SOSCON Russia 2021

Kotlin API for Apache Spark: why we decided to add one more language to support in Spark

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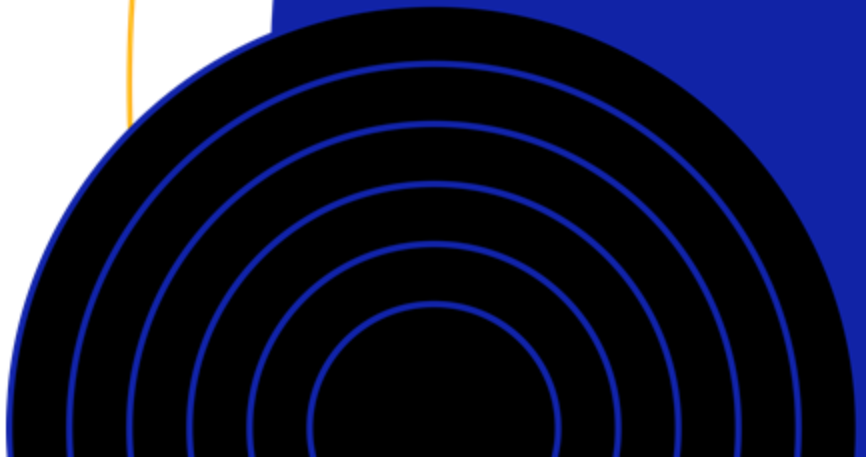
Developer Advocate
JetBrains



Pasha Finkelshteyn

Developer 🥑 for Big Data @ JetBrains

@asm0di0

How did I fall in love with Big Data?

- 7 years ago Hadoop looked like a magic to Java enterprise developer
- Started to look for data-related projects
- Started to read about DBs
- Moved from Team Lead to Data Engineer

Data engineers

Those who build your data pipelines
And your storage

What did I have

- Java
- Kotlin
- Scala
- Groovy
- bash, XML, YAML 😄

Sparse experience with other languages

What did I have

- Core Java
- GC
- Lots of debug experience
- Distributed systems
- Architecture

First thing Data Engineer learns?


APACHE
Spark
TM

Example

```
1 spark
2       .read
3       .csv(path)
4       .as[MyDTO]
5       .map(dto ⇒ AnotherDTO(dto.x, dto.y))
6       .fiter(_.n ≠ null)
7       .write
8       .json(path)
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Supported languages

The most popular language in data engineering

```python
from pyspark.sql import DataFrame, functions as F
from pyspark.sql.types import *

data_type = StructType([
    StructField("pk", LongType(), False),
    StructField("aa", StringType(), False)
  ])

transformed_data = (
  sample_df
  .withColumn("json_object", F.get_json_object(F.col("json_value"), "$.data"))
  .withColumn("parsed_struct", F.from_json(F.col("json_object"), data_type))
  .selectExpr("parsed_struct.*")
)
```

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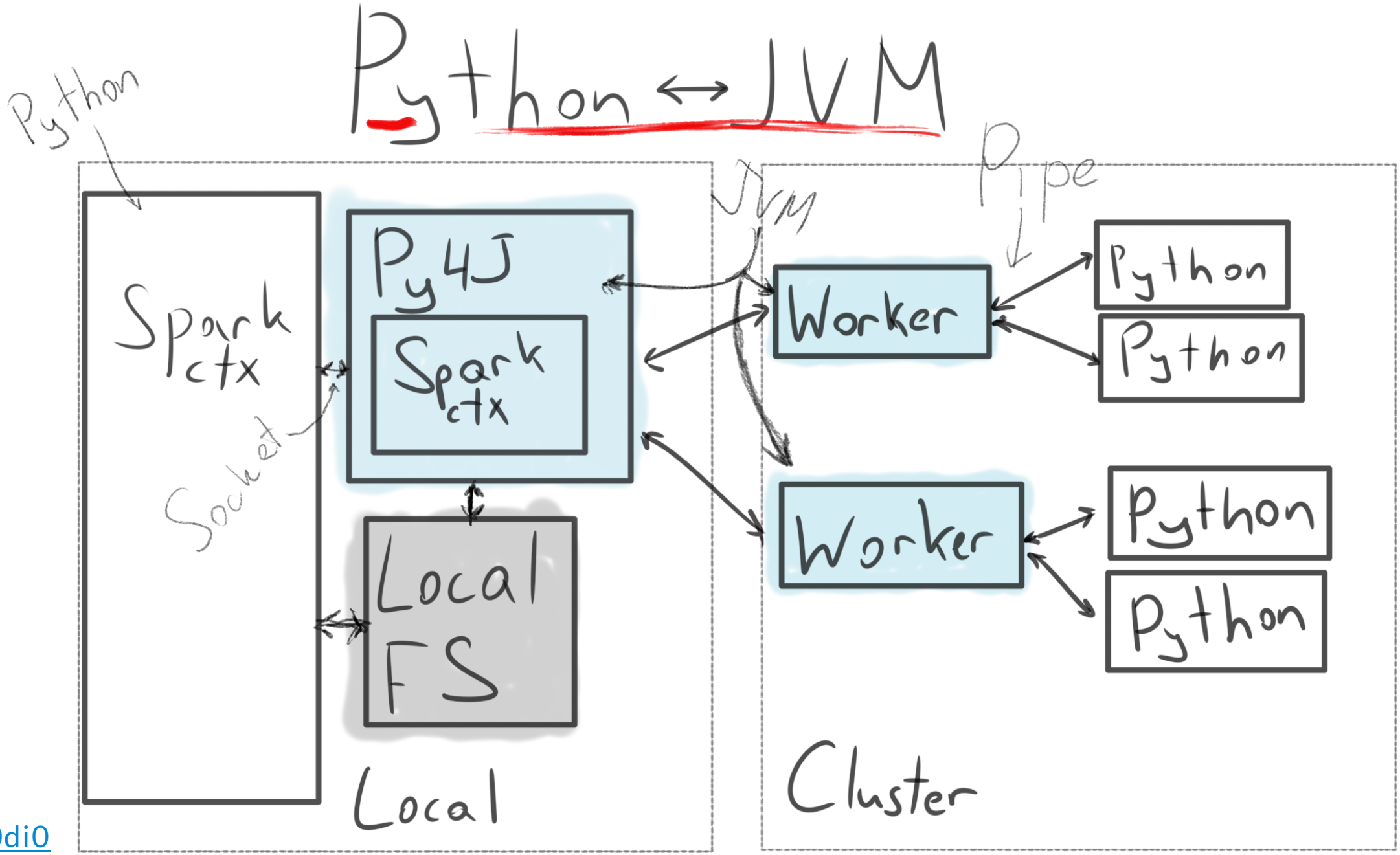
Python

- `F` is made to distinct Spark built-ins from self-made.
  Who have ever created their own function over column?
- API is untyped
- Everything is string-based
- `UDF`s are SLOW
- Custom type support is complex


Python ↔ JVM
Python
Spark ctx
Socket
Py4J
Spark ctx
Local FS
Local
JVM
Pipe
Worker
Worker
Python
Python
Python
Python
Cluster

The best* official API

- Typed and untyped APIs
- Awesome smart encoders
- Spark is written in Scala:
  - Best interop possible
- Huge ecosystem

* by my own rating among official APIs

The hard parts

```
trait HashSet[+T] {
  def add[U >: T](item: U)
}
```

The hard parts

```
trait Zulimba[+T] {
  def gogoThere[U >: T](next: U)
}
```

The hard parts

- Hard to learn for people without JVM knowledge
- Hard to read code somebody else wrote
- Easy to abuse language features
  - operator overloading
  - implicit
  - traits

Scala's type system is awesome and powerful!

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For the greater good

Objects in Spark

```
1 val newInstance = NewInstance(
2         cls, arguments, ObjectType(cls), propagateNull = false)
3 expressions.If(
4   IsNull(path),
5   expressions.Literal.create(null, ObjectType(cls)),
6   newInstance
7 )
```

Everything is expression

- `NewInstance`
- `ObjectType`
- `If`
- `IsNull`
- `Literal`

Type safety is not silver bullet

Java is verbose

```
public class Employee {
  private String name;
  private String id;
  private double sal;
  public String getName() { }
  public void setName(String name) { }
  public String getId() { }
  public void setId(String id) { }
  public double getSal() { }
  public void setSal(double sal) { }
  public int hashCode() { }
  public boolean equals() { }
}
```

```java
Encoder<Person> personEncoder = Encoders.bean(Person.class);
Dataset<Person> javaBeanDS = spark.createDataset(
  Collections.singletonList(person),
  personEncoder
);
// --- and then ---
Encoder<Integer> integerEncoder = Encoders.INT();
Dataset<Integer> primitiveDS = spark.createDataset(
  Arrays.asList(1, 2, 3),
  integerEncoder);
Dataset<Integer> transformedDS = primitiveDS.map(
    (MapFunction<Integer, Integer>) value -> value + 1,
    integerEncoder);
```

Java is verbose

R is hard

```
1 mtcars_tbl ← copy_to(sc, mtcars)
2
3 partitions ← mtcars_tbl %>%
4   filter(hp ⩾ 100) %>%
5   mutate(cyl8 = cyl == 8) %>%
6   sdf_partition(training = 0.5, test = 0.5, seed = 1099)
```

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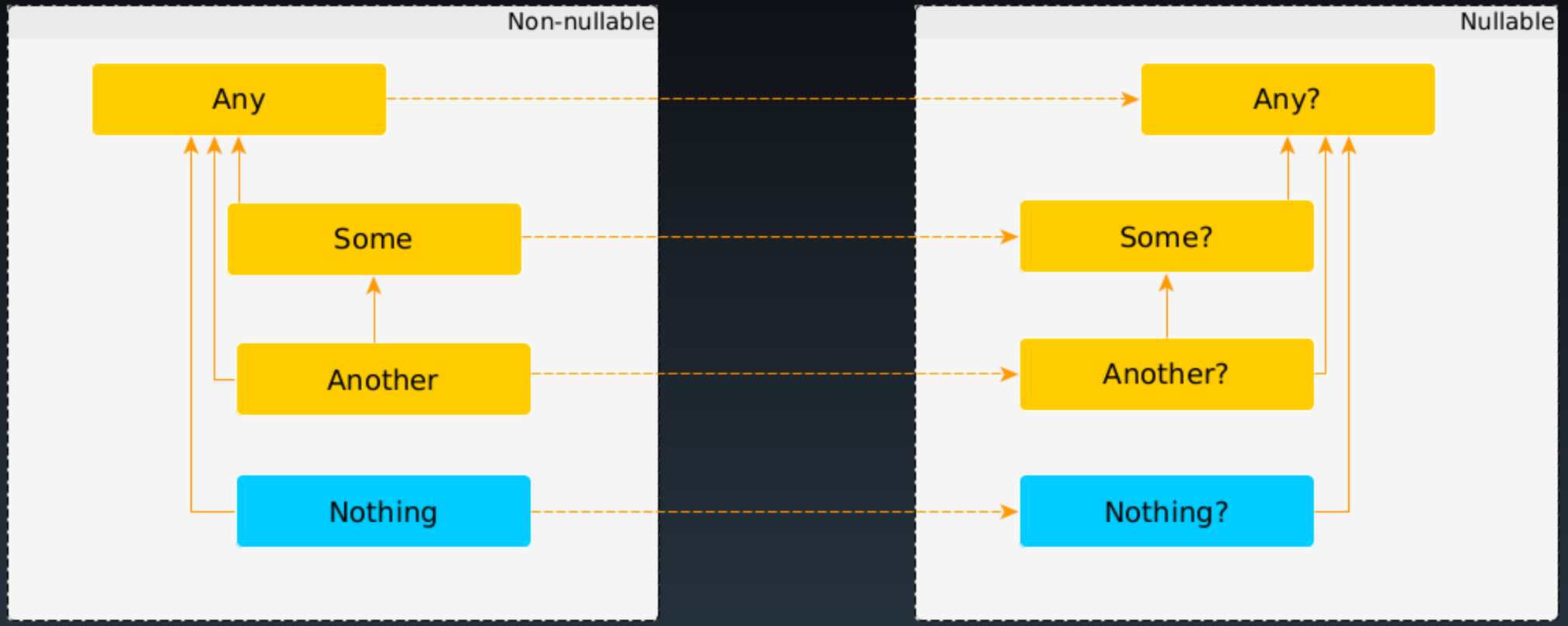
Thoughts on R

- There are ideas on deprecating SparkR
- There always will be performance gap between native (JVM) and other languages

Null-aware type system



Extension methods

```
fun Iterable<Int>.sum() = reduce { a, b -> a + b }
```

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fun Iterable<Int>.sum() = reduce { a, b -> a + b }
```

This ⬆️ already exists in stdlib

Join them together

Scala:

```
payment.join(customer, Seq("customerId"), "left_outer")
```

A bit later:

```
.map { _._2.id }
```

`NullPointerException` 

Because Java has unique exception for everything.

We can do better

Kotlin:

```
payment.leftJoin(customer, col("customerId"))
```

A bit later

```
.map { it.second.id }
```

This ⬆️ won't compile!

We can do better

Kotlin:

```
payment.leftJoin(customer, col("customerId"))
```

A bit later

```
.map { it.second?.id }
```

This ⬆️ will!

DSL-building capabilities

```
1 fun html(init: HTML.() → Unit): HTML {
2     val result = HTML()
3     HTML.init() // or return HTML().apply { init () }
4     return result
5 }
6 fun HTML.h1(text: String) = addElement("<h1>$text<h1>")
7 html { h1("Example") }
```

DSL-building capabilities

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7 html { h1("Example") }
```

Correct caching

```
1 dsOf(1, 2, 3, 4, 5)
2   .map { it to (it + 2) }
3   .withCached {
4     // source dataset is cached here
5     showDS()
6   } // and unpersisted here
7   .map { c(it.first, it.second, (it.first + it.second) * 2) }
```

withSpark

```
1 withSpark(logLevel = SparkLogLevel.INFO,
2           props = mapOf("spark.sql.codegen.wholeStage" to true) {
3     val first = dsOf(Left(1, "a"), Left(2, "b"))
4     val second = dsOf(Right(1, 100), Right(3, 300))
5     first
6             .leftJoin(second, first.col("id").eq(second.col("id")))
7             .map { c(it.first.id, it.first.name, it.second?.value) }
8             .show()
9 }
```

`withSpark` signature

```
inline fun withSpark(props: Map<String, Any> = emptyMap(),
                     master: String = "local[*]",
                     appName: String = "Kotlin Spark Sample",
                     logLevel: SparkLogLevel = ERROR,
                     func: KSparkSession.() → Unit)
```

`withSpark` signature

```
inline fun withSpark(builder: SparkSession.Builder,
                     logLevel: SparkLogLevel = ERROR,
                     func: KSparkSession.() → Unit)
```

Kotlin for Spark benefits

- Easy to read
- No encoders
- Null-safety
- Extension methods and DSL helpers
- Scala-like API
- Option to opt-out from any "non-native" experience
- Strong typing

Things to improve

- ML support
- Better syntax for `UDF`s
- More audience
- More extensions
- Scala 3 (?)

github.com/JetBrains/kotlin-spark-api

Thank you!

Pasha Finkelshteyn, JetBrains

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