Hibernate Fetch Strategies & N+1 Select Problem

"Code with JPassion!"

Topics

- Fetching strategies
- Types of fetching strategies
  - How fetching is done
  - When fetching is done
- N+1 select problem
  - Factors that influence number of select statements, thus influence the overall performance
  - Various examples
- Recommendations

Fetching Strategies

What is a Fetching Strategy?

- A fetching strategy is the strategy Hibernate will use for retrieving associated objects (from the database server) if the application needs to navigate the association
- Fetching strategy will have performance impact
  - Number of select statements executed will be different depending on fetching strategy
- Fetch strategies may be declared in the mapping files, or over-ridden by a particular HQL or Criteria query

Types of Fetching Strategies

- How fetching is done
  - Select (default)
  - Join
  - Subselect
  - Batch
- When fetching is done
  - Lazy (default)
  - Immediate

Fetching Strategies: How Fetching is Done

Select Fetching

- Select fetching is the default fetch mode
- Vulnerable to “N+1 selects problem”, which means
  - “N” number of SELECT's are executed to retrieve the associated entity or collection

Join Fetching

- In “Join fetching”, Hibernate retrieves the associated instance or collection in the same SELECT, using an INNER JOIN

Join Fetching in HQL

```
String hql = "from Product p join fetch p.supplier as s";
Query query = session.createQuery(hql);
List results = query.list();
```

Join Fetching in Criteria API

```
Criteria crit = session.createCriteria(Product.class);
crit.setFetchMode("supplier", FetchMode.JOIN);
List results = crit.list();
```

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 actually access the association.

Batch Fetching

- With batch-size="N" on a collection or an entity class mapping you tell Hibernate to optimize the second SELECT (either lazy or non-lazy) by fetching up to N other collections (or entity instances)

How to set “fetch” strategy in Mapping file

- Select fetching (the default) is extremely vulnerable to “N+1 selects problem”, so you might want to enable join fetching in the mapping document:

```
<set name="permissions"
        fetch="join">
   <key column="userId"/>
   <one-to-many class="Permission"/>
</set>
```

Fetching Strategies: "When" Fetching is Done

Lazy Fetching

- A collection is fetched when the application invokes an operation upon that collection
- Default

N+1 Select Problem

Example Scenario We are going to use

- *Supplier* with a one-to-many relationship with *Product*
  - One *Supplier* has (or supplies) many *Products*

Example Data: Supplier & Product Tables

******** Table: Supplier *******

ID	NAME
1	Supplier Name 1
2	Supplier Name 2
3	Supplier Name 3
4	Supplier Name 4

******** Table: Product *******

ID	NAME	DESCRIPTION	PRICE	SUPPLIERID
1	Product 1	Name for Product 1	2.0	1
2	Product 2	Name for Product 2	22.0	1
3	Product 3	Name for Product 3	30.0	2
4	Product 4	Name for Product 4	7.0	3

Factors that influence "number of select statements"

- "When" fetching is done
  - *lazy* mode for *Supplier*
- "How" fetching is done
  - Fetch mode used for querying on Product
  - Select vs. Join
- Whether *Supplier* is "accessed" or not in the application (through *Product*)
- Caching
  - Whether *Supplier* is cached or now

Hands-on Lab Exercises

1. *LazyTrue-SelectFetch-SupplierNotAccessed*
2. *LazyTrue-SelectFetch-SupplierAccessed*
3. *LazyFalse-SelectFetch-SupplierNotAccessed*
4. *LazyFalse-SelectFetch-SupplierAccessed*
5. *LazyTrue-JoinFetch-SupplierNotAccessed*
6. *LazyTrue-JoinFetch-SupplierAccessed*
7. *LazyFalse-JoinFetch-SupplierNotAccessed*
8. *LazyFalse-JoinFetch-SupplierAccessed*

Hands-on Lab Exercises

9. LazyFalse-JoinFetchLeftOuter-SupplierAccessed

10.LazyFalse-JoinFetchRightOuter-SupplierAccessed

Example #1

LazyTrue-SelectFetch-SupplierNotAccessed

Example #1

- Factors
  - *lazy* mode for *Supplier* set to "true" (default)
  - Fetch mode used for querying on *Product* is Select fetch mode (default)
  - *Supplier* information is not accessed in the application
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *01HibernateHQLQuery-LazyTrue-SelectFetch-SupplierNotAccessed*

Supplier.hbm.xml: lazy=”true”

```
<hibernate-mapping>
  <!-- lazy attribute is not set so it takes the default value of true -->
  <class name="Supplier">
    <id name="id" type="int">
      <generator class="increment"/>
    </id>

    <property name="name" type="string"/>
    <bag name="products" inverse="true" cascade="all,delete-orphan">
          <key column="supplierId"/>
          <one-to-many class="Product"/>
    </bag>

  </class>
</hibernate-mapping>
```

Fetch mode is Select Fetch (default)

```
// It takes Select fetch mode as a default
Query query = session.createQuery( "from Product p");
List list = query.list();

// Supplier is not being accessed
displayProductsListWithoutSupplierName(results);
```

Supplier is not accessed

```
public static void displayProductsListWithoutSupplierName(List list){
        Iterator iter = list.iterator();
        if (!iter.hasNext()){
            System.out.println("No products to display.");
            return;
        }
        while (iter.hasNext()){
            Product product = (Product) iter.next();
            // Note that we are not accessing the Supplier
            // String msg = product.getSupplier().getName() + "\t";
            String msg = "\t";
            msg += product.getName() + "\t";
            msg += product.getPrice() + "\t";
            msg += product.getDescription();
            System.out.println(msg);
        }
    }
```

Number of Select Statements

select ... various field names ... from PRODUCT

- 1 select statement for Product
- Delayed N+1 select problem, however, since Supplier is not accessed for now

Lab:

Exercise1:
01HibernateHQLQuery-LazyTrue-SelectFetch-SupplierNotAccessed
3519_hibernate_joinfetch.zip

Example #2

LazyTrue-SelectFetch-SupplierAccessed

Example #2

- Factors
  - *lazy* mode for *Supplier* set to "true" (default)
  - Fetch mode used for querying on *Product* is Select fetch mode (default)
  - *Supplier* information is accessed (difference from Example #1)
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *02HibernateHQLQuery-LazyTrue-SelectFetch-SupplierAccessed*

Fetch mode is Select Fetch (default)

```
// It takes Select fetch mode as a default
Query query = session.createQuery( "from Product p");
List list = query.list();

// Supplier is being accessed
displayProductsListWithSupplierName(results);
```

Supplier is accessed

```
public static void displayProductsListWithSupplierName(List list){
        Iterator iter = list.iterator();
        if (!iter.hasNext()){
            System.out.println("No products to display.");
            return;
        }
        while (iter.hasNext()){
            Product product = (Product) iter.next();
            String msg = product.getSupplier().getName() + "\t";
            String msg = "\t";
            msg += product.getName() + "\t";
            msg += product.getPrice() + "\t";
            msg += product.getDescription();
            System.out.println(msg);
        }
    }
```

Select Statements Used

select ... various field names ... from PRODUCT

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

- Result
  - 1 select statement for Product
  - N select statements for Supplier
- This is N+1 select problem!!!

Lab:

Exercise 2:
02HibernateHQLQuery-LazyTrue-SelectFetch-SupplierAccessed
3519_hibernate_joinfetch.zip

Example #3

LazyFalse-SelectFetch-SupplierNotAccessed

Example Scenario #3

- Factors
  - *lazy* mode for *Supplier* set to "false" (non-default)
  - Fetch mode used for querying on *Product* is Select fetch mode (default)
  - *Supplier* information is not accessed
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *03HibernateHQLQuery-LazyFase-SelectFetch-SupplierNotAccessed*

Supplier.hbm.xml: lazy=”false”

```
<hibernate-mapping>

  <class name="Supplier"  lazy="false">
    <id name="id" type="int">
      <generator class="increment"/>
    </id>

    <property name="name" type="string"/>
    <bag name="products" inverse="true" cascade="all,delete-orphan">
          <key column="supplierId"/>
          <one-to-many class="Product"/>
    </bag>

  </class>
</hibernate-mapping>
```

Fetch mode is Select Fetch (default)

```
// It takes Select fetch mode as a default
Query query = session.createQuery( "from Product p");
List list = query.list();

// Supplier is not being accessed in our code
displayProductsListWithoutSupplierName(results);
```

Select Statements Used

select ... various field names ... from PRODUCT

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

- Result
  - 1 select statement for Product
  - N select statements for Supplier
- This is N+1 select problem!
  - Even though Supplier is not accessed in our code, because lazy is set to false, N select statements are used to access Supplier

Lab:

Exercise 3:
03HibernateHQLQuery-LazyFalse-SelectFetch-SupplierNotAccessed
3519_hibernate_joinfetch.zip

Example #4

LazyFalse-SelectFetch-SupplierAccessed

Example Scenario #4

- Factors
  - *lazy* mode for *Supplier* set to "false"
  - Fetch mode used for querying on *Product* is Select fetch mode (default)
  - *Supplier* information is accessed
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *04HibernateHQLQuery-LazyFase-SelectFetch-SupplierAccessed*

Select Statements Used

select ... various field names ... from PRODUCT

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

- Result
  - 1 select statement for Product
  - N select statements for Supplier
- This is N+1 select problem!
  - Regardless the explicit access to Supplier in our code, because lazy is set to false, N select statements are used to access Supplier

Lab:

Exercise 4:
04HibernateHQLQuery-LazyFalse-SelectFetch-SupplierAccessed 3519_hibernate_joinfetch.zip

Example #5

LazyTrue-JoinFetch-SupplierNotAccessed

Example #5

- Factors
  - *lazy* mode for *Supplier* set to "true" (default)
  - Fetch mode used for querying on *Product* is Join fetch mode
  - *Supplier* information is not accessed
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *05HibernateHQLQuery-LazyTrue-JoinFetch-SupplierNotAccessed*

Fetch mode is Join Fetch

```
// Perform Join Fetch
String hql = "from Product p join fetch p.supplier as s";
Query query = session.createQuery(hql);
List results = query.list();

// Supplier is not being accessed
displayProductsListWithoutSupplierName(results);
```

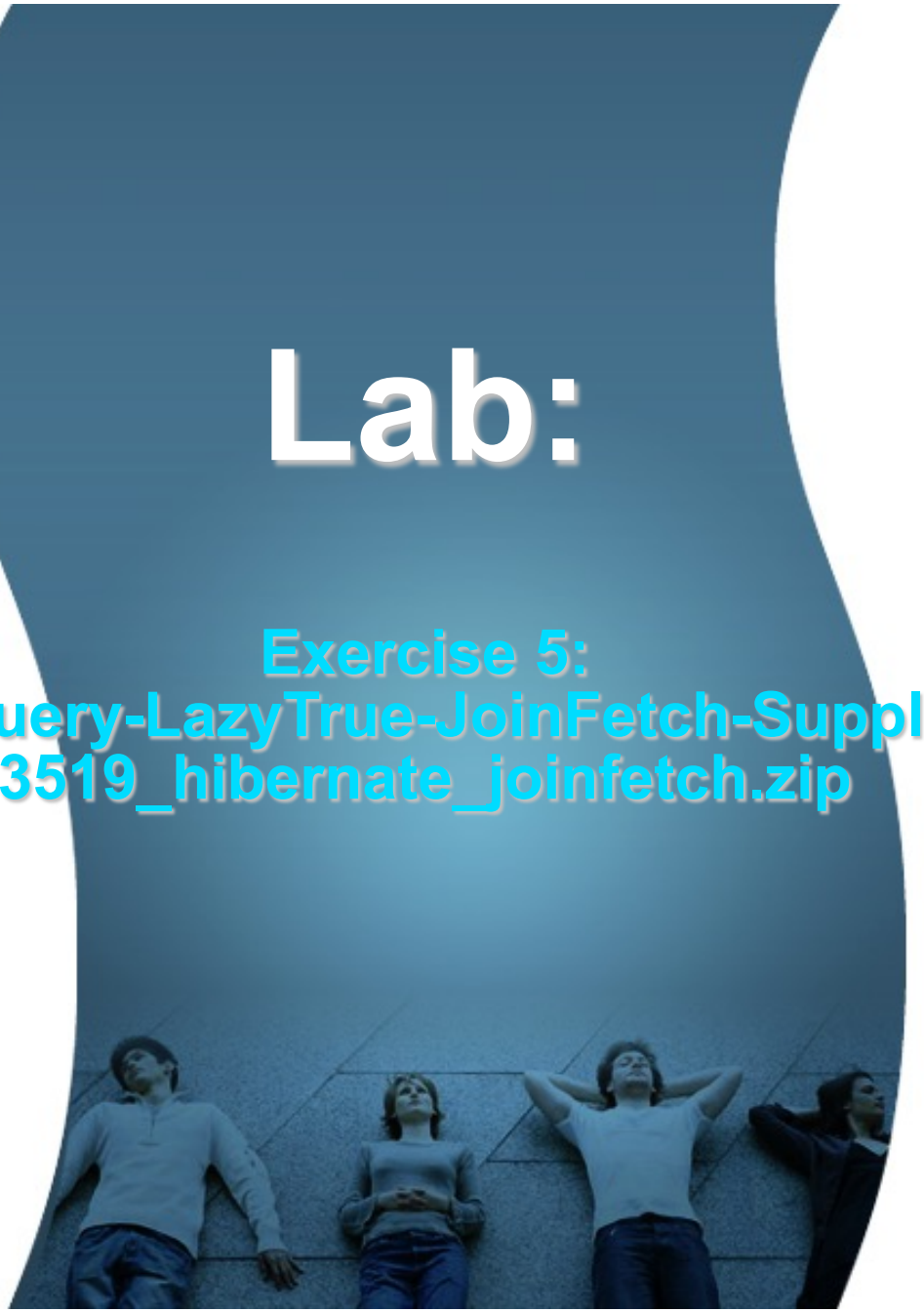
Number of Select Statements

```
select ... various field names from Product product0_    inner join
   Supplier supplier1_ on product0_.supplierId=supplier1_.id
```

- 1 inner join select statement
- No N+1 select problem

Lab:

Exercise 5:
05HibernateHQLQuery-LazyTrue-JoinFetch-SupplierNotAccessed
3519_hibernate_joinfetch.zip



Example #6

LazyTrue-JoinFetch-SupplierAccessed

Example #6

- Factors
  - *lazy* mode for *Supplier* set to "true" (default)
  - Fetch mode used for querying on *Product* is Join fetch mode
  - *Supplier* information is accessed
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *06HibernateHQLQuery-LazyTrue-JoinFetch-SupplierAccessed*

Fetch mode is Join Fetch

```
// Perform Join Fetch
  String hql = "from Product p join fetch p.supplier as s";
  Query query = session.createQuery(hql);
  List results = query.list();

  // Supplier is being accessed
  displayProductsListWithSupplierName(results);
```

Number of Select Statements

```
select ... various field names from Product product0_ inner join
    Supplier supplier1_ on product0_.supplierId=supplier1_.id
```

- 1 inner join select statement
- No N+1 select problem

Lab:

Exercise 6:
06HibernateHQLQuery-LazyTrue-JoinFetch-SupplierAccessed
3519_hibernate_joinfetch.zip

Example #7

LazyFalse-JoinFetch-SupplierNotAccessed

Example #7

- Factors
  - *lazy* mode for *Supplier* set to "false"
  - Fetch mode used for querying on *Product* is Join fetch mode
  - *Supplier* information is not accessed
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *07HibernateHQLQuery-LazyFalse-JoinFetch-SupplierNotAccessed*

Number of Select Statements

```
select ... various field names from Product product0_ inner join
    Supplier supplier1_ on product0_.supplierId=supplier1_.id
```

- 1 inner join select statement
- No N+1 select problem

Lab:

Exercise 7:
07HibernateHQLQuery-LazyFalse-JoinFetch-SupplierNotAccessed
3519_hibernate_joinfetch.zip

Example #8

LazyFalse-JoinFetch-SupplierAccessed

Example #8

- Factors
  - *lazy* mode for *Supplier* set to "false"
  - Fetch mode used for querying on *Product* is Join fetch mode
  - *Supplier* information is accessed
  - Caching does not play a role for the first time the *Supplier* is accessed
- Sample project in the hands-on lab
  - *08HibernateHQLQuery-LazyFalse-JoinFetch-SupplierAccessed*

Number of Select Statements

```
select ... various field names from Product product0_ inner join
    Supplier supplier1_ on product0_.supplierId=supplier1_.id
```

- 1 inner join select statement
- No N+1 select problem

Lab:

Exercise 8:
08HibernateHQLQuery-LazyFalse-JoinFetch-SupplierAccessed
3519_hibernate_joinfetch.zip

Example #9 #10

Use “Left Outer Join” &
Use “Right Outer Join”

Lab:

Exercise 9:
09HibernateHQLQuery-LazyFalse-JoinFetchLeftOuter-SupplierAccessed
Exercise 10:
10HibernateHQLQuery-LazyFalse-JoinFetchRightOuter-SupplierAccessed

3519_hibernate_joinfetch.zip

Example #10, #11, #12, #13
Use Criteria Query

Lab:

Exercise 11, 12, 13, 14:
11HibernateCriteriaQuery-LazyTrue-SelectFetch-SupplierNotAccessed
3519_hibernate_joinfetch.zip

Example #15

LazyTrue-SelectFetch-SupplierAccessed-Caching

Example #15

- Factors
  - *lazy* mode for *Supplier* set to "true" (default)
  - Fetch mode used for querying on *Product* is Select fetch mode (default)
  - *Supplier* information is accessed
  - Caching play a role the *Supplier* is accessed the second time
- Sample project in the hands-on lab
  - *HibernateHQLQuery-LazyTrue-SelectFetch-SupplierAccessed-Caching*

Access Supplier Through Cache

```
System.out.println("\n---Performing HQL query with LazyTrue-SelectFetch-SupplierAccessed...");
Query query = session.createQuery("from Product");
List results = query.list();
displayProductsListWithSupplierName(results);

System.out.println("\n---Performing HQL query using Cache...");
Query query = session.createQuery("from Product");
List results = query.list();
displayProductsListWithSupplierName(results);

// Clear cache
session.clear();
System.out.println("\n---Performing HQL query after clearing Cache...");
Query query = session.createQuery("from Product");
List results = query.list();
displayProductsListWithSupplierName(results);
```

Select Statements Used

select ... various field names ... from PRODUCT

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from PRODUCT

select ... various field names ... from PRODUCT

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

select ... various field names ... from SUPPLIER where SUPPLIER.id=?

Lab:

Exercise 15:
15HibernateHQLQuery-LazyTrue-SelectFetch-SupplierAccessed-Caching
3519_hibernate_joinfetch.zip

Fetching Strategies: Recommendations

Recommendation

- Join fetching is good for small collection of child objects often used with parent
- Large collections and/or not always used collections are better retrieved with lazy select fetching

Code with Passion!