Querying

with HQL and JPA QL

Contents

I/ Understanding the various query options

- There are three ways to express queries in Hibernate:
    - Hibernate Query Language (HQL) and the subset standardized as JPA QL:

```
session.createQuery("from EmployeeEntity e where e.firstName like
'Hai%' ");

entityManager.createQuery("from EmployeeEntity e where e.firstName
like 'Hai%' ");
```

- Criteria API for query by criteria (QBC) and query by example (QBE):

```
session.createCriteria(EmployeeEntity.class)
     .add(Restrictions.like("firstName", "Hai%"));
```

- Direct SQL with or without automatic mapping of resultsets to objects:

```
session.createSQLQuery("select {e.*} from EmployeeEntity {e}
                      where firstName like 'Hai%'")
                           .addEntity("e", EmployeeEntity.class);
```

II/ Writing HQL and JPA QL queries

1/ Configuration and preparing a query

1.1/ HQL

- **Step 1:** Add this code into file pom.xml of the project:

```
<!--  https://mvnrepository.com/artifact/org.hibernate/hibernate-core
-->
<dependency>
	<groupId>org.hibernate</groupId>
	<artifactId>hibernate-core</artifactId>
	<version>5.1.2.Final</version>
	<scope>provided</scope>
</dependency>
```

- **Step 2:** The **org.hibernate.Query** interface defines several methods for controlling execution of a query. In addition, Query provides methods for binding concrete values to query parameters. To execute a query in your application, you need to obtain an instance of one of these interfaces, using the **Session**.

  So, import:

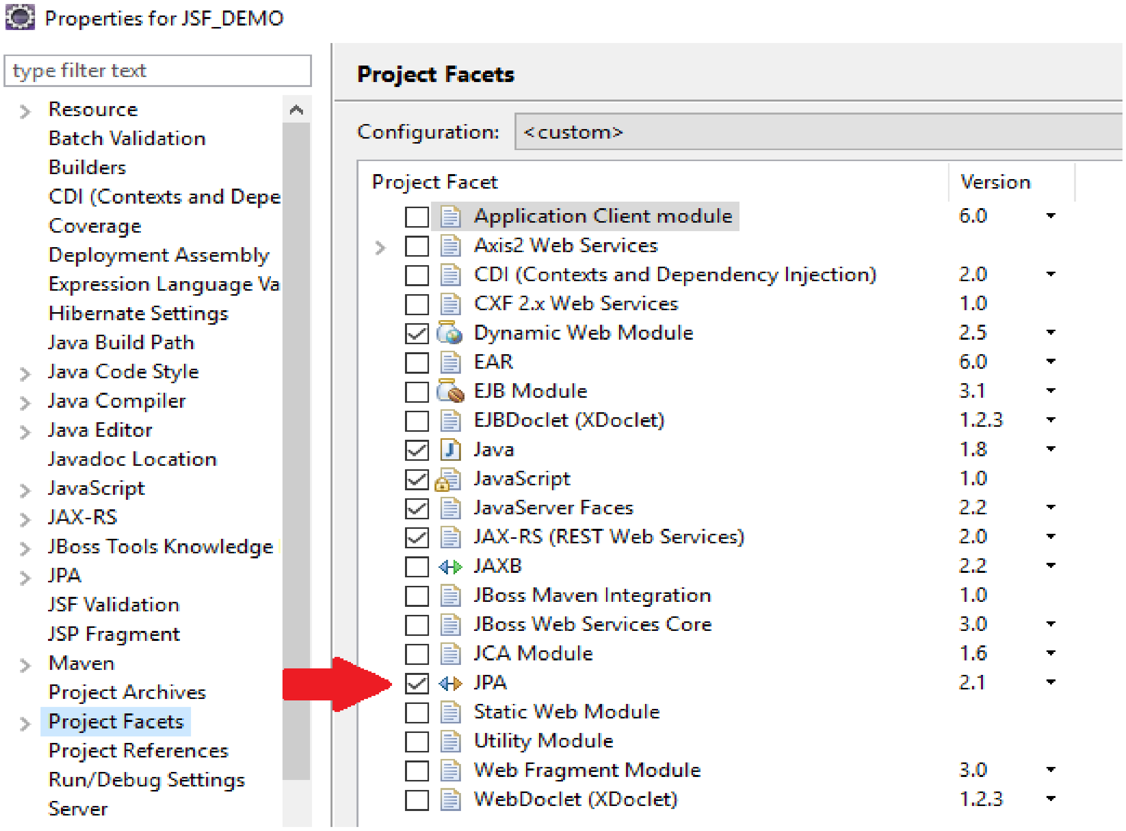
```
import javax.persistence.PersistenceContext;
import org.hibernate.Query;
import org.hibernate.Session;
```

  And declare:

```
@PersistenceContext
Session session;
```

1.2/ JPA QL

- **Step 1:** Remember how to create a maven project and the first steps to configurate necessities relating to JPA to work on it:
  - Right click on the project, choose **Properties** > **Project Facets**, then check **JPA** (you can also select the version of JPA):



Properties for JSF_DEMO

type filter text

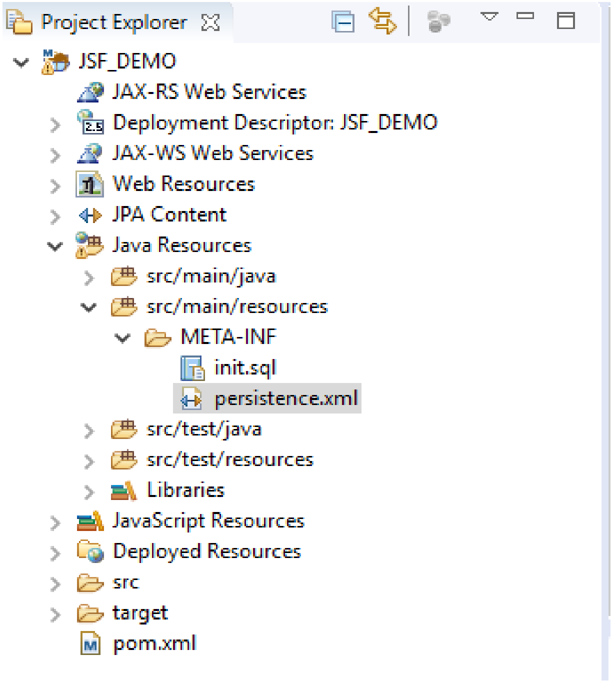
- Resource
- Batch Validation
- Builders
- CDI (Contexts and Depe
- Coverage
- Deployment Assembly
- Expression Language Va
- Hibernate Settings
- Java Build Path
- Java Code Style
- Java Compiler
- Java Editor
- Javadoc Location
- JavaScript
- JAX-RS
- JBoss Tools Knowledge
- JPA
- JSF Validation
- JSP Fragment
- Maven
- Project Archives
- Project Facets
- Project References
- Run/Debug Settings
- Server

Project Facets

Configuration: <custom>

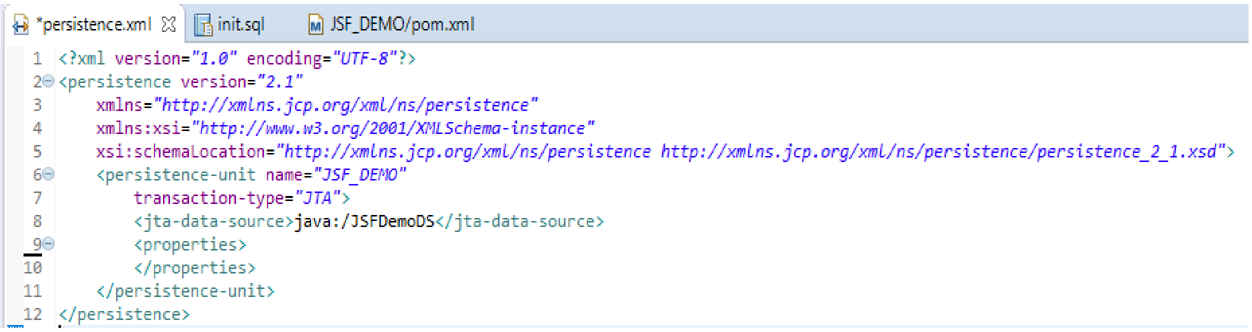
Project Facet	Version
□ Application Client module	6.0
□ Axis2 Web Services	
□ CDI (Contexts and Dependency Injection)	2.0
□ CXF 2.x Web Services	1.0
☑ Dynamic Web Module	2.5
□ EAR	6.0
□ EJB Module	3.1
□ EJBDoclet (XDoclet)	1.2.3
☑ Java	1.8
☑ JavaScript	1.0
☑ JavaServer Faces	2.2
☑ JAX-RS (REST Web Services)	2.0
□ JAXB	2.2
□ JBoss Maven Integration	1.0
□ JBoss Web Services Core	3.0
□ JCA Module	1.6
☑ JPA	2.1
□ Static Web Module	
□ Utility Module	
□ Web Fragment Module	3.0
□ WebDoclet (XDoclet)	1.2.3

- And remember how to create the file **persistence.xml** in **src/main/resources**:



Project Explorer

```
JSF_DEMO
    JAX-RS Web Services
  > Deployment Descriptor: JSF_DEMO
  > JAX-WS Web Services
  > Web Resources
  > JPA Content
  v Java Resources
    > src/main/java
    v src/main/resources
      v META-INF
          init.sql
          persistence.xml
    > src/test/java
    > src/test/resources
    > Libraries
  > JavaScript Resources
  > Deployed Resources
  > src
  > target
    pom.xml
```



```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence version="2.1"
    xmlns="http://xmlns.jcp.org/xml/ns/persistence"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://xmlns.jcp.org/xml/ns/persistence http://xmlns.jcp.org/xml/ns/persistence/persistence_2_1.xsd">
    <persistence-unit name="JSF_DEMO"
        transaction-type="JTA">
        <jta-data-source>java:/JSFDemoDS</jta-data-source>
        <properties>
        </properties>
    </persistence-unit>
</persistence>
```

- **Step 2:** A little bit same as HQL, we import and declare:

```java
import javax.persistence.EntityManager;
import javax.persistence.PersistenceContext;
import javax.persistence.Query;

@PersistenceContext
EntityManager em;
```

2/ Creating a query

2.1/ Creating a query object

- HQL query:

```java
Query hqlQuery = session.createQuery("from User");
```

- SQL query:

```java
Query sqlQuery = session.createSQLQuery(
                     "select {user.*} from USERS {user}"
                ).addEntity("user", User.class);
```

- Criteria query:

```java
Criteria crit = session.createCriteria(User.class);
```

- JPA QL query:

```java
Query ejbQuery = em.createQuery("select u from User u");
```

- Native query:

```
Query sqlQuery = em.createNativeQuery(
     "select u.USER_ID, u.FIRSTNAME, u.LASTNAME from USERS u",
     User.class
);
```

2.2/ Paging the result

- HQL and JPA QL are the same in the way using **setMaxResults**:
    - HQL:

```
Query query = session.createQuery("from EmployeeEntity e order by
e.firstName asc");
query.setMaxResults(10);
```

- JPA QL:

```
Query query = em.createQuery("select e from EmployeeEntity e order by
e.firstName asc").setFirstResult(40);
```

2.3/ Considering parameter binding

- HQL:

```
String queryString = "from Item item"
                + " where item.description like :search"
                + " and item.date > :minDate";

Query q = session.createQuery(queryString)
           .setString("search", searchString)
           .setDate("minDate", mDate);
```

- JPA QL:

```
String queryString = "from Item item"
                + " where item.description like :search"
                + " and item.date > :minDate";

Query q = em.createQuery(queryString)
           .setParameter("search", searchString)
           .setParameter("minDate", mDate, TemporalType.DATE);
```

2.4/ Using positional parameters

- HQL:

```
String queryString = "from Item item"
                + " where item.description like ?"
                + " and item.date > ?";

Query q = session.createQuery(queryString)
           .setString(0, searchString)
           .setDate(1, minDate);
```

- JPA QL:

```
String queryString = "from Item item"
                + " where item.description like ?1"
                + " and item.date > ?2";

Query q = em.createQuery(queryString)
           .setParameter(1, searchString)
           .setParameter(2, minDate, TemporalType.DATE);
```

*** Notice:** If you have to use positional parameters, remember that Hibernate starts counting at 0, but Java Persistence starts at 1, and that you have to add a number to each question mark in a JPA QL query string. They have different legacy roots: Hibernate in JDBC, Java Persistence in older versions of EJB QL.

3/ Executing a query

- In this document, we only consider the case that we list all the results:
    - HQL: In Hibernate, the **list()** method executes the query and returns the results as a **java.util.List**:

```
List result = myQuery.list();
```

    - JPA QL: Java Persistence offers a method with the same semantics, but a different name:

```
List result = myJPAQuery.getResultList();
```

III/ Named Query and Named Stored Procedure

1/ Named query

1.1/ Benefits

- Compiled and validated at app start-up time: That means if anything is wrong with it, it will be reported immediately, and the application won't start.
- Easier to maintain than string literals embedded in your code: HQL (or JPA SQL) and Native SQL queries can be used and replaced without code changes (no need to re-compile your code).
- Good for performance: The query is prepared once and ready for usage anywhere in the app. So, any subsequent usage of named query will not cause any additional processing.

1.2/ Usage

- We can define a named query in XML metadata or define a named query with annotations, but in this document, we only consider defining a named query with annotations.
- The Java Persistence standard specifies the @NamedQuery and @NamedNativeQuery annotations. You can either place these annotations into the metadata of a particular class or into JPA XML descriptor file. Note that the query name must be globally unique in all cases; no class or package name is automatically prefixed.
- Let’s assume you consider a particular named query to belong to a particular entity class:

```
package auction.model;

import ...;

@NamedQueries({
      @NamedQuery(
           name = "getSpecialEmployeeListWithNamedQuery",
           query = "select e from EmployeeEntity e where e.gender
                      like :gender and e.firstName like :firstName"
      )
})
@Entity
```

```
@Table(name = "ITEM")
public class Item { ... }
```

- And you can call it:
  - HQL:

```
Query query =
session.getNamedQuery("getSpecialEmployeeListWithNamedQuery")
      .setString("gender", gender)
      .setString("firstName", firstName);
```

  - JPA QL:

```
Query query =
em.createNamedQuery("getSpecialEmployeeListWithNamedQuery")
      .setParameter("gender", gender)
      .setParameter("firstName", firstName);
```

2/ Named stored procedure

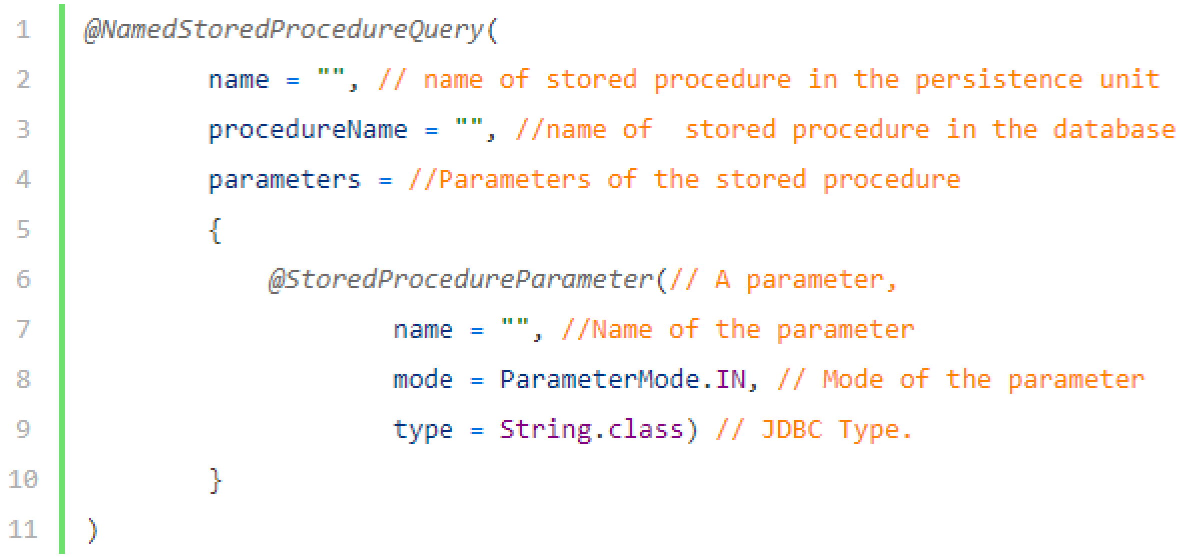
2.1/ Working with stored procedure that return a refcursor

- Step 1: Firstly, we have a function (because we are using PostgreSQL and there are only functions supported in PostgreSQL, no stored procedures) as below. This function returns a list of employees of a specific department:

In Postgres database, please create one **Function that returns a refcursor**

```
CREATE OR REPLACE FUNCTION
fn_getEmployeesOfOneDepartment(departmentName varchar)
   RETURNS refcursor AS
$BODY$
   DECLARE employees refcursor; -- Declare cursor variables
   BEGIN
      OPEN employees FOR
         SELECT e.*
         FROM employee e, department d
         WHERE e.department = d.id and d.name = departmentName;
      RETURN employees;
   END;
$BODY$
LANGUAGE plpgsql
```

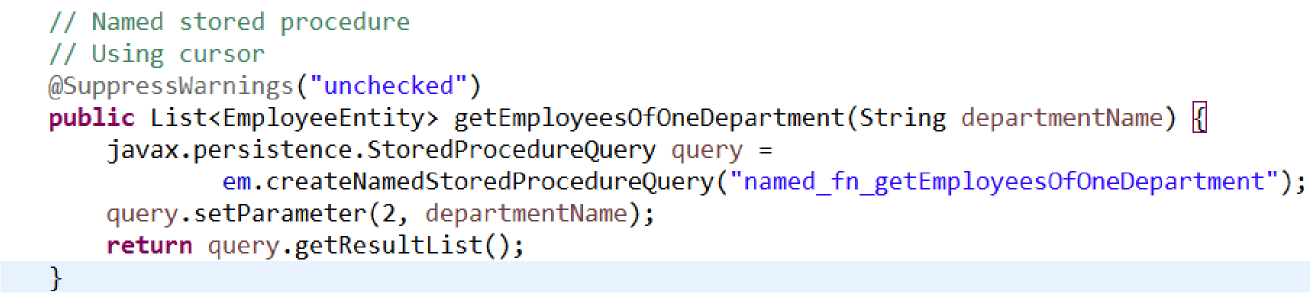
- Step 2: Secondly, we define or named stored procedure call via annotation:



```
@NamedStoredProcedureQuery(
        name = "", // name of stored procedure in the persistence unit
        procedureName = "", //name of  stored procedure in the database
        parameters = //Parameters of the stored procedure
        {
            @StoredProcedureParameter(// A parameter,
                    name = "", //Name of the parameter
                    mode = ParameterMode.IN, // Mode of the parameter
                    type = String.class) // JDBC Type.
        }
)
```

```
@NamedStoredProcedureQuery(
      name = "named_fn_getEmployeesOfOneDepartment",
      procedureName = "fn_getEmployeesOfOneDepartment",
      resultClasses = EmployeeEntity.class,
      parameters = {
            @StoredProcedureParameter(mode = ParameterMode.REF_CURSOR,
                  type = void.class),
            @StoredProcedureParameter(mode = ParameterMode.IN,
                  type = String.class)
      }
)
@Entity
@Table(name = "employee")
public class EmployeeEntity implements IEntity {
…
}
```

- Step 3:



```
// Named stored procedure
// Using cursor
@SuppressWarnings("unchecked")
public List<EmployeeEntity> getEmployeesOfOneDepartment(String departmentName) {
    javax.persistence.StoredProcedureQuery query =
            em.createNamedStoredProcedureQuery("named_fn_getEmployeesOfOneDepartment");
    query.setParameter(2, departmentName);
    return query.getResultList();
}
```

2.2/ Working with stored procedure that return a table

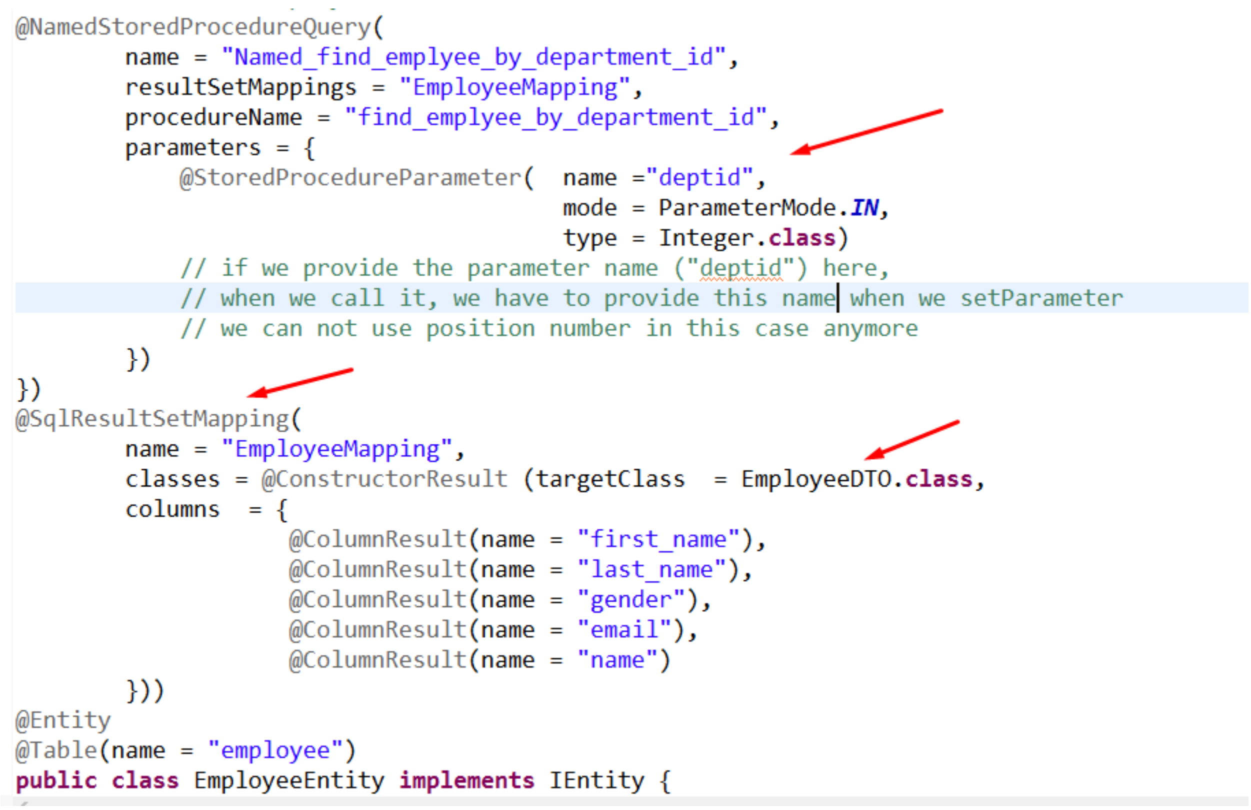
- Step 1: Create a function in Postgres database named as following:

```
CREATE OR REPLACE FUNCTION find_Emplyee_By_Department_ID(_Department_ID int)
  RETURNS TABLE (
                first_name   character varying(255)   -- visible as OUT parameter inside and outside function
              , last_name   character varying(255)
              , gender   character varying(255)
              , email   character varying(255)
              , name character varying(255)) AS
$func$
BEGIN
   RETURN QUERY
              SELECT e.first_name, e.last_name, e.gender, e.email, d.name
              FROM employee e, department d
              WHERE e.department = d.id AND
                           d.id = _Department_ID
              ORDER  BY e.first_name DESC;
END
$func$ LANGUAGE plpgsql;
```

Note: you can check this function by following query:

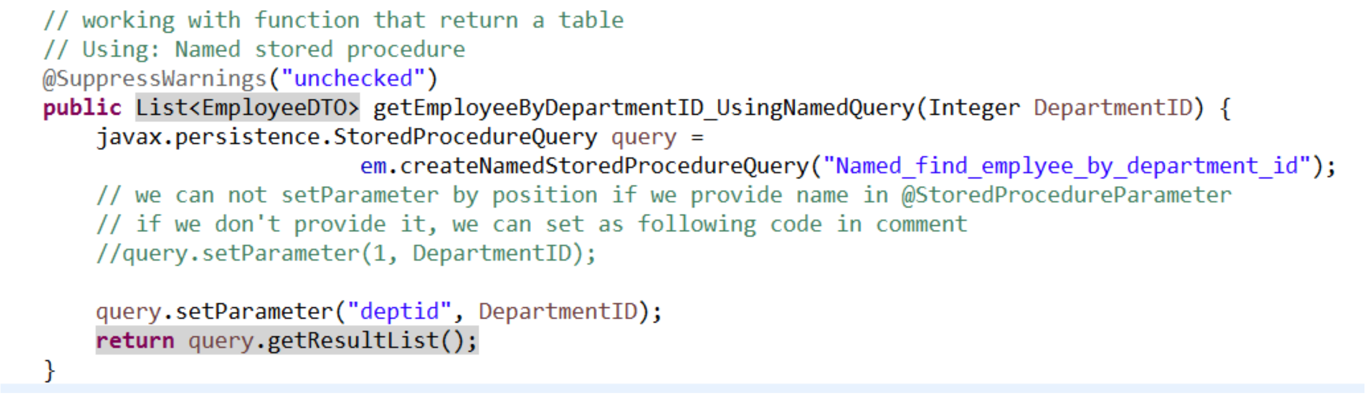
select * from find_Emplyee_By_Department_ID(1);

- Step 2: Create named query in an Entiy and @SqlResultMapping (Because this function not return an Entity, it returns a DTO or columns from many database table)



```
@NamedStoredProcedureQuery(
        name = "Named_find_emplyee_by_department_id",
        resultSetMappings = "EmployeeMapping",
        procedureName = "find_emplyee_by_department_id",
        parameters = {
            @StoredProcedureParameter(  name ="deptid",
                                        mode = ParameterMode.IN,
                                        type = Integer.class)
            // if we provide the parameter name ("deptid") here,
            // when we call it, we have to provide this name when we setParameter
            // we can not use position number in this case anymore
        })
})
@SqlResultSetMapping(
        name = "EmployeeMapping",
        classes = @ConstructorResult (targetClass  = EmployeeDTO.class,
        columns  = {
                    @ColumnResult(name = "first_name"),
                    @ColumnResult(name = "last_name"),
                    @ColumnResult(name = "gender"),
                    @ColumnResult(name = "email"),
                    @ColumnResult(name = "name")
        }))
@Entity
@Table(name = "employee")
public class EmployeeEntity implements IEntity {
```

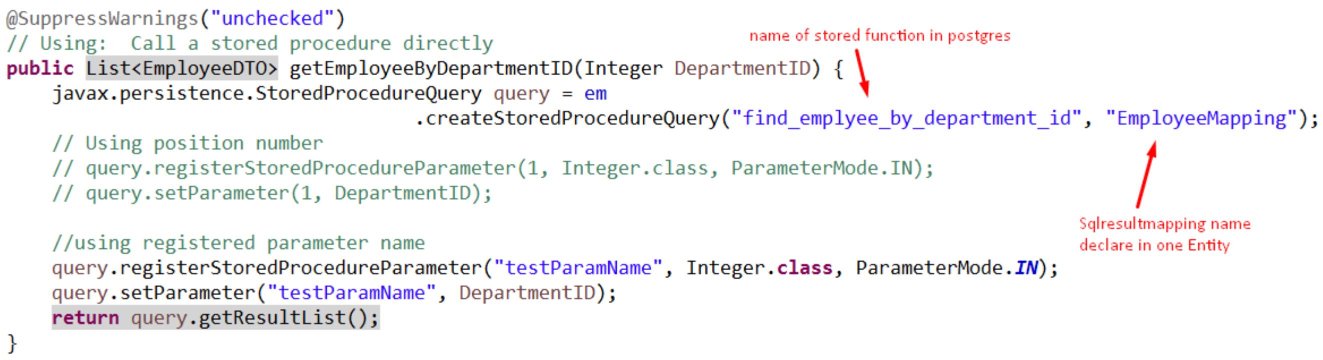
- Step 3:



```
// working with function that return a table
// Using: Named stored procedure
@SuppressWarnings("unchecked")
public List<EmployeeDTO> getEmployeeByDepartmentID_UsingNamedQuery(Integer DepartmentID) {
    javax.persistence.StoredProcedureQuery query =
                        em.createNamedStoredProcedureQuery("Named_find_emplyee_by_department_id");
    // we can not setParameter by position if we provide name in @StoredProcedureParameter
    // if we don't provide it, we can set as following code in comment
    //query.setParameter(1, DepartmentID);

    query.setParameter("deptid", DepartmentID);
    return query.getResultList();
}
```

3/ Call stored procedure directly

3.1/ call a stored proc that return a table

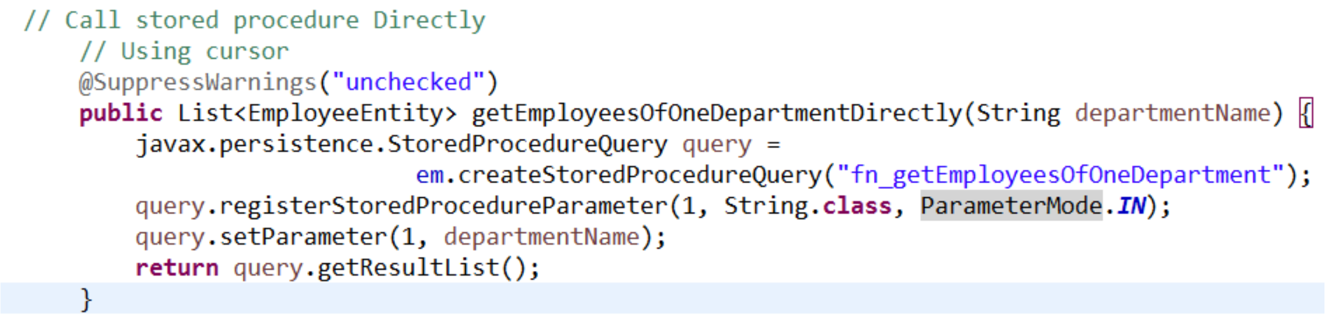


```
@SuppressWarnings("unchecked")
// Using:  Call a stored procedure directly
public List<EmployeeDTO> getEmployeeByDepartmentID(Integer DepartmentID) {
    javax.persistence.StoredProcedureQuery query = em
                                    .createStoredProcedureQuery("find_emplyee_by_department_id", "EmployeeMapping");
    // Using position number
    // query.registerStoredProcedureParameter(1, Integer.class, ParameterMode.IN);
    // query.setParameter(1, DepartmentID);

    //using registered parameter name
    query.registerStoredProcedureParameter("testParamName", Integer.class, ParameterMode.IN);
    query.setParameter("testParamName", DepartmentID);
    return query.getResultList();
}
```

name of stored function in postgres

Sqlresultmapping name
declare in one Entity

3.2/ call a stored proc that return a cursor

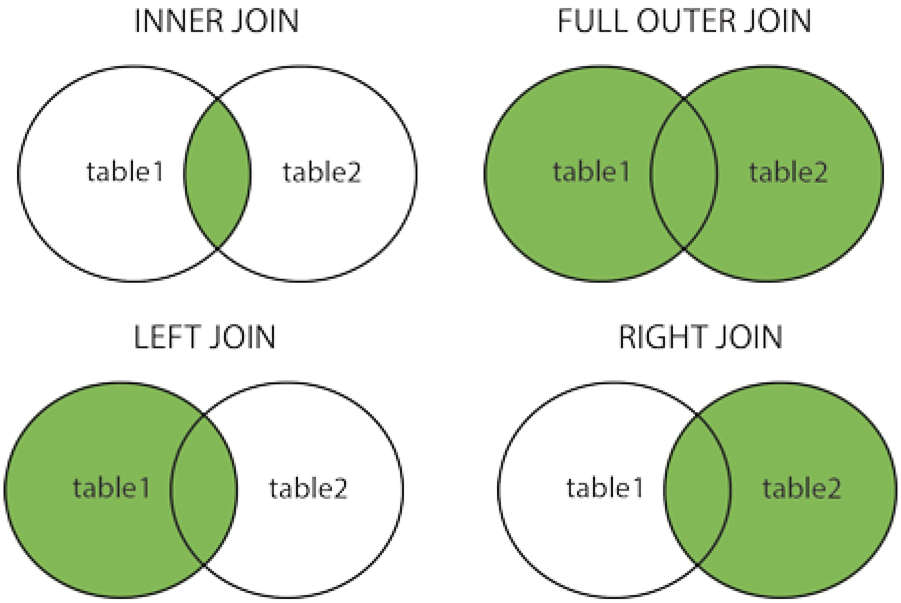


```
// Call stored procedure Directly
    // Using cursor
    @SuppressWarnings("unchecked")
    public List<EmployeeEntity> getEmployeesOfOneDepartmentDirectly(String departmentName) {
        javax.persistence.StoredProcedureQuery query =
                            em.createStoredProcedureQuery("fn_getEmployeesOfOneDepartment");
        query.registerStoredProcedureParameter(1, String.class, ParameterMode.IN);
        query.setParameter(1, departmentName);
        return query.getResultList();
    }
```

IV/ Joins, reporting queries, subselects

1/ Joins

- We use a join to combine data in two (or more) relations.
- We have 4 types of join: **join** (inner join), **left join** (left outer join), **right join** (right outer join) and **full join** (full outer join).



- HQL and JPA QL provide 4 ways of expressing (inner and outer) joins:
  - An implicit association join
  - An ordinary join in the FROM clause
  - A fetch join in the FROM clause
  - A theta-style join in the WHERE clause

- Before we go to each way how to use joins, we should first take a look at the database structure given for example:

We have 2 tables: **employee** and **department**

- In Java:

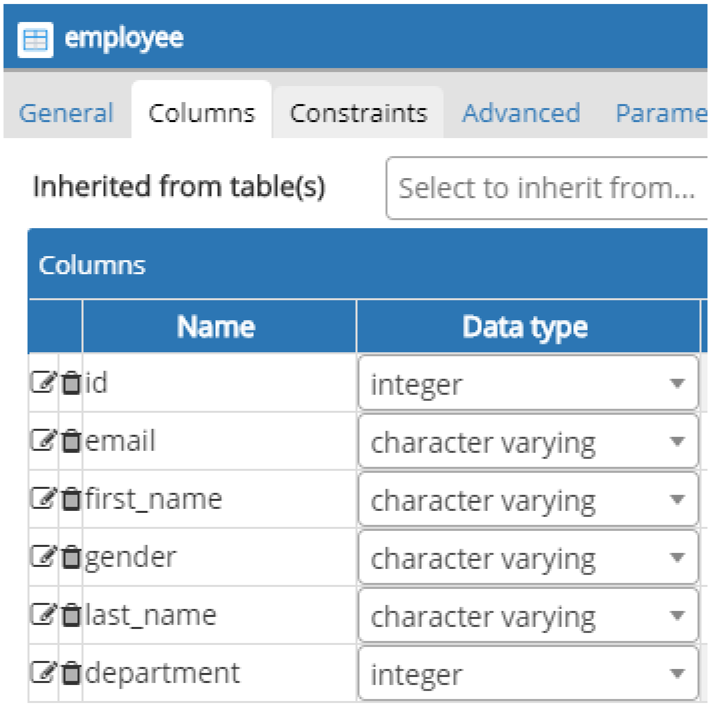
Employee:

```
@Entity
@Table(name = "employee")
public class EmployeeEntity implements IEntity {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private int id;

   @Column(name = "first_name", nullable = false)
   private String firstName;

   @Column(name = "last_Name", nullable = false)
   private String lastName;

   @Column(name = "gender", nullable = false)
   private String gender;

   @Column(name = "email", nullable = false)
   private String email;

   @ManyToOne
   @JoinColumn(name = "department", nullable = true)
   private DepartmentEntity department;
```

Department:

```
@Entity
@Table(name = "department")
public class DepartmentEntity implements IEntity {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private int id;

   @Column(name = "name", nullable = false)
   private String name;
```

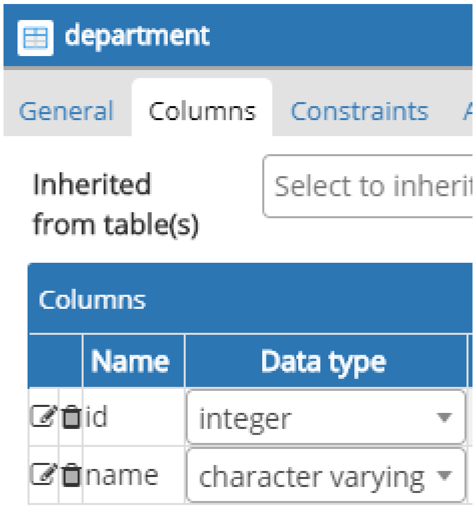
- In PostgreSQL:



Inherited from table(s): Select to inherit from...

Columns

Name	Data type
id	integer
email	character varying
first_name	character varying
gender	character varying
last_name	character varying
department	integer



Inherited from table(s): Select to inherit

Columns

Name	Data type
id	integer
name	character varying

1.1/ Implicit association joins

- So far, you use simple qualified property name like department.name in query. HQL and JPA QL support multipart property path expressions with a dot notation for two different purposes:
    - Querying components
    - Expressing implicit association joins
- Example:
    - In HQL or JPA QL:

```
from EmployeeEntity e where e.department.name like 'C-level'
```

- In Native SQL:

```
select e.*
from employee e join department d on e.department = d.id
where d.name like 'C-level'
```

1.2/ Joins expressed in the FROM clause

- Example:
    - Using foreign keys:

- In HQL or JPA QL:

```
select e
from EmployeeEntity e right join e.department d
where d.id > 2
```

- In Native SQL:

```
select e.*
from employee e right join department d on e.department = d.id
where d.id > 2
```

- Not using foreign keys:
  - In HQL or JPA QL:

```
select e
from  EmployeeEntity e right join DepartmentEntity d
           on e.department.id = d.id
where d.id > 2
```

  - In Native SQL:

```
select e.*
from employee e right join department d on e.department = d.id
where d.id > 2
```

1.3/ Dynamic fetching strategies with joins

- In One-To-Many relationship, the returned instances have a collection (for example: Employees collection in Department) . This collection, if mapped as lazy="true" (default), isn’t initialized, and an additional SQL statement is triggered as soon as you access it. The same is true for all single-ended associations. By default, Hibernate generates a proxy and loads the associated Department instance lazily and only on-demand.
- By default, we have:
  - One-To-Many: LAZY
  - Many-To-One: EAGER
  - Many-To-Many: LAZY
  - One-To-One: EAGER

- In HQL and JPA QL you can specify that an associated entity instance or a collection should be eagerly fetched with the FETCH keyword in the FROM clause. You can also prefetch many-to-one or one-to-one associations, using the same syntax:
    - In HQL or JPA QL:

```
select e
from EmployeeEntity e left join fetch e.department d
where e.gender like 'female'
```

    - In Native SQL:

```
select e.*
from employee e left join department d on e.department = d.id
where e.gender like 'female'
```

1.4/ Theta-style joins

- In traditional SQL, a theta-style join is a Cartesian product together with a join condition in the WHERE clause, which is applied on the product to restrict the result. So, it has worse performance than putting join condition in the FROM clause.
- In HQL and JPA QL, the theta-style syntax is useful when your join condition isn't a foreign key relationship mapped to a class association.
- For example:
    - In HQL or JPA QL:

```
select e
from  EmployeeEntity e, DepartmentEntity d
where e.department.id = d.id and d.id > 2
```

    - In Native SQL:

```
select e.*
from employee e, department d
where e.department = d.id and d.id > 2
```

2/ Reporting queries

- The aggregate functions that are recognized by HQL and standardized in JPA QL are **count(), min(), max(), sum()** and **avg().**
- For example: This query counts all the Items:

```
select count(e) from EmployeeEntity e
```

And the result is returned as a Long:

```
Long count = (Long) session
                .createQuery("select count(e) from EmployeeEntity e ")
                .uniqueResult();
```

3/ Subselects

- For example:
    - In HQL and JPA QL:

```
from EmployeeEntity e
where e.department.id >= (select max(d.id) from DepartmentEntity d)
```

- In Native SQL:

```
select *
from employee e
where e.department >= (select max(d.id) from department d)
```

https://www.programcreek.com/java-api-examples/index.php?api=javax.persistence.StoredProcedureQuery

https://stackoverflow.com/questions/46786528/error-in-namedstoredprocedurequery-in-spring-jpa-found-named-stored-procedure

==========END==========