Main sponsor

What's New in Groovy 2.0?

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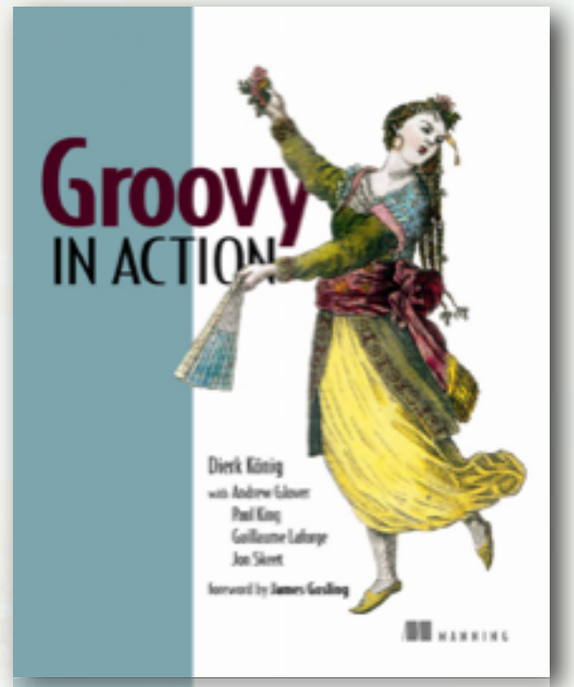
Groovy project Manager

33rd Degree Conference
Conference for Java Masters

19-21 March 2012
Kraków, Poland

Guillaume Laforge

- **Groovy Project Manager** at VMware
  - Initiator of the **Grails** framework
  - Creator of the **Gaelyk** and **Caelyf** toolkits



- Co-author of **Groovy in Action**

- Follow me on...
  - My blog: **http://glaforge.appspot.com**
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Agenda

- **What's new in Groovy 1.8?**
  - Nicer DSLs with command chains
  - Runtime performance improvements
  - GPars bundled for taming your multicores
  - Closure enhancements
  - Builtin JSON support
  - New AST transformations

Agenda

- **What's cooking for Groovy 2.0?**
  - Alignments with JDK 7
    - Project Coin (small language changes)
    - Invoke Dynamic support
      - Continued runtime performance improvements
  - Static type checking
  - Static compilation
  - Modularity

Command chains

- A grammar improvement allowing you to **drop dots** & **parens** when **chaining method calls**
  - –an extended version of top-level statements like println

- Less dots, less parens allow you to
  - –write more readable business rules
  - –in almost plain English sentences
    - (or any language, of course)

Command chains

```
turn left  then right
```

Command chains

Alternation of method names

```
turn left  then right
```

Command chains

Alternation of method names

```
turn left  then right
```

and parameters (even named ones)

Command chains

```
turn left  then right
```

Command chains

Equivalent to:

```
turn(left).then(right)
```

Look Ma!
No parens,
no dots!

Command chains

Before... we used to do...

```
take 2.pills, of: chloroquinine, after: 6.hours
```

Command chains

Before... we used to do...

```
take 2.pills, of: chloroquinine, after: 6.hours
```

Normal argument

Command chains

Before... we used to do...

```
take 2.pills, of: chloroquinine, after: 6.hours
```

Normal argument

Named arguments

Command chains

Before... we used to do...

```
take 2.pills, of: chloroquinine, after: 6.hours
```

Normal argument

Named arguments

Woud call:

```
def take(Map m, Quantity q)
```

Command chains

Now, even less punctuation!

```
take 2  pills of  chloroquinine  after  6 hours
```

Command chains

Now, even less punctuation!

```
take(2).pills(of).chloroquinine (after).6(hours)
```

Command chains

```
// Java fluent API approach
class RegimenBuilder {
    ...
    def take(int n) {
        this.pills = n
        return this
    }

    def pills(String of) {
        return this
    }
    ...
}
```

Command chains

```
// variable injection
def (of, after, hours) = /*...*/

// implementing the DSL logic
def take(n) {
    [pills: { of ->
        [chloroquinine: { after ->
            ['6': { time -> }]
        }]
    }]
}

// ------------------------------------
take 2 pills of chloroquinine after 6 hours
```

Command chains

Command chains

```
// methods with multiple arguments (commas)
```

Command chains

```
// methods with multiple arguments (commas)
take coffee  with sugar, milk  and liquor
```

Command chains

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// leverage named-args as punctuation
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check that: margarita  tastes good
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```

Command chains

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// methods with multiple arguments (commas)
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// closure parameters for new control structures
given {}  when {}  then {}
```

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select all  unique() from names
```

Command chains

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// possible with an odd number of terms
```

Command chains

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// closure parameters for new control structures
given {}  when {}  then {}

// zero-arg methods require parens
select all  unique() from names

// possible with an odd number of terms
take 3  cookies
```

Command chains

```
// methods with multiple arguments (commas)
take(coffee).with(sugar, milk).and(liquor)

// leverage named-args as punctuation
check that: margarita  tastes good

// closure parameters for new control structures
given {}  when {}  then {}

// zero-arg methods require parens
select all  unique() from names

// possible with an odd number of terms
take 3  cookies
```

Command chains

```
// methods with multiple arguments (commas)
take(coffee).with(sugar, milk).and(liquor)

// leverage named-args as punctuation
check(that: margarita).tastes(good)

// closure parameters for new control structures
given {}  when {}  then {}

// zero-arg methods require parens
select all  unique() from names

// possible with an odd number of terms
take 3  cookies
```

Command chains

```
// methods with multiple arguments (commas)
take(coffee).with(sugar, milk).and(liquor)

// leverage named-args as punctuation
check(that: margarita).tastes(good)

// closure parameters for new control structures
given({}).when({}).then({})

// zero-arg methods require parens
select all  unique() from names

// possible with an odd number of terms
take 3  cookies
```

Command chains

```
// methods with multiple arguments (commas)
take(coffee).with(sugar, milk).and(liquor)

// leverage named-args as punctuation
check(that: margarita).tastes(good)

// closure parameters for new control structures
given({}).when({}).then({})

// zero-arg methods require parens
select(all).unique().from(names)

// possible with an odd number of terms
take 3  cookies
```

Command chains

```
// methods with multiple arguments (commas)
take(coffee).with(sugar, milk).and(liquor)

// leverage named-args as punctuation
check(that: margarita).tastes(good)

// closure parameters for new control structures
given({}).when({}).then({})

// zero-arg methods require parens
select(all).unique().from(names)

// possible with an odd number of terms
take(3).cookies
```

Runtime performance improvements

- Significant **runtime improvements** for **primitive type operations**
  - –classical Fibonacci example x13 faster!
  - –closer to Java performance

- Some **direct method calls on this**
- More on performance later on

GPars bundled

- **GPars** is bundled in the Groovy distribution

- GPars covers a wide range of parallel and concurrent paradigms
  - actors, fork/join, map/filter/reduce, dataflow, agents
  - parallel arrays, executors, STM, and more...

- And you can use it from plain Java as well!

Closure enhancements

- **Closure annotation parameters**
- Some more functional flavor
  - composition
    - compose several closures into one single closure
  - trampoline
    - avoid stack overflow errors for recursive algorithms
  - memoization
    - remember the outcome of previous closure invocations
- Currying improvements

Closure annotation parameters

```
@Retention(RetentionPolicy.RUNTIME)
@interface Invariant {
    Class value() // a closure class
}

@Invariant({ number >= 0 })
class Distance {
    float number
    String unit
}

def d = new Distance(number: 10, unit: "meters")
def anno = Distance.getAnnotation(Invariant)
def check = anno.value().newInstance(d, d)
assert check(d)
```

Closure annotation parameters

```groovy
@Retention(RetentionPolicy.RUNTIME)
@interface Invariant {
    Class value() // a closure class
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class Distance {
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assert check(d)
```

Poor-man's GContracts

Builtin JSON support

- Consuming
- Producing
- Pretty-printing

Builtin JSON support

```
import groovy.json.*

def payload = new URL(
    "http://github.../json/commits/...").text

def slurper = new JsonSlurper()
def doc = slurper.parseText(payload)

doc.commits.message.each { println it }
```

@glaforge

Builtin JSON support

```groovy
import groovy.json.*

def json = new JsonBuilder()

json.person {
    name "Guillaume"
    age 34
    pets "Hector", "Felix"
}
println json.toString()
```

Builtin JSON support

```groovy
import groovy.json.*

def json = new JsonBuilder()

json.person {
    name "Guillaume"
    age 34
    pets "Hector", "Fel
}
println json.toString()
```

```
{
    "person": {
        "name": "Guillaume",
        "age": 34,
        "pets": [
            "Hector",
            "Felix"
        ]
    }
}
```

Builtin JSON support

```
import groovy.json.*

println JsonOutput.prettyPrint(
    '''{"person":{"name":"Guillaume","age":34,''' +
    '''"pets":["Hector","Felix"]}}''')
```

```
{
    "person": {
        "name": "Guillaume",
        "age": 34,
        "pets": [
            "Hector",
            "Felix"
        ]
    }
}
```

New AST transformations

- **@Log**
- @Field
- @AutoClone
- @AutoExternalizable
- **@Canonical**
  - **@ToString,**
  - **@EqualsAndHashCode,**
  - **@TupleConstructor**
- **Controlling the execution of your code**
  - **@ThreadInterrupt,**
  - **@TimedInterrupt,**
  - **@ConditionalInterrupt**
- **@InheritConstructor**
- @WithReadLock
- @WithWriteLock
- @ListenerList

@Log

- Four different loggers can be injected
  - –@Log, @Commons, @Log4j, @Slf4j
- Possible to implement your own strategy

```groovy
import groovy.util.logging.*

@Log
class Car {
    Car() {
        log.info 'Car constructed'
    }
}

def c = new Car()
```

@Log

- Four different loggers can be injected
  - @Log, @Commons, @Log4j, @Slf4j
- Possible to implement your own strategy

Guarded w/ an if

```groovy
import groovy.util.logging.*

@Log
class Car {
    Car() {
        log.info 'Car constructed'
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def c = new Car()
```

Controlling code execution

- Your application may run user's code
  - what if the code runs in infinite loops or for too long?
  - what if the code consumes too many resources?

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- 3 new transforms at your rescue
  - **@ThreadInterrupt**: adds Thread#isInterrupted checks so your executing thread stops when interrupted
  - **@TimedInterrupt**: adds checks in method and closure bodies to verify it's run longer than expected
  - **@ConditionalInterrupt**: adds checks with your own conditional logic to break out from the user code

@ThreadInterrupt

```
@ThreadInterrupt
import groovy.transform.ThreadInterrupt

while (true) {


    // eat lots of CPU
}
```

@ThreadInterrupt

```
@ThreadInterrupt
import groovy.transform.ThreadInterrupt

while (true) {
    if (Thread.currentThread.isInterrupted())
        throw new InterruptedException()
    // eat lots of CPU
}
```

@ThreadInterrupt

```
@ThreadInterrupt
import groovy.transform.ThreadInterrupt

while (true) {
    if (Thread.currentThread.isInterrupted())
        throw new InterruptedException()
    // eat lots of CPU
}
```

- Two optional annotation parameters available
  - **checkOnMethodStart** (true by default)
  - **applyToAllClasses** (true by default)

@ToString

- Provides a default toString() method to your types
- Available annotation options
  - includeNames, includeFields, includeSuper, excludes

```groovy
import groovy.transform.ToString

@ToString
class Person {
    String name
    int age
}

println new Person(name: 'Pete', age: 15)
// => Person(Pete, 15)
```

@EqualsAndHashCode

- Provides default implementations for equals() and hashCode() methods

```groovy
import groovy.transform.EqualsAndHashCode

@EqualsAndHashCode
class Coord {
    int x, y
}

def c1 = new Coord(x: 20, y: 5)
def c2 = new Coord(x: 20, y: 5)

assert c1 == c2
assert c1.hashCode() == c2.hashCode()
```

@TupleConstructor

- Provides a «classical» constructor with all properties
- Several annotation parameter options available

```groovy
import groovy.transform.TupleConstructor

@TupleConstructor
class Person {
    String name
    int age
}

def m = new Person('Marion', 3)

assert m.name == 'Marion'
assert m.age  == 3
```

@Canonical

- One annotation to rule them all!
  - –@Canonical mixes together
    - @ToString
    - @EqualsAndHashCode
    - @TupleConstructor
- You can customize behavior by combining @Canonical and one of the other annotations

@InheritConstructors

- Classes like Exception are painful when extended, as all the base constructors should be replicated

```
class CustomException extends Exception {
    CustomException()                          { super()       }
    CustomException(String msg)                { super(msg)    }
    CustomException(String msg, Throwable t) { super(msg, t) }
    CustomException(Throwable t)               { super(t)      }
}
```

@InheritConstructors

- Classes like Exception are painful when extended, as all the base constructors should be replicated

```
import groovy.transform.*

@InheritConstructors
class CustomException extends Exception {



}
```

Miscelanous

- **Compilation customizers**
- Java 7 diamond operator
- Slashy and dollar slashy strings
- New GDK methods
- (G)String to Enum coercion
- **Customizing the Groovysh prompt**
- Executing remote scripts

Compilation customizers

- Ability to apply some customization to the Groovy compilation process

- Three available customizers
  - **ImportCustomizer**
  - ASTTransformationCustomizer
  - SecureASTCustomizer

- But you can implement your own

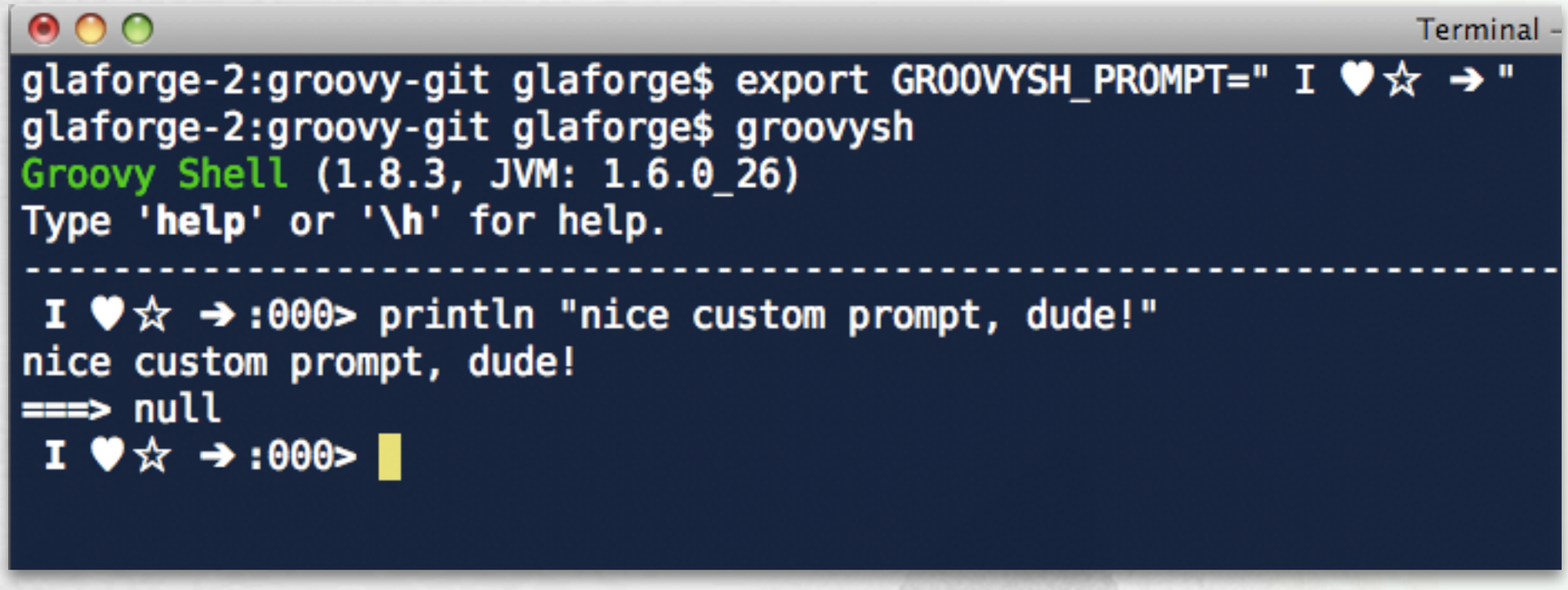
Imports customizer

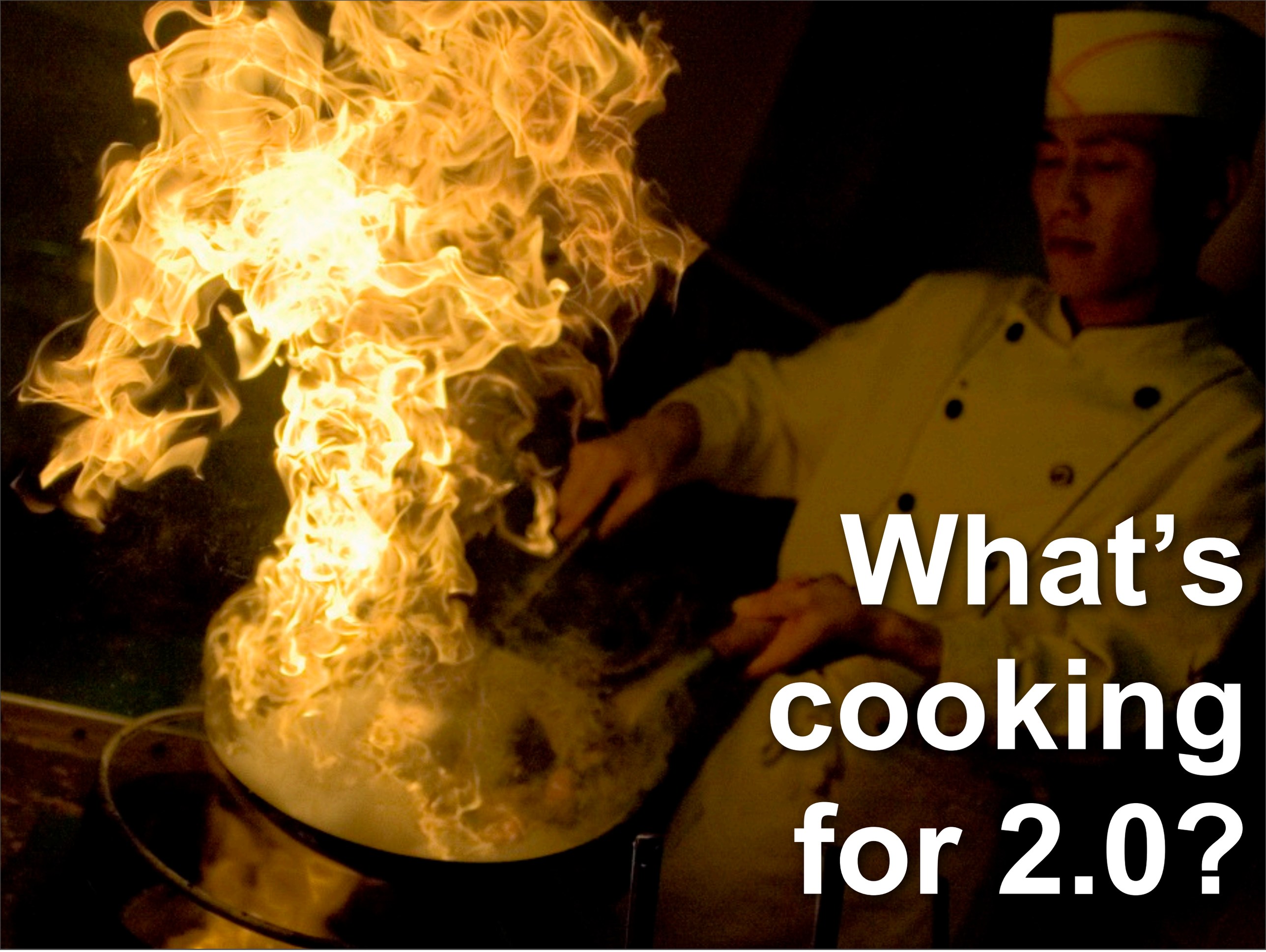
```
def configuration = new CompilerConfiguration()

def custo = new ImportCustomizer()
custo.addStaticStar(Math.name)
configuration.addCompilationCustomizers(custo)

def result = new GroovyShell(configuration)
                // import static java.lang.Math.*
    .evaluate(" cos PI/3 ")
```

Customizing the Groovysh prompt





What's cooking for 2.0?

Groovy 2.0 roadmap

- Java 7 alignements: **Project Coin**
  - binary literals
  - underscore in literals
  - multicatch
- JDK 7: **InvokeDynamic**
- Towards a **more modular** Groovy
- **Static type checking**
- **Static compilation**

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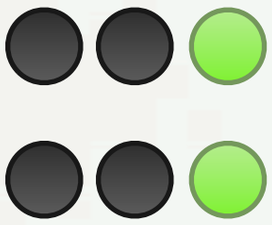

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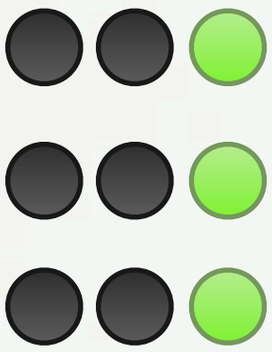

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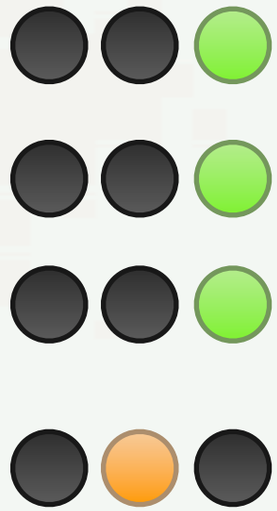

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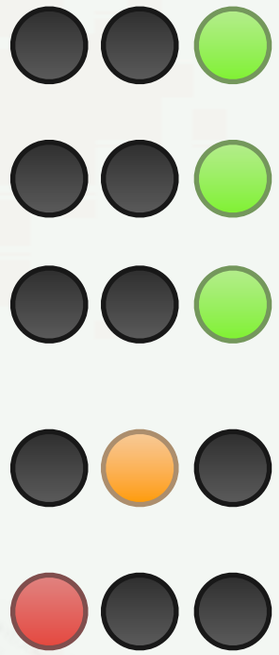

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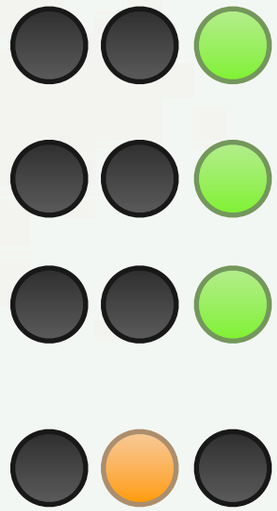

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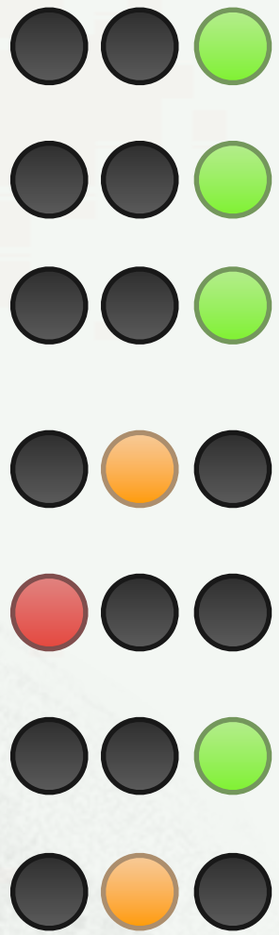

Groovy 2.0 roadmap

End of April?

- Java 7 alignements: **Project Coin**
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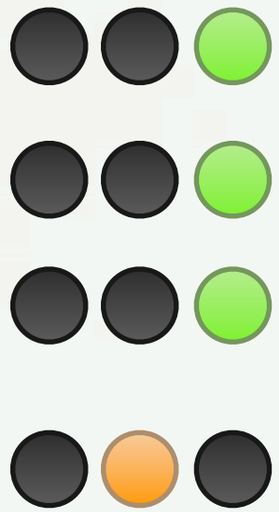


Java 7 / JDK 7

- **Project Coin** and **InvokeDynamic**

Binary literals

- We had decimal, octal and hexadecimal notations for number literals
- We can now use binary representations too

```
int x = 0b10101111
assert x == 175

byte aByte = 0b00100001
assert aByte == 33

int anInt = 0b1010000101000101
assert anInt == 41285
```

Underscore in literals

- Now we can also add underscores in number literals for more readability

```
long creditCardNumber = 1234_5678_9012_3456L
long socialSecurityNumbers = 999_99_9999L
float monetaryAmount = 12_345_132.12
long hexBytes = 0xFF_EC_DE_5E
long hexWords = 0xFFEC_DE5E
long maxLong = 0x7fff_ffff_ffff_ffffL
long alsoMaxLong = 9_223_372_036_854_775_807L
long bytes = 0b11010010_01101001_10010100_10010010
```

Multicatch

- One block for multiple exception caught
  - rather than duplicating the block

```
try {
    /* ... */
} catch(IOException | NullPointerException e) {
    /* one block to treat 2 exceptions */
}
```

InvokeDynamic

- **Groovy 2.0 supports JDK 7's invokeDynamic**
  - compiler will have a flag for compiling against JDK 7
  - might use the invokeDynamic backport for < JDK 7

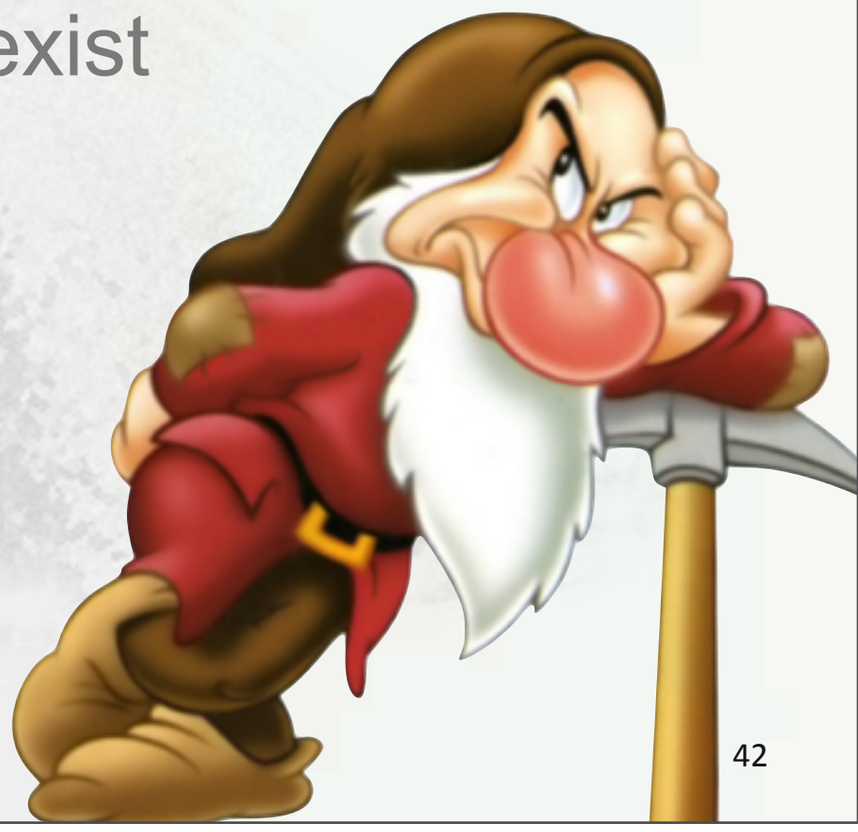
- Benefits
  - **more runtime performance!**
    - at least as fast as current «dynamic» Groovy
  - in the long run, will allow us to get rid of code!
    - call site caching, thanks to MethodHandles
    - metaclass registry, thanks to ClassValues
    - will let the JIT inline calls more easily

Groovy Modularity

- Groovy's «all» JAR weighs in at 4MB
- **Nobody needs everything**
  - Template engine, Ant scripting, Swing UI building...
- Provide a smaller core
  - and several smaller JARs per feature
- Provide hooks for setting up DGM methods, etc.

Static Type Checking

- Goal: **make the Groovy compiler «grumpy»**!
  - and throw **compilation errors** (not at runtime)
- **Not everybody needs dynamic features all the time**
  - think Java libraries scripting
- Grumpy should...
  - tell you about your method or variable typos
  - complain if you call methods that don't exist
  - shout on assignments of wrong types
  - infer the types of your variables
  - figure out GDK methods
  - etc...



Typos in your variable or method

```groovy
import groovy.transform.TypeChecked

void method() {}

@TypeChecked test() {
    // Cannot find matching method metthhoood()
    metthhoood()

    def name = "Guillaume"
    // variable naamme is undeclared
    println naamme
}
```

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Compilation errors!

Typos in your variable or method

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    metthhoood()

    def name = "Guillaume"
    // variable naamme is undeclared
    println naamme
}
```

Annotation can be at class or method level

Compilation errors!

Complain on wrong assignments

```
// cannot assign value of type... to variable...
int x = new Object()
Set set = new Object()

def o = new Object()
int x = o

String[] strings = ['a','b','c']
int str = strings[0]

// cannot find matching method plus()
int i = 0
i += '1'
```

Complain on wrong assignments

```
// cannot assign value of type... to variable...
int x = new Object()
Set set = new Object()

def o = new Object()
int x = o

String[] strings = ['a','b','c']
int str = strings[0]

// cannot find matching method plus()
int i = 0
i += '1'
```

Compilation errors!

Complain on wrong return types

```
// checks if/else branch return values
int method() {
    if (true) { 'String' }
    else { 42 }
}
// works for switch/case & try/catch/finally

// transparent toString() implied
String greeting(String name) {
    def sb = new StringBuilder()
    sb << "Hi " << name
}
```

Complain on wrong return types

```
// checks if/else branch return values
int method() {
    if (true) { 'String' }
    else { 42 }
}
// works for switch/case & try/catch/finally

// transparent toString() implied
String greeting(String name) {
    def sb = new StringBuilder()
    sb << "Hi " << name
}
```

Compilation error!

Type inference

```
@TypeChecked test() {
    def name = "  Guillaume  "

    // String type infered (even inside GString)
    println "NAME = ${name.toUpperCase()}"

    // Groovy GDK method support
    // (GDK operator overloading too)
    println name.trim()

    int[] numbers = [1, 2, 3]
    // Element n is an int
    for (int n in numbers) {
        println n
    }
}
```

Staticly checked & dyn. methods

```
@TypeChecked
String greeting(String name) {
    // call method with dynamic behavior
    // but with proper signature
    generateMarkup(name.toUpperCase())
}

// usual dynamic behavior
String generateMarkup(String name) {
    def sw = new StringWriter()
    new MarkupBuilder(sw).html {
        body {
            div name
        }
    }
    sw.toString()
}
```

Instanceof checks

```
@TypeChecked
void test(Object val) {

    if (val instanceof String) {
        println val.toUpperCase()
    } else if (val instanceof Number) {
        println "X" * val.intValue()
    }

}
```

Instanceof checks

```
@TypeChecked
void test(Object val) {

    if (val instanceof String) {
        println val.toUpperCase()
    } else if (val instanceof Number) {
        println "X" * val.intValue()
    }

}
```

No need for casts

Instanceof checks

```
@TypeChecked
void test(Object val) {

    if (val instanceof String) {
        println val.toUpperCase()
    } else if (val instanceof Number) {
        println "X" * val.intValue()
    }

}
```

No need for casts

Can call String#multiply(int) from the Groovy Development Kit

Lowest Upper Bound

- Represents the lowest «super» type classes have in common
  - may be virtual (aka «non-denotable»)

```
@TypeChecked test() {
    // an integer and a BigDecimal
    return [1234, 3.14]
}
```

Lowest Upper Bound

- Represents the lowest «super» type classes have in common
  - may be virtual (aka «non-denotable»)

```
@TypeChecked test() {
    // an integer and a BigDecimal
    return [1234, 3.14]
}
```

Inferred return type:
List<Number>

Flow typing

- Static type checking shouldn't complain even for bad coding practicies which work w/o type checks

```
@TypeChecked test() {
    def var = 123               // inferred type is int
    int x = var                 // var is an int
    var = "123"                 // assign var with a String

    x = var.toInteger()   // no problem, no need to cast

    var = 123
    x = var.toUpperCase() // error, var is int!
}
```

Gotchas: static checking vs dynamic

- Type checking works at compile-time
  - –adding @TypeChecked doesn't change behavior
    - do not confuse with static compilation

- Most dynamic features cannot be type checked
  - –metaclass changes, categories
  - –dynamically bound variables (ex: script's binding)

- However, compile-time metaprogramming works
  - –as long as proper type information is defined

Gotchas: runtime metaprogramming

```
@TypeChecked
void test() {
    Integer.metaClass.foo = {}
    123.foo()
}
```

Gotchas: runtime metaprogramming

```
@TypeChecked
void test() {
    Integer.metaClass.foo = {}
    123.foo()
}
```

Not allowed:
metaClass property
is dynamic

Gotchas: runtime metaprogramming

```
@TypeChecked
void test() {
    Integer.metaClass.foo = {}
    123.foo()
}
```

Method not recognized

Not allowed: metaClass property is dynamic

Gotchas: closures need explicit types

```
@TypeChecked test() {
    ["a", "b", "c"].collect {
        it.toUpperCase() // Not OK
    }
}
```

- A «Groovy Enhancement Proposal» to address this issue

Gotchas: closures need explicit types

```
@TypeChecked test() {
    ["a", "b", "c"].collect { String it ->
        it.toUpperCase() // OK, it's a String
    }
}
```

- A «Groovy Enhancement Proposal» to address this issue

Closure shared variables

```
@TypeChecked test() {
    def var = "abc"
    def cl = { var = new Date() }
    cl()
    var.toUpperCase()  // Not OK!
}
```

Closure shared variables

var assigned in the closure:
«shared closure variable»

```
@TypeChecked test() {
    def var = "abc"
    def cl = { var = new Date() }
    cl()
    var.toUpperCase()  // Not OK!
}
```

Closure shared variables

var assigned in the closure:
«shared closure variable»

```
@TypeChecked test() {
    def var = "abc"
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    cl()
    var.toUpperCase()  // Not OK!
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```

Impossible to ensure
the assignment
really happens

Closure shared variables

var assigned in the closure:
«shared closure variable»

```
@TypeChecked test() {
    def var = "abc"
    def cl = { var = new Date() }
    cl()
    var.toUpperCase()  // Not OK!
}
```

Impossible to ensure
the assignment
really happens

Only methods of the most
specific compatible type (LUB)
are allowed by the type checker

Closure shared variables

```
class A                { void foo() {} }
class B extends A { void bar() {} }

@TypeChecked test() {
    def var = new A()
    def cl = { var = new B() }
    cl()
    var.foo()    // OK!
}
```

Closure shared variables

```
class A                { void foo() {} }
class B extends A { void bar() {} }

@TypeChecked test() {
    def var = new A()
    def cl = { var = new B() }
    cl()
    var.foo()    // OK!
}
```

var is at least
an instance of A

Static Compilation

- Given your Groovy code can be type checked... we can as well compile it «statically»
  - ie. generate the same byte code as javac

Static Compilation: advantages

- You gain:
  - Type safety
    - thanks to static type checking
      - static compilation builds upon static type checking
  - Faster code
    - as close to Java's performance as possible
  - Code immune to «monkey patching»
    - metaprogramming badly used can interfere with framework code
  - Smaller bytecode size

Static Compilation: disadvantages

- But you loose:
  - Dynamic features
    - metaclass changes, categories, etc.
  - Dynamic method dispatch
    - although emulated as close as possible to «dynamic» Groovy

Staticly compiled & dyn. methods

```
@CompileStatic
String greeting(String name) {
    // call method with dynamic behavior
    // but with proper signature
    generateMarkup(name.toUpperCase())
}

// usual dynamic behavior
String generateMarkup(String name) {
    def sw = new StringWriter()
    new MarkupBuilder(sw).html {
        body {
            div name
        }
    }
    sw.toString()
}
```

What about performance?

- Comparisons between:
  - Java
  - Groovy static compilation
    - ie. Groovy 2.0
  - Groovy with primitive optimizations
    - ie. since Groovy 1.8
  - Groovy without optimizations
    - ie. Groovy 1.7 and before

What about performance?

	Fibonacci	Pi (π) quadrature	Binary trees
Java	140 ms	93 ms	4.5 s
2.0 Static compilation	150 ms	220 ms	7.6 s
1.8 Primitive optimizations	270 ms	110 ms	29.6 s
1.7 No prim. optimizations	3800 ms	3.8 s	50.0 s

Summary

- Main themes of the Groovy 2.0 release
  - Modularity
  - Embark the JDK 7 enhancements
    - Project Coin
    - Invoke Dynamic
  - Static aspects
    - Static type checking
    - Static compilation

Summary

ROCKS!

Thank you!


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Q&A

Got questions,
really?

Image credits

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- Bicycle: http://drunkcyclist.com/gallery/main.php?g2_view=core.DownloadItem&g2_itemId=2131&g2_serialNumber=2
- Pills: http://www.we-ew.com/wp-content/uploads/2011/01/plan-b-pills.jpg
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- Grumpy 2: http://grumpy.division-par-zero.fr/wp-content/images/grumpy.jpg
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