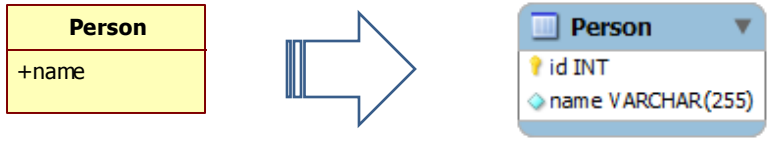
Entity Mapping

CS544: Enterprise Architecture

Entity Class Mapping

- Entity classes can be thought of as the distinct business concepts in a domain driven design
- We will start with the basic Java class requirements for persisting entity classes
- After which we will go into identity mapping, mapping data types, and Hibernate access
- We will provide both XML and annotation mapping examples for each subject we cover



Class Requirements

- Hibernate requires that entity classes have:
  - A field that can be used as identifier
  - A default constructor
  - Getter and Setter Methods for all properties

```
package intro;

public class Person {
  private long id;
  private String name;

  public Person() {}
  public Person(String name) { this.name = name; }

  public long getId() { return id; }
  public void setId(long id) { this.id = id; }
  public String getName() { return name; }
  public void setName(String name) { this.name = name; }
}
```

An identifier

A default constructor

Getter and Setter Methods

About Annotations

- Most of the mapping annotations we will use are part of the Java Persistence API (JPA)

```
@Entity(name="MY_PERSON")
public class Person {
  @Id
  @Column(name="PERSON_ID")
  private long id;
  @Column(name="FULLNAME")
  private String name;

  ...
```

Person class with JPA Annotations

- JPA is supported by many Java persistence frameworks as a standard, portable API

Hibernate Annotations

- Additional Hibernate specific functionality can be exposed using Hibernate annotations

```
import javax.persistence.Entity;
import javax.persistence.GeneratedValue;
import javax.persistence.Id;

@Entity
public class Person {
  @Id
  @GeneratedValue
  private long id;
  @org.hibernate.annotations.AccessType("property")
  private String name;

  ...
```

Full org.hibernate.annotations pacakge name to clearly distinguish from JPA

- Best practice to use full package name for hibernate annotations to clearly distinguish from JPA

Annotation based Mapping

```
@Entity
@Table(name="MY_PERSON")
public class Person {
  @Id
  @Column(name="PERSON_ID")
  private long id;
  @Column(name="FULLNAME")
  private String name;

  public Person() {}
  public Person(String name) { this.name = name; }

  public long getId() { return id; }
  private void setId(long id) { this.id = id; }
  public String getName() { return name; }
  public void setName(String name) { this.name = name; }
}
```

Map class to 'MY_PERSON' table

Map to PERSON_ID column

Map to FULLNAME column

Table: MY_PERSON

PERSON_ID	FULLNAME
1	Frank Brown
2	John Smith

Defaults to 'Person' table

```
@Entity
public class Person {
  @Id
  private long id;
  private String name;

  ...
```

Defaults to 'id' column name (same as property)

No annotation needed, persisted to the 'name' column by default

Table: PERSON

ID	NAME
1	Frank Brown
2	John Smith

Hibernate XML Mapping

- Person.hbm.xml
  - Usually in the same package as Person.java

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE hibernate-mapping PUBLIC
 "-//Hibernate/Hibernate Mapping DTD 3.0/
 "http://hibernate.sourceforge.net/hibern

<hibernate-mapping>
  <class name="intro.Person" table="MY_PERSON">
    <id name="id" column="PERSON_ID" />
    <property name="name" column="FULLNAME" />
  </class>
</hibernate-mapping>
```

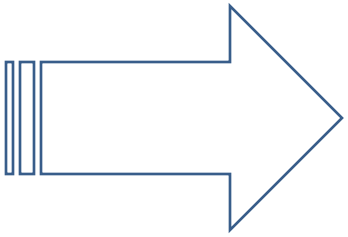
<class> tag to map Person to the `MY_PERSON' table

<id> tag to map the primary key

<property> tag to map normal properties

Table: MY_PERSON

PERSON_ID	FULLNAME
1	Frank Brown
2	John Smith



```
<hibernate-mapping>
  <class name="intro.Person">
    <id name="id" />
    <property name="name" />
    </class>
</hibernate-mapping>
```

Unlike annotations, you have to specify all properties!

Table: PERSON

ID	NAME
1	Frank Brown
2	John Smith

Entity Class Mapping:

MAPPING IDENTITY

Primary key

- A primary key is
  - Unique
    - No duplicate values
  - Constant
    - Value never changes
  - Required
    - Value can never be null

- Primary key types:
  - Natural key
    - Has a meaning in the business domain
  - Surrogate key
    - Has no meaning in the business domain
    - Best practice

Mapping Primary Keys

- Object / Relational mismatch
  - Hibernate requires you to specify the property that will map to the primary key
- Prefer surrogate keys
  - Natural keys often lead to a brittle schema

```
@Entity
public class Person {
  @Id
  private String name;

  ...
```

Name as a natural primary key for Person can give problems

```
@Entity
public class Person {
  @Id
  private long id;
  private String name;

  ...
```

Instead use id as a surrogate key for Person

Generating Identity

- Generated identity values
  - Ensure identity uniqueness
- Private setId() methods
  - Ensure identity immutability

```
@Entity
public class Person {
  @Id
  @GeneratedValue
  private long id;
  private String name;

  public Person() {}
  public Person(String name) { this.name = name; }

  public long getId() { return id; }
  private void setId(long id) { this.id = id; }
  public String getName() { return name; }
  public void setName(String name) { this.name = name; }
}
```

Id is generated

Id can not be set by the application

Generation Strategies

Hibernate	JPA	Description
native	AUTO	Selects the best strategy for your database
identity	IDENTITY	Use an identity column (MS SQL, MySQL, HSQL, …)
sequence	SEQUENCE	Use a sequence (Oracle, PostgreSQL, SAP DB, …)
-	TABLE	Uses a table to hold last generated values for PKs
hilo	-	Like table, uses efficient algorithm to generate values
seqhilo	-	Like regular hilo, but using a sequence
increment	-	Finds the current max value and increments by 1*
uuid.hex	-	Creates globally unique 128-bit UUIDs
guid	-	Uses MySQL and MS SQL server global uid generator
select	-	Have Hibernate select a value generated by a trigger
assigned	(implicit)	Specifies that the value is assigned by the application

Specifying Identity Generation

- @GeneratedValue

```
@Entity
public class Person {
  @Id
  @GeneratedValue(strategy=GenerationType.AUTO)
  private long id;
  private String name;
```

Specify the generation strategy

```
@Entity
public class Person {
  @Id
  @GeneratedValue
  private long id;
  private String name;
```

Defaults to 'AUTO' when not specified

- <generator> tag

```
<hibernate-mapping>
  <class name="identity.Person">
    <id name="id">
      <generator class="native" />
    </id>
    <property name="name" />
  </class>
</hibernate-mapping>
```

Always have to specify a strategy, cannot leave it off

Identity Column

- Identity columns are columns that can automatically generate the next unique id

```java
@Entity
public class Person {
  @Id
  @GeneratedValue(strategy=GenerationType.IDENTITY)
  private long id;
  private String name;
```

JPA identity strategy

```xml
<hibernate-mapping>
  <class name="identity.Person">
    <id name="id">
      <generator class="identity" />
    </id>
    <property name="name" />
  </class>
</hibernate-mapping>
```

XML identity strategy

- If your database support identity columns the native strategy will default to using them

Sequence

- The SEQUENCE strategy will default to using the 'hibernate_sequence' for all tables
  - The AUTO strategy will do so too if sequence is the default strategy (Oracle, PostgreSQL)

```
@Entity
public class Person {
  @Id
  @GeneratedValue(strategy=GenerationType.SEQUENCE)
  private long id;
  private String name;
```

Both AUTO and SEQUENCE

```
<hibernate-mapping>
  <class name="identity.Person">
    <id name="id">
      <generator class="sequence" />
    </id>
    <property name="name" />
  </class>
</hibernate-mapping>
```

Both native and sequence

Sequences

- By default Hibernate only uses a single sequence called ‘hibernate-sequence’
- You can specify additional custom sequences

Tip: You can use the native strategy and still also specify a custom sequence

Using Custom Sequences

Create Custom Sequence

```
@Entity
@SequenceGenerator(name="personSeq", sequenceName="PERSON_SEQUENCE")
public class Person_annotated_sequence {
  @Id
  @GeneratedValue(strategy=GenerationType.SEQUENCE, generator="personSeq")
  private long id;

  ...
```

Use Custom Sequence

```
<hibernate-mapping>
  <class name="identity.Person">
    <id name="id" >
      <generator class="sequence">
        <param name="sequence">PERSON_SEQUENCE</param>
      </generator>
    </id>
    <property name="name" />
  </class>
</hibernate-mapping>
```

Use ‘sequence’ strategy

Specify the custom sequence

Entity Class Mapping

MAPPING DATA TYPES

Data Types

- So far we haven't specified any data types
  - Hibernate automatically mapped to SQL types
- You can be very specific
  - Specify the data type, length, precision and more

```
@Entity
public class Person {
  @Id
  @GeneratedValue
  private long id;
  @Column(name="FULLNAME", length=255, nullable=false)
  private String name;

  ...
```

Name will be stored as:
FULLNAME VARCHAR(255) NOT NULL

Specify Date Type

- Sometimes you need to be specific
  - Should a java.util.Date be stored as date, as a time or as a timestamp in the database?

```
@Entity
public class Person {
  @Id
  @GeneratedValue
  private long id;
  private String name;
  @Temporal(TemporalType.DATE)
  private Date birthday;

  ...
```

Birthday will be stored as a Date

- If left unspecified a java.util.Date will be stored as a timestamp to preserve accuracy

Annotation Types

- Reflection is used to find java type information
- Use @Column to specify more details
- Use @Temporal to specify how a Date should be persisted (DATE, TIME or TIMESTAMP)
- Use @Lob to indicate Large values
- Use @Transient to indicate that a property should ***not*** be persisted

All in One Example

```
@Entity
public class Person {
  @Id
  @GeneratedValue
  private long id;
  @Column(name="FULLNAME", length=255, nullable=false)
  private String name;
  @Temporal(TemporalType.DATE)
  private Date birthday;
  @Lob
  private String biography;
  @Transient
  private String temp;

  ...
```

Name will be stored as:
FULLNAME VARCHAR(255) NOT NULL

Birthday will be stored as a Date

Biography will be stored as CLOB instead of VARCHAR

Temp will not be stored in the database

XML Type Example

Same class and properties as the previous annotation example

Now without annotations

```
public class Person {
  private long id;
  private String name;
  private Date birthday;
  private String biography;
  private String temp;

  ...
```

```
<hibernate-mapping>
  <class name="model.Person" table="MY_PERSON">
    <id name="id" type="long" column="PERSON_ID">
      <generator class="native" />
    </id>
    <property name="name" column="FULLNAME"
        type="string" length="255" not-null="true" />
    <property name="birthday" column="BIRTHDAY" type="date" />
    <property name="biography" type="text" />
  </class>
</hibernate-mapping>
```

Name will be stored as: FULLNAME VARCHAR(255) NOT NULL

Birthday will be stored as a Date

Biography will be stored as CLOB instead of VARCHAR

Temp is not listed and will not be stored in the database

XML Types

Hibernate Type	Java Type	SQL Type
byte	byte or java.lang.Byte	TINYINT
short	short or java.lang.Short	SMALLINT
integer	int or java.lang.Integer	INTEGER
long	long or java.lang.Long	BIGINT
float	float or java.lang.Float	FLOAT
double	double or java.lang.Double	DOUBLE
big_decimal	java.math.BigDecimal	NUMERIC
boolean	boolean	BIT
yes_no	boolean	CHAR(1) – 'Y' or 'N'
true_false	boolean	CHAR(1) – 'T' or 'F'
string	java.lang.String	VARCHAR
character	char, java.lang.Character or java.lang.String	CHAR(1)

Date Time & Large Values

Hibernate Type	Java Type	SQL Type
date	java.util.Date or java.sql.Date	DATE
time	java.util.Date or java.sql.Time	TIME
timestamp	java.util.Date or java.sql.Timestamp	TIMESTAMP
calendar	java.util.Calendar	TIMESTAMP
calendar_date	java.util.Calendar	DATE

Hibernate Type	Java Type	SQL Type
binary	byte[] or java.lang.Byte[]	VARBINARY
text	java.lang.String	CLOB
clob	java.sql.Clob	CLOB
blob	Java.sql.Blob	BLOB
serializable	java.io.serializable	VARBINARY

Entity Class Mapping

SPECIFYING ACCESS TYPE

Property or Field Access

- Hibernate can access objects in two ways
  - property access gets and sets object values through getter /setter methods
  - field access gets and sets object values directly from / to the fields

```
@Entity
public class Person {
  @Id
  @GeneratedValue
  private long id;
  private String name;

  ...
```

JPA field access

```
@Entity
public class Person {
  private long id;
  private String name;

  public Person() {}
  public Person(String name) { this.name = name; }

  @Id
  @GeneratedValue
  public long getId() { return id; }
  private void setId(long id) { this.id = id; }
  public String getName() { return name; }
  public void setName(String name) { this.name = name; }
}
```

JPA property access

Specifying Access with Annotations

- The JPA specification lets you set the Access Type with the location of @Id
  - Placing @Id on a field specifies field access for the entire object
    - All other mapping annotations should be on the fields
  - Placing @Id on a getter specifies property access for the entire object
    - All other mapping annotations should be on the getters

- Using additional annotations you can also change access for individual fields

Access Example

```
@Entity
public class Person {
  private long id;
  private String name;
  private Date birthday;

  public Person() {}
  public Person(String name) { this.name = name; }

  @Id
  @GeneratedValue
  public long getId() { return id; }
  private void setId(long id) { this.id = id; }

  @Access(AccessType.FIELD)
  public String getName() { return name; }
  public void setName(String name) { this.name = name; }

  @Temporal(TemporalType.DATE)
  public Date getBirthday() { return birthday; }
  public void setBirthday(Date birthday) { this.birthday = birthday; }
}
```

All other annotations have to be on getter methods as well

@Id on a getter sets property access for all attributes

Name will be accessed through the field instead

Birthday is still accessed through getters / setters

Access / Encapsulation

- Property access hides implementation details
  - Maintains OO Principle of Encapsulation
- Hibernate dirty checking compares by value
  - With property access your implementation can differ from your relational mapping without disturbing Hibernate

Reflection

- Hibernate accesses data in private fields through reflection

```
public static void main(String[] args) t
                    hrows NoSuchFieldException, IllegalAccessException {
  Person p = new Person("Test");

  Field f = p.getClass().getDeclaredField("name"); //NoSuchFieldException
  f.setAccessible(true);
  String fieldData = (String) f.get(p); //IllegalAccessException
  System.out.println(fieldData);
}
```

Annotations Encapsulation Example

```
@Entity
public class Person {
  private long id;
  private String firstname;
  private String lastname;

  public Person() {}

  @Id
  @GeneratedValue
  public long getId() { return id; }
  public void setId(long id) { this.id = id; }

  @Column
  public String getName() { return firstname + " " + lastname; }
  public void setName(String name) { /* see code prev slide */; }

  @Transient
  public String getFirstname() { return firstname; }
  public void setFirstname(String firstname) { this.firstname = firstname; }

  @Transient
  public String getLastname() { return lastname; }
  public void setLastname(String lastname) { this.lastname = lastname; }
}
```

Three class properties mapped to two columns

Property access

Table: PERSON

ID	NAME
1	Frank Brown
2	John Smith

@Transient firstname and lastname

Setting Access with XML

- Use the “default-access” attribute on the <hibernate-mapping> tag to set the default
- Use the “access” attribute on the <property> tag to change access for individual fields

Sets the default access for Person to field

```
<hibernate-mapping default-access="field">
  <class name="model.Person">
    <id name="id">
      <generator class="native" />
    </id>
    <property name="name" access="property" />
    <property name="birthday" type="date" />
  </class>
</hibernate-mapping>
```

Changes the access for the name attribute to property

Birthday will be accessed through its field (as set by the default)

Encapsulation Example XML

```
public class Person {
  private long id;
  private String firstname;
  private String lastname;

  public Person() {}

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

  public String getName() { return firstname + " " + lastname; }
  public void setName(String name) {
    StringTokenizer st = new StringTokenizer(name);
    firstname = st.nextToken();
    lastname = st.nextToken();
  }

  public String getFirstname() { return firstname; }
  public void setFirstname(String firstname) { this.firstname = firstname; }

  public String getLastname() { return lastname; }
  public void setLastname(String lastname) { this.lastname = lastname; }
}
```

3 field implementation details are encapsulated

Mapped to 2 column table

Table: PERSON

ID	NAME
1	Frank Brown
2	John Smith

Firstname and lastname are combined in getter

Firstname and lastname are separated in setter

```
<hibernate-mapping default-access="property">
  <class name="model.Person" >
    <id name="id">
      <generator class="native"/>
    </id>
    <property name="name" />
  </class>
</hibernate-mapping>
```

Property access

maps the 2 fields: id and name

Entity Class Mapping

WRAPPING UP

Loading Data

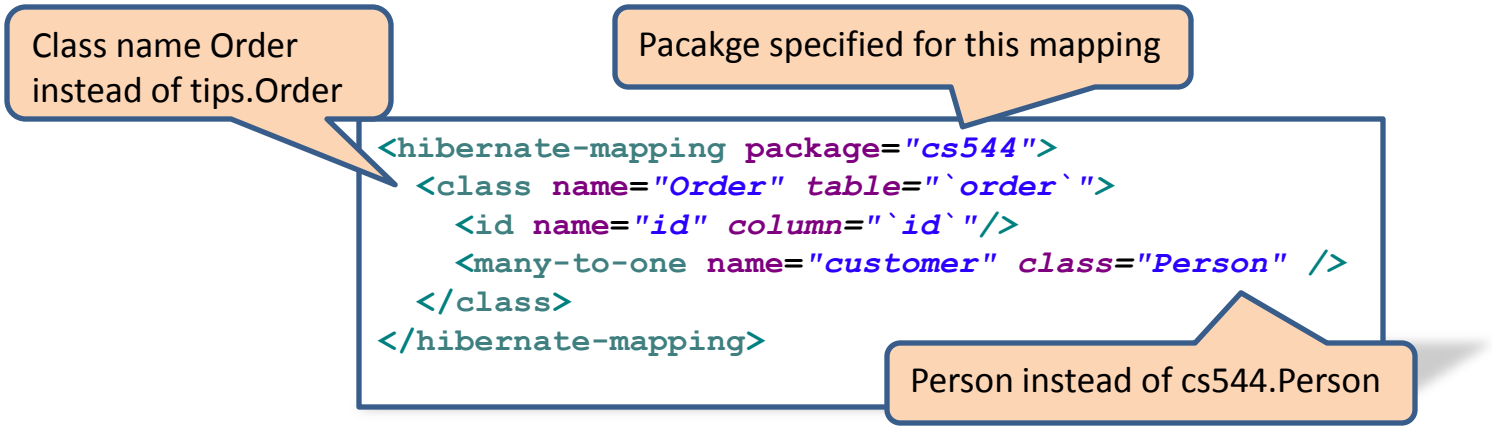
- import.sql will automatically be loaded
- You can specify different file(s) to load with:
  - hbm2ddl.import_files

```
<?xml version="1.0" encoding="windows-1252" ?>
 <!DOCTYPE hibernate-configuration PUBLIC "-//Hibernate/Hibernate Configuration DTD 3.0//EN"
 "http://hibernate.sourceforge.net/hibernate-configuration-3.0.dtd">
<hibernate-configuration>
    <session-factory>
 <!-- MySQL DB running on localhost -->
        <property name="connection.url">jdbc:mysql://localhost/test</property>
        <property name="connection.driver_class">com.mysql.jdbc.Driver</property>
        <property name="connection.username">root</property>
        <property name="connection.password">root</property>
        <property name="dialect">org.hibernate.dialect.MySQL5Dialect</property>

         <property name="hbm2ddl.auto">create</property>
         <!-- Needed since Hibernate 5 to generate identity columns properly -->
         <property name="hbm2ddl.import_files">import.sql</property>
```

XML Mapping Tip

- You can specify a package attribute on the <hibernate-mapping> XML element
  - No longer need fully qualified class names
  - Useful when mapping associations



Active Learning

- What do the following annotations do:
  @Temporal @Transient

- How does property access work, how does field access work?

Module Summary

- In this module we covered entity class mapping including:
  - Mapping an entity classes to tables
  - Mapping properties to columns
  - Mapping Identity and setting Identity Generation
  - Mapping Data types
  - Property / Field Access

Main Point

- When mapping an Entity we map properties with data types, an identity, and possibly access type for a class. These are the tools you'll need to map any class; Highest First.
- *Science of Consciousness:* By first settling our mind, we can achieve greater success in action, similar to drawing a bow before shooting an arrow.