mutatoren für persistente Felder deklarieren (optional)

`Cat` declares accessor methods for all its persistent fields. Many other ORM tools directly persist instance variables. It is better to provide an indirection between the relational schema and internal data structures of the class. By default, Hibernate persists JavaBeans style properties and recognizes method names of the form `getFoo`, `isFoo` and `setFoo`. If required, you can switch to direct field access for particular properties.

Properties müssen *nicht* als öffentlich deklariert werden - Hibernate kann eine Property als `protected` oder `private` "Get"-/ "Set"-Paar persistieren.

4.2. Implementierung der Vererbung

A subclass must also observe the first and second rules. It inherits its identifier property from the superclass, `Cat`. For example:

```
package eg;

public class DomesticCat extends Cat {
        private String name;

        public String getName() {
                return name;
        }
        protected void setName(String name) {
                this.name=name;
        }
}
```

4.3. Implementing `equals()` and `hashCode()`

You have to override the `equals()` and `hashCode()` methods if you:

- intend to put instances of persistent classes in a `Set` (the recommended way to represent many-valued associations); *and*
- planen, den Wiederanbindung abgesetzter Instanzen zu verwenden

Hibernate guarantees equivalence of persistent identity (database row) and Java identity only inside a particular session scope. When you mix instances retrieved in different sessions, you must implement `equals()` and `hashCode()` if you wish to have meaningful semantics for `Sets`.

The most obvious way is to implement `equals()`/`hashCode()` by comparing the identifier value of both objects. If the value is the same, both must be the same database row, because they are equal. If both are added to a `Set`, you will only have one element in the `Set`). Unfortunately, you cannot use that approach with generated identifiers. Hibernate will only assign identifier values to objects that are persistent; a newly created instance will not have any identifier value. Furthermore, if an instance is unsaved and currently in a `Set`, saving it will assign an identifier value to the object. If `equals()` and `hashCode()` are based on the identifier value, the hash code would change, breaking the contract of the `Set`. See the Hibernate website for a full discussion of this problem. This is not a Hibernate issue, but normal Java semantics of object identity and equality.

It is recommended that you implement `equals()` and `hashCode()` using *Business key equality*. Business key equality means that the `equals()` method compares only the properties that form the business key. It is a key that would identify our instance in the real world (a *natural* candidate key):

```
public class Cat {

    ...
    public boolean equals(Object other) {
        if (this == other) return true;
        if ( !(other instanceof Cat) ) return false;

        final Cat cat = (Cat) other;
```

```
        if ( !cat.getLitterId().equals( getLitterId() ) ) return false;
        if ( !cat.getMother().equals( getMother() ) ) return false;

        return true;
    }

    public int hashCode() {
        int result;
        result = getMother().hashCode();
        result = 29 * result + getLitterId();
        return result;
    }

}
```

A business key does not have to be as solid as a database primary key candidate (see *Abschnitt 12.1.3, „Die Berücksichtigung der Objektidentität“*). Immutable or unique properties are usually good candidates for a business key.

4.4. Dynamische Modelle

Note

The following features are currently considered experimental and may change in the near future.

Persistent entities do not necessarily have to be represented as POJO classes or as JavaBean objects at runtime. Hibernate also supports dynamic models (using `Maps` of `Maps` at runtime) and the representation of entities as DOM4J trees. With this approach, you do not write persistent classes, only mapping files.

By default, Hibernate works in normal POJO mode. You can set a default entity representation mode for a particular `SessionFactory` using the `default_entity_mode` configuration option (see *Tabelle 3.3, „Konfigurationseigenschaften von Hibernate“*).

The following examples demonstrate the representation using `Maps`. First, in the mapping file an `entity-name` has to be declared instead of, or in addition to, a class name:

```
<hibernate-mapping>

    <class entity-name="Customer">

        <id name="id"
            type="long"
            column="ID">
            <generator class="sequence"/>
        </id>

        <property name="name"
```

```
            column="NAME"
            type="string"/>

        <property name="address"
            column="ADDRESS"
            type="string"/>

        <many-to-one name="organization"
            column="ORGANIZATION_ID"
            class="Organization"/>

        <bag name="orders"
            inverse="true"
            lazy="false"
            cascade="all">
            <key column="CUSTOMER_ID"/>
            <one-to-many class="Order"/>
        </bag>

    </class>

</hibernate-mapping
>
```

Even though associations are declared using target class names, the target type of associations can also be a dynamic entity instead of a POJO.

After setting the default entity mode to `dynamic-map` for the `SessionFactory`, you can, at runtime, work with `Maps` of `Maps`:

```
Session s = openSession();
Transaction tx = s.beginTransaction();

// Create a customer
Map david = new HashMap();
david.put("name", "David");

// Create an organization
Map foobar = new HashMap();
foobar.put("name", "Foobar Inc.");

// Link both
david.put("organization", foobar);

// Save both
s.save("Customer", david);
s.save("Organization", foobar);

tx.commit();
s.close();
```

One of the main advantages of dynamic mapping is quick turnaround time for prototyping, without the need for entity class implementation. However, you lose compile-time type checking and will likely deal with many exceptions at runtime. As a result of the Hibernate mapping, the

database schema can easily be normalized and sound, allowing to add a proper domain model implementation on top later on.

Die Modi für die Entity Repräsentation können auch auf per `Session`-Basis eingestellt werden:

```
Session dynamicSession = pojoSession.getSession(EntityMode.MAP);

// Create a customer
Map david = new HashMap();
david.put("name", "David");
dynamicSession.save("Customer", david);
...
dynamicSession.flush();
dynamicSession.close()
...
// Continue on pojoSession
```

Please note that the call to `getSession()` using an `EntityMode` is on the `Session` API, not the `SessionFactory`. That way, the new `Session` shares the underlying JDBC connection, transaction, and other context information. This means you do not have to call `flush()` and `close()` on the secondary `Session`, and also leave the transaction and connection handling to the primary unit of work.

More information about the XML representation capabilities can be found in *Kapitel 19, XML-Mapping*.

4.5. Tuplizer

`org.hibernate.tuple.Tuplizer`, and its sub-interfaces, are responsible for managing a particular representation of a piece of data given that representation's `org.hibernate.EntityMode`. If a given piece of data is thought of as a data structure, then a tuplizer is the thing that knows how to create such a data structure and how to extract values from and inject values into such a data structure. For example, for the POJO entity mode, the corresponding tuplizer knows how create the POJO through its constructor. It also knows how to access the POJO properties using the defined property accessors.

There are two high-level types of Tuplizers, represented by the `org.hibernate.tuple.entity.EntityTuplizer` and `org.hibernate.tuple.component.ComponentTuplizer` interfaces. `EntityTuplizers` are responsible for managing the above mentioned contracts in regards to entities, while `ComponentTuplizers` do the same for components.

Users can also plug in their own tuplizers. Perhaps you require that a `java.util.Map` implementation other than `java.util.HashMap` be used while in the dynamic-map entity-mode. Or perhaps you need to define a different proxy generation strategy than the one used by default. Both would be achieved by defining a custom tuplizer implementation. Tuplizer definitions are attached to the entity or component mapping they are meant to manage. Going back to the example of our customer entity:

```
<hibernate-mapping>
    <class entity-name="Customer">
        <!--
            Override the dynamic-map entity-mode
            tuplizer for the customer entity
        -->
        <tuplizer entity-mode="dynamic-map"
                class="CustomMapTuplizerImpl"/>

        <id name="id" type="long" column="ID">
            <generator class="sequence"/>
        </id>

        <!-- other properties -->
        ...
    </class>
</hibernate-mapping>


public class CustomMapTuplizerImpl
        extends org.hibernate.tuple.entity.DynamicMapEntityTuplizer {
    // override the buildInstantiator() method to plug in our custom map...
    protected final Instantiator buildInstantiator(
            org.hibernate.mapping.PersistentClass mappingInfo) {
        return new CustomMapInstantiator( mappingInfo );
    }

    private static final class CustomMapInstantiator
            extends org.hibernate.tuple.DynamicMapInstantitor {
        // override the generateMap() method to return our custom map...
            protected final Map generateMap() {
                    return new CustomMap();
            }
    }
}
```

4.6. EntityNameResolvers

The `org.hibernate.EntityNameResolver` interface is a contract for resolving the entity name of a given entity instance. The interface defines a single method `resolveEntityName` which is passed the entity instance and is expected to return the appropriate entity name (null is allowed and would indicate that the resolver does not know how to resolve the entity name of the given entity instance). Generally speaking, an `org.hibernate.EntityNameResolver` is going to be most useful in the case of dynamic models. One example might be using proxied interfaces as your domain model. The hibernate test suite has an example of this exact style of usage under the org.hibernate.test.dynamicentity.tuplizer2. Here is some of the code from that package for illustration.

```
/**
 * A very trivial JDK Proxy InvocationHandler implementation where we proxy an interface as
 * the domain model and simply store persistent state in an internal Map.  This is an extremely
 * trivial example meant only for illustration.
```

```
 */
public final class DataProxyHandler implements InvocationHandler {
        private String entityName;
        private HashMap data = new HashMap();

        public DataProxyHandler(String entityName, Serializable id) {
                this.entityName = entityName;
                data.put( "Id", id );
        }

        public Object invoke(Object proxy, Method method, Object[] args) throws Throwable {
                String methodName = method.getName();
                if ( methodName.startsWith( "set" ) ) {
                        String propertyName = methodName.substring( 3 );
                        data.put( propertyName, args[0] );
                }
                else if ( methodName.startsWith( "get" ) ) {
                        String propertyName = methodName.substring( 3 );
                        return data.get( propertyName );
                }
                else if ( "toString".equals( methodName ) ) {
                        return entityName + "#" + data.get( "Id" );
                }
                else if ( "hashCode".equals( methodName ) ) {
                        return new Integer( this.hashCode() );
                }
                return null;
        }

        public String getEntityName() {
                return entityName;
        }

        public HashMap getData() {
                return data;
        }
}

/**
 *
 */
public class ProxyHelper {
    public static String extractEntityName(Object object) {
        // Our custom java.lang.reflect.Proxy instances actually bundle
        // their appropriate entity name, so we simply extract it from there
        // if this represents one of our proxies; otherwise, we return null
        if ( Proxy.isProxyClass( object.getClass() ) ) {
            InvocationHandler handler = Proxy.getInvocationHandler( object );
            if ( DataProxyHandler.class.isAssignableFrom( handler.getClass() ) ) {
                DataProxyHandler myHandler = ( DataProxyHandler ) handler;
                return myHandler.getEntityName();
            }
        }
        return null;
    }

    // various other utility methods ....

}
```

```
/**
 * The EntityNameResolver implementation.
 * IMPL NOTE : An EntityNameResolver really defines a strategy for how entity names should be
 * resolved.  Since this particular impl can handle resolution for all of our entities we want to
 * take advantage of the fact that SessionFactoryImpl keeps these in a Set so that we only ever
 * have one instance registered.  Why?  Well, when it comes time to resolve an entity name,
 * Hibernate must iterate over all the registered resolvers.  So keeping that number down
 * helps that process be as speedy as possible.  Hence the equals and hashCode impls
 */
public class MyEntityNameResolver implements EntityNameResolver {
    public static final MyEntityNameResolver INSTANCE = new MyEntityNameResolver();

    public String resolveEntityName(Object entity) {
        return ProxyHelper.extractEntityName( entity );
    }

    public boolean equals(Object obj) {
        return getClass().equals( obj.getClass() );
    }

    public int hashCode() {
        return getClass().hashCode();
    }
}

public class MyEntityTuplizer extends PojoEntityTuplizer {
       public MyEntityTuplizer(EntityMetamodel entityMetamodel, PersistentClass mappedEntity) {
               super( entityMetamodel, mappedEntity );
        }

        public EntityNameResolver[] getEntityNameResolvers() {
               return new EntityNameResolver[] { MyEntityNameResolver.INSTANCE };
        }

    public String determineConcreteSubclassEntityName(Object entityInstance, SessionFactoryImplementor factory) {
        String entityName = ProxyHelper.extractEntityName( entityInstance );
        if ( entityName == null ) {
            entityName = super.determineConcreteSubclassEntityName( entityInstance, factory );
        }
        return entityName;
    }

    ...
}
```

In order to register an `org.hibernate.EntityNameResolver` users must either:

1. Implement a custom *Tuplizer*, implementing the `getEntityNameResolvers` method.
2. Register it with the `org.hibernate.impl.SessionFactoryImpl` (which is the implementation class for `org.hibernate.SessionFactory`) using the `registerEntityNameResolver` method.

Grundlagen des O/R Mappings

5.1. Mapping-Deklaration

Object/relational mappings are usually defined in an XML document. The mapping document is designed to be readable and hand-editable. The mapping language is Java-centric, meaning that mappings are constructed around persistent class declarations and not table declarations.

Please note that even though many Hibernate users choose to write the XML by hand, a number of tools exist to generate the mapping document. These include XDoclet, Middlegen and AndroMDA.

Here is an example mapping:

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC
      "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
          "http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">

<hibernate-mapping package="eg">

        <class name="Cat"
            table="cats"
            discriminator-value="C">

                <id name="id">
                        <generator class="native"/>
                </id>

                <discriminator column="subclass"
                     type="character"/>

                <property name="weight"/>

                <property name="birthdate"
                    type="date"
                    not-null="true"
                    update="false"/>

                <property name="color"
                    type="eg.types.ColorUserType"
                    not-null="true"
                    update="false"/>

                <property name="sex"
                    not-null="true"
                    update="false"/>

                <property name="litterId"
                    column="litterId"
                    update="false"/>

                <many-to-one name="mother"
                    column="mother_id"
                    update="false"/>
```

```
                <set name="kittens"
                    inverse="true"
                    order-by="litter_id">
                        <key column="mother_id"/>
                        <one-to-many class="Cat"/>
                </set>

                <subclass name="DomesticCat"
                    discriminator-value="D">

                        <property name="name"
                            type="string"/>

                </subclass>

        </class>

        <class name="Dog">
                <!-- mapping for Dog could go here -->
        </class>

</hibernate-mapping
>
```

We will now discuss the content of the mapping document. We will only describe, however, the document elements and attributes that are used by Hibernate at runtime. The mapping document also contains some extra optional attributes and elements that affect the database schemas exported by the schema export tool (for example, the `not-null` attribute).

5.1.1. Doctype

All XML mappings should declare the doctype shown. The actual DTD can be found at the URL above, in the directory `hibernate-x.x.x/src/org/hibernate` , or in `hibernate3.jar`. Hibernate will always look for the DTD in its classpath first. If you experience lookups of the DTD using an Internet connection, check the DTD declaration against the contents of your classpath.

5.1.1.1. EntityResolver

Hibernate will first attempt to resolve DTDs in its classpath. It does this is by registering a custom `org.xml.sax.EntityResolver` implementation with the SAXReader it uses to read in the xml files. This custom `EntityResolver` recognizes two different systemId namespaces:

- a `hibernate namespace` is recognized whenever the resolver encounters a systemId starting with `http://hibernate.sourceforge.net/`. The resolver attempts to resolve these entities via the classloader which loaded the Hibernate classes.
- a `user namespace` is recognized whenever the resolver encounters a systemId using a `classpath://` URL protocol. The resolver will attempt to resolve these entities via (1) the current thread context classloader and (2) the classloader which loaded the Hibernate classes.

The following is an example of utilizing user namespacing:

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC '-//Hibernate/Hibernate Mapping DTD 3.0//EN' 'http://
hibernate.sourceforge.net/hibernate-mapping-3.0.dtd' [
<!ENTITY version "3.5.4-Final">
<!ENTITY today "July 21, 2010">

    <!ENTITY types SYSTEM "classpath://your/domain/types.xml">


]>


<hibernate-mapping package="your.domain">
    <class name="MyEntity">
        <id name="id" type="my-custom-id-type">
            ...
        </id>
    <class>
    &types;
</hibernate-mapping>
```

Where `types.xml` is a resource in the `your.domain` package and contains a custom *typedef*.

5.1.2. Hibernate-mapping

This element has several optional attributes. The `schema` and `catalog` attributes specify that tables referred to in this mapping belong to the named schema and/or catalog. If they are specified, tablenames will be qualified by the given schema and catalog names. If they are missing, tablenames will be unqualified. The `default-cascade` attribute specifies what cascade style should be assumed for properties and collections that do not specify a `cascade` attribute. By default, the `auto-import` attribute allows you to use unqualified class names in the query language.

```
<hibernate-mapping
         schema="schemaName"                                    (1)
         catalog="catalogName"                                  (2)
         default-cascade="cascade_style"                        (3)
         default-access="field|property|ClassName"              (4)
         default-lazy="true|false"                              (5)
         auto-import="true|false"                               (6)
         package="package.name"                                 (7)
 />
```

(1) `schema` (optional): the name of a database schema.

(2) `catalog` (optional): the name of a database catalog.

3. `default-cascade` (optional - defaults to `none`): a default cascade style.
4. `default-access` (optional - defaults to `property`): the strategy Hibernate should use for accessing all properties. It can be a custom implementation of `PropertyAccessor`.
5. `default-lazy` (optional - defaults to `true`): the default value for unspecified `lazy` attributes of class and collection mappings.
6. `auto-import` (optional - defaults to `true`): specifies whether we can use unqualified class names of classes in this mapping in the query language.
7. `package` (optional): specifies a package prefix to use for unqualified class names in the mapping document.

If you have two persistent classes with the same unqualified name, you should set `auto-import="false"`. An exception will result if you attempt to assign two classes to the same "imported" name.

The `hibernate-mapping` element allows you to nest several persistent `<class>` mappings, as shown above. It is, however, good practice (and expected by some tools) to map only a single persistent class, or a single class hierarchy, in one mapping file and name it after the persistent superclass. For example, `Cat.hbm.xml`, `Dog.hbm.xml`, or if using inheritance, `Animal.hbm.xml`.

5.1.3. Class

You can declare a persistent class using the `class` element. For example:

```
<class
        name="ClassName"                                                    (1)
        table="tableName"                                                   (2)
        discriminator-value="discriminator_value"                           (3)
        mutable="true|false"                                                (4)
        schema="owner"                                                      (5)
        catalog="catalog"                                                   (6)
        proxy="ProxyInterface"                                              (7)
        dynamic-update="true|false"                                         (8)
        dynamic-insert="true|false"                                         (9)
        select-before-update="true|false"                                   (10)
        polymorphism="implicit|explicit"                                    (11)
        where="arbitrary sql where condition"                               (12)
        persister="PersisterClass"                                          (13)
        batch-size="N"                                                      (14)
        optimistic-lock="none|version|dirty|all"                            (15)
        lazy="true|false"                                                   (16)
        entity-name="EntityName"                                            (17)
        check="arbitrary sql check condition"                               (18)
        rowid="rowid"                                                       (19)
        subselect="SQL expression"                                          (20)
        abstract="true|false"                                               (21)
```

```
        node="element-name"
/>
```

1. `name` (optional): the fully qualified Java class name of the persistent class or interface. If this attribute is missing, it is assumed that the mapping is for a non-POJO entity.
2. `table` (optional - defaults to the unqualified class name): the name of its database table.
3. `discriminator-value` (optional - defaults to the class name): a value that distinguishes individual subclasses that is used for polymorphic behavior. Acceptable values include `null` and `not null`.
4. `mutable` (optional - defaults to `true`): specifies that instances of the class are (not) mutable.
5. `schema` (optional): overrides the schema name specified by the root `<hibernate-mapping>` element.
6. `catalog` (optional): overrides the catalog name specified by the root `<hibernate-mapping>` element.
7. `proxy` (optional): specifies an interface to use for lazy initializing proxies. You can specify the name of the class itself.
8. `dynamic-update` (optional - defaults to `false`): specifies that `UPDATE` SQL should be generated at runtime and can contain only those columns whose values have changed.
9. `dynamic-insert` (optional - defaults to `false`): specifies that `INSERT` SQL should be generated at runtime and contain only the columns whose values are not null.
10. `select-before-update` (optional - defaults to `false`): specifies that Hibernate should *never* perform an SQL `UPDATE` unless it is certain that an object is actually modified. Only when a transient object has been associated with a new session using `update()`, will Hibernate perform an extra SQL `SELECT` to determine if an `UPDATE` is actually required.
11. `polymorphism` (optional - defaults to `implicit`): determines whether implicit or explicit query polymorphism is used.
12. `where` (optional): specifies an arbitrary SQL `WHERE` condition to be used when retrieving objects of this class.
13. `persister` (optional): specifies a custom `ClassPersister`.
14. `batch-size` (optional - defaults to `1`): specifies a "batch size" for fetching instances of this class by identifier.
15. `optimistic-lock` (optional - defaults to `version`): determines the optimistic locking strategy.
16. `lazy` (optional): lazy fetching can be disabled by setting `lazy="false"`.
17. `entity-name` (optional - defaults to the class name): Hibernate3 allows a class to be mapped multiple times, potentially to different tables. It also allows entity mappings that are represented by Maps or XML at the Java level. In these cases, you should provide an explicit arbitrary name for the entity. See *Abschnitt 4.4, „Dynamische Modelle“* and *Kapitel 19, XML-Mapping* for more information.
18. `check` (optional): an SQL expression used to generate a multi-row *check* constraint for automatic schema generation.
19. `rowid` (optional): Hibernate can use ROWIDs on databases. On Oracle, for example, Hibernate can use the `rowid` extra column for fast updates once this option has been set

to `rowid`. A ROWID is an implementation detail and represents the physical location of a stored tuple.

20 `subselect` (optional): maps an immutable and read-only entity to a database subselect. This is useful if you want to have a view instead of a base table. See below for more information.

21 `abstract` (optional): is used to mark abstract superclasses in `<union-subclass>` hierarchies.

It is acceptable for the named persistent class to be an interface. You can declare implementing classes of that interface using the `<subclass>` element. You can persist any *static* inner class. Specify the class name using the standard form i.e. `e.g.Foo$Bar`.

Immutable classes, `mutable="false"`, cannot be updated or deleted by the application. This allows Hibernate to make some minor performance optimizations.

The optional `proxy` attribute enables lazy initialization of persistent instances of the class. Hibernate will initially return CGLIB proxies that implement the named interface. The persistent object will load when a method of the proxy is invoked. See "Initializing collections and proxies" below.

Implicit polymorphism means that instances of the class will be returned by a query that names any superclass or implemented interface or class, and that instances of any subclass of the class will be returned by a query that names the class itself. *Explicit* polymorphism means that class instances will be returned only by queries that explicitly name that class. Queries that name the class will return only instances of subclasses mapped inside this `<class>` declaration as a `<subclass>` or `<joined-subclass>`. For most purposes, the default `polymorphism="implicit"` is appropriate. Explicit polymorphism is useful when two different classes are mapped to the same table This allows a "lightweight" class that contains a subset of the table columns.

The `persister` attribute lets you customize the persistence strategy used for the class. You can, for example, specify your own subclass of `org.hibernate.persister.EntityPersister`, or you can even provide a completely new implementation of the interface `org.hibernate.persister.ClassPersister` that implements, for example, persistence via stored procedure calls, serialization to flat files or LDAP. See `org.hibernate.test.CustomPersister` for a simple example of "persistence" to a `Hashtable`.

The `dynamic-update` and `dynamic-insert` settings are not inherited by subclasses, so they can also be specified on the `<subclass>` or `<joined-subclass>` elements. Although these settings can increase performance in some cases, they can actually decrease performance in others.

Use of `select-before-update` will usually decrease performance. It is useful to prevent a database update trigger being called unnecessarily if you reattach a graph of detached instances to a `Session`.

Wenn Sie `dynamic-update` aktivieren, haben Sie die Wahl zwischen verschiedenen Strategien für das optimistische Sperren:

- `version`: check the version/timestamp columns

- `all`: check all columns
- `dirty`: check the changed columns, allowing some concurrent updates
- `none`: do not use optimistic locking

It is *strongly* recommended that you use version/timestamp columns for optimistic locking with Hibernate. This strategy optimizes performance and correctly handles modifications made to detached instances (i.e. when `Session.merge()` is used).

There is no difference between a view and a base table for a Hibernate mapping. This is transparent at the database level, although some DBMS do not support views properly, especially with updates. Sometimes you want to use a view, but you cannot create one in the database (i.e. with a legacy schema). In this case, you can map an immutable and read-only entity to a given SQL subselect expression:

```
<class name="Summary">
    <subselect>
        select item.name, max(bid.amount), count(*)
        from item
        join bid on bid.item_id = item.id
        group by item.name
    </subselect>
    <synchronize table="item"/>
    <synchronize table="bid"/>
    <id name="name"/>
    ...
</class
>
```

Declare the tables to synchronize this entity with, ensuring that auto-flush happens correctly and that queries against the derived entity do not return stale data. The `<subselect>` is available both as an attribute and a nested mapping element.

5.1.4. id

Gemappte Klassen *müssen* die Spalte des Primärschlüssels der Datenbanktabelle deklarieren. Die meisten Klassen werden außerdem eine Property nach Art von JavaBeans besitzen, die den eindeutigen Bezeichner einer Instanz enthält. Das `<id>`-Element definiert das Mapping von der Property zur Spalte des Primärschlüssels.

```
<id
        name="propertyName"                                          1
        type="typename"                                              2
        column="column_name"                                         3
        unsaved-value="null|any|none|undefined|id_value"             4
        access="field|property|ClassName">                           5
        node="element-name|@attribute-name|element/@attribute|."
```

```
        <generator class="generatorClass"/>
</id
>
```

1. `name` (optional): the name of the identifier property.
2. `type` (optional): Ein Name, der den Hibernate-Typ anzeigt.
3. `column` (optional - defaults to the property name): the name of the primary key column.
4. `unsaved-value` (optional - defaults to a "sensible" value): an identifier property value that indicates an instance is newly instantiated (unsaved), distinguishing it from detached instances that were saved or loaded in a previous session.
5. `access` (optional - defaults to `property`): the strategy Hibernate should use for accessing the property value.

Falls das `name`-Attribut fehlt, wird davon ausgegangen, dass die Klasse keine Bezeichner-Property besitzt.

Das `unsaved-value`-Attribut wird in Hibernate3 fast nie benötigt.

There is an alternative `<composite-id>` declaration that allows access to legacy data with composite keys. Its use is strongly discouraged for anything else.

5.1.4.1. Programmgenerator

Das optionale `<generator>`-Unterelement benennt eine Java-Klasse, die zur Generierung eindeutiger Bezeichner für Instanzen der persistenten Klasse verwendet werden. Falls Parameter zur Konfiguration oder Initialisierung der Generatorinstanz benötigt werden, werden Sie unter Verwendung des `<param>`-Elements weitergeleitet.

```
<id name="id" type="long" column="cat_id">
        <generator class="org.hibernate.id.TableHiLoGenerator">
                <param name="table"
>uid_table</param>
                <param name="column"
>next_hi_value_column</param>
        </generator>
</id
>
```

All generators implement the interface `org.hibernate.id.IdentifierGenerator`. This is a very simple interface. Some applications can choose to provide their own specialized implementations, however, Hibernate provides a range of built-in implementations. The shortcut names for the built-in generators are as follows:

`increment`
: generiert Bezeichner des Typs `long`, `short` oder `int`, die nur eindeutig sind, wenn kein anderer Vorgang Daten derselben Tabelle hinzufügt. *Nicht in einem Cluster zu verwenden.*

`identity`
: unterstützt die Identitätsspalten in DB2, MySQL, MS SQL Server, Sybase und HypersonicSQL. Der zurückgesendete Bezeichner ist vom Typ `long`, `short` oder `int`.

`sequence`
: verwendet eine Sequenz in DB2, PostgreSQL, Oracle, SAP DB, McKoi oder einen Generator in Interbase. Der zurückgeschickte Bezeichner ist vom Typ `long`, `short` oder `int`

`hilo`
: verwendet einen hi/lo Algorithmus um effizient Bezeichner des Typs `long`, `short` oder `int` zu generieren, bei gegebener Tabelle und Spalte (Standardeinstellung lautet `hibernate_unique_key` bzw. `next_hi`) als Quelle der hi-Werte. Der hi/lo-Algorithmus generiert Bezeichner, die für eine bestimmte Datenbank eindeutig sind.

`seqhilo`
: verwendet einen hi/lo-Algorithmus um effizient Bezeichner des Typs `long`, `short` oder `int` zu generieren, bei einer vorgegebenen und benannten Datenbanksequenz.

`uuid`
: uses a 128-bit UUID algorithm to generate identifiers of type string that are unique within a network (the IP address is used). The UUID is encoded as a string of 32 hexadecimal digits in length.

`guid`
: verwendet einen von der Datenbank generierten GUID-String auf dem MS SQL Server und MySQL.

`native`
: selects `identity`, `sequence` or `hilo` depending upon the capabilities of the underlying database.

`assigned`
: lets the application assign an identifier to the object before `save()` is called. This is the default strategy if no `<generator>` element is specified.

`select`
: retrieves a primary key, assigned by a database trigger, by selecting the row by some unique key and retrieving the primary key value.

`foreign`
: uses the identifier of another associated object. It is usually used in conjunction with a `<one-to-one>` primary key association.

`sequence-identity`
: a specialized sequence generation strategy that utilizes a database sequence for the actual value generation, but combines this with JDBC3 getGeneratedKeys to return the generated identifier value as part of the insert statement execution. This strategy is only supported on Oracle 10g drivers targeted for JDK 1.4. Comments on these insert statements are disabled due to a bug in the Oracle drivers.

5.1.4.2. Hi/lo-Algorithmus

The `hilo` and `seqhilo` generators provide two alternate implementations of the hi/lo algorithm. The first implementation requires a "special" database table to hold the next available "hi" value. Where supported, the second uses an Oracle-style sequence.

```
<id name="id" type="long" column="cat_id">
        <generator class="hilo">
                <param name="table"
>hi_value</param>
                <param name="column"
>next_value</param>
                <param name="max_lo"
>100</param>
        </generator>
</id
>
```

```
<id name="id" type="long" column="cat_id">
        <generator class="seqhilo">
                <param name="sequence"
>hi_value</param>
                <param name="max_lo"
>100</param>
        </generator>
</id
>
```

Unfortunately, you cannot use `hilo` when supplying your own `Connection` to Hibernate. When Hibernate uses an application server datasource to obtain connections enlisted with JTA, you must configure the `hibernate.transaction.manager_lookup_class`.

5.1.4.3. UUID-Algorithmus

The UUID contains: IP address, startup time of the JVM that is accurate to a quarter second, system time and a counter value that is unique within the JVM. It is not possible to obtain a MAC address or memory address from Java code, so this is the best option without using JNI.

5.1.4.4. Identitätsspalten und Sequenzen

For databases that support identity columns (DB2, MySQL, Sybase, MS SQL), you can use `identity` key generation. For databases that support sequences (DB2, Oracle, PostgreSQL, Interbase, McKoi, SAP DB) you can use `sequence` style key generation. Both of these strategies require two SQL queries to insert a new object. For example:

```
<id name="id" type="long" column="person_id">
        <generator class="sequence">
                <param name="sequence"
```

```
>person_id_sequence</param>
        </generator>
</id
>
```

```
<id name="id" type="long" column="person_id" unsaved-value="0">
        <generator class="identity"/>
</id
>
```

For cross-platform development, the `native` strategy will, depending on the capabilities of the underlying database, choose from the `identity`, `sequence` and `hilo` strategies.

5.1.4.5. Zugeordnete Bezeichner

If you want the application to assign identifiers, as opposed to having Hibernate generate them, you can use the `assigned` generator. This special generator uses the identifier value already assigned to the object's identifier property. The generator is used when the primary key is a natural key instead of a surrogate key. This is the default behavior if you do not specify a `<generator>` element.

The `assigned` generator makes Hibernate use `unsaved-value="undefined"`. This forces Hibernate to go to the database to determine if an instance is transient or detached, unless there is a version or timestamp property, or you define `Interceptor.isUnsaved()`.

5.1.4.6. Durch Trigger zugeordnete Primärschlüssel

Hibernate does not generate DDL with triggers. It is for legacy schemas only.

```
<id name="id" type="long" column="person_id">
        <generator class="select">
                <param name="key"
>socialSecurityNumber</param>
        </generator>
</id
>
```

In the above example, there is a unique valued property named `socialSecurityNumber`. It is defined by the class, as a natural key and a surrogate key named `person_id`, whose value is generated by a trigger.

5.1.5. Enhanced identifier generators

Starting with release 3.2.3, there are 2 new generators which represent a re-thinking of 2 different aspects of identifier generation. The first aspect is database portability; the second is optimization Optimization means that you do not have to query the database for every request for a new identifier value. These two new generators are intended to take the place of some of the named

generators described above, starting in 3.3.x. However, they are included in the current releases and can be referenced by FQN.

The first of these new generators is `org.hibernate.id.enhanced.SequenceStyleGenerator` which is intended, firstly, as a replacement for the `sequence` generator and, secondly, as a better portability generator than `native`. This is because `native` generally chooses between `identity` and `sequence` which have largely different semantics that can cause subtle issues in applications eyeing portability. `org.hibernate.id.enhanced.SequenceStyleGenerator`, however, achieves portability in a different manner. It chooses between a table or a sequence in the database to store its incrementing values, depending on the capabilities of the dialect being used. The difference between this and `native` is that table-based and sequence-based storage have the same exact semantic. In fact, sequences are exactly what Hibernate tries to emulate with its table-based generators. This generator has a number of configuration parameters:

- `sequence_name` (optional, defaults to `hibernate_sequence`): the name of the sequence or table to be used.
- `initial_value` (optional, defaults to `1`): the initial value to be retrieved from the sequence/table. In sequence creation terms, this is analogous to the clause typically named "STARTS WITH".
- `increment_size` (optional - defaults to `1`): the value by which subsequent calls to the sequence/table should differ. In sequence creation terms, this is analogous to the clause typically named "INCREMENT BY".
- `force_table_use` (optional - defaults to `false`): should we force the use of a table as the backing structure even though the dialect might support sequence?
- `value_column` (optional - defaults to `next_val`): only relevant for table structures, it is the name of the column on the table which is used to hold the value.
- `optimizer` (optional - defaults to `none`): See *Abschnitt 5.1.6, „Identifier generator optimization“*

The second of these new generators is `org.hibernate.id.enhanced.TableGenerator`, which is intended, firstly, as a replacement for the `table` generator, even though it actually functions much more like `org.hibernate.id.MultipleHiLoPerTableGenerator`, and secondly, as a re-implementation of `org.hibernate.id.MultipleHiLoPerTableGenerator` that utilizes the notion of pluggable optimizers. Essentially this generator defines a table capable of holding a number of different increment values simultaneously by using multiple distinctly keyed rows. This generator has a number of configuration parameters:

- `table_name` (optional - defaults to `hibernate_sequences`): the name of the table to be used.
- `value_column_name` (optional - defaults to `next_val`): the name of the column on the table that is used to hold the value.
- `segment_column_name` (optional - defaults to `sequence_name`): the name of the column on the table that is used to hold the "segment key". This is the value which identifies which increment value to use.
- `segment_value` (optional - defaults to `default`): The "segment key" value for the segment from which we want to pull increment values for this generator.
- `segment_value_length` (optional - defaults to `255`): Used for schema generation; the column size to create this segment key column.

- `initial_value` (optional - defaults to `1`): The initial value to be retrieved from the table.
- `increment_size` (optional - defaults to `1`): The value by which subsequent calls to the table should differ.
- `optimizer` (optional - defaults to): See *Abschnitt 5.1.6, „Identifier generator optimization“*

5.1.6. Identifier generator optimization

For identifier generators that store values in the database, it is inefficient for them to hit the database on each and every call to generate a new identifier value. Instead, you can group a bunch of them in memory and only hit the database when you have exhausted your in-memory value group. This is the role of the pluggable optimizers. Currently only the two enhanced generators (*Abschnitt 5.1.5, „Enhanced identifier generators“* support this operation.

- `none` (generally this is the default if no optimizer was specified): this will not perform any optimizations and hit the database for each and every request.
- `hilo`: applies a hi/lo algorithm around the database retrieved values. The values from the database for this optimizer are expected to be sequential. The values retrieved from the database structure for this optimizer indicates the "group number". The `increment_size` is multiplied by that value in memory to define a group "hi value".
- `pooled`: as with the case of `hilo`, this optimizer attempts to minimize the number of hits to the database. Here, however, we simply store the starting value for the "next group" into the database structure rather than a sequential value in combination with an in-memory grouping algorithm. Here, `increment_size` refers to the values coming from the database.

5.1.7. composite-id

```
<composite-id
        name="propertyName"
        class="ClassName"
        mapped="true|false"
        access="field|property|ClassName">
        node="element-name|."

        <key-property name="propertyName" type="typename" column="column_name"/>
        <key-many-to-one name="propertyName" class="ClassName" column="column_name"/>
        ......
</composite-id
>
```

A table with a composite key can be mapped with multiple properties of the class as identifier properties. The `<composite-id>` element accepts `<key-property>` property mappings and `<key-many-to-one>` mappings as child elements.

```
<composite-id>
        <key-property name="medicareNumber"/>
        <key-property name="dependent"/>
</composite-id
```

```
>
```

The persistent class *must* override `equals()` and `hashCode()` to implement composite identifier equality. It must also implement `Serializable`.

Unfortunately, this approach means that a persistent object is its own identifier. There is no convenient "handle" other than the object itself. You must instantiate an instance of the persistent class itself and populate its identifier properties before you can `load()` the persistent state associated with a composite key. We call this approach an *embedded* composite identifier, and discourage it for serious applications.

Eine zweite Vorgehensweise trägt den Namen *gemappter* zusammengesetzter Bezeichner (sog. "mapped composite identifier"), wobei die innerhalb des `<composite-id>`-Elements genannten Bezeichner-Properties sowohl an der persistenten Klasse als auch einer separaten Bezeichnerklasse dupliziert werden.

```
<composite-id class="MedicareId" mapped="true">
        <key-property name="medicareNumber"/>
        <key-property name="dependent"/>
</composite-id
>
```

In this example, both the composite identifier class, `MedicareId`, and the entity class itself have properties named `medicareNumber` and `dependent`. The identifier class must override `equals()` and `hashCode()` and implement `Serializable`. The main disadvantage of this approach is code duplication.

Die folgenden Attribute werden verwendet, um einen gemappten zusammengesetzten Bezeichner zu bestimmen:

- `mapped` (optional - defaults to `false`): indicates that a mapped composite identifier is used, and that the contained property mappings refer to both the entity class and the composite identifier class.
- `class` (optional - but required for a mapped composite identifier): the class used as a composite identifier.

We will describe a third, even more convenient approach, where the composite identifier is implemented as a component class in *Abschnitt 8.4, „Komponenten als zusammengesetzte Bezeichner“*. The attributes described below apply only to this alternative approach:

- `name` (optional - required for this approach): a property of component type that holds the composite identifier. Please see chapter 9 for more information.
- `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the property value.
- `class` (optional - defaults to the property type determined by reflection): the component class used as a composite identifier. Please see the next section for more information.

The third approach, an *identifier component*, is recommended for almost all applications.

5.1.8. Discriminator

The `<discriminator>` element is required for polymorphic persistence using the table-per-class-hierarchy mapping strategy. It declares a discriminator column of the table. The discriminator column contains marker values that tell the persistence layer what subclass to instantiate for a particular row. A restricted set of types can be used: `string`, `character`, `integer`, `byte`, `short`, `boolean`, `yes_no`, `true_false`.

```
<discriminator
        column="discriminator_column"                    (1)
        type="discriminator_type"                        (2)
        force="true|false"                               (3)
        insert="true|false"                              (4)
        formula="arbitrary sql expression"               (5)
/>
```

1. `column` (optional - defaults to `class`): the name of the discriminator column.
2. `type` (optional - defaults to `string`): a name that indicates the Hibernate type
3. `force` (optional - defaults to `false`): "forces" Hibernate to specify the allowed discriminator values, even when retrieving all instances of the root class.
4. `insert` (optional - defaults to `true`): set this to `false` if your discriminator column is also part of a mapped composite identifier. It tells Hibernate not to include the column in SQL `INSERT`s.
5. `formula` (optional): an arbitrary SQL expression that is executed when a type has to be evaluated. It allows content-based discrimination.

Die tatsächlichen Werte der Diskriminatorspalte werden durch das `discriminator-value`-Attribut der `<class>` und `<subclass>`-Elemente spezifiziert.

The `force` attribute is only useful if the table contains rows with "extra" discriminator values that are not mapped to a persistent class. This will not usually be the case.

The `formula` attribute allows you to declare an arbitrary SQL expression that will be used to evaluate the type of a row. For example:

```
<discriminator
    formula="case when CLASS_TYPE in ('a', 'b', 'c') then 0 else 1 end"
    type="integer"/>
```

5.1.9. Version (optional)

The `<version>` element is optional and indicates that the table contains versioned data. This is particularly useful if you plan to use *long transactions*. See below for more information:

```
<version
        column="version_column"                                    1
        name="propertyName"                                        2
        type="typename"                                            3
        access="field|property|ClassName"                          4
        unsaved-value="null|negative|undefined"                    5
        generated="never|always"                                   6
        insert="true|false"                                        7
        node="element-name|@attribute-name|element/@attribute|."
/>
```

1. `column` (optional - defaults to the property name): the name of the column holding the version number.
2. `name`: the name of a property of the persistent class.
3. `type` (optional - defaults to `integer`): the type of the version number.
4. `access` (optional - defaults to `property`): the strategy Hibernate uses to access the property value.
5. `unsaved-value` (optional - defaults to `undefined`): a version property value that indicates that an instance is newly instantiated (unsaved), distinguishing it from detached instances that were saved or loaded in a previous session. `Undefined` specifies that the identifier property value should be used.
6. `generated` (optional - defaults to `never`): specifies that this version property value is generated by the database. See the discussion of *generated properties* for more information.
7. `insert` (optional - defaults to `true`): specifies whether the version column should be included in SQL insert statements. It can be set to `false` if the database column is defined with a default value of `0`.

Version numbers can be of Hibernate type `long`, `integer`, `short`, `timestamp` or `calendar`.

A version or timestamp property should never be null for a detached instance. Hibernate will detect any instance with a null version or timestamp as transient, irrespective of what other `unsaved-value` strategies are specified. *Declaring a nullable version or timestamp property is an easy way to avoid problems with transitive reattachment in Hibernate. It is especially useful for people using assigned identifiers or composite keys*.

5.1.10. Timestamp (optional)

The optional `<timestamp>` element indicates that the table contains timestamped data. This provides an alternative to versioning. Timestamps are a less safe implementation of optimistic locking. However, sometimes the application might use the timestamps in other ways.

```
<timestamp
        column="timestamp_column"                                  1
```

```
        name="propertyName"                                                    (2)
        access="field|property|ClassName"                                      (3)
        unsaved-value="null|undefined"                                         (4)
        source="vm|db"                                                         (5)
        generated="never|always"                                               (6)
        node="element-name|@attribute-name|element/@attribute|."
/>
```

(1) `column` (optional - defaults to the property name): the name of a column holding the timestamp.

(2) `name`: the name of a JavaBeans style property of Java type `Date` or `Timestamp` of the persistent class.

(3) `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the property value.

(4) `unsaved-value` (optional - defaults to `null`): a version property value that indicates that an instance is newly instantiated (unsaved), distinguishing it from detached instances that were saved or loaded in a previous session. `Undefined` specifies that the identifier property value should be used.

(5) `source` (optional - defaults to `vm`): Where should Hibernate retrieve the timestamp value from? From the database, or from the current JVM? Database-based timestamps incur an overhead because Hibernate must hit the database in order to determine the "next value". It is safer to use in clustered environments. Not all `Dialects` are known to support the retrieval of the database's current timestamp. Others may also be unsafe for usage in locking due to lack of precision (Oracle 8, for example).

(6) `generated` (optional - defaults to `never`): specifies that this timestamp property value is actually generated by the database. See the discussion of *generated properties* for more information.

Note

`<Timestamp>` is equivalent to `<version type="timestamp">`. And `<timestamp source="db">` is equivalent to `<version type="dbtimestamp">`

5.1.11. Property

The `<property>` element declares a persistent JavaBean style property of the class.

```
<property
        name="propertyName"                                                    (1)
        column="column_name"                                                   (2)
        type="typename"                                                        (3)
        update="true|false"                                                    (4)
```

```
        insert="true|false"                                                    4
        formula="arbitrary SQL expression"                                     5
        access="field|property|ClassName"                                      6
        lazy="true|false"                                                      7
        unique="true|false"                                                    8
        not-null="true|false"                                                  9
        optimistic-lock="true|false"                                           10
        generated="never|insert|always"                                        11
        node="element-name|@attribute-name|element/@attribute|."
        index="index_name"
        unique_key="unique_key_id"
        length="L"
        precision="P"
        scale="S"
/>
```

1. `name`: Der Name der Property mit klein geschriebenem Anfangsbuchstaben.
2. `column` (optional - defaults to the property name): the name of the mapped database table column. This can also be specified by nested `<column>` element(s).
3. `type` (optional): Ein Name, der den Hibernate-Typ anzeigt.
4. `update, insert` (optional - defaults to `true`): specifies that the mapped columns should be included in SQL `UPDATE` and/or `INSERT` statements. Setting both to `false` allows a pure "derived" property whose value is initialized from some other property that maps to the same column(s), or by a trigger or other application.
5. `formula` (optional): ein SQL-Ausdruck, der den Wert für eine *errechnete* Property definiert. Errechnete Properties besitzen kein eigenes Spalten-Mapping.
6. `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the property value.
7. `lazy` (optional - defaults to `false`): specifies that this property should be fetched lazily when the instance variable is first accessed. It requires build-time bytecode instrumentation.
8. `unique` (optional): enables the DDL generation of a unique constraint for the columns. Also, allow this to be the target of a `property-ref`.
9. `not-null` (optional): enables the DDL generation of a nullability constraint for the columns.
10. `optimistic-lock` (optional - defaults to `true`): specifies that updates to this property do or do not require acquisition of the optimistic lock. In other words, it determines if a version increment should occur when this property is dirty.
11. `generated` (optional - defaults to `never`): specifies that this property value is actually generated by the database. See the discussion of *generated properties* for more information.

typename könnte sein:

1. The name of a Hibernate basic type: `integer, string, character, date, timestamp, float, binary, serializable, object, blob` etc.
2. The name of a Java class with a default basic type: `int, float, char, java.lang.String, java.util.Date, java.lang.Integer, java.sql.Clob` etc.

3. Der Name einer serialisierbaren Java-Klasse.
4. The class name of a custom type: `com.illflow.type.MyCustomType` etc.

If you do not specify a type, Hibernate will use reflection upon the named property and guess the correct Hibernate type. Hibernate will attempt to interpret the name of the return class of the property getter using, in order, rules 2, 3, and 4. In certain cases you will need the `type` attribute. For example, to distinguish between `Hibernate.DATE` and `Hibernate.TIMESTAMP`, or to specify a custom type.

The `access` attribute allows you to control how Hibernate accesses the property at runtime. By default, Hibernate will call the property get/set pair. If you specify `access="field"`, Hibernate will bypass the get/set pair and access the field directly using reflection. You can specify your own strategy for property access by naming a class that implements the interface `org.hibernate.property.PropertyAccessor`.

A powerful feature is derived properties. These properties are by definition read-only. The property value is computed at load time. You declare the computation as an SQL expression. This then translates to a `SELECT` clause subquery in the SQL query that loads an instance:

```
<property name="totalPrice"
    formula="( SELECT SUM (li.quantity*p.price) FROM LineItem li, Product p
                WHERE li.productId = p.productId
                AND li.customerId = customerId
                AND li.orderNumber = orderNumber )"/>
```

You can reference the entity table by not declaring an alias on a particular column. This would be `customerId` in the given example. You can also use the nested `<formula>` mapping element if you do not want to use the attribute.

5.1.12. Many-to-one

An ordinary association to another persistent class is declared using a `many-to-one` element. The relational model is a many-to-one association; a foreign key in one table is referencing the primary key column(s) of the target table.

```
<many-to-one
        name="propertyName"                                    1
        column="column_name"                                   2
        class="ClassName"                                      3
        cascade="cascade_style"                                4
        fetch="join|select"                                    5
        update="true|false"                                    6
        insert="true|false"                                    6
        property-ref="propertyNameFromAssociatedClass"         7
```

```
        access="field|property|ClassName"                                    8
        unique="true|false"                                                  9
        not-null="true|false"                                                10
        optimistic-lock="true|false"                                         11
        lazy="proxy|no-proxy|false"                                          12
        not-found="ignore|exception"                                         13
        entity-name="EntityName"                                             14
        formula="arbitrary SQL expression"                                   15
        node="element-name|@attribute-name|element/@attribute|."
        embed-xml="true|false"
        index="index_name"
        unique_key="unique_key_id"
        foreign-key="foreign_key_name"
/>
```

1. `name`: the name of the property.
2. `column` (optional): the name of the foreign key column. This can also be specified by nested `<column>` element(s).
3. `class` (optional - defaults to the property type determined by reflection): the name of the associated class.
4. `cascade` (optional): specifies which operations should be cascaded from the parent object to the associated object.
5. `fetch` (optional - defaults to `select`): chooses between outer-join fetching or sequential select fetching.
6. `update, insert` (optional - defaults to `true`): specifies that the mapped columns should be included in SQL `UPDATE` and/or `INSERT` statements. Setting both to `false` allows a pure "derived" association whose value is initialized from another property that maps to the same column(s), or by a trigger or other application.
7. `property-ref` (optional): the name of a property of the associated class that is joined to this foreign key. If not specified, the primary key of the associated class is used.
8. `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the property value.
9. `unique` (optional): enables the DDL generation of a unique constraint for the foreign-key column. By allowing this to be the target of a `property-ref`, you can make the association multiplicity one-to-one.
10. `not-null` (optional): enables the DDL generation of a nullability constraint for the foreign key columns.
11. `optimistic-lock` (optional - defaults to `true`): specifies that updates to this property do or do not require acquisition of the optimistic lock. In other words, it determines if a version increment should occur when this property is dirty.
12. `lazy` (optional - defaults to `proxy`): by default, single point associations are proxied. `lazy="no-proxy"` specifies that the property should be fetched lazily when the instance variable is first accessed. This requires build-time bytecode instrumentation. `lazy="false"` specifies that the association will always be eagerly fetched.

13. `not-found` (optional - defaults to `exception`): specifies how foreign keys that reference missing rows will be handled. `ignore` will treat a missing row as a null association.
14. `entity-name` (optional): the entity name of the associated class.
15. `formula` (optional): Ein SQL-Ausdruck, der den Wert für einen *errechneten* Fremdschlüssel definiert.

Setting a value of the `cascade` attribute to any meaningful value other than `none` will propagate certain operations to the associated object. The meaningful values are divided into three categories. First, basic operations, which include: `persist, merge, delete, save-update, evict, replicate, lock and refresh`; second, special values: `delete-orphan`; and third, `all` comma-separated combinations of operation names: `cascade="persist,merge,evict"` or `cascade="all,delete-orphan"`. See *Abschnitt 10.11, „Transitive Persistenz“* for a full explanation. Note that single valued, many-to-one and one-to-one, associations do not support orphan delete.

Here is an example of a typical `many-to-one` declaration:

```
<many-to-one name="product" class="Product" column="PRODUCT_ID"/>
```

The `property-ref` attribute should only be used for mapping legacy data where a foreign key refers to a unique key of the associated table other than the primary key. This is a complicated and confusing relational model. For example, if the `Product` class had a unique serial number that is not the primary key. The `unique` attribute controls Hibernate's DDL generation with the SchemaExport tool.

```
<property name="serialNumber" unique="true" type="string" column="SERIAL_NUMBER"/>
```

Dann könnte das Mapping für `OrderItem` folgendes verwenden:

```
<many-to-one name="product" property-ref="serialNumber" column="PRODUCT_SERIAL_NUMBER"/>
```

This is not encouraged, however.

Wenn der eindeutige Schlüssel, auf den verwiesen wird, mehrere Properties der zugehörigen Entity enthält, so sollten die Properties, auf die verwiesen wird, in einem benannten `<properties>`-Element gemappt werden.

If the referenced unique key is the property of a component, you can specify a property path:

```
<many-to-one name="owner" property-ref="identity.ssn" column="OWNER_SSN"/>
```

5.1.13. One-to-one

Eine "One-to-One"-Assoziation mit einer anderen persistenten Klasse wird unter Verwendung eines `one-to-one`-Elements deklariert.

```
<one-to-one
        name="propertyName"                                                    (1)
        class="ClassName"                                                      (2)
        cascade="cascade_style"                                                (3)
        constrained="true|false"                                               (4)
        fetch="join|select"                                                    (5)
        property-ref="propertyNameFromAssociatedClass"                         (6)
        access="field|property|ClassName"                                      (7)
        formula="any SQL expression"                                           (8)
        lazy="proxy|no-proxy|false"                                            (9)
        entity-name="EntityName"                                               (10)
        node="element-name|@attribute-name|element/@attribute|."
        embed-xml="true|false"
        foreign-key="foreign_key_name"
/>
```

1. `name`: the name of the property.
2. `class` (optional - defaults to the property type determined by reflection): the name of the associated class.
3. `cascade` (optional): specifies which operations should be cascaded from the parent object to the associated object.
4. `constrained` (optional): specifies that a foreign key constraint on the primary key of the mapped table and references the table of the associated class. This option affects the order in which `save()` and `delete()` are cascaded, and determines whether the association can be proxied. It is also used by the schema export tool.
5. `fetch` (optional - defaults to `select`): chooses between outer-join fetching or sequential select fetching.
6. `property-ref` (optional): the name of a property of the associated class that is joined to the primary key of this class. If not specified, the primary key of the associated class is used.
7. `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the property value.
8. `formula` (optional): almost all one-to-one associations map to the primary key of the owning entity. If this is not the case, you can specify another column, columns or expression to join on using an SQL formula. See `org.hibernate.test.onetooneformula` for an example.
9. `lazy` (optional - defaults to `proxy`): by default, single point associations are proxied. `lazy="no-proxy"` specifies that the property should be fetched lazily when the instance variable is first accessed. It requires build-time bytecode instrumentation. `lazy="false"` specifies that the association will always be eagerly fetched. *Note that*

if `constrained="false"`, proxying is impossible and Hibernate will eagerly fetch the association.

10. `entity-name` (optional): the entity name of the associated class.

There are two varieties of one-to-one associations:

- Assoziationen des Primärschlüssels
- Assoziationen eines eindeutigen Fremdschlüssels

Primary key associations do not need an extra table column. If two rows are related by the association, then the two table rows share the same primary key value. To relate two objects by a primary key association, ensure that they are assigned the same identifier value.

For a primary key association, add the following mappings to `Employee` and `Person` respectively:

```
<one-to-one name="person" class="Person"/>
```

```
<one-to-one name="employee" class="Employee" constrained="true"/>
```

Ensure that the primary keys of the related rows in the PERSON and EMPLOYEE tables are equal. You use a special Hibernate identifier generation strategy called `foreign`:

```
<class name="person" table="PERSON">
    <id name="id" column="PERSON_ID">
        <generator class="foreign">
            <param name="property"
>employee</param>
        </generator>
    </id>
    ...
    <one-to-one name="employee"
        class="Employee"
        constrained="true"/>
</class
>
```

A newly saved instance of `Person` is assigned the same primary key value as the `Employee` instance referred with the `employee` property of that `Person`.

Alternatively, a foreign key with a unique constraint, from `Employee` to `Person`, can be expressed as:

```
<many-to-one name="person" class="Person" column="PERSON_ID" unique="true"/>
```

This association can be made bidirectional by adding the following to the `Person` mapping:

```
<one-to-one name="employee" class="Employee" property-ref="person"/>
```

5.1.14. Natural-id

```
<natural-id mutable="true|false"/>
        <property ... />
        <many-to-one ... />
        ......
</natural-id
>
```

Although we recommend the use of surrogate keys as primary keys, you should try to identify natural keys for all entities. A natural key is a property or combination of properties that is unique and non-null. It is also immutable. Map the properties of the natural key inside the `<natural-id>` element. Hibernate will generate the necessary unique key and nullability constraints and, as a result, your mapping will be more self-documenting.

It is recommended that you implement `equals()` and `hashCode()` to compare the natural key properties of the entity.

This mapping is not intended for use with entities that have natural primary keys.

- `mutable` (optional - defaults to `false`): by default, natural identifier properties are assumed to be immutable (constant).

5.1.15. Component and dynamic-component

The `<component>` element maps properties of a child object to columns of the table of a parent class. Components can, in turn, declare their own properties, components or collections. See the "Component" examples below:

```
<component
        name="propertyName"                          1
        class="className"                            2
        insert="true|false"                          3
        update="true|false"                          4
        access="field|property|ClassName"            5
        lazy="true|false"                            6
        optimistic-lock="true|false"                 7
        unique="true|false"                          8
        node="element-name|."
>
```

```
        <property ...../>
        <many-to-one .... />
        ........
</component
>
```

1. `name`: the name of the property.
2. `class` (optional - defaults to the property type determined by reflection): the name of the component (child) class.
3. `insert`: do the mapped columns appear in SQL `INSERT`s?
4. `update`: do the mapped columns appear in SQL `UPDATE`s?
5. `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the property value.
6. `lazy` (optional - defaults to `false`): specifies that this component should be fetched lazily when the instance variable is first accessed. It requires build-time bytecode instrumentation.
7. `optimistic-lock` (optional - defaults to `true`): specifies that updates to this component either do or do not require acquisition of the optimistic lock. It determines if a version increment should occur when this property is dirty.
8. `unique` (optional - defaults to `false`): specifies that a unique constraint exists upon all mapped columns of the component.

Die untergeordneten `<property>`-Tags mappen Properties der untergeordneten Klasse zu den Spalten der Tabelle.

Das `<component>`-Element ermöglicht ein `<parent>`-Subelement, das eine Property der Komponentenklasse als Rückreferenz zur enthaltenden Entity mappt.

The `<dynamic-component>` element allows a `Map` to be mapped as a component, where the property names refer to keys of the map. See *Abschnitt 8.5, „Dynamische Komponenten“* for more information.

5.1.16. Properties

The `<properties>` element allows the definition of a named, logical grouping of the properties of a class. The most important use of the construct is that it allows a combination of properties to be the target of a `property-ref`. It is also a convenient way to define a multi-column unique constraint. For example:

```
<properties
        name="logicalName"                  1
        insert="true|false"                 2
        update="true|false"                 3
        optimistic-lock="true|false"        4
        unique="true|false"                 5
>
```

```
        <property ...../>
        <many-to-one .... />
        ........
</properties
>
```

1. `name`: the logical name of the grouping. It is *not* an actual property name.
2. `insert`: do the mapped columns appear in SQL `INSERT`s?
3. `update`: do the mapped columns appear in SQL `UPDATE`s?
4. `optimistic-lock` (optional - defaults to `true`): specifies that updates to these properties either do or do not require acquisition of the optimistic lock. It determines if a version increment should occur when these properties are dirty.
5. `unique` (optional - defaults to `false`): specifies that a unique constraint exists upon all mapped columns of the component.

Nehmen wir etwa das folgende `<properties>`-Mapping:

```
<class name="Person">
    <id name="personNumber"/>

    ...
    <properties name="name"
            unique="true" update="false">
        <property name="firstName"/>
        <property name="initial"/>
        <property name="lastName"/>
    </properties>
</class
>
```

You might have some legacy data association that refers to this unique key of the `Person` table, instead of to the primary key:

```
<many-to-one name="person"
         class="Person" property-ref="name">
    <column name="firstName"/>
    <column name="initial"/>
    <column name="lastName"/>
</many-to-one
>
```

The use of this outside the context of mapping legacy data is not recommended.

5.1.17. Subclass

Polymorphic persistence requires the declaration of each subclass of the root persistent class. For the table-per-class-hierarchy mapping strategy, the `<subclass>` declaration is used. For example:

```
<subclass
        name="ClassName"                                    (1)
        discriminator-value="discriminator_value"           (2)
        proxy="ProxyInterface"                              (3)
        lazy="true|false"                                   (4)
        dynamic-update="true|false"
        dynamic-insert="true|false"
        entity-name="EntityName"
        node="element-name"
        extends="SuperclassName">

        <property .... />
        .....
</subclass
>
```

1. `name`: the fully qualified class name of the subclass.
2. `discriminator-value` (optional - defaults to the class name): a value that distinguishes individual subclasses.
3. `proxy` (optional): specifies a class or interface used for lazy initializing proxies.
4. `lazy` (optional - defaults to `true`): setting `lazy="false"` disables the use of lazy fetching.

Each subclass declares its own persistent properties and subclasses. `<version>` and `<id>` properties are assumed to be inherited from the root class. Each subclass in a hierarchy must define a unique `discriminator-value`. If this is not specified, the fully qualified Java class name is used.

For information about inheritance mappings see *Kapitel 9, Inheritance mapping*.

5.1.18. Joined-subclass

Each subclass can also be mapped to its own table. This is called the table-per-subclass mapping strategy. An inherited state is retrieved by joining with the table of the superclass. To do this you use the `<joined-subclass>` element. For example:

```
<joined-subclass
        name="ClassName"                                    (1)
        table="tablename"                                   (2)
        proxy="ProxyInterface"                              (3)
        lazy="true|false"                                   (4)
        dynamic-update="true|false"
        dynamic-insert="true|false"
        schema="schema"
        catalog="catalog"
        extends="SuperclassName"
        persister="ClassName"
        subselect="SQL expression"
```

```
        entity-name="EntityName"
        node="element-name">

        <key .... >

        <property .... />
        .....
</joined-subclass
>
```

1. `name`: the fully qualified class name of the subclass.
2. `table`: the name of the subclass table.
3. `proxy` (optional): specifies a class or interface to use for lazy initializing proxies.
4. `lazy` (optional, defaults to `true`): setting `lazy="false"` disables the use of lazy fetching.

A discriminator column is not required for this mapping strategy. Each subclass must, however, declare a table column holding the object identifier using the `<key>` element. The mapping at the start of the chapter would then be re-written as:

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC
        "-//Hibernate/Hibernate Mapping DTD//EN"
        "http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">

<hibernate-mapping package="eg">

        <class name="Cat" table="CATS">
                <id name="id" column="uid" type="long">
                        <generator class="hilo"/>
                </id>
                <property name="birthdate" type="date"/>
                <property name="color" not-null="true"/>
                <property name="sex" not-null="true"/>
                <property name="weight"/>
                <many-to-one name="mate"/>
                <set name="kittens">
                        <key column="MOTHER"/>
                        <one-to-many class="Cat"/>
                </set>
                <joined-subclass name="DomesticCat" table="DOMESTIC_CATS">
                    <key column="CAT"/>
                    <property name="name" type="string"/>
                </joined-subclass>
        </class>

        <class name="eg.Dog">
                <!-- mapping for Dog could go here -->
        </class>

</hibernate-mapping
>
```

For information about inheritance mappings see *Kapitel 9, Inheritance mapping*.

5.1.19. Union-subclass

A third option is to map only the concrete classes of an inheritance hierarchy to tables. This is called the table-per-concrete-class strategy. Each table defines all persistent states of the class, including the inherited state. In Hibernate, it is not necessary to explicitly map such inheritance hierarchies. You can map each class with a separate `<class>` declaration. However, if you wish use polymorphic associations (e.g. an association to the superclass of your hierarchy), you need to use the `<union-subclass>` mapping. For example:

```
<union-subclass
        name="ClassName"                    (1)
        table="tablename"                   (2)
        proxy="ProxyInterface"              (3)
        lazy="true|false"                   (4)
        dynamic-update="true|false"
        dynamic-insert="true|false"
        schema="schema"
        catalog="catalog"
        extends="SuperclassName"
        abstract="true|false"
        persister="ClassName"
        subselect="SQL expression"
        entity-name="EntityName"
        node="element-name">

        <property .... />
        .....
</union-subclass
>
```

1. `name`: the fully qualified class name of the subclass.
2. `table`: the name of the subclass table.
3. `proxy` (optional): specifies a class or interface to use for lazy initializing proxies.
4. `lazy` (optional, defaults to `true`): setting `lazy="false"` disables the use of lazy fetching.

Für diese Mapping-Strategie ist keine Diskriminatorspalte oder Schlüsselspalte erforderlich.

For information about inheritance mappings see *Kapitel 9, Inheritance mapping*.

5.1.20. Join

Using the `<join>` element, it is possible to map properties of one class to several tables that have a one-to-one relationship. For example:

```
<join
```

```
        table="tablename"                                    1
        schema="owner"                                       2
        catalog="catalog"                                    3
        fetch="join|select"                                  4
        inverse="true|false"                                 5
        optional="true|false">                               6

        <key ... />

        <property ... />
        ...
</join
>
```

1. `table`: the name of the joined table.
2. `schema` (optional): overrides the schema name specified by the root `<hibernate-mapping>` element.
3. `catalog` (optional): overrides the catalog name specified by the root `<hibernate-mapping>` element.
4. `fetch` (optional - defaults to `join`): if set to `join`, the default, Hibernate will use an inner join to retrieve a `<join>` defined by a class or its superclasses. It will use an outer join for a `<join>` defined by a subclass. If set to `select` then Hibernate will use a sequential select for a `<join>` defined on a subclass. This will be issued only if a row represents an instance of the subclass. Inner joins will still be used to retrieve a `<join>` defined by the class and its superclasses.
5. `inverse` (optional - defaults to `false`): if enabled, Hibernate will not insert or update the properties defined by this join.
6. `optional` (optional - defaults to `false`): if enabled, Hibernate will insert a row only if the properties defined by this join are non-null. It will always use an outer join to retrieve the properties.

For example, address information for a person can be mapped to a separate table while preserving value type semantics for all properties:

```
<class name="Person"
    table="PERSON">

    <id name="id" column="PERSON_ID"
>...</id>

    <join table="ADDRESS">
        <key column="ADDRESS_ID"/>
        <property name="address"/>
        <property name="zip"/>
        <property name="country"/>
    </join>
    ...
```

This feature is often only useful for legacy data models. We recommend fewer tables than classes and a fine-grained domain model. However, it is useful for switching between inheritance mapping strategies in a single hierarchy, as explained later.

5.1.21. Key

The `<key>` element has featured a few times within this guide. It appears anywhere the parent mapping element defines a join to a new table that references the primary key of the original table. It also defines the foreign key in the joined table:

```
<key
        column="columnname"                    (1)
        on-delete="noaction|cascade"           (2)
        property-ref="propertyName"            (3)
        not-null="true|false"                  (4)
        update="true|false"                    (5)
        unique="true|false"                    (6)
/>
```

(1) `column` (optional): the name of the foreign key column. This can also be specified by nested `<column>` element(s).
(2) `on-delete` (optional - defaults to `noaction`): specifies whether the foreign key constraint has database-level cascade delete enabled.
(3) `property-ref` (optional): specifies that the foreign key refers to columns that are not the primary key of the original table. It is provided for legacy data.
(4) `not-null` (optional): specifies that the foreign key columns are not nullable. This is implied whenever the foreign key is also part of the primary key.
(5) `update` (optional): specifies that the foreign key should never be updated. This is implied whenever the foreign key is also part of the primary key.
(6) `unique` (optional): specifies that the foreign key should have a unique constraint. This is implied whenever the foreign key is also the primary key.

For systems where delete performance is important, we recommend that all keys should be defined `on-delete="cascade"`. Hibernate uses a database-level `ON CASCADE DELETE` constraint, instead of many individual `DELETE` statements. Be aware that this feature bypasses Hibernate's usual optimistic locking strategy for versioned data.

The `not-null` and `update` attributes are useful when mapping a unidirectional one-to-many association. If you map a unidirectional one-to-many association to a non-nullable foreign key, you *must* declare the key column using `<key not-null="true">`.

5.1.22. Column and formula elements

Mapping elements which accept a `column` attribute will alternatively accept a `<column>` subelement. Likewise, `<formula>` is an alternative to the `formula` attribute. For example:

```
<column
        name="column_name"
        length="N"
        precision="N"
        scale="N"
        not-null="true|false"
        unique="true|false"
        unique-key="multicolumn_unique_key_name"
        index="index_name"
        sql-type="sql_type_name"
        check="SQL expression"
        default="SQL expression"
        read="SQL expression"
        write="SQL expression"/>
```

```
<formula
>SQL expression</formula
>
```

Most of the attributes on `column` provide a means of tailoring the DDL during automatic schema generation. The `read` and `write` attributes allow you to specify custom SQL that Hibernate will use to access the column's value. For more on this, see the discussion of *column read and write expressions*.

The `column` and `formula` elements can even be combined within the same property or association mapping to express, for example, exotic join conditions.

```
<many-to-one name="homeAddress" class="Address"
        insert="false" update="false">
    <column name="person_id" not-null="true" length="10"/>
    <formula
>'MAILING'</formula>
</many-to-one
>
```

5.1.23. Import

If your application has two persistent classes with the same name, and you do not want to specify the fully qualified package name in Hibernate queries, classes can be "imported" explicitly, rather than relying upon `auto-import="true"`. You can also import classes and interfaces that are not explicitly mapped:

```
<import class="java.lang.Object" rename="Universe"/>
```

```
<import
```

```
        class="ClassName"                                                    (1)
        rename="ShortName"                                                   (2)
/>
```

(1) `class`: the fully qualified class name of any Java class.

(2) `rename` (optional - defaults to the unqualified class name): a name that can be used in the query language.

5.1.24. Any

There is one more type of property mapping. The `<any>` mapping element defines a polymorphic association to classes from multiple tables. This type of mapping requires more than one column. The first column contains the type of the associated entity. The remaining columns contain the identifier. It is impossible to specify a foreign key constraint for this kind of association. This is not the usual way of mapping polymorphic associations and you should use this only in special cases. For example, for audit logs, user session data, etc.

The `meta-type` attribute allows the application to specify a custom type that maps database column values to persistent classes that have identifier properties of the type specified by `id-type`. You must specify the mapping from values of the meta-type to class names.

```
<any name="being" id-type="long" meta-type="string">
    <meta-value value="TBL_ANIMAL" class="Animal"/>
    <meta-value value="TBL_HUMAN" class="Human"/>
    <meta-value value="TBL_ALIEN" class="Alien"/>
    <column name="table_name"/>
    <column name="id"/>
</any
>
```

```
<any
        name="propertyName"                                                  (1)
        id-type="idtypename"                                                 (2)
        meta-type="metatypename"                                             (3)
        cascade="cascade_style"                                              (4)
        access="field|property|ClassName"                                    (5)
        optimistic-lock="true|false"                                         (6)
>
        <meta-value ... />
        <meta-value ... />
        .....
        <column .... />
        <column .... />
        .....
</any
```

```
>
```

1. `name`: Der Property-Name.
2. `id-type`: Der Bezeichnertyp.
3. `meta-type` (optional - defaults to `string`): any type that is allowed for a discriminator mapping.
4. `cascade` (optional- die Standardeinstellung lautet `none`): der "Cascade-Style" (Weitergabestil).
5. `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the property value.
6. `optimistic-lock` (optional - defaults to `true`): specifies that updates to this property either do or do not require acquisition of the optimistic lock. It defines whether a version increment should occur if this property is dirty.

5.2. Hibernate types

5.2.1. Entities und Werte

In relation to the persistence service, Java language-level objects are classified into two groups:

An *entity* exists independently of any other objects holding references to the entity. Contrast this with the usual Java model, where an unreferenced object is garbage collected. Entities must be explicitly saved and deleted. Saves and deletions, however, can be *cascaded* from a parent entity to its children. This is different from the ODMG model of object persistence by reachability and corresponds more closely to how application objects are usually used in large systems. Entities support circular and shared references. They can also be versioned.

An entity's persistent state consists of references to other entities and instances of *value* types. Values are primitives: collections (not what is inside a collection), components and certain immutable objects. Unlike entities, values in particular collections and components, *are* persisted and deleted by reachability. Since value objects and primitives are persisted and deleted along with their containing entity, they cannot be independently versioned. Values have no independent identity, so they cannot be shared by two entities or collections.

Until now, we have been using the term "persistent class" to refer to entities. We will continue to do that. Not all user-defined classes with a persistent state, however, are entities. A *component* is a user-defined class with value semantics. A Java property of type `java.lang.String` also has value semantics. Given this definition, all types (classes) provided by the JDK have value type semantics in Java, while user-defined types can be mapped with entity or value type semantics. This decision is up to the application developer. An entity class in a domain model will normally have shared references to a single instance of that class, while composition or aggregation usually translates to a value type.

We will revisit both concepts throughout this reference guide.

The challenge is to map the Java type system, and the developers' definition of entities and value types, to the SQL/database type system. The bridge between both systems is provided by Hibernate. For entities, `<class>`, `<subclass>` and so on are used. For value types we use `<property>`, `<component>`etc., that usually have a `type` attribute. The value of this attribute is the name of a Hibernate *mapping type*. Hibernate provides a range of mappings for standard JDK value types out of the box. You can write your own mapping types and implement your own custom conversion strategies.

With the exception of collections, all built-in Hibernate types support null semantics.

5.2.2. Grundlegende Wertetypen

The built-in *basic mapping types* can be roughly categorized into the following:

`integer, long, short, float, double, character, byte, boolean, yes_no, true_false`
: Typen-Mappings von Java-"Primitives" oder "Wrapper-Klassen" zu passenden (Anbieter-spezifischen) SQL-Spaltentypen. `boolean`, `yes_no` und `true_false` sind alternative Verschlüsselungen für einen Java `boolean` oder `java.lang.Boolean`.

`string`
: Ein "Type-Mapping" von `java.lang.String` zu `VARCHAR` (oder Oracle `VARCHAR2`).

`date, time, timestamp`
: Type-Mappings von `java.util.Date` und dessen Subklassen zu SQL-Typen `DATE`, `TIME` und `TIMESTAMP` (oder äquivalent).

`calendar, calendar_date`
: Type-Mappings von `java.util.Calendar` zu SQL-Typen `TIMESTAMP` und `DATE` (oder äquivalent).

`big_decimal, big_integer`
: Type-Mappings von `java.math.BigDecimal` und `java.math.BigInteger` zu `NUMERIC` (oder Oracle `NUMBER`).

`locale, timezone, currency`
: Type-Mappings von `java.util.Locale`, `java.util.TimeZone` und `java.util.Currency` zu`VARCHAR` (oder Oracle `VARCHAR2`). Instanzen von `Locale` und `Currency` werden zu ihren ISO-Codes gemappt. Instanzen von `TimeZone` werden zu ihrer `ID` gemappt.

`class`
: Ein Type-Mapping von `java.lang.Class` zu `VARCHAR` (oder Oracle `VARCHAR2`). Eine `Class` wird zu ihrem vollständigen Namen gemappt.

`binary`
: Mappt Byte-Arrays zum zugehörigen SQL-Binärtyp.

`text`
: Mappt lange Java-Strings zum SQL `CLOB` oder `TEXT`-Typ.

`serializable`
: Maps serializable Java types to an appropriate SQL binary type. You can also indicate the Hibernate type `serializable` with the name of a serializable Java class or interface that does not default to a basic type.

`clob, blob`
: Type mappings for the JDBC classes `java.sql.Clob` and `java.sql.Blob`. These types can be inconvenient for some applications, since the blob or clob object cannot be reused outside of a transaction. Driver support is patchy and inconsistent.

`imm_date, imm_time, imm_timestamp, imm_calendar, imm_calendar_date, imm_serializable, imm_binary`
: Type mappings for what are considered mutable Java types. This is where Hibernate makes certain optimizations appropriate only for immutable Java types, and the application treats the object as immutable. For example, you should not call `Date.setTime()` for an instance mapped as `imm_timestamp`. To change the value of the property, and have that change made persistent, the application must assign a new, nonidentical, object to the property.

Unique identifiers of entities and collections can be of any basic type except `binary`, `blob` and `clob`. Composite identifiers are also allowed. See below for more information.

Die grundlegenden Wertetypen haben entsprechende `Type`-Konstanten, die auf `org.hibernate.Hibernate` definiert sind. So repräsentiert `Hibernate.STRING` zum Beispiel den `string`-Typ.

5.2.3. Angepasste Wertetypen

It is relatively easy for developers to create their own value types. For example, you might want to persist properties of type `java.lang.BigInteger` to `VARCHAR` columns. Hibernate does not provide a built-in type for this. Custom types are not limited to mapping a property, or collection element, to a single table column. So, for example, you might have a Java property `getName()`/`setName()` of type `java.lang.String` that is persisted to the columns `FIRST_NAME`, `INITIAL`, `SURNAME`.

To implement a custom type, implement either `org.hibernate.UserType` or `org.hibernate.CompositeUserType` and declare properties using the fully qualified classname of the type. View `org.hibernate.test.DoubleStringType` to see the kind of things that are possible.

```
<property name="twoStrings" type="org.hibernate.test.DoubleStringType">
    <column name="first_string"/>
    <column name="second_string"/>
</property
>
```

Beachten Sie die Verwendung von `<column>`-Tags beim Mappen einer Property zu mehreren Spalten.

Die `CompositeUserType`, `EnhancedUserType`, `UserCollectionType` und `UserVersionType` Interfaces unterstützen auch speziellere Einsatzmöglichkeiten.

You can even supply parameters to a `UserType` in the mapping file. To do this, your `UserType` must implement the `org.hibernate.usertype.ParameterizedType` interface. To supply parameters to your custom type, you can use the `<type>` element in your mapping files.

```
<property name="priority">
    <type name="com.mycompany.usertypes.DefaultValueIntegerType">
        <param name="default"
>0</param>
    </type>
</property
>
```

Der `UserType` kann jetzt den Wert für den Parameter mit Namen `default` von dem an ihn geleiteten `Properties`-Objekt abrufen.

If you regularly use a certain `UserType`, it is useful to define a shorter name for it. You can do this using the `<typedef>` element. Typedefs assign a name to a custom type, and can also contain a list of default parameter values if the type is parameterized.

```
<typedef class="com.mycompany.usertypes.DefaultValueIntegerType" name="default_zero">
    <param name="default"
>0</param>
</typedef
>
```

```
<property name="priority" type="default_zero"/>
```

Es ist auch möglich, die in einer "typedef" bereitgestellten Parameter von Fall zu Fall unter Verwendung der Typ-Parameter des Property-Mappings außer Kraft zu setzen.

Even though Hibernate's rich range of built-in types and support for components means you will rarely need to use a custom type, it is considered good practice to use custom types for non-entity classes that occur frequently in your application. For example, a `MonetaryAmount` class is a good candidate for a `CompositeUserType`, even though it could be mapped as a component. One reason for this is abstraction. With a custom type, your mapping documents would be protected against changes to the way monetary values are represented.

5.3. Das mehrfache Mappen einer Klasse

It is possible to provide more than one mapping for a particular persistent class. In this case, you must specify an *entity name* to disambiguate between instances of the two mapped entities. By default, the entity name is the same as the class name. Hibernate lets you specify the entity name

when working with persistent objects, when writing queries, or when mapping associations to the named entity.

```
<class name="Contract" table="Contracts"
        entity-name="CurrentContract">
    ...
    <set name="history" inverse="true"
            order-by="effectiveEndDate desc">
        <key column="currentContractId"/>
        <one-to-many entity-name="HistoricalContract"/>
    </set>
</class>

<class name="Contract" table="ContractHistory"
        entity-name="HistoricalContract">
    ...
    <many-to-one name="currentContract"
            column="currentContractId"
            entity-name="CurrentContract"/>
</class
>
```

Associations are now specified using `entity-name` instead of `class`.

5.4. SQL angeführte Bezeichner

You can force Hibernate to quote an identifier in the generated SQL by enclosing the table or column name in backticks in the mapping document. Hibernate will use the correct quotation style for the SQL `Dialect`. This is usually double quotes, but the SQL Server uses brackets and MySQL uses backticks.

```
<class name="LineItem" table="`Line Item`">
    <id name="id" column="`Item Id`"/><generator class="assigned"/></id>
    <property name="itemNumber" column="`Item #`"/>
    ...
</class
>
```

5.5. Metadata-Alternativen

XML does not suit all users so there are some alternative ways to define O/R mapping metadata in Hibernate.

5.5.1. Die Verwendung von XDoclet-Markup

Many Hibernate users prefer to embed mapping information directly in sourcecode using XDoclet `@hibernate.tags`. We do not cover this approach in this reference guide since it is considered part of XDoclet. However, we include the following example of the `Cat` class with XDoclet mappings:

```
package eg;
import java.util.Set;
import java.util.Date;

/**
 * @hibernate.class
 *  table="CATS"
 */
public class Cat {
    private Long id; // identifier
    private Date birthdate;
    private Cat mother;
    private Set kittens
    private Color color;
    private char sex;
    private float weight;

    /*
     * @hibernate.id
     *  generator-class="native"
     *  column="CAT_ID"
     */
    public Long getId() {
        return id;
    }
    private void setId(Long id) {
        this.id=id;
    }

    /**
     * @hibernate.many-to-one
     *  column="PARENT_ID"
     */
    public Cat getMother() {
        return mother;
    }
    void setMother(Cat mother) {
        this.mother = mother;
    }

    /**
     * @hibernate.property
     *  column="BIRTH_DATE"
     */
    public Date getBirthdate() {
        return birthdate;
    }
    void setBirthdate(Date date) {
        birthdate = date;
    }
    /**
     * @hibernate.property
     *  column="WEIGHT"
     */
    public float getWeight() {
        return weight;
    }
    void setWeight(float weight) {
```

```
        this.weight = weight;
    }

    /**
     * @hibernate.property
     *  column="COLOR"
     *  not-null="true"
     */
    public Color getColor() {
        return color;
    }
    void setColor(Color color) {
        this.color = color;
    }
    /**
     * @hibernate.set
     *  inverse="true"
     *  order-by="BIRTH_DATE"
     * @hibernate.collection-key
     *  column="PARENT_ID"
     * @hibernate.collection-one-to-many
     */
    public Set getKittens() {
        return kittens;
    }
    void setKittens(Set kittens) {
        this.kittens = kittens;
    }
    // addKitten not needed by Hibernate
    public void addKitten(Cat kitten) {
        kittens.add(kitten);
    }

    /**
     * @hibernate.property
     *  column="SEX"
     *  not-null="true"
     *  update="false"
     */
    public char getSex() {
        return sex;
    }
    void setSex(char sex) {
        this.sex=sex;
    }
}
```

See the Hibernate website for more examples of XDoclet and Hibernate.

5.5.2. Die Verwendung von JDK 5.0 Annotationen

JDK 5.0 introduced XDoclet-style annotations at the language level that are type-safe and checked at compile time. This mechanism is more powerful than XDoclet annotations and better supported by tools and IDEs. IntelliJ IDEA, for example, supports auto-completion and syntax highlighting of JDK 5.0 annotations. The new revision of the EJB specification (JSR-220) uses JDK 5.0 annotations as the primary metadata mechanism for entity beans. Hibernate3 implements the

`EntityManager` of JSR-220 (the persistence API). Support for mapping metadata is available via the *Hibernate Annotations* package as a separate download. Both EJB3 (JSR-220) and Hibernate3 metadata is supported.

Nachfolgend sehen Sie ein Beispiel für eine als EJB Entity-Bean annotierte POJO-Klasse:

```
@Entity(access = AccessType.FIELD)
public class Customer implements Serializable {

    @Id;
    Long id;

    String firstName;
    String lastName;
    Date birthday;

    @Transient
    Integer age;

    @Embedded
    private Address homeAddress;

    @OneToMany(cascade=CascadeType.ALL)
    @JoinColumn(name="CUSTOMER_ID")
    Set<Order
> orders;

    // Getter/setter and business methods
}
```

Note

Support for JDK 5.0 Annotations (and JSR-220) is currently under development. Please refer to the Hibernate Annotations module for more details.

5.6. Generated properties

Generated properties are properties that have their values generated by the database. Typically, Hibernate applications needed to `refresh` objects that contain any properties for which the database was generating values. Marking properties as generated, however, lets the application delegate this responsibility to Hibernate. When Hibernate issues an SQL INSERT or UPDATE for an entity that has defined generated properties, it immediately issues a select afterwards to retrieve the generated values.

Properties marked as generated must additionally be non-insertable and non-updateable. Only *versions*, *timestamps*, and *simple properties*, can be marked as generated.

`never` (the default): the given property value is not generated within the database.

`insert`: the given property value is generated on insert, but is not regenerated on subsequent updates. Properties like created-date fall into this category. Even though *version* and *timestamp* properties can be marked as generated, this option is not available.

`always`: the property value is generated both on insert and on update.

5.7. Column read and write expressions

Hibernate allows you to customize the SQL it uses to read and write the values of columns mapped to *simple properties*. For example, if your database provides a set of data encryption functions, you can invoke them for individual columns like this:

```
<property name="creditCardNumber">
        <column
          name="credit_card_num"
          read="decrypt(credit_card_num)"
          write="encrypt(?)"/>
</property
>
```

Hibernate applies the custom expressions automatically whenever the property is referenced in a query. This functionality is similar to a derived-property `formula` with two differences:

- The property is backed by one or more columns that are exported as part of automatic schema generation.
- The property is read-write, not read-only.

The `write` expression, if specified, must contain exactly one '?' placeholder for the value.

5.8. Auxiliary database objects

Auxiliary database objects allow for the CREATE and DROP of arbitrary database objects. In conjunction with Hibernate's schema evolution tools, they have the ability to fully define a user schema within the Hibernate mapping files. Although designed specifically for creating and dropping things like triggers or stored procedures, any SQL command that can be run via a `java.sql.Statement.execute()` method is valid (for example, ALTERs, INSERTS, etc.). There are essentially two modes for defining auxiliary database objects:

The first mode is to explicitly list the CREATE and DROP commands in the mapping file:

```
<hibernate-mapping>
    ...
    <database-object>
        <create
>CREATE TRIGGER my_trigger ...</create>
        <drop
>DROP TRIGGER my_trigger</drop>
```

```
    </database-object>
</hibernate-mapping
>
```

The second mode is to supply a custom class that constructs the CREATE and DROP commands. This custom class must implement the `org.hibernate.mapping.AuxiliaryDatabaseObject` interface.

```
<hibernate-mapping>
    ...
    <database-object>
        <definition class="MyTriggerDefinition"/>
    </database-object>
</hibernate-mapping
>
```

Additionally, these database objects can be optionally scoped so that they only apply when certain dialects are used.

```
<hibernate-mapping>
    ...
    <database-object>
        <definition class="MyTriggerDefinition"/>
        <dialect-scope name="org.hibernate.dialect.Oracle9iDialect"/>
        <dialect-scope name="org.hibernate.dialect.Oracle10gDialect"/>
    </database-object>
</hibernate-mapping
>
```

Collection mapping

6.1. Persistente Collections

Hibernate requires that persistent collection-valued fields be declared as an interface type. For example:

```
public class Product {
    private String serialNumber;
    private Set parts = new HashSet();

    public Set getParts() { return parts; }
    void setParts(Set parts) { this.parts = parts; }
    public String getSerialNumber() { return serialNumber; }
    void setSerialNumber(String sn) { serialNumber = sn; }
}
```

The actual interface might be `java.util.Set`, `java.util.Collection`, `java.util.List`, `java.util.Map`, `java.util.SortedSet`, `java.util.SortedMap` or anything you like ("anything you like" means you will have to write an implementation of `org.hibernate.usertype.UserCollectionType`.)

Notice how the instance variable was initialized with an instance of `HashSet`. This is the best way to initialize collection valued properties of newly instantiated (non-persistent) instances. When you make the instance persistent, by calling `persist()` for example, Hibernate will actually replace the `HashSet` with an instance of Hibernate's own implementation of `Set`. Be aware of the following errors:

```
Cat cat = new DomesticCat();
Cat kitten = new DomesticCat();
....
Set kittens = new HashSet();
kittens.add(kitten);
cat.setKittens(kittens);
session.persist(cat);
kittens = cat.getKittens(); // Okay, kittens collection is a Set
(HashSet) cat.getKittens(); // Error!
```

The persistent collections injected by Hibernate behave like `HashMap`, `HashSet`, `TreeMap`, `TreeSet` or `ArrayList`, depending on the interface type.

Collections instances have the usual behavior of value types. They are automatically persisted when referenced by a persistent object and are automatically deleted when unreferenced. If a collection is passed from one persistent object to another, its elements might be moved from one table to another. Two entities cannot share a reference to the same collection instance. Due to

the underlying relational model, collection-valued properties do not support null value semantics. Hibernate does not distinguish between a null collection reference and an empty collection.

Use persistent collections the same way you use ordinary Java collections. However, please ensure you understand the semantics of bidirectional associations (these are discussed later).

6.2. Collection-Mappings

Tipp

There are quite a range of mappings that can be generated for collections that cover many common relational models. We suggest you experiment with the schema generation tool so that you understand how various mapping declarations translate to database tables.

The Hibernate mapping element used for mapping a collection depends upon the type of interface. For example, a `<set>` element is used for mapping properties of type `Set`.

```
<class name="Product">
    <id name="serialNumber" column="productSerialNumber"/>
    <set name="parts">
        <key column="productSerialNumber" not-null="true"/>
        <one-to-many class="Part"/>
    </set>
</class
>
```

Neben `<set>` gibt es auch `<list>`, `<map>`, `<bag>`, `<array>` und `<primitive-array>` Mapping-Elemente. Das `<map>`-Element ist charakteristisch:

```
<map
    name="propertyName"                                                          1
    table="table_name"                                                           2
    schema="schema_name"                                                         3
    lazy="true|extra|false"                                                      4
    inverse="true|false"                                                         5
    cascade="all|none|save-update|delete|all-delete-orphan|delete-orphan"        6
    sort="unsorted|natural|comparatorClass"                                      7
    order-by="column_name asc|desc"                                              8
    where="arbitrary sql where condition"                                        9
    fetch="join|select|subselect"                                                10
    batch-size="N"                                                               11
    access="field|property|ClassName"                                            12
```

```
    optimistic-lock="true|false"                                    13
    mutable="true|false"                                            14
    node="element-name|."
    embed-xml="true|false"
>

    <key .... />
    <map-key .... />
    <element .... />
</map
>
```

1. `name`: the collection property name
2. `table` (optional - defaults to property name): the name of the collection table. It is not used for one-to-many associations.
3. `schema` (optional): the name of a table schema to override the schema declared on the root element
4. `lazy` (optional - defaults to `true`): disables lazy fetching and specifies that the association is always eagerly fetched. It can also be used to enable "extra-lazy" fetching where most operations do not initialize the collection. This is suitable for large collections.
5. `inverse` (optional - defaults to `false`): marks this collection as the "inverse" end of a bidirectional association.
6. `cascade` (optional - defaults to `none`): enables operations to cascade to child entities.
7. `sort` (optional): specifies a sorted collection with `natural` sort order or a given comparator class.
8. `order-by` (optional, JDK1.4 only): specifies a table column or columns that define the iteration order of the `Map`, `Set` or bag, together with an optional `asc` or `desc`.
9. `where` (optional): specifies an arbitrary SQL `WHERE` condition that is used when retrieving or removing the collection. This is useful if the collection needs to contain only a subset of the available data.
10. `fetch` (optional, defaults to `select`): chooses between outer-join fetching, fetching by sequential select, and fetching by sequential subselect.
11. `batch-size` (optional, defaults to `1`): specifies a "batch size" for lazily fetching instances of this collection.
12. `access` (optional - defaults to `property`): the strategy Hibernate uses for accessing the collection property value.
13. `optimistic-lock` (optional - defaults to `true`): specifies that changes to the state of the collection results in increments of the owning entity's version. For one-to-many associations you may want to disable this setting.
14. `mutable` (optional - defaults to `true`): a value of `false` specifies that the elements of the collection never change. This allows for minor performance optimization in some cases.

6.2.1. Collection-Fremdschlüssel

Collection instances are distinguished in the database by the foreign key of the entity that owns the collection. This foreign key is referred to as the *collection key column*, or columns, of the collection table. The collection key column is mapped by the `<key>` element.

There can be a nullability constraint on the foreign key column. For most collections, this is implied. For unidirectional one-to-many associations, the foreign key column is nullable by default, so you may need to specify `not-null="true"`.

```
<key column="productSerialNumber" not-null="true"/>
```

The foreign key constraint can use `ON DELETE CASCADE`.

```
<key column="productSerialNumber" on-delete="cascade"/>
```

Die vollständige Definition des `<key>`-Elements finden Sie im vorangegangenen Kapitel.

6.2.2. Collection-Elemente

Collections can contain almost any other Hibernate type, including: basic types, custom types, components and references to other entities. This is an important distinction. An object in a collection might be handled with "value" semantics (its life cycle fully depends on the collection owner), or it might be a reference to another entity with its own life cycle. In the latter case, only the "link" between the two objects is considered to be a state held by the collection.

Der enthaltene Typ wird als *Typ von Collection-Element* bezeichnet. Collection-Elemente werden durch `<element>` oder `<composite-element>` - oder im Fall von Entity-Verweisen - durch `<one-to-many>` oder `<many-to-many>` gemappt. Die ersten beiden Elemente mappen mit Wertsemantik, die beiden folgenden werden für das Mappen von Entity-Assoziationen verwendet.

6.2.3. Indizierte Collections

All collection mappings, except those with set and bag semantics, need an *index column* in the collection table. An index column is a column that maps to an array index, or `List` index, or `Map` key. The index of a `Map` may be of any basic type, mapped with `<map-key>`. It can be an entity reference mapped with `<map-key-many-to-many>`, or it can be a composite type mapped with `<composite-map-key>`. The index of an array or list is always of type `integer` and is mapped using the `<list-index>` element. The mapped column contains sequential integers that are numbered from zero by default.

```
<list-index
        column="column_name"
```

```
        base="0|1|..."/>
```

1. `column_name` (required): the name of the column holding the collection index values.
1. `base` (optional - defaults to `0`): the value of the index column that corresponds to the first element of the list or array.

```
<map-key
        column="column_name"                    (1)
        formula="any SQL expression"            (2)
        type="type_name"                        (3)
        node="@attribute-name"
        length="N"/>
```

1. `column` (optional): the name of the column holding the collection index values.
2. `formula` (optional): a SQL formula used to evaluate the key of the map.
3. `type` (required): the type of the map keys.

```
<map-key-many-to-many
        column="column_name"                    (1)
        formula="any SQL expression"            (2)(3)
        class="ClassName"
/>
```

1. `column` (optional): the name of the foreign key column for the collection index values.
2. `formula` (optional): a SQ formula used to evaluate the foreign key of the map key.
3. `class` (required): the entity class used as the map key.

If your table does not have an index column, and you still wish to use `List` as the property type, you can map the property as a Hibernate *<bag>*. A bag does not retain its order when it is retrieved from the database, but it can be optionally sorted or ordered.

6.2.4. Collections von Werten und "Many-to-Many"-Assoziationen

Any collection of values or many-to-many associations requires a dedicated *collection table* with a foreign key column or columns, *collection element column* or columns, and possibly an index column or columns.

For a collection of values use the `<element>` tag. For example:

```
<element
        column="column_name"                    (1)
```

```
        formula="any SQL expression"                    (2)
        type="typename"                                 (3)
        length="L"
        precision="P"
        scale="S"
        not-null="true|false"
        unique="true|false"
        node="element-name"
/>
```

1. `column` (optional): the name of the column holding the collection element values.
2. `formula` (optional): an SQL formula used to evaluate the element.
3. `type` (required): the type of the collection element.

A *many-to-many association* is specified using the `<many-to-many>` element.

```
<many-to-many
        column="column_name"                            (1)
        formula="any SQL expression"                    (2)
        class="ClassName"                               (3)
        fetch="select|join"                             (4)
        unique="true|false"                             (5)
        not-found="ignore|exception"                    (6)
        entity-name="EntityName"                        (7)
        property-ref="propertyNameFromAssociatedClass"  (8)
        node="element-name"
        embed-xml="true|false"
    />
```

1. `column` (optional): the name of the element foreign key column.
2. `formula` (optional): an SQL formula used to evaluate the element foreign key value.
3. `class` (required): the name of the associated class.
4. `fetch` (optional - defaults to `join`): enables outer-join or sequential select fetching for this association. This is a special case; for full eager fetching in a single `SELECT` of an entity and its many-to-many relationships to other entities, you would enable `join` fetching,not only of the collection itself, but also with this attribute on the `<many-to-many>` nested element.
5. `unique` (optional): enables the DDL generation of a unique constraint for the foreign-key column. This makes the association multiplicity effectively one-to-many.
6. `not-found` (optional - defaults to `exception`): specifies how foreign keys that reference missing rows will be handled: `ignore` will treat a missing row as a null association.
7. `entity-name` (optional): the entity name of the associated class, as an alternative to `class`.
8. `property-ref` (optional): the name of a property of the associated class that is joined to this foreign key. If not specified, the primary key of the associated class is used.

Here are some examples.

A set of strings:

```
<set name="names" table="person_names">
    <key column="person_id"/>
    <element column="person_name" type="string"/>
</set
>
```

A bag containing integers with an iteration order determined by the `order-by` attribute:

```
<bag name="sizes"
        table="item_sizes"
        order-by="size asc">
    <key column="item_id"/>
    <element column="size" type="integer"/>
</bag
>
```

An array of entities, in this case, a many-to-many association:

```
<array name="addresses"
        table="PersonAddress"
        cascade="persist">
    <key column="personId"/>
    <list-index column="sortOrder"/>
    <many-to-many column="addressId" class="Address"/>
</array
>
```

Eine Map von String-Indexen zu Daten:

```
<map name="holidays"
        table="holidays"
        schema="dbo"
        order-by="hol_name asc">
    <key column="id"/>
    <map-key column="hol_name" type="string"/>
    <element column="hol_date" type="date"/>
</map
>
```

A list of components (this is discussed in the next chapter):

```
<list name="carComponents"
        table="CarComponents">
```

```
    <key column="carId"/>
    <list-index column="sortOrder"/>
    <composite-element class="CarComponent">
        <property name="price"/>
        <property name="type"/>
        <property name="serialNumber" column="serialNum"/>
    </composite-element>
</list
>
```

6.2.5. "One-to-Many"-Assoziationen

A *one-to-many association* links the tables of two classes via a foreign key with no intervening collection table. This mapping loses certain semantics of normal Java collections:

- An instance of the contained entity class cannot belong to more than one instance of the collection.
- An instance of the contained entity class cannot appear at more than one value of the collection index.

An association from `Product` to `Part` requires the existence of a foreign key column and possibly an index column to the `Part` table. A `<one-to-many>` tag indicates that this is a one-to-many association.

```
<one-to-many
        class="ClassName"                    (1)
        not-found="ignore|exception"         (2)
        entity-name="EntityName"             (3)
        node="element-name"
        embed-xml="true|false"
    />
```

(1) `class` (required): the name of the associated class.

(2) `not-found` (optional - defaults to `exception`): specifies how cached identifiers that reference missing rows will be handled. `ignore` will treat a missing row as a null association.

(3) `entity-name` (optional): the entity name of the associated class, as an alternative to `class`.

The `<one-to-many>` element does not need to declare any columns. Nor is it necessary to specify the `table` name anywhere.

Warnung

If the foreign key column of a `<one-to-many>` association is declared `NOT NULL`, you must declare the `<key>` mapping `not-null="true"` or *use a bidirectional*

association with the collection mapping marked `inverse="true"`. See the discussion of bidirectional associations later in this chapter for more information.

The following example shows a map of `Part` entities by name, where `partName` is a persistent property of `Part`. Notice the use of a formula-based index:

```
<map name="parts"
        cascade="all">
    <key column="productId" not-null="true"/>
    <map-key formula="partName"/>
    <one-to-many class="Part"/>
</map
>
```

6.3. Fortgeschrittene Collection-Mappings

6.3.1. Sortierte Collections

Hibernate unterstützt `java.util.SortedMap` und `java.util.SortedSet` implementierende Collections. Sie müssen ein Vergleichsprogramm in der Mapping-Datei bestimmen:

```
<set name="aliases"
            table="person_aliases"
            sort="natural">
    <key column="person"/>
    <element column="name" type="string"/>
</set>

<map name="holidays" sort="my.custom.HolidayComparator">
    <key column="year_id"/>
    <map-key column="hol_name" type="string"/>
    <element column="hol_date" type="date"/>
</map
>
```

Erlaubte Werte für das `sort`-Attribut sind `unsorted`, `natural` und der Name einer Klassenimplementierung `java.util.Comparator`.

Sortierte Collections verhalten sich tatsächlich wie `java.util.TreeSet` oder `java.util.TreeMap`.

If you want the database itself to order the collection elements, use the `order-by` attribute of `set`, `bag` or `map` mappings. This solution is only available under JDK 1.4 or higher and is implemented using `LinkedHashSet` or `LinkedHashMap`. This performs the ordering in the SQL query and not in the memory.

```
<set name="aliases" table="person_aliases" order-by="lower(name) asc">
```

```
    <key column="person"/>
    <element column="name" type="string"/>
</set>

<map name="holidays" order-by="hol_date, hol_name">
    <key column="year_id"/>
    <map-key column="hol_name" type="string"/>
    <element column="hol_date type="date"/>
</map
>
```

Note

The value of the `order-by` attribute is an SQL ordering, not an HQL ordering.

Associations can even be sorted by arbitrary criteria at runtime using a collection `filter()`:

```
sortedUsers = s.createFilter( group.getUsers(), "order by this.name" ).list();
```

6.3.2. Bidirektionale Assoziationen

Eine *bidirektionale Assoziation* erlaubt die Navigation von beiden "Enden" der Assoziation. Es werden zwei Arten bidirektionaler Assoziationen unterstützt:

"One-to-Many"
: set or bag valued at one end and single-valued at the other

"Many-to-Many"
: an beiden Enden "Set"- oder "Bag"-wertig

You can specify a bidirectional many-to-many association by mapping two many-to-many associations to the same database table and declaring one end as *inverse*. You cannot select an indexed collection.

Here is an example of a bidirectional many-to-many association that illustrates how each category can have many items and each item can be in many categories:

```
<class name="Category">
    <id name="id" column="CATEGORY_ID"/>
    ...
    <bag name="items" table="CATEGORY_ITEM">
        <key column="CATEGORY_ID"/>
        <many-to-many class="Item" column="ITEM_ID"/>
    </bag>
</class>

<class name="Item">
    <id name="id" column="ITEM_ID"/>
```

```
    ...

    <!-- inverse end -->
    <bag name="categories" table="CATEGORY_ITEM" inverse="true">
        <key column="ITEM_ID"/>
        <many-to-many class="Category" column="CATEGORY_ID"/>
    </bag>
</class
>
```

Changes made only to the inverse end of the association are *not* persisted. This means that Hibernate has two representations in memory for every bidirectional association: one link from A to B and another link from B to A. This is easier to understand if you think about the Java object model and how a many-to-many relationship in Javais created:

```


category.getItems().add(item);          // The category now "knows" about the relationship
item.getCategories().add(category);     // The item now "knows" about the relationship

session.persist(item);                   // The relationship won't be saved!
session.persist(category);               // The relationship will be saved
```

Die nicht-invertierte Seite wird dazu benutzt, die gespeicherte Darstellung in der Datenbank zu speichern.

You can define a bidirectional one-to-many association by mapping a one-to-many association to the same table column(s) as a many-to-one association and declaring the many-valued end `inverse="true"`.

```
<class name="Parent">
    <id name="id" column="parent_id"/>
    ....
    <set name="children" inverse="true">
        <key column="parent_id"/>
        <one-to-many class="Child"/>
    </set>
</class>

<class name="Child">
    <id name="id" column="child_id"/>
    ....
    <many-to-one name="parent"
        class="Parent"
        column="parent_id"
        not-null="true"/>
</class
>
```

Mapping one end of an association with `inverse="true"` does not affect the operation of cascades as these are orthogonal concepts.

6.3.3. Bidirektionale Assoziationen mit indizierten Collections

A bidirectional association where one end is represented as a `<list>` or `<map>`, requires special consideration. If there is a property of the child class that maps to the index column you can use `inverse="true"` on the collection mapping:

```
<class name="Parent">
    <id name="id" column="parent_id"/>
    ....
    <map name="children" inverse="true">
        <key column="parent_id"/>
        <map-key column="name"
            type="string"/>
        <one-to-many class="Child"/>
    </map>
</class>

<class name="Child">
    <id name="id" column="child_id"/>
    ....
    <property name="name"
        not-null="true"/>
    <many-to-one name="parent"
        class="Parent"
        column="parent_id"
        not-null="true"/>
</class
>
```

If there is no such property on the child class, the association cannot be considered truly bidirectional. That is, there is information available at one end of the association that is not available at the other end. In this case, you cannot map the collection `inverse="true"`. Instead, you could use the following mapping:

```
<class name="Parent">
    <id name="id" column="parent_id"/>
    ....
    <map name="children">
        <key column="parent_id"
            not-null="true"/>
        <map-key column="name"
            type="string"/>
        <one-to-many class="Child"/>
    </map>
</class>

<class name="Child">
    <id name="id" column="child_id"/>
    ....
    <many-to-one name="parent"
        class="Parent"
        column="parent_id"
        insert="false"
```

```
        update="false"
        not-null="true"/>
</class
>
```

Note that in this mapping, the collection-valued end of the association is responsible for updates to the foreign key.

6.3.4. Dreifache Assoziationen

There are three possible approaches to mapping a ternary association. One approach is to use a `Map` with an association as its index:

```
<map name="contracts">
    <key column="employer_id" not-null="true"/>
    <map-key-many-to-many column="employee_id" class="Employee"/>
    <one-to-many class="Contract"/>
</map
>
```

```
<map name="connections">
    <key column="incoming_node_id"/>
    <map-key-many-to-many column="outgoing_node_id" class="Node"/>
    <many-to-many column="connection_id" class="Connection"/>
</map
>
```

A second approach is to remodel the association as an entity class. This is the most common approach.

A final alternative is to use composite elements, which will be discussed later.

6.3.5. `Using an <idbag>`

The majority of the many-to-many associations and collections of values shown previously all map to tables with composite keys, even though it has been have suggested that entities should have synthetic identifiers (surrogate keys). A pure association table does not seem to benefit much from a surrogate key, although a collection of composite values *might*. It is for this reason that Hibernate provides a feature that allows you to map many-to-many associations and collections of values to a table with a surrogate key.

The `<idbag>` element lets you map a `List` (or `Collection`) with bag semantics. For example:

```
<idbag name="lovers" table="LOVERS">
    <collection-id column="ID" type="long">
        <generator class="sequence"/>
    </collection-id>
```

```
    <key column="PERSON1"/>
    <many-to-many column="PERSON2" class="Person" fetch="join"/>
</idbag
>
```

An `<idbag>` has a synthetic id generator, just like an entity class. A different surrogate key is assigned to each collection row. Hibernate does not, however, provide any mechanism for discovering the surrogate key value of a particular row.

The update performance of an `<idbag>` supersedes a regular `<bag>`. Hibernate can locate individual rows efficiently and update or delete them individually, similar to a list, map or set.

In der aktuellen Implementierung wird die `native` Bezeichnergenerierungsstrategie nicht für `<idbag>` Collection-Bezeichner unterstützt.

6.4. Collection-Beispiele

This section covers collection examples.

The following class has a collection of `Child` instances:

```
package eg;
import java.util.Set;

public class Parent {
    private long id;
    private Set children;

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

    private Set getChildren() { return children; }
    private void setChildren(Set children) { this.children=children; }

    ....
    ....
}
```

If each child has, at most, one parent, the most natural mapping is a one-to-many association:

```
<hibernate-mapping>

    <class name="Parent">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <set name="children">
            <key column="parent_id"/>
            <one-to-many class="Child"/>
        </set>
    </class>
```

```
    <class name="Child">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <property name="name"/>
    </class>

</hibernate-mapping
>
```

Das mappt zu den folgenden Tabellendefinitionen:

```
create table parent ( id bigint not null primary key )
create table child ( id bigint not null primary key, name varchar(255), parent_id bigint )
alter table child add constraint childfk0 (parent_id) references parent
```

Falls der "parent" *erforderlich* ist, verwenden Sie eine bidirektionale "One-to-Many"-Assoziation:

```
<hibernate-mapping>

    <class name="Parent">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <set name="children" inverse="true">
            <key column="parent_id"/>
            <one-to-many class="Child"/>
        </set>
    </class>

    <class name="Child">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <property name="name"/>
        <many-to-one name="parent" class="Parent" column="parent_id" not-null="true"/>
    </class>

</hibernate-mapping
>
```

Beachten Sie die `NOT NULL`-Bedingung:

```
create table parent ( id bigint not null primary key )
create table child ( id bigint not null
                     primary key,
                     name varchar(255),
                     parent_id bigint not null )
alter table child add constraint childfk0 (parent_id) references parent
```

Alternatively, if this association must be unidirectional you can declare the `NOT NULL` constraint on the `<key>` mapping:

```
<hibernate-mapping>

    <class name="Parent">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <set name="children">
            <key column="parent_id" not-null="true"/>
            <one-to-many class="Child"/>
        </set>
    </class>

    <class name="Child">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <property name="name"/>
    </class>

</hibernate-mapping
>
```

On the other hand, if a child has multiple parents, a many-to-many association is appropriate:

```
<hibernate-mapping>

    <class name="Parent">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <set name="children" table="childset">
            <key column="parent_id"/>
            <many-to-many class="Child" column="child_id"/>
        </set>
    </class>

    <class name="Child">
        <id name="id">
            <generator class="sequence"/>
        </id>
        <property name="name"/>
    </class>

</hibernate-mapping
>
```

Tabellendefinitionen:

```
create table parent ( id bigint not null primary key )
```

```
create table child ( id bigint not null primary key, name varchar(255) )
create table childset ( parent_id bigint not null,
                        child_id bigint not null,
                        primary key ( parent_id, child_id ) )
alter table childset add constraint childsetfk0 (parent_id) references parent
alter table childset add constraint childsetfk1 (child_id) references child
```

For more examples and a complete explanation of a parent/child relationship mapping, see *Kapitel 22, Beispiel: "Parent/Child"* for more information.

Even more complex association mappings are covered in the next chapter.

Assoziations-Mappings

7.1. Einführung

Association mappings are often the most difficult thing to implement correctly. In this section we examine some canonical cases one by one, starting with unidirectional mappings and then bidirectional cases. We will use `Person` and `Address` in all the examples.

Associations will be classified by multiplicity and whether or not they map to an intervening join table.

Nullable foreign keys are not considered to be good practice in traditional data modelling, so our examples do not use nullable foreign keys. This is not a requirement of Hibernate, and the mappings will work if you drop the nullability constraints.

7.2. Unidirektionale Assoziationen

7.2.1. Many-to-one

Eine *unidirektionale "Many-to-One"-Assoziation* ist der gängigste Typ unidirektionaler Assoziationen.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <many-to-one name="address"
        column="addressId"
        not-null="true"/>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
</class
>
```

```
create table Person ( personId bigint not null primary key, addressId bigint not null )
create table Address ( addressId bigint not null primary key )
```

7.2.2. One-to-one

Eine *unidirektionale "One-to-One"-Assoziation an einem Fremdschlüssel* ist fast identisch. Der einzige Unterschied besteht in der Spalte der eindeutigen Bedingung.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <many-to-one name="address"
        column="addressId"
        unique="true"
        not-null="true"/>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
</class
>
```

```
create table Person ( personId bigint not null primary key, addressId bigint not null unique )
create table Address ( addressId bigint not null primary key )
```

A *unidirectional one-to-one association on a primary key* usually uses a special id generator In this example, however, we have reversed the direction of the association:

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
</class>

<class name="Address">
    <id name="id" column="personId">
        <generator class="foreign">
            <param name="property"
>person</param>
        </generator>
    </id>
    <one-to-one name="person" constrained="true"/>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table Address ( personId bigint not null primary key )
```

7.2.3. One-to-many

A *unidirectional one-to-many association on a foreign key* is an unusual case, and is not recommended.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <set name="addresses">
        <key column="personId"
            not-null="true"/>
        <one-to-many class="Address"/>
    </set>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table Address ( addressId bigint not null primary key, personId bigint not null )
```

You should instead use a join table for this kind of association.

7.3. Unidirektionale Assoziationen mit Verbundtabellen

7.3.1. One-to-many

A *unidirectional one-to-many association on a join table* is the preferred option. Specifying `unique="true"`, changes the multiplicity from many-to-many to one-to-many.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <set name="addresses" table="PersonAddress">
        <key column="personId"/>
        <many-to-many column="addressId"
            unique="true"
            class="Address"/>
    </set>
</class>

<class name="Address">
```

```
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table PersonAddress ( personId not null, addressId bigint not null primary key )
create table Address ( addressId bigint not null primary key )
```

7.3.2. Many-to-one

A *unidirectional many-to-one association on a join table* is common when the association is optional. For example:

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <join table="PersonAddress"
        optional="true">
        <key column="personId" unique="true"/>
        <many-to-one name="address"
            column="addressId"
            not-null="true"/>
    </join>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table PersonAddress ( personId bigint not null primary key, addressId bigint not null )
create table Address ( addressId bigint not null primary key )
```

7.3.3. One-to-one

A *unidirectional one-to-one association on a join table* is possible, but extremely unusual.

```
<class name="Person">
```

```
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <join table="PersonAddress"
        optional="true">
        <key column="personId"
            unique="true"/>
        <many-to-one name="address"
            column="addressId"
            not-null="true"
            unique="true"/>
    </join>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table PersonAddress ( personId bigint not null primary key, addressId bigint not null
 unique )
create table Address ( addressId bigint not null primary key )
```

7.3.4. Many-to-many

Finally, here is an example of a *unidirectional many-to-many association*.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <set name="addresses" table="PersonAddress">
        <key column="personId"/>
        <many-to-many column="addressId"
            class="Address"/>
    </set>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table PersonAddress ( personId bigint not null, addressId bigint not null, primary key
 (personId, addressId) )
create table Address ( addressId bigint not null primary key )
```

7.4. Bidirektionale Assoziationen

7.4.1. one-to-many / many-to-one

A *bidirectional many-to-one association* is the most common kind of association. The following example illustrates the standard parent/child relationship.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <many-to-one name="address"
        column="addressId"
        not-null="true"/>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
    <set name="people" inverse="true">
        <key column="addressId"/>
        <one-to-many class="Person"/>
    </set>
</class
>
```

```
create table Person ( personId bigint not null primary key, addressId bigint not null )
create table Address ( addressId bigint not null primary key )
```

If you use a `List`, or other indexed collection, set the `key` column of the foreign key to `not null`. Hibernate will manage the association from the collections side to maintain the index of each element, making the other side virtually inverse by setting `update="false"` and `insert="false"`:

```
<class name="Person">
   <id name="id"/>
   ...
   <many-to-one name="address"
      column="addressId"
      not-null="true"
      insert="false"
```

```
      update="false"/>
</class>

<class name="Address">
   <id name="id"/>
   ...
   <list name="people">
      <key column="addressId" not-null="true"/>
      <list-index column="peopleIdx"/>
      <one-to-many class="Person"/>
   </list>
</class
>
```

If the underlying foreign key column is `NOT NULL`, it is important that you define `not-null="true"` on the `<key>` element of the collection mapping. Do not only declare `not-null="true"` on a possible nested `<column>` element, but on the `<key>` element.

7.4.2. One-to-one

A *bidirectional one-to-one association on a foreign key* is common:

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <many-to-one name="address"
        column="addressId"
        unique="true"
        not-null="true"/>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
   <one-to-one name="person"
        property-ref="address"/>
</class
>
```

```
create table Person ( personId bigint not null primary key, addressId bigint not null unique )
create table Address ( addressId bigint not null primary key )
```

A *bidirectional one-to-one association on a primary key* uses the special id generator:

```
<class name="Person">
    <id name="id" column="personId">
```

```
        <generator class="native"/>
    </id>
    <one-to-one name="address"/>
</class>

<class name="Address">
    <id name="id" column="personId">
        <generator class="foreign">
            <param name="property"
>person</param>
        </generator>
    </id>
    <one-to-one name="person"
        constrained="true"/>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table Address ( personId bigint not null primary key )
```

7.5. Bidirektionale Assoziationen mit Verbundtabellen

7.5.1. one-to-many / many-to-one

The following is an example of a *bidirectional one-to-many association on a join table*. The `inverse="true"` can go on either end of the association, on the collection, or on the join.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <set name="addresses"
        table="PersonAddress">
        <key column="personId"/>
        <many-to-many column="addressId"
            unique="true"
            class="Address"/>
    </set>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
    <join table="PersonAddress"
        inverse="true"
        optional="true">
        <key column="addressId"/>
        <many-to-one name="person"
            column="personId"
```

```
            not-null="true"/>
    </join>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table PersonAddress ( personId bigint not null, addressId bigint not null primary key )
create table Address ( addressId bigint not null primary key )
```

7.5.2. "One-to-One"

A *bidirectional one-to-one association on a join table* is possible, but extremely unusual.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <join table="PersonAddress"
        optional="true">
        <key column="personId"
            unique="true"/>
        <many-to-one name="address"
            column="addressId"
            not-null="true"
            unique="true"/>
    </join>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
    <join table="PersonAddress"
        optional="true"
        inverse="true">
        <key column="addressId"
            unique="true"/>
        <many-to-one name="person"
            column="personId"
            not-null="true"
            unique="true"/>
    </join>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table PersonAddress ( personId bigint not null primary key, addressId bigint not null
 unique )
```

```
create table Address ( addressId bigint not null primary key )
```

7.5.3. Many-to-many

Here is an example of a *bidirectional many-to-many association*.

```
<class name="Person">
    <id name="id" column="personId">
        <generator class="native"/>
    </id>
    <set name="addresses" table="PersonAddress">
        <key column="personId"/>
        <many-to-many column="addressId"
            class="Address"/>
    </set>
</class>

<class name="Address">
    <id name="id" column="addressId">
        <generator class="native"/>
    </id>
    <set name="people" inverse="true" table="PersonAddress">
        <key column="addressId"/>
        <many-to-many column="personId"
            class="Person"/>
    </set>
</class
>
```

```
create table Person ( personId bigint not null primary key )
create table PersonAddress ( personId bigint not null, addressId bigint not null, primary key
 (personId, addressId) )
create table Address ( addressId bigint not null primary key )
```

7.6. Komplexere Assoziations-Mappings

More complex association joins are *extremely* rare. Hibernate handles more complex situations by using SQL fragments embedded in the mapping document. For example, if a table with historical account information data defines `accountNumber`, `effectiveEndDate` and `effectiveStartDate`columns, it would be mapped as follows:

```
<properties name="currentAccountKey">
    <property name="accountNumber" type="string" not-null="true"/>
    <property name="currentAccount" type="boolean">
        <formula
>case when effectiveEndDate is null then 1 else 0 end</formula>
```

```
    </property>
</properties>
<property name="effectiveEndDate" type="date"/>
<property name="effectiveStateDate" type="date" not-null="true"/>
```

You can then map an association to the *current* instance, the one with null `effectiveEndDate`, by using:

```
<many-to-one name="currentAccountInfo"
        property-ref="currentAccountKey"
        class="AccountInfo">
    <column name="accountNumber"/>
    <formula
>'1'</formula>
</many-to-one
>
```

In a more complex example, imagine that the association between `Employee` and `Organization` is maintained in an `Employment` table full of historical employment data. An association to the employee's *most recent* employer, the one with the most recent `startDate`, could be mapped in the following way:

```
<join>
    <key column="employeeId"/>
    <subselect>
        select employeeId, orgId
        from Employments
        group by orgId
        having startDate = max(startDate)
    </subselect>
    <many-to-one name="mostRecentEmployer"
            class="Organization"
            column="orgId"/>
</join
>
```

This functionality allows a degree of creativity and flexibility, but it is more practical to handle these kinds of cases using HQL or a criteria query.

Komponenten-Mapping

The notion of a *component* is re-used in several different contexts and purposes throughout Hibernate.

8.1. Abhängige Objekte

A component is a contained object that is persisted as a value type and not an entity reference. The term "component" refers to the object-oriented notion of composition and not to architecture-level components. For example, you can model a person like this:

```
public class Person {
    private java.util.Date birthday;
    private Name name;
    private String key;
    public String getKey() {
        return key;
    }
    private void setKey(String key) {
        this.key=key;
    }
    public java.util.Date getBirthday() {
        return birthday;
    }
    public void setBirthday(java.util.Date birthday) {
        this.birthday = birthday;
    }
    public Name getName() {
        return name;
    }
    public void setName(Name name) {
        this.name = name;
    }
    ......
    ......
}
```

```
public class Name {
    char initial;
    String first;
    String last;
    public String getFirst() {
        return first;
    }
    void setFirst(String first) {
        this.first = first;
    }
    public String getLast() {
        return last;
    }
    void setLast(String last) {
```

```
        this.last = last;
    }
    public char getInitial() {
        return initial;
    }
    void setInitial(char initial) {
        this.initial = initial;
    }
}
```

Now `Name` can be persisted as a component of `Person`. `Name` defines getter and setter methods for its persistent properties, but it does not need to declare any interfaces or identifier properties.

Our Hibernate mapping would look like this:

```
<class name="eg.Person" table="person">
    <id name="Key" column="pid" type="string">
        <generator class="uuid"/>
    </id>
    <property name="birthday" type="date"/>
    <component name="Name" class="eg.Name"
> <!-- class attribute optional -->
        <property name="initial"/>
        <property name="first"/>
        <property name="last"/>
    </component>
</class
>
```

Die Personentabelle würde die Spalten `pid`, `birthday`, `initial`, `first` und `last` besitzen.

Like value types, components do not support shared references. In other words, two persons could have the same name, but the two person objects would contain two independent name objects that were only "the same" by value. The null value semantics of a component are *ad hoc*. When reloading the containing object, Hibernate will assume that if all component columns are null, then the entire component is null. This is suitable for most purposes.

The properties of a component can be of any Hibernate type (collections, many-to-one associations, other components, etc). Nested components should *not* be considered an exotic usage. Hibernate is intended to support a fine-grained object model.

Das `<component>`-Element ermöglicht ein `<parent>`-Subelement, das eine Property der Komponentenklasse als Rückreferenz zur enthaltenden Entity mappt.

```
<class name="eg.Person" table="person">
    <id name="Key" column="pid" type="string">
        <generator class="uuid"/>
    </id>
    <property name="birthday" type="date"/>
    <component name="Name" class="eg.Name" unique="true">
```

```
        <parent name="namedPerson"/> <!-- reference back to the Person -->
        <property name="initial"/>
        <property name="first"/>
        <property name="last"/>
    </component>
</class
>
```

8.2. Collections abhängiger Objekte

Collections of components are supported (e.g. an array of type `Name`). Declare your component collection by replacing the `<element>` tag with a `<composite-element>` tag:

```
<set name="someNames" table="some_names" lazy="true">
    <key column="id"/>
    <composite-element class="eg.Name"
> <!-- class attribute required -->
        <property name="initial"/>
        <property name="first"/>
        <property name="last"/>
    </composite-element>
</set
>
```

Wichtig

If you define a `Set` of composite elements, it is important to implement `equals()` and `hashCode()` correctly.

Composite elements can contain components but not collections. If your composite element contains components, use the `<nested-composite-element>` tag. This case is a collection of components which themselves have components. You may want to consider if a one-to-many association is more appropriate. Remodel the composite element as an entity, but be aware that even though the Java model is the same, the relational model and persistence semantics are still slightly different.

A composite element mapping does not support null-able properties if you are using a `<set>`. There is no separate primary key column in the composite element table. Hibernate uses each column's value to identify a record when deleting objects, which is not possible with null values. You have to either use only not-null properties in a composite-element or choose a `<list>`, `<map>`, `<bag>` or `<idbag>`.

A special case of a composite element is a composite element with a nested `<many-to-one>` element. This mapping allows you to map extra columns of a many-to-many association table to the composite element class. The following is a many-to-many association from `Order` to `Item`, where `purchaseDate`, `price` and `quantity` are properties of the association:

```
<class name="eg.Order" .... >
    ....
    <set name="purchasedItems" table="purchase_items" lazy="true">
        <key column="order_id">
        <composite-element class="eg.Purchase">
            <property name="purchaseDate"/>
            <property name="price"/>
            <property name="quantity"/>
            <many-to-one name="item" class="eg.Item"/> <!-- class attribute is optional -->
        </composite-element>
    </set>
</class
>
```

There cannot be a reference to the purchase on the other side for bidirectional association navigation. Components are value types and do not allow shared references. A single `Purchase` can be in the set of an `Order`, but it cannot be referenced by the `Item` at the same time.

Sogar dreifache (oder vierfache, usw.) Assoziationen sind möglich:

```
<class name="eg.Order" .... >
    ....
    <set name="purchasedItems" table="purchase_items" lazy="true">
        <key column="order_id">
        <composite-element class="eg.OrderLine">
            <many-to-one name="purchaseDetails class="eg.Purchase"/>
            <many-to-one name="item" class="eg.Item"/>
        </composite-element>
    </set>
</class
>
```

Composite elements can appear in queries using the same syntax as associations to other entities.

8.3. Komponenten als Map-Indizes

The `<composite-map-key>` element allows you to map a component class as the key of a `Map`. Ensure that you override `hashCode()` and `equals()` correctly on the component class.

8.4. Komponenten als zusammengesetzte Bezeichner

You can use a component as an identifier of an entity class. Your component class must satisfy certain requirements:

- Es muss `java.io.Serializable` implementieren.
- It must re-implement `equals()` and `hashCode()` consistently with the database's notion of composite key equality.

Note

In Hibernate3, although the second requirement is not an absolutely hard requirement of Hibernate, it is recommended.

You cannot use an `IdentifierGenerator` to generate composite keys. Instead the application must assign its own identifiers.

Use the `<composite-id>` tag, with nested `<key-property>` elements, in place of the usual `<id>` declaration. For example, the `OrderLine` class has a primary key that depends upon the (composite) primary key of `Order`.

```
<class name="OrderLine">

    <composite-id name="id" class="OrderLineId">
        <key-property name="lineId"/>
        <key-property name="orderId"/>
        <key-property name="customerId"/>
    </composite-id>

    <property name="name"/>

    <many-to-one name="order" class="Order"
            insert="false" update="false">
        <column name="orderId"/>
        <column name="customerId"/>
    </many-to-one>
    ....

</class
>
```

Any foreign keys referencing the `OrderLine` table are now composite. Declare this in your mappings for other classes. An association to `OrderLine` is mapped like this:

```
<many-to-one name="orderLine" class="OrderLine">
<!-- the "class" attribute is optional, as usual -->
    <column name="lineId"/>
    <column name="orderId"/>
    <column name="customerId"/>
</many-to-one
>
```

Tipp

The `column` element is an alternative to the `column` attribute everywhere. Using the `column` element just gives more declaration options, which are mostly useful when utilizing `hbm2ddl`

Eine `many-to-many`-Assoziation zu `OrderLine` verwendet ebenfalls den zusammengesetzten Fremdschlüssel:

```
<set name="undeliveredOrderLines">
    <key column name="warehouseId"/>
    <many-to-many class="OrderLine">
        <column name="lineId"/>
        <column name="orderId"/>
        <column name="customerId"/>
    </many-to-many>
</set
>
```

The collection of `OrderLines` in `Order` would use:

```
<set name="orderLines" inverse="true">
    <key>
        <column name="orderId"/>
        <column name="customerId"/>
    </key>
    <one-to-many class="OrderLine"/>
</set
>
```

The `<one-to-many>` element declares no columns.

Falls `OrderLine` selbst eine Collection besitzt, so besitzt es auch einen zusammengesetzten Fremdschlüssel.

```
<class name="OrderLine">
    ....
    ....
    <list name="deliveryAttempts">
        <key
>   <!-- a collection inherits the composite key type -->
            <column name="lineId"/>
            <column name="orderId"/>
            <column name="customerId"/>
        </key>
        <list-index column="attemptId" base="1"/>
        <composite-element class="DeliveryAttempt">
            ...
```

```
        </composite-element>
    </set>
</class
>
```

8.5. Dynamische Komponenten

You can also map a property of type `Map`:

```
<dynamic-component name="userAttributes">
    <property name="foo" column="FOO" type="string"/>
    <property name="bar" column="BAR" type="integer"/>
    <many-to-one name="baz" class="Baz" column="BAZ_ID"/>
</dynamic-component
>
```

The semantics of a `<dynamic-component>` mapping are identical to `<component>`. The advantage of this kind of mapping is the ability to determine the actual properties of the bean at deployment time just by editing the mapping document. Runtime manipulation of the mapping document is also possible, using a DOM parser. You can also access, and change, Hibernate's configuration-time metamodel via the `Configuration` object.

Inheritance mapping

9.1. The three strategies

Hibernate unterstützt drei grundlegende Mapping-Strategien der Vererbung:

- "Tabelle-pro-Klasse"-Hierarchie
- table per subclass
- "Tabelle-pro-konkrete-Klasse"

Desweiteren unterstützt Hibernate eine vierte, etwas andere Art der Polymorphie:

- implizite Polymorphie

It is possible to use different mapping strategies for different branches of the same inheritance hierarchy. You can then make use of implicit polymorphism to achieve polymorphism across the whole hierarchy. However, Hibernate does not support mixing `<subclass>`, `<joined-subclass>` and `<union-subclass>` mappings under the same root `<class>` element. It is possible to mix together the table per hierarchy and table per subclass strategies under the the same `<class>` element, by combining the `<subclass>` and `<join>` elements (see below for an example).

It is possible to define `subclass`, `union-subclass`, and `joined-subclass` mappings in separate mapping documents directly beneath `hibernate-mapping`. This allows you to extend a class hierarchy by adding a new mapping file. You must specify an `extends` attribute in the subclass mapping, naming a previously mapped superclass. Previously this feature made the ordering of the mapping documents important. Since Hibernate3, the ordering of mapping files is irrelevant when using the extends keyword. The ordering inside a single mapping file still needs to be defined as superclasses before subclasses.

```
 <hibernate-mapping>
     <subclass name="DomesticCat" extends="Cat" discriminator-value="D">
          <property name="name" type="string"/>
     </subclass>
 </hibernate-mapping
>
```

9.1.1. "Tabelle-pro-Klasse"-Hierarchie

Suppose we have an interface `Payment` with the implementors `CreditCardPayment`, `CashPayment`, and `ChequePayment`. The table per hierarchy mapping would display in the following way:

```
<class name="Payment" table="PAYMENT">
    <id name="id" type="long" column="PAYMENT_ID">
        <generator class="native"/>
    </id>
    <discriminator column="PAYMENT_TYPE" type="string"/>
    <property name="amount" column="AMOUNT"/>
    ...
    <subclass name="CreditCardPayment" discriminator-value="CREDIT">
        <property name="creditCardType" column="CCTYPE"/>
        ...
    </subclass>
    <subclass name="CashPayment" discriminator-value="CASH">
        ...
    </subclass>
    <subclass name="ChequePayment" discriminator-value="CHEQUE">
        ...
    </subclass>
</class
>
```

Exactly one table is required. There is a limitation of this mapping strategy: columns declared by the subclasses, such as `CCTYPE`, cannot have `NOT NULL` constraints.

9.1.2. "Tabelle-pro-Subklasse"

A table per subclass mapping looks like this:

```
<class name="Payment" table="PAYMENT">
    <id name="id" type="long" column="PAYMENT_ID">
        <generator class="native"/>
    </id>
    <property name="amount" column="AMOUNT"/>
    ...
    <joined-subclass name="CreditCardPayment" table="CREDIT_PAYMENT">
        <key column="PAYMENT_ID"/>
        <property name="creditCardType" column="CCTYPE"/>
        ...
    </joined-subclass>
    <joined-subclass name="CashPayment" table="CASH_PAYMENT">
        <key column="PAYMENT_ID"/>
        ...
    </joined-subclass>
    <joined-subclass name="ChequePayment" table="CHEQUE_PAYMENT">
        <key column="PAYMENT_ID"/>
        ...
    </joined-subclass>
</class
>
```

Four tables are required. The three subclass tables have primary key associations to the superclass table so the relational model is actually a one-to-one association.

9.1.3. Table per subclass: using a discriminator

Hibernate's implementation of table per subclass does not require a discriminator column. Other object/relational mappers use a different implementation of table per subclass that requires a type discriminator column in the superclass table. The approach taken by Hibernate is much more difficult to implement, but arguably more correct from a relational point of view. If you want to use a discriminator column with the table per subclass strategy, you can combine the use of `<subclass>` and `<join>`, as follows:

```
<class name="Payment" table="PAYMENT">
    <id name="id" type="long" column="PAYMENT_ID">
        <generator class="native"/>
    </id>
    <discriminator column="PAYMENT_TYPE" type="string"/>
    <property name="amount" column="AMOUNT"/>
    ...
    <subclass name="CreditCardPayment" discriminator-value="CREDIT">
        <join table="CREDIT_PAYMENT">
            <key column="PAYMENT_ID"/>
            <property name="creditCardType" column="CCTYPE"/>
            ...
        </join>
    </subclass>
    <subclass name="CashPayment" discriminator-value="CASH">
        <join table="CASH_PAYMENT">
            <key column="PAYMENT_ID"/>
            ...
        </join>
    </subclass>
    <subclass name="ChequePayment" discriminator-value="CHEQUE">
        <join table="CHEQUE_PAYMENT" fetch="select">
            <key column="PAYMENT_ID"/>
            ...
        </join>
    </subclass>
</class
>
```

Durch die optionale `fetch="select"`-Deklaration ruft Hibernate die `ChequePayment`-Subklassendaten unter Verwendung eines äußeren Verbunds (sog. "outer Join") bei Anfragen an die Superklasse nicht auf.

9.1.4. Das Mischen der "Tabelle-pro-Klasse"-Hierarchie mit "Tabelle-pro-Subklasse"

You can even mix the table per hierarchy and table per subclass strategies using the following approach:

```
<class name="Payment" table="PAYMENT">
    <id name="id" type="long" column="PAYMENT_ID">
```

```
        <generator class="native"/>
    </id>
    <discriminator column="PAYMENT_TYPE" type="string"/>
    <property name="amount" column="AMOUNT"/>
    ...
    <subclass name="CreditCardPayment" discriminator-value="CREDIT">
        <join table="CREDIT_PAYMENT">
            <property name="creditCardType" column="CCTYPE"/>
            ...
        </join>
    </subclass>
    <subclass name="CashPayment" discriminator-value="CASH">
        ...
    </subclass>
    <subclass name="ChequePayment" discriminator-value="CHEQUE">
        ...
    </subclass>
</class
>
```

Bei allen diesen Mapping-Strategien wird eine polymorphe Assoziation zur Stamm-`Payment`-Klasse mittels `<many-to-one>` gemappt.

```
<many-to-one name="payment" column="PAYMENT_ID" class="Payment"/>
```

9.1.5. "Tabelle-pro-konkrete-Klasse"

There are two ways we can map the table per concrete class strategy. First, you can use `<union-subclass>`.

```
<class name="Payment">
    <id name="id" type="long" column="PAYMENT_ID">
        <generator class="sequence"/>
    </id>
    <property name="amount" column="AMOUNT"/>
    ...
    <union-subclass name="CreditCardPayment" table="CREDIT_PAYMENT">
        <property name="creditCardType" column="CCTYPE"/>
        ...
    </union-subclass>
    <union-subclass name="CashPayment" table="CASH_PAYMENT">
        ...
    </union-subclass>
    <union-subclass name="ChequePayment" table="CHEQUE_PAYMENT">
        ...
    </union-subclass>
</class
>
```

Drei Tabellen sind für die Subklassen involviert. Jede Tabelle definiert Spalten für alle Properties der Klasse, einschließlich vererbter Properties.

The limitation of this approach is that if a property is mapped on the superclass, the column name must be the same on all subclass tables. The identity generator strategy is not allowed in union subclass inheritance. The primary key seed has to be shared across all unioned subclasses of a hierarchy.

If your superclass is abstract, map it with `abstract="true"`. If it is not abstract, an additional table (it defaults to `PAYMENT` in the example above), is needed to hold instances of the superclass.

9.1.6. Table per concrete class using implicit polymorphism

Alternativ kann implizite Polymorphie angewendet werden:

```
<class name="CreditCardPayment" table="CREDIT_PAYMENT">
    <id name="id" type="long" column="CREDIT_PAYMENT_ID">
        <generator class="native"/>
    </id>
    <property name="amount" column="CREDIT_AMOUNT"/>
    ...
</class>

<class name="CashPayment" table="CASH_PAYMENT">
    <id name="id" type="long" column="CASH_PAYMENT_ID">
        <generator class="native"/>
    </id>
    <property name="amount" column="CASH_AMOUNT"/>
    ...
</class>

<class name="ChequePayment" table="CHEQUE_PAYMENT">
    <id name="id" type="long" column="CHEQUE_PAYMENT_ID">
        <generator class="native"/>
    </id>
    <property name="amount" column="CHEQUE_AMOUNT"/>
    ...
</class
>
```

Notice that the `Payment` interface is not mentioned explicitly. Also notice that properties of `Payment` are mapped in each of the subclasses. If you want to avoid duplication, consider using XML entities (for example, `[ <!ENTITY allproperties SYSTEM "allproperties.xml"> ]` in the `DOCTYPE` declaration and `&allproperties;` in the mapping).

The disadvantage of this approach is that Hibernate does not generate SQL `UNIONS` when performing polymorphic queries.

Bei dieser Mapping-Strategie wird in der Regel eine polymorphe Assoziation zu `Payment` mittels `<any>` gemappt.

```
<any name="payment" meta-type="string" id-type="long">
    <meta-value value="CREDIT" class="CreditCardPayment"/>
```

```
    <meta-value value="CASH" class="CashPayment"/>
    <meta-value value="CHEQUE" class="ChequePayment"/>
    <column name="PAYMENT_CLASS"/>
    <column name="PAYMENT_ID"/>
</any
>
```

9.1.7. Das Mischen impliziter Polymorphie mit anderen Vererbungsmappings

Since the subclasses are each mapped in their own `<class>` element, and since `Payment` is just an interface), each of the subclasses could easily be part of another inheritance hierarchy. You can still use polymorphic queries against the `Payment` interface.

```
<class name="CreditCardPayment" table="CREDIT_PAYMENT">
    <id name="id" type="long" column="CREDIT_PAYMENT_ID">
        <generator class="native"/>
    </id>
    <discriminator column="CREDIT_CARD" type="string"/>
    <property name="amount" column="CREDIT_AMOUNT"/>
    ...
    <subclass name="MasterCardPayment" discriminator-value="MDC"/>
    <subclass name="VisaPayment" discriminator-value="VISA"/>
</class>

<class name="NonelectronicTransaction" table="NONELECTRONIC_TXN">
    <id name="id" type="long" column="TXN_ID">
        <generator class="native"/>
    </id>
    ...
    <joined-subclass name="CashPayment" table="CASH_PAYMENT">
        <key column="PAYMENT_ID"/>
        <property name="amount" column="CASH_AMOUNT"/>
        ...
    </joined-subclass>
    <joined-subclass name="ChequePayment" table="CHEQUE_PAYMENT">
        <key column="PAYMENT_ID"/>
        <property name="amount" column="CHEQUE_AMOUNT"/>
        ...
    </joined-subclass>
</class
>
```

Once again, `Payment` is not mentioned explicitly. If we execute a query against the `Payment` interface, for example `from Payment`, Hibernate automatically returns instances of `CreditCardPayment` (and its subclasses, since they also implement `Payment`), `CashPayment` and `ChequePayment`, but not instances of `NonelectronicTransaction`.

9.2. Einschränkungen

There are limitations to the "implicit polymorphism" approach to the table per concrete-class mapping strategy. There are somewhat less restrictive limitations to `<union-subclass>` mappings.

The following table shows the limitations of table per concrete-class mappings, and of implicit polymorphism, in Hibernate.

Tabelle 9.1. Features von Vererbungsmappings

Vererbun	Polymorp many-to-one	Polymorp "One-to-One"	Polymorp "One-to-Many"	Polymorp "Many-to-Many"	Polymorp `load()/get()`	Polymorp Anfragen	Polymorp Verknüpf	Outer join fetching
table per class-hierarchy	`<many-to-one>`	`<one-to-one>`	`<one-to-many>`	`<many-to-many>`	`s.get(Payment.class, id)`	`from Payment p`	`from Order o join o.payment p`	*supported*
table per subclass	`<many-to-one>`	`<one-to-one>`	`<one-to-many>`	`<many-to-many>`	`s.get(Payment.class, id)`	`from Payment p`	`from Order o join o.payment p`	*supported*
Tabelle-pro-konkrete-Klasse (Union-Subklasse)	`<many-to-one>`	`<one-to-one>`	`<one-to-many>` (for `inverse="true"` only)	`<many-to-many>`	`s.get(Payment.class, id)`	`from Payment p`	`from Order o join o.payment p`	*supported*
table per concrete class (implicit polymorphism)	`<any>`	*not supported*	*not supported*	`<many-to-any>`	`s.createCriteria(Payment.class).add( Restrictions.`	`from Payment p`	*not supported*	*not supported*

Das Arbeiten mit Objekten

Hibernate is a full object/relational mapping solution that not only shields the developer from the details of the underlying database management system, but also offers *state management* of objects. This is, contrary to the management of SQL `statements` in common JDBC/SQL persistence layers, a natural object-oriented view of persistence in Java applications.

Mit anderen Worten - Hibernate Anwendungsentwickler sollten sich stets über den *Status* Ihrer Objekte Gedanken machen und nicht unbedingt über die Ausführung von SQL-Anweisungen. Dieser Teil wird von Hibernate übernommen und ist nur dann für den Anwendungsentwickler von Bedeutung, wenn die Performance des Systems eingestellt wird.

10.1. Statusarten von Hibernate Objekten

Hibernate definiert und unterstützt die folgenden Arten des Objektstatus:

- *Transient* - an object is transient if it has just been instantiated using the `new` operator, and it is not associated with a Hibernate `Session`. It has no persistent representation in the database and no identifier value has been assigned. Transient instances will be destroyed by the garbage collector if the application does not hold a reference anymore. Use the Hibernate `Session` to make an object persistent (and let Hibernate take care of the SQL statements that need to be executed for this transition).
- *Persistent* - a persistent instance has a representation in the database and an identifier value. It might just have been saved or loaded, however, it is by definition in the scope of a `Session`. Hibernate will detect any changes made to an object in persistent state and synchronize the state with the database when the unit of work completes. Developers do not execute manual `UPDATE` statements, or `DELETE` statements when an object should be made transient.
- *Detached* - a detached instance is an object that has been persistent, but its `Session` has been closed. The reference to the object is still valid, of course, and the detached instance might even be modified in this state. A detached instance can be reattached to a new `Session` at a later point in time, making it (and all the modifications) persistent again. This feature enables a programming model for long running units of work that require user think-time. We call them *application transactions*, i.e., a unit of work from the point of view of the user.

We will now discuss the states and state transitions (and the Hibernate methods that trigger a transition) in more detail.

10.2. Objekte persistent machen

Newly instantiated instances of a persistent class are considered *transient* by Hibernate. We can make a transient instance *persistent* by associating it with a session:

```
DomesticCat fritz = new DomesticCat();
```

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

If `Cat` has a generated identifier, the identifier is generated and assigned to the `cat` when `save()` is called. If `Cat` has an `assigned` identifier, or a composite key, the identifier should be assigned to the `cat` instance before calling `save()`. You can also use `persist()` instead of `save()`, with the semantics defined in the EJB3 early draft.

- `persist()` makes a transient instance persistent. However, it does not guarantee that the identifier value will be assigned to the persistent instance immediately, the assignment might happen at flush time. `persist()` also guarantees that it will not execute an `INSERT` statement if it is called outside of transaction boundaries. This is useful in long-running conversations with an extended Session/persistence context.
- `save()` does guarantee to return an identifier. If an INSERT has to be executed to get the identifier (e.g. "identity" generator, not "sequence"), this INSERT happens immediately, no matter if you are inside or outside of a transaction. This is problematic in a long-running conversation with an extended Session/persistence context.

Alternatively, you can assign the identifier using an overloaded version of `save()`.

```
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) );
```

If the object you make persistent has associated objects (e.g. the `kittens` collection in the previous example), these objects can be made persistent in any order you like unless you have a `NOT NULL` constraint upon a foreign key column. There is never a risk of violating foreign key constraints. However, you might violate a `NOT NULL` constraint if you `save()` the objects in the wrong order.

Usually you do not bother with this detail, as you will normally use Hibernate's *transitive persistence* feature to save the associated objects automatically. Then, even `NOT NULL` constraint violations do not occur - Hibernate will take care of everything. Transitive persistence is discussed later in this chapter.

10.3. Das Laden eines Objekts

The `load()` methods of `Session` provide a way of retrieving a persistent instance if you know its identifier. `load()` takes a class object and loads the state into a newly instantiated instance of that class in a persistent state.

```
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) );
```

Alternativ können Sie den Status in eine beliebige Instanz laden:

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

Be aware that `load()` will throw an unrecoverable exception if there is no matching database row. If the class is mapped with a proxy, `load()` just returns an uninitialized proxy and does not actually hit the database until you invoke a method of the proxy. This is useful if you wish to create an association to an object without actually loading it from the database. It also allows multiple instances to be loaded as a batch if `batch-size` is defined for the class mapping.

If you are not certain that a matching row exists, you should use the `get()` method which hits the database immediately and returns null if there is no matching row.

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

You can even load an object using an SQL `SELECT ... FOR UPDATE`, using a `LockMode`. See the API documentation for more information.

```
Cat cat = (Cat) sess.get(Cat.class, id, LockMode.UPGRADE);
```

Any associated instances or contained collections will *not* be selected `FOR UPDATE`, unless you decide to specify `lock` or `all` as a cascade style for the association.

Es ist mittels der `refresh()`-Methode jederzeit möglich, ein Objekt und alle seine Collections erneut zu laden. Dies ist insbesondere dann von Nutzen, wenn Datenbank-Trigger zur Initialisierung der Objekt-Properties verwendet werden.

```
sess.save(cat);
```

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

How much does Hibernate load from the database and how many SQL `SELECT`s will it use? This depends on the *fetching strategy*. This is explained in *Abschnitt 20.1, „Abrufstrategien“*.

10.4. Anfragen

If you do not know the identifiers of the objects you are looking for, you need a query. Hibernate supports an easy-to-use but powerful object oriented query language (HQL). For programmatic query creation, Hibernate supports a sophisticated Criteria and Example query feature (QBC and QBE). You can also express your query in the native SQL of your database, with optional support from Hibernate for result set conversion into objects.

10.4.1. Ausführen von Anfragen

HQL und native SQL-Anfragen werden durch eine Instanz von `org.hibernate.Query` repräsentiert. Dieses Interface bietet Methoden zur Parameter-Bindung, Handhabung von Ergebnissätzen (sog. "result sets") und für das Ausführen der tatsächlichen Anfrage. Sie können mittels der `Session` immer eine `Query` erhalten:

```
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());
```

A query is usually executed by invoking `list()`. The result of the query will be loaded completely into a collection in memory. Entity instances retrieved by a query are in a persistent state. The `uniqueResult()` method offers a shortcut if you know your query will only return a single object.

Queries that make use of eager fetching of collections usually return duplicates of the root objects, but with their collections initialized. You can filter these duplicates through a `Set`.

10.4.1.1. Iterationsergebnisse

Occasionally, you might be able to achieve better performance by executing the query using the `iterate()` method. This will usually be the case if you expect that the actual entity instances returned by the query will already be in the session or second-level cache. If they are not already cached, `iterate()` will be slower than `list()` and might require many database hits for a simple query, usually *1* for the initial select which only returns identifiers, and *n* additional selects to initialize the actual instances.

```
// fetch ids
Iterator iter = sess.createQuery("from eg.Qux q order by q.likeliness").iterate();
while ( iter.hasNext() ) {
    Qux qux = (Qux) iter.next();  // fetch the object
    // something we couldnt express in the query
    if ( qux.calculateComplicatedAlgorithm() ) {
        // delete the current instance
        iter.remove();
        // dont need to process the rest
        break;
    }
}
```

10.4.1.2. Anfragen, die mit Tupeln reagieren

Hibernate queries sometimes return tuples of objects. Each tuple is returned as an array:

```
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];
    ....
}
```

10.4.1.3. Skalare Ergebnisse

Queries can specify a property of a class in the `select` clause. They can even call SQL aggregate functions. Properties or aggregates are considered "scalar" results and not entities in persistent state.

```
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];
    .....
}
```

10.4.1.4. Bind-Parameter

Methods on `Query` are provided for binding values to named parameters or JDBC-style `?` parameters. *Contrary to JDBC, Hibernate numbers parameters from zero.* Named parameters are identifiers of the form `:name` in the query string. The advantages of named parameters are as follows:

- benannte Parameter sind unempfindlich im Bezug auf die Reihenfolge, in der sie im Anfragenstring erscheinen
- they can occur multiple times in the same query
- sie dokumentieren sich selbst

```
//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();
```

10.4.1.5. Nummerierung

If you need to specify bounds upon your result set, that is, the maximum number of rows you want to retrieve and/or the first row you want to retrieve, you can use methods of the `Query` interface:

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

Hibernate weiß, wie die Grenzanfrage in die native SQL Ihres DBMS zu übersetzen ist.

10.4.1.6. Scrollbare Iteration

If your JDBC driver supports scrollable `ResultSets`, the `Query` interface can be used to obtain a `ScrollableResults` object that allows flexible navigation of the query results.

```
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()
```

Note that an open database connection and cursor is required for this functionality. Use `setMaxResult()`/`setFirstResult()` if you need offline pagination functionality.

10.4.1.7. Externalisierung benannter Anfragen

You can also define named queries in the mapping document. Remember to use a `CDATA` section if your query contains characters that could be interpreted as markup.

```
<query name="ByNameAndMaximumWeight"
><![CDATA[
    from eg.DomesticCat as cat
        where cat.name = ?
        and cat.weight
> ?
] ]></query
```

```
>
```

Die Bindung und Ausführung der Parameter erfolgen befehlsorientiert:

```
Query q = sess.getNamedQuery("ByNameAndMaximumWeight");
q.setString(0, name);
q.setInt(1, minWeight);
List cats = q.list();
```

The actual program code is independent of the query language that is used. You can also define native SQL queries in metadata, or migrate existing queries to Hibernate by placing them in mapping files.

Also note that a query declaration inside a `<hibernate-mapping>` element requires a global unique name for the query, while a query declaration inside a `<class>` element is made unique automatically by prepending the fully qualified name of the class. For example `eg.Cat.ByNameAndMaximumWeight`.

10.4.2. Das Filtern von Collections

A collection *filter* is a special type of query that can be applied to a persistent collection or array. The query string can refer to `this`, meaning the current collection element.

```
Collection blackKittens = session.createFilter(
    pk.getKittens(),
    "where this.color = ?")
    .setParameter( Color.BLACK, Hibernate.custom(ColorUserType.class) )
    .list()
);
```

The returned collection is considered a bag that is a copy of the given collection. The original collection is not modified. This is contrary to the implication of the name "filter", but consistent with expected behavior.

Observe that filters do not require a `from` clause, although they can have one if required. Filters are not limited to returning the collection elements themselves.

```
Collection blackKittenMates = session.createFilter(
    pk.getKittens(),
    "select this.mate where this.color = eg.Color.BLACK.intValue")
    .list();
```

Even an empty filter query is useful, e.g. to load a subset of elements in a large collection:

```
Collection tenKittens = session.createFilter(
```

```
    mother.getKittens(), "")
    .setFirstResult(0).setMaxResults(10)
    .list();
```

10.4.3. Kriterienanfragen

HQL is extremely powerful, but some developers prefer to build queries dynamically using an object-oriented API, rather than building query strings. Hibernate provides an intuitive `Criteria` query API for these cases:

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

The `Criteria` and the associated `Example` API are discussed in more detail in *Kapitel 16, "Criteria Queries"*.

10.4.4. Anfragen in nativer SQL

You can express a query in SQL, using `createSQLQuery()` and let Hibernate manage the mapping from result sets to objects. You can at any time call `session.connection()` and use the JDBC `Connection` directly. If you choose to use the Hibernate API, you must enclose SQL aliases in braces:

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

```
List cats = session.createSQLQuery(
    "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()
```

SQL queries can contain named and positional parameters, just like Hibernate queries. More information about native SQL queries in Hibernate can be found in *Kapitel 17, Native SQL*.

10.5. Änderungen an persistenten Objekten vornehmen

Transactional persistent instances (i.e. objects loaded, saved, created or queried by the `Session`) can be manipulated by the application, and any changes to persistent state will be persisted when the `Session` is *flushed*. This is discussed later in this chapter. There is no need to call a particular

method (like `update()`, which has a different purpose) to make your modifications persistent. The most straightforward way to update the state of an object is to `load()` it and then manipulate it directly while the `Session` is open:

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

Sometimes this programming model is inefficient, as it requires in the same session both an SQL `SELECT` to load an object and an SQL `UPDATE` to persist its updated state. Hibernate offers an alternate approach by using detached instances.

Wichtig

Hibernate does not offer its own API for direct execution of `UPDATE` or `DELETE` statements. Hibernate is a *state management* service, you do not have to think in *statements* to use it. JDBC is a perfect API for executing SQL statements, you can get a JDBC `Connection` at any time by calling `session.connection()`. Furthermore, the notion of mass operations conflicts with object/relational mapping for online transaction processing-oriented applications. Future versions of Hibernate can, however, provide special mass operation functions. See *Kapitel 14, Batch-Verarbeitung* for some possible batch operation tricks.

10.6. Änderungen an abgesetzten Objekten

Zahlreiche Anwendungen müssen ein Objekt in einer Transaktion abrufen, dieses für Modifizierungen an die UI-Schicht schicken und die Änderungen anschließend in einer neuen Transaktion speichern. Anwendungen, die diese Herangehensweise in einer Umgebung mit hoher Nebenläufigkeit (d.h. häufigem gleichzeitigen Zugriff) benutzen, verwenden in der Regel versionierte Daten, um die Isolation der "langen" Arbeitseinheit zu gewährleisten.

Hibernate unterstützt dieses Modell, indem es mittels der `Session.update()` oder `Session.merge()`-Methoden die Möglichkeit der Wiederanbindung abgesetzter Instanzen bietet:

```
// 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
```

Wäre `Cat` mit Bezeichner `catId` bereits durch `secondSession` geladen worden, wenn die Anwendung die Wiederanbindung durchzuführen versucht hätte, so wäre eine Ausnahme gemeldet worden.

Use `update()` if you are certain that the session does not contain an already persistent instance with the same identifier. Use `merge()` if you want to merge your modifications at any time without consideration of the state of the session. In other words, `update()` is usually the first method you would call in a fresh session, ensuring that the reattachment of your detached instances is the first operation that is executed.

The application should individually `update()` detached instances that are reachable from the given detached instance *only* if it wants their state to be updated. This can be automated using *transitive persistence*. See *Abschnitt 10.11, „Transitive Persistenz“* for more information.

The `lock()` method also allows an application to reassociate an object with a new session. However, the detached instance has to be unmodified.

```
//just reassociate:
sess.lock(fritz, LockMode.NONE);
//do a version check, then reassociate:
sess.lock(izi, LockMode.READ);
//do a version check, using SELECT ... FOR UPDATE, then reassociate:
sess.lock(pk, LockMode.UPGRADE);
```

Note that `lock()` can be used with various `LockMode`s. See the API documentation and the chapter on transaction handling for more information. Reattachment is not the only usecase for `lock()`.

Other models for long units of work are discussed in *Abschnitt 12.3, „Optimistische Nebenläufigkeitskontrolle“*.

10.7. Automatische Statuserkennung

Benutzer von Hibernate haben den Wunsch nach einer allgemeinen Methode geäußert, die entweder eine transiente Instanz durch Generierung eines neuen Bezeichners speichert oder die dem aktuellen Bezeichner zugehörigen abgesetzten Instanzen aktualisiert/erneut hinzufügt. Die `saveOrUpdate()`-Methode implementiert diese Funktionalität.

```
// 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)
```

Gebrauch und Semantik von `saveOrUpdate()` scheinen neue Benutzer manchmal zu überfordern. So lange Sie nicht versuchen, diese Instanzen von einer Session in einer neuen Session zu verwenden, sollten Sie `update()`, `saveOrUpdate()` oder `merge()` ohnehin nicht benutzen müssen. Manchmal kommen ganze Anwendungen ohne irgendeine dieser Methoden aus.

In der Regel kommen `update()` oder `saveOrUpdate()` in folgenden Situationen zum Einsatz:

- die Anwendung lädt ein Objekt in der ersten Session
- das Objekt wird an den UI-"Tier" weitergegeben
- am Objekt werden einige Modifikationen vorgenommen
- das Objekt wird zurück an den "Business-Logic-Tier" geleitet
- die Anwendung persistiert diese Modifikationen durch Aufruf von `update()` in einer zweiten Session

`saveOrUpdate()` tut folgendes:

- falls das Objekt in dieser Session bereits persistent ist, geschieht nichts
- falls ein anderes mit der Session assoziiertes Objekt denselben Bezeichner besitzt, wird eine Ausnahme gemeldet
- falls das Objekt keine Bezeichner-Property besitzt, speichern Sie es mittels `save()`
- falls der Bezeichner des Objekts einen ihm zugeordneten Wert am neu instantiierten Objekt besitzt, speichern Sie mittels `save()`
- if the object is versioned by a `<version>` or `<timestamp>`, and the version property value is the same value assigned to a newly instantiated object, `save()` it
- andernfalls aktualisieren Sie das Objekt mittels `update()`

und `merge()` ist völlig anders:

- falls eine persistente Instanz mit demselben Bezeichner zum gegenwärtigen Zeitpunkt mit der Session assoziiert ist, so kopieren Sie den Status des vorgegebenen Objekts in die persistente Instanz
- falls keine persistente Instanz zum gegenwärtigen Zeitpunkt mit der Session assoziiert wird, so versuchen Sie sie aus der Datenbank zu laden oder erstellen Sie eine neue persistente Instanz
- die persistente Instanz wird zurückgeschickt
- die vorgegebene Instanz wird nicht mit der Session assoziiert, sie bleibt abgesetzt

10.8. Das Löschen persistenter Objekte

`Session.delete()` will remove an object's state from the database. Your application, however, can still hold a reference to a deleted object. It is best to think of `delete()` as making a persistent instance, transient.

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

You can delete objects in any order, without risk of foreign key constraint violations. It is still possible to violate a `NOT NULL` constraint on a foreign key column by deleting objects in the wrong order, e.g. if you delete the parent, but forget to delete the children.

10.9. Objektreplikation zwischen zwei verschiedenen Datenspeichern

It is sometimes useful to be able to take a graph of persistent instances and make them persistent in a different datastore, without regenerating identifier values.

```
//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();
```

The `ReplicationMode` determines how `replicate()` will deal with conflicts with existing rows in the database:

- `ReplicationMode.IGNORE`: ignores the object when there is an existing database row with the same identifier
- `ReplicationMode.OVERWRITE`: overwrites any existing database row with the same identifier
- `ReplicationMode.EXCEPTION`: throws an exception if there is an existing database row with the same identifier
- `ReplicationMode.LATEST_VERSION`: overwrites the row if its version number is earlier than the version number of the object, or ignore the object otherwise

Anwendungsfälle dieses Features beinhalten die Abstimmung von in verschiedenen Datenbankinstanzen eingegebenen Daten, das Upgrade von Systemkonfigurationsinformationen während Produkt-Upgrades, die Wiederholung von während nicht-ACID Transaktionen gemachten Änderungen und mehr.

10.10. Das Räumen der Session

Sometimes the `Session` will execute the SQL statements needed to synchronize the JDBC connection's state with the state of objects held in memory. This process, called *flush*, occurs by default at the following points:

- vor dem Ausführen einiger Anfragen
- von `org.hibernate.Transaction.commit()`
- von `Session.flush()`

The SQL statements are issued in the following order:

1. all entity insertions in the same order the corresponding objects were saved using `Session.save()`
2. alle Entity-Aktualisierungen
3. alle Collection-Löschungen
4. alle Löschungen, Aktualisierungen und Einfügungen von Elementen der Collection
5. alle Einfügungen in Collections
6. all entity deletions in the same order the corresponding objects were deleted using `Session.delete()`

An exception is that objects using `native` ID generation are inserted when they are saved.

Except when you explicitly `flush()`, there are absolutely no guarantees about *when* the `Session` executes the JDBC calls, only the *order* in which they are executed. However, Hibernate does guarantee that the `Query.list(..)` will never return stale or incorrect data.

It is possible to change the default behavior so that flush occurs less frequently. The `FlushMode` class defines three different modes: only flush at commit time when the Hibernate `Transaction` API is used, flush automatically using the explained routine, or never flush unless `flush()` is called explicitly. The last mode is useful for long running units of work, where a `Session` is kept open and disconnected for a long time (see *Abschnitt 12.3.2, „Erweiterte Session und automatische Versionierung“*).

```
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();
```

During flush, an exception might occur (e.g. if a DML operation violates a constraint). Since handling exceptions involves some understanding of Hibernate's transactional behavior, we discuss it in *Kapitel 12, Transactions and Concurrency*.

10.11. Transitive Persistenz

Es ist recht mühselig, einzelne Objekte zu speichern, zu löschen und erneut hinzuzufügen, insbesondere dann, wenn man es mit einem Diagramm assoziierter Objekte zu tun hat. Ein gängiger Fall ist die Beziehung zwischen übergeordneten und untergeordneten Objekten (sog. "parent/child"-Beziehung). Sehen Sie sich das folgende Beispiel an:

If the children in a parent/child relationship would be value typed (e.g. a collection of addresses or strings), their life cycle would depend on the parent and no further action would be required for convenient "cascading" of state changes. When the parent is saved, the value-typed child objects are saved and when the parent is deleted, the children will be deleted, etc. This works for operations such as the removal of a child from the collection. Since value-typed objects cannot have shared references, Hibernate will detect this and delete the child from the database.

Now consider the same scenario with parent and child objects being entities, not value-types (e.g. categories and items, or parent and child cats). Entities have their own life cycle and support shared references. Removing an entity from the collection does not mean it can be deleted), and there is by default no cascading of state from one entity to any other associated entities. Hibernate does not implement *persistence by reachability* by default.

Für jeden Grundvorgang der Hibernate Session - einschließlich `persist()`, `merge()`, `saveOrUpdate()`, `delete()`, `lock()`, `refresh()`, `evict()`, `replicate()` - gibt es eine entsprechende Art der Weitergabe. Die Arten sind dem entsprechend `create`, `merge`, `save-update`, `delete`, `lock`, `refresh`, `evict`, `replicate` benannt. Falls Sie möchten, dass ein Vorgang entlang einer Assoziation weitergegeben wird, so müssen Sie dass im Mapping-Dokument angeben. Zum Beispiel wie folgt aussehen:

```
<one-to-one name="person" cascade="persist"/>
```

Die Arten der Weitergabe (sog. "Cascade Styles") können kombiniert werden:

```
<one-to-one name="person" cascade="persist,delete,lock"/>
```

You can even use `cascade="all"` to specify that *all* operations should be cascaded along the association. The default `cascade="none"` specifies that no operations are to be cascaded.

Eine besondere Art der Weitergabe namens `delete-orphan` gilt nur bei "One-to-Many"-Assoziationen und zeigt an, dass der `delete()`-Vorgang angewendet werden soll, wenn ein untergeordnetes Objekt aus der Assoziation entfernt wird.

Empfehlungen:

- It does not usually make sense to enable cascade on a `<many-to-one>` or `<many-to-many>` association. Cascade is often useful for `<one-to-one>` and `<one-to-many>` associations.

- If the child object's lifespan is bounded by the lifespan of the parent object, make it a *life cycle object* by specifying `cascade="all,delete-orphan"`.
- Andernfalls wird keine Weitergabe benötigt. Wenn Sie jedoch glauben, dass Sie oft mit über- und untergeordneten Objekten in derselben Transaktion arbeiten werden und Sie sich etwas Tipparbeit sparen möchten, so können Sie `cascade="persist,merge,save-update"` verwenden.

Das Mappen einer Assoziation (entweder einer einwertigen Assoziation oder einer Collection) unter Verwendung von `cascade="all"` kennzeichnet die Assoziation als zum *Parent/Child*-Beziehungstyp gehörig, bei dem Speichern/Aktualisieren/Löschen des übergeordneten Objekts zum Speichern/Aktualisieren/Löschen des untergeordneten Objekts (oder Objekte) führt.

Furthermore, a mere reference to a child from a persistent parent will result in save/update of the child. This metaphor is incomplete, however. A child which becomes unreferenced by its parent is *not* automatically deleted, except in the case of a `<one-to-many>` association mapped with `cascade="delete-orphan"`. The precise semantics of cascading operations for a parent/child relationship are as follows:

- Falls für einen "Parent" `persist()` gilt, so gilt für sämtliche "Children" ebenfalls `persist()`
- Falls für einen "Parent" `merge()` gilt, so gilt für sämtliche "Children" ebenfalls `merge()`
- Falls für einen "Parent" `save()`, `update()` oder `saveOrUpdate()` gilt, so gilt für sämtliche "Children" ebenfalls `saveOrUpdate()`
- Falls auf ein transientes oder abgesetztes "Child" durch einen persistenten "Parent" verwiesen wird, so gilt dafür `saveOrUpdate()`
- Falls ein "Parent" gelöscht wird, so gilt für alle "Children" `delete()`
- Falls der Verweis auf ein "Child" von einem persistenten "Parent" entfällt, *passiert nicht besonderes* - die Anwendung sollte das "Child" explizit löschen falls nötig - außer es gilt `cascade="delete-orphan"`, in welchem Fall das "verwaiste" Child gelöscht wird.

Finally, note that cascading of operations can be applied to an object graph at *call time* or at *flush time*. All operations, if enabled, are cascaded to associated entities reachable when the operation is executed. However, `save-update` and `delete-orphan` are transitive for all associated entities reachable during flush of the `Session`.

10.12. Die Verwendung von Metadata

Hibernate requires a rich meta-level model of all entity and value types. This model can be useful to the application itself. For example, the application might use Hibernate's metadata to implement a "smart" deep-copy algorithm that understands which objects should be copied (eg. mutable value types) and which objects that should not (e.g. immutable value types and, possibly, associated entities).

Hibernate exposes metadata via the `ClassMetadata` and `CollectionMetadata` interfaces and the `Type` hierarchy. Instances of the metadata interfaces can be obtained from the `SessionFactory`.

```
Cat fritz = ......;
ClassMetadata catMeta = sessionfactory.getClassMetadata(Cat.class);

Object[] propertyValues = catMeta.getPropertyValues(fritz);
String[] propertyNames = catMeta.getPropertyNames();
Type[] propertyTypes = catMeta.getPropertyTypes();

// get a Map of all properties which are not collections or associations
Map namedValues = new HashMap();
for ( int i=0; i<propertyNames.length; i++ ) {
    if ( !propertyTypes[i].isEntityType() && !propertyTypes[i].isCollectionType() ) {
        namedValues.put( propertyNames[i], propertyValues[i] );
    }
}
```

Read-only entities

Wichtig

Hibernate's treatment of *read-only* entities may differ from what you may have encountered elsewhere. Incorrect usage may cause unexpected results.

When an entity is read-only:

- Hibernate does not dirty-check the entity's simple properties or single-ended associations;
- Hibernate will not update simple properties or updatable single-ended associations;
- Hibernate will not update the version of the read-only entity if only simple properties or single-ended updatable associations are changed;

In some ways, Hibernate treats read-only entities the same as entities that are not read-only:

- Hibernate cascades operations to associations as defined in the entity mapping.
- Hibernate updates the version if the entity has a collection with changes that dirties the entity;
- A read-only entity can be deleted.

Even if an entity is not read-only, its collection association can be affected if it contains a read-only entity.

For details about the affect of read-only entities on different property and association types, see *Abschnitt 11.2, „Read-only affect on property type“*.

For details about how to make entities read-only, see *Abschnitt 11.1, „Making persistent entities read-only“*

Hibernate does some optimizing for read-only entities:

- It saves execution time by not dirty-checking simple properties or single-ended associations.
- It saves memory by deleting database snapshots.

11.1. Making persistent entities read-only

Only persistent entities can be made read-only. Transient and detached entities must be put in persistent state before they can be made read-only.

Hibernate provides the following ways to make persistent entities read-only:

- you can map an entity class as *immutable*; when an entity of an immutable class is made persistent, Hibernate automatically makes it read-only. see *Abschnitt 11.1.1, „Entities of immutable classes“* for details
- you can change a default so that entities loaded into the session by Hibernate are automatically made read-only; see *Abschnitt 11.1.2, „Loading persistent entities as read-only“* for details
- you can make an HQL query or criteria read-only so that entities loaded when the query or criteria executes, scrolls, or iterates, are automatically made read-only; see *Abschnitt 11.1.3, „Loading read-only entities from an HQL query/criteria“* for details
- you can make a persistent entity that is already in the in the session read-only; see *Abschnitt 11.1.4, „Making a persistent entity read-only“* for details

11.1.1. Entities of immutable classes

When an entity instance of an immutable class is made persistent, Hibernate automatically makes it read-only.

An entity of an immutable class can created and deleted the same as an entity of a mutable class.

Hibernate treats a persistent entity of an immutable class the same way as a read-only persistent entity of a mutable class. The only exception is that Hibernate will not allow an entity of an immutable class to be changed so it is not read-only.

11.1.2. Loading persistent entities as read-only

Anmerkung

Entities of immutable classes are automatically loaded as read-only.

To change the default behavior so Hibernate loads entity instances of mutable classes into the session and automatically makes them read-only, call:

```
Session.setDefaultReadOnly( true );
```

To change the default back so entities loaded by Hibernate are not made read-only, call:

```
Session.setDefaultReadOnly( false );
```

You can determine the current setting by calling:

```
Session.isDefaultReadOnly();
```

If Session.isDefaultReadOnly() returns true, entities loaded by the following are automatically made read-only:

- Session.load()
- Session.get()
- Session.merge()
- executing, scrolling, or iterating HQL queries and criteria; to override this setting for a particular HQL query or criteria see *Abschnitt 11.1.3, „Loading read-only entities from an HQL query/criteria“*

Changing this default has no effect on:

- persistent entities already in the session when the default was changed
- persistent entities that are refreshed via Session.refresh(); a refreshed persistent entity will only be read-only if it was read-only before refreshing
- persistent entities added by the application via Session.persist(), Session.save(), and Session.update() Session.saveOrUpdate()

11.1.3. Loading read-only entities from an HQL query/criteria

Anmerkung

Entities of immutable classes are automatically loaded as read-only.

If Session.isDefaultReadOnly() returns false (the default) when an HQL query or criteria executes, then entities and proxies of mutable classes loaded by the query will not be read-only.

You can override this behavior so that entities and proxies loaded by an HQL query or criteria are automatically made read-only.

For an HQL query, call:

```
Query.setReadOnly( true );
```

`Query.setReadOnly( true )` must be called before `Query.list()`, `Query.uniqueResult()`, `Query.scroll()`, or `Query.iterate()`

For an HQL criteria, call:

```
Criteria.setReadOnly( true );
```

`Criteria.setReadOnly( true )` must be called before `Criteria.list()`, `Criteria.uniqueResult()`, or `Criteria.scroll()`

Entities and proxies that exist in the session before being returned by an HQL query or criteria are not affected.

Uninitialized persistent collections returned by the query are not affected. Later, when the collection is initialized, entities loaded into the session will be read-only if Session.isDefaultReadOnly() returns true.

Using `Query.setReadOnly( true )` or `Criteria.setReadOnly( true )` works well when a single HQL query or criteria loads all the entities and intializes all the proxies and collections that the application needs to be read-only.

When it is not possible to load and initialize all necessary entities in a single query or criteria, you can temporarily change the session default to load entities as read-only before the query is executed. Then you can explicitly initialize proxies and collections before restoring the session default.

```
Session session = factory.openSession();
Transaction tx = session.beginTransaction();

setDefaultReadOnly( true );
Contract contract =
   ( Contract ) session.createQuery(
           "from Contract where customerName = 'Sherman'" )
           .uniqueResult();
Hibernate.initialize( contract.getPlan() );
Hibernate.initialize( contract.getVariations() );
Hibernate.initialize( contract.getNotes() );
setDefaultReadOnly( false );
...
tx.commit();
session.close();
```

If Session.isDefaultReadOnly() returns true, then you can use Query.setReadOnly(false) and Criteria.setReadOnly(false) to override this session setting and load entities that are not read-only.

11.1.4. Making a persistent entity read-only

Anmerkung

Persistent entities of immutable classes are automatically made read-only.

To make a persistent entity or proxy read-only, call:

```
Session.setReadOnly(entityOrProxy, true)
```

To change a read-only entity or proxy of a mutable class so it is no longer read-only, call:

```
Session.setReadOnly(entityOrProxy, false)
```

Wichtig

When a read-only entity or proxy is changed so it is no longer read-only, Hibernate assumes that the current state of the read-only entity is consistent with its database representation. If this is not true, then any non-flushed changes made before or while the entity was read-only, will be ignored.

To throw away non-flushed changes and make the persistent entity consistent with its database representation, call:

```
session.refresh( entity );
```

To flush changes made before or while the entity was read-only and make the database representation consistent with the current state of the persistent entity:

```
// evict the read-only entity so it is detached
session.evict( entity );

// make the detached entity (with the non-flushed changes) persistent
session.update( entity );

// now entity is no longer read-only and its changes can be flushed
s.flush();
```

11.2. Read-only affect on property type

The following table summarizes how different property types are affected by making an entity read-only.

Tabelle 11.1. Affect of read-only entity on property types

Property/Association Type	Changes flushed to DB?
Simple	no*

Property/Association Type	Changes flushed to DB?
(*Abschnitt 11.2.1, „Simple properties“*)	
Unidirectional one-to-one Unidirectional many-to-one (*Abschnitt 11.2.2.1, „Unidirectional one-to-one and many-to-one“*)	no* no*
Unidirectional one-to-many Unidirectional many-to-many (*Abschnitt 11.2.2.2, „Unidirectional one-to-many and many-to-many“*)	yes yes
Bidirectional one-to-one (*Abschnitt 11.2.3.1, „Bidirectional one-to-one“*)	only if the owning entity is not read-only*
Bidirectional one-to-many/many-to-one inverse collection non-inverse collection (*Abschnitt 11.2.3.2, „Bidirectional one-to-many/many-to-one“*)	only added/removed entities that are not read-only* yes
Bidirectional many-to-many (*Abschnitt 11.2.3.3, „Bidirectional many-to-many“*)	yes

* Behavior is different when the entity having the property/association is read-only, compared to when it is not read-only.

11.2.1. Simple properties

When a persistent object is read-only, Hibernate does not dirty-check simple properties.

Hibernate will not synchronize simple property state changes to the database. If you have automatic versioning, Hibernate will not increment the version if any simple properties change.

```
Session session = factory.openSession();
Transaction tx = session.beginTransaction();

// get a contract and make it read-only
Contract contract = ( Contract ) session.get( Contract.class, contractId );
session.setReadOnly( contract, true );

// contract.getCustomerName() is "Sherman"
```

```
contract.setCustomerName( "Yogi" );
tx.commit();

tx = session.beginTransaction();

contract = ( Contract ) session.get( Contract.class, contractId );
// contract.getCustomerName() is still "Sherman"
...
tx.commit();
session.close();
```

11.2.2. Unidirectional associations

11.2.2.1. Unidirectional one-to-one and many-to-one

Hibernate treats unidirectional one-to-one and many-to-one associations in the same way when the owning entity is read-only.

We use the term *unidirectional single-ended association* when referring to functionality that is common to unidirectional one-to-one and many-to-one associations.

Hibernate does not dirty-check unidirectional single-ended associations when the owning entity is read-only.

If you change a read-only entity's reference to a unidirectional single-ended association to null, or to refer to a different entity, that change will not be flushed to the database.

Anmerkung

If an entity is of an immutable class, then its references to unidirectional single-ended associations must be assigned when that entity is first created. Because the entity is automatically made read-only, these references can not be updated.

If automatic versioning is used, Hibernate will not increment the version due to local changes to unidirectional single-ended associations.

In the following examples, Contract has a unidirectional many-to-one association with Plan. Contract cascades save and update operations to the association.

The following shows that changing a read-only entity's many-to-one association reference to null has no effect on the entity's database representation.

```
// get a contract with an existing plan;
// make the contract read-only and set its plan to null
tx = session.beginTransaction();
Contract contract = ( Contract ) session.get( Contract.class, contractId );
```

```
session.setReadOnly( contract, true );
contract.setPlan( null );
tx.commit();

// get the same contract
tx = session.beginTransaction();
contract = ( Contract ) session.get( Contract.class, contractId );

// contract.getPlan() still refers to the original plan;

tx.commit();
session.close();
```

The following shows that, even though an update to a read-only entity's many-to-one association has no affect on the entity's database representation, flush still cascades the save-update operation to the locally changed association.

```
// get a contract with an existing plan;
// make the contract read-only and change to a new plan
tx = session.beginTransaction();
Contract contract = ( Contract ) session.get( Contract.class, contractId );
session.setReadOnly( contract, true );
Plan newPlan = new Plan( "new plan"
contract.setPlan( newPlan);
tx.commit();

// get the same contract
tx = session.beginTransaction();
contract = ( Contract ) session.get( Contract.class, contractId );
newPlan = ( Contract ) session.get( Plan.class, newPlan.getId() );

// contract.getPlan() still refers to the original plan;
// newPlan is non-null because it was persisted when
// the previous transaction was committed;

tx.commit();
session.close();
```

11.2.2.2. Unidirectional one-to-many and many-to-many

Hibernate treats unidirectional one-to-many and many-to-many associations owned by a read-only entity the same as when owned by an entity that is not read-only.

Hibernate dirty-checks unidirectional one-to-many and many-to-many associations;

The collection can contain entities that are read-only, as well as entities that are not read-only.

Entities can be added and removed from the collection; changes are flushed to the database.

If automatic versioning is used, Hibernate will update the version due to changes in the collection if they dirty the owning entity.

11.2.3. Bidirectional associations

11.2.3.1. Bidirectional one-to-one

If a read-only entity owns a bidirectional one-to-one association:

- Hibernate does not dirty-check the association.
- updates that change the association reference to null or to refer to a different entity will not be flushed to the database.
- If automatic versioning is used, Hibernate will not increment the version due to local changes to the association.

Anmerkung

If an entity is of an immutable class, and it owns a bidirectional one-to-one association, then its reference must be assigned when that entity is first created. Because the entity is automatically made read-only, these references cannot be updated.

When the owner is not read-only, Hibernate treats an association with a read-only entity the same as when the association is with an entity that is not read-only.

11.2.3.2. Bidirectional one-to-many/many-to-one

A read-only entity has no impact on a bidirectional one-to-many/many-to-one association if:

- the read-only entity is on the one-to-many side using an inverse collection;
- the read-only entity is on the one-to-many side using a non-inverse collection;
- the one-to-many side uses a non-inverse collection that contains the read-only entity

When the one-to-many side uses an inverse collection:

- a read-only entity can only be added to the collection when it is created;
- a read-only entity can only be removed from the collection by an orphan delete or by explicitly deleting the entity.

11.2.3.3. Bidirectional many-to-many

Hibernate treats bidirectional many-to-many associations owned by a read-only entity the same as when owned by an entity that is not read-only.

Hibernate dirty-checks bidirectional many-to-many associations.

The collection on either side of the association can contain entities that are read-only, as well as entities that are not read-only.

Entities are added and removed from both sides of the collection; changes are flushed to the database.

If automatic versioning is used, Hibernate will update the version due to changes in both sides of the collection if they dirty the entity owning the respective collections.

Transactions and Concurrency

The most important point about Hibernate and concurrency control is that it is easy to understand. Hibernate directly uses JDBC connections and JTA resources without adding any additional locking behavior. It is recommended that you spend some time with the JDBC, ANSI, and transaction isolation specification of your database management system.

Hibernate does not lock objects in memory. Your application can expect the behavior as defined by the isolation level of your database transactions. Through `Session`, which is also a transaction-scoped cache, Hibernate provides repeatable reads for lookup by identifier and entity queries and not reporting queries that return scalar values.

In addition to versioning for automatic optimistic concurrency control, Hibernate also offers, using the `SELECT FOR UPDATE` syntax, a (minor) API for pessimistic locking of rows. Optimistic concurrency control and this API are discussed later in this chapter.

The discussion of concurrency control in Hibernate begins with the granularity of `Configuration`, `SessionFactory`, and `Session`, as well as database transactions and long conversations.

12.1. Gültigkeitsbereiche von Session und Transaktion

A `SessionFactory` is an expensive-to-create, threadsafe 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-threadsafe 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.

In order to reduce lock contention in the database, a database transaction has to be as short as possible. Long database transactions will prevent your application from scaling to a highly concurrent load. It is not recommended that you hold a database transaction open during user think time until the unit of work is complete.

What is the scope of a unit of work? Can a single Hibernate `Session` span several database transactions, or is this a one-to-one relationship of scopes? When should you open and close a `Session` and how do you demarcate the database transaction boundaries? These questions are addressed in the following sections.

12.1.1. Arbeitseinheit

First, let's define a 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. “[PoEAA] 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 (see *Abschnitt 12.1.2,*

„Lange Konversationen“). So really we are talking about a more abstract notion of a transaction. The term "business transaction" is also sometimes used in lieu of unit of work.

Do not use the *session-per-operation* antipattern: do not open and close a `Session` for every simple database call in a single thread. The same is true for database transactions. Database calls in an application are made using a planned sequence; they are grouped into atomic units of work. This also means that auto-commit after every single SQL statement is useless in an application as this mode is intended for ad-hoc SQL console work. Hibernate disables, or expects the application server to disable, auto-commit mode immediately. Database transactions are never optional. All communication with a database has to occur inside a transaction. Auto-commit behavior for reading data should be avoided, as many small transactions are unlikely to perform better than one clearly defined unit of work. The latter is also more maintainable and extensible.

The most common pattern in a multi-user client/server application is *session-per-request*. In this model, a request from the client is sent to the server, where the Hibernate persistence layer runs. A new Hibernate `Session` is opened, and all database operations are executed in this unit of work. On completion of the work, and once the response for the client has been prepared, the session is flushed and closed. Use a single database transaction to serve the clients request, starting and committing it when you open and close the `Session`. The relationship between the two is one-to-one and this model is a perfect fit for many applications.

The challenge lies in the implementation. Hibernate provides built-in management of the "current session" to simplify this pattern. Start a transaction when a server request has to be processed, and end the transaction before the response is sent to the client. Common solutions are `ServletFilter`, AOP interceptor with a pointcut on the service methods, or a proxy/interception container. An EJB container is a standardized way to implement cross-cutting aspects such as transaction demarcation on EJB session beans, declaratively with CMT. If you use programmatic transaction demarcation, for ease of use and code portability use the Hibernate `Transaction` API shown later in this chapter.

Your application code can access a "current session" to process the request by calling `sessionFactory.getCurrentSession()`. You will always get a `Session` scoped to the current database transaction. This has to be configured for either resource-local or JTA environments, see *Abschnitt 2.5, „Contextual sessions“*.

You can extend the scope of a `Session` and database transaction until the "view has been rendered". This is especially useful in servlet applications that utilize a separate rendering phase after the request has been processed. Extending the database transaction until view rendering, is achieved by implementing your own interceptor. However, this will be difficult if you rely on EJBs with container-managed transactions. A transaction will be completed when an EJB method returns, before rendering of any view can start. See the Hibernate website and forum for tips and examples relating to this *Open Session in View* pattern.

12.1.2. Lange Konversationen

The session-per-request pattern is not the only way of designing units of work. Many business processes require a whole series of interactions with the user that are interleaved with database

accesses. In web and enterprise applications, it is not acceptable for a database transaction to span a user interaction. Consider the following example:

- The first screen of a dialog opens. The data seen by the user has been loaded in a particular `Session` and database transaction. The user is free to modify the objects.
- The user clicks "Save" after 5 minutes and expects their modifications to be made persistent. The user also expects that they were the only person editing this information and that no conflicting modification has occurred.

From the point of view of the user, we call this unit of work a long-running *conversation* or *application transaction*. There are many ways to implement this in your application.

A first naive implementation might keep the `Session` and database transaction open during user think time, with locks held in the database to prevent concurrent modification and to guarantee isolation and atomicity. This is an anti-pattern, since lock contention would not allow the application to scale with the number of concurrent users.

You have to use several database transactions to implement the conversation. In this case, maintaining isolation of business processes becomes the partial responsibility of the application tier. A single conversation usually spans several database transactions. It will be atomic if only one of these database transactions (the last one) stores the updated data. All others simply read data (for example, in a wizard-style dialog spanning several request/response cycles). This is easier to implement than it might sound, especially if you utilize some of Hibernate's features:

- *Automatic Versioning*: Hibernate can perform automatic optimistic concurrency control for you. It can automatically detect if a concurrent modification occurred during user think time. Check for this at the end of the conversation.
- *Detached Objects*: if you decide to use the *session-per-request* pattern, all loaded instances will be in the detached state during user think time. Hibernate allows you to reattach the objects and persist the modifications. The pattern is called *session-per-request-with-detached-objects*. Automatic versioning is used to isolate concurrent modifications.
- *Extended (or Long) Session*: the Hibernate `Session` can be disconnected from the underlying JDBC connection after the database transaction has been committed and reconnected when a new client request occurs. This pattern is known as *session-per-conversation* and makes even reattachment unnecessary. Automatic versioning is used to isolate concurrent modifications and the `Session` will not be allowed to be flushed automatically, but explicitly.

Both *session-per-request-with-detached-objects* and *session-per-conversation* have advantages and disadvantages. These disadvantages are discussed later in this chapter in the context of optimistic concurrency control.

12.1.3. Die Berücksichtigung der Objektidentität

An application can concurrently access the same persistent state in two different `Session`s. However, an instance of a persistent class is never shared between two `Session` instances. It is for this reason that there are two different notions of identity:

Datenbank-Identität

```
foo.getId().equals( bar.getId() )
```

JVM-Identität

```
foo==bar
```

For objects attached to a *particular* `Session` (i.e., in the scope of a `Session`), the two notions are equivalent and JVM identity for database identity is guaranteed by Hibernate. While the application might concurrently access the "same" (persistent identity) business object in two different sessions, the two instances will actually be "different" (JVM identity). Conflicts are resolved using an optimistic approach and automatic versioning at flush/commit time.

This approach leaves Hibernate and the database to worry about concurrency. It also provides the best scalability, since guaranteeing identity in single-threaded units of work means that it does not need expensive locking or other means of synchronization. The application does not need to synchronize on any business object, as long as it maintains a single thread per `Session`. Within a `Session` the application can safely use `==` to compare objects.

However, an application that uses == outside of a `Session` might produce unexpected results. This might occur even in some unexpected places. For example, if you put two detached instances into the same `Set`, both might have the same database identity (i.e., they represent the same row). JVM identity, however, is by definition not guaranteed for instances in a detached state. 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. Use a business key that is a combination of unique, usually immutable, attributes. The database identifier will change if a transient object is made persistent. If the transient instance (usually together with detached instances) is held in a `Set`, changing the hashcode breaks the contract of the `Set`. Attributes for business keys do not have to be as stable as database primary keys; you only have to guarantee stability as long as the objects are in the same `Set`. See the Hibernate website for a more thorough discussion of this issue. Please note that this is not a Hibernate issue, but simply how Java object identity and equality has to be implemented.

12.1.4. Gängige Probleme

Do not use the anti-patterns *session-per-user-session* or *session-per-application* (there are, however, rare exceptions to this rule). Some of the following issues might also arise within the recommended patterns, so ensure that you understand the implications before making a design decision:

- A `Session` is not thread-safe. Things that work concurrently, like HTTP requests, session beans, or Swing workers, will cause race conditions if a `Session` instance is shared. If you keep your Hibernate `Session` in your `HttpSession` (this is discussed later in the chapter), you should consider synchronizing access to your Http session. Otherwise, a user that clicks reload fast enough can use the same `Session` in two concurrently running threads.
- An exception thrown by Hibernate means you have to rollback your database transaction and close the `Session` immediately (this is discussed in more detail later in the chapter). If your

`Session` is bound to the application, you have to stop the application. Rolling back the database transaction does not put your business objects back into the state they were at the start of the transaction. This means that the database state and the business objects will be out of sync. Usually this is not a problem, because exceptions are not recoverable and you will have to start over after rollback anyway.

- The `Session` caches every object that is in a persistent state (watched and checked for dirty state by Hibernate). If you keep it open for a long time or simply load too much data, it will grow endlessly until you get an OutOfMemoryException. One solution is to call `clear()` and `evict()` to manage the `Session` cache, but you should consider a Stored Procedure if you need mass data operations. Some solutions are shown in *Kapitel 14, Batch-Verarbeitung*. Keeping a `Session` open for the duration of a user session also means a higher probability of stale data.

12.2. Abgrenzung von Datenbanktransaktionen

Database, or system, transaction boundaries are always necessary. 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). Always use clear transaction boundaries, even for read-only operations. Depending on your isolation level and database capabilities this might not be required, but there is no downside if you always demarcate transactions explicitly. Certainly, a single database transaction is going to perform better than many small transactions, even for reading data.

A Hibernate application can run in non-managed (i.e., standalone, simple Web- or Swing applications) and managed J2EE environments. In a non-managed environment, Hibernate is usually responsible for its own database connection pool. The application developer has to manually set transaction boundaries (begin, commit, or rollback database transactions) themselves. A managed environment usually provides container-managed transactions (CMT), with the transaction assembly defined declaratively (in deployment descriptors of EJB session beans, for example). Programmatic transaction demarcation is then no longer necessary.

However, it is often desirable to keep your persistence layer portable between non-managed resource-local environments, and systems that can rely on JTA but use BMT instead of CMT. In both cases use programmatic transaction demarcation. Hibernate offers a wrapper API called `Transaction` that translates into the native transaction system of your deployment environment. This API is actually optional, but we strongly encourage its use unless you are in a CMT session bean.

Ending a `Session` usually involves four distinct phases:

- Räumen der Session
- Festschreibung der Transaktion
- Schließen der Session
- Bearbeitung von Ausnahmen

We discussed Flushing the session earlier, so we will now have a closer look at transaction demarcation and exception handling in both managed and non-managed environments.

12.2.1. Die nicht-gemanagte Umgebung

If a Hibernate persistence layer runs in a non-managed environment, database connections are usually handled by simple (i.e., non-DataSource) connection pools from which Hibernate obtains connections as needed. The session/transaction handling idiom looks like this:

```
// 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();
}
```

You do not have to `flush()` the `Session` explicitly: the call to `commit()` automatically triggers the synchronization depending on the *FlushMode* for the session. A call to `close()` marks the end of a session. The main implication of `close()` is that the JDBC connection will be relinquished by the session. This Java code is portable and runs in both non-managed and JTA environments.

As outlined earlier, a much more flexible solution is Hibernate's built-in "current session" context management:

```
// 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
}
```

You will not see these code snippets in a regular application; fatal (system) exceptions should always be caught at the "top". In other words, the code that executes Hibernate calls in the persistence layer, and the code that handles `RuntimeException` (and usually can only clean up

and exit), are in different layers. The current context management by Hibernate can significantly simplify this design by accessing a `SessionFactory`. Exception handling is discussed later in this chapter.

You should select `org.hibernate.transaction.JDBCTransactionFactory`, which is the default, and for the second example select `"thread"` as your `hibernate.current_session_context_class`.

12.2.2. Die Verwendung von JTA

If your persistence layer runs in an application server (for example, behind EJB session beans), every datasource connection obtained by Hibernate will automatically be part of the global JTA transaction. You can also install a standalone JTA implementation and use it without EJB. Hibernate offers two strategies for JTA integration.

If you use bean-managed transactions (BMT), Hibernate will tell the application server to start and end a BMT transaction if you use the `Transaction` API. The transaction management code is identical to the non-managed environment.

```
// BMT 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();
}
```

If you want to use a transaction-bound `Session`, that is, the `getCurrentSession()` functionality for easy context propagation, use the JTA `UserTransaction` API directly:

```
// 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
}
```

With CMT, transaction demarcation is completed in session bean deployment descriptors, not programmatically. The code is reduced to:

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

 // do some work
 ...
```

In a CMT/EJB, even rollback happens automatically. An unhandled `RuntimeException` thrown by a session bean method tells the container to set the global transaction to rollback. *You do not need to use the Hibernate `Transaction` API at all with BMT or CMT, and you get automatic propagation of the "current" Session bound to the transaction.*

When configuring Hibernate's transaction factory, choose `org.hibernate.transaction.JTATransactionFactory` if you use JTA directly (BMT), and `org.hibernate.transaction.CMTTransactionFactory` in a CMT session bean. Remember to also set `hibernate.transaction.manager_lookup_class`. Ensure that your `hibernate.current_session_context_class` is either unset (backwards compatibility), or is set to `"jta"`.

The `getCurrentSession()` operation has one downside in a JTA environment. There is one caveat to the use of `after_statement` connection release mode, which is then used by default. Due to a limitation of the JTA spec, it is not possible for Hibernate to automatically clean up any unclosed `ScrollableResults` or `Iterator` instances returned by `scroll()` or `iterate()`. You *must* release the underlying database cursor by calling `ScrollableResults.close()` or `Hibernate.close(Iterator)` explicitly from a `finally` block. Most applications can easily avoid using `scroll()` or `iterate()` from the JTA or CMT code.)

12.2.3. Der Umgang mit Ausnahmen

If the `Session` throws an exception, including any `SQLException`, immediately rollback the database transaction, call `Session.close()` and discard the `Session` instance. Certain methods of `Session` will *not* leave the session in a consistent state. No exception thrown by Hibernate can be treated as recoverable. Ensure that the `Session` will be closed by calling `close()` in a `finally` block.

The `HibernateException`, which wraps most of the errors that can occur in a Hibernate persistence layer, is an unchecked exception. It was not in older versions of Hibernate. In our

opinion, we should not force the application developer to catch an unrecoverable exception at a low layer. In most systems, unchecked and fatal exceptions are handled in one of the first frames of the method call stack (i.e., in higher layers) and either an error message is presented to the application user or some other appropriate action is taken. Note that Hibernate might also throw other unchecked exceptions that are not a `HibernateException`. These are not recoverable and appropriate action should be taken.

Hibernate wraps `SQLExceptions` thrown while interacting with the database in a `JDBCException`. In fact, Hibernate will attempt to convert the exception into a more meaningful subclass of `JDBCException`. The underlying `SQLException` is always available via `JDBCException.getCause()`. Hibernate converts the `SQLException` into an appropriate `JDBCException` subclass using the `SQLExceptionConverter` attached to the `SessionFactory`. By default, the `SQLExceptionConverter` is defined by the configured dialect. However, it is also possible to plug in a custom implementation. See the javadocs for the `SQLExceptionConverterFactory` class for details. The standard `JDBCException` subtypes are:

- `JDBCConnectionException`: indicates an error with the underlying JDBC communication.
- `SQLGrammarException`: indicates a grammar or syntax problem with the issued SQL.
- `ConstraintViolationException`: indicates some form of integrity constraint violation.
- `LockAcquisitionException`: indicates an error acquiring a lock level necessary to perform the requested operation.
- `GenericJDBCException`: a generic exception which did not fall into any of the other categories.

12.2.4. Transaktions-Timeout

An important feature provided by a managed environment like EJB, that is never provided for non-managed code, is transaction timeout. Transaction timeouts ensure that no misbehaving transaction can indefinitely tie up resources while returning no response to the user. Outside a managed (JTA) environment, Hibernate cannot fully provide this functionality. However, Hibernate can at least control data access operations, ensuring that database level deadlocks and queries with huge result sets are limited by a defined timeout. In a managed environment, Hibernate can delegate transaction timeout to JTA. This functionality is abstracted by the Hibernate `Transaction` object.

```
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();
}
```

`setTimeout()` cannot be called in a CMT bean, where transaction timeouts must be defined declaratively.

12.3. Optimistische Nebenläufigkeitskontrolle

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. Hibernate provides three possible approaches to writing application code that uses optimistic concurrency. The use cases we discuss are in the context of long conversations, but version checking also has the benefit of preventing lost updates in single database transactions.

12.3.1. Kontrolle der Anwendungsversion

In an implementation without much help from Hibernate, each interaction with the database occurs in a new `Session` and the developer is responsible for reloading all persistent instances from the database before manipulating them. The application is forced to carry out its own version checking to ensure conversation transaction isolation. This approach is the least efficient in terms of database access. It is the approach most similar to entity EJBs.

```
// 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();
```

Die `version`-Property wird unter Verwendung von `<version>` gemappt, und Hibernate wird diese während des Räumens automatisch inkrementieren, falls die Entity aufgrund eines Zugriffs als "dirty" erkannt wird.

If you are operating in a low-data-concurrency environment, and do not require version checking, you can use this approach and skip the version check. In this case, *last commit wins* is the default strategy for long conversations. Be aware that this might confuse the users of the application, as they might experience lost updates without error messages or a chance to merge conflicting changes.

Manual version checking is only feasible in trivial circumstances and not practical for most applications. Often not only single instances, but complete graphs of modified objects, have to be checked. Hibernate offers automatic version checking with either an extended `Session` or detached instances as the design paradigm.

12.3.2. Erweiterte Session und automatische Versionierung

A single `Session` instance and its persistent instances that are used for the whole conversation are known as *session-per-conversation*. Hibernate checks instance versions at flush time, throwing an exception if concurrent modification is detected. It is up to the developer to catch and handle this exception. Common options are the opportunity for the user to merge changes or to restart the business conversation with non-stale data.

The `Session` is disconnected from any underlying JDBC connection when waiting for user interaction. This approach is the most efficient in terms of database access. The application does not version check or reattach detached instances, nor does it have to reload instances in every database transaction.

```
// 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
```

The `foo` object knows which `Session` it was loaded in. Beginning a new database transaction on an old session obtains a new connection and resumes the session. Committing a database transaction disconnects a session from the JDBC connection and returns the connection to the pool. After reconnection, to force a version check on data you are not updating, you can call `Session.lock()` with `LockMode.READ` on any objects that might have been updated by another transaction. You do not need to lock any data that you *are* updating. Usually you would set `FlushMode.MANUAL` on an extended `Session`, so that only the last database transaction cycle is allowed to actually persist all modifications made in this conversation. Only this last database transaction will include the `flush()` operation, and then `close()` the session to end the conversation.

This pattern is problematic if the `Session` is too big to be stored during user think time (for example, an `HttpSession` should be kept as small as possible). As the `Session` is also the first-level cache and contains all loaded objects, we can probably use this strategy only for a few request/response cycles. Use a `Session` only for a single conversation as it will soon have stale data.

Note

Earlier versions of Hibernate required explicit disconnection and reconnection of a `Session`. These methods are deprecated, as beginning and ending a transaction has the same effect.

Keep the disconnected `Session` close to the persistence layer. Use an EJB stateful session bean to hold the `Session` in a three-tier environment. Do not transfer it to the web layer, or even serialize it to a separate tier, to store it in the `HttpSession`.

The extended session pattern, or *session-per-conversation*, is more difficult to implement with automatic current session context management. You need to supply your own implementation of the `CurrentSessionContext` for this. See the Hibernate Wiki for examples.

12.3.3. Abgesetzte Objekte und automatische Versionierung

Jede Interaktion mit dem persistenten Speicher geschieht in einer neuen `Session`. Allerdings werden dieselben persistenten Instanzen für jede Interaktion mit der Datenbank wiederverwendet. Die Anwendung manipuliert den Status der abgesetzten Instanzen, die ursprünglich in einer anderen `Session` geladen wurden und fügt diese mittels `Session.update()`, `Session.saveOrUpdate()` oder `Session.merge()` erneut hinzu.

```
// 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();
```

Again, Hibernate will check instance versions during flush, throwing an exception if conflicting updates occurred.

You can also call `lock()` instead of `update()`, and use `LockMode.READ` (performing a version check and bypassing all caches) if you are sure that the object has not been modified.

12.3.4. Anpassung der automatischen Versionierung

You can disable Hibernate's automatic version increment for particular properties and collections by setting the `optimistic-lock` mapping attribute to `false`. Hibernate will then no longer increment versions if the property is dirty.

Legacy database schemas are often static and cannot be modified. Or, other applications might access the same database and will not know how to handle version numbers or even timestamps. In both cases, versioning cannot rely on a particular column in a table. To force a version check with a comparison of the state of all fields in a row but without a version or timestamp property

mapping, turn on `optimistic-lock="all"` in the `<class>` mapping. This conceptually only works if Hibernate can compare the old and the new state (i.e., if you use a single long `Session` and not session-per-request-with-detached-objects).

Concurrent modification can be permitted in instances where the changes that have been made do not overlap. If you set `optimistic-lock="dirty"` when mapping the `<class>`, Hibernate will only compare dirty fields during flush.

In both cases, with dedicated version/timestamp columns or with a full/dirty field comparison, Hibernate uses a single `UPDATE` statement, with an appropriate `WHERE` clause, per entity to execute the version check and update the information. If you use transitive persistence to cascade reattachment to associated entities, Hibernate may execute unnecessary updates. This is usually not a problem, but *on update* triggers in the database might be executed even when no changes have been made to detached instances. You can customize this behavior by setting `select-before-update="true"` in the `<class>` mapping, forcing Hibernate to `SELECT` the instance to ensure that changes did occur before updating the row.

12.4. Pessimistic locking

It is not intended that users spend much time worrying about locking strategies. It is usually enough to specify an isolation level for the JDBC connections and then simply let the database do all the work. However, advanced users may wish to obtain exclusive pessimistic locks or re-obtain locks at the start of a new transaction.

Hibernate will always use the locking mechanism of the database; it never lock objects in memory.

The `LockMode` class defines the different lock levels that can be acquired by Hibernate. A lock is obtained by the following mechanisms:

- `LockMode.WRITE` wird automatisch erlangt, wenn Hibernate eine Reihe aktualisiert oder einfügt.
- `LockMode.UPGRADE` can be acquired upon explicit user request using `SELECT ... FOR UPDATE` on databases which support that syntax.
- `LockMode.UPGRADE_NOWAIT` can be acquired upon explicit user request using a `SELECT ... FOR UPDATE NOWAIT` under Oracle.
- `LockMode.READ` is acquired automatically when Hibernate reads data under Repeatable Read or Serializable isolation level. It can be re-acquired by explicit user request.
- `LockMode.NONE` repräsentiert das Fehlen einer Sperre. Alle Objekte wechseln am Ende einer `Transaction` in diesen Sperrmodus. Objekte, die durch Aufruf von `update()` oder `saveOrUpdate()` der Session zugeordnet werden, starten ebenfalls in diesem Sperrmodus.

Die "explizite Benutzeranfrage" wird auf eine der folgenden Arten ausgedrückt:

- Ein Aufruf an `Session.load()`, der einen `LockMode` bestimmt.
- Ein Aufruf an `Session.lock()`.
- Ein Aufruf an `Query.setLockMode()`.

Falls `Session.load()` mit `UPGRADE` oder `UPGRADE_NOWAIT` aufgerufen wird und das angefragte Objekt bis jetzt noch nicht durch die Session geladen wurde, so wird das Objekt unter Verwendung von `SELECT ... FOR UPDATE` geladen. Falls `load()` für ein bereits mit weniger restriktiver Sperre geladenes Objekt als das angefragte aufgerufen wird, so ruft Hibernate `lock()` für das Objekt auf.

`Session.lock()` performs a version number check if the specified lock mode is `READ`, `UPGRADE` or `UPGRADE_NOWAIT`. In the case of `UPGRADE` or `UPGRADE_NOWAIT`, `SELECT ... FOR UPDATE` is used.

If the requested lock mode is not supported by the database, Hibernate uses an appropriate alternate mode instead of throwing an exception. This ensures that applications are portable.

12.5. Connection release modes

One of the legacies of Hibernate 2.x JDBC connection management meant that a `Session` would obtain a connection when it was first required and then maintain that connection until the session was closed. Hibernate 3.x introduced the notion of connection release modes that would instruct a session how to handle its JDBC connections. The following discussion is pertinent only to connections provided through a configured `ConnectionProvider`. User-supplied connections are outside the breadth of this discussion. The different release modes are identified by the enumerated values of `org.hibernate.ConnectionReleaseMode`:

- `ON_CLOSE`: is the legacy behavior described above. The Hibernate session obtains a connection when it first needs to perform some JDBC access and maintains that connection until the session is closed.
- `AFTER_TRANSACTION`: releases connections after a `org.hibernate.Transaction` has been completed.
- `AFTER_STATEMENT` (also referred to as aggressive release): releases connections after every statement execution. This aggressive releasing is skipped if that statement leaves open resources associated with the given session. Currently the only situation where this occurs is through the use of `org.hibernate.ScrollableResults`.

The configuration parameter `hibernate.connection.release_mode` is used to specify which release mode to use. The possible values are as follows:

- `auto` (the default): this choice delegates to the release mode returned by the `org.hibernate.transaction.TransactionFactory.getDefaultReleaseMode()` method. For JTATransactionFactory, this returns ConnectionReleaseMode.AFTER_STATEMENT; for JDBCTransactionFactory, this returns ConnectionReleaseMode.AFTER_TRANSACTION. Do not change this default behavior as failures due to the value of this setting tend to indicate bugs and/or invalid assumptions in user code.
- `on_close`: uses ConnectionReleaseMode.ON_CLOSE. This setting is left for backwards compatibility, but its use is discouraged.
- `after_transaction`: uses ConnectionReleaseMode.AFTER_TRANSACTION. This setting should not be used in JTA environments. Also note that with ConnectionReleaseMode.AFTER_TRANSACTION, if a session is considered to be in auto-commit mode, connections will be released as if the release mode were AFTER_STATEMENT.

- `after_statement`: uses ConnectionReleaseMode.AFTER_STATEMENT. Additionally, the configured `ConnectionProvider` is consulted to see if it supports this setting (`supportsAggressiveRelease()`). If not, the release mode is reset to ConnectionReleaseMode.AFTER_TRANSACTION. This setting is only safe in environments where we can either re-acquire the same underlying JDBC connection each time you make a call into `ConnectionProvider.getConnection()` or in auto-commit environments where it does not matter if we re-establish the same connection.

Interzeptoren und Ereignisse

It is useful for the application to react to certain events that occur inside Hibernate. This allows for the implementation of generic functionality and the extension of Hibernate functionality.

13.1. Interzeptoren

The `Interceptor` interface provides callbacks from the session to the application, allowing the application to inspect and/or manipulate properties of a persistent object before it is saved, updated, deleted or loaded. One possible use for this is to track auditing information. For example, the following `Interceptor` automatically sets the `createTimestamp` when an `Auditable` is created and updates the `lastUpdateTimestamp` property when an `Auditable` is updated.

You can either implement `Interceptor` directly or extend `EmptyInterceptor`.

```
package org.hibernate.test;

import java.io.Serializable;
import java.util.Date;
import java.util.Iterator;

import org.hibernate.EmptyInterceptor;
import org.hibernate.Transaction;
import org.hibernate.type.Type;

public class AuditInterceptor extends EmptyInterceptor {

    private int updates;
    private int creates;
    private int loads;

    public void onDelete(Object entity,
                         Serializable id,
                         Object[] state,
                         String[] propertyNames,
                         Type[] types) {
        // do nothing
    }

    public boolean onFlushDirty(Object entity,
                                Serializable id,
                                Object[] currentState,
                                Object[] previousState,
                                String[] propertyNames,
                                Type[] types) {

        if ( entity instanceof Auditable ) {
            updates++;
            for ( int i=0; i < propertyNames.length; i++ ) {
                if ( "lastUpdateTimestamp".equals( propertyNames[i] ) ) {
                    currentState[i] = new Date();
                    return true;
                }
```

```
            }
        }
        return false;
    }

    public boolean onLoad(Object entity,
                          Serializable id,
                          Object[] state,
                          String[] propertyNames,
                          Type[] types) {
        if ( entity instanceof Auditable ) {
            loads++;
        }
        return false;
    }

    public boolean onSave(Object entity,
                          Serializable id,
                          Object[] state,
                          String[] propertyNames,
                          Type[] types) {

        if ( entity instanceof Auditable ) {
            creates++;
            for ( int i=0; i<propertyNames.length; i++ ) {
                if ( "createTimestamp".equals( propertyNames[i] ) ) {
                    state[i] = new Date();
                    return true;
                }
            }
        }
        return false;
    }

    public void afterTransactionCompletion(Transaction tx) {
        if ( tx.wasCommitted() ) {
         System.out.println("Creations: " + creates + ", Updates: " + updates, "Loads: " + loads);
        }
        updates=0;
        creates=0;
        loads=0;
    }

}
```

There are two kinds of inteceptors: `Session`-scoped and `SessionFactory`-scoped.

Ein für die `Session` zuständiger Interzeptor wird beim Öffnen einer Session unter Verwendung einer der überlasteten SessionFactory.openSession()-Methoden spezifiziert, die einen `Interceptor` akzeptieren.

```
Session session = sf.openSession( new AuditInterceptor() );
```

A `SessionFactory`-scoped interceptor is registered with the `Configuration` object prior to building the `SessionFactory`. Unless a session is opened explicitly specifying the interceptor to use, the supplied interceptor will be applied to all sessions opened from that `SessionFactory`. `SessionFactory`-scoped interceptors must be thread safe. Ensure that you do not store session-specific states, since multiple sessions will use this interceptor potentially concurrently.

```
new Configuration().setInterceptor( new AuditInterceptor() );
```

13.2. Ereignissystem

If you have to react to particular events in your persistence layer, you can also use the Hibernate3 *event* architecture. The event system can be used in addition, or as a replacement, for interceptors.

All the methods of the `Session` interface correlate to an event. You have a `LoadEvent`, a `FlushEvent`, etc. Consult the XML configuration-file DTD or the `org.hibernate.event` package for the full list of defined event types. When a request is made of one of these methods, the Hibernate `Session` generates an appropriate event and passes it to the configured event listeners for that type. Out-of-the-box, these listeners implement the same processing in which those methods always resulted. However, you are free to implement a customization of one of the listener interfaces (i.e., the `LoadEvent` is processed by the registered implementation of the `LoadEventListener` interface), in which case their implementation would be responsible for processing any `load()` requests made of the `Session`.

The listeners should be considered singletons. This means they are shared between requests, and should not save any state as instance variables.

A custom listener implements the appropriate interface for the event it wants to process and/or extend one of the convenience base classes (or even the default event listeners used by Hibernate out-of-the-box as these are declared non-final for this purpose). Custom listeners can either be registered programmatically through the `Configuration` object, or specified in the Hibernate configuration XML. Declarative configuration through the properties file is not supported. Here is an example of a custom load event listener:

```
public class MyLoadListener implements LoadEventListener {
    // this is the single method defined by the LoadEventListener interface
    public void onLoad(LoadEvent event, LoadEventListener.LoadType loadType)
            throws HibernateException {
        if ( !MySecurity.isAuthorized( event.getEntityClassName(), event.getEntityId() ) ) {
            throw MySecurityException("Unauthorized access");
        }
    }
}
```

Sie benötigen außerdem einen Konfigurationseintrag, der Hibernate mitteilt, dass der Listener zusätzlich zum Standard-Listener verwendet werden soll:

```
<hibernate-configuration>
    <session-factory>
        ...
        <event type="load">
            <listener class="com.eg.MyLoadListener"/>
            <listener class="org.hibernate.event.def.DefaultLoadEventListener"/>
        </event>
    </session-factory>
</hibernate-configuration
>
```

Instead, you can register it programmatically:

```
Configuration cfg = new Configuration();
LoadEventListener[] stack = { new MyLoadListener(), new DefaultLoadEventListener() };
cfg.EventListeners().setLoadEventListeners(stack);
```

Listeners registered declaratively cannot share instances. If the same class name is used in multiple `<listener/>` elements, each reference will result in a separate instance of that class. If you need to share listener instances between listener types you must use the programmatic registration approach.

Why implement an interface and define the specific type during configuration? A listener implementation could implement multiple event listener interfaces. Having the type additionally defined during registration makes it easier to turn custom listeners on or off during configuration.

13.3. Deklarative Sicherheit in Hibernate

Usually, declarative security in Hibernate applications is managed in a session facade layer. Hibernate3 allows certain actions to be permissioned via JACC, and authorized via JAAS. This is an optional functionality that is built on top of the event architecture.

Zunächst einmal müssen die betreffenden Event-Listener konfiguriert werden, damit die Verwendung der JAAS Authorisierung aktiviert ist.

```
<listener type="pre-delete" class="org.hibernate.secure.JACCPreDeleteEventListener"/>
<listener type="pre-update" class="org.hibernate.secure.JACCPreUpdateEventListener"/>
<listener type="pre-insert" class="org.hibernate.secure.JACCPreInsertEventListener"/>
<listener type="pre-load" class="org.hibernate.secure.JACCPreLoadEventListener"/>
```

Note that `<listener type="..." class="..."/>` is shorthand for `<event type="..."><listener class="..."/></event>` when there is exactly one listener for a particular event type.

Next, while still in `hibernate.cfg.xml`, bind the permissions to roles:

```
<grant role="admin" entity-name="User" actions="insert,update,read"/>
<grant role="su" entity-name="User" actions="*"/>
```

Die Rollennamen sind die von Ihrem JACC-Anbieter verstandenen Rollen.

Batch-Verarbeitung

A naive approach to inserting 100,000 rows in the database using Hibernate might look like this:

```
Session session = sessionFactory.openSession();
Transaction tx = session.beginTransaction();
for ( int i=0; i<100000; i++ ) {
    Customer customer = new Customer(.....);
    session.save(customer);
}
tx.commit();
session.close();
```

This would fall over with an `OutOfMemoryException` somewhere around the 50,000th row. That is because Hibernate caches all the newly inserted `Customer` instances in the session-level cache. In this chapter we will show you how to avoid this problem.

If you are undertaking batch processing you will need to enable the use of JDBC batching. This is absolutely essential if you want to achieve optimal performance. Set the JDBC batch size to a reasonable number (10-50, for example):

```
hibernate.jdbc.batch_size 20
```

Hibernate disables insert batching at the JDBC level transparently if you use an `identity` identifier generator.

You can also do this kind of work in a process where interaction with the second-level cache is completely disabled:

```
hibernate.cache.use_second_level_cache false
```

Dies ist jedoch nicht unbedingt erforderlich, da der `CacheMode` so eingestellt werden kann, dass die Interaktion mit dem Cache der zweiten Ebene deaktiviert ist.

14.1. Batch-Einfügungen ("Batch-Inserts")

When making new objects persistent `flush()` and then `clear()` the session regularly in order to control the size of the first-level cache.

```
Session session = sessionFactory.openSession();
Transaction tx = session.beginTransaction();

for ( int i=0; i<100000; i++ ) {
```

```
    Customer customer = new Customer(.....);
    session.save(customer);
    if ( i % 20 == 0 ) { //20, same as the JDBC batch size
        //flush a batch of inserts and release memory:
        session.flush();
        session.clear();
    }
}

tx.commit();
session.close();
```

14.2. Batch-Aktualisierungen

For retrieving and updating data, the same ideas apply. In addition, you need to use `scroll()` to take advantage of server-side cursors for queries that return many rows of data.

```
Session session = sessionFactory.openSession();
Transaction tx = session.beginTransaction();

ScrollableResults customers = session.getNamedQuery("GetCustomers")
    .setCacheMode(CacheMode.IGNORE)
    .scroll(ScrollMode.FORWARD_ONLY);
int count=0;
while ( customers.next() ) {
    Customer customer = (Customer) customers.get(0);
    customer.updateStuff(...);
    if ( ++count % 20 == 0 ) {
        //flush a batch of updates and release memory:
        session.flush();
        session.clear();
    }
}

tx.commit();
session.close();
```

14.3. Das Interface der StatelessSession

Alternatively, Hibernate provides a command-oriented API that can be used for streaming data to and from the database in the form of detached objects. A `StatelessSession` has no persistence context associated with it and does not provide many of the higher-level life cycle semantics. In particular, a stateless session does not implement a first-level cache nor interact with any second-level or query cache. It does not implement transactional write-behind or automatic dirty checking. Operations performed using a stateless session never cascade to associated instances. Collections are ignored by a stateless session. Operations performed via a stateless session bypass Hibernate's event model and interceptors. Due to the lack of a first-level cache, Stateless sessions are vulnerable to data aliasing effects. A stateless session is a lower-level abstraction that is much closer to the underlying JDBC.

```
StatelessSession session = sessionFactory.openStatelessSession();
Transaction tx = session.beginTransaction();

ScrollableResults customers = session.getNamedQuery("GetCustomers")
    .scroll(ScrollMode.FORWARD_ONLY);
while ( customers.next() ) {
    Customer customer = (Customer) customers.get(0);
    customer.updateStuff(...);
    session.update(customer);
}

tx.commit();
session.close();
```

In this code example, the `Customer` instances returned by the query are immediately detached. They are never associated with any persistence context.

The `insert(), update()` and `delete()` operations defined by the `StatelessSession` interface are considered to be direct database row-level operations. They result in the immediate execution of a SQL `INSERT, UPDATE` or `DELETE` respectively. They have different semantics to the `save(), saveOrUpdate()` and `delete()` operations defined by the `Session` interface.

14.4. Vorgänge im DML-Stil

As already discussed, automatic and transparent object/relational mapping is concerned with the management of the object state. The object state is available in memory. This means that manipulating data directly in the database (using the SQL `Data Manipulation Language` (DML) the statements: `INSERT`, `UPDATE`, `DELETE`) will not affect in-memory state. However, Hibernate provides methods for bulk SQL-style DML statement execution that is performed through the Hibernate Query Language (*HQL*).

The pseudo-syntax for `UPDATE` and `DELETE` statements is: `( UPDATE | DELETE ) FROM? EntityName (WHERE where_conditions)?`.

Some points to note:

- In der "from"-Klausel, ist der "FROM"-Schlüsselbegriff optional
- There can only be a single entity named in the from-clause. It can, however, be aliased. If the entity name is aliased, then any property references must be qualified using that alias. If the entity name is not aliased, then it is illegal for any property references to be qualified.
- No *joins*, either implicit or explicit, can be specified in a bulk HQL query. Sub-queries can be used in the where-clause, where the subqueries themselves may contain joins.
- Die "where"-Klausel ist ebenfalls optional.

As an example, to execute an HQL `UPDATE`, use the `Query.executeUpdate()` method. The method is named for those familiar with JDBC's `PreparedStatement.executeUpdate()`:

```
Session session = sessionFactory.openSession();
Transaction tx = session.beginTransaction();

String hqlUpdate = "update Customer c set c.name = :newName where c.name = :oldName";
// or String hqlUpdate = "update Customer set name = :newName where name = :oldName";
int updatedEntities = s.createQuery( hqlUpdate )
        .setString( "newName", newName )
        .setString( "oldName", oldName )
        .executeUpdate();
tx.commit();
session.close();
```

In keeping with the EJB3 specification, HQL `UPDATE` statements, by default, do not effect the *version* or the *timestamp* property values for the affected entities. However, you can force Hibernate to reset the `version` or `timestamp` property values through the use of a `versioned update`. This is achieved by adding the `VERSIONED` keyword after the `UPDATE` keyword.

```
Session session = sessionFactory.openSession();
Transaction tx = session.beginTransaction();
String hqlVersionedUpdate = "update versioned Customer set name = :newName where name = :oldName";
int updatedEntities = s.createQuery( hqlUpdate )
        .setString( "newName", newName )
        .setString( "oldName", oldName )
        .executeUpdate();
tx.commit();
session.close();
```

Custom version types, `org.hibernate.usertype.UserVersionType`, are not allowed in conjunction with a `update versioned` statement.

Um HQL `DELETE`auszuführen, verwenden Sie dieselbe `Query.executeUpdate()`-Methode:

```
Session session = sessionFactory.openSession();
Transaction tx = session.beginTransaction();

String hqlDelete = "delete Customer c where c.name = :oldName";
// or String hqlDelete = "delete Customer where name = :oldName";
int deletedEntities = s.createQuery( hqlDelete )
        .setString( "oldName", oldName )
        .executeUpdate();
tx.commit();
session.close();
```

The `int` value returned by the `Query.executeUpdate()` method indicates the number of entities effected by the operation. This may or may not correlate to the number of rows effected in the database. An HQL bulk operation might result in multiple actual SQL statements being executed (for joined-subclass, for example). The returned number indicates the number of actual entities affected by the statement. Going back to the example of joined-subclass, a delete against one

of the subclasses may actually result in deletes against not just the table to which that subclass is mapped, but also the "root" table and potentially joined-subclass tables further down the inheritance hierarchy.

Die Pseudo-Syntax für `INSERT`-Anweisungen lautet: `INSERT INTO EntityName properties_list select_statement`. Hierzu einige wichtige Punkte:

- Nur INSERT INTO ... SELECT ... wird unterstützt, nicht jedoch INSERT INTO ... VALUES ....

  The properties_list is analogous to the `column specification` in the SQL `INSERT` statement. For entities involved in mapped inheritance, only properties directly defined on that given class-level can be used in the properties_list. Superclass properties are not allowed and subclass properties do not make sense. In other words, `INSERT` statements are inherently non-polymorphic.
- select_statement can be any valid HQL select query, with the caveat that the return types must match the types expected by the insert. Currently, this is checked during query compilation rather than allowing the check to relegate to the database. This might, however, cause problems between Hibernate `Type`s which are *equivalent* as opposed to *equal*. This might cause issues with mismatches between a property defined as a `org.hibernate.type.DateType` and a property defined as a `org.hibernate.type.TimestampType`, even though the database might not make a distinction or might be able to handle the conversion.
- For the id property, the insert statement gives you two options. You can either explicitly specify the id property in the properties_list, in which case its value is taken from the corresponding select expression, or omit it from the properties_list, in which case a generated value is used. This latter option is only available when using id generators that operate in the database; attempting to use this option with any "in memory" type generators will cause an exception during parsing. For the purposes of this discussion, in-database generators are considered to be `org.hibernate.id.SequenceGenerator` (and its subclasses) and any implementers of `org.hibernate.id.PostInsertIdentifierGenerator`. The most notable exception here is `org.hibernate.id.TableHiLoGenerator`, which cannot be used because it does not expose a selectable way to get its values.
- For properties mapped as either `version` or `timestamp`, the insert statement gives you two options. You can either specify the property in the properties_list, in which case its value is taken from the corresponding select expressions, or omit it from the properties_list, in which case the `seed value` defined by the `org.hibernate.type.VersionType` is used.

The following is an example of an HQL `INSERT` statement execution:

```
Session session = sessionFactory.openSession();
Transaction tx = session.beginTransaction();

String hqlInsert = "insert into DelinquentAccount (id, name) select c.id, c.name from Customer
 c where ...";
int createdEntities = s.createQuery( hqlInsert )
        .executeUpdate();
tx.commit();
```

```
session.close();
```

HQL: Die "Hibernate Query Language"

Hibernate uses a powerful query language (HQL) that is similar in appearance to SQL. Compared with SQL, however, HQL is fully object-oriented and understands notions like inheritance, polymorphism and association.

15.1. Beachtung der Groß- und Kleinschreibung

With the exception of names of Java classes and properties, queries are case-insensitive. So `SeLeCT` is the same as `sELEct` is the same as `SELECT`, but `org.hibernate.eg.FOO` is not `org.hibernate.eg.Foo`, and `foo.barSet` is not `foo.BARSET`.

This manual uses lowercase HQL keywords. Some users find queries with uppercase keywords more readable, but this convention is unsuitable for queries embedded in Java code.

15.2. Die "from"-Klausel

Die einfachste Form der Hibernate-Anfrage lautet:

```
from eg.Cat
```

This returns all instances of the class `eg.Cat`. You do not usually need to qualify the class name, since `auto-import` is the default. For example:

```
from Cat
```

In order to refer to the `Cat` in other parts of the query, you will need to assign an *alias*. For example:

```
from Cat as cat
```

This query assigns the alias `cat` to `Cat` instances, so you can use that alias later in the query. The `as` keyword is optional. You could also write:

```
from Cat cat
```

Multiple classes can appear, resulting in a cartesian product or "cross" join.

```
from Formula, Parameter
```

```
from Formula as form, Parameter as param
```

It is good practice to name query aliases using an initial lowercase as this is consistent with Java naming standards for local variables (e.g. `domesticCat`).

15.3. Assoziationen und Verbünde ("Joins")

You can also assign aliases to associated entities or to elements of a collection of values using a `join`. For example:

```
from Cat as cat
    inner join cat.mate as mate
    left outer join cat.kittens as kitten
```

```
from Cat as cat left join cat.mate.kittens as kittens
```

```
from Formula form full join form.parameter param
```

The supported join types are borrowed from ANSI SQL:

- `inner join`
- `left outer join`
- `right outer join`
- `full join` (in der Regel nicht sehr nützlich)

Die `inner join`, `left outer join` und `right outer join`-Konstrukte können abgekürzt werden.

```
from Cat as cat
    join cat.mate as mate
    left join cat.kittens as kitten
```

Sie können weitere Verbundbedingungen unter Verwendung des HQL-Schlüsselbegriffs `with` eingeben.

```
from Cat as cat
    left join cat.kittens as kitten
        with kitten.bodyWeight
```

```
> 10.0
```

A "fetch" join allows associations or collections of values to be initialized along with their parent objects using a single select. This is particularly useful in the case of a collection. It effectively overrides the outer join and lazy declarations of the mapping file for associations and collections. See *Abschnitt 20.1, „Abrufstrategien“* for more information.

```
from Cat as cat
    inner join fetch cat.mate
    left join fetch cat.kittens
```

A fetch join does not usually need to assign an alias, because the associated objects should not be used in the `where` clause (or any other clause). The associated objects are also not returned directly in the query results. Instead, they may be accessed via the parent object. The only reason you might need an alias is if you are recursively join fetching a further collection:

```
from Cat as cat
    inner join fetch cat.mate
    left join fetch cat.kittens child
    left join fetch child.kittens
```

The `fetch` construct cannot be used in queries called using `iterate()` (though `scroll()` can be used). `Fetch` should be used together with `setMaxResults()` or `setFirstResult()`, as these operations are based on the result rows which usually contain duplicates for eager collection fetching, hence, the number of rows is not what you would expect. `Fetch` should also not be used together with impromptu `with` condition. It is possible to create a cartesian product by join fetching more than one collection in a query, so take care in this case. Join fetching multiple collection roles can produce unexpected results for bag mappings, so user discretion is advised when formulating queries in this case. Finally, note that `full join fetch` and `right join fetch` are not meaningful.

If you are using property-level lazy fetching (with bytecode instrumentation), it is possible to force Hibernate to fetch the lazy properties in the first query immediately using `fetch all properties`.

```
from Document fetch all properties order by name
```

```
from Document doc fetch all properties where lower(doc.name) like '%cats%'
```

15.4. Formen der Verbundsyntax

HQL unterstützt zwei Arten von "Association-Joining": `implicit` und `explicit`.

The queries shown in the previous section all use the `explicit` form, that is, where the join keyword is explicitly used in the from clause. This is the recommended form.

Die `implicit`-Form verwendet den "Join"-Schlüsselbegriff nicht. Statt dessen sind die Assoziationen unter Verwendung von Punktnotation "dereferenziert". `implicit`-Joins können in jedem der HQL-Sätze erscheinen. `implicit`-Join-Ergebnisse resultieren in "inner Joins" in der sich ergebenden SQL-Anweisung.

```
from Cat as cat where cat.mate.name like '%s%'
```

15.5. Referring to identifier property

There are 2 ways to refer to an entity's identifier property:

- The special property (lowercase) `id` may be used to reference the identifier property of an entity *provided that the entity does not define a non-identifier property named id*.
- If the entity defines a named identifier property, you can use that property name.

References to composite identifier properties follow the same naming rules. If the entity has a non-identifier property named id, the composite identifier property can only be referenced by its defined named. Otherwise, the special `id` property can be used to reference the identifier property.

Wichtig

Please note that, starting in version 3.2.2, this has changed significantly. In previous versions, `id` *always* referred to the identifier property regardless of its actual name. A ramification of that decision was that non-identifier properties named `id` could never be referenced in Hibernate queries.

15.6. Die "select"-Klausel

The `select` clause picks which objects and properties to return in the query result set. Consider the following:

```
select mate
from Cat as cat
    inner join cat.mate as mate
```

The query will select `mate`s of other `Cat`s. You can express this query more compactly as:

```
select cat.mate from Cat cat
```

Queries can return properties of any value type including properties of component type:

```
select cat.name from DomesticCat cat
where cat.name like 'fri%'
```

```
select cust.name.firstName from Customer as cust
```

Queries can return multiple objects and/or properties as an array of type `Object[]`:

```
select mother, offspr, mate.name
from DomesticCat as mother
    inner join mother.mate as mate
    left outer join mother.kittens as offspr
```

Or as a `List`:

```
select new list(mother, offspr, mate.name)
from DomesticCat as mother
    inner join mother.mate as mate
    left outer join mother.kittens as offspr
```

Or - assuming that the class `Family` has an appropriate constructor - as an actual typesafe Java object:

```
select new Family(mother, mate, offspr)
from DomesticCat as mother
    join mother.mate as mate
    left join mother.kittens as offspr
```

You can assign aliases to selected expressions using `as`:

```
select max(bodyWeight) as max, min(bodyWeight) as min, count(*) as n
from Cat cat
```

Das ist besonders in Verbindung mit `select new map` nützlich:

```
select new map( max(bodyWeight) as max, min(bodyWeight) as min, count(*) as n )
from Cat cat
```

Diese Anfrage reagiert mit einer `Map` von Aliassen zu gewählten Werten.

15.7. Aggregierte Funktionen

HQL queries can even return the results of aggregate functions on properties:

```
select avg(cat.weight), sum(cat.weight), max(cat.weight), count(cat)
from Cat cat
```

The supported aggregate functions are:

- `avg(...), sum(...), min(...), max(...)`
- `count(*)`
- `count(...), count(distinct ...), count(all...)`

You can use arithmetic operators, concatenation, and recognized SQL functions in the select clause:

```
select cat.weight + sum(kitten.weight)
from Cat cat
    join cat.kittens kitten
group by cat.id, cat.weight
```

```
select firstName||' '||initial||' '||upper(lastName) from Person
```

The `distinct` and `all` keywords can be used and have the same semantics as in SQL.

```
select distinct cat.name from Cat cat

select count(distinct cat.name), count(cat) from Cat cat
```

15.8. Polymorphe Anfragen

Eine Anfrage wie:

```
from Cat as cat
```

returns instances not only of `Cat`, but also of subclasses like `DomesticCat`. Hibernate queries can name *any* Java class or interface in the `from` clause. The query will return instances of all persistent classes that extend that class or implement the interface. The following query would return all persistent objects:

```
from java.lang.Object o
```

Das Interface `Named` könnte durch verschiedene persistente Klassen implementiert werden:

```
from Named n, Named m where n.name = m.name
```

These last two queries will require more than one SQL `SELECT`. This means that the `order by` clause does not correctly order the whole result set. It also means you cannot call these queries using `Query.scroll()`.

15.9. Die "where"-Klausel

The `where` clause allows you to refine the list of instances returned. If no alias exists, you can refer to properties by name:

```
from Cat where name='Fritz'
```

Falls ein Alias existiert, verwenden Sie einen vollständigen Property-Namen:

```
from Cat as cat where cat.name='Fritz'
```

This returns instances of `Cat` named 'Fritz'.

The following query:

```
select foo
from Foo foo, Bar bar
where foo.startDate = bar.date
```

returns all instances of `Foo` with an instance of `bar` with a `date` property equal to the `startDate` property of the `Foo`. Compound path expressions make the `where` clause extremely powerful. Consider the following:

```
from Cat cat where cat.mate.name is not null
```

This query translates to an SQL query with a table (inner) join. For example:

```
from Foo foo
```

```
where foo.bar.baz.customer.address.city is not null
```

would result in a query that would require four table joins in SQL.

The = operator can be used to compare not only properties, but also instances:

```
from Cat cat, Cat rival where cat.mate = rival.mate
```

```
select cat, mate
from Cat cat, Cat mate
where cat.mate = mate
```

The special property (lowercase) `id` can be used to reference the unique identifier of an object. See *Abschnitt 15.5, „Referring to identifier property“* for more information.

```
from Cat as cat where cat.id = 123

from Cat as cat where cat.mate.id = 69
```

The second query is efficient and does not require a table join.

Properties of composite identifiers can also be used. Consider the following example where `Person` has composite identifiers consisting of `country` and `medicareNumber`:

```
from bank.Person person
where person.id.country = 'AU'
    and person.id.medicareNumber = 123456
```

```
from bank.Account account
where account.owner.id.country = 'AU'
    and account.owner.id.medicareNumber = 123456
```

Once again, the second query does not require a table join.

See *Abschnitt 15.5, „Referring to identifier property“* for more information regarding referencing identifier properties)

The special property `class` accesses the discriminator value of an instance in the case of polymorphic persistence. A Java class name embedded in the where clause will be translated to its discriminator value.

```
from Cat cat where cat.class = DomesticCat
```

You can also use components or composite user types, or properties of said component types. See *Abschnitt 15.17, „Komponenten“* for more information.

An "any" type has the special properties `id` and `class` that allows you to express a join in the following way (where `AuditLog.item` is a property mapped with `<any>`):

```
from AuditLog log, Payment payment
where log.item.class = 'Payment' and log.item.id = payment.id
```

The `log.item.class` and `payment.class` would refer to the values of completely different database columns in the above query.

15.10. Ausdrücke

Expressions used in the `where` clause include the following:

- mathematical operators: `+, -, *, /`
- binary comparison operators: `=, >=, <=, <>, !=, like`
- logische Vorgänge `and, or, not`
- Parentheses `( )` that indicates grouping
- `in`, `not in`, `between`, `is null`, `is not null`, `is empty`, `is not empty`, `member of` and `not member of`
- "Einfacher" Fall `case ... when ... then ... else ... end`, und "gesuchter" Fall `case when ... then ... else ... end`
- String-Verkettung `...||...` oder `concat(...,...)`
- `current_date()`, `current_time()`, and `current_timestamp()`
- `second(...)`, `minute(...)`, `hour(...)`, `day(...)`, `month(...)`, and `year(...)`
- Jede Funktion oder Operator definiert durch EJB-QL 3.0: `substring(), trim(), lower(), upper(), length(), locate(), abs(), sqrt(), bit_length(), mod()`
- `coalesce()` und `nullif()`
- `str()` zur Konvertierung numerischer oder temporärer Werte in einen lesbaren String
- `cast(... as ...)`, wo ein zweites Argument der Name eines Hibernate-Typs ist und `extract(... from ...)`, wenn ANSI `cast()` und `extract()` von der zu Grunde liegenden Datenbank unterstützt werden
- die HQL `index()`-Funktion, die für Aliasse eine verbundenen indizierten Collection gilt
- HQL functions that take collection-valued path expressions: `size(), minelement(), maxelement(), minindex(), maxindex()`, along with the special `elements()` and `indices` functions that can be quantified using `some, all, exists, any, in`.
- Any database-supported SQL scalar function like `sign()`, `trunc()`, `rtrim()`, and `sin()`
- Positionelle Parameter im JDBC-Stil `?`

- named parameters `:name`, `:start_date`, and `:x1`
- SQL-Literale `'foo'`, `69`, `6.66E+2`, `'1970-01-01 10:00:01.0'`
- Java `public static final`-Konstanten `eg.Color.TABBY`

`in` and `between` can be used as follows:

```
from DomesticCat cat where cat.name between 'A' and 'B'
```

```
from DomesticCat cat where cat.name in ( 'Foo', 'Bar', 'Baz' )
```

The negated forms can be written as follows:

```
from DomesticCat cat where cat.name not between 'A' and 'B'
```

```
from DomesticCat cat where cat.name not in ( 'Foo', 'Bar', 'Baz' )
```

Similarly, `is null` and `is not null` can be used to test for null values.

Booleans can be easily used in expressions by declaring HQL query substitutions in Hibernate configuration:

```
<property name="hibernate.query.substitutions"
>true 1, false 0</property
>
```

Das ersetzt die Schlüsselbegriffe `true` und `false` durch die Literale `1` und `0` in der aus dieser HQL übersetzten SQL:

```
from Cat cat where cat.alive = true
```

You can test the size of a collection with the special property `size` or the special `size()` function.

```
from Cat cat where cat.kittens.size
> 0
```

```
from Cat cat where size(cat.kittens)
> 0
```

For indexed collections, you can refer to the minimum and maximum indices using `minindex` and `maxindex` functions. Similarly, you can refer to the minimum and maximum elements of a collection of basic type using the `minelement` and `maxelement` functions. For example:

```
from Calendar cal where maxelement(cal.holidays)
> current_date
```

```
from Order order where maxindex(order.items)
> 100
```

```
from Order order where minelement(order.items)
> 10000
```

The SQL functions `any, some, all, exists, in` are supported when passed the element or index set of a collection (`elements` and `indices` functions) or the result of a subquery (see below):

```
select mother from Cat as mother, Cat as kit
where kit in elements(foo.kittens)
```

```
select p from NameList list, Person p
where p.name = some elements(list.names)
```

```
from Cat cat where exists elements(cat.kittens)
```

```
from Player p where 3
> all elements(p.scores)
```

```
from Show show where 'fizard' in indices(show.acts)
```

Note that these constructs - `size`, `elements`, `indices`, `minindex`, `maxindex`, `minelement`, `maxelement` - can only be used in the where clause in Hibernate3.

Elements of indexed collections (arrays, lists, and maps) can be referred to by index in a where clause only:

```
from Order order where order.items[0].id = 1234
```

```
select person from Person person, Calendar calendar
where calendar.holidays['national day'] = person.birthDay
    and person.nationality.calendar = calendar
```

```
select item from Item item, Order order
where order.items[ order.deliveredItemIndices[0] ] = item and order.id = 11
```

```
select item from Item item, Order order
where order.items[ maxindex(order.items) ] = item and order.id = 11
```

The expression inside `[]` can even be an arithmetic expression:

```
select item from Item item, Order order
where order.items[ size(order.items) - 1 ] = item
```

HQL also provides the built-in `index()` function for elements of a one-to-many association or collection of values.

```
select item, index(item) from Order order
    join order.items item
where index(item) < 5
```

Scalar SQL functions supported by the underlying database can be used:

```
from DomesticCat cat where upper(cat.name) like 'FRI%'
```

Consider how much longer and less readable the following query would be in SQL:

```
select cust
from Product prod,
    Store store
    inner join store.customers cust
where prod.name = 'widget'
    and store.location.name in ( 'Melbourne', 'Sydney' )
    and prod = all elements(cust.currentOrder.lineItems)
```

Tipp: etwas wie

```
SELECT cust.name, cust.address, cust.phone, cust.id, cust.current_order
FROM customers cust,
    stores store,
    locations loc,
    store_customers sc,
    product prod
WHERE prod.name = 'widget'
    AND store.loc_id = loc.id
    AND loc.name IN ( 'Melbourne', 'Sydney' )
    AND sc.store_id = store.id
    AND sc.cust_id = cust.id
    AND prod.id = ALL(
        SELECT item.prod_id
        FROM line_items item, orders o
        WHERE item.order_id = o.id
            AND cust.current_order = o.id
    )
```

15.11. Die Reihenfolge nach Klausel

The list returned by a query can be ordered by any property of a returned class or components:

```
from DomesticCat cat
order by cat.name asc, cat.weight desc, cat.birthdate
```

Die optionalen `asc` oder `desc` zeigen die aufsteigende bzw. absteigende Reihenfolge an.

15.12. Die Gruppe nach Klausel

A query that returns aggregate values can be grouped by any property of a returned class or components:

```
select cat.color, sum(cat.weight), count(cat)
from Cat cat
group by cat.color
```

```
select foo.id, avg(name), max(name)
from Foo foo join foo.names name
group by foo.id
```

Eine `having`-Klausel ist ebenfalls gestattet.

```
select cat.color, sum(cat.weight), count(cat)
```

```
from Cat cat
group by cat.color
having cat.color in (eg.Color.TABBY, eg.Color.BLACK)
```

SQL functions and aggregate functions are allowed in the `having` and `order by` clauses if they are supported by the underlying database (i.e., not in MySQL).

```
select cat
from Cat cat
    join cat.kittens kitten
group by cat.id, cat.name, cat.other, cat.properties
having avg(kitten.weight)
> 100
order by count(kitten) asc, sum(kitten.weight) desc
```

Neither the `group by` clause nor the `order by` clause can contain arithmetic expressions. Hibernate also does not currently expand a grouped entity, so you cannot write `group by cat` if all properties of `cat` are non-aggregated. You have to list all non-aggregated properties explicitly.

15.13. Unteranfragen

Für Datenbanken, die Unterauswahlen unterstützen, unterstützt Hibernate innerhalb von Anfragen Unteranfragen. Eine Unteranfrage muss eingeklammert sein (oftmals durch einen SQL aggregierten Funktionsaufruf). Selbst korrelierende Unteranfragen (Unteranfragen, die auf einen Alias in der außerhalb liegenden Anfrage verweisen) sind gestattet.

```
from Cat as fatcat
where fatcat.weight
> (
    select avg(cat.weight) from DomesticCat cat
)
```

```
from DomesticCat as cat
where cat.name = some (
    select name.nickName from Name as name
)
```

```
from Cat as cat
where not exists (
    from Cat as mate where mate.mate = cat
)
```

```
from DomesticCat as cat
where cat.name not in (
```

```
    select name.nickName from Name as name
)
```

```
select cat.id, (select max(kit.weight) from cat.kitten kit)
from Cat as cat
```

Note that HQL subqueries can occur only in the select or where clauses.

Note that subqueries can also utilize `row value constructor` syntax. See *Abschnitt 15.18, „Die Syntax des "Row-Value-Constructors"“* for more information.

15.14. HQL-Beispiele

Hibernate queries can be quite powerful and complex. In fact, the power of the query language is one of Hibernate's main strengths. The following example queries are similar to queries that have been used on recent projects. Please note that most queries you will write will be much simpler than the following examples.

The following query returns the order id, number of items, the given minimum total value and the total value of the order for all unpaid orders for a particular customer. The results are ordered by total value. In determining the prices, it uses the current catalog. The resulting SQL query, against the `ORDER`, `ORDER_LINE`, `PRODUCT`, `CATALOG` and `PRICE` tables has four inner joins and an (uncorrelated) subselect.

```
select order.id, sum(price.amount), count(item)
from Order as order
    join order.lineItems as item
    join item.product as product,
    Catalog as catalog
    join catalog.prices as price
where order.paid = false
    and order.customer = :customer
    and price.product = product
    and catalog.effectiveDate < sysdate
    and catalog.effectiveDate
>= all (
        select cat.effectiveDate
        from Catalog as cat
        where cat.effectiveDate < sysdate
    )
group by order
having sum(price.amount)
> :minAmount
order by sum(price.amount) desc
```

Monströs! Im wirklichen Leben bin ich kein großer Freund von Unteranfragen, daher sieht meine Anfrage eher wie folgt aus:

```
select order.id, sum(price.amount), count(item)
from Order as order
    join order.lineItems as item
    join item.product as product,
    Catalog as catalog
    join catalog.prices as price
where order.paid = false
    and order.customer = :customer
    and price.product = product
    and catalog = :currentCatalog
group by order
having sum(price.amount)
> :minAmount
order by sum(price.amount) desc
```

Die nächste Anfrage zählt die Anzahl von Zahlungen in jedem Status, wobei Zahlungen mit `AWAITING_APPROVAL`-Status, bei denen die aktuellste Statusänderung durch den Benutzer vorgenommen wurde, ausgenommen sind. Sie wird in eine SQL-Anfrage mit zwei inneren Verbünden und eine korrelierte Unterauswahl an die `PAYMENT`, `PAYMENT_STATUS` und `PAYMENT_STATUS_CHANGE`-Tabellen übersetzt.

```
select count(payment), status.name
from Payment as payment
    join payment.currentStatus as status
    join payment.statusChanges as statusChange
where payment.status.name <
> PaymentStatus.AWAITING_APPROVAL
    or (
        statusChange.timeStamp = (
            select max(change.timeStamp)
            from PaymentStatusChange change
            where change.payment = payment
        )
        and statusChange.user <
> :currentUser
    )
group by status.name, status.sortOrder
order by status.sortOrder
```

If the `statusChanges` collection was mapped as a list, instead of a set, the query would have been much simpler to write.

```
select count(payment), status.name
from Payment as payment
    join payment.currentStatus as status
where payment.status.name <
> PaymentStatus.AWAITING_APPROVAL
    or payment.statusChanges[ maxIndex(payment.statusChanges) ].user <
> :currentUser
group by status.name, status.sortOrder
```

```
order by status.sortOrder
```

Die nächste Anfrage verwendet die MS SQL Server `isNull()`-Funktion, um alle Konten und unbezahlten Zahlungen für the Organisation, zu der der aktuelle Benutzer gehört, wiederzugeben. Sie wird in eine SQL-Anfrage mit drei inneren Verbünden ("inner Joins"), einen äußeren Verbund ("outer Join") und eine Unterauswahl gegen die `ACCOUNT`, `PAYMENT`, `PAYMENT_STATUS`, `ACCOUNT_TYPE`, `ORGANIZATION` und `ORG_USER`-Tabellen übersetzt.

```
select account, payment
from Account as account
    left outer join account.payments as payment
where :currentUser in elements(account.holder.users)
    and PaymentStatus.UNPAID = isNull(payment.currentStatus.name, PaymentStatus.UNPAID)
order by account.type.sortOrder, account.accountNumber, payment.dueDate
```

Bei einigen Datenbanken würden wir die (korrelierende) Unterauswahl abschaffen müssen.

```
select account, payment
from Account as account
    join account.holder.users as user
    left outer join account.payments as payment
where :currentUser = user
    and PaymentStatus.UNPAID = isNull(payment.currentStatus.name, PaymentStatus.UNPAID)
order by account.type.sortOrder, account.accountNumber, payment.dueDate
```

15.15. "Bulk"-Aktualisierung und Löschen

HQL now supports `update`, `delete` and `insert ... select ...` statements. See *Abschnitt 14.4, „Vorgänge im DML-Stil“* for more information.

15.16. Tipps & Tricks

You can count the number of query results without returning them:

```
( (Integer) session.createQuery("select count(*) from ....").iterate().next() ).intValue()
```

Um ein Ergebnis nach der Größe einer Collection zu ordnen, verwenden Sie die folgende Anfrage:

```
select usr.id, usr.name
from User as usr
    left join usr.messages as msg
group by usr.id, usr.name
order by count(msg)
```

Falls Ihre Datenbank Unterauswahlen unterstützt, können Sie eine Bedingung bezüglich der Auswahlgröße in der "where"-Klausel Ihrer Anfrage stellen:

```
from User usr where size(usr.messages)
>= 1
```

If your database does not support subselects, use the following query:

```
select usr.id, usr.name
from User usr
    join usr.messages msg
group by usr.id, usr.name
having count(msg)
>= 1
```

As this solution cannot return a `User` with zero messages because of the inner join, the following form is also useful:

```
select usr.id, usr.name
from User as usr
    left join usr.messages as msg
group by usr.id, usr.name
having count(msg) = 0
```

Properties eines JavaBean können an benannte Anfragenparameter gebunden werden:

```
Query q = s.createQuery("from foo Foo as foo where foo.name=:name and foo.size=:size");
q.setProperties(fooBean); // fooBean has getName() and getSize()
List foos = q.list();
```

Collections sind unter Verwendung des `Query`-Interface mit einem Filter seitenwechselbar:

```
Query q = s.createFilter( collection, "" ); // the trivial filter
q.setMaxResults(PAGE_SIZE);
q.setFirstResult(PAGE_SIZE * pageNumber);
List page = q.list();
```

Collection elements can be ordered or grouped using a query filter:

```
Collection orderedCollection = s.filter( collection, "order by this.amount" );
Collection counts = s.filter( collection, "select this.type, count(this) group by this.type" );
```

Sie können die Größe einer Collection finden, ohne diese zu initialisieren:

```
( (Integer) session.createQuery("select count(*) from ....").iterate().next() ).intValue();
```

15.17. Komponenten

Components can be used similarly to the simple value types that are used in HQL queries. They can appear in the `select` clause as follows:

```
select p.name from Person p
```

```
select p.name.first from Person p
```

wo die Namen-Property der Person eine Komponente ist. Komponenten können auch in der `where`-Klausel verwendet werden:

```
from Person p where p.name = :name
```

```
from Person p where p.name.first = :firstName
```

Komponenten können auch in der `order by`-Klausel verwendet werden:

```
from Person p order by p.name
```

```
from Person p order by p.name.first
```

Another common use of components is in *row value constructors*.

15.18. Die Syntax des "Row-Value-Constructors"

HQL supports the use of ANSI SQL `row value constructor` syntax, sometimes referred to AS `tuple` syntax, even though the underlying database may not support that notion. Here, we are generally referring to multi-valued comparisons, typically associated with components. Consider an entity Person which defines a name component:

```
from Person p where p.name.first='John' and p.name.last='Jingleheimer-Schmidt'
```

That is valid syntax although it is a little verbose. You can make this more concise by using `row value constructor` syntax:

```
from Person p where p.name=('John', 'Jingleheimer-Schmidt')
```

Es kann sich als nützlich erweisen, dies in der `select`-Klausel zu spezifizieren:

```
select p.name from Person p
```

Using `row value constructor` syntax can also be beneficial when using subqueries that need to compare against multiple values:

```
from Cat as cat
where not ( cat.name, cat.color ) in (
    select cat.name, cat.color from DomesticCat cat
)
```

One thing to consider when deciding if you want to use this syntax, is that the query will be dependent upon the ordering of the component sub-properties in the metadata.

"Criteria Queries"

Hibernate besitzt eine intuitive, erweiterbare "Criteria Query"-API.

16.1. Creating a `criteria` instance

Das Interface `org.hibernate.Criteria` repräsentiert eine Anfrage an eine bestimmte persistente Klasse. Bei der `Session` handelt es sich um eine Factory für `Criteria`-Instanzen.

```
Criteria crit = sess.createCriteria(Cat.class);
crit.setMaxResults(50);
List cats = crit.list();
```

16.2. Den Ergebnissatz eingrenzen

Ein individuelles "Query Criterion" (Anfragenkriterium) ist eine Instanz des Interface `org.hibernate.criterion.Criterion`. Die Klasse `org.hibernate.criterion.Restrictions` definiert Factory-Methoden, um bestimmte eingebaute `Criterion`-Typen einzuholen.

```
List cats = sess.createCriteria(Cat.class)
    .add( Restrictions.like("name", "Fritz%") )
    .add( Restrictions.between("weight", minWeight, maxWeight) )
    .list();
```

Restrictions can be grouped logically.

```
List cats = sess.createCriteria(Cat.class)
    .add( Restrictions.like("name", "Fritz%") )
    .add( Restrictions.or(
        Restrictions.eq( "age", new Integer(0) ),
        Restrictions.isNull("age")
    ) )
    .list();
```

```
List cats = sess.createCriteria(Cat.class)
    .add( Restrictions.in( "name", new String[] { "Fritz", "Izi", "Pk" } ) )
    .add( Restrictions.disjunction()
        .add( Restrictions.isNull("age") )
        .add( Restrictions.eq("age", new Integer(0) ) )
        .add( Restrictions.eq("age", new Integer(1) ) )
        .add( Restrictions.eq("age", new Integer(2) ) )
    ) )
    .list();
```

There are a range of built-in criterion types (`Restrictions` subclasses). One of the most useful allows you to specify SQL directly.

```
List cats = sess.createCriteria(Cat.class)
          .add(   Restrictions.sqlRestriction("lower({alias}.name)   like   lower(?)",   "Fritz
%", Hibernate.STRING) )
    .list();
```

Der `{alias}`-Platzhalter wird durch den Reihen-Alias der angefragten Entity ersetzt.

You can also obtain a criterion from a `Property` instance. You can create a `Property` by calling `Property.forName()`:

```
Property age = Property.forName("age");
List cats = sess.createCriteria(Cat.class)
    .add( Restrictions.disjunction()
        .add( age.isNull() )
        .add( age.eq( new Integer(0) ) )
        .add( age.eq( new Integer(1) ) )
        .add( age.eq( new Integer(2) ) )
    ) )
    .add( Property.forName("name").in( new String[] { "Fritz", "Izi", "Pk" } ) )
    .list();
```

16.3. Die Ergebnisse ordnen

You can order the results using `org.hibernate.criterion.Order`.

```
List cats = sess.createCriteria(Cat.class)
    .add( Restrictions.like("name", "F%")
    .addOrder( Order.asc("name") )
    .addOrder( Order.desc("age") )
    .setMaxResults(50)
    .list();
```

```
List cats = sess.createCriteria(Cat.class)
    .add( Property.forName("name").like("F%") )
    .addOrder( Property.forName("name").asc() )
    .addOrder( Property.forName("age").desc() )
    .setMaxResults(50)
    .list();
```

16.4. Assoziationen

By navigating associations using `createCriteria()` you can specify constraints upon related entities:

```
List cats = sess.createCriteria(Cat.class)
    .add( Restrictions.like("name", "F%") )
    .createCriteria("kittens")
        .add( Restrictions.like("name", "F%") )
    .list();
```

The second `createCriteria()` returns a new instance of `Criteria` that refers to the elements of the `kittens` collection.

There is also an alternate form that is useful in certain circumstances:

```
List cats = sess.createCriteria(Cat.class)
    .createAlias("kittens", "kt")
    .createAlias("mate", "mt")
    .add( Restrictions.eqProperty("kt.name", "mt.name") )
    .list();
```

(`createAlias()` erstellt keine neue Instanz von `Criteria`.)

The kittens collections held by the `Cat` instances returned by the previous two queries are *not* pre-filtered by the criteria. If you want to retrieve just the kittens that match the criteria, you must use a `ResultTransformer`.

```
List cats = sess.createCriteria(Cat.class)
    .createCriteria("kittens", "kt")
        .add( Restrictions.eq("name", "F%") )
    .setResultTransformer(Criteria.ALIAS_TO_ENTITY_MAP)
    .list();
Iterator iter = cats.iterator();
while ( iter.hasNext() ) {
    Map map = (Map) iter.next();
    Cat cat = (Cat) map.get(Criteria.ROOT_ALIAS);
    Cat kitten = (Cat) map.get("kt");
}
```

Additionally you may manipulate the result set using a left outer join:

```
List cats = session.createCriteria( Cat.class )
    .createAlias("mate", "mt", Criteria.LEFT_JOIN, Restrictions.like("mt.name",
 "good%") )
       .addOrder(Order.asc("mt.age"))
```

```
                        .list();
```

This will return all of the `Cats` with a mate whose name starts with "good" ordered by their mate's age, and all cats who do not have a mate. This is useful when there is a need to order or limit in the database prior to returning complex/large result sets, and removes many instances where multiple queries would have to be performed and the results unioned by java in memory.

Without this feature, first all of the cats without a mate would need to be loaded in one query.

A second query would need to retreive the cats with mates who's name started with "good" sorted by the mates age.

Thirdly, in memory; the lists would need to be joined manually.

16.5. Dynamischer Assoziationsabruf

You can specify association fetching semantics at runtime using `setFetchMode()`.

```
List cats = sess.createCriteria(Cat.class)
    .add( Restrictions.like("name", "Fritz%") )
    .setFetchMode("mate", FetchMode.EAGER)
    .setFetchMode("kittens", FetchMode.EAGER)
    .list();
```

This query will fetch both `mate` and `kittens` by outer join. See *Abschnitt 20.1, „Abrufstrategien“* for more information.

16.6. Beispielanfragen

Mit der Klasse `org.hibernate.criterion.Example` können Sie ein Anfragenkriterium aus einer gegebenen Instanz zu konstruieren.

```
Cat cat = new Cat();
cat.setSex('F');
cat.setColor(Color.BLACK);
List results = session.createCriteria(Cat.class)
    .add( Example.create(cat) )
    .list();
```

Versions-Properties, Bezeichner und Assoziationen werden übergangen. In der Standardeinstellung werden auch Properties mit dem Wert Null ausgeschlossen.

Sie können anpassen, wie das `Example` angewendet wird.

```
Example example = Example.create(cat)
```

```
    .excludeZeroes()           //exclude zero valued properties
    .excludeProperty("color")  //exclude the property named "color"
    .ignoreCase()              //perform case insensitive string comparisons
    .enableLike();             //use like for string comparisons
List results = session.createCriteria(Cat.class)
    .add(example)
    .list();
```

Sie können sogar Beispiele verwenden, um Kriterien auf assoziierte Objekte anzuwenden.

```
List results = session.createCriteria(Cat.class)
    .add( Example.create(cat) )
    .createCriteria("mate")
        .add( Example.create( cat.getMate() ) )
    .list();
```

16.7. Projektionen, Aggregation und Gruppierung

The class `org.hibernate.criterion.Projections` is a factory for `Projection` instances. You can apply a projection to a query by calling `setProjection()`.

```
List results = session.createCriteria(Cat.class)
    .setProjection( Projections.rowCount() )
    .add( Restrictions.eq("color", Color.BLACK) )
    .list();
```

```
List results = session.createCriteria(Cat.class)
    .setProjection( Projections.projectionList()
        .add( Projections.rowCount() )
        .add( Projections.avg("weight") )
        .add( Projections.max("weight") )
        .add( Projections.groupProperty("color") )
    )
    .list();
```

In einer "Criteria Query" ist kein explizites "gruppieren nach" notwendig. Bestimmte Projektionstypen sind als *Gruppierungsprojektionen definiert*, die auch in der SQL `group by`-Klausel auftreten.

An alias can be assigned to a projection so that the projected value can be referred to in restrictions or orderings. Here are two different ways to do this:

```
List results = session.createCriteria(Cat.class)
    .setProjection( Projections.alias( Projections.groupProperty("color"), "colr" ) )
    .addOrder( Order.asc("colr") )
```

```
    .list();
```

```
List results = session.createCriteria(Cat.class)
    .setProjection( Projections.groupProperty("color").as("colr") )
    .addOrder( Order.asc("colr") )
    .list();
```

Die `alias()` und `as()`-Methoden wrappen die Projektionsinstanzen in eine andere Alias-Instanz von `Projection`. Als Tastenkürzel können Sie einen Alias zuordnen, wenn Sie der Projektionsliste eine Projektion hinzufügen:

```
List results = session.createCriteria(Cat.class)
    .setProjection( Projections.projectionList()
        .add( Projections.rowCount(), "catCountByColor" )
        .add( Projections.avg("weight"), "avgWeight" )
        .add( Projections.max("weight"), "maxWeight" )
        .add( Projections.groupProperty("color"), "color" )
    )
    .addOrder( Order.desc("catCountByColor") )
    .addOrder( Order.desc("avgWeight") )
    .list();
```

```
List results = session.createCriteria(Domestic.class, "cat")
    .createAlias("kittens", "kit")
    .setProjection( Projections.projectionList()
        .add( Projections.property("cat.name"), "catName" )
        .add( Projections.property("kit.name"), "kitName" )
    )
    .addOrder( Order.asc("catName") )
    .addOrder( Order.asc("kitName") )
    .list();
```

Sie können auch `Property.forName()` verwenden, um Projektionen auszudrücken:

```
List results = session.createCriteria(Cat.class)
    .setProjection( Property.forName("name") )
    .add( Property.forName("color").eq(Color.BLACK) )
    .list();
```

```
List results = session.createCriteria(Cat.class)
    .setProjection( Projections.projectionList()
        .add( Projections.rowCount().as("catCountByColor") )
        .add( Property.forName("weight").avg().as("avgWeight") )
        .add( Property.forName("weight").max().as("maxWeight") )
        .add( Property.forName("color").group().as("color" )
    )
```

```
    .addOrder( Order.desc("catCountByColor") )
    .addOrder( Order.desc("avgWeight") )
    .list();
```

16.8. Abgesetzte Anfragen und Unteranfragen

The `DetachedCriteria` class allows you to create a query outside the scope of a session and then execute it using an arbitrary `Session`.

```
DetachedCriteria query = DetachedCriteria.forClass(Cat.class)
    .add( Property.forName("sex").eq('F') );

Session session = ....;
Transaction txn = session.beginTransaction();
List results = query.getExecutableCriteria(session).setMaxResults(100).list();
txn.commit();
session.close();
```

A `DetachedCriteria` can also be used to express a subquery. Criterion instances involving subqueries can be obtained via `Subqueries` or `Property`.

```
DetachedCriteria avgWeight = DetachedCriteria.forClass(Cat.class)
    .setProjection( Property.forName("weight").avg() );
session.createCriteria(Cat.class)
    .add( Property.forName("weight").gt(avgWeight) )
    .list();
```

```
DetachedCriteria weights = DetachedCriteria.forClass(Cat.class)
    .setProjection( Property.forName("weight") );
session.createCriteria(Cat.class)
    .add( Subqueries.geAll("weight", weights) )
    .list();
```

Correlated subqueries are also possible:

```
DetachedCriteria avgWeightForSex = DetachedCriteria.forClass(Cat.class, "cat2")
    .setProjection( Property.forName("weight").avg() )
    .add( Property.forName("cat2.sex").eqProperty("cat.sex") );
session.createCriteria(Cat.class, "cat")
    .add( Property.forName("weight").gt(avgWeightForSex) )
    .list();
```

16.9. Anfrage über natürlichen Bezeichner

For most queries, including criteria queries, the query cache is not efficient because query cache invalidation occurs too frequently. However, there is a special kind of query where you can optimize the cache invalidation algorithm: lookups by a constant natural key. In some applications, this kind of query occurs frequently. The criteria API provides special provision for this use case.

First, map the natural key of your entity using `<natural-id>` and enable use of the second-level cache.

```
<class name="User">
    <cache usage="read-write"/>
    <id name="id">
        <generator class="increment"/>
    </id>
    <natural-id>
        <property name="name"/>
        <property name="org"/>
    </natural-id>
    <property name="password"/>
</class
>
```

This functionality is not intended for use with entities with *mutable* natural keys.

Once you have enabled the Hibernate query cache, the `Restrictions.naturalId()` allows you to make use of the more efficient cache algorithm.

```
session.createCriteria(User.class)
    .add( Restrictions.naturalId()
        .set("name", "gavin")
        .set("org", "hb")
    ).setCacheable(true)
    .uniqueResult();
```

Native SQL

You can also express queries in the native SQL dialect of your database. This is useful if you want to utilize database-specific features such as query hints or the `CONNECT` keyword in Oracle. It also provides a clean migration path from a direct SQL/JDBC based application to Hibernate.

Hibernate3 allows you to specify handwritten SQL, including stored procedures, for all create, update, delete, and load operations.

17.1. Using a `SQLQuery`

Execution of native SQL queries is controlled via the `SQLQuery` interface, which is obtained by calling `Session.createSQLQuery()`. The following sections describe how to use this API for querying.

17.1.1. Skalare Anfragen

Die grundlegendste SQL-Anfrage erfolgt durch eine Liste von Skalaren (Werten).

```
sess.createSQLQuery("SELECT * FROM CATS").list();
sess.createSQLQuery("SELECT ID, NAME, BIRTHDATE FROM CATS").list();
```

These will return a List of Object arrays (Object[]) with scalar values for each column in the CATS table. Hibernate will use ResultSetMetadata to deduce the actual order and types of the returned scalar values.

To avoid the overhead of using `ResultSetMetadata`, or simply to be more explicit in what is returned, one can use `addScalar()`:

```
sess.createSQLQuery("SELECT * FROM CATS")
 .addScalar("ID", Hibernate.LONG)
 .addScalar("NAME", Hibernate.STRING)
 .addScalar("BIRTHDATE", Hibernate.DATE)
```

Diese Anfrage spezifiziert:

- den SQL-Anfragen-String
- die wiederzugebenden Spalten und Typen

This will return Object arrays, but now it will not use `ResultSetMetadata` but will instead explicitly get the ID, NAME and BIRTHDATE column as respectively a Long, String and a Short from the underlying resultset. This also means that only these three columns will be returned, even though the query is using `*` and could return more than the three listed columns.

Es ist möglich, die Typeninformationen für alle oder einige der Skalare auszulassen.

```
sess.createSQLQuery("SELECT * FROM CATS")
 .addScalar("ID", Hibernate.LONG)
 .addScalar("NAME")
 .addScalar("BIRTHDATE")
```

This is essentially the same query as before, but now `ResultSetMetaData` is used to determine the type of NAME and BIRTHDATE, where as the type of ID is explicitly specified.

How the java.sql.Types returned from ResultSetMetaData is mapped to Hibernate types is controlled by the Dialect. If a specific type is not mapped, or does not result in the expected type, it is possible to customize it via calls to `registerHibernateType` in the Dialect.

17.1.2. Entity-Anfragen

Die Anfragen oben behandeln die erhaltenen Skalarwerte, wobei es sich dabei um die "unbearbeiteten" Werte von resultset handelt. Nachfolgend sehen Sie, wie Sie Entity-Objekte von einer nativen SQL-Anfrage mittels `addEntity()` erhalten.

```
sess.createSQLQuery("SELECT * FROM CATS").addEntity(Cat.class);
sess.createSQLQuery("SELECT ID, NAME, BIRTHDATE FROM CATS").addEntity(Cat.class);
```

Diese Anfrage spezifiziert:

- den SQL-Anfragen-String
- die von der Anfrage wiedergegebene Entity

Geht man davon aus, dass Cat als Klasse mit den Spalten ID, NAME und BIRTHDATE gemappt ist, werden die Anfragen oben beide mit einer Liste antworten, in der jedes Element eine Entity von Cat ist.

Falls die Entity mit `many-to-one` zu einer anderen Entity gemappt ist, so ist dies ebenfalls erforderlich wenn die native Anfrage durchgeführt wird, da sonst eine Datenbank-spezifische "Spalte nicht gefunden"-Fehlermeldung ("column not found") erscheint. Die zusätzlichen Spalten werden bei Verwendung der * Notation automatisch wiedergegeben, aber wie im folgenden Beispiel für eine `many-to-one` zu `Dog` wollen wir lieber explizit sein:

```
sess.createSQLQuery("SELECT ID, NAME, BIRTHDATE, DOG_ID FROM CATS").addEntity(Cat.class);
```

Dies ermöglicht die ordnungsgemäße Funktion von cat.getDog().

17.1.3. Umgang mit Assoziationen und Collections

Es ist möglich "eager Join" in `Dog` anzuwenden, um den Extra-Weg zur Datenbank zur Initialisierung des Proxy zu vermeiden. Dies geschieht mittels der `addJoin()`-Methode, die es Ihnen ermöglicht, eine Assoziation oder Collection zu verbinden.

```
sess.createSQLQuery("SELECT c.ID, NAME, BIRTHDATE, DOG_ID, D_ID, D_NAME FROM CATS c, DOGS d
 WHERE c.DOG_ID = d.D_ID")
 .addEntity("cat", Cat.class)
 .addJoin("cat.dog");
```

In this example, the returned `Cat`'s will have their `dog` property fully initialized without any extra roundtrip to the database. Notice that you added an alias name ("cat") to be able to specify the target property path of the join. It is possible to do the same eager joining for collections, e.g. if the `Cat` had a one-to-many to `Dog` instead.

```
sess.createSQLQuery("SELECT ID, NAME, BIRTHDATE, D_ID, D_NAME, CAT_ID FROM CATS c, DOGS d WHERE
 c.ID = d.CAT_ID")
 .addEntity("cat", Cat.class)
 .addJoin("cat.dogs");
```

At this stage you are reaching the limits of what is possible with native queries, without starting to enhance the sql queries to make them usable in Hibernate. Problems can arise when returning multiple entities of the same type or when the default alias/column names are not enough.

17.1.4. Wiedergabe mehrerer Entities

Until now, the result set column names are assumed to be the same as the column names specified in the mapping document. This can be problematic for SQL queries that join multiple tables, since the same column names can appear in more than one table.

Spalten Alias-Einspeisung wird bei der folgenden Anfrage benötigt (die aller Wahrscheinlichkeit nach fehlschlagen wird):

```
sess.createSQLQuery("SELECT c.*, m.*  FROM CATS c, CATS m WHERE c.MOTHER_ID = c.ID")
 .addEntity("cat", Cat.class)
 .addEntity("mother", Cat.class)
```

The query was intended to return two Cat instances per row: a cat and its mother. The query will, however, fail because there is a conflict of names; the instances are mapped to the same column names. Also, on some databases the returned column aliases will most likely be on the form "c.ID", "c.NAME", etc. which are not equal to the columns specified in the mappings ("ID" and "NAME").

Die folgende Form ist nicht anfällig für die Duplizierung von Spaltennamen:

```
sess.createSQLQuery("SELECT {cat.*}, {mother.*}  FROM CATS c, CATS m WHERE c.MOTHER_ID = c.ID")
 .addEntity("cat", Cat.class)
 .addEntity("mother", Cat.class)
```

Diese Anfrage spezifiziert:

- der SQL Anfragen-String mit Platzhaltern für die durch Hibernate eingespeisten Aliasse
- die von der Anfrage erhaltenen Entities

The {cat.*} and {mother.*} notation used above is a shorthand for "all properties". Alternatively, you can list the columns explicitly, but even in this case Hibernate injects the SQL column aliases for each property. The placeholder for a column alias is just the property name qualified by the table alias. In the following example, you retrieve Cats and their mothers from a different table (cat_log) to the one declared in the mapping metadata. You can even use the property aliases in the where clause.

```
String sql = "SELECT ID as {c.id}, NAME as {c.name}, " +
         "BIRTHDATE as {c.birthDate}, MOTHER_ID as {c.mother}, {mother.*} " +
         "FROM CAT_LOG c, CAT_LOG m WHERE {c.mother} = c.ID";

List loggedCats = sess.createSQLQuery(sql)
        .addEntity("cat", Cat.class)
        .addEntity("mother", Cat.class).list()
```

17.1.4.1. Alias- und Property-Referenzen

In most cases the above alias injection is needed. For queries relating to more complex mappings, like composite properties, inheritance discriminators, collections etc., you can use specific aliases that allow Hibernate to inject the proper aliases.

The following table shows the different ways you can use the alias injection. Please note that the alias names in the result are simply examples; each alias will have a unique and probably different name when used.

Tabelle 17.1. Alias-Einspeisungsnamen

Beschreibung	Syntax	Beispiel
Eine einfache Property	`{[aliasname].[propertyname]`	`A_NAME as {item.name}`
Eine zusammengesetzte Property	`{[aliasname].[componentname].[propertyname]}`	`CURRENCY as {item.amount.currency}, VALUE as {item.amount.value}`
Diskriminator einer Entity	`{[aliasname].class}`	`DISC as {item.class}`

Beschreibung	Syntax	Beispiel
Alle Properties einer Entity	`{[aliasname].*}`	`{item.*}`
Ein Collection-Schlüssel	`{[aliasname].key}`	`ORGID as {coll.key}`
Die id einer Collection	`{[aliasname].id}`	`EMPID as {coll.id}`
Das Element einer Collection	`{[aliasname].element}`	`XID as {coll.element}`
property of the element in the collection	`{[aliasname].element.[propertyname]}`	`NAME as {coll.element.name}`
Alle Properties des Elements in der Collection	`{[aliasname].element.*}`	`{coll.element.*}`
All properties of the collection	`{[aliasname].*}`	`{coll.*}`

17.1.5. Wiedergabe nicht gemanagter Entities

It is possible to apply a ResultTransformer to native SQL queries, allowing it to return non-managed entities.

```
sess.createSQLQuery("SELECT NAME, BIRTHDATE FROM CATS")
        .setResultTransformer(Transformers.aliasToBean(CatDTO.class))
```

Diese Anfrage spezifiziert:

- den SQL-Anfragen-String
- ein Ergebnistransformer

Die Anfrage oben wird eine Liste von `CatDTO` wiedergeben, die instantiiert wurde und die Werte für NAME und BIRTHNAME in die entsprechenden Properties oder Felder eingespeist hat.

17.1.6. Umgang mit Vererbung

Native SQL queries which query for entities that are mapped as part of an inheritance must include all properties for the baseclass and all its subclasses.

17.1.7. Parameter

Native SQL queries support positional as well as named parameters:

```
Query query = sess.createSQLQuery("SELECT * FROM CATS WHERE NAME like ?").addEntity(Cat.class);
List pusList = query.setString(0, "Pus%").list();

query = sess.createSQLQuery("SELECT * FROM CATS WHERE NAME like :name").addEntity(Cat.class);
List pusList = query.setString("name", "Pus%").list();
```

17.2. Benannte SQL-Anfragen

Named SQL queries can be defined in the mapping document and called in exactly the same way as a named HQL query. In this case, you do *not* need to call `addEntity()`.

```
<sql-query name="persons">
    <return alias="person" class="eg.Person"/>
    SELECT person.NAME AS {person.name},
           person.AGE AS {person.age},
           person.SEX AS {person.sex}
    FROM PERSON person
    WHERE person.NAME LIKE :namePattern
</sql-query
>
```

```
List people = sess.getNamedQuery("persons")
    .setString("namePattern", namePattern)
    .setMaxResults(50)
    .list();
```

The `<return-join>` element is use to join associations and the `<load-collection>` element is used to define queries which initialize collections,

```
<sql-query name="personsWith">
    <return alias="person" class="eg.Person"/>
    <return-join alias="address" property="person.mailingAddress"/>
    SELECT person.NAME AS {person.name},
           person.AGE AS {person.age},
           person.SEX AS {person.sex},
           address.STREET AS {address.street},
           address.CITY AS {address.city},
           address.STATE AS {address.state},
           address.ZIP AS {address.zip}
    FROM PERSON person
    JOIN ADDRESS address
        ON person.ID = address.PERSON_ID AND address.TYPE='MAILING'
    WHERE person.NAME LIKE :namePattern
</sql-query
>
```

Eine benannte SQL-Anfrage kann einen Skalarwert wiedergeben. Sie müssen unter Verwendung des `<return-scalar>`-Elements den Spalten-Alias und den Hibernate-Typ deklarieren:

```
<sql-query name="mySqlQuery">
    <return-scalar column="name" type="string"/>
    <return-scalar column="age" type="long"/>
    SELECT p.NAME AS name,
           p.AGE AS age,
    FROM PERSON p WHERE p.NAME LIKE 'Hiber%'
</sql-query
>
```

You can externalize the resultset mapping information in a `<resultset>` element which will allow you to either reuse them across several named queries or through the `setResultSetMapping()` API.

```
<resultset name="personAddress">
    <return alias="person" class="eg.Person"/>
    <return-join alias="address" property="person.mailingAddress"/>
</resultset>

<sql-query name="personsWith" resultset-ref="personAddress">
    SELECT person.NAME AS {person.name},
           person.AGE AS {person.age},
           person.SEX AS {person.sex},
           address.STREET AS {address.street},
           address.CITY AS {address.city},
           address.STATE AS {address.state},
           address.ZIP AS {address.zip}
    FROM PERSON person
    JOIN ADDRESS address
        ON person.ID = address.PERSON_ID AND address.TYPE='MAILING'
    WHERE person.NAME LIKE :namePattern
</sql-query
>
```

You can, alternatively, use the resultset mapping information in your hbm files directly in java code.

```
List cats = sess.createSQLQuery(
        "select {cat.*}, {kitten.*} from cats cat, cats kitten where kitten.mother = cat.id"
    )
    .setResultSetMapping("catAndKitten")
    .list();
```

17.2.1. Die Verwendung der Return-Property zur expliziten Spezifizierung von Spalten-/Aliasnamen

You can explicitly tell Hibernate what column aliases to use with `<return-property>`, instead of using the `{}`-syntax to let Hibernate inject its own aliases.For example:

```
<sql-query name="mySqlQuery">
    <return alias="person" class="eg.Person">
        <return-property name="name" column="myName"/>
        <return-property name="age" column="myAge"/>
        <return-property name="sex" column="mySex"/>
    </return>
    SELECT person.NAME AS myName,
           person.AGE AS myAge,
           person.SEX AS mySex,
    FROM PERSON person WHERE person.NAME LIKE :name
</sql-query>
```

`<return-property>` also works with multiple columns. This solves a limitation with the `{}`-syntax which cannot allow fine grained control of multi-column properties.

```
<sql-query name="organizationCurrentEmployments">
    <return alias="emp" class="Employment">
        <return-property name="salary">
            <return-column name="VALUE"/>
            <return-column name="CURRENCY"/>
        </return-property>
        <return-property name="endDate" column="myEndDate"/>
    </return>
        SELECT EMPLOYEE AS {emp.employee}, EMPLOYER AS {emp.employer},
        STARTDATE AS {emp.startDate}, ENDDATE AS {emp.endDate},
        REGIONCODE as {emp.regionCode}, EID AS {emp.id}, VALUE, CURRENCY
        FROM EMPLOYMENT
        WHERE EMPLOYER = :id AND ENDDATE IS NULL
        ORDER BY STARTDATE ASC
</sql-query
>
```

In this example `<return-property>` was used in combination with the `{}`-syntax for injection. This allows users to choose how they want to refer column and properties.

Falls Ihr Mapping über einen Diskriminator verfügt, so müssen Sie `<return-discriminator>` verwenden, um die Diskriminator-Spalte festzulegen.

17.2.2. Die Verwendung gespeicherter Prozeduren für Anfragen

Hibernate3 provides support for queries via stored procedures and functions. Most of the following documentation is equivalent for both. The stored procedure/function must return a resultset as

the first out-parameter to be able to work with Hibernate. An example of such a stored function in Oracle 9 and higher is as follows:

```
CREATE OR REPLACE FUNCTION selectAllEmployments
    RETURN SYS_REFCURSOR
AS
    st_cursor SYS_REFCURSOR;
BEGIN
    OPEN st_cursor FOR
 SELECT EMPLOYEE, EMPLOYER,
 STARTDATE, ENDDATE,
 REGIONCODE, EID, VALUE, CURRENCY
 FROM EMPLOYMENT;
      RETURN  st_cursor;
 END;
```

Um diese Anfrage in Hibernate zu verwenden, müssen Sie sie durch eine benannte Anfrage mappen.

```
<sql-query name="selectAllEmployees_SP" callable="true">
    <return alias="emp" class="Employment">
        <return-property name="employee" column="EMPLOYEE"/>
        <return-property name="employer" column="EMPLOYER"/>
        <return-property name="startDate" column="STARTDATE"/>
        <return-property name="endDate" column="ENDDATE"/>
        <return-property name="regionCode" column="REGIONCODE"/>
        <return-property name="id" column="EID"/>
        <return-property name="salary">
            <return-column name="VALUE"/>
            <return-column name="CURRENCY"/>
        </return-property>
    </return>
    { ? = call selectAllEmployments() }
</sql-query
>
```

Stored procedures currently only return scalars and entities. `<return-join>` and `<load-collection>` are not supported.

17.2.2.1. Regeln/Einschränkungen bei der Verwendung gespeicherter Prozeduren

You cannot use stored procedures with Hibernate unless you follow some procedure/function rules. If they do not follow those rules they are not usable with Hibernate. If you still want to use these procedures you have to execute them via `session.connection()`. The rules are different for each database, since database vendors have different stored procedure semantics/syntax.

Stored procedure queries cannot be paged with `setFirstResult()/setMaxResults()`.

The recommended call form is standard SQL92: `{ ? = call functionName(<parameters>) }` or `{ ? = call procedureName(<parameters>}`. Native call syntax is not supported.

Für Oracle gelten die folgenden Regeln:

- A function must return a result set. The first parameter of a procedure must be an `OUT` that returns a result set. This is done by using a `SYS_REFCURSOR` type in Oracle 9 or 10. In Oracle you need to define a `REF CURSOR` type. See Oracle literature for further information.

Für Sybase oder MS SQL Server gelten die folgenden Regeln:

- The procedure must return a result set. Note that since these servers can return multiple result sets and update counts, Hibernate will iterate the results and take the first result that is a result set as its return value. Everything else will be discarded.
- Falls Sie `SET NOCOUNT ON` in Ihrer Prozedur aktivieren können, so würde sie wahrscheinlich effizienter. Dies ist jedoch keine Voraussetzung.

17.3. Anwenderspezifische SQL für "create" (erstellen), "update" (aktualisieren) und "delete" (löschen)

Hibernate3 can use custom SQL for create, update, and delete operations. The SQL can be overridden at the statement level or inidividual column level. This section describes statement overrides. For columns, see *Abschnitt 5.7, „Column read and write expressions“*.

The class and collection persisters in Hibernate already contain a set of configuration time generated strings (insertsql, deletesql, updatesql etc.). The mapping tags `<sql-insert>`, `<sql-delete>`, and `<sql-update>` override these strings:

```
<class name="Person">
    <id name="id">
        <generator class="increment"/>
    </id>
    <property name="name" not-null="true"/>
    <sql-insert
>INSERT INTO PERSON (NAME, ID) VALUES ( UPPER(?), ? )</sql-insert>
    <sql-update
>UPDATE PERSON SET NAME=UPPER(?) WHERE ID=?</sql-update>
    <sql-delete
>DELETE FROM PERSON WHERE ID=?</sql-delete>
</class
>
```

The SQL is directly executed in your database, so you can use any dialect you like. This will reduce the portability of your mapping if you use database specific SQL.

Gespeicherte Prozeduren werden unterstützt, wenn das `callable`-Attribut wie folgt eingestellt ist:

```
<class name="Person">
```

```
    <id name="id">
        <generator class="increment"/>
    </id>
    <property name="name" not-null="true"/>
    <sql-insert callable="true"
>{call createPerson (?, ?)}</sql-insert>
    <sql-delete callable="true"
>{? = call deletePerson (?)}</sql-delete>
    <sql-update callable="true"
>{? = call updatePerson (?, ?)}</sql-update>
</class
>
```

The order of the positional parameters is vital, as they must be in the same sequence as Hibernate expects them.

You can view the expected order by enabling debug logging for the `org.hibernate.persister.entity` level. With this level enabled, Hibernate will print out the static SQL that is used to create, update, delete etc. entities. To view the expected sequence, do not include your custom SQL in the mapping files, as this will override the Hibernate generated static SQL.

The stored procedures are in most cases required to return the number of rows inserted, updated and deleted, as Hibernate has some runtime checks for the success of the statement. Hibernate always registers the first statement parameter as a numeric output parameter for the CUD operations:

```
CREATE OR REPLACE FUNCTION updatePerson (uid IN NUMBER, uname IN VARCHAR2)
    RETURN NUMBER IS
BEGIN

    update PERSON
    set
        NAME = uname,
    where
        ID = uid;

    return SQL%ROWCOUNT;

END updatePerson;
```

17.4. Angepasste SQL für das Laden

You can also declare your own SQL (or HQL) queries for entity loading. As with inserts, updates, and deletes, this can be done at the individual column level as described in *Abschnitt 5.7, „Column read and write expressions“* or at the statement level. Here is an example of a statement level override:

```
<sql-query name="person">
```

```
    <return alias="pers" class="Person" lock-mode="upgrade"/>
    SELECT NAME AS {pers.name}, ID AS {pers.id}
    FROM PERSON
    WHERE ID=?
    FOR UPDATE
</sql-query
>
```

This is just a named query declaration, as discussed earlier. You can reference this named query in a class mapping:

```
<class name="Person">
    <id name="id">
        <generator class="increment"/>
    </id>
    <property name="name" not-null="true"/>
    <loader query-ref="person"/>
</class
>
```

Das funktioniert sogar mit gespeicherten Prozeduren.

You can even define a query for collection loading:

```
<set name="employments" inverse="true">
    <key/>
    <one-to-many class="Employment"/>
    <loader query-ref="employments"/>
</set
>
```

```
<sql-query name="employments">
    <load-collection alias="emp" role="Person.employments"/>
    SELECT {emp.*}
    FROM EMPLOYMENT emp
    WHERE EMPLOYER = :id
    ORDER BY STARTDATE ASC, EMPLOYEE ASC
</sql-query
>
```

You can also define an entity loader that loads a collection by join fetching:

```
<sql-query name="person">
    <return alias="pers" class="Person"/>
    <return-join alias="emp" property="pers.employments"/>
    SELECT NAME AS {pers.*}, {emp.*}
    FROM PERSON pers
    LEFT OUTER JOIN EMPLOYMENT emp
```

```
        ON pers.ID = emp.PERSON_ID
    WHERE ID=?
</sql-query
>
```

Das Filtern von Daten

Hibernate3 provides an innovative new approach to handling data with "visibility" rules. A *Hibernate filter* is a global, named, parameterized filter that can be enabled or disabled for a particular Hibernate session.

18.1. Hibernate Filter

Hibernate3 has the ability to pre-define filter criteria and attach those filters at both a class level and a collection level. A filter criteria allows you to define a restriction clause similar to the existing "where" attribute available on the class and various collection elements. These filter conditions, however, can be parameterized. The application can then decide at runtime whether certain filters should be enabled and what their parameter values should be. Filters can be used like database views, but they are parameterized inside the application.

Um Filter zu benutzen müssen diese zunächst definiert und anschließend den betreffenden Mapping-Elementen zugefügt werden. Um einen Filter zu definieren, verwenden Sie das `<filter-def/>`-Element innerhalb eines `<hibernate-mapping/>`-Elements:

```
<filter-def name="myFilter">
    <filter-param name="myFilterParam" type="string"/>
</filter-def
>
```

This filter can then be attached to a class:

```
<class name="myClass" ...>
    ...
    <filter name="myFilter" condition=":myFilterParam = MY_FILTERED_COLUMN"/>
</class
>
```

Or, to a collection:

```
<set ...>
    <filter name="myFilter" condition=":myFilterParam = MY_FILTERED_COLUMN"/>
</set
>
```

Or, to both or multiples of each at the same time.

The methods on `Session` are: `enableFilter(String filterName)`, `getEnabledFilter(String filterName)`, and `disableFilter(String filterName)`. By default, filters are *not* enabled for a given session. Filters must be enabled through use of the

`Session.enableFilter()` method, which returns an instance of the `Filter` interface. If you used the simple filter defined above, it would look like this:

```
session.enableFilter("myFilter").setParameter("myFilterParam", "some-value");
```

Methods on the org.hibernate.Filter interface do allow the method-chaining common to much of Hibernate.

The following is a full example, using temporal data with an effective record date pattern:

```
<filter-def name="effectiveDate">
    <filter-param name="asOfDate" type="date"/>
</filter-def>

<class name="Employee" ...>
...
    <many-to-one name="department" column="dept_id" class="Department"/>
    <property name="effectiveStartDate" type="date" column="eff_start_dt"/>
    <property name="effectiveEndDate" type="date" column="eff_end_dt"/>
...
    <!--
        Note that this assumes non-terminal records have an eff_end_dt set to
        a max db date for simplicity-sake
    -->
    <filter name="effectiveDate"
            condition=":asOfDate BETWEEN eff_start_dt and eff_end_dt"/>
</class>

<class name="Department" ...>
...
    <set name="employees" lazy="true">
        <key column="dept_id"/>
        <one-to-many class="Employee"/>
        <filter name="effectiveDate"
                condition=":asOfDate BETWEEN eff_start_dt and eff_end_dt"/>
    </set>
</class
>
```

In order to ensure that you are provided with currently effective records, enable the filter on the session prior to retrieving employee data:

```
Session session = ...;
session.enableFilter("effectiveDate").setParameter("asOfDate", new Date());
List results = session.createQuery("from Employee as e where e.salary
> :targetSalary")
         .setLong("targetSalary", new Long(1000000))
         .list();
```

Even though a salary constraint was mentioned explicitly on the results in the above HQL, because of the enabled filter, the query will return only currently active employees who have a salary greater than one million dollars.

If you want to use filters with outer joining, either through HQL or load fetching, be careful of the direction of the condition expression. It is safest to set this up for left outer joining. Place the parameter first followed by the column name(s) after the operator.

After being defined, a filter might be attached to multiple entities and/or collections each with its own condition. This can be problematic when the conditions are the same each time. Using `<filter-def/>` allows you to definine a default condition, either as an attribute or CDATA:

```
<filter-def name="myFilter" condition="abc
> xyz"
>...</filter-def>
<filter-def name="myOtherFilter"
>abc=xyz</filter-def
>
```

This default condition will be used whenever the filter is attached to something without specifying a condition. This means you can give a specific condition as part of the attachment of the filter that overrides the default condition in that particular case.

XML-Mapping

XML Mapping is an experimental feature in Hibernate 3.0 and is currently under active development.

19.1. Das Arbeiten mit XML-Daten

Hibernate allows you to work with persistent XML data in much the same way you work with persistent POJOs. A parsed XML tree can be thought of as another way of representing the relational data at the object level, instead of POJOs.

Hibernate unterstützt dom4j als API zur Verarbeitung von XML-Bäumen. Sie können Anfragen, die dom4j-Bäume von der Datenbank abrufen, schreiben, wobei alle Modifikationen am Baum automatisch mit der Datenbank synchronisiert werden. Sie können sogar ein XML-Dokument unter Verwendung von dom4j auf die Syntax prüfen und mittels Hibernates Grundvorgängen: `persist(), saveOrUpdate(), merge(), delete(), replicate()` ("Merging" wird noch nicht unterstützt) in die Datenbank schreiben.

Dieses Feature bietet zahlreiche Anwendungen einschließlich des Imports/Exports von Daten, Externalisierung von Entity-Daten via JMS oder SOAP und XSLT-basiertem Reporting.

A single mapping can be used to simultaneously map properties of a class and nodes of an XML document to the database, or, if there is no class to map, it can be used to map just the XML.

19.1.1. Spezifizierung des gemeinsamen Mappens von XML und Klasse

Hier ist ein Beispiel für das gleichzeitige Mappen eines POJO und XML:

```
<class name="Account"
        table="ACCOUNTS"
        node="account">

    <id name="accountId"
            column="ACCOUNT_ID"
            node="@id"/>

    <many-to-one name="customer"
            column="CUSTOMER_ID"
            node="customer/@id"
            embed-xml="false"/>

    <property name="balance"
            column="BALANCE"
            node="balance"/>

    ...

</class
```

```
>
```

19.1.2. Spezifizierung des Mappens von nur XML

Dieses ist ein Beispiel ohne POJO-Klasse:

```
<class entity-name="Account"
        table="ACCOUNTS"
        node="account">

    <id name="id"
            column="ACCOUNT_ID"
            node="@id"
            type="string"/>

    <many-to-one name="customerId"
            column="CUSTOMER_ID"
            node="customer/@id"
            embed-xml="false"
            entity-name="Customer"/>

    <property name="balance"
            column="BALANCE"
            node="balance"
            type="big_decimal"/>

    ...

</class
>
```

This mapping allows you to access the data as a dom4j tree, or as a graph of property name/value pairs or java `Maps`. The property names are purely logical constructs that can be referred to in HQL queries.

19.2. XML-Mapping Metadaten

A range of Hibernate mapping elements accept the `node` attribute. This lets you specify the name of an XML attribute or element that holds the property or entity data. The format of the `node` attribute must be one of the following:

- `"element-name"`: map to the named XML element
- `"@attribute-name"`: map to the named XML attribute
- `"."`: map to the parent element
- `"element-name/@attribute-name"`: map to the named attribute of the named element

For collections and single valued associations, there is an additional `embed-xml` attribute. If `embed-xml="true"`, the default, the XML tree for the associated entity (or collection of value type)

will be embedded directly in the XML tree for the entity that owns the association. Otherwise, if `embed-xml="false"`, then only the referenced identifier value will appear in the XML for single point associations and collections will not appear at all.

Do not leave `embed-xml="true"` for too many associations, since XML does not deal well with circularity.

```
<class name="Customer"
        table="CUSTOMER"
        node="customer">

    <id name="id"
            column="CUST_ID"
            node="@id"/>

    <map name="accounts"
            node="."
            embed-xml="true">
        <key column="CUSTOMER_ID"
                not-null="true"/>
        <map-key column="SHORT_DESC"
                node="@short-desc"
                type="string"/>
        <one-to-many entity-name="Account"
                embed-xml="false"
                node="account"/>
    </map>

    <component name="name"
            node="name">
        <property name="firstName"
                node="first-name"/>
        <property name="initial"
                node="initial"/>
        <property name="lastName"
                node="last-name"/>
    </component>

    ...

</class
>
```

In this case, the collection of account ids is embedded, but not the actual account data. The following HQL query:

```
from Customer c left join fetch c.accounts where c.lastName like :lastName
```

would return datasets such as this:

```
<customer id="123456789">
```

```
    <account short-desc="Savings"
>987632567</account>
    <account short-desc="Credit Card"
>985612323</account>
    <name>
        <first-name
>Gavin</first-name>
        <initial
>A</initial>
        <last-name
>King</last-name>
    </name>
    ...
</customer
>
```

Wenn Sie die Einstellung `embed-xml="true"` im `<one-to-many>`-Mapping vornehmen, so sehen die Daten eher wie folgt aus:

```
<customer id="123456789">
    <account id="987632567" short-desc="Savings">
        <customer id="123456789"/>
        <balance
>100.29</balance>
    </account>
    <account id="985612323" short-desc="Credit Card">
        <customer id="123456789"/>
        <balance
>-2370.34</balance>
    </account>
    <name>
        <first-name
>Gavin</first-name>
        <initial
>A</initial>
        <last-name
>King</last-name>
    </name>
    ...
</customer
>
```

19.3. Manipulation von XML-Daten

You can also re-read and update XML documents in the application. You can do this by obtaining a dom4j session:

```
Document doc = ....;

Session session = factory.openSession();
Session dom4jSession = session.getSession(EntityMode.DOM4J);
Transaction tx = session.beginTransaction();
```

```
List results = dom4jSession
    .createQuery("from Customer c left join fetch c.accounts where c.lastName like :lastName")
    .list();
for ( int i=0; i<results.size(); i++ ) {
    //add the customer data to the XML document
    Element customer = (Element) results.get(i);
    doc.add(customer);
}

tx.commit();
session.close();
```

```
Session session = factory.openSession();
Session dom4jSession = session.getSession(EntityMode.DOM4J);
Transaction tx = session.beginTransaction();

Element cust = (Element) dom4jSession.get("Customer", customerId);
for ( int i=0; i<results.size(); i++ ) {
    Element customer = (Element) results.get(i);
    //change the customer name in the XML and database
    Element name = customer.element("name");
    name.element("first-name").setText(firstName);
    name.element("initial").setText(initial);
    name.element("last-name").setText(lastName);
}

tx.commit();
session.close();
```

When implementing XML-based data import/export, it is useful to combine this feature with Hibernate's `replicate()` operation.

Verbesserung der Performance

20.1. Abrufstrategien

Hibernate uses a *fetching strategy* to retrieve associated objects if the application needs to navigate the association. Fetch strategies can be declared in the O/R mapping metadata, or overridden by a particular HQL or `Criteria` query.

Hibernate3 definiert die folgenden Abrufstrategien:

- *Join fetching*: Hibernate retrieves the associated instance or collection in the same `SELECT`, using an `OUTER JOIN`.
- *Select fetching*: a second `SELECT` is used to retrieve the associated entity or collection. Unless you explicitly disable lazy fetching by specifying `lazy="false"`, this second select will only be executed when you access the association.
- *Subselect fetching*: a second `SELECT` is used to retrieve the associated collections for all entities retrieved in a previous query or fetch. Unless you explicitly disable lazy fetching by specifying `lazy="false"`, this second select will only be executed when you access the association.
- *Batch fetching*: an optimization strategy for select fetching. Hibernate retrieves a batch of entity instances or collections in a single `SELECT` by specifying a list of primary or foreign keys.

Hibernate unterscheidet außerdem zwischen:

- *Immediate fetching*: an association, collection or attribute is fetched immediately when the owner is loaded.
- *Lazy collection fetching*: a collection is fetched when the application invokes an operation upon that collection. This is the default for collections.
- *"Extra-lazy" collection fetching*: individual elements of the collection are accessed from the database as needed. Hibernate tries not to fetch the whole collection into memory unless absolutely needed. It is suitable for large collections.
- *Proxy fetching*: a single-valued association is fetched when a method other than the identifier getter is invoked upon the associated object.
- *"No-proxy" fetching*: a single-valued association is fetched when the instance variable is accessed. Compared to proxy fetching, this approach is less lazy; the association is fetched even when only the identifier is accessed. It is also more transparent, since no proxy is visible to the application. This approach requires buildtime bytecode instrumentation and is rarely necessary.
- *Lazy attribute fetching*: an attribute or single valued association is fetched when the instance variable is accessed. This approach requires buildtime bytecode instrumentation and is rarely necessary.

We have two orthogonal notions here: *when* is the association fetched and *how* is it fetched. It is important that you do not confuse them. We use `fetch` to tune performance. We can use `lazy` to define a contract for what data is always available in any detached instance of a particular class.

20.1.1. Der Umgang mit "lazy"-Assoziationen

By default, Hibernate3 uses lazy select fetching for collections and lazy proxy fetching for single-valued associations. These defaults make sense for most associations in the majority of applications.

If you set `hibernate.default_batch_fetch_size`, Hibernate will use the batch fetch optimization for lazy fetching. This optimization can also be enabled at a more granular level.

Please be aware that access to a lazy association outside of the context of an open Hibernate session will result in an exception. For example:

```
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!
```

Since the permissions collection was not initialized when the `Session` was closed, the collection will not be able to load its state. *Hibernate does not support lazy initialization for detached objects*. This can be fixed by moving the code that reads from the collection to just before the transaction is committed.

Alternatively, you can use a non-lazy collection or association, by specifying `lazy="false"` for the association mapping. However, it is intended that lazy initialization be used for almost all collections and associations. If you define too many non-lazy associations in your object model, Hibernate will fetch the entire database into memory in every transaction.

On the other hand, you can use join fetching, which is non-lazy by nature, instead of select fetching in a particular transaction. We will now explain how to customize the fetching strategy. In Hibernate3, the mechanisms for choosing a fetch strategy are identical for single-valued associations and collections.

20.1.2. Abstimmung von Abrufstrategien

Der Auswahlabruf - "Select Fetching" (Standard) ist extrem anfällig für N+1 Auswahlprobleme, weswegen sich die Aktivierung von "Join-Fetching" im Mapping-Dokument empfiehlt:

```
<set name="permissions"
            fetch="join">
    <key column="userId"/>
    <one-to-many class="Permission"/>
</set
```

```
<many-to-one name="mother" class="Cat" fetch="join"/>
```

Die im Mapping-Dokument definierte `fetch`-Strategie hat Auswirkungen auf:

- Abruf mittels `get()` oder `load()`
- einem impliziten Abruf, der beim Navigieren der Assoziation erfolgt
- `Criteria`-Anfragen
- HQL-Anfragen, wenn `subselect`-Abruf verwendet wird

Irrespective of the fetching strategy you use, the defined non-lazy graph is guaranteed to be loaded into memory. This might, however, result in several immediate selects being used to execute a particular HQL query.

Usually, the mapping document is not used to customize fetching. Instead, we keep the default behavior, and override it for a particular transaction, using `left join fetch` in HQL. This tells Hibernate to fetch the association eagerly in the first select, using an outer join. In the `Criteria` query API, you would use `setFetchMode(FetchMode.JOIN)`.

If you want to change the fetching strategy used by `get()` or `load()`, you can use a `Criteria` query. For example:

```
User user = (User) session.createCriteria(User.class)
                .setFetchMode("permissions", FetchMode.JOIN)
                .add( Restrictions.idEq(userId) )
                .uniqueResult();
```

This is Hibernate's equivalent of what some ORM solutions call a "fetch plan".

A completely different approach to problems with N+1 selects is to use the second-level cache.

20.1.3. Einendige Assoziationsproxies

Lazy fetching for collections is implemented using Hibernate's own implementation of persistent collections. However, a different mechanism is needed for lazy behavior in single-ended associations. The target entity of the association must be proxied. Hibernate implements lazy

initializing proxies for persistent objects using runtime bytecode enhancement which is accessed via the CGLIB library.

At startup, Hibernate3 generates proxies by default for all persistent classes and uses them to enable lazy fetching of `many-to-one` and `one-to-one` associations.

The mapping file may declare an interface to use as the proxy interface for that class, with the `proxy` attribute. By default, Hibernate uses a subclass of the class. *The proxied class must implement a default constructor with at least package visibility. This constructor is recommended for all persistent classes*.

There are potential problems to note when extending this approach to polymorphic classes.For example:

```
<class name="Cat" proxy="Cat">
    ......
    <subclass name="DomesticCat">
        .....
    </subclass>
</class
>
```

Zunächst einmal werden Instanzen von `Cat` hinsichtlich ihres Datentyps niemals in `DomesticCat` konvertierbar sein, selbst wenn die zu Grunde liegende Instanz eine Instanz von `DomesticCat` ist:

```
Cat cat = (Cat) session.load(Cat.class, id);  // instantiate a proxy (does not hit the db)
if ( cat.isDomesticCat() ) {                  // hit the db to initialize the proxy
    DomesticCat dc = (DomesticCat) cat;       // Error!
    ....
}
```

Secondly, it is possible to break proxy ==:

```
Cat cat = (Cat) session.load(Cat.class, id);            // instantiate a Cat proxy
DomesticCat dc =
        (DomesticCat) session.load(DomesticCat.class, id);  // acquire new DomesticCat proxy!
System.out.println(cat==dc);                            // false
```

Allerdings ist die Situation nicht so schlimm wie sie aussieht. Obwohl wir jetzt zwei Verweise auf verschiedene Proxy-Objekte besitzen, so bleibt die zu Grunde liegende Instanz nach wie vor dasselbe Objekt:

```
cat.setWeight(11.0);  // hit the db to initialize the proxy
System.out.println( dc.getWeight() );  // 11.0
```

Third, you cannot use a CGLIB proxy for a `final` class or a class with any `final` methods.

Finally, if your persistent object acquires any resources upon instantiation (e.g. in initializers or default constructor), then those resources will also be acquired by the proxy. The proxy class is an actual subclass of the persistent class.

These problems are all due to fundamental limitations in Java's single inheritance model. To avoid these problems your persistent classes must each implement an interface that declares its business methods. You should specify these interfaces in the mapping file where `CatImpl` implements the interface `Cat` and `DomesticCatImpl` implements the interface `DomesticCat`. For example:

```
<class name="CatImpl" proxy="Cat">
    ......
    <subclass name="DomesticCatImpl" proxy="DomesticCat">
        .....
    </subclass>
</class
>
```

Then proxies for instances of `Cat` and `DomesticCat` can be returned by `load()` or `iterate()`.

```
Cat cat = (Cat) session.load(CatImpl.class, catid);
Iterator iter = session.createQuery("from CatImpl as cat where cat.name='fritz'").iterate();
Cat fritz = (Cat) iter.next();
```

Note

`list()` does not usually return proxies.

Beziehungen werden ebenfalls "lazy" initialisiert. Das bedeutet, dass Sie sämtliche Properties als Typ `Cat`, nicht `CatImpl` deklarieren müssen.

Certain operations do *not* require proxy initialization:

- `equals()`: if the persistent class does not override `equals()`
- `hashCode()`: if the persistent class does not override `hashCode()`
- Die "Getter"-Methode des Bezeichners

Hibernate erkennt persistente Klassen, die `equals()` oder `hashCode()` außer Kraft setzen.

By choosing `lazy="no-proxy"` instead of the default `lazy="proxy"`, you can avoid problems associated with typecasting. However, buildtime bytecode instrumentation is required, and all operations will result in immediate proxy initialization.

20.1.4. Initialisierung von Collections und Proxies

A `LazyInitializationException` will be thrown by Hibernate if an uninitialized collection or proxy is accessed outside of the scope of the `Session`, i.e., when the entity owning the collection or having the reference to the proxy is in the detached state.

Sometimes a proxy or collection needs to be initialized before closing the `Session`. You can force initialization by calling `cat.getSex()` or `cat.getKittens().size()`, for example. However, this can be confusing to readers of the code and it is not convenient for generic code.

The static methods `Hibernate.initialize()` and `Hibernate.isInitialized()`, provide the application with a convenient way of working with lazily initialized collections or proxies. `Hibernate.initialize(cat)` will force the initialization of a proxy, `cat`, as long as its `Session` is still open. `Hibernate.initialize( cat.getKittens() )` has a similar effect for the collection of kittens.

Another option is to keep the `Session` open until all required collections and proxies have been loaded. In some application architectures, particularly where the code that accesses data using Hibernate, and the code that uses it are in different application layers or different physical processes, it can be a problem to ensure that the `Session` is open when a collection is initialized. There are two basic ways to deal with this issue:

- In a web-based application, a servlet filter can be used to close the `Session` only at the end of a user request, once the rendering of the view is complete (the *Open Session in View* pattern). Of course, this places heavy demands on the correctness of the exception handling of your application infrastructure. It is vitally important that the `Session` is closed and the transaction ended before returning to the user, even when an exception occurs during rendering of the view. See the Hibernate Wiki for examples of this "Open Session in View" pattern.
- In an application with a separate business tier, the business logic must "prepare" all collections that the web tier needs before returning. This means that the business tier should load all the data and return all the data already initialized to the presentation/web tier that is required for a particular use case. Usually, the application calls `Hibernate.initialize()` for each collection that will be needed in the web tier (this call must occur before the session is closed) or retrieves the collection eagerly using a Hibernate query with a `FETCH` clause or a `FetchMode.JOIN` in `Criteria`. This is usually easier if you adopt the *Command* pattern instead of a *Session Facade*.
- You can also attach a previously loaded object to a new `Session` with `merge()` or `lock()` before accessing uninitialized collections or other proxies. Hibernate does not, and certainly *should* not, do this automatically since it would introduce impromptu transaction semantics.

Sometimes you do not want to initialize a large collection, but still need some information about it, like its size, for example, or a subset of the data.

Sie können einen Collection-Filter verwenden, um die Größe der Collection zu ermitteln ohne diese zu initialisieren:

```
( (Integer) s.createFilter( collection, "select count(*)" ).list().get(0) ).intValue()
```

Die `createFilter()`-Methode wird außerdem benutzt, um effizient Untersätze einer Collection abzurufen, ohne die gesamte Collection zu initialisieren:

```
s.createFilter( lazyCollection, "").setFirstResult(0).setMaxResults(10).list();
```

20.1.5. Die Verwendung von Stapelabruf ("Batch-Fetching")

Using batch fetching, Hibernate can load several uninitialized proxies if one proxy is accessed. Batch fetching is an optimization of the lazy select fetching strategy. There are two ways you can configure batch fetching: on the class level and the collection level.

Batch fetching for classes/entities is easier to understand. Consider the following example: at runtime you have 25 `Cat` instances loaded in a `Session`, and each `Cat` has a reference to its `owner`, a `Person`. The `Person` class is mapped with a proxy, `lazy="true"`. If you now iterate through all cats and call `getOwner()` on each, Hibernate will, by default, execute 25 `SELECT` statements to retrieve the proxied owners. You can tune this behavior by specifying a `batch-size` in the mapping of `Person`:

```
<class name="Person" batch-size="10"
>...</class
>
```

Hibernate will now execute only three queries: the pattern is 10, 10, 5.

You can also enable batch fetching of collections. For example, if each `Person` has a lazy collection of `Cats`, and 10 persons are currently loaded in the `Session`, iterating through all persons will generate 10 `SELECTS`, one for every call to `getCats()`. If you enable batch fetching for the `cats` collection in the mapping of `Person`, Hibernate can pre-fetch collections:

```
<class name="Person">
    <set name="cats" batch-size="3">
        ...
    </set>
</class
>
```

With a `batch-size` of 3, Hibernate will load 3, 3, 3, 1 collections in four `SELECTS`. Again, the value of the attribute depends on the expected number of uninitialized collections in a particular `Session`.

Batch fetching of collections is particularly useful if you have a nested tree of items, i.e. the typical bill-of-materials pattern. However, a *nested set* or a *materialized path* might be a better option for read-mostly trees.

20.1.6. Die Verwendung von "Subselect-Fetching"

If one lazy collection or single-valued proxy has to be fetched, Hibernate will load all of them, re-running the original query in a subselect. This works in the same way as batch-fetching but without the piecemeal loading.

20.1.7. Fetch profiles

Another way to affect the fetching strategy for loading associated objects is through something called a fetch profile, which is a named configuration associated with the `org.hibernate.SessionFactory` but enabled, by name, on the `org.hibernate.Session`. Once enabled on a `org.hibernate.Session`, the fetch profile wull be in affect for that `org.hibernate.Session` until it is explicitly disabled.

So what does that mean? Well lets explain that by way of an example. Say we have the following mappings:

```
<hibernate-mapping>
    <class name="Customer">
        ...
        <set name="orders" inverse="true">
            <key column="cust_id"/>
            <one-to-many class="Order"/>
        </set>
    </class>
    <class name="Order">
        ...
    </class>
</hibernate-mapping
>
```

Now normally when you get a reference to a particular customer, that customer's set of orders will be lazy meaning we will not yet have loaded those orders from the database. Normally this is a good thing. Now lets say that you have a certain use case where it is more efficient to load the customer and their orders together. One way certainly is to use "dynamic fetching" strategies via an HQL or criteria queries. But another option is to use a fetch profile to achieve that. Just add the following to your mapping:

```
<hibernate-mapping>
    ...
    <fetch-profile name="customer-with-orders">
        <fetch entity="Customer" association="orders" style="join"/>
    </fetch-profile>
</hibernate-mapping
```

```
>
```

or even:

```
<hibernate-mapping>
    <class name="Customer">
        ...
        <fetch-profile name="customer-with-orders">
            <fetch association="orders" style="join"/>
        </fetch-profile>
    </class>
    ...
</hibernate-mapping
>
```

Now the following code will actually load both the customer *and their orders*:

```
    Session session = ...;
    session.enableFetchProfile( "customer-with-orders" );  // name matches from mapping
    Customer customer = (Customer) session.get( Customer.class, customerId );
```

Currently only join style fetch profiles are supported, but they plan is to support additional styles. See *HHH-3414* [http://opensource.atlassian.com/projects/hibernate/browse/HHH-3414] for details.

20.1.8. Die Verwendung von "Lazy-Property-Fetching"

Hibernate3 supports the lazy fetching of individual properties. This optimization technique is also known as *fetch groups*. Please note that this is mostly a marketing feature; optimizing row reads is much more important than optimization of column reads. However, only loading some properties of a class could be useful in extreme cases. For example, when legacy tables have hundreds of columns and the data model cannot be improved.

Um das "lazy" Laden von Properties zu aktivieren, setzen Sie das `lazy`-Attribut auf Ihr bestimmtes Property-Mapping:

```
<class name="Document">
       <id name="id">
        <generator class="native"/>
    </id>
    <property name="name" not-null="true" length="50"/>
    <property name="summary" not-null="true" length="200" lazy="true"/>
    <property name="text" not-null="true" length="2000" lazy="true"/>
</class
>
```

Lazy property loading requires buildtime bytecode instrumentation. If your persistent classes are not enhanced, Hibernate will ignore lazy property settings and return to immediate fetching.

Für die Bytecode-Instrumentierung verwenden Sie folgende Ant-Funktion:

```
<target name="instrument" depends="compile">
    <taskdef name="instrument" classname="org.hibernate.tool.instrument.InstrumentTask">
        <classpath path="${jar.path}"/>
        <classpath path="${classes.dir}"/>
        <classpath refid="lib.class.path"/>
    </taskdef>

    <instrument verbose="true">
        <fileset dir="${testclasses.dir}/org/hibernate/auction/model">
            <include name="*.class"/>
        </fileset>
    </instrument>
</target
>
```

A different way of avoiding unnecessary column reads, at least for read-only transactions, is to use the projection features of HQL or Criteria queries. This avoids the need for buildtime bytecode processing and is certainly a preferred solution.

You can force the usual eager fetching of properties using `fetch all properties` in HQL.

20.2. Das Cache der zweiten Ebene

A Hibernate `Session` is a transaction-level cache of persistent data. It is possible to configure a cluster or JVM-level (`SessionFactory`-level) cache on a class-by-class and collection-by-collection basis. You can even plug in a clustered cache. Be aware that caches are not aware of changes made to the persistent store by another application. They can, however, be configured to regularly expire cached data.

You have the option to tell Hibernate which caching implementation to use by specifying the name of a class that implements `org.hibernate.cache.CacheProvider` using the property `hibernate.cache.provider_class`. Hibernate is bundled with a number of built-in integrations with the open-source cache providers that are listed below. You can also implement your own and plug it in as outlined above. Note that versions prior to 3.2 use EhCache as the default cache provider.

Tabelle 20.1. Cache-Provider

Cache	Provider-Klasse	Typ	Cluster-sicher	Anfragen-Cache unterstützt
Hash-Tabelle (nicht	`org.hibernate.cache.HashtableCacheProvider`	Speicher	yes	

Cache	Provider-Klasse	Typ	Cluster-sicher	Anfragen-Cache unterstützt
für den Produktionsgebrauch vorgesehen)				
EHCache	`org.hibernate.cache.EhCacheProvider`	Speicher, Disk	yes	
OSCache	`org.hibernate.cache.OSCacheProvider`	Speicher, Disk	yes	
SwarmCache	`org.hibernate.cache.SwarmCacheProvider`	geclustert (ip multicast)	ja (geclusterte Außerkraftsetzung)	
JBoss Cache 1.x	`org.hibernate.cache.TreeCacheProvider`	geclustert (ip multicast), transaktional	ja (Replikation)	ja (clock sync req.)
JBoss Cache 2	`org.hibernate.cache.jbc.JBossCacheRegionFactory`	geclustert (ip multicast), transaktional	yes (replication or invalidation)	ja (clock sync req.)

20.2.1. Cache-Mappings

Das `<cache>`-Element des Mappings einer Klasse oder Collection besitzt folgende Form:

```
<cache
    usage="transactional|read-write|nonstrict-read-write|read-only"    (1)
    region="RegionName"                                                (2)
    include="all|non-lazy"                                             (3)
/>
```

1. `usage` (erforderlich) bestimmt die Caching-Strategie: `transactional`, `read-write`, `nonstrict-read-write` oder `read-only`
2. `region` (optional: defaults to the class or collection role name): specifies the name of the second level cache region
3. `include` (optional: defaults to `all`) `non-lazy`: specifies that properties of the entity mapped with `lazy="true"` cannot be cached when attribute-level lazy fetching is enabled

Alternatively, you can specify `<class-cache>` and `<collection-cache>` elements in `hibernate.cfg.xml`.

Das `usage`-Attribut bestimmt eine *Cache-Nebenläufigkeitsstrategie*.

20.2.2. Strategie: "read only"

If your application needs to read, but not modify, instances of a persistent class, a `read-only` cache can be used. This is the simplest and optimal performing strategy. It is even safe for use in a cluster.

```
<class name="eg.Immutable" mutable="false">
    <cache usage="read-only"/>
    ....
</class
>
```

20.2.3. Strategie: "read/write"

If the application needs to update data, a `read-write` cache might be appropriate. This cache strategy should never be used if serializable transaction isolation level is required. If the cache is used in a JTA environment, you must specify the property `hibernate.transaction.manager_lookup_class` and naming a strategy for obtaining the JTA `TransactionManager`. In other environments, you should ensure that the transaction is completed when `Session.close()` or `Session.disconnect()` is called. If you want to use this strategy in a cluster, you should ensure that the underlying cache implementation supports locking. The built-in cache providers *do not* support locking.

```
<class name="eg.Cat" .... >
    <cache usage="read-write"/>
    ....
    <set name="kittens" ... >
        <cache usage="read-write"/>
        ....
    </set>
</class
>
```

20.2.4. Strategie: "nonstrict read/write"

If the application only occasionally needs to update data (i.e. if it is extremely unlikely that two transactions would try to update the same item simultaneously), and strict transaction isolation is not required, a `nonstrict-read-write` cache might be appropriate. If the cache is used in a JTA environment, you must specify `hibernate.transaction.manager_lookup_class`. In other environments, you should ensure that the transaction is completed when `Session.close()` or `Session.disconnect()` is called.

20.2.5. Strategie: transaktional

The `transactional` cache strategy provides support for fully transactional cache providers such as JBoss TreeCache. Such a cache can only be used in a JTA environment and you must specify `hibernate.transaction.manager_lookup_class`.

20.2.6. Cache-provider/concurrency-strategy compatibility

Wichtig

None of the cache providers support all of the cache concurrency strategies.

The following table shows which providers are compatible with which concurrency strategies.

Tabelle 20.2. Cache-Nebenläufigkeitsstrategie-Support

Cache	read-only	nonstrict-read-write	read-write	transactional
Hash-Tabelle (nicht für den Produktionsgebrauch vorgesehen)	yes	yes	yes	
EHCache	yes	yes	yes	
OSCache	yes	yes	yes	
SwarmCache	yes	yes		
JBoss Cache 1.x	yes	yes		
JBoss Cache 2	yes	yes		

20.3. Management der Caches

Whenever you pass an object to `save()`, `update()` or `saveOrUpdate()`, and whenever you retrieve an object using `load()`, `get()`, `list()`, `iterate()` or `scroll()`, that object is added to the internal cache of the `Session`.

When `flush()` is subsequently called, the state of that object will be synchronized with the database. If you do not want this synchronization to occur, or if you are processing a huge number of objects and need to manage memory efficiently, the `evict()` method can be used to remove the object and its collections from the first-level cache.

```
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);
}
```

Die `Session` bietet außerdem eine `contains()`-Methode um zu bestimmen, ob eine Instanz zu dem Session-Cache gehört.

To evict all objects from the session cache, call `Session.clear()`

Für das Cache der zweiten Ebene gibt es in der `SessionFactory` definierte Methoden, um den gecachten Status einer Instanz, gesamten Klasse, Collection-Instanz oder der gesamten Collection-Rolle zu räumen.

```
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
```

The `CacheMode` controls how a particular session interacts with the second-level cache:

- `CacheMode.NORMAL`: will read items from and write items to the second-level cache
- `CacheMode.GET`: will read items from the second-level cache. Do not write to the second-level cache except when updating data
- `CacheMode.PUT`: will write items to the second-level cache. Do not read from the second-level cache
- `CacheMode.REFRESH`: will write items to the second-level cache. Do not read from the second-level cache. Bypass the effect of `hibernate.cache.use_minimal_puts` forcing a refresh of the second-level cache for all items read from the database

Um die Inhalte eines Cache der zweiten Ebene oder eines Cache-Bereichs zu durchsuchen, verwenden Sie die `Statistics`-API:

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

You will need to enable statistics and, optionally, force Hibernate to keep the cache entries in a more readable format:

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

20.4. Das Anfragen-Cache

Query result sets can also be cached. This is only useful for queries that are run frequently with the same parameters.

20.4.1. Enabling query caching

Caching of query results introduces some overhead in terms of your applications normal transactional processing. For example, if you cache results of a query against Person Hibernate will need to keep track of when those results should be invalidated because changes have been committed against Person. That, coupled with the fact that most applications simply gain no benefit from caching query results, leads Hibernate to disable caching of query results by default. To use query caching, you will first need to enable the query cache:

```
hibernate.cache.use_query_cache true
```

This setting creates two new cache regions:

- `org.hibernate.cache.StandardQueryCache`, holding the cached query results
- `org.hibernate.cache.UpdateTimestampsCache`, holding timestamps of the most recent updates to queryable tables. These are used to validate the results as they are served from the query cache.

Wichtig

If you configure your underlying cache implementation to use expiry or timeouts is very important that the cache timeout of the underlying cache region for the UpdateTimestampsCache be set to a higher value than the timeouts of any of the query caches. In fact, we recommend that the the UpdateTimestampsCache region not be configured for expiry at all. Note, in particular, that an LRU cache expiry policy is never appropriate.

As mentioned above, most queries do not benefit from caching or their results. So by default, individual queries are not cached even after enabling query caching. To enable results caching for a particular query, call `org.hibernate.Query.setCacheable(true)`. This call allows the query to look for existing cache results or add its results to the cache when it is executed.

Anmerkung

The query cache does not cache the state of the actual entities in the cache; it caches only identifier values and results of value type. For this reaso, the query

cache should always be used in conjunction with the second-level cache for those entities expected to be cached as part of a query result cache (just as with collection caching).

20.4.2. 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();
```

If you want to force the query cache to refresh one of its regions (disregard any cached results it finds there) you can use `org.hibernate.Query.setCacheMode(CacheMode.REFRESH)`. In conjunction with the region you have defined for the given query, Hibernate will selectively force the results cached in that particular region to be refreshed. This is particularly useful in cases where underlying data may have been updated via a separate process and is a far more efficient alternative to bulk eviction of the region via `org.hibernate.SessionFactory.evictQueries()`.

20.5. Die Perfomance der Collection verstehen

In the previous sections we have covered collections and their applications. In this section we explore some more issues in relation to collections at runtime.

20.5.1. Taxonomie

Hibernate unterscheidet drei Grundtypen von Collections:

- Collections von Werten
- one-to-many associations
- many-to-many associations

Diese Klassifizierung unterscheidet die verschiedenen Tabellen- und Fremdschlüsselbeziehungen, aber sagt so gut wie nichts über das relationale Modell aus. Um die relationale Struktur und Performance-Eigenschaften vollständig zu verstehen, müssen wir die Struktur des von Hibernate zur Aktualisierung und Löschung von Reihen der Collection verwendeten Primärschlüssels berücksichtigen. Das legt die folgende Klassifizierung nahe:

- indizierte Collections

- Sets
- Bags

All indexed collections (maps, lists, and arrays) have a primary key consisting of the `<key>` and `<index>` columns. In this case, collection updates are extremely efficient. The primary key can be efficiently indexed and a particular row can be efficiently located when Hibernate tries to update or delete it.

Sets have a primary key consisting of `<key>` and element columns. This can be less efficient for some types of collection element, particularly composite elements or large text or binary fields, as the database may not be able to index a complex primary key as efficiently. However, for one-to-many or many-to-many associations, particularly in the case of synthetic identifiers, it is likely to be just as efficient. If you want `SchemaExport` to actually create the primary key of a `<set>`, you must declare all columns as `not-null="true"`.

`<idbag>` mappings define a surrogate key, so they are efficient to update. In fact, they are the best case.

Bags are the worst case since they permit duplicate element values and, as they have no index column, no primary key can be defined. Hibernate has no way of distinguishing between duplicate rows. Hibernate resolves this problem by completely removing in a single `DELETE` and recreating the collection whenever it changes. This can be inefficient.

For a one-to-many association, the "primary key" may not be the physical primary key of the database table. Even in this case, the above classification is still useful. It reflects how Hibernate "locates" individual rows of the collection.

20.5.2. Listen, Maps, "idbags" und Sets sind die am effizientesten zu aktualisierenden Collections

From the discussion above, it should be clear that indexed collections and sets allow the most efficient operation in terms of adding, removing and updating elements.

There is, arguably, one more advantage that indexed collections have over sets for many-to-many associations or collections of values. Because of the structure of a `Set`, Hibernate does not `UPDATE` a row when an element is "changed". Changes to a `Set` always work via `INSERT` and `DELETE` of individual rows. Once again, this consideration does not apply to one-to-many associations.

After observing that arrays cannot be lazy, you can conclude that lists, maps and idbags are the most performant (non-inverse) collection types, with sets not far behind. You can expect sets to be the most common kind of collection in Hibernate applications. This is because the "set" semantics are most natural in the relational model.

However, in well-designed Hibernate domain models, most collections are in fact one-to-many associations with `inverse="true"`. For these associations, the update is handled by the many-to-one end of the association, and so considerations of collection update performance simply do not apply.

20.5.3. Bags und Listen sind die effizientesten invertierten Collections

There is a particular case, however, in which bags, and also lists, are much more performant than sets. For a collection with `inverse="true"`, the standard bidirectional one-to-many relationship idiom, for example, we can add elements to a bag or list without needing to initialize (fetch) the bag elements. This is because, unlike a `set`, `Collection.add()` or `Collection.addAll()` must always return true for a bag or `List`. This can make the following common code much faster:

```
Parent p = (Parent) sess.load(Parent.class, id);
Child c = new Child();
c.setParent(p);
p.getChildren().add(c);  //no need to fetch the collection!
sess.flush();
```

20.5.4. "One-Shot-Löschung"

Deleting collection elements one by one can sometimes be extremely inefficient. Hibernate knows not to do that in the case of an newly-empty collection (if you called `list.clear()`, for example). In this case, Hibernate will issue a single `DELETE`.

Suppose you added a single element to a collection of size twenty and then remove two elements. Hibernate will issue one `INSERT` statement and two `DELETE` statements, unless the collection is a bag. This is certainly desirable.

Nehmen wir jedoch an wir entfernen 18 Elemente, ließen also zwei übrig und fügten dann drei weitere hinzu. In diesem Fall gibt es zwei mögliche Vorgehensweisen:

- die 18 Reihen eine nach der anderen löschen und anschließend drei Reihen einfügen
- remove the whole collection in one SQL `DELETE` and insert all five current elements one by one

Hibernate cannot know that the second option is probably quicker. It would probably be undesirable for Hibernate to be that intuitive as such behavior might confuse database triggers, etc.

Fortunately, you can force this behavior (i.e. the second strategy) at any time by discarding (i.e. dereferencing) the original collection and returning a newly instantiated collection with all the current elements.

One-shot-delete does not apply to collections mapped `inverse="true"`.

20.6. Leistungsüberwachung

Optimierungen machen ohne Überwachung und Zugriff auf Performanzzahlen wenig Sinn. Hibernate liefert eine ganze Bandbreite von Zahlen zu seinen internen Vorgängen. Statistiken sind in Hibernate über die `SessionFactory` verfügbar.

20.6.1. Die Überwachung einer SessionFactory

Sie können auf zwei Arten auf `SessionFactory`-Metriken zugreifen. Die erste Möglichkeit ist es, `sessionFactory.getStatistics()` aufzurufen und die `Statistics` selbst zu lesen und anzuzeigen.

Hibernate can also use JMX to publish metrics if you enable the `StatisticsService` MBean. You can enable a single MBean for all your `SessionFactory` or one per factory. See the following code for minimalistic configuration examples:

```
// 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
```

You can activate and deactivate the monitoring for a `SessionFactory`:

- zum Konfigurationszeitpunkt setzen Sie `hibernate.generate_statistics` auf `false`
- zur Runtime: `sf.getStatistics().setStatisticsEnabled(true)` oder `hibernateStatsBean.setStatisticsEnabled(true)`

Statistics can be reset programmatically using the `clear()` method. A summary can be sent to a logger (info level) using the `logSummary()` method.

20.6.2. Metriken

Hibernate provides a number of metrics, from basic information to more specialized information that is only relevant in certain scenarios. All available counters are described in the `Statistics` interface API, in three categories:

- Mit dem allgemeinen `Session`-Gebrauch zusammenhängende Metriken wie etwa die Anzahl geöffneter Sessions, abgerufener JDBC-Verbindungen usw.

- Metrics related to the entities, collections, queries, and caches as a whole (aka global metrics).
- Detaillierte Metriken, die sich auf eine bestimmte Entity, Collection, Anfrage oder Cache-Region beziehen.

For example, you can check the cache hit, miss, and put ratio of entities, collections and queries, and the average time a query needs. Be aware that the number of milliseconds is subject to approximation in Java. Hibernate is tied to the JVM precision and on some platforms this might only be accurate to 10 seconds.

Simple getters are used to access the global metrics (i.e. not tied to a particular entity, collection, cache region, etc.). You can access the metrics of a particular entity, collection or cache region through its name, and through its HQL or SQL representation for queries. Please refer to the `Statistics`, `EntityStatistics`, `CollectionStatistics`, `SecondLevelCacheStatistics`, and `QueryStatistics` API Javadoc for more information. The following code is a simple example:

```
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"  );
```

You can work on all entities, collections, queries and region caches, by retrieving the list of names of entities, collections, queries and region caches using the following methods: `getQueries()`, `getEntityNames()`, `getCollectionRoleNames()`, and `getSecondLevelCacheRegionNames()`.

Toolset-Handbuch

Roundtrip engineering with Hibernate is possible using a set of Eclipse plugins, commandline tools, and Ant tasks.

Hibernate Tools currently include plugins for the Eclipse IDE as well as Ant tasks for reverse engineering of existing databases:

- *Mapping Editor:* an editor for Hibernate XML mapping files that supports auto-completion and syntax highlighting. It also supports semantic auto-completion for class names and property/field names, making it more versatile than a normal XML editor.
- *Console:* the console is a new view in Eclipse. In addition to a tree overview of your console configurations, you are also provided with an interactive view of your persistent classes and their relationships. The console allows you to execute HQL queries against your database and browse the result directly in Eclipse.
- *Development Wizards:* several wizards are provided with the Hibernate Eclipse tools. You can use a wizard to quickly generate Hibernate configuration (cfg.xml) files, or to reverse engineer an existing database schema into POJO source files and Hibernate mapping files. The reverse engineering wizard supports customizable templates.
-

Please refer to the *Hibernate Tools* package documentation for more information.

However, the Hibernate main package comes bundled with an integrated tool : *SchemaExport* aka `hbm2ddl`.It can even be used from "inside" Hibernate.

21.1. Automatische Schema-Generierung

DDL can be generated from your mapping files by a Hibernate utility. The generated schema includes referential integrity constraints, primary and foreign keys, for entity and collection tables. Tables and sequences are also created for mapped identifier generators.

You *must* specify a SQL `Dialect` via the `hibernate.dialect` property when using this tool, as DDL is highly vendor-specific.

First, you must customize your mapping files to improve the generated schema. The next section covers schema customization.

21.1.1. Anpassung des Schemas

Many Hibernate mapping elements define optional attributes named `length`, `precision` and `scale`. You can set the length, precision and scale of a column with this attribute.

```
<property name="zip" length="5"/>
```

```
<property name="balance" precision="12" scale="2"/>
```

Some tags also accept a `not-null` attribute for generating a `NOT NULL` constraint on table columns, and a `unique` attribute for generating `UNIQUE` constraint on table columns.

```
<many-to-one name="bar" column="barId" not-null="true"/>
```

```
<element column="serialNumber" type="long" not-null="true" unique="true"/>
```

A `unique-key` attribute can be used to group columns in a single, unique key constraint. Currently, the specified value of the `unique-key` attribute is *not* used to name the constraint in the generated DDL. It is only used to group the columns in the mapping file.

```
<many-to-one name="org" column="orgId" unique-key="OrgEmployeeId"/>
<property name="employeeId" unique-key="OrgEmployee"/>
```

An `index` attribute specifies the name of an index that will be created using the mapped column or columns. Multiple columns can be grouped into the same index by simply specifying the same index name.

```
<property name="lastName" index="CustName"/>
<property name="firstName" index="CustName"/>
```

A `foreign-key` attribute can be used to override the name of any generated foreign key constraint.

```
<many-to-one name="bar" column="barId" foreign-key="FKFooBar"/>
```

Zahlreiche Mapping-Elemente akzeptieren auch ein untergeordnetes `<column>`-Element. Das ist insbesondere für das Mappen von vielspaltigen Typen hilfreich:

```
<property name="name" type="my.customtypes.Name"/>
    <column name="last" not-null="true" index="bar_idx" length="30"/>
    <column name="first" not-null="true" index="bar_idx" length="20"/>
    <column name="initial"/>
</property
>
```

The `default` attribute allows you to specify a default value for a column.You should assign the same value to the mapped property before saving a new instance of the mapped class.

```
<property name="credits" type="integer" insert="false">
    <column name="credits" default="10"/>
</property
>
```

```
<version name="version" type="integer" insert="false">
    <column name="version" default="0"/>
</property
>
```

Das `sql-type`-Attribut ermöglicht die Außerkraftsetzung des Standard-Mappings eines Hibernate-Typs zum SQL-Datentyp.

```
<property name="balance" type="float">
    <column name="balance" sql-type="decimal(13,3)"/>
</property
>
```

Das `check`-Attribut ermöglicht es Ihnen, eine Prüfungsbedingung festzulegen.

```
<property name="foo" type="integer">
    <column name="foo" check="foo
> 10"/>
</property
>
```

```
<class name="Foo" table="foos" check="bar < 100.0">
    ...
    <property name="bar" type="float"/>
</class
>
```

The following table summarizes these optional attributes.

Tabelle 21.1. Zusammenfassung

Attribut	Werte	Bedeutung
`length`	Zahl	Spaltenlänge
`precision`	Zahl	Dezimale Genauigkeit der Spalte
`scale`	Zahl	Dezimale Skalierung der Spalte

Attribut	Werte	Bedeutung
`not-null`	`true|false`	specifies that the column should be non-nullable
`unique`	`true|false`	bestimmt, dass die Spalte eine eindeutige Bedingung besitzt
`index`	`index_name`	bestimmt den Namen eines (mehrspaltigen) Index
`unique-key`	`unique_key_name`	bestimmt den Namen einer mehrspaltigen, eindeutigen Bedingung
`foreign-key`	`foreign_key_name`	legt den Namen einer Bedingung des Fremdschlüssels fest, der für eine Assoziation generiert wurde für ein `<one-to-one>`, `<many-to-one>`, `<key>` oder `<many-to-many>`-Mapping-Element. Bitte beachten Sie, dass `inverse="true"`-Seiten beim `SchemaExport` nicht berücksichtigt werden.
`sql-type`	`SQL column type`	setzt den Standard-Spaltentyp außer Kraft (nur Attribut von `<column>`-Element)
`default`	SQL-Ausdruck	bestimmt einen Standardwert für die Spalte
`check`	SQL-Ausdruck	erstellt eine SQL-Überprüfungsbedingung an entweder der Spalte oder der Tabelle

Das `<comment>`-Element erlaubt die Bestimmung von Kommentaren für das generierte Schema.

```
<class name="Customer" table="CurCust">
    <comment
>Current customers only</comment>
    ...
</class
>
```

```
<property name="balance">
    <column name="bal">
        <comment
>Balance in USD</comment>
    </column>
</property
>
```

This results in a `comment on table` or `comment on column` statement in the generated DDL where supported.

21.1.2. Start des Tools

Das `SchemaExport`-Tool schreibt ein DDL-Skript um DDL-Anweisungen zu standardisieren und/oder auszuführen.

The following table displays the `SchemaExport` command line options

`java -cp` *hibernate_classpaths* `org.hibernate.tool.hbm2ddl.SchemaExport` *options mapping_files*

Tabelle 21.2. `SchemaExport`-Befehlszeilenoptionen

Option	Beschreibung
`--quiet`	do not output the script to stdout
`--drop`	nur Tabellen droppen
`--create`	nur Tabellen erstellen
`--text`	do not export to the database
`--output=my_schema.ddl`	ddl-Skript an eine Datei ausgeben
`--naming=eg.MyNamingStrategy`	wählen Sie eine `NamingStrategy`
`--config=hibernate.cfg.xml`	Hibernate Konfiguration aus einer XML-Datei lesen
`--properties=hibernate.properties`	Datenbank-Properties aus einer Datei lesen
`--format`	generierte SQL sauber im Skript formatieren
`--delimiter=;`	einen Delimiter für das Zeilenende des Skripts setzen

You can even embed `SchemaExport` in your application:

```
Configuration cfg = ....;
new SchemaExport(cfg).create(false, true);
```

21.1.3. Properties

Database properties can be specified:

- wie System-Properties mit `-D`*<property>*
- in `hibernate.properties`
- in einer benannten Properties-Datei mit `--properties`

Die benötigten Properties sind:

Tabelle 21.3. SchemaExport-Connection-Properties

Property-Name	Beschreibung
`hibernate.connection.driver_class`	jdbc-Treiberklasse

Property-Name	Beschreibung
`hibernate.connection.url`	jdbc url
`hibernate.connection.username`	Datenbankbenutzer
`hibernate.connection.password`	Benutzer-Passwort
`hibernate.dialect`	Dialekt

21.1.4. Die Verwendung von Ant

Sie können `SchemaExport` vom Ihrem Ant-Build-Skript aufrufen:

```
<target name="schemaexport">
    <taskdef name="schemaexport"
        classname="org.hibernate.tool.hbm2ddl.SchemaExportTask"
        classpathref="class.path"/>

    <schemaexport
        properties="hibernate.properties"
        quiet="no"
        text="no"
        drop="no"
        delimiter=";"
        output="schema-export.sql">
        <fileset dir="src">
            <include name="**/*.hbm.xml"/>
        </fileset>
    </schemaexport>
</target
>
```

21.1.5. Inkrementelle Schema-Aktualisierungen

The `SchemaUpdate` tool will update an existing schema with "incremental" changes. The `SchemaUpdate` depends upon the JDBC metadata API and, as such, will not work with all JDBC drivers.

`java -cp` *hibernate_classpaths* `org.hibernate.tool.hbm2ddl.SchemaUpdate` *options mapping_files*

Tabelle 21.4. `SchemaUpdate`-Befehlszeilenoptionen

Option	Beschreibung
`--quiet`	do not output the script to stdout
`--text`	do not export the script to the database
`--naming=eg.MyNamingStrategy`	wählen Sie eine `NamingStrategy`
`--properties=hibernate.properties`	Datenbank-Properties aus einer Datei lesen

Option	Beschreibung
`--config=hibernate.cfg.xml`	eine `.cfg.xml`-Datei bestimmen

You can embed `SchemaUpdate` in your application:

```
Configuration cfg = ....;
new SchemaUpdate(cfg).execute(false);
```

21.1.6. Die Verwendung von Ant bei inkrementellen Schema-Aktualisierungen

Sie können `SchemaUpdate` vom Ant-Skript aufrufen:

```
<target name="schemaupdate">
    <taskdef name="schemaupdate"
        classname="org.hibernate.tool.hbm2ddl.SchemaUpdateTask"
        classpathref="class.path"/>

    <schemaupdate
        properties="hibernate.properties"
        quiet="no">
        <fileset dir="src">
            <include name="**/*.hbm.xml"/>
        </fileset>
    </schemaupdate>
</target
>
```

21.1.7. Schema-Validierung

The `SchemaValidator` tool will validate that the existing database schema "matches" your mapping documents. The `SchemaValidator` depends heavily upon the JDBC metadata API and, as such, will not work with all JDBC drivers. This tool is extremely useful for testing.

`java -cp` *hibernate_classpaths* `org.hibernate.tool.hbm2ddl.SchemaValidator` *options mapping_files*

The following table displays the `SchemaValidator` command line options:

Tabelle 21.5. `SchemaValidator`-Befehlszeilenoptionen

Option	Beschreibung
`--naming=eg.MyNamingStrategy`	wählen Sie eine `NamingStrategy`
`--properties=hibernate.properties`	Datenbank-Properties aus einer Datei lesen
`--config=hibernate.cfg.xml`	eine `.cfg.xml`-Datei bestimmen

You can embed `SchemaValidator` in your application:

```
Configuration cfg = ....;
new SchemaValidator(cfg).validate();
```

21.1.8. Die Verwendung von Ant zur Schema-Validierung

Sie können `SchemaValidator` vom Ant-Skript aus aufrufen:

```
<target name="schemavalidate">
    <taskdef name="schemavalidator"
        classname="org.hibernate.tool.hbm2ddl.SchemaValidatorTask"
        classpathref="class.path"/>

    <schemavalidator
        properties="hibernate.properties">
        <fileset dir="src">
            <include name="**/*.hbm.xml"/>
        </fileset>
    </schemavalidator>
</target
>
```

Beispiel: "Parent/Child"

One of the first things that new users want to do with Hibernate is to model a parent/child type relationship. There are two different approaches to this. The most convenient approach, especially for new users, is to model both `Parent` and `Child` as entity classes with a `<one-to-many>` association from `Parent` to `Child`. The alternative approach is to declare the `Child` as a `<composite-element>`. The default semantics of a one-to-many association in Hibernate are much less close to the usual semantics of a parent/child relationship than those of a composite element mapping. We will explain how to use a *bidirectional one-to-many association with cascades* to model a parent/child relationship efficiently and elegantly.

22.1. Eine Anmerkung zu Collections

Hibernate collections are considered to be a logical part of their owning entity and not of the contained entities. Be aware that this is a critical distinction that has the following consequences:

- When you remove/add an object from/to a collection, the version number of the collection owner is incremented.
- If an object that was removed from a collection is an instance of a value type (e.g. a composite element), that object will cease to be persistent and its state will be completely removed from the database. Likewise, adding a value type instance to the collection will cause its state to be immediately persistent.
- Conversely, if an entity is removed from a collection (a one-to-many or many-to-many association), it will not be deleted by default. This behavior is completely consistent; a change to the internal state of another entity should not cause the associated entity to vanish. Likewise, adding an entity to a collection does not cause that entity to become persistent, by default.

Adding an entity to a collection, by default, merely creates a link between the two entities. Removing the entity will remove the link. This is appropriate for all sorts of cases. However, it is not appropriate in the case of a parent/child relationship. In this case, the life of the child is bound to the life cycle of the parent.

22.2. Bidirektionales "One-to-Many"

Gehen wir einmal davon aus, wir wollten mit einer einfachen `<one-to-many>`-Assoziation von `Parent` zu `Child` beginnen.

```
<set name="children">
    <key column="parent_id"/>
    <one-to-many class="Child"/>
</set
>
```

If we were to execute the following code:

```
Parent p = .....;
Child c = new Child();
p.getChildren().add(c);
session.save(c);
session.flush();
```

so würde Hibernate zwei SQL-Anweisungen herausgeben:

- ein `INSERT`, um den Datensatz für `c` zu erstellen
- ein `UPDATE`, um die Verbindung von `p` zuc zu erstellen

This is not only inefficient, but also violates any `NOT NULL` constraint on the `parent_id` column. You can fix the nullability constraint violation by specifying `not-null="true"` in the collection mapping:

```
<set name="children">
    <key column="parent_id" not-null="true"/>
    <one-to-many class="Child"/>
</set
>
```

Dieses ist jedoch nicht die empfohlene Lösung:

The underlying cause of this behavior is that the link (the foreign key `parent_id`) from `p` to `c` is not considered part of the state of the `Child` object and is therefore not created in the `INSERT`. The solution is to make the link part of the `Child` mapping.

```
<many-to-one name="parent" column="parent_id" not-null="true"/>
```

You also need to add the `parent` property to the `Child` class.

Now that the `Child` entity is managing the state of the link, we tell the collection not to update the link. We use the `inverse` attribute to do this:

```
<set name="children" inverse="true">
    <key column="parent_id"/>
    <one-to-many class="Child"/>
</set
>
```

The following code would be used to add a new `Child`:

```
Parent p = (Parent) session.load(Parent.class, pid);
```

```
Child c = new Child();
c.setParent(p);
p.getChildren().add(c);
session.save(c);
session.flush();
```

Only one SQL `INSERT` would now be issued.

You could also create an `addChild()` method of `Parent`.

```
public void addChild(Child c) {
    c.setParent(this);
    children.add(c);
}
```

The code to add a `Child` looks like this:

```
Parent p = (Parent) session.load(Parent.class, pid);
Child c = new Child();
p.addChild(c);
session.save(c);
session.flush();
```

22.3. Cascading life cycle

You can address the frustrations of the explicit call to `save()` by using cascades.

```
<set name="children" inverse="true" cascade="all">
    <key column="parent_id"/>
    <one-to-many class="Child"/>
</set
>
```

This simplifies the code above to:

```
Parent p = (Parent) session.load(Parent.class, pid);
Child c = new Child();
p.addChild(c);
session.flush();
```

Similarly, we do not need to iterate over the children when saving or deleting a `Parent`. The following removes `p` and all its children from the database.

```
Parent p = (Parent) session.load(Parent.class, pid);
```

```
session.delete(p);
session.flush();
```

However, the following code:

```
Parent p = (Parent) session.load(Parent.class, pid);
Child c = (Child) p.getChildren().iterator().next();
p.getChildren().remove(c);
c.setParent(null);
session.flush();
```

will not remove `c` from the database. In this case, it will only remove the link to `p` and cause a `NOT NULL` constraint violation. You need to explicitly `delete()` the `Child`.

```
Parent p = (Parent) session.load(Parent.class, pid);
Child c = (Child) p.getChildren().iterator().next();
p.getChildren().remove(c);
session.delete(c);
session.flush();
```

In our case, a `Child` cannot exist without its parent. So if we remove a `Child` from the collection, we do want it to be deleted. To do this, we must use `cascade="all-delete-orphan"`.

```
<set name="children" inverse="true" cascade="all-delete-orphan">
    <key column="parent_id"/>
    <one-to-many class="Child"/>
</set
>
```

Even though the collection mapping specifies `inverse="true"`, cascades are still processed by iterating the collection elements. If you need an object be saved, deleted or updated by cascade, you must add it to the collection. It is not enough to simply call `setParent()`.

22.4. Cascades and `unsaved-value`

Suppose we loaded up a `Parent` in one `Session`, made some changes in a UI action and wanted to persist these changes in a new session by calling `update()`. The `Parent` will contain a collection of children and, since the cascading update is enabled, Hibernate needs to know which children are newly instantiated and which represent existing rows in the database. We will also assume that both `Parent` and `Child` have generated identifier properties of type `Long`. Hibernate will use the identifier and version/timestamp property value to determine which of the children are new. (See *Abschnitt 10.7, „Automatische Statuserkennung“*.) *In Hibernate3, it is no longer necessary to specify an `unsaved-value` explicitly.*

The following code will update `parent` and `child` and insert `newChild`:

```
//parent and child were both loaded in a previous session
parent.addChild(child);
Child newChild = new Child();
parent.addChild(newChild);
session.update(parent);
session.flush();
```

This may be suitable for the case of a generated identifier, but what about assigned identifiers and composite identifiers? This is more difficult, since Hibernate cannot use the identifier property to distinguish between a newly instantiated object, with an identifier assigned by the user, and an object loaded in a previous session. In this case, Hibernate will either use the timestamp or version property, or will actually query the second-level cache or, worst case, the database, to see if the row exists.

22.5. Zusammenfassung

The sections we have just covered can be a bit confusing. However, in practice, it all works out nicely. Most Hibernate applications use the parent/child pattern in many places.

We mentioned an alternative in the first paragraph. None of the above issues exist in the case of `<composite-element>` mappings, which have exactly the semantics of a parent/child relationship. Unfortunately, there are two big limitations with composite element classes: composite elements cannot own collections and they should not be the child of any entity other than the unique parent.

Beispiel: Web-Log Anwendung

23.1. Persistente Klassen

The persistent classes here represent a weblog and an item posted in a weblog. They are to be modelled as a standard parent/child relationship, but we will use an ordered bag, instead of a set:

```
package eg;

import java.util.List;

public class Blog {
    private Long _id;
    private String _name;
    private List _items;

    public Long getId() {
        return _id;
    }
    public List getItems() {
        return _items;
    }
    public String getName() {
        return _name;
    }
    public void setId(Long long1) {
        _id = long1;
    }
    public void setItems(List list) {
        _items = list;
    }
    public void setName(String string) {
        _name = string;
    }
}
```

```
package eg;

import java.text.DateFormat;
import java.util.Calendar;

public class BlogItem {
    private Long _id;
    private Calendar _datetime;
    private String _text;
    private String _title;
    private Blog _blog;

    public Blog getBlog() {
        return _blog;
    }
    public Calendar getDatetime() {
```

```
        return _datetime;
    }
    public Long getId() {
        return _id;
    }
    public String getText() {
        return _text;
    }
    public String getTitle() {
        return _title;
    }
    public void setBlog(Blog blog) {
        _blog = blog;
    }
    public void setDatetime(Calendar calendar) {
        _datetime = calendar;
    }
    public void setId(Long long1) {
        _id = long1;
    }
    public void setText(String string) {
        _text = string;
    }
    public void setTitle(String string) {
        _title = string;
    }
}
```

23.2. Hibernate-Mappings

The XML mappings are now straightforward. For example:

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC
    "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
    "http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">

<hibernate-mapping package="eg">

    <class
        name="Blog"
        table="BLOGS">

        <id
            name="id"
            column="BLOG_ID">

            <generator class="native"/>

        </id>

        <property
            name="name"
            column="NAME"
            not-null="true"
            unique="true"/>
```

```
        <bag
            name="items"
            inverse="true"
            order-by="DATE_TIME"
            cascade="all">

            <key column="BLOG_ID"/>
            <one-to-many class="BlogItem"/>

        </bag>

    </class>

</hibernate-mapping
>
```

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC
    "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
    "http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">

<hibernate-mapping package="eg">

    <class
        name="BlogItem"
        table="BLOG_ITEMS"
        dynamic-update="true">

        <id
            name="id"
            column="BLOG_ITEM_ID">

            <generator class="native"/>

        </id>

        <property
            name="title"
            column="TITLE"
            not-null="true"/>

        <property
            name="text"
            column="TEXT"
            not-null="true"/>

        <property
            name="datetime"
            column="DATE_TIME"
            not-null="true"/>

        <many-to-one
            name="blog"
            column="BLOG_ID"
            not-null="true"/>
```

```
    </class>

</hibernate-mapping
>
```

23.3. Hibernate-Code

The following class demonstrates some of the kinds of things we can do with these classes using Hibernate:

```
package eg;

import java.util.ArrayList;
import java.util.Calendar;
import java.util.Iterator;
import java.util.List;

import org.hibernate.HibernateException;
import org.hibernate.Query;
import org.hibernate.Session;
import org.hibernate.SessionFactory;
import org.hibernate.Transaction;
import org.hibernate.cfg.Configuration;
import org.hibernate.tool.hbm2ddl.SchemaExport;

public class BlogMain {

    private SessionFactory _sessions;

    public void configure() throws HibernateException {
        _sessions = new Configuration()
            .addClass(Blog.class)
            .addClass(BlogItem.class)
            .buildSessionFactory();
    }

    public void exportTables() throws HibernateException {
        Configuration cfg = new Configuration()
            .addClass(Blog.class)
            .addClass(BlogItem.class);
        new SchemaExport(cfg).create(true, true);
    }

    public Blog createBlog(String name) throws HibernateException {

        Blog blog = new Blog();
        blog.setName(name);
        blog.setItems( new ArrayList() );

        Session session = _sessions.openSession();
        Transaction tx = null;
        try {
            tx = session.beginTransaction();
            session.persist(blog);
            tx.commit();
```

```
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
        finally {
            session.close();
        }
        return blog;
    }

    public BlogItem createBlogItem(Blog blog, String title, String text)
                        throws HibernateException {

        BlogItem item = new BlogItem();
        item.setTitle(title);
        item.setText(text);
        item.setBlog(blog);
        item.setDatetime( Calendar.getInstance() );
        blog.getItems().add(item);

        Session session = _sessions.openSession();
        Transaction tx = null;
        try {
            tx = session.beginTransaction();
            session.update(blog);
            tx.commit();
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
        finally {
            session.close();
        }
        return item;
    }

    public BlogItem createBlogItem(Long blogid, String title, String text)
                        throws HibernateException {

        BlogItem item = new BlogItem();
        item.setTitle(title);
        item.setText(text);
        item.setDatetime( Calendar.getInstance() );

        Session session = _sessions.openSession();
        Transaction tx = null;
        try {
            tx = session.beginTransaction();
            Blog blog = (Blog) session.load(Blog.class, blogid);
            item.setBlog(blog);
            blog.getItems().add(item);
            tx.commit();
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
```

```
        finally {
            session.close();
        }
        return item;
    }

    public void updateBlogItem(BlogItem item, String text)
                    throws HibernateException {

        item.setText(text);

        Session session = _sessions.openSession();
        Transaction tx = null;
        try {
            tx = session.beginTransaction();
            session.update(item);
            tx.commit();
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
        finally {
            session.close();
        }
    }

    public void updateBlogItem(Long itemid, String text)
                    throws HibernateException {

        Session session = _sessions.openSession();
        Transaction tx = null;
        try {
            tx = session.beginTransaction();
            BlogItem item = (BlogItem) session.load(BlogItem.class, itemid);
            item.setText(text);
            tx.commit();
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
        finally {
            session.close();
        }
    }

    public List listAllBlogNamesAndItemCounts(int max)
                    throws HibernateException {

        Session session = _sessions.openSession();
        Transaction tx = null;
        List result = null;
        try {
            tx = session.beginTransaction();
            Query q = session.createQuery(
                "select blog.id, blog.name, count(blogItem) " +
                "from Blog as blog " +
                "left outer join blog.items as blogItem " +
```

```
                "group by blog.name, blog.id " +
                "order by max(blogItem.datetime)"
            );
            q.setMaxResults(max);
            result = q.list();
            tx.commit();
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
        finally {
            session.close();
        }
        return result;
    }

    public Blog getBlogAndAllItems(Long blogid)
                    throws HibernateException {

        Session session = _sessions.openSession();
        Transaction tx = null;
        Blog blog = null;
        try {
            tx = session.beginTransaction();
            Query q = session.createQuery(
                "from Blog as blog " +
                "left outer join fetch blog.items " +
                "where blog.id = :blogid"
            );
            q.setParameter("blogid", blogid);
            blog  = (Blog) q.uniqueResult();
            tx.commit();
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
        finally {
            session.close();
        }
        return blog;
    }

    public List listBlogsAndRecentItems() throws HibernateException {

        Session session = _sessions.openSession();
        Transaction tx = null;
        List result = null;
        try {
            tx = session.beginTransaction();
            Query q = session.createQuery(
                "from Blog as blog " +
                "inner join blog.items as blogItem " +
                "where blogItem.datetime
> :minDate"
            );

            Calendar cal = Calendar.getInstance();
```

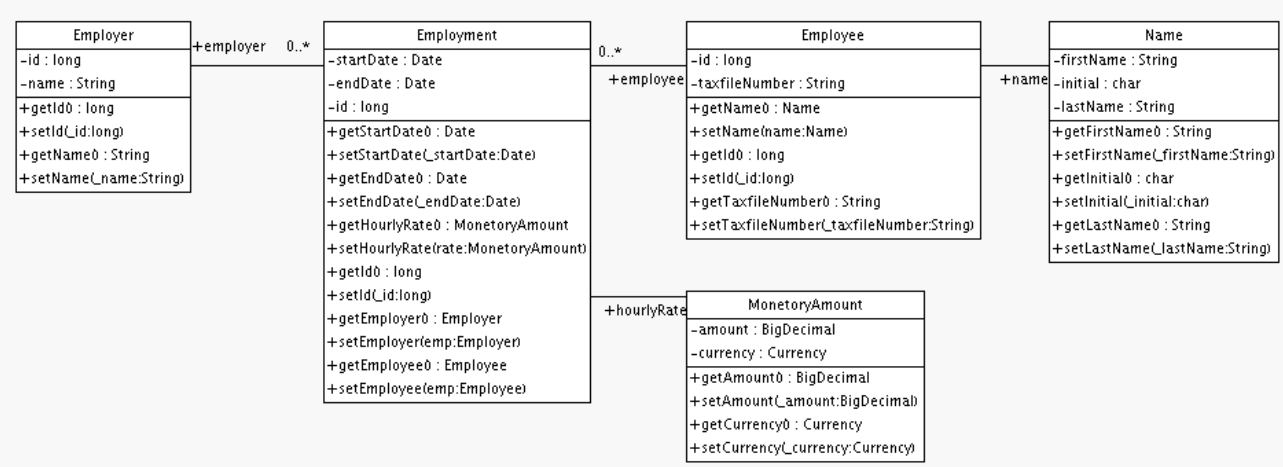
```
            cal.roll(Calendar.MONTH, false);
            q.setCalendar("minDate", cal);

            result = q.list();
            tx.commit();
        }
        catch (HibernateException he) {
            if (tx!=null) tx.rollback();
            throw he;
        }
        finally {
            session.close();
        }
        return result;
    }
}
```

Beispiel: Verschiedene Mappings

This chapters explores some more complex association mappings.

24.1. Arbeitgeber/Arbeitnehmer

The following model of the relationship between `Employer` and `Employee` uses an entity class (`Employment`) to represent the association. You can do this when there might be more than one period of employment for the same two parties. Components are used to model monetary values and employee names.



Here is a possible mapping document:

```
<hibernate-mapping>

    <class name="Employer" table="employers">
        <id name="id">
            <generator class="sequence">
                <param name="sequence"
>employer_id_seq</param>
            </generator>
        </id>
        <property name="name"/>
    </class>

    <class name="Employment" table="employment_periods">

        <id name="id">
            <generator class="sequence">
                <param name="sequence"
>employment_id_seq</param>
            </generator>
        </id>
        <property name="startDate" column="start_date"/>
        <property name="endDate" column="end_date"/>

        <component name="hourlyRate" class="MonetaryAmount">
            <property name="amount">
```

```
                <column name="hourly_rate" sql-type="NUMERIC(12, 2)"/>
            </property>
            <property name="currency" length="12"/>
        </component>

        <many-to-one name="employer" column="employer_id" not-null="true"/>
        <many-to-one name="employee" column="employee_id" not-null="true"/>

    </class>

    <class name="Employee" table="employees">
        <id name="id">
            <generator class="sequence">
                <param name="sequence"
>employee_id_seq</param>
            </generator>
        </id>
        <property name="taxfileNumber"/>
        <component name="name" class="Name">
            <property name="firstName"/>
            <property name="initial"/>
            <property name="lastName"/>
        </component>
    </class>

</hibernate-mapping
>
```

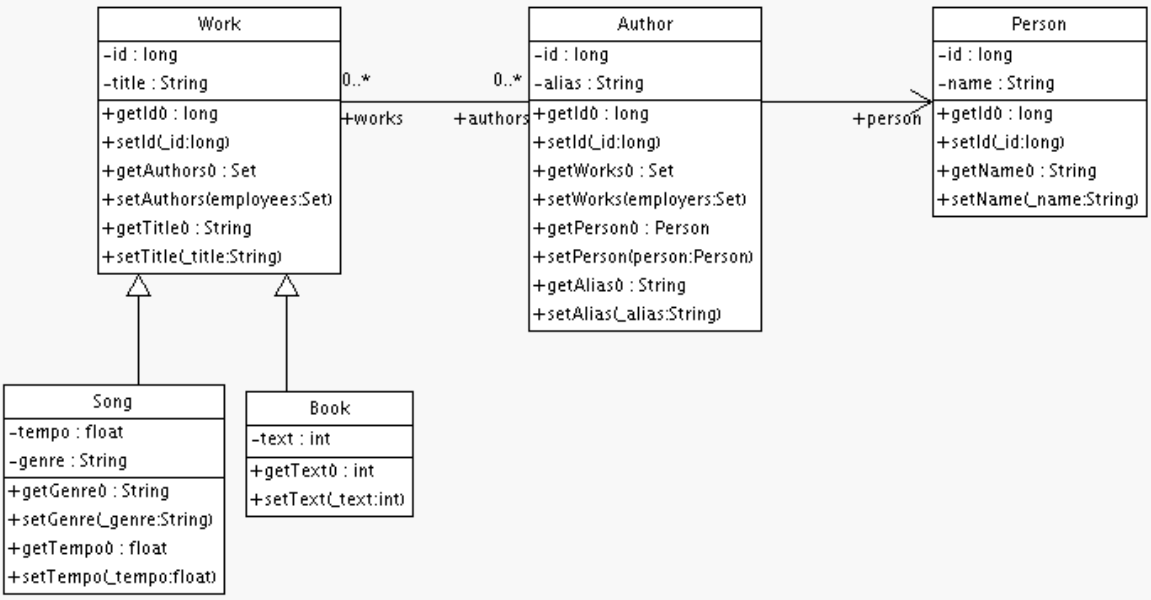
Here is the table schema generated by `SchemaExport`.

```
create table employers (
    id BIGINT not null,
    name VARCHAR(255),
    primary key (id)
)

create table employment_periods (
    id BIGINT not null,
    hourly_rate NUMERIC(12, 2),
    currency VARCHAR(12),
    employee_id BIGINT not null,
    employer_id BIGINT not null,
    end_date TIMESTAMP,
    start_date TIMESTAMP,
    primary key (id)
)

create table employees (
    id BIGINT not null,
    firstName VARCHAR(255),
    initial CHAR(1),
    lastName VARCHAR(255),
    taxfileNumber VARCHAR(255),
    primary key (id)
)
```

```
alter table employment_periods
    add constraint employment_periodsFK0 foreign key (employer_id) references employers
alter table employment_periods
    add constraint employment_periodsFK1 foreign key (employee_id) references employees
create sequence employee_id_seq
create sequence employment_id_seq
create sequence employer_id_seq
```

24.2. Autor/Werk

Consider the following model of the relationships between `Work`, `Author` and `Person`. In the example, the relationship between `Work` and `Author` is represented as a many-to-many association and the relationship between `Author` and `Person` is represented as one-to-one association. Another possibility would be to have `Author` extend `Person`.



Das folgende Mapping-Dokument repräsentiert diese Beziehungen auf korrekte Weise:

```
<hibernate-mapping>

    <class name="Work" table="works" discriminator-value="W">

        <id name="id" column="id">
            <generator class="native"/>
        </id>
        <discriminator column="type" type="character"/>

        <property name="title"/>
        <set name="authors" table="author_work">
            <key column name="work_id"/>
            <many-to-many class="Author" column name="author_id"/>
        </set>
```

```
        <subclass name="Book" discriminator-value="B">
            <property name="text"/>
        </subclass>

        <subclass name="Song" discriminator-value="S">
            <property name="tempo"/>
            <property name="genre"/>
        </subclass>

    </class>

    <class name="Author" table="authors">

        <id name="id" column="id">
            <!-- The Author must have the same identifier as the Person -->
            <generator class="assigned"/>
        </id>

        <property name="alias"/>
        <one-to-one name="person" constrained="true"/>

        <set name="works" table="author_work" inverse="true">
            <key column="author_id"/>
            <many-to-many class="Work" column="work_id"/>
        </set>

    </class>

    <class name="Person" table="persons">
        <id name="id" column="id">
            <generator class="native"/>
        </id>
        <property name="name"/>
    </class>

</hibernate-mapping
>
```

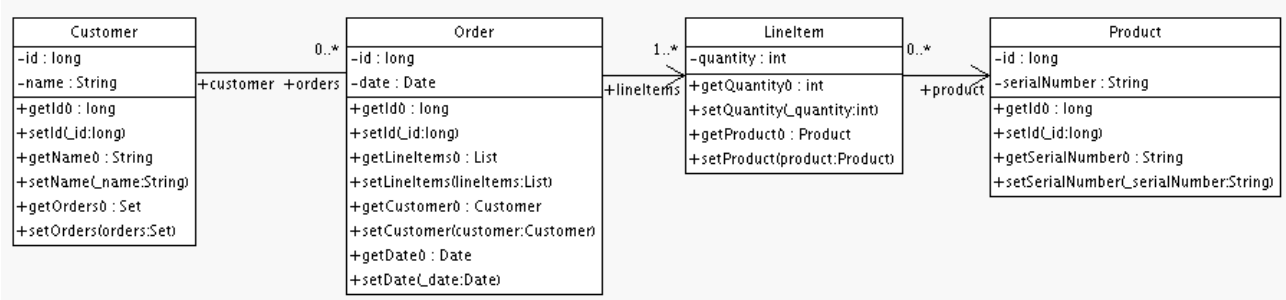
There are four tables in this mapping: `works`, `authors` and `persons` hold work, author and person data respectively. `author_work` is an association table linking authors to works. Here is the table schema, as generated by `SchemaExport`:

```
create table works (
    id BIGINT not null generated by default as identity,
    tempo FLOAT,
    genre VARCHAR(255),
    text INTEGER,
    title VARCHAR(255),
    type CHAR(1) not null,
    primary key (id)
)

create table author_work (
    author_id BIGINT not null,
    work_id BIGINT not null,
```

```
    primary key (work_id, author_id)
)

create table authors (
    id BIGINT not null generated by default as identity,
    alias VARCHAR(255),
    primary key (id)
)

create table persons (
    id BIGINT not null generated by default as identity,
    name VARCHAR(255),
    primary key (id)
)

alter table authors
    add constraint authorsFK0 foreign key (id) references persons
alter table author_work
    add constraint author_workFK0 foreign key (author_id) references authors
alter table author_work
    add constraint author_workFK1 foreign key (work_id) references works
```

24.3. Kunde/Bestellung/Produkt

In this section we consider a model of the relationships between `Customer`, `Order`, `Line Item` and `Product`. There is a one-to-many association between `Customer` and `Order`, but how can you represent `Order` / `LineItem` / `Product`? In the example, `LineItem` is mapped as an association class representing the many-to-many association between `Order` and `Product`. In Hibernate this is called a composite element.



The mapping document will look like this:

```
<hibernate-mapping>

    <class name="Customer" table="customers">
        <id name="id">
            <generator class="native"/>
        </id>
        <property name="name"/>
        <set name="orders" inverse="true">
            <key column="customer_id"/>
            <one-to-many class="Order"/>
        </set>
    </class>
```

```
    <class name="Order" table="orders">
        <id name="id">
            <generator class="native"/>
        </id>
        <property name="date"/>
        <many-to-one name="customer" column="customer_id"/>
        <list name="lineItems" table="line_items">
            <key column="order_id"/>
            <list-index column="line_number"/>
            <composite-element class="LineItem">
                <property name="quantity"/>
                <many-to-one name="product" column="product_id"/>
            </composite-element>
        </list>
    </class>

    <class name="Product" table="products">
        <id name="id">
            <generator class="native"/>
        </id>
        <property name="serialNumber"/>
    </class>

</hibernate-mapping
>
```

`customers`, `orders`, `line_items` und `products` enthalten Kunde, Bestellung, Bestellungsbelegzeile und Produktdaten. `line_items` fungiert auch als Assoziationstabelle, die Bestellungen mit Produkten verbindet.

```
create table customers (
    id BIGINT not null generated by default as identity,
    name VARCHAR(255),
    primary key (id)
)

create table orders (
    id BIGINT not null generated by default as identity,
    customer_id BIGINT,
    date TIMESTAMP,
    primary key (id)
)

create table line_items (
    line_number INTEGER not null,
    order_id BIGINT not null,
    product_id BIGINT,
    quantity INTEGER,
    primary key (order_id, line_number)
)

create table products (
    id BIGINT not null generated by default as identity,
    serialNumber VARCHAR(255),
    primary key (id)
```

```
)

alter table orders
    add constraint ordersFK0 foreign key (customer_id) references customers
alter table line_items
    add constraint line_itemsFK0 foreign key (product_id) references products
alter table line_items
    add constraint line_itemsFK1 foreign key (order_id) references orders
```

24.4. Verschiedene Beispiele von Mappings

These examples are available from the Hibernate test suite. You will find many other useful example mappings there by searching in the `test` folder of the Hibernate distribution.

24.4.1. Typisierte "One-to-One"-Assoziation

```
<class name="Person">
    <id name="name"/>
    <one-to-one name="address"
            cascade="all">
        <formula
>name</formula>
        <formula
>'HOME'</formula>
    </one-to-one>
    <one-to-one name="mailingAddress"
            cascade="all">
        <formula
>name</formula>
        <formula
>'MAILING'</formula>
    </one-to-one>
</class>

<class name="Address" batch-size="2"
        check="addressType in ('MAILING', 'HOME', 'BUSINESS')">
    <composite-id>
        <key-many-to-one name="person"
                column="personName"/>
        <key-property name="type"
                column="addressType"/>
    </composite-id>
    <property name="street" type="text"/>
    <property name="state"/>
    <property name="zip"/>
</class
>
```

24.4.2. Beispiel für einen zusammengesetzten Schlüssel

```
<class name="Customer">
```

```
    <id name="customerId"
        length="10">
        <generator class="assigned"/>
    </id>

    <property name="name" not-null="true" length="100"/>
    <property name="address" not-null="true" length="200"/>

    <list name="orders"
            inverse="true"
            cascade="save-update">
        <key column="customerId"/>
        <index column="orderNumber"/>
        <one-to-many class="Order"/>
    </list>

</class>

<class name="Order" table="CustomerOrder" lazy="true">
    <synchronize table="LineItem"/>
    <synchronize table="Product"/>

    <composite-id name="id"
            class="Order$Id">
        <key-property name="customerId" length="10"/>
        <key-property name="orderNumber"/>
    </composite-id>

    <property name="orderDate"
            type="calendar_date"
            not-null="true"/>

    <property name="total">
        <formula>
            ( select sum(li.quantity*p.price)
            from LineItem li, Product p
            where li.productId = p.productId
                and li.customerId = customerId
                and li.orderNumber = orderNumber )
        </formula>
    </property>

    <many-to-one name="customer"
            column="customerId"
            insert="false"
            update="false"
            not-null="true"/>

    <bag name="lineItems"
            fetch="join"
            inverse="true"
            cascade="save-update">
        <key>
            <column name="customerId"/>
            <column name="orderNumber"/>
        </key>
        <one-to-many class="LineItem"/>
    </bag>
```

```
</class>

<class name="LineItem">

    <composite-id name="id"
            class="LineItem$Id">
        <key-property name="customerId" length="10"/>
        <key-property name="orderNumber"/>
        <key-property name="productId" length="10"/>
    </composite-id>

    <property name="quantity"/>

    <many-to-one name="order"
            insert="false"
            update="false"
            not-null="true">
        <column name="customerId"/>
        <column name="orderNumber"/>
    </many-to-one>

    <many-to-one name="product"
            insert="false"
            update="false"
            not-null="true"
            column="productId"/>

</class>

<class name="Product">
    <synchronize table="LineItem"/>

    <id name="productId"
        length="10">
        <generator class="assigned"/>
    </id>

    <property name="description"
        not-null="true"
        length="200"/>
    <property name="price" length="3"/>
    <property name="numberAvailable"/>

    <property name="numberOrdered">
        <formula>
            ( select sum(li.quantity)
            from LineItem li
            where li.productId = productId )
        </formula>
    </property>

</class
>
```

24.4.3. "Many-to-Many" mit geteiltem Attribut des zusammengesetzten Schlüssels

```
<class name="User" table="`User`">
    <composite-id>
        <key-property name="name"/>
        <key-property name="org"/>
    </composite-id>
    <set name="groups" table="UserGroup">
        <key>
            <column name="userName"/>
            <column name="org"/>
        </key>
        <many-to-many class="Group">
            <column name="groupName"/>
            <formula
>org</formula>
        </many-to-many>
    </set>
</class>

<class name="Group" table="`Group`">
    <composite-id>
        <key-property name="name"/>
        <key-property name="org"/>
    </composite-id>
    <property name="description"/>
    <set name="users" table="UserGroup" inverse="true">
        <key>
            <column name="groupName"/>
            <column name="org"/>
        </key>
        <many-to-many class="User">
            <column name="userName"/>
            <formula
>org</formula>
        </many-to-many>
    </set>
</class>
```

24.4.4. Inhaltsbasierte Diskriminierung

```
<class name="Person"
    discriminator-value="P">

    <id name="id"
        column="person_id"
        unsaved-value="0">
        <generator class="native"/>
    </id>


    <discriminator
```

```
        type="character">
        <formula>
            case
                when title is not null then 'E'
                when salesperson is not null then 'C'
                else 'P'
            end
        </formula>
    </discriminator>

    <property name="name"
        not-null="true"
        length="80"/>

    <property name="sex"
        not-null="true"
        update="false"/>

    <component name="address">
        <property name="address"/>
        <property name="zip"/>
        <property name="country"/>
    </component>

    <subclass name="Employee"
        discriminator-value="E">
            <property name="title"
                length="20"/>
            <property name="salary"/>
            <many-to-one name="manager"/>
    </subclass>

    <subclass name="Customer"
        discriminator-value="C">
            <property name="comments"/>
            <many-to-one name="salesperson"/>
    </subclass>

</class
>
```

24.4.5. Assoziationen bei wechselnden Schlüsseln

```
<class name="Person">

    <id name="id">
        <generator class="hilo"/>
    </id>

    <property name="name" length="100"/>

    <one-to-one name="address"
        property-ref="person"
        cascade="all"
        fetch="join"/>
```

```
    <set name="accounts"
        inverse="true">
        <key column="userId"
            property-ref="userId"/>
        <one-to-many class="Account"/>
    </set>

    <property name="userId" length="8"/>

</class>

<class name="Address">

    <id name="id">
        <generator class="hilo"/>
    </id>

    <property name="address" length="300"/>
    <property name="zip" length="5"/>
    <property name="country" length="25"/>
    <many-to-one name="person" unique="true" not-null="true"/>

</class>

<class name="Account">
    <id name="accountId" length="32">
        <generator class="uuid"/>
    </id>

    <many-to-one name="user"
        column="userId"
        property-ref="userId"/>

    <property name="type" not-null="true"/>

</class
>
```

Optimale Verfahren

Write fine-grained classes and map them using `<component>`:
: Verwenden Sie eine `Address`-Klasse, um `street`, `suburb`, `state`, `postcode` einzukapseln. Das unterstützt die Wiederverwendung des Code und vereinfacht die Erhöhung der Bedienerfreundlichkeit.

Declare identifier properties on persistent classes:
: Hibernate makes identifier properties optional. There are a range of reasons why you should use them. We recommend that identifiers be 'synthetic', that is, generated with no business meaning.

Identify natural keys:
: Bestimmen Sie natürliche Schlüssel für alle Entities, und mappen Sie diese mittels `<natural-id>`. Implementieren Sie `equals()` und `hashCode()`, um die Properties, aus denen der natürliche Schlüssel besteht, zu vergleichen.

Place each class mapping in its own file:
: Do not use a single monolithic mapping document. Map `com.eg.Foo` in the file `com/eg/Foo.hbm.xml`. This makes sense, particularly in a team environment.

Load mappings as resources:
: Deployen Sie die Mappings gemeinsam mit den Klassen, die sie mappen.

Consider externalizing query strings:
: This is recommended if your queries call non-ANSI-standard SQL functions. Externalizing the query strings to mapping files will make the application more portable.

Verwenden Sie "bind"-Variablen.
: As in JDBC, always replace non-constant values by "?". Do not use string manipulation to bind a non-constant value in a query. You should also consider using named parameters in queries.

Do not manage your own JDBC connections:
: Hibernate allows the application to manage JDBC connections, but his approach should be considered a last-resort. If you cannot use the built-in connection providers, consider providing your own implementation of `org.hibernate.connection.ConnectionProvider`.

Consider using a custom type:
: Suppose you have a Java type from a library that needs to be persisted but does not provide the accessors needed to map it as a component. You should consider implementing `org.hibernate.UserType`. This approach frees the application code from implementing transformations to/from a Hibernate type.

Use hand-coded JDBC in bottlenecks:
: In performance-critical areas of the system, some kinds of operations might benefit from direct JDBC. Do not assume, however, that JDBC is necessarily faster. Please wait until you

know something is a bottleneck. If you need to use direct JDBC, you can open a Hibernate `Session`, wrap your JDBC operation as a `org.hibernate.jdbc.Work` object and using that JDBC connection. This way you can still use the same transaction strategy and underlying connection provider.

Understand `Session` flushing:

Sometimes the Session synchronizes its persistent state with the database. Performance will be affected if this process occurs too often. You can sometimes minimize unnecessary flushing by disabling automatic flushing, or even by changing the order of queries and other operations within a particular transaction.

In a three tiered architecture, consider using detached objects:

When using a servlet/session bean architecture, you can pass persistent objects loaded in the session bean to and from the servlet/JSP layer. Use a new session to service each request. Use `Session.merge()` or `Session.saveOrUpdate()` to synchronize objects with the database.

In a two tiered architecture, consider using long persistence contexts:

Database Transactions have to be as short as possible for best scalability. However, it is often necessary to implement long running *application transactions*, a single unit-of-work from the point of view of a user. An application transaction might span several client request/response cycles. It is common to use detached objects to implement application transactions. An appropriate alternative in a two tiered architecture, is to maintain a single open persistence contact session for the whole life cycle of the application transaction. Then simply disconnect from the JDBC connection at the end of each request and reconnect at the beginning of the subsequent request. Never share a single session across more than one application transaction or you will be working with stale data.

Do not treat exceptions as recoverable:

This is more of a necessary practice than a "best" practice. When an exception occurs, roll back the `Transaction` and close the `Session`. If you do not do this, Hibernate cannot guarantee that in-memory state accurately represents the persistent state. For example, do not use `Session.load()` to determine if an instance with the given identifier exists on the database; use `Session.get()` or a query instead.

Prefer lazy fetching for associations:

Use eager fetching sparingly. Use proxies and lazy collections for most associations to classes that are not likely to be completely held in the second-level cache. For associations to cached classes, where there is an a extremely high probability of a cache hit, explicitly disable eager fetching using `lazy="false"`. When join fetching is appropriate to a particular use case, use a query with a `left join fetch`.

Use the *open session in view* pattern, or a disciplined *assembly phase* to avoid problems with unfetched data:

Hibernate frees the developer from writing tedious *Data Transfer Objects* (DTO). In a traditional EJB architecture, DTOs serve dual purposes: first, they work around the problem that entity beans are not serializable; second, they implicitly define an assembly phase where

all data to be used by the view is fetched and marshalled into the DTOs before returning control to the presentation tier. Hibernate eliminates the first purpose. Unless you are prepared to hold the persistence context (the session) open across the view rendering process, you will still need an assembly phase. Think of your business methods as having a strict contract with the presentation tier about what data is available in the detached objects. This is not a limitation of Hibernate. It is a fundamental requirement of safe transactional data access.

Consider abstracting your business logic from Hibernate:

Hide Hibernate data-access code behind an interface. Combine the *DAO* and *Thread Local Session* patterns. You can even have some classes persisted by handcoded JDBC associated to Hibernate via a `UserType`. This advice is, however, intended for "sufficiently large" applications. It is not appropriate for an application with five tables.

Do not use exotic association mappings:

Practical test cases for real many-to-many associations are rare. Most of the time you need additional information stored in the "link table". In this case, it is much better to use two one-to-many associations to an intermediate link class. In fact, most associations are one-to-many and many-to-one. For this reason, you should proceed cautiously when using any other association style.

Prefer bidirectional associations:

Unidirektionale Assoziationen sind schwieriger abzufragen. In einer großen Anwendung müssen fast alle Assoziationen bei Anfragen nach beiden Richtungen navigierbar sein.

Database Portability Considerations

26.1. Portability Basics

One of the selling points of Hibernate (and really Object/Relational Mapping as a whole) is the notion of database portability. This could mean an internal IT user migrating from one database vendor to another, or it could mean a framework or deployable application consuming Hibernate to simultaneously target multiple database products by their users. Regardless of the exact scenario, the basic idea is that you want Hibernate to help you run against any number of databases without changes to your code, and ideally without any changes to the mapping metadata.

26.2. Dialekt

The first line of portability for Hibernate is the dialect, which is a specialization of the `org.hibernate.dialect.Dialect` contract. A dialect encapsulates all the differences in how Hibernate must communicate with a particular database to accomplish some task like getting a sequence value or structuring a SELECT query. Hibernate bundles a wide range of dialects for many of the most popular databases. If you find that your particular database is not among them, it is not terribly difficult to write your own.

26.3. Dialect resolution

Originally, Hibernate would always require that users specify which dialect to use. In the case of users looking to simultaneously target multiple databases with their build that was problematic. Generally this required their users to configure the Hibernate dialect or defining their own method of setting that value.

Starting with version 3.2, Hibernate introduced the notion of automatically detecting the dialect to use based on the `java.sql.DatabaseMetaData` obtained from a `java.sql.Connection` to that database. This was much better, expect that this resolution was limited to databases Hibernate know about ahead of time and was in no way configurable or overrideable.

Starting with version 3.3, Hibernate has a fare more powerful way to automatically determine which dialect to should be used by relying on a series of delegates which implement the `org.hibernate.dialect.resolver.DialectResolver` which defines only a single method:

```
public Dialect resolveDialect(DatabaseMetaData metaData) throws JDBCConnectionException
```

. The basic contract here is that if the resolver 'understands' the given database metadata then it returns the corresponding Dialect; if not it returns null and the process continues to the next resolver. The signature also identifies `org.hibernate.exception.JDBCConnectionException` as possibly being thrown. A JDBCConnectionException here is interpreted to imply a "non transient" (aka non-recoverable) connection problem and is used to indicate an immediate stop to resolution attempts. All other exceptions result in a warning and continuing on to the next resolver.

The cool part about these resolvers is that users can also register their own custom resolvers which will be processed ahead of the built-in Hibernate ones. This might be useful in a number of different situations: it allows easy integration for auto-detection of dialects beyond those shipped with HIbernate itself; it allows you to specify to use a custom dialect when a particular database is recognized; etc. To register one or more resolvers, simply specify them (seperated by commas, tabs or spaces) using the 'hibernate.dialect_resolvers' configuration setting (see the `DIALECT_RESOLVERS` constant on `org.hibernate.cfg.Environment`).

26.4. Identifier generation

When considering portability between databases, another important decision is selecting the identifier generation stratagy you want to use. Originally Hibernate provided the *native* generator for this purpose, which was intended to select between a *sequence*, *identity*, or *table* strategy depending on the capability of the underlying database. However, an insidious implication of this approach comes about when targtetting some databases which support *identity* generation and some which do not. *identity* generation relies on the SQL definition of an IDENTITY (or auto-increment) column to manage the identifier value; it is what is known as a post-insert generation strategy becauase the insert must actually happen before we can know the identifier value. Because Hibernate relies on this identifier value to uniquely reference entities within a persistence context it must then issue the insert immediately when the users requests the entitiy be associated with the session (like via save() e.g.) regardless of current transactional semantics.

Anmerkung

Hibernate was changed slightly once the implication of this was better understood so that the insert is delayed in cases where that is feasible.

The underlying issue is that the actual semanctics of the application itself changes in these cases.

Starting with version 3.2.3, Hibernate comes with a set of *enhanced* [http://in.relation.to/2082.lace] identifier generators targetting portability in a much different way.

Anmerkung

There are specifically 2 bundled *enhanced*generators:

- `org.hibernate.id.enhanced.SequenceStyleGenerator`
- `org.hibernate.id.enhanced.TableGenerator`

The idea behind these generators is to port the actual semantics of the identifer value generation to the different databases. For example, the `org.hibernate.id.enhanced.SequenceStyleGenerator` mimics the behavior of a sequence on databases which do not support sequences by using a table.

26.5. Database functions

Warnung

This is an area in Hibernate in need of improvement. In terms of portability concerns, this function handling currently works pretty well from HQL; however, it is quite lacking in all other aspects.

SQL functions can be referenced in many ways by users. However, not all databases support the same set of functions. Hibernate, provides a means of mapping a *logical* function name to a delegate which knows how to render that particular function, perhaps even using a totally different physical function call.

Wichtig

Technically this function registration is handled through the `org.hibernate.dialect.function.SQLFunctionRegistry` class which is intended to allow users to provide custom function definitions without having to provide a custom dialect. This specific behavior is not fully completed as of yet.

It is sort of implemented such that users can programatically register functions with the `org.hibernate.cfg.Configuration` and those functions will be recognized for HQL.

26.6. Type mappings

This section scheduled for completion at a later date...

References

[PoEAA] *Patterns of Enterprise Application Architecture*. 0-321-12742-0. von Martin Fowler. Copyright © 2003 Pearson Education, Inc.. Addison-Wesley Publishing Company.

[JPwH] *Java Persistence with Hibernate*. Second Edition of Hibernate in Action. 1-932394-88-5. *http://www.manning.com/bauer2* . von Christian Bauer und Gavin King. Copyright © 2007 Manning Publications Co.. Manning Publications Co..