

Building Restful Services Using Spring Boot and Kotlin

About Me

- Dilip
- Building Software's since 2008
- Teaching in **UDEMY** Since 2016

Why this course on Kotlin ?

Adoption [\[edit \]](#)

In 2018, Kotlin was the fastest growing language on GitHub with 2.6 times more developers compared to 2017.^[50] It is the fourth most loved programming language according to the 2020 Stack Overflow Developer Survey.^[51]

Kotlin was also awarded the O'Reilly Open Source Software Conference Breakout Award for 2019.^[52]

Many companies/organizations have used Kotlin for backend development:

- • Google^[53]
- Norwegian Tax Administration^[54]
- Gradle^[55]
- • Amazon^[56]
- Square^[57]
- JetBrains^[58]
- Flux^[59]
- Allegro^[60]
- OLX^[61]
- Shazam^[62]
- • Pivotal^[63]
- Rocket Travel^[64]
- Meshcloud^[65]
- Zalando^[66]

Some companies/organizations have used Kotlin for web development:

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- Data2viz^[68]
- Fritz2^[69]
- Barclay's Bank^[70]

A number of companies have publicly stated they were using Kotlin:

- DripStat^[71]
- Basecamp^[72]
- Pinterest^[73]
- Coursera^[74]
- • Netflix^[75]
- • Uber^[76]
- Square^[77]
- Trello^[78]
- Duolingo^[79]
- Corda, a distributed ledger developed by a consortium of well-known banks (such as [Goldman Sachs](#), [Wells Fargo](#), [J.P. Morgan](#), [Deutsche Bank](#), [UBS](#), [HSBC](#), [BNP Paribas](#), [Société Générale](#)), has over 90% Kotlin code in its codebase.^[80]

What's Covered ?

- Kotlin Introduction
- Code and Explore Kotlin Fundamentals
- Kotlin and SpringBoot Integration
- Build a RestFul Service using Kotlin and SpringBoot
- Unit/Integration tests using JUnit5 and Kotlin

Targeted Audience

- Experienced Java Developers
- Any Java Developer who is interested in learning Kotlin can enroll in this course
- Any Java/Kotlin Developer who is interested in building applications using SpringBoot can enroll in this course

Source Code

Thank You!

Prerequisites

- Java 17 (Java 11 or Higher is needed)
- Prior Java Experience is a must
- Prior Spring Framework Experience is a must
- Experience Writing JUnit tests
- **IntelliJ** or any other IDE

Kotlin Introduction

What is Kotlin?

- Kotlin is a modern object oriented and functional programming language
- Kotlin is a statically typed Programming language like Java
 - All the types are resolved at compile time
- This is free and open source language licensed under Apache 2.0

Who uses Kotlin ?

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Why Kotlin ?

- Kotlin is an expressive language and it has a concise syntax
 - Code readability and maintainability
- Kotlin is a safe language which prevents un-necessary errors
 - Prevents **NullPointerException** using the Nullable and Non-Nullable types
- Interoperable with Java
 - Kotlin and Java works together very well

What kind of applications can we build with Kotlin ?

- Build Server Side Applications
 - Web Applications
 - RestFul Services
 - Messaging Applications
 - Build any kind of applications that we can build using Java
- Widely used in the Android

Popular Framework Support

Frameworks for server-side development with Kotlin



- [Spring](#) [↗] makes use of Kotlin's language features to offer more concise APIs [↗], starting with version 5.0. The online project generator [↗] allows you to quickly generate a new project in Kotlin.
- [Vert.x](#) [↗], a framework for building reactive Web applications on the JVM, offers dedicated support [↗] for Kotlin, including full documentation [↗].
- [Ktor](#) [↗] is a framework built by JetBrains for creating Web applications in Kotlin, making use of coroutines for high scalability and offering an easy-to-use and idiomatic API.
- [kotlinx.html](#) [↗] is a DSL that can be used to build HTML in a Web application. It serves as an alternative to traditional templating systems such as JSP and FreeMarker.

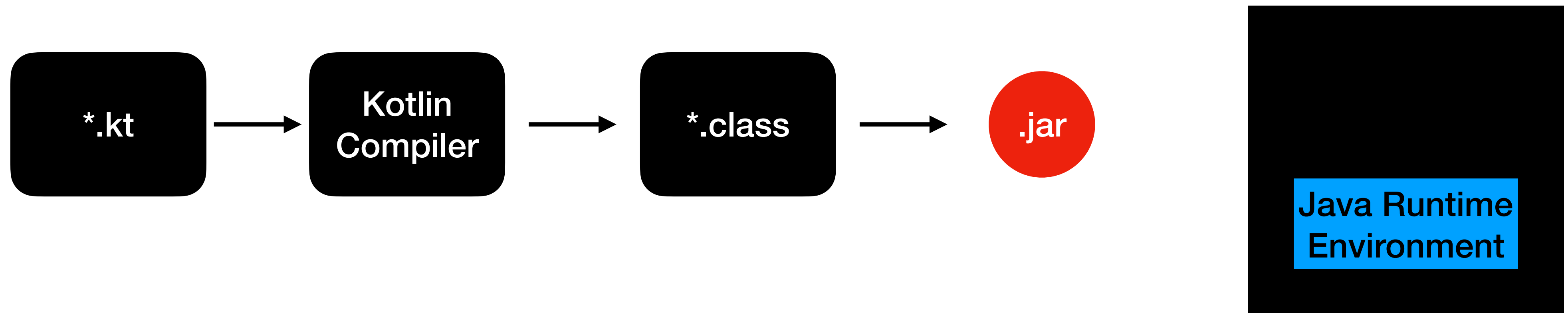


- [Micronaut](#) [↗] is a modern, JVM-based, full-stack framework for building modular, easily testable microservice and serverless applications. It comes with a lot of built-in, handy features.
- [http4k](#) [↗] is the functional toolkit with a tiny footprint for Kotlin HTTP applications, written in pure Kotlin. The library is based on the "Your Server as a Function" paper from Twitter and represents modeling both HTTP Servers and Clients as simple Kotlin functions that can be composed together.
- [Javalin](#) [↗] is a very lightweight web framework for Kotlin and Java which supports WebSockets, HTTP2 and async requests.
- The available options for persistence include direct JDBC access, JPA, as well as using NoSQL databases through their Java drivers. For JPA, the kotlin-jpa compiler plugin adapts Kotlin-compiled classes to the requirements of the framework.

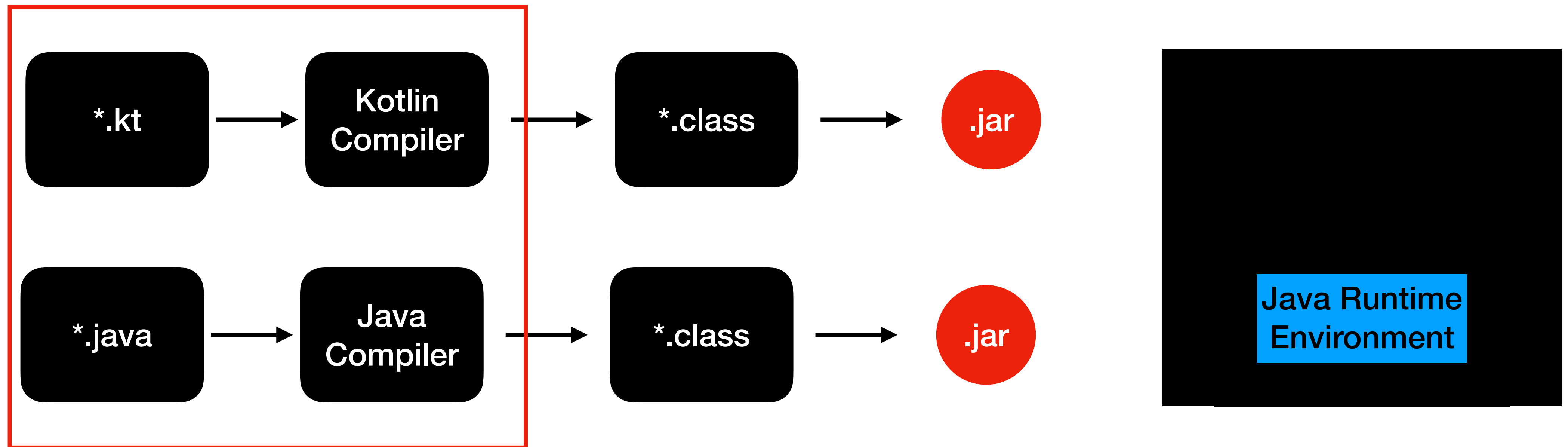
Kotlin Community

**How does Kotlin work with the
JVM ?**

Kotlin Build Process



Kotlin/Java Build Process



val & var

- Any variable in Kotlin should be declared as **val** or **var**
- **val**
 - Variables declared with **val** are immutable variables

```
val name : String = "Dilip"
```

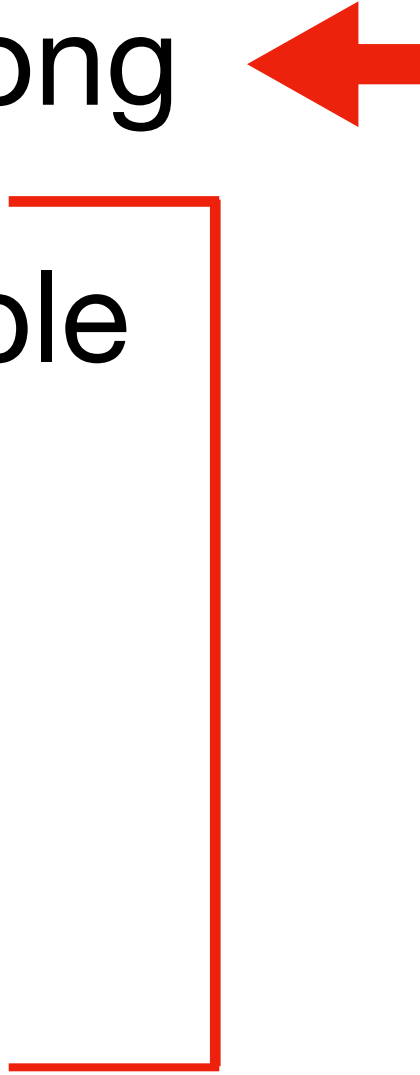
↑ ↑
Name of the Type of the
Variable Variable

- **var**
 - Variables declared with **var** are mutable variables

```
var age : Int = 33
```

↑ ↑
Name of the Type of the
Variable Variable

Types in Kotlin

- In Kotlin, there is no distinction between primitives and wrapper types
 - All numbers in Kotlin are represented as types
 - Integer Types - Byte, Short, Int, Long ←
 - Floating-Point Types - Float, Double
 - Character Type - Char
 - Boolean Type - Boolean
- 

String and its related Operations

- String Interpolation

```
val course = "Kotlin Spring"  
println("course : $course and the length of the course is ${course.length}")
```



- Multiline Strings using TripleQuotes

```
val multiLine1 = """ ←  
    ABC  
    DEF  
    """.trimIndent()
```

if-else

- if-else is an expression in kotlin
- Expression always evaluate to a result

```
val result = if(name.length == 4){  
    println("Name is Four Characters")  
    name ←  
}else{  
    println("Name is Not Four Characters")  
    name ←  
}
```

when

- when block allows us to write concise and expressive code when dealing with multiple conditions

```
val medal1 = when(position){  
    1 -> "GOLD"  
    2 -> "SILVER"  
    3 -> {  
        println("Inside position 3")  
        "BRONZE"  
    }  
    else -> "NO MEDAL"  
}
```

Ranges

```
val range = 1..10
for (i in range){
    println(i)
}
```

Creates a Range of 10 values

```
val reverseRange = 10 downTo 1
for (i in reverseRange){
    println(i)
}
for (i in reverseRange step 2){
    println(i)
}
```

Progression of Values in decreasing order

Skip values in the iteration

while


```
fun exploreWhile() {  
    var x = 1  
    ➔ while(x < 5){  
        println("Value of x is $x")  
        x++  
    }  
}
```

doWhile

```
fun exploreDoWhile() {  
    var i = 0  
    ➔ do {  
        println("Inside do while : $i")  
        i++  
    }while (i < 5)  
}
```



break

```
for(i in 1..5){  
    println("i is $i ")  
    if(i==3) break  
}
```




label

```
fun label() {  
    loop@ for(i in 1..5){  
        println("i in label $i: ")  
        innerLoop@ for (j in 1..10){  
            //if(j==2) break@innerLoop  
            if(j==2) break@loop  
        }  
    }  
}
```



return

```
listOf(1,2,3,4,5).forEach each@{  
    //if(it==3) return@forEach  
    if(it==3) return@each  
}
```



Functions in Kotlin


Function

- Functions are primarily used in Object Oriented Language to express some behavior or logic

Function Name
↓
→ `fun printHello() {`
 `println("Hello!")` } Function Body
}

Functions with No return value

- Functions with no return value are represented as **Unit** in Kotlin



```
fun printHello() : Unit {  
    println("Hello!")  
}
```

- Defining Unit is redundant and it can be ignored

Function with parameters and return value

- Functions with expression body can be simplified like below

```
fun addition(x: Int, y : Int) : Int {  
    return x+y  
}
```

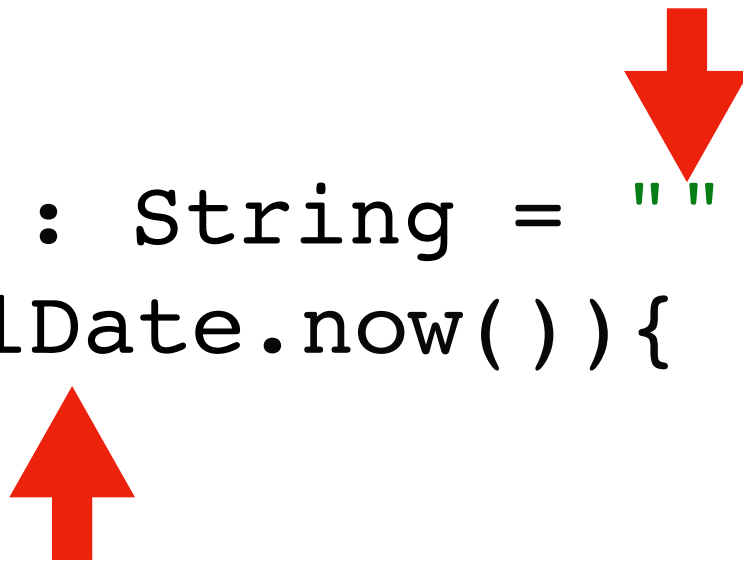
```
fun addition(x: Int, y : Int) = x+y
```

Default Value Parameters & Named Arguments

Default Value Parameters

- This provides a default value to a function parameter when its not passed by the caller


```
fun printPersonDetails(name : String, email : String = "",  
                        dob : LocalDate = LocalDate.now()) {  
    println("Name is $name and the email is $email and the dob is $dob")  
}
```

A diagram with two red arrows. One arrow points down from above to the default value "" for the email parameter. The other arrow points up from below to the default value LocalDate.now() for the dob parameter.

Named Arguments


- The caller can invoke the function by using the variable name

```
fun printPersonDetails(name : String, email : String = "",  
                        dob : LocalDate = LocalDate.now()) {  
    println("Name is $name and the email is $email and the dob is $dob")  
}
```



- Caller can invoke the function using the name of the function arguments, in no particular order

```
printPersonDetails(dob = LocalDate.parse("2000-01-01") , name = "Dilip", email =  
"abc@gmail.com")
```



Top Level Functions & Properties

Top Level Functions

- Functions that does not belong to a class are **top-level** functions
 - In Java , functions can only be part of class
 - In Java applications, you can find classes that just has some static methods which holds some common logic that can be used across the app
- Kotlin avoids this by using top level functions that can be part of a **Kotlin file** not a class

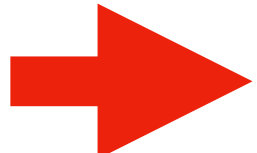
Top Level Properties

- In Kotlin, properties that does not belong to class are called top-level properties
 - In Java, you can only define properties in a class or an interface
 - Most common use case in a Java application is you may have to be define static constants in a class file that can be used across the app
- Kotlin avoids these by allowing us to create properties that can be part of a **Kotlin file** not a class

Class

Class in Object Oriented Programming

- Class in object oriented programming is fundamentally the blueprint for creating objects



```
class Person {  
    → fun action() {  
        println("Person Walks")  
    }  
}
```

Instance of the class:

```
val person = Person() // new keyword is not needed
```



```
person.action()
```

Constructors in Kotlin

Constructors in Kotlin

- Constructors is a concept in object oriented programming through which we can create an Object with initial values

```
class Person(val name: String,
              val age: Int) {
    fun action() {
        println("Person Walks")
    }
}
```

1 Primary Constructor

2

Instance of the class:



```
val person = Person("Alex", 25)
```



Secondary Constructor

- This is an alternative way of defining constructors

```
class Item(){  
    var name : String = ""  
    → constructor(_name : String) : this(){  
        name = _name  
    }  
}
```



- **constructor** keyword
- **this()** call to the actual class is mandatory

Recommended approach for constructors

- Use Primary Constructors whenever possible
- Use default values for overloaded constructor scenario

```
class Person(val name: String = "",  
             val age: Int = 0) {  
  
    fun action() {  
        println("Person Walks")  
    }  
  
}
```

Use Secondary Constructors only necessary

Initializer code using init block

- init code block can be used to run some initialization logic during the instance creation

```
init {  
  
    println("Inside Init Block")  
  
}
```

data class

- Classes just holds the data can be categorized as data classes
 - DTOs, domain classes and value object classes fall under this category
 - In Java, these type of classes are also Java Beans

➔ `data class Course(
 val id: Int,
 val name: String,
 val author: String
)`

- Automatically generates the equals(), hashCode() and toString() methods

Usage & Benefits of data class

- Data classes are primarily for classes that's going to behave as a data container
- It autogenerates a lot of functionalities for you when you add the **data** modifier to the class
- Its pretty easy to create a clone of the object using the **copy()** function

When to use Custom Getter/Setter ?

Use it when you have the need to implement the custom logic for setting or retrieving the properties.

Inheritance

- Inheritance is supported in Kotlin
- Kotlin Concepts:
 - **Any** is the superclass for any class in Kotlin
 - **Object** Class in Java
 - All the classes in Kotlin are **final**
 - Extending classes are not allowed by default

Inheritance - Extending Classes

- Kotlin allows inheritance when **open** modifier is used

➡ `open class User(val name: String) {`
 `open fun login() {`
 `println("Inside user login")`
 `}`
`}`

- Subclass extending the **User** Class

`class Student(name: String) : User(name)` ⬅

Inheritance - Overriding Functions

- Mark the function with **open** modifier

```
open class User(val name: String) {  
    ➡ open fun login() {  
        println("Inside user login")  
    }  
}  
  
class Student(name: String): User(name, age) {  
    ➡ override fun login() {  
        ➡ super.login()  
        println("Inside Student login")  
    }  
}
```

Inheritance - Overriding Variables

- Similar to functions using the **open** and **override** keywords

```
open class User(val name: String) {
```

```
➔ open val isLoggedIn : Boolean = true  
}
```

```
class Student(name: String) : User(name, age) {
```

```
➔ override val isLoggedIn : Boolean = true  
}
```

object keyword

- This keyword allows us to create a class and an instance of the class at the same time
- Equivalent to a **singleton** pattern in java

➡ `object Authenticate {`

```
    fun authenticate(userName : String, password: String){  
        println("User Authenticated for userName : $userName")  
    }  
}
```

Usage:

```
fun main() {
```

➡ `Authenticate.authenticate("Dilip", "abc")`
`}`


- Limitations
 - You cannot inject constructor arguments to object classes

companion object

- Kotlin does not have the support for the **static** keyword
- **companion object** can be used to introduce static functionalities that are tied to the class.
- Using object inside the class requires you to use the **companion** keyword
- You can have variables and functions
- Usage

`Student.country()`

```
class Student(  
    name: String,  
    override val age: Int = 0  
) : User(name, age) {
```



```
    companion object {  
        const val noOfEnrolledCourses = 10  
  
        fun country(): String {  
            return "USA"  
        }  
    }  
}
```

Interface

- Interfaces in oops defines the contract which has some abstract methods
- The classes that implements the interface needs to implement it.
 - This is similar to Java
- Interfaces can have abstract and non-abstract methods in it
- It cannot contain any state

Interface

- Interface with abstract method

➡ `interface CourseRepository {`

 `fun getById(id: Int): Course`

 `}`



`class SqlCourseRepository : CourseRepository {`

➡ `override fun getById(id: Int): Course {`
 `return Course(id = id,`
 `"Kafka For Developers using Spring Boot",`
 `"Dilip Sundarraaj")`
 `}`

 `}`

- Interface with abstract/non-abstract method

`interface CourseRepository {`
 `fun getById(id: Int): Course`

➡ `fun save(course: Course): Int {`
 `println("course : $course")`
 `return course.id`
 `}`

`class SqlCourseRepository : CourseRepository {`

 `override fun getById(id: Int): Course {`
 `return Course(id = id,`
 `"Kafka For Developers using Spring Boot",`
 `"Dilip Sundarraaj")`
 `}`

➡ `override fun save(course: Course): Int {`
 `println("course in SqlCourseRepository : $course")`
 `return course.id`
 `}`

 `}`

Visibility Modifiers in Kotlin

Visibility Modifiers in Kotlin

- There are four visibility modifiers in Kotlin :
 - public, protected, private and internal
- public
 - This is the default access modifiers
- private
 - This marks the function or variable accessible only to that class
- protected
 - A protected member is visible in the class and subclass
- internal
 - This is new in Kotlin. Anything that's marked with internal is private to the module that's published using the Gradle or Maven

Type Checking & Casting

- Kotlin has some handy operators

- **is** operator

- Check a particular value is of a certain type

```
val name = "Dilip"
```

```
val result = name is String
```

true or false

- **as** operator

- Cast a value to a certain type

```
val name = "Dilip" as String
```

- If cast is not possible then it throws **java.lang.ClassCastException**

Nulls in Kotlin



Handling Nulls in Kotlin

- Kotlin handles nulls little differently compared to Java
- Kotlin has the concept of **Nullable** and **Non-Nullable** types
- These can be assigned to variables or properties

Nullable Type

- A variable or property can hold a null value
- How to define a Nullable Type?

```
val nameNullale : String? = null
```



Or

```
val nameNullale : String? = "Dilip"
```



Non Nullable Type

- A variable or property can hold only a non-null value
- How to define a Non-Nullable Type?



```
val nameNonNull : String = "Dilip"
```

Or

null value is not allowed

```
val nameNonNull = "Dilip"
```



By Default , types are Non-Nullable

Dealing with Nulls

Safe Call Operator

- Use the safe call operator to invoke functions safely on it


```
val length = nameNullable?.length
```



Elvis Operator

- Return a Default value if null


```
val length = nameNullable?.length ?: 0
```



Not Null Assertions

- Making sure the value is not null after some updates

```
val movie =  
    saveMovie(Movie(null,  
                    "Avengers"))  
  
println(movie.id!!)
```



Collections in Kotlin

Collections

- Kotlin re-uses the collections from Java
 - Kotlin does not have collections of their own
 - Kotlin added a lot of new features through extension functions
- Kotlin has two types of collections
 - Mutable Collections
 - Immutable Collections

Immutable Collection

- Collection is not modifiable once created

```
val names = listOf("Alex", "Ben", "Chloe")
```



Map

```
mapOf("dilip" to 33, "scooby" to 4)
```



Set

```
setOf("adam", "ben", "chloe")
```



Mutable Collection

- Modifying the data in the collection is allowed

```
val namesMutableList = mutableListOf("Alex", "Ben", "Chloe")
```



```
mutableMapOf("dilip" to 33, "scooby" to 4)
```

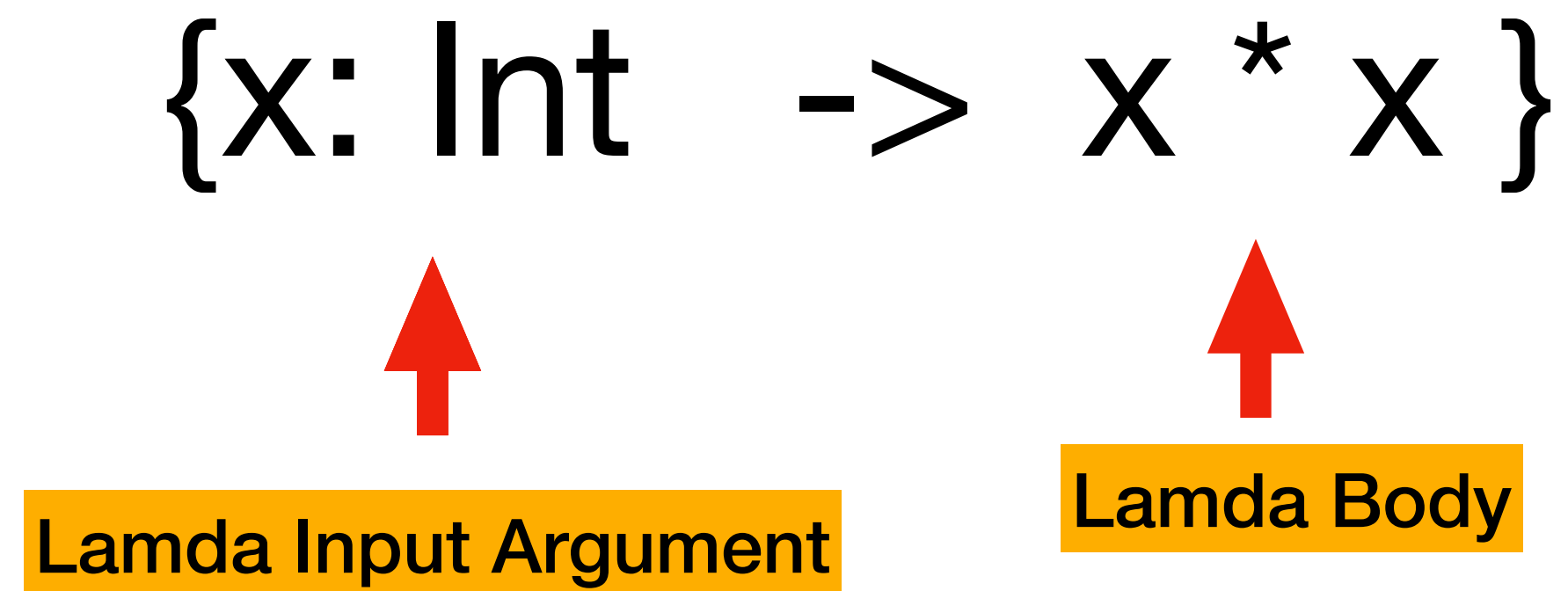


```
mutableSetOf("adam", "ben", "chloe")
```



What is a Lambda Expression ?

- Lambda Expressions are small piece of code that can be passed to other functions



Benefit of Lambda Expression

- You can assign the behavior to a variable

```
val add = { x : Int -> x+x }
```

```
fun add(x:Int) = x+x
```

- The advantage here is that , you can pass the lambda as an argument to other functions

```
listOf(1, 2, 3) ←  
  .forEach {  
    val result = add(it)  
    println(result)  
  }
```

2 4 6

Collections & Operations on it

- Using Collections are very common in any application development
- Performing some logic on each elements in the list
- Filter out some elements in the collection
- Collections has operators to perform operations on it

filter



- filter
 - This is used to filter out the elements from the collection

```
val numList = listOf(1, 2, 3, 4, 5, 6) ←  
  
val result = numList.filter {  
    it >= 5 ←  
} ↑
```

map

- This operator is fundamentally used to transfer the elements from one form to other form

```
val numList = listOf(1, 2, 3, 4, 5, 6)
```



```
val result = numList.map {  
    it.toDouble()   
}  

```

```
result : [1.0, 2.0, 3.0, 4.0, 5.0, 6.0]
```

flatMap

- This operators can be used if the collection has another collection
- Used to flatten the list of lists that is operating on and returns the result as a single list

map

```
val list = listOf(listOf(1,2,3),listOf(4,5,6) )  
val result = list.map { outerList ->   
    outerList.map {   
        it.toDouble()  
    }  
}  
println("result : $result")
```

result : [[1.0, 2.0, 3.0], [4.0, 5.0, 6.0]]

flatMap

```
val list = listOf(listOf(1,2,3),listOf(4,5,6) )  
val result = list.flatMap { outerList ->  
    outerList.map {  
        it.toDouble()  
    }  
}  
println("result : $result")
```

result : [1.0, 2.0, 3.0, 4.0, 5.0, 6.0]



Lazy Evaluation of Collections using Sequences

- This is an alternative API to work with collections
- The operations on the elements of the collection are evaluated lazily

Not a sequence

```
val namesList = listOf("alex", "ben", "chloe")  
  
    .filter { it.length >= 4 } // ["alex", "chloe"]  
  
    .map { it.uppercase() } // ["ALEX", "CHLOE"]
```

sequence

```
val namesListUsingSequence = listOf("alex", "ben", "chloe")  
    .asSequence()  
    .filter { it.length >= 4 } // "alex" "ben" "chloe"  
    .map { it.uppercase() } // "ALEX" "CHLOE"  
    .toList() "ALEX" "CHLOE"
```

Terminal Operator

Whats the benefit of using Sequences ?

- Sequences perform better when dealing with collections that are extremely big
 - Does not create intermediate collection for each operator
 - Sequences are lazy, does not apply the operations for all the elements in the collection

Arrays in Kotlin

- Arrays in Kotlin are represented using the `Array<T>` class
- Arrays in Kotlin are immutable
- How can we create an Array ?

```
val namesArray = arrayOf("alex", "ben", "chloe")
```

```
val emptyArray= emptyArray<String>()
```

Exceptions in Kotlin

- All Exception classes in Kotlin extends the Throwable class
- Exceptions are handled pretty much the standard way using the try-catch block
- Kotlin does not have checked exceptions

Checked Exceptions

Java

```
import java.io.File;
import java.io.FileInputStream;

public class Test {

    public static void main(String[] args) {

        File file = new File( pathname: "not_existing_file.txt");
        FileInputStream stream = new FileInputStream(file);

    }
}
```



Kotlin

```
val file = File("file.txt")
val stream = FileInputStream(file)
```

Scope Functions

Scope Functions

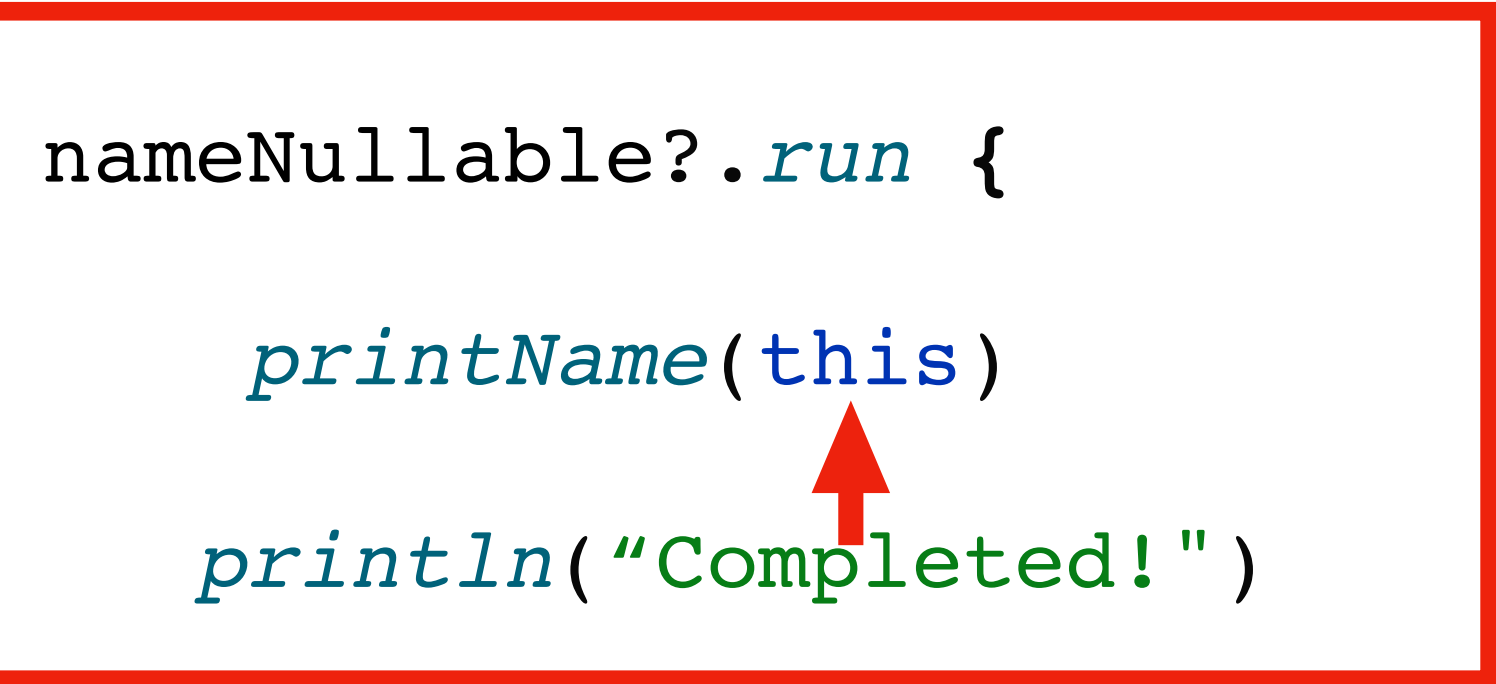
- These functions are there in Kotlin to execute a piece of code within the context of the object
- These functions form a temporary scope, that's why the name

Scope Functions in Action

With Scope Function

```
var nameNullable : String? = null

nameNullable?.run {
    printName(this)
    println("Completed!")
}
```



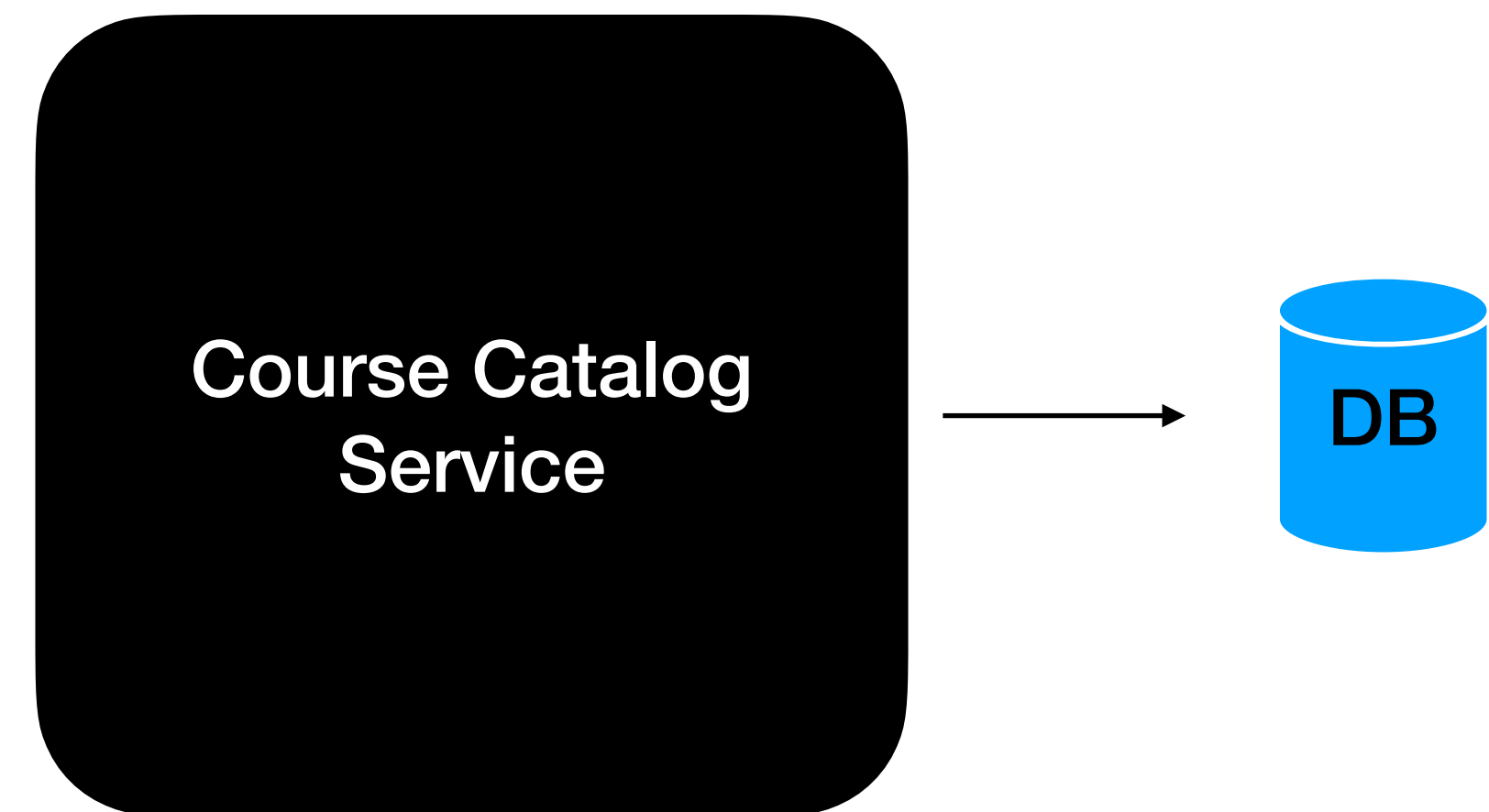
Scope Function accepts the lambda

Without Scope Function

```
if(nameNullable!=null){
    printName(nameNullable)
    println("Completed!")
}
```


Overview of the Application

- Build a Course Catalog Service
- RestFul API that manages the course catalog for an online learning platform
- Use DB for storing the course Information



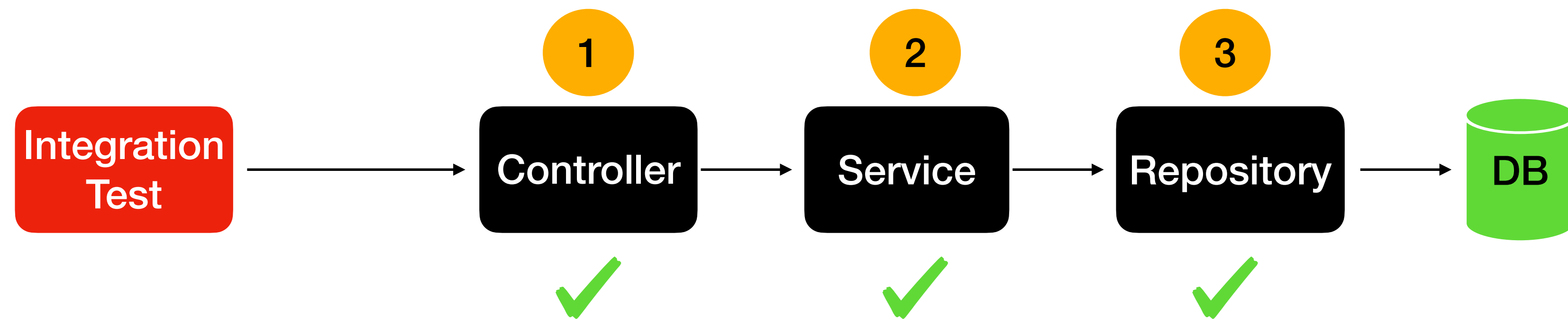
Automated Testing Using JUnit5

Automated Tests

- Automated Tests plays a vital role in delivering quality Software
- Two types of Automated Tests:
 - Integration Tests
 - Unit Tests

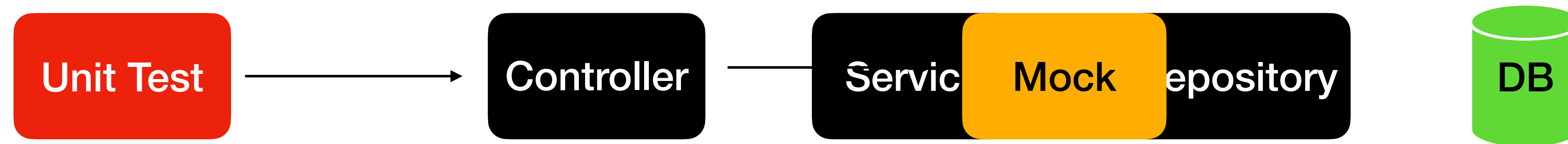
Integration Tests

- Integration test is a kind of test which actually test the application end to end



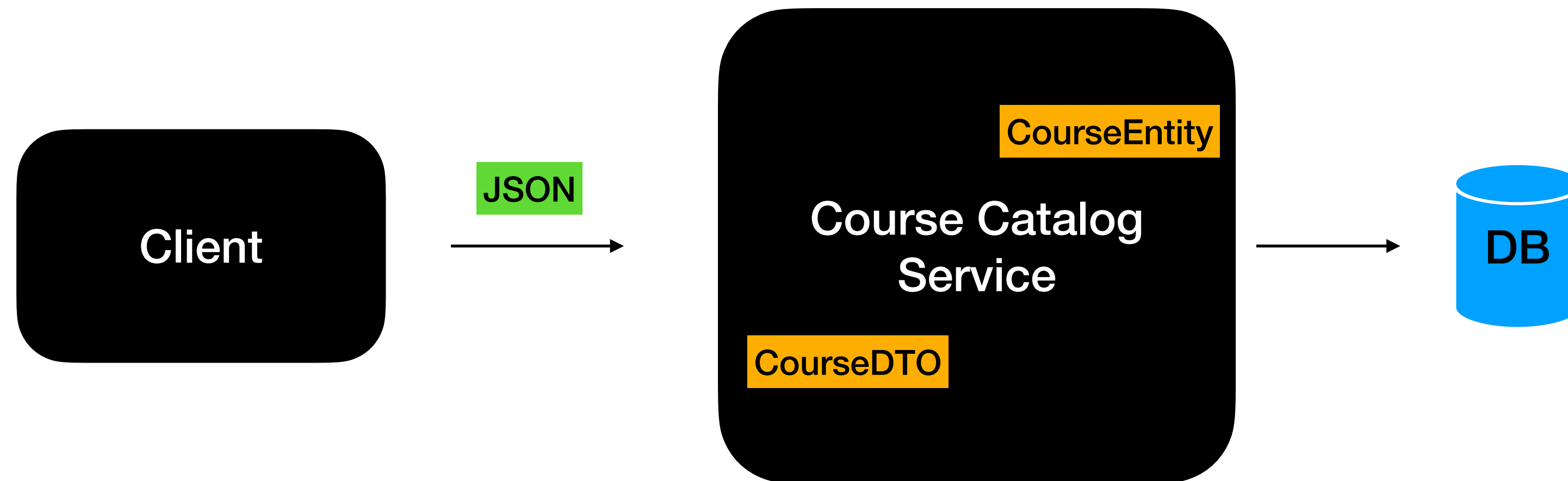
Unit Tests

- Unit test is a kind of test which tests only the class and method of interest and mocks the next layer of the code

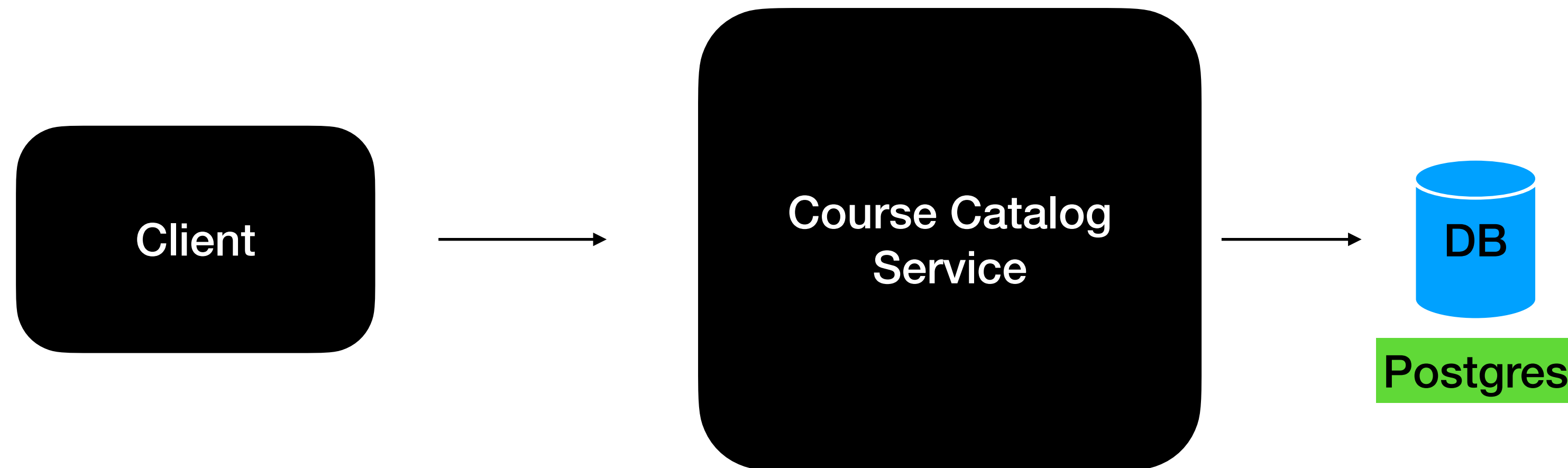


Course Catalog Service

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Course Catalog Service



JVM related Kotlin Annotations

- **@JvmOverloads** - This is used to instruct the JVM to create the overloaded version of methods when dealing with default values
- **@JvmField** - This is used to instruct the JVM to create the variable as a field
- **@JvmName** - This is used to instruct the JVM to create a custom name for a class or function
- **@JvmStatic** - This is used to expose the function that's part of the companion object or object as a static function