Scala and the web

Using Lift to write a simple CMS

What are Scala and Lift?

Monday, 27 April 2009

A new language that has a number of interesting features. I want to talk about some of these features, and to put them in context, I'll be using a very small example application.

My current day job is web programming, so it was natural for me to chose a web framework as a route into using Scala; there are other ones (Slinky), but this is the one that is generating the most buzz at the moment, and it makes

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Diminishes your test burden
Better chance of getting it right first time
Better tool support

* Dynamic
Concise and expressive: absence of boilerplate: *"Tasteful typing"*
Interactive interpreter
Type inferencing

* Object Oriented
Classes
Multiple Inheritance via mix-in traits
Virtual functions
Overloaded functions
Can build your own value types that implement operators: just like the ints
Programming with mutable state: collections, vars

* Functional
Functions are first class objects
Pattern matching
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* Compiles to JVM byte code:
interoperate with other libraries (in both directions)
uses JVM debug format, and thus works with existing debuggers out-of-the-box

* MSIL
Support lags behind the JVM implementation: for the adventurous only

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Lift

"Lift borrows from the best of existing frameworks, providing Seaside's highly granular sessions and security, Rails' fast flash-to-bang, Django's "more than just CRUD is included" and Wicket's designer-friendly templating style"

liftweb.net

Lift is a web framework written in Scala by David Pollak.

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When used with Jetty: it will also work with the suspend/resume behaviour in v3.0 of the servlet specification

* ...and more
modules for a number of things, all cleanly separated out into packages: you don't pay for what you don't use.
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- COMET applications using the Scala Actors library

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Lift architecture

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David Pollak

* Servlet API
Can be hosted by any servlet container: if you use Jetty you get extra stuff (continuations)

* Dispatch via partial functions
HTTP requests are routed to handlers using partial functions

* “View-first model”
This is to contrast it with Rails' "controller-first" model

* Multiple controllers
A web page might have several pieces of functionality on it, and thus multiple controllers.

* Snippets and bind points
A snippet declares bind points, which the snippet controller can bind data and controls to

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Lift architecture

- Choice of persistence model is a separate concern
- ...although Mapper is a good starting point

Mapper, Record, JPA etc.

cms

cmless

Show the CMS

cmless

- Tree of pages

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- Tree of pages
- Create/edit/delete

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Show the CMS

cmless

- Tree of pages
- Create/edit/delete
- Page URL reflects its place in the hierarchy

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Show the CMS

Sitemap

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This is a lift component that provides a simple way to plug-in different components of a web-app into a single navigational structure. As an example, show the demo lift application (demo.liftweb.net <http://demo.liftweb.net/>)

It:
* displays the component parts of your application in a menu hierarchy
* plugs those components into the lift dispatch rules table for you
* provides a means to translate an HTTP request into a typed parameter that can subsequently be used in the display code

Building an entire app through a single sitemap handler is probably a bit daft, but it let me keep a lot of stuff in what place, which was handy for exposition purposes: this isn't the path that most lift tutorials will take you down!

* Loc[T] is the trait you extend to implement this functionality

* There are two phases to the process, handled separately by two partial functions in PageLoc: mapping the URL into a possible data item, and rendering the data or displaying an error if it’s not there.

** Retrieval: controlled by rewrite()

* PageInfo
This is a type we provide to store the data we want to render later; in this case, PageInfo associates a path relative to our component with a Page

* Page
stores the title and content of a page: persisted to an SQL DB using lift's Mapper ORM

** Rendering

* pages.html
The template used to display a page; contains snippets for viewing the contents, create new pages, edit and delete the current one.

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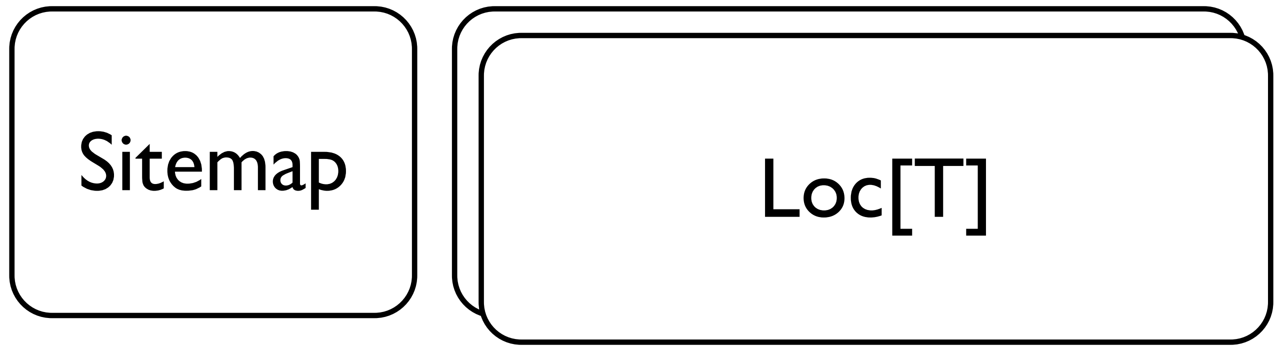

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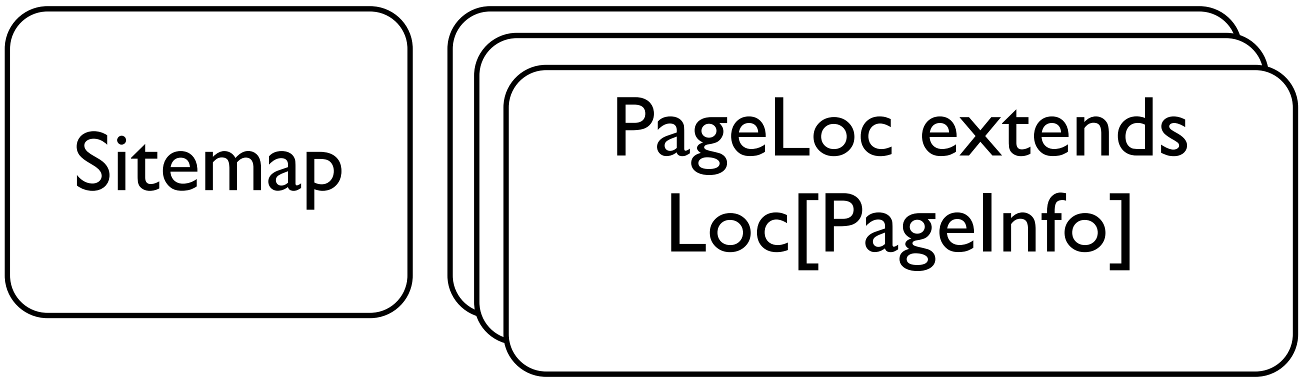

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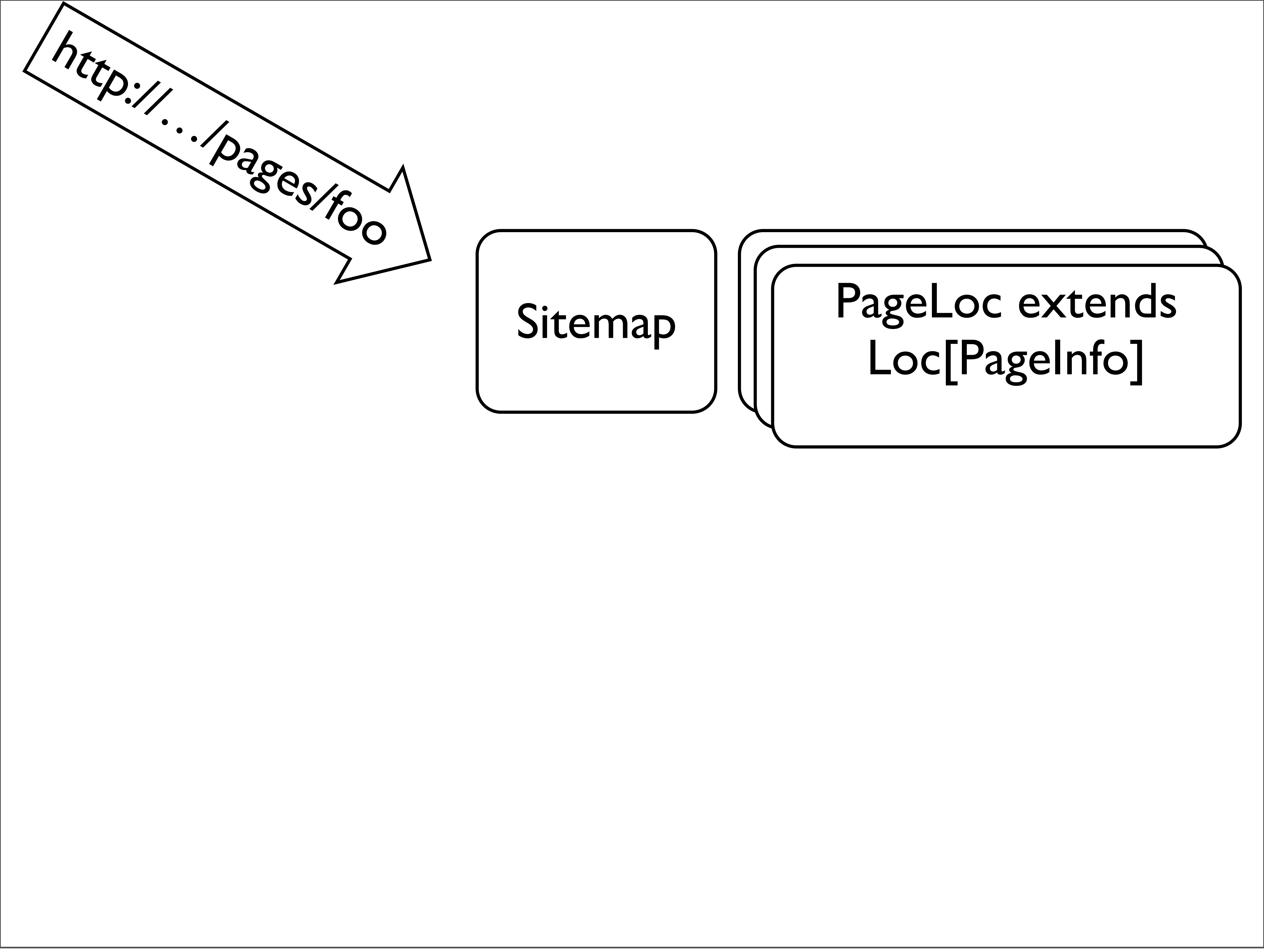

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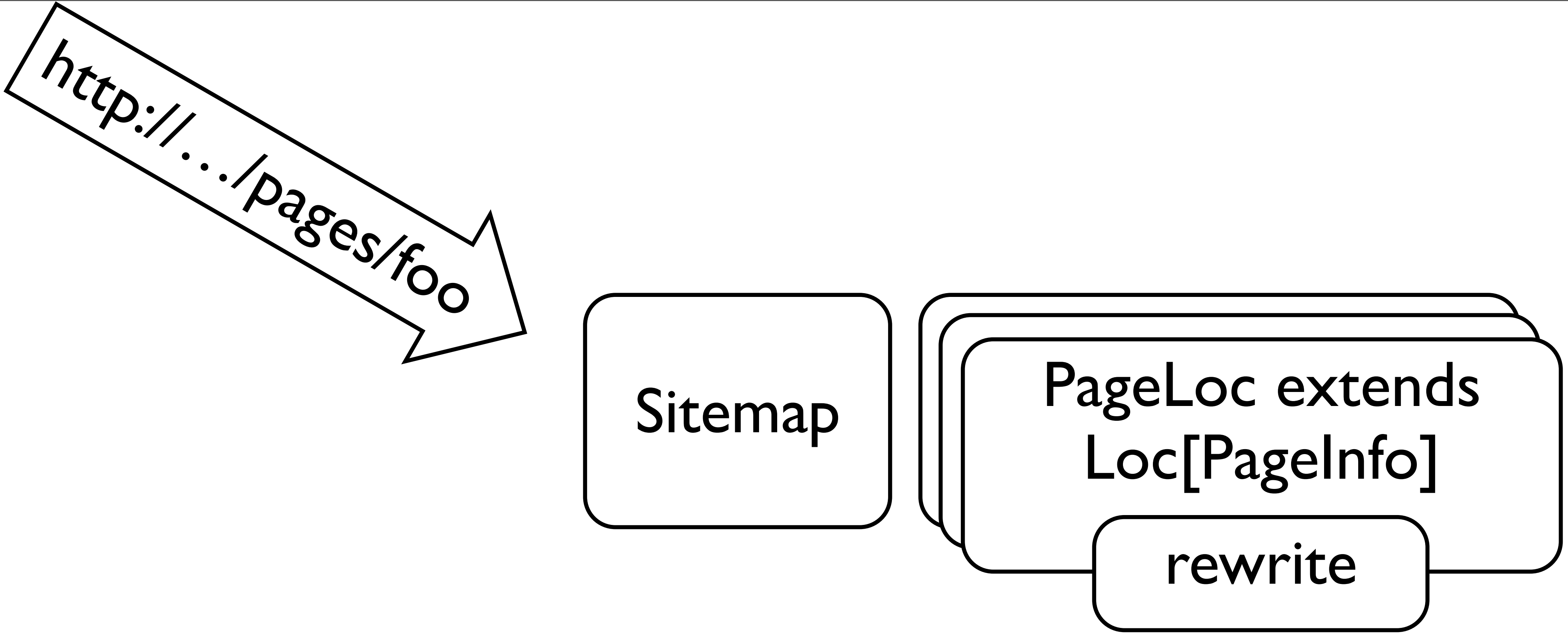

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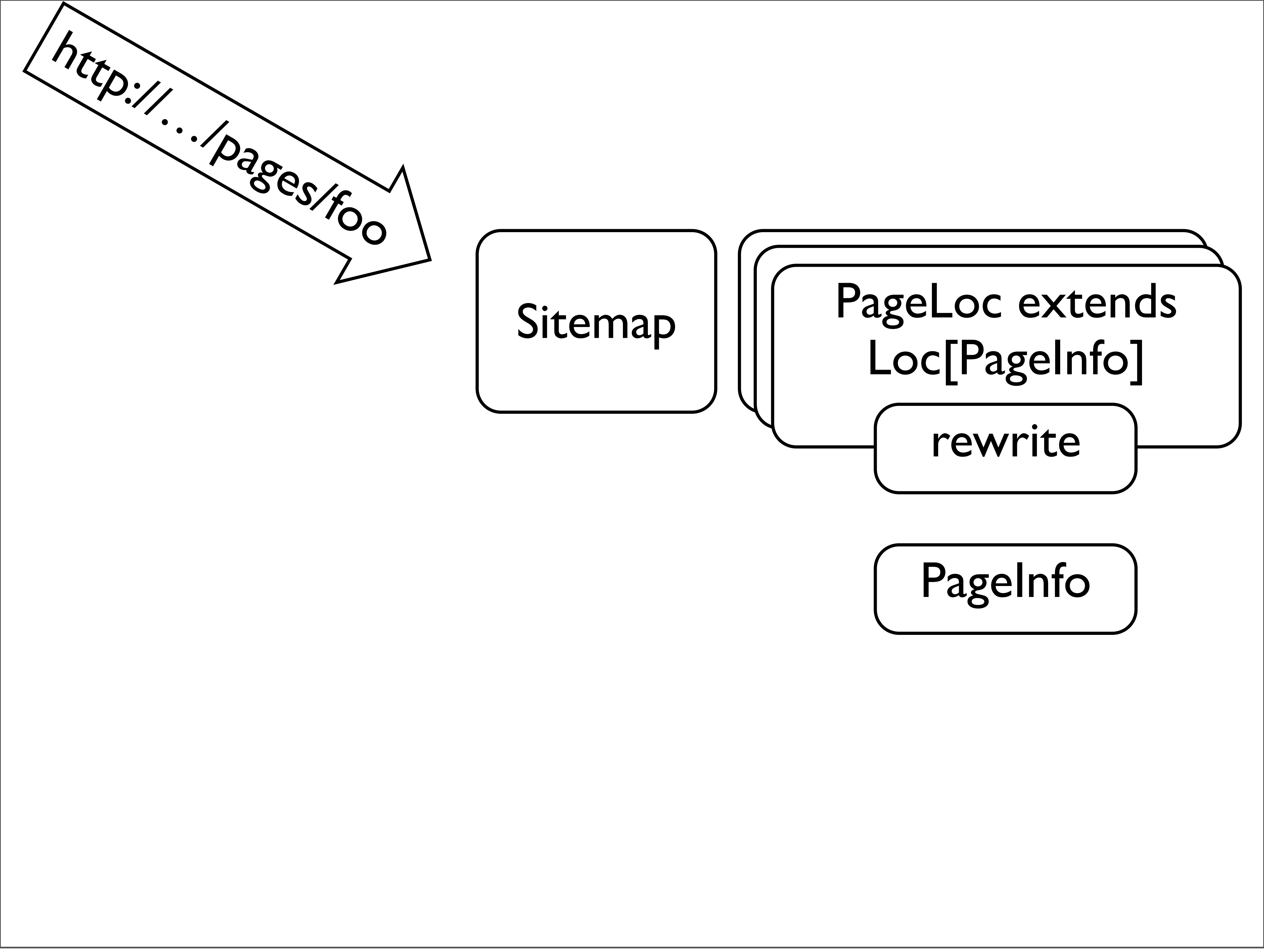

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* Loc[T] is the trait you extend to implement this functionality

* There are two phases to the process, handled separately by two partial functions in PageLoc: mapping the URL into a possible data item, and rendering the data or displaying an error if it's not there.

** Retrieval: controlled by rewrite()

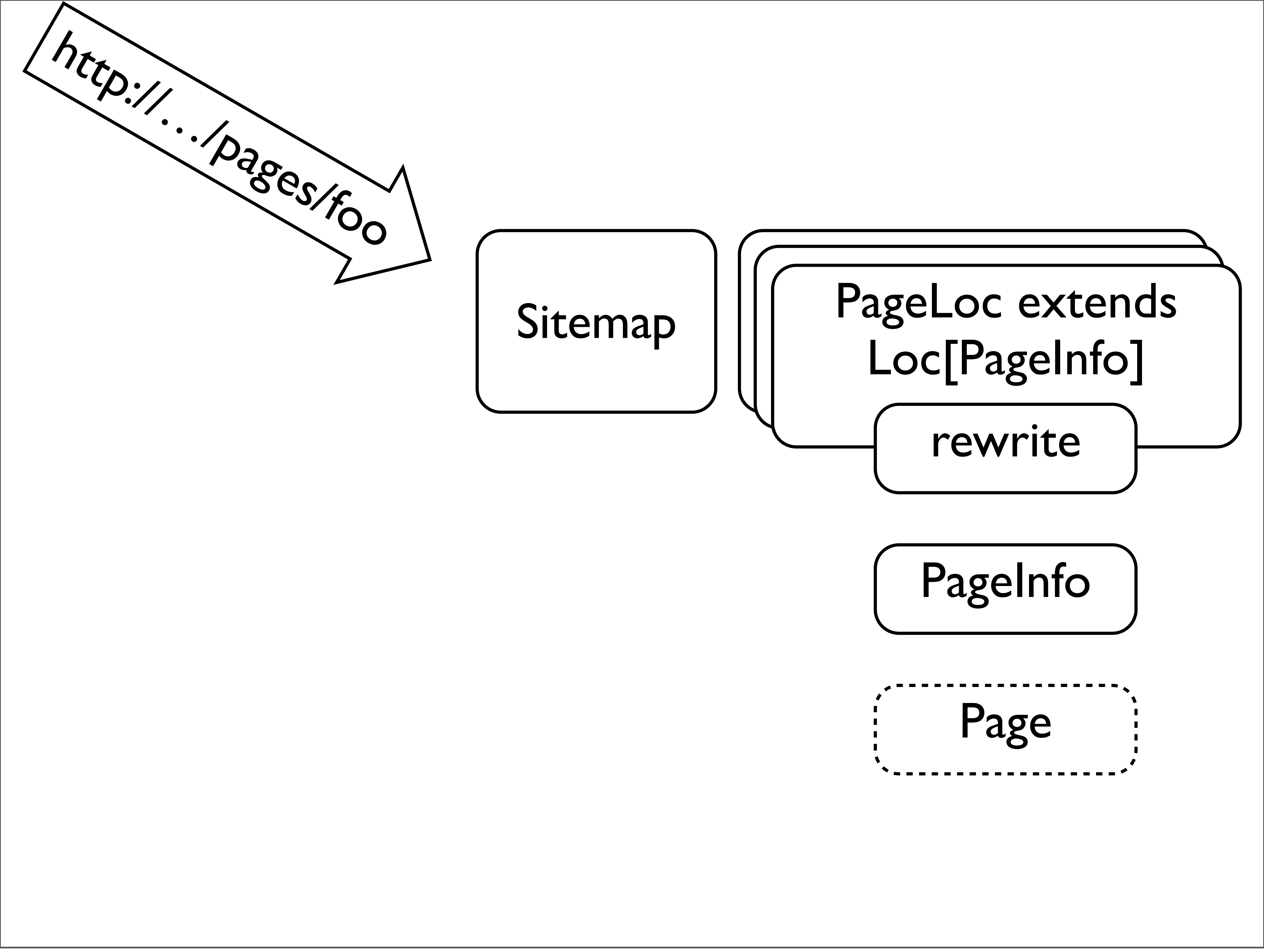
* PageInfo
This is a type we provide to store the data we want to render later; in this case, PageInfo associates a path relative to our component with a Page

* Page
stores the title and content of a page: persisted to an SQL DB using lift's Mapper ORM

** Rendering

* pages.html
The template used to display a page; contains snippets for viewing the contents, create new pages, edit and delete the current one.

* snippets()
called to create each snippets content in pages.html



Monday, 27 April 2009

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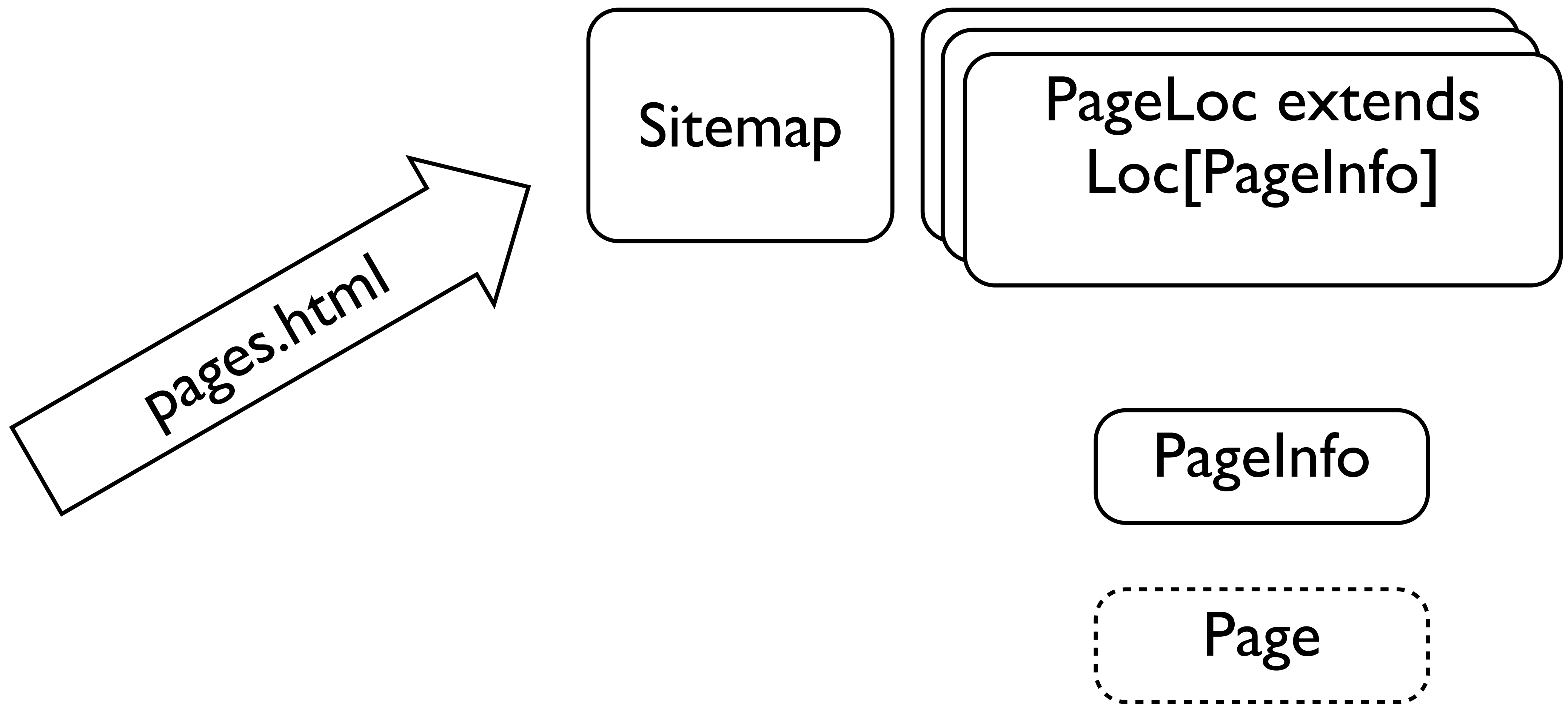

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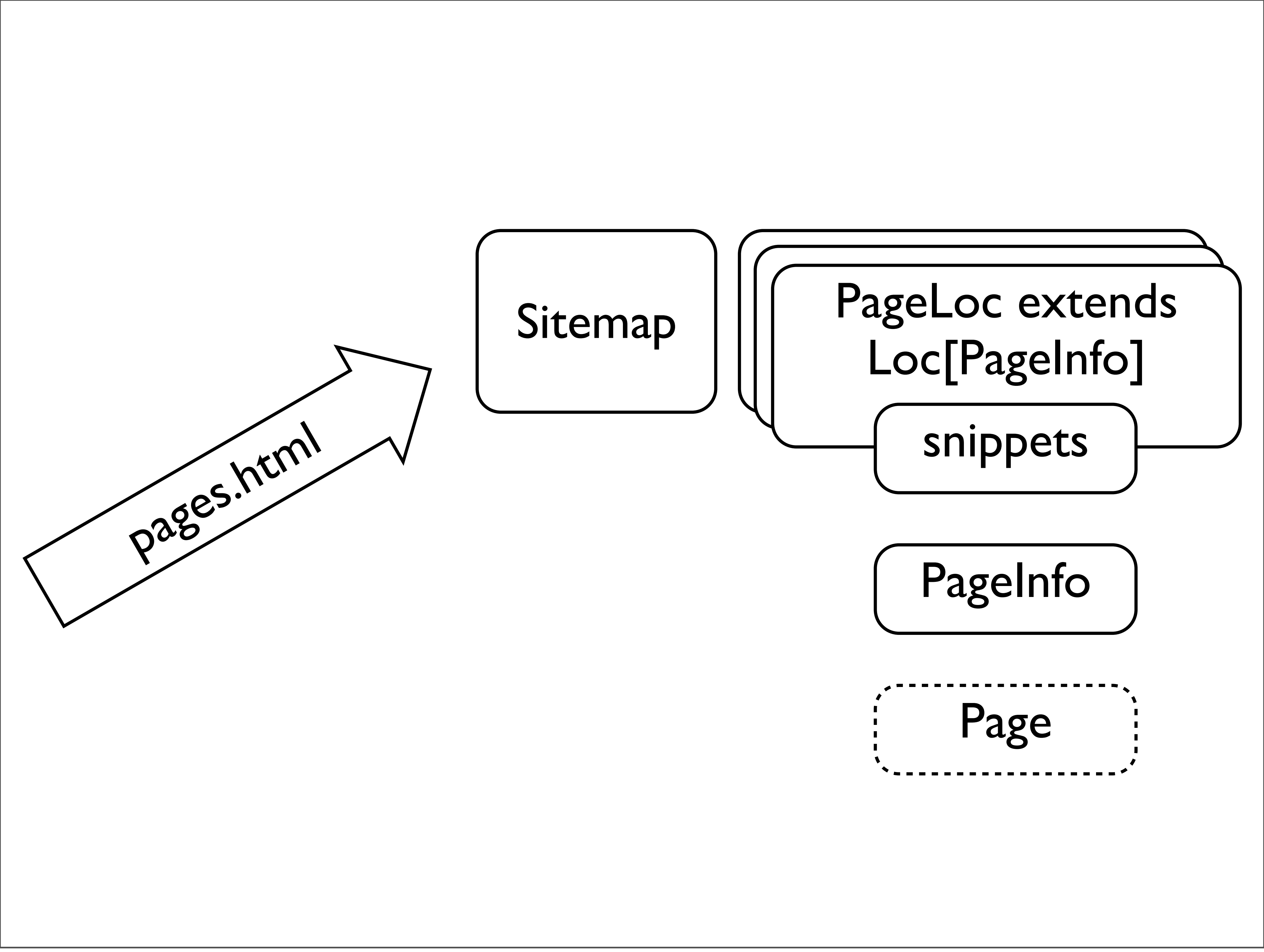

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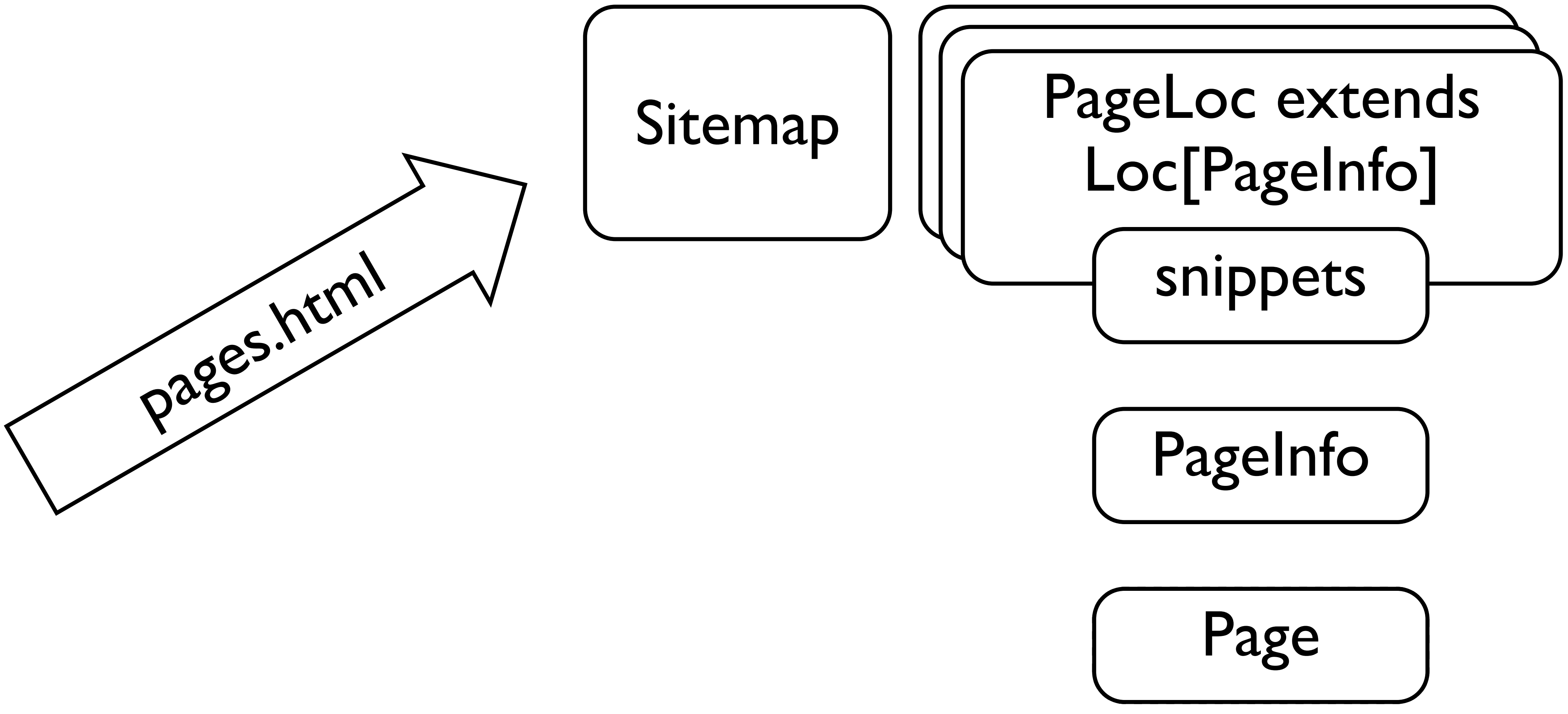

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PageInfo

```
case class PageInfo(path: List[String]) {
  private def url(path: List[String]) = path.map(urlEncode _).mkString("/")

  val urlpath = url(path)

  lazy val page = {
    val p = PageInfo.findPage(path)
    p match {
      case Failure(msg, _, _) => S.error(urlpath + ": " + msg)
      case Empty => S.error(urlpath + ": Page not found")
      case _ => ()
    }
    p
  }

  def create(title: String): Box[Page] =
    page.flatMap(PageInfo.createPage(_, title))
}
```

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This is PageInfo. In order to understand what this code means, we need a few scala basics…

A rubbish example

Classes

```
   class Litter(name: String, grams: Int) {
  private val _name = name
  private val _grams = grams

  def name(): String = { _name }
  def grams(): Int = { _grams }

  override def toString(): String = _name + "(" + _grams + "g)"
}

object Main {
  def main(args: Array[String]): Unit = {
    val crisps = new Litter("crisp wrapper", 5)
    println("name " + crisps.name)
    println("weight " + crisps.grams)
    println(crisps)
  }
}
```

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* A simple class without any behaviour
* Things to note:
* def declares a function
* val declares a variable
* the class declaration is also the initialiser (you can declare other initialisers)
* Litter derives from scala.lang.Any, which contains toString, hashCode and equals
* We need to _explicitly_ override toString: scala won't let you override otherwise
* You don't have to provide empty parens for method calls that don't have any parameters
* object: scala doesn't have static members, instead it has singleton objects. Thus Main#main above is equivalent to a static method.

* We seem to be writing a lot for something that doesn't do much
* First, all members occupy the same namespace, and since we can omit parens on getter-type methods, we can replace the calls with the vals themselves: this is fine, since if we need to run code, we can always go back to def

Classes

```
    class Litter(val name: String, val grams: Int) {
  override def toString() = name + "(" + grams + "g)"
}
```

Monday, 27 April 2009

* Here’s something with some state
* vars can be reassigned; vals cannot
* Things to note:
* Calling a base class initialiser is done in the extends clause
* pickUp’s return type is Unit (as is main’s); this can be shortened (show them)
* just as with vals, we can have public vars: let’s allow maxLitterGrams to be changeable
* whoops: constraint violation! vars automatically generate a getter and a setter: we can override these.

Classes

```
    class Litter(val name: String, val grams: Int) {
  override def toString() = name + "(" + grams + "g)"
}

class Womble(val name: String, val maxLitterGrams: Int) {
  private var _litter: List[Litter] = Nil
  private var _litterGrams: Int = 0

  class TooMuchLitter extends RuntimeException("Too heavy for me!")

  def pickUp(litter: Litter): Unit = {
    if ((_litterGrams + litter.grams) > maxLitterGrams)
      throw new TooMuchLitter
    _litter = litter :: _litter
    _litterGrams += litter.grams
  }
}
```

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    if ((_litterGrams + litter.grams) > maxLitterGrams)
      throw new TooMuchLitter
    _litter = litter :: _litter
    _litterGrams += litter.grams
  }

  def maxLitterGrams = _maxLitterGrams
  def maxLitterGrams_=(grams: Int) =
    if (grams > _maxLitterGrams)
      _maxLitterGrams = grams

  override def toString =
    "Womble(" + name + ", " + maxLitterGrams +
    "g) is carrying " + _litterGrams + "g: " +
    _litter.mkString(",")
}
```


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* Things to note:
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Factory methods

```
class Litter(val name: String, val grams: Int)
val crisps = new Litter("crisp wrapper", 5)
```

Monday, 27 April 2009

* We want to restrict litter creation to a factory method: only that can create litter

Factory methods

```
class Litter(val name: String, val grams: Int)
val crisps = new Litter("crisp wrapper", 5)
```

```
class Litter private (val name: String, val grams: Int)
object Litter {
  def makeLitter(name: String, grams: Int) = new Litter(name, grams)
}
val crisps = Litter.makeLitter("crisp wrapper", 5)
```


* We want to restrict litter creation to a factory method: only that can create litter

Factory methods

```
class Litter(val name: String, val grams: Int)
val crisps = new Litter("crisp wrapper", 5)

class Litter private (val name: String, val grams: Int)
object Litter {
  def makeLitter(name: String, grams: Int) = new Litter(name, grams)
}
val crisps = Litter.makeLitter("crisp wrapper", 5)

class Litter private (val name: String, val grams: Int)
object Litter {
  def apply(name: String, grams: Int) = new Litter(name, grams)
}
val crisps = Litter("crisp wrapper", 5)
```

Monday, 27 April 2009

* We want to restrict litter creation to a factory method: only that can create litter

apply(...)

- apply is special
- C++'s operator()
- Python's __call__

* apply() is special: when you 'call' an object, the compiler looks for an apply method with the same arguments on the class and calls that. Compare C++'s operator() and Python's __call__

Classes

- val
- var
- def
- Initialisers
- Factory methods

We’ve just looked at val, var and def and initialisers. Most of this was just syntactic differences to other languages, although these differences allow a conciseness of expression without sacrificing the ability to transparently make changes later on.

Case Classes

```
class Litter private (val name: String, val grams: Int)
object Litter {
  def apply(name: String, grams: Int) = new Litter(name, grams)
}
val crisps = Litter("crisp wrapper", 5)
```

Monday, 27 April 2009

* We can make the code for Litter even more concise
* In fact, case is (more or less) shorthand for this:
* Things to note:
* Sensible overrides of toString, hashCode and equals (deep comparison)
* unapply: what's that? What's an Option?
* It's a thing: the important thing to note is, like many of the things we've already seen, you can always implement it the long way round. unapply is an extractor, and it enables a class to be used for Pattern Matching.

Case Classes

```scala
class Litter private (val name: String, val grams: Int)
object Litter {
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}
val crisps = Litter("crisp wrapper", 5)
```

```scala
case class Litter(name: String, grams: Int)
```


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Case Classes

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class Litter private (val name: String, val grams: Int)
object Litter {
  def apply(name: String, grams: Int) = new Litter(name, grams)
}
val crisps = Litter("crisp wrapper", 5)
```

```
case class Litter(name: String, grams: Int)
```

```
class Litter(val name: String, val grams: Int) {
  override def toString = …
  override def hashCode = …
  override def equals(that: Any) = …
}
object Litter {
  def apply(name: String, grams: Int) = new Litter(name, grams)
  def unapply(litter: Litter): Option[(String, Int)] =
    Some((litter.name, litter.grams))
}
```


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class Litter private (val name: String, val grams: Int)
object Litter {
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}
val crisps = Litter("crisp wrapper", 5)
```

```
case class Litter(name: String, grams: Int)
```

```
class Litter(val name: String, val grams: Int) {
  override def toString = …
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  override def equals(that: Any) = …
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object Litter {
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Pattern matching

- Superficially similar to Java/C++ switch statements
- Not just primitive types

Pattern matching

```
    val i = 5
val s = i match {
  case 5 => "half"
  case 10 => "full"
  case something => something
}
```

Monday, 27 April 2009

* Things to note:
* A lower-case variable name in a case statement binds the variable to the value
* Case classes give us this power
* Guard expressions

Pattern matching

```
    val i = 5
val s = i match {
  case 5 => "half"
  case 10 => "full"
  case something => something
}

val crisps = Litter("crisp wrapper", 5)
crisps match {
  case Litter(_, 5) => println("light litter")
  case Litter(_, 10) => println("heavier litter")
  case Litter(what, _) => println("unclassified: " + what)
}
```

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    val i = 5
val s = i match {
  case 5 => "half"
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}

val crisps = Litter("crisp wrapper", 5)
crisps match {
  case Litter(_, 5) => println("light litter")
  case Litter(_, 10) => println("heavier litter")
  case Litter(what, _) => println("unclassified: " + what)
}

val crisps = Litter("crisp wrapper", 7)
crisps match {
  case Litter(_, weight) if weight <= 5 => println("light litter")
  case Litter(_, weight) if weight <= 10 => println("heavier litter")
  case Litter(what, _) => println("unclassified: " + what)
}
```

Monday, 27 April 2009

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Pattern matching

```
  class Womble(val name: String, val maxLitterGrams: Int) {
  private var _litter: List[Litter] = Nil

  class TooMuchLitter extends RuntimeException("Too heavy for me!")

  def pickUp(litter: Litter): Unit = {
    if ((litterGrams + litter.grams) > maxLitterGrams)
      throw new TooMuchLitter
    _litter = litter :: _litter
  }

  private def litterGrams(litter: List[Litter]): Int = litter match {
    case l :: ls => l.grams + litterGrams(ls)
    case Nil => 0
  }

  def litterGrams: Int = litterGrams(_litter)
}
```

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* Most of scala's core classes implement pattern matching, including list
* pickUp: Point out the list cons operator
* Cons can also be used in pattern matching: the details of the mechanism are too much to go into here
* For some reason, we've decided to trade-off time for space, and changed litterGrams to be a method that iterates over the litter list.
* Things to note:
* Pattern matching
* Tail recursion

Tail recursion

- Scala supports tail recursion
- Only works with calls to the calling method
- 2.8.0 will bring the @tailrec annotation

Parameterized Types

- `class Container[T](val t: T)`
- Still limited by erasure
- But not as limited as Java
  - Upper and lower bounds [T <: Womble]
  - View bounds [T <% Womble]
  - No wildcards at point of use i.e. declaration-site variance

* Lose run-time type information through erasure
* Upper and lower bounds are sort-of equivalent to the Java <T extends Womble> syntax

Erasure

```
  object Main {
case class Container[T](val t: T)

def contents(c: Any) = c match {
  case c: Container[Int] => println(c.t)
  case c: Container[String] => println(c.t)
}

def main(args: Array[String]) {
  val ic = new Container(1)
  val sc = new Container("foo")
  contents(ic)
  contents(sc)
}
}
```

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* Erasure: this is an example of using a typed pattern: it results in compiler warnings (underlined):
* non variable type-argument Int in type pattern is unchecked since it is eliminated by erasure

Erasure

```
object Main {
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  def main(args: Array[String]) {
    val ic = new Container(1)
    val sc = new Container("foo")
    contents(ic)
    contents(sc)
  }
}
```

```
TestApp.scala:5: warning: non variable type-argument Int in
type pattern is unchecked since it is eliminated by erasure
    case c: Container[Int] => println(c.t)
            ^
TestApp.scala:6: warning: non variable type-argument String in
type pattern is unchecked since it is eliminated by erasure
    case c: Container[String] => println(c.t)
            ^
TestApp.scala:6: error: unreachable code
    case c: Container[String] => println(c.t)
                                 ^
```


* Erasure: this is an example of using a typed pattern: it results in compiler warnings (underlined):
* non variable type-argument Int in type pattern is unchecked since it is eliminated by erasure

Upper/lower bounds

```
    case class Litter(val name: String, val grams: Int)
  extends Ordered[Litter] {
    def compare(that: Litter) = grams - that.grams
}

def max[T <: Ordered[T]](elements: List[T]): T =
  elements match {
    case List() =>
      throw new IllegalArgumentException("Empty!")
    case List(x) => x
    case x :: xs =>
      val m = max(xs)
      if (x > m) x else m
}
```

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* Things to note

Option[T]

Monday, 27 April 2009

* null is a poor choice for a result value
* it’s not obvious when it’s expected for something to return null and when it isn’t
* Get it wrong and you’ll only detect it when you get a NullPointerException, and that could happen anywhere
* Option[T] makes it obvious

Option[T]

- Express absence of a value

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- …without using null

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Option[T]

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```
def getName(id: Int): String
```

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Option[T]

- Express absence of a value
- …without using null

```
def getName(id: Int): String

def getName(id: Int): Option[String]
```

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Box[T]

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* Box is lift's take on Option
* It adds Failure to the possible values
* Failure can contain a chained failure/exception
*

Box[T]

- Lift’s version of Option[T]

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- Full(t)

Monday, 27 April 2009

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Box[T]

- Lift’s version of Option[T]
- Full(t)
- Empty

Monday, 27 April 2009

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* Failure can contain a chained failure/exception
*

Box[T]

- Lift’s version of Option[T]
- Full(t)
- Empty
- Failure(reason)

* Box is lift’s take on Option
* It adds Failure to the possible values
* Failure can contain a chained failure/exception
*

Option and Box

- Effectively containers with a max. size of 1
- Implement conventional container methods:
  - map(), flatMap() and filter()
  - None/Empty/Failure values ripple up through these methods
- getOrElse() allows getting at values safely
- (They're monads)

Option and Box

Option and Box

```
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res2: Option[Int] = None

scala> some.map(_ + 1).map(_ + 2)

res3: Option[Int] = Some(4)
```

PageInfo

```
  case class PageInfo(path: List[String]) {
private def url(path: List[String]) = path.map(urlEncode _).mkString("/")

val urlpath = url(path)

lazy val page = {
  val p = PageInfo.findPage(path)
  p match {
    case Failure(msg, _, _) => S.error(urlpath + ": " + msg)
    case Empty => S.error(urlpath + ": Page not found")
    case _ => ()
  }
  p
}

def create(title: String): Box[Page] =
  page.flatMap(PageInfo.createPage(_, title))
}
```

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* Things to note:
path is a constructor param
urlpath is part of the initializer
page uses pattern matching on a Box returned by a findPage method
create: creates a child of the current page and returns it as a Box[Page]; if page is None, then createPage won't be called.

First-class functions

- Function literals:
  - (x: Int) => x + 1
  - (_: Int) + 1
  - val inc: (Int) => Int = _ + 1
  - val inc: Function[Int, Int] = _ + 1

* Already seen the inc _ form in Box and Option

First-class functions

- Partially applied functions:
  - def inc(x: Int) = x + 1

    inc _
  - def sum(x: Int, y: Int) = x + y

    val inc = sum(_: Int, 1)

Closures

- Behave as you would (hopefully) expect
- Referring to an in-scope variable in a function body closes over it:

```
val a = 1
val inca = (x: Int) => x + a
List(1, 2, 3).filter(_ == a)
```

- Closes over the instance not the value

Closures

- Close over the instance not the value
- Can close over vars:

```
var a = 1
val inca = (x: Int) => x + a
inca(1) == 2
a = 2
inca(1) == 3
```

Partial functions

- A function that may not be defined for all possible input values
- Case sequences are function literals
- val pf: Int => Int = { case 2 => 2 }
- pf(3) throws a MatchError
- val pf: PartialFunction[Int, Int] = { case 2 => 2 }
- pf.isDefinedAt(3) returns false

Getting the data

rewrite

```
  class PageLoc extends Loc[PageInfo] {
val name = "pages"
// ...
override val rewrite: LocRewrite =
  Full(NamedPF("Pages rewrite") {
    case RewriteRequest(ParsePath(head :: tail, _, _, _), _, httpRequest)
      if head == name =>
        (RewriteResponse(ParsePath(head :: Nil, "", true, false),
                         Map.empty, true),
       PageInfo(tail))
})
// ...
}
```

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* ParamType is the type we want to store our retrieved data in, which in our case is PageInfo
* This is a partial function: note the guard on the case: it’s defined for head == name
* This handles the mapping of an HTTP request to something concrete i.e. an instance of PageInfo

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       if head == name =>
         (RewriteResponse(ParsePath(head :: Nil, "", true, false),
                          Map.empty, true),
        PageInfo(tail))
 })
 // ...
}

case class ParsePath(partPath: List[String], suffix: String,
                     absolute: Boolean, endSlash: Boolean)
case class RewriteRequest(path: ParsePath, requestType: RequestType,
                          httpRequest: HttpServletRequest)
case class RewriteResponse(path: ParsePath, params: Map[String, String],
                           stopRewriting: Boolean)
type LocRewrite =
  Box[PartialFunction[RewriteRequest, (RewriteResponse, ParamType)]]
```


* ParamType is the type we want to store our retrieved data in, which in our case is PageInfo
* This is a partial function: note the guard on the case: it’s defined for head == name
* This handles the mapping of an HTTP request to something concrete i.e. an instance of PageInfo

Displaying our results

pages.html

```
  <lift:surround with="default" at="content">
 <h1>Pages</h1>
 <lift:read>
   <p><read:ancestors/></p>
   <h2><read:title/></h2>
   <p><read:children/></p>
   <p><read:content/></p>
 </lift:read>
 <lift:create form="POST">
   <create:title/>
   <create:submit/>
 </lift:create>
 <lift:update form="POST">
   <update:content/><br/>
   <update:submit/>
 </lift:update>
 <lift:delete form="POST">
   <delete:submit/>
 </lift:delete>
</lift:surround>
```

```scala
    override def snippets: SnippetTest = {
  case ("read", Full(pageInfo)) => read(pageInfo, _)
  case ("create", Full(pageInfo)) => create(pageInfo, _)
  case ("update", Full(pageInfo)) => update(pageInfo, _)
  case ("delete", Full(pageInfo)) => delete(pageInfo, _)
}

private def read(pageInfo: PageInfo, content: NodeSeq): NodeSeq = {
  def join[A](xs: List[A], sep: A): List[A] = ...
  def children(page: Page) = ...
  def ancestors: List[Elem] = ...

  pageInfo.page match {
    case Full(page) =>
      bind("read", content,
           "title" -> Text(page.title.is),
           "ancestors" -> join(ancestors, Text(" >> ")),
           "children" -> join(children(page), Text(" :: ")),
           "content" -> Text(page.content.is))
    case _ => NodeSeq.Empty
  }
}
```


* Things to note:
* read()
  * nested functions
* lift#bind(snippet-name, contents, BindParam*)

bind

```
def bind(namespace: String, xml: NodeSeq,
         params: BindParam*): NodeSeq
```

- binds xml items in the specified namespace
- BindParam associates a snippet parameter with a replacement
- “a” -> replacement is an overloaded function on SuperArrowAssoc, which has an implicit conversion from string


```
mvn -o scala:console
scala> import net.liftweb.util.BindHelpers._
scala> bind("user", <user:hello>foo</user:hello>, "hello" -> <h1>bar</h1>)
bind("user", <user:hello>foo</user:hello>, "hello" -> <h1>bar</h1>)
res2: scala.xml.NodeSeq = <h1>bar</h1>
```

```scala
def join[A](xs: List[A], sep: A): List[A] = xs match {
  case Nil => Nil
  case x :: Nil => x :: Nil
  case x :: xs => x :: sep :: join(xs, sep)
}

def children(page: Page) =
  for (c <- page.children)
      yield <a href={ url(pageInfo.path ::: List(c.title.is)) }>
            { c.title.is }</a>

def ancestors: List[Elem] = {
  import scala.collection.mutable.ListBuffer
  val path = new ListBuffer[String]()
  val home = <a href={ url(path.toList) }>{PageInfo.home.title.is}</a>
  val rest = if (pageInfo.path.size > 1) {
    for (a <- pageInfo.path.dropRight(1)) yield {
      path += a
      <a href={ url(path.toList) }>{a}</a>
    }
  }
  else {
    Nil
  }
  home :: rest
}
```


* Things to note:
* join is functional and recursive
* children is functional
* ancestors is imperative (I was going to make it functional, but thought it was worth leaving in as an example)

bind & forms

- bind() is also used to bind input data

```
private object createTitle extends RequestVar("")

private def create(pageInfo: PageInfo, content: NodeSeq): NodeSeq =
  pageInfo.page match {
    case Full(page) =>
      bind("create", content,
           "title" -> SHtml.text(createTitle.is, createTitle(_)),
           "submit" -> SHtml.submit("Create a new page",
                                    { () => doCreate(pageInfo,
                                                     createTitle.is) }))
    case _ => NodeSeq.Empty
  }
```

SHtml.text

```
private object createTitle extends RequestVar("")
SHtml.text(createTitle.is, createTitle(_))
```

- createTitle is like a ThreadLocal, but per Request
- Registers createTitle(_) as a callback in session state
- Generates <input ... id="*callback-id*"/>
- POST request looks up the callback and executes it

What have I talked about?

- Scala:
  - Conciseness of classes
  - Power of pattern matching
  - Flexibility of functions
- Lift:
  - Partial functions for dispatching
  - Model: Simple Mapper ORM
  - Views: Snippets
  - Controller: bind()

What haven't I talked about?

- Traits
- XML literals
- Duck typing using anonymous classes
- Implicits
- Co/contravariance specification at declaration point enforces LSP
- DSL-supporting features
  - operator definition
  - method call syntax doesn't require dots, and single argument method calls can be made without parens
  - ScalaTest & ScalaSpec's BDD specs

...just a small selection of language features.
There's also an increasing number of libraries: the actors library, combinator parser, scalaz, scalax
...and tools: ScalaCheck (a port of Haskell's QuickCheck)

Scala 2.8.0

- Redesigned collection libraries (mostly backwards compatible)
- Redesigned combinator parser library
- Named & default parameters
- Continuations
- Revamped REPL, including completion
- Source compatible with old code (but not binary)

http://xkcd.com/568/

```
object Lunar extends Baysick {
  def main(args:Array[String]) = {
    10 PRINT "Welcome to Baysick Lunar Lander v0.9"
    20 LET ('dist := 100)
    30 LET ('v := 1)
    40 LET ('fuel := 1000)
    50 LET ('mass := 1000)

    60 PRINT "You are drifting towards the moon."
    70 PRINT "You must decide how much fuel to burn."
    80 PRINT "To accelerate enter a positive number"
    90 PRINT "To decelerate a negative"

    100 PRINT "Distance " % 'dist % "km, " % "Velocity " % 'v % "km/s, " % "Fuel " % 'fuel
    110 INPUT 'burn
    120 IF ABS('burn) <= 'fuel THEN 150
    130 PRINT "You don't have that much fuel"
    140 GOTO 100
    150 LET ('v := 'v + 'burn * 10 / ('fuel + 'mass))
    160 LET ('fuel := 'fuel - ABS('burn))
    170 LET ('dist := 'dist - 'v)
    180 IF 'dist > 0 THEN 100
    190 PRINT "You have hit the surface"
    200 IF 'v < 3 THEN 240
    210 PRINT "Hit surface too fast (" % 'v % ")km/s"
    220 PRINT "You Crashed!"
    230 GOTO 250
    240 PRINT "Well done"

    250 END

    RUN
  }
}
```

Find out more

- http://www.scala-lang.org
- http://www.liftweb.net
- Programming in Scala *Odersky, Spoon, Venners* Artima 2008
- Monads are Elephants *James Iry* http://james-iry.blogspot.com/2007/09/monads-are-elephants-part-1.html