Scala Object System

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Recap: Syntax Differences from Kotlin

Syntax

`Kotlin` $\Leftrightarrow$ `Scala`

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`List<Integer>` $\Leftrightarrow$ `List[Int]`

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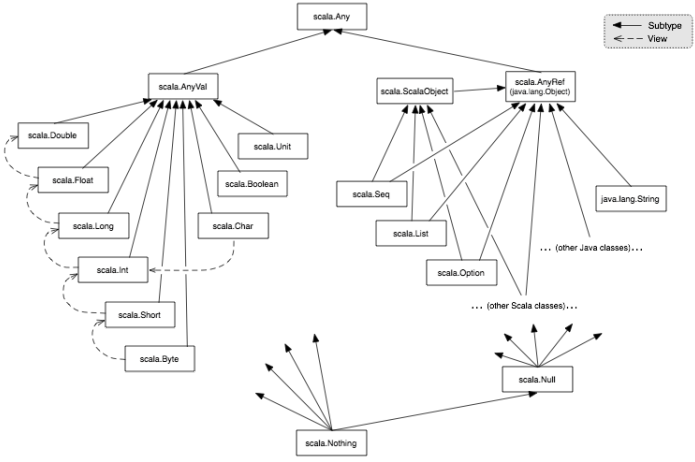
`->`	⇔	`=>`
`it`	⇔	`_`

Scala Type System

Everything is a type



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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

```
1  class Useless
2
3  class Calculator {
4    val brand: String = "HP"
5    def add(m: Int, n: Int): Int = m + n
6  }
```

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`

```
1  class Calculator(brand: String) {
2    val color: String = ???
3
4    def this(other: Cal) = ??? // <<<
5
6    // An instance method.
7    def +(m: Int, n: Int): Int = m + n
8  }
```

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

```
1 object Constants {
2   val e = 2.71828182846
3   def **(num: Double) = num * e
4 }
5
6 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

```
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

```
1  trait Planar {
2    def height: Int
3    def width: Int
4    def surface = height * width // <<<
5    val denom: Double
6    val coeff: Double = 3.74716565 // <<<
7  }
8
9  class Square extends Shape with Planar with Movable
```

Mixins

```
1  trait A
2    { def foo: Int }
3  trait B extends A
4    { override def foo = 1 }
5  trait C extends A
6    { override def foo = 2 }
7
8  new (trait D extends C with B).foo == 1
```

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6    { def foo = 2 }
7
8  trait D extends C with B // <<<
```

```
error: trait D inherits conflicting members:
  method foo in trait C of type => Int  and
  method foo in trait B of type => Int
(Note: this can be resolved by declaring an override in trait D.)
       trait D extends C with B
```

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

```
1 class WelcomeActivity extends Activity {
2     override def onCreate(bundle: Bundle) {
3         super.onCreate(bundle)
4         // more code here ...
5     }
6 }
```

Super calls

Controlling which trait you call a method from

```
1 class Child extends Human with Mother with Father {
2     def printSuper = super.hello
3     def printMother = super[Mother].hello
4     def printFather = super[Father].hello
5     def printHuman = super[Human].hello
6 }
```

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

```
1 class Person() {
2  private var name = ""
3  var age = 0
4 }
```

Properties

```
class Person() {
 private var name = ""
 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	✓	✓	✓

Abstract override

TODO

Acess modifiers

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- package
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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.

```
1  class Foo {
2      private[this] def isFoo = true
3      def doFoo(other: Foo) {
4          if (other.isFoo) { // this line won't compile
5              // ...
6          }
7      }
8  }
```

Access modifiers

package scope

```
1  package com.acme.coolapp.model {
2      class Foo {
3          private[model] def doX {}
4          private def doY {}
5      }
6      class Bar {
7          val f = new Foo
8          f.doX // compiles
9          f.doY // won't compile
10     }
11 }
```

`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

```
1  class SomeClass(val x: Int)
2
3  object SomeClass {
4    def apply(x: Int) = new SomeClass(x)
5  }
6
7  new SomeClass(42)
8  SomeClass(42)
```

Packages

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

```
1 package users
2 class User
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1 package users
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- declare packages by using braces

```
1 package users {
2   package administrators {
3     class NormalUser
4   }
5   package normalusers {
6     class NormalUser
7   }
8 }
```

Imports

- single name

```
1 import users.User
```

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1 import users.{User, UserPreferences}
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- rename imported member

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

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- can contain arbitrary definitions
- can inherit from other classes and traits
- one package object per package
- should be placed in `package.scala`

Package obejcts

```
1 package com.myapp
2 package object model {
3   val MAGIC_NUM = 42 // field
4   def echo(a: Any) { println(a) } // method
5 }
```

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1  package com.myapp
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3    val MAGIC_NUM = 42 // field
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5  }
```

```
1  package com.myapp.model
2  class MainDriver {
3    echo(42)
4    echo(MAGIC_NUM)
5  }
```

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

```
1  class Cat(val name: String, val age: Int)
2
3  object Cat {
4    def apply(name: String, age: Int): Cat = new Cat(name, age)
5    def unapply(cat: Cat): Option[(String, Int)] = Some(cat.name -> cat.age)
6  }
```

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- use sealed traits when the number of possibly subtypes is finite and known in advance
- 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

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

Clase classes

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- `copy` method with default values

Destructuring bindings

Initializing a value may be more than binding a name — it's a pattern.

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

Pattern matching

Values

```
1  val times = 1
2
3  times match {
4    case 1 => "one"
5    case 2 => "two"
6    case _ => "some other number"
7  }
```

Pattern matching

Guards

```
1  val times = 1
2
3  times match {
4    case i if i == 1 => "one"
5    case i if i == 2 => "two"
6    case _ => "some other number"
7  }
```

Pattern matching

Types

```
1  val animal = Cat("eve", 10)
2
3  val owner = animal match {
4    case a: Cat if a.name == "eve" => "Bob"
5    case a: Dog if a.name == "dis" => "Mary"
6    case _ => "Unknown"
7  }
```

Pattern matching

Unapply

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

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

Pattern matching

Binding

```
1  val animal = Cat("eve", 10)
2
3  val fullName = animal match {
4    case c@Cat("eve", _) => s"Bob's ${c.name}"
5    case d@Dog("dis", _) => s"Mary's ${d.name}"
6    case _ => "Unknown"
7  }
```

Practice

Functional List