Hibernate Query Language and Native SQL

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Topics in This Section

- Spend some time learning about the Hibernate Query Language, and how to leverage it to write database queries
- Prepare ourselves for cases where we need to write our own SQL by understanding how to accomplish its execution through Hibernate

The Hibernate Query Language

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Hibernate Query Language (HQL)

- **Similar to SQL**
  - Object based. Instead of tables and columns, syntax includes objects and attributes
- **Understands inheritance**
  - Can issue a query using a superclass or interface
- **Hibernate engine may turn one HQL statement into several SQL statements**
  - Does not allow for SQL database hints
- **Bypasses any object caches, such as the persistence context or 2nd Level Cache**

**org.hibernate.Query**

- **Main class used for building and executing HQL**
- **Similar to a JDBC prepared statement**
  - Bind parameter values
    - `setLong()`, `setString()`, `setDate()` etc…
    - `setParameter()``;
      - Generic way of binding variables
  - Submit Requests
    - `list();`
      - Execute, and return a collection of result objects
    - `uniqueResult();`
      - Execute and return a single result object
- **Created using the Hibernate Session**
Basic Object Queries

// return all CheckingAccounts
Query getAllCheckingAccounts = session.createQuery("from CheckingAccount");
List checkingAccounts = getAllCheckingAccounts.list();

// return all Account types
Query getAllAccounts = session.createQuery("from Account");
List accounts = getAllAccounts.list();

// return ALL object types
Query getAllAccounts = session.createQuery("from java.lang.Object");
List objects = getAllAccounts.list();

Binding Query Parameters

- **Position-based**
  - Just like JDBC
  - Set parameters in an ordered fashion, starting with zero
- **Name-based**
  - Use names as placeholders
  - Set parameters by name
- **Pros/Cons**
  - Position-based faster on executing variable substitution
  - Name-based doesn’t require code changes if a new parameter gets added in the middle of the statement
Position-Based Parameters

// return all Accounts based on
// balance and creation date
String query = "from Account a where"
    + " a.balance > ?" 
    + " and a.creationDate > ?";

// deprecated. for demo only
Date date = new Date(2008, 12, 01);

Query getAccounts = session.createQuery(query)
    .setLong(0, 1000)
    .setDate(1, date);

List accounts = getAccounts.list();

Can alias objects, just like in SQL
Can set parameters in order, just like a JDBC PreparedStatement

Name-Based Parameters

// return all Accounts based on
// balance and creation date
String query = "from Account a where"
    + " a.balance > :someBalance"
    + " and a.creationDate > :someDate";

// deprecated. for demo only
Date date = new Date(2008, 12, 01);

// order doesn't matter
Query getAccounts = session.createQuery(query)
    .setDate("someDate", date)
    .setLong("someBalance", 1000);

List accounts = getAccounts.list();
Setting Parameters Generically

// return all Accounts based on balance and creation date
String query = "from Account a where"
  + " a.balance > :someBalance"
  + " and a.creationDate > :someDate";

// deprecated. for demo only
Date date = new Date(2008, 12, 01);

// order doesn’t matter.
// Temporal (time) values need to be specified
Query getAccounts = session.createQuery(query)
  .setParameter("someBalance", 1000)
  .setParameter("someDate", date, Hibernate.DATE);

List accounts = getAccounts.list();

Binding by Object

• Name-based binding accepts an entire object for setting query parameters
  – Placeholder names must match object attribute names
  – Hibernate uses reflection/java bean properties to map the attributes
• Doesn’t work with temporal data types
  – Like Date
## Binding by Object

```java
// return all Accounts based on balance and creation date
String query = "from EBill e where" + " e.balance > :balance" + " and e.ebillerId > :ebillerId";

EBill queryParams = new EBill();
queryParams.setBalance(1000);
queryParams.setEbillerId(1);

// this will use java bean properties/reflection to bind the variables
Query getEBills = session.createQuery(query)
    .setProperties(queryParams);
List accounts = getEBills.list();
```

Assume an object with attribute names that matched the placeholder names...

...pass that object in to set the parameter values

## Pagination

- Break up large result sets into smaller groups (pages)
  - setFirstResults(int startRow);
    - Set the starting record position
    - Zero-based indexing
  - setMaxResults(int numberToGet);
    - Set the number of records to retrieve
- Keep track of current index in order to continue paging data through the data
Pagination

// retrieve initial page, up to 50 records
Query getAccountsPage1 = 
    session.createQuery("from Account")
    .setMaxResult(50);

...

// retrieve subsequent pages, passing
// in the first record to start with
Query getAccountsNextPage = 
    session.createQuery("from Account")
    .setFirstResult(:startingIndex)
    .setMaxResult(50);

Setting Timeout

• Set the time allowed for a specified query to execute
  – setTimeout(int second);
  – Hibernate will throw an exception if limit is exceeded

• Based on the JDBC timeout implementation
try {

    // retrieve accounts, allow 30 seconds
    Query getAccounts =
        session.createQuery("from Account")
        .setTimeout(30);

    List accounts = getAccountsPage1.list();
}

...
Setting Fetch Size

// retrieve initial page, up to 50 records
Query getAccountsPage1 =
    session.createQuery("from Account")
    .setMaxResult(50)
    .setFetchSize(50);

...

// retrieve subsequent pages, passing
// in the first record to start with
Query getAccountsNextPage =
    session.createQuery("from Account")
    .setFirstResult(:startingIndex)
    .setMaxResult(50)
    .setFetchSize(50);

Adding Comments to Query

• Developer provided comments included in the log along with the Hibernate SQL statement
  – setComment(String comment);
  – Need to enable 'user_sql_comments' in the Hibernate configuration

• Assists in distinguishing user-generated queries vs. Hibernate-generated
  – Also be used to explain query intention
Adding Comments to Query

// retrieve initial page, up to 50 records
Query getAccountsPage1 =
    session.createQuery("from Account")
    .setMaxResult(50)
    .setComment("Retrieving first page of Account objects");

...

// retrieve subsequent pages, passing // in the first record to start with
Query getAccountsNextPage =
    session.createQuery("from Account")
    .setFirstResult(:startingIndex)
    .setMaxResult(50)
    .setComment("Retrieving page: " + pageNum);

Combining Settings

• Settings can be combined together on a single query
• Set on individual queries, not across all HQL queries
Combined Settings

```java
Query getAccountPage1 = 
    session.createQuery("from Account")
    .setMaxResult(50)
    .setFetchSize(50)
    .setTimeout(60)
    .setComment("Retrieving all account objects");

List accounts = getAccounts.list();
...

Query getAccountNextPage = 
    session.createQuery("from Account")
    .setFirstResult(:startingIndex)
    .setMaxResult(25)
    .setFetchSize(25)
    .setTimeout(30)
    .setComment("Retrieving page " + pageNum);
```

Externalizing Queries

- Define queries in object mapping files
- Can be ‘global’ or included inside class definition
  - If inside class definition, need to prefix with fully qualified class name when calling
- **Isolates the SQL statements**
  - Useful if you want to modify all queries
    - Optimize queries
    - Switch vendors
    - May not require recompiling code
External: Global

```xml
<hibernate-mapping>
  <class name="courses.hibernate.vo.Account" table="ACCOUNT">
    <id name="accountId" column="ACCOUNT_ID">
      <generator class="native" />
    </id>
    <property name="creationDate" column="CREATION_DATE" type="timestamp" update="false" />
    <property name="accountType" column="ACCOUNT_TYPE" type="string" update="false" />
    <property name="balance" column="BALANCE" type="double" />
  </class>
  <query name="getAllAccounts" fetch-size="50" comment="My account query" timeout="30">
    <![CDATA[from Account]]>
  </query>
</hibernate-mapping>
```

External: Inside Class

```xml
<hibernate-mapping>
  <class name="courses.hibernate.vo.Account" table="ACCOUNT">
    <id name="accountId" column="ACCOUNT_ID">
      <generator class="native" />
    </id>
    <property name="creationDate" column="CREATION_DATE" type="timestamp" update="false" />
    <property name="accountType" column="ACCOUNT_TYPE" type="string" update="false" />
    <property name="balance" column="BALANCE" type="double" />
    <query name="getAccountByBalance" fetch-size="50" comment="Get account by balance" timeout="30">
      <![CDATA[from Account where balance=:balance]]>
    </query>
  </class>
</hibernate-mapping>
```
Calling Externalizing Queries

// globally named query
Query getAccounts =
    session.getNamedQuery("getAllAccounts")

List accounts = getAccounts.list();
...

// defined within class definition
Query getAccountByBalance =
    session.getNamedQuery(
        "courses.hibernate.vo.Account.getAccountByBalance")
    .setParameter("someBalance", 1000)

List accounts = getAccountByBalance.list();

Specifying Order

... 

Query getAccounts =
    session.createQuery("from Account
        order by balance desc, creationDate
        asc")

List accounts = getAccounts.list();
...

Specifying Columns

- Requires the use of the ‘select’ keyword
- Returns a list of object arrays
  - Each index in the list contains an object array of the values for that row
  - Within each object array, columns are ordered as listed
    - Index 0 is the first identified column
    - Index 1 is the second identified column
    - Index n-1 is the nth identified column
- Loop through the returned list of returned row column objects

Query getAccountInfo = session.createQuery("select accountId, balance from Account");

// get a list of results, where each result is an object array representing one row of data
List listOfRowValues = getAccountsInfo.list();

// for each object array...
for (Object[] singleRowValues : listOfRowValues) {
    // ...pull off the accountId and balance
    long accountId = (Long)singleRowValues[0];
    double balance = (Double)singleRowValues[1];
}
Using SQL/Database Functions

Query getAccountOwners =
    session.createQuery(
        "select upper(lastName),
        lower(firstName),
        sysdate
        from AccountOwner");
 Implicit Association Join

- Leverages the associations identified in the object’s mapping file to figure out what SQL needs to be generated
- Uses dot notation to access the associated object in the query
- Only works for a single association reference
  - Does not work against collections of objects

Implicit Association Join

- Search for EBills by the name of the EBiller, through the EBill object

```java
Query getVisaCardEbills = session.createQuery(
    "from EBill ebill where ebill.ebiller.name like '%VISA%'"
)
List ebills = getVisaCardEbills.list();
```
**EBill issued from EBiller**

```xml
<!-- EBill Mapping -->
<class name="courses.hibernate.vo.EBill" table="EBILL">
    ...
    <many-to-one name="ebiller" column="EBILLER_ID"
        class="courses.hibernate.vo.EBiller"/>
</class>

<!-- EBiller Mapping-->
<class name="courses.hibernate.vo.EBiller"
    table="EBILLER">
    ...
    <property name="name" column="NAME" type="string" />
    ...
</class>
```

**Ordinary Join**

- Join object types in the statement’s 'from' clause, bringing back all associated objects, or just specified ones
- Returns a list of a single object type, or an array of objects containing returned types
  - For single object type, use the ‘select’ clause
  - For multiple types, returns a list of objects arrays
    - For repeated items, uses copies of object references, not instances
- Works for collections of associated objects
Ordinary Join

Query getVisaCardEbills =
  session.createQuery(
    "from EBill ebill
    join ebill.ebiller ebiller
    where ebiller.name like '%VISA%'
  
  // get a list of results, where each result is
  // an object array representing one row of data
  List listOfRowValues = getVisaCardEbills.list();

  // returns BOTH object types
  for (Object[] singleRowValues : listOfRowValues) {
    // ...pull off the EBill and EBiller
    EBill ebill = (EBill)singleRowValues[0];
    EBiller ebiller = (EBiller)singleRowValues[1];
    ...
  }

EBill issued from EBiller

<!-- EBill Mapping -->
<class name="courses.hibernate.vo.EBill" table="EBILL">
  ...
  <many-to-one name="ebiller" column="EBILLER_ID"
    class="courses.hibernate.vo.EBiller"/>
</class>

<!-- EBiller Mapping-->
<class name="courses.hibernate.vo.EBiller"
  table="EBILLER">
  ...
  <property name="name" column="NAME" type="string" />
  ...
</class>
Ordinary Join – Return One Type

Query getVisaCardEbills = 
    session.createQuery("select ebill from EBill ebill
    join ebill.ebiller ebiller
    where ebiller.name like '%VISA%'")

List visaBills = 
    getVisaCardEbills.list();

Ordinary Join – Collections

Query getVisaCardEbills = 
    session.createQuery("from EBiller ebiller
    join ebiller.ebills ebill
    where ebill.balance > 500"

// get a list of results, where each result is
// an object array representing one row of data
List listOfRowValues = getVisaCardEbills.list();

// go through the rows of object arrays
for (Object[] singleRowValues : listOfRowValues) {
    // ...pull off the EBiller and EBill
    EBiller ebiller = (EBiller)singleRowValues[0];
    EBill ebill = (EBill)singleRowValues[1];
    ...
}
Left Outer Joins

- Bring back all items of the 'left' side of a relationship, even if there is no matching 'right' side
  - If there IS a matching right side, bring that back too
  - Returns all objects in an object array per row
- Returns all objects in an object array per row
- Used for eager loading of objects

AccountTransactions may have EBills

<!-- EBill Mapping -->
<class name="courses.hibernate.vo.EBill" table="EBILL">
  ...
  <many-to-one name="accountTransaction"
    class="courses.hibernate.vo.AccountTransaction"
    column="ACCOUNT_TRANSACTION_ID"/>
</class>

<!-- AccountTransaction Mapping -->
<class name="courses.hibernate.vo.AccountTransaction"
  table="ACCOUNT_TRANSACTION">
  ...
  <one-to-one name="ebill"
    class="courses.hibernate.vo.EBill"
    property-ref="accountTransaction" />
</class>
Left Outer Join

Query getEBills =
   session.createQuery("from EBill ebill
   left join ebill.accountTransaction where
   ebill.balance > 500");

List listOfRowValues = getDebitTransactions.list();

for (Object[] singleRowValues : listOfRowValues) {
   // pull off the EBill
   EBill ebill = (EBill)singleRowValues[0];

   // we may or may not have an AccountTransaction.
   // if no related AccountTransaction, value is null
   AccountTransaction atx =
      (AccountTransaction)singleRowValues[1];

   ...
}

Fetch Join

- Return a single object type with specified associations fully initialized
- Results in fewer, more optimized, SQL statements
- Used for eager loading or objects
- Never fetch more than one collection in parallel
  - Will result in a Cartesian product
  - Can fetch many single-valued associations
Fetch Join

```java
Query getEBills = 
    session.createQuery("from EBill ebill
        join fetch ebill.accountTransaction where
        ebill.balance > 500");

List listOfRowValues = getDebitTransactions.list();

for (Object[] singleRowValues : listOfRowValues) {
    // pull off the EBill
    EBill ebill = (EBill)singleRowValues[0];

    // we may or may not have an AccountTransaction.
    // if no related AccountTransaction, value is null
    AccountTransaction atx =
        (AccountTransaction)singleRowValues[1];

    ...
}
```

Theta-Style Join

- Join in a traditional SQL-like format
- Does not support outer joins
- Can join otherwise unrelated objects
  - Objects not associated in mapping files
 Theta-Style Join

```java
Query getVisaCardEmployees =
    session.createQuery(
        "select owner
         from AccountOwner owner, EBiller ebiller
         where
             owner.cellPhone = ebiller.phone and
             ebiller.name like '%VISA%'"
    )

List visaEmployees =
    getVisaCardEmployees.list();

...
HQL Aggregation Functions

- Functions that operate against groups of resulting records
- Supported functions include:
  - `count()`;
  - `min()`;
  - `max()`;
  - `sum()`;
  - `avg()`;

Count Function

```java
Query countQuery = session.createQuery("select count(ao) from AccountOwner ao ");
long cnt = (Long)countQuery.uniqueResult();
```
Min, Max, and Avg Functions

```java
Query accountStatsQuery = 
    session.createQuery(
        "select min(a.balance), max(a.balance),
        avg(a.balance) from Account a"");

List listOfRowValues = accountStatsQuery.list();

for (Object[] singleRowValues : listOfRowValues) {
    // pull off the values
    double min = (Double)singleRowValues[0];
    double max = (Double)singleRowValues[1];
    double avg = (Double)singleRowValues[2];
}
```

Group By and Having

- **Group subsets of returned results**
  - ‘group by’ clause, just like SQL
- **Restrict groups returned**
  - ‘having’ clause, also like SQL
Group By Aggregation

Query avgTxAmountPerAccountQuery = 
session.createQuery(
    "select atx.account.accountId, 
    avg(atx.amount) 
    from 
    AccountTransaction atx 
    group by 
    atx.account.accountId";)

List listOfRowValues = 
    avgTxAmountPerAccountQuery.list();

for (Object[] singleRowValues : listOfRowValues) {
    // pull off the values
    long accountId = (Long)singleRowValues[0];
    double average = (Double)singleRowValues[1];
}

Having Aggregation Restriction

Query avgTxAmountPerAccountQuery = 
    session.createQuery(
        "select atx.account.accountId, 
        avg(atx.amount) 
        from 
        AccountTransaction atx 
        group by 
        atx.account.accountId 
        having 
        count(atx) > 20";)

List listOfRowValues = 
    avgTxAmountPerAccountQuery.list();

for (Object[] singleRowValues : listOfRowValues) {
    // pull off the values
    long accountId = (Long)singleRowValues[0];
    double average = (Double)singleRowValues[1];
}
Native SQL

Native SQL Queries

- Write traditional SQL statements and execute them through the Hibernate engine
  - Hibernate can handle the result set
- Needed for very complicated queries or taking advantage of some database features, like hints
Returning Scalar Values – All Columns

Query getEBills =
  session.createQuery("SELECT * FROM EBILL");

List listOfRowValues =
  getEBills.list();

for (Object[] singleRowValues : listOfRowValues) {
  // returned in the order on the table
  long id = (long)singleRowValues[0];
  double balance = (balance)singleRowValues[1];
  ...
}

Return List of Objects

Query getEBills =
  session.createQuery("SELECT * FROM EBill")
  .addEntity(EBill.class);

List ebills =
  getEBills.list();
Returning Scalar Values – Projections

Query getScalarVariables =
    session.createQuery("SELECT EBILL_ID AS ID, EB.BALANCE AS BALANCE
                         FROM EBILL EB")
    .addScalar("id", Hibernate.LONG)
    .addScalar("balance", Hibernate.DOUBLE);

List listOfRowValues =
    getScalarVariables.list();

for (Object[] singleRowValues : listOfRowValues) {
    long id = (Long)singleRowValues[0];
    double balance = (Double)singleRowValues[1];
}

Combining Scalars and Objects

Query getComboInfo =
    session.createQuery("SELECT EBILL_ID AS ID, EBLR.*
                         FROM EBILL E, EBILLER EBLR")
    .addScalar("id", Hibernate.LONG)
    .addEntity("EBLR", EBiller.class);

List listOfRowValues = getComboInfo.list();

for (Object[] singleRowValues : listOfRowValues) {
    long id = (Long)singleRowValues[0];
    EBlr eblr = (EBiller)singleRowValues[1];
Wrap-up

Summary

- Learned how to use HQL to execute queries by binding dynamic parameters and settings
  - Named and position based binding
  - Paging, fetch-size, timeout, comments
- Saw how to externalize our queries for maintenance purposes
  - In mapping files globally, or within class definitions
- Joins, Joins, Joins
  - Implicitly; in from clause; with eager loading; traditional SQL-style
- Aggregations:
  - Grouping and Having
- Native SQL
  - Returning both scalar and object results
Preview of Next Sections

• Hibernate Advanced Features