



# Classes and Objects

# About me

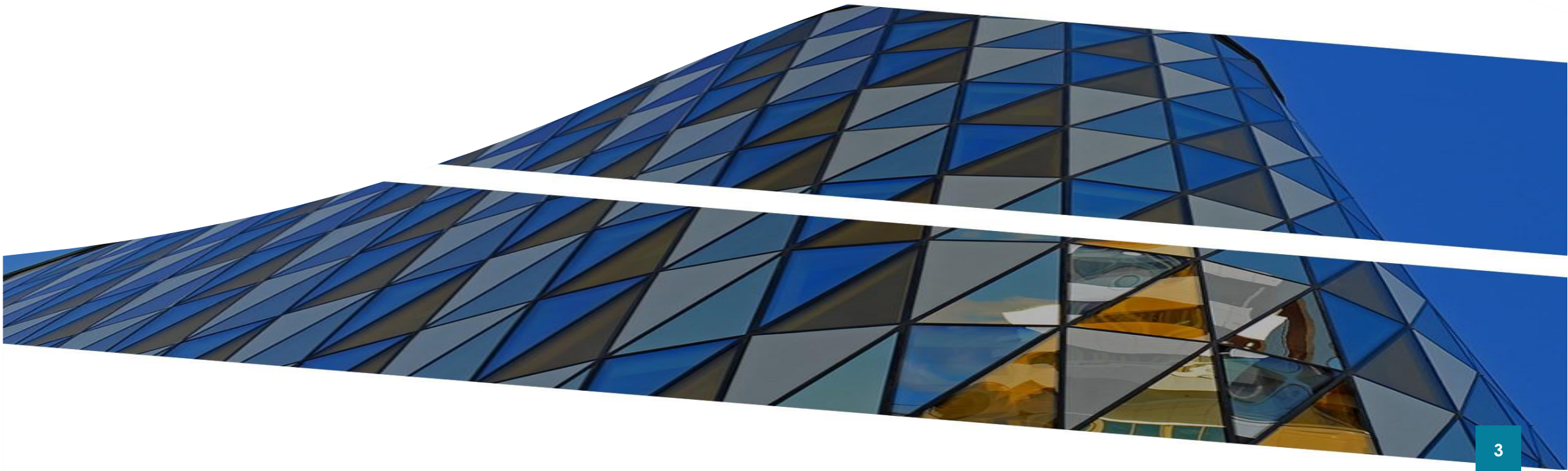


## Trayan Iliev

- 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

# Classes

Download, installation, environment setup



# Classes and Constructors

- Classes in Kotlin are declared using the keyword `class`:

```
class Person { /*...*/ }
```

```
class Empty
```

- A class in Kotlin can have a **primary constructor** and one or more **secondary constructors**. The **primary constructor** is a part of the **class header**, and it goes after the class name and optional type parameters:

```
class Person constructor(firstName: String) { /*...*/ }
```

- If the primary constructor **does not have any annotations or visibility modifiers**, the **constructor** keyword **can be omitted**:

```
class Person(firstName: String) { /*...*/ }
```

# Order of Initialization

- The primary constructor **cannot contain any code**. Initialization code can be placed in **initializer blocks** prefixed with the **init** keyword:

```
class InitOrderDemo(name: String) {  
    val firstProperty = "First property: $name".also(::println) // 1  
  
    init {  
        println("First initializer block that prints ${name}") // 2  
    }  
  
    val secondProperty = "Second property: ${name.length}".also(::println) // 3  
  
    init {  
        println("Second initializer block that prints ${name.length}") // 4  
    }  
}
```

# Initializing Class Properties

- Primary constructor parameters can be used in the initializer blocks. They can also be used in property initializers declared in the class body:

```
class Customer(name: String) {  
    val customerKey = name.uppercase()  
}
```

- Kotlin has a concise syntax for declaring properties and initializing them from the primary constructor (including default values):

```
class Person(val firstName: String, val lastName: String, var age: Int)
```

```
class Person(val firstName: String, val lastName: String, var isEmployed: Boolean = true)
```

# Constructor with Modifiers / Annotations

- Trailing commas can be added if necessary:

```
class Person6(  
    val firstName: String,  
    val lastName: String,  
    var age: Int, // trailing comma  
) { /*...*/ }
```

- If the constructor has annotations or visibility modifiers, the **constructor** keyword is required and the modifiers go before it:

```
class Customer2 public @Inject constructor(name: String) { /*...*/ }
```

# Secondary Constructors

- A class can also declare one or more **secondary constructors**, which are prefixed with **constructor**:

```
class Person(val pets: MutableList<Pet> = mutableListOf())
```

```
class Pet {  
    constructor(owner: Person) {  
        owner.pets.add(this) // adds this pet to the list of its owner's pets  
    }  
}
```



## Secondary Constructors - II

```
class Person(val name: String, val pets: MutableList<Pet> = mutableListOf()) {  
    override fun toString() = "$name's pets: $pets"  
}  
class Pet(val name: String) {  
    constructor(name: String, owner: Person) : this(name) {  
        owner.pets.add(this) // adds this pet to the list of its owner's pets  
    }  
    override fun toString() = "Pet($name)"  
}  
fun main() {  
    val ivan = Person("Ivan Petrov")  
    val Johny = Pet("Johny", ivan)  
    val Silvester = Pet("Silvester", ivan)  
    val Caty = Pet("Caty", ivan)  
    println(ivan) //Ivan Petrov's pets: [Pet(Johny), Pet(Silvester), Pet(Caty)]  
}
```

# Constructor Delegation

- Code in **initializer blocks** effectively becomes **part of the primary constructor**. Delegation to the primary constructor happens as the **first statement** of a secondary constructor, so the code in all initializer blocks and property initializers is executed before the body of the secondary constructor.
- Even if the class has **no primary constructor**, the **delegation still happens**:

```
class Constructors {  
    init {  
        println("Init block")  
    }  
    constructor(i: Int) {  
        println("Constructor $i")  
    }  
}
```

```
val c2 = Constructors(42) // Init block, Constructor 42
```

# Private constructors and constructors with default values

- If you don't want your class to have a public constructor, declare an empty primary constructor with non-default visibility:

```
class DontCreateMe private constructor () { /*...*/ }
```

- On the JVM, if all of the primary constructor parameters have default values, the compiler will generate an additional parameterless constructor which will use the default values. This makes it easier to use Kotlin with libraries such as Jackson or JPA that create class instances through parameterless constructors.

```
class Customer(val customerName: String = "")
```

# Creating Class Instances

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

```
data class Invoice(  
    val number: Int,  
    val customer: Customer,  
    val items: MutableList<Product> = mutableListOf()  
)
```

```
val customer = Customer("Joe Smith")
```

```
val invoice = Invoice(1, customer)
```

```
println(invoice) // Invoice(number=1, customer=Customer: JOE SMITH, items=[])
```

- Kotlin does not have a new keyword.

# Class Members

- Constructors and initializer blocks
- Functions
- Properties
- Nested and inner classes
- Object declarations

# Inheritance

- All classes in Kotlin have a common superclass, `Any`, which is the default superclass for a class with no supertypes declared:

```
class Example // Implicitly inherits from Any
```

- `Any` class has three methods: `equals()`, `hashCode()`, and `toString()`. Thus, these methods are defined for all Kotlin classes.
- By default, `Kotlin classes are final` – they can't be inherited. To `make a class inheritable`, mark it with the `open` keyword:

```
open class Base(p: Int)
```

```
class Derived(p: Int) : Base(p)
```

# Inheritance – base class initialization

- If the **derived class has no primary constructor**, then **each secondary constructor** has to initialize the base type using the **super** keyword or it has to delegate to another constructor which does. Different secondary constructors can call different constructors of the base type:

```
class Context
class AttributeSet
open class View(val ctx: Context) {
    private var attributes: AttributeSet = AttributeSet()
    constructor(ctx: Context, attrs: AttributeSet): this(ctx) {
        this.attributes = attrs
    }
}
class MyView : View {
    constructor(ctx: Context) : super(ctx)
    constructor(ctx: Context, attrs: AttributeSet) : super(ctx, attrs)
}
```

# Overriding Methods

```
open class Shape {  
    open fun draw() { /*...*/}  
    fun fill() { /*...*/}  
}
```

```
class Circle() : Shape() {  
    override fun draw() { /*...*/}  
}
```

```
open class Rectangle() : Shape() {  
    final override fun draw() { /*...*/}  
}
```



# Overriding Properties

```
open class Shape2 {  
    open val vertexCount: Int = 0  
}
```

```
class Rectangle2 : Shape2() {  
    override val vertexCount = 4  
}
```

---

```
interface Shape3 {  
    val vertexCount: Int  
}
```

```
class Rectangle3(override val vertexCount: Int = 4) : Shape3 // Always has 4 vertices
```

```
class Polygon3 : Shape3 {  
    override var vertexCount: Int = 0 // Can be set to any number later  
}
```

# Derived class initialization order

```
open class Base(val name: String) {  
    init { println("Initializing a base class") }  
    open val size: Int =  
        name.length.also { println("Initializing size in the base class: $it") }  
}  
class Derived(  
    name: String,  
    val lastName: String,  
) : Base(name.replaceFirstChar { it.uppercase() }.also { println("Argument for the base class: $it") }) {  
    init { println("Initializing a derived class") }  
    override val size: Int =  
        (super.size + lastName.length).also { println("Initializing size in the derived class: $it") }  
}  
  
fun main() {  
    val d = Derived("ivan", "Petrov")  
}
```



Argument for the base class: Ivan  
Initializing a base class  
Initializing size in the base class: 4  
Initializing a derived class  
Initializing size in the derived class: 10

# Derived class initialization order

- When the base class constructor is executed, the properties declared or overridden in the derived class have not yet been initialized. Using any of those properties in the base class initialization logic (either directly or indirectly through another overridden open member implementation) may lead to incorrect behavior or a runtime failure.
- When designing a base class, you **should avoid using open members in the constructors, property initializers, or init blocks.**

# Calling the superclass implementation

- Code in a derived class can call its superclass functions and property accessor implementations using the **super** keyword:

```
open class Rectangle4 {  
    open fun draw() { println("Drawing a rectangle") }  
    val borderColor: String get() = "black"  
}
```

```
class FilledRectangle : Rectangle4() {  
    override fun draw() {  
        super.draw()  
        println("Filling the rectangle")  
    }  
  
    val fillColor: String get() = super.borderColor  
}
```

# Calling the superclass implementation in inner class

```
class FilledRectangle2: Rectangle4() {  
    override fun draw() {  
        val filler = Filler()  
        filler.drawAndFill()  
    }  
  
    inner class Filler {  
        fun fill() { println("Filling") }  
        fun drawAndFill() {  
            super@FilledRectangle2.draw() // Calls Rectangle's implementation of draw()  
            fill()  
            // Uses Rectangle's implementation of borderColor's get()  
            println("Drawn a filled rectangle with color ${super@FilledRectangle2.borderColor}")  
        }  
    }  
}
```

# Overriding Rules

- If a class inherits **multiple implementations** of the **same member** from its **immediate superclasses**, it **must override this member and provide its own implementation** (perhaps, using one of the inherited ones).
- To denote the supertype from which the inherited implementation is taken, use **super** qualified by the supertype name in angle brackets, such as **super<Base>**:

```
open class Rectangle5 {    open fun draw() { /* ... */ }    }
interface Polygon {    fun draw() { /* ... */ } // interface members are 'open' by default    }

class Square() : Rectangle5(), Polygon { // The compiler requires draw() to be overridden:
    override fun draw() {
        super<Rectangle5>.draw() // call to Rectangle.draw()
        super<Polygon>.draw() // call to Polygon.draw()
    }
}
```

# Abstract Classes

- A class may be declared **abstract**, along with some or all of its members. An abstract member does not have an implementation in its class. You don't need to annotate abstract classes or functions with open.

```
abstract class Polygon6 {  
    abstract fun draw()  
}
```

```
class Rectangle6 : Polygon6() {  
    override fun draw() {  
        // draw the rectangle  
    }  
}
```

```
open class Polygon7{  
    open fun draw() {  
        // some default polygon drawing method  
    }  
}
```

```
abstract class WildShape : Polygon7() {  
    // Classes that inherit WildShape need to provide their own  
    // draw method instead of using the default on Polygon  
    abstract override fun draw()  
}
```

# Companion Objects

- If you need to write a function that can be called without having a class instance but that needs [access to the internals of a class](#) (such as a factory method), you can write it as a member of an [object declaration inside that class](#).
- Even more specifically, if you declare a companion object inside your class, you can access its members using only the [class name as a qualifier](#).

```
class MyClass {  
    companion object Factory {  
        fun create(): MyClass = MyClass()  
    }  
}  
val instance = MyClass.create()
```

```
class MyClass2 {  
    companion object { }  
}  
val x = MyClass2.Companion
```



# Examples

```
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
}
```

# Generate a Ktor project

Estimated reading time: 1 minute



**NOTE:** You can also use the [Ktor IntelliJ plugin](#) instead. This page can also be accessed at [start.ktor.io](https://start.ktor.io).

 **Ktor Project Generator (1.3.2)**

### Configuration

Gradle project ☐ with Wrapper ☒

Server Engine: Netty

Ktor 1.3.2

Group: com.example

Name: ktor-demo

Version: 0.0.1-SNAPSHOT

Swagger (Optional)

or

### Server

Filter Server Features

#### Templating

☐ **HTML DSL** (ktor-html-builder)  
Generate HTML using Kotlin code like a pure-core template engine  
[Documentation](#)

☐ **CSS DSL** (org.jetbrains.kotlin-css-jvm:1.0.0-pre.31-kotlin-1.2.41)  
Generate CSS using Kotlin code  
[Documentation](#)

☐ **Freemarker** (ktor-freemarker)  
Serve HTML content using Apache's FreeMarker template engine  
[Documentation](#)

☐ **Velocity** (ktor-velocity)  
Serve HTML content using Apache's Velocity template engine

☐ Show marked dependencies only

### Client

Filter Client Features

#### HttpClient Engine

☐ **HttpClient Engine** (ktor-client-core, ktor-client-core-jvm)  
Core of the HttpClient. Required for libraries.  
[Documentation](#)

☐ **Apache HttpClient Engine** (ktor-client-apache)  
Engine for the Ktor HttpClient using Apache. Supports HTTP 1.x and HTTP 2.0.  
[Documentation](#)

☐ **CIO HttpClient Engine** (ktor-client-cio)  
Engine for the Ktor HttpClient using CIO (Corroutine I/O). Only supports HTTP 1.x.  
[Documentation](#)

☐ **Jetty HttpClient Engine** (ktor-client-jetty)

☐ Show marked dependencies only

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!")  
        }  
    }  
}
```

# Learn Kotlin by Example & Kotlin idioms

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

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

# Thank's for Your Attention!



Trayan Iliev

IPT – Intellectual Products & Technologies

<http://iproduct.org/>

<https://github.com/iproduct>

<https://twitter.com/trayaniliev>

<https://www.facebook.com/IPT.EACAD>