What you will learn in Topic 3

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Topic 3: Introduction to Hibernate

- Introduction to Hibernate
- Setting Up Hibernate Development Environment
- Hibernate Configuration with Annotations
- Hibernate CRUD Features Create, Read, Update and Delete
- Hibernate Advanced Mappings
- Hibernate Advanced Mappings - @OneToOne
- Hibernate Advanced Mappings - @OneToMany
- Hibernate Advanced Mappings - Eager vs Lazy Loading
- Hibernate Advanced Mappings - @OneToMany - Unidirectional
- Hibernate Advanced Mappings - @ManyToMany

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Introduction to Hibernate

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Hibernate Overview

Topics

1. What is Hibernate?
2. Benefits of Hibernate
3. Code Snippets

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Hibernate Overview

What is Hibernate?

1. A framework for persisting / saving Java objects in a database
2. www.hibernate.org

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Hibernate Overview

Benefits of Hibernate

1. Hibernate handles all of the low-level SQL
2. Minimizes the amount of JDBC code you have to develop
3. Hibernate provides the Object-to-Relational Mapping (ORM)

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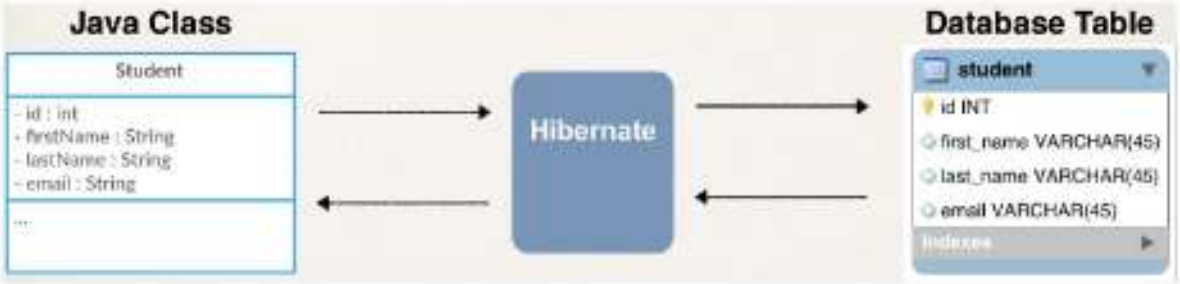
Hibernate Overview

Benefits of Hibernate

Object-To-Relational Mapping (ORM)

The developer defines mapping between Java class and database table



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Hibernate Overview

Saving a Java Object with Hibernate

```
// create Java object
Student theStudent = new Student("Xu", "Ming", "xu@javaweb.edu");

// save it to database
int theId = (Integer) session.save(theStudent);
```

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Hibernate Overview

Retrieving a Java Object with Hibernate

```
// create Java object
Student theStudent = new Student("Xu", "Ming", "rigat@javaweb.edu");

// save it to database
int theId = (Integer) session.save(theStudent);

// now retrieve from database using the primary key
Student myStudent = session.get(Student.class, theId);
```

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Hibernate Overview

Querying for Java Objects

```
Query query = session.createQuery("from Student");
List<Student> students= query.list();
```

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Hibernate Overview

Hibernate CRUD Apps

- **C**reate objects
- **R**ead objects
- **U**pdate objects
- **D**elete objects

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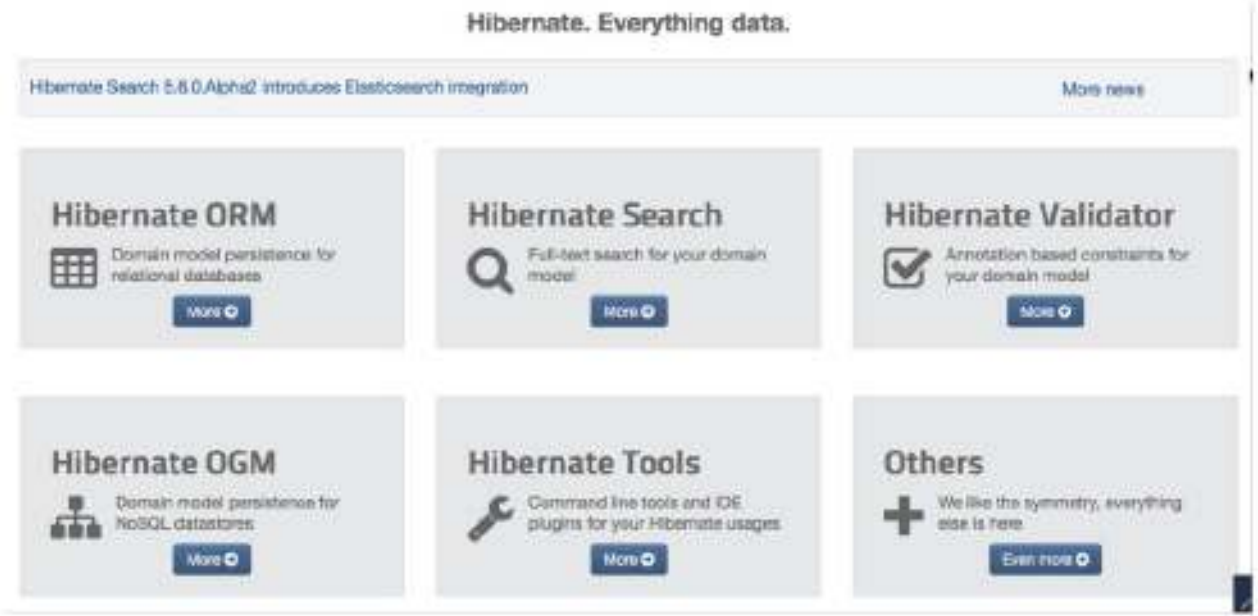
Hibernate is actually more than ORM!



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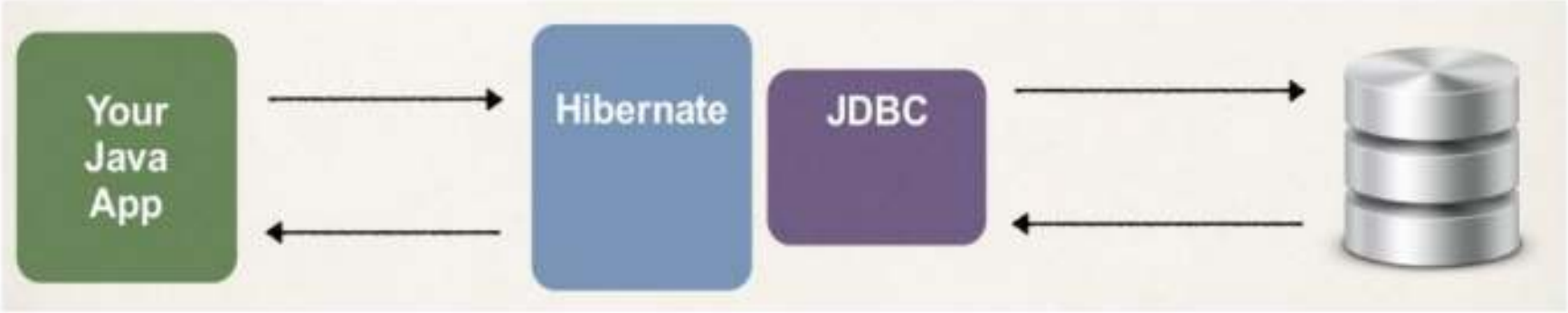
Hibernate and JDBC

How does Hibernate relate to JDBC?

Hibernate uses JDBC for all database communications



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Setting Up Hibernate Development Environment

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Required Software

To Build Hibernate Applications, you need the following:

1. Java Integrated Development Environment (IDE)
2. Database Server
3. Hibernate JAR files and JDBC Driver

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Install MySQL on MS Windows

1. Download MySQL
2. Install MySQL
3. Verify Installation

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Install MySQL on MS Windows

1. Download MySQL

   https://dev..mysql.com/downloads/installer/

Check **demo-1-Hibernate-sql-scripts-and-starter**

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Uninstall MySQL on MS Windows

To do so, you need to do it in four steps:

1.Run Command Prompt as Administrator and execute the following commands to stop then remove MySQL service

net stop MySQL80
sc delete MySQL80

2.Go to Control Panel>>Programs>>Uninstall program >> MySQL installer - Community >> uninstall

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Uninstall MySQL on MS Windows

3.Open Windows Explorer(that means any folder)>>View>>Options>> change folder and search options>>View>>tab and under "Hidden files and folders">> choose "**Show hidden files and folders**">>Apply. Now explore the following locations and delete the following folders:

C:\Program Files\MySQL
C:\Program Files(x86)\MySQL
C:\ProgramData\MySQL
C:\Users\[user-name]\AppData\Roaming\MySQL(very important, check all the users you have)

4.Restart you PC

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Setup Database scripts

Folder: sql-scripts

1. create-user.sql

2. student-tracker.sql

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Setup Database scripts

About:01-create-user.sql

1.Create a new MySQL user for our application
    1. user id: **hbstudent**
    2. password: **hbstudent**

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Setup Database scripts

About: 02-student-tracker.sql

1.Create a new database table: **student**

```
select * from hb_student_tracker.student;
```

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Setup Hibernate in Eclipse

To Do List

1. Create Eclipse Project
2. Download Hibernate Files
3. Download MySQL JDBC Driver
4. Add JAR files to Eclipse Project … Build Path

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Hibernate Configuration with Annotations

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Test JDBC Connection - Hibernate Dev Process

To Do List

1. Add Hibernate Configuration file
2. Annotate Java Class
3. Develop Java Code to perform database operations

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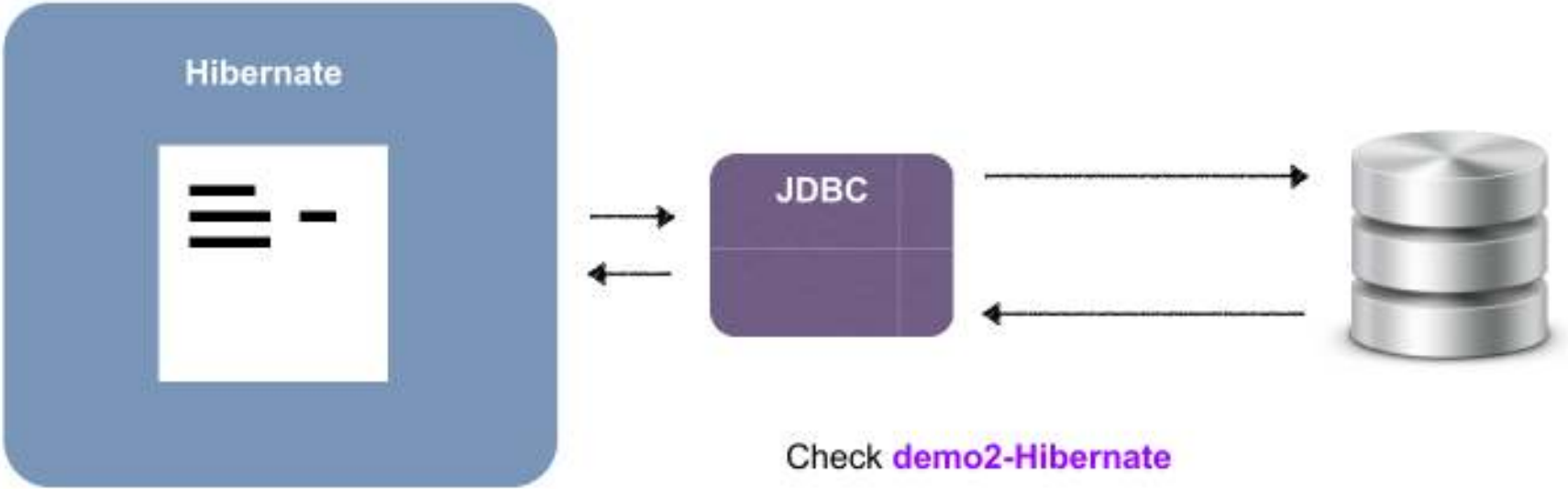
Configuration File



Check **demo2-Hibernate**

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Annotate Java Class

To Do List

1. Add Hibernate Configuration file

2. Annotate Java Class

3. Develop Java Code to perform database operations

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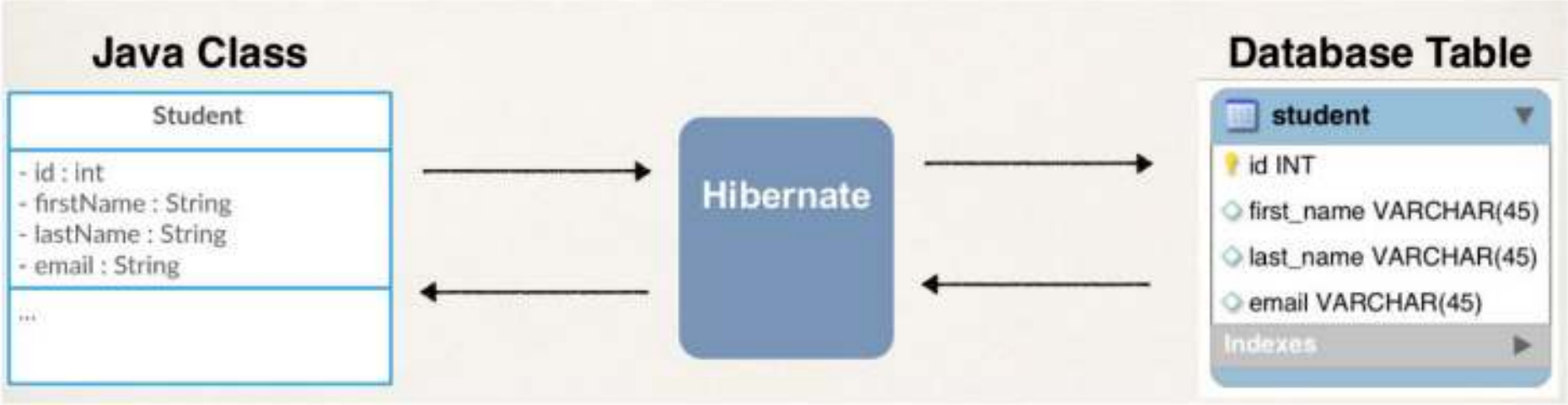
Entity Class Java class that is mapped to a database table

Object-to-Relational Mapping (ORM)



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Annotate Java Class

Two Options for Mapping

1. Option 1: XML config file (legacy)

2. Option 2: Java Annotations (modern, preferred)

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Annotate Java Class

Java Annotations

1. Step 1: Map class to database table

2. Step 2: Map fields to database columns

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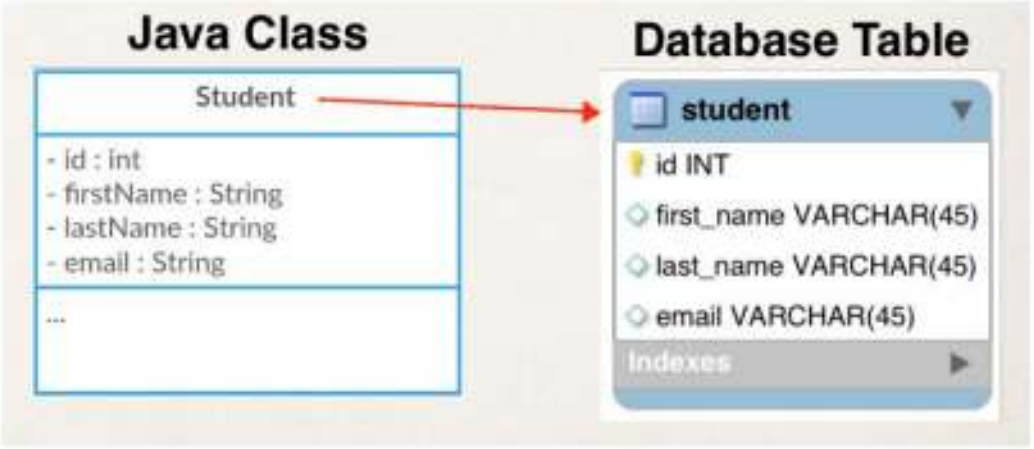
Step 1: Map class to database table

```
@Entity
@Table(name="student")
public class Student {
...
}
```



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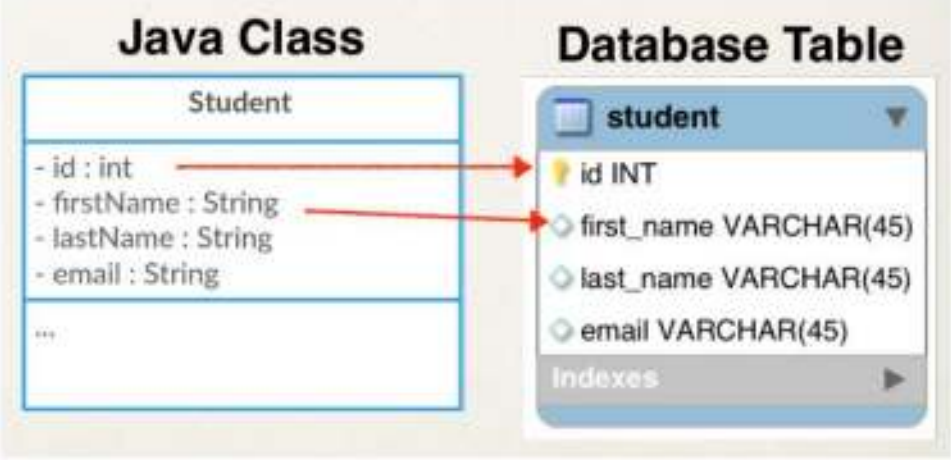
Step 2: Map fields to database columns

```
@Entity
@Table(name="student")
public class Student {

    @Id
    @Column(name="id")
    private int id;

    @Column(name="first_name")
    private String firstName;
    …
}
```



Check **demo3-Hibernate-Config**

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Hibernate CRUD Features Create, Read, Update and Delete

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Hibernate Dev Process - To Do List

1. Add Hibernate Configuration file
2. Annotate Java Class
3. Develop Java Code to perform database operations

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Two Key Players

Class	Description
SessionFactory	Reads the hibernate config file Creates Session objects Heavy-weight object Only create once in your app
Session	Wraps a JDBC connection Main object used to save/retrieve objects Short-lived object Retrieved from SessionFactory

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Java Code Setup

```
public static void main(String[] args) {

    SessionFactory factory = new Configuration()
                             .configure("hibernate.cfg.xml")
                             .addAnnotatedClass(Student.class)
                             .buildSessionFactory();

    Session session = factory.getCurrentSession();

    try {

        // now use the session object to save/retrieve Java objects

    } finally {
        factory.close();
    }

}
```

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Save a Java Object

```
try {

    // create a student object
    Student tempStudent = new Student("Paul", "Wall", "paul@luv2code.com");

    // start transaction
    session.beginTransaction();

    // save the student
    session.save(tempStudent);

    // commit the transaction
    session.getTransaction().commit();

} finally {
    factory.close();
}
```

Check **demo4-Hibernate-CreateStudent**

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Hibernate and Primary Key

Primary Key

1. Uniquely identifies each row in a table

2. Must be a unique value

3. Cannot contain NULL values

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MySQL - Auto Increment

```
CREATE TABLE student (

id int(11) NOT NULL AUTO_INCREMENT,
first_name varchar(45) DEFAULT NULL,  last_name varchar(45) DEFAULT NULL,  email varchar(45) DEFAULT
NULL,  PRIMARY KEY (id)

)
```

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Hibernate Identity - Primary Key

```
@Entity
@Table(name="student")
public class Student {

    @Id
    @Column(name="id")
    private int id;

    ...
}
```

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Hibernate Identity - Primary Key

```
@Entity
@Table(name="student")
public class Student {

    @Id
    @GeneratedValue(strategy=GenerationType.IDENTITY)
    @Column(name="id")
    private int id;

    ...
}
```

Check **demo5-Hibernate-AddMoreStudents**

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ID Generation Strategies

Name	Description
GenerationType.AUTO	Pick an appropriate strategy for the particular database
GenerationType.IDENTITY	Assign primary keys using database identity column
GenerationType.SEQUENCE	Assign primary keys using a database sequence
GenerationType.TABLE	Assign primary keys using an underlying database table to ensure uniqueness

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Change the start point of your table index

```
alter table hb_student_tracker.student AUTO_INCREMENT=3000;
```

Delete all rows and set the index to 1

```
truncate hb_student_tracker.student;
```

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Tricks

- You can define your own CUSTOM generation strategy :-)
- Create implementation of **org.hibernate.id.IdentifierGenerator**
- Override the method: **public Serializable generate(…)**

- **Always generate unique value**
- **Work in high-volume, multi-volume, multi-threaded environment**
- **If using server clusters, always generate unique value.**

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Retrieving a Java Object with Hibernate

```
// create Java object
Student theStudent = new Student("Mary", "Public", "mary@javaweb.com");

// save it to database
session.save(theStudent);
.....

//now retrieve/read from database usign the primary key
Student = myStudent = session.get(Student.class, theStudent.getId());
```

Check **demo6-Hibernate-read**

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Querying Objects

- Query language for retrieving objects
- Similar in nature to SQL
- **where, like, order by, join, in, etc…**

```
List<Student> theStudents = session.createQuery("from Student").getResultList();
```

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Querying Objects

```
List<Student> theStudents =  session
.createQuery("from Student s where s.lastName='Doe'")
.getResultList();

List<Student> theStudents =  session
.createQuery("from Student s where s.lastName='Doe'"
+ " OR s.firstName='Daffy'")
.getResultList();

List<Student> theStudents =  session
.createQuery("from Student s where"
+ " s.email LIKE '%javaweb.edu'")
.getResultList();
```

Check **demo7-Hibernate-query**

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Updating Object(s)

```
int studentId = 1;

Student myStudent = session.get(Student.class, studentId);

// update first name to "Scooby"
myStudent.setFirstName("Scooby");

// commit the transaction
session.getTransaction().commit();

// update all the students emails
session.createQuery("update Student set email='foo@gmail.com'")
.executeUpdate();
```

Check **demo8-Hibernate-update**

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Delete Object(s)

```
int studentId =1 ;
student myStudent = session.get(Studetn.class, studentId);

// delete the student
session.delete(myStudent)

// commit the transaction
session.getTransaction().commit();


session.createQuery("delete from Student where id=2")
       .executeUpdate();
```

Check **demo9-Hibernate-delete**

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Hibernate Advanced Mappings

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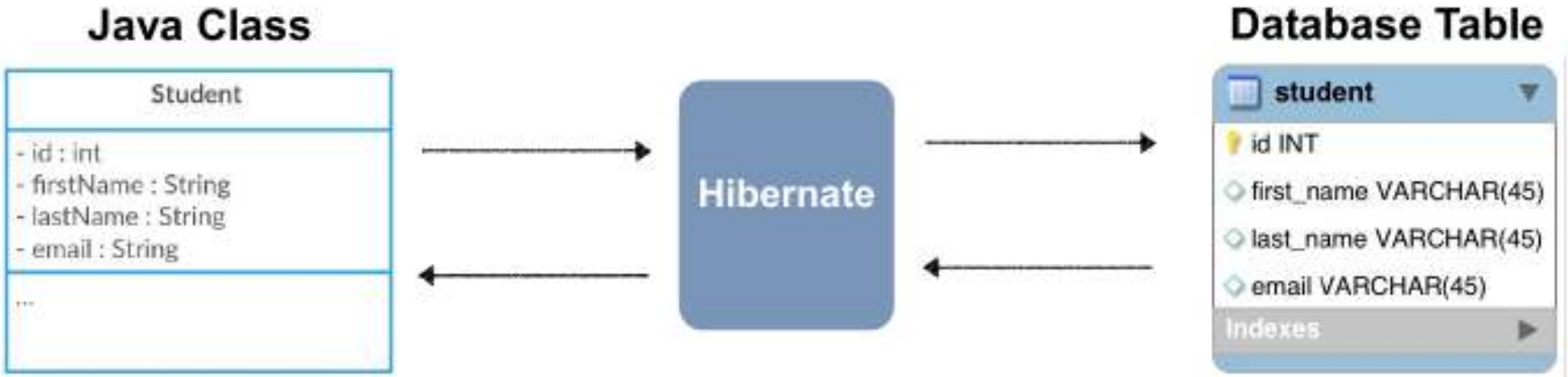
Basic Mapping



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Advanced Mappings

- In the database, you most likely will have
  - Multiple Tables
  - Relationships between Tables
- Need to model this with Hibernate

- One-to-One
- One-to-Many, Many-to-One
- Many-to-Many

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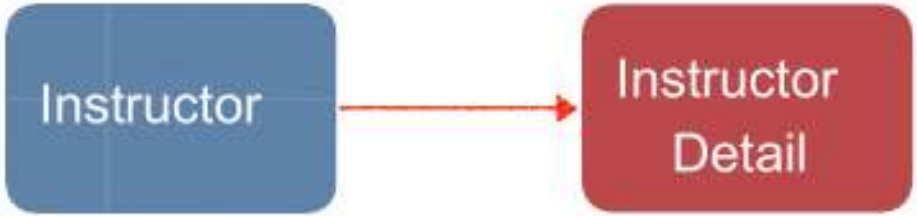
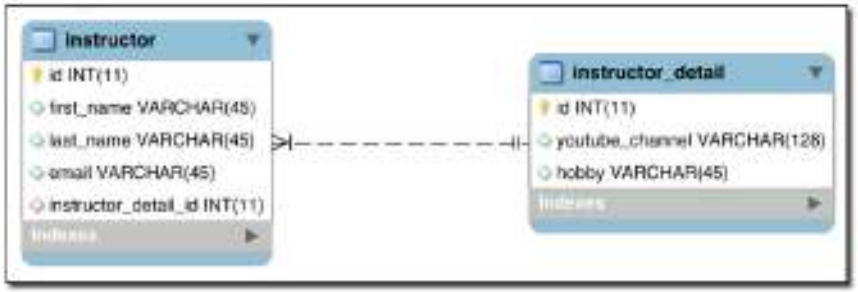
One-to-One Mapping





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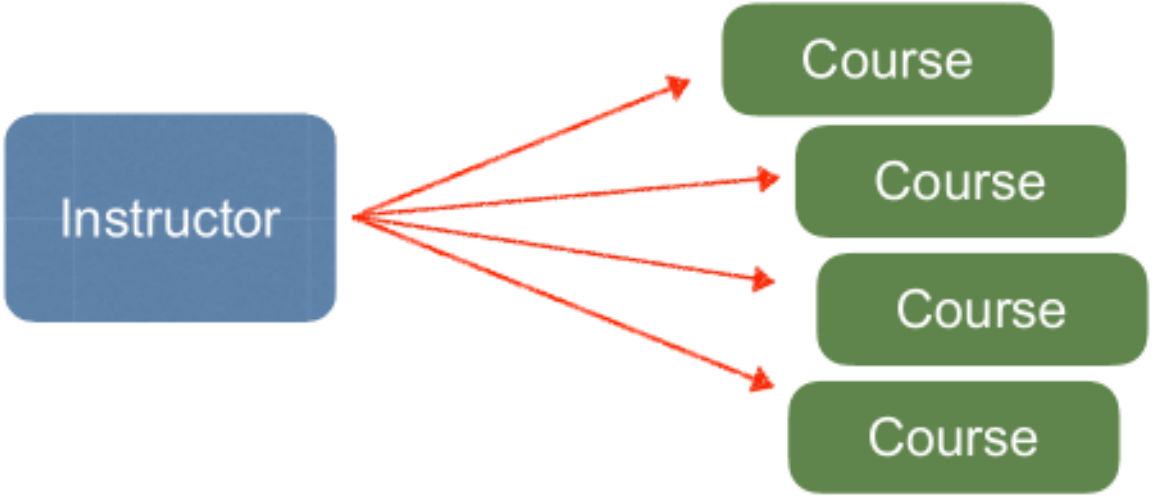
One-to-Many Mapping

An instructor can have many courses



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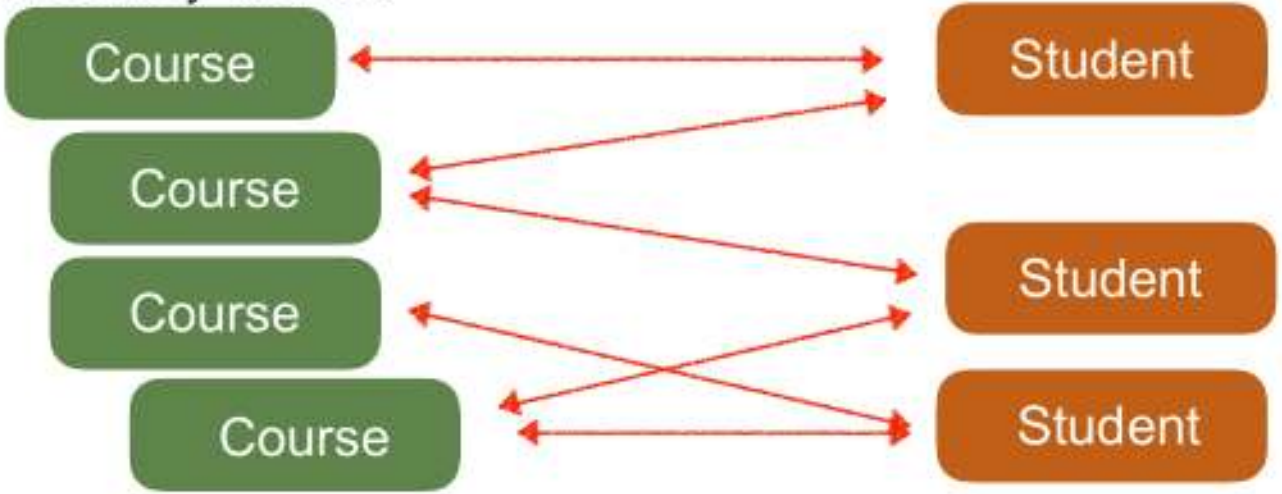
Many-to-Many Mapping

- A course can have many students
- A student can have many courses



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Important Database Concepts

- Primary key and foreign key

- Cascade

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Primary Key and Foreign Key

Primary Key:

- identify a unique row in a table

Foreign key:

- Link tables together
- a field in one table that refers to primary key in another table

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Foreign Key Example

Foreign key column

Table: instructor

id	first_name	last_name	instructor_detail_id
1	Chad	Darby	100
2	Madhu	Patel	200

Table: instructor_detail

id	youtube_channel	hobby
100	ww.youtube.com/Javaweb	Luv 2 Code!!!
200	www.youtube.com	Guitar

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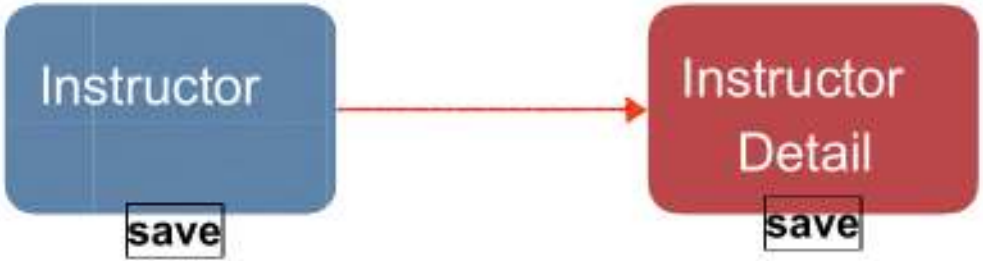
Cascade

- You can cascade operations

- Apply the same operation to related entities



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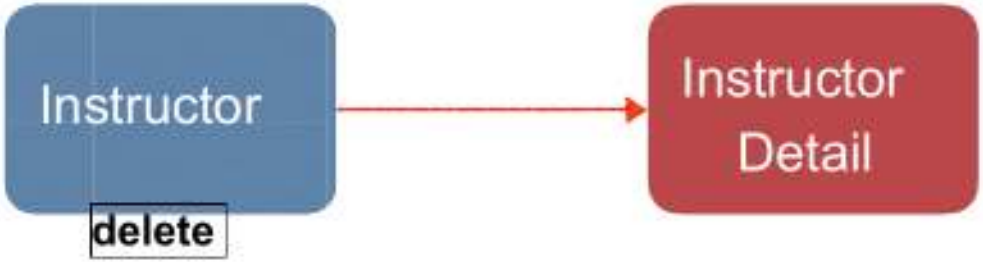
Cascade

If we delete an instructor, we should also delete their instructor_detail

- This is known as “CASCADE DELETE”



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Cascade Delete

Foreign key column

Table: instructor

id	first_name	last_name	instructor_detail_id
~~1~~	~~Chad~~	~~Darby~~	~~100~~
2	Madhu	Patel	200

Table: instructor_detail

id	youtube_channel	hobby
~~100~~	~~www. Javaweb~~ /youtube	~~Javaweb~~
200	www.youtube.com	Guitar

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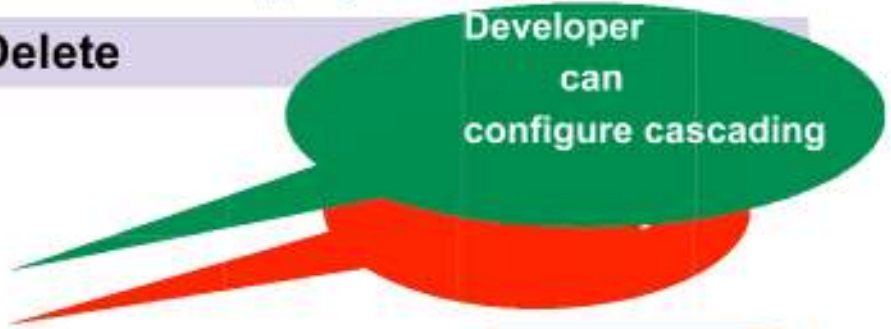
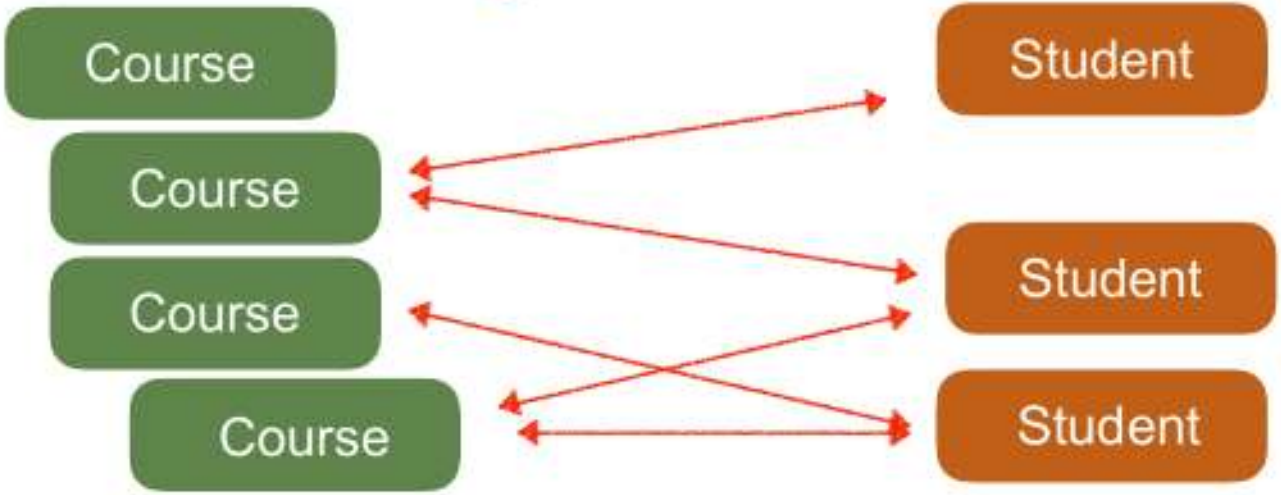
Cascade Delete

- Cascade delete depends on the use case
- Should we do cascade delete here???





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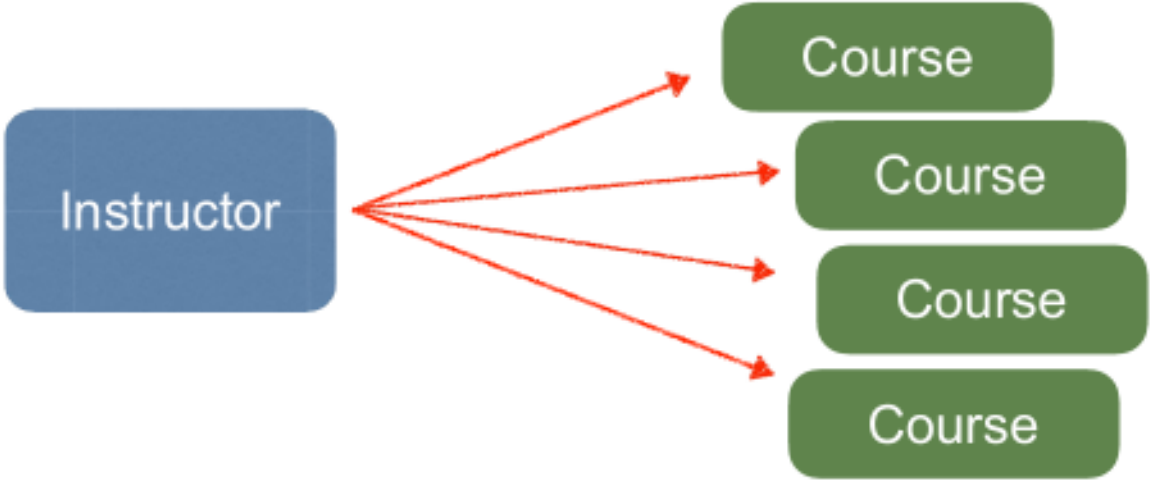
Fetch Types: Eager vs Lazy Loading

When we fetch / retrieve data, should we retrieve EVERYTHING?

- **Eager** will retrieve everything
- **Lazy** will retrieve on request



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Uni-Directional

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Bi-Directional

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Hibernate Advanced Mappings - @OneToOne

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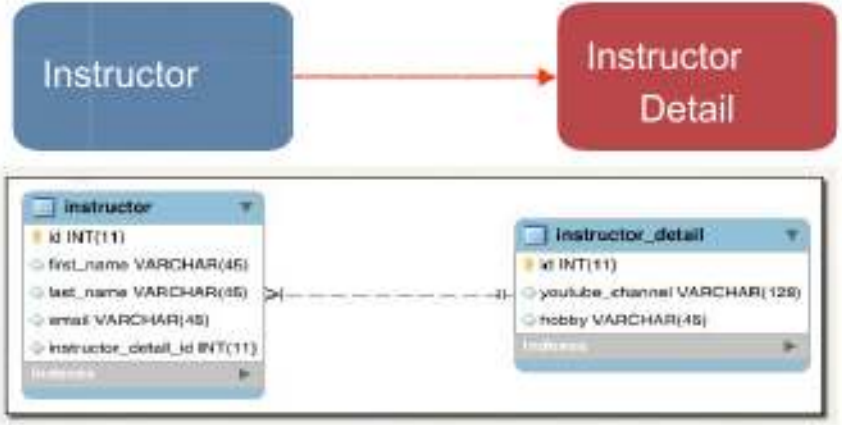
One-to-One Mapping

- An instructor can have an “instructor detail” entity
- Similar to an “instructor profile”



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Uni-Directional

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Development Process: One-to-One

1. Prep Work - Define database tables
2. Create Instructor Detail class
3. Create Instructor class
4. Create Main App

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table: instructor_detail

File: create-db.sql

```
CREATE TABLE `instructor_detail` (

    `id` int(11) NOT NULL AUTO_INCREMENT,
    `youtube_channel` varchar(128) DEFAULT NULL,
    `hobby` varchar(45) DEFAULT NULL,

);
```

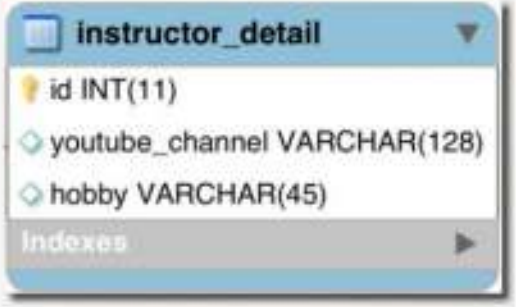

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table: instructor_detail

File: create-db.sql

```
CREATE TABLE `instructor_detail` (

    `id` int(11) NOT NULL AUTO_INCREMENT,
    `youtube_channel` varchar(128) DEFAULT NULL,
    `hobby` varchar(45) DEFAULT NULL,
     PRIMARY KEY (`id`)

);
```

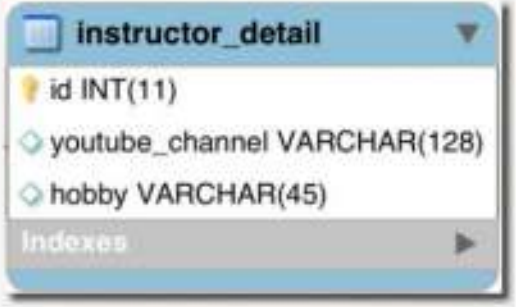

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table: instructor_detail

File: create-db.sql

```
CREATE TABLE `instructor` (

    `id` int(11) NOT NULL AUTO_INCREMENT,
    `first_name` varchar(45) DEFAULT NULL,
    `last_name` varchar(45) DEFAULT NULL,
    `email` varchar(45) DEFAULT NULL,
    `instructor_detail_id` int(11) DEFAULT NULL,

    PRIMARY KEY (`id`)
    ...
);
```

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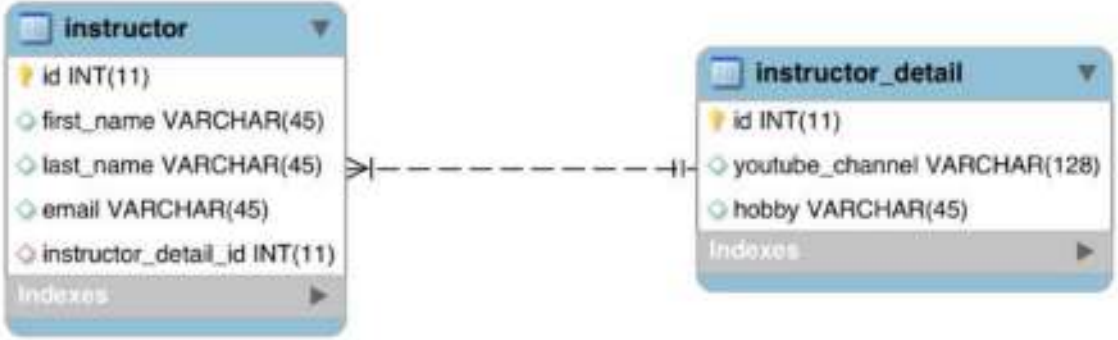
Foreign Key

1. Link tables together

2. A field in one table that refers to primary key in another table



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Foreign Key Example

Foreign key column

Table: instructor

id	first_name	last_name	instructor_detail_id
1	Chad	Darby	100
2	Madhu	Patel	200

Table: instructor_detail

id	youtube_channel	hobby
100	ww.youtube.com/Javaweb	Luv 2 Code!!!
200	www.youtube.com	Guitar

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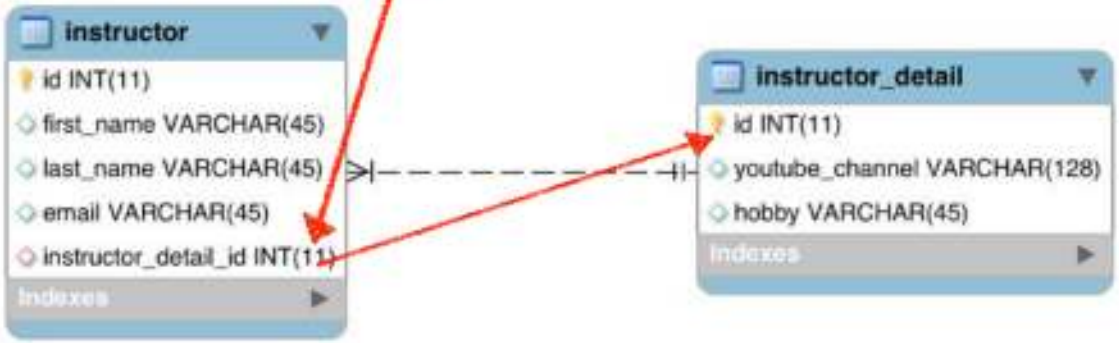
Defining Foreign Key

File: create-db.sql

```
CREATE TABLE `instructor` (
    ...
    CONSTRAINT `FK_DETAIL` FOREIGN KEY (`instructor_detail_id`)
    REFERENCES `instructor_detail` (`id`)
);
```



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More on Foreign Key

- Main purpose is to preserve relationship between tables
- Referential Integrity
    - Prevents operations that would destroy relationship
    - Ensures only valid data is inserted into the foreign key column
        - Can only contain valid reference to primary key in other table

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More on Foreign Key

1. Prep Work - Define database tables
2. Create InstructorDetail class
3. Create Instructor class
4. Create Main App

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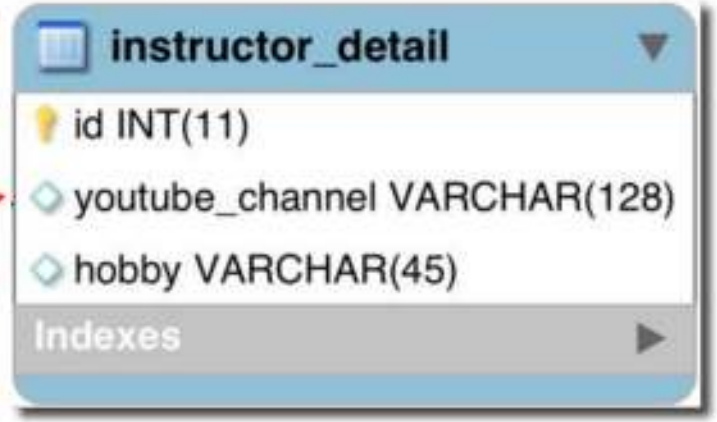
Step 2: Create InstructorDetail class

```
@Entity
@Table(name="instructor_detail")
public class InstructorDetail {

    @Id
    @GeneratedValue(strategy=GenerationType.IDENTITY)
    @Column(name="id")
    private int id;

    @Column(name="youtube_channel")
    private String youtubeChannel;

    @Column(name="hobby")
    private String hobby;
    // constructors
    // getters / setters
```



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Step 3: Create Instructor class

```
@Entity  @Table(name="instructor")
public class Instructor {
    @Id
    @GeneratedValue(strategy=GenerationType.IDENTITY)
    @Column(name="id")
    private int id;
    @Column(name="first_name")
    private String firstName;
    @Column(name="last_name")
    private String lastName;
    @Column(name="email")
    private String email;
    …
    // constructors, getters / setters
}
```

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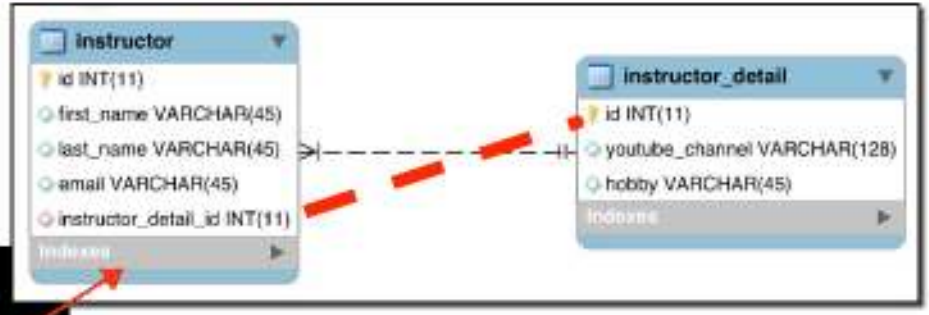
Step 3: Create Instructor class

```
@Entity
@Table(name="instructor")
public class Instructor {
...

   @OneToOne
   @JoinColumn(name="instructor_detail_id")
   private InstructorDetail instructorDetail;

...
// constructors, getters / setters
}
```



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Entity Lifecycle

Operations	Description
Detach	If entity is detached, it is not associated with a Hibernate session
Merge	If instance is detached from session, then merge will reattach to session
Persist	Transitions new instances to managed state. Next flush / commit will save in db.
Remove	Transitions managed entity to be removed. Next flush / commit will delete from db.
Refresh	Reload / synch object with data from db. Prevents stale data

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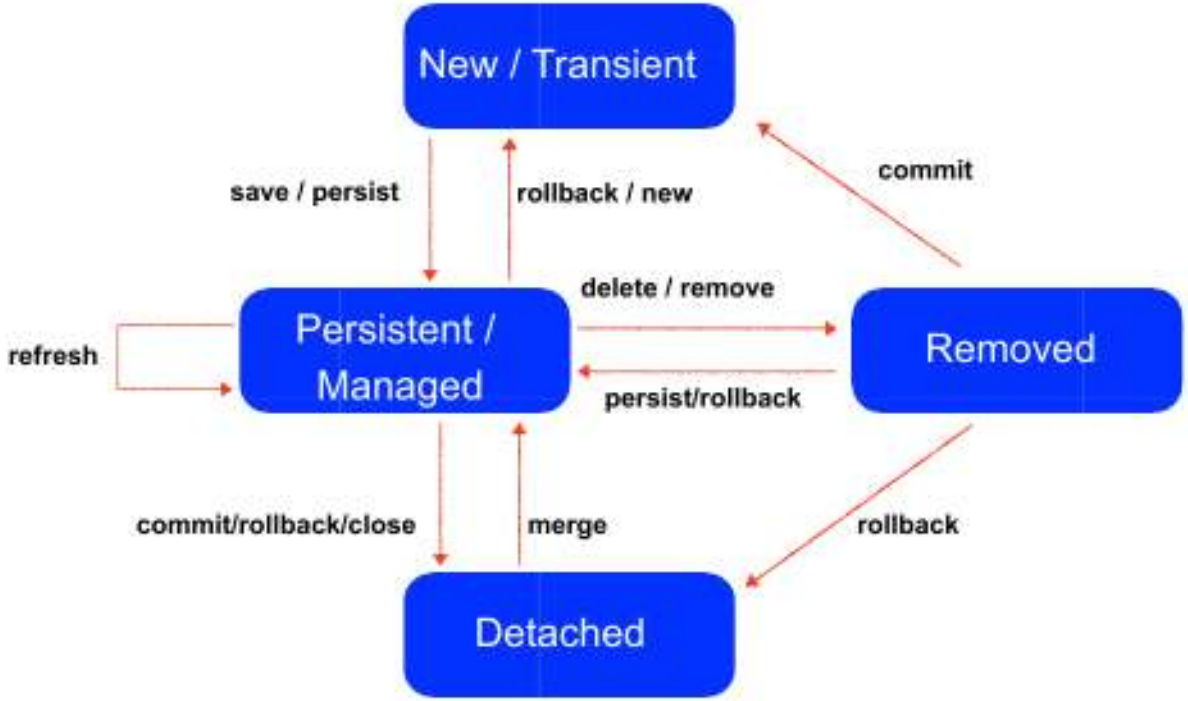
Entity Lifecycle - session method calls



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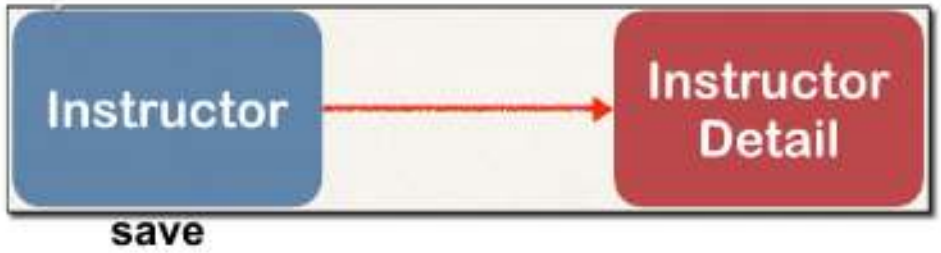
Cascade

- Recall: You can cascade operations
- Apply the same operation to related entities



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Cascade Delete

Foreign key column

Table: instructor

id	first_name	last_name	instructor_detail_id
1	Chad	Darby	100
2	Madhu	Patel	200

Table: instructor_detail

id	youtube_channel	hobby
100	ww.youtube.com/Javaweb	Luv 2 Code!!!
200	www.youtube.com	Guitar

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@OneToOne - Cascade Types

Cascade type	Description
REMOVE	If entity is removed / deleted, related entity will also be deleted
PERSIST	If entity is persisted / saved, related entity will also be persisted
REFRESH	If entity is refreshed, related entity will also be refreshed
DETACH	If entity is detached (not associated w/ session), then related entity will also be detached
MERGE	If entity is merged, then related entity will also be merged
ALL	All of above cascade types

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Configure Cascade Type

```
@Entity
@Table(name="instructor")
public class Instructor {

    ...

    @OneToOne(cascade=CascadeType.ALL)
    @JoinColumn(name="instructor_detail_id")
    private InstructorDetail instructorDetail;

    ...
    // constructors, getters / setters
}
```

By default, no operations are cascaded.

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Configure Multiple Cascade Types

```
@OneToOne(cascade={CascadeType.DETACH,
                   CascadeType.MERGE,
                   CascadeType.PERSIST,
                   CascadeType.REFRESH,
                   CascadeType.REMOVE})
```

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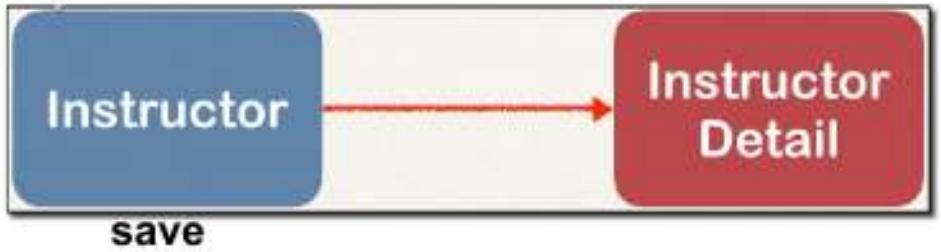
Step 4: Create Main App

```
public static void main(String[] args) {
    // create the objects
    Instructor tempInstructor = new Instructor("Chad", "Darby", "darby@javaweb.edu");
    InstructorDetail tempInstructorDetail =
    new InstructorDetail("http://www.javaweb.edu/youtube", "Java Web 4 coding!!!");

    // associate the objects
    tempInstructor.setInstructorDetail(tempInstructorDetail);

    // start a transaction
    session.beginTransaction();
    session.save(tempInstructor);

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



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Development Process: One-to-One

1. Prep Work

-

2. Create InstructorDetail class

3. Create Instructor class

4. Create Main App

Try to do **demo-10-Hibernate-one-to-one**

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New Use Case

- If we load an InstructorDetail,
- Then we'd like to get the associated Instructor.
- Can't do this with current uni-directional relationship :-(

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Bi-Directional relationship is the solution

- We can start with InstructorDetail and make it back to the Instructor

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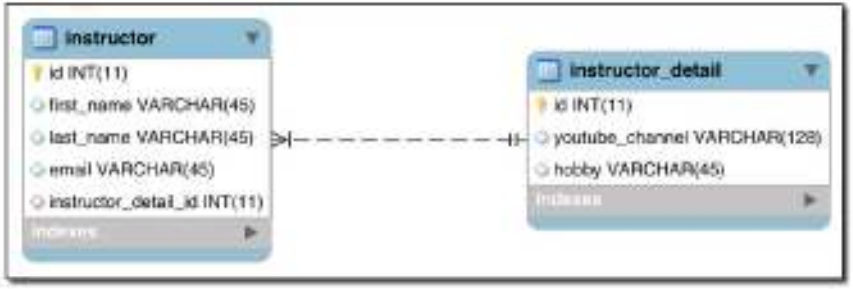
Bi-Directional - The Good News

- To use Bi-Directional, we can keep the existing database schema
  - No changes required to database
- Simply update the Java code



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Development Process: One-to-One (Bi-Directional)

1. Make updates to InstructorDetail class:

    a. Add new field to reference Instructor

    b. Add getter/setter methods for Instructor

    c. Add @OneToOne annotation

2. Create Main App

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Step 1.a: Add new field to reference Instructor

```
@Entity
@Table(name="instructor_detail")
public class InstructorDetail {
    ...

    private Instructor instructor;

}
```

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Step 1.b: Add getter/setter methods Instructor

```
@Entity
@Table(name="instructor_detail")
public class InstructorDetail {
    ...

    public Instructor getInstructor() {
        return instructor;
    }

    public void setInstructor(Instructor instructor) {
        this.instructor = instructor;
    }
    ...

}
```

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Step 1.c: Add @OneToOne annotation

```
@Entity
@Table(name="instructor_detail")
public class InstructorDetail {

    ...
    @OneToOne(mappedBy="instructorDetail")
    private Instructor instructor;

    public Instructor getInstructor() {
        return instructor;
    }

    public void setInstructor(Instructor instructor) {
        this.instructor = instructor;
    }
    ...
}
```

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More on mappedBy

```
public class InstructorDetail {
    ...

    @OneToOne(mappedBy="instructorDetail")
    private Instructor instructor;
```

mappedBy tells Hibernate

- Look at the instructorDetail property in the Instructor class
- Use information from the Instructor class @JoinColumn To help find associated instructor

```
public class Instructor {
    ...
    @OneToOne(cascade=CascadeType.ALL)
    @JoinColumn(name="instructor_detail_id")
    private InstructorDetail instructorDetail;
```

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Add support for Cascadi

Cascade all operations

```
@Entity
@Table(name="instructor_detail")
public class InstructorDetail {
    …
    @OneToOne(mappedBy="instructorDetail", cascade=CascadeType.ALL)
    private Instructor instructor;
    public Instructor getInstructor() {
        return instructor;
    }
    public void setInstructor(Instructor instructor) {
        this.instructor = instructor;
    }
    …

}
```

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Step 2: Create Main App

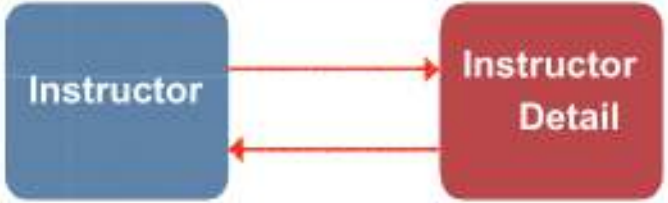
```
public static void main(String[] args) {
    …

    // get the instructor detail object
    int theId = 1;
    InstructorDetail tempInstructorDetail =
session.get(InstructorDetail.class, theId);

    // print detail
    System.out.println("tempInstructorDetail: " + tempInstructorDetail);

    // print the associated instructor
    System.out.println("the associated instructor: "
            + tempInstructorDetail.getInstructor());

    …
}
```



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Assignment 17

Make an implementation of @OneToOne in the bidirectional way using the sides code

Deadline: 2019-November-21

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Hibernate Advanced Mappings - @OneToMany

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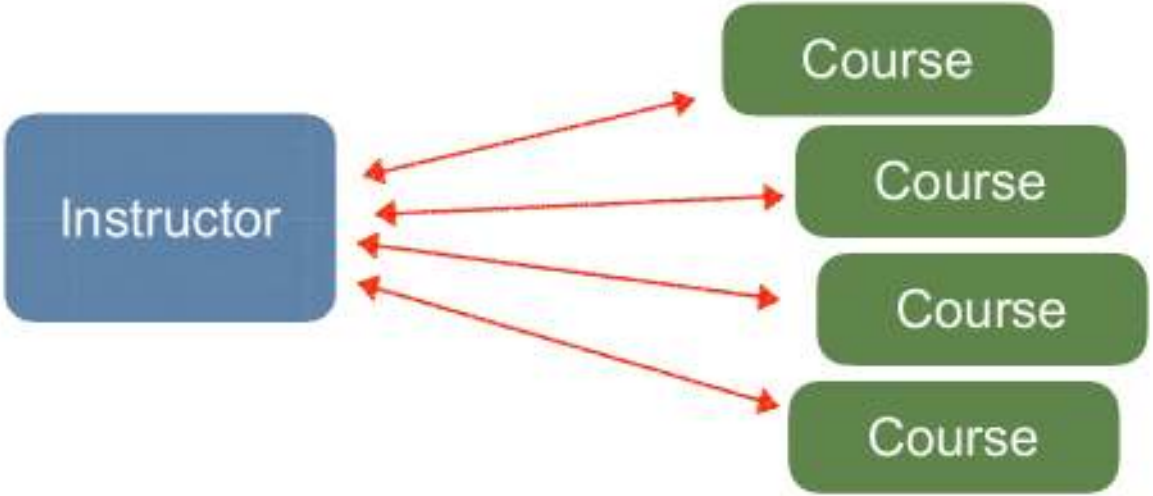
Development Process

- An instructor can have many courses

  a. Bi-directional



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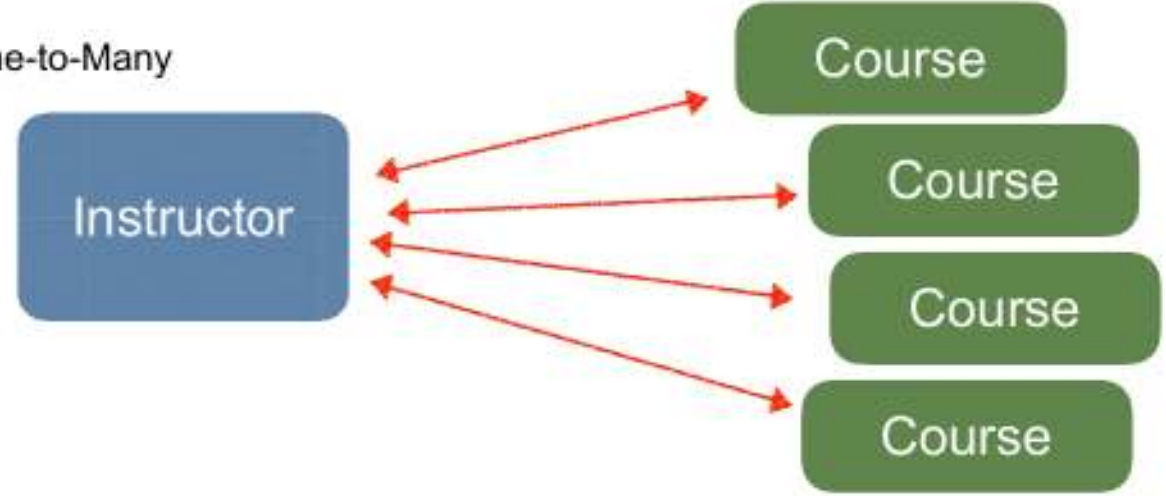
Development Process

- Many courses can have one instructor

  a. Inverse / opposite of One-to-Many



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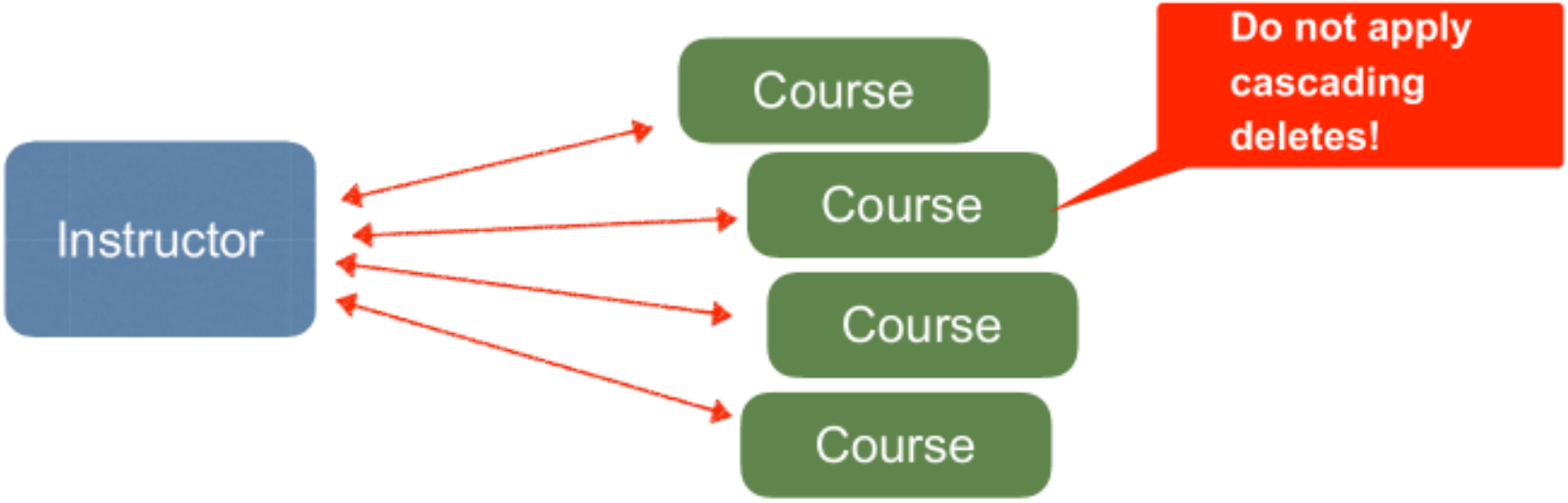
Real-World Project Requirement

- If you delete an instructor, DO NOT delete the courses
- If you delete a course, DO NOT delete the instructor



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Development Process: One-to-Many

1. Prep Work - Define database tables
2. Create Course class
3. Update Instructor class
4. Create Main App

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table: course

File: create-db.sql

```
CREATE TABLE `course` (
    `id` int(11) NOT NULL AUTO_INCREMENT,
    `title` varchar(128) DEFAULT NULL,
    `instructor_id` int(11) DEFAULT NULL,

    PRIMARY KEY (`id`),

    UNIQUE KEY `TITLE_UNIQUE` (`title`),
    ...
);
```

Prevent duplicate course

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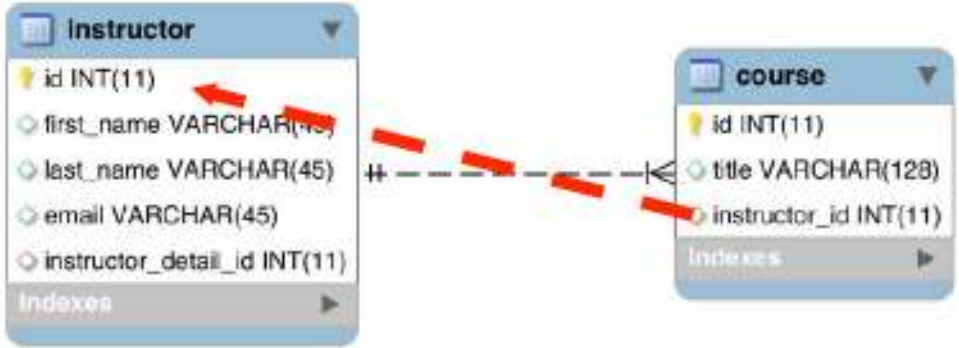
table: course - foreign key

File: create-db.sql

```
CREATE TABLE `course` (
    ...
    KEY `FK_INSTRUCTOR_idx` (`instructor_id`),
    CONSTRAINT `FK_INSTRUCTOR`
    FOREIGN KEY (`instructor_id`)
    REFERENCES `instructor` (`id`)
    ...
);
```



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Step 2: Create Course class

```
@Entity
@Table(name="course")
public class Course {

    @Id
    @GeneratedValue(strategy=GenerationType.IDENTITY)
    @Column(name="id")
    private int id;

    @Column(name="title")
    private String title;

    ...
    // constructors, getters / setters

}
```

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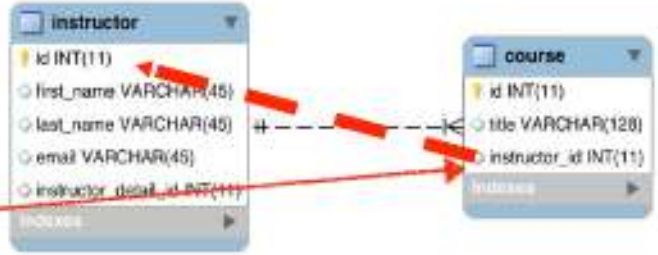
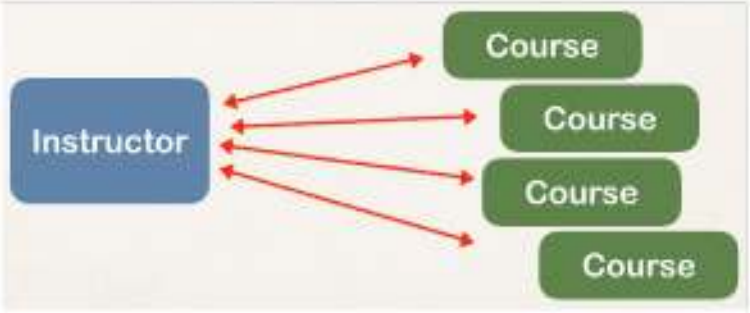
Step 2: Create Course class - @ManyToOne

```
@Entity
@Table(name="course")
public class Course {
    ...

    @ManyToOne
    @JoinColumn(name="instructor_id")
    private Instructor instructor;

    ...
    // constructors, getters / setters
}
```





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Step 3: Update Instructor - reference courses

```
@Entity  @Table(name="instructor")
public class Instructor {
…

private List<Course> courses;

  public List<Course> getCourses() {
      return courses;
  }

  public void setCourses(List<Course> courses) {
      this.courses = courses;
  }
  …
}
```

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Add @OneToMany annotation

```
@Entity  @Table(name="instructor")
public class Instructor {
…

   @OneToMany(mappedBy="instructor")
   private List<Course> courses;


   public List<Course> getCourses() {
       return courses;
   }

   public void setCourses(List<Course> courses) {
       this.courses = courses;
   }
   …
```

Refers to “instructor” property in “Course” class

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Add @OneToMany annotation

mappedBy tells Hibernate

- Look at the instructor property in the Course class
- Use information from the Course class @JoinColumn
- To help find associated courses for instructor

```
public class Instructor {
    ...
    @OneToMany(mappedBy="instructor")
    private List<Course> courses;
```

```
public class Course {
    ...
    @ManyToOne
    @JoinColumn(name="instructor_id")
    private Instructor instructor;
```

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Add support for Cascading

```
@Entity
@Table(name="instructor")
public class Instructor {
    …

    @OneToMany(mappedBy="instructor",
        cascade={CascadeType.PERSIST, CascadeType.MERGE
        CascadeType.DETACH, CascadeType.REFRESH})
    private List<Course> courses;

    …

}
```

Do not apply cascading deletes!

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Add support for Cascading

```
@Entity
@Table(name="course")
public class Course {
    …
    @ManyToOne(cascade={CascadeType.PERSIST,
        CascadeType.MERGE  CascadeType.DETACH, CascadeType.REFRESH})
    @JoinColumn(name="instructor_id")
    private Instructor instructor;
    …
    // constructors, getters / setters

}
```

Do not apply cascading deletes!

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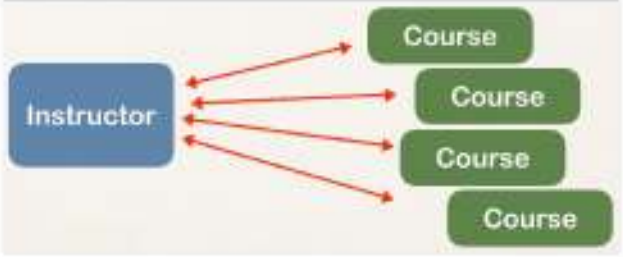
Add convenience methods for bi-directional

```
@Entity
@Table(name="instructor")
public class Instructor {
    …
    // add convenience methods for bi-directional relationship
    public void add(Course tempCourse) {
        if (courses == null) {
            courses = new ArrayList<>();
        }
    courses.add(tempCourse);

    tempCourse.setInstructor(this);

    }
    …
}
```



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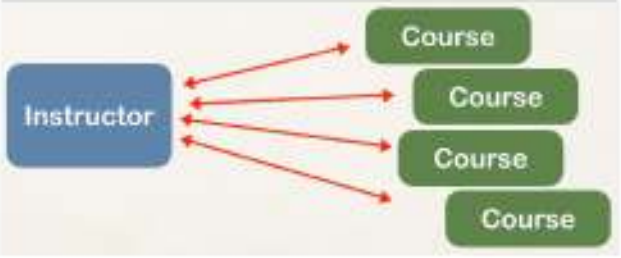
Step 4: Create Main App

```
public static void main(String[] args) {

    …
    // get the instructor object
    int theId = 1;
    Instructor tempInstructor = session.get(Instructor.class, theId);

    // print instructor
    System.out.println("tempInstructor: " + tempInstructor);

    // print the associated courses
    System.out.println("courses: " + tempInstructor.getCourses());
    …
}
```



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Assignment 18

Make an implementation of @OneToMany in the bidirectional way using the sides code

Deadline: 2019-November-21

Topic 3, Hibernate Advanced Mappings - Eager vs Lazy Loading

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Hibernate Advanced Mappings - Fetch Types: Eager vs Lazy Loading

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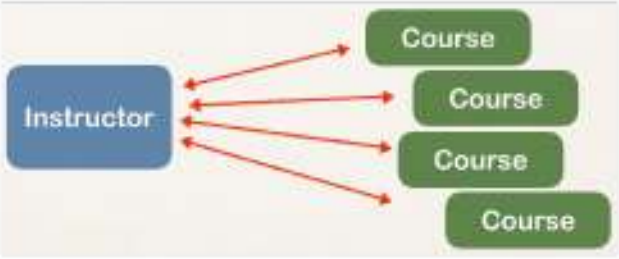
Fetches types

When we fetch / retrieve data, should we retrieve EVERYTHING?

- **Eager** will retrieve everything
- **Lazy** will retrieve on request



Topic 3, Hibernate Advanced Mappings - Eager vs Lazy Loading

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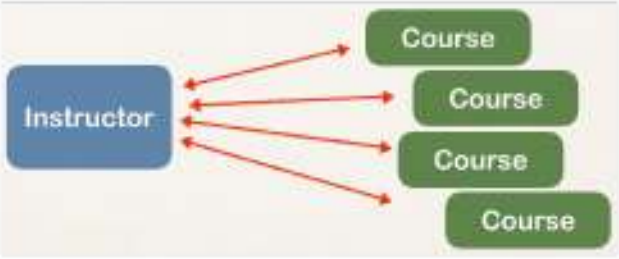
Eager Loading

- Eager loading will load all dependent entities

- Load instructor and all of their courses at once



Topic 3, Hibernate Advanced Mappings - Eager vs Lazy Loading

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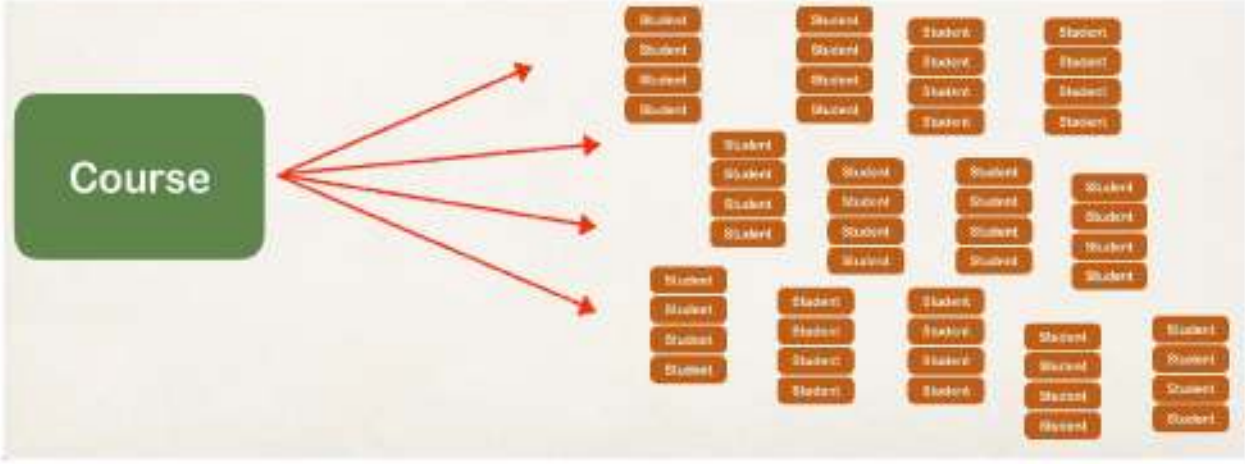
Eager Loading

- What about course and students?
- Could easily turn into a performance nightmare ….



Topic 3, Hibernate Advanced Mappings - Eager vs Lazy Loading

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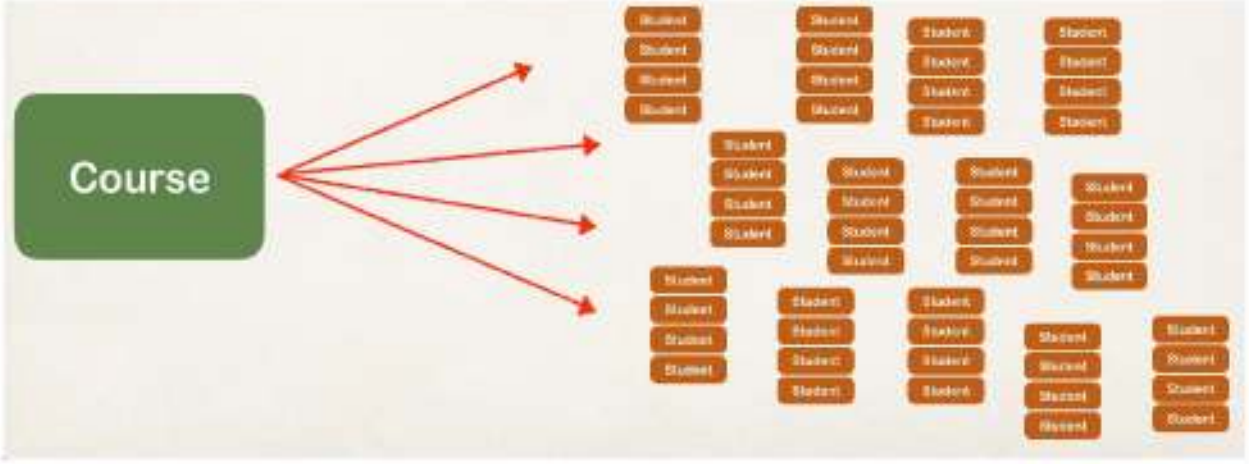
Eager Loading

- In our app, if we are searching for a course by keyword
  a. Only want a list of matching courses
- Eager loading would still load **all students** for **each course** …. not good!



Topic 3, Hibernate Advanced Mappings - Eager vs Lazy Loading

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Eager Loading

Best Practice

Only load data when absolutely needed

Prefer Lazy loading
instead of

Eager loading

Topic 3, Hibernate Advanced Mappings - Eager vs Lazy Loading

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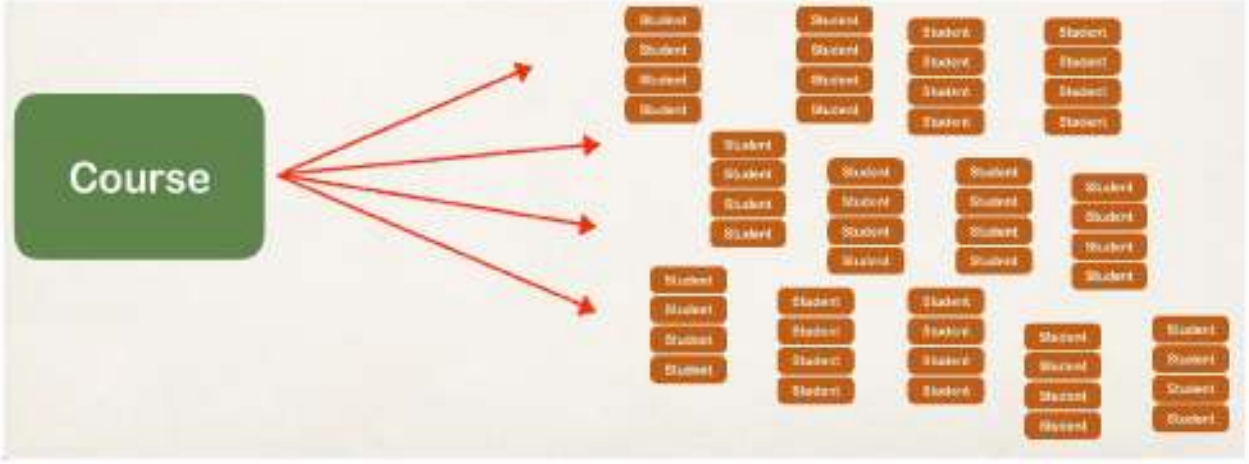
Eager Loading

- In our app, if we are searching for a course by keyword
  a. Only want a list of matching courses
- Eager loading would still load **all students** for **each course** …. not good!



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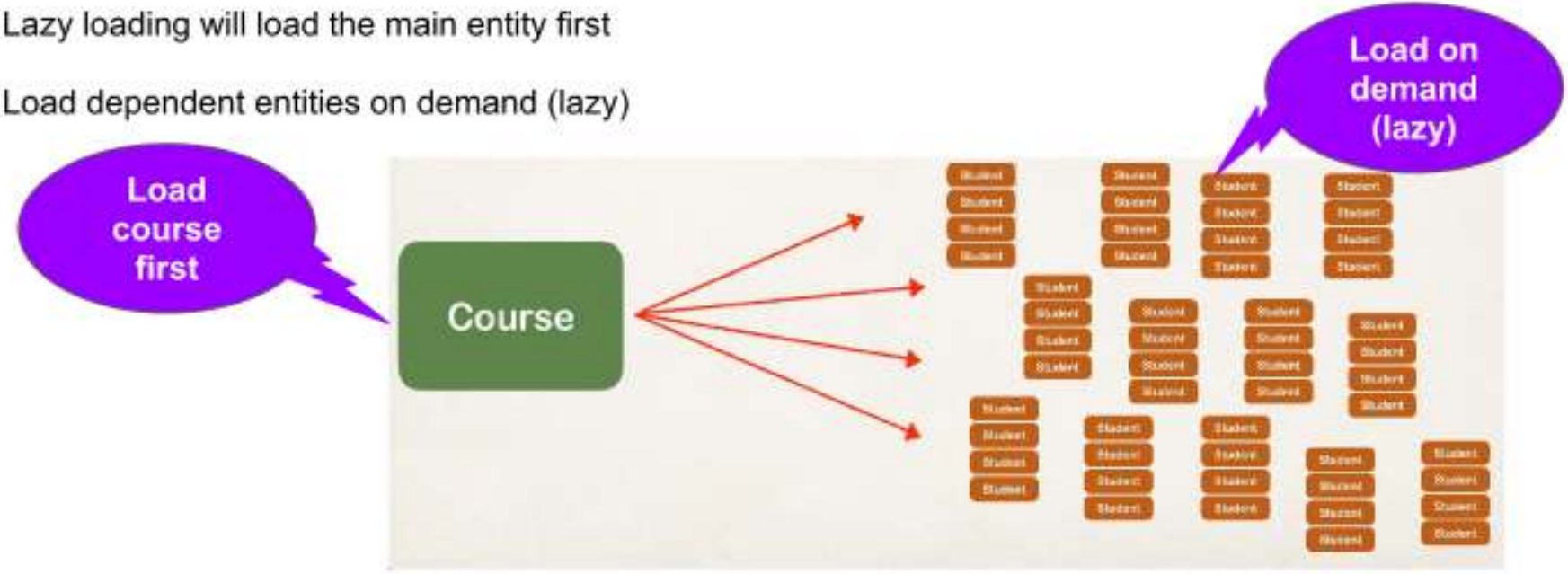
Lazy Loading

- Lazy loading will load the main entity first
- Load dependent entities on demand (lazy)



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Real-World Use Case

Search for instructors

Javaweb academy

Search for Instructors | Go

Last Name	First Name	Email	Action
Public	Mary	mary@javaweb.edu	View Details
Doe	John	john@javaweb.edu	View Details
Rao	Ajay	ajay@javaweb.edu	View Details
Kublanov	Victor	victor@javaweb.edu	View Details
O'Keefe	Paul	paul@javaweb.edu	View Details
Peterson	Anthony	anthony@javaweb.edu	View Details
Patel	Trupti	trupti@javaweb.edu	View Details

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Real-World Use Case: Master view

- In Master view, use lazy loading
- In Detail view, retrieve the entity and necessary dependent entities
- In Master view, use lazy loading for search results
- Only load instructors … not their courses

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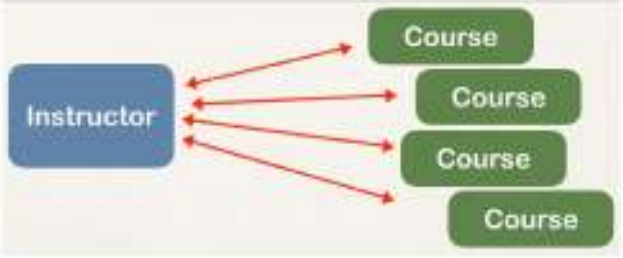
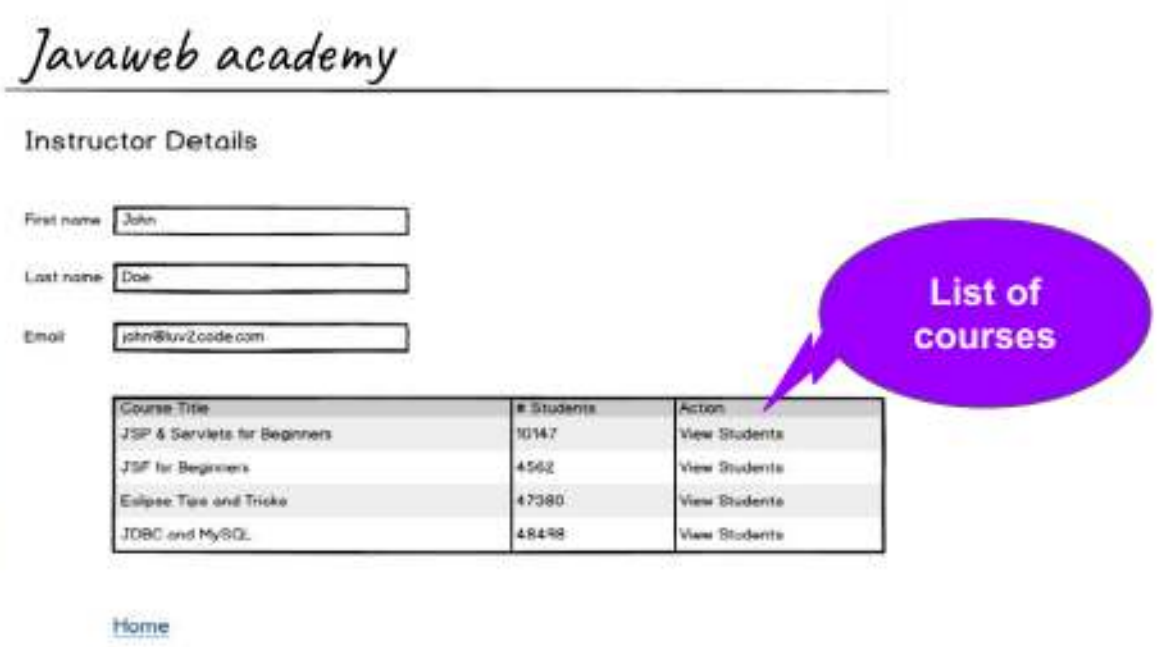
Real-World Use Case: Detail view

- In Detail view, retrieve the entity and necessary dependent entities
- Load instructor AND their courses





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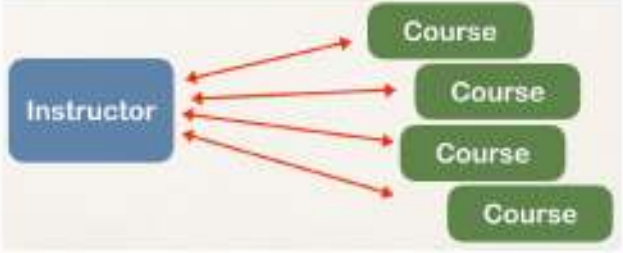
Fetch Type

- When you define the mapping relationship
- You can specify the fetch type: EAGER or LAZY

```
@Entity
@Table(name="instructor")
public class Instructor {
    …

    @OneToMany(fetch=FetchType.LAZY, mappedBy="instructor")
    private List<Course> courses;

    …
}
```



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Default Fetch Types

Mapping	Default Fetch Type
@OneToOne	FetchType.EAGER
@OneToMany	FetchType.LAZY
@ManyToOne	FetchType.EAGER
@ManyToMany	FetchType.LAZY

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Overriding Default Fetch Type

Specifying the fetch type, overrides the defaults

```
@ManyToOne(fetch=FetchType.LAZY)
@JoinColumn(name="instructor_id")
private Instructor instructor;
```

Mapping	Default Fetch Type
@ManyToOne	FetchType.EAGER

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More about Lazy Loading

- When you lazy load, the data is only retrieved on demand
- However, this requires an open Hibernate session
    - need an connection to database to retrieve data

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More about Lazy Loading

- If the Hibernate session is closed
  - And you attempt to retrieve lazy data
  - Hibernate will throw an exception

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More about Lazy Loading

- To retrieve lazy data, you will need to open a Hibernate session
- Retrieve lazy data using
    - Option 1: session.get and call appropriate getter method(s)
    - Option 2: Hibernate query with HQL
- Many other techniques available but the two above are most common

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Hibernate Advanced Mappings - @OneToMany - Unidirectional

Topic 3, Hibernate Advanced Mappings - @OneToMany - Unidirectional

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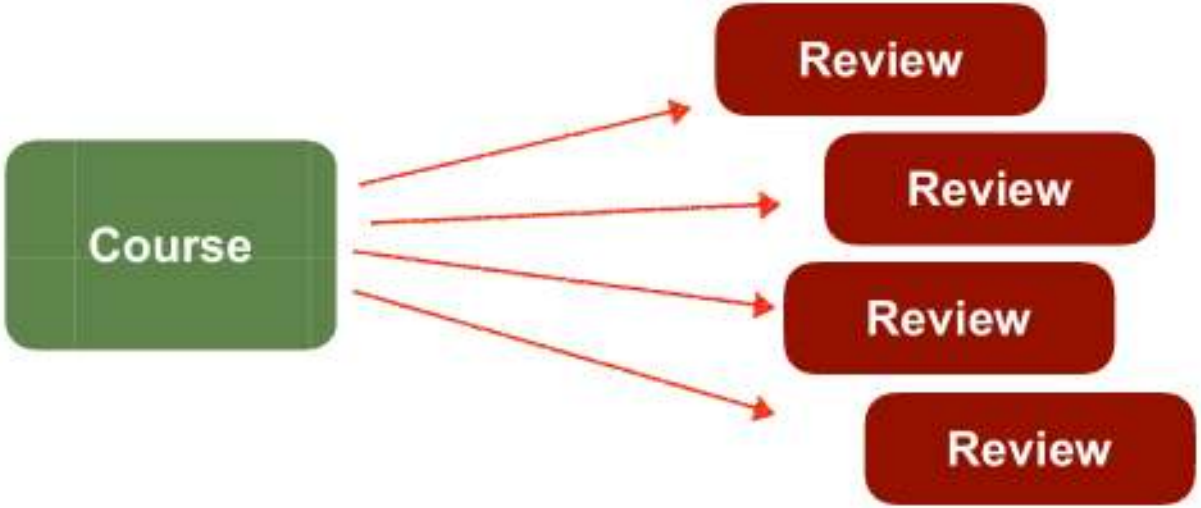
One-to-Many Mapping

- A course can have many reviews
  a. Uni-directional



Topic 3, Hibernate Advanced Mappings - @OneToMany - Unidirectional

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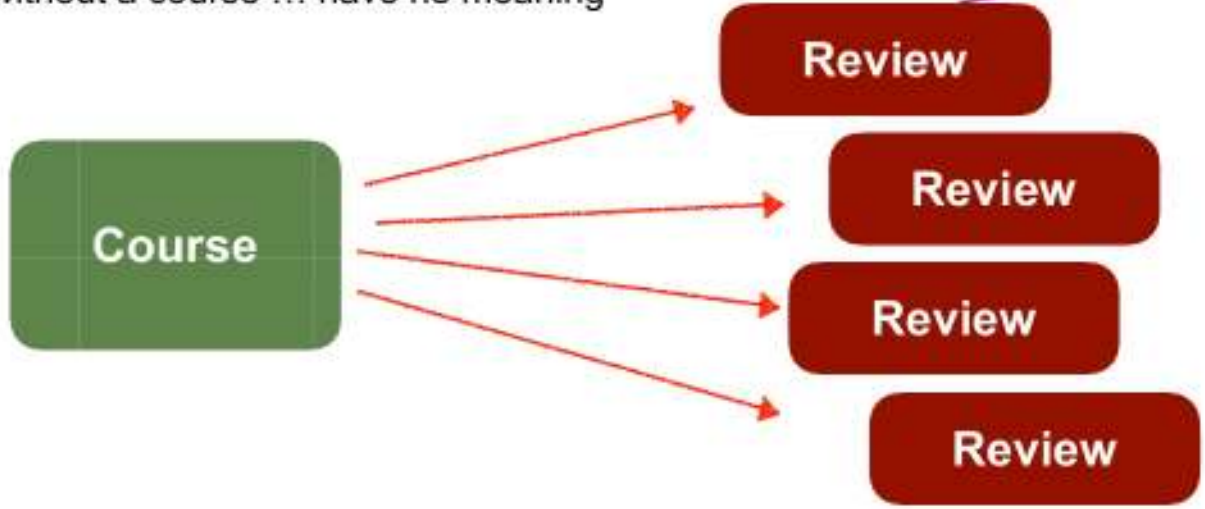
One-to-Many Mapping

- If you delete a course, also delete the reviews
- Reviews without a course … have no meaning

Apply cascading deletes!



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@OneToMany

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Look Mom … our project is growing!

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Development Process: One-to-Many

1. Prep Work - Define database tables
2. Create **Review** class
3. Update **Course** class
4. Create Main App

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table: review

File: create-db.sql

```
CREATE TABLE `review` (

    `id` int(11) NOT NULL AUTO_INCREMENT,
    `comment` varchar(256) DEFAULT NULL,
    `course_id` int(11) DEFAULT NULL,

    ...
);
```

comment:
"Wow ... this course awesome!"

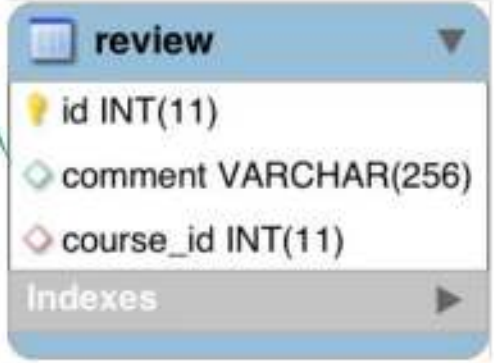

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table: review - foreign key

File: create-db.sql

```
CREATE TABLE `review` (
    ...
    KEY `FK_COURSE_ID_idx` (`course_id`),
    CONSTRAINT `FK_COURSE`
    FOREIGN KEY (`course_id`)
    REFERENCES `course` (`id`)
    ...
);
```

Table

Column

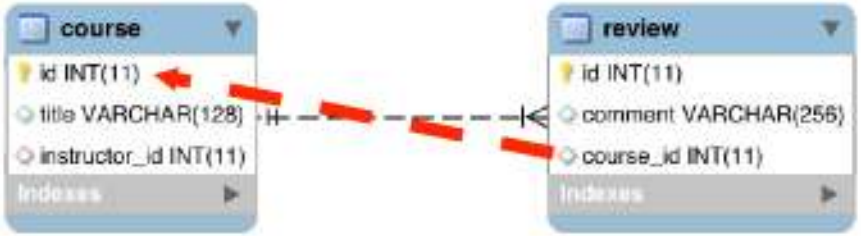

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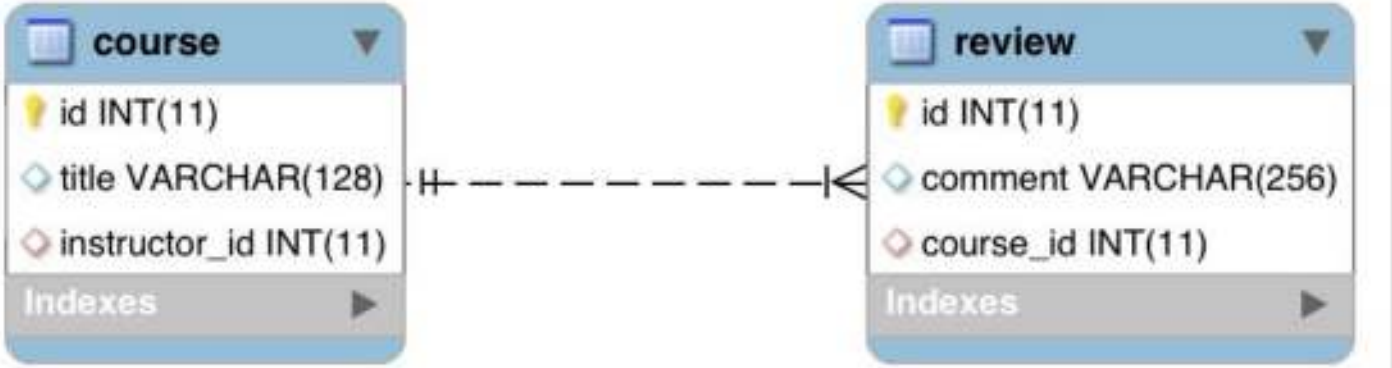
table: course - no changes



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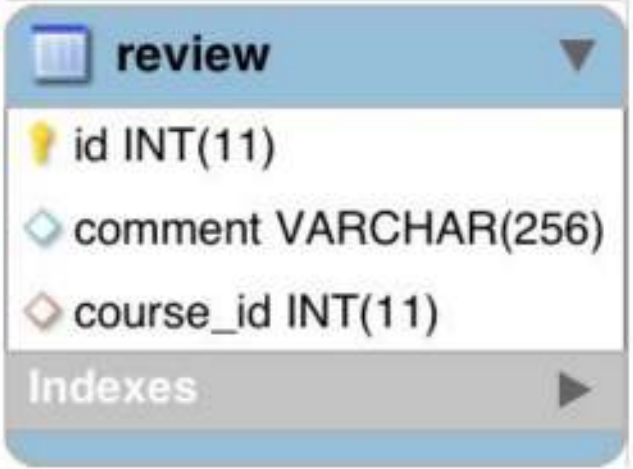
Step 2: Create Review class

```
@Entity
@Table(name="review")
public class Review {

    @Id  @GeneratedValue(strategy=GenerationType.IDENTITY)
    @Column(name="id")
    private int id;

    @Column(name="comment")
    private String comment;

    ...
    // constructors, getters / setters
}
```



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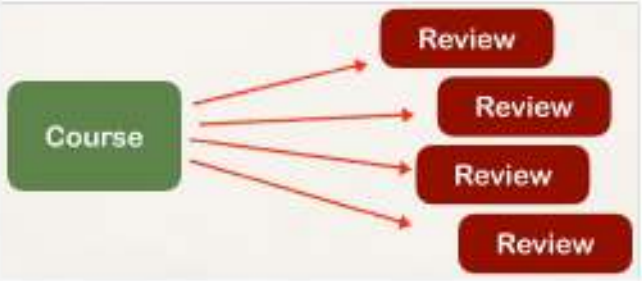
Step 3: Update Course - reference reviews

```
@Entity  @Table(name="course")
public class Course {
    ...

    private List<Review> reviews;

    // getter / setters
    ...

}
```



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Add @OneToMany annotation

```
@Entity  @Table(name="course")
public class Course {
    …


    @OneToMany
    @JoinColumn(name="course_id")
    private List<Review> reviews;

    // getter / setters
    …

}
```

Refers to “course_id” column in “review” table

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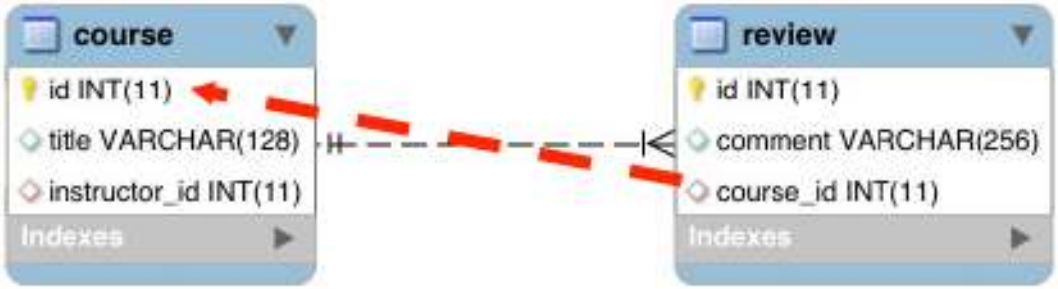
More: @JoinColumn

- In this scenario, @JoinColumn tells Hibernate
  - Look at the course_id column in the **review** table
  -
  - Use this information to help find associated reviews for a course




```
public class Course {
    …

    @OneToMany
    @JoinColumn(name="course_id")
    private List<Review> reviews;
```

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Add support for Cascading

```
@Entity  @Table(name="course")
public class Course {
    …

    @OneToMany(cascade=CascadeType.ALL)
    @JoinColumn(name="course_id")
    private List<Review> reviews;

    …

}
```

Cascade all operations including deletes!

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Add support for Lazy loading

Lazy load the reviews

```
@Entity  @Table(name="course")
public class Course {
    …

    @OneToMany(fetch=FetchType.LAZY, cascade=CascadeType.ALL)
    JoinColumn(name="course_id")
    private List<Review> reviews;

    …

}
```

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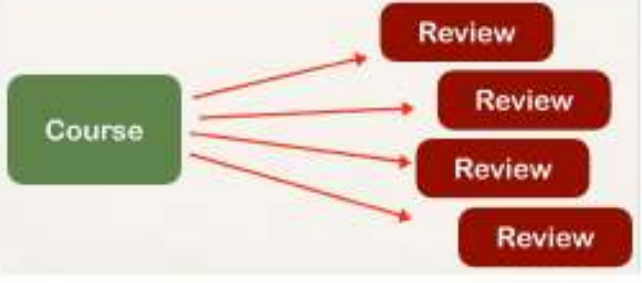
Add convenience method for adding review

```
@Entity  @Table(name="course")
public class Course {

    …
    // add convenience methods for adding reviews
    public void add(Review tempReview) {
        if (reviews == null) {
            reviews = new ArrayList<>();
        }

    reviews.add(tempReview);

    }
    …
}
```



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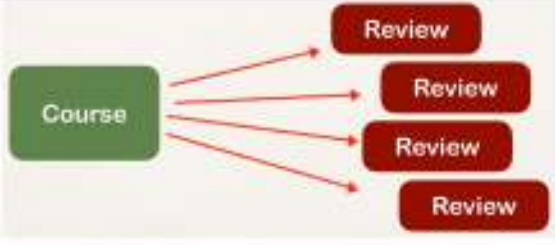
Step 4: Create Main App

```
public static void main(String[] args) {
    …

    // get the course object
    int theId = 10;
    Course tempCourse = session.get(Course.class, theId);

    // print the course
    System.out.println("tempCourse: " + tempCourse);

    // print the associated reviews
    System.out.println("reviews: " + tempCourse.getReviews());
    …
}
```



Lazy load the reviews

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Hibernate Advanced Mappings - @ManyToMany

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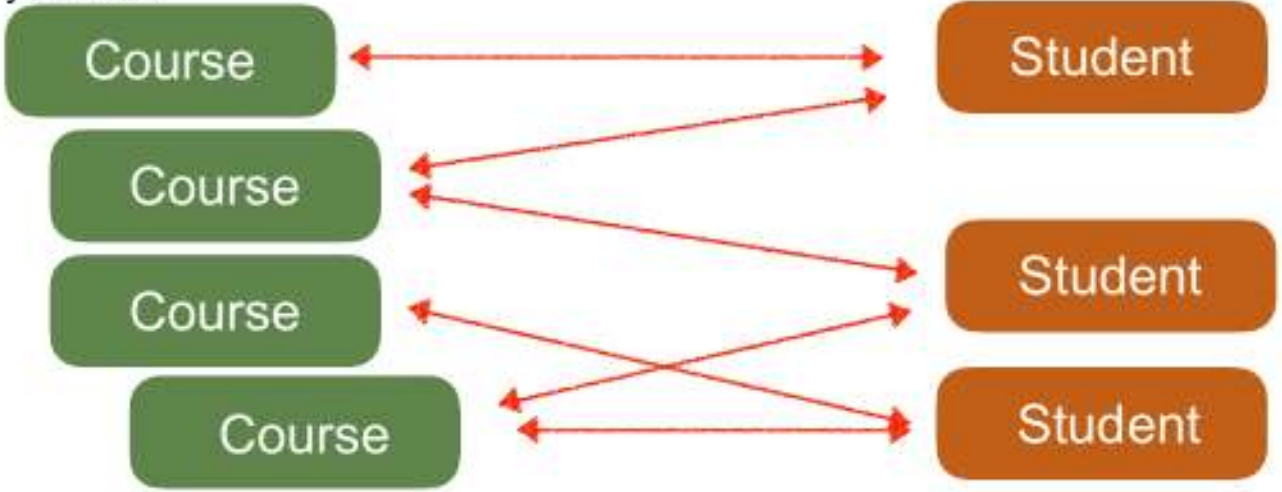
Many-to-Many Mapping

- A course can have many students
- A student can have many courses



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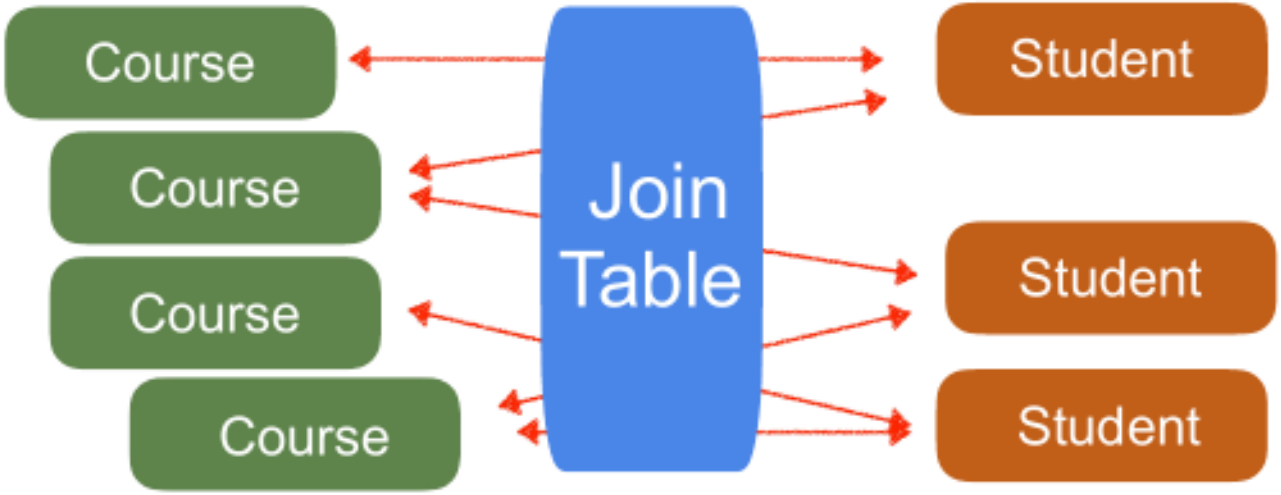
Keep track of relationships

- Need to track which student is in which course and vice-versa



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Join Table

A table that provides a mapping between two tables.

**It has foreign keys for each table
to define the mapping relationship.**

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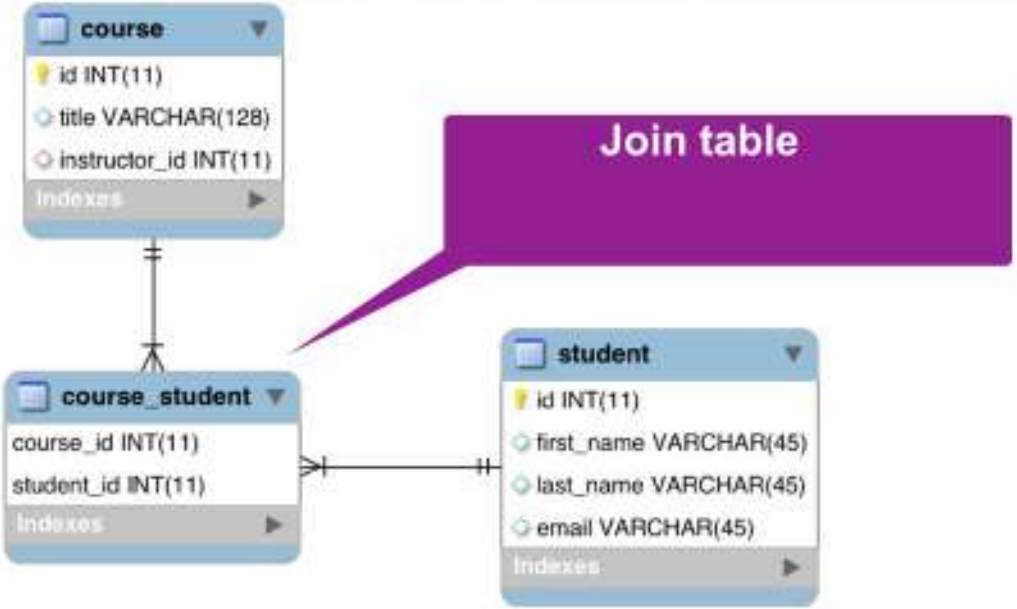
@ManyToMany



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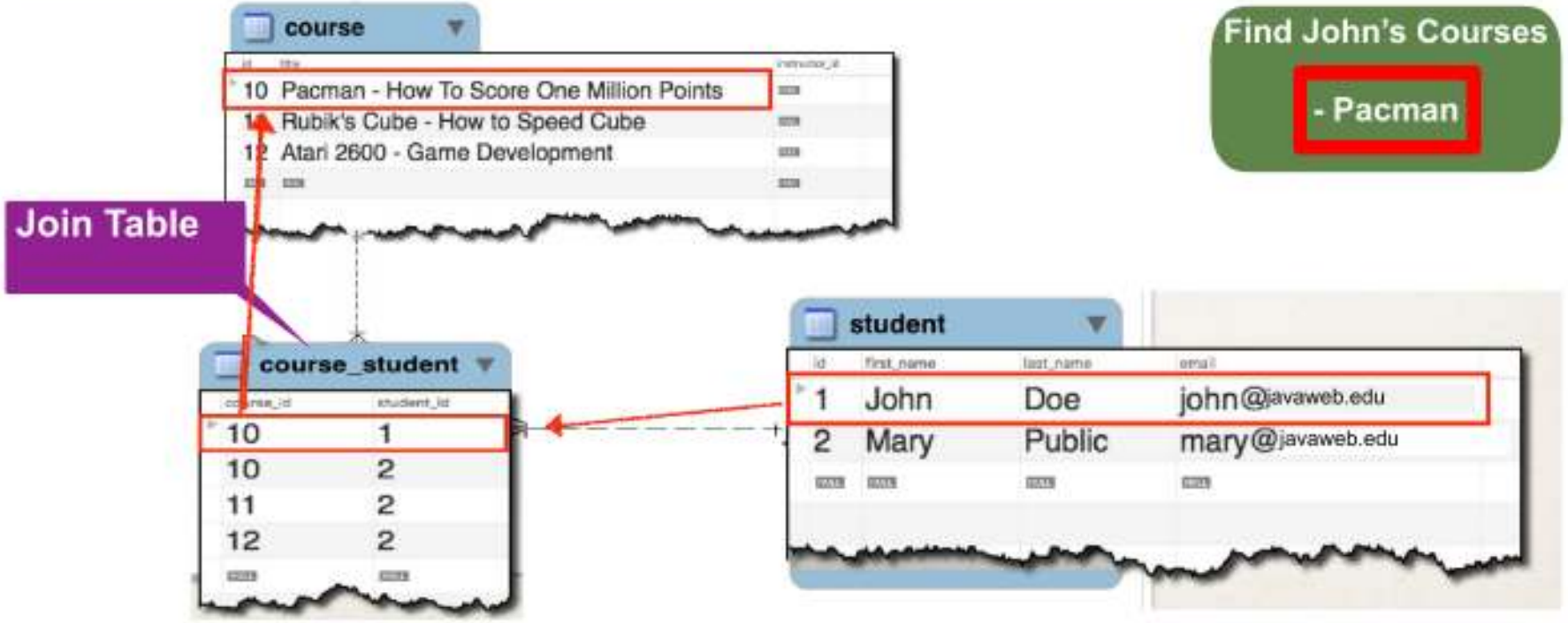
Join Table Example



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Development Process: Many-to-Many

1. Prep Work - Define database tables
2. Update Course class
3. Update Student class
4. Create Main App

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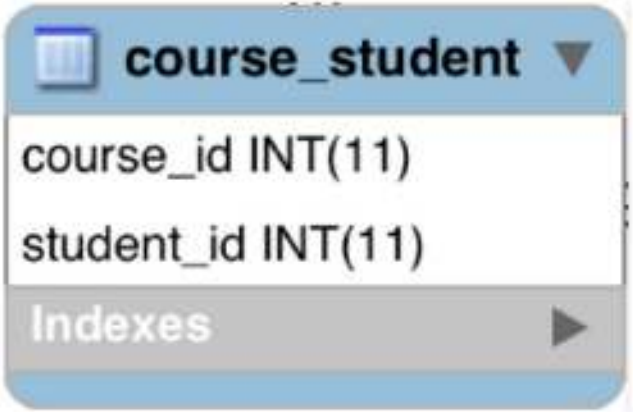
join table: course_student

File: create-db.sql

```
CREATE TABLE `course_student` (
    `course_id` int(11) NOT NULL,
    `student_id` int(11) NOT NULL,
    PRIMARY KEY (`course_id`, `student_id`),
    ...
);
```



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join table: course_student - foreign keys

File: create-db.sql

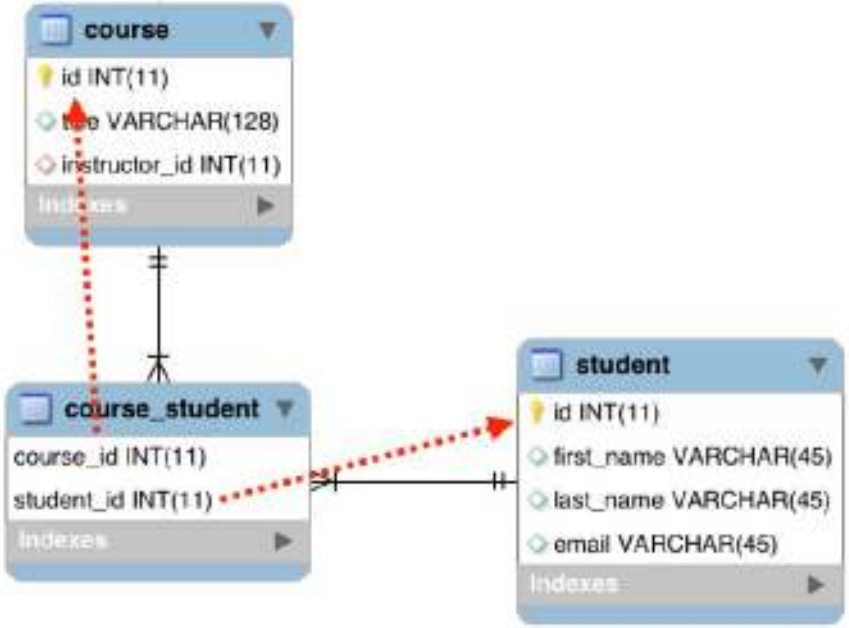
```
CREATE TABLE `course_student` (
    ...
    CONSTRAINT `FK_COURSE_05`
    FOREIGN KEY (`course_id`)
    REFERENCES `course` (`id`),

    CO  `FK_STUDENT`

    FOREIGN KEY (`student_id
    REFERENCES `student` (`id`),
    ...
);
```

Column

Table

Column

Table



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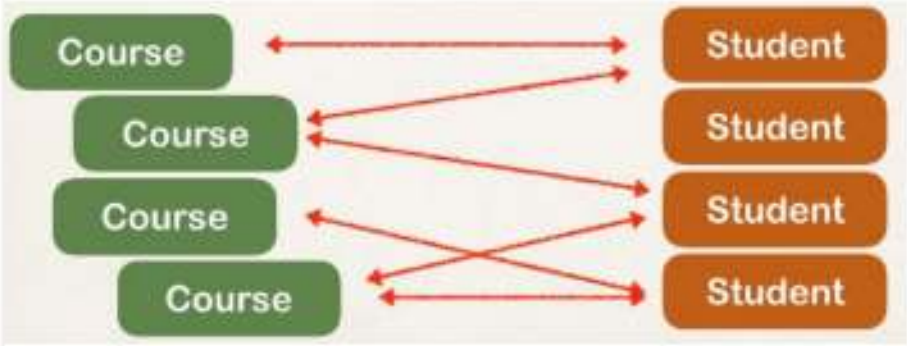
Step 2: Update Course - reference students

```
@Entity
@Table(name="course")
public class Course {
    ...

    private List<Student> students;

    // getter / setters
    ...

}
```



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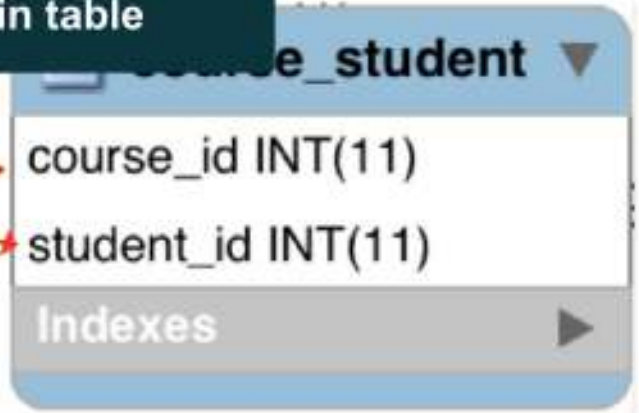
Add @ManyToMany

```
@Entity
@Table(name="course")
public class Course {
   ...
   @ManyToMany
   @JoinTable(
   name="course_student",
   joinColumns=@JoinColumn(name="course_id"),
   inverseJoinColumns=@JoinColumn(name="student_id"),
   )
   private List<Student> students;

   // getter / setters
}
```

Refers to "course_id" column in "course_

Refers to "student_id" column in "course_student" join table



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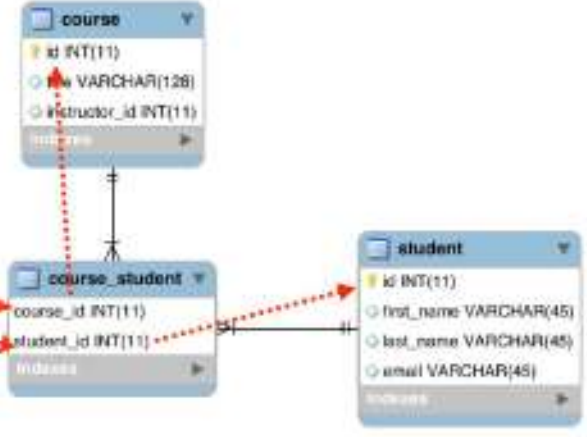
More: @JoinTable

@JoinTable tells Hibernate

- Look at the **course_id** column in the **course_student** table
- For other side (inverse), look at the **student_id** column in the **course_student** table
- Use this information to find relationship between **course** and **students**

```
public class Course {
    @ManyToMany
    @JoinTable(
        name="course_student",
        joinColumns=@JoinColumn(name="course_id"),
        inverseJoinColumns=@JoinColumn(name="student_id")
        )
    private List<Student> students;
}
```



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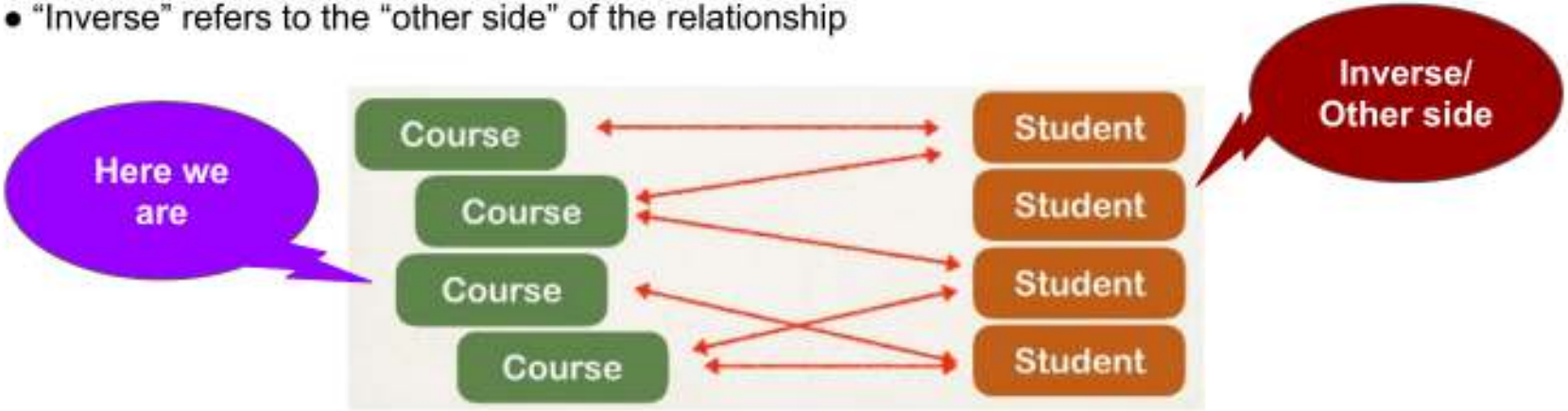
More on "inverse"

- In this context, we are defining the relationship in the **Course** class
- The **Student** class is on the "other side" … so it is considered the "inverse"
- "Inverse" refers to the "other side" of the relationship



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Now, let's do a similar thing for Student

just going the other way …

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Step 3: Update Student - reference courses

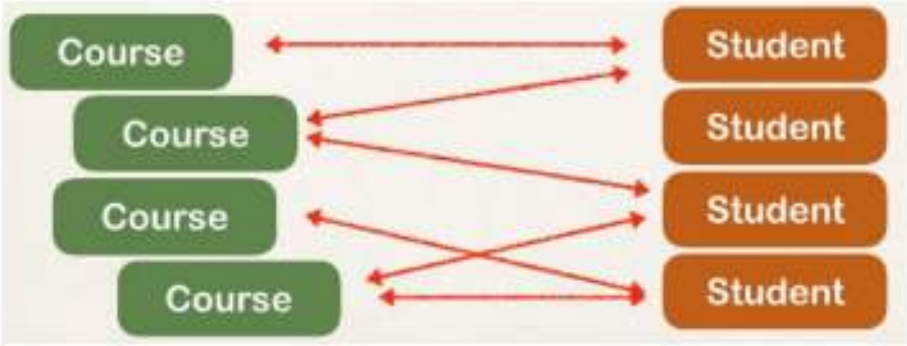
```
@Entity

   @Table(name="student")
   public class Student {
   …

   private List<Course> courses;

   // getter / setters
   …

}
```



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Add @ManyToMany

```
@Entity
@Table(name="student")
public class Student {
    ...
    @ManyToMany
    @JoinTable(
        name="course_student",
        joinColumns=@JoinColumn(name="student_id"),
        inverseJoinColumns=@JoinColumn(name="course_id")
        )
    private List<Course> courses;
    // getter / setters
}
```

Refers to “student_id” column in “course_student“ join table

column in table

_student

course_id INT(11)

student_id INT(11)

Indexes

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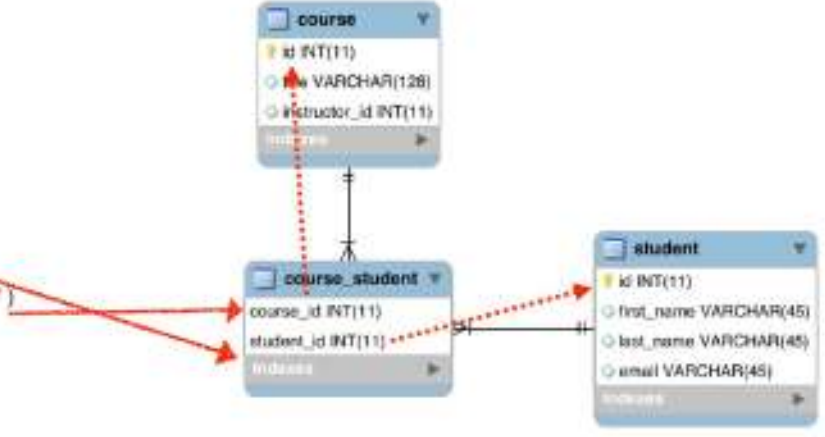
More: @JoinTable

@JoinTable tells Hibernate

- Look at the **student_id** column in the **course_student** table
- For other side (inverse), look at the **course_id** column in the **course_student** table
- Use this information to find relationship between **course** and **students**

```
public class Student {
    @ManyToMany
    @JoinTable(
        name="course_student",
        joinColumns=@JoinColumn(name="student_id"),
        inverseJoinColumns=@JoinColumn(name="course_id")
        )
    private List<Courses> courses;
}
```



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More on "inverse"

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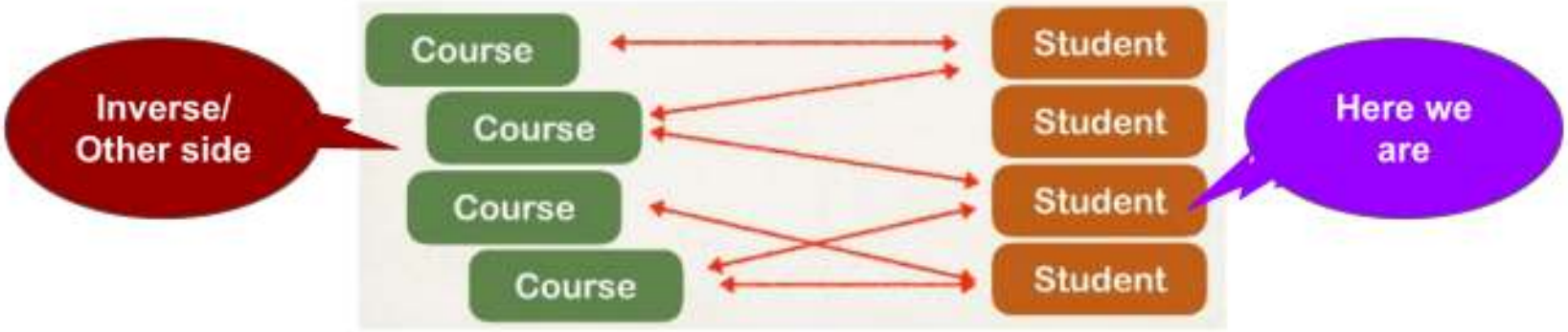

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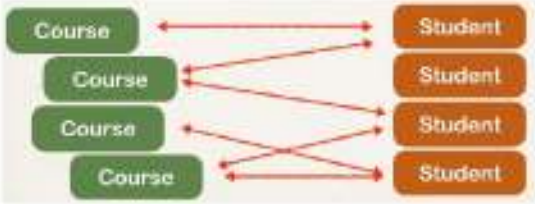
Step 4: Create Main App

```
public static void main(String[] args) {
    …
    // get the course object
    int theId = 10;
    Course tempCourse = session.get(Course.class, theId);

    // print the course
    System.out.println("tempCourse: " + tempCourse);

    // print the associated students
    System.out.println("students: " + tempCourse.getStudents());
    …
}
```



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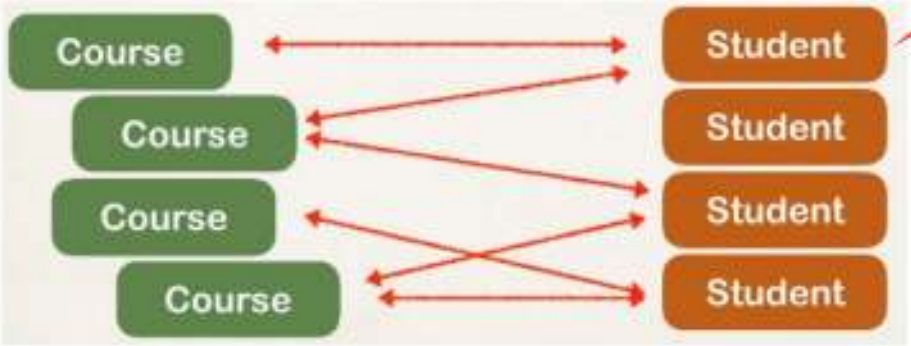
Real-World Project Requirement

- If you delete a course, DO NOT delete the students

DO NOT apply cascading deletes!



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Other features

In the next set of lectures, we'll add support for other features

- **Lazy Loading** of students and courses
- **Cascading** to handle cascading saves … but NOT deletes
    a. If we delete a course, DO NOT delete students
    b. If we delete a student, DO NOT delete courses

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Assignment 19

Make an implementation of @ManyToMany in the bidirectional way using the sides code

Deadline: 2019-November-21