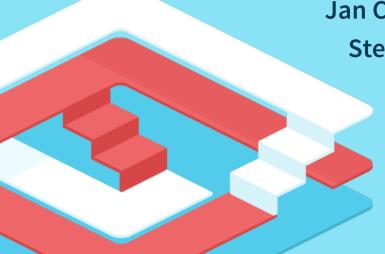
# Scaling Scala to the Database

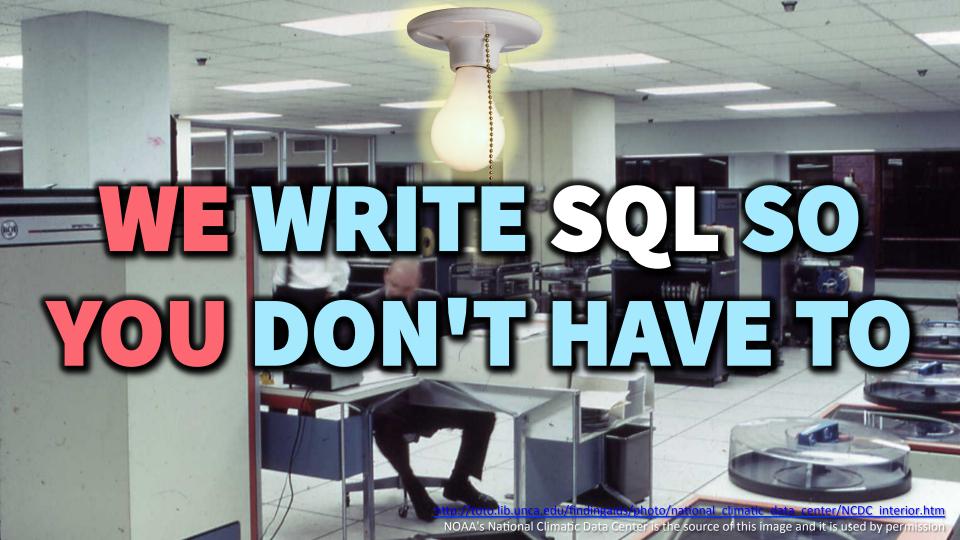
Jan Christopher Vogt, EPFL Stefan Zeiger, Typesafe





# 1 Overview / Key Concepts





#### Write database code in Scala

• Instead of SQL, JPQL, Criteria API, etc.

for { p <- persons } yield p.name</pre>



select p.NAME from PERSON p

```
(for {
    p <- persons.filter(_.age < 20) ++
        persons.filter(_.age >= 50)
        if p.name.startsWith("A")
} yield p).groupBy(_.age).map { case (age, ps) =>
        (age, ps.length)
}
```



```
select x2.x3, count(1) from (
   select * from (
      select x4."NAME" as x5, x4."AGE" as x3
        from "PERSON" x4 where x4."AGE" < 20
   union all select x6."NAME" as x5, x6."AGE" as x3
        from "PERSON" x6 where x6."AGE" >= 50
   ) x7 where x7.x5 like 'A%' escape '^'
) x2 group by x2.x3
```



#### Scala Language Slick Scata Language Integrated Connection Kit

- Database query and access library for Scala
- Successor of ScalaQuery
- Developed at Typesafe and EPFL
- Open Source

#### **Supported Databases**

- PostgreSQL
- MySQL
- H2
- Hsqldb
- Derby / JavaDB
- SQLite
- Access

Closed-Source *Slick Extensions* (with commercial support by Typesafe):

- Oracle
- DB/2
- SQL Server

#### Components

- Lifted Embedding
- Direct Embedding
- Plain SQL
- Session Management
- Schema Model

# 2 Compared to ORMs



#### Impedance Mismatch: Retrieval



**Espresso** 

Price: 9.99

Supplier: The High Ground

```
select COF_NAME
from COFFEES
```

```
select c.*, s.SUP_NAME
from COFFEES c, SUPPLIERS s
where c.COF_NAME = ?
and c.SUP_ID = s.SUP_ID
```

#### Impedance Mismatch: Retrieval

```
def getAllCoffees(): Seq[Coffee] = ...
def printLinks(s: Seq[Coffee]) {
  for(c <- s) println(c.name + " " + c.price )</pre>
def printDetails(c: Coffee) {
  println(c.name)
  println("Price: " + c.price)
  println("Supplier: " + c.supplier.name)
```



### O/R Mapper

 Mapping low-level programming (OOP) to high-level concepts (relational algebra)

Not transparent (but pretends to be)

#### **Better Match: Functional Programming**

```
case class Coffee(name: String,

    Relation

                           supplierId: Int, price: Double)

    Attribute

                           val coffees == Set(
                              Coffee( Colombian",
                                                      101, 7.99),
Tuple
                              Coffee("French_Roast", 49, 8.99),
                              Coffee("Espresso",
                                                      150, 9.99)

    Relation Value

                     - mutable state in the DB

    Relation Variable
```

### **Functional-Relational Mapping**

- Embraces the relational model
- No impedance mismatch
- Composable Queries
- Explicit control over statement execution
- Stateless

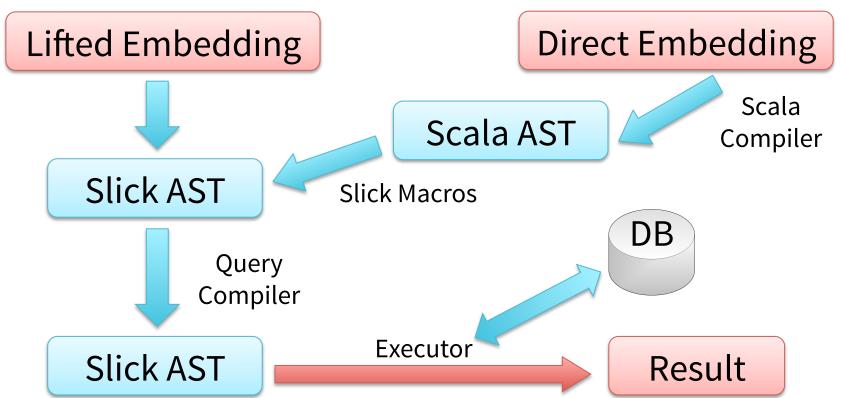
# 3 Live Coding Demo



## 4 Under The Hood



#### **APIs**



### Lifted Embedding

```
Query[ (Column[String], Column[String]), (String, String) ]
                             TableQuery[Coffees]
                                                    ColumnExtensionMethods.<
                 val q = for {
    Coffees
                    c <- coffees if c.price < 9.0</pre>
                    s, <- c.supplier</pre>
    Suppliers
                  } yield (c.name, s.name)
                                                             ConstColumn(9.0)
(Column[String], Column[String])
                                 Seq[ (String, String) ]
                                                         Column[Double]
                 val result = q.run
```

### **Direct Embedding (experimental)**

```
Queryable (String, String)
                                                      Double.<
                        Queryable[Coffee]
            val q = for {
Coffee
              c <- coffees if c.price < 9.0</pre>
              s, <- c.supplier</pre>
Supplier
            } yield (c.name, s.name)
                                                         9.0: Double
  (String, String)
                           Seq[ (String, String) ]
                                                      Double
            val result = q.run
```

### **Query Compiler**

- Immutable ASTs
  - Types can be mutated until they are observed
- Immutable compiler state
  - containing AST + phase output state
- Phases transform compiler state
  - using mutable state locally
- Drivers provide their own compilers

### **Compiler Phases: SQL**

#### Clean Up

- inline
- assignUniqueSymbols
- expandTables
- inferTypes
- createResultSetMapping
- forceOuterBinds

#### **Flatten Columns**

- expandRefs
- replaceFieldSymbols
- rewritePaths
- relabelUnions
- pruneFields
- assignTypes

#### **SQL Shape**

- resolveZipJoins
- convertToComprehensions
- fuseComprehensions
- fixRowNumberOrdering
- hoistClientOps

#### **Generate Code**

codeGen

(driver-specific)

### **Compiler Phases: Memory Driver**

#### Clean Up

- inline
- assignUniqueSymbols
- expandTables
- inferTypes
- createResultSetMapping
- forceOuterBinds

#### **Flatten Columns**

- expandRefs
- replaceFieldSymbols
- rewritePaths
- relabelUnions
- pruneFields
- assignTypes

Prepare for Interpreter

codeGen

### **Compiler Phases: Scheduling**

assignTypes

#### Clean Up II Clean Up **Distribute** inline distribute (to other drivers' compilers) assignUniqueSymbols expandTables inferTypes createResultSetMapping forceOuterBinds e.g. H2 MySQL . . . Query Query Query Compiler Compiler Compiler **Flatten Columns Prepare for** expandRefs replaceFieldSymbols Interpreter rewritePaths codeGen relabelUnions pruneFields

# 5 Outlook



#### Outlook

- NoSQL support
- Other data sources
- Async / Reactive API



# **slick.typesafe.com**



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