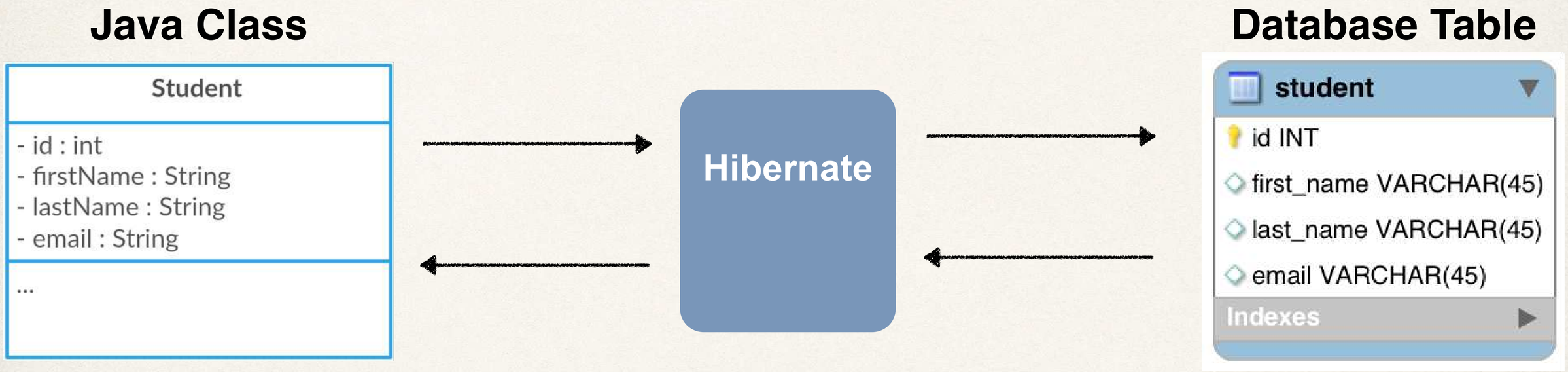
JPA / Hibernate
Advanced Mappings

Basic Mapping



Advanced Mappings

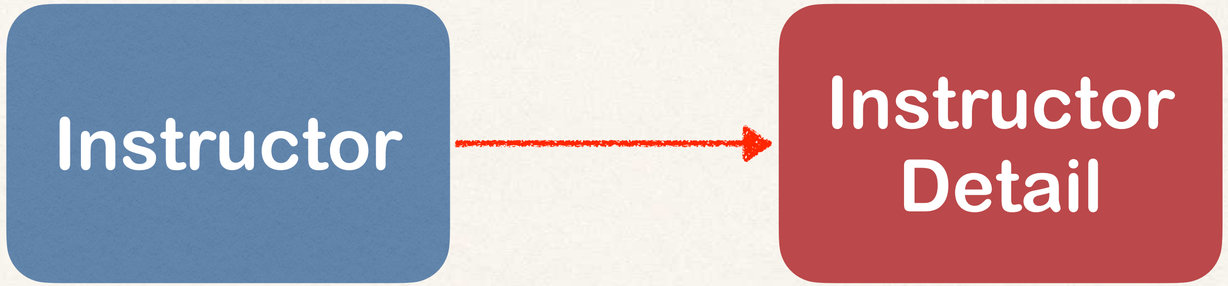
- In the database, you most likely will have
  - Multiple Tables
  - Relationships between Tables
- Need to model this with Hibernate

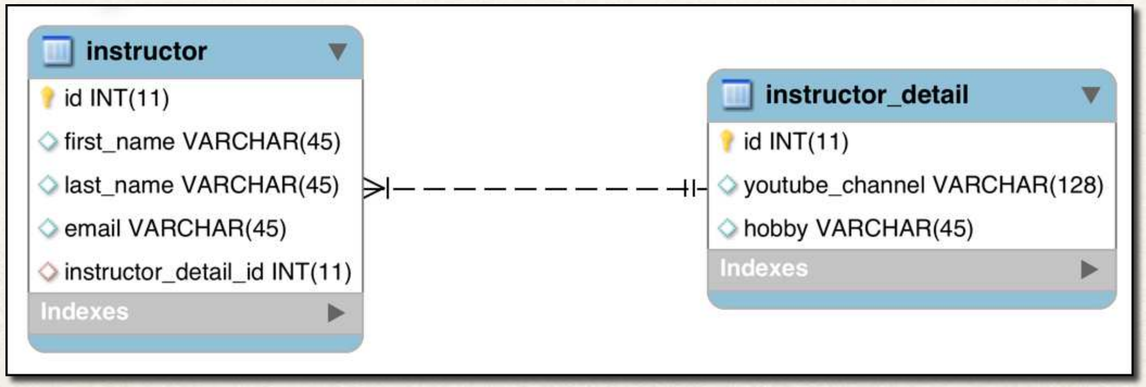
Advanced Mappings

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

One-to-One Mapping

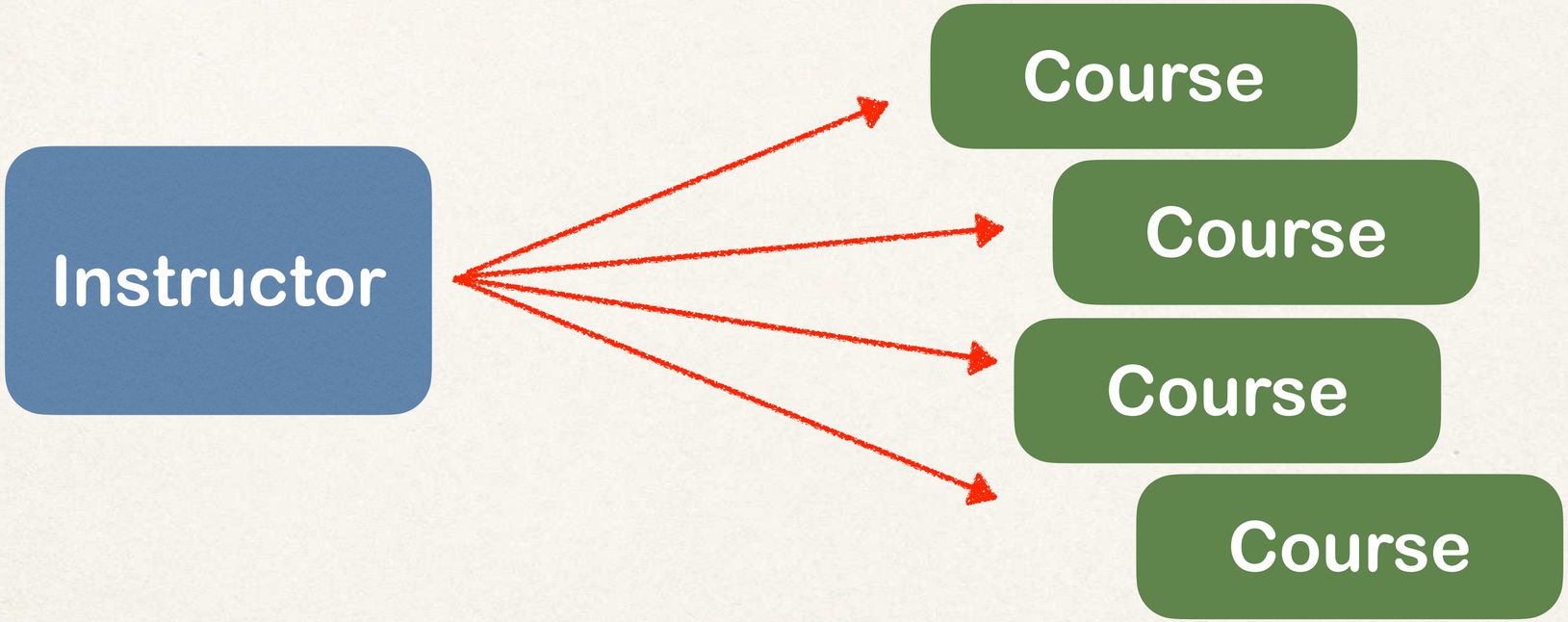
- An instructor can have an “instructor detail” entity
  - Similar to an “instructor profile”





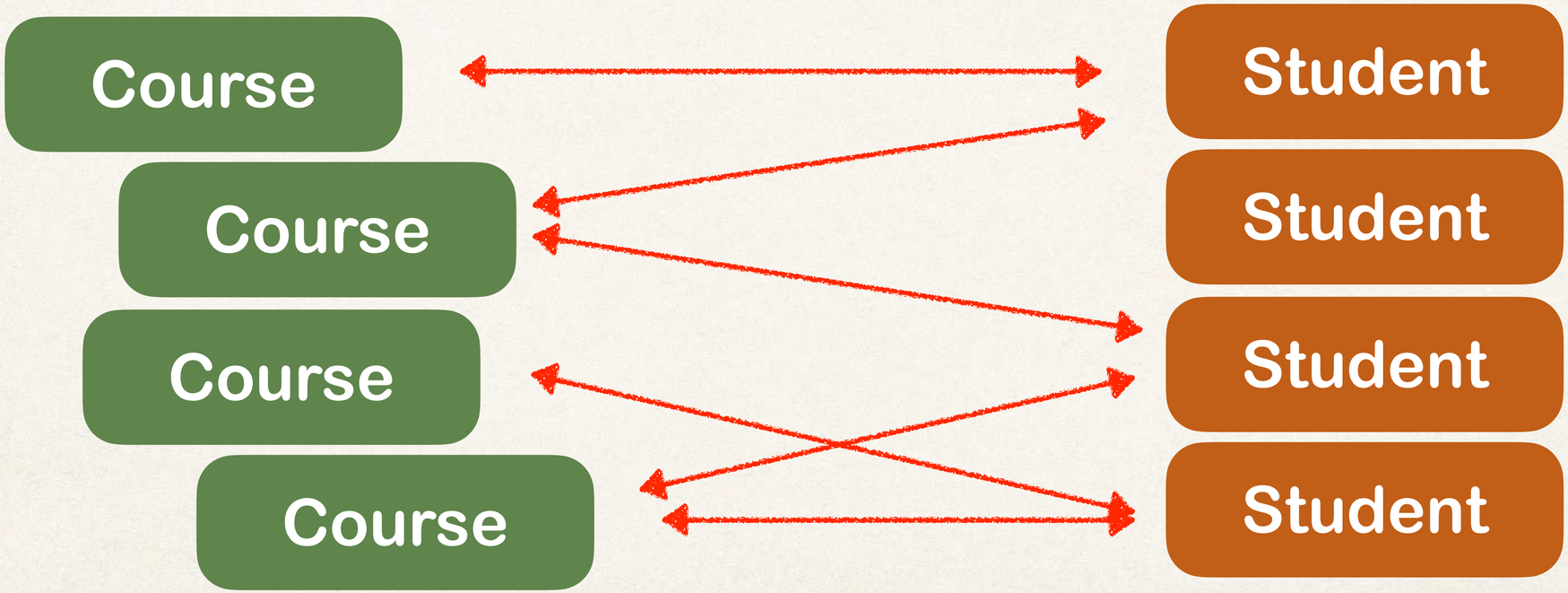
One-to-Many Mapping

- An instructor can have many courses



Many-to-Many Mapping

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



Important Database Concepts

- Primary key and foreign key

- Cascade

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

Foreign Key Example

Table: instructor

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

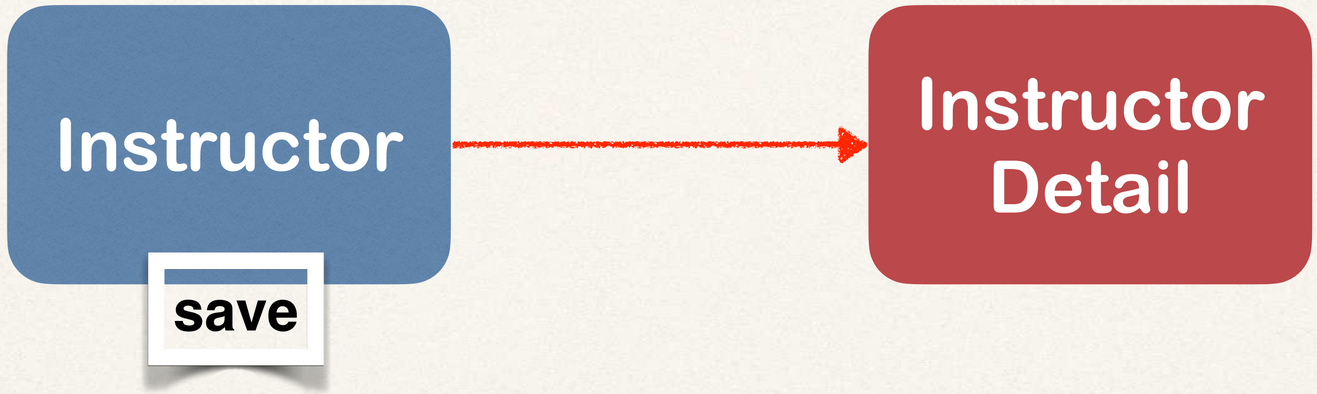
Table: instructor_detail

id	youtube_channel	hobby
100	www.luv2code.com/youtube	Luv 2 Code!!!
200	www.youtube.com	Guitar

Cascade

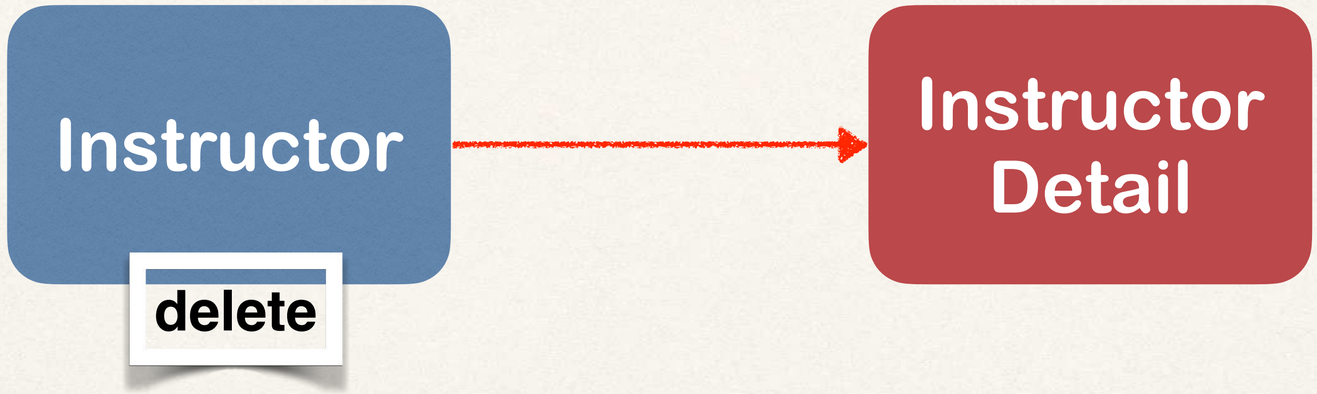
- You can **cascade** operations

- Apply the same operation to related entities



Cascade

- If we delete an **instructor**, we should also delete their **instructor_detail**
  - This is known as “CASCADE DELETE”



Cascade Delete

Table: instructor

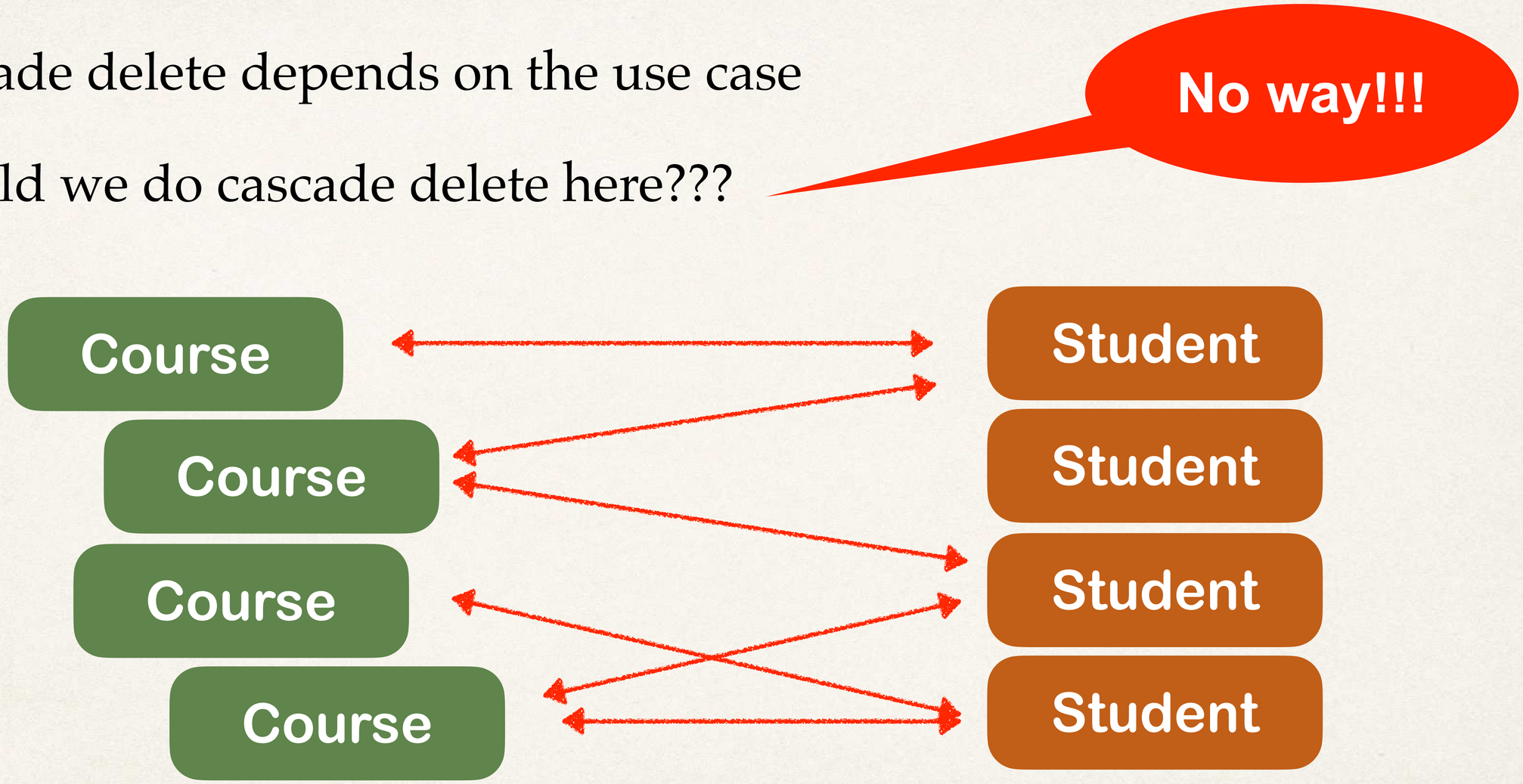
id	first_name	last_name	instructor_detail_id
1	Chad	Darby	100
2	Madhu	Patel	200

Table: instructor_detail

id	youtube_channel	hobby
100	www.luv2code.com/youtube	Luv 2 Code!!!
200	www.youtube.com	Guitar

Cascade Delete

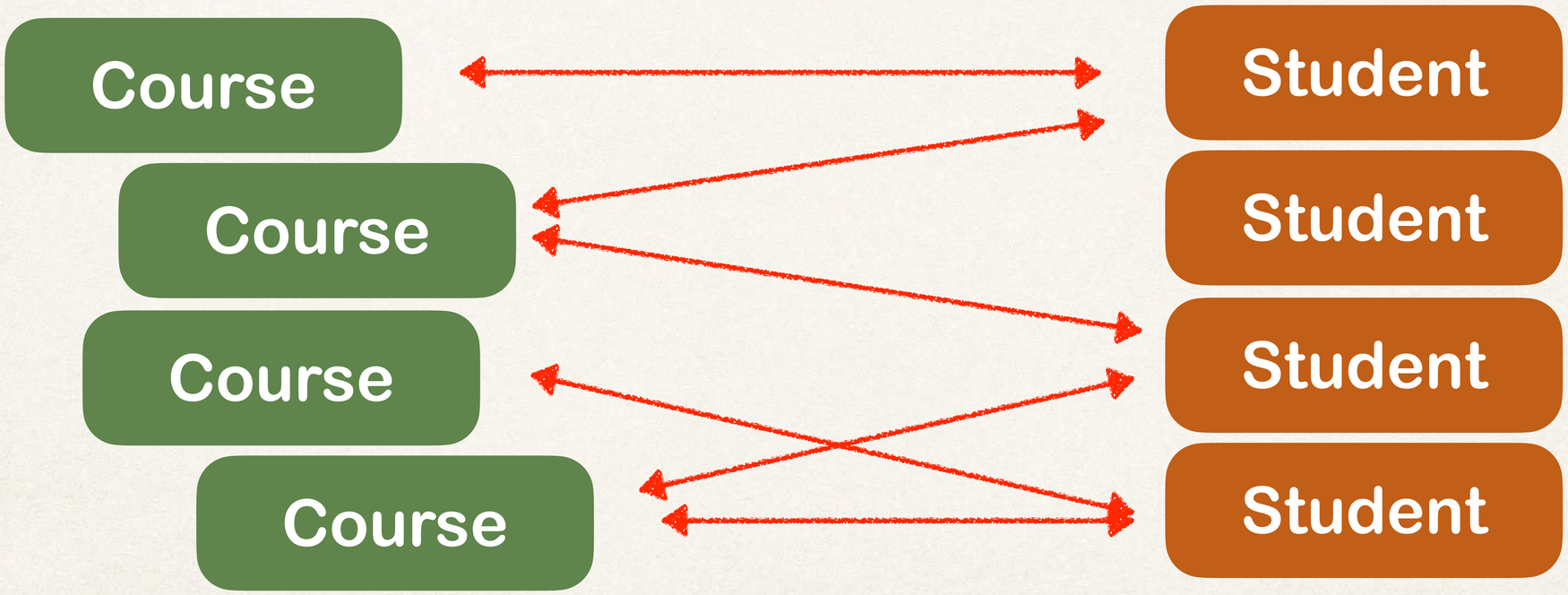
- Cascade delete depends on the use case
- Should we do cascade delete here???



Cascade Delete

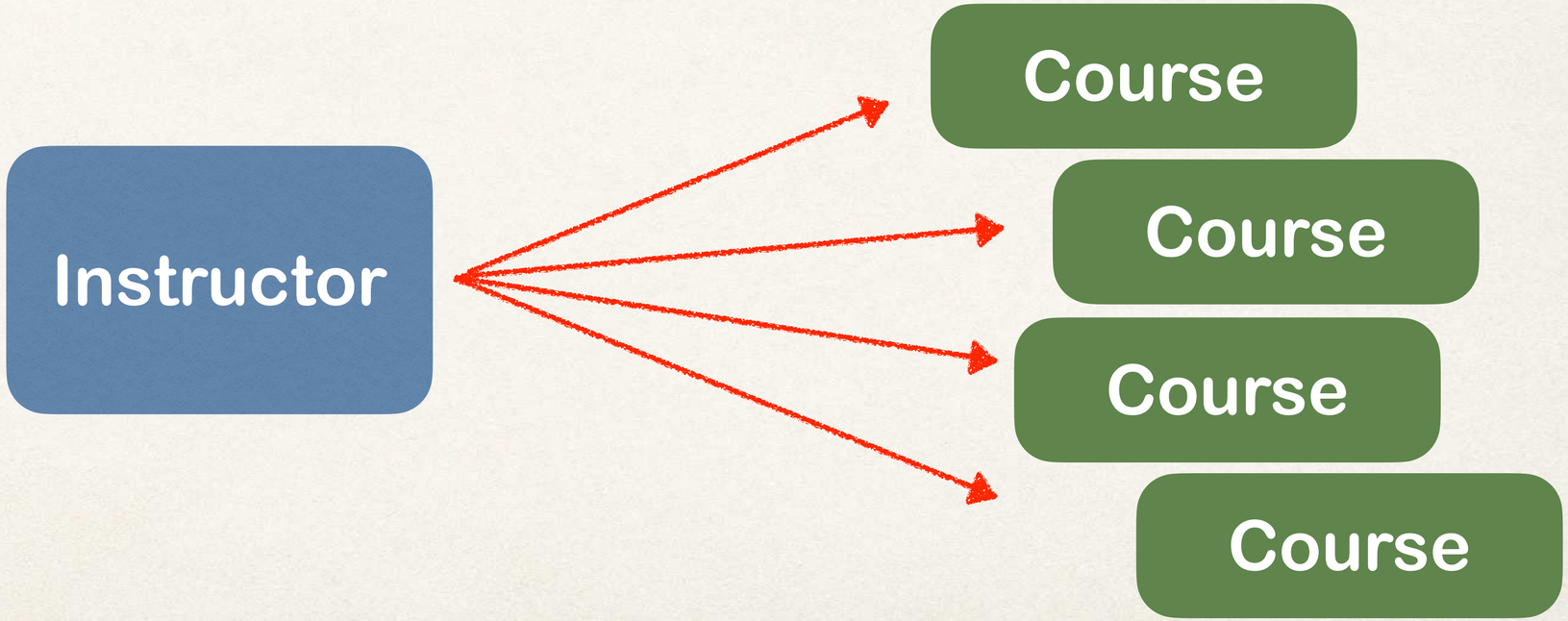
- Cascade delete depends on the use case
- Should we do cascade delete here???

Developer can configure cascading

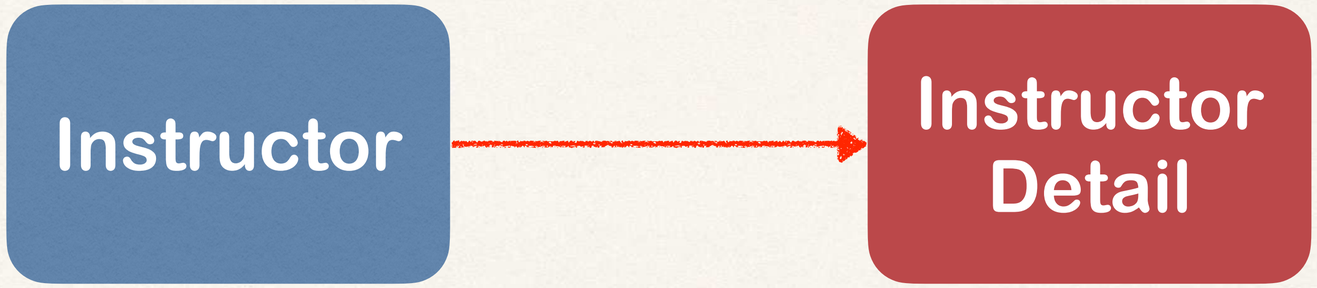


Fetch Types: Eager vs Lazy Loading

- When we fetch / retrieve data, should we retrieve EVERYTHING?
  - **Eager** will retrieve everything
  - **Lazy** will retrieve on request



Uni-Directional

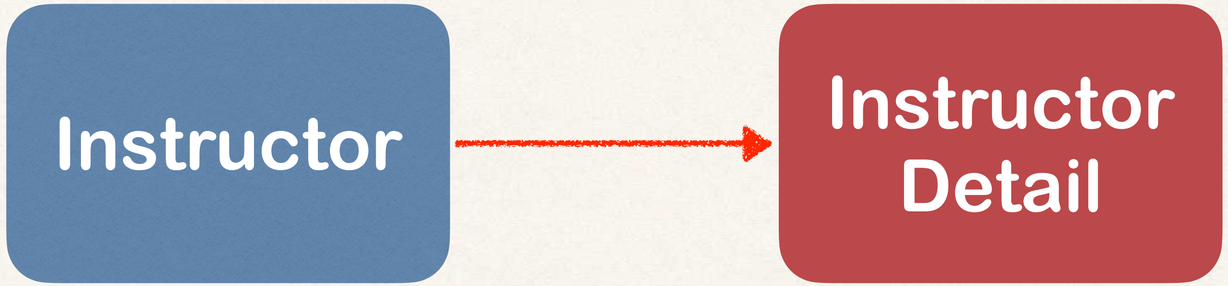


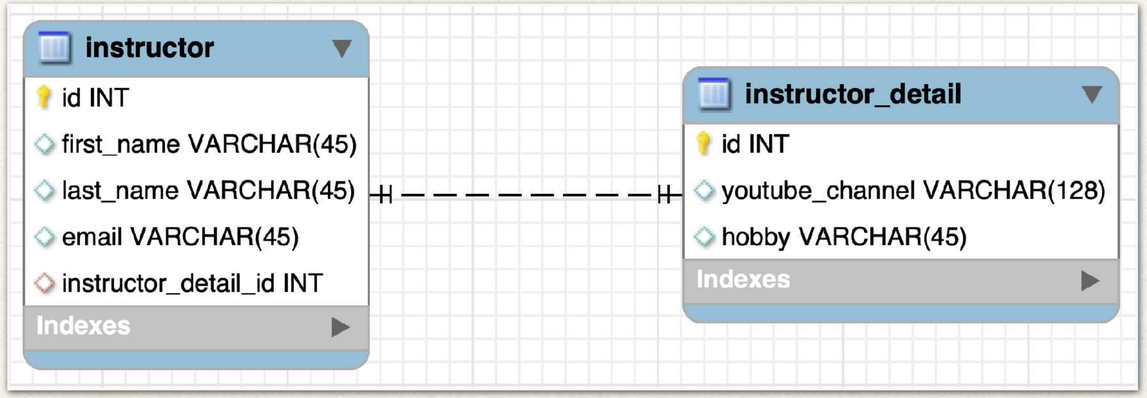
Bi-Directional

JPA / Hibernate
One-to-One

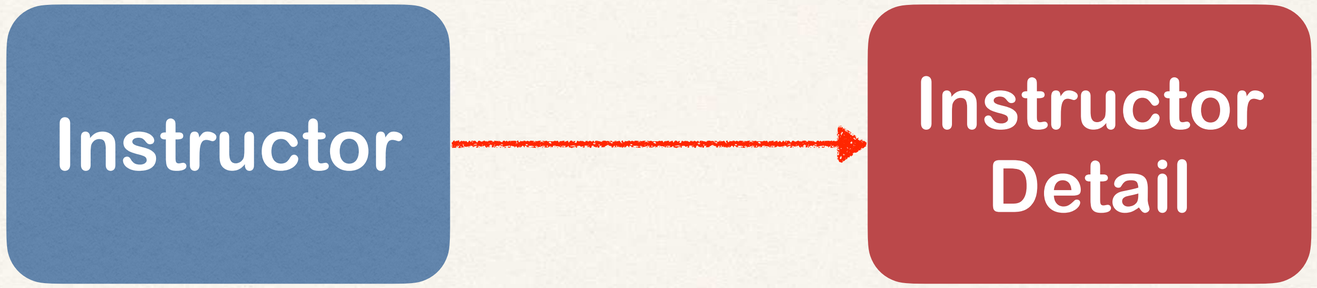
One-to-One Mapping

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





Uni-Directional



Development Process: One-to-One

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

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,


);

...
```

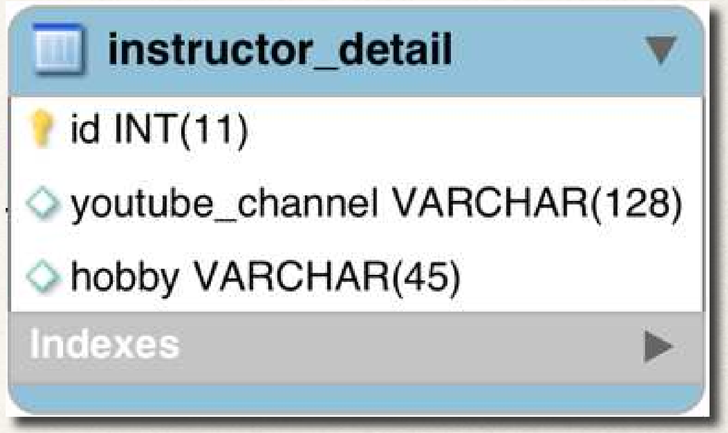


table: instructor_detail

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`)
);

...
```

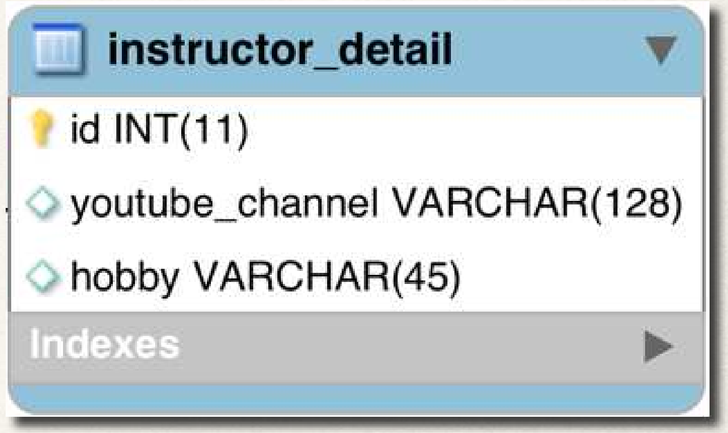
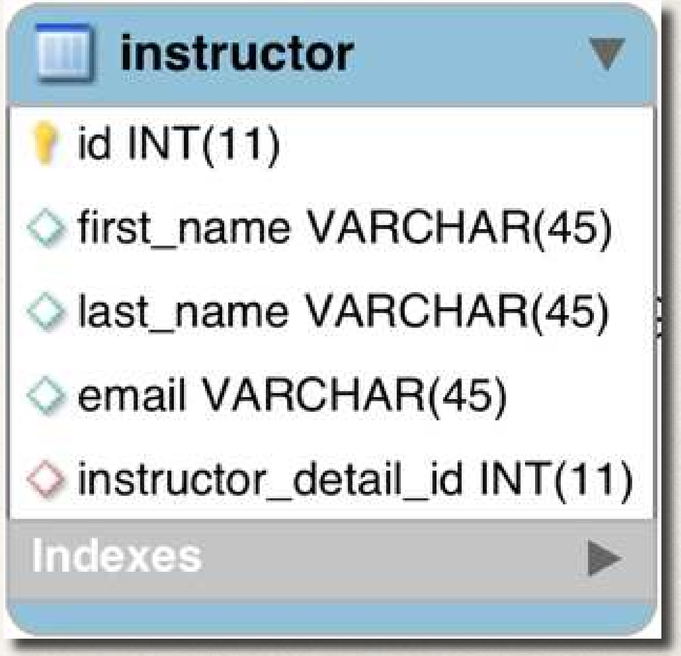


table: instructor

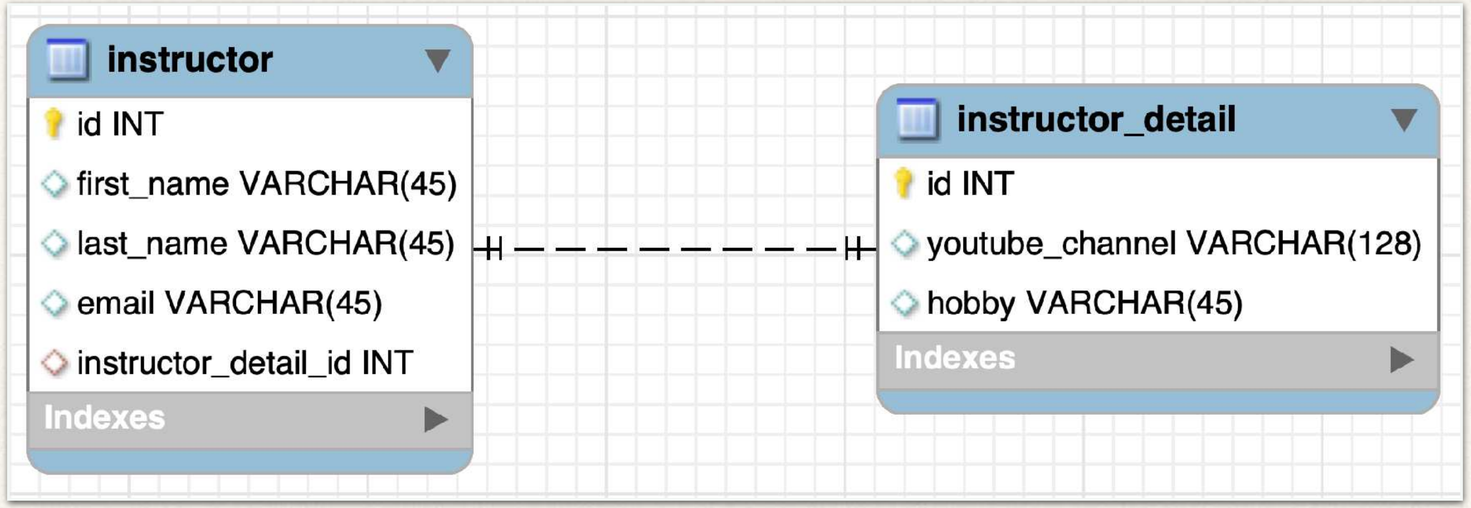
File: create-db.sql

```
...

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`)
    ...
);
```



Foreign Key

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



Foreign Key Example

Table: instructor

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

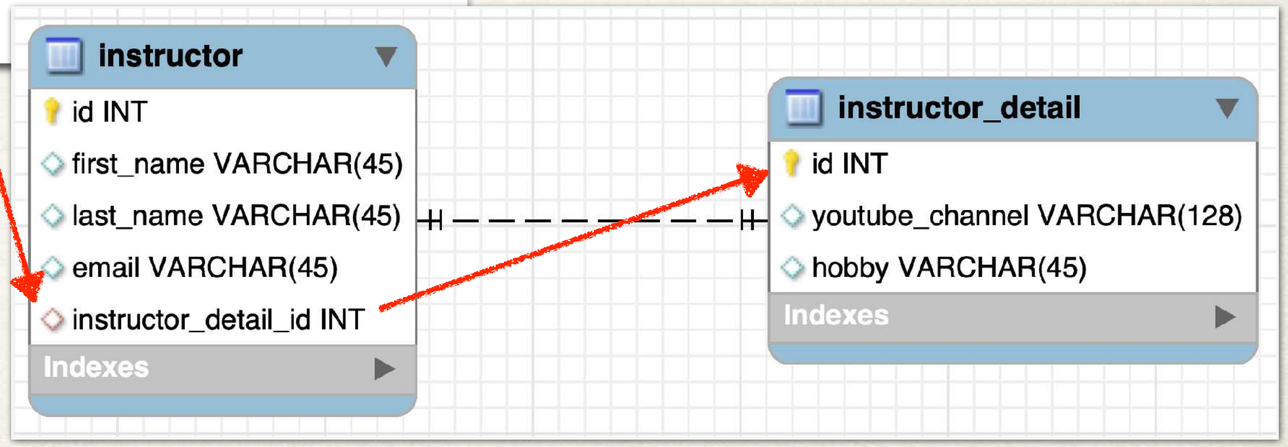
Table: instructor_detail

id	youtube_channel	hobby
100	www.luv2code.com/youtube	Luv 2 Code!!!
200	www.youtube.com	Guitar

Defining Foreign Key

File: create-db.sql

```
...
CREATE TABLE `instructor` (
  ...

  CONSTRAINT `FK_DETAIL` FOREIGN KEY (`instructor_detail_id`)
  REFERENCES `instructor_detail` (`id`)

);
```



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

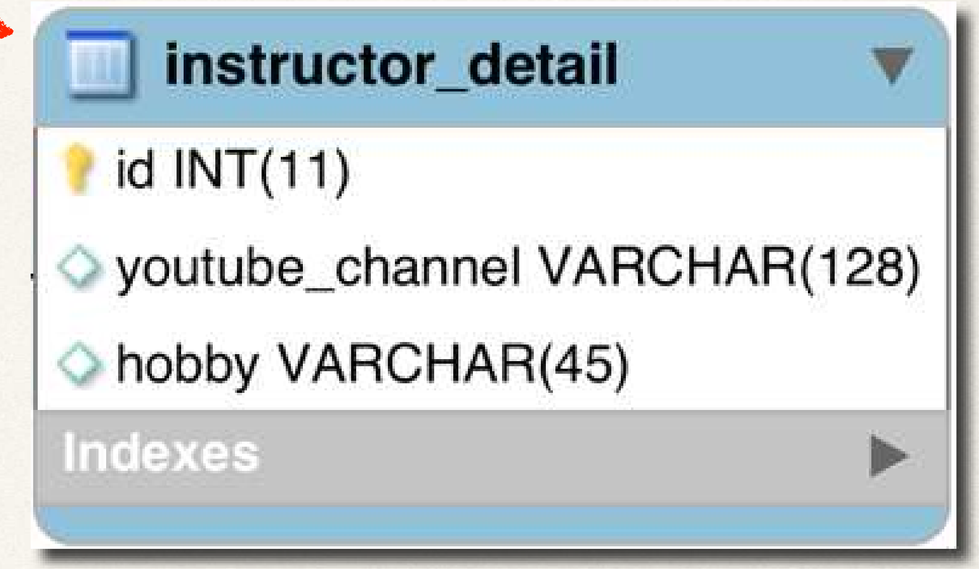
Development Process: One-to-One

Step-By-Step

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

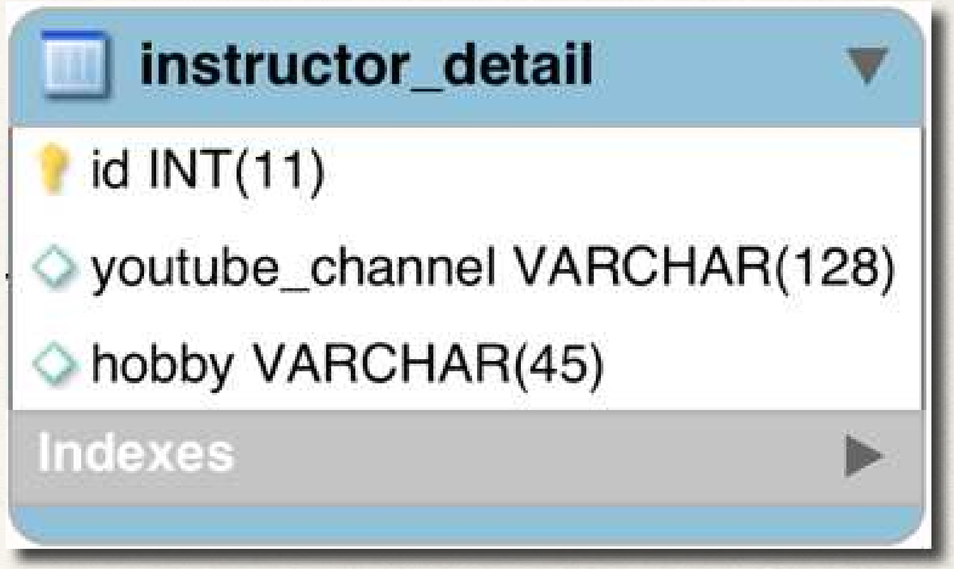
Step 2: Create InstructorDetail class

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



}
```



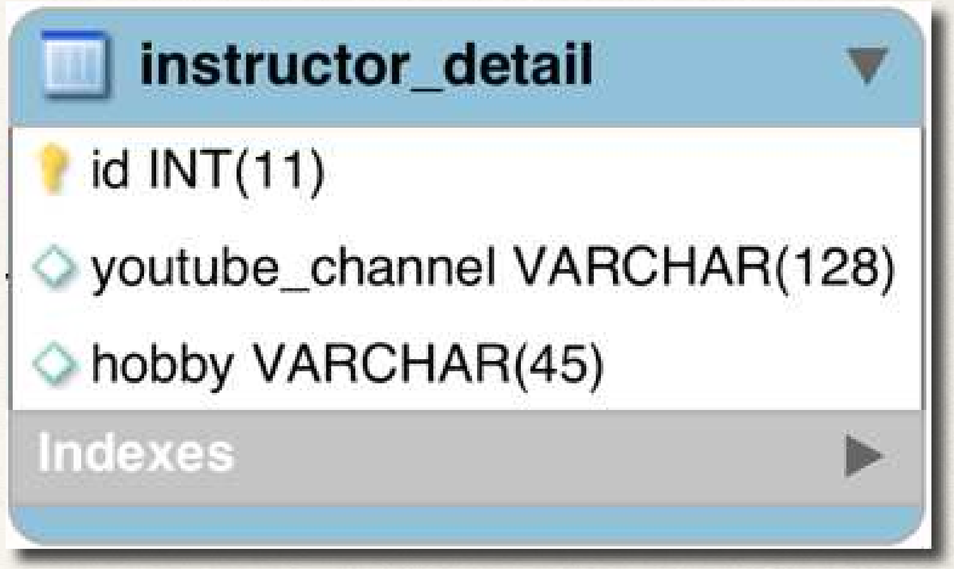
Step 2: Create InstructorDetail class

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

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



}
```



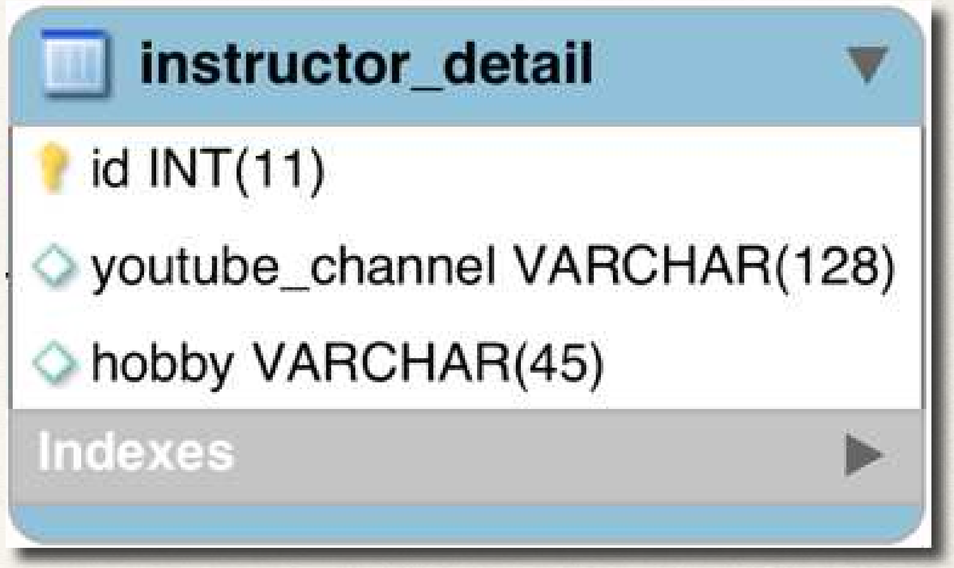
Step 2: Create InstructorDetail class

```
@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;



}
```



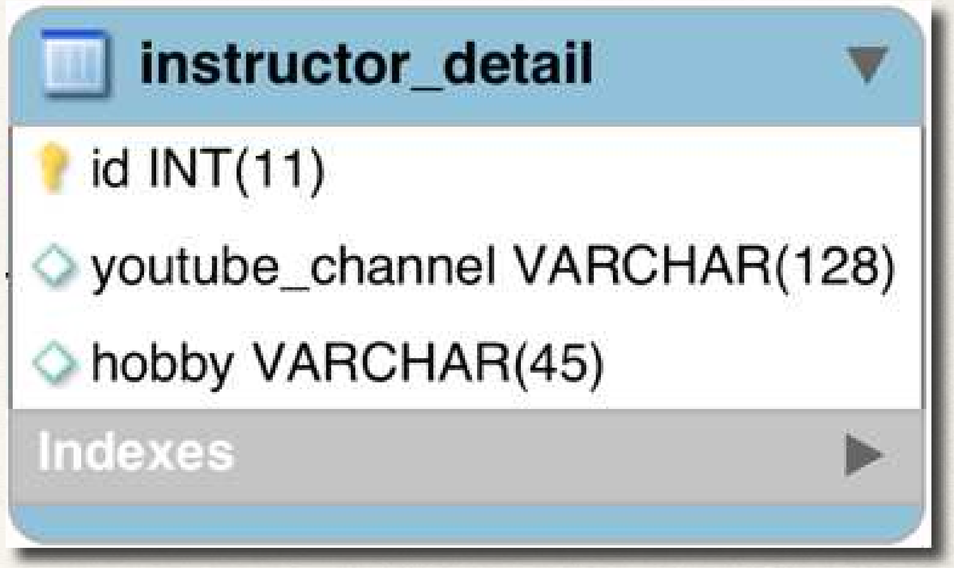
Step 2: Create InstructorDetail class

```
@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;



}
```



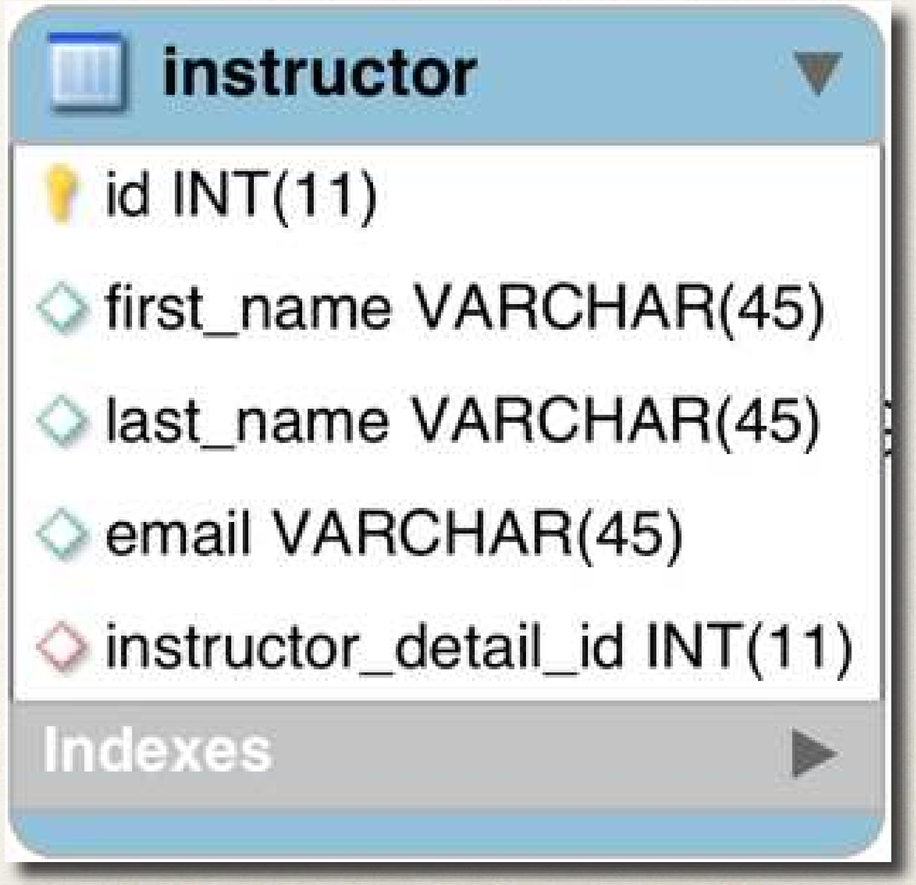
Step 2: Create InstructorDetail class

```
@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
}
```



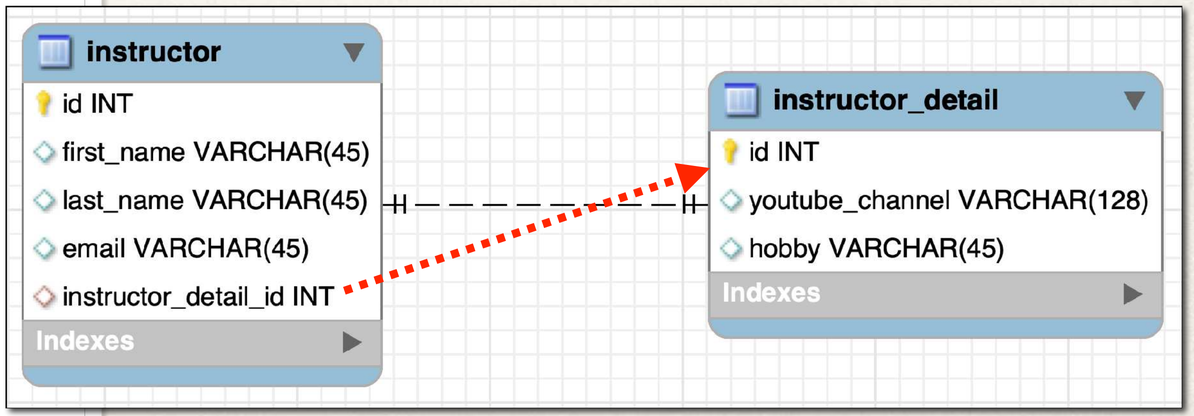
Step 3: Create Instructor class

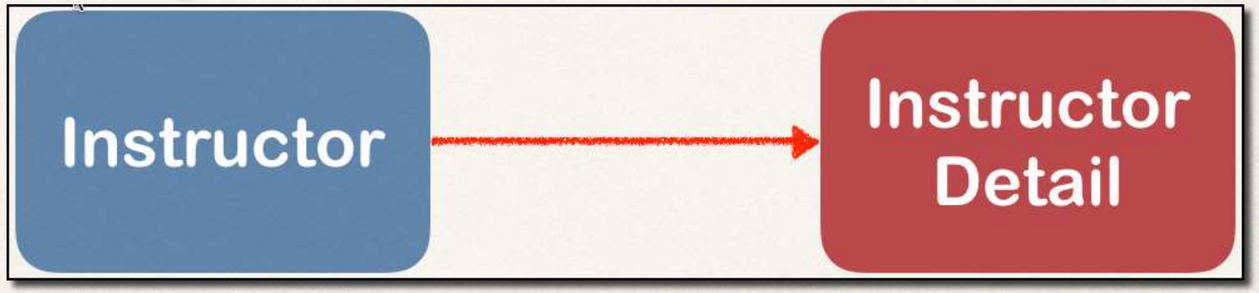
```
@Entity
@Table(name="instructor")
public class Instructor {

    @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
}
```



Step 3: Create Instructor class - @OneToOne

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

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

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

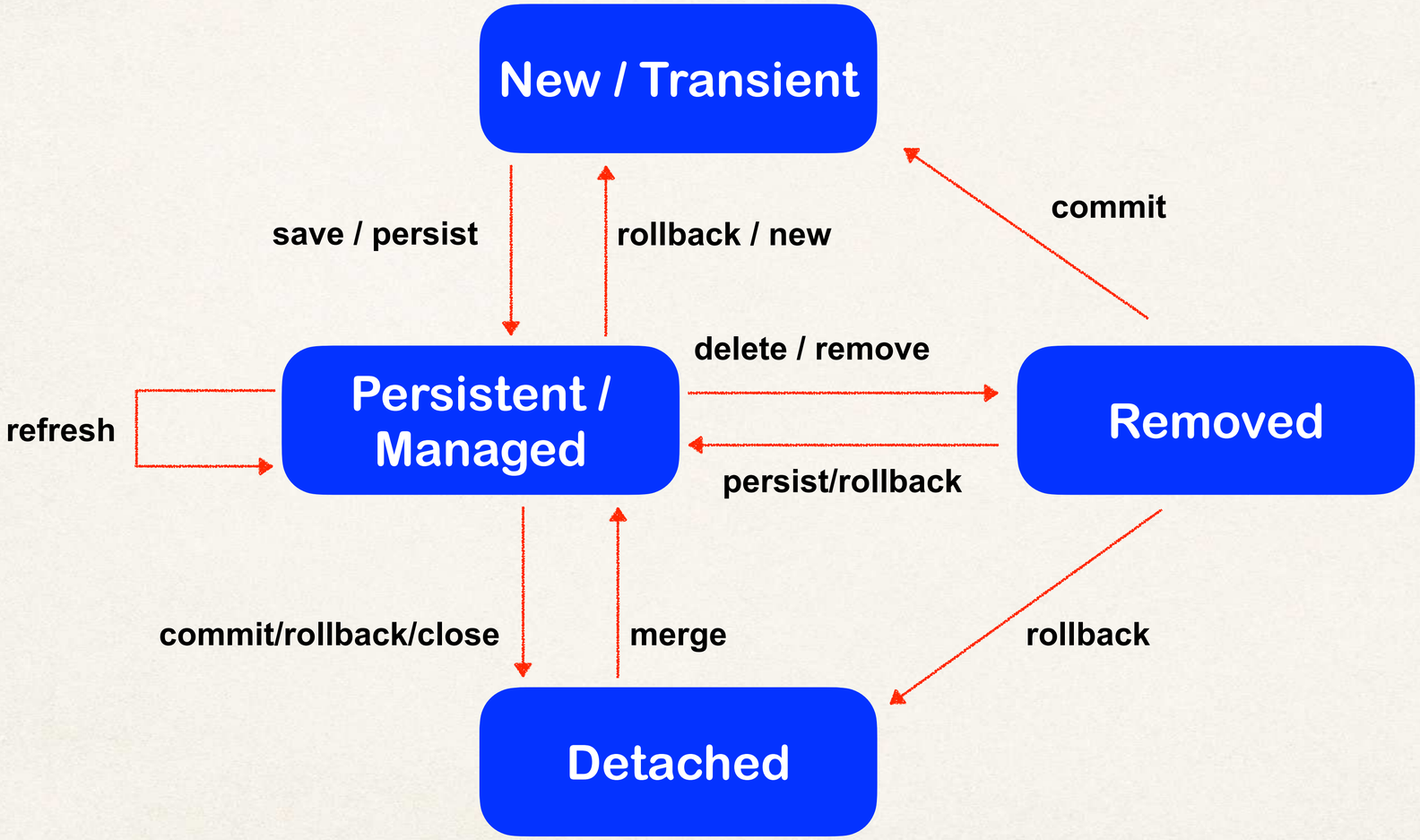




Entity Lifecycle

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

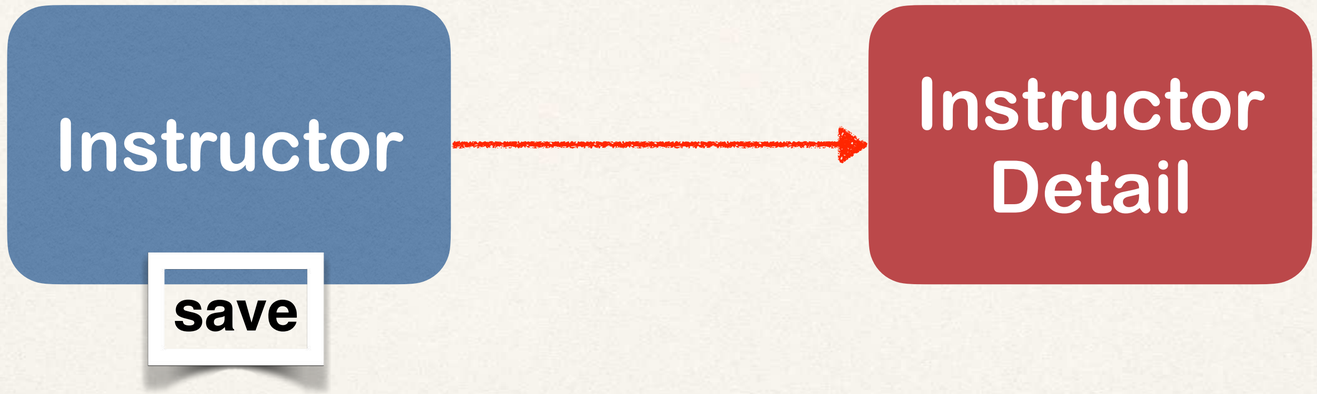
Entity Lifecycle - session method calls



Cascade

- Recall: You can **cascade** operations

- Apply the same operation to related entities



Cascade Delete

Foreign key column

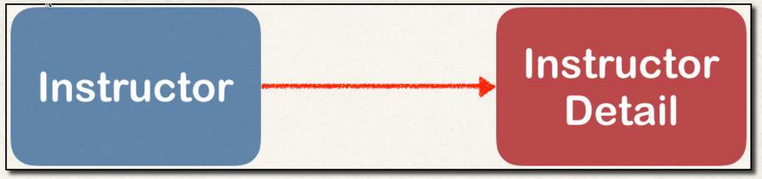
Table: instructor

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

Table: instructor_detail

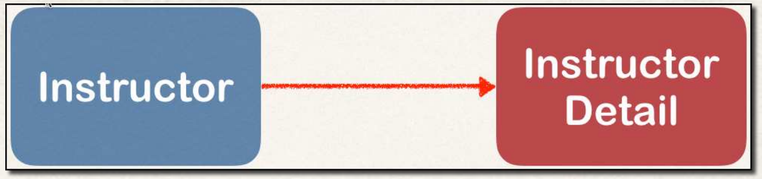
id	youtube_channel	hobby
100	www.luv2code.com/youtube	Luv 2 Code!!!
200	www.youtube.com	Guitar

@OneToOne - Cascade Types



Cascade Type	Description
PERSIST	If entity is persisted / saved, related entity will also be persisted
REMOVE	If entity is removed / deleted, related entity will also be deleted
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

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
}
```

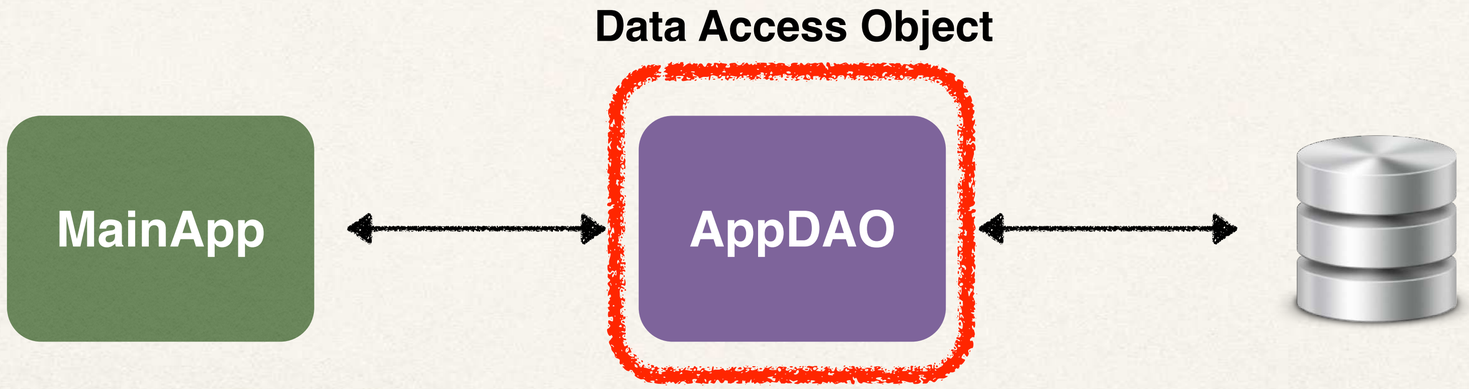
By default, no operations are cascaded.

Configure Multiple Cascade Types

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

Step 4 - Creating Spring Boot - Command Line App

- We will create a Spring Boot - Command Line App
- This will allow us to focus on JPA / Hibernate
- Leverage our DAO pattern as in previous videos



Define DAO interface

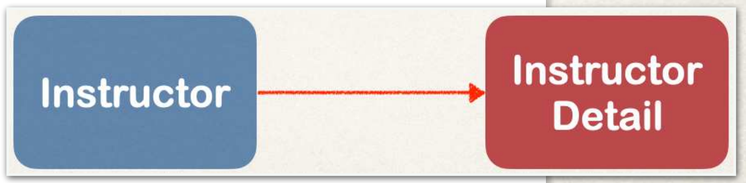
```
import com.luv2code.cruddemo.entity.Instructor;

public interface AppDAO {

    void save(Instructor theInstructor);

}
```

Define DAO implementation

```
import com.luv2code.cruddemo.entity.Instructor;
import jakarta.persistence.EntityManager;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Repository;
import org.springframework.transaction.annotation.Transactional;

@Repository
public class AppDAOImpl implements AppDAO {

    // define field for entity manager
    private EntityManager entityManager;

    // inject entity manager using constructor injection
    @Autowired
    public AppDAOImpl(EntityManager entityManager) {
        this.entityManager = entityManager;
    }

    @Override
    @Transactional
    public void save(Instructor theInstructor) {
        entityManager.persist(theInstructor);
    }

}
```

Inject the Entity Manager

Save the Java object

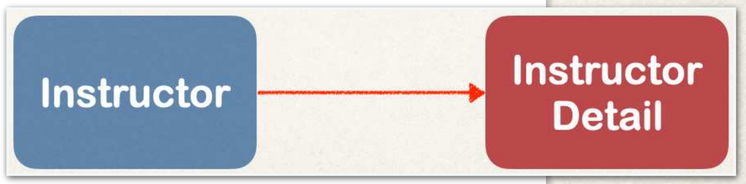


Define DAO implementation

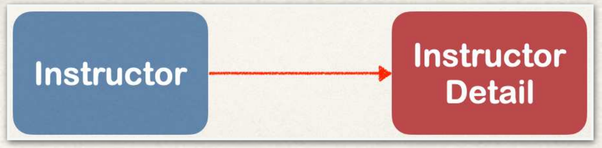
```
import com.luv2code.cruddemo.entity.Instructor;
import jakarta.persistence.EntityManager;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Repository;
import org.springframework.transaction.annotation.Transactional;

@Repository
public class AppDAOImpl implements AppDAO {

    // define field for entity manager
    private EntityManager entityManager;

    // inject entity manager using constructor injection
    @Autowired
    public AppDAOImpl(EntityManager entityManager) {
        this.entityManager = entityManager;
    }

    @Override
    @Transactional
    public void save(Instructor theInstructor) {
        entityManager.persist(theInstructor);
    }

}
```

This will ALSO save the details object

Because of CascadeType.ALL



Update main app




```
@SpringBootApplication
public class MainApplication {

    public static void main(String[] args) {
        SpringApplication.run(MainApplication.class, args);
    }

    @Bean
    public CommandLineRunner commandLineRunner(AppDAO appDAO) {
        return runner -> {

            createInstructor(appDAO);
    }

    …
```

Inject the AppDAO

```
    private void createInstructor(AppDAO appDAO) {

        // create the instructor
        Instructor tempInstructor =
                new Instructor("Chad", "Darby", "darby@luv2code.com");

        // create the instructor detail
        InstructorDetail tempInstructorDetail =
                new InstructorDetail(
                        "http://www.luv2code.com/youtube",
                        "Luv 2 code!!!");

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

        // save the instructor
        System.out.println("Saving instructor: " + tempInstructor);
        appDAO.save(tempInstructor);

        System.out.println("Done!");
    }
}
```

Remember:

This will ALSO save the details object

Because of CascadeType.ALL

In AppDAO, delegated to entityManager.persist(…)

JPA / Hibernate
One-to-One: Find an entity

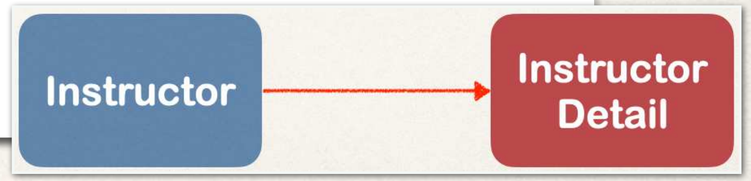
Define DAO implementation

```
@Repository
public class AppDAOImpl implements AppDAO {

    …

    @Override
    public Instructor findInstructorById(int theId) {
        return entityManager.find(Instructor.class, theId);
    }

}
```

We'll add supporting code in the video: interface, main app

This will ALSO retrieve the instructor details object

Because of default behavior of @OneToOne fetch type is eager … more on fetch types later

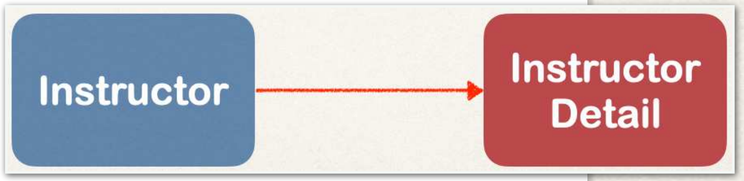


JPA / Hibernate
One-to-One: Delete an entity

Define DAO implementation

```
@Repository
public class AppDAOImpl implements AppDAO {
    …

   @Override
   @Transactional
   public void deleteInstructorById(int theId) {

       // retrieve the instructor
       Instructor tempInstructor = entityManager.find(Instructor.class, theId);

       // delete the instructor
       entityManager.remove(tempInstructor);
   }

}
```

We'll add supporting code in the video: interface, main app



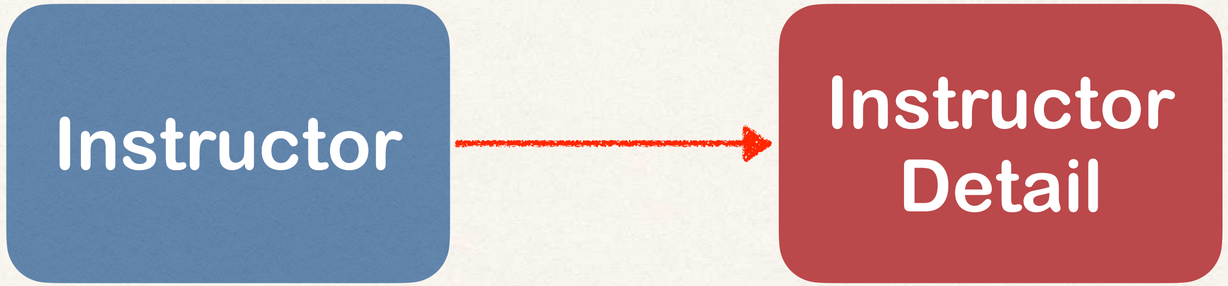
This will ALSO delete the instructor details object

Because of CascadeType.ALL

JPA / Hibernate
One-to-One: Bi-Directional

One-to-One Mapping

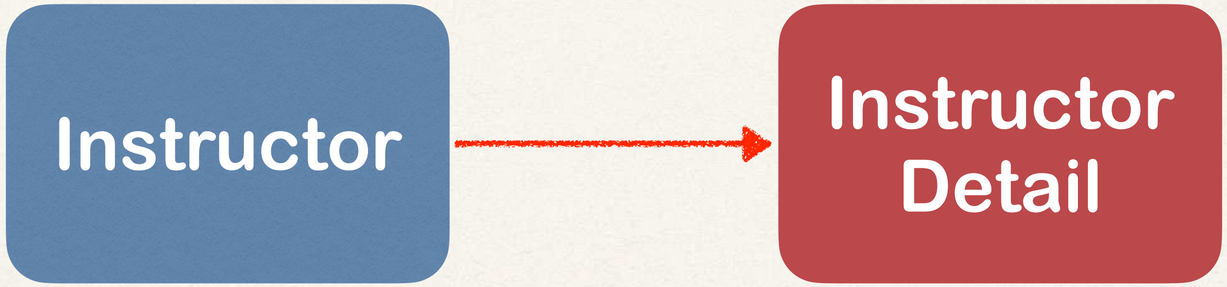
- We currently have a uni-directional mapping



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 :-(



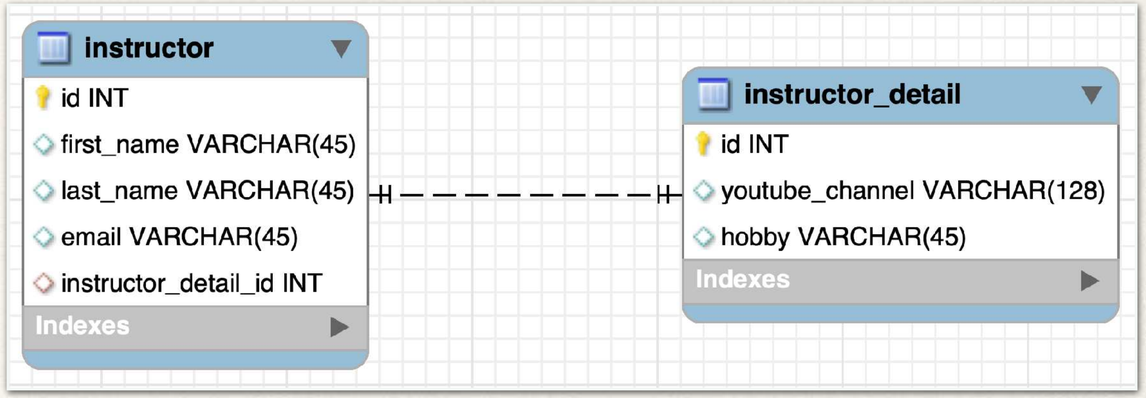
Bi-Directional

- Bi-Directional relationship is the solution

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

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



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

Step-By-Step

1. Make updates to InstructorDetail class:
    1. Add new field to reference Instructor
    2. Add getter/setter methods for Instructor
    3. Add @OneToOne annotation

2. Create Main App

Step 1.1: Add new field to reference Instructor

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

    private Instructor instructor;

    ...

}
```

Step 1.2: Add getter/setter methods Instructor

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


    private Instructor instructor;

    public Instructor getInstructor() {
        return instructor;
    }

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

}
```

Step 1.3: 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;
    }
    ...

}
```

Refers to “instructorDetail” property in “Instructor” class

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;
```

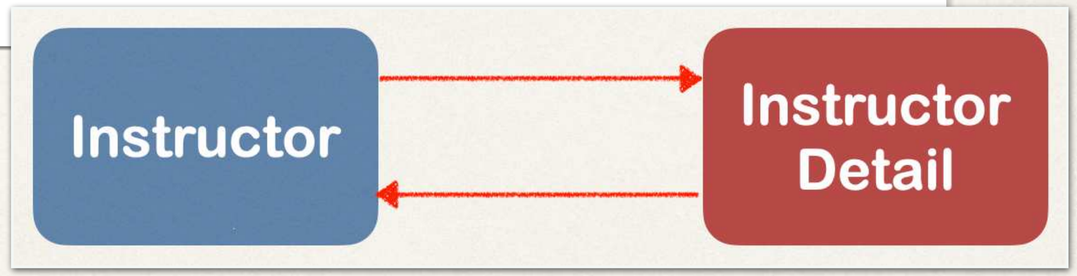
Add support for Cascading

Cascade all operations
to the associated Instructor

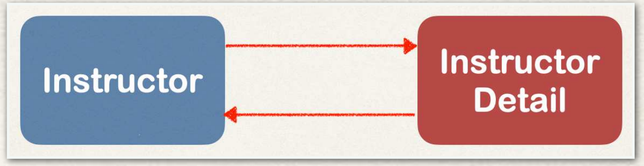
```
@Entity
@Table(name="instructor_detail")
public class InstructorDetail {
    ...

    @OneToOne(mappedBy="instructorDetail", cascade=CascadeType.ALL)
    private Instructor instructor;

    public Instructor getInstructor() {
        return instructor;
    }

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

}
```

Define DAO interface

```
import com.luv2code.cruddemo.entity.Instructor;

public interface AppDAO {

    InstructorDetail findInstructorDetailById(int theId);

}
```



Define DAO implementation



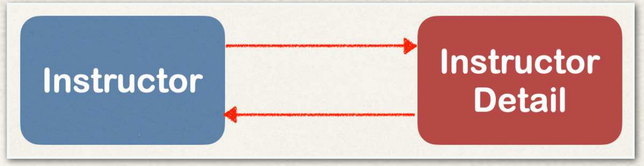

```
import com.luv2code.cruddemo.entity.InstructorDetail;
…

@Repository
public class AppDAOImpl implements AppDAO {

    // define field for entity manager
    private EntityManager entityManager;

    // inject entity manager using constructo
    …

    @Override
    public InstructorDetail findInstructorDetailById(int theId) {

        return entityManager.find(InstructorDetail.class, theId);
    }

}
```

This will ALSO retrieve the instructor object

Because of default behavior of @OneToOne

Retrieve the InstructorDetail

Update main app




```
@SpringBootApplication
public class MainApplication {

    public static void main(String[] args) {
        SpringApplication.run(MainApplication.class, args);
    }

    @Bean
    public CommandLineRunner commandLineRunner(AppDAO appDAO) {
        return runner -> {

            findInstructorDetail(appDAO);
    }

    …
```

Inject the AppDAO

```
    private void findInstructorDetail(AppDAO appDAO) {

        int theId = 1;
        System.out.println("Finding instructor detail id: " + theId);

        InstructorDetail tempInstructorDetail = appDAO.findInstructorDetailById(theId);

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

    }
}
```