Implementing a many-to-many Relationship with Slick

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Source code and Slides available at:

https://github.com/hermannhueck/MusicService/tree/master/Services/MusicService-Play-Scala-Slick-NoAuth

http://de.slideshare.net/hermannhueck/implementing-a-manytomany-relationship-with-slick

Who am I?

Hermann Hueck

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Presentation Overview

- Short Intro to Slick
- Many-to-many Relationship with Slick – Example: A Music Service
- Q & A

Part 1: Intro to Slick

- What is Slick?
- What is FRM (Functional Relational Mapping)?
- How to execute a database action?
- Why is it reactive?
- Short Reminder of Scala Futures
- Simple Slick Example (Activator Template: hello-slick-3.1)
- Table Definitions without and with Case Class Mapping

What is Slick?

The Slick manual says:

Slick (“Scala Language-Integrated Connection Kit”) is Typesafe‘s Functional Relational Mapping (FRM) library for Scala that makes it easy to work with relational databases. It allows you to work with stored data almost ***as if you were using Scala collections*** while at the same time giving you full control over when a database access happens and which data is transferred. You can also ***use SQL directly***. Execution of database actions is done ***asynchronous***ly, making Slick a perfect fit for your reactive applications based on Play and Akka.

What is FRM?

- FRM = Functional Relational Mapping (opposed to ORM)
- Slick allows you to process persistent relational data stored in DB tables the same (functional) way as you do with in-memory data, i.e. Scala collections.
- Table Queries are monads.
- Table Queries are pre-optimized.
- Table Queries are type-safe.
- The Scala compiler complains, if you specify your table query incorrectly.

TableQuery s are Monads.

- ***filter()*** for the selection of data
- ***map()*** for the projection
- ***flatMap()*** to pass the output of your 1st DB operation as input to the 2nd DB operation.
- With the provision of these three monadical functions *TableQuery* s are monads.
- Hence you can also use the syntactic sugar of ***for-comprehensions***.
- There is more. E.g. the ***sortBy()*** function allows you to define the sort order of your query result.

How to execute a Slick DB Action?

- Define a TableQuery

```
val query: Query[…] = TableQuery(…)…
```

- For this TableQuery, define a database action which might be a query, insert, bulk insert, update or a delete action or even a DDL action.

```
val dbAction: DBIO[…] = query += record                                               // insert
val dbAction: DBIO[…] = query ++= Seq(row0, row1, …, rowN)      // bulk insert
val dbAction: DBIO[…] = query.update(valuesToUpdate)                         // update
val dbAction: DBIO[…] = query.delete                                                  // delete
val dbAction: DBIO[…] = query.result                                                  // insert
```

- Run the database action by calling *db.run(dbAction)*. *db.run* never returns the *Result*. You always get a *Future[Result]*.

```
val dbAction: DBIO[…] = TableQuery(…).result
val future: Future[…] = db.run(dbAction)
```

Why is Slick reactive?

- It is asynchronous and non-blocking.
- It provides its own configurable thread pool.
- If you run a database action you never get the *Result* directly. You always get a *Future[Result]*.

```
val dbAction: DBIOAction[Seq[String]] = TableQuery(…).result
val future: Future[Seq[String]] = db.run( dbAction )
```

- Slick supports Reactive Streams. Hence it can easily be used together with Akka-Streams (which is not subject of this talk).

```
val dbAction: StreamingDBIO[Seq[String]] = TableQuery(…).result
val publisher: DatabasePublisher[String] = db.stream( dbAction )
val source: Source = Source.fromPublisher( publisher )
// Now use the Source to construct a RunnableGraph. Then run the graph.
```

Short Reminder of Scala Futures

In Slick every database access returns a Future.

How can one async (DB) function process the result of another async (DB) function?

This scenario happens very often when querying and manipulating database records.

A very informative and understandable blog on Futures can be found here:
http://danielwestheide.com/blog/2013/01/09/the-neophytes-guide-to-scala-part-8-welcome-to-the-future.html

How to process the Result of an Async Function by another Async Function

Using ***Future.flatMap***:

```
def doAAsync(input: String): Future[A] = Future { val a = f(input); a }

def doBAsync(a: A): Future[B] = Future { val b = g(a); b }

val input = “some input“

val futureA: Future[A] = doAAsync(input)

val futureB: Future[B] = futureA flatMap { a => doBAsync(a) }

futureB.foreach { b => println(b) }
```

Async Function processing the Result of another Async Function

Using a **for-comprehension**:

```
def doAAsync(input: String): Future[A] = Future { val a = f(input); a }
def doBAsync(a: A): Future[B] = Future { val b = g(a); b }
val input = “some input”
val futureB: Future[B] = for {
    a <- doAAsync(input)
    b <- doBAsync(a)
} yield b
futureB.foreach { b => println(b) }
```

A Simple Slick Example

Activator Template: ***hello-slick-3.1***

Table Definition with a Tuple

Tuple

```
class Users(tag: Tag) extends Table[(String, Option[Int])](tag, "USERS") {

  // Auto Increment the id primary key column
  def id = column[Int]("ID", O.PrimaryKey, O.AutoInc)

  // The name can't be null
  def name = column[String]("NAME", O.NotNull)

  // the * projection (e.g. select * ...)
  def * = (name, id.?)
}
```

Table Definition with Case Class Mapping

```
case class User(name: String, id: Option[Int] = None)


class Users(tag: Tag) extends Table[User](tag, "USERS") {

  // Auto Increment the id primary key column
  def id = column[Int]("ID", O.PrimaryKey, O.AutoInc)

  // The name can't be null
  def name = column[String]("NAME", O.NotNull)

  // the * projection (e.g. select * ...) auto-transforms the tupled
  // column values to / from a User
  def * = (name, id.?) <> (User.tupled, User.unapply)
}
```

Map Tuple to User

Map User to Tuple

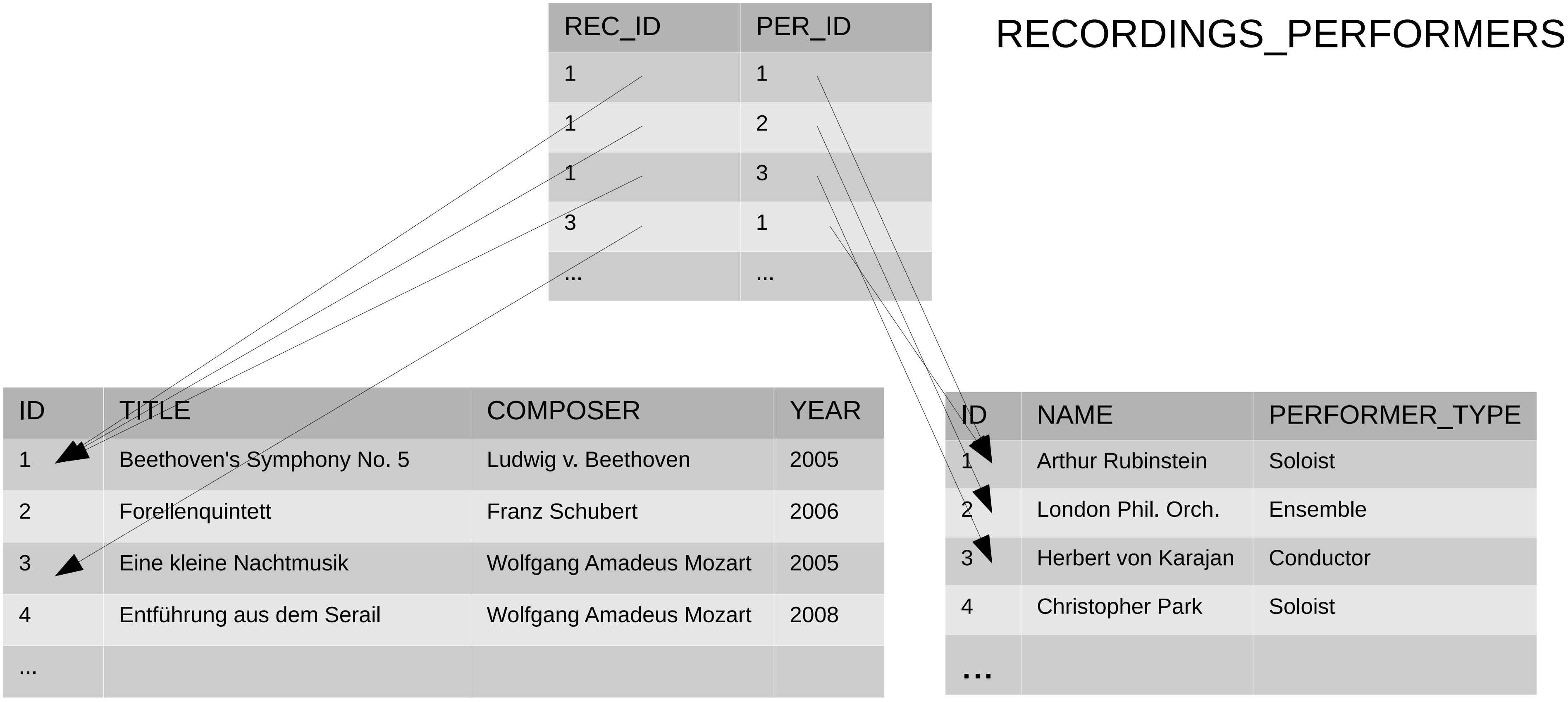
Part 2: Many-to-many with Slick

- The Demo App: *MusicService*
- Many-to-many Relationship (DB Schema)
- Web Application Demo
- Many-to-many in Slick Table Definitions
- Ensuring Referential Integrity
- Adding and Deleting Relationships
- Traversing the many-to-many Relationship in Queries

The Demo App: *MusicService*

- The MusicService manages Music ***Recording***s and ***Performer***s.
- A Recording is ***performedBy*** many (0 … n) Performers.
- A Performer is ***performingIn*** many (0 … n) Recordings.

Many-to-many in the DB Schema



RECORDINGS_PERFORMERS

REC_ID	PER_ID
1	1
1	2
1	3
3	1
...	...

ID	TITLE	COMPOSER	YEAR
1	Beethoven's Symphony No. 5	Ludwig v. Beethoven	2005
2	Forellenquintett	Franz Schubert	2006
3	Eine kleine Nachtmusik	Wolfgang Amadeus Mozart	2005
4	Entführung aus dem Serail	Wolfgang Amadeus Mozart	2008
...			

RECORDINGS

ID	NAME	PERFORMER_TYPE
1	Arthur Rubinstein	Soloist
2	London Phil. Orch.	Ensemble
3	Herbert von Karajan	Conductor
4	Christopher Park	Soloist
...		

PERFORMERS

Web Application Demo

MusicService is a Play Application with a rather primitive UI. This interface allows the user to …

- Create, delete, update Performers and Recordings
- Assign Performers to Recordings or Recordings to Performers and delete these Assignments
- Query / Search for Performers and Recordings
- Play Recordings

Many-to-many Relationship in the Slick Table Definitions

```
case class RecordingPerformer(recId: Long, perId: Long)


// Table 'RecordingsPerformers' mapped to case class 'RecordingPerformer' as join table to map
// the many-to-many relationship between Performers and Recordings
//
class RecordingsPerformers(tag: Tag)
      extends Table[RecordingPerformer](tag, "RECORDINGS_PERFORMERS") {

  def recId: Rep[Long] = column[Long]("REC_ID")
  def perId: Rep[Long] = column[Long]("PER_ID")

  def * = (recId, perId) <> (RecordingPerformer.tupled, RecordingPerformer.unapply)
  def pk = primaryKey("primaryKey", (recId, perId))

  def recFK = foreignKey("FK_RECORDINGS", recId, TableQuery[Recordings])(recording =>
    recording.id, onDelete=ForeignKeyAction.Cascade)

  def perFK = foreignKey("FK_PERFORMERS", perId, TableQuery[Performers])(performer =>
    performer.id)

  // onUpdate=ForeignKeyAction.Restrict is omitted as this is the default
}
```

Ensuring Referential Integrity

- Referential Integrity is guaranteed by the definition of a ***foreignKey()*** function in the referring table, which allows to navigate to the referred table.
- You can optionally specify an ***onDelete*** action and an ***onUpdate*** action, which has one of the following values:
  - *ForeignKeyAction.NoAction*
  - *ForeignKeyAction.Restrict*
  - *ForeignKeyAction.Cascade*
  - *ForeignKeyAction.SetNull*
  - *ForeignKeyAction.SetDefault*

Adding and Deleting Relationships

- Adding a concrete relationship == Adding an entry into the Mapping Table, if it doesn't already exist.
- Deleting a concrete relationship == Deleting an entry from the Mapping Table, if it exists.
- Updates in the Mapping Table do not make much sense. Hence I do not support them im my implementation.

Traversing many-to-many the Relationship in Queries

- The ***Query.join()*** function allows you to perform an inner join on tables.
- The ***Query.on()*** function allows you to perform an inner join on tables.
- Example:

```
val query = TableQuery[Performers] join TableQuery[RecordingsPerformers] on (_.id === _.perId)

val future: Future[Seq[(Performer, RecordingPerformer)]] = db.run { query.result }

// Now postprocess this future with filter, map, flatMap etc.

// Especially filter the result for a specific recording id.
```

Thank you for listening!

Q & A

Resources

- Slick Website:
  http://slick.typesafe.com/doc/3.1.1/
- Slick Activator Template Website with Tutorial:
  https://www.typesafe.com/activator/template/hello-slick-3.1
- Slick Activator Template Source Code:
  https://github.com/typesafehub/activator-hello-slick#slick-3.1
- A very informative blog on Futures:
  http://danielwestheide.com/blog/2013/01/09/the-neophytes-guide-to-scala-part-8-welcome-to-the-future.html
- MusicService Source Code and Slides at Github:
  https://github.com/hermannhueck/MusicService/tree/master/Services/MusicService-Play-Scala-Slick-NoAuth
- MusicService Slides at SlideShare:
  http://de.slideshare.net/hermannhueck/implementing-a-manytomany-relationship-with-slick
- Authors XING Profile:
  https://www.xing.com/profile/Hermann_Hueck