PEP Scala (1)

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Why Scala?

twitter
LinkedIn
theguardian
Morgan Stanley
CREDIT SUISSE
...

eDF ENERGY
Novell
foursquare
HSBC
...

developed since 2004 by Martin Odersky
(he was behind Generic Java which was included in Java 5 ...I am using it maybe since 2008?)

Why Scala?

- compiles to the JVM
  (also JavaScript, native X86 in the works)
- integrates seamlessly with Java
- combines **functional** and **object-oriented** programming
- it is a bit on the "mathematical" side
  (no pointers, no `null`, but expressions)
- often one can write very concise and elegant code

alternatives:
Elm, Haskell, Ocaml, F♯, Erlang, ML, Lisp (Racket), ...

Java vs Scala

Java

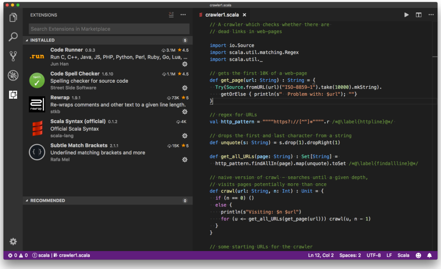
```java
public class Point {
  private final int x, y;

  public Point(int x, int y) {
    this.x = x;
    this.y = y;
  }

  public int x() { return x; }

  public int y() { return y; }
}
```

Scala

```scala
class Point(val x: Int, val y: Int)
```

First Steps: Scala Tools

- I use VS Code and a Scala extension (M'place)



Code Runner 0.9.3 — 3.1M ★4.5
Run C, C++, Java, JS, PHP, Python, Perl, Ruby, Go, Lua, ...
Jun Han

Code Spell Checker 1.6.10 — 1.1M ★4.5
Spelling checker for source code
Street Side Software

Rewrap 1.9.1 — 73K ★5
Re-wraps comments and other text to a given line length.
stkb

Scala Syntax (official) 0.1.2 — 4K
Official Scala Syntax
scala-lang

Subtle Match Brackets 2.1.1 — 15K ★5
Underlined matching brackets and more
Rafa Mel

```scala
// A crawler which checks whether there are
// dead links in web-pages

import io.Source
import scala.util.matching.Regex
import scala.util._

// gets the first 10K of a web-page
def get_page(url: String) : String = {
  Try(Source.fromURL(url)("ISO-8859-1").take(10000).mkString).
    getOrElse { println(s"  Problem with: $url"); ""}
}

// regex for URLs
val http_pattern = """"https?://[^"]*"""".r /*@\label{httpline}@*/

// drops the first and last character from a string
def unquote(s: String) = s.drop(1).dropRight(1)

def get_all_URLs(page: String) : Set[String] =
  http_pattern.findAllIn(page).map(unquote).toSet /*@\label{findallline}@*/

// naive version of crawl - searches until a given depth,
// visits pages potentially more than once
def crawl(url: String, n: Int) : Unit = {
  if (n == 0) ()
  else {
    println(s"Visiting: $n $url")
    for (u <- get_all_URLs(get_page(url))) crawl(u, n - 1)
  }
}

// some starting URLs for the crawler
```

⊗ 0 ⚠ 0 ⓘ scala | crawler1.scala — Ln 12, Col 2 Spaces: 2 UTF-8 LF Scala

- there is a plugin for Eclipse (called Scala IDE)
- there is also a plugin for IntelliJ

Why Scala?

Scala, Elm, Haskell, Ocaml, F♯, Erlang, ML, Lisp (Racket), ...

Why Functional Programming?

Scala, Elm, Haskell, Ocaml, F♯, Erlang, ML, Lisp (Racket), …

Why Functional Programming?

"If you want to see which features will be in mainstream programming languages tomorrow, then take a look at functional programming languages today."

—Simon Peyton Jones (works at Microsoft)
main developer of the Glasgow Haskell Compiler

Scala, Elm, Haskell, Ocaml, F♯, Erlang, ML, Lisp (Racket), ...

Why Functional Programming?

Immutability

Scala, Elm, Haskell, Ocaml, F♯, Erlang, ML, Lisp (Racket), ...

Why bother? or What is wrong with this?

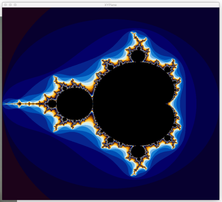
```
for (int i = 10; i < 20; i++) {

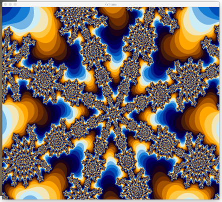
  //...Do something interesting
  //   with i...

}
```

1986

3 days





64K RAM, no HD, no monitor, lots of cables

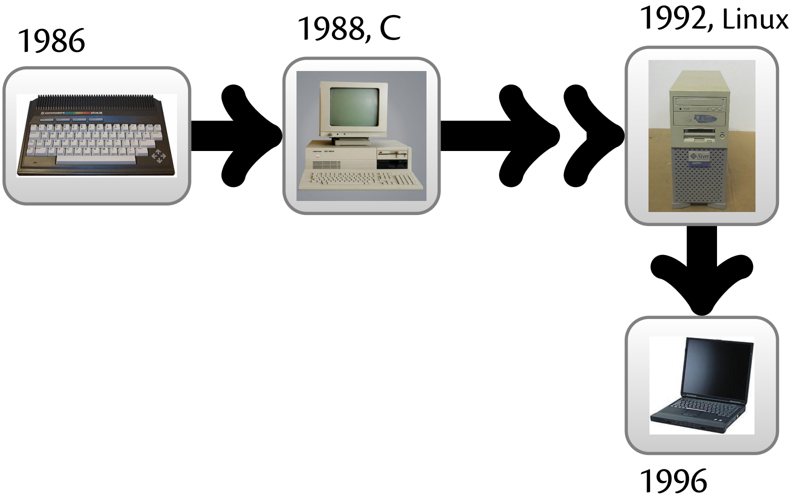
1986

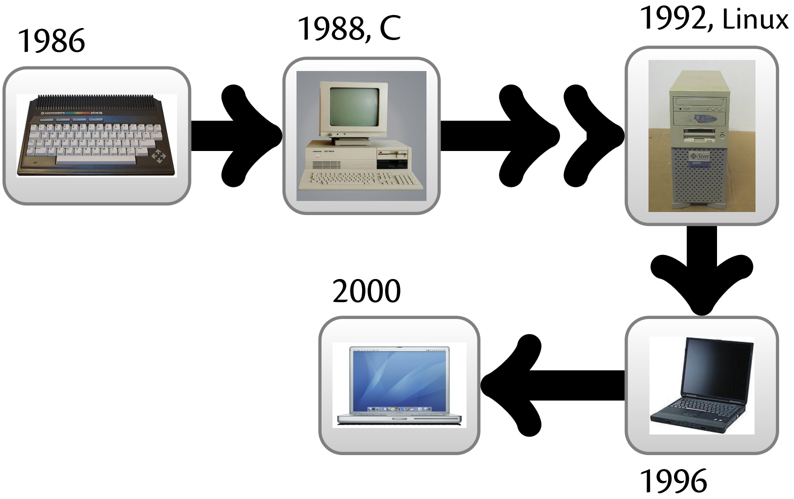
1988, C

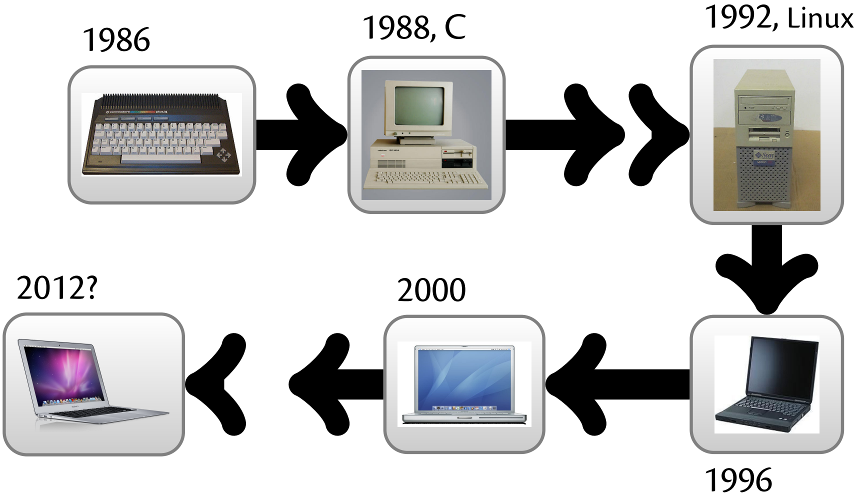
1986

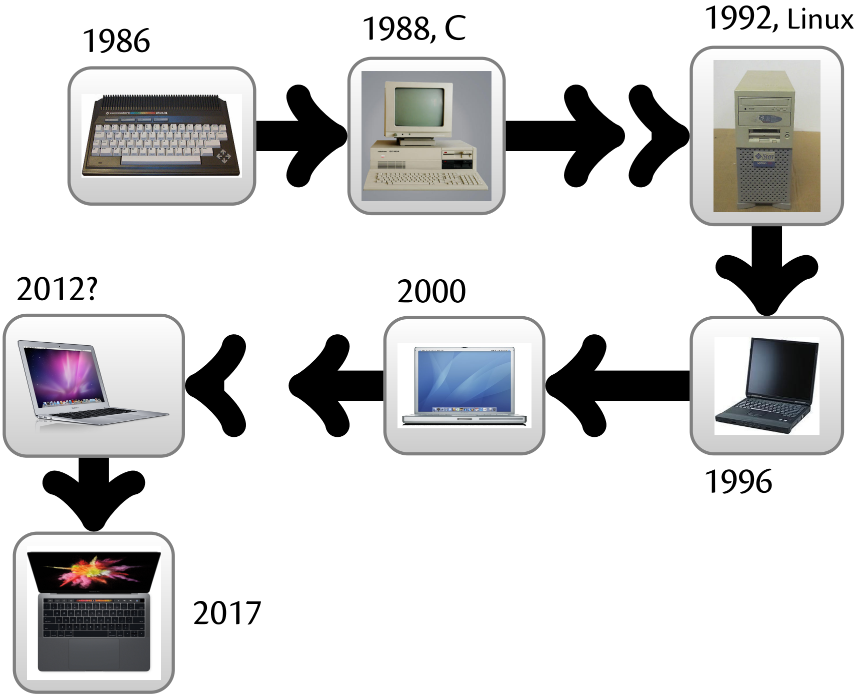
1988, C

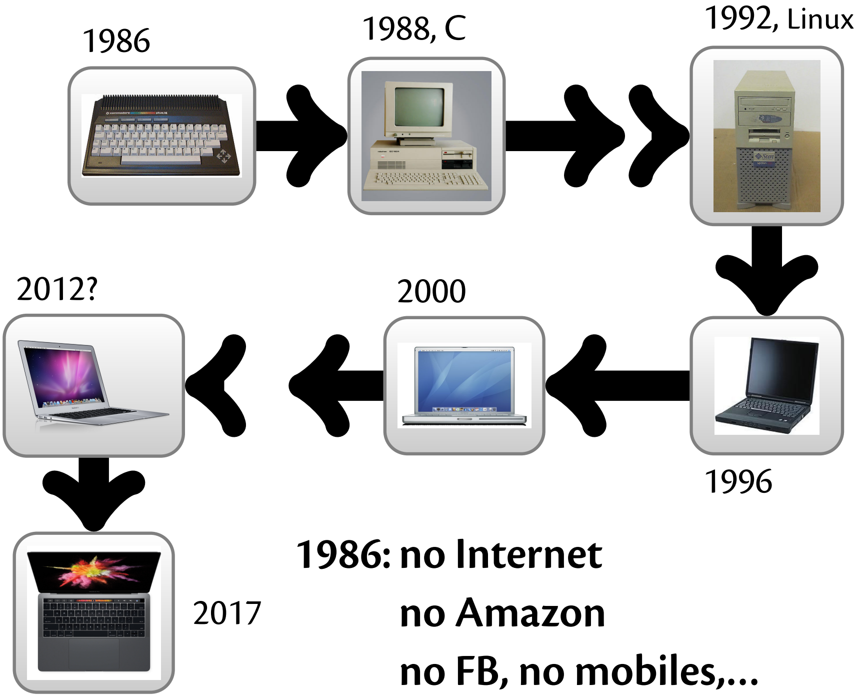
1992, Linux


1986
1988, C
1992, Linux
1996


1986
1988, C
1992, Linux
2000
1996


1986
1988, C
1992, Linux
1996
2000
2012?


1986
1988, C
1992, Linux
1996
2000
2012?
2017

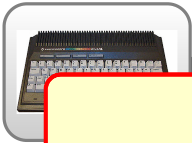


1986: no Internet

no Amazon

no FB, no mobiles,...

1986



1988, C

1992, Linux

2012?

Speedup by Moore's Law

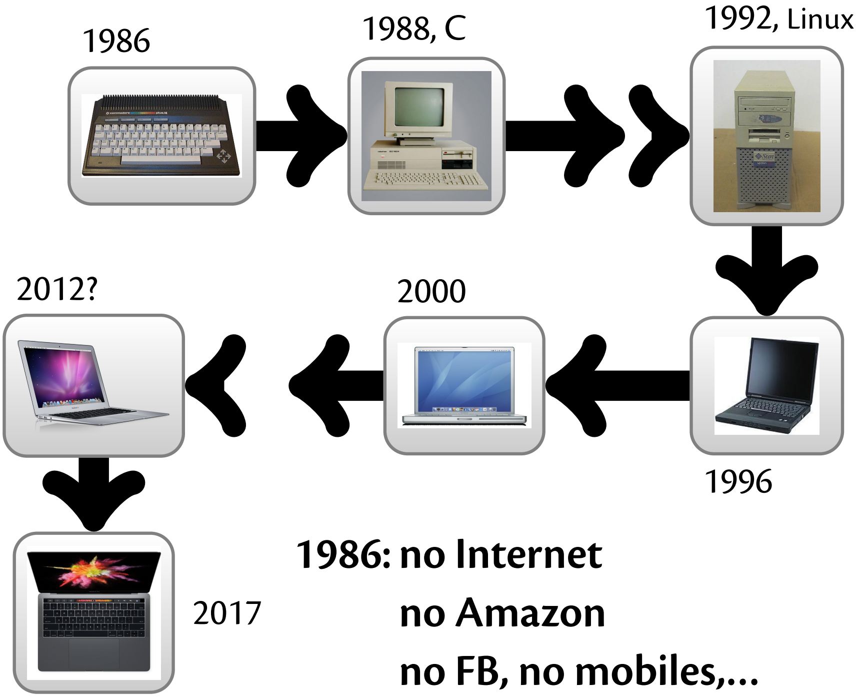
1986:	3 days	**1996:**	135 mins
1988:	1.5 days	**1998:**	67 mins
1990:	18 hs	**2000:**	33 mins
1992:	9 hs	**2002:**	16 mins
1994:	4.5 hs		???

Every two years, computers got twice as powerful.

2017

no Amazon

no FB, no mobiles,...



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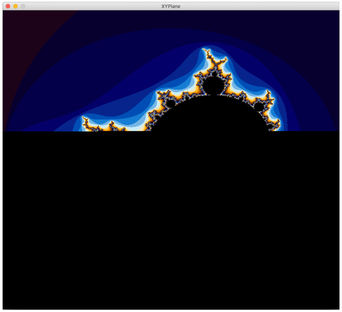
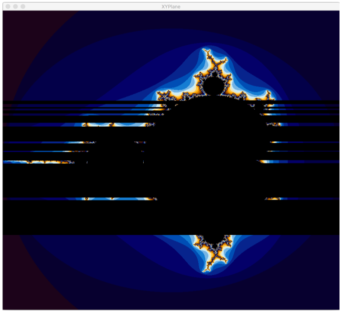
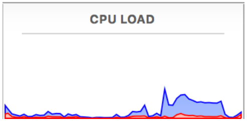
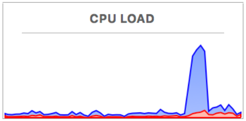
Seq vs Par

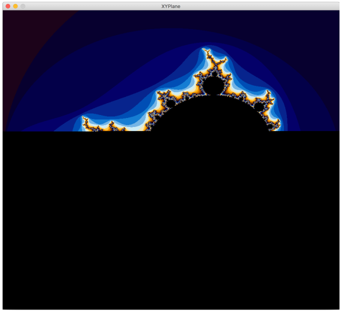


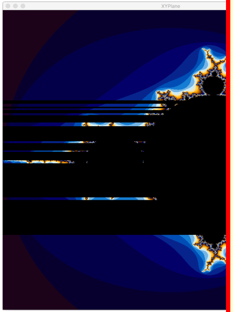


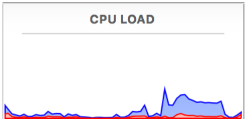


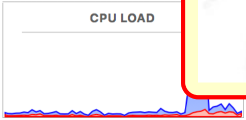


Seq vs Par

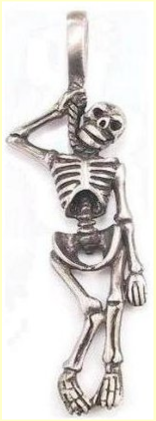




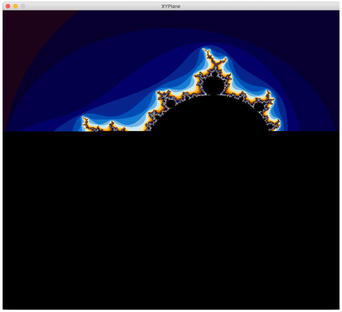


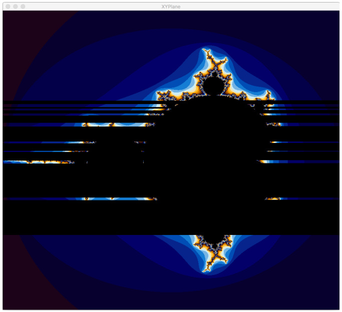


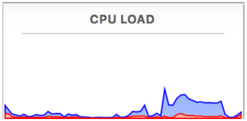
in Java or C++

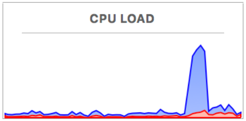


Seq vs Par









In FP: Once a variable is created, it is assigned a value and then never changed again $\Rightarrow$ no synchronisation

Types

- Base types

  `Int`, `Long`, `BigInt`, `Float`, `Double`
  `String`, `Char`
  `Boolean`

- Compound types

`List[Int]`	lists of Int's
`Set[Double]`	sets of Double's
`(Int, String)`	Int-String pair
`List[(BigInt, String)]`	lists of BigInt-String pairs
`List[List[Int]]`	list of lists of Int's
`Option[Int]`	options of Int's

Coursework

- Sorry, I might have been a bit wordy:
  CW description is 7 pages, but I only needed < 100 loc for *all* the CW6.

- there is email feedback when pushing code to github

- there are `jar`-files you can use to test my implementation

- we want you to learn FP: **no vars**, no mutable data-structures, e.g. no `Arrays`, no `ListBuffer`

The Joy of Immutability

- If you need to manipulate some data in a list say, then you make a new list with the updated values, rather than revise the original list. Easy!

```
    val old_list = List(1, 2, 3, 5)
    val new_list = 0 :: old_list
```

- You do not have to be defensive about who can access the data.
- You can look at your code in isolation.

Email: Hate 'val'

Subject: **Hate '`val`'** 01:00 AM

Hello Mr Urban,

I just wanted to ask, how are we suppose to work with the completely useless **`val`**, that can't be changed ever? Why is this rule active at all? I've spent 4 hours not thinking on the coursework, but how to bypass this annoying rule. What's the whole point of all these coursework, when we can't use everything Scala gives us?!?

Regards.
« deleted »

Subject: **Re: Hate '`val`'** 01:02 AM

«my usual rant about fp...
concurrency bla bla... better programs yada»

PS: What are you trying to do where you desperately want to use `var`?

Subject: **Re: Re: Hate 'val'** 01:04 AM

Right now my is_legal function works fine:

```
def is_legal(dim: Int, path: Path)(x: Pos): Boolean = {
  var boolReturn = false
  if(x._1 > dim || x._2 > dim || x._1 < 0 || x._2 < 0) {
  else { var breakLoop = false
         if(path == Nil) { boolReturn = true }
         else { for(i <- 0 until path.length) {
                   if(breakLoop == false) {
                     if(path(i) == x) {
                       boolReturn = true
                       breakLoop = true
                     }
                     else { boolReturn = false }
                   } else breakLoop
              }
         }
         boolReturn
  }
```

...but I can't make it work with boolReturn being val. What approach would you recommend in this case, and is using var in this case justified?

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                   if(breakLoop == false) {
                     if(path(i) == x) {
                       boolReturn = true
                       breakLoop = true
                     }
                     else { boolReturn = false }
                   } else brea

                  turn
```

Me:

...but I can't make it work with boolReturn being val. What approach would you recommend in this case, and is using var in this case justified?

Subject: **Re: Re: Re: Hate ’val’** 01:06 AM

OK. So you want to make sure that the x-position is not outside the board....and furthermore you want to make sure that the x-position is not yet in the path list. How about something like

```
def is_legal(dim: Int, path: Path)(x: Pos): Boolean =
  ...<<some board conditions>>... && !path.contains(x)
```

Does not even contain a `val`.

(This is all on one line)

Subject: **Re: Re: Re: Re: Hate '`val`'** 11:02 AM

THANK YOU! You made me change my coding perspective. Because of you, I figured out the next one...

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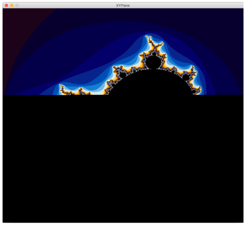
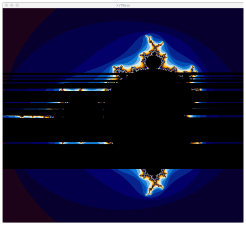
Me:

Conclusion

- Scala is still under heavy development (the compiler is terribly slow)
- **`http://www.scala-lang.org/`**
- it is a rather **deep** language...i.e. gives you a lot of rope to shoot yourself
- learning functional programming is not easy...when you have spent all of your career thinking in an imperative way, it is hard to change
- hope you have fun with Scala and the assignments

Questions?





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