Scala Object System

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Recap: Syntax Differences from Kotlin

Syntax

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`List<Integer>` ⇔ `List[Int]`

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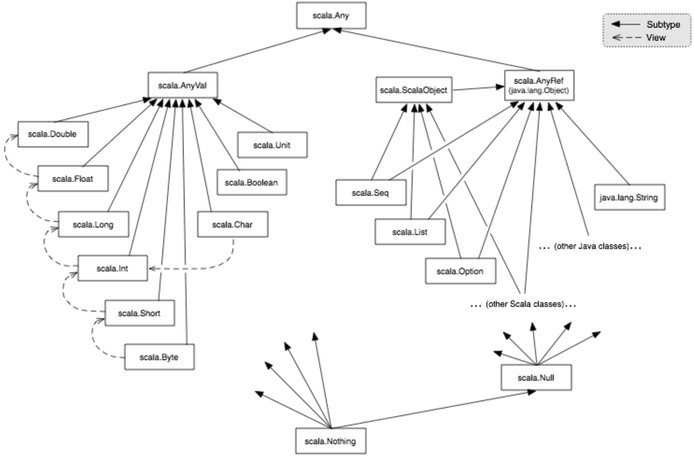
it	⇔	_

Scala Type System

Everything is a type



Top types

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  - Methods: `==`, `!=`, `equals`, `hashCode`, `toString`

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  - Methods: `==`, `!=`, `equals`, `hashCode`, `toString`
- `AnyRef`
  - The base type of all reference types
  - Alias of `java.lang.Object`
- `AnyVal`
  - The base type of all primitive types

Bottom type

Nothing is at the bottom of Scala's type hierarchy. It is a subtype of every other type.

There is no value of type Nothing.

Why is that useful?

- To signal abnormal termination
- As an element type of empty collections

Classes, Objects, Traits . . .

Basic

```scala
class Useless

class Calculator {
  val brand: String = "HP"
  def add(m: Int, n: Int): Int = m + n
}
```

Class constructor

- In Scala, a class implicitly introduces a primary constructor
- Takes the parameters of the class
- Executes all statements in the class body
- Can introduce members if parameters are specified as `val` or `var`

Class constructor

Example

```
class Calculator(brand: String) {
  /*  A constructor */
  val colour: String = if (brand == "TI") {
    "blue"
  } else if (brand == "HP") {
    "black"
  } else {
    "white"
  }
  def add(m: Int, n: Int): Int = m + n
}
```

Auxiliary Constructors

Scala also allows the declaration of auxiliary constructors.

These are methods named `this`

```scala
class Calculator(brand: String) {
  val color: String = ???

  def this(other: Cal) = ??? // <<<

  // An instance method.
  def +(m: Int, n: Int): Int = m + n
}
```

Objects

- Scala has no static classes / methods / fields
- Objects are used to hold single instances of a class
- Objects are lazy, and are not initialized until first reference

Objects

Example

```scala
object Constants {
  val e = 2.71828182846
  def **(num: Double) = num * e
}

Constants ** Constants.e
```

Companion objects

A companion object in Scala is an object that's declared in the same file as a class, and has the same name as the class

```scala
class SomeClass {
    def printFilename() = {
        println(SomeClass.HiddenFilename)
    }
}

object SomeClass {
    private val HiddenFilename = "/tmp/foo.bar"
}
```

Traits

Traits are collections of fields and behaviors that you can extend or mixin to your classes

- In Scala, a class can only have one superclass, but many traits
- Can have methods and properties
- Can have member definitions
- Cannot have constructors

Traits

Example

```
trait Planar {
  def height: Int
  def width: Int
  def surface = height * width // <<<
}

class Square extends Shape with Planar with Movable
```

Abstarct classes

- Can have methods and properties
- Can have member definitions
- Can have constructors

Super calls

Problem

To keep your Scala code DRY (“Don’t Repeat Yourself ”), you want to invoke a method that’s already defined in a parent class or trait.

Super calls

Example

```
class WelcomeActivity extends Activity {
    override def onCreate(bundle: Bundle) {
        super.onCreate(bundle)
        // more code here ...
    }
}
```

Super calls

Controlling which trait you call a method from

```
class Child extends Human with Mother with Father {
    def printSuper = super.hello
    def printMother = super[Mother].hello
    def printFather = super[Father].hello
    def printHuman = super[Human].hello
}
```

Members

- `def` - method
- `val` - immutable property
- `var` - mutable property
- `lazy val` - lazy immutable property

Properties

All properties implicitly generate a backing field, a setter and a getter

Except for `private` ones

Properties

```
class Person() {
 private var name = ""
 var age = 0
}
```

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 var age = 0
}
```

```
class Person() {
 private var name = ""
 // Private age variable, renamed to _age
 private var _age = 0

 // Getter
 def age = _age

 // Setter
 def age_= (value:Int):Unit = _age = value
}
```

Concrete member overriding

- `val`: can only be overridden by val
- `lazy val`: can only be overridden by lazy val
- `var`: a concrete var cannot be overridden
- `def`: can be overridden by all kinds of members

	val	lazy	var	def
val	✓	✗	✗	✗
lazy	✓	✗	✗	✗
var	✗	✗	✗	✗
def	✓	✓	✓	✓

Abstract member overriding

- `lazy val`: cannot be abstract
- `val`: can be overridden by val and lazy val
- `var`: can be overridden by var, or a pair of read and write operations implemented by def, val, or lazy val
- `def`: can be overridden by all kinds of members

	val	var	def
val	✓	✗	✗
var	✓+	✓	✓+
def	✓	✓	✓

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- object-private scope
- private
- package
- protected

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Scopes

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Access modifiers

object-private

The most restrictive access is to mark a method as “object-private.” When you do this, the method is available only to the current instance of the current object. Other instances of the same class cannot access the method.

```scala
class Foo {
    private[this] def isFoo = true
    def doFoo(other: Foo) {
        if (other.isFoo) { // this line won’t compile
            // ...
        }
    }
}
```

Access modifiers

package scope

```
package com.acme.coolapp.model {
    class Foo {
        private[model] def doX {}
        private def doY {}
    }
    class Bar {
        val f = new Foo
        f.doX // compiles
        f.doY // won’t compile
    }
}
```

apply method

apply is a syntactic sugar for calling something

- construct new instances
- directly call anonymous functions
- mimic callable behaviour
- see also: update method

apply method

example

```scala
class SomeClass(val x: Int)

object SomeClass {
  def apply(x: Int) = new SomeClass(x)
}

new SomeClass(42)
SomeClass(42)
```

Packages

- declare one or more package names at the top of a Scala file

```scala
package users
class User
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```scala
package users
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- declare packages by using braces

```scala
package users {
  package administrators {
    class NormalUser
  }
  package normalusers {
    class NormalUser
  }
}
```

Imports

- single name

```
import users.User
```

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- single name

```
import users.User
```

- all from package

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```scala
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- rename imported member

```scala
import users.{UserPreferences => UPrefs}
```

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- one package object per package
- should be placed in `package.scala`

Package obejcts

```scala
package com.myapp
package object model {
  val MAGIC_NUM = 42 // field
  def echo(a: Any) { println(a) } // method
}
```

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package object model {
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```

```scala
package com.myapp.model
class MainDriver {
  echo(42)
  echo(MAGIC_NUM)
}
```

Functional OOP

Extractor object

An extractor object is an object with an unapply method.

`apply`

takes arguments and creates an object

`unapply`

takes an object and tries to give back the arguments

`unapply` method

Return type

- If it is just a test, return a `Boolean`
- If it returns a single sub-value of type `T`, return an `Option[T]`
- If you want to return several sub-values `T1,...,Tn`, group them in an optional tuple `Option[(T1,...,Tn)]`

Extractor object

Example

```scala
class Cat(val name: String, val age: Int)

object Cat {
  def apply(name: String, age: Int): Cat = new Cat(name, age)
  def unapply(cat: Cat): Option[(String, Int)] = Some(cat.name -> cat.age)
}
```

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- they can be a way of creating something like an enum in Java
- they help you define algebraic data types, or ADTs

Sealed traits

Example

```
sealed trait Answer
case object Yes extends Answer
case object No extends Answer
case class Maybe(something: String)
```

Clase classes

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- companion object with `apply` and `unapply` methods
- `copy` method with default values

Destructuring bindings

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```
val pi = 3.1415
val pi: Double = 3.1415 // equivalent to first definition
val c@Cat(name, age) = Cat("bobik", 42) // a pattern definition
val x :: xs = c :: name :: age :: Nil  // an infix pattern definition
```

Pattern matching

Values

```scala
val times = 1

times match {
  case 1 => "one"
  case 2 => "two"
  case _ => "some other number"
}
```

Pattern matching

Guards

```
val times = 1

times match {
  case i if i == 1 => "one"
  case i if i == 2 => "two"
  case _ => "some other number"
}
```

Pattern matching

Types

```scala
val animal = Cat("eve", 10)

val owner = animal match {
  case a: Cat if a.name == "eve" => "Bob"
  case a: Dog if a.name == "dis" => "Mary"
  case _ => "Unknown"
}
```

Pattern matching

Unapply

```scala
val animal = Cat("eve", 10)

val owner = animal match {
  case Cat("eve", _) => "Bob"
  case Dog("dis", _) => "Mary"
  case _ => "Unknown"
}
```

Pattern matching

Binding

```
val animal = Cat("eve", 10)

val fullName = animal match {
  case c@Cat("eve", _) => s"Bob’s ${c.name}"
  case d@Dog("dis", _) => s"Mary’s ${d.name}"
  case _ => "Unknown"
}
```

Practice

Functional List