PEP Scala (1)

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Slides & Code: KEATS

Office Hour: Fridays 13:00 – 14:00
Location: N7.07 (North Wing, Bush House)

Pollev: https://pollev.com/cfltutoratki576

Why Scala?

LinkedIn
theguardian
Morgan Stanley
Credit Suisse
Standard & Poor's
...

EDF Energy
Novell
foursquare
HSBC
...

lichess engine (open source)

A former student working now at Quantexa:

"I am a former student. I graduated last year. I got my dream job as a backend Scala developer. Most of the Scala I know is from PEP 2018/19. My interviewers said they expect code of a lesser quality even from people with one year of experience."

"I am currently working as a software engineer at Morgan Stanley whilst doing my year-in-industry and am using Scala in the workplace. My team were impressed that I could already program in the language and even had knowledge of other functional languages. They told me that most university students are not taught such languages."

– Sumaiya Mohbubul 2021/22

"PEP was my favourite module so far during these 2 years. It motivated me to apply and get a summer internship offer at S&P Global as a Scala developer. The module content was more than enough for me to start working on the projects here at the company."

– Szabolcs Nagy 2021/22

Why Scala?

- compiles to the JVM
  (also JavaScript, native X86 in the works)
- integrates seamlessly with Java
- combines **functional** and **object-oriented** programming
- no pointers, no null
- often one can write very concise and elegant code

Java vs Scala

Java

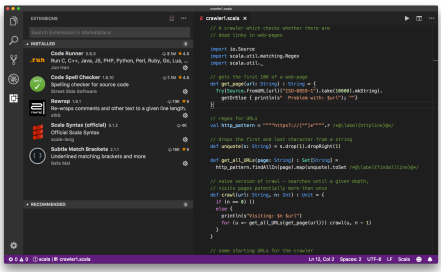
```
public class Point {
  private final int x, y;

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

  public int x() { return x; }

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

Scala

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

First Steps: Scala 3 Tools

- contains a REPL $\Rightarrow$ but this year we use `scala-cli`
- I use VS Codium and a Scala extension (M'place)



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

My personal keboard shortcut for VS Code
(in keybindings.json)

```
[
    {
        ”key”: ”ctrl+enter”,
        ”command”: ”workbench.action.terminal.runSelectedText”,
        ”when”: ”editorTextFocus && editorHasSelection”
    }
]
```

This year Scala 3/ `scala-cli`

`scala-cli` $\Rightarrow$ `https://scala-cli.virtuslab.org/`

Installation problems:

- Oscar Sjostedt (`oscar.sjostedt@kcl.ac.uk`)
- Nicole Lehchevska (`nicole.lehchevska@kcl.ac.uk`)

Github problems:

- Quan Tran (`anh.tran@kcl.ac.uk`)

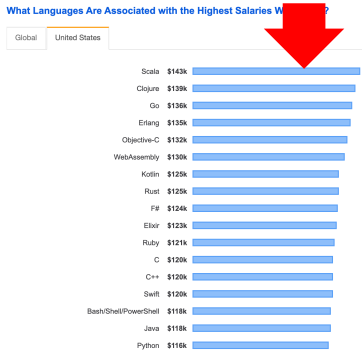
Discussion forum:

- Ruben Ticehurst-James (`ruben.ticehurst-james@kcl.ac.uk`)

Why Scala?

Why Scala?

Money?

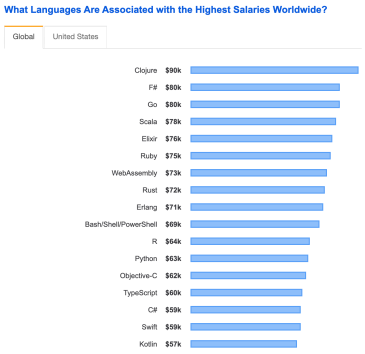


* source: Stackoverflow Developer Survey, 2019

Elm, Rust, Haskell, Ocaml, F#, Erlang, ML, Lisp (Racket)…

Why Scala?

Money?



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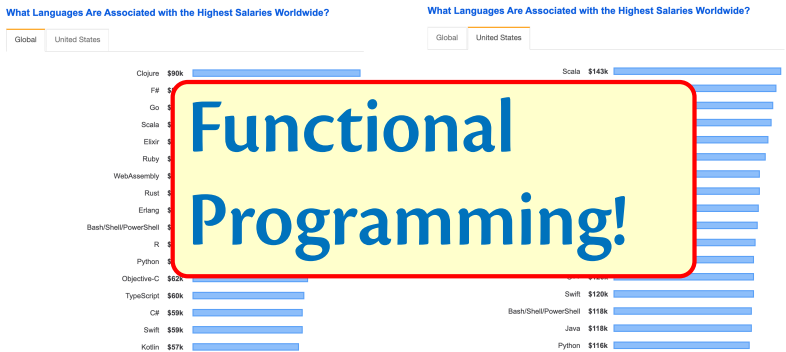
Why Scala?

Money?



Functional Programming!

* source: Stackoverflow Developer Survey, 2019

Elm, Rust, Haskell, Ocaml, F#, Erlang, ML, Lisp (Racket)...

Why Functional Programming?

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 Epic Games, used to work at Microsoft)
main developer of the Glasgow Haskell Compiler

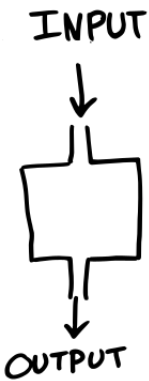
Elm, Haskell, Ocaml, F#, Erlang, ML, Lisp (Racket)...

Why Functional Programming?

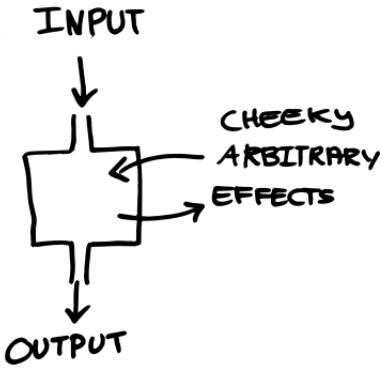
Immutability

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

Functions



Procedures



* from "What pure functional programming is all about?"

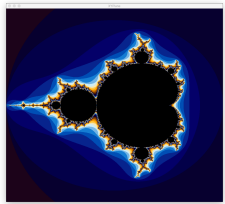
Why bother? or What is wrong with this?

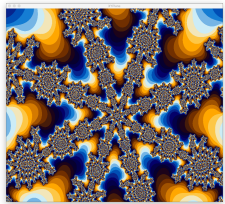
```
for (int i = 10; i < 20; i++) {

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

}
```

1986

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

3 days





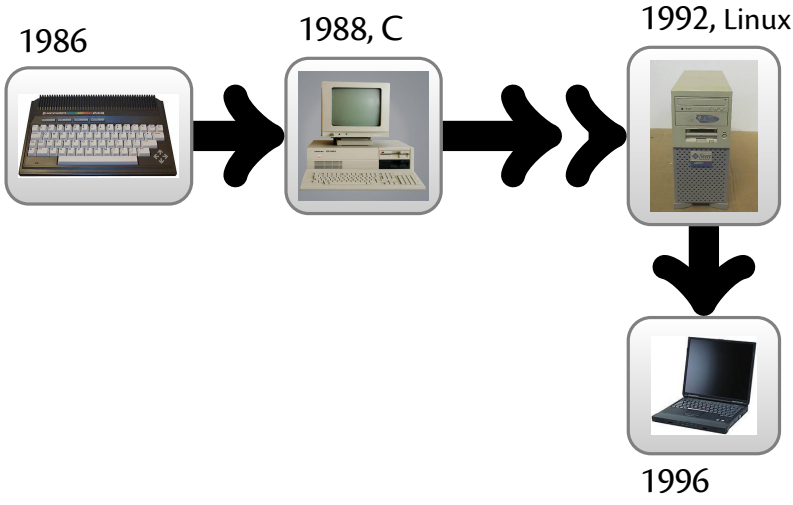
1986

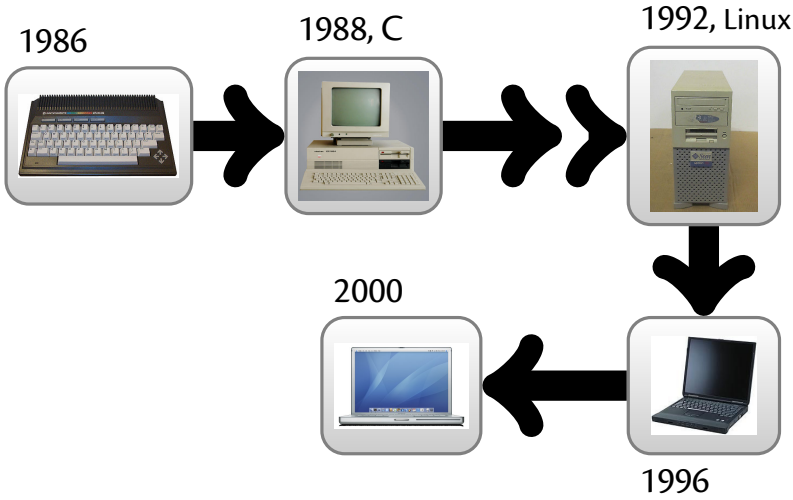
1988, C

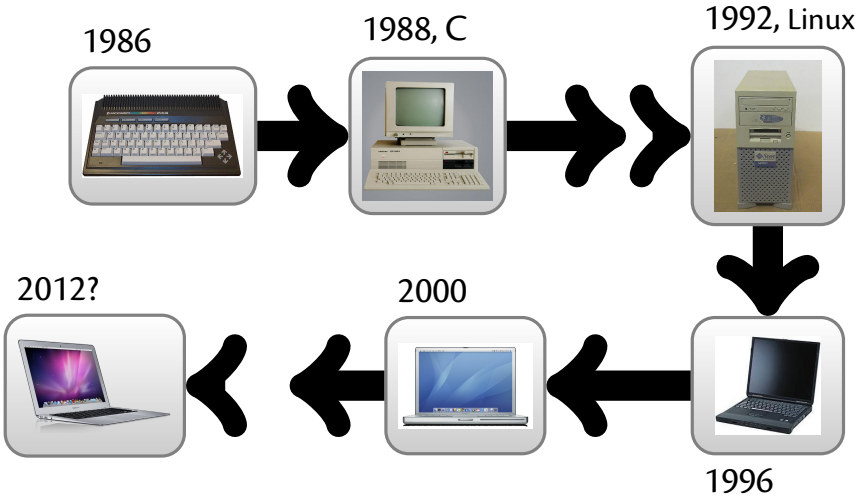
1986

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

1988, C

1992, Linux

1996

2000

2012?

2017

1986: no Internet

no Amazon

no FB, no mobiles,...

1986

1988, C

1992, Linux

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.

2012?

2017

no Amazon

no FB, no mobiles,...

1986

1988, C

1992, Linux

1996

2000

2012?

2017

1986: no Internet

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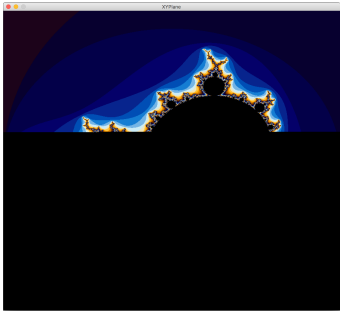
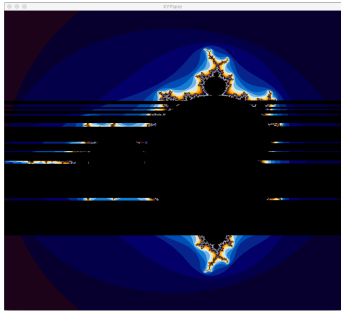
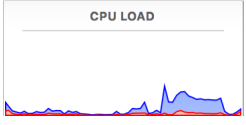
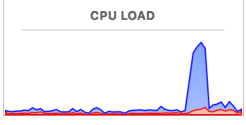
Seq vs Par

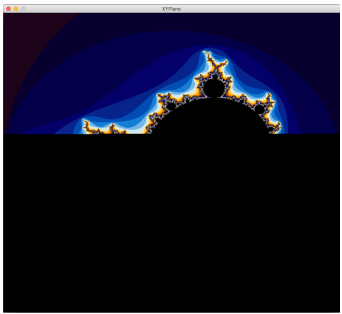


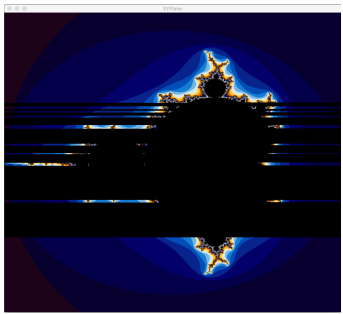


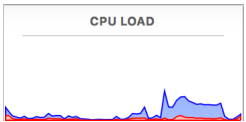


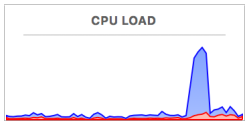


Seq vs Par

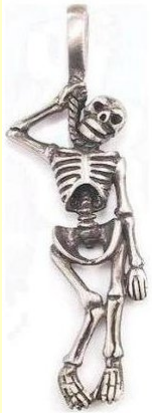




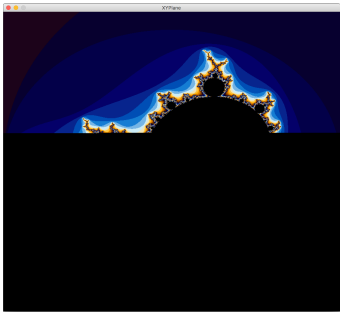


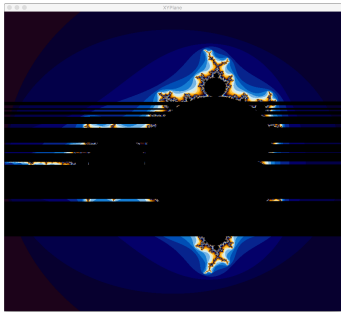


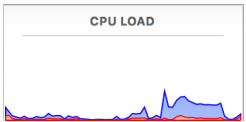
in Java or C++

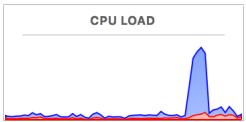


Seq vs Par









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

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

```
def fname(arg1: ty1, arg2: ty2,..., argn: tyn): rty = {
    ....
}
```

```scala
def average(xs: List[Int]) : Int = {
  val s = xs.sum
  val n = xs.length
  s / n
}
```

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
               // -> List(0, 1, 2, 3, 4, 5)
```

- 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?

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

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         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

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: 

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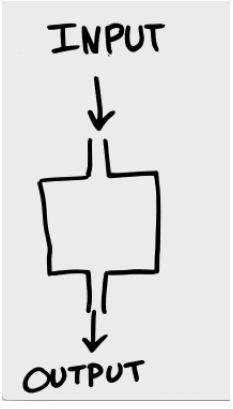
— Szabolcs Daniel Nagi (PEP 2021)

Conclusion for Today

- This year we will be using Scala 3 with the `scala-cli` REPL!
- **`https://scala-cli.virtuslab.org/`**
- Scala can be 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.


INPUT
OUTPUT