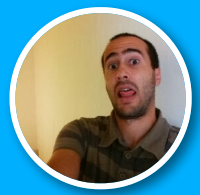

Deep Dive Kotlin :
du Hello World au
ByteCode



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Roadmap

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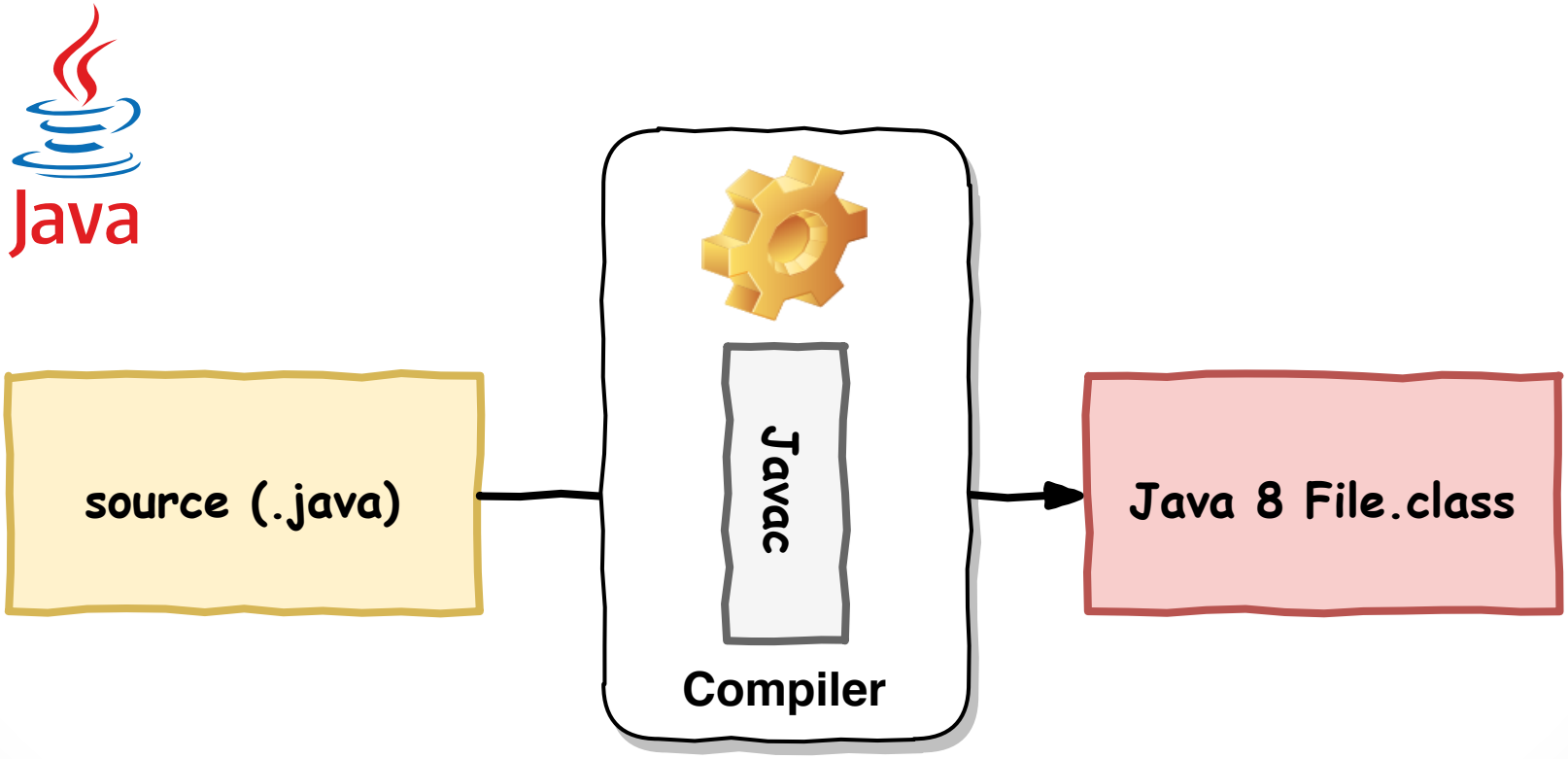
ByteCode Java ?

javac



HelloWorld.java


```java
public class HelloWorld {

    public static void main(String[] args) {
        System.out.println("Hello RivieraDev");
    }
}
```

```
javac HelloWorld.java
```

Java ByteCode binary


```
hexdump -C HelloWorld.class
```

```
00000000  ca fe ba be 00 00 00 34  00 1d 0a 00 06 00 0f 09  |.......4........|
00000010  00 10 00 11 08 00 12 0a  00 13 00 14 07 00 15 07  |................|
00000020  00 16 01 00 06 3c 69 6e  69 74 3e 01 00 03 28 29  |.....<init>...()|
00000030  56 01 00 04 43 6f 64 65  01 00 0f 4c 69 6e 65 4e  |V...Code...LineN|
00000040  75 6d 62 65 72 54 61 62  6c 65 01 00 04 6d 61 69  |umberTable...mai|
00000050  6e 01 00 16 28 5b 4c 6a  61 76 61 2f 6c 61 6e 67  |n...([Ljava/lang|
00000060  2f 53 74 72 69 6e 67 3b  29 56 01 00 0a 53 6f 75  |/String;)V...Sou|
00000070  72 63 65 46 69 6c 65 01  00 0f 48 65 6c 6c 6f 57  |rceFile...HelloW|
00000080  6f 72 6c 64 2e 6a 61 76  61 0c 00 07 00 08 07 00  |orld.java.......|
00000090  17 0c 00 18 00 19 01 00  0c 48 65 6c 6c 6f 20 44  |.........Hello D|
000000a0  65 76 6f 78 78 07 00 1a  0c 00 1b 00 1c 01 00 19  |evoxx...........|
000000b0  5f 30 30 5f 68 65 6c 6c  6f 77 6f 72 6c 64 2f 48  |_00_helloworld/H|
000000c0  65 6c 6c 6f 57 6f 72 6c  64 01 00 10 6a 61 76 61  |elloWorld...java|
000000d0  2f 6c 61 6e 67 2f 4f 62  6a 65 63 74 01 00 10 6a  |/lang/Object...j|
000000e0  61 76 61 2f 6c 61 6e 67  2f 53 79 73 74 65 6d 01  |ava/lang/System.|
000000f0  00 03 6f 75 74 01 00 15  4c 6a 61 76 61 2f 69 6f  |..out...Ljava/io|
00000100  2f 50 72 69 6e 74 53 74  72 65 61 6d 3b 01 00 13  |/PrintStream;...|
00000110  6a 61 76 61 2f 69 6f 2f  50 72 69 6e 74 53 74 72  |java/io/PrintStr|
00000120  65 61 6d 01 00 07 70 72  69 6e 74 6c 6e 01 00 15  |eam...println...|
00000130  28 4c 6a 61 76 61 2f 6c  61 6e 67 2f 53 74 72 69  |(Ljava/lang/Stri|
00000140  6e 67 3b 29 56 00 21 00  05 00 06 00 00 00 00 00  |ng;)V.!.........|
00000150  02 00 01 00 07 00 08 00  01 00 09 00 00 00 1d 00  |................|
```

Explorons le ByteCode


```
javap -c HelloWorld.class
```

```
Compiled from "HelloWorld.java"
public class _00_helloworld.HelloWorld {
  public _00_helloworld.HelloWorld();
    Code:
       0: aload_0
       1: invokespecial #1                  // Method java/lang/Object."<init>":()V
       4: return

  public static void main(java.lang.String[]);
    Code:
       0: getstatic     #2                  // Field java/lang/System.out:Ljava/io/PrintStream;
       3: ldc           #3                  // String Hello RivieraDev
       5: invokevirtual #4                  // Method java/io/PrintStream.println:(Ljava/lang/String
       8: return
}
```

À propos du ByteCode

Environ 200 opérations possibles (maxi. 256 opscodes)

Préfixe pour le type d'opérations (`i` pour entier, `d` pour double, ...)

Manipulation de la pile, des variables locales (`iconst_0`, `istore`, `iload`, ...)

Contrôle du flux des instructions (`if_icmpgt`, `goto`, ...)

Arithmétiques et conversion de type (`iadd`, `iinc`, `i2d`, ...)

Manipulation d'objets (`invokevirtual`, `invokedynamic`, ...)

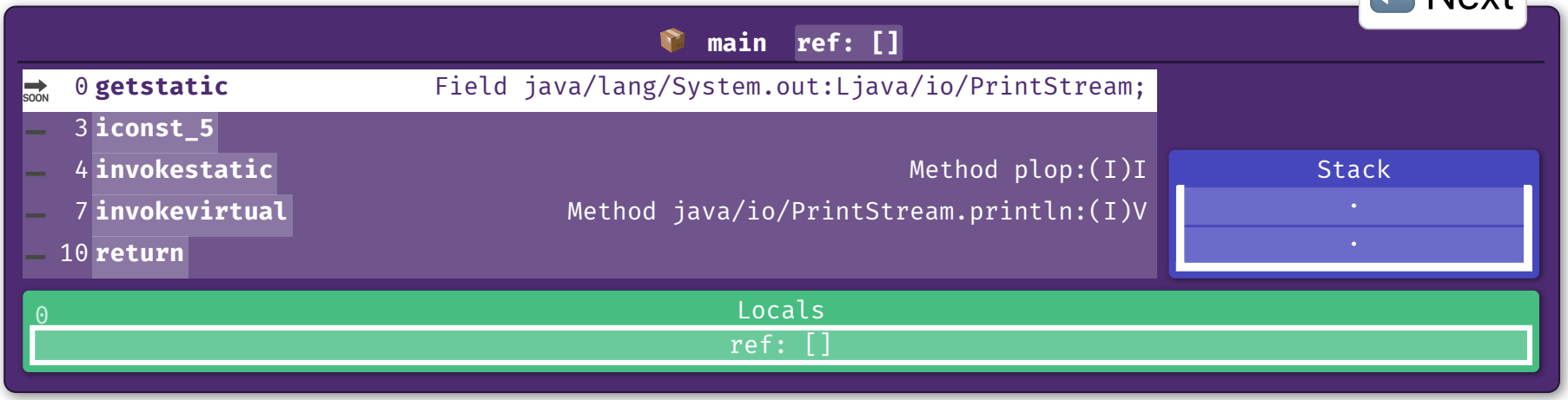
Autres (`athrow`, ...)

Jouons un peu

▶ Constant Pool

▼ Frames

Next



Liens

- Mastering Java Bytecode at the Core of the JVM <https://zeroturnaround.com/rebellabs/rebel-labs-report-mastering-java-bytecode-at-the-core-of-the-jvm/>
- Introduction to Java Bytecode <https://mahmoudanouti.wordpress.com/2018/03/20/introduction-to-java-bytecode/>
- The Java® Virtual Machine Specification <https://docs.oracle.com/javase/specs/jvms/se10/html/index.html>
- The Java Virtual Machine Instruction Set <https://docs.oracle.com/javase/specs/jvms/se10/html/jvms-6.html>
- Suivez le lapin blanc : Exploration au coeur de la JVM <https://www.youtube.com/watch?v=rB0EIXf05nU>
- Byte Buddy <http://bytebuddy.net/#/>
- asm <http://asm.ow2.org/>

> *"Soyez curieux, regardez comment ça marche avec* `javap -c` *!*

Introduction Kotlin

Historique


Dévoilé par JetBrains
v1.1 : coroutines, JS, ...
Support par Google
v1.2 : multiplatform
v1.4 ?
???
2011 - 2015
2016
2017
2018
2019
...
v1.0
Support annoncé par Spring
v1.3
Coroutine stable
Kotlin Native beta
Kotlin Foundation

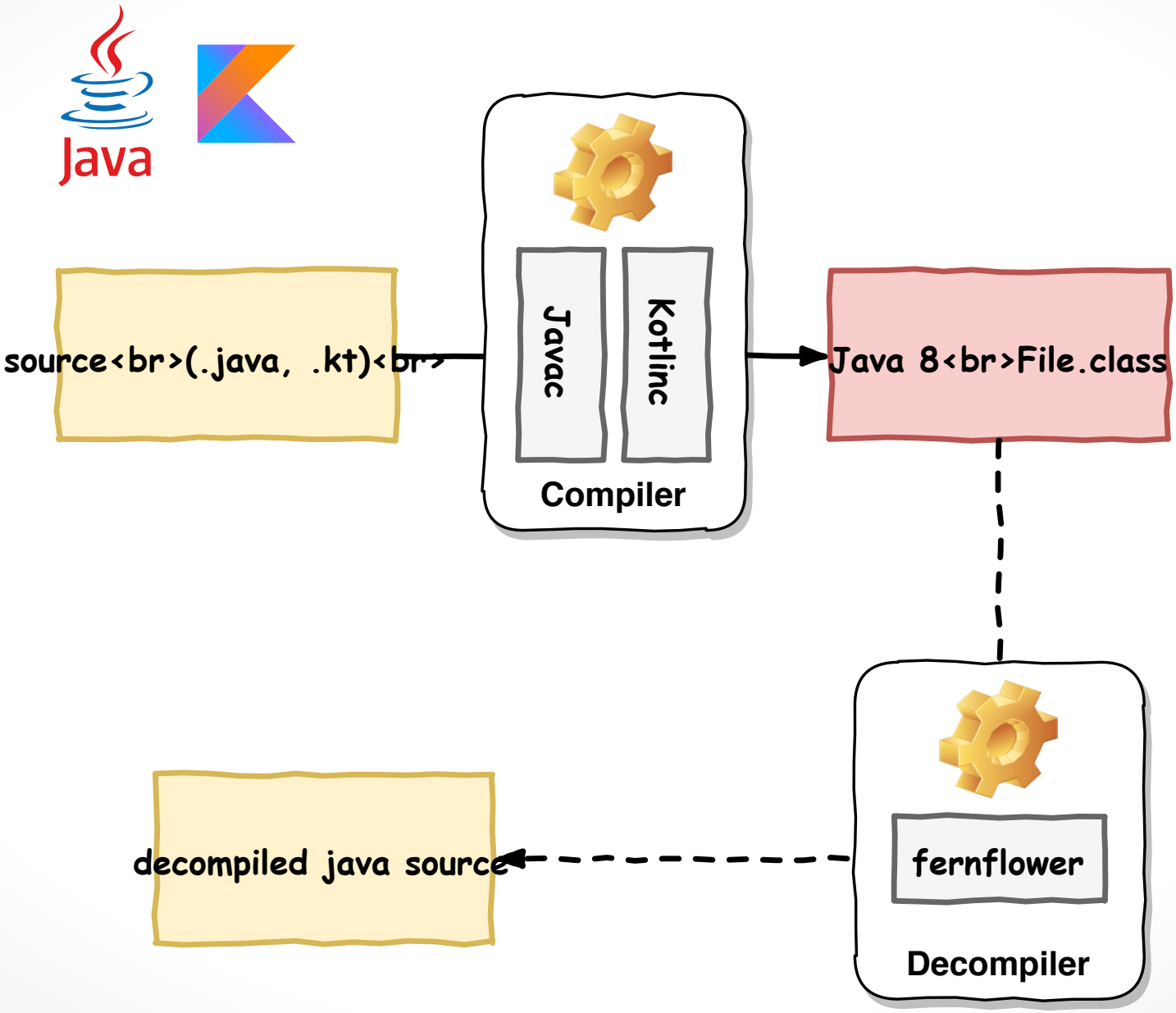
Cibles

HelloWorld.kt


```kotlin
package _00_helloworld

fun main(args: Array<String>) {
    println("Hello RivieraDev")
}
```

```
kotlinc HelloWorld.kt
```

kotlinc


Java
source
(.java, .kt)
Javac
Kotlinc
Compiler
Java 8
File.class
fernflower
Decompiler
decompiled java source

hexdump


```
00000000  ca fe ba be 00 00 00 32  00 34 01 00 1b 5f 30 30  |.......2.4 ... _00|
00000010  5f 68 65 6c 6c 6f 77 6f  72 6c 64 2f 48 65 6c 6c  |_helloworld/Hell|
00000020  6f 57 6f 72 6c 64 4b 74  07 00 01 01 00 10 6a 61  |oWorldKt......ja|
00000030  76 61 2f 6c 61 6e 67 2f  4f 62 6a 65 63 74 07 00  |va/lang/Object .. |
00000040  03 01 00 04 6d 61 69 6e  01 00 16 28 5b 4c 6a 61  |....main ... ([Lja|
00000050  76 61 2f 6c 61 6e 67 2f  53 74 72 69 6e 67 3b 29  |va/lang/String;)|
00000060  56 01 00 23 4c 6f 72 67  2f 6a 65 74 62 72 61 69  |V .. #Lorg/jetbrai|
00000070  6e 73 2f 61 6e 6e 6f 74  61 74 69 6f 6e 73 2f 4e  |ns/annotations/N|
00000080  6f 74 4e 75 6c 6c 3b 01  00 04 61 72 67 73 08 00  |otNull; ... args .. |
00000090  08 01 00 1e 6b 6f 74 6c  69 6e 2f 6a 76 6d 2f 69  |....kotlin/jvm/i|
000000a0  6e 74 65 72 6e 61 6c 2f  49 6e 74 72 69 6e 73 69  |nternal/Intrinsi|
000000b0  63 73 07 00 0a 01 00 17  63 68 65 63 6b 50 61 72  |cs......checkPar|
000000c0  61 6d 65 74 65 72 49 73  4e 6f 74 4e 75 6c 6c 01  |ameterIsNotNull.|
000000d0  00 27 28 4c 6a 61 76 61  2f 6c 61 6e 67 2f 4f 62  |.'(Ljava/lang/Ob|
000000e0  6a 65 63 74 3b 4c 6a 61  76 61 2f 6c 61 6e 67 2f  |ject;Ljava/lang/|
000000f0  53 74 72 69 6e 67 3b 29  56 0c 00 0c 00 0d 0a 00  |String;)V.......|
00000100  0b 00 0e 01 00 10 48 65  6c 6c 6f 20 52 69 76 69  |......Hello Rivi|
00000110  65 72 61 44 65 76 08 00  10 01 00 10 6a 61 76 61  |eraDev......java|
00000120  2f 6c 61 6e 67 2f 53 79  73 74 65 6d 07 00 12 01  |/lang/System....|
00000130  00 03 6f 75 74 01 00 15  4c 6a 61 76 61 2f 69 6f  | .. out ... Ljava/io|
00000140  2f 50 72 69 6e 74 53 74  72 65 61 6d 3b 0c 00 14  |/PrintStream; ... |
00000150  00 15 09 00 13 00 16 01  00 13 6a 61 76 61 2f 69  |..........java/i|
00000160  6f 2f 50 72 69 6e 74 53  74 72 65 61 6d 07 00 18  |o/PrintStream ... |
00000170  01 00 07 70 72 69 6e 74  6c 6e 01 00 15 28 4c 6a  | ... println ... (Lj|
```

Java ByteCode


```
Compiled from "HelloWorld.kt"
public final class _00_helloworld.HelloWorldKt {
  public static final void main(java.lang.String[]);
    Code:
       0: aload_0
       1: ldc           #9                  // String args
       3: invokestatic  #15                 // Method kotlin/jvm/internal/Intrinsics.checkParameterI
       6: ldc           #17                 // String Hello RivieraDev
       8: astore_1
       9: iconst_0
      10: istore_2
      11: getstatic     #23                 // Field java/lang/System.out:Ljava/io/PrintStream;
      14: aload_1
      15: invokevirtual #29                 // Method java/io/PrintStream.println:(Ljava/lang/Object
      18: return
}
```

HelloWorld-java

```java
package _00_helloworld;

import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\u0014\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0010\u0011\n\u0002\u0010\u0
        d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V", "slides2-kt"}
)
public final class HelloWorldKt {
   public static final void main(@NotNull String[] args) {
      Intrinsics.checkParameterIsNotNull(args, "args");
      String var1 = "Hello RivieraDev";
      boolean var2 = false;
      System.out.println(var1);
   }
}
```

Bilan HelloWorld.kt

👮 Kotlin ajoute des contrôles

du coup, on a besoin de JARs en plus

	jar	version	taille
kotlin-stdlib	kotlin-stdlib	1.3.31	1.3M
kotlin-stdlib-jdk7	kotlin-stdlib-jdk7	1.3.31	3.1k
kotlin-stdlib-jdk8	kotlin-stdlib-jdk8	1.3.31	13k
kotlin-reflect	kotlin-reflect	1.3.31	2.8M
lombok	lombok	1.18.6	1.7M
spring-core	spring-core	5.1.6	1.3M

🏎 Performances ?

Performance HelloWorld.kt

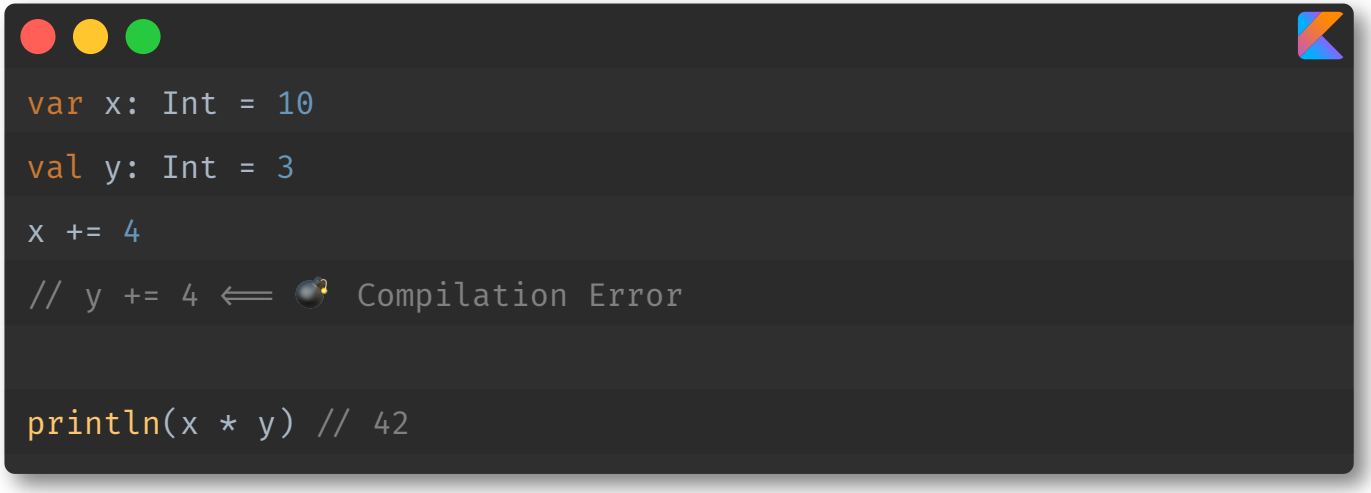
> *"Ne croyez pas les benchmarks, faites-les vous-même !*

- https://github.com/JetBrains/kotlin-benchmarks <https://github.com/JetBrains/kotlin-benchmarks>
- https://github.com/MonkeyPatchIo/kotlin-perf <https://github.com/MonkeyPatchIo/kotlin-perf>

Benchmark	Mode	Cnt	Score	Error	Units
testJava	thrpt	200	66490.271	879.996	ops/s
testKotlin	thrpt	200	72393.914	935.962	ops/s

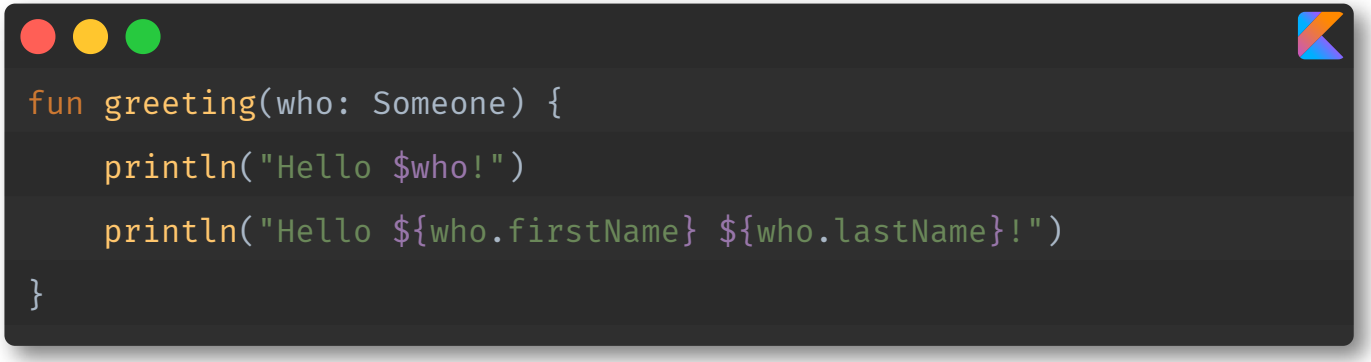
Les bases

val-var.kt



```kotlin
var x: Int = 10
val y: Int = 3
x += 4
// y += 4 ⟸ 💣 Compilation Error

println(x * y) // 42
```

string-template.kt



```kotlin
fun greeting(who: Someone) {
    println("Hello $who!")
    println("Hello ${who.firstName} ${who.lastName}!")
}
```

string-template.java


```java
package _01_basic;

import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\f\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0018\u0002\u001a\u000e\u0010\u0000\u
   d2 = {"greeting", "", "who", "L_01_basic/Someone;"}
)
public final class String_templatesKt {
   public static final void greeting(@NotNull Someone who) {
      Intrinsics.checkParameterIsNotNull(who, "who");
      String var1 = "Hello " + who + '!';
      System.out.println(var1);
      var1 = "Hello " + who.getFirstName() + ' ' + who.getLastName() + '!';
      System.out.println(var1);
   }
}
```

ByteCode de string-template


```
Compiled from "string-templates.kt"
public final class _01_basic.String_templatesKt {
  public static final void greeting(_01_basic.Someone);
    Code:
       0: aload_0
       1: ldc           #9                  // String who
       3: invokestatic  #15                 // Method kotlin/jvm/internal/Intrinsics.checkParameterI
       6: new           #17                 // class java/lang/StringBuilder
       9: dup
      10: invokespecial #21                 // Method java/lang/StringBuilder."<init>":()V
      13: ldc           #23                 // String Hello
      15: invokevirtual #27                 // Method java/lang/StringBuilder.append:(Ljava/lang/Str
      18: aload_0
      19: invokevirtual #30                 // Method java/lang/StringBuilder.append:(Ljava/lang/Obj
      22: bipush        33
      24: invokevirtual #33                 // Method java/lang/StringBuilder.append:(C)Ljava/lang/S
      27: invokevirtual #37                 // Method java/lang/StringBuilder.toString:()Ljava/lang/
      30: astore_1
      31: getstatic     #43                 // Field java/lang/System.out:Ljava/io/PrintStream;
      34: aload_1
      35: invokevirtual #49                 // Method java/io/PrintStream.println:(Ljava/lang/Object
      38: new           #17                 // class java/lang/StringBuilder
      41: dup
      42: invokespecial #21                 // Method java/lang/StringBuilder."<init>":()V
```

```kotlin
val anInt = 42  // type inference: Int
val aLong = 42L // type inference: Long
var aDouble: Double? = null
```

numeric.java


```java
package _01_basic;

import kotlin.Metadata;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\u0006\n\u0000\n\u0002\u0010\u0002\u001a\u0006\u0010\u0000\u001a\u00020\u0001"},
   d2 = {"tryNumeric", ""}
)
public final class NumericKt {
   public static final void tryNumeric() {
      int anInt = true;
      long aLong = 42L;
      Double aDouble = (Double)null;
   }
}
```

ByteCode de numeric


```
Compiled from "numeric.kt"
public final class _01_basic.NumericKt {
  public static final void tryNumeric();
    Code:
       0: bipush        42
       2: istore_0
       3: ldc2_w        #7                  // long 42l
       6: lstore_1
       7: aconst_null
       8: checkcast     #10                 // class java/lang/Double
      11: astore_3
      12: return
}
```

C'est simple

Plus de `;` *

😍 String templating

😘 Plus de types primitifs (avant la compilation)

🧐 Inférence de type

🤝 On peut mélanger du code Java et Kotlin

null-safety

> *"I call it my billion-dollar mistake. It was the invention of the `null` reference in 1965. [...]. This has led to innumerable errors, vulnerabilities, and system crashes, which have probably caused a billion dollars of pain and damage in the last forty years.*
>
> — Tony Hoare (C.A.R. Hoare)

➽ Null References: The Billion Dollar Mistake <https://www.infoq.com/presentations/Null-References-The-Billion-Dollar-Mistake-Tony-Hoare>

null-safety.kt

```kotlin
fun main(args: Array<String>) {

    val somethingNotNull: String = "aString"
    // somethingNotNull: String = null ⟹ compilation error

    var length = somethingNotNull.length

    var something: String? = null
    length = something?.length ?: 0

    length = something()?.length ?: 0

    // length = something()!!.length // throw kotlin.KotlinNullPointerException

    // SmartCast
    something = "aString"
    length = something.length
}

fun something(): String? = null
```

null-safety.java


```java
package _02_null_safety;

import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;
import org.jetbrains.annotations.Nullable;

@Metadata(
        mv = {1, 1, 9},
        bv = {1, 0, 2},
        k = 2,
        d1 = {"\u0000\u0014\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0010\u0011\n\u0002\u0010\u0
        d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V", "something"}
)
public final class NullSafetyKt {
   public static final void main(@NotNull String[] args) {
      Intrinsics.checkParameterIsNotNull(args, "args");
      String somethingNotNull = "aString";
      int length = somethingNotNull.length();
      String something = (String)null;
      int length = false;
      String var10000 = something();
      length = var10000 ≠ null ? var10000.length() : 0;
      var10000 = something();
```

Bilan null-safety

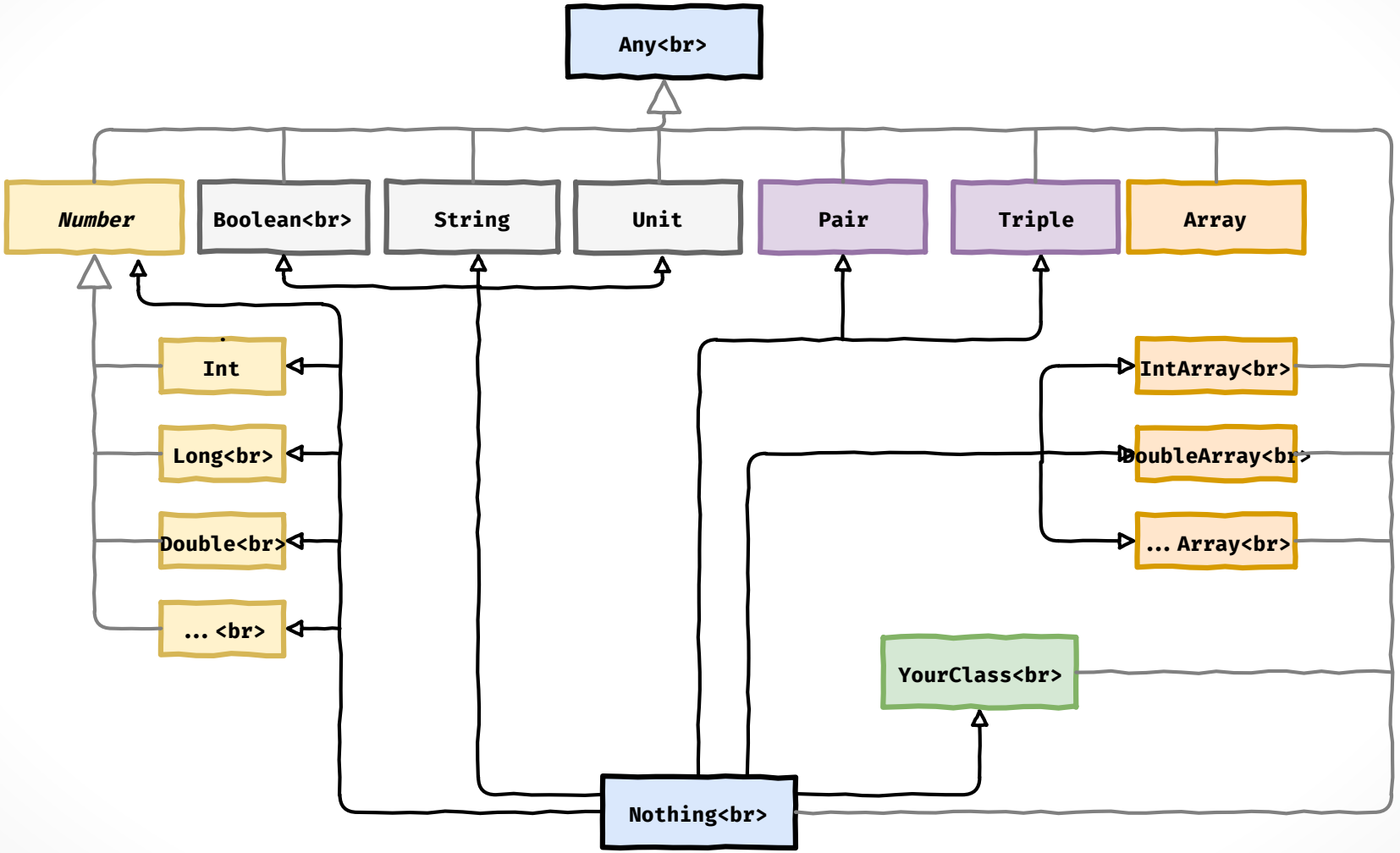
🎸 Elvis operator: `?:`

🙌 plus de `NullPointerException`

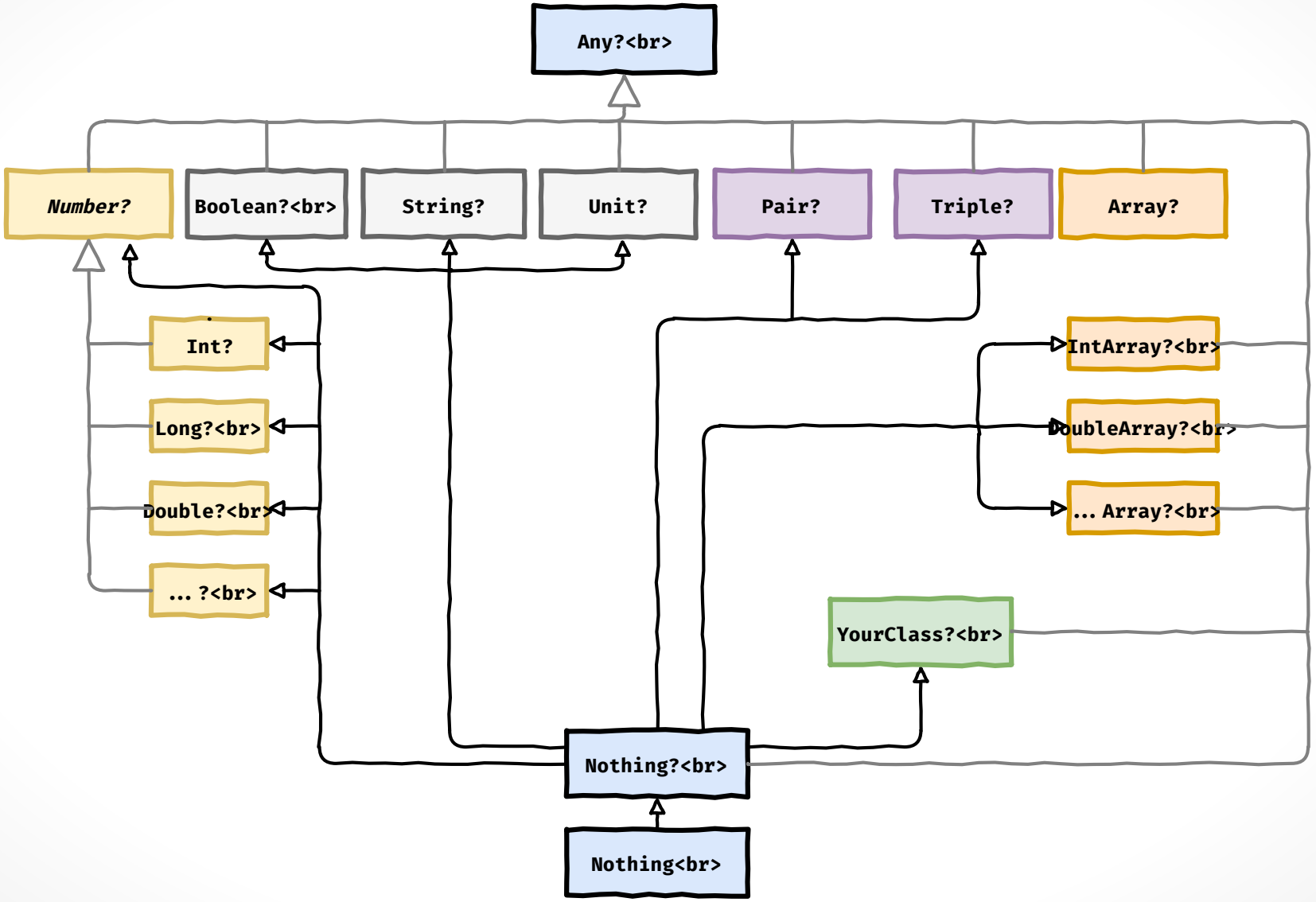
⚠️ quand on appelle du Java

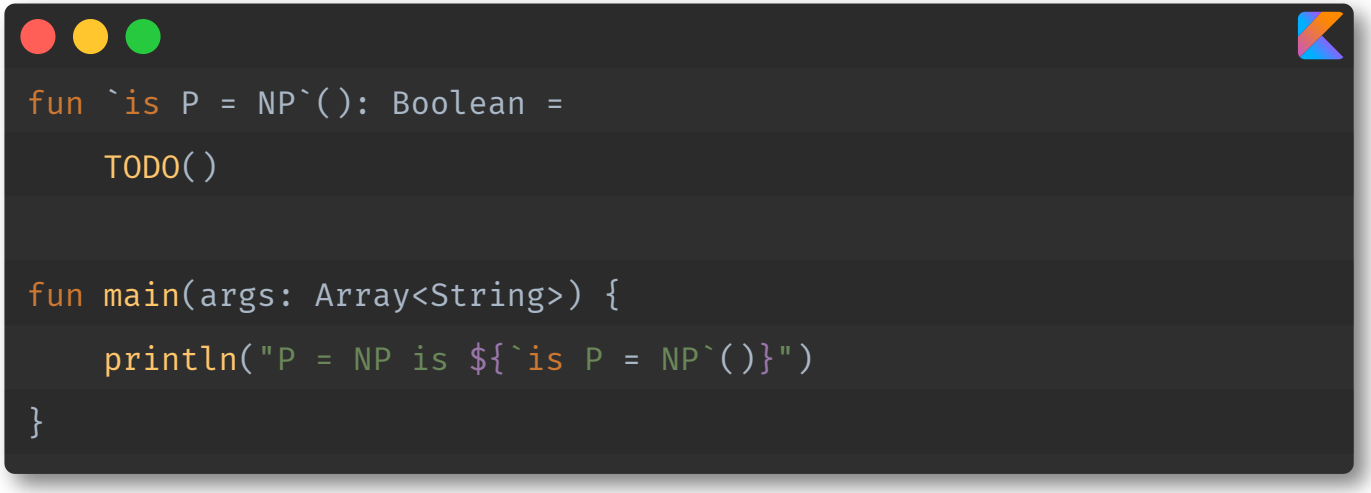
Les types

Types basiques



Types basiques nullable





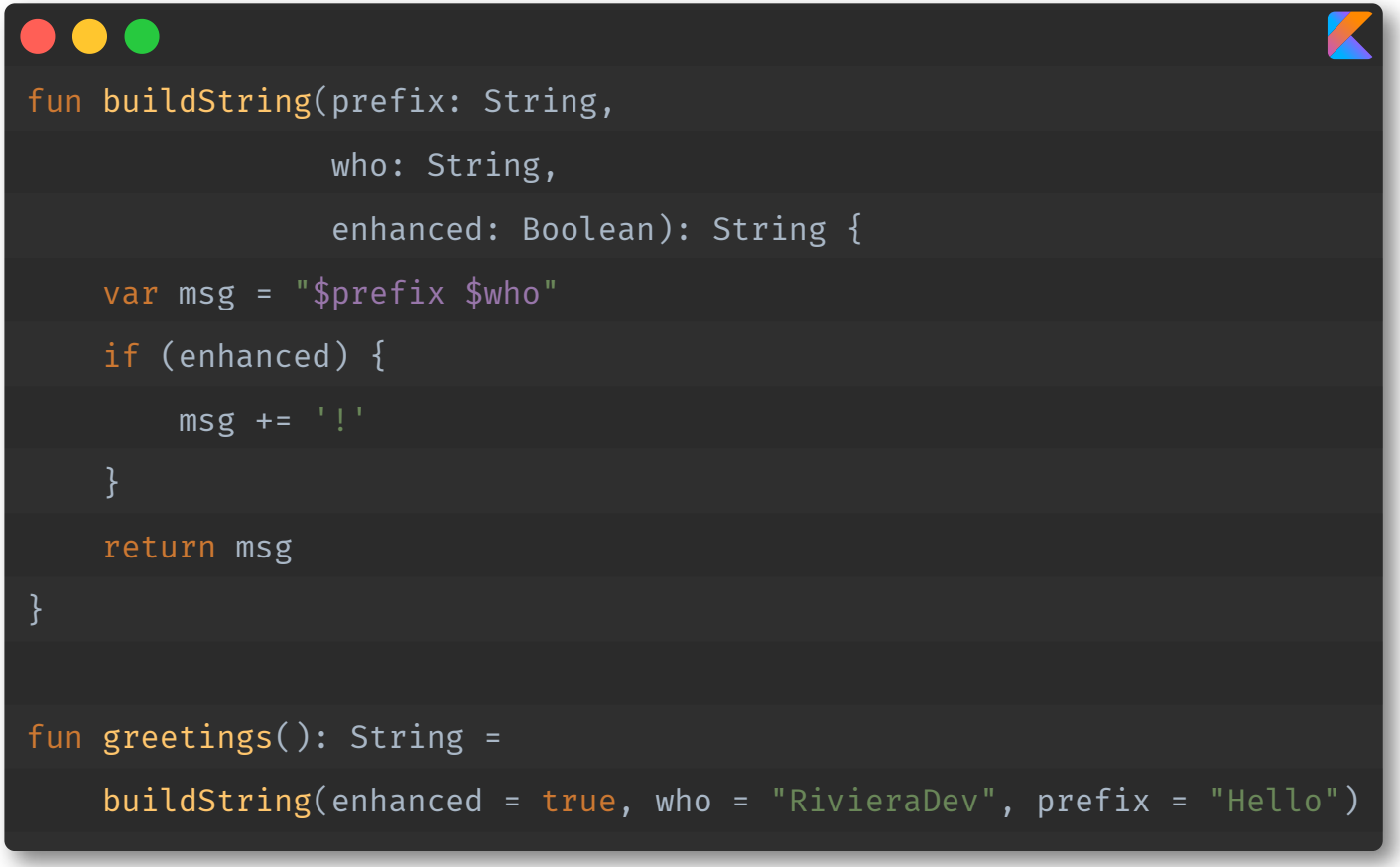
```kotlin
fun `is P = NP`(): Boolean =
    TODO()

fun main(args: Array<String>) {
    println("P = NP is ${`is P = NP`()}")
}
```

Hiérarchie des types

🤝 le `TODO()` est l'ami du TDD

Les fonctions

named-params.kt



```kotlin
fun buildString(prefix: String,
                who: String,
                enhanced: Boolean): String {
    var msg = "$prefix $who"
    if (enhanced) {
        msg += '!'
    }
    return msg
}

fun greetings(): String =
    buildString(enhanced = true, who = "RivieraDev", prefix = "Hello")
```

named-params.java


```
package _03_fun;

import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\u0010\n\u0000\n\u0002\u0010\u000e\n\u0002\b\u0003\n\u0002\u0010\u000b\n\u0000\u001a
   d2 = {"buildString", "", "prefix", "who", "enhanced", "", "greetings"}
)
public final class NamedKt {
   @NotNull
   public static final String buildString(@NotNull String prefix, @NotNull String who, boolean enhan
      Intrinsics.checkParameterIsNotNull(prefix, "prefix");
      Intrinsics.checkParameterIsNotNull(who, "who");
      String msg = "" + prefix + ' ' + who;
      if (enhanced) {
         msg = msg + '!';
      }

      return msg;
```

```kotlin
fun buildString2(prefix: String = "Hello",
                 who: String,
                 enhanced: Boolean = true): String {
    var msg = "$prefix $who"
    if (enhanced) {
        msg += '!'
    }
    return msg
}

fun greetings2(): String =
    buildString2(who = "RivieraDev")
```

default-value.java


```java
package _03_fun;

import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\u0010\n\u0000\n\u0002\u0010\u000e\n\u0002\b\u0003\n\u0002\u0010\u000b\n\u0000\u001a
   d2 = {"buildString2", "", "prefix", "who", "enhanced", "", "greetings2"}
)
public final class Default_valueKt {
   @NotNull
   public static final String buildString2(@NotNull String prefix, @NotNull String who, boolean enha
      Intrinsics.checkParameterIsNotNull(prefix, "prefix");
      Intrinsics.checkParameterIsNotNull(who, "who");
      String msg = "" + prefix + ' ' + who;
      if (enhanced) {
         msg = msg + '!';
      }

      return msg;
```

ByteCode de default-value


```
Compiled from "default-value.kt"
public final class _03_fun.Default_valueKt {
  public static final java.lang.String buildString2(java.lang.String, java.lang.String, boolean);
    Code:
       0: aload_0
       1: ldc           #9                  // String prefix
       3: invokestatic  #15                 // Method kotlin/jvm/internal/Intrinsics.checkParameterI
       6: aload_1
       7: ldc           #17                 // String who
       9: invokestatic  #15                 // Method kotlin/jvm/internal/Intrinsics.checkParameterI
      12: new           #19                 // class java/lang/StringBuilder
      15: dup
      16: invokespecial #23                 // Method java/lang/StringBuilder."<init>":()V
      19: ldc           #25                 // String
      21: invokevirtual #29                 // Method java/lang/StringBuilder.append:(Ljava/lang/Str
      24: aload_0
      25: invokevirtual #29                 // Method java/lang/StringBuilder.append:(Ljava/lang/Str
      28: bipush        32
      30: invokevirtual #32                 // Method java/lang/StringBuilder.append:(C)Ljava/lang/S
      33: aload_1
      34: invokevirtual #29                 // Method java/lang/StringBuilder.append:(Ljava/lang/Str
      37: invokevirtual #36                 // Method java/lang/StringBuilder.toString:()Ljava/lang/
      40: astore_3
      41: iload_2
```

✨ Conseils

Toujours typer le retour de vos fonctions
(sauf si c'est évident et une surcharge comme le $\rightarrow Str \in g$)
Kotlin est plus concis que Java => évitez de faire des fonctions trop longues

- Sautez une ligne après le `=`
- Utilisez le passage des arguments par nom quand ça lève des ambiguïtés

📝 Note

Le passage des arguments par nom, ne marche pas sur les appels de code Java

Les lambdas

```kotlin
// Declare apply function with function as parameter
fun apply(x: Int, y: Int, operation: (Int, Int) → Int): Int =
    operation(x, y)

// Declare function
fun sumf(x: Int, y: Int) : Int =
    x + y

// call apply with function reference
val sum5 = apply(2,3, ::sumf)

// store function reference
val sumLam = ::sumf

// call apply with the function reference
val sum6 = apply(1,5, sumLam)
```

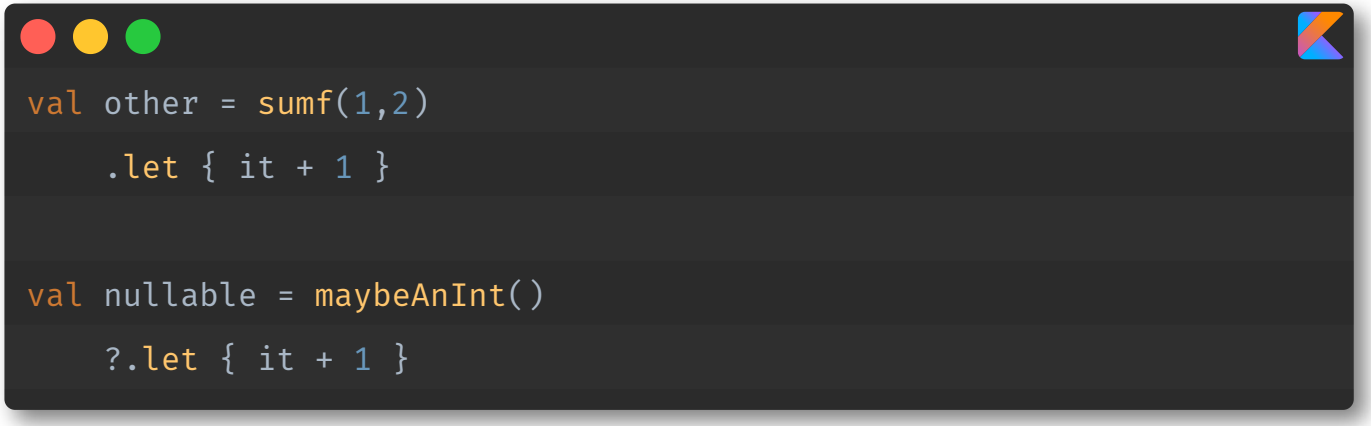
function.java


```java
package _04_lamda;

import kotlin.Metadata;
import kotlin.jvm.functions.Function2;
import kotlin.jvm.internal.Intrinsics;
import kotlin.reflect.KFunction;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\u001c\n\u0000\n\u0002\u0010\b\n\u0002\b\u0005\n\u0002\u0018\u0002\n\u0002\u0018\u00
   d2 = {"sum5", "", "getSum5", "()I", "sum6", "getSum6", "sumLam", "Lkotlin/reflect/KFunction2;", "
)
public final class FunctionKt {
   private static final int sum5;
   @NotNull
   private static final KFunction sumLam;
   private static final int sum6;

   public static final int apply(int x, int y, @NotNull Function2 operation) {
      Intrinsics.checkParameterIsNotNull(operation, "operation");
      return ((Number)operation.invoke(x, y)).intValue();
```

```kotlin
// Declare lambda
val suml: (Int, Int) → Int = { x: Int, y: Int → x + y }

// call apply with suml lambda
val sum3 = apply(1, 2, suml)

// call apply with lamda
val sum4 = apply(1, 3) { x, y → x + y }
```

lambda.java


```java
package _04_lamda;

import kotlin.Metadata;
import kotlin.jvm.functions.Function2;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\u0012\n\u0000\n\u0002\u0010\b\n\u0002\b\u0005\n\u0002\u0018\u0002\n\u0002\b\u0002\"
   d2 = {"sum3", "", "getSum3", "()I", "sum4", "getSum4", "suml", "Lkotlin/Function2;", "getSuml", "
)
public final class LambdaKt {
   @NotNull
   private static final Function2 suml;
   private static final int sum3;
   private static final int sum4;

   @NotNull
   public static final Function2 getSuml() {
      return suml;
   }
```



```
val other = sumf(1,2)
    .let { it + 1 }

val nullable = maybeAnInt()
    ?.let { it + 1 }
```

```java
package _04_lamda;

import kotlin.Metadata;
import kotlin.NotImplementedError;
import kotlin.jvm.internal.DefaultConstructorMarker;
import org.jetbrains.annotations.Nullable;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\n\n\u0000\n\u0002\u0010\b\n\u0002\b\u0007\u001a\r\u0010\b\u001a\u0004\u0018\u00010\
   d2 = {"nullable", "", "getNullable", "()Ljava/lang/Integer;", "Ljava/lang/Integer;", "other", "ge
)
public final class LetKt {
   private static final int other;
   @Nullable
   private static final Integer nullable;

   @Nullable
   public static final Integer maybeAnInt() {
      throw (Throwable)(new NotImplementedError((String)null, 1, (DefaultConstructorMarker)null));
   }
```

Les lambdas

⚠️ pas de `return`

pensez à mettre vos lambda comme dernier argument

voir aussi les `apply`, `also`, `run` , `use`, `with`

➽ the tldr; on Kotlin's let, apply, also, with and run functions

<https://proandroiddev.com/the-tldr-on-kotlins-let-apply-also-with-and-run-functions-6253f06d152b>

Les classes

```kotlin
interface AstronomicalBody {
    val name: String
}

data class Planet(override val name: String,
                  val moons: List<Moon> = emptyList()) : AstronomicalBody {
    init {
        require(name.isNotEmpty())
    }

    operator fun plus(moon: Moon): Planet {
        return this.copy(moons = moons + moon)
    }
}

data class Moon(override val name: String) : AstronomicalBody

object SolarSystem {
    val earth = Planet(name = "Earth")
    val moon = Moon(name = "Moon")

    val bodies: List<AstronomicalBody> = listOf(
        earth,
        Planet(name = "Jupiter")
```

astronomy.java


```java
package _05_class_1;

import java.util.List;
import kotlin.Metadata;
import kotlin.collections.CollectionsKt;
import kotlin.jvm.internal.DefaultConstructorMarker;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 1,
   d1 = {"\u00000\n\u0002\u0018\u0002\n\u0002\u0018\u0002\n\u0000\n\u0002\u0010\u000e\n\u0000\n\u000
   d2 = {"L_05_class_1/Planet;", "L_05_class_1/AstronomicalBody;", "name", "", "moons", "", "L_05_cl
)
public final class Planet implements AstronomicalBody {
   @NotNull
   private final String name;
   @NotNull
   private final List moons;

   @NotNull
   public final Planet plus(@NotNull Moon moon) {
```

Héritage en Kotlin


```kotlin
class SmallBody {
    fun sizeRange(): IntRange = 0..10
}

// Inherit SmallBody
data class Comet(val name: String)

// Inherit SmallBody
data class Asteroid(val name: String) {
    fun sizeRange(): IntRange = 0..4
}

fun main(args: Array<String>) {
    val bodies = listOf(Comet("Halley"), Asteroid("Adeona"))

//    bodies.forEach { body ->
//        println("$body: ${body.sizeRange()}")
//    }
}
```

Génériques

⚠️ Les contrôles de types génériques ne sont faits qu'au moment de la compilation

Covariant: `out`, en java `? extends T`

Contravariant: `in`, en java `? super T`

Borne supérieure

```
fun <T : Comparable<T>> sort(list: List<T>): List<T>
```

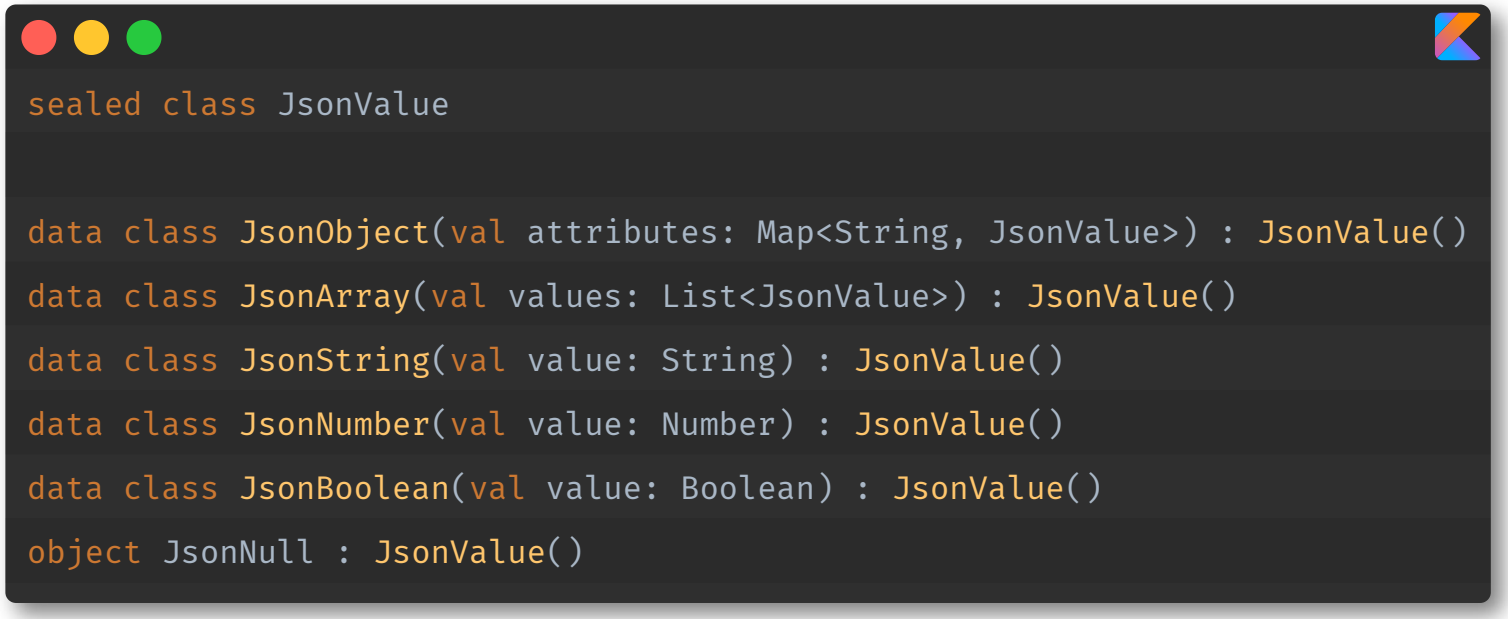
Les détails: ➳ https://kotlinlang.org/docs/reference/generics.html

<https://kotlinlang.org/docs/reference/generics.html>

Projection *

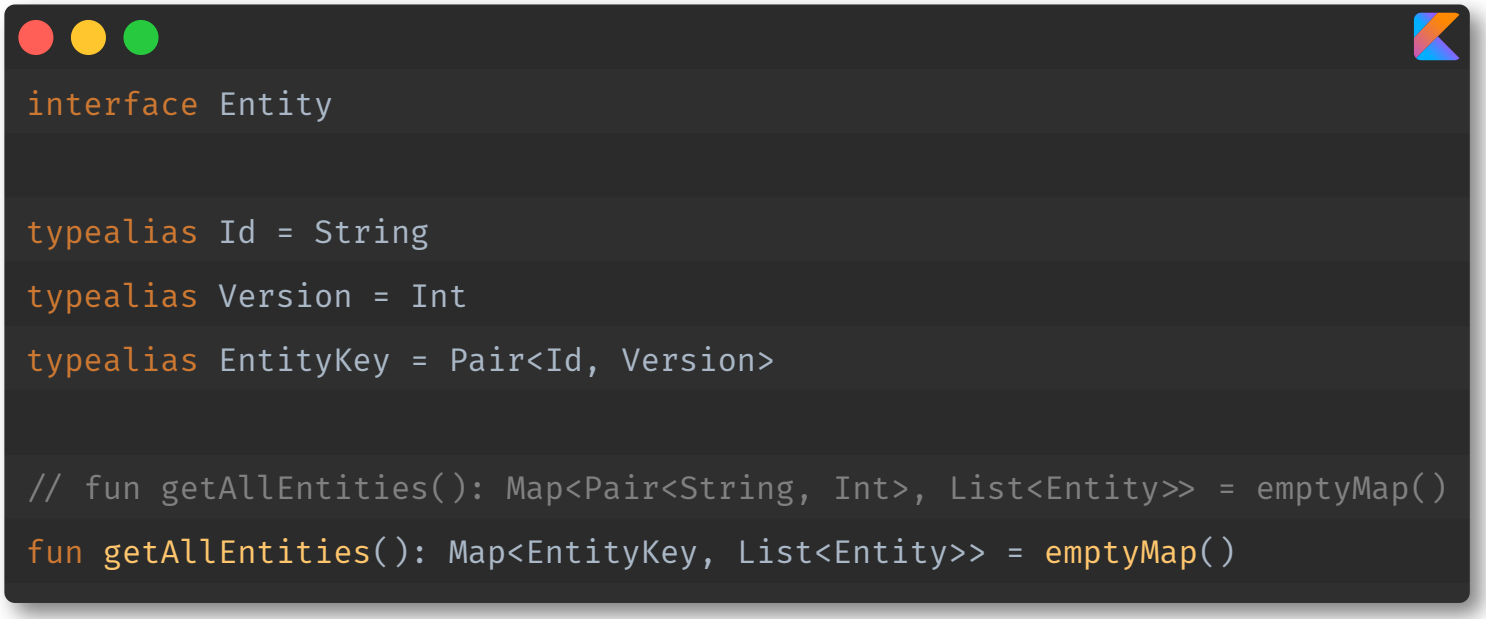

```kotlin
interface Function<in T, out U>

Function<*, String> // correspond à Function<in Nothing, String>

Function<Int, *> // correspond à Function<Int, out Any?>

Function<*, *> // correspond à Function<in Nothing, out Any?>
```

Sealed



```
sealed class JsonValue

data class JsonObject(val attributes: Map<String, JsonValue>) : JsonValue()
data class JsonArray(val values: List<JsonValue>) : JsonValue()
data class JsonString(val value: String) : JsonValue()
data class JsonNumber(val value: Number) : JsonValue()
data class JsonBoolean(val value: Boolean) : JsonValue()
object JsonNull : JsonValue()
```

Alias en Kotlin



```kotlin
interface Entity

typealias Id = String
typealias Version = Int
typealias EntityKey = Pair<Id, Version>

// fun getAllEntities(): Map<Pair<String, Int>, List<Entity>> = emptyMap()
fun getAllEntities(): Map<EntityKey, List<Entity>> = emptyMap()
```

ByteCode d'alias


```
Compiled from "typealias.kt"
public final class _06_class_2.TypealiasKt {
  public static final java.util.Map<kotlin.Pair<java.lang.String, java.lang.Integer>, java.util.List
    Code:
       0: invokestatic  #12                 // Method kotlin/collections/MapsKt.emptyMap:()Ljava/uti
       3: areturn
}
```

Classe, le bilan

🤩 `data class`

🤔 Mais pourquoi on n'a pas ça en Java ?

➽ JEP draft: Records and Sealed Types <https://openjdk.java.net/jeps/8222777>

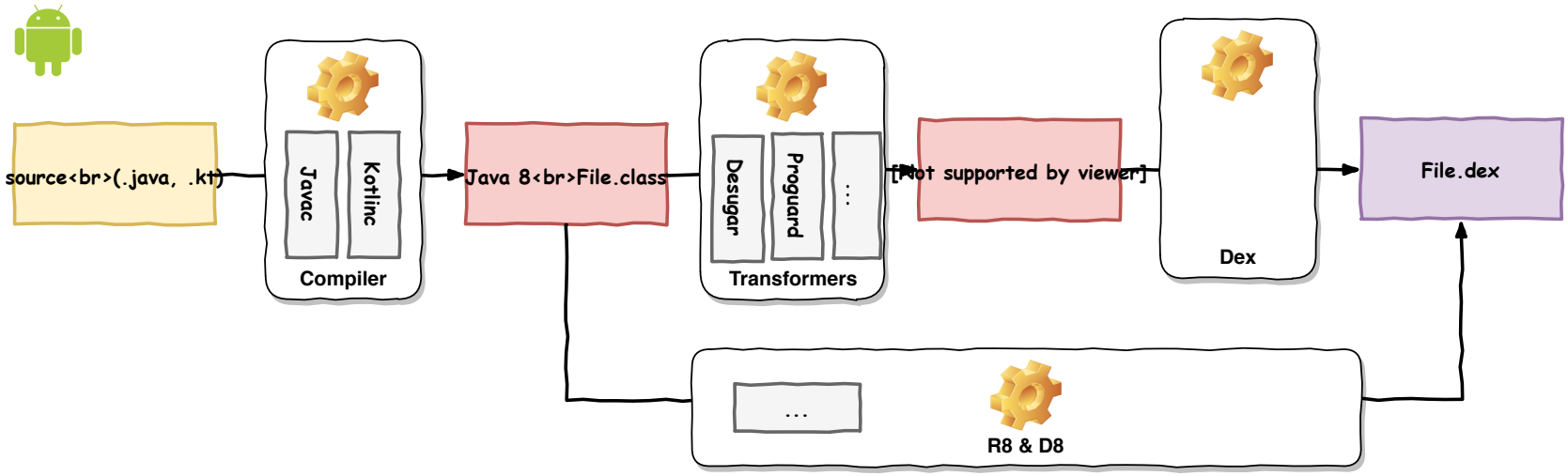
Une seule classe par fichier n'est pas utile

🤓 `sealed` permet de faire des types algébriques de données (Algebraic Data Type)

Pause

ByteCode Android

Compilation pour Android



Dalvik EXecutable format

➳ Dalvik Executable format <https://source.android.com/devices/tech/dalvik/dex-format>

```
java -jar ./scripts/lib/d8.jar --release \
            --output ./target/android/dex \
            ./target/android/hello.jar
```

```
00000000  64 65 78 0a 30 33 35 00  06 50 f0 61 50 10 7c c0  |dex.035..P.aP.|.|
00000010  b2 f9 77 2d 54 df 60 f3  ac dd b0 10 eb 55 53 e1  |..w-T.`......US.|
00000020  28 f6 10 00 70 00 00 00  78 56 34 12 00 00 00 00  |(...p...xV4.....|
00000030  00 00 00 00 4c f5 10 00  12 17 00 00 70 00 00 00  |....L.......p...|
00000040  31 03 00 00 b8 5c 00 00  2a 08 00 00 7c 69 00 00  |1....\..*...|i..|
00000050  30 03 00 00 74 cb 00 00  20 1a 00 00 f4 e4 00 00  |0...t...  .......|
00000060  75 02 00 00 f4 b5 01 00  94 f1 0e 00 94 04 02 00  |u...............|
00000070  4a f1 07 00 4c f1 07 00  75 f1 07 00 a4 f1 07 00  |J...L...u.......|
00000080  c2 f1 07 00 e0 f1 07 00  00 f2 07 00 23 f2 07 00  |............#...|
00000090  71 f2 07 00 b9 f2 07 00  07 f3 07 00 37 f3 07 00  |q...........7...|
000000a0  69 f3 07 00 90 f3 07 00  bc f3 07 00 e3 f3 07 00  |i...............|
000000b0  27 f4 07 00 71 f4 07 00  8f f4 07 00 ad f4 07 00  |'...q...........|
000000c0  cb f4 07 00 ed f4 07 00  0f f5 07 00 2c f5 07 00  |............,...|
000000d0  49 f5 07 00 79 f5 07 00  b1 f5 07 00 e9 f5 07 00  |I...y...........|
000000e0  1a f6 07 00 51 f6 07 00  7b f6 07 00 a6 f6 07 00  |....Q...{.......|
000000f0  d1 f6 07 00 0a f7 07 00  47 f7 07 00 84 f7 07 00  |........G.......|
00000100  c1 f7 07 00 02 f8 07 00  43 f8 07 00 84 f8 07 00  |........C.......|
```

dexdump

```
~/.android-sdk/build-tools/23.0.1/dexdump -d \
      ./target/android/dex/classes.dex \
      > ./target/android/dex/classes.dex.dump
```

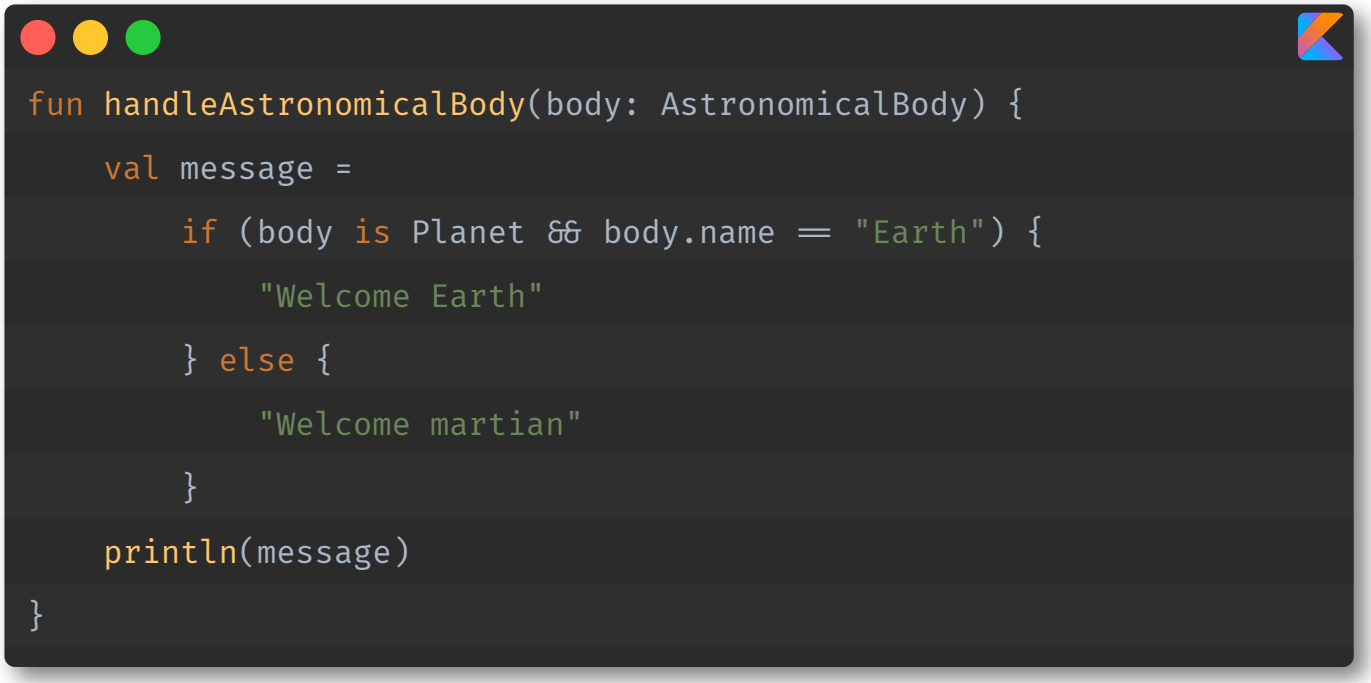
```
Processing './target/android/dex/classes.dex'...
Opened './target/android/dex/classes.dex', DEX version '035'
Class #0            -
  Class descriptor  : 'L_00_helloworld/HelloWorldKt;'
  Access flags      : 0×0011 (PUBLIC FINAL)
  Superclass        : 'Ljava/lang/Object;'
  Interfaces        -
  Static fields     -
  Instance fields   -
  Direct methods    -
    #0              : (in L_00_helloworld/HelloWorldKt;)
      name          : 'main'
      type          : '([Ljava/lang/String;)V'
      access        : 0×0019 (PUBLIC STATIC FINAL)
      code          -
      registers     : 2
      ins           : 1
```

```
sh ./scripts/lib/dextools/d2j-dex2smali.sh \
     ./target/android/dex/classes.dex -f \
     -o ./target/android/smali
```

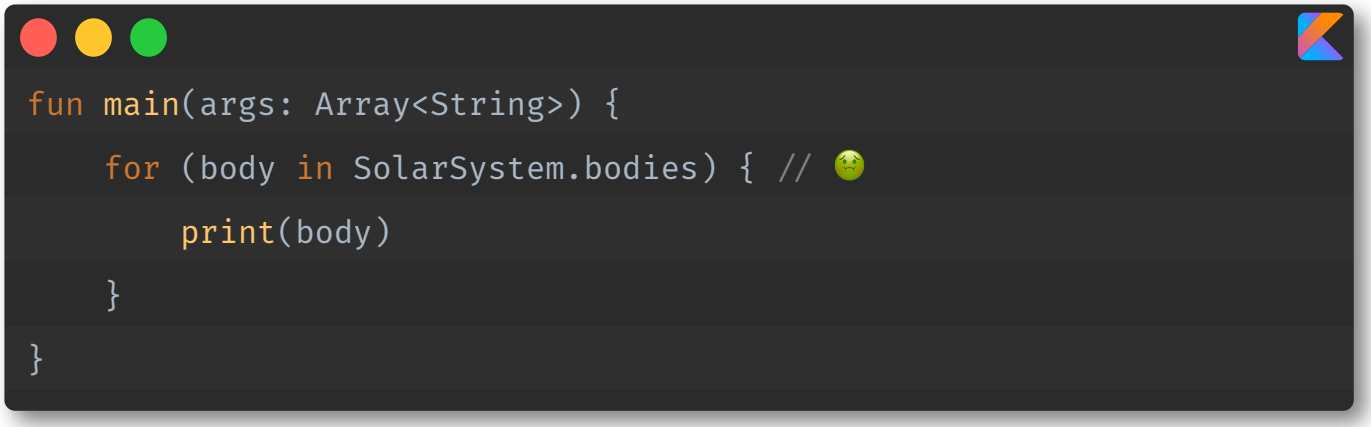
```
.class public final L_00_helloworld/HelloWorldKt;
.super Ljava/lang/Object;
.source "HelloWorld.kt"

.annotation system Ldalvik/annotation/SourceDebugExtension;
  value = "SMAP\nHelloWorld.kt\nKotlin\n*S Kotlin\n*F\n+ 1 HelloWorld.kt\n_00_helloworld/HelloWorldK
.end annotation
.annotation runtime Lkotlin/Metadata;
  bv = {
    1,
    0,
    2
  }
  d1 = {
    "\u0000\u0012\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0010\u0011\n\u0002\u0010\u000e\n\u000
  }
  d2 = {
```

Autres structures

if-then-else.kt



```kotlin
fun handleAstronomicalBody(body: AstronomicalBody) {
    val message =
        if (body is Planet && body.name == "Earth") {
            "Welcome Earth"
        } else {
            "Welcome martian"
        }
    println(message)
}
```

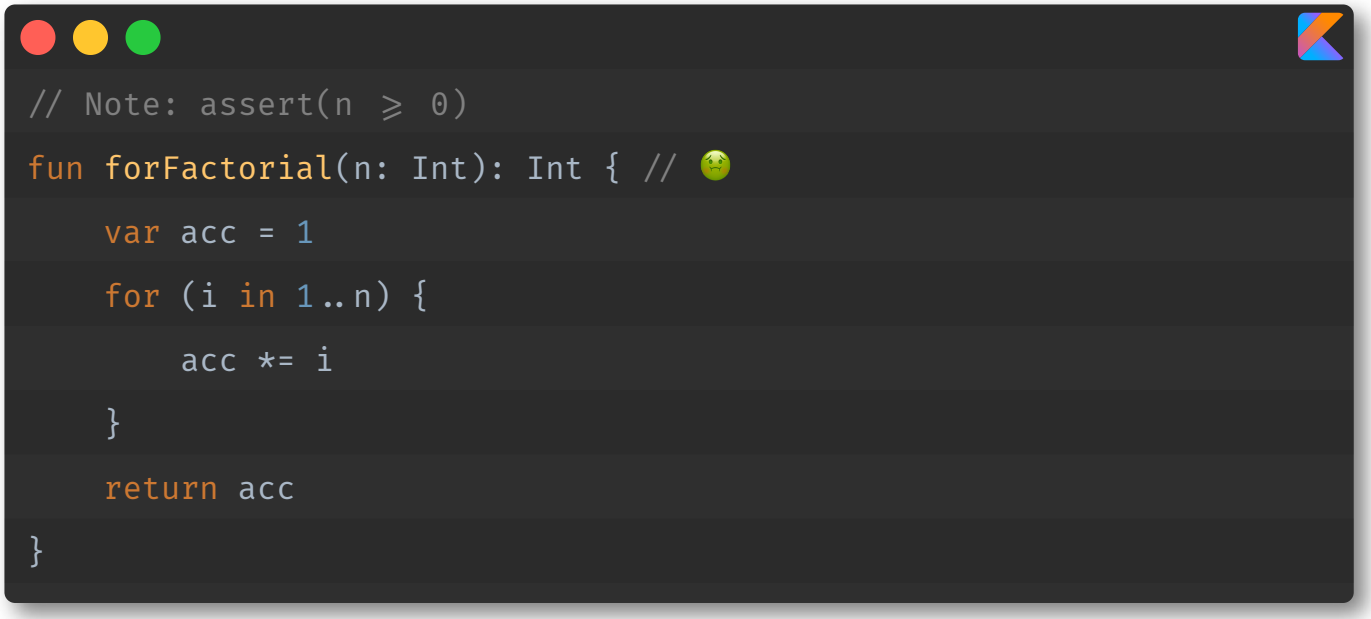


```kotlin
fun main(args: Array<String>) {
    for (body in SolarSystem.bodies) { // 🤢
        print(body)
    }
}
```

Mais aussi des `while` et `do while`

et des `break`, `continue`, et label

```
for (body in SolarSystem.bodies) { // 🤢

    val message = when (body) {
        is Planet → "Planet ${body.name}"
        is Star   → "Star ${body.name}"
        else      → null
    }

    if (message ≠ null) {
        println(message)
    }
}
```

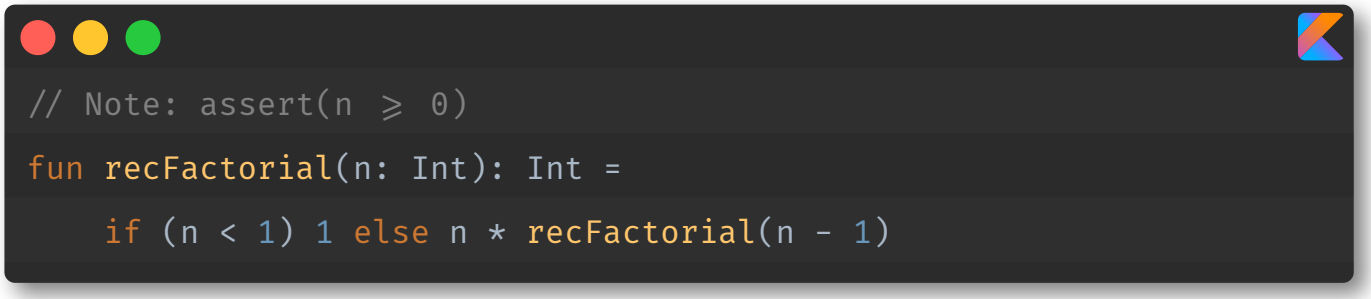


```kotlin
// Note: assert(n ≥ 0)
fun forFactorial(n: Int): Int { // 🤢
    var acc = 1
    for (i in 1..n) {
        acc *= i
    }
    return acc
}
```

ByteCode factoriel avec for


```
Compiled from "for-factorial.kt"
public final class _09_structures.recusion.For_factorialKt {
  public static final int forFactorial(int);
    Code:
       0: iconst_1
       1: istore_1
       2: iconst_1
       3: istore_2
       4: iload_0
       5: istore_3
       6: iload_2
       7: iload_3
       8: if_icmpgt     26
      11: iload_1
      12: iload_2
      13: imul
      14: istore_1
      15: iload_2
      16: iload_3
      17: if_icmpeq     26
      20: iinc          2, 1
      23: goto          11
      26: iload_1
      27: ireturn
```

rec-factorial.kt



```kotlin
// Note: assert(n ≥ 0)
fun recFactorial(n: Int): Int =
    if (n < 1) 1 else n * recFactorial(n - 1)
```

ByteCode factoriel avec récursivité


```
Compiled from "rec-factorial.kt"
public final class _09_structures.recusion.Rec_factorialKt {
  public static final int recFactorial(int);
    Code:
       0: iload_0
       1: iconst_1
       2: if_icmpge     9
       5: iconst_1
       6: goto          17
       9: iload_0
      10: iload_0
      11: iconst_1
      12: isub
      13: invokestatic  #8                  // Method recFactorial:(I)I
      16: imul
      17: ireturn
}
```

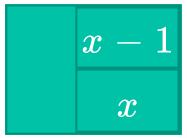
Récursion non terminale

$$x! = x \times (x-1) \times ... \times 2 \times 1$$
$$1! = 0! = 1$$

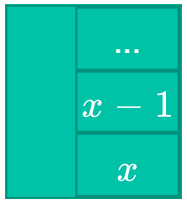
$fact(x)$

$x \times fact(x-1)$

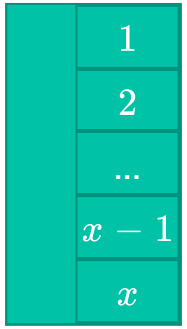
$x \times (x-1) \times fact(x-2)$



$x \times (x-1) \times (x-2) \times ...$



$x \times (x-1) \times (x-2) \times ... \times 2 \times 1$



Récursion terminale

$$fact(x) = fact(x, 1)$$

$$fact(x - 1, x \times 1)$$

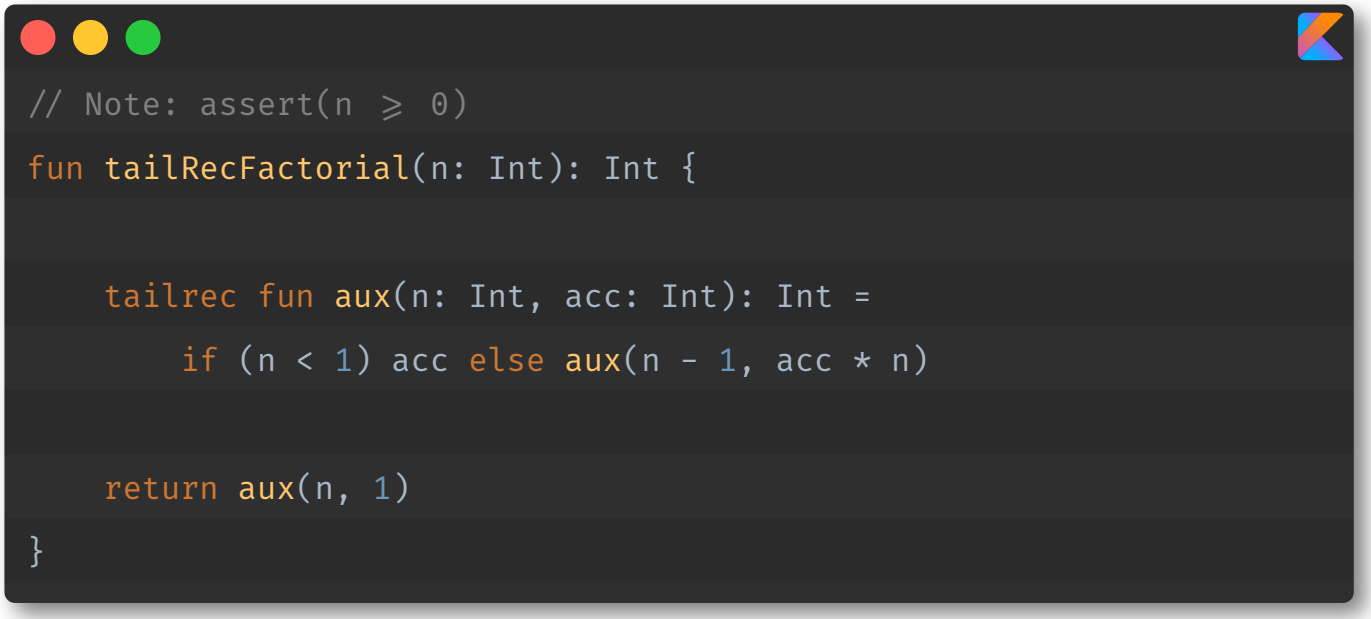
$$fact(x - 2, x \times (x - 1))$$

$$fact(..., x \times (x - 1) \times (x - 2) \times ...)$$

$$fact(1, x \times (x - 1) \times (x - 2) \times ... \times 2)$$

⚠️ Nécessite une optimisation par le compilateur

tailrec-factorial.kt



```kotlin
// Note: assert(n ⩾ 0)
fun tailRecFactorial(n: Int): Int {

    tailrec fun aux(n: Int, acc: Int): Int =
        if (n < 1) acc else aux(n - 1, acc * n)

    return aux(n, 1)
}
```

ByteCode factoriel avec recursivité terminale 1/2


```
Compiled from "tailrec-factorial.kt"
public final class _09_structures.recusion.Tailrec_factorialKt {
  public static final int tailRecFactorial(int);
    Code:
       0: getstatic     #12                 // Field _09_structures/recusion/Tailrec_factorialKt$tai
       3: astore_1
       4: aload_1
       5: iload_0
       6: iconst_1
       7: invokevirtual #16                 // Method _09_structures/recusion/Tailrec_factorialKt$ta
      10: ireturn
}
```

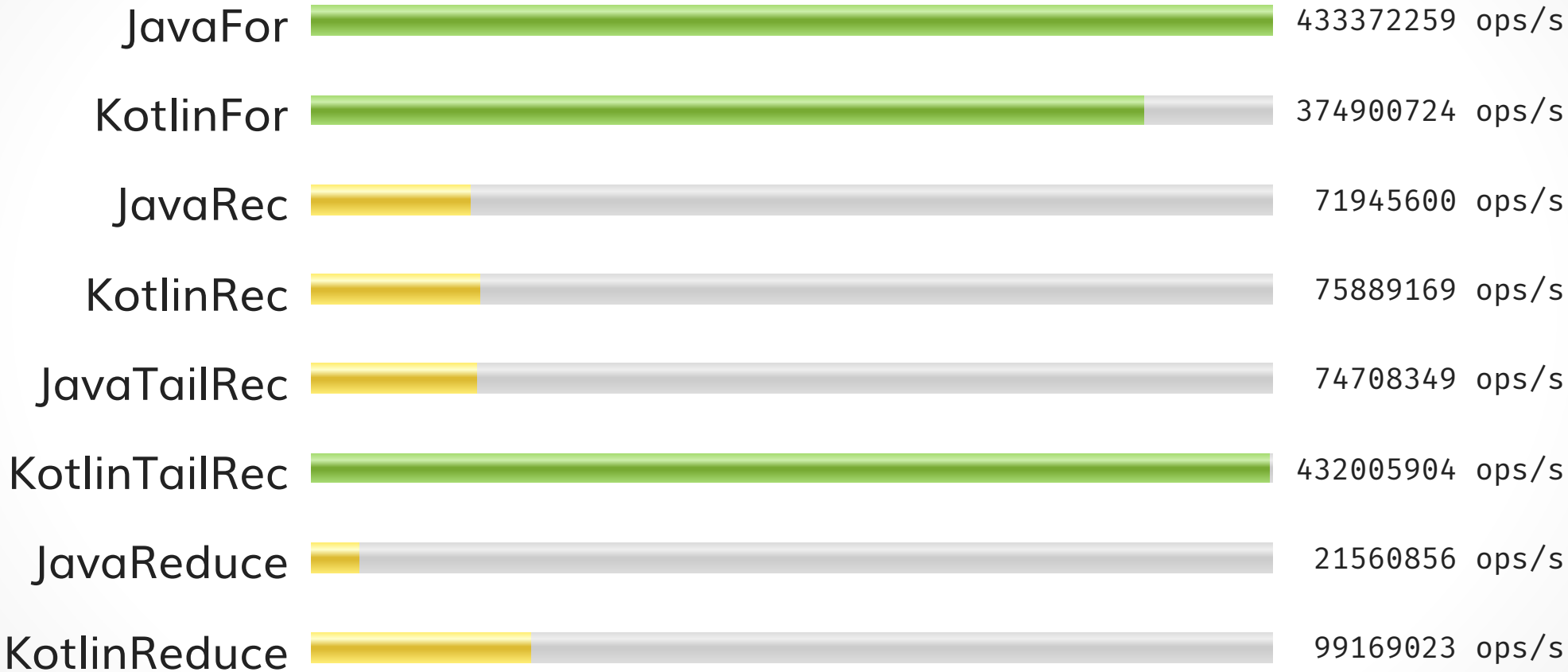
ByteCode factoriel avec recursivité terminale 2/2


```
Compiled from "tailrec-factorial.kt"
final class _09_structures.recusion.Tailrec_factorialKt$tailRecFactorial$1 extends kotlin.jvm.intern
  public static final _09_structures.recusion.Tailrec_factorialKt$tailRecFactorial$1 INSTANCE;

  public java.lang.Object invoke(java.lang.Object, java.lang.Object);
    Code:
       0: aload_0
       1: aload_1
       2: checkcast     #11                 // class java/lang/Number
       5: invokevirtual #15                 // Method java/lang/Number.intValue:()I
       8: aload_2
       9: checkcast     #11                 // class java/lang/Number
      12: invokevirtual #15                 // Method java/lang/Number.intValue:()I
      15: invokevirtual #18                 // Method invoke:(II)I
      18: invokestatic  #24                 // Method java/lang/Integer.valueOf:(I)Ljava/lang/Intege
      21: areturn

  public final int invoke(int, int);
    Code:
       0: iload_1
       1: iconst_1
       2: if_icmpge     9
       5: iconst_1
       6: goto          25
```

Performances sur 10! 1/2

Benchmark	Mode	Cnt	Score	Error	Uni
factorialJavaFor	thrpt	200	4.33372258508E8	1218796.228	ops
factorialKotlinFor	thrpt	200	3.74900724013E8	1836466.839	ops
factorialJavaRec	thrpt	200	7.1945600003E7	1621282.609	ops
factorialKotlinRec	thrpt	200	7.5889169327E7	803516.13	ops
factorialJavaTailRec	thrpt	200	7.470834854E7	385285.112	ops
factorialKotlinTailRec	thrpt	200	4.3200590395E8	2558012.821	ops
factorialJavaReduce	thrpt	200	2.1560855907E7	586144.742	ops
factorialKotlinReduce	thrpt	200	9.9169022775E7	5.2711794007E7	ops

Performances sur 10! 2/2



Bilan structures

`when` peut être utilisé avec

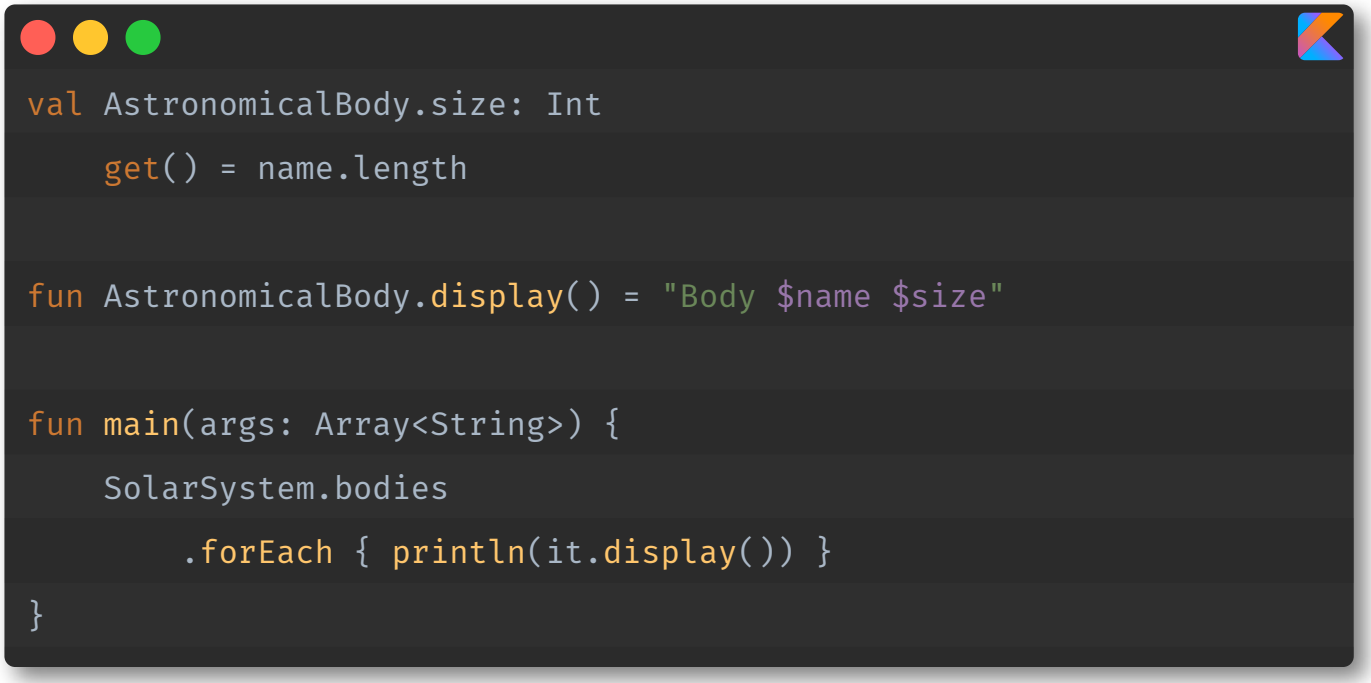
- des constantes
- plusieurs valeurs séparées par `,`
- une expression
- avec `is` et un type (avec un 'smart cast')

✨ Tips

privilégier les `when` si vous avez plus de 2 cas

si vous faites des fonctions récursives, faites les `tailrec`

Extensions de fonctions



```kotlin
val AstronomicalBody.size: Int
    get() = name.length

fun AstronomicalBody.display() = "Body $name $size"

fun main(args: Array<String>) {
    SolarSystem.bodies
        .forEach { println(it.display()) }
}
```

extension.java


```java
package _08_extension;

import astronomy.AstronomicalBody;
import astronomy.SolarSystem;
import java.util.Iterator;
import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
        mv = {1, 1, 9},
        bv = {1, 0, 2},
        k = 2,
        d1 = {"\u0000 \n\u0000\n\u0002\u0010\b\n\u0002\u0018\u0002\n\u0002\b\u0003\n\u0002\u0010\u00
        d2 = {"size", "", "Lastronomy/AstronomicalBody;", "getSize", "(Lastronomy/AstronomicalBody;)
)
public final class ExtensionKt {
   public static final int getSize(@NotNull AstronomicalBody $receiver) {
      Intrinsics.checkParameterIsNotNull($receiver, "$receiver");
      return $receiver.getName().length();
   }

   @NotNull
   public static final String display(@NotNull AstronomicalBody $receiver) {
```

Extension

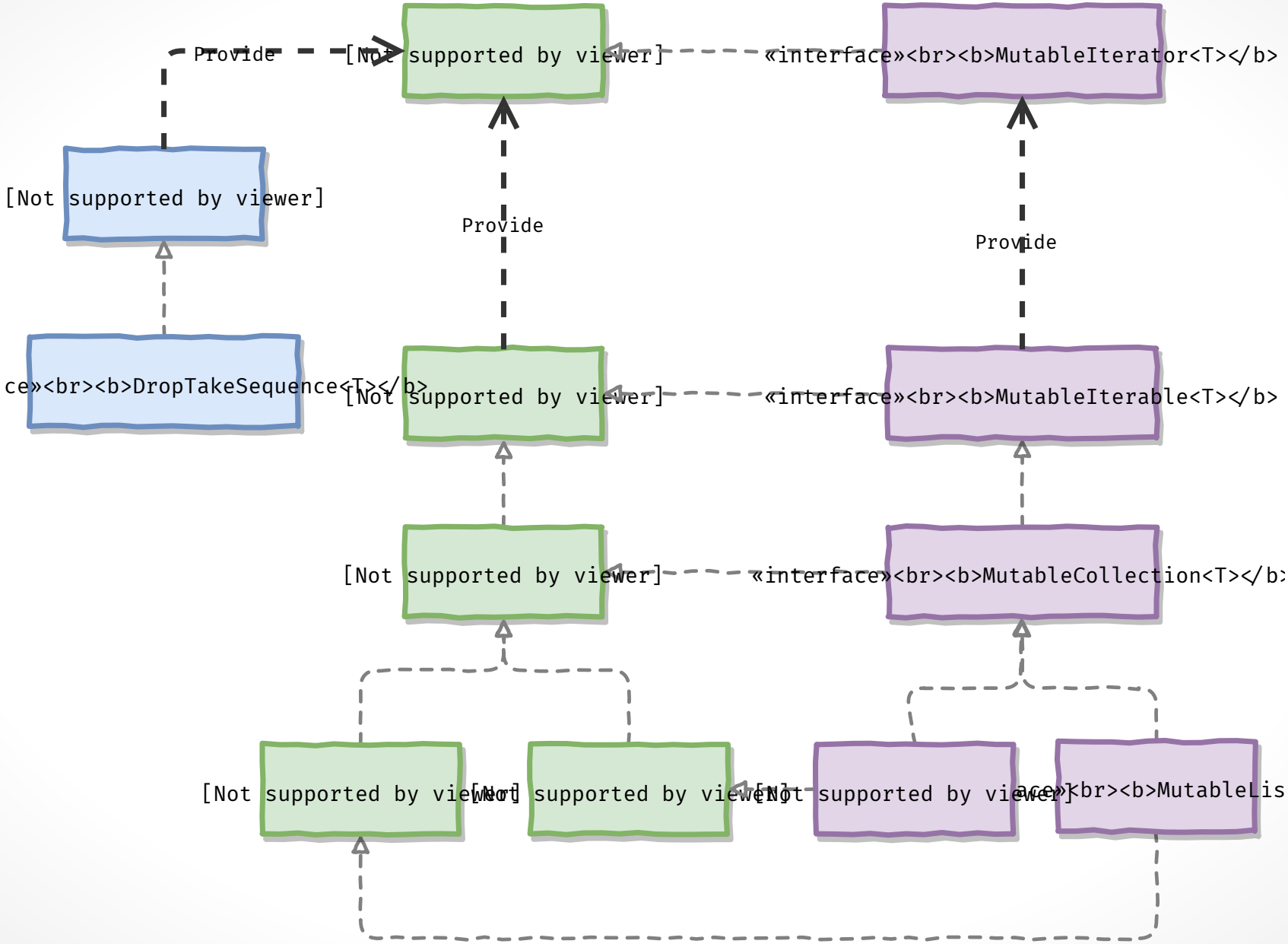
Permet d'enrichir les APIs Java

- ➳ Spring <https://docs.spring.io/spring/docs/current/spring-framework-reference/languages.html#kotlin-spring-projects-in-kotlin>
- ➳ RxKotlin <https://github.com/ReactiveX/RxKotlin>
- ➳ SparkJava <http://sparkjava.com/news#spark-kotlin-released>
- ...

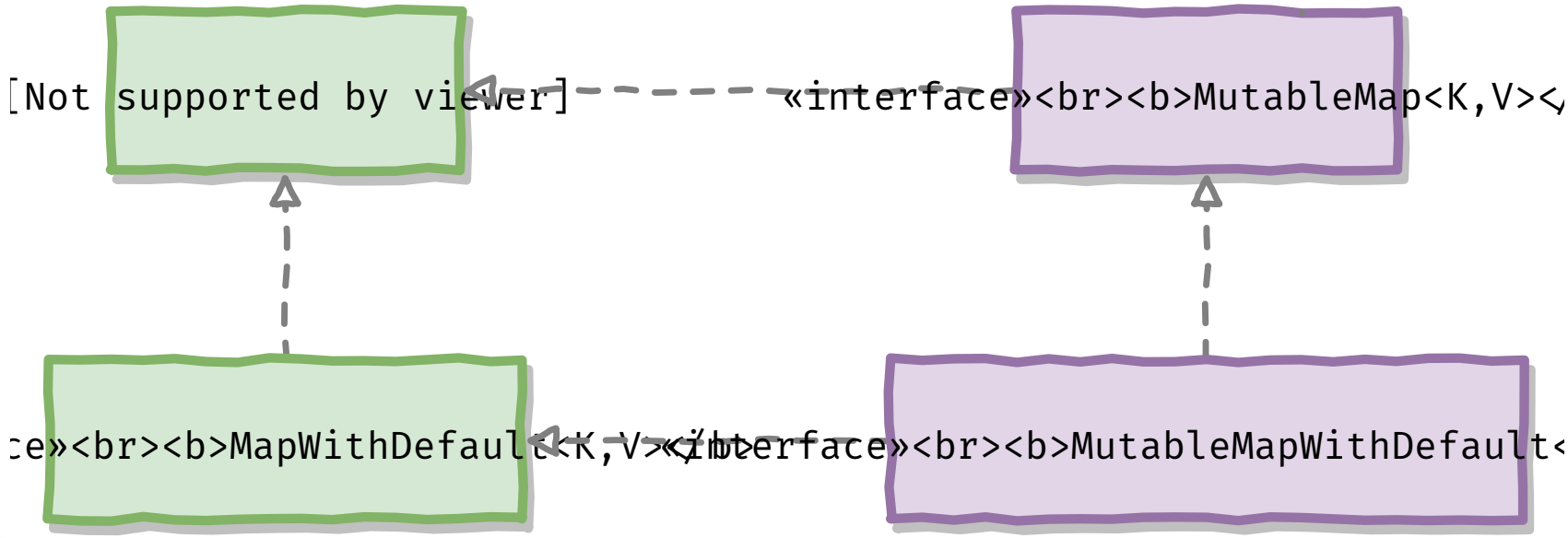
Permet la *SoC* (Separation of Concerns)

Les collections

Collections



Les Maps


[Not supported by viewer]
«interface»
<b>MutableMap<K,V></
ce»
<b>MapWithDefault<K,V></
«interface»
<b>MutableMapWithDefault<

```kotlin
val s = SolarSystem.bodies
    .filterIsInstance<Planet>()
    .flatMap { planet → planet.moons } // 😻
    .filterNot { it.name.startsWith("S/") }
    .sortedBy { it.name }
//        .fold("") { acc, moon →
//            (if (acc == "") "" else "$acc,\n") + moon.name
//        }
    .joinToString(",\n") { it.name }

println(s)
```

immutable-mutable.kt

```kotlin
fun main(args: Array<String>) {

    val earthMoon = listOf(Moon("moon"))
    val add = earthMoon + Moon("moon 2")

    println("earthMoon: $earthMoon") // earthMoon: [Moon(name=moon)]
    println("add: $add")             // add: [Moon(name=moon), Moon(name=moon 2)]
    println("reference equality: ${earthMoon === add}") //reference equality: false

    println("\n")
    val earthMoon2 = mutableListOf(Moon("moon"))
    val add2 = earthMoon2.add(Moon("moon 2"))

    println("earthMoon2: $earthMoon2") // earthMoon2: [Moon(name=moon), Moon(name=moon 2)]
    println("add2: $add2")             // add2: true
}
```

break-immutable.kt


```kotlin
fun main(args: Array<String>) {
    val moons = (1..9).map { Moon("Moon #$it") }.toList()

    println(moons.javaClass) // class java.util.ArrayList

    moons.javaClass.methods
        .find { it.name == "add" && it.parameterCount == 1 }
        ?.invoke(moons, Moon("XXX"))

    println(moons.joinToString("\n"))
    // Moon(name=Moon #1)
    // Moon(name=Moon #2)
    // Moon(name=Moon #3)
    // Moon(name=Moon #4)
    // Moon(name=Moon #5)
    // Moon(name=Moon #6)
    // Moon(name=Moon #7)
    // Moon(name=Moon #8)
    // Moon(name=Moon #9)
    // Moon(name=XXX)
}
```

```
val s = SolarSystem.bodies.asSequence()
    .filterIsInstance<Planet>()
    .flatMap { planet → planet.moons.asSequence() } // 😻
    .filterNot { it.name.startsWith("S/") }
    .sortedBy { it.name }
    .joinToString(",\n") { it.name }

println(s)
```

Performance des séquences 1/2

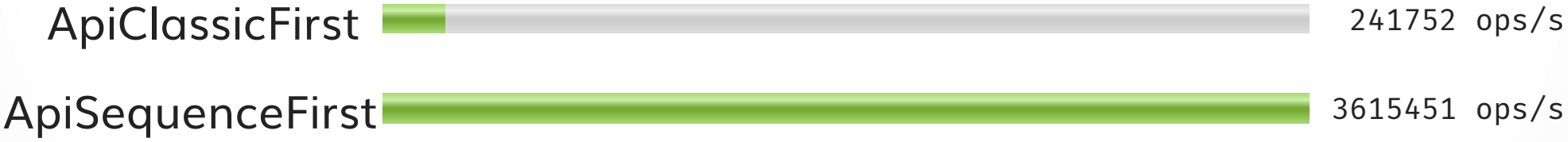
Benchmark	Mode	Cnt	Score	Error	Units
ApiClassic	thrpt	200	44535.029	3550.944	ops/s
ApiSequence	thrpt	200	23652.238	1967.535	ops/s

sequence2.kt


```kotlin
val s = SolarSystem.bodies.asSequence()
    .filterIsInstance<Planet>()
    .flatMap { planet -> planet.moons.asSequence() } // 😻
    .filterNot { it.name.startsWith("S/") }
    .map { it.name }
    .first()

println(s)
```

Performance des séquences 2/2

Benchmark	Mode	Cnt	Score	Error	Units
ApiClassicFirst	thrpt	200	241752.062	5022.663	ops/s
ApiSequenceFirst	thrpt	200	3615451.391	454502.198	ops/s



timed-sequence.kt


```kotlin
fun <T> timed(block: () -> T) {
    val startTime = System.currentTimeMillis()
    val result = block()
    val endTime = System.currentTimeMillis()
    val duration = endTime - startTime
    val readable = String.format("%d min %02d seconds", duration / 60000, (duration % 60000) / 1000)
    println("$result in $readable")
}

fun main(args: Array<String>) {
    fun Long.toMB(): String =
        "${this / 1048576}MB"

    fun Runtime.usedMemory(): String =
        (totalMemory() - freeMemory()).toMB()

    fun Runtime.getMemoryInfo(): String =
        "used: ${usedMemory()}, total: ${totalMemory().toMB()}"

    timed {
        (0..1_000_000)
            .asSequence()
            .onEach {
                if (it % 10_000 == 0) {
```

```
for (i in 1..3) print(i) // prints 123

for (i in 3 downTo 1) print(i) // prints 321

for (i in 1..5 step 2) print(i) // prints 135
```

ranges.java


```java
package _11_collections_2;

import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import kotlin.ranges.IntProgression;
import kotlin.ranges.IntRange;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 2,
   d1 = {"\u0000\u0012\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0010\u0011\n\u0002\u0010\u000e\n
   d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V"}
)
public final class RangesKt {
   public static final void main(@NotNull String[] args) {
      Intrinsics.checkParameterIsNotNull(args, "args");
      int i = 1;

      byte var2;
      for(var2 = 3; i <= var2; ++i) {
         System.out.print(i);
      }
```

```kotlin
fun main(args: Array<String>) {
    val aPair = "Earth" to "Moon" // ~  Pair("Earth", "Moon")
    val (planet, moon) = aPair

    val aTriple = Triple("Voyager 1", 1977, listOf("Jupiter", "Saturn"))
    val (probeNane, launchYear, flyOver) = aTriple
}
```

tuples.java


```java
package _11_collections_2;

import java.util.List;
import kotlin.Metadata;
import kotlin.Pair;
import kotlin.Triple;
import kotlin.collections.CollectionsKt;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
        mv = {1, 1, 9},
        bv = {1, 0, 2},
        k = 2,
        d1 = {"\u0000\u0012\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0010\u0011\n\u0002\u0010\u0
        d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V"}
)
public final class TuplesKt {
   public static final void main(@NotNull String[] args) {
      Intrinsics.checkParameterIsNotNull(args, "args");
      Pair aPair = kotlin.TuplesKt.to("Earth", "Moon");
      String var2 = (String)aPair.component1();
      String moon = (String)aPair.component2();
      Triple aTriple = new Triple("Voyager 1", 1977, CollectionsKt.listOf(new String[]{"Jupiter", "S
```

Bilan collection

💪 Super on a de l'immutabilité, des `map`, `flatMap`, `fold`, `aggregate`,...

😒 Mais ça reste des collections Java

⚖️ Avant d'utiliser les `Sequence`, faites des mesures

Les delegates

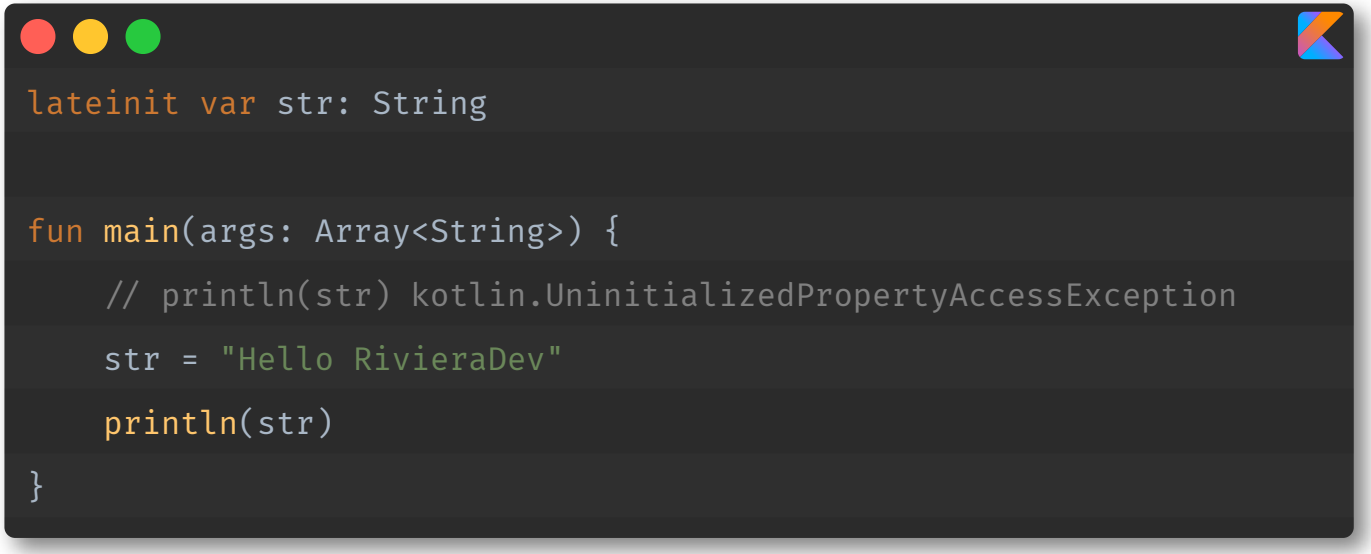
```kotlin
import kotlin.properties.ReadOnlyProperty
import kotlin.reflect.KProperty

fun main(args: Array<String>) {
    val value: String by MyDelegateClass()
    println(value)
}

class MyDelegateClass : ReadOnlyProperty<Nothing?, String> {
    override operator fun getValue(thisRef: Nothing?,
                                   property: KProperty<*>) = "Hello RivieraDev"
}
```

```kotlin
object DeepThought {
    fun answer(): Int {
        print("Computing ...")
        return 42
    }
}

fun main(args: Array<String>) {

    val ultimateQuestionOfLife: Int by lazy {
        DeepThought.answer()
    }
    println("The Ultimate Question of Life, " +
                    "the Universe and Everything ?")
    println("Answer: $ultimateQuestionOfLife" )
}
```

observable.kt

```kotlin
import kotlin.properties.Delegates

fun main(args: Array<String>) {

    var observable: String by Delegates.observable("Initial value") {
        _, old, new →
            println("$old → $new")
    }

    observable = "new value"
}
```

lateinit.kt



```kotlin
lateinit var str: String

fun main(args: Array<String>) {
    // println(str) kotlin.UninitializedPropertyAccessException
    str = "Hello RivieraDev"
    println(str)
}
```

Delegate

`Lazy` : utile pour les propriétés qui ne sont pas systématiquement utilisées.

⚠️ À manipuler avec précaution dans les activités Android (avec le cycle de vie, cela peut référencer une ancienne instance)

`Delegate` : Observable, Not null, ...

`lateinit` : évite les *null check* pour les propriétés qui ne peuvent être initialisées immédiatement (ex: référence de vues sur `Activity`, `Fragment`).

Ne peut pas être utilisé avec les types primitifs

Un peu plus sur les fonctions

```kotlin
import java.time.Instant

class Logger(private val name: String) {
    private enum class Level { TRACE, DEBUG, INFO, WARN, ERROR, FATAL }
    private val level = Level.INFO

    fun info(message: () → String) {
        log(Level.INFO, message)
    }

    private inline fun log(lvl: Level, message: () → String) { // inline
        if (level ≥ lvl) {
            println("[${level.name}] $name - ${message()}")
        }
    }
}

fun main(args: Array<String>) {
    val logger = Logger("Main")

    logger.info { "Time: ${Instant.now()}" }
}
```

Logger.java


```java
package _13_advanced_function;

import kotlin.Metadata;
import kotlin.jvm.functions.Function0;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
   mv = {1, 1, 9},
   bv = {1, 0, 2},
   k = 1,
   d1 = {"\u0000&\n\u0002\u0018\u0002\n\u0002\u0010\u0000\n\u0000\n\u0002\u0010\u000e\n\u0002\b\u000
   d2 = {"L_13_advanced_function/Logger;", "", "name", "", "(Ljava/lang/String;)V", "level", "L_13_a
)
public final class Logger {
   private final Logger.Level level;
   private final String name;

   public final void info(@NotNull Function0 message) {
      Intrinsics.checkParameterIsNotNull(message, "message");
      Logger.Level lvl$iv = Logger.Level.INFO;
      if (access$getLevel$p(this).compareTo((Enum)lvl$iv) ≥ 0) {
         String var4 = '[' + access$getLevel$p(this).name() + "] " + access$getName$p(this) + " - "
         System.out.println(var4);
```

```kotlin
class Pojo {
    var name: String? = null
    override fun toString() = "Pojo $name"
}

object JavaBeanBuilder {

    fun <T> createBean(clazz: Class<T>): T =
        clazz.newInstance()

    inline fun <reified T> createBean(): T =
        createBean(T::class.java)
}

fun main(args: Array<String>) {
    val p1 = Pojo()
    p1.name = "Plop1"
    println(p1)

    val p2 = JavaBeanBuilder.createBean<Pojo>()
```

reified.java


```java
package _13_advanced_function;

import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import org.jetbrains.annotations.NotNull;

@Metadata(
        mv = {1, 1, 9},
        bv = {1, 0, 2},
        k = 2,
        d1 = {"\u0000\u0012\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0010\u0011\n\u0002\u0010\u0
        d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V"}
)
public final class ReifiedKt {
    public static final void main(@NotNull String[] args) {
        Intrinsics.checkParameterIsNotNull(args, "args");
        Pojo p1 = new Pojo();
        p1.setName("Plop1");
        System.out.println(p1);
        JavaBeanBuilder this_$iv = JavaBeanBuilder.INSTANCE;
        Pojo p2 = (Pojo)this_$iv.createBean(Pojo.class);
        p2.setName("Plop2");
        System.out.println(p2);
    }
```

Cas d'utilisation du `reified`

Pour créer des extensions Kotlin des fonctions Java qui utilisent des `Class<T>`

Cas d'utilisation du `inline`, `noinline`, `crossinline`

Quand on utilise `reified`

Quand on sait ce qu'on fait, ➳

https://kotlinlang.org/docs/reference/inline-functions.html

<https://kotlinlang.org/docs/reference/inline-functions.html>

Conclusion

Faible surcharge

Support officiel par Google

- Using Project Kotlin for Android <https://docs.google.com/document/d/1ReS3ep-hjxWA8kZi0YqDbEhCqTt29hG8P44aA9W0DM8/edit>
- Kotlin Guide <https://android.github.io/kotlin-guides/>
- android-ktx <https://github.com/android/android-ktx>
- Kotlin Android Extensions <https://kotlinlang.org/docs/tutorials/android-plugin.html>

Serveur

Supporté officiellement depuis ➳ Spring 5 <https://projects.spring.io/spring-framework/>, ➳ Spring Boot 2 <https://projects.spring.io/spring-boot/>

➳ SparkJava <https://sparktutorials.github.io/2017/01/28/using-spark-with-kotlin.html>, ➳ javalin <https://javalin.io/>

➳ Vert.x <http://vertx.io/docs/vertx-core/kotlin/>

➳ KTor <http://ktor.io/>

...

Web

Partager du code commun

➽ Use Kotlin with npm, webpack and react <https://blog.jetbrains.com/kotlin/2017/04/use-kotlin-with-npm-webpack-and-react/>

Natif

Faire des applications sans JVM

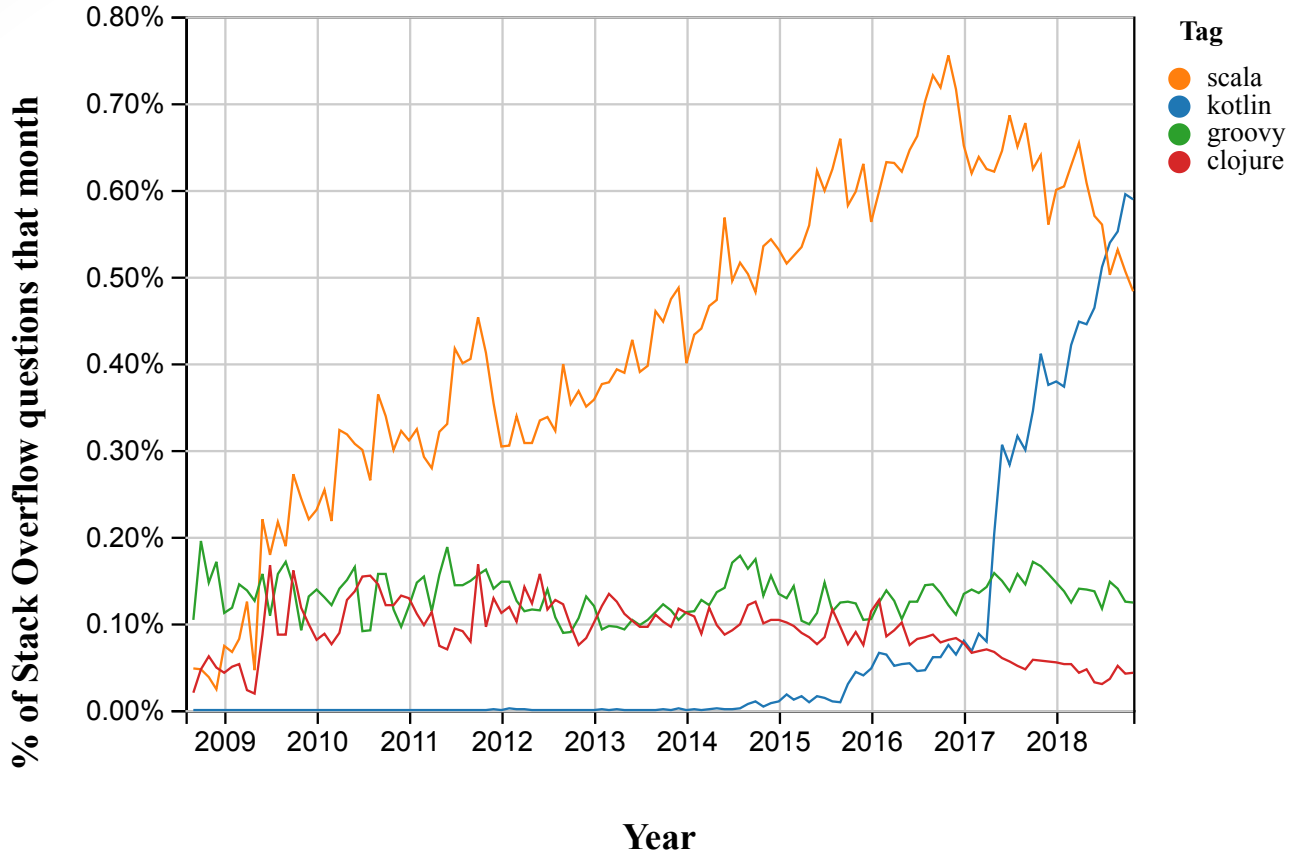
Partager du code avec iOS

WebAssembly

Bilan

- 💎 JVM
- 😎 Le byte code c'est cool
- 🔮 Généralement, ça ne suffit pas pour prédire les performances
- 📏 Mesurez !

Tendance



- Stackoverflow insights <https://insights.stackoverflow.com/trends?tags=kotlin%2Cscala%2Cgroovy%2Cclojure>

Kotlin vs Java

C'est déjà mature

✊ Code plus expressif, plus sûr, plus simple

🤝 Interopérable avec Java

👍 Outillage (éditeur, gradle, maven)

👍 Ecosystème et communauté

🚀 Évolution rapide

🐣 Code multiplatform

DSL

> *"Kotlin réussit une belle alchimie entre pragmatisme, puissance, sûreté, accessibilité.*

Merci

Questions ?