Under the Hood of Scala Implicits

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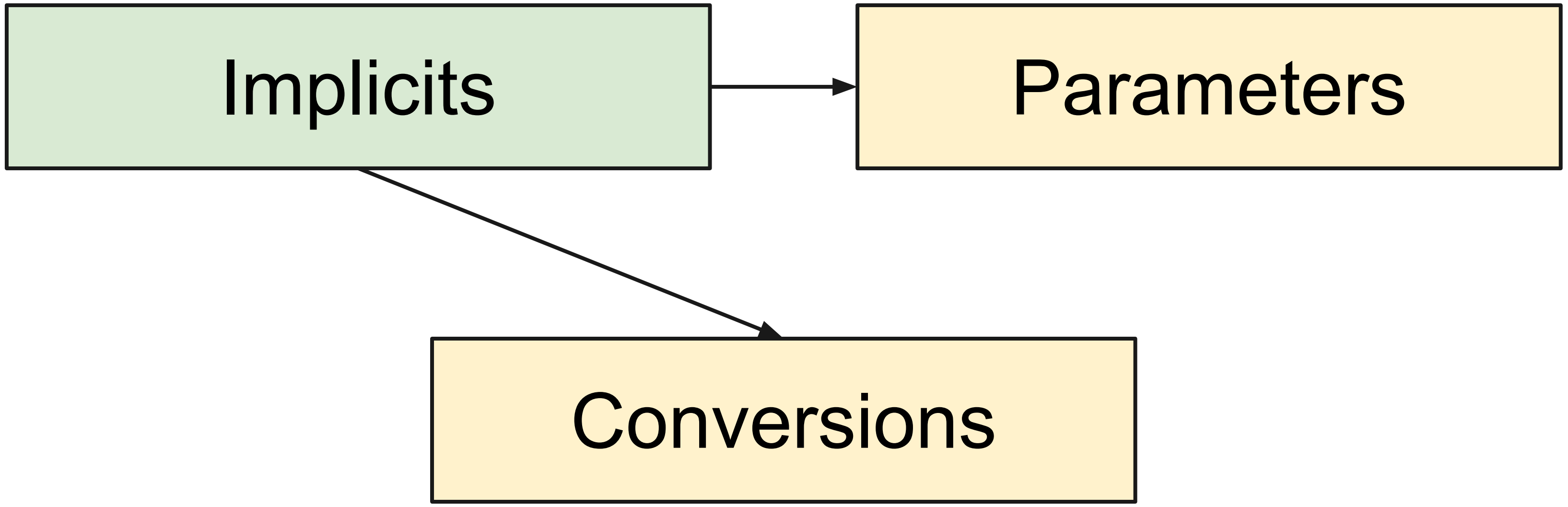
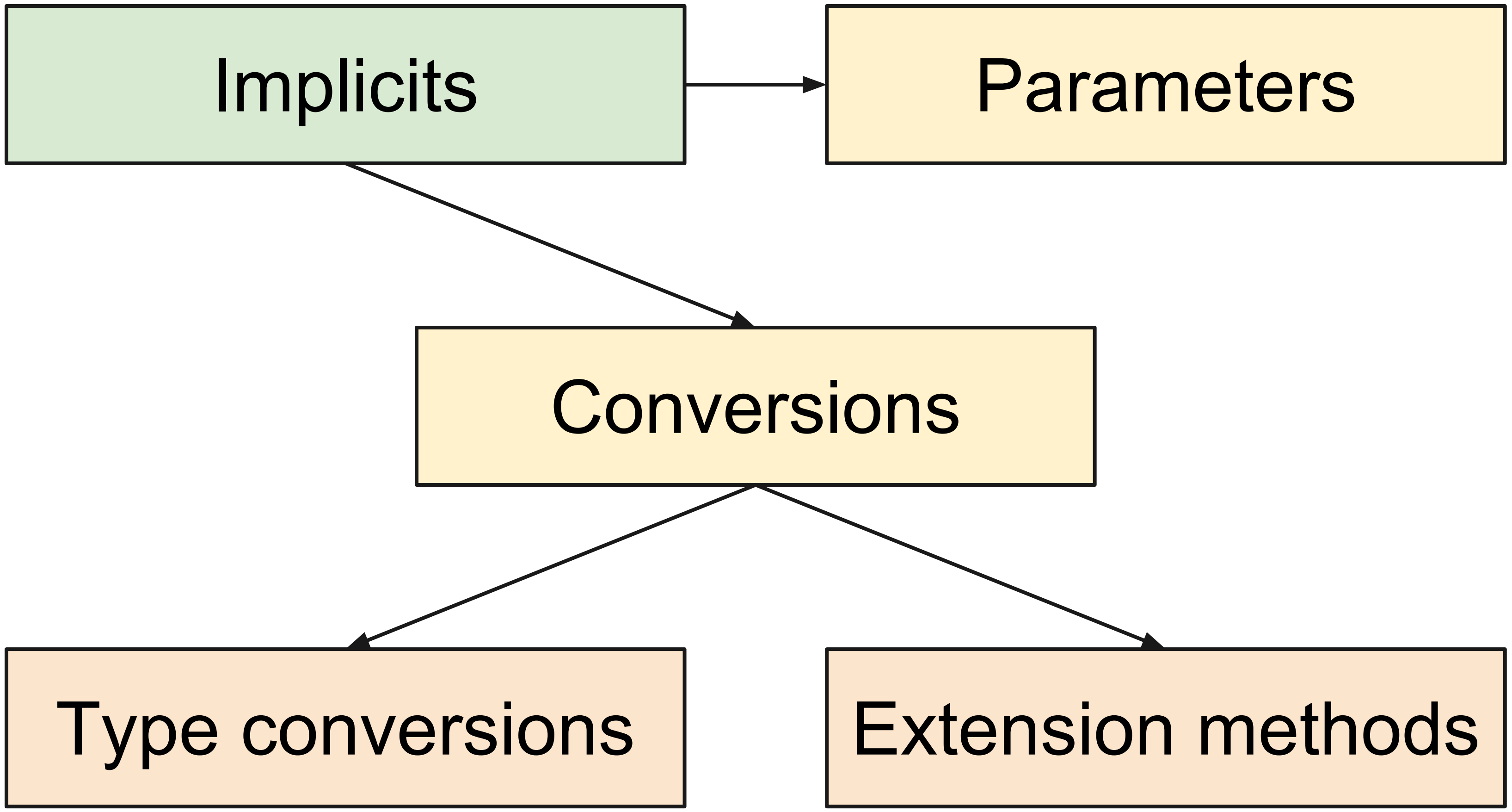
Agenda

- How implicits work
- How IDE can help with them
- Possibilities to improve performance of compilation and IDE responsiveness

Implicits: The Beginning



Implicits: Conversions



Type conversions

```
implicit def b2a(a: B): A = new A
class A; class B
val a: A = new B
```

Compiler will search implicits of type *B* => *A*.

Search scopes

1. Resolve scope
   a. Declared implicits
   b. Imported implicits
   c. Implicitly imported implicits
2. Extended scope
   a. Companion objects of parts? of *B* => *A* type.

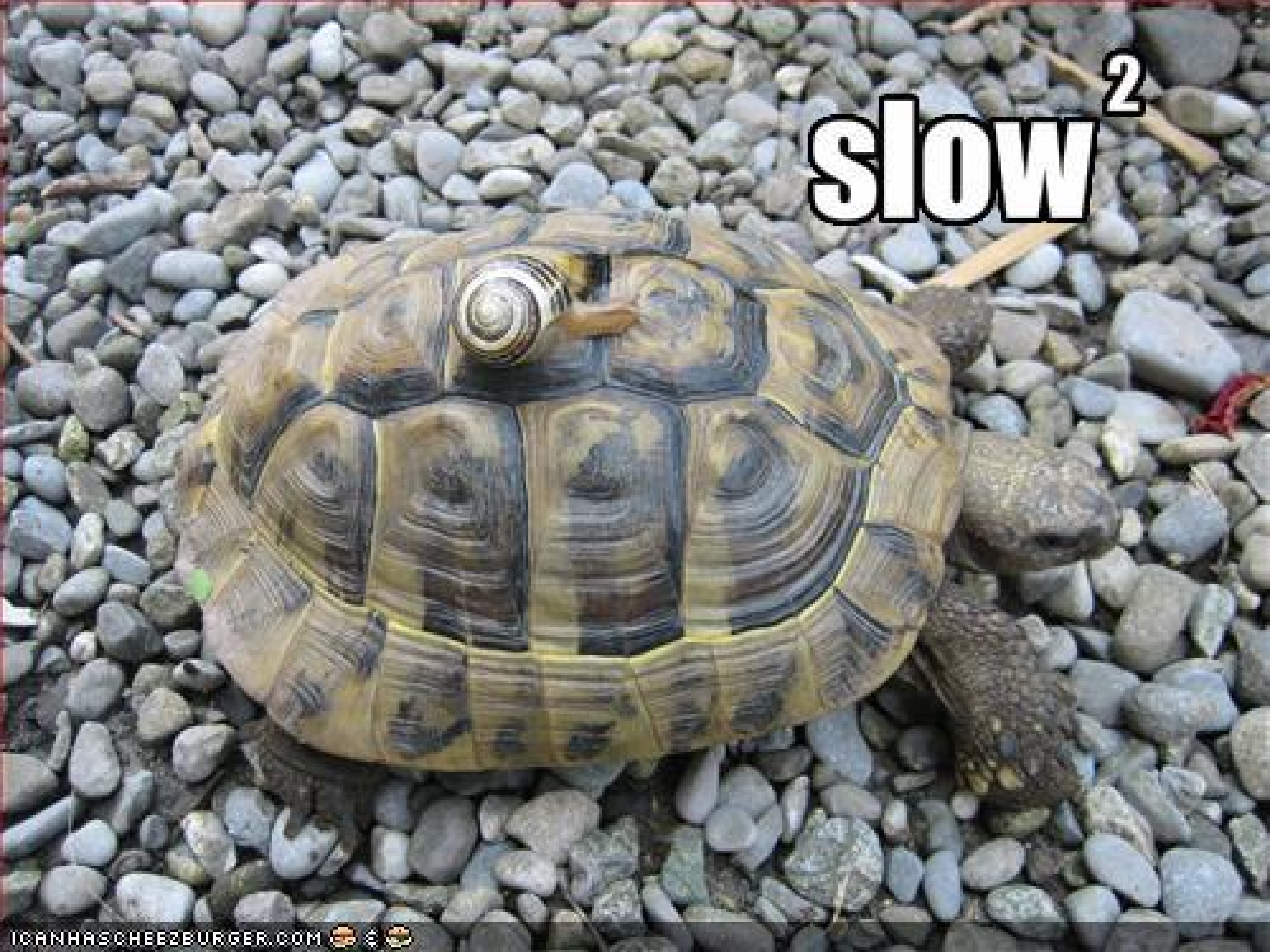
If few implicits were found...

```
class Base; object Base {
  implicit def clazz2str(c: Clazz): String = ""
}
class Clazz extends Base; object Clazz {
  implicit def base2str(b: Base): String = ""
}
val c: String = new Clazz
```

Performance

If all implicits are in the resolve scope

1. Harder to debug problems, when wrong implicit is chosen
2. Complexity to find right one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Performance

Solution:

1. Use “Extended scope” to encapsulate implicits as much as possible
2. Try to split implicits by priority

Explicit return type

```
class A; class B
def toInt(x: B): Int = 123
def goo(x: A) = toInt(new A)
implicit def a2b(x: A) = new B
```

Extension methods

We can add new methods to existing types

```scala
class Type
class TypeExt {
 def foo(x: Int) = 123
}
implicit def extType(a: Type): TypeExt =
  new TypeExt
(new Type).foo(1)
```

Algorithm...

1. Find method without implicit conversion.
2. All are not applicable
    a. Find such conversions, which add applicable method
    b. Choose most specific conversion of them
3. If in (1) we found something not applicable, then we can’t use implicits for args
4. We can’t choose most specific method among methods coming from different implicit conversions

Implicit classes

For most cases we want implicit classes:

```
implicit class Foo(s: String) {
  def intValue: Int = s.toInt
}
```

Magnet pattern

- Widely used in Spray routes
- Originally was described in spray.io blog

Parameter Info problem

With magnet pattern “Parameter Info” stops working in IDE, isn’t it?..

Implicit parameters

Compiler is able to fill missing implicit parameter list on the call site:

```
implicit val x: Int = 1
def foo(implicit x: Int) = x + 1
foo
```

Recursiveness

The main feature, which gives us a step towards type-level programming:

```
class Ordering[T]
implicit val intOrdering: Ordering[Int] = null
implicit def listOrdering[T](
    implicit t: Ordering[T]
  ): Ordering[List[T]] = null
```

How it works?

Implicit parameter search is completely the same as Implicit conversion search, just we will search not only function types.

SOE...

```scala
implicit def a(implicit s: String): Int = 1
implicit def b(implicit i: Int): String = "1"
```

Compiler is able to stop recursion. How?

Another example

```
implicit def a[T](implicit t: T): List[T] = ???
implicit def b[T](implicit t: T): Option[T] = ???
implicit val s: String = ???
def foo(implicit l: List[Option[List[String]]]) {}
foo //foo(a(b(a(s))))
```

Complexity of type

Number of different parts of type:

List[Int] complexity is 2

Seq[Int, Option[String]] complexity is 4

Top level classes are *List* and *Seq*.

Complexity of type

To avoid SOE:

- Have list of types to search
- Do not add new search for some type if
  - List contains equivalent type
  - List contains type with same top level class and complexity of new type is bigger

Local type inference

It’s not legal in Scala:

```
def foo[T](x: T, y: T => String) = y(x)
foo("text", s => s + s)
```

Local type inference

Scala compiler tries to solve type parameters for every single parameter list.

Solution:

```
def foo[T](x: T)(y: T => String) = y(x)
foo("text")(s => s + s)
```

Type inference for implicits

So is it the same for implicit parameters?

-Xprint:typer

It’s good when everything is ok.

-Xprint:typer can help you to see implicits.

Implicit conversions

In IntelliJ IDEA you can use currently available tool to analyze available implicit conversions.

Implicit parameters

In IntelliJ IDEA

- Full analysis even in bad cases
- It’s not including implicit conversions

What’s next

- Use implicits as it’s most important feature of Scala language
- Now you know almost everything about implicits, so use it safely
- Choose right tools...

Thank you!

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