Introduction to Kotlin

About me

Trayan Iliev

– CEO of **IPT – Intellectual Products & Technologies**
http://www.iproduct.org

– Oracle® certified programmer 15+ Y

– end-to-end reactive fullstack apps with Java, ES6+, TypeScript, Angular, React and Vue.js

– 12+ years IT trainer: Spring, Java EE, Node.js, Express, GraphQL, SOA, REST, DDD & Reactive Microservices

– Voxxed Days, jPrime, Java2Days, jProfessionals, BGOUG, BGJUG, DEV.BG speaker

– Organizer RoboLearn hackathons and IoT enthusiast

Course Schedule

- [Oct 4/5, 2021] Introduction to Kotlin
- [Oct 7/8, 2021] Kotlin basic syntax
- [Oct 11/12, 2021] Packages and imports
- [Oct 14/15, 2021] Classes and objects - I
- [Oct 18/19, 2021] Classes and objects - II
- [Oct 21/22, 2021] Functions and lambdas - I
- [Oct 25/26, 2021] Functions and lambdas - II
- [Oct 28/29, 2021] Collections and sequences
- [Nov 1/2, 2021] Exception handling. Annotations.

Course Schedule

- [Nov 4/5, 2021] Reflection. IO
- [Nov 8/9, 2021] Data Serialization. Interoperability with Java
- [Nov 11/12, 2021] Coroutines and concurrency
- [Nov 15/16, 2021] Coroutine Context and Dispatchers
- [Nov 18/19, 2021] Asynchronous Flow
- [Nov 22/23, 2021] Channels
- [Nov 25/26, 2021] Shared mutable state and concurrency
- [Nov 29/30, 2021] Test Driven Development (TDD). Logging
- [Dec 2/3, 2021] Databases and persistence. Spring Data in Kotlin

Course Schedule

- [Dec 6/7, 2021] Spring Boot, Spring MVC in Kotlin - I
- [Dec 9/10, 2021] Spring Boot, Spring MVC in Kotlin - II
- [Dec 13/14, 2021] Web Flux REST/ WebSocket API development in Kotlin
- [Dec 16/17, 2021] Rapid development of production REST APIs using Ktor - I
- [Dec 20/21, 2021] Rapid development of production REST APIs using Ktor - II

Where to Find The Code and Materials?

https://github.com/iproduct/course-kotlin

Kotlin - A modern programming language with less legacy debts

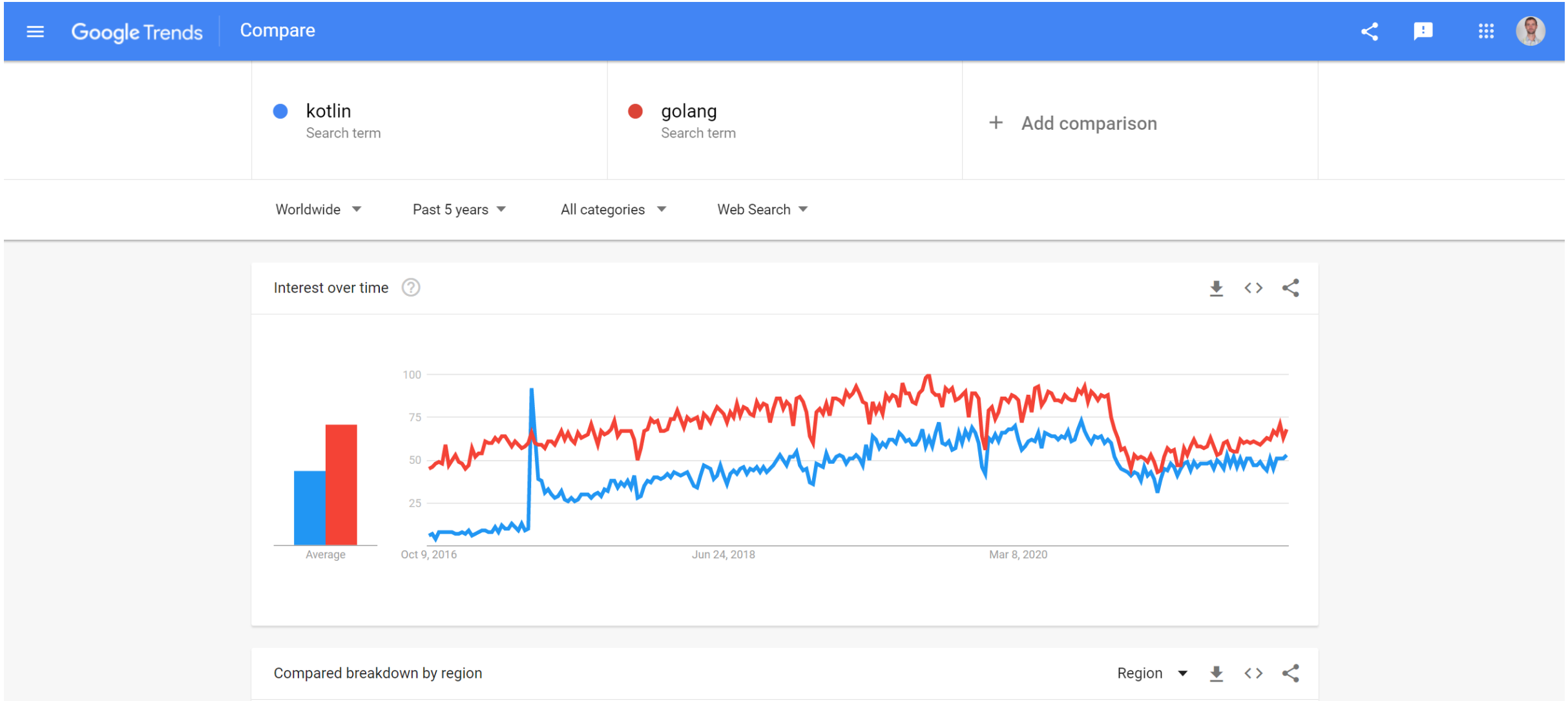
https://kotlinlang.org/

- Kotlin → since July 2011, JetBrains lead Dmitry Jemerov said that most languages did not have the features they were looking for, with the exception of Scala. However, he cited the slow compilation time of Scala as a deficiency.
- Kotlin docs admit how good Java is, but mention that the Java programming language has limitations and problems that are "either impossible or very hard to fix due to backward-compatibility issues."
- Kotlin is a statically typed JVM-targeted language "free of the legacy trouble and having the features so desperately wanted by the developers", safer and more concise than Java, statically checking for pitfalls such as null pointer dereference, as well as simpler than Scala.

Kotlin Features

- statically typed,
- general-purpose programming language
- type inference - allows more concise syntax than Java
- fully interoperate with Java (the JVM version of its standard library depends on the Java Class Library)
- cross-platform - Kotlin mainly targets the JVM, but also compiles to JavaScript or native code (via LLVM).
- targeting mobile, native (including WebAssembly), web, server-side, data science and cross-platform application development
- open sourced under the Apache 2 license.

Kotlin Popularity According to Google Trends



Source: [Google Trends]

Some Java Issues Addressed in Kotlin

- Null references are controlled by the type system.
- No raw types
- Arrays in Kotlin are invariant
- Kotlin has proper function types, as opposed to Java's SAM-conversions
- Use-site variance without wildcards
- Kotlin does not have checked exceptions

Source: https://kotlinlang.org/

What Java Has that Kotlin Does Not

- Checked exceptions
- Primitive types that are not classes
- Static members
- Non-private fields
- Wildcard-types
- Ternary-operator a ? b : c

Source: https://kotlinlang.org/

What Kotlin Has that Java Does Not - I

- Lambda expressions + Inline functions = performant custom control structures
- Extension functions
- Null-safety
- Smart casts
- String templates
- Properties
- Primary constructors

Source: https://kotlinlang.org/

What Kotlin Has that Java Does Not - II

- First-class delegation
- Type inference for variable and property types
- Singletons
- Declaration-site variance & Type projections
- Range expressions
- Operator overloading
- Companion objects

Source: https://kotlinlang.org/

What Kotlin Has that Java Does Not – III

- Data classes
- Separate interfaces for read-only and mutable collections
- Coroutines !!!

Source: https://kotlinlang.org/

Kotlin Is Consize – Reduces the Boilerplate

```
// Create a POJO with getters, setters, `equals()`, `hashCode()`, `toString()` and `copy()` in a single line:
data class Customer(val name: String, val email: String, val company: String)

// Want a singleton? Create an object:
object ThisIsASingleton {
    val companyName: String = "JetBrains"
}

fun main() {
    // Or filter a list using a lambda expression:
    val positiveNumbers = listOf(0, 1, -1, 2, -2, 3, -3).filter { it > 0 }
    println(positiveNumbers);

    val customerWithCompany = listOf(
        Customer("Trayan Iliev", "office@iproduct.org", "IPT"),
        Customer("John Smith", "john@nobrainer.com", "NoBrainer"),
        Customer("Silvia Popova", "silvia@acme.com", "ACME Corp")
    ).map({"${it.name} - ${it.company}"})  // template strings and single argument lambdas iterator
    println(customerWithCompany); // => [Trayan Iliev - IPT, John Smith - NoBrainer, Silvia Popova - ACME Corp]
}
```

Kotlin Is Safe – Avoids Null Pointer Exceptions

```
// Get rid of those pesky NullPointerExceptions
var output: String
output = null   // Compilation error

// Kotlin protects you from mistakenly operating on nullable types
val name: String? = null    // Nullable type
println(name.length())      // Compilation error
```

Kotlin Is Safe – Automatic Type Casting

```
data class Product(val name: String, val price: Double)
class Order(val number: Int, val products: List<Product>, val date: LocalDateTime = LocalDateTime.now() ){
    fun calculateTotal(): Double {
        return products
            .map { it.price }
            .reduce { acc, prod  ->  acc + prod }
        }
    }

// And if you check a type is right, the compiler will auto-cast it for you
fun calculateTotal(obj: Any): Double? {
    if (obj is Order)  return obj.calculateTotal()
    return 0.0
}

fun main() {
    val products = listOf(Product("Keyboard", 27.5),  Product("Mouse", 17.1))
    val order = Order(1, products)
    println(calculateTotal((order))); // => 44.6
}
```

Kotlin Is Interoperable – JVM, Android

```
import io.reactivex.rxjava3.core.Flowable
import io.reactivex.rxjava3.schedulers.Schedulers
import kotlinx.coroutines.delay
import kotlinx.coroutines.runBlocking

fun main() = runBlocking {
    Flowable
        .fromCallable {
            Thread.sleep(1000) //  imitate expensive computation
            "Done"
        }
        .subscribeOn(Schedulers.io())
        .observeOn(Schedulers.single())
        .subscribe(::println, Throwable::printStackTrace)
    delay(2000)
    println("Demo finished.")
}
```

Kotlin Is Interoperable – … and in The Browser

```
fun getCommonWorldString() = "common-world"
```

```
import io.ktor.samples.fullstack.common.*
import kotlin.browser.*

@Suppress("unused")
@JsName("helloWorld")
fun helloWorld(salutation: String) {
    val message = "$salutation from Kotlin.JS ${getCommonWorldString()}"
    document.getElementById("js-response")?.textContent = message
}

fun main() {
    document.addEventListener("DOMContentLoaded", {
        helloWorld("Hi!")
    })
}
```

Kotlin Is Interoperable – … Fullstack with Ktor as MPP

```
fun Application.main() {
    val currentDir = File(".").absoluteFile
    environment.log.info("Current directory: $currentDir")
    routing {
        get("/") {
            call.respondHtml {
                body {
                    +"Hello ${getCommonWorldString()} from Ktor"
                    div { id = "js-response“+ "Loading..." }
                    script(src = "/static/ktor-samples-fullstack-mpp-frontend.js") {}
}
            }
        }
        static("/static") { resource("ktor-samples-fullstack-mpp-frontend.js") }
}}

fun main(args: Array<String>) {
    embeddedServer(Netty, port = 8080) { main() }.start(wait = true)
}
```

Tool Support for Kotlin

Tool-friendly

Choose any Java IDE or build from the command line

IntelliJ IDEA

Bundled with both IntelliJ IDEA Community Edition and IntelliJ IDEA Ultimate

Download ↗ Instructions

Android Studio

Bundled with Android Studio

Download ↗ Instructions

Eclipse

Install the plugin from the Eclipse Marketplace

Instructions

Standalone Compiler

Use any editor and build from the command line

Instructions

Source: https://kotlinlang.org/

Who Uses Kotlin? – to Mention just a Few

Gradle is introducing Kotlin as a language for writing build scripts

Corda is an open-source distributed ledger platform, supported by major banks, and built entirely in Kotlin

Evernote recently integrated Kotlin into their Android client

Coursera Android app is partially written in Kotlin

Spring makes use of Kotlin's language features to offer more concise APIs

All new code in the Trello Android app is in Kotlin

Source: https://kotlinlang.org/

Ktor

Asyncronous client / server framework utilizing Kotlin features such as DSLs and coroutines

What is Ktor?

- **Ktor** is an OSS Apache 2 licensed framework for building **asynchronous servers and clients in connected systems** using the power of **Kotlin** programming language.
- Drawing inspiration from other frameworks, such as **Wasabi** and **Kara**, to leverage to the maximum extent the Kotlin language features such as **DSLs** and **coroutines**.
- It is **low-ceremony** in that it requires very **little code and configuration** to get a system up and running.
- Currently, the **Ktor client** works on **all platforms** Kotlin targets, that is, **JVM, JavaScript, and Native**. Right now, **Ktor server-side** is restricted to the **JVM**.

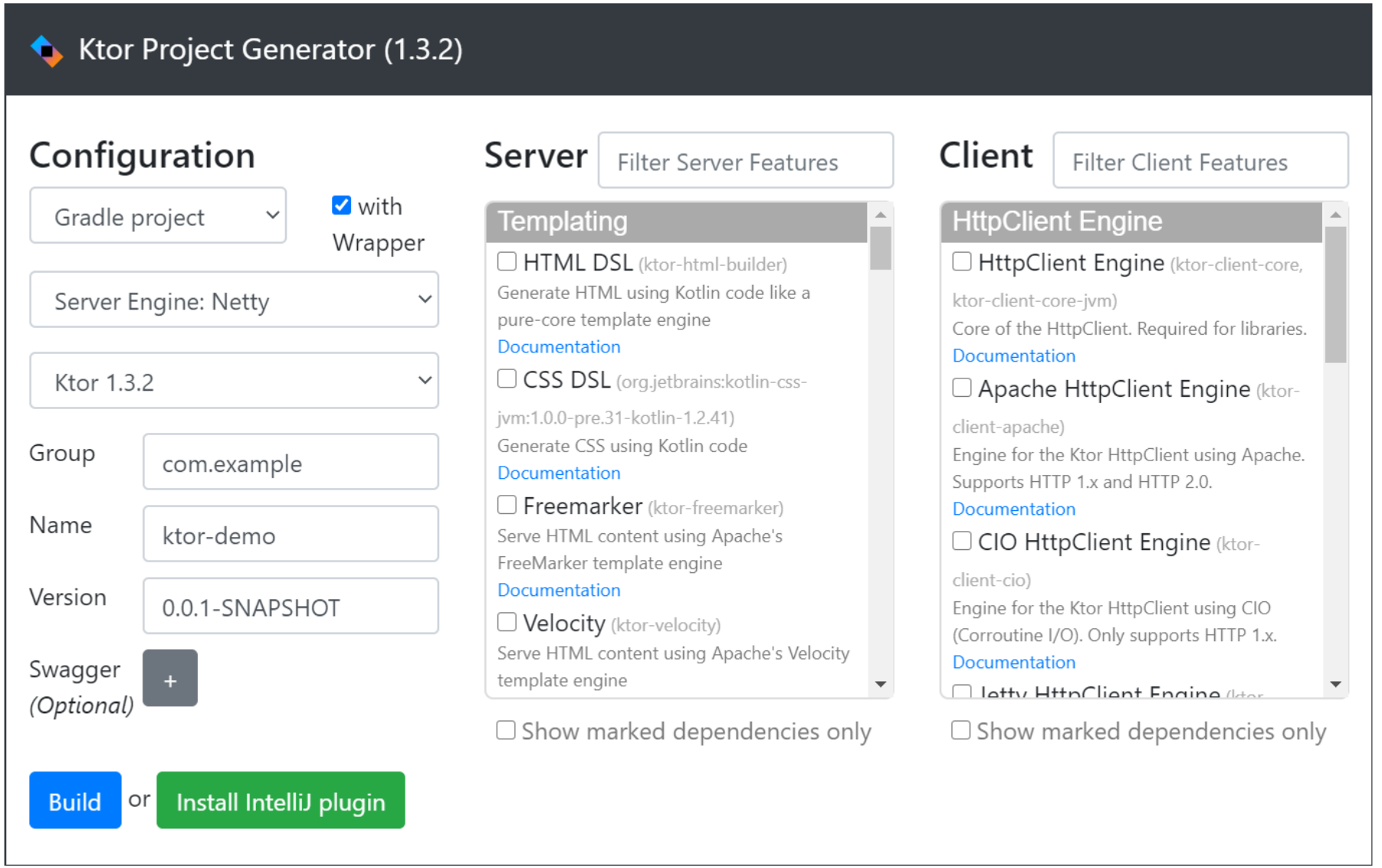
Source: https://kotlinlang.org/

Generate a Ktor project

Estimated reading time: 1 minute

Edit Page

NOTE: You can also use the Ktor IntelliJ plugin instead. This page can also be accessed at start.ktor.io.



Source: https://kotlinlang.org/

Simple Web Service with Ktor

```
fun main() {
    val server = embeddedServer(Netty, 8080) {
        routing {
            get("/hello") {
                call.respondText("<h2>Hello from Ktor and Kotlin!</h2>", ContentType.Text.Html)
            }
        }
    }
    server.start(true)
}
```

… And that's all :)

```
data class Product(val name: String, val price: Double, var id: Int)

object Repo: ConcurrentHashMap<Int, Product>() {
    private idCounter = AtomicInteger()
    fun addProduct(product: Product) {
        product.id = idCounter.incrementAndGet()
        put(product.id, product)
    }
}
fun main() {
    embeddedServer(Netty, 8080, watchPaths = listOf("build/classes"), module= Application::mymodule).start(true)
}
fun Application.mymodule() {
    install(DefaultHeaders)
    install(CORS) {  maxAgeInSeconds = Duration.ofDays(1).toSeconds() }
    install(Compression)
    install(CallLogging)
    install(ContentNegotiation) {
        gson {
            setDateFormat(DateFormat.LONG)
            setPrettyPrinting()
        }
    }
```

```
routing {
    get("/products") {
        call.respond(Repo.values)
    }
    get("/products/{id}") {
        try {
            val item = Repo.get(call.parameters["id"]?.toInt())
            if (item == null) {
                call.respond(
                    HttpStatusCode.NotFound,
                    """{"error":"Product not found with id = ${call.parameters["id"]}"}"""
                )
            } else {
                call.respond(item)
            }
        } catch(ex :NumberFormatException) {
            call.respond(HttpStatusCode.BadRequest,
                """{"error":"Invalid product id: ${call.parameters["id"]}"}""")
        }
    }
```

```
post("/products") {
        errorAware {
            val product: Product = call.receive<Product>(Product::class)
            println("Received Post Request: $product")
            Repo.addProduct(product)
            call.respond(HttpStatusCode.Created, product)
        }
    }
}

private suspend fun <R> PipelineContext<*, ApplicationCall>.errorAware(block: suspend () -> R): R? {
    return try {
        block()
    } catch (e: Exception) {
        call.respondText(
            """{"error":"$e"}""",
            ContentType.parse("application/json"),
            HttpStatusCode.InternalServerError
        )
        null
    }
}
```

Ktor Applications

- **Ktor Server Application** is a custom program **listening to one or more ports** using a **configured server engine**, **composed by modules** with the application logic, that install **features, like routing, sessions, compression**, etc. to handle **HTTP/S 1.x/2.x** and **WebSocket** requests.
- **ApplicationCall** – the context for handling routes, or directly intercepting the pipeline – provides access to two main properties **ApplicationRequest** and **ApplicationResponse** ,as well as **request parameters, attributes, authentication, session, typesafe locations**, and the **application** itself. Example:

```
intercept(ApplicationCallPipeline.Call) {
    if (call.request.uri == "/")
        call.respondHtml {
            body {
                    a(href = "/products") { + "Go to /products" }
} } }
```

Routing DSL Using Higher Order Functions

- **routing**, **get**, and **post** are all **higher-order functions** (functions that take other functions as parameters or return functions).
- Kotlin has a convention that **if the last parameter to a function is another function**, we can place this **outside of the brackets**
- **routing** is a **lambda with receiver** == higher-order function taking as parameter an **extension function** => anything enclosed within **routing** has access to members of the type **Routing**.
- **get** and **post** are functions of the **Routing** type => also **lambdas with receivers**, with own members, such as **call**.
- This combination of **conventions** and **functions** allows to create elegant DSLs, such as Ktor's **routing DSL**.

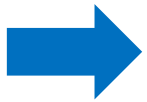
Features

- A **feature** is a **singleton** (usually a **companion object**) that you can **install and configure for a pipeline**.
- Ktor includes some **standard features**, but you **can add your own** or other features from the community.
- You can install features in **any pipeline**, like the **application** itself, or specific **routes**.
- Features are **injected into the request and response pipeline**. Usually, an application would have a series of features such as **DefaultHeaders** which add headers to every outgoing response, **Routing** which allows us to define routes to handle requests, etc.

Installing Features

Using *install*:

```
fun Application.main() {
    install(DefaultHeaders)
    install(CallLogging)
    install(Routing) {
        get("/") {
            call.respondText("Hello, World!")
        }
    }
}
```



Using routing DSL:

```
fun Application.main() {
    install(DefaultHeaders)
    install(CallLogging)
    routing {
        get("/") {
            call.respondText("Hello, World!")
        }
    }
}
```

Standard Features I

- Authenticating Clients
- Enable Automatic HEAD Responses
- Basic and Form authentication
- Controlling cache headers
- CallId
- Log the client requests
- Client/Server Sessions
- Enable HTTP Compression Facilities

Standard Features - II

- Easy '304 Not Modified' Responses
- Content conversion based on Content-Type and Accept headers
- Cookie/Header Sessions
- Enable Cross-Origin Resource Sharing (CORS)
- Data Conversion
- Send Headers Automatically
- Digest authentication
- DoubleReceive for request body

Standard Features - III

- XForwardedHeaderSupport (Reverse Proxy Support)
- Using Freemarker Templates
- JSON support using Gson
- Enable HTTP Strict Transport Security
- Emit HTML with a DSL
- Redirect HTTP requests to HTTPS
- JSON support using Jackson
- JWT and JWK authentication
- LDAP authentication

Standard Features - IV

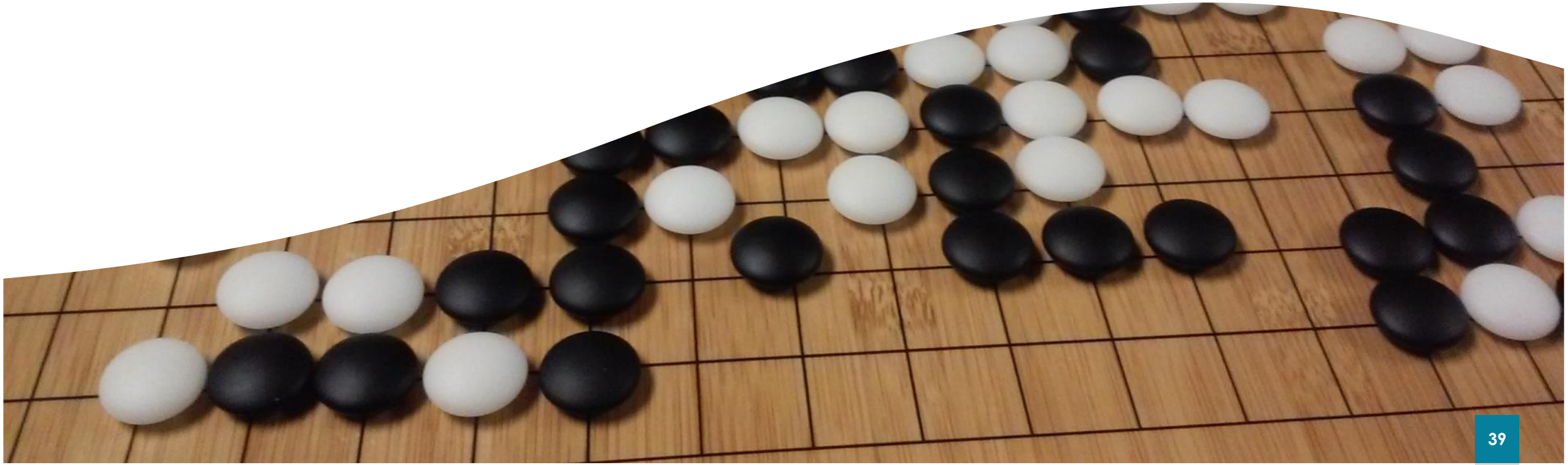
- Type-safe Routing
- Metrics with Micrometer metrics
- Metrics with Dropwizard metrics
- Using Mustache Templates
- OAuth authentication
- Streaming Movies and Other Content
- Using Pebble Templates
- Structured Handling of HTTP Requests
- JSON support using kotlinx.serialization

Standard Features - V

- Handle Conversations with Sessions
- Add an URL for shutting down the server
- Serving Static Content
- Handle Exceptions and Customize Status Pages
- Session Storages
- Templates, Using Thymeleaf Templates, Using Velocity Templates
- Session Transformers
- Webjars support
- WebSockets

Kotlin Basics

Basic types, type checks and casts, control flow



Basic types: Numbers

- Integer types:

Type	Size (bits)	Min value	Max value
Byte	8	-128	127
Short	16	-32768	32767
Int	32	-2,147,483,648 (-2^{31})	2,147,483,647 ($2^{31}-1$)
Long	64	-9,223,372,036,854,775,808 (-2^{63})	9,223,372,036,854,775,807 ($2^{63}-1$)

- Examples:

```
val one = 1 // Int
val threeBillion = 3000000000 // Long
val oneLong = 1L // Long
val oneByte: Byte = 1
```

Basic types: Numbers

- Floating-point types:

Type	Size (bits)	Significant bits	Exponent bits	Decimal digits
Float	32	24	8	6-7
Double	64	53	11	15-16

- Examples:

```
    val pi = 3.14 // Double
//    val two: Double = 1 // Error: type mismatch
    val twoDouble = 1.0 // Double
    val e = 2.7182818284 // Double
    val eFloat = 2.7182818284f // Float, actual value is 2.7182817
    fun printDouble(d: Double) { print(d) }
    val i = 1
    val d = 1.0
    printDouble(d)
//    printDouble(i) // Error: Type mismatch
//    printDouble(eFloat ) // Error: Type mismatch
```

Basic types: Numbers

- Literal constants:
  - Decimals: 123
  - Longs are tagged by a capital L: 123L
  - Hexadecimals: 0x0F
  - Binaries: 0b00001011
  - Octal literals are not supported.
  - Doubles by default: 123.5, 123.5e10
  - Floats are tagged by f or F: 123.5f
- Examples:

```
val oneMillion = 1_000_000
val creditCardNumber = 1234_5678_9012_3456L
val socialSecurityNumber = 999_99_9999L
val hexBytes = 0xFF_EC_DE_5E
val bytes = 0b11010010_01101001_10010100_10010010
```

Numbers representation on the JVM

- On the JVM platform, numbers are stored as primitive types: int, double, etc.
- Exceptions are cases when you create a **nullable** number reference such as **Int?** or **use generics** -> numbers are boxed in Java classes Integer, Double, etc. Nullable references to the same number can be different objects.
- Example:

```
val a: Int = 100
val boxedA: Int? = a
val anotherBoxedA: Int? = a
val b: Int = 10000
val boxedB: Int? = b
val anotherBoxedB: Int? = b
println(boxedA === anotherBoxedA) // true
println(boxedB === anotherBoxedB) // false
println(b == b) // Prints 'true'
println(boxedB == anotherBoxedB) // Prints 'true'
```

Explicit conversions

- **toByte(): Byte**
- **toShort(): Short**
- **toInt(): Int**
- **toLong(): Long**
- **toFloat(): Float**
- **toDouble(): Double**
- **toChar(): Char**
- Example:

```
// Hypothetical code, does not actually compile:
    val x: Int? = 1 // A boxed Int (java.lang.Integer)
    val y: Long? = x // implicit conversion yields a boxed Long (java.lang.Long)
    print(x == y) // Surprise! This prints "false" as Long's equals() checks whether the other is Long as well

    val b: Byte = 1 // OK, literals are checked statically
// val i: Int = b // ERROR
    val i1: Int = b.toInt()
    val l = 1L + 3 // Long + Int => Long
```

Operators

- Arithmetic: +, -, *, /, %
- Examples:

```
println(1 + 2)
println(2_500_000_000L - 1L)
println(3.14 * 2.71)
println(10.0 / 3)

val x = 5 / 2
//println(x == 2.5) // ERROR: Operator '==' cannot be applied to 'Int' and 'Double'
println(x == 2)

val x2 = 5L / 2
println(x2 == 2L)
val x3 = 5 / 2.toDouble()
println(x3 == 2.5)
```

Operators

- Bitwise operations:
  - shl(bits) – signed shift left
  - shr(bits) – signed shift right
  - ushr(bits) – unsigned shift right
  - and(bits) – bitwise and
  - or(bits) – bitwise or
  - xor(bits) – bitwise xor
  - inv() – bitwise inversion
- Example:

```
val x4 = (1 shl 9) and 0x000FF00
```

Floating-point numbers comparison

- Equality checks: **a == b** and **a != b**
- Comparison operators: **a < b**, **a > b**, **a <= b**, **a >= b**
- Range instantiation and range checks: **a..b**, **x in a..b**, **x !in a..b**
- NaN is considered equal to itself
- NaN is considered greater than any other element including POSITIVE_INFINITY
- -0.0 is considered less than 0.0

Unsigned integer types

- **UByte**: an unsigned 8-bit integer, ranges from 0 to 255
- **UShort**: an unsigned 16-bit integer, ranges from 0 to 65535
- **UInt**: an unsigned 32-bit integer, ranges from 0 to 2^32 - 1
- **ULong**: an unsigned 64-bit integer, ranges from 0 to 2^64 – 1

- **UByteArray**: an array of unsigned bytes
- **UShortArray**: an array of unsigned shorts
- **UIntArray**: an array of unsigned ints
- **ULongArray**: an array of unsigned longs

- Ranges and progressions: **UIntRange, UIntProgression, ULongRange, ULongProgression**

- When you use unsigned arrays, you'll get a warning that indicates that this feature is not stable yet. To remove the warning, opt in using the **@ExperimentalUnsignedTypes** annotation.

Unsigned integer types - Examples

```
val ub: UByte = 1u  // UByte, expected type provided
val us: UShort = 1u // UShort, expected type provided
val ul: ULong = 1u  // ULong, expected type provided

val a1 = 42u // UInt: no expected type provided, constant fits in UInt
val a2 = 0xFFFF_FFFF_FFFFu // ULong: no expected type provided, constant doesn't fit in UInt
val a3 = 1UL // ULong, even though no expected type provided and constant fits into UInt

val u: UIntProgression = 1U..10U step 2
val ua: UIntArray = UIntArray(10)
var j = 0
for (e in u) {
    ua[j] = e
    j++
}

for (e in ua) {
    print("$e, ")   // prints: 1, 3, 5, 7, 9, 0, 0, 0, 0, 0,
}
```

Booleans

- The type **Boolean** represents boolean objects: **true** and **false**.
- Boolean has a nullable counterpart **Boolean?** that also has the null value.
- Built-in operations on booleans include:
  - `||` – disjunction (logical OR)
  - **&&** – conjunction (logical AND)
  - **!** – negation (logical NOT)
- `||` and **&&** work lazily, nullable references are boxed on JVM
- Examples:

```
val myTrue: Boolean = true
val myFalse: Boolean = false
val boolNull: Boolean? = null
println(myTrue || myFalse)      // true
println(myTrue && myFalse)      // false
println(!myTrue)      // false
```

Characters

- Characters are represented by the type **Char**. Character literals go in single quotes: '1'.
- Special characters start from an escaping backslash \. The following escape sequences are supported: \t, \b, \n, \r, \', \", \\ and \$.
- To encode any other character, use the Unicode escape sequence syntax: '\uFF00'
- Examples:

```
val aChar: Char = 'a'
println(aChar)
println('\n') //prints an extra newline character
println('\uFF00')
```

Strings

- Strings in Kotlin are represented by the type **String**. Generally, a string value is a sequence of characters in double quotes (").
- Elements of a string are characters that you can access via the indexing operation: **s[i]**. You can iterate over these characters with a for loop.
- Strings are immutable. All operations that transform strings return their results in a new String object, leaving the original string unchanged.

```
val s = "abcd 123"
for (c in s) {
    println(c)
}
val str = "abcd"
val str1 = str.toUpperCase()
println(str1) // Create and print a new String object
println(str === str1) // different objects
val s2 = "abc" + 1
println(s2 + "def")
```

String Literals & String Templates

```
val s3 = "Hello, world!\n"
val text = """
           |Tell me and I forget.
           |Teach me and I remember.
           |Involve me and I learn.
           |(Benjamin Franklin)
           |
           """
val text2 = text.trimIndent()
val text3 = text.trimMargin()
println(text2)
println(text3)

val i3 = 10
println("i = $i") // prints "i = 10"
val s4 = "abc"
println("$s.length is ${s.length}") // prints "abc.length is 3"
```

Arrays

- Arrays in Kotlin are represented by the **Array** class. It has **get** and **set** functions that turn into **[]** by operator overloading conventions, and the size property, along with other useful member functions:

```
class Array<T> private constructor() {
    val size: Int
    operator fun get(index: Int): T
    operator fun set(index: Int, value: T): Unit

    operator fun iterator(): Iterator<T>
    // ...
}
```

Array Examples

```
val a4 = arrayOf(1, 2, 3)
val a5: Array<String?> = arrayOfNulls(3)
val asc = Array(5) { i -> (i * i).toString() }
a4.forEach { println(it) }
a5.forEach { println(it) }
asc.forEach { println(it) }
val x2: IntArray = intArrayOf(1, 2, 3)
x2[0] = x2[1] + x2[2]
println(x2.asList())

val arr1 = IntArray(5)
val arr2 = IntArray(5) { 42 }
var arr3 = IntArray(20) { it * 2 }
arr1.forEach { println(it) }
arr2.forEach { println(it) }
arr3.filter { it % 3 == 0 }.forEach { print(it) }    // prints:  0, 6, 12, 18, 24, 30, 36,
```

Type checks and casts: is and !is operators

```
fun f(obj: Any): Unit {
    if (obj is String && obj.length > 0) {
        println("$obj: ${obj.length}")
    }

    if (obj !is String) { // same as !(obj is String)
        println("Not a String")
    } else {
        println(obj.length)
    }
}
f("abc")
```

Type checks and casts: smart, unsafe and safe casts

```
fun g(x: Any) {
    when (x) {
        is Int -> println(x + 1)
        is String -> println(x.length + 1)
        is IntArray -> println(x.sum())
    }
}
g(1)
g("abc")
g(IntArray(5) { it })

fun h(y: Any?) {
//      val x: String = y as String
//      val x: String? = y as String?
    val x: String? = y as? String
    println(x)
}
h(12)
```

Unchecked Casts

```
fun readDictionary(file: File): Map<String, *> = file.inputStream().use {
    TODO("Read a mapping of strings to arbitrary elements.")
}

// We saved a map with `Int`s into this file
val intsFile = File("ints.dictionary")

// Warning: Unchecked cast: `Map<String, *>` to `Map<String, Int>`
val intsDictionary: Map<String, Int> = readDictionary(intsFile) as Map<String, Int>
```

- To avoid unchecked casts, you can redesign the program structure. In the example above, you could use the DictionaryReader<T> and DictionaryWriter<T> interfaces with type-safe implementations for different types. You can introduce reasonable abstractions to move unchecked casts from the call site to the implementation details.
- @Suppress("UNCHECKED_CAST")

If expression

```
val a = 5
val b = 10
var max = a
if (a < b) max = b

// With else
if (a > b) {
    max = a
} else {
    max = b
}
```

```
// As expression
val max2 = if (a > b) a else b

val max3 = if (a > b) {
    print("Choose a")
    a
} else {
    print("Choose b")
    b
}
```

When expression

```
val x = 3
when (x) {
    1 -> println("x == 1")
    2 -> println("x == 2")
    else -> {
        println("x is neither 1 nor 2")
    }
}
```

```
enum class Bit {
    ZERO, ONE
}

val numericValue = when (getRandomBit()) {
    Bit.ZERO -> 0
    Bit.ONE -> 1
    // the 'else' clause is not required because all cases are covered
}
```

When expression examples

```
when (x) {
    0, 1 -> print("x == 0 or x == 1")
    else -> print("otherwise")
}
```

```
when (x) {
    s.toInt() -> print("s encodes x")
    else -> print("s does not encode x")
}
```

```
when (x) {
    in 1..10 -> print("x is in the range")
    in validNumbers -> print("x is valid")
    !in 10..20 -> print("x is outside the range")
    else -> print("none of the above")
}
```

```
fun hasPrefix(x: Any) = when(x) {
    is String -> x.startsWith("prefix")
    else -> false
}
```

```
when {
    x.isOdd() -> print("x is odd")
    y.isEven() -> print("y is even")
    else -> print("x+y is odd")
}
```

```
fun Request.getBody() =
    when (val response = executeRequest()) {
        is Authenticator.Success -> response.body
        is HttpError -> throw HttpException(response.status)
    }
```

For loops

```
val collection = listOf(1,2,3,4, 5)
for (item in collection) println(item)

for (i in 1..3) {
    println(i)
}
for (i in 6 downTo 0 step 2) {
    println(i)
}
val array = IntArray(5){ it * it}
for (i in array.indices) {
    println("$i -> ${array[i]}")
}
for ((index, value) in array.withIndex()) {
    println("the element at $index is $value")
}
```

While loops

```
var x = 5
while (x > 0) {
    x--
}

fun retrieveData() = "data ..."

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

Returns and Jumps

Kotlin has three structural jump expressions:

- **return** by default returns from the nearest enclosing function or anonymous function
- **break** terminates the nearest enclosing loop
- **continue** proceeds to the next step of the nearest enclosing loop
- All of these expressions can be used as part of larger expressions:

```
data class Person(val name: String? = null, val email: String? =null, val age: Int? =0)
val person = Person("Ivan Petrov")
val s = person.name ?: return
println("Person name: $s")
```

Labeled break and continue

```
loop@ for (i in 1..100) {
    for (j in 1..100) {
        print(j)
        if (j == 3) break@loop
    }
}
println()
```

Labeled return - I

```
fun foo() {
    listOf(1, 2, 3, 4, 5).forEach lit@{
        if (it == 3) return@lit// local return to the caller of the lambda - the forEach loop
        print(it)
    }
    println(" done with explicit label")
}
foo()

fun bar() {
    listOf(1, 2, 3, 4, 5).forEach {
        if (it == 3) return@forEach // local return to the caller of the lambda - the forEach loop
        print(it)
    }
    println(" done with implicit label")
}
bar()
```

Labeled return - II

```
// simulate break
fun baz() {
    run loop@{
        listOf(1, 2, 3, 4, 5).forEach {
            if (it == 3) return@loop // non-local return from the lambda passed to run
            print(it)
        }
    }
    println(" done with nested loop")
}
baz()
```

Let’s practice some Kotlin koans ☺

https://play.kotlinlang.org/koans/overview

And solve progeamming problem (for more ambitios)

https://codeforces.com/contest/1157/problem/B

Learn Kotlin by Example & Kotlin idioms

https://play.kotlinlang.org/byExample/

https://kotlinlang.org/docs/idioms.html

Thank's for Your Attention!

Trayan Iliev

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