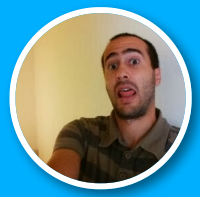

Deep Dive Kotlin :
du Hello World au
ByteCode



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<Monkey Patch/>

Roadmap

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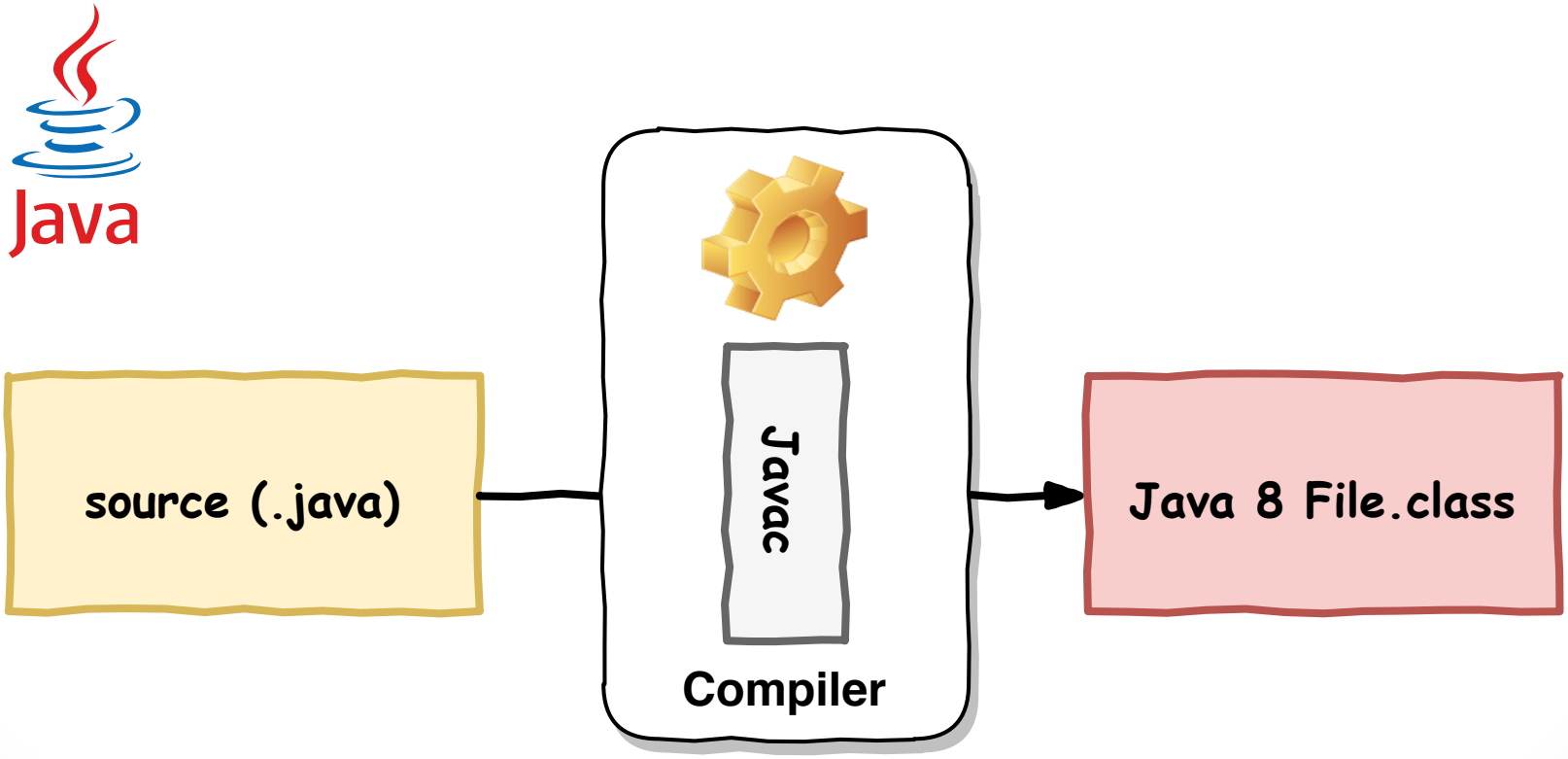
ByteCode Java ?

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  |................|
00000160  01 00 01 00 00 00 05 2a  b7 00 01 b1 00 00 00 01  |.......*........|
00000170  00 0a 00 00 00 06 00 01  00 00 00 03 00 09 00 0b  |................|
00000180  00 0c 00 01 00 09 00 00  00 25 00 02 00 01 00 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;)V
       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`, ...)

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

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

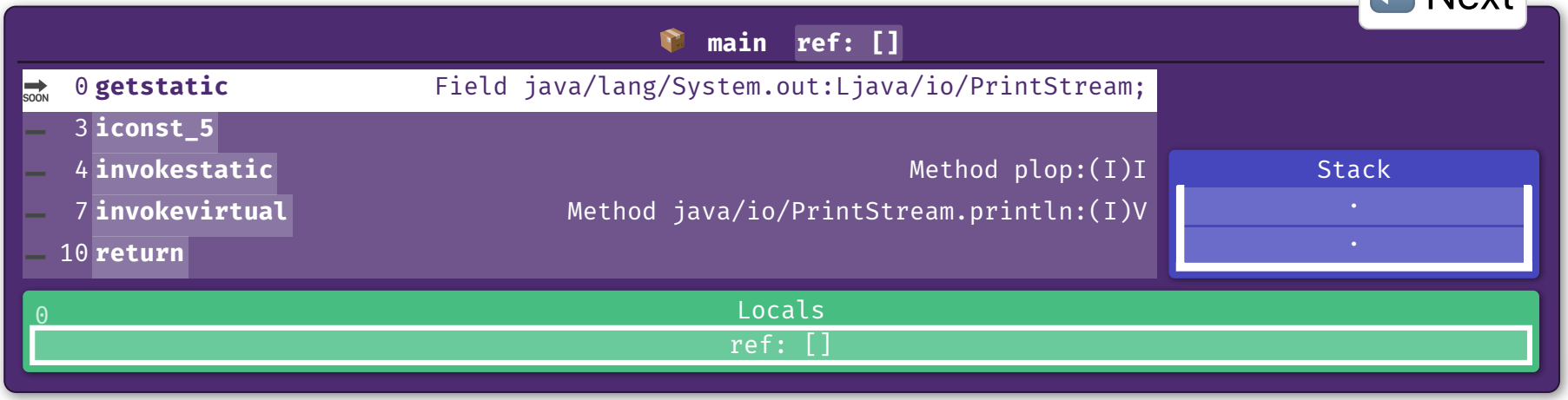
Autres (`athrow`, ...)

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
corountine-flow
v1.4 ?
???
2011 - 2015
2016
2017
2018
2019
...
v1.0
Support annoncé par Spring
v1.3
Coroutine stable
Kotlin Native beta
Kotlin Foundation

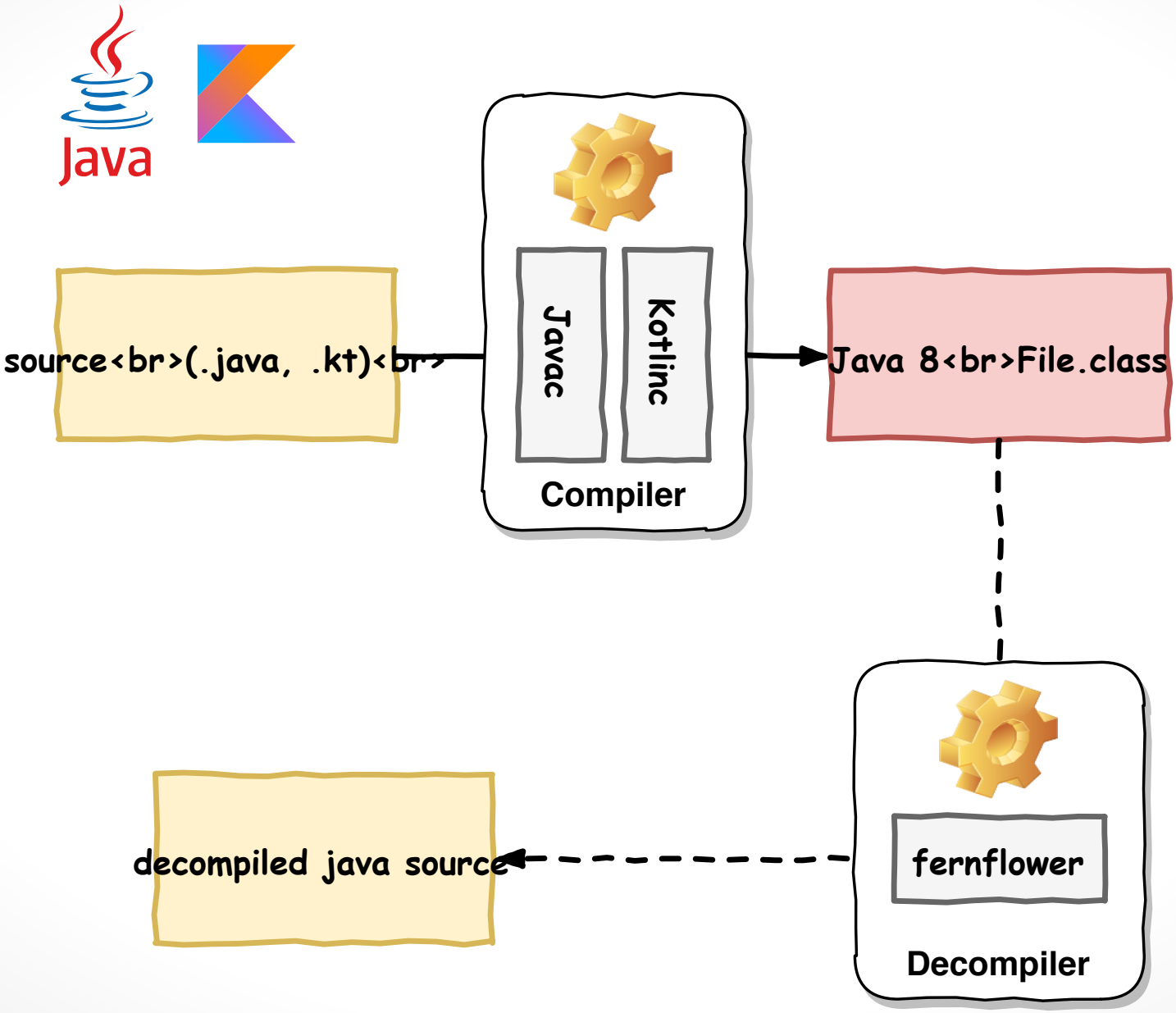
Cibles

HelloWorld.kt


```kotlin
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 2b 01 00 0c 48 65 6c  |.......2.+ ... Hel|
00000010  6c 6f 57 6f 72 6c 64 4b  74 07 00 01 01 00 10 6a  |loWorldKt......j|
00000020  61 76 61 2f 6c 61 6e 67  2f 4f 62 6a 65 63 74 07  |ava/lang/Object.|
00000030  00 03 01 00 04 6d 61 69  6e 01 00 03 28 29 56 01  |.....main ... ()V.|
00000040  00 16 28 5b 4c 6a 61 76  61 2f 6c 61 6e 67 2f 53  |..([Ljava/lang/S|
00000050  74 72 69 6e 67 3b 29 56  0c 00 05 00 06 0a 00 02  |tring;)V........|
00000060  00 08 01 00 10 48 65 6c  6c 6f 20 52 69 76 69 65  |.....Hello Rivie|
00000070  72 61 44 65 76 08 00 0a  01 00 10 6a 61 76 61 2f  |raDev......java/|
00000080  6c 61 6e 67 2f 53 79 73  74 65 6d 07 00 0c 01 00  |lang/System.....|
00000090  03 6f 75 74 01 00 15 4c  6a 61 76 61 2f 69 6f 2f  |.out ... Ljava/io/|
000000a0  50 72 69 6e 74 53 74 72  65 61 6d 3b 0c 00 0e 00  |PrintStream;....|
000000b0  0f 09 00 0d 00 10 01 00  13 6a 61 76 61 2f 69 6f  |.........java/io|
000000c0  2f 50 72 69 6e 74 53 74  72 65 61 6d 07 00 12 01  |/PrintStream....|
000000d0  00 07 70 72 69 6e 74 6c  6e 01 00 15 28 4c 6a 61  |..println ... (Lja|
000000e0  76 61 2f 6c 61 6e 67 2f  4f 62 6a 65 63 74 3b 29  |va/lang/Object;)|
000000f0  56 0c 00 14 00 15 0a 00  13 00 16 01 00 11 4c 6b  |V.............Lk|
00000100  6f 74 6c 69 6e 2f 4d 65  74 61 64 61 74 61 3b 01  |otlin/Metadata;.|
00000110  00 02 6d 76 03 00 00 00  01 03 00 00 00 0f 01 00  |..mv............|
00000120  02 62 76 03 00 00 00 00  03 00 00 00 03 01 00 01  |.bv.............|
00000130  6b 03 00 00 00 02 01 00  02 64 31 01 00 13 c0 80  |k........d1.....|
00000140  06 0a c0 80 0a 02 10 02  1a 06 10 c0 80 1a 02 30  |...............0|
00000150  01 01 00 02 64 32 01 00  00 01 00 0d 48 65 6c 6c  |....d2......Hell|
00000160  6f 57 6f 72 6c 64 2e 6b  74 01 00 04 43 6f 64 65  |oWorld.kt ... Code|
00000170  01 00 0f 4c 69 6e 65 4e  75 6d 62 65 72 54 61 62  | ... LineNumberTab|
00000180  6c 65 01 00 0a 53 6f 75  72 63 65 46 69 6c 65 01  |le ... SourceFile.|
00000190  00 14 53 6f 75 72 63 65  44 65 62 75 67 45 78 74  |..SourceDebugExt|
000001a0  65 6e 73 69 6f 6e 01 00  19 52 75 6e 74 69 6d 65  |ension ... Runtime|
```

Java ByteCode


```
Compiled from "HelloWorld.kt"
public final class HelloWorldKt {
  public static final void main();
    Code:
       0: ldc           #11                 // String Hello RivieraDev
       2: astore_0
       3: iconst_0
       4: istore_1
       5: getstatic     #17                 // Field java/lang/System.out:Ljava/io/PrintStream;
       8: aload_0
       9: invokevirtual #23                 // Method java/io/PrintStream.println:(Ljava/lang/Object;)V
      12: return

  public static void main(java.lang.String[]);
    Code:
       0: invokestatic  #9                  // Method main:()V
       3: return
}
```

HelloWorld-java


```java
import kotlin.Metadata;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\b\n\u0000\n\u0002\u0010\u0002\n\u0000\u001a\u0006\u0010\u0000\u001a\u00020\u0001¨\u00
        d2 = {"main", "", "kotlinDee"}
)
public final class HelloWorldKt {
   public static final void main() {
      String var0 = "Hello RivieraDev";
      boolean var1 = false;
      System.out.println(var0);
   }

   // $FF: synthetic method
   public static void main(String[] var0) {
      main();
   }
}
```

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

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} ${who.lastName}!")
    println("""
        multi
        line "$who"
        string""".trimIndent())
}
```

string-template.java


```java
import kotlin.Metadata;
import kotlin.jvm.internal.Intrinsics;
import kotlin.text.StringsKt;
import org.jetbrains.annotations.NotNull;

@Metadata(
         mv = {1, 1, 15},
         bv = {1, 0, 3},
         k = 2,
         d1 = {"\u0000\u000e\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u0002\u0018\u0002\n\u0000\u001a\u000e\u00
         d2 = {"greeting", "", "who", "LSomeone;", "kotlinDee"}
)
public final class GreetingKt {
   public static final void greeting(@NotNull Someone who) {
      Intrinsics.checkParameterIsNotNull(who, "who");
      String var1 = "Hello " + who + '!';
      boolean var2 = false;
      System.out.println(var1);
      var1 = "Hello " + who.getFirstName() + ' ' + who.getLastName() + '!';
      var2 = false;
      System.out.println(var1);
      var1 = StringsKt.trimIndent("\n        multi\n        line \"" + who + "\"\n        string");
      var2 = false;
      System.out.println(var1);
   }
}
```

ByteCode de string-template


```
Compiled from "greeting.kt"
public final class GreetingKt {
  public static final void greeting(Someone);
    Code:
       0: aload_0
       1: ldc           #9                  // String who
       3: invokestatic  #15                 // Method kotlin/jvm/internal/Intrinsics.checkParameterIsNotNul
       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/String;)Lj
      18: aload_0
      19: invokevirtual #30                 // Method java/lang/StringBuilder.append:(Ljava/lang/Object;)Lj
      22: bipush        33
      24: invokevirtual #33                 // Method java/lang/StringBuilder.append:(C)Ljava/lang/StringBu
      27: invokevirtual #37                 // Method java/lang/StringBuilder.toString:()Ljava/lang/String;
      30: astore_1
      31: iconst_0
      32: istore_2
      33: getstatic     #43                 // Field java/lang/System.out:Ljava/io/PrintStream;
      36: aload_1
      37: invokevirtual #49                 // Method java/io/PrintStream.println:(Ljava/lang/Object;)V
      40: new           #17                 // class java/lang/StringBuilder
      43: dup
      44: invokespecial #21                 // Method java/lang/StringBuilder."<init>":()V
      47: ldc           #23                 // String Hello
```

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

numeric.java


```java
import kotlin.Metadata;
import org.jetbrains.annotations.Nullable;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\u001a\n\u0000\n\u0002\u0010\u0006\n\u0002\b\u0006\n\u0002\u0010\t\n\u0002\b\u0003\n\u
        d2 = {"aDouble", "", "getADouble", "()Ljava/lang/Double;", "setADouble", "(Ljava/lang/Double;)V", "
)
public final class NumericKt {
   private static final int anInt = 42;
   private static final long aLong = 42L;
   @Nullable
   private static Double aDouble;

   public static final int getAnInt() {
      return anInt;
   }

   public static final long getALong() {
      return aLong;
   }

   @Nullable
   public static final Double getADouble() {
      return aDouble;
```

ByteCode de numeric


```
Compiled from "numeric.kt"
public final class NumericKt {
  public static final int getAnInt();
    Code:
       0: getstatic     #11                 // Field anInt:I
       3: ireturn

  public static final long getALong();
    Code:
       0: getstatic     #19                 // Field aLong:J
       3: lreturn

  public static final java.lang.Double getADouble();
    Code:
       0: getstatic     #26                 // Field aDouble:Ljava/lang/Double;
       3: areturn

  public static final void setADouble(java.lang.Double);
    Code:
       0: aload_0
       1: putstatic     #26                 // Field aDouble:Ljava/lang/Double;
       4: return

  static {};
    Code:
       0: bipush        42
       2: putstatic     #11                 // Field anInt:I
```

C'est simple

Plus de `;` *

😍 String templating

😘 Plus de types primitifs (avant la compilation)

🧐 Inférence de type

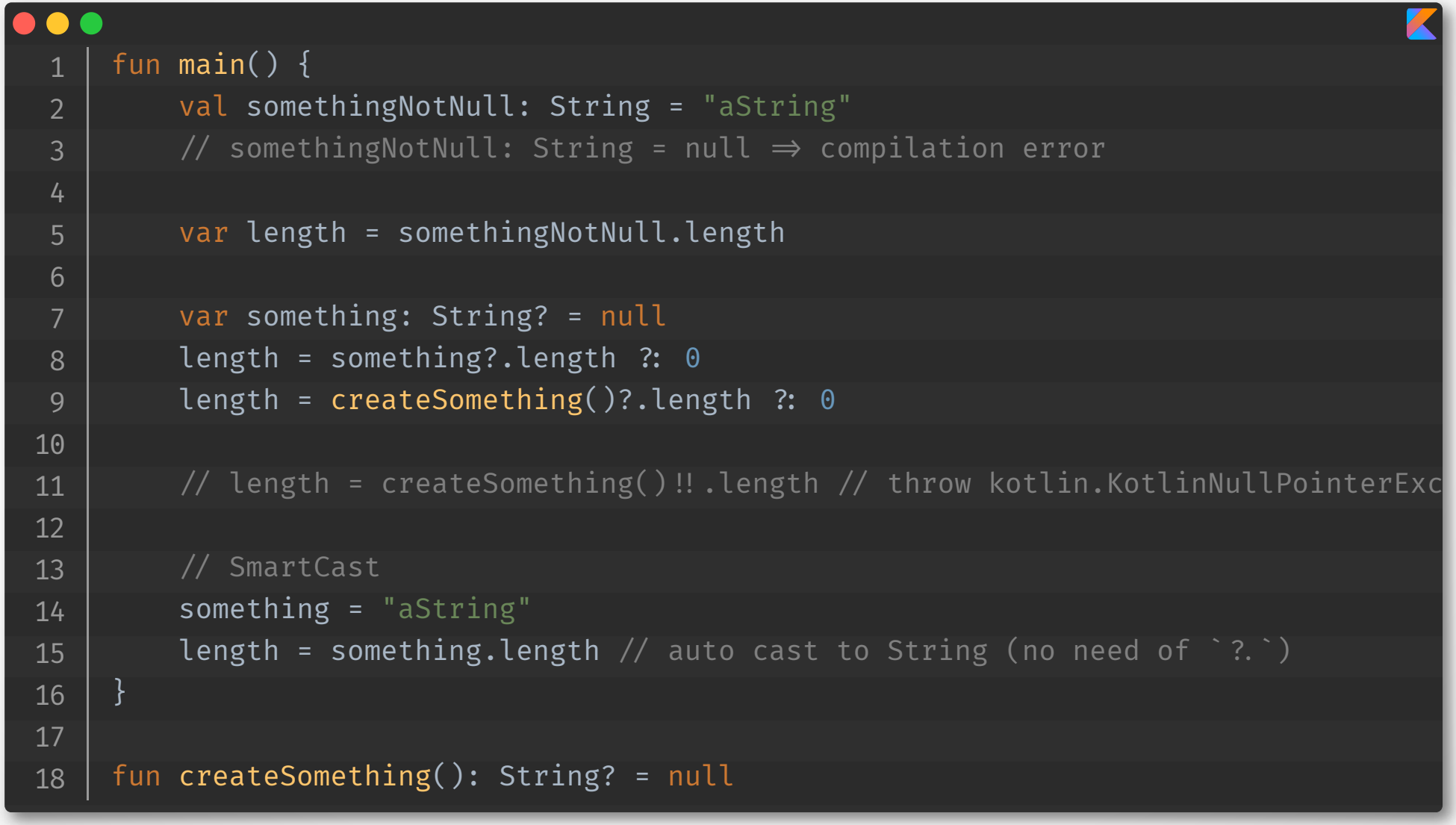
🤝 On peut mélanger du code Java et Kotlin

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() {
    val somethingNotNull: String = "aString"
    // somethingNotNull: String = null ⇒ compilation error

    var length = somethingNotNull.length

    var something: String? = null
    length = something?.length ?: 0
    length = createSomething()?.length ?: 0

    // length = createSomething()!!.length // throw kotlin.KotlinNullPointerExc

    // SmartCast
    something = "aString"
    length = something.length // auto cast to String (no need of `?.`)
}

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

null-safety.java


```java
import kotlin.Metadata;
import org.jetbrains.annotations.Nullable;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\u000e\n\u0000\n\u0002\u0010\u000e\n\u0000\n\u0002\u0010\u0002\n\u0000\u001a\b\u0010\u
        d2 = {"createSomething", "", "main", "", "kotlinDee"}
)
public final class Null_safetyKt {
   public static final void main() {
      String somethingNotNull = "aString";
      int length = somethingNotNull.length();
      String something = (String)null;
      int length = false;
      String var10000 = createSomething();
      length = var10000 ≠ null ? var10000.length() : 0;
      something = "aString";
      length = something.length();
   }

   // $FF: synthetic method
   public static void main(String[] var0) {
      main();
   }

```

Bilan null-safety

🎸 Elvis operator: `?:`

🙌 plus de `NullPointerException`

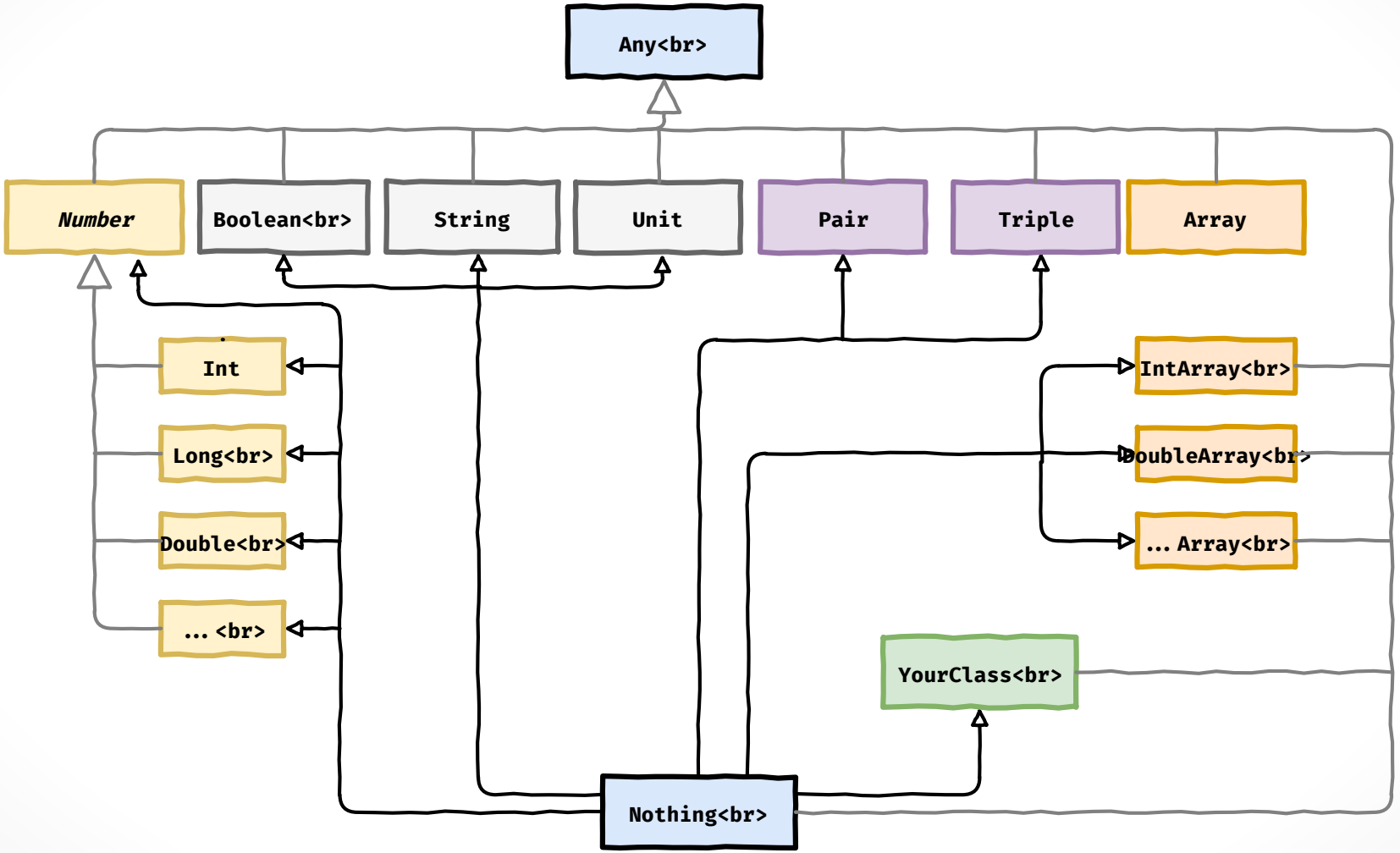
⚠️ quand on appelle du Java

➽ Le compilateur Kotlin peut interpréter des annotions de nullabilité (JSR-305, Android, ...) <https://kotlinlang.org/docs/reference/java-interop.html#nullability-annotations>

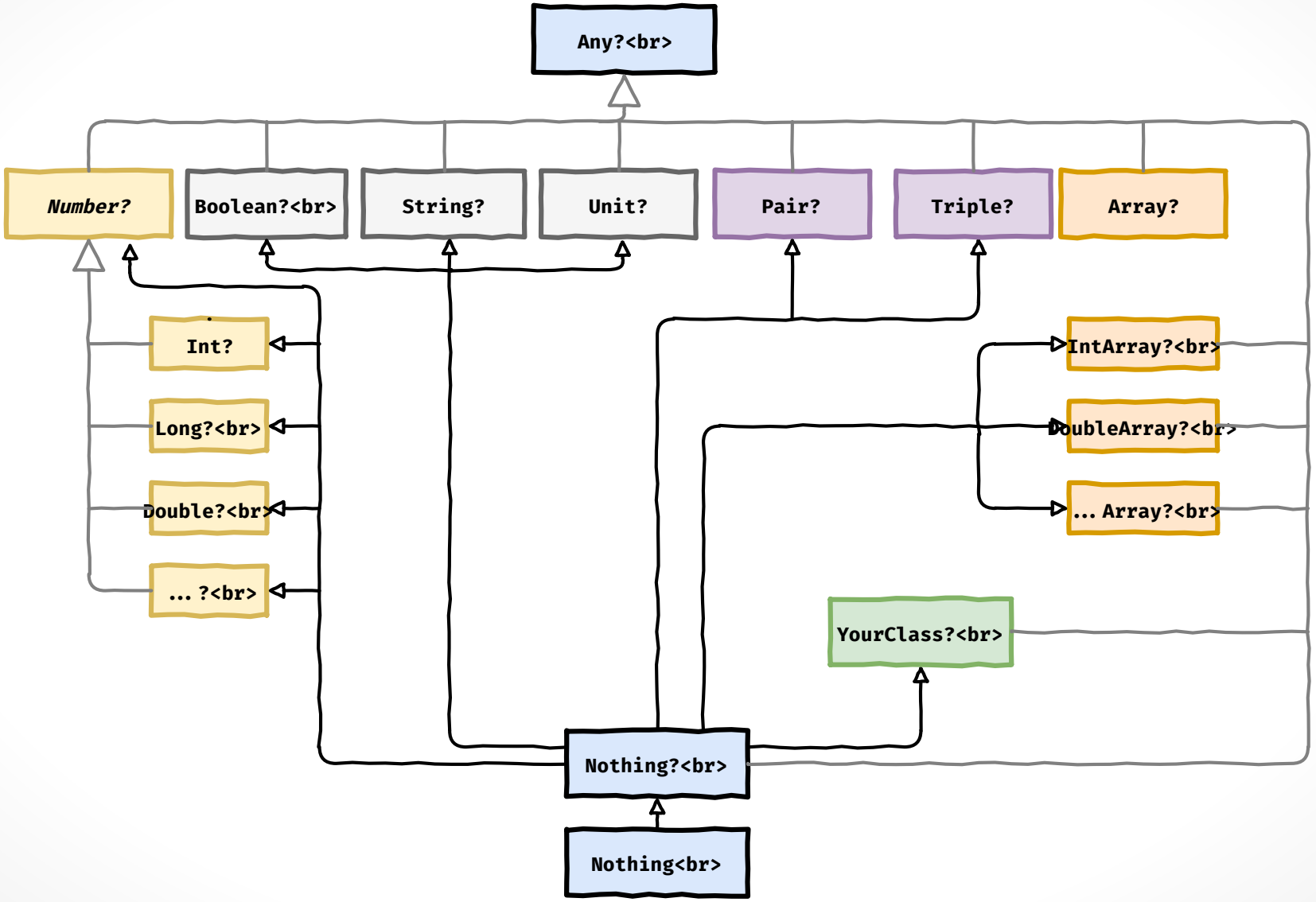
Pas de `Optional`, si nécessaire voir ➽ Arrow <https://arrow-kt.io/>

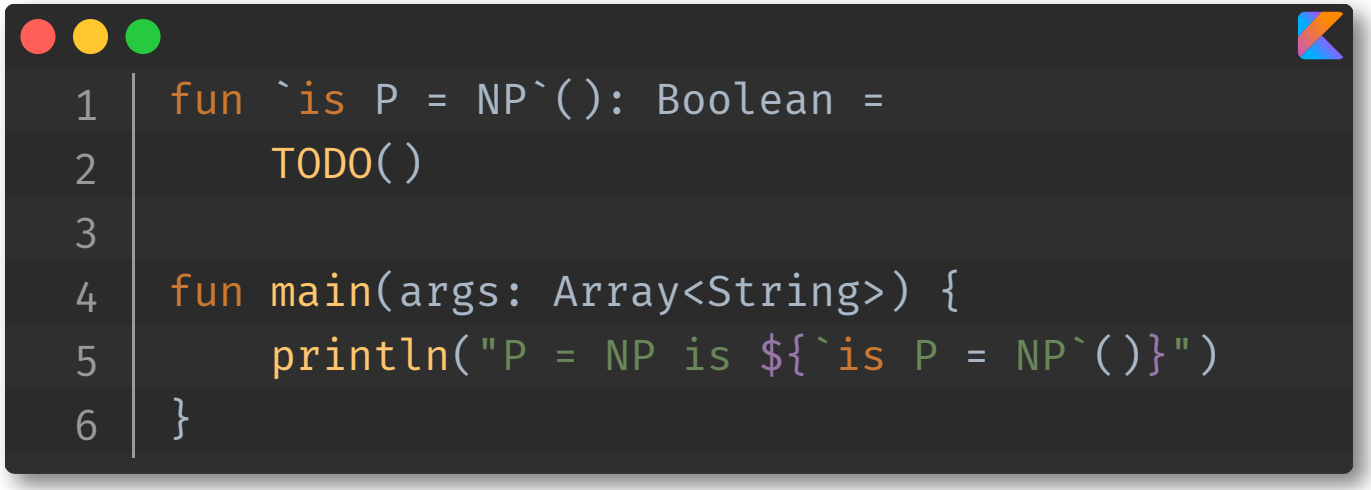
Les types

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

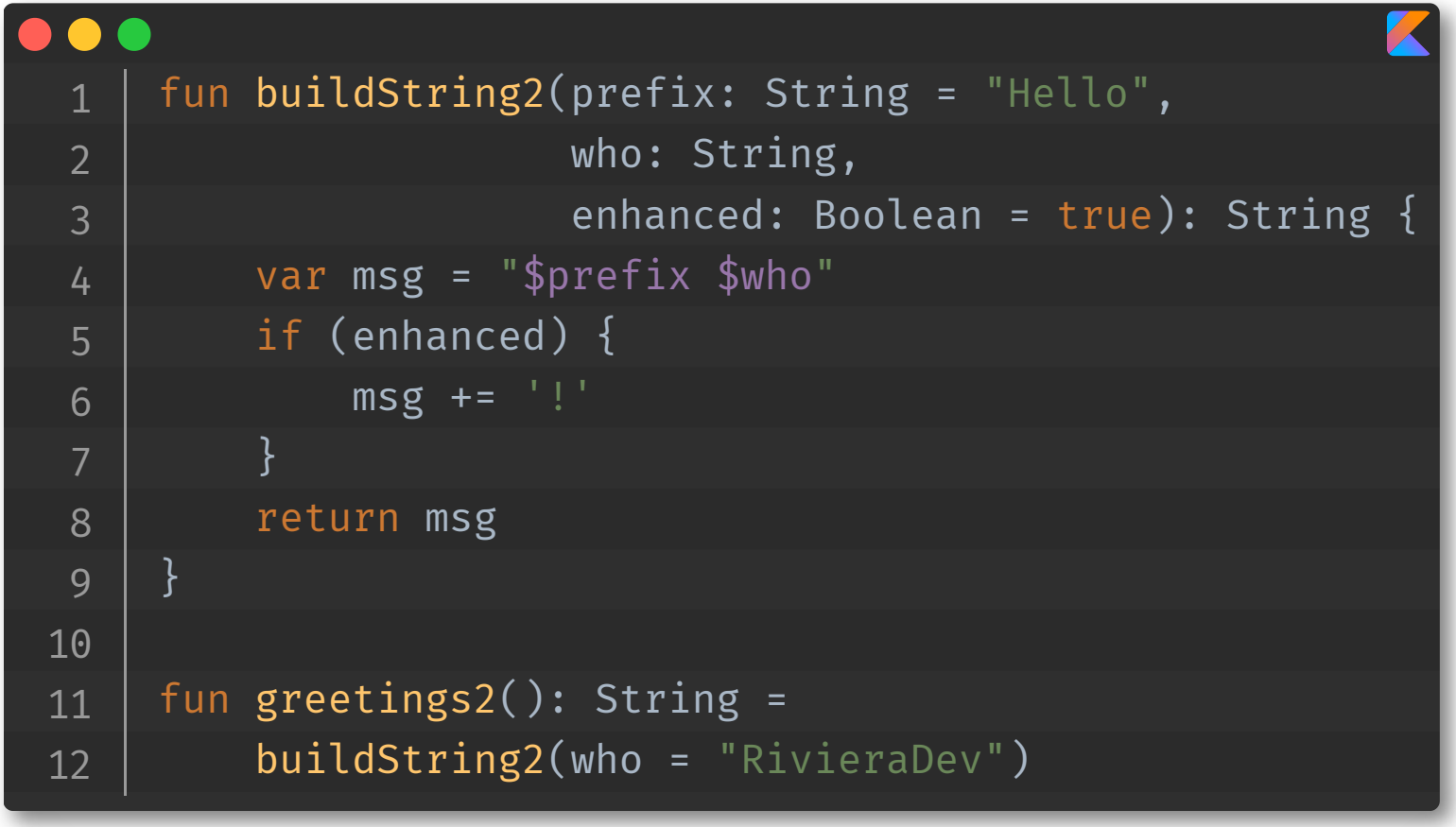
Les fonctions

```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


```java
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\u0012\n\u0000\n\u0002\u0010\u000e\n\u0002\b\u0003\n\u0002\u0010\u000b\n\u0002\b\u0002
        d2 = {"buildString", "", "prefix", "who", "enhanced", "", "greetings", "kotlinDee"}
)
public final class Named_paramsKt {
   @NotNull
   public static final String buildString(@NotNull String prefix, @NotNull String who, boolean enhanced) {
      Intrinsics.checkParameterIsNotNull(prefix, "prefix");
      Intrinsics.checkParameterIsNotNull(who, "who");
      String msg = prefix + ' ' + who;
      if (enhanced) {
         msg = msg + '!';
      }

      return msg;
   }

   @NotNull
   public static final String greetings() {
      String var0 = "Hello";
```

default-value.kt



```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")
```

Comment ça marche


```kotlin
// In my-app.jar
fun main() {
    println(compute())
}

// In lib-v1.0.0
fun compute(result: Int = 1) = result

// In lib-v1.0.1
fun compute(result: Int = 42) = result
```

Compile `my-app` avec `lib-v1.0.0`

```
java my-app.jar -cp lib-v1.0.0.jar
```

```
java my-app.jar -cp lib-v1.0.1.jar
```

Résultat ?

default-value.java


```java
import kotlin.Metadata;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\b\n\u0000\n\u0002\u0010\u0002\n\u0000\u001a\u0006\u0010\u0000\u001a\u00020\u0001¨\u00
        d2 = {"main", "", "kotlinDee"}
)
public final class My_appKt {
    public static final void main() {
        int var0 = LibKt.compute$default(0, 1, (Object)null);
        boolean var1 = false;
        System.out.println(var0);
    }

    // $FF: synthetic method
    public static void main(String[] var0) {
        main();
    }
}
```

ByteCode de default-value


```java
import kotlin.Metadata;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\n\n\u0000\n\u0002\u0010\b\n\u0002\b\u0002\u001a\u0010\u0010\u0000\u001a\u00020\u00012
        d2 = {"compute", "", "result", "kotlinDee"}
)
public final class LibKt {
    public static final int compute(int result) {
        return result;
    }

    // $FF: synthetic method
    public static int compute$default(int var0, int var1, Object var2) {
        if ((var1 & 1) ≠ 0) {
            var0 = 42;
        }

        return compute(var0);
    }
}
```

Kotlin c'est fun !

Toujours typer le retour de vos fonctions

(sauf si c'est évident et une surcharge comme le `toString`)

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

Les lambdas

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

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

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

// store function reference
val sumLam = ::sumf

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

function.java

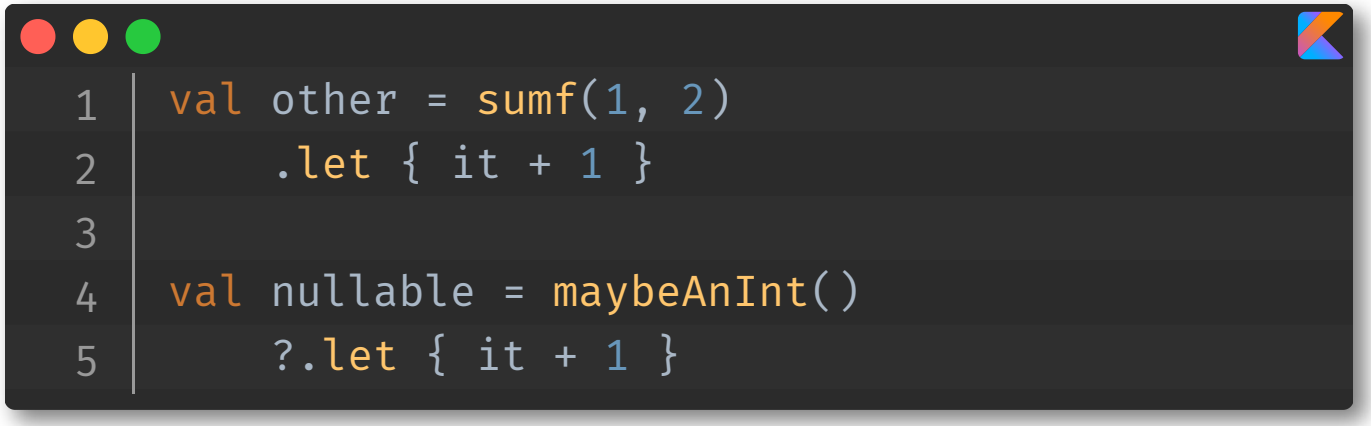

```java
import kotlin.Metadata;
import kotlin.jvm.functions.Function2;
import kotlin.jvm.internal.Intrinsics;
import kotlin.reflect.KFunction;
import org.jetbrains.annotations.NotNull;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\u001e\n\u0000\n\u0002\u0010\b\n\u0002\b\u0005\n\u0002\u0018\u0002\n\u0002\u0018\u0002
        d2 = {"sum5", "", "getSum5", "()I", "sum6", "getSum6", "sumLam", "Lkotlin/reflect/KFunction2;", "Lk
)
public final class FunctionKt {
   private static final int sum5;
   @NotNull
   private static final KFunction sumLam;
   private static final int sum6;

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

   public static final int sumf(int x, int y) {
      return x + y;
   }
```

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

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

// call compute with lamda
val sum4 = compute(1, 3) { x, y ->
    x + y
}
```

lambda.java


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

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\u0012\n\u0000\n\u0002\u0010\b\n\u0002\b\u0005\n\u0002\u0018\u0002\n\u0002\b\u0003\"\u
        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;
   }

   public static final int getSum3() {
      return sum3;
   }

   public static final int getSum4() {
```

let.kt



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

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

let.java


```java
import kotlin.Metadata;
import org.jetbrains.annotations.Nullable;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\n\n\u0000\n\u0002\u0010\b\n\u0002\b\u0007\"\u0015\u0010\u0000\u001a\u0004\u0018\u0001
        d2 = {"nullable", "", "getNullable", "()Ljava/lang/Integer;", "Ljava/lang/Integer;", "other", "getO
)
public final class LetKt {
   private static final int other;
   @Nullable
   private static final Integer nullable;

   public static final int getOther() {
      return other;
   }

   @Nullable
   public static final Integer getNullable() {
      return nullable;
   }

   static {
      int var0 = FunctionKt.sumf(1, 2);
      boolean var1 = false;
```

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

astronomy.kt

```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 moon = Moon(name = "Moon")
    val earth = Planet(name = "Earth") + moon

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

```

astronomy.java


```java
import java.util.Collection;
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;
import org.jetbrains.annotations.Nullable;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 1,
        d1 = {"\u00000\n\u0002\u0018\u0002\n\u0002\u0018\u0002\n\u0000\n\u0002\u0010\u000e\n\u0000\n\u0002\
        d2 = {"LPlanet;", "LAstronomicalBody;", "name", "", "moons", "", "LMoon;", "(Ljava/lang/String;Ljav
)
public final class Planet implements AstronomicalBody {
   @NotNull
   private final String name;
   @NotNull
   private final List moons;

   @NotNull
   public final Planet plus(@NotNull Moon moon) {
      Intrinsics.checkParameterIsNotNull(moon, "moon");
      return copy$default(this, (String)null, CollectionsKt.plus((Collection)this.moons, moon), 1, (Object)
   }
```

Héritage en Kotlin


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

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

// Inherit SmallBody
data class Asteroid(val name: String): SmallBody() {
    override 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`

Projection `*` correspondant à `Any?` ou `Nothing`

Borne supérieure

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

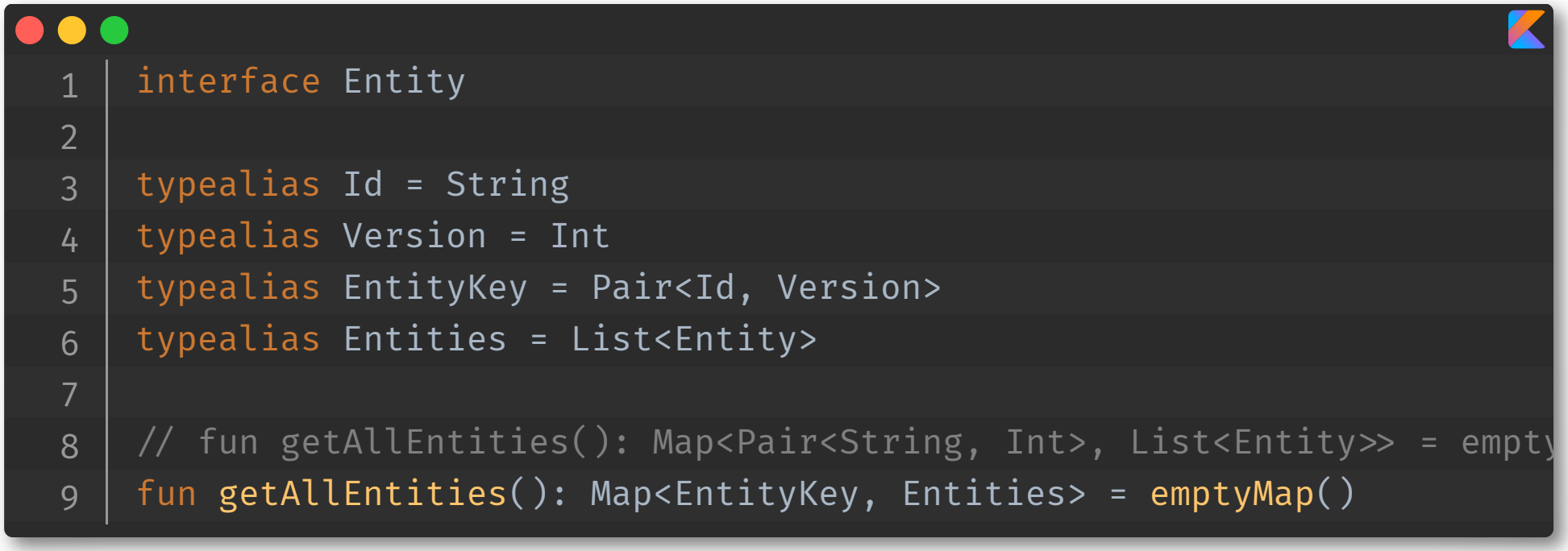
Les détails: ➳ https://kotlinlang.org/docs/reference/generics.html

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

Sealed


```kotlin
sealed class JsonValue

data class JsonObject(val attributes: Map<String, JsonValue>) : JsonV
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>
typealias Entities = List<Entity>

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

ByteCode d'alias


```
Compiled from "typealias.kt"
public final class TypealiasKt {
  public static final java.util.Map<kotlin.Pair<java.lang.String, java.lang.Integer>, java.util.List<Entity
    Code:
       0: invokestatic  #13                 // Method kotlin/collections/MapsKt.emptyMap:()Ljava/util/Map;
       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>

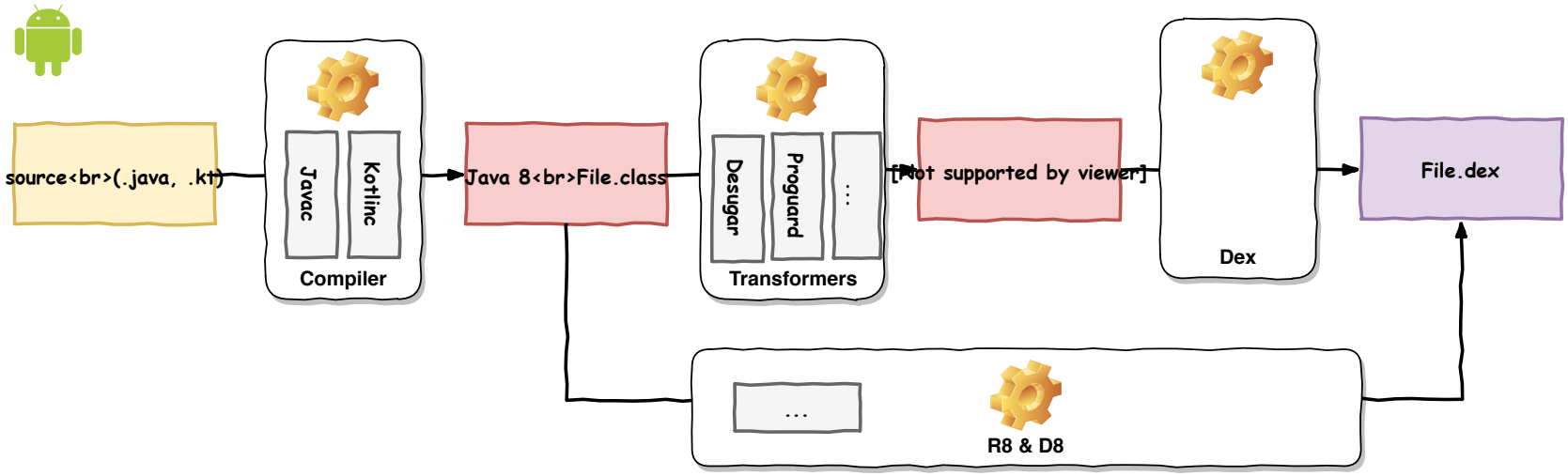
Une seule classe par fichier n'est pas utile

🤓 `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>

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

```
1  00000000  64 65 78 0a 30 33 35 00  06 50 f0 61 50 10 7c c0  |dex.035..P.aP.|.|
2  00000010  b2 f9 77 2d 54 df 60 f3  ac dd b0 10 eb 55 53 e1  |..w-T.`......US.|
3  00000020  28 f6 10 00 70 00 00 00  78 56 34 12 00 00 00 00  |(...p...xV4.....|
4  00000030  00 00 00 00 4c f5 10 00  12 17 00 00 70 00 00 00  |....L.......p...|
5  00000040  31 03 00 00 b8 5c 00 00  2a 08 00 00 7c 69 00 00  |1....\..*...|i..|
6  00000050  30 03 00 00 74 cb 00 00  20 1a 00 00 f4 e4 00 00  |0...t... .......|
7  00000060  75 02 00 00 f4 b5 01 00  94 f1 0e 00 94 04 02 00  |u...............|
8  00000070  4a f1 07 00 4c f1 07 00  75 f1 07 00 a4 f1 07 00  |J...L...u.......|
9  00000080  c2 f1 07 00 e0 f1 07 00  00 f2 07 00 23 f2 07 00  |............#...|
10 00000090  71 f2 07 00 b9 f2 07 00  07 f3 07 00 37 f3 07 00  |q...........7...|
11 000000a0  69 f3 07 00 90 f3 07 00  bc f3 07 00 e3 f3 07 00  |i...............|
12 000000b0  27 f4 07 00 71 f4 07 00  8f f4 07 00 ad f4 07 00  |'...q...........|
13 000000c0  cb f4 07 00 ed f4 07 00  0f f5 07 00 2c f5 07 00  |............,...|
14 000000d0  49 f5 07 00 79 f5 07 00  b1 f5 07 00 e9 f5 07 00  |I...y...........|
15 000000e0  1a f6 07 00 51 f6 07 00  7b f6 07 00 a6 f6 07 00  |....Q...{.......|
16 000000f0  d1 f6 07 00 0a f7 07 00  47 f7 07 00 84 f7 07 00  |........G.......|
17 00000100  c1 f7 07 00 02 f8 07 00  43 f8 07 00 84 f8 07 00  |........C.......|
18 00000110  f1 f8 07 00 12 f9 07 00  41 f9 07 00 6e f9 07 00  |........A...n...|
19 00000120  b0 f9 07 00 dd f9 07 00  0a fa 07 00 39 fa 07 00  |............9...|
20 00000130  68 fa 07 00 ab fa 07 00  e0 fa 07 00 25 fb 07 00  |h...........%...|
```

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      : 0x0011 (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        : 0x0019 (PUBLIC STATIC FINAL)
      code          -
      registers     : 2
      ins           : 1
      outs          : 2
      insns size    : 13 16-bit code units
020494:                                        |[020494] 00 helloworld.HelloWorldKt.main:([Ljava/lang/Stri
```

```
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/HelloWorldKt\n*L\n
.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\u0000\u001a
  }
  d2 = {
    "main",
    "",
    "args",
```

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

```kotlin
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)
    }
}
```

for-factorial.kt

```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 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 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
}
```

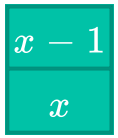
Récursion non terminale

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

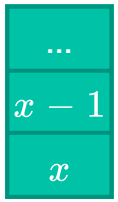
$fact(x)$

$x \times fact(x-1)$

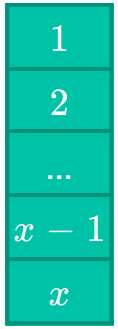
$x \times (x-1) \times fact(x-2)$



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



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



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)
}
```

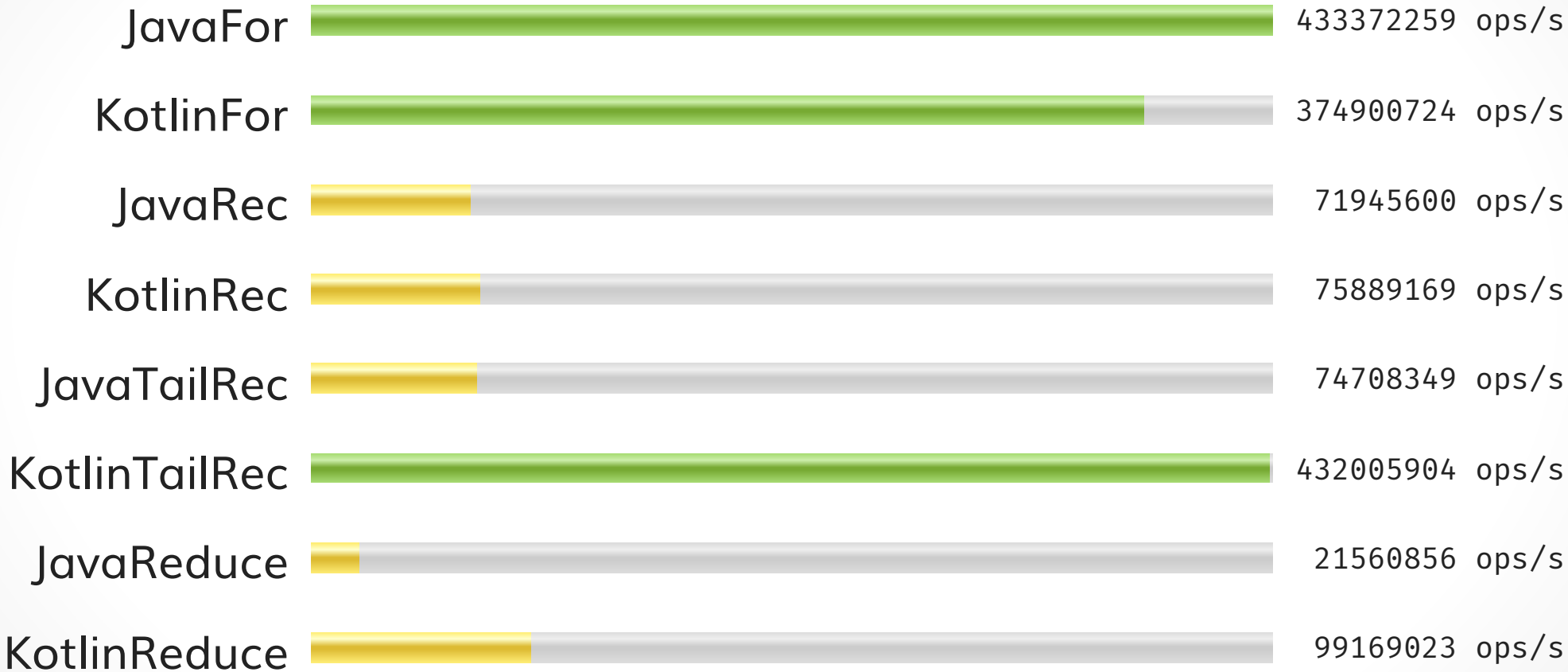
ByteCode factoriel avec recursivité terminale 1/2


```
public final class Tailrec_factorialKt {
  public static final int tailRecFactorial(int);
    Code:
       0: getstatic     #12                 // Field Tailrec_factorialKt$tailRecFactorial$1.INSTANCE:LTailr
       3: astore_1
       4: aload_1
       5: iload_0
       6: iconst_1
       7: invokevirtual #16                 // Method Tailrec_factorialKt$tailRecFactorial$1.invoke:(II)I
      10: ireturn
}
```

ByteCode factoriel avec recursivité terminale 2/2


```
Compiled from "tailrec-factorial.kt"
final class Tailrec_factorialKt$tailRecFactorial$1 extends kotlin.jvm.internal.Lambda implements kotlin.jvm
  public static final Tailrec_factorialKt$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/Integer;
      21: areturn

  public final int invoke(int, int);
    Code:
       0: iload_1
       1: iconst_1
       2: if_icmpge     9
       5: iload_2
       6: goto          25
       9: aload_0
      10: checkcast     #2                  // class Tailrec_factorialKt$tailRecFactorial$1
      13: pop
```

Performances sur 10!



Bilan structures

`when` peut être utilisé avec

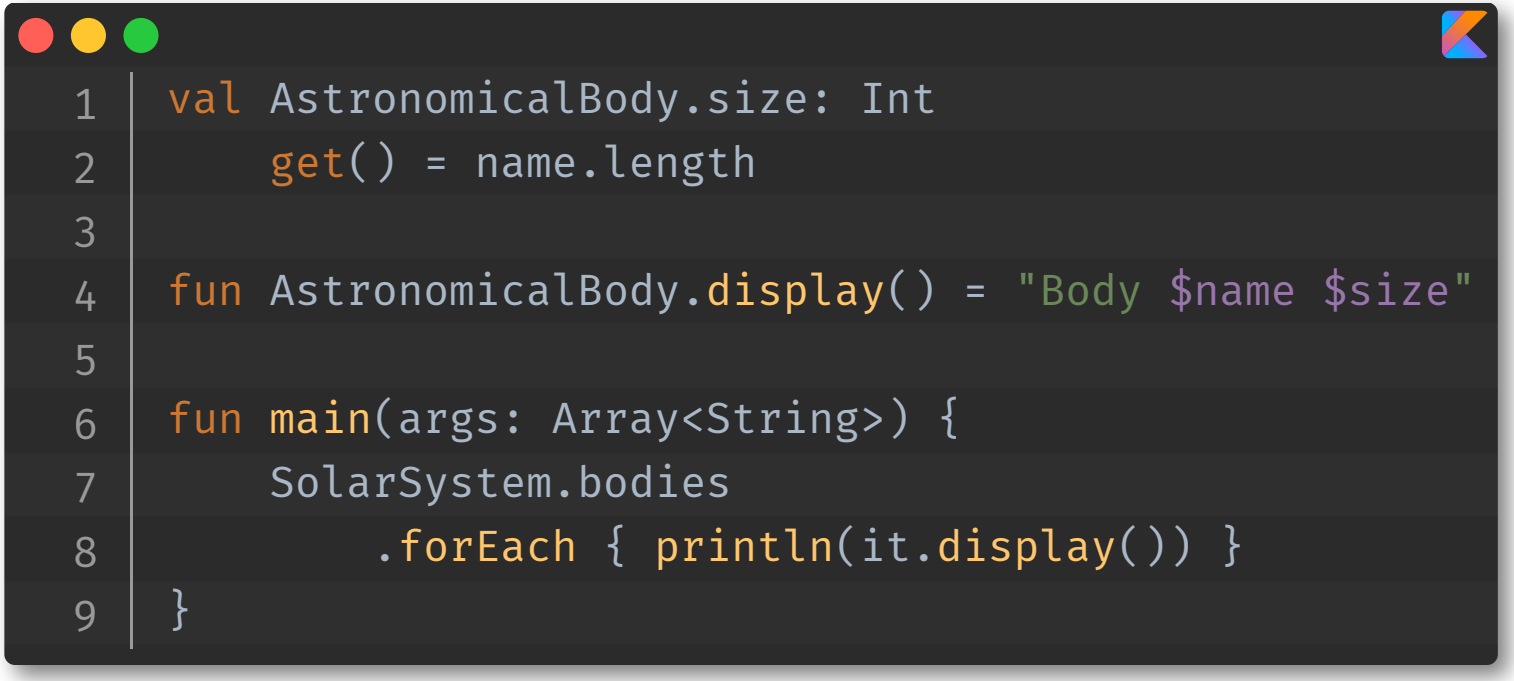
- des constantes
- plusieurs valeurs séparées par `,`
- une expression
- avec `is` et un type (avec un 'smart cast')

✨ 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
import java.util.Iterator;
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 \n\u0000\n\u0002\u0010\b\n\u0002\u0018\u0002\n\u0002\b\u0003\n\u0002\u0010\u0002\n\u0
        d2 = {"size", "", "LAstronomicalBody;", "getSize", "(LAstronomicalBody;)I", "main", "", "args", "",
)
public final class ExtensionKt {
   public static final int getSize(@NotNull AstronomicalBody $this$size) {
      Intrinsics.checkParameterIsNotNull($this$size, "$this$size");
      return $this$size.getName().length();
   }

   @NotNull
   public static final String display(@NotNull AstronomicalBody $this$display) {
      Intrinsics.checkParameterIsNotNull($this$display, "$this$display");
      return "Body " + $this$display.getName() + ' ' + getSize($this$display);
   }

   public static final void main(@NotNull String[] args) {
      Intrinsics.checkParameterIsNotNull(args, "args");
      Iterable $this$forEach$iv = (Iterable)SolarSystem.INSTANCE.getBodies();
```

Extension

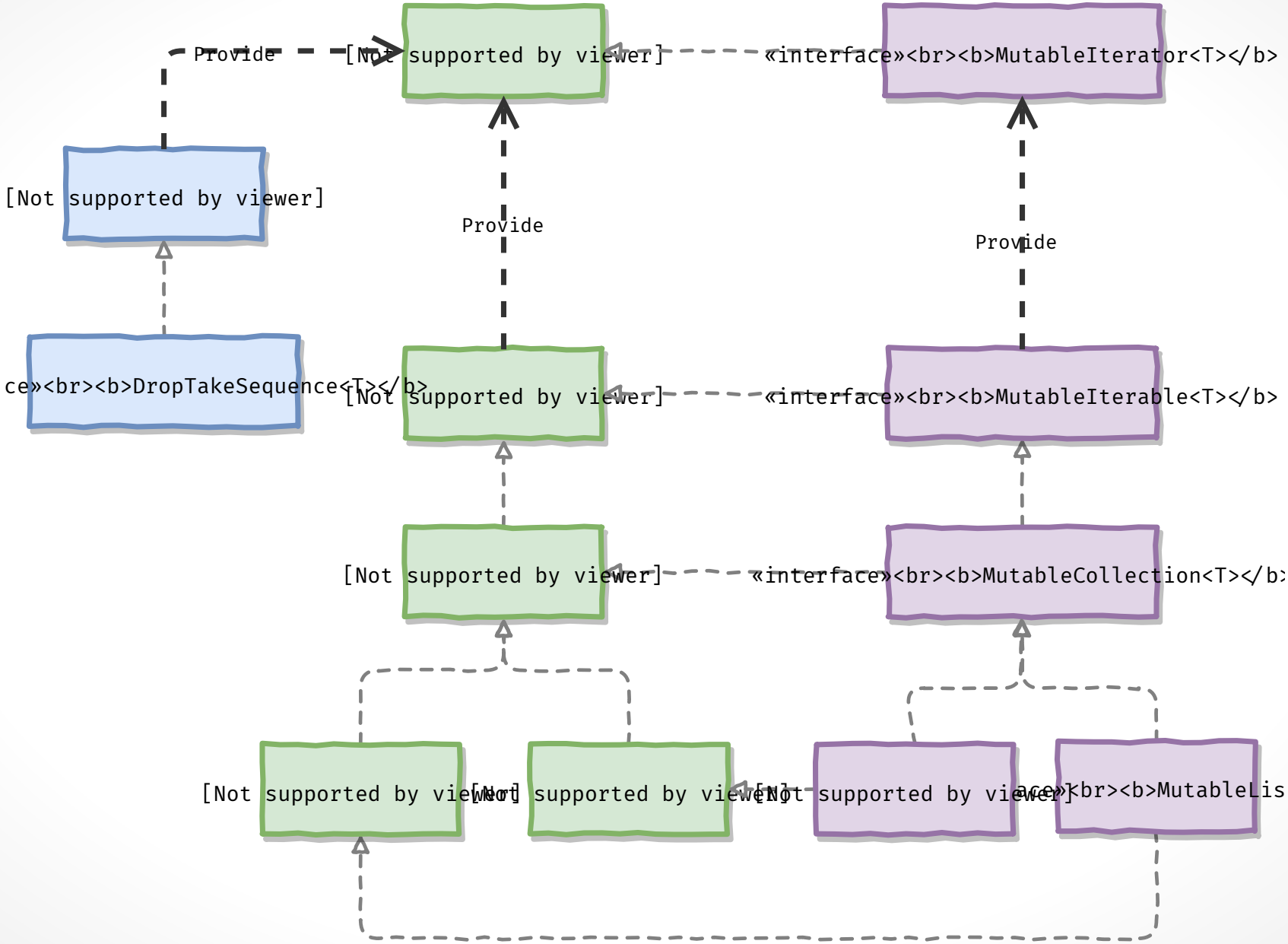
Permet d'enrichir les APIs Java

- ➳ Android KTX <https://developer.android.com/kotlin/ktx>
- ➳ Spring <https://docs.spring.io/spring/docs/current/spring-framework-reference/languages.html#kotlin-spring-projects-in-kotlin>
- ➳ RxKotlin <https://github.com/ReactiveX/RxKotlin>
- ...

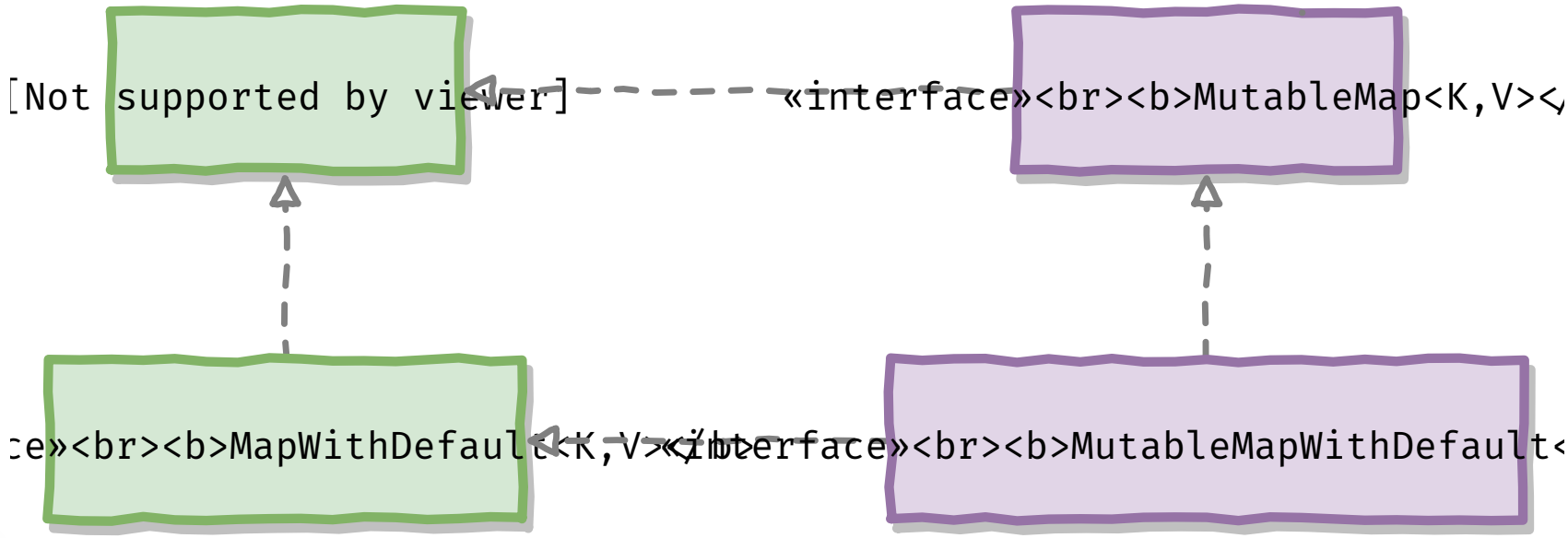
Permet la *SoC* (Separation of Concerns)

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)
```

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)
}
```

```kotlin
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

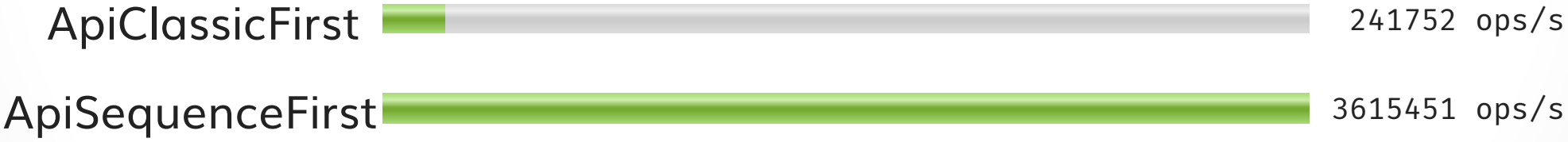
Benchmark	Mode	Cnt	Score	Error	Units
ApiClassic	thrpt	200	44535.029	3550.944	ops/s
ApiSequence	thrpt	200	23652.238	1967.535	ops/s

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



Bilan collection

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

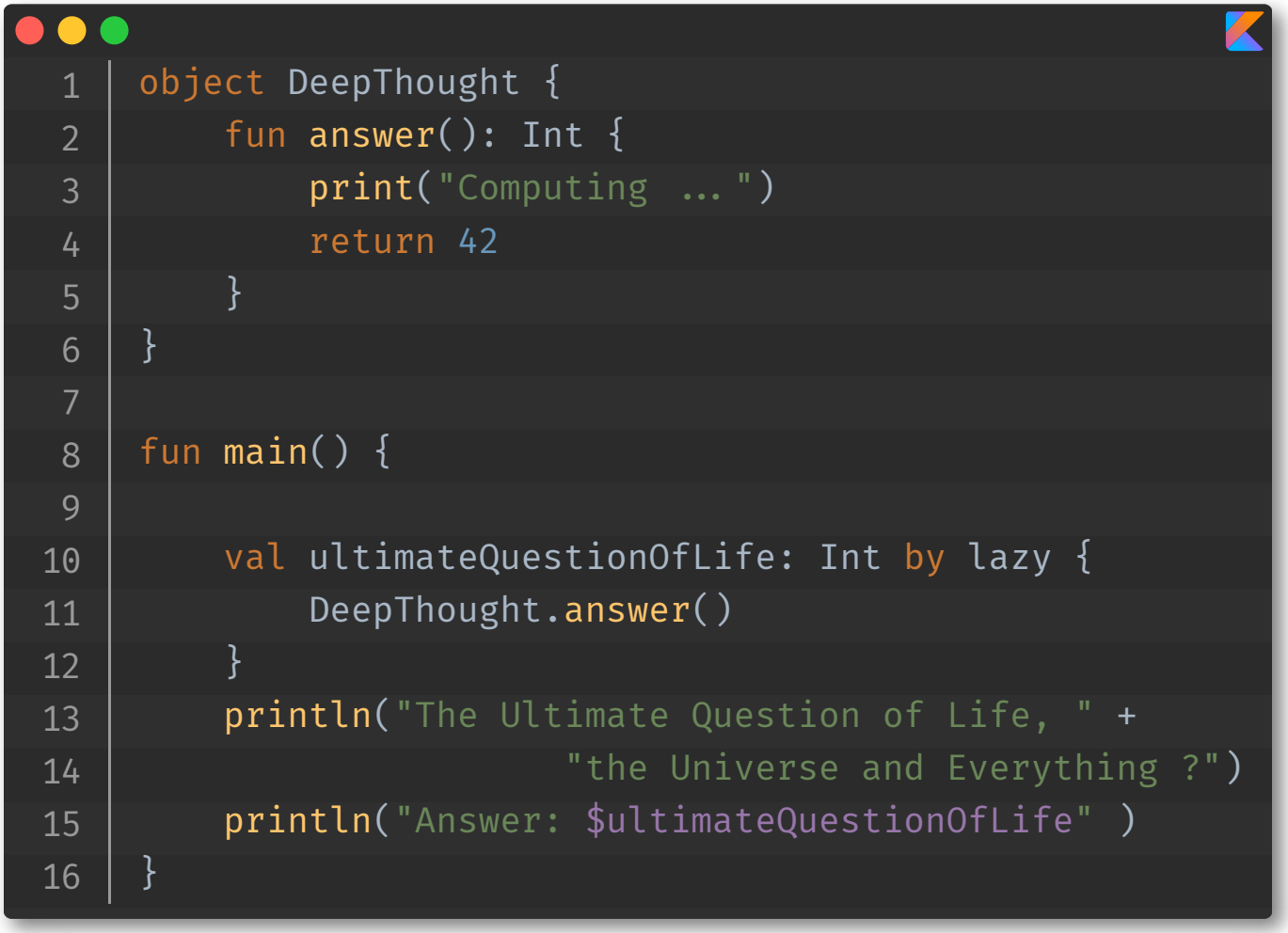
😐 Mais ça reste des collections Java

API standard avec `Range`, `Pair`, et `Triple`

📏 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 P
}
```

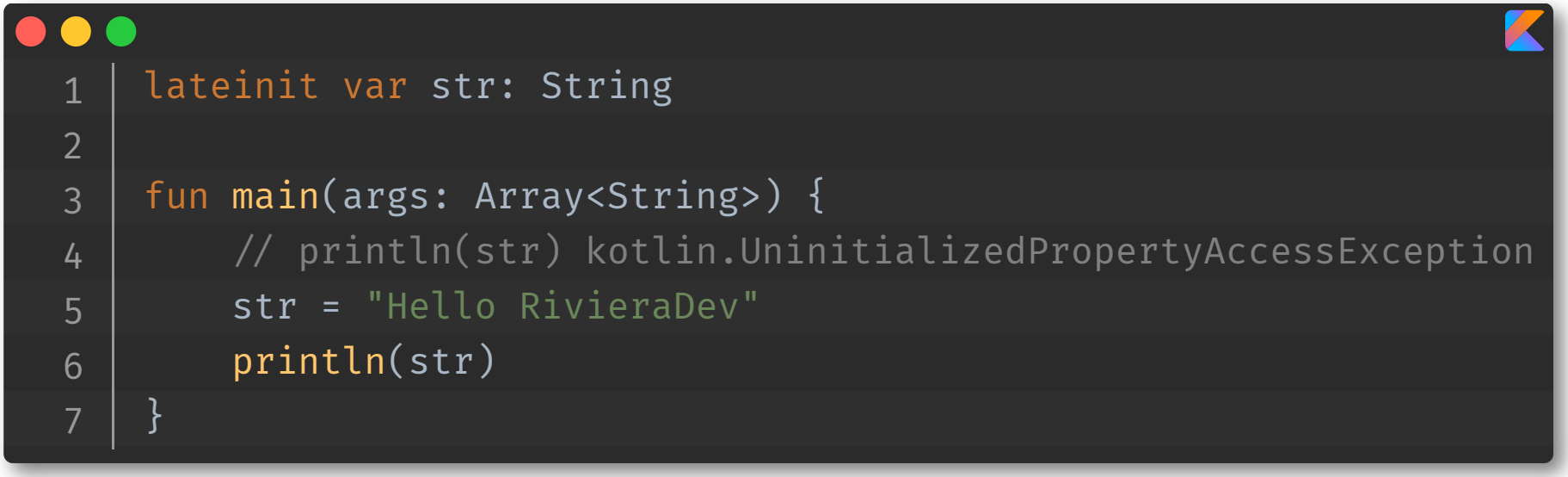


```kotlin
object DeepThought {
    fun answer(): Int {
        print("Computing ...")
        return 42
    }
}

fun main() {

    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

inline

```kotlin
object Logger {
    var enable: Boolean = false

    inline fun log(msg: () -> String) {
        if (enable) {
            println(msg())
        }
    }
}

fun main() {
    Logger.log { "Hello" }
}
```

Logger.java


```
Compiled from "inline-fun.kt"
public final class Inline_funKt {
  public static final void main();
    Code:
       0: getstatic     #15                 // Field Logger.INSTANCE:LLogger;
       3: astore_0
       4: iconst_0
       5: istore_1
       6: aload_0
       7: invokevirtual #19                 // Method Logger.getEnable:()Z
      10: ifeq          27
      13: iconst_0
      14: istore_2
      15: ldc           #21                 // String Hello
      17: astore_2
      18: iconst_0
      19: istore_3
      20: getstatic     #27                 // Field java/lang/System.out:Ljava/io/PrintStream;
      23: aload_2
      24: invokevirtual #33                 // Method java/io/PrintStream.println:(Ljava/lang/Object;)V
      27: nop
      28: return

  public static void main(java.lang.String[]);
    Code:
       0: invokestatic  #9                  // Method main:()V
       3: return
}
```

```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>()
    p2.name = "Plop2"
    println(p2)
}
```

```java
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\u000e\n\u
        d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V", "kotlinDee"}
)
public final class ReifiedKt {
    public static final void main(@NotNull String[] args) {
        Intrinsics.checkParameterIsNotNull(args, "args");
        Pojo p1 = new Pojo();
        p1.setName("Plop1");
        boolean var2 = false;
        System.out.println(p1);
        JavaBeanBuilder this_$iv = JavaBeanBuilder.INSTANCE;
        int $i$f$createBean = false;
        Pojo p2 = (Pojo)this_$iv.createBean(Pojo.class);
        p2.setName("Plop2");
        boolean var6 = false;
        System.out.println(p2);
    }
}
```

```kotlin
inline class Latitude(val value: Double)
inline class Longitude(val value: Double)

data class Geoloc(val lat: Latitude, val lng: Longitude) {

    infix fun distanceTo(other: Geoloc): Double = TODO()
}

fun main() {
    val toulouse = Geoloc(Latitude(43.60426), Longitude(1.44367))
    val nice = Geoloc(Latitude(43.70313), Longitude(7.26608))

    val travel = toulouse distanceTo nice
    println(travel)
}
```

geoloc bytecode


```
Compiled from "geoloc.kt"
public final class Geoloc {
  public final double distanceTo(Geoloc);
    Code:
       0: aload_1
       1: ldc           #9                  // String other
       3: invokestatic  #15                 // Method kotlin/jvm/internal/Intrinsics.checkParameterIsNotNul
       6: iconst_0
       7: istore_2
       8: new           #17                 // class kotlin/NotImplementedError
      11: dup
      12: aconst_null
      13: iconst_1
      14: aconst_null
      15: invokespecial #21                 // Method kotlin/NotImplementedError."<init>":(Ljava/lang/Strin
      18: checkcast     #23                 // class java/lang/Throwable
      21: athrow

  public final double getLat();
    Code:
       0: aload_0
       1: getfield      #31                 // Field lat:D
       4: dreturn

  public final double getLng();
    Code:
       0: aload_0
```

Bilan inline

⚠️ les `inline`, `reified`, ... sont à manier avec précaution

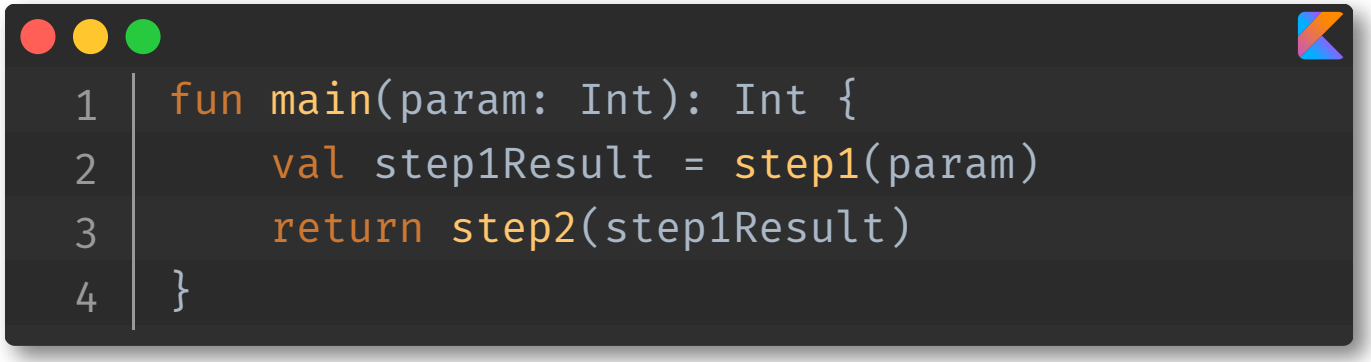
➳ Inline Functions <https://kotlinlang.org/docs/reference/inline-functions.html>

⚠️ les `inline class` sont encore expérimentales

➳ Inline classes <https://kotlinlang.org/docs/reference/inline-classes.html>

Coroutines

Callback hell problem



```kotlin
fun main(param: Int): Int {
    val step1Result = step1(param)
    return step2(step1Result)
}
```

Utilisons un callback


```kotlin
fun main(param: Int): Int {
    val step1Result = step1(param)
    return step2(step1Result)
}
```

```kotlin
fun main(param: Int): Int {
    return step1(param) { step1Result →
        step2(step1Result)
    }
```

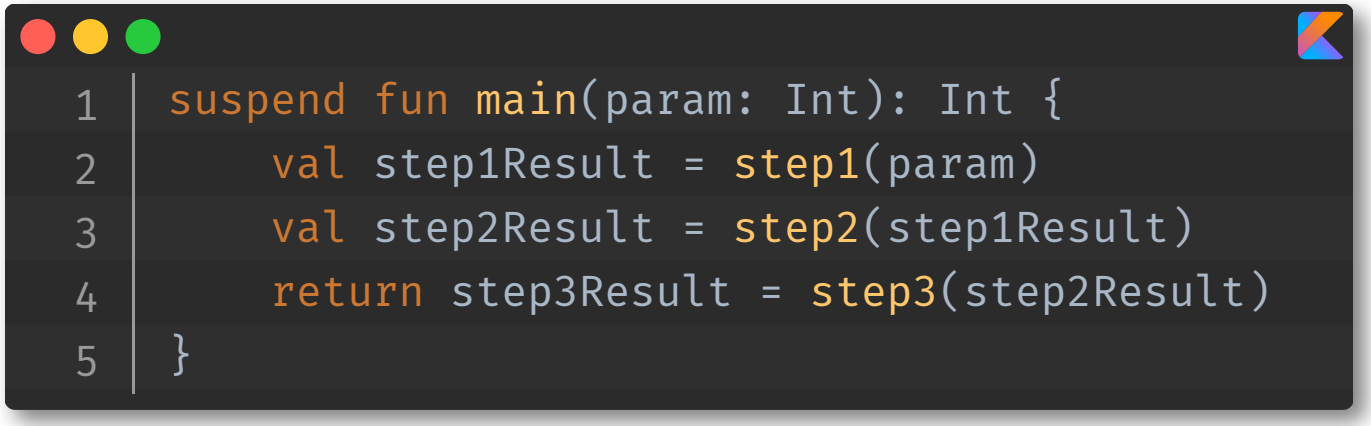
Ajoutons une étape


```kotlin
fun main(param: Int): Int {
    val step1Result = step1(param)
    val step2Result = step2(step1Result)
    return step3Result = step3(step2Result)
}
```

⇒

```kotlin
fun main(param: Int): Int {
    return step1(param) { step1Result →
        step2(step1Result) { step2Result →
            step3(step2Result)
        }
    }
```

suspend



```kotlin
suspend fun main(param: Int): Int {
    val step1Result = step1(param)
    val step2Result = step2(step1Result)
    return step3Result = step3(step2Result)
}
```

Continuation


```kotlin
suspend fun step2(step1Result: Int): Int = TODO()
```

```java
import kotlin.Metadata;
import kotlin.NotImplementedError;
import kotlin.coroutines.Continuation;
import kotlin.jvm.internal.DefaultConstructorMarker;
import org.jetbrains.annotations.NotNull;
import org.jetbrains.annotations.Nullable;

@Metadata(
        mv = {1, 1, 15},
        bv = {1, 0, 3},
        k = 2,
        d1 = {"\u0000\n\n\u0000\n\u0002\u0010\b\n\u0002\b\u0003\u001a\u0019\u0010\u0000\u001a\u00020\u00012
        d2 = {"step2", "", "step1Result", "(ILkotlin/coroutines/Continuation;)Ljava/lang/Object;", "devoxxf
)
public final class BaseKt {
    @Nullable
    public static final Object step2(int step1Result, @NotNull Continuation $completion) {
        boolean var2 = false;
```

➳ API Continuation <https://kotlinlang.org/api/latest/jvm/stdlib/kotlin.coroutines.experimental/-continuation/index.html>

Plus sur les coroutines

- Channel (expérimental)
- Context
- dispatchers
- Jobs
- Scope

On atteind les ➳ limites du décompilateur <https://discuss.kotlinlang.org/t/decompiled-file-is-extremely-large-when-it-includes-coroutine-builder-functions-such-as-launch-async/10882>

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 et Natif

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

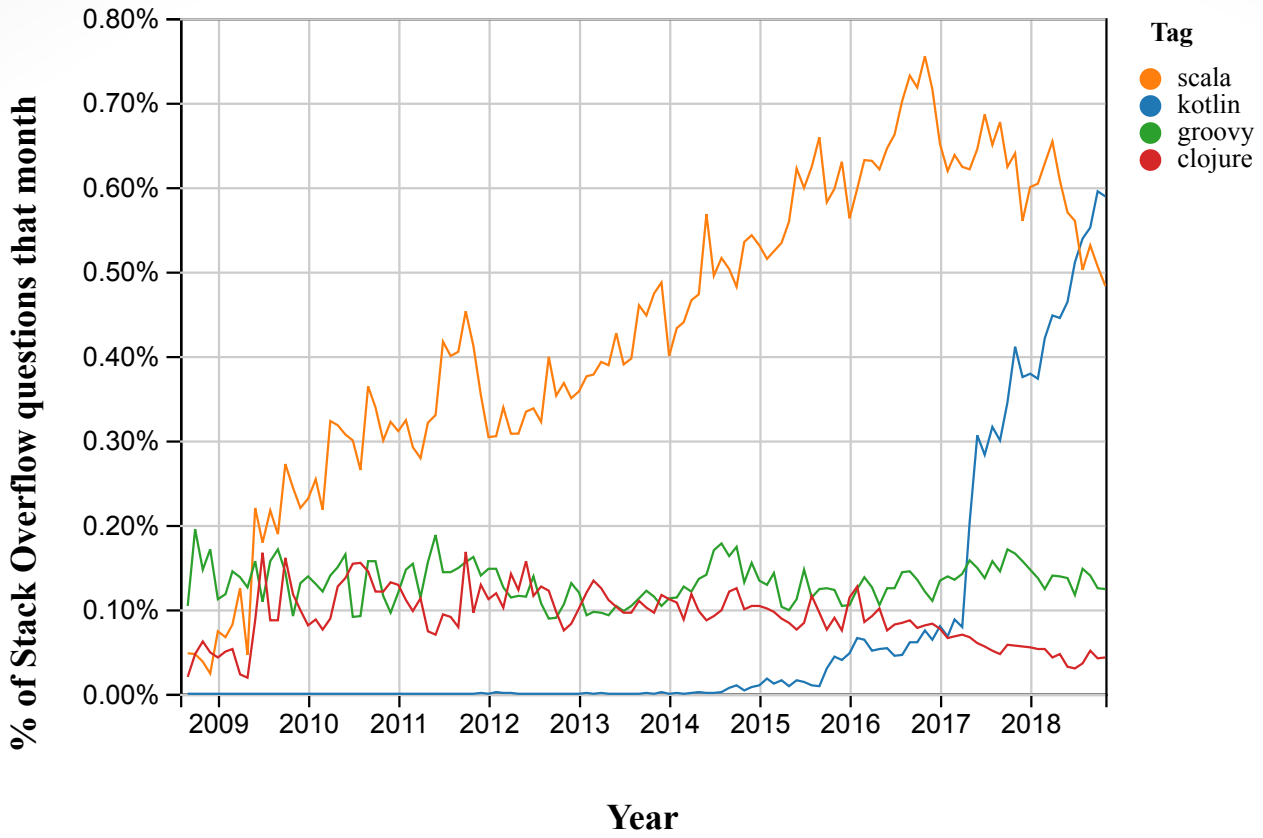
Partager du code avec iOS

WebAssembly

Bilan

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

Tendance



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

, et ➳ Stackoverflow insights <https://insights.stackoverflow.com/survey/2019#most-loved-dreaded-and-wanted>

➳ The State of the Octoverse <https://octoverse.github.com/projects#languages>

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

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

Merci

Questions ?