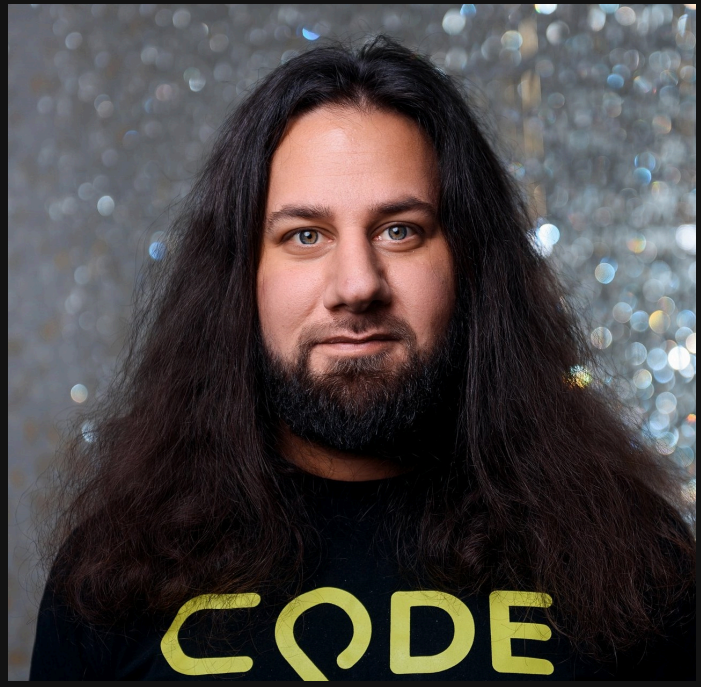
Advanced Kotlin Techniques for Spring Developers

Pasha Finkelshteyn

bellsoft

whoami



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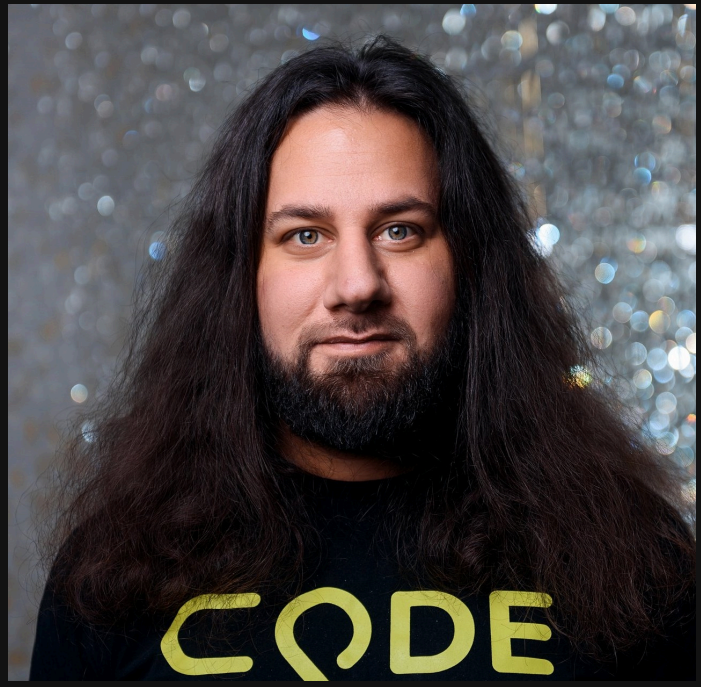

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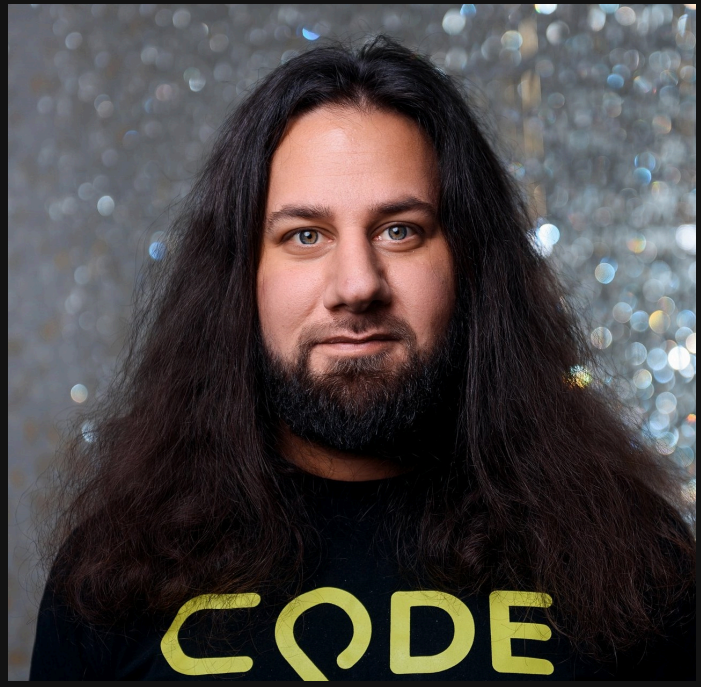

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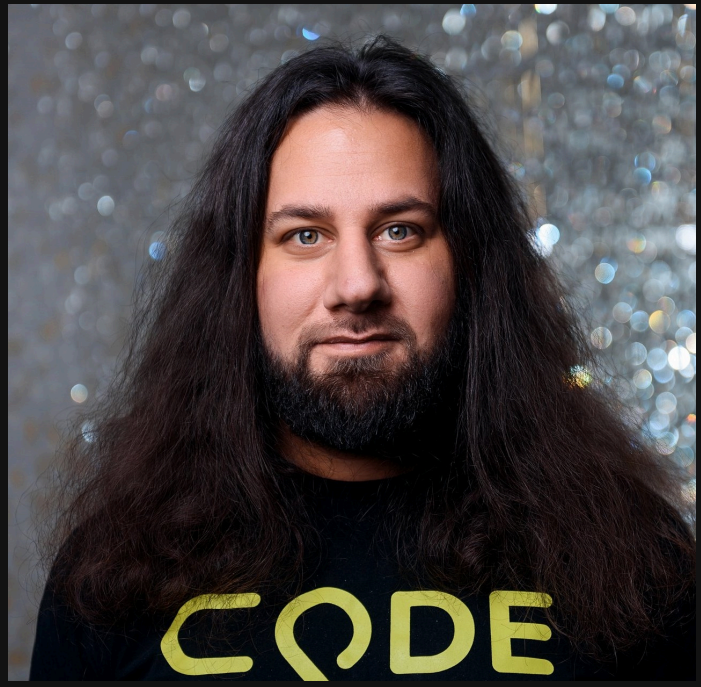

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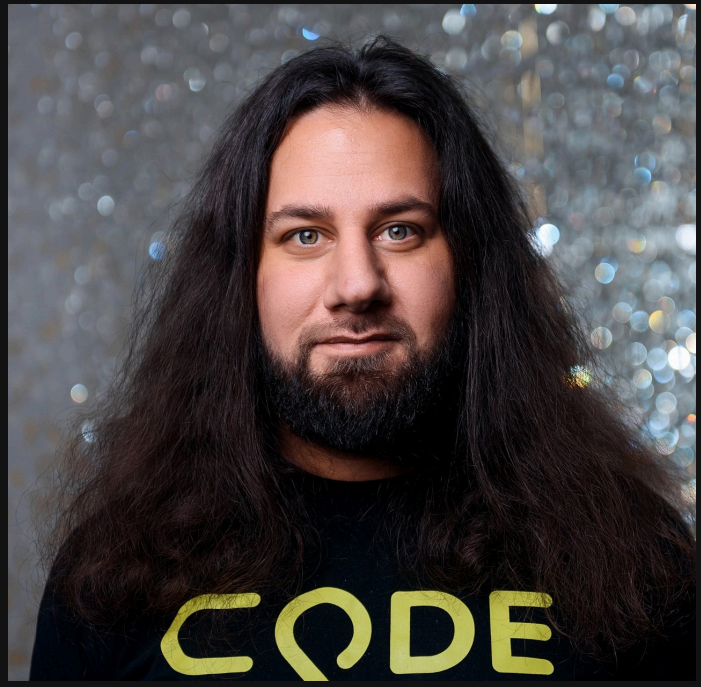

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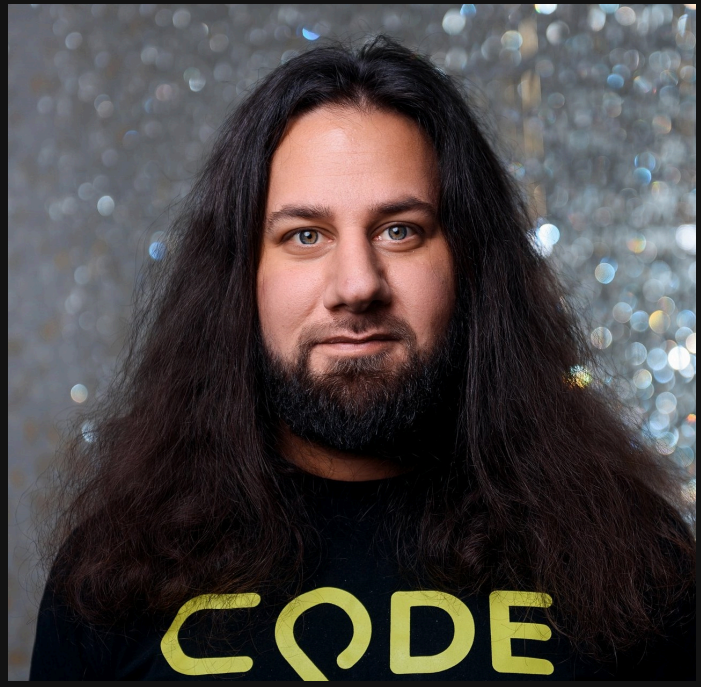

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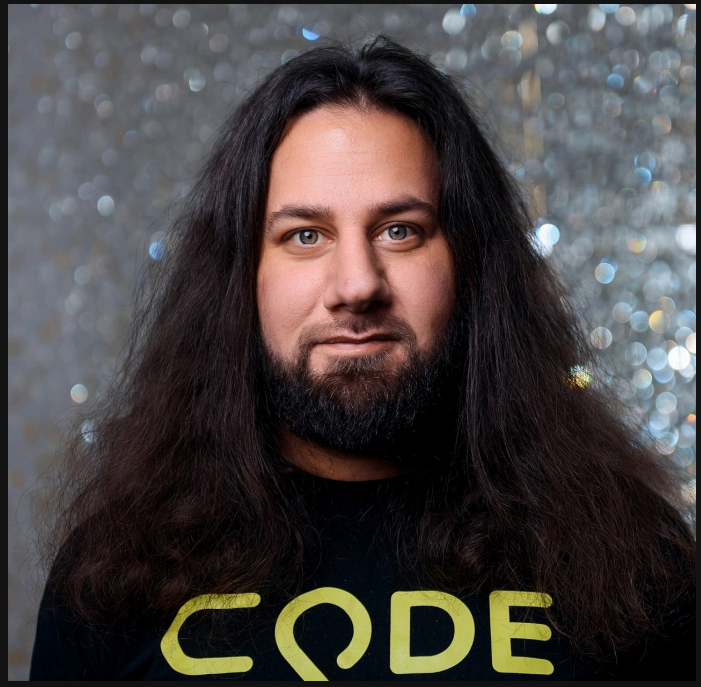
- @asm0dey@fosstodon.org



BellSoft

- Vendor of Liberica JDK
- Contributor to the OpenJDK
- Author of ARM32 support in JDK

Liberica is the JDK officially recommended by

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We know our stuff!

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I hope to showcase something you don't know yet!

My application

My application

- Simple nano-service

My application

- Simple nano-service
- MVC

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- Simple nano-service
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- Validation

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My application

- Simple nano-service
- MVC
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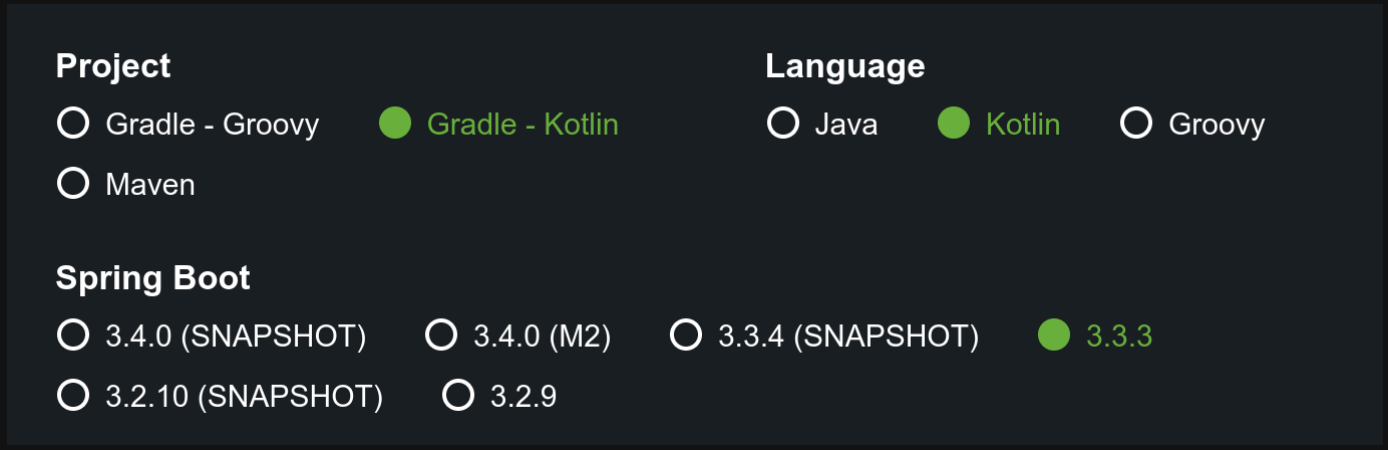
- JPA
- JDBC
- Tests

Where do I start?

https://start.spring.io



Minimum dependencies

Dependencies | **ADD DEPENDENCIES...** CTRL + B

Spring Data JPA SQL
Persist data in SQL stores with Java Persistence API using Spring Data and Hibernate.

Validation I/O
Bean Validation with Hibernate validator.

Spring Web WEB
Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

Spring Security SECURITY
Highly customizable authentication and access-control framework for Spring applications.

PostgreSQL Driver SQL
A JDBC and R2DBC driver that allows Java programs to connect to a PostgreSQL database using standard, database independent Java code.

Testcontainers TESTING
Provide lightweight, throwaway instances of common databases, Selenium web browsers, or anything else that can run in a Docker container.

2 files are generated

- `build.gradle.kts`
- `SpringKotlinStartApplication.kt`

What happens

```
plugins {
  kotlin("jvm") version "2.0.20"
  kotlin("plugin.spring") version "2.0.20"
  id("org.springframework.boot") version "3.3.3"
  id("io.spring.dependency-management") version "1.1.6"
  kotlin("plugin.jpa") version "2.0.20"
}

group = "com.example"
version = "0.0.1-SNAPSHOT"

java {
  toolchain {
    languageVersion = JavaLanguageVersion.of(21)
  }
}

repositories {
  mavenCentral()
```

The main class

Main class

```
1  import org.springframework.boot.autoconfigure.SpringBootApplication
2  import org.springframework.boot.runApplication
3
4  @SpringBootApplication
5  class SampleApplication
6
7  fun main(args: Array<String>) {
8    runApplication<SampleApplication>(*args)
9  }
```

Main class

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```

runApplication

```
1  inline fun <reified T : Any> runApplication(vararg args: String) =
2      SpringApplication.run(T::class.java, *args)
```

runApplication

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```

The first goodie of Spring for Kotlin

Let’s start implementing

Chapter 1. MVC + Validation

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First controller

```
1  @RestController
2  @RequestMapping("/person")
3  class PersonController {
4    @PostMapping
5    fun createPerson(@RequestBody @Valid person: Person) {}
6  }
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```

`Person.kt`:

```
data class Person(
  val name: String,
  val age: Int
)
```

Make an empty `POST` ...

```
1   POST localhost:8080/person
2   Content-Type: application/json
```

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Make an empty `POST` ...

```
HTTP/1.1 400 Bad Request
Content-Type: application/json
{
  "timestamp": 1674735741056,
  "status": 400,
  "error": "Bad Request",
  "path": "/person"
}
```

Make an empty `POST` ...

```
HTTP/1.1 400 Bad Request
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{
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HTTP/1.1 400 Bad Request
Content-Type: application/json
{
  "timestamp": 1674735741056,
  "status": 400,
  "error": "Bad Request",
  "path": "/person"
}
```

Since `Person` is non-nullable — it's validated without `@NotNull` annotation

Why? How?

`build.greadle.kts`:

```
1  tasks.withType<KotlinCompile> {
2    kotlinOptions {
3      freeCompilerArgs = listOf("-Xjsr305=strict")
4      jvmTarget = "21"
5    }
6  }
```

Why? How?

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```

`JSR 305: Annotations for Software Defect Detection`:

- Nullness annotations (e.g., `@NonNull` and `@CheckForNull`)
- Internationalization annotations, such as `@NonNls` or `@Nls`

Non-empty `POST` with empty properties

```
POST localhost:8080/person
Content-Type: application/json

{"name": null, "age": null}
```

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On client

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On server

Non-empty `POST` with empty properties

```
POST localhost:8080/person
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{"name": null, "age": null}
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On client

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HTTP/1.1 400 Bad Request
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```

On server

```
…Instantiation of [simple type, class com.github.asm0dey.sample.Person]
  value failed for JSON property name due to missing
```

Non-empty `POST` with empty properties

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POST localhost:8080/person
Content-Type: application/json

{"name": null, "age": null}
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On client

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HTTP/1.1 400 Bad Request
Content-Type: application/json
```

On server

```
…Instantiation of [simple type, class com.github.asm0dey.sample.Person]
  value failed for JSON property name due to missing
```

`POST` with non-empty name

```
1  POST localhost:8080/person
2  Content-Type: application/json
3
4  {"name": "Pasha", "age": null}
```

`POST` with non-empty name

```
POST localhost:8080/person
Content-Type: application/json

{"name": "Pasha", "age": null}
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`POST` with non-empty name

```
POST localhost:8080/person
Content-Type: application/json

{"name": "Pasha", "age": null}
```

```
HTTP/1.1 200
Content-Length: 0
```

`POST` with non-empty name

```
POST localhost:8080/person
Content-Type: application/json

{"name": "Pasha", "age": null}
```

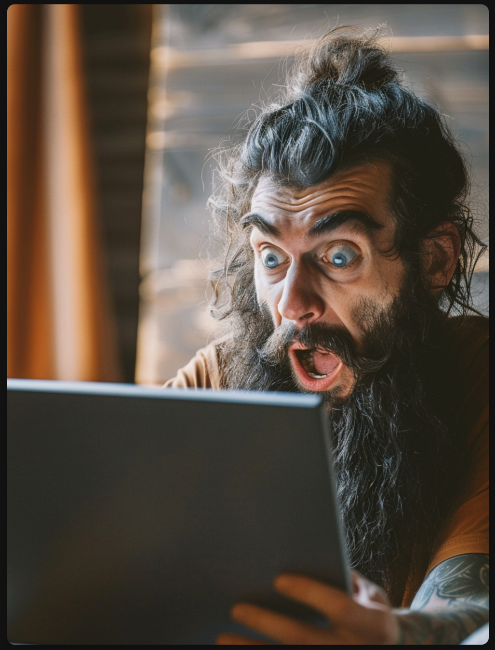
```
HTTP/1.1 200
Content-Length: 0
```

`POST` with non-empty name

```
POST localhost:8080/person
Content-Type: application/json

{"name": "Pasha", "age": null}
```

```
HTTP/1.1 200
Content-Length: 0
```



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Rechecking

```
1  data class Person(
2    val name: String,
3    val age: Int
4  )
```

Rechecking

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```

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In JVM primitive types have default values

These types will be JVM primitives:

- `Double`
- `Int`
- `Float`
- `Char`
- `Short`
- `Byte`
- `Boolean`

Updating class

```
1  data class Person(
2    val name: String,
3    @field:NotNull val age: Int?
4  )
```

Updating class

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data class Person(
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Updating class

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data class Person(
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)
```

```
POST localhost:8080/person
Content-Type: application/json

{"name": "Pasha", "age": null}
```

```
HTTP/1.1 400 Bad Request
…
{ "timestamp": 1674760360096, "status": 400, "error": "Bad Request", "path": "/person" }
```

Updating class

```
data class Person(
  val name: String,
  @field:NotNull val age: Int?
)
```

```
POST localhost:8080/person
Content-Type: application/json

{"name": "Pasha", "age": null}
```

```
HTTP/1.1 400 Bad Request
…
{ "timestamp": 1674760360096, "status": 400, "error": "Bad Request", "path": "/person" }
```

```
Field error in object 'person' on field 'age': rejected value [null]
```

Also…

```yaml
spring:
  jackson:
    deserialization:
      FAIL_ON_NULL_FOR_PRIMITIVES: true
```

Quick summary

- `-Xjsr305=strict` will make the validation easier
- For JVM primitive types we have to put `@field:NotNull` and mark them nullable
- Sometimes can work it around with jackson settings

JPA

Chapter 2

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Nanoentity

```
@Entity
data class Person(
  @Id
  @GeneratedValue(strategy = IDENTITY)
  var id: Int? = null,
  @Column(nullable = false)
  val name: String,
  @Column(nullable = false)
  val age: Int,
)
```

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- `data` class
- `val name` and `val age`

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Improving

`data` classes have `copy`, `equals`, `hashCode`, `copy`, and `componentX` defined

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JPA won’s be able to write to `val`

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JPA won’s be able to write to `val`

But there is no no-arg constructor!

How to make it work?

Magic:

```
1   kotlin("plugin.jpa") version "2.0.20"
```

But there is no no-arg constructor!

How to make it work?

Magic:

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1   kotlin("plugin.jpa") version "2.0.20"
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- Puts annotations on the fields
- Adds a default constructor in bytecode*!

But there is no no-arg constructor!

How to make it work?

Magic:

```
1   kotlin("plugin.jpa") version "2.0.20"
```

- Puts annotations on the fields
- Adds a default constructor in bytecode*!

* In Kotlin the default constructor would not be possible, but in Java it is

Current result

```
@Entity
class Person(
  @Id
  @GeneratedValue(strategy = IDENTITY)
  var id: Int? = null,
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  var name: String,
  @Column(nullable = false)
  var age: Int,
)
```

Is this enough?

Not quite.

At the very least we have to redefine `equals` and `hashCode`.

For example…

```
1  @Entity
2  class Person(
3    // properties
4  ) {
5    // equals…
6    override fun hashCode(): Int {
7      return id ?: 0
8    }
9  }
```

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JDBC

Chapter 3

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Obtain user by id

Let’s imagine we need to call the following:

```
1   SELECT *
2   FROM  users
3   WHERE id = ?
```

Or, for example…

Or, for example…

In Java

Let's inline mapper

```java
public List<Person> findById(int id) {
  return jdbcTemplate.query("SELECT * FROM users WHERE id = ?", new UserRowMapper(), id);
}

private static class UserRowMapper implements RowMapper<Person> {
  @Override
  public Person mapRow(ResultSet resultSet, int i) throws SQLException {
    int id = resultSet.getInt("id");
    String name = resultSet.getString("name");
    Double age = resultSet.getDouble("age");
    return new Person(id, name, age);
  }
}
```

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```

In Java

Let’s inline mapper

```java
public List<Person> findById(int id) {
  return jdbcTemplate.query("SELECT * FROM users WHERE id = ?", new UserRowMapper(), id);
}

private static class UserRowMapper implements RowMapper<Person> {
  @Override
  public Person mapRow(ResultSet resultSet, int i) throws SQLException {
    int id = resultSet.getInt("id");
    String name = resultSet.getString("name");
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    return new Person(id, name, age);
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}
```

I don’t like it

- Too many mappers
- Parameters are too far from query

Why should it be so?

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Let’s Look at the signature

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```
1   public <T> List<T> query(String sql, RowMapper<T> rowMapper, @Nullable Object... args)
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```
1   public <T> List<T> query(String sql, RowMapper<T> rowMapper, @Nullable Object... args)
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Because in ☕ vararg can be only the last… 😢

`JdbcTemplate` in Kotlin 

```kotlin
return jdbcTemplate.query("SELECT * FROM users WHERE id = ?", userId) { rs, _ ->
  val id = rs.getInt("id")
  val name = rs.getString("name")
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  Person(id, name, age)
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  Person(id, name, age)
}
```

- `vararg` doesn't have to be in the last position
- unused parameter of a lambda can be named `_`

Extension functions

```
fun <T> JdbcOperations.query(
  sql: String,
  vararg args: Any,
  function: (ResultSet, Int) -> T
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Which allows

```
return jdbcTemplate.query("SELECT * FROM users WHERE id = ?", userId)
{ rs, _ ->
  // TODO: ResultSet → Person
}
```

You can do the same for your own code!

From 

```
1   public List<String> transformStrings(Function<String, String> mapper, String... args){}
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From 

```
1   public List<String> transformStrings(Function<String, String> mapper, String... args){}
```

To 

```
1   fun transformStrings(vararg args: String, mapper: (String) -> String): List<String>{}
```

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More on extensions for Spring

- spring-beans
- spring-context
- spring-core
- spring-jdbc
- spring-messaging
- spring-r2dbc
- spring-test
- spring-tx
- spring-web
- spring-webflux
- spring-webmvc

Reactive persistence

Chapter 4

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Who knows what is reactive?

Who knows what is reactive?

- non-blocking

Who knows what is reactive?

- non-blocking
- asynchronous

Who knows what is reactive?

- non-blocking
- asynchronous
- handles back-pressure

Who knows what is reactive?

- non-blocking
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The result is a monad…

Who knows what is reactive?

- non-blocking
- asynchronous
- handles back-pressure

The result is either:

- `Mono` : produces 0 to 1 items when it's ready
- `Flux` : Produces 0 to ∞ items

In Kotlin

Coroutines operate on `suspend` functions

`suspend` can be called from:

- coroutine context
- another `suspend` `fun`

returns usual types - Lists, Strings, etc

```
1   suspend fun randomNum(): Int {
2     val x = service1.randomNum() // suspend
3     val y = service2.randomNum() // suspend
4     return x + y
5   }
```

In Kotlin

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Spring R2DBC

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1  @Repository
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            .fetch()
            .awaitSingle()["id"] as? Long ?: error("not long on not returned")
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8              .fetch()
9              .awaitSingle()["id"] as? Long ?: error("not long on not returned")
10     // inside Spring ↓
11     suspend fun <T> RowsFetchSpec<T>.awaitSingle(): T {
12       return first().awaitSingleOrNull() ?: throw EmptyResultDataAccessException(1)
13     }
14 }
```

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Transactions

```
1   @Transactional
2   suspend fun failTransactional(): Long {
3       val curId =  repo.createUserAndReturnId()
4       repo.createUserWithConflictingId(curId) // will throw
5       return curId
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Nothing changes from the client standpoint!

Repositories

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interface CoroutineCrudRepository<T, ID> : Repository<T, ID> {
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  // Flow is an async unbounded collection
  fun findAll(): Flow<T>
  // ...
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Function is either suspend or returns `Flow`

Transactions with repositories?

```
1   @Transactional
2   suspend fun failTransactional(): Long {
3     val u = User(null, "me@asm0dey.site", 37)
4     val savedId =  repo.save(u)
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Configuration

Let’s start simple

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Modified Jackson’s `ObjectMapper` to work with `data` classes from `jackson-module-kotlin`

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4 lines instead of 1 😱

Custom bean

```
1   class JsonLogger(private val objectMapper: ObjectMapper) {
2     fun log(o: Any) {
3       if (o::class.isData) {
4         println(objectMapper.writeValueAsString(o))
5       } else println(o.toString())
6     }
7   }
8
9   val beans = beans {
10    bean { jacksonObjectMapper() }
11    bean(::JsonLogger)
12  }
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Arbitrary logic

```
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Arbitrary logic

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OK How do I use it?

Let’s return to our very first file

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runApplication<SampleApplication>(*args)
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val beans = { /* */ }
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And run it…

```
Started SampleApplicationKt in 1.776 seconds (process running for 2.133)
```

Let’s test it

Bean:

```
@Component
class MyBean(val jsonLogger: JsonLogger) {
  fun test() = jsonLogger.log("Test")
}
```

Test:

```
@SpringBootTest
class ConfigTest {
  @Autowired private lateinit var myBean: MyBean
  @Test
  fun testIt() = assertEquals("Test", myBean.test())
}
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  available: expected at least 1
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That’s because our tests do not call `main` !

Requires some glue to work

```
1  val beans = { /* */ }
2  class BeansInitializer : ApplicationContextInitializer<GenericApplicationContext> {
3    override fun initialize(context: GenericApplicationContext) = beans.initialize(context)
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`application.yml`:

```
1   context.initializer.classes: "com.github.asm0dey.sample.BeansInitializer"
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`Main.kt`:

```
1  fun main(args: Array<String>) {
2    runApplication<SampleApplication>(*args)
3  }
```

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Security

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Spring Security

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- Validation is better with Kotlin, but remember about primitives
- `data` classes should not be used for JPA
- JDBC is simpler with Kotlin
- R2DBC is simpler with coroutines
- Bean definition DSL is awesome
- Specifically with security!

Thank you!

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Thank you! Questions?

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END