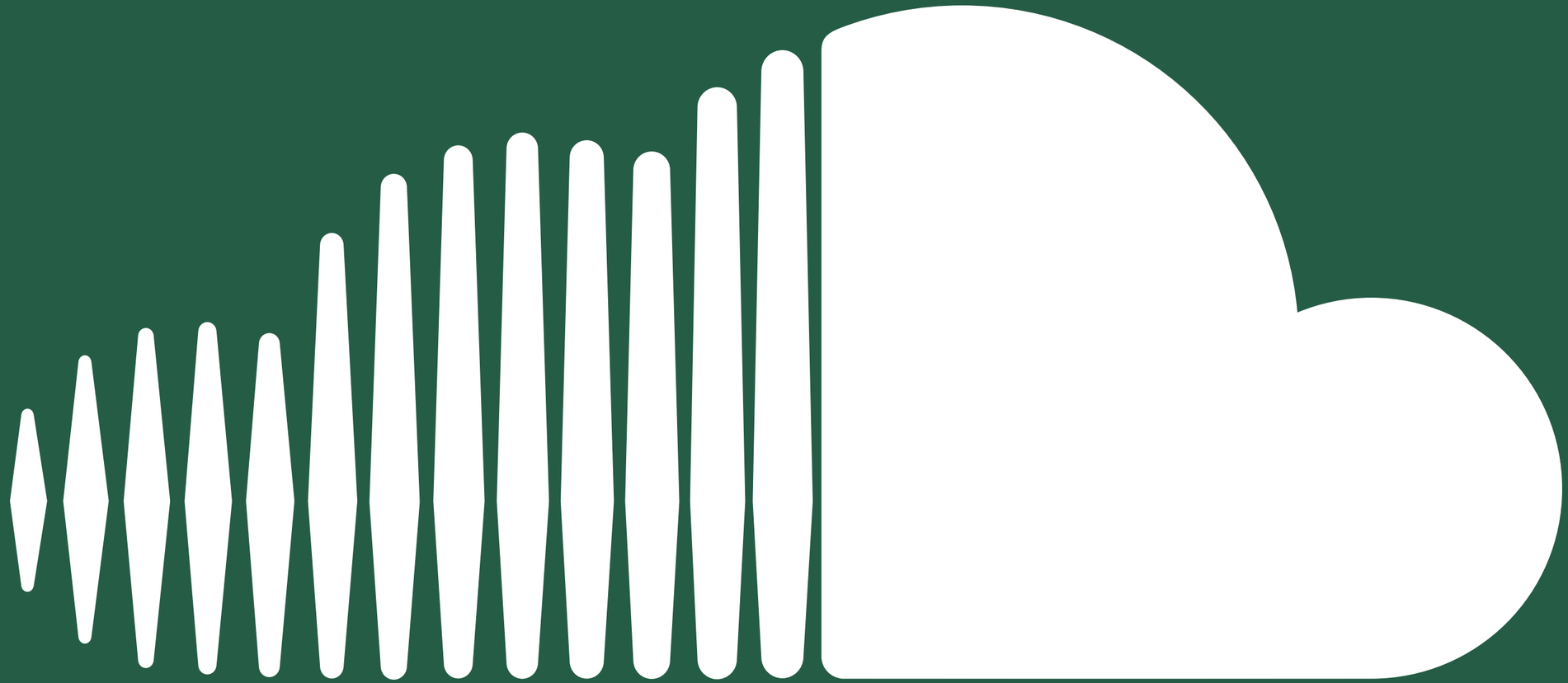

CASE STUDY:
TYPE-LEVEL PROGRAMMING IN THE REAL WORLD

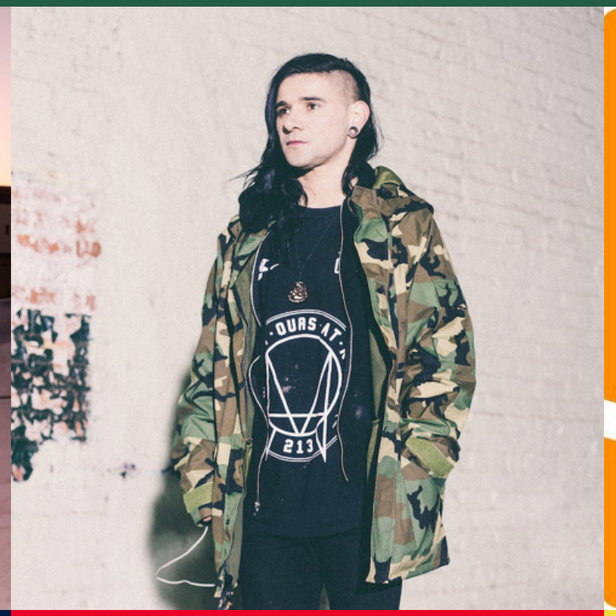
MY NAME IS @FOLONE

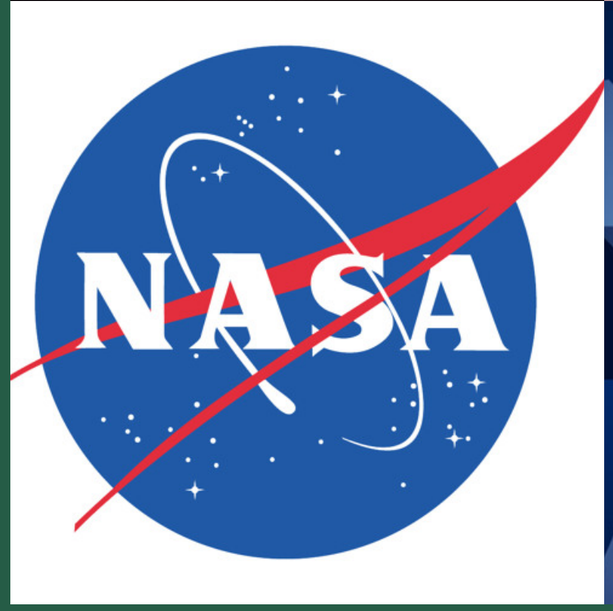
https://github.com/folone/scalar-conf



SOUNDCLOUD


AC/DC
ROCK OR BUST




NASA


Haskell Cast


LED ZEPPELIN


cool kids of death

- 12 HOURS UPLOADED EVERY MINUTE
- ~35K LISTENING YEARS EVERY MONTH
- >135M TRACKS (INCLUDING CONTENT FROM MAJORS: SONY/UNIVERSAL/WARNER)
- ~180M MONTHLY ACTIVE USERS


SOUNDCLOUD

CASE STUDY:

TYPE-LEVEL PROGRAMMING IN THE REAL WORLD

IN THE BEGINNING THERE WAS

```
def json(o: Any): Result
```

```
def typedJson[A : Writes](o: A): Result
```

```
implicit val writes = Json.writes[Track]
```

```
@ import play.api.libs.json.{Json => PJson}
import play.api.libs.json.{Json => PJson}
@ case class Omg(_1: Int, _2: Int, _3: Int, _4: Int, _5: Int,
_6: Int, _7: Int, _8: Int, _9: Int, _10: Int, _11: Int, _12: Int,
_13: Int, _14: Int, _15: Int, _16: Int, _17: Int, _18: Int,
_19: Int, _20: Int, _21: Int, _22: Int, _23: Int)
defined class Omg
@ PJson.writes[Omg]
cmd9.sc:1: No unapply or unapplySeq function found for class Omg.
val res9 = PJson.writes[Omg]
                        ^
Compilation Failed
```

```
import Json.writes._ // Json.writes.deriveInstance, implementation details
implicit val writes = Json.writes[Track]
```

```
cmd9.sc:1: No unapply or unapplySeq function found for class Omg.
val res9 = PJson.writes[Omg]
                       ^
Compilation Failed
@ import com.soundcloud.json.Json
import com.soundcloud.json.Json
@ import Json.writes._
import Json.writes._
@ Json.writes[Omg]
res11: play.api.libs.json.Writes[Omg] =
  play.api.libs.json.Writes$$anon$5@60ec44ee
```


HOW DOES THIS WORK EXACTLY? ಠ_ಠ


😱 >700LOC OF MACRO 😱

TWO (MANDATORY) BUILDING BLOCKS

- `HLists`
- `Generic` (TINY LIE: WHAT WE ACTUALLY NEED IS A `LabelledGeneric`)
- [OPTIONAL] `Coproducts`

HLIST

```
@ import shapeless._
import shapeless._

@ val hlist = 1 :: "hello" :: HNil
hlist: Int :: String :: HNil = 1 :: hello :: HNil
```

```
@ hlist(0)
res7: Int = 1

@ hlist(1)
res8: String = hello

@ hlist(2)
<console>:16: error:
Implicit not found: Scary[Type].Please#Ignore
You requested to access an element at the position
TypelevelEncodingFor[2.type]
but the HList Int :: String :: HNil is too short.
       hlist(2)
             ^
Compilation failed.
```

GENERIC

```
@ case class Track(id: Long, payload: String)
defined class Track

@ val generic = Generic[Track]
generic: shapeless.Generic[Track]{type Repr = Int :: String :: HNil} =
  anon$macro$3$1@7f8f5e52
```

```
@ val representation = generic.to(Track(1, "hello"))
representation: res0.Repr = 1 :: hello :: HNil

@ representation(0)
res10: Int = 1

@ representation(1)
res11: String = hello

@ representation(2)
<console>:19: error:
Implicit not found: Scary[Type].Please#Ignore
You requested to access an element at the position
TypelevelEncodingFor[2.type]
but the HList Int :: String :: HNil is too short.
       representation(2)
                      ^
```

```
@ generic.from(hlist)
res7: Track = Track(1L, "hello")
```

PUTTING THIS TOGETHER

```
object writes extends LabelledProductTypeClassCompanion[Writes] with DefaultWrites {
    object typeClass extends LabelledProductTypeClass[Writes] {
      override def emptyProduct: Writes[HNil] =
        Writes(_ => PlayJson.obj())

      override def product[H, T <: HList](name: String, headEv: Writes[H], tailEv: Writes[T]) =
        Writes[H :: T] {
          case head :: tail =>
            val h = headEv.writes(head)
            val t = tailEv.writes(tail)

            (h, t) match {
              case (JsNull, t: JsObject) => t
              case (h: JsValue, t: JsObject) => PlayJson.obj(name -> h) ++ t
              case _ => PlayJson.obj()
            }
        }

      override def project[F, G](instance: => Writes[G], to: F => G, from: G => F) =
        Writes[F](f => instance.writes(to(f)))

    }
}
```

```
override def emptyProduct: Writes[HNil] =
  Writes(_ => PlayJson.obj())
```

```
override def product[H, T <: HList](name: String,
  headEv: Writes[H], tailEv: Writes[T]) =
    Writes[H :: T] {
      case head :: tail =>
        val h = headEv.writes(head)
        val t = tailEv.writes(tail)

        (h, t) match {
          case (JsNull, t: JsObject) => t
          case (h: JsValue, t: JsObject) =>
            PlayJson.obj(name -> h) ++ t
          case _ => PlayJson.obj()
        }
    }
```

```
override def project[F, G](instance: => Writes[G],
  to: F => G, from: G => F) =
    Writes[F](f => instance.writes(to(f)))
```


THE WHOLE CODE


THREE DETAILS

```
import play.api.libs.json.DefaultWrites
```

... with DefaultWrites

```
@annotation.implicitAmbiguous("You have a Unit hiding somewhere in your types")
implicit def noUnits: Writes[Unit] = null
implicit def noUnitsBitte: Writes[Unit] = null
```

```
@ Json.writes[Unit]
cmd2.sc:1: You have a Unit hiding somewhere in your types
val res2 = Json.writes[Unit]
    ^
```


COPRODUC:+:S

```
@ import shapeless._
import shapeless._
@ {
  sealed trait Playable
  case class Track(id: Long, payload: String) extends Playable
  case class Album(tracks: List[Track]) extends Playable
  }
defined trait Playable
defined class Track
defined class Album

@ Generic[Playable]
res2: Generic[Playable]{type Repr = Album :+: Track :+: CNil} =
  $sess.cmd2$anon$macro$1$1@2f4344c6
```

```
@ import com.soundcloud.json.Json
import com.soundcloud.json.Json
@ import play.api.libs.json.{Json => PJson}
import play.api.libs.json.{Json => PJson}
@ PJson.writes[Playable]
cmd5.sc:1: not found: type Writes
val res5 = PJson.writes[Playable]
                       ^
Compilation Failed
@ import Json.writes._
import Json.writes._
@ Json.writes[Playable]
res6: play.api.libs.json.Writes[Playable] =
  play.api.libs.json.Writes$$anon$5@c5ff6e1
```

```
@ PJson.toJson(Album(List(Track(1, "payload1"),
                          Track(2, "payload2"))))
res7: play.api.libs.json.JsValue =
  {"tracks":[{"id":1,"payload":"payload1"},
             {"id":2,"payload":"payload2"}]}
```

? =

*QUESTIONS