How Classes are Organized

Principles of Functional Programming

Packages

Classes and objects are organized in packages.

To place a class or object inside a package, use a package clause at the top of your source file.

```
package progfun.examples

object Hello
  ...
```

This would place `Hello` in the package `progfun.examples`.

You can then refer it by its *fully qualified name*, `progfun.examples.Hello`. For instance, to run the `Hello` program:

```
> scala progfun.examples.Hello
```

Imports

Say we have a class `Rational` in package `week3`.

You can use the class using its fully qualified name:

```
val r = week3.Rational(1, 2)
```

Alternatively, you can use an import:

```
import week3.Rational
val r = Rational(1, 2)
```

Forms of Imports

Imports come in several forms:

```
import week3.Rational           // imports just Rational
import week3.{Rational, Hello}  // imports both Rational and Hello
import week3._                  // imports everything in package week3
```

The first two forms are called *named imports*.

The last form is called a *wildcard import*.

You can import from either a package or an object.

Automatic Imports

Some entities are automatically imported in any Scala program.

These are:

- All members of package `scala`
- All members of package `java.lang`
- All members of the singleton object `scala.Predef`.

Here are the fully qualified names of some types and functions which you have seen so far:

`Int`	`scala.Int`
`Boolean`	`scala.Boolean`
`Object`	`java.lang.Object`
`require`	`scala.Predef.require`
`assert`	`scala.Predef.assert`

Scaladoc

You can explore the standard Scala library using the scaladoc web pages.

You can start at

www.scala-lang.org/api/current

Traits

In Java, as well as in Scala, a class can only have one superclass.

But what if a class has several natural supertypes to which it conforms or from which it wants to inherit code?

Here, you could use `traits`.

A trait is declared like an abstract class, just with `trait` instead of `abstract class`.

```
trait Planar:
  def height: Int
  def width: Int
  def surface = height * width
```

Traits (2)

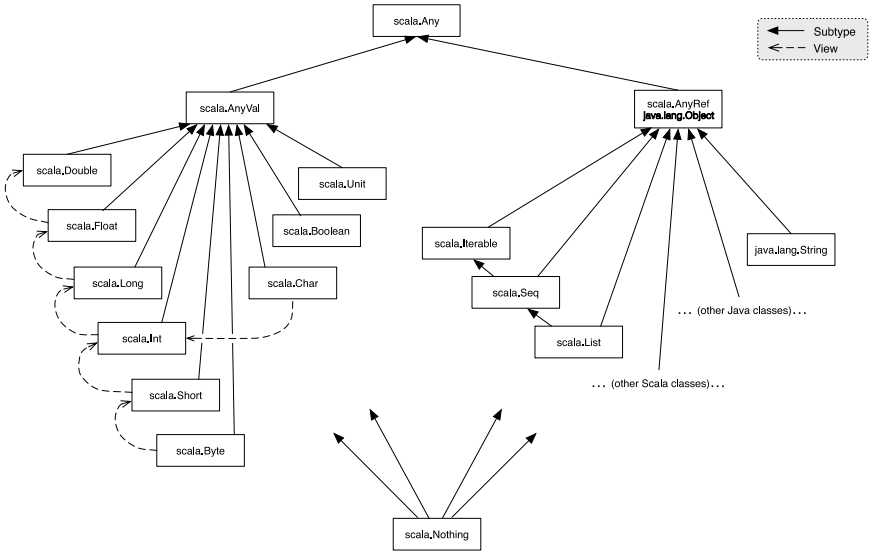
Classes, objects and traits can inherit from at most one class but arbitrary many traits.

Example:

```
class Square extends Shape, Planar, Movable ...
```

Traits resemble interfaces in Java, but are more powerful because they can have parameters and can contain fields and concrete methods.

Scala's Class Hierarchy



Top Types

At the top of the type hierarchy we find:

`Any`	the base type of all types 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.

The Nothing 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 (see next session)

Exceptions

Scala's exception handling is similar to Java's.

The expression

```
throw Exc
```

aborts evaluation with the exception `Exc`.

The type of this expression is `Nothing`.

Exercise

What is the type of

```
if true then 1 else false
```

- O Int
- O Boolean
- O AnyVal
- O Object
- O Any