SCALA MACROS

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WHAT WILL YOU FIND OUT?

- What is a macro?
- How to write a macro?
- So … anybody uses macros?
- What's "macro paradise"?

WHAT IS A MACRO?

mac·ro [**mak**-roh] Show IPA ***adjective, noun, plural*** **mac·ros.**

adjective

1. very large in scale, scope, or capability.
2. of or pertaining to macroeconomics.

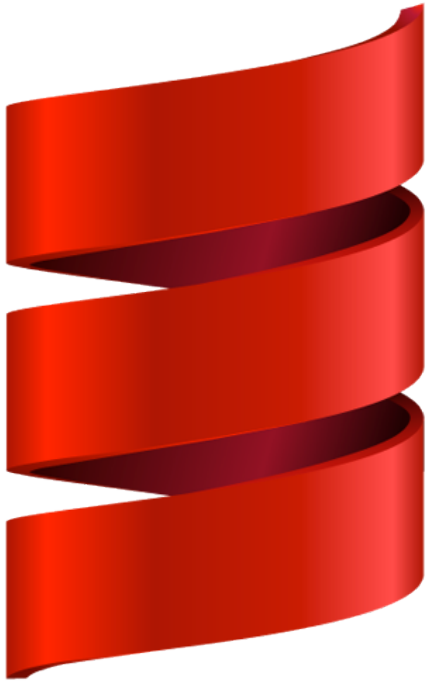
noun

3. anything very large in scale, scope, or capability.
4. *Photography* . a macro lens.

- **Macro (large): expands into something larger**
- **Function: `code => code`**
- **Invoked at build/compile-time**

SCALA MACROS

- Written in Scala
- Have access to and can manipulate the AST
- Use compiler/reflection APIs
- Type-safe



MACROS IN OTHER LANGUAGES

C/C++ – preprocessor

- `#define BUFFER_SIZE 1024`
- `#define min(X, Y) ((X) < (Y) ? (X) : (Y))`

Lisp/Clojure, Racket (Scheme)

- code is data (list)
- quoting
- *"Since macros are so much harder to use than functions, a good rule of thumb is: don't use defmacro if defun will work fine"*

from http://www.apl.jhu.edu/~hall/Lisp-Notes/Macros.html

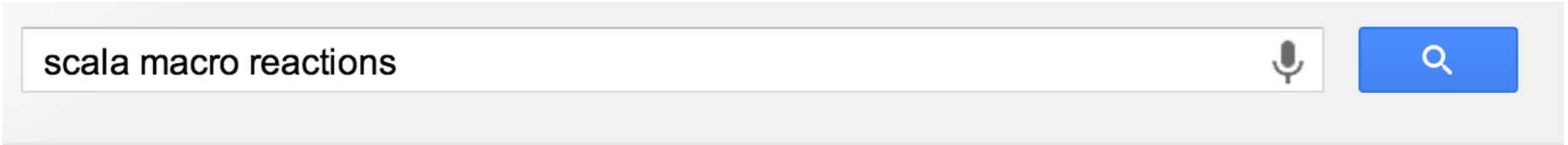
MOTIVATION TO ADD MACROS TO SCALA

(it's not a lean language already!)

- ✓ Remove boilerplate
- ✓ Replace run-time reflection
- ✓ Generate type-checked code
- ✓ Deep embedding of DSLs
- ✓ Type-check external DSLs
- ✓ Simplify compiler in the long run

REACTIONS TO MACROS

Mixed ;)



ABOUT ME

During the day: **coding @ SoftwareMill**

SoftwareMill: **a great software house!**

Afternoon: **playgrounds, Duplo, etc.**

Evening: **blogging, open-source**

- Original author of Hibernate Envers
- ElasticMQ, Veripacks, MacWire

http://www.warski.org

“DEF” MACROS

- Available since Scala 2.10 (Jan 2013)
- Only one type of many possible macro types
- Experimental status

WRITING A MACRO STEP-BY-STEP

Goal – transform this:

```
debug(x*amount)
```

To:

```
println("x*amount = " + (x*amount))
```

So that it outputs:

```
x*amount = 10.23
```

DEMO

WRITING A SIMPLE MACRO

WHERE ARE MACROS USED?

- Slick
- Akka
- Async
- MacWire

examples are mostly from the projects' websites

SLICK

```
@table(name="COFFEES") case class Coffee(
  @column(name="NAME") name: String,
  @column(name="PRICE") price: Double
)

val q = Queryable[Coffee]
val r = q.filter(_.price > 3.0).map(_.name)
```

ASYNC

```
val f1 = Future { beSlow(); 19 }
val f2 = Future { beSlow(); 23 }
val futureResult = for {
    v1 <- f1
    v2 <- f2
} yield v1 + v2
```

ASYNC

```
val futureResult = async {
  val f1 = async { beSlow(); 19 }
  val f2 = async { beSlow(); 23 }
  await(f1) + await(f2)
}
```

ASYNC

```
val future = async {
  val f1 = async { beSlow(); true }
  val f2 = async { beSlow(); 42 }
  if (await(f1)) await(f2) else 0
}
```

- **Also possible with Akka Dataflow & CPS (but that's so '09)**
- **Can also use for-comprehensions; but quickly gets tricky**

ERRORS

- **Cryptic errors?**
- **Can be, if generated code doesn't compile**
- **But we can provide user-friendly errors**

```
context.error(
        c.enclosingPosition,
        "You can't do that")
```

DEMO

MACWIRE

AND OTHERS!

- Scala Pickling
- Akka 2.2 typed channels
- ScalaMock
- Typesafe Logging
- Scala Blitz
- Expecty
- …

OTHER TYPES OF MACROS

- **Coming in Scala 2.12+**
- **Also available as a compiler plugin in 2.10/2.11**
  - Macro Paradise

based on the examples from http://scalamacros.org/

DEF MACROS

- **What we've seen so far**
- **Look like a method invocation**
- **Generate code basing on:**
  - The parameters
  - Enclosing method/class
  - Implicit lookups

IMPLICIT MACROS

- **Useful for Type Classes**

```
trait Showable[T] { def show(x: T): String }

def useShow[T](x: T)(implicit s: Showable[T]) =
s.show(x)

implicit object IntShowable {
      def show(x: Int) = x.toString }
```

IMPLICIT MACROS

We want to provide a “default implementation” for a type

```
trait Showable[T] { def show(x: T): String }
object Showable {
  implicit def materialize [T]: Showable[T] =
      macro ...
}
```

We can get access to T at compile-time and generate what’s needed

MACRO ANNOTATIONS

```
trait Foo {
  def m1(p: Int): Long
  def m2(p1: String, p2: Date): Double
}

class FooWrapper(@delegate wrapped: Foo)
  extends Foo {

  def m1(p: Int) = wrapped.m1(p)+1L
}
```

MACRO ANNOTATIONS

Annotation-drive macros

- Any definitions can be annotated

```
class delegate extends StaticAnnotation {
  def macroTransform(annottees: Any*) = macro ???
}
```

MACRO ANNOTATIONS

- **Annottees is:**
  - Annotated class + companion object
  - Method parameter, owner, companion

- **Can expand classes**
- **Can create companion objects**

QUASIQUOTES

- **Similar to string interpolators**
- **Extract from trees:**

```
val q"def $name[..$tparams](...$vparamss): $tpt
      = $body" = methodTree
```

- **Pattern match**

```
tree match {
   case q"def $name[..$tps](...$vps): $tpt
      = $body" =>
}
```

QUASIQUOTES

Construct

- Terms: `q"future{ $body }"`
- Types: `tq"Future[$t]"`
- Cases: `cq"x => x"`
- Patterns: `pq"xs @ (hd :: tl)"`

POTENTIAL PROBLEMS

- Hard to write
- Code may be harder to understand
- And to debug

WHEN TO WRITE A MACRO?

- **Always think it through**
- **Lots of repeated, boilerplate code**
- **Unavoidable copy-paste (patterns)**
- **Library code**

```
macro: power => responsibility
```

LINKS

- http://www.warski.org/blog/2012/12/starting-with-scala-macros-a-short-tutorial/
- http://scalamacros.org/
- http://slick.typesafe.com/
- https://github.com/scala/async
- https://github.com/adamw/macwire
- https://github.com/adamw/scala-macro-tutorial

http://codebrag.com
COME & GET A STICKER