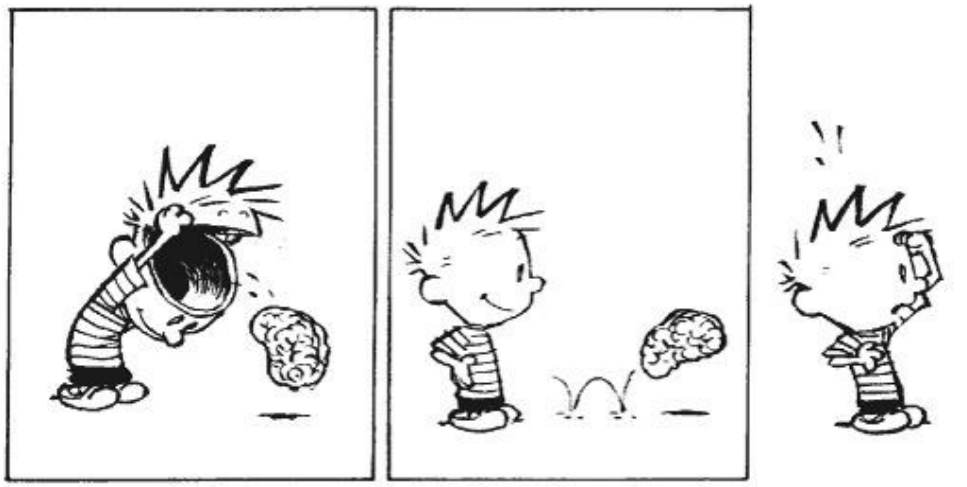
Data Oriented Programming in Java

Rémi Forax
Université Gustave Eiffel – Sept 2022

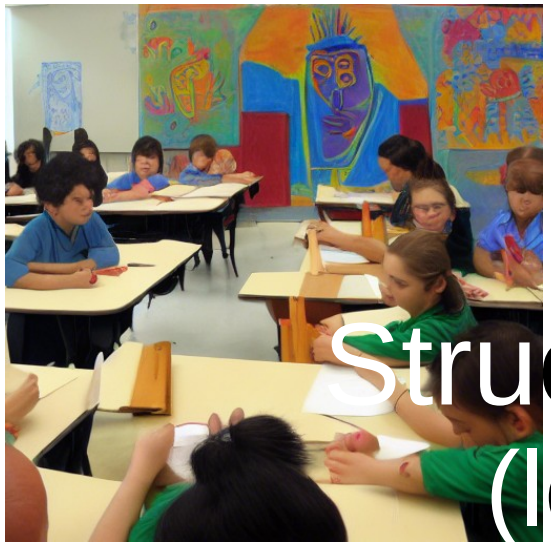


Don’t believe what I’m saying !

I’m a huge proponent of designing your code around the data, rather than the other way around […]
Bad programmers worry about the code. Good programmers worry about data structures and their relationships.

-- *Linus Torvalds*

Did Linus just disrespect OOP ?



class-room-as-picasso

Structure definitions in Java (let’s go back to school)

Structure definitions (Java 1.0)

A **class** mixed

- Data definition (mutable fields)
- Behaviors (methods)

```
class Drawing {
  private String title;

  public Drawing(String title) { this.title = title; }

  public int price() { return title.length * 100; }
}
```

Structure definitions (Java 8)

A **lambda** is an anonymous function

- data ?
- one function

```
interface Article {
  int price();
}
…
public static Article drawing(String title) { return () - > title.length * 100; }
```

Structure definitions in Java 8+

class (mutable data + methods)

lambda (immutable data + one function)

Structure definitions (Java 17)

A **record** is pure data ?

- immutable data
- methods ?

```
record Drawing(String title) {}
…
public static int price(Drawing drawing) {
  return drawing.title() * 100;
}
```

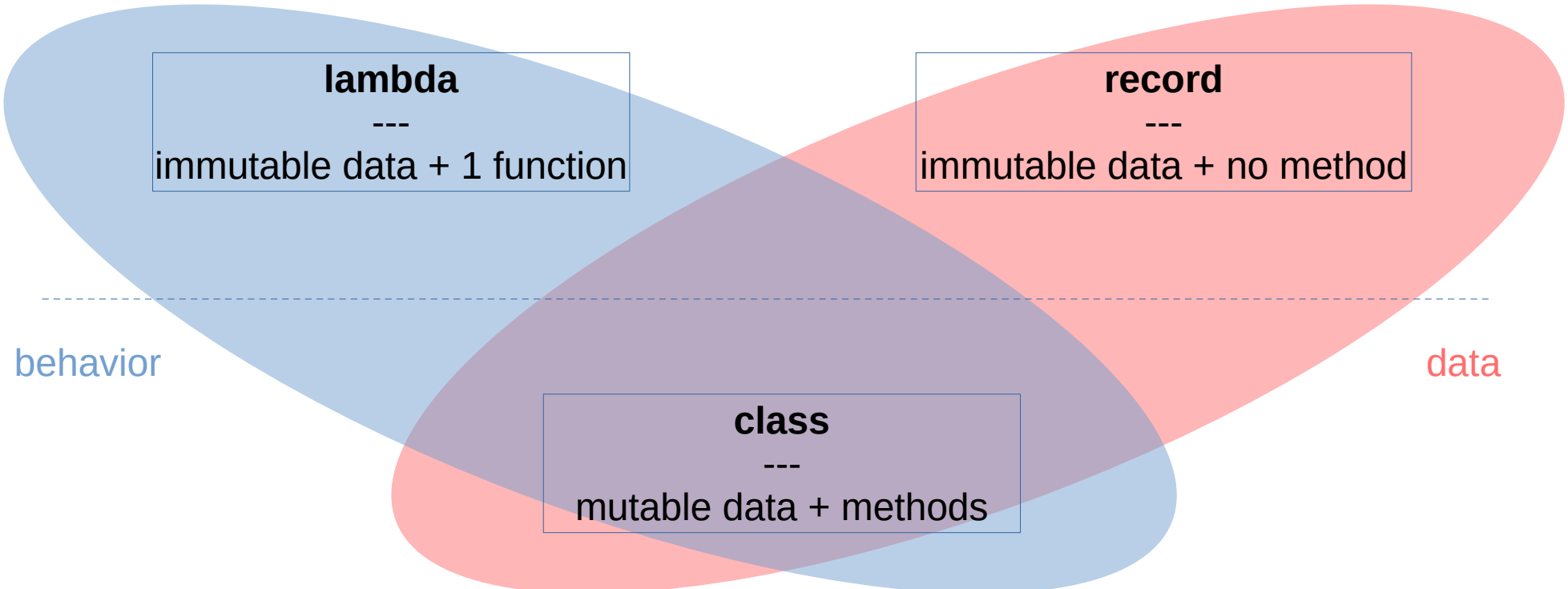
Structure definitions (Java 17+)

class (mutable data + methods)

lambda (immutable data + one function)

record (immutable data + no methods)

Structure definitions (Java 17+)



fantastic-unicorn-as-picasso

What is a record and where to use them ?

DEMO !
(1 / 3)

matching-as-picasso

Pattern Matching

Virtual Polymorphism

```
interface Article {
  int price();
}

record Drawing(String title) implements Article {
  public int price() { return title.length() * 100}
}

enum Maker { DISNEY, ACME }
record Toy(Maker maker) implements Article {
  public int price() {
    return switch(maker) {
      case DISNEY -> 1_000;
      case ACME - > 130;
    };
  }
}
```

Pattern Matching

```
interface Article { int price(); }

record Drawing(String title) implements Article { }

enum Maker { DISNEY, ACME }
record Toy(Maker maker) implements Article { }

int price(Article article) {
  return switch(article) {
    case Drawing drawing - > drawing.title().length() * 100;
    case Toy toy - >
         switch(toy.maker()) {
           case DISNEY - > 1_000;
           case ACME - > 13;
         };
    default - > …   // FIXME
  };
}
```

Wadler’s Expression Problem

Polymorphism

- add new subtypes
- No new operation

Pattern Matching

- Add new operations
- No new subtypes

We can not get both :(

DEMO !
(2 / 3)

dope-as-picasso

Data Oriented Programming

(no, not this one ...)

DOP Principle

Data are more important than code

When data are updated, code should follow

- Compilers should flags where updates need to be done

DOP in Java

Switch Expression must be exhaustive

- Add sealed types
- Switch statement get a warning

Record Pattern test the shape of a record

DOP in Java

```
sealed interface Article permits Drawing, Toy { int price(); }

record Drawing(String title) implements Article { }

enum Maker { DISNEY, ACME }
record Toy(Maker maker) implements Article { }

int price(Article article) {
  return switch(article) {
    case Drawing(String title) - > title.length() * 100;
    case Toy(Maker maker) - >
          switch(toy.maker()) {
             case DISNEY - > 1_000;
             case ACME - > 13;
          };
    // no default here !
  };
}
```

We steal everything !

From Scala (2004) / Kotlin (2011)

- record come from “case class” / “data class”
- sealed keyword

We steal everything !

From Scala (2004) / Kotlin (2011)

- record come from “case class” / “data class”
- sealed keyword

From Standard ML (1983)

```
datatype article
    =  Drawing of String
    |  Toy of Maker
```

picasso-as-picasso

Good Artists Copy, Great Artists Steal

-- Pablo Picasso

DEMO !
(3 / 3)

oops-as-picasso

OOP vs DOP

OOP vs DOP

Not on the same interfaces

- not-sealed (users can provide new implementations)
- sealed (all implementations are known)

Not at the same level

- OOP works at API level
- DOP works at implementation level

OOP and DOP

Not on the same interfaces

Not at the same level

=> OOP and DOP should work together

patterns-as-picasso

Patterns in Pattern Matching

(everything is in preview)

Type Pattern (Java 17)

Equivalent to an instanceof check

but type safe !

```
Article article = …
switch(article) {
  case Toy toy -> …
  case Drawing drawing -> ...
}
```

Record Pattern (Java 19)

Check the shape of a record (DOP)

```
Article article = …
switch(article) {
  case Toy(Maker maker) toy -> …
  case Drawing(String title) -> ...
}
```

Var Pattern (Java 19)

Ask the compiler to infer the type

```
Article article = …
switch(article) {
  case Toy(var maker) -> …
  case Drawing(var title) -> ...
}
```

Null ~~Pattern~~ (Java 19)

Not really a pattern

If there is a case null, switch allows null

```
String s = …
switch(s) {
  case null -> …
  case String s -> ...
}
```

Guard ~~Pattern~~ (Java 19)

No really a pattern, attached to a case

```
Article article = …
switch(article) {
  case Toy(var maker) when maker == Maker.DISNEY -> …
  case Toy toy -> …   // for the other makers
  case Drawing d -> …
}
```

Instanceof vs switch

All patterns also works with instanceof

```
record House(String… persons) {
  public boolean equals(Object o) {
    return o instanceof House(var persons) &&
        Arrays.equals(this.persons, persons);
  }
  // + hashCode
}
```

Any Pattern ‘_’ (Java 20)

I don’t care about that value

```
Point point = ...
switch(point) {
  case Point(var x, _) - > …
  case Point(_, _) - > ...
}
```

Also works in lambda, for, catch and try-with-resources !

Primitive Pattern (Java 20)

Is a primitive cast is safe ?

```
int value = …
switch(value) {
  case short -> …  // values in Short.MIN_VALUE … MAX_VALUE
  case int i -> ...
}
```

I don’t like it but I’m not the spec lead !

Array Pattern (Java 20)

Has several items (exact count)

```
String[] array = …
switch(array) {
  case String[] { var i1, var i2 } -> …  // if two items
  case String[] array -> …  // other arrays
}
```

Constant Pattern (Java 21+)

Use a constant (syntax still in flux)

```
Point p = …
switch(point) {
  case Point(0, 0) -> ...
  case Point _ -> ...
}
```

And more ...

Pattern assignment

```
Point(int x, int y) = point;
```

Deconstruction pattern

Record pattern but on interface class and enum

Named pattern

```
switch(optional) {
  case Optional.of(var value) -> ...
  case Optional.empty() -> ...
}
```

questions-as-picasso

Questions ?

All images have been dreamed by Stable Diffusion