# NPRG014 – 2019 plan

1. 10. - Groovy (FP, scripting) (VP)

8.10. - Groovy (dynamism, meta-programming) (VP)

15.10. - Groovy (DSL) (VP)

22.10. - Scala (TB)

29.10. - Scala (TB)

5.11. - Scala (TB)

12.11. - Concurrency (VP)

19.11. - buffer - Scala (TB)

26.11. - Prototypy (TB)

3.12. - Prototypy (TB)

10.12. - spare

17.12. - buffer - Prototypy (TB)

7.1. - spare

# Criteria

A homework assignment will be given at each lecture

A solution to each homework must be submited through the university system **by the start of the following lecture**

Submit **at least 8** out of 10 correctly implemented homeworks

# Repository

https://github.com/d3scomp/NPRG014

Clone and then checkout before each lecture

https://github.com/d3scomp/NPRG014.git

# Language dynamism, scripting and functional programming



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# Today's agenda

Groovy syntax and interoperability

Language dynamism

Scripting

Functional programming

# Groovy


A JVM programming language

- Dynamic
- Dynamically-typed
- Scripting
- Object-oriented
- Building on Java syntax

### Flat learning curve

Concise, readable and expressive syntax, easy to learn for Java developers

### Smooth Java integration

Seamlessly and transparently integrates and interoperates with Java and any third-party libraries

### Vibrant and rich ecosystem

Web development, reactive applications, concurrency / asynchronous / parallelism library, test frameworks, build tools, code analysis, GUI building

### Powerful features

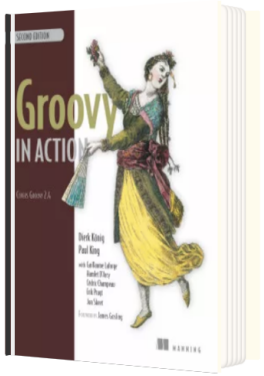
Closures, builders, runtime & compile-time meta-programming, functional programming, type inference, and static compilation

### Domain-Specific Languages

Flexible & malleable syntax, advanced integration & customization mechanisms, to integrate readable business rules in your applications

### Scripting and testing glue

Great for writing concise and maintainable tests, and for all your build and automation tasks




## The 7 usage patterns

- Super Glue
- Liquid Heart
- Keyhole Surgery
- Smart Configuration
- Unlimited Openness
- House-Elf Scripts
- Prototype

Examples in Groovy



http://www.slideshare.net/gr8conf/groovy-usage-patterns-by-dierk-knig

# They all use Apache Groovy!

# Part 1

Groovy syntax and interoperability

# Interoperability

*Groovy* and *Java* can **implement**, **extend**, **refer** and **call** each other at will.

Groovy sources compile into *.class* files

IDEs provide cross-reference support

# Java

```
public class Person {
    private final String name;
    public Person(String name) {
        this.name = name;
    }
    public String getName() {
        return name;
    }
}
```

# Groovy

```
public class Person {
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# Groovy

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# Groovy

```
class Person {
    final String name
    Person(String name) {
        this.name = name
    }
}
```

# Groovy is Java

```
class Person {
    final String name
}
```

# Variables, constants, params

String a

def a – „*var*“

final a - „*val*“

# Intuitiveness

Equality a == b

Identity a.is(b)

() sometimes optional: println 'Joe'

# String interpolation

```
final s = 'Hi Joe'

final s = "Hi Dave"

final s = "Hi $name"

final s = "Hi ${user.name}"

final s = """Hi Dave,

How are you?

"""
```

# Numbers and primitive types

15 - integer

15G - BigInteger

1.5 - BigDecimal

1.5d - Double

*All values are objects:* 5.upto(10)

Clever boxing and unboxing

# Properties

```
class City {
    String name
    int size
    boolean capital = false
}

City c1 = new City(name: 'Praha', size: 1200000, capital: true)
City c2 = new City(name: 'Písek', size: 25000)

print c1.name
c2.size = 25001
```

# Power assert

```
assert 5 == customer.score
```

```
Exception thrown
17.2.2012 12:30:12 org.codehaus.groovy.runtime.StackTraceUtils sanitize

WARNING: Sanitizing stacktrace:

Assertion failed:

assert 5 == customer.score
         |  |        |
         |  |        4
         |  [score:4]
         false
```

# Closures

```
Closure multiply = {int a, int b -> return a * b}
```

# Closures

```
Closure multiply = {int a, int b -> a * b}
```

# Closures

```
Closure multiply = {a, b -> a * b}
```

# Closures – implicit parameter

```
def triple1 = {int number -> number * 3}

def triple2 = {number -> number * 3}

def triple3 = {it * 3}
```

# Groovy is functional

```
def multiply = {a, b -> a * b}
def double = multiply.curry(2)
def triple = multiply.curry(3)

assert 4 == multiply(2, 2)
assert 8 == double(4)
assert 6 == triple(2)
```

# Currying vs. Partial application

```
def multiply = {a, b → a * b}

def partial = multiply.curry(3)

def curried1 = {x → {y → multiply(x, y)}}

def curried2 = {x → multiply.curry(x)}
```

# Memoize

def func = {a → longComputation(a)}

def fastFunc = func.memoize()

# Closure scope

owner

delegate

this

closure.resolveStrategy =

DELEGATE_FIRST / OWNER_FIRST

DELEGATE_ONLY / OWNER_ONLY

# Collections

```
final emptyList = []
final list = [1, 2, 3, 4, 5]
final emptyMap = [:]
final capitals = [cz : 'Prague', uk : 'London']

final list = [1, 2, 3, 4, 5] as LinkedList
final emptyMap = [:] as ConcurrentHashMap
```

# Collections API

```
(1..10).each {println it}
2.step(10, 2) {println it}

(10..20).findAll{it%2==0}
        .collect {3*it}
        .inject(0){acc, v -> acc + v}
```

# map, filter, and reduce explained with emoji 😂

```
map([🐮, 🍠, 🐔, 🌽], cook)
=> [🍔, 🍟, 🍗, 🍿]

filter([🍔, 🍟, 🍗, 🍿], isVegetarian)
=> [🍟, 🍿]

reduce([🍔, 🍟, 🍗, 🍿], eat)
=> 💩
```

# (Not exhaustive) list

each (aka for loop)

collect (aka map)

inject (aka reduce)

findAll (aka filter)

sum, size, findFirst, grep, groupBy

any, every, min, max, ...

# Some more operators

```
['Java', 'Groovy']*.toUpperCase()

customer?.shippingAddress?.street

return user.locale ?: defaultLocale
```

# GDK = JDK + FUN

- java.util.Collection
  - each(), find(), join(), min(), max() …
- java.lang.Object
  - any(), every(), print(), invokeMethod(), …
- java.lang.Number
  - plus(), minus(), power(), upto(), times(), …

Tip: Ask *DefaultGroovyMethods* for help

# Syntax enhancements

- Dynamic (duck) typing – optional!
- GDK
- Syntax enhancements
  - Properties, Named parameters
  - Closures
  - Collections and maps
  - Operator overloading
  - …

# List comprehension (Python)

```
odd = [x for x in range(0, 100) if x % 2 !=0]

squares = [x*x for x in odd]
```

# Generators (Python)

```
def fibonacci():
    a = 0
    b = 1
    yield b
    while True:
        a, b = b, a + b
        yield b


allFibs = fibonacci()
```

# Part 2

Scripting

# Agenda

- Scripting
- Script engine customization
- Grabbing libraries

# Scripting

Evaluate custom Groovy code

At run-time!!!

```
new GroovyShell().evaluate('println Hi!')
```

http://groovyconsole.appspot.com/

# Script customization

*CompilerConfiguration*

*CompilationCustomizer*

- ImportCustomizer
- ASTCustomizer
- SecureASTCustomizer

# Functors

Dealing with wrapped data

map: ([A], f: A -> B) → [B]

map: (Maybe<A>, f: A -> B) → Maybe<B>

Functors are *mappable* (they have a **map** operation)

# Monoids

Aggregating data and operations

# Monoids

## Aggregating data and operations

- A set of elements
- An operation that combines two elements
- An 'id' element neutral with respect to the operation
- Closure of the set with respect to the operation

1. $a + id = id + a = a$
2. $(a + b) + c = a + (b + c)$
3. $a \in M \,\&\, b \in M \Rightarrow a+b \in M$

# Monoids

**Reducible** – any set of elements from a monoid can be reduced into a single value

reduce: ([A], f: (A, A) → A) → A

# Monoids

class Customer {name, address, orders}

vs.

class CustData {orders, totalAmount}

# Monoids

class Customer {name, address, orders}

not a monoid

vs.

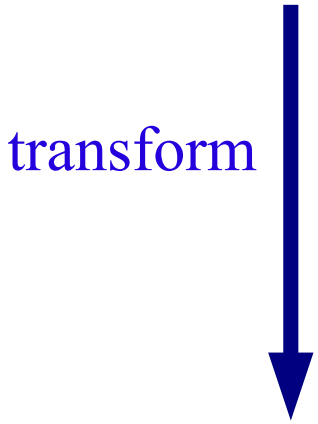
class CustData {orders, totalAmount}

a monoid

# Monoids

class Customer {name, address, orders}

not a monoid




vs.

class CustData {orders, totalAmount}

a monoid

# Reduce vs. Fold

# Composing functions

f: A → B

g: B → C

f >> g: A → C

# Composing functions

f: A → B

g: B → C

f >> g: A → C

```
def f = {String s → s.size()}

def g = {Integer i → i%2==0 ? true : false}

def h = f >> g
```

# Composing functions

f: A → B

g: B → C

f >> g: A → C

Not a monoid

# Endofunctors

f: A → A

with composition (**>>**) and an **id()** function form a monoid

[f1, f2, f3, f4, f5, …].reduce(id, >>)

# Other monoids of functions

Elements: f: String → Boolean

# Other monoids of functions

Elements: f: String → Boolean

id() – returns *true/false*

Operation: logical AND/OR

# Summary

The joy of Ruby for Java programmers

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# References

http://groovy-lang.org

http://grails.org

http://groovyconsole.appspot.com/

http://www.manning.com/koenig2/