Deep Dive Kotlin : du Hello World au ByteCode

#DevoxxFR #Kotlin @emmanuelVinas @ilaborie

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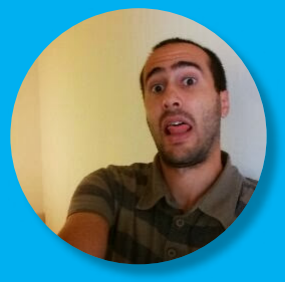

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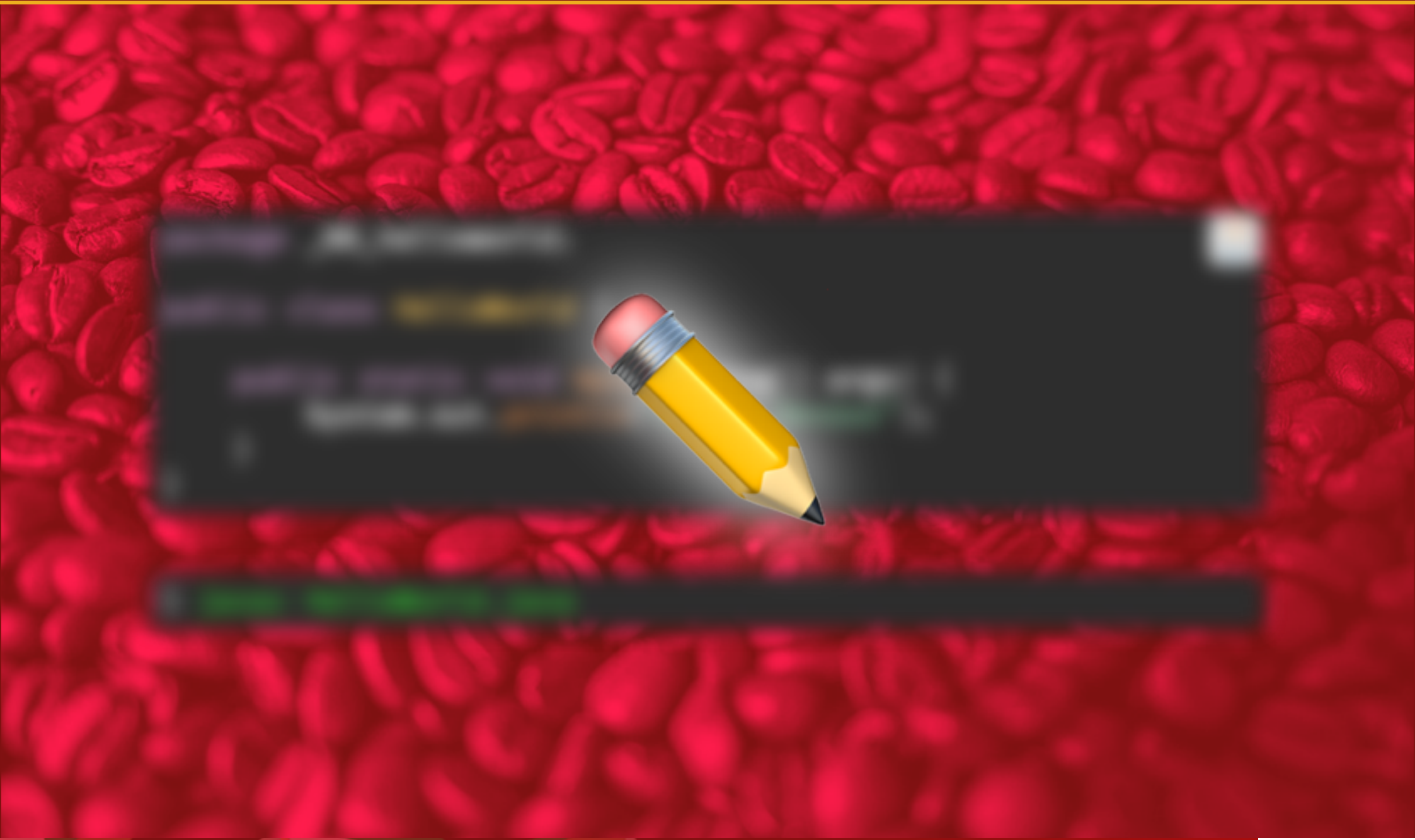
Roadmap

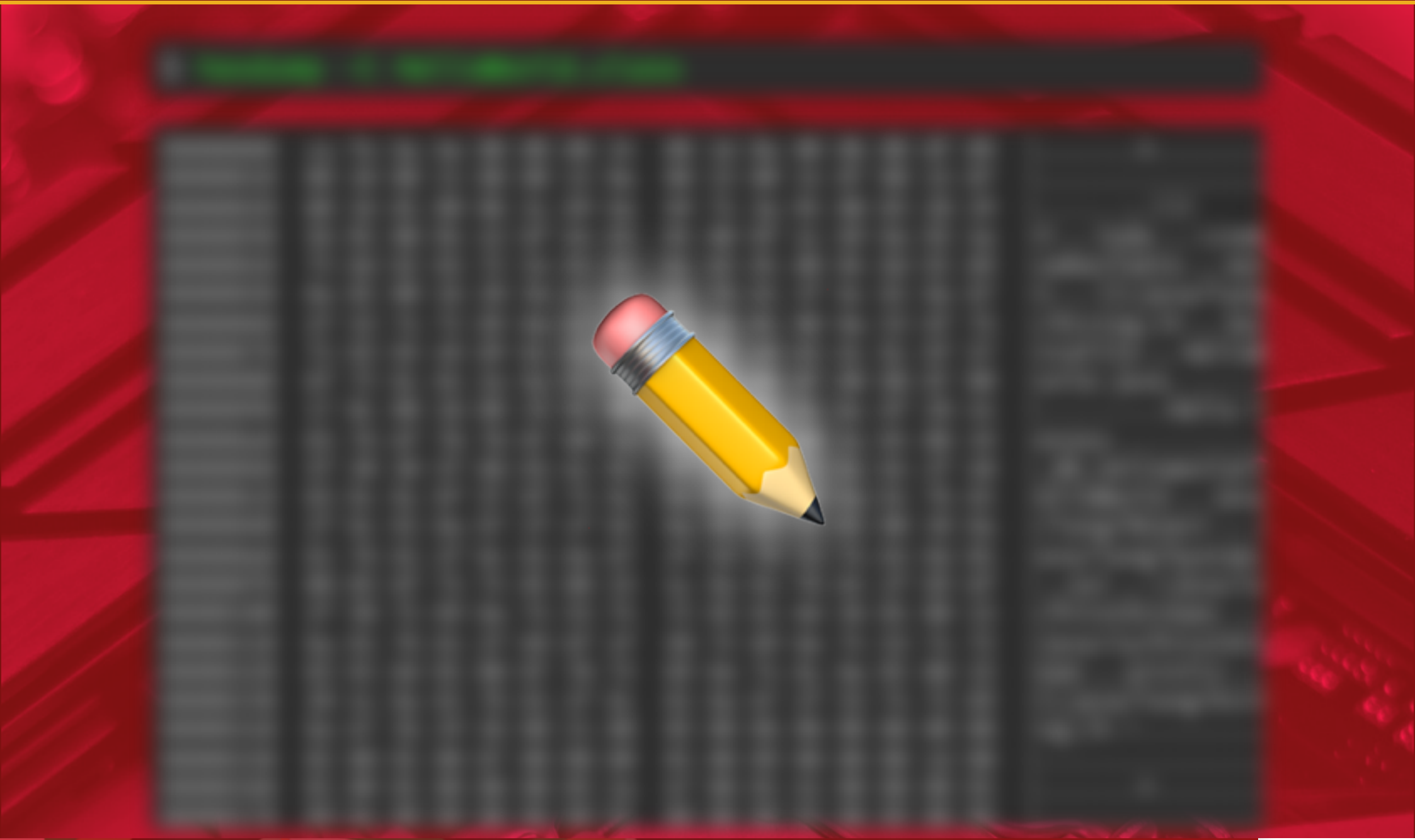
I. ByteCode Java ?
II. Introduction Kotlin
III. Les bases
IV. null-safety
V. Les types
VI. Les fonctions
VII. Les lambdas
VIII. Les classes
IX. Extensions de fonctions
X. Pause
XI. ByteCode Android
XII. Autres structures
XIII. Les collections
XIV. Les delegates
XV. Un peu plus sur les fonctions
XVI. Conclusion

ByteCode Java ?

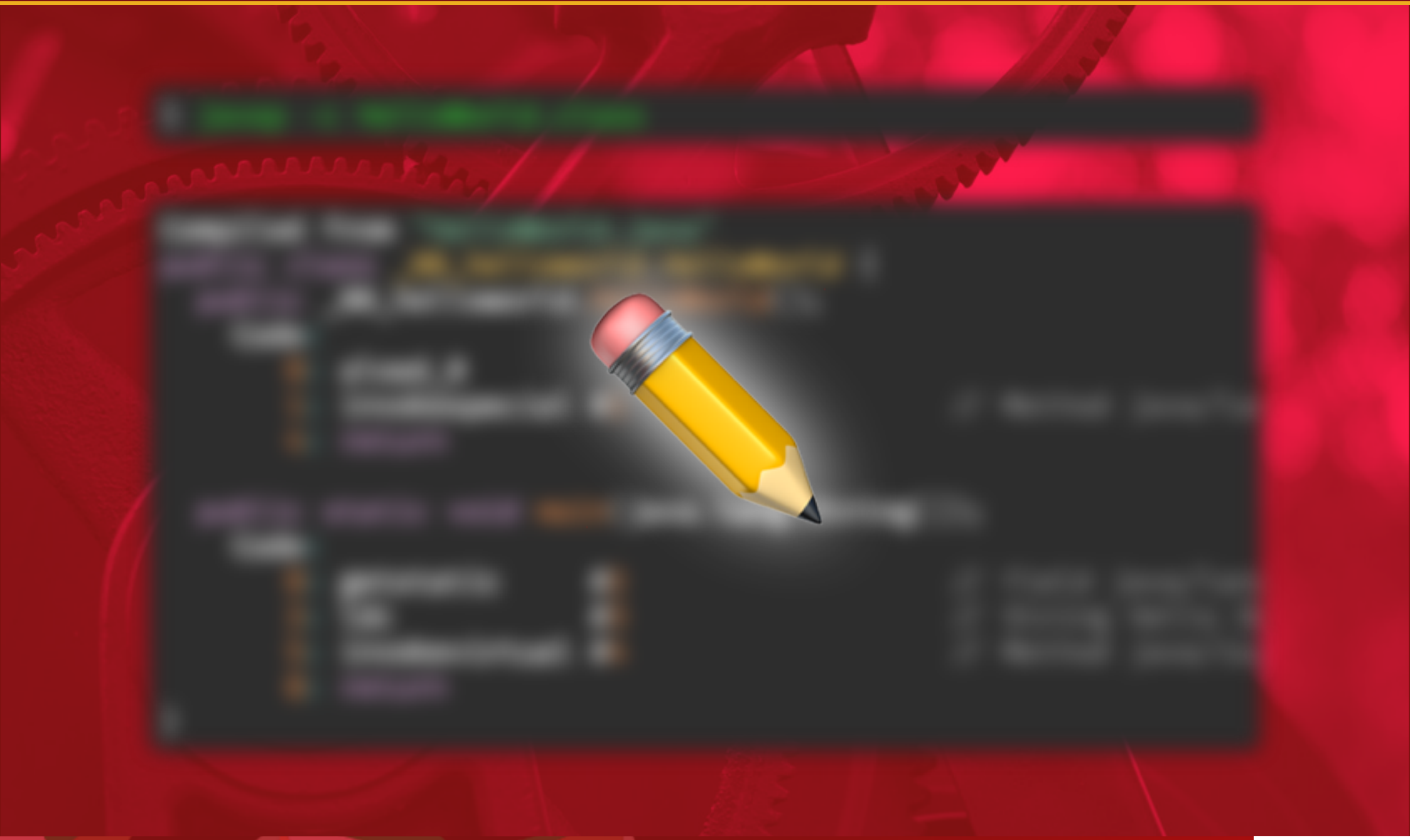
HelloWorld.java



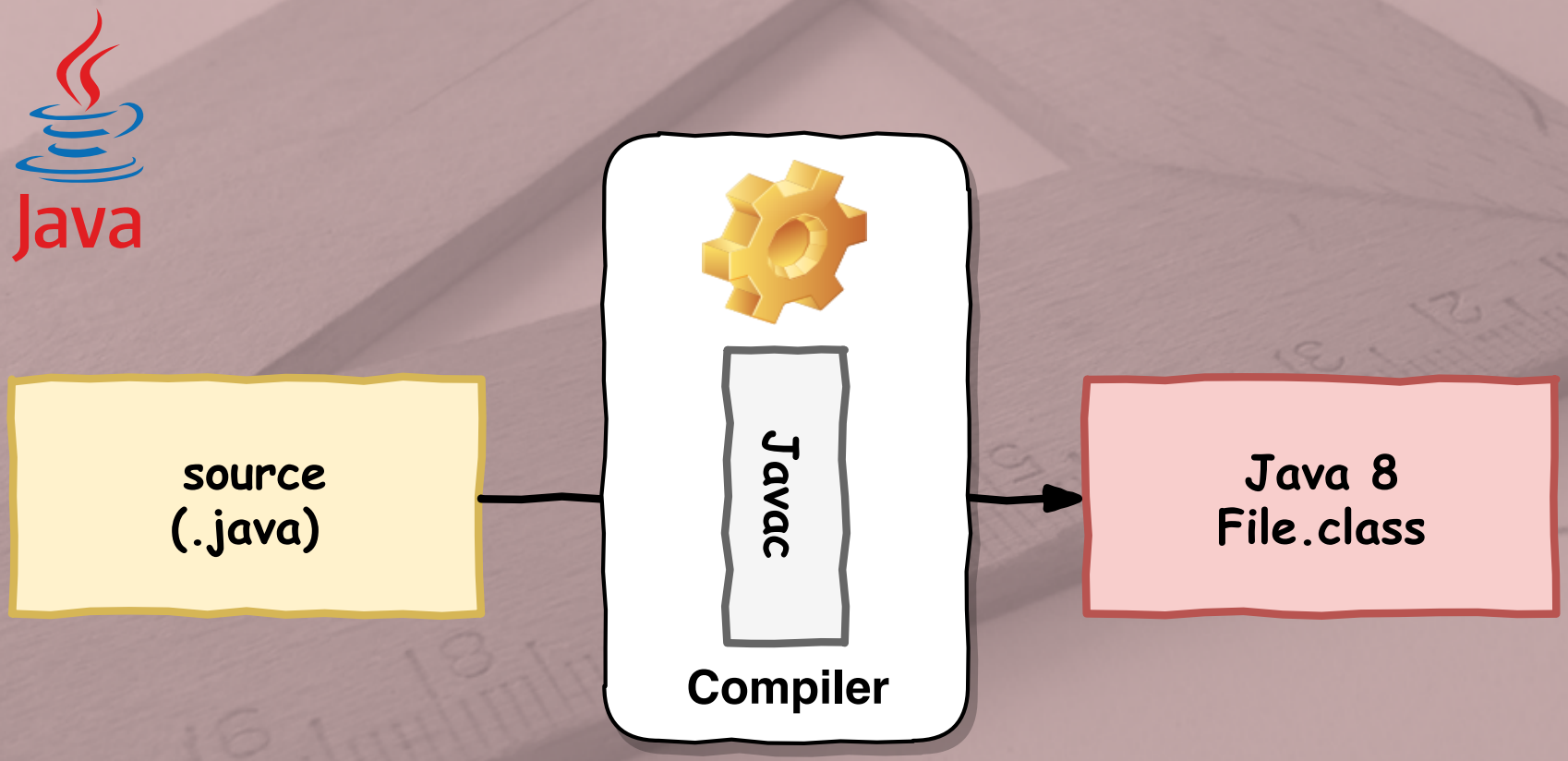
Java ByteCode binary



Explorons le ByteCode



javac



À propos du ByteCode

- environ 200 opérations possibles (maxi. 256 opscodes)
- préfix pour le type d'opérations (`i` pour entier, `d` pour double, ...)
- manipulation de la pile, des variables locales (`iconst_0`, `istore`, `iload`, ...)
- controle du flux des instructions (`if_icmpgt`, `goto`, ...)
- manipulation d'objets (`invokevirtual`, `invokedynamic`, ...)
- arithmétiques et conversion de type (`iadd`, `iinc`, `i2d`, ...)
- autres (`athrow`, ...)

Jouons un peu

▶ Constant Pool

▼ Frames

Next

main

```
0 getstatic                                   Field
                java/lang/System.out:Ljava/io/PrintStream;
3 iconst_5
4 invokestatic                          Method plop:(I)I
7 invokevirtual       Method java/io/PrintStream.println:(I)V
10 return
```

Stack

Locals

0

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Liens

- ➽ Mastering Java Bytecode at the Core of the JVM
- ➽ Introduction to Java Bytecode
- ➽ The Java® Virtual Machine Specification
- ➽ The Java Virtual Machine Instruction Set

- ➽ Byte Buddy
- ➽ asm

> Soyez curieux: regardez comment ça marche avec `javap -c`

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Introduction Kotlin

Historique

- **2011**

  Dévoilé par JetBrains

- **2016:**

  v1.0

  Supporté par Spring Framework

- **2017:**

  v1.1: coroutines, ...

  Officiellement supportée par Google

  v1.2: multiplatform

- **2018:**

  Kotlin Native (external) 0.6

Cibles

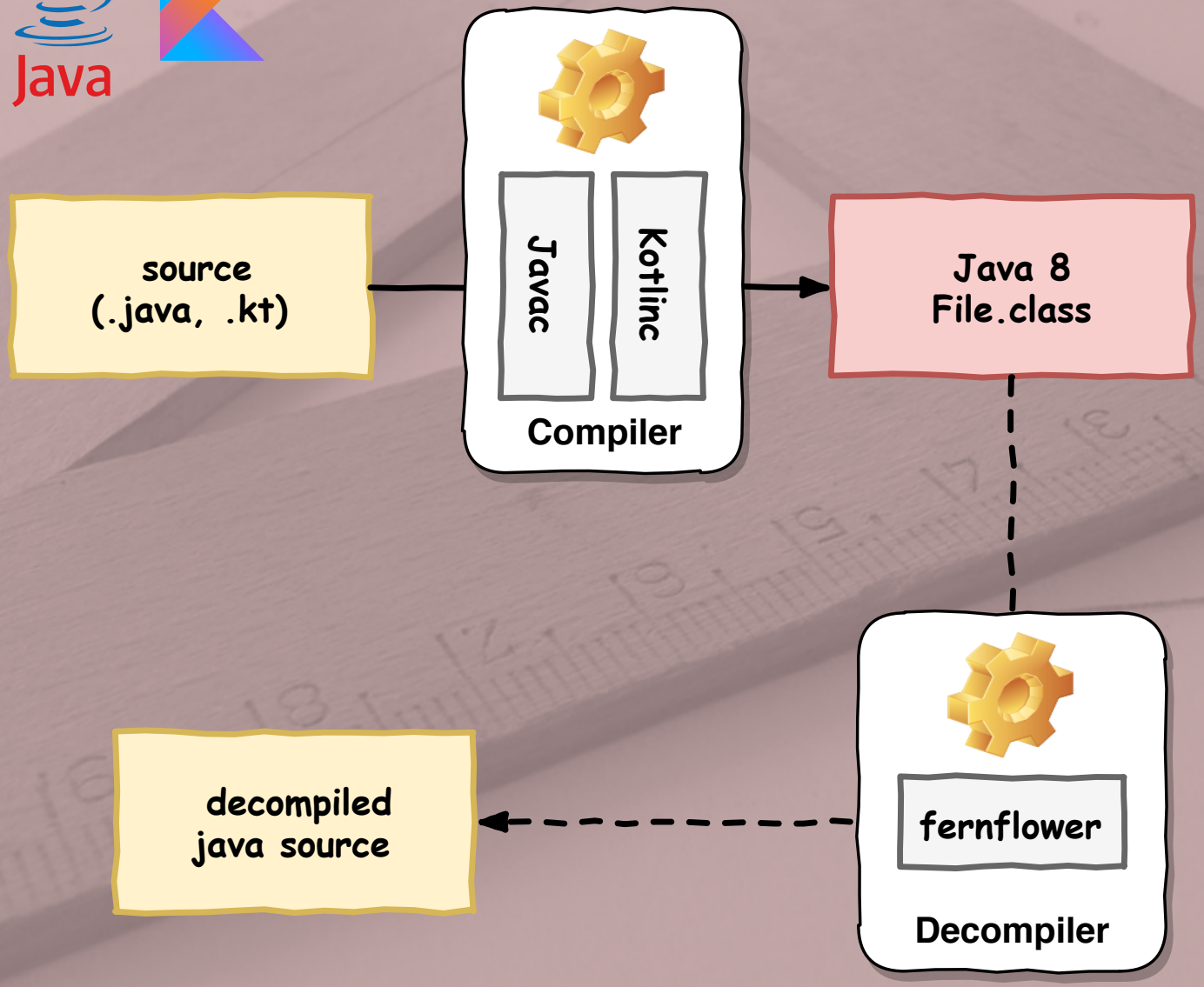
JVM et Android

JavaScript

Native avec LLVM

HelloWorld.kt

kotlinc



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hexdump


```
00000000  ca fe ba be 00 00 00 32  00 33 01 00 1b 5f 30 30  |.......2.3...._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 0c 48 65  6c 6c 6f 20 44 65 76 6f  |......Hello Devo
00000110  78 78 08 00 10 01 00 10  6a 61 76 61 2f 6c 61 6e  |xx......java/lan
00000120  67 2f 53 79 73 74 65 6d  07 00 12 01 00 03 6f 75  |g/System......ou
00000130  74 01 00 15 4c 6a 61 76  61 2f 69 6f 2f 50 72 69  |t...Ljava/io/Pri
00000140  6e 74 53 74 72 65 61 6d  3b 0c 00 14 00 15 09 00  |ntStream;.......
00000150  13 00 16 01 00 13 6a 61  76 61 2f 69 6f 2f 50 72  |......java/io/Pr
00000160  69 6e 74 53 74 72 65 61  6d 07 00 18 01 00 07 70  |intStream......p
00000170  72 69 6e 74 6c 6e 01 00  15 28 4c 6a 61 76 61 2f  |rintln...(Ljava/
00000180  6c 61 6e 67 2f 4f 62 6a  65 63 74 3b 29 56 0c 00  |lang/Object;)V..
00000190  1a 00 1b 0a 00 19 00 1c  01 00 13 5b 4c 6a 61 76  |...........[Ljav
000001a0  61 2f 6c 61 6e 67 2f 53  74 72 69 6e 67 3b 01 00  |a/lang/String;..
000001b0  11 4c 6b 6f 74 6c 69 6e  2f 4d 65 74 61 64 61 74  |.Lkotlin/Metadat
```

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/
       6: ldc           #17                 // String Hello D
       8: astore_1
       9: getstatic     #23                 // Field java/lan
      12: aload_1
      13: invokevirtual #29                 // Method java/io/
      16: return
}
```


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HelloWorld-java


```java
package _00_helloworld;

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\u
    d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V"
)
public final class HelloWorldKt {
    public static final void main(@NotNull String[] args) {
        Intrinsics.checkParameterIsNotNull(args, "args");
        String var1 = "Hello Devoxx";
        System.out.println(var1);
    }
}
```


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Bilan HelloWorld.kt

- Kotlin ajoute des contrôles
- du coup on a besoin de JARs en plus

jar	taille
kotlin-stdlib-1.2.31.jar	919K
kotlin-stdlib-jdk7-1.2.31.jar	3.1K
kotlin-stdlib-jdk8-1.2.31.jar	13K
kotlin-reflect-1.2.31.jar	2.5M
guava-18.0.jar	2.2M
lombok-1.16.18.jar	1.4M
spring-core-5.0.5.RELEASE.jar	1.2M
jackson-databind-2.9.5.jar	1.3M

- Performances ?

Performance HelloWorld.kt

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

- https://github.com/JetBrains/kotlin-benchmarks
- 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


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

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


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string-template.kt


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


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string-template.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\u000
    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.getLas
        System.out.println(var1);
    }
```


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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/
       6: new           #17                 // class java/lang
       9: dup
      10: invokespecial #21                 // Method java/la
      13: ldc           #23                 // String Hello
      15: invokevirtual #27                 // Method java/la
      18: aload_0
      19: invokevirtual #30                 // Method java/la
      22: bipush        33
      24: invokevirtual #33                 // Method java/la
      27: invokevirtual #37                 // Method java/la
      30: astore_1
      31: getstatic     #43                 // Field java/lang
      34: aload_1
      35: invokevirtual #49                 // Method java/io/
```


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numeric.kt


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


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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\u0000
    d2 = {"tryNumeric", ""}
)
public final class NumericKt {
    public static final void tryNumeric() {
        int anInt = true;
        long aLong = 42L;
        Double aDouble = (Double)null;
    }
}
```


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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
      11: astore_3
      12: return
}
```


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C'est simple

- plus de ; *
- 😍 String templating
- 😘 plus de types primitifs (avant la compilation)
- 🧐 inférence de types
- on peut mélanger du code Java et Kotlin

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null-safety

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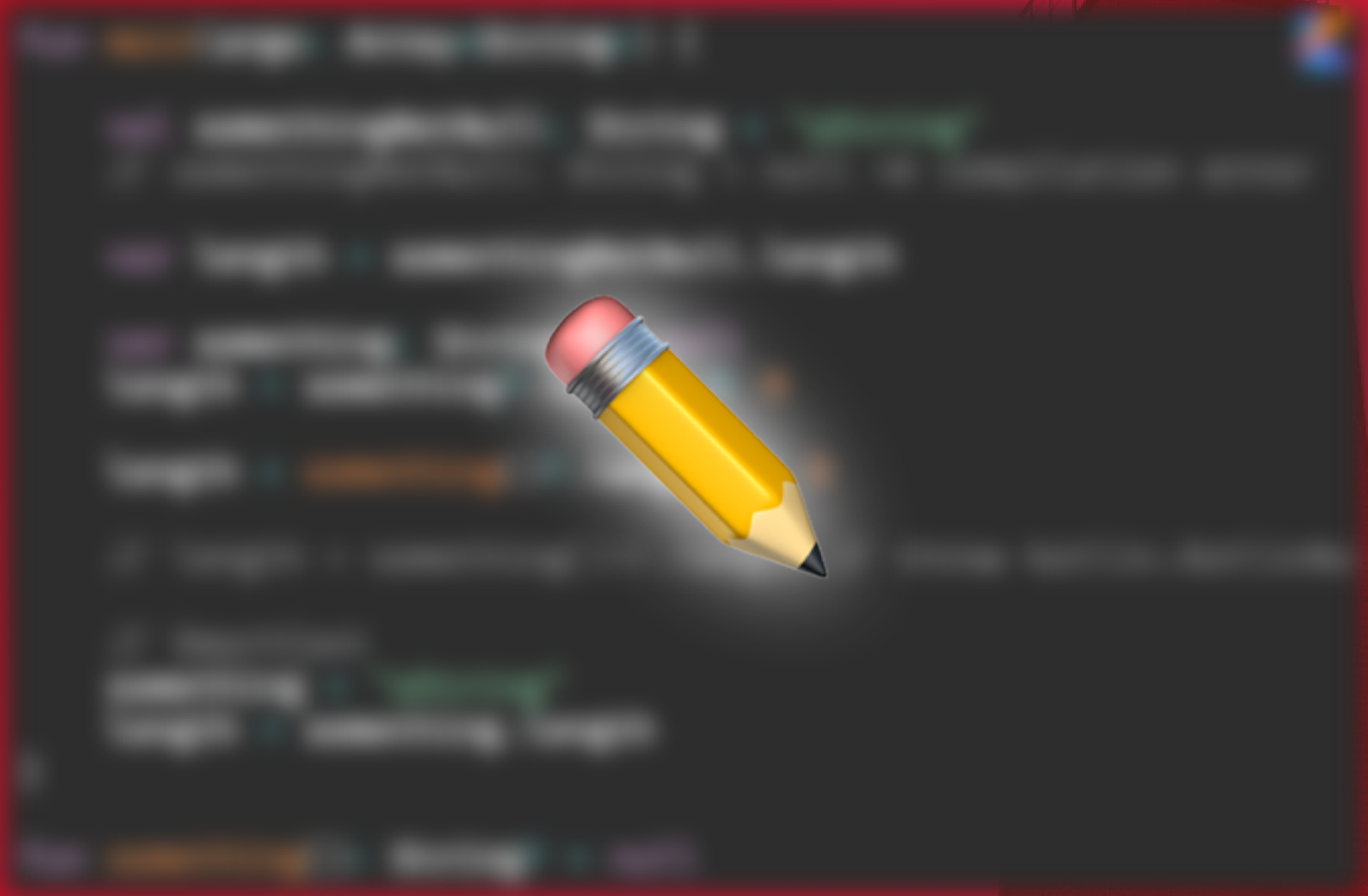
billion-dollar mistake

> I call it my billion-dollar mistake. It was the invention of the `null` reference in 1965. At that time, I was designing the first comprehensive type system for references in an object oriented language (ALGOL W). My goal was to ensure that all use of references should be absolutely safe, with checking performed automatically by the compiler. But I couldn't resist the temptation to put in a `null` reference, simply because it was so easy to implement. 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

null-safety.kt



null-safety.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\u
    d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V"
)
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;
```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elvis

- plus de `NullPointerException`
- ⚠️ quand on appel du Java

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Les types

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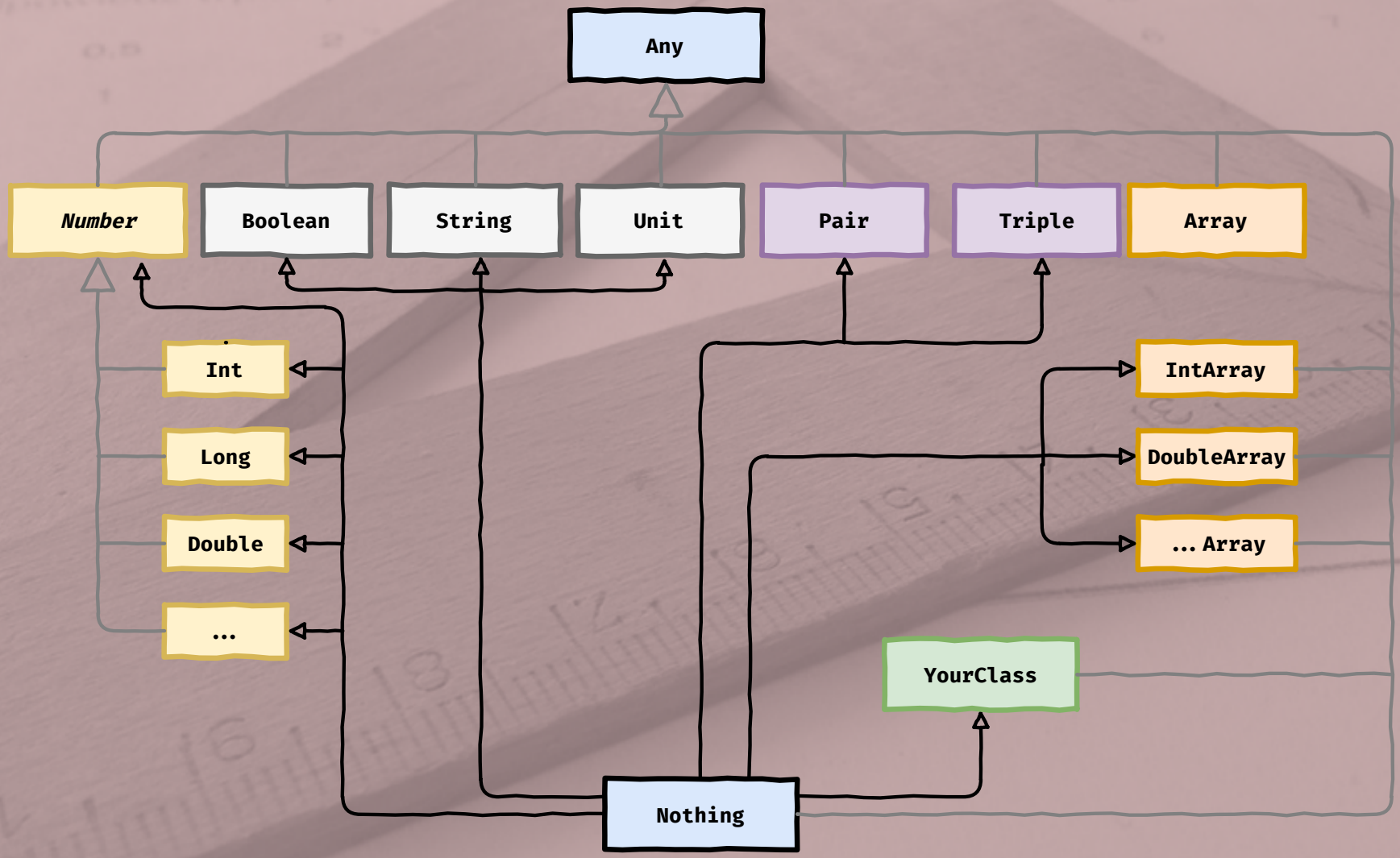
Types basiques



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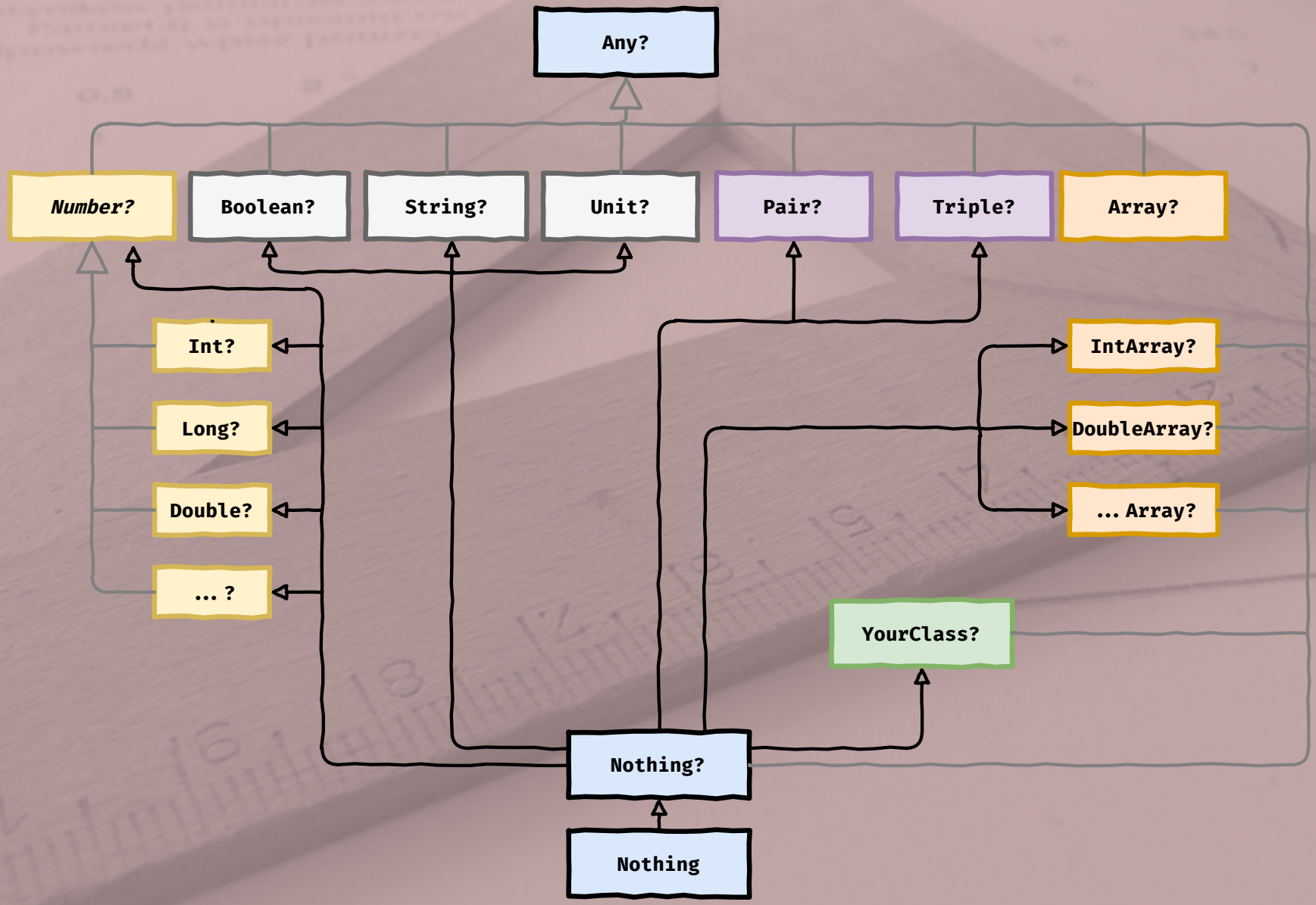
Types basiques nullable



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todo.kt

Hierarchie des types

- 🤝 le `TODO( )` est l'ami du TDD

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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 = "Devoxx", prefix = "He
```


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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\u
    d2 = {"buildString", "", "prefix", "who", "enhanced", "",
)
public final class NamedKt {
    @NotNull
    public static final String buildString(@NotNull String pre
        Intrinsics.checkParameterIsNotNull(prefix, "prefix");
        Intrinsics.checkParameterIsNotNull(who, "who");
        String msg = "" + prefix + ' ' + who;
        if (enhanced) {
            msg = msg + '!';
```


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default-value.kt


```
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 = "Devoxx")
```


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default-value.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\u
    d2 = {"buildString2", "", "prefix", "who", "enhanced", "",
)
public final class Default_valueKt {
    @NotNull
    public static final String buildString2(@NotNull String pre
        Intrinsics.checkParameterIsNotNull(prefix, "prefix");
        Intrinsics.checkParameterIsNotNull(who, "who");
        String msg = "" + prefix + ' ' + who;
        if (enhanced) {
            msg = msg + '!';
```


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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
    Code:
       0: aload_0
       1: ldc           #9                  // String prefix
       3: invokestatic  #15                 // Method kotlin/
       6: aload_1
       7: ldc           #17                 // String who
       9: invokestatic  #15                 // Method kotlin/
      12: new           #19                 // class java/lang
      15: dup
      16: invokespecial #23                 // Method java/la
      19: ldc           #25                 // String
      21: invokevirtual #29                 // Method java/la
      24: aload_0
      25: invokevirtual #29                 // Method java/la
      28: bipush        32
      30: invokevirtual #32                 // Method java/la
      33: aload_1
      34: invokevirtual #29                 // Method java/la
```


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C'est fun !

✨ Conseils

- Toujours typer le retour de vos fonctions (sauf si c'est évident et une surcharge comme le `toString`)
- Kotlin est plus expressif 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 ambigüités

📝 Notes

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

Les lambdas

function.kt


```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) =
    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)
```


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function.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\u000
    d2 = {"sum5", "", "getSum5", "()I", "sum6", "getSum6", "su
)
public final class FunctionKt {
    private static final int sum5;
    @NotNull
    private static final KFunction sumLam;
    private static final int sum6;
```


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lambda.kt

lambda.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\u000!
    d2 = {"sum3", "", "getSum3", "()I", "sum4", "getSum4", "sur
)
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() {
```


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let.kt


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

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


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let.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\u0(
    d2 = {"nullable", "", "getNullable", "()Ljava/lang/Integer
)
public final class LetKt {
    private static final int other;
    @Nullable
    private static final Integer nullable;

    @Nullable
    public static final Integer maybeAnInt() {
```


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Les lambdas

- ⚠️ pas de `return`
- pensez à mettre vos lambda comme dernier argument
- voir aussi les `apply`, `also`, `run` , `use`, `with`

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Les classes

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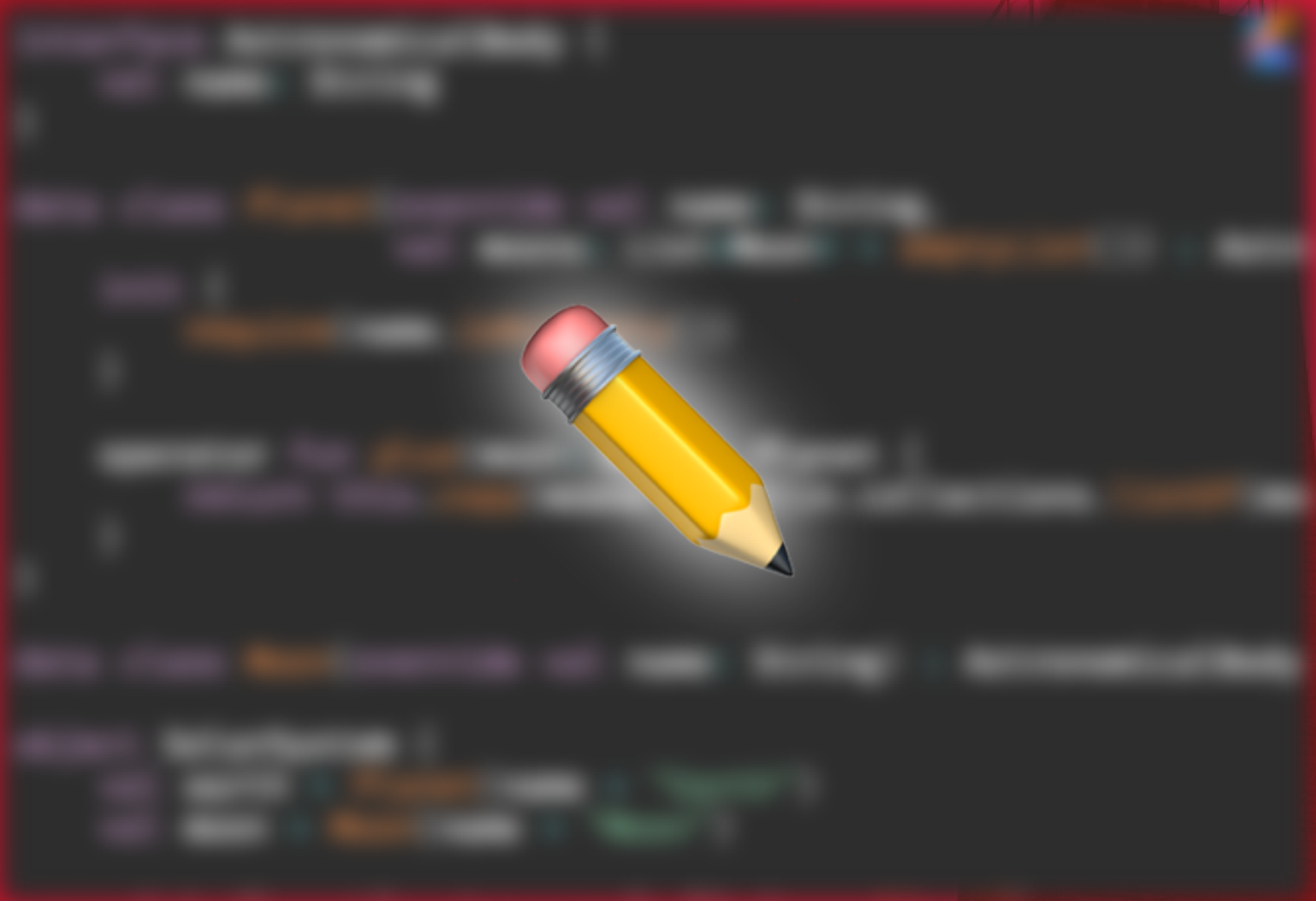
astronomy.kt



astronomy.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\u0
    d2 = {"L_05_class_1/Planet;", "L_05_class_1/AstronomicalBo
)
public final class Planet implements AstronomicalBody {
    @NotNull
    private final String name;
    @NotNull
    private final List moons;
```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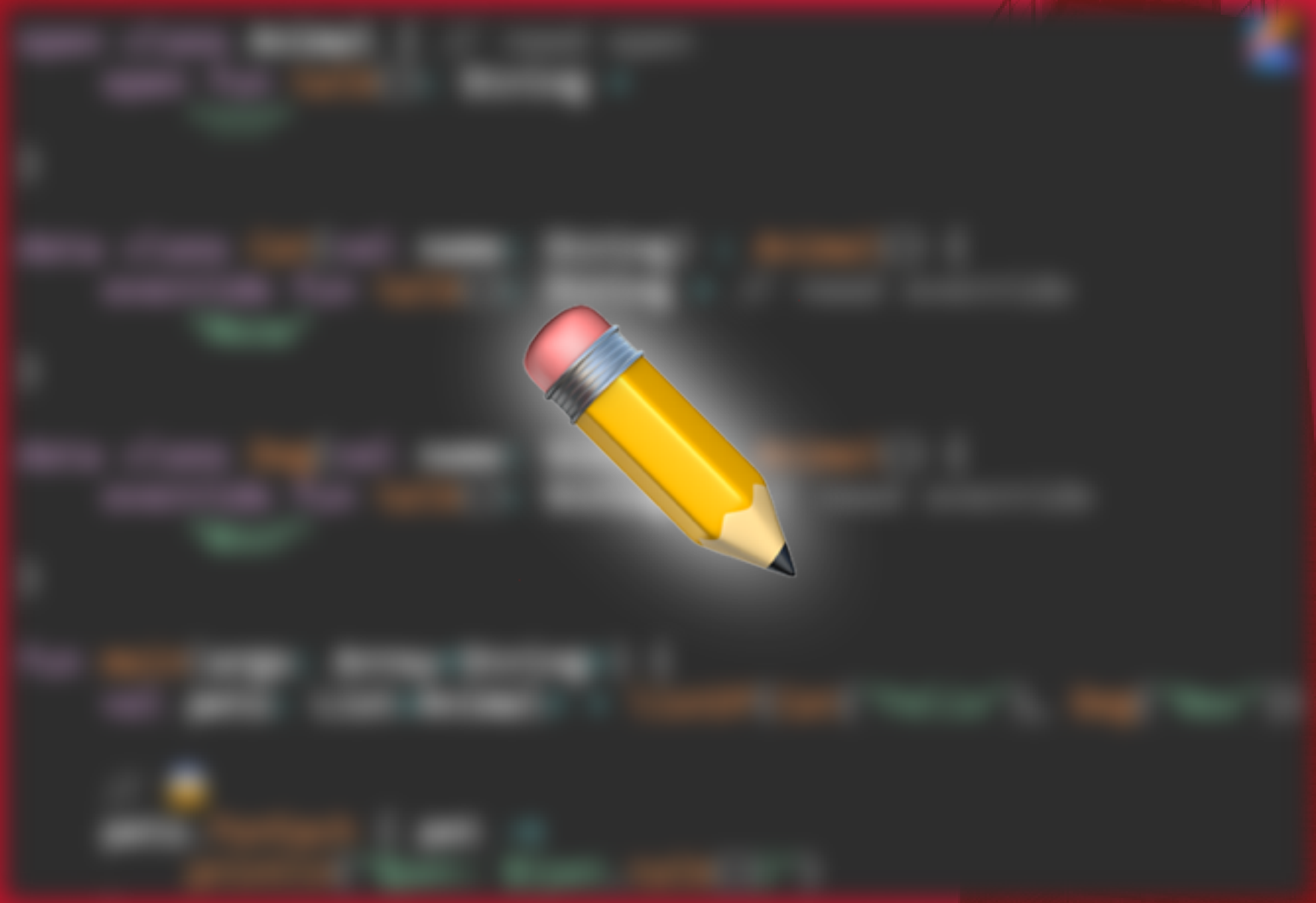
Héritage en Kotlin



Générics

- ⚠️ Les contrôles de types générics ne sont fait qu'au moment de la compilation
- Covariant (consome): `out`, en java `? extends T`
- Contravariant (produit): `in`, en java `? super T`

Borne supérieur

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

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

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Projection *


```
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>)
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>>
fun getAllEntities(): Map<EntityKey, List<Entity>> = emptyMap(
```


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ByteCode d'alias


```
Compiled from "typealias.kt"
public final class _06_class_2.TypealiasKt {
  public static final java.util.Map<kotlin.Pair<java.lang.Str
    Code:
       0: invokestatic  #12                    // Method kotlin/
       3: areturn
}
```


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Classe, le bilan

- 🤩 `data class`
- 🤔 Mais pourquoi on n'a pas ça en Java ?
- Une seule classe par fichier n'est pas utile
- 🤓 `sealed` permet de faire des types algébriques de données (Algebraic Data Type)

Extensions de fonctions

extension.kt

extension.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
    d2 = {"size", "", "Lastronomy/AstronomicalBody;", "getSize
)
public final class ExtensionKt {
    public static final int getSize(@NotNull AstronomicalBody
        Intrinsics.checkParameterIsNotNull($receiver, "$receive
        return $receiver.getName().length();
    }
```


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Extension

- Permet d'enrichire les api Java
  - Spring, RxKotlin, SparkJava
- Permet la *SoC*

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Pause

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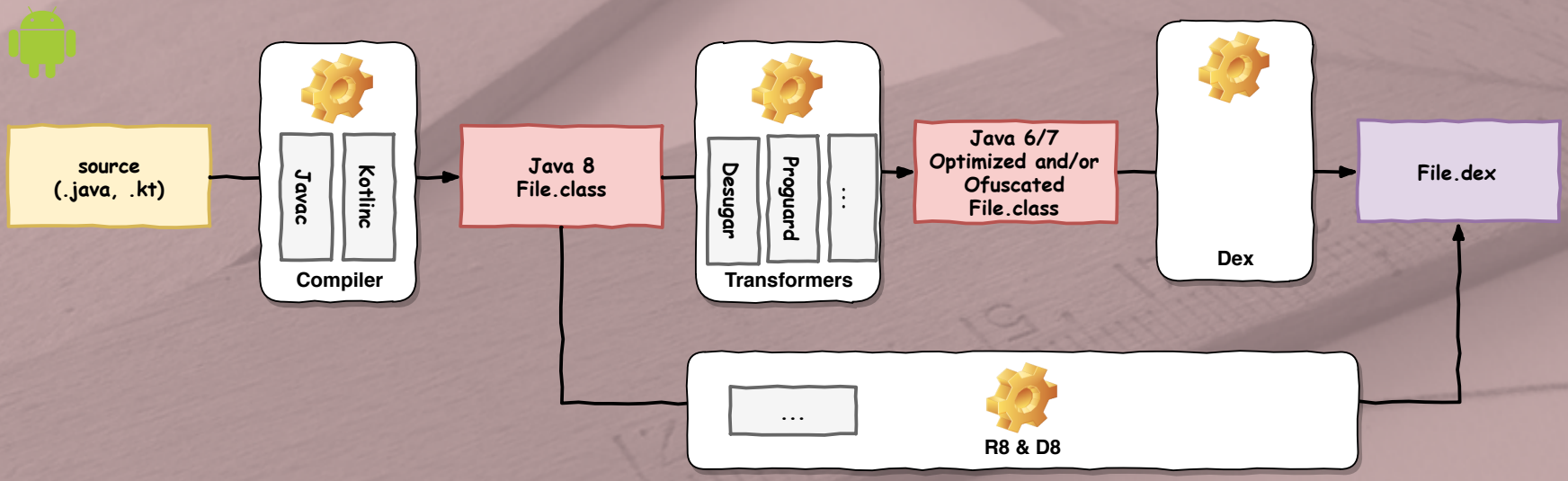
ByteCode Android

Compilation pour Android



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Dalvik EXecutable format

Dalvik Executable format

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

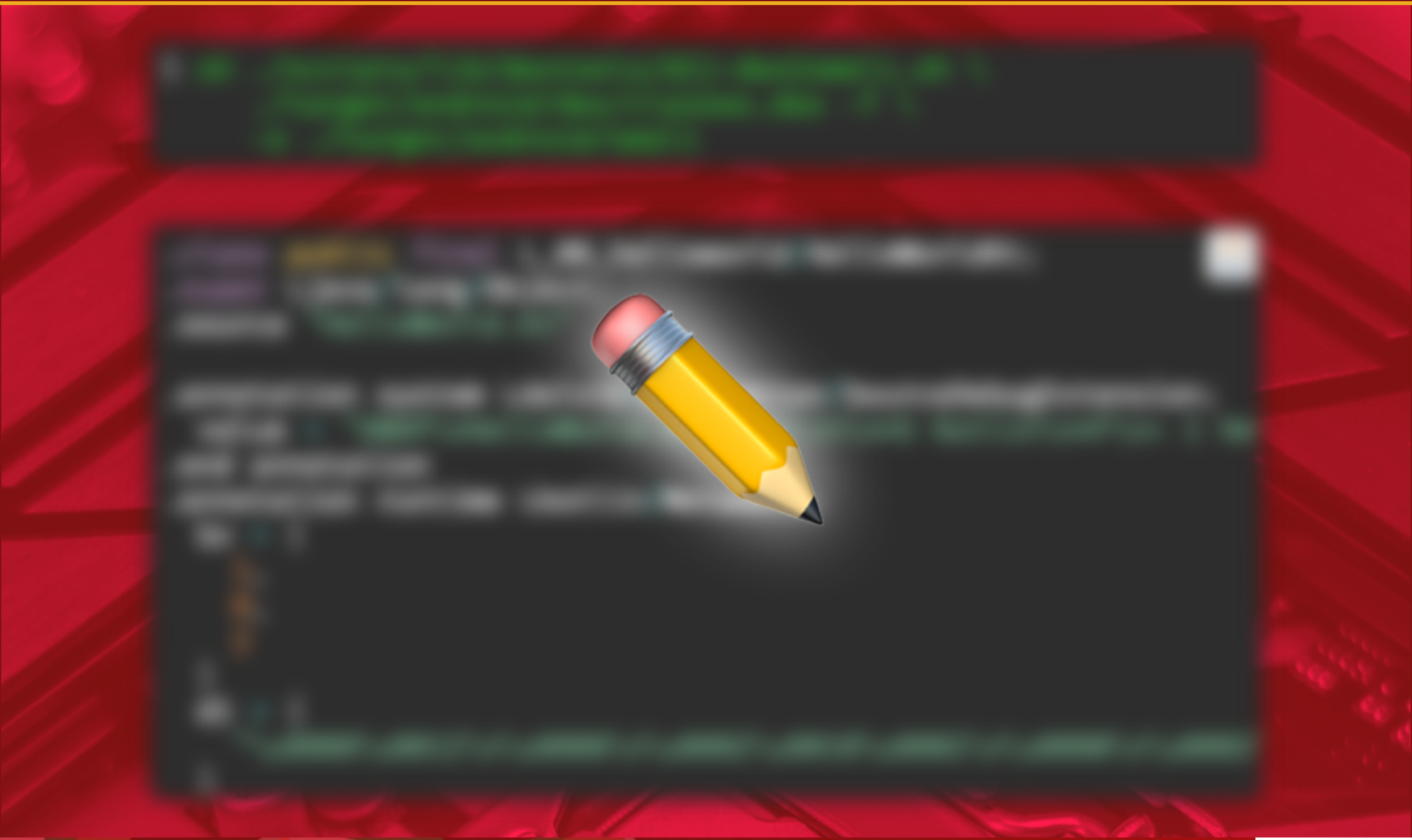
```
00000000  64 65 78 0a 30 33 35 00  06 50 f0 61 50 10 7c c0  |dex.035..P.aP.|.
00000010  b2 f9 77 2d 54 df 60 f3  ac dd b0 10 eb 55 53 e1  |..w-T.`......US.
00000020  28 f6 10 00 70 00 00 00  78 56 34 12 00 00 00 00  |(...p...xV4.....
00000030  00 00 00 00 4c f5 10 00  12 17 00 00 70 00 00 00  |....L.......p...
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.......
00000110  f1 f8 07 00 12 f9 07 00  41 f9 07 00 6e f9 07 00  |........A...n...
00000120  b0 f9 07 00 dd f9 07 00  0a fa 07 00 39 fa 07 00  |............9...
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
```

smali



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Autres structures

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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)
}
```


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for.kt


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


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for.java


```
package _09_structures;

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\u0012\n\u0000\n\u0002\u0010\u0002\n\u0000\n\u
    d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V"
)
public final class ForKt {
    public static final void main(@NotNull String[] args) {
        Intrinsics.checkParameterIsNotNull(args, "args");
        Iterator var2 = SolarSystem.INSTANCE.getBodies().iterat
```


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ByteCode du for


```
Compiled from "for.kt"
public final class _09_structures.ForKt {
  public static final void main(java.lang.String[]);
    Code:
       0: aload_0
       1: ldc           #9                  // String args
       3: invokestatic  #15                 // Method kotlin/
       6: getstatic     #21                 // Field astronomy
       9: invokevirtual #25                 // Method astronor
      12: invokeinterface #31,  1           // InterfaceMetho
      17: astore_2
      18: aload_2
      19: invokeinterface #37,  1           // InterfaceMetho
      24: ifeq          47
      27: aload_2
      28: invokeinterface #41,  1           // InterfaceMetho
      33: checkcast     #43                 // class astronomy
      36: astore_1
      37: getstatic     #49                 // Field java/lang
      40: aload_1
      41: invokevirtual #55                 // Method java/io/
```


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while-do.kt


```kotlin
while (x > 0) {
    x--
}

do {
    val y = retrieveData()
} while (y ≠ null) // y is visible here!
```


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when.kt


```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)
    }
}
```


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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
}
```


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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
```


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rec-factorial.kt


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


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ByteCode factoriel avec recursivité


```
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 recFact
      16: imul
      17: ireturn
}
```


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tailrec-factorial.kt


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

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

    return aux(n, 1)
}
```


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ByteCode factoriel avec recursivité terminal 1/2


```
Compiled from "tailrec-factorial.kt"
public final class _09_structures.recusion.Tailrec_factorialK
  public static final int tailRecFactorial(int);
    Code:
       0: getstatic     #12                 // Field _09_stru
       3: astore_1
       4: aload_1
       5: iload_0
       6: iconst_1
       7: invokevirtual #16                 // Method _09_stru
      10: ireturn
}
```


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ByteCode factoriel avec recursivité terminal 2/2


```
Compiled from "tailrec-factorial.kt"
final class _09_structures.recusion.Tailrec_factorialKt$tailRe
  public static final _09_structures.recusion.Tailrec_factoria

  public java.lang.Object invoke(java.lang.Object, java.lang.(
    Code:
       0: aload_0
       1: aload_1
       2: checkcast     #11                 // class java/lang
       5: invokevirtual #15                 // Method java/lan
       8: aload_2
       9: checkcast     #11                 // class java/lang
      12: invokevirtual #15                 // Method java/lan
      15: invokevirtual #18                 // Method invoke:(
      18: invokestatic  #24                 // Method java/lan
      21: areturn

  public final int invoke(int, int);
    Code:
       0: iload_1
       1: iconst_1
```


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Performances sur 10 !

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

https://github.com/MonkeyPatchIo/kotlin-perf

Benchmark	Mode	Cnt	Score	Error	Units
factorialJava	thrpt	200	274141213.561	± 28963758.069	ops/s
factorialKotlinFor	thrpt	200	267717955.205	± 8457315.205	ops/s
factorialKotlinRec	thrpt	200	56270660.700	± 2453418.383	ops/s
factorialKotlinTailRec	thrpt	200	341898899.761	± 11456349.191	ops/s

Bilan structures

- Il y a aussi des `break` et `continue`, label pour les boucles
- `when` peut être utiliser 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 recursives, faites les `tailrec`

Les collections

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api.kt

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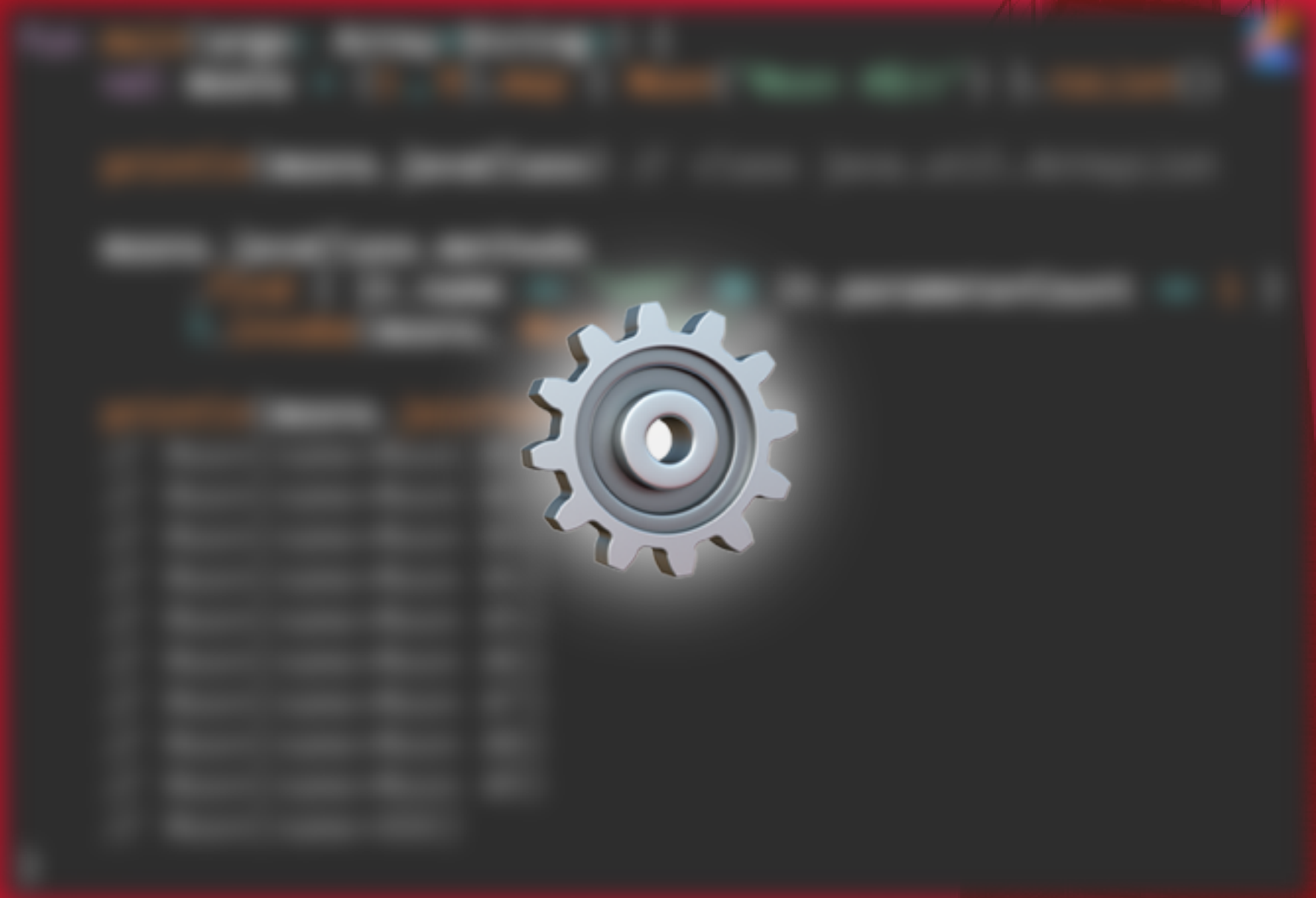
immutable-mutable.kt

break-immutable.kt



sequence.kt

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Performance des sequences 1/2

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

Benchmark	Mode	Cnt	Score	Error	Units
collectionApiClassic	thrpt	200	44535.029	± 3550.944	ops/s
collectionApiSequence	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)
```


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Performance des sequences 2/2

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

Benchmark	Mode	Cnt	Score	Error	Units
collectionApiClassicFirst	thrpt	200	241752.062	± 5022.663	ops/s
collectionApiSequenceFirst	thrpt	200	3615451.391	± 454502.198	ops/s

timed-sequence.kt

ranges.kt


```
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
```


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ranges.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\u
   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;
```


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tuples.kt


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

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


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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\u
    d2 = {"main", "", "args", "", "", "([Ljava/lang/String;)V"
)
public final class TuplesKt {
    public static final void main(@NotNull String[] args) {
        Intrinsics.checkParameterIsNotNull(args, "args");
        Pair pair = new Pair(1, "x");
```


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Bilan collection

- Super on a de l'immutabilité, des `map`, `flatMap`, `fold`, `aggregate`,...
- Mais ça reste des collections Java
- Avant d'utiliser les sequences, faites des mesures

Les delegates

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delegate.kt

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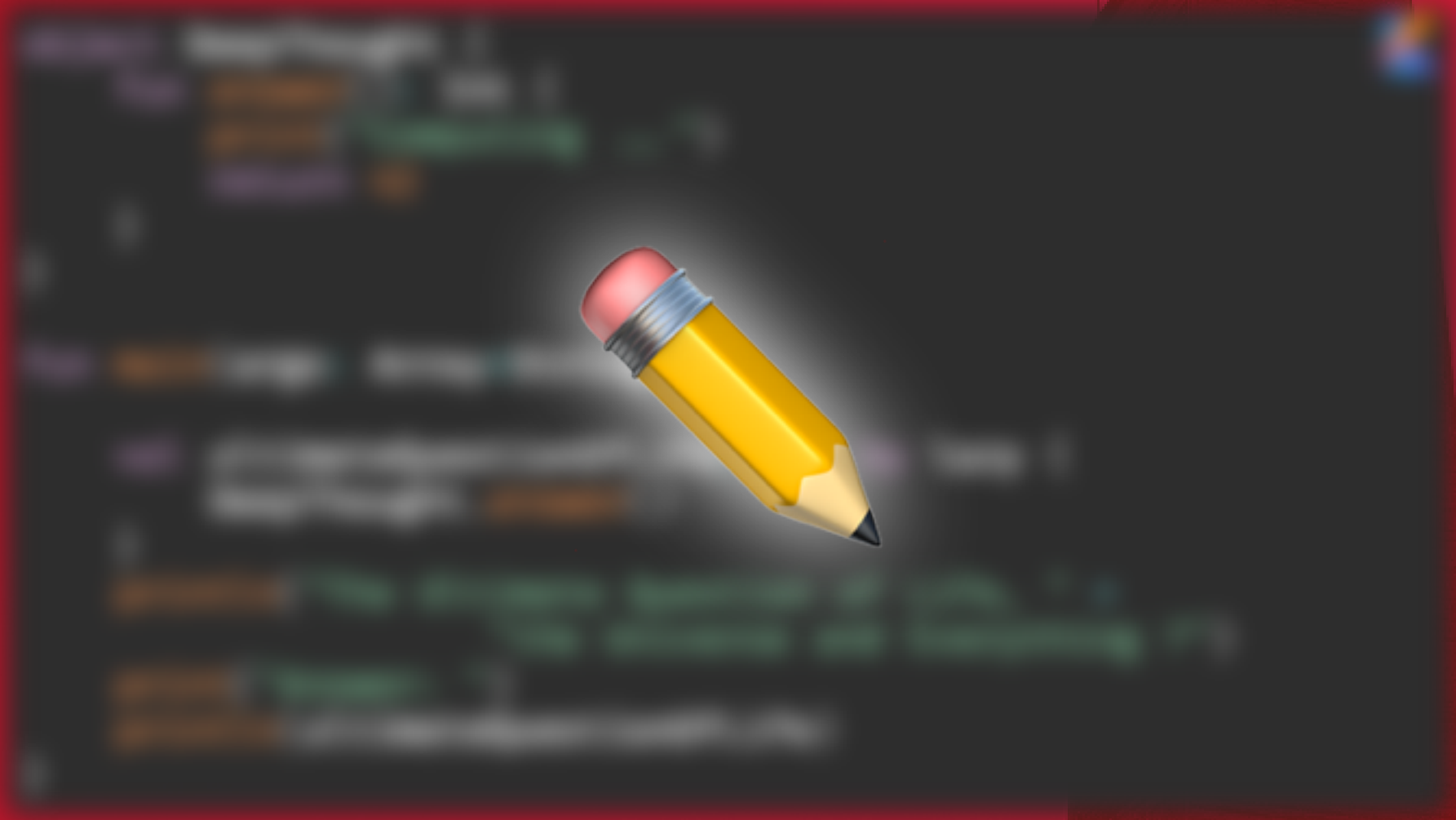
lazy.kt



observable.kt

lateinit.kt


```
lateinit var str: String

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

- lateinit : évite les null check pour les propriétés qui ne peuvent etre initialisées immédiatement (ex référence de vues sur `Activity`, `Fragment`).
  - Ne peut pas être utilisé avec les types primitifs
- Lazy : utile pour les propriétés qui ne sont pas systèmatiquement utilisées.
  ⚠️ À manipuler avec précaution dans les activités Android (avec le cycle de vie, cela peut référencer une ancienne instance)
- Delegate : Observable, Not null, ...

Un peu plus sur les fonctions

inline.kt


```kotlin
import java.time.Instant

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

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

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

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

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

Logger.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\u
    d2 = {"L_13_advanced_function/Logger;", "", "name", "", "(
)
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;
```


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reified.kt

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Plus sur les fonctions

Cas d'utilisation du `reified`

- pour créer des extensions kotlin des fonctions Java qui utilisent des `Class<T>`

Cas d'utilisation des `inline`, `noinline`

- quand on utilise `reified`
- quand on sait se qu'on fait, https://kotlinlang.org/docs/reference/inline-functions.html

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Conclusion

- Faible surchage
- Support officiel par Google
- Using Project Kotlin for Android
- Kotlin Guide
- android-ktx
- Kotlin Android Extensions

Serveur

- Supporter officiellement depuis Spring 5, Spring Boot 2
- SparkJava, javalin
- Vert.x
- KTor
- ...

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Web et Natif

Web

- Partager du code commun
- 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 !

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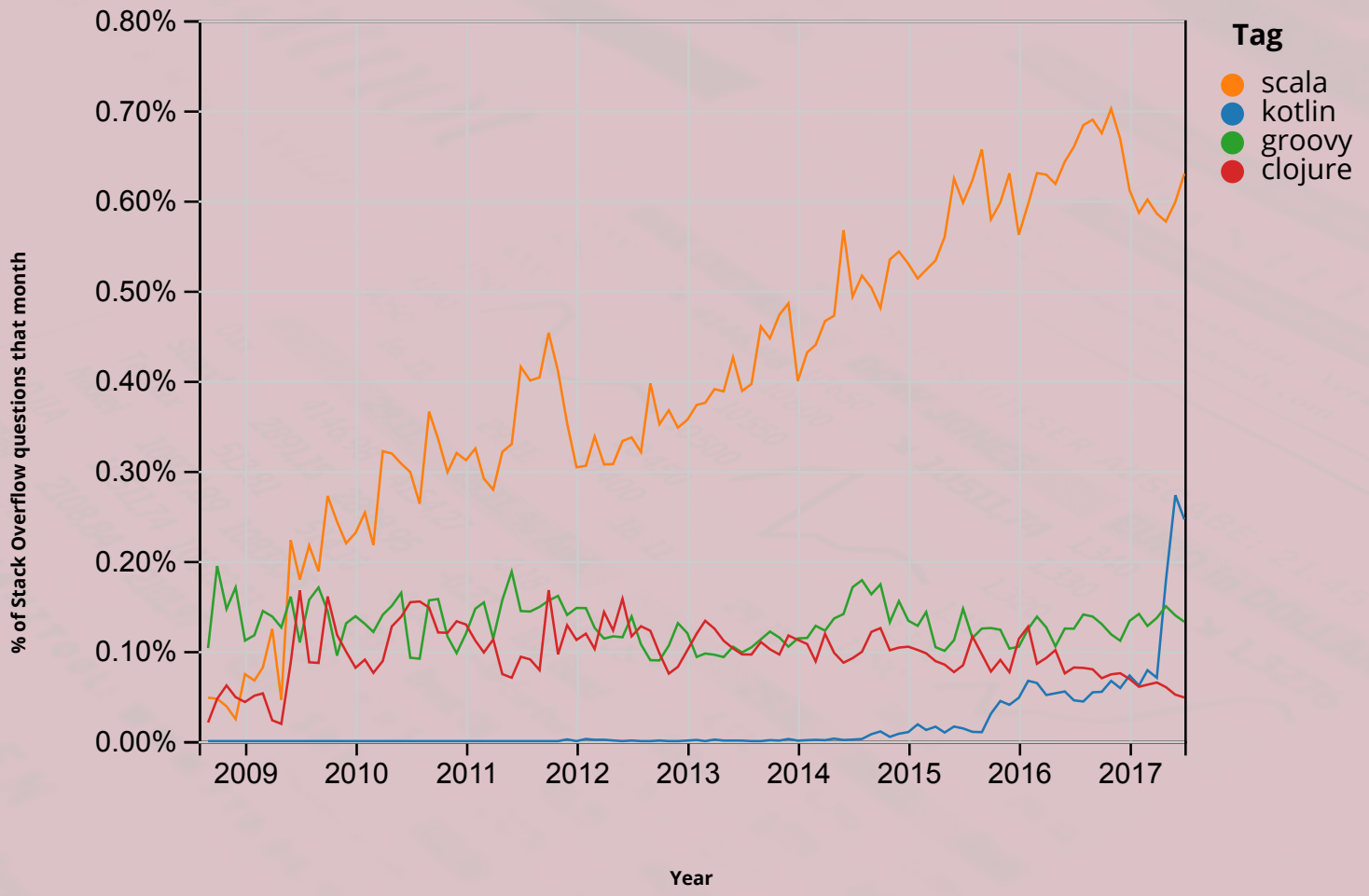
Tendance



Stackoverflow insights

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Kotlin vs Java

- C'est déjà mature
- ✊ Code plus expressif, plus sûr, plus simple
- 🤝 Interopérable avec Java
- 👍 Outillage (editeur, gradle, maven)
- 👍 Ecosystème et communauté
- 🚀 Évolution rapide
- 🐣 Code multiplatform

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

Liens

- Référence
- Blog
- Forum
- Slack
- Koans
- KEEP - Kotlin Evolution and Enhancement Process

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Liens presentation

- Slides en HTML: ➽ http://bit.ly/KotlinDevoxxFR
- Slides en PDF: http://bit.ly/kotlinDevoxxFRpdf
- kotlin-perf
- Kotlin by example

Bibliothèques

- kotlinx.serialization
- kotlinx.coroutines
- KotlinTest
- Javalin
- RxKotlin
- ∧rrow
- ...
- Kotlin is Awesome

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Questions ?

Pensez au votes et aux retours