



# PEP Scala (1)

Email: christian.urban at kcl.ac.uk

Slides & Code: KEATS

# Why Scala?

twitter 

Linked 

theguardian

Morgan Stanley

CREDIT SUISSE 

...



edf  
ENERGY

Novell.

foursquare™

HSBC 

...

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."*

# 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

```
public class Point { 1
    private final int x, y; 2
    3
    public Point(int x, int y) { 4
        this.x = x; 5
        this.y = y; 6
    } 7
    8
    public int x() { return x; } 9
    10
    public int y() { return y; } 11
} 12
```

Java

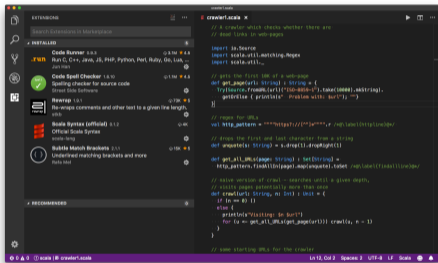
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```
case class Point(val x: Int, val y: Int)
```

Scala

# First Steps: Scala Tools

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



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

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

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

# Why Scala?

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

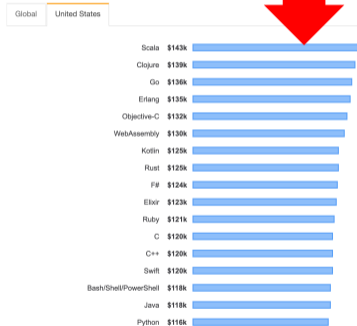
# Why Scala?

## Money?

What Languages Are Associated with the Highest Salaries Worldwide?



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\* source: Stackoverflow Developer Survey, 2019

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# Why Scala?

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# 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 Microsoft)  
main developer of the Glasgow Haskell Compiler

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

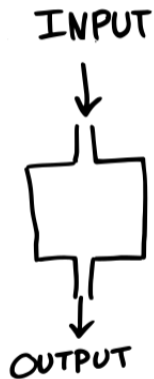
# Why Functional Programming?



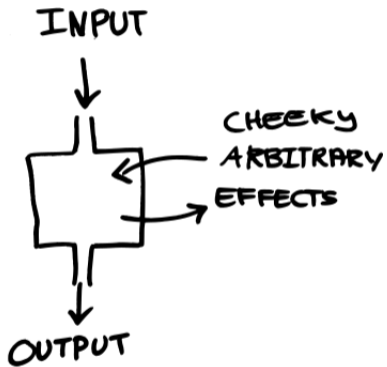
## Immutability

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?

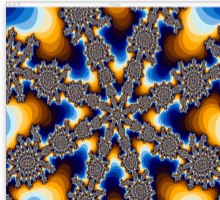
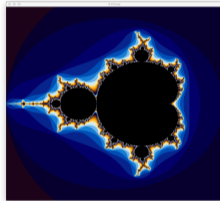
```
for (int i = 10; i < 20; i++) {  
  
    //...Do something interesting  
    //    with i...  
  
}
```

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



1996

2000



1986



1988, C



1992, Linux



2012?



2000



1996



1986



1988, C



1992, Linux



1996

2012?



2000



2017

1986



1988, C



1992, Linux



2012?



2000



1996



**1986: no Internet**

**no Amazon**

**no FB, no mobiles,...**

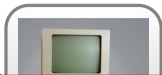
2017



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		???

2012?



2017

Every two years, computers got twice as powerful.

**no Amazon**

**no FB, no mobiles,...**

1986



1988, C



1992, Linux



2012?



2000



1996



2017



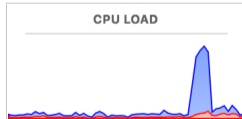
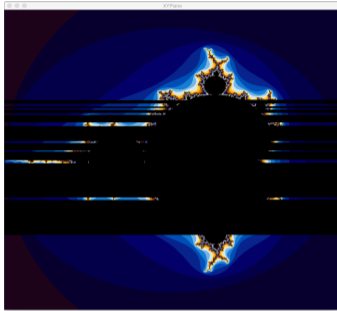
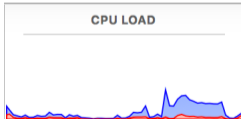
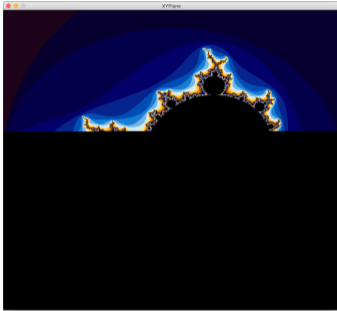
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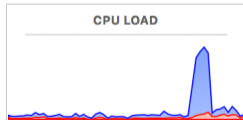
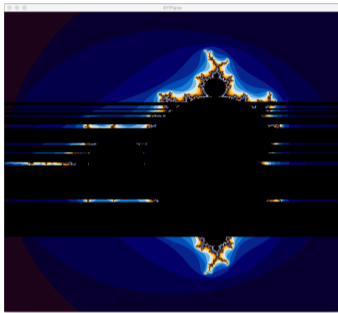
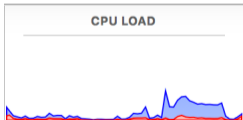
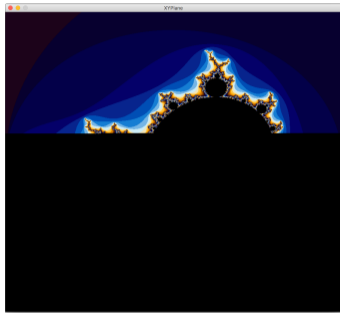
**no FB, no mobiles,...**



# Seq vs Par



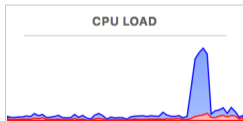
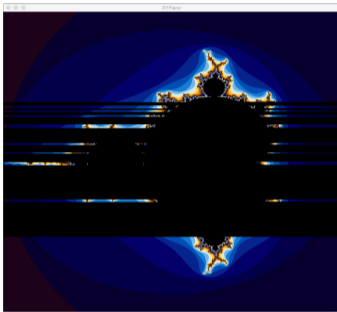
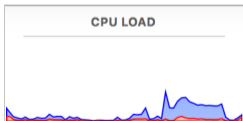
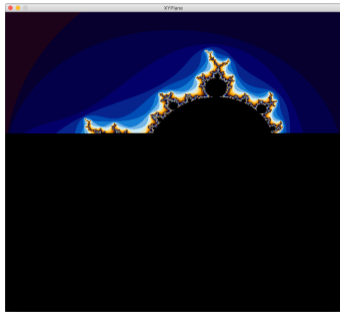
# Seq vs Par



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

# Coursework Dates

Similar to C++:

- Preliminary Parts: Wednesdays 4pm
  - Preliminary Part 6: 3% (13 November)
  - Preliminary Part 7: 4% (20 November)
  - Preliminary Part 8: 4% (27 November)
  - Preliminary Part 9: 4% (5 December)
- Core Part: 35% (15 January 2020)

# Coursework

- Sorry, I might have been a bit wordy:  
Part 6 of CW description is 7 pages, but I only needed  $< 100$  loc for *all* Part 6.
- there is feedback when pushing code to github
- there are jar-files you can use to test my reference 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
                // -> 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  
          }  
        }  
      }  
    }  
  }  
  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?

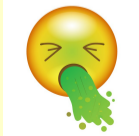
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    if(path == Nil) { boolReturn = true }  
    else { for(i <- 0 until path.length) {  
      if(breakLoop == false) {  
        if(path(i) == x) {  
          boolReturn = true  
          breakLoop = true  
        }  
      }  
    }  
  } else { boolReturn = false }  
} else breakLoop
```

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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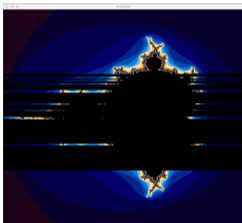
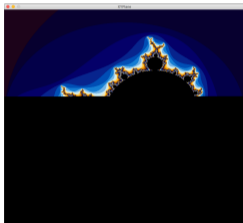
Me:



# Conclusion for Today

- Scala is still under development, 2.13.1 came out in Sept.  
(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?



My Office Hours: Thursdays 12 – 14  
And specifically for Scala: Tuesdays 10:45 – 11:45





# Mind-Blowing Programming Languages: C/C++