
learning Scalaz
eugene yokota (@eed3si9n)

about eugene

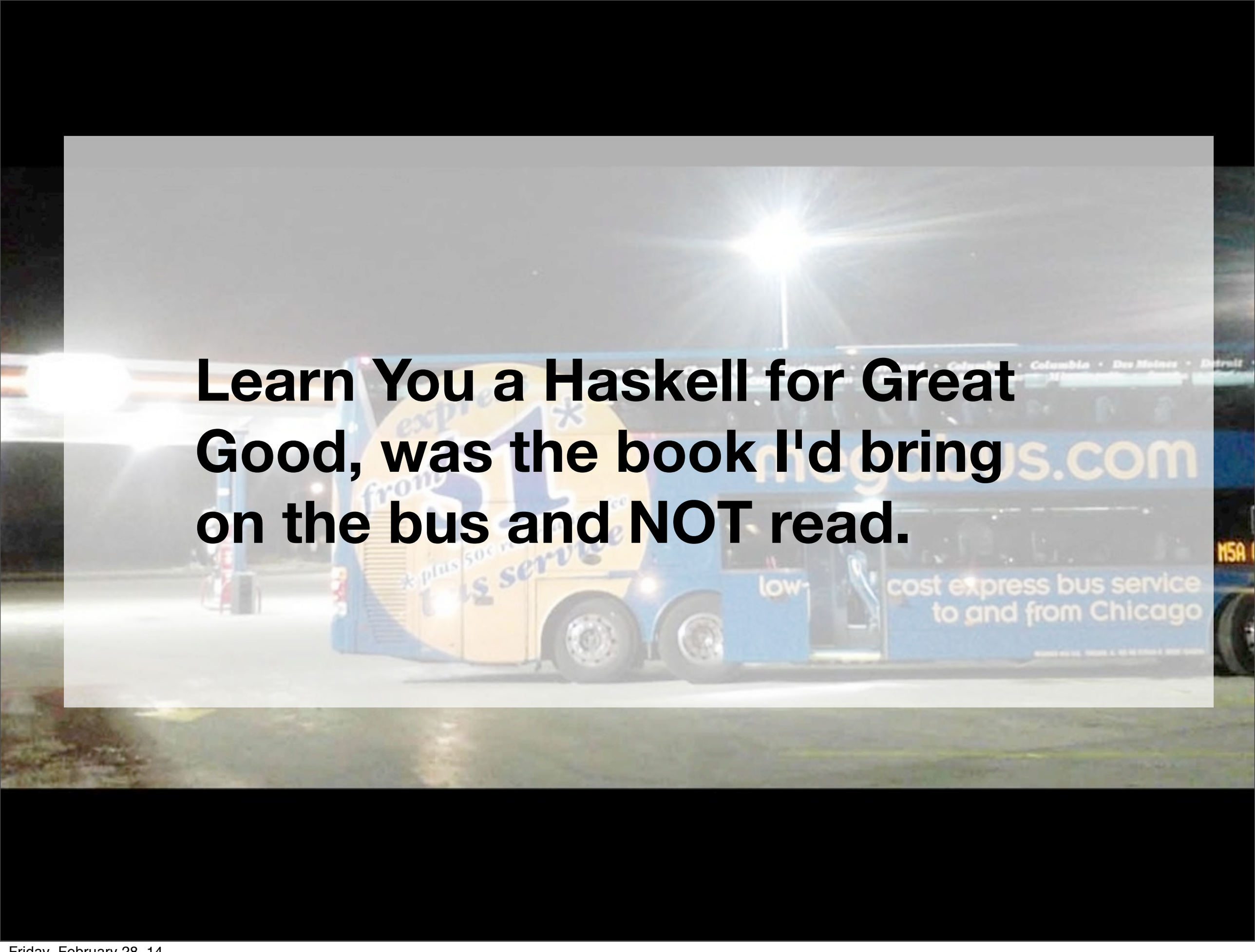
- nights-and-weekend Scala programmer
- scalaxb, treehugger, scopt
- sbt-(assembly, buildinfo, etc.)
- contributor to n8han/pamflet, etc.
- translator of docs.scala-lang.org

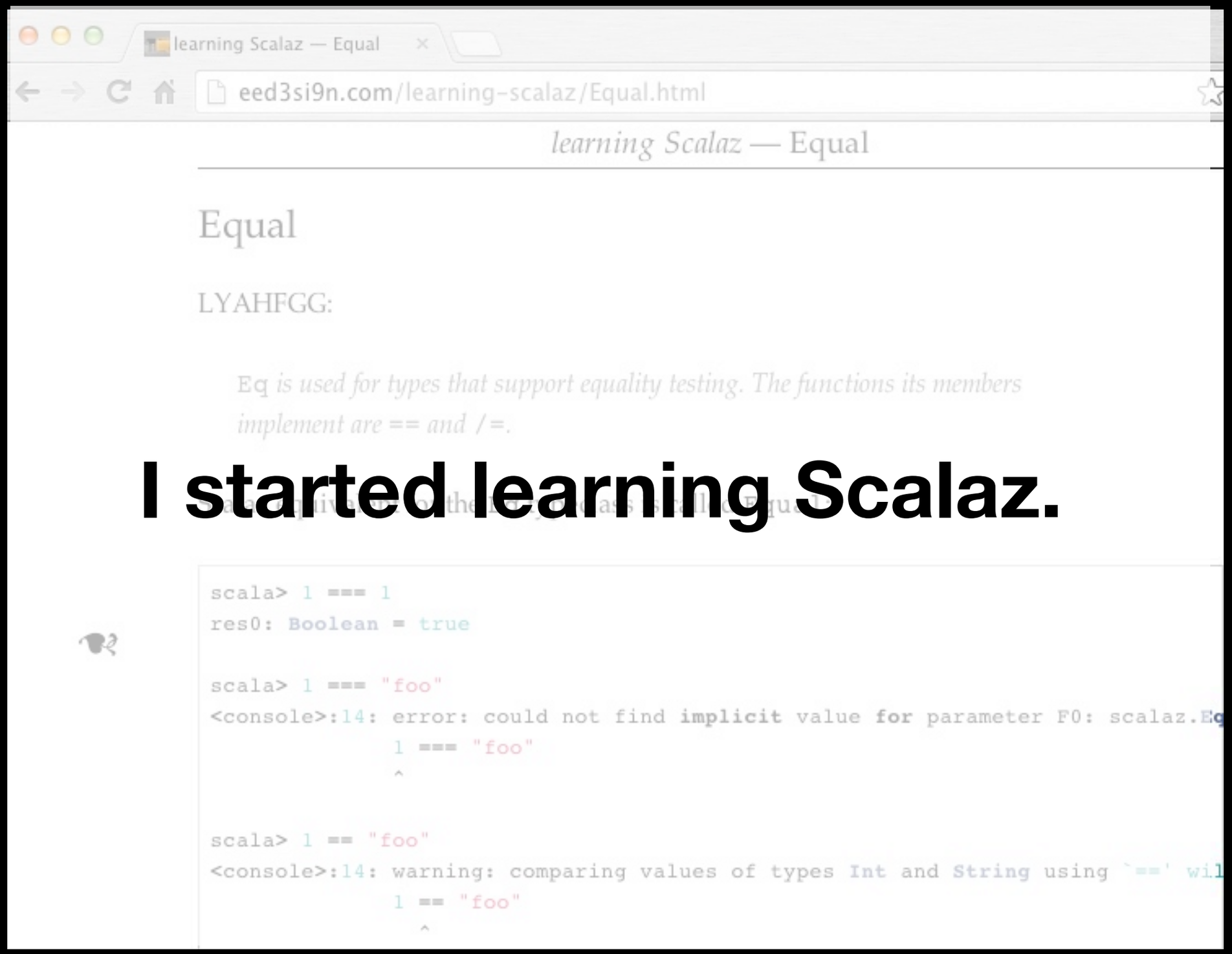
Started Scala code in 2009.
By 2010, started scalaxb,
joined ny-scala.

twitter and Meetup changed my life

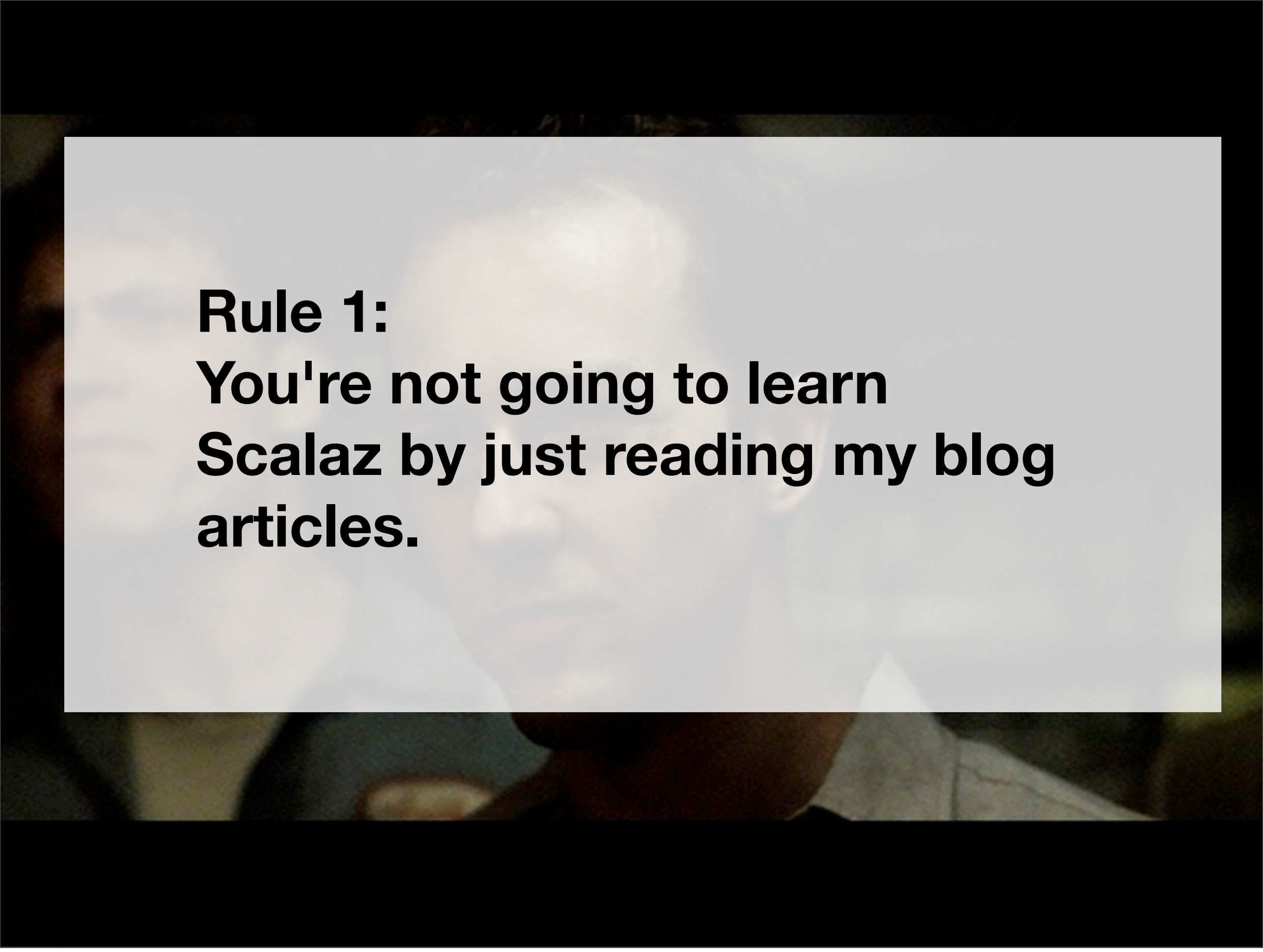
Joined more meetup groups.
tinkered with Haskell and Lisp.

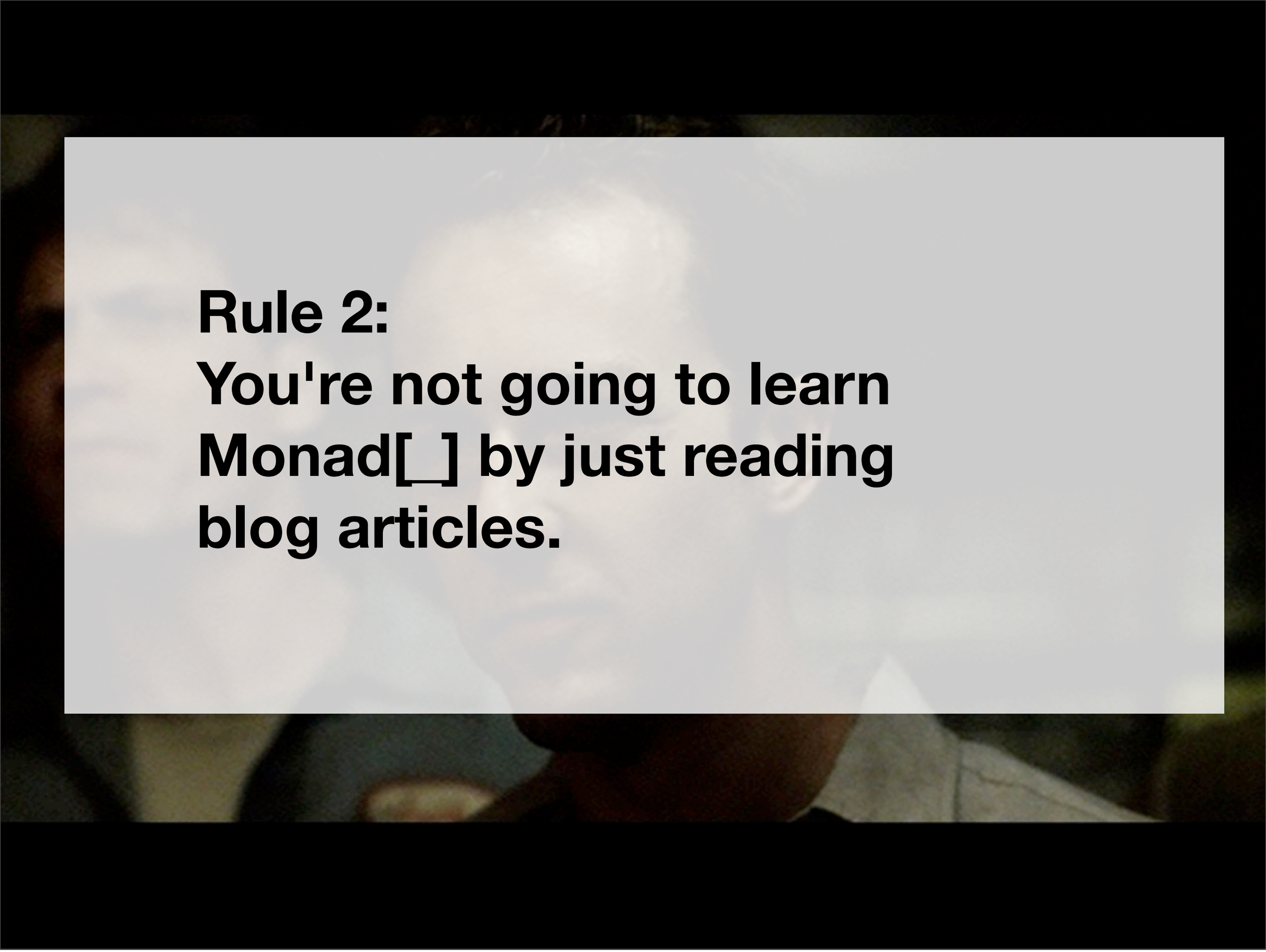

Then I moved to Amherst,
Massachusetts in 2011.


Learn You a Haskell for Great Good, was the book I'd bring on the bus and NOT read.
low-
cost express bus service
to and from Chicago

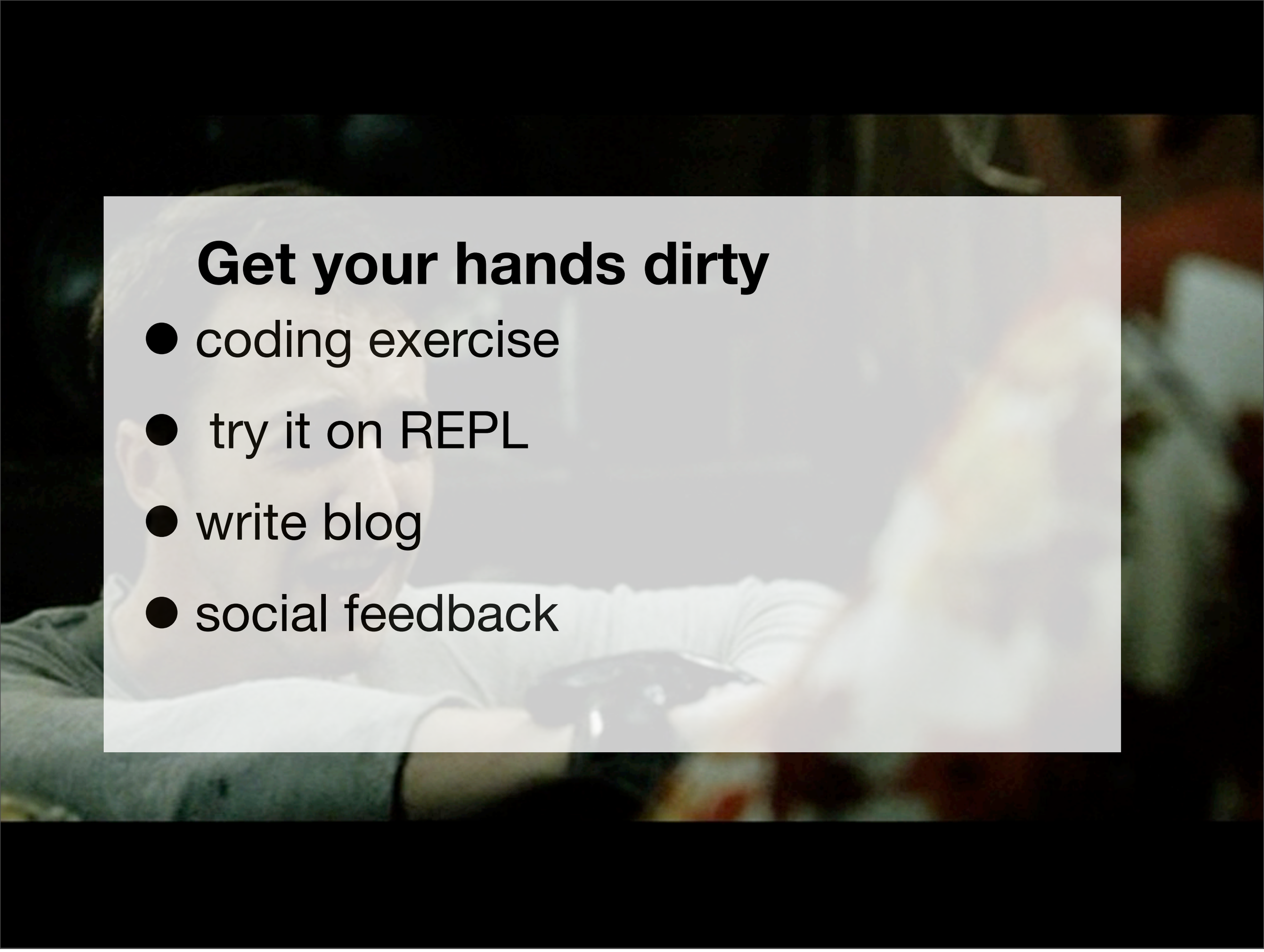


I started learning Scalaz.


Rule 1:
You're not going to learn
Scalaz by just reading my blog
articles.

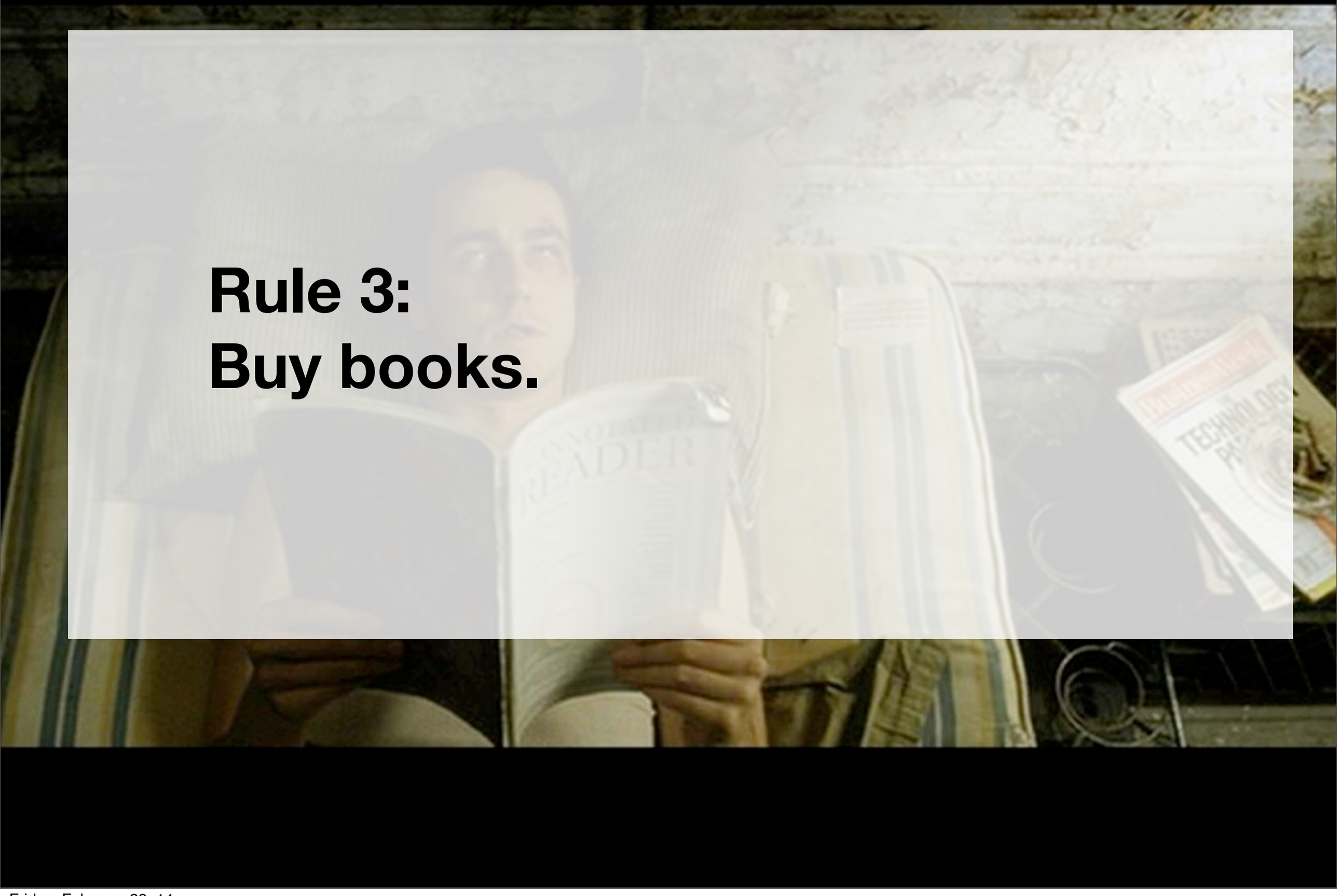


Rule 2:
You're not going to learn Monad[_] by just reading blog articles.

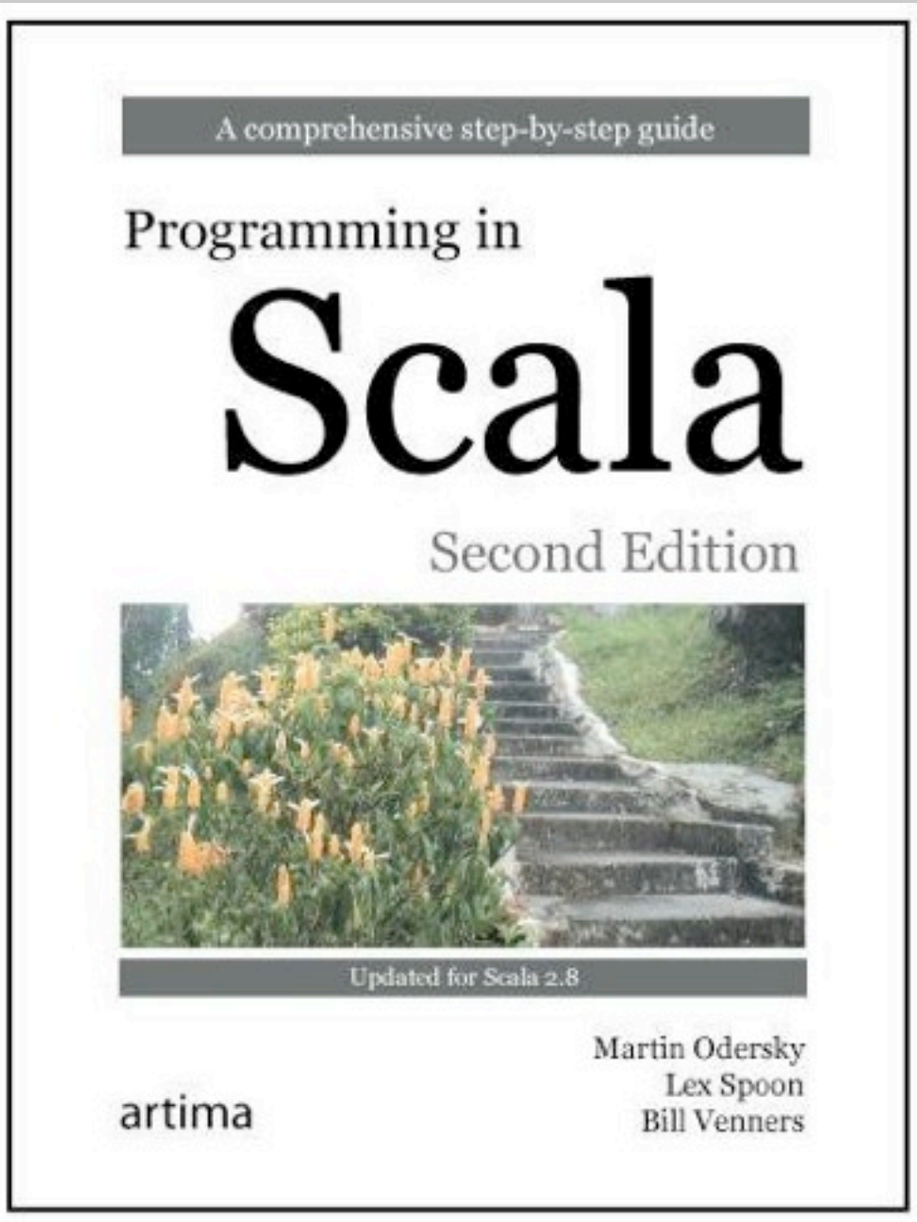


Get your hands dirty

- coding exercise
- try it on REPL
- write blog
- social feedback

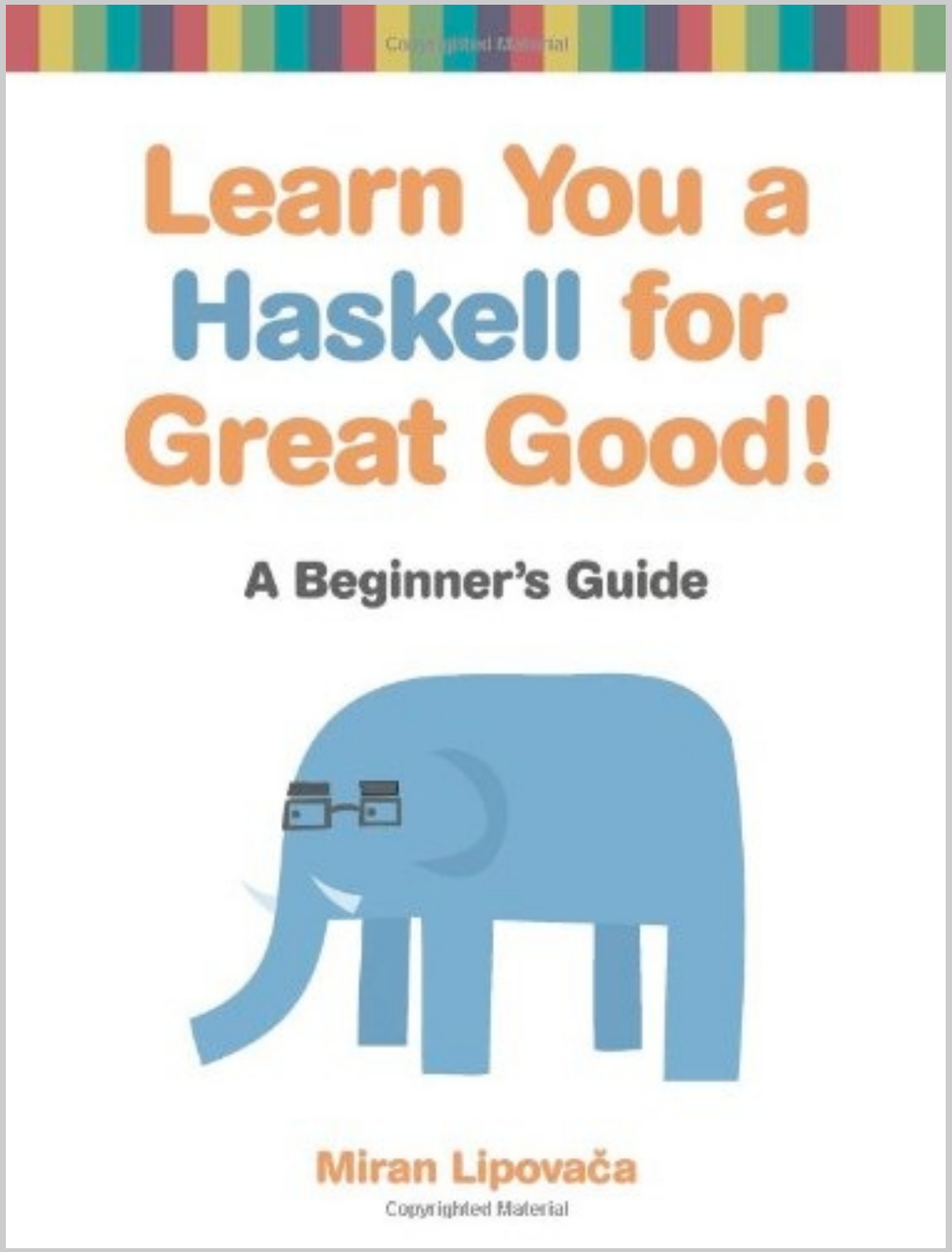


Rule 3:
Buy books.



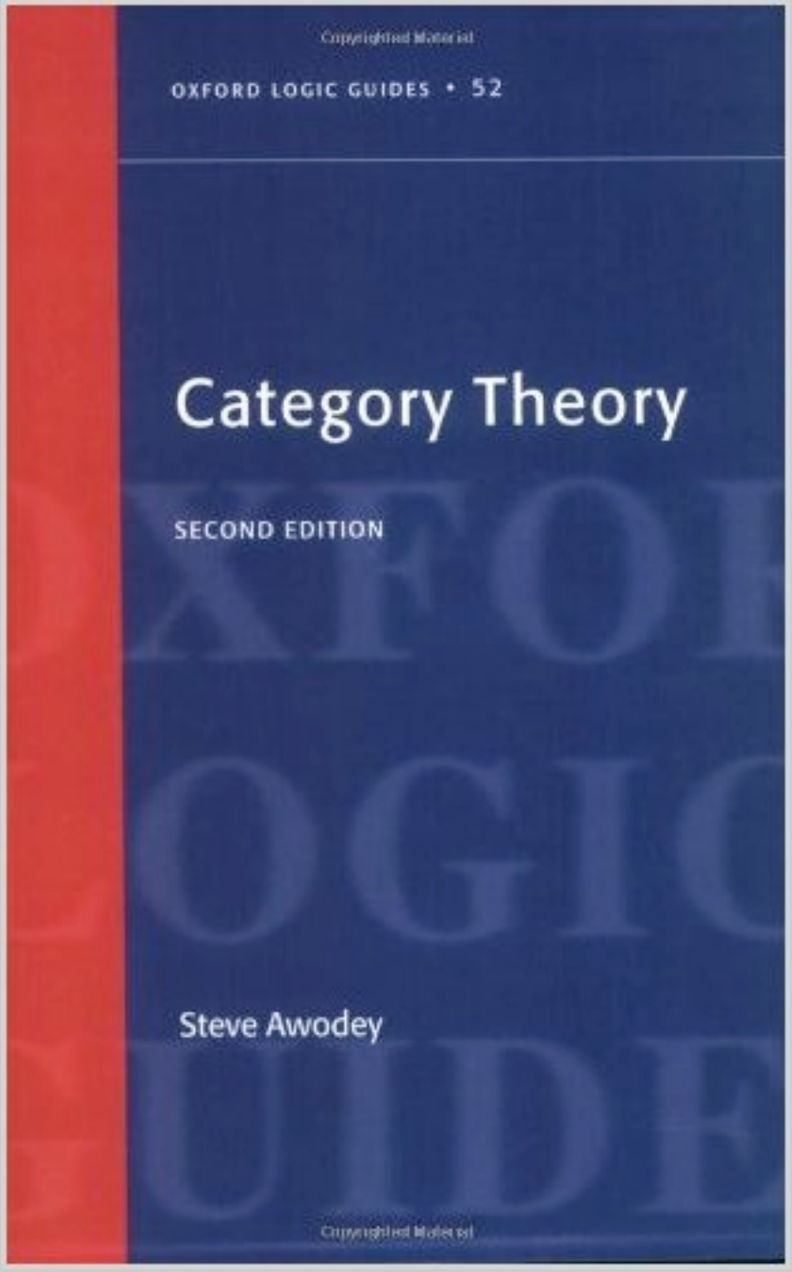
Programming in Scala, 2nd ed

Odersky, Spoon, Venners



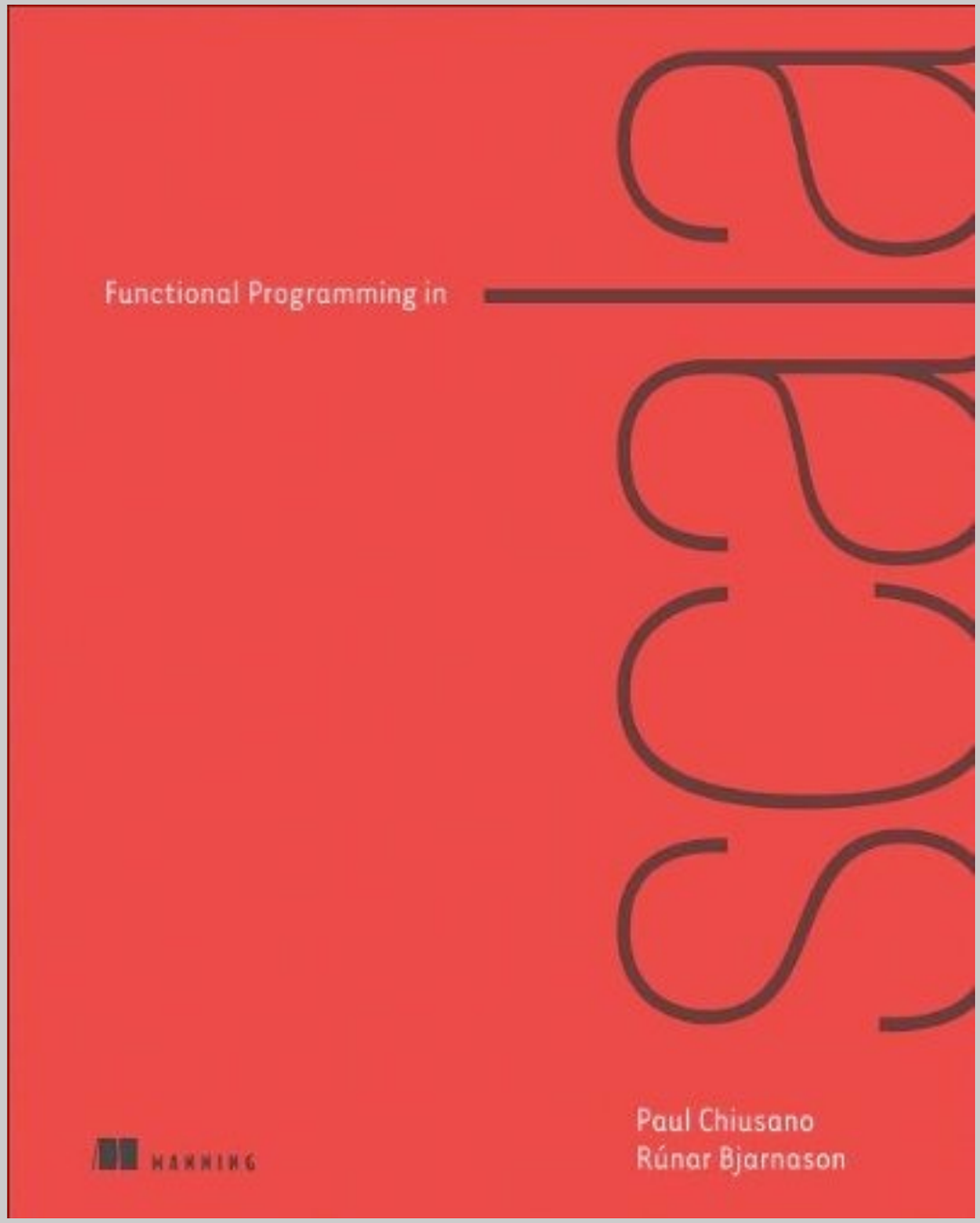
Learn You a Haskell for Great Good!

Lipovača



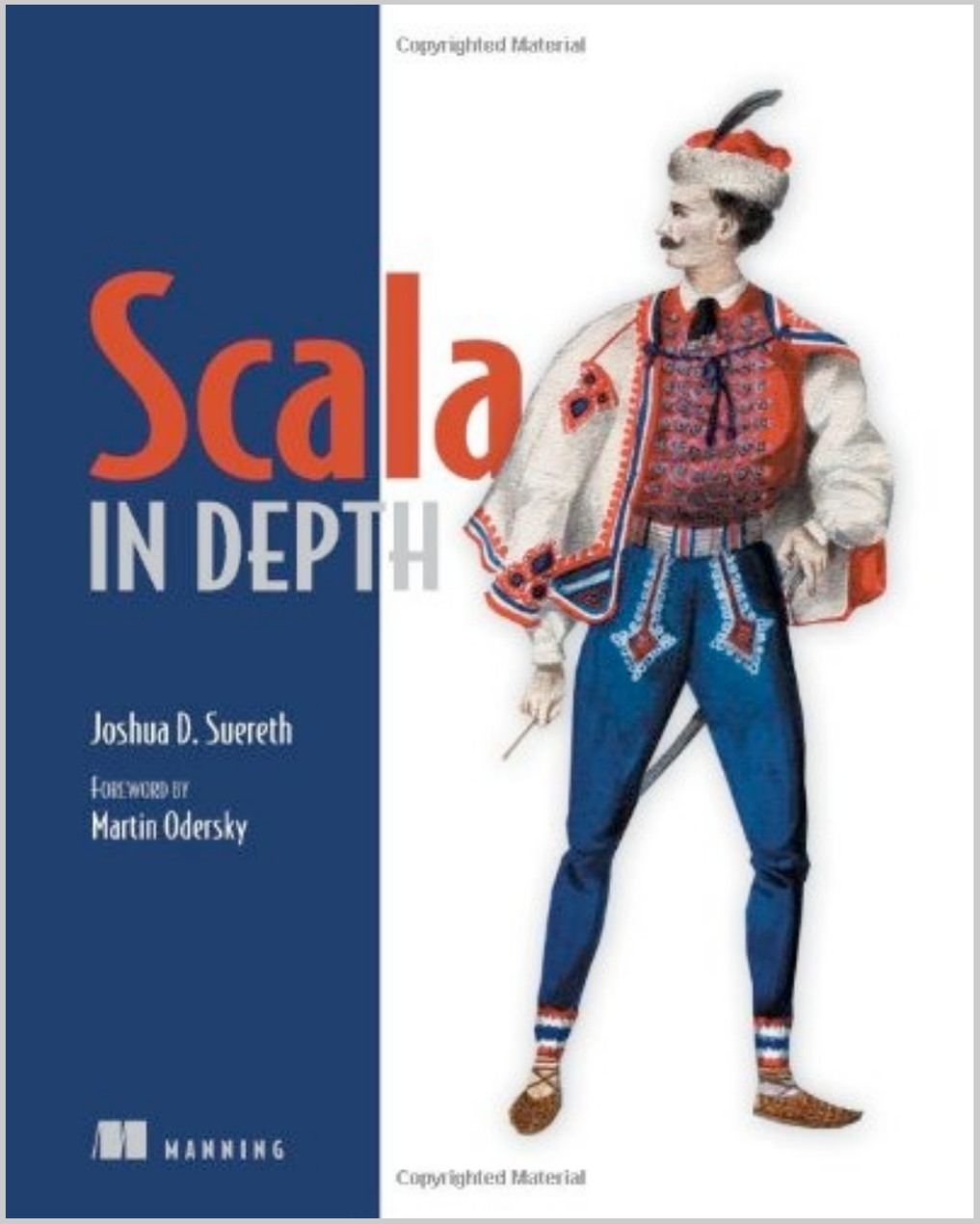
Category Theory

Awodey

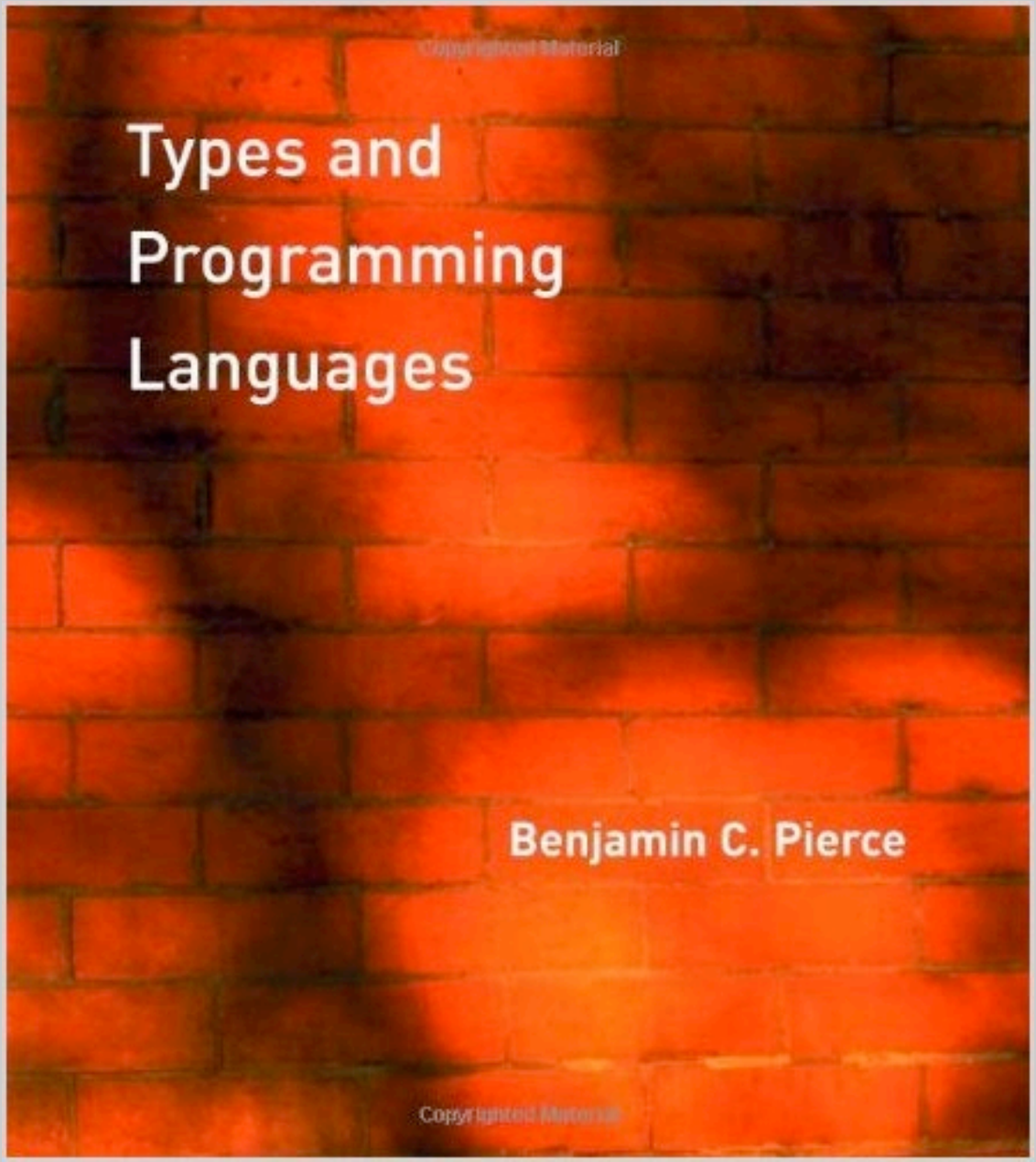


Functional Programming in Scala

Chiusano and Rúnar

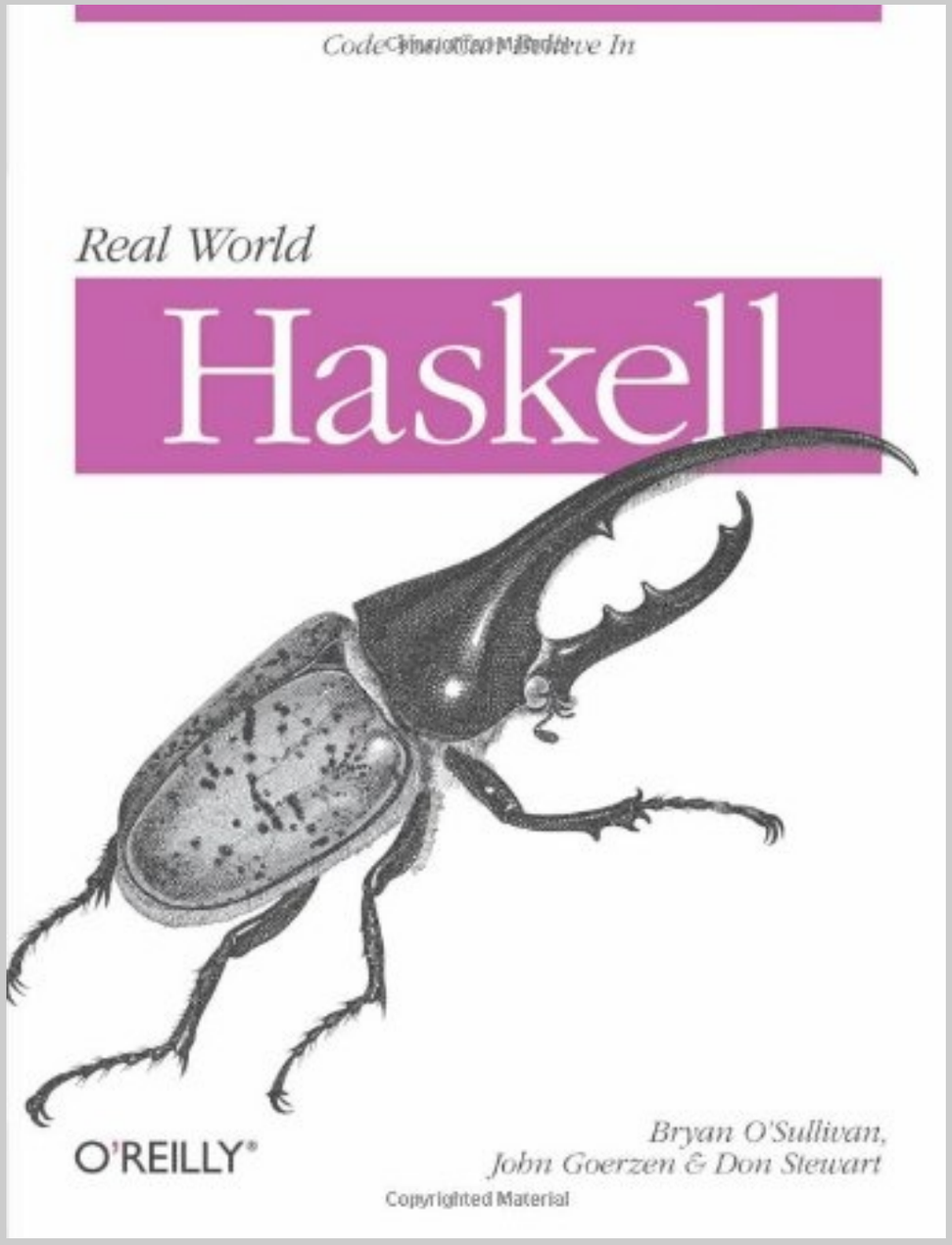


Scala in Depth
Suereth



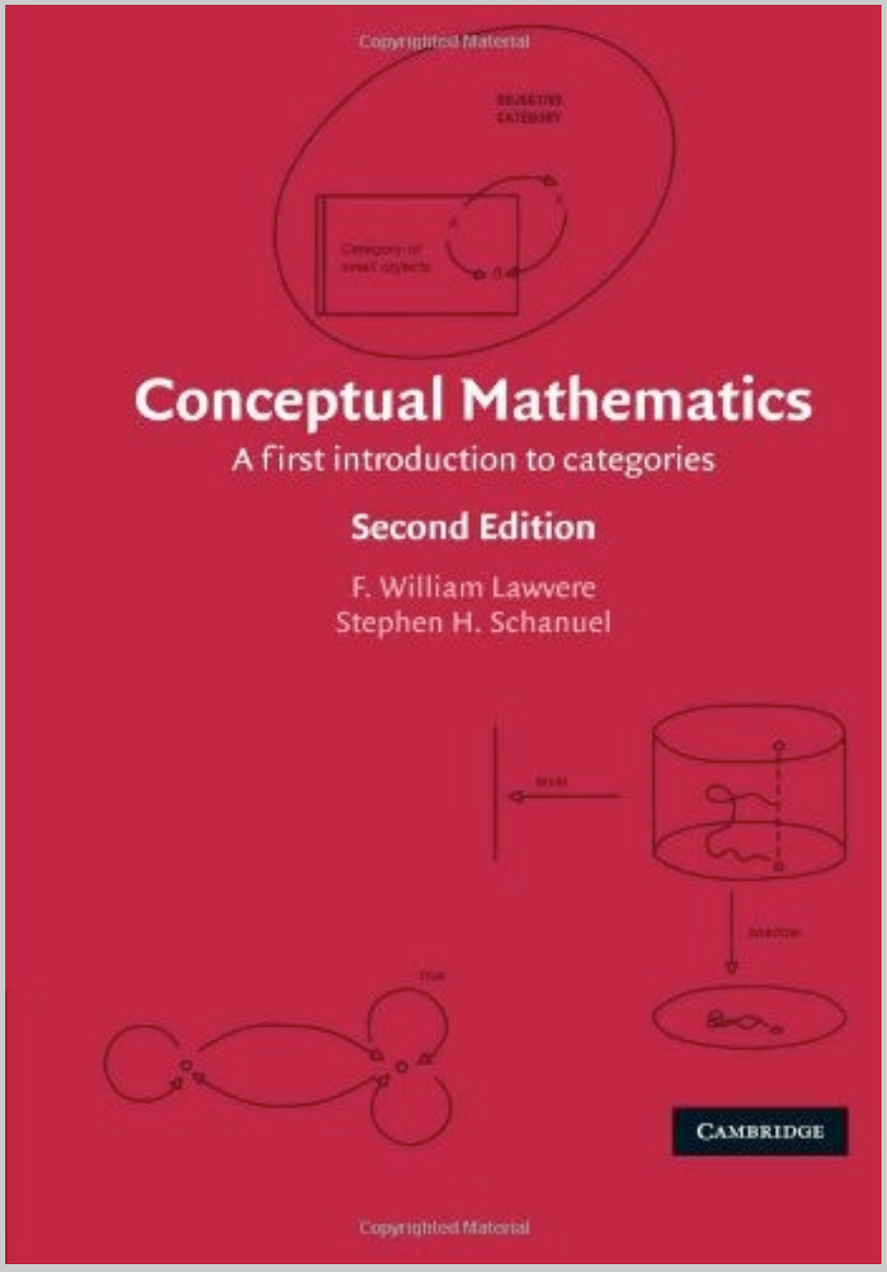
Types and Programming Languages

Pierce



Real World Haskell

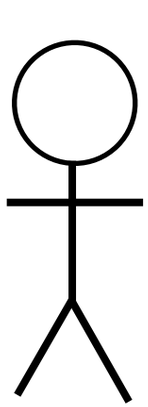
O'Sullivan, Goerzen, Stewart



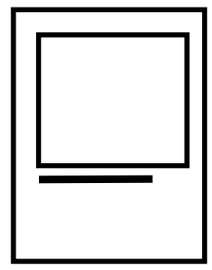
Conceptual Mathematics, 2nd ed

Lawvere, Schanuel

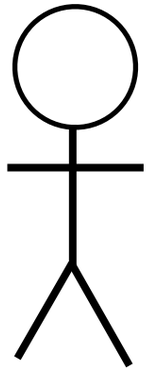
Problem Domain



Computer



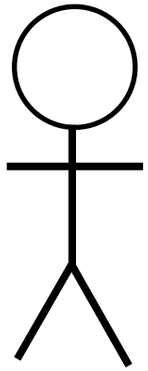
Model

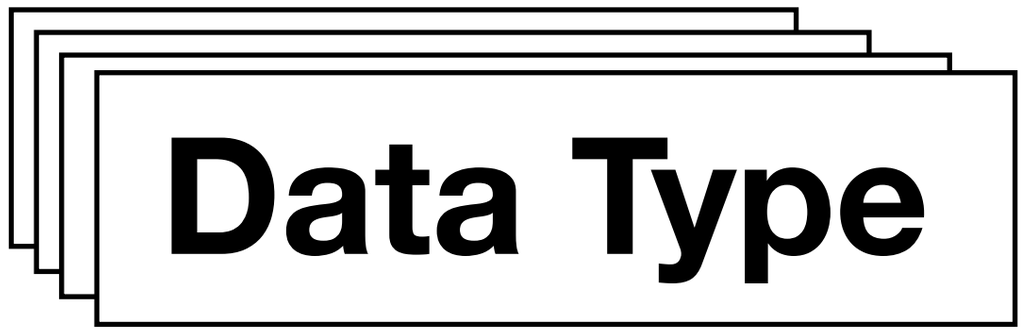


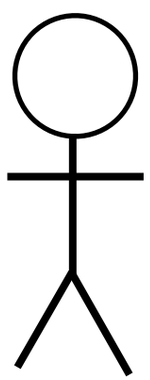
Problem Domain

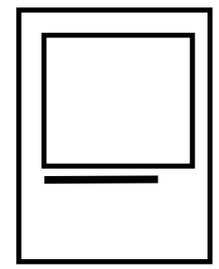
Operators

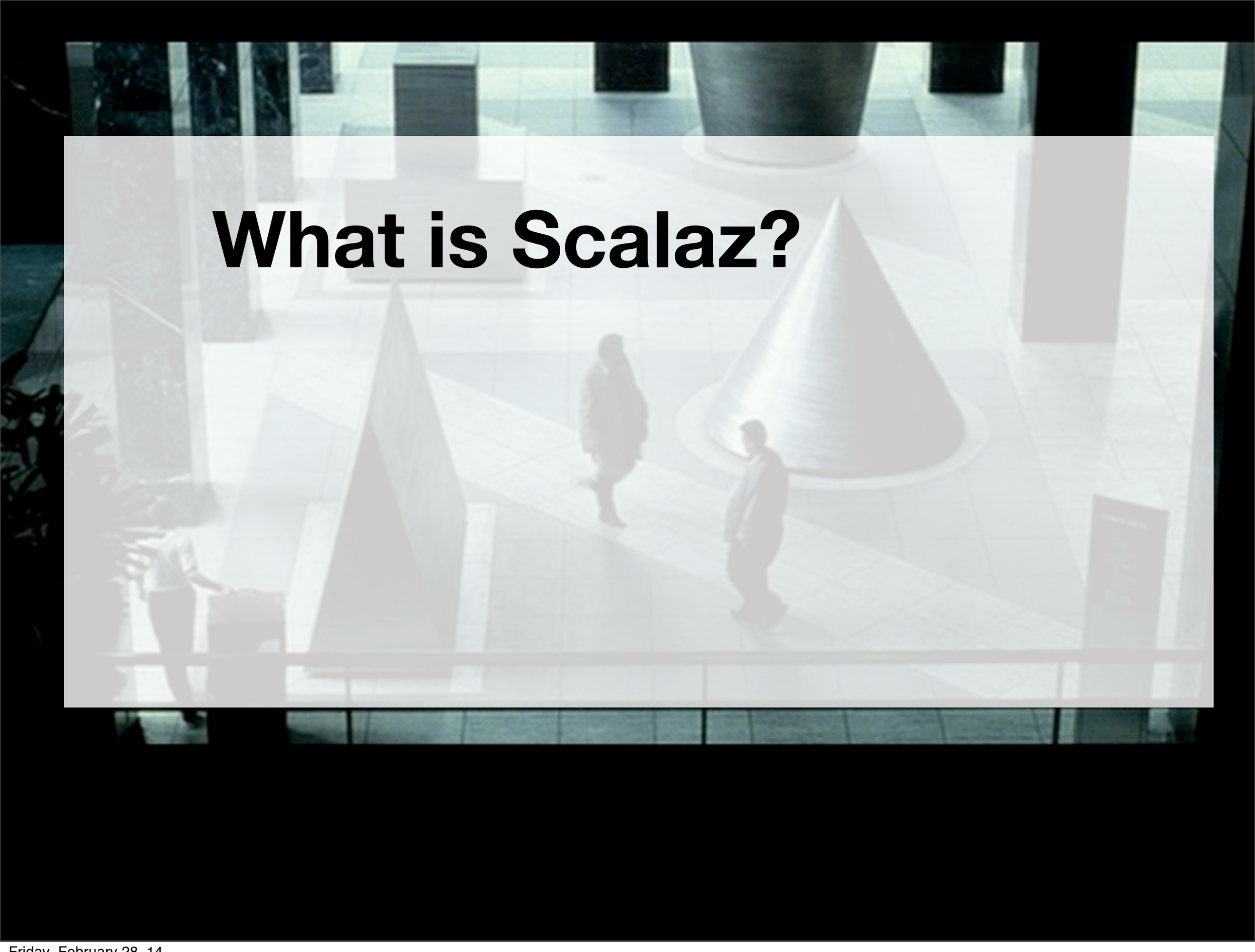
Computer







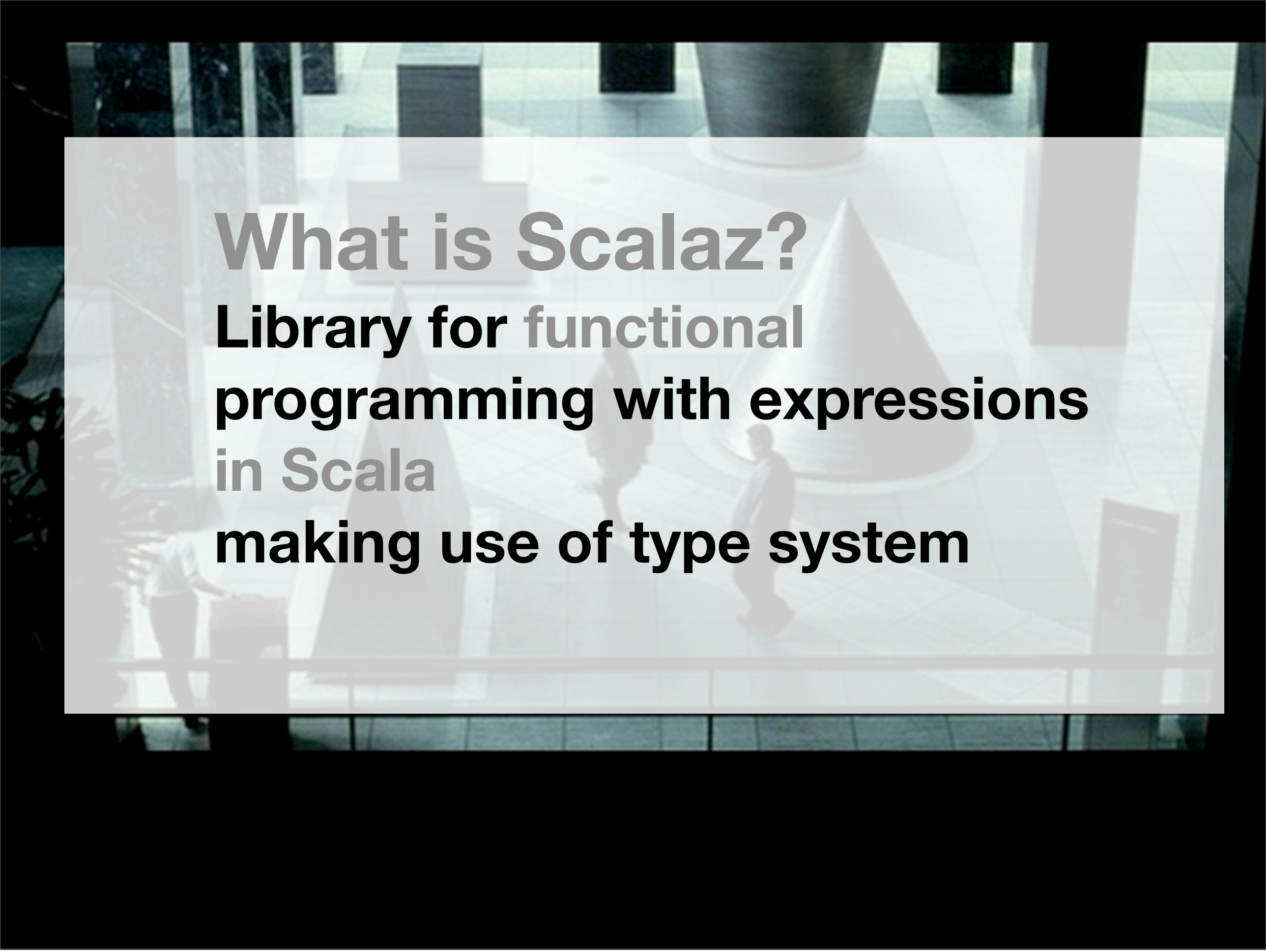




What is Scalaz?

What is Scalaz?

Library for functional programming in Scala



What is Scalaz?

Library for functional programming with expressions in Scala making use of type system

Soundness

- **Argument is valid**
  $P \rightarrow Q$
- **All premise is true**
  $P \sim true$

Soundness

A *type system* is a syntactic method for automatically checking the absence of certain erroneous behaviors…

Soundness?

```
scala> "1" == 1
res0: Boolean = false
```

This should *not* compile

Equality

```
trait Equal[A] {
  def equal(a1: A, a2: A):
      Boolean
}
```

Equality

```
scala> import scalaz._,
                  Scalaz._
scala> "1" === 1
<console>:20: error: could not
implicit value for parameter F0
scalaz.Equal[Any]
                    "1" === 1
                    ^
```

Expression Problem

Given implementation of Int addition: $a + b$

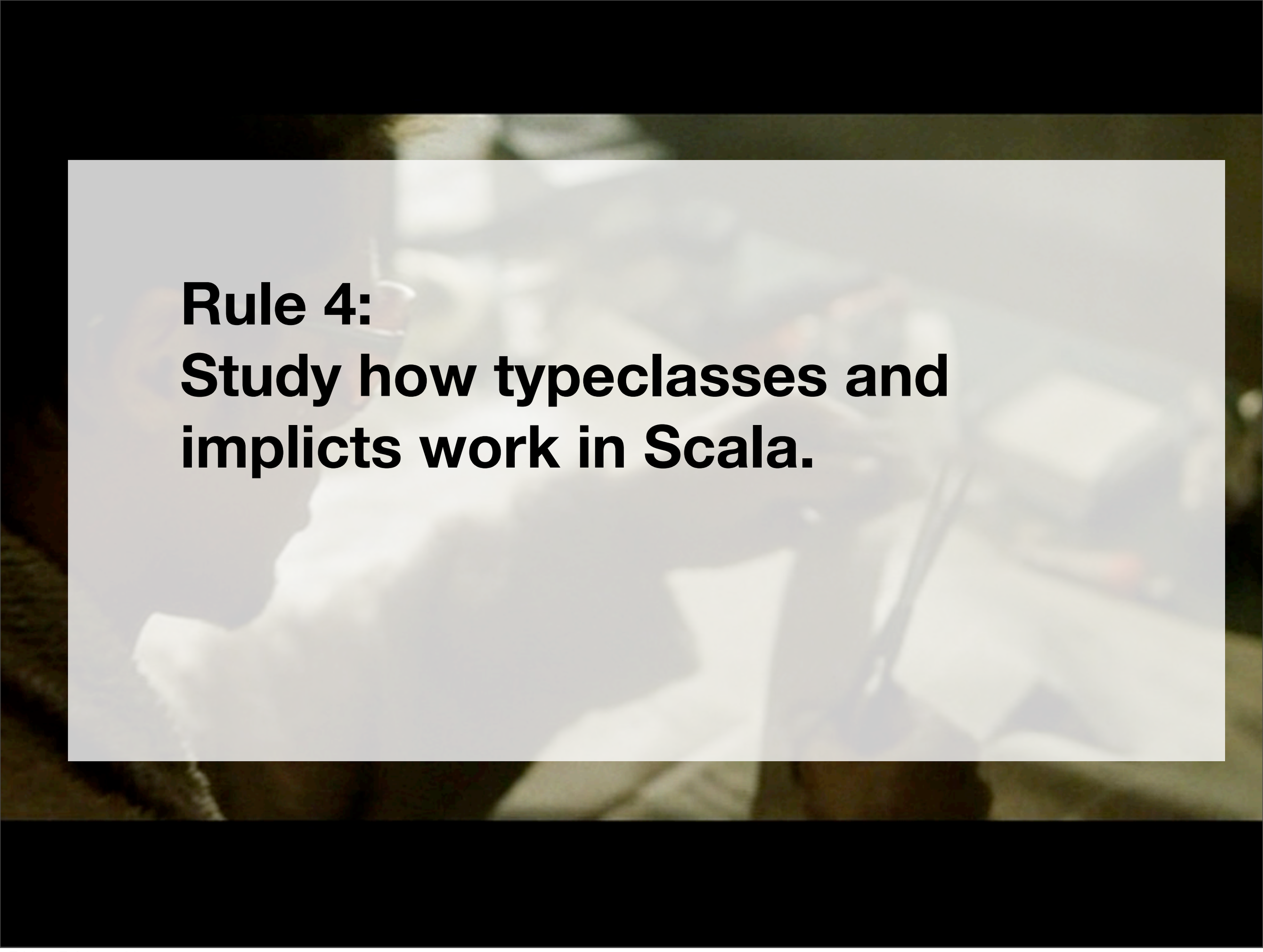
- **Add multiplication of Int: $a * b$**
- **Add addition of Double: $c + d$**

without recompilation or casting.

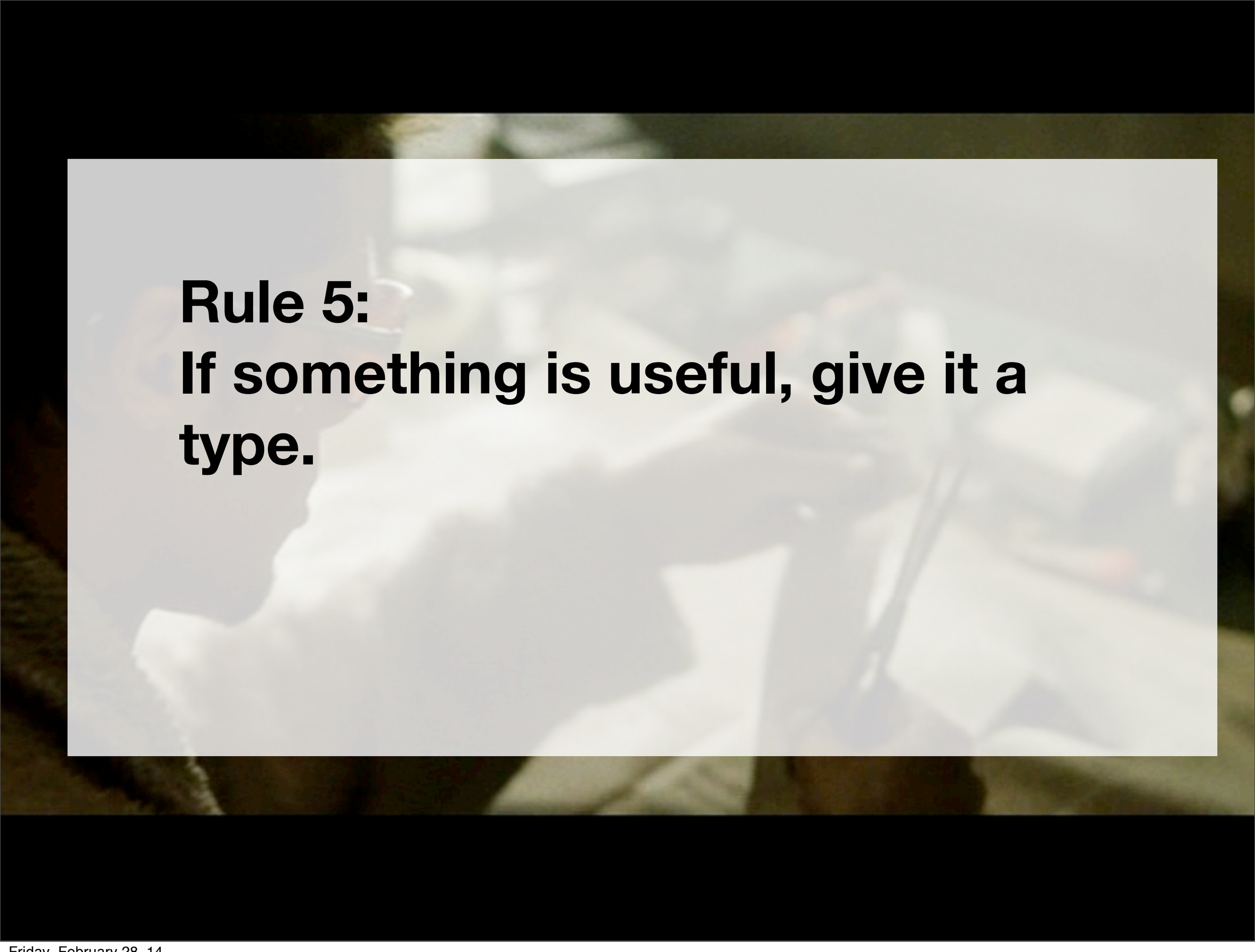
Expression Problem

- Add multiplication of Int: $a * b$
- Add addition of Double: $c + d$

Statically typed plugin system



Rule 4:
Study how typeclasses and implicts work in Scala.



Rule 5:
If something is useful, give it a type.

Parametric Polymorphism

```
def head[A](xs: List[A]): A
  = xs(0)
```

```
scala> head(1 :: 2 :: Nil)
res0: Int = 1
```

Subtype Polymorphism

```
class Foo extends Equal[Foo] {
  def equal(a2: Foo): Foo
    = ???
}
```

Ad-hoc Polymorphism

```
trait Equal[A] {
  def equal(a1: A, a2: A): A
}
```

```
def equal[A: Equal](a1: A,
  a2: A): A =
  implicitly[Equal[A]].
  equal(a1, a2)
```

Typeclass contract

```
trait Equal[A] {
  def equal(a1: A, a2: A): A
}
```

```
def equal[A: Equal](a1: A,
  a2: A): A =
  implicitly[Equal[A]].
    equal(a1, a2)
```

Defining typeclass instance

```
implicit val fooEqual: Equal[Foo]
  = Equal.equal { _ == _ }
  // = Equal.equalA
```

Using typeclass instance

```
  implicit val fooEqual: Equal[Foo]
    = Equal.equal { _ == _ }
  // = Equal.equalA
```

```
def equal[A: Equal](a1: A,
    a2: A): A =
    implicitly[Equal[A]].
    equal(a1, a2)
```

Stop stereotyping

Inheritance ~ "is born as"
Typeclass ~ "is capable of"

```
def equal[A: Equal](a1: A,
   a2: A): A =
   implicitly[Equal[A]].
   equal(a1, a2)
```

Scalaz consists of:

1. **Typeclasses**
   a. **Instances**
   b. **Syntax (ops)**
2. **Functional data structures**
3. **Syntax (ops) on standard classes**

Extracting a typeclass

```
def sum(xs: List[Int]): Int =
  xs.foldLeft(0) { _ + _ }
```

```
scala> sum(List(1, 2, 3, 4))
res3: Int = 10
```

Extracting a typeclass

```
def sum(xs: List[Int]): Int =
  xs.foldLeft(0) { _ + _ }

val intAddition extends Monoid[I
  def zero: Int = 0
  def append(a: Int, b: Int)
    : Int = a + b
}
```

Extracting a typeclass

```
def sum[A: Monoid]
    (xs: List[A]): A = {
   val m = implicitly[Monoid[A]]
   xs.foldLeft(m.zero)
     { m.append(_, _) }
}
```

We have abstracted out (Int, +).

Extracting a typeclass

```
scala> sum(List(1, 2, 3, 4))
res3: Int = 10

scala> sum(List("1", "2", "3"))
res4: String = 123

scala>
sum(List(Tags.Disjunction(true),
Tags.Disjunction(false)))
res5: scalaz.@@[...] = true
```

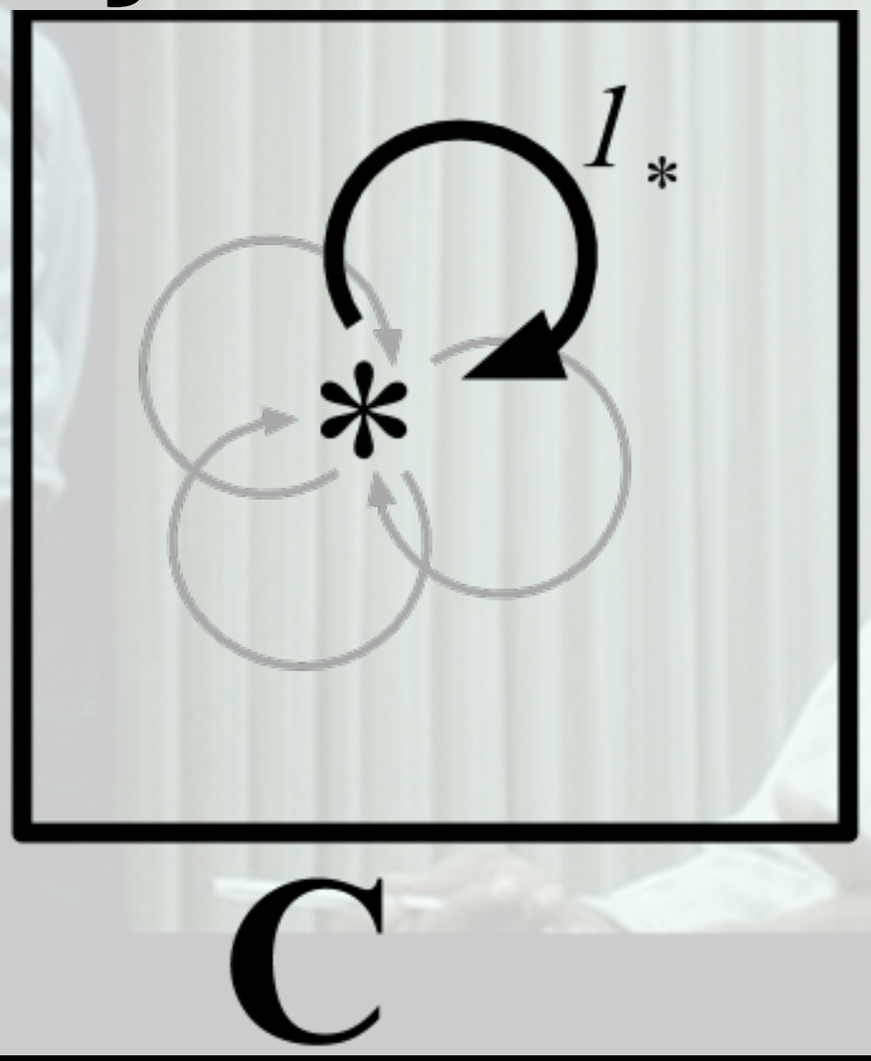
Ad-hoc polymorphism + Method injection (Enrich-my)

```
scala> mzero[Int] mappend 1
res16: Int = 1


scala> ∅[Int] |+| 1
res17: Int = 1


scala> ∅[String] |+| "x"
res18: String = x
```

Monoid Laws

- Left Identity
- Right Identity
- Associativity

Monoid ~ Category with one object



- $zero \mid+\mid x = x$
- $x \mid+\mid zero = x$
- $(x \mid+\mid y) \mid+\mid z =$
  $x \mid+\mid (y \mid+\mid z)$

Syntax for Options

```
(1 < 10) option 1
    === 1.some
1.some
    === (Some(1): Option[Int])
none[Int]
    === (None: Option[Int])
1.some? 'x' | 'y' === 'x'
1.some | 2
    === 1 // getOrElse
```

Validation

```
("first ok".successNel[String] |@|
  "last failed!".failureNel[String] |@|
  "password failed!".failureNel[String]) {
  _ + _ + _ }
res25: scalaz.Unapply... =
  Failure(NonEmptyList(last failed!,
    password failed!))
```

Memo

```
val memoizedFib: Int => Int =
Memo.mutableHashMapMemo {
  case 0 => 0
  case 1 => 1
  case n => memoizedFib(n - 2) +
            memoizedFib(n - 1)
}
```

Tagged type

```
sealed trait KiloGram
def KiloGram[A](a: A):
    A @@ KiloGram =
    Tag[A, KiloGram](a)
def f[A](mass: A @@ KiloGram):
    A @@ KiloGram = ???
```

Tagged type

```
sealed trait KiloGram
def KiloGram[A](a: A):
    A @@ KiloGram =
    Tag[A, KiloGram](a)
def f[A](mass: A @@ KiloGram):
    A @@ KiloGram = ???
```

State

```
(for {
   xs <- get[List[Int]]
   _  <- put(xs.tail)
} yield xs.head).run(1 :: Nil)
```

```
assert_=== (Nil, 1)
```

Biggest Win:
Changes the way you look at the world programmatically.

http://eed3si9n.com/