Groovy, Java, and Kotlin

Functional Programming

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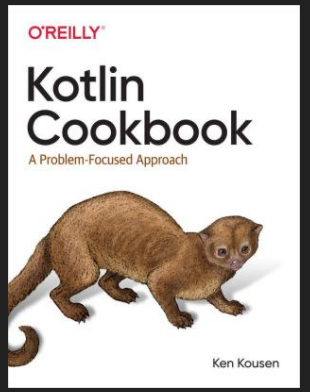
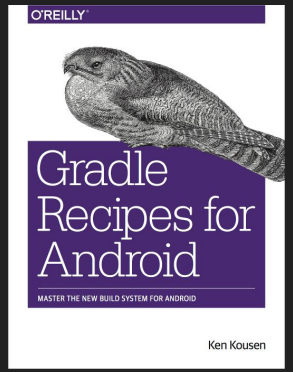
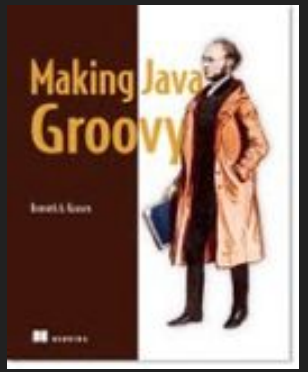
All demos at:

https://github.com/kousen/java_groovy_kotlin







New Book

Help Your Boss Help You

https://pragprog.com/titles/kkmanage/help-your-boss-help-you/

Kotlin Certified Training Partner

- Certified by JetBrains for Kotlin

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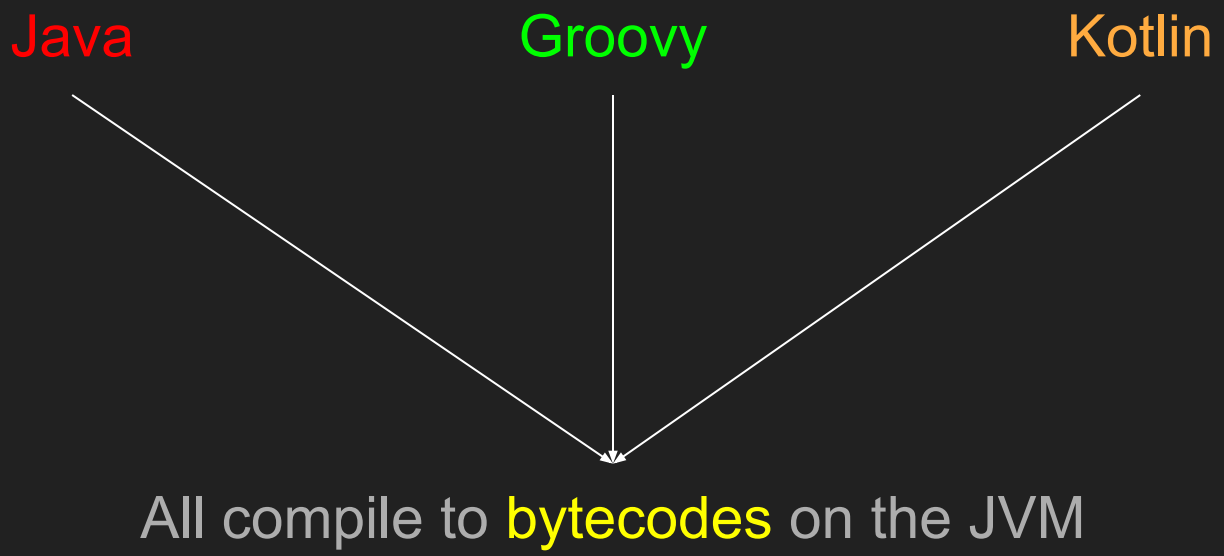
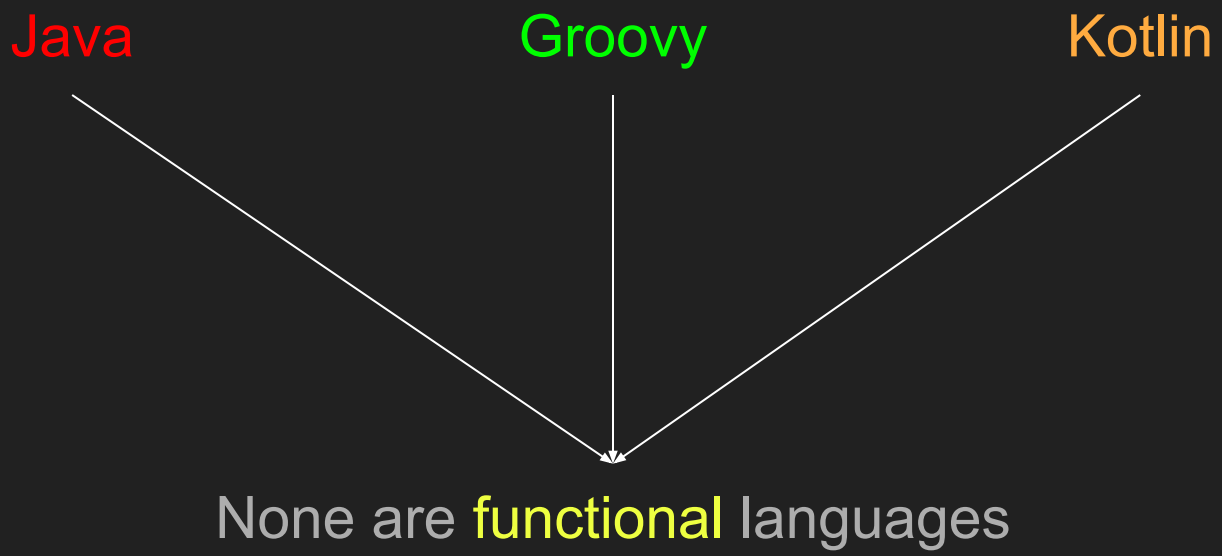
- (Ditto for Java)

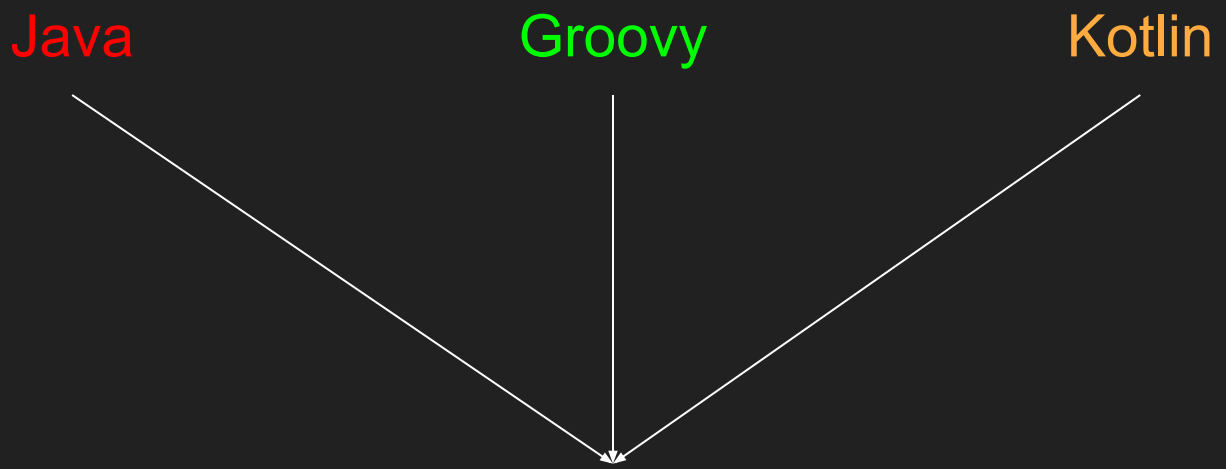
Java, Groovy, and Kotlin



Java, Groovy, and Kotlin



Java, Groovy, and Kotlin



They are OO languages with functional features

Java

Just had its 25 year anniversary

Managed by Oracle, but with many implementations

- OpenJDK, Azul, Amazon Coretto, SAP, …

Functional features added in version 1.8

Current LTS version is 11

Current version is 16

- Java 17 (LTS) will be released in September 2021

Groovy

Apache project

https://groovy-lang.org

Syntax very similar to Java

Easy for Java devs to learn

Most Groovy projects are actually combined Java + Groovy projects

Current version is 3.0.*

Grails, Spock, Gradle, Ratpack, Geb, Griffon, ...

Kotlin

Managed by JetBrains

https://kotlinlang.org

Compiles to JVM, or generates JS

Mobile and native available

Definitive language for Android

Google develops Android libs "Kotlin first"

Gradle Kotlin DSL also available

Current version is 1.4.*

Lambda Expressions

Java lambda expressions

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- Java lambda expressions
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  - Parameter types inferred from context
  - Can access local variables but not modify them
    - final or "effectively final"

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Groovy closures

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```
(InputType1, InputType2, ...) → OutputType
```

Have a receiver for resolving members

Can access local variables and modify them

(Are really closures)

Functional Programming

Lambda, Method References, and Streams

LambdaDemo.java

MapFilterReduce.java

PrimeChecker.java

StreamsDemo.java

Functional Programming

Groovy closures

Many methods added to collections

collect, findAll, inject vs map, filter, reduce

closures.groovy

map_filter_reduce.groovy

PrimeCheckerGroovy.groovy

Kotlin Functions

Return type shown after signature

```
fun sum(a: Int, b:Int) : Int {
    return a + b
}
```

Single-expression functions:

```
fun sum(a: Int, b: Int) = a + b
```

Return type inferred

primes.kt

Lazy Streams

Java Streams are lazy

- Only process as much data as needed

Groovy and Kotlin collections are not

- But Groovy can use Java streams and Kotlin has sequences
- LazyStreams.java
- LazyStreamsGroovy.groovy
- LazyStreamsSpec.groovy

Kotlin Sequences

Methods like map, filter, reduce, and fold are added to collections

The "`asSequence()`" method converts collection to sequence

- Like Java streams
- Evaluated element at a time
- No data processed unless there is a terminal expression
  - lazySequences.kt
  - sequenceFunction.kt

map, filter, reduce

Java:

```
int total = myNums.stream()
    .filter(n → n % 3 == 0)
    .map(n → n * 2)
    .reduce(0, (acc, val) → acc + val);

total = myNums.stream()
    .filter(n → n % 3 == 0)
    .mapToInt(n → n * 2)   // map to IntStream
    .sum();
```

map, filter, reduce

Groovy:

```
int total = nums.findAll { it % 3 == 0 }
    .collect { it * 2 }         // unfortunate name
    .inject(0) { acc, val -> acc + val }

total = nums.findAll { it % 3 == 0 }
     .collect { it * 2 }
     .sum()  // duck typing
```

map, filter, reduce

Kotlin:

```
int total = nums.filter { it % 3 == 0 }
    .map { it * 2 }
    .fold(0) { acc, val -> acc + val }

total = nums.filter { it % 3 == 0 }
     .map { it * 2 }
     .sum()
```

map, filter, reduce

Kotlin:

```
int total = nums.asSequence()
    .filter { it % 3 == 0 }
    .map { it * 2 }
    .sum()
```

Sequence works like Java stream:

- each num through entire pipeline before next
- requires terminal operation to process values

POGOs vs POJOs

Plain Old Groovy Objects

- private attributes, public methods, public class
- map-based constructor
- generated getters and setters
- @Canonical → toString, equals, hashCode, tuple ctor

POJOs vs POGOs

Sorting streams with POJOs/POGOs

Golfer.java, SortGolfers.java

GroovyGolfer.groovy, sort_groovy_golfers.groovy

GroovyGolferCS.groovy

Kotlin Data Classes

Classes defined using the keyword "data"

```
data class Customer(val name: String, val email: String)
```

(That's the entire class)

Data classes have:

- generated getters and setters
- toString, equals, hashCode
- `copy()` method
- componentN() methods for destructuring

Beyond map/filter/reduce

Closure Composition

Memoization, Tail Recursion

Currying

Closure Composition

Java:

default methods in Consumer, Predicate, …

CombineLambdas.java

Groovy:

right-shift operator

composition.groovy

Kotlin:

write your own

composition.kt

Tail Recursion

Groovy:

```
@TailRecursive  // AST transformation
```

Kotlin:

```
tailrec  // keyword
```

Beyond map/filter/reduce

AST transformations:

AnnotatedFunctions.groovy

UseAnnotatedFunctions.groovy

AnnotatedFunctionsTest.groovy

Libraries

Library to add functional capabilities to Kotlin

Arrow, https://arrow-kt.io/

For Groovy, every Java library can be used right away

Metaprogramming

Groovy can add methods to a class at runtime or compile time

pirate.groovy

Metaprogramming

Kotlin allows for extension functions added at compile time

palindrome.kt

primes.kt

Cat Pictures

Flickr RESTful (sort of) web service

https://www.flickr.com/services/api/flickr.photos.search.html

Parsing JSON

SwingBuilder

Can use Java parallel streams

cat_pictures.groovy

Summary

Can use Groovy, Kotlin, and Java together

Use each for what it does well

Java functional capabilities are limited

Groovy goes beyond them and is quite mature

builders, parsers, metaprogramming, traits, AST transformations

Kotlin does too, but has its own quirks

All demos at: https://github.com/kousen/java_groovy_kotlin