Mobile Computing
Writing Kotlin for Android

Slides: tmb.gr/mc-ktn

Source on GDocs

Overview

These slides introduce programing in Kotlin.

Basic concepts of the Kotlin language.

How they compare to Java.

Slides are new. Found an issue? Let me know.

Prerequisites

Access the Kotlin Playground online editor.

Edit the code there to print your name.

Run the code to see the result.

Kotlin language

"Kotlin is a multiplatform, statically typed, general-purpose programming language."

"[Inspired by] Java, Scala, C# and Groovy. [Intended to be] pragmatic, i.e., being a programming language useful for day-to-day development [...]"

— Kotlin Language Specification

Compared to Java

Kotlin compiles to JVM bytecode, among others.

Many language concepts are similar to Java.

There seems to be less clutter in Kotlin.

Kotlin can call Java and vice versa.

Kotlin for Android

The default is to develop Android apps with Kotlin.

Android Studio has full tooling support for Kotlin.

Android committed to a "Kotlin-first approach".

Libraries can be used from / written in Kotlin.

Hello, world!

```
fun main() {
    println("Hello, world!")
}
```

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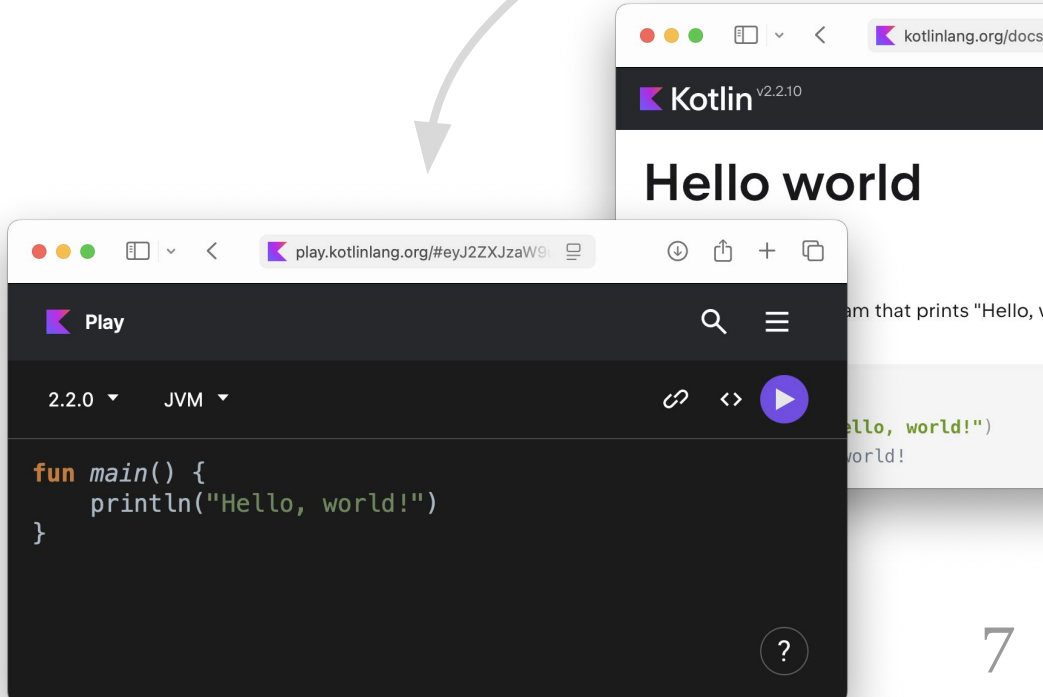
.kt shows this code in play.kotlinlang.org

.html links to docs on kotlinlang.org/docs



Variables

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Declare read-only values with *val* (recommended).

```
val i = 3 // read-only
i = 2 // error: 'val' cannot be reassigned
```

Declare mutable variables with *var* (if needed).

```
var x = 5 // mutable
x = 7
```

*CTRL-click to open links in a new tab.

Basic types

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A type (here *Int*) can either be inferred, or explicit.

```
val i = 3 // inferred type, initialized

val j: Int // explicit type, required for
j = 4 // late initialization of value

val k: Int = 5 // explicit type, redundant
```

Basic types are *Byte*, *Short*, *Int*, *Long*, *UByte*, *UShort*, *UInt*, *ULong*, *Float*, *Double*, *Boolean*, *Char*, *String*.

String templates

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String templates allow to embed values of variables.

```
val what = "hi"
val whom = "folks"
val text = "$what, $whom!"
val stat = "(${text.length} chars)"
```

Concatenation with + is possible, but less concise.

```
val copy = what + ", " + whom + "!"
```

Arrays

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Array<T> is a Kotlin class (vs. part of the language).

```
val pets = arrayOf("dog", "cat", "snake")
val legs: Array<Int?> = arrayOfNulls(3)
legs[0] = 4;
```

To keep primitive types unboxed, use *IntArray*, etc.

```
val legs = IntArray(3) // Java: = new int[3];
```

If performance matters, use Arrays, else Collections.

Collections

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The Kotlin library contains three collection types.

Lists — ordered collections of (duplicate) items.

Sets — unordered collections of unique items.

Maps — sets of keys that map to one value each.

Each of these have read-only and mutable versions.

Note: Arrays are not Collections, always mutable.

Lists

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Lists of type *List<E>* are read-only.

```
val list = listOf("hello", "hola", "hi")
val item = list[0] // or .get(0)
```

Lists of type *MutableList<E>* can be modified.

```
val mutableList = list.toMutableList()
mutableList[0] = "ciao" // or .set(0, "…")
```

Sets

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Sets of type *Set<T>* are read-only, items are unique.

```
val animalList = listOf("cow", "cow", "horse")
val speciesSet = animalList.toSet()
```

Sets of type *MutableSet<T>* can be modified.

```
val mutableSet = speciesSet.toMutableSet()
mutableSet.remove("cow") // or -=
mutableSet.add("cattle") // or +=
```

Maps

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Maps of type *Maps<K,V>* are read-only, keys are a Set.

```
val dataMap = mapOf("temp" to 23, "humi" to 42)
val t = dataMap["temp"] // or .get("temp")
val keySet = dataMap.keys
```

Maps of type *MutableMap<K,V>* can be modified.

```
val mutableMap = dataMap.toMutableMap()
mutableMap["temp"] = 5 // or .put("temp", 5)
```

Conditionals

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Kotlin provides *if* and *when* to check conditions.

Both can be used as a statement, or an expression.

If statements (like *if* in Java), must use curly braces.

```
if (cond) { … } else { … }
```

If expressions (like the *?* *:* ternary operator in Java).

```
val max = if (a > b) a else b
```

When statement

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When statement (*switch* in Java)

```
when (ch) {
    'a' -> result = 'A' // break
    else -> result = '?' // default
}
```

When expression

```
val result = when (ch) { 'a' -> 'A' }
```

Ranges

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Range *to* or *until* the last element, with optional *step*.

```
val r = 1..4 // 1, 2, 3, 4 or 1.rangeTo(4)
val r2 = 1..<4 // 1, 2, 3 or 1.rangeUntil(4)
val r3 = 1..10 step 2 // or .step(2)
```

Ranges work for other types, like *Double* and *Char*.

```
val r4 = 1.0..4.0 // according to IEEE-754
val r5 = 'a'..'d' // 'a', 'b', 'c', 'd'
```

Loops

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For iterates over an *Iterable*, e.g. a range or collection.

```
for (i in 1..3) { println(i) }
for (item in list) { println(item) }
```

While and *do* ... *while* a condition holds (as in Java).

```
var i = 0
while (i < 4) { i++ }
do { i-- } while (i > 0)
```

Functions

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Declaring a function with parameters, return type.

```
fun sum(x: Int, y: Int): Int { return x + y }
fun log(x: Double, b: Double = 2.0): Double …
```

Calling the function with (named, default) arguments.

```
val i = sum(3, 5)
val d = log(x = 100.0, b = 10.0) // named args
val e = log(128.0) // default argument b = 2.0
```

Classes

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Declare a *class* with *properties* in its header or body.

```
class Contact (val id: Int, var email: String)
class Project (val pl: Contact) { val team … }
```

Add *member functions* (methods in Java) to its body.

```
class Project (…) { // class name, constructor
    fun start() { … } // member function
}
```

Instances

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Create an *instance* by calling a *constructor* of a class.

```
val c = Contact(23, "me@example.com")
val p = Project(c) // no new keyword
```

Access *properties* and call *member functions*.

```
c.email = "you@example.com"
println(p.team.size)
p.start()
```

Constructors

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The *constructor* keyword allows visibility modifiers.

```
class A() // public class, public constructor
class B private constructor() // non-public c.
```

Secondary constructor, calling the primary one, *this()*.

```
class C(val i: Int, val j: Int) { // primary c.
    constructor(i: Int): this(i, 0) // 2ndry c.
}
```

Visibility

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Visibility modifiers include *public*, which is the default.

The *internal* modifier reduces visibility to the module*.

And *private* reduces it to the containing file or class.

```
val a = 1 // public, visible from everywhere
internal val b = 2 // … *unit of compilation
private val c = 3 // … inside same .kt file
class C () { private val d = 4 } // … class
```

Null safety

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Values can be *null* in Kotlin, but not by default.

```
var s: String = null // cannot be a value
```

A type like String becomes *nullable* by adding *?*

```
var s2: String? = null
```

Safe calls *?.* return *null* if an instance is null.

```
val n = s2?.length
```

Hands-on, 15': Kotlin basics

Extend the example on p. 22 with additional features.

- Allow the *email* property of a contact to be *null*.
- Hide the *team* property inside the *Project* class.
- Add a new member function *.addContact(...)*.
- Limit the number of contacts per team to *5*.
- Make sure each contact is only added once.

Discuss your solutions with your peers.

Lambdas

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A function can be written as a lambda expression.

```
fun len(s: String): Int { return s.length }
val len2 = { s: String -> s.length } // lambda
```

A lambda expression can be called like a function.

```
val m = len("hola") // calling a function
val n = len2("hey") // calling a lambda
```

Filters

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A filter takes a lambda expression as a predicate.

```
val range = 1..10 // or array, collection, etc.
val isEven = { i: Int -> i % 2 == 0 }
```

Calling *filter()* checks the predicate for each item.

```
val evens = range.filter(isEven)
val odds = range.filter({ i -> i % 2 == 1 })
```

For another typical use of lambdas, see *map()*.

Extension functions

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Add a new function, here *len()*, to an existing class.

```
fun String.len(): Int { return this.length }
// or fun String.len(): Int = this.length
// or fun String.len() = this.length

val s = "hello" // type String, not our class
val n = s.len() // extended ~~member~~ function
```

Extension functions are dispatched statically.

Class inheritance

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A class can be a subclass of another (non-final) class.

```
open class B // default w/o open would be final
class C: B() // c.tor calls superclass c.tor
```

The top level parent class is *Any* (like *object* in Java).

```
val c = C()
val isC = c is B // true
val isAny = c is Any // true
```

Abstract classes

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An *abstract* (base) class can be inherited by default.

```
abstract class B { // not instantiated
    abstract fun m() // no implementation
} // can have non-abstract members/functions
```

Subclasses implement abstract members/functions.

```
class C: B() { override fun m() { … } }
```

The *override* modifier prevents ambiguity.

Interfaces

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A class can implement one or more interfaces.

```
interface I { // not instantiated, no c.tor
    fun m() // no impl., abstract by default
} // only abstract members/functions
```

Subclasses implement members/functions.

```
class C() : I { override fun m() { … } }
```

It's possible to delegate interface implementation.

Objects

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The keyword *object* allows to declare a singleton.

```
object C { fun m() { … } } // no constructor
```

To call such a single instance, use the object name.

```
C.m() // single instance, not an extension
```

Inheriting from classes works, so do interfaces.

```
object D : B(), I, J { … }
```

Companion objects

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An object inside a class can be declared a *companion*.

```
class C private constructor() {
    companion object Factory {
        fun create(): C = C()
    } }
```

Call companion object members via the class name.

```
val c = C.create() // like static in Java
```

Generics

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Write type safe code without relying on specific types.

```
class Hat<T>() { var item: T? = null }
class Bunny()\n class Dove() // our item types
```

The *T* in *Hat<T>* is set (to *Bunny*) at compile time.

```
val h = Hat<Bunny>() // hat for bunnies
h.item = Bunny() // instance assigned
h.item = Dove() // type mismatch
```

Exceptions

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Exceptions allow to *throw* and *catch* runtime errors.

```
throw MyException() // unchecked (unlike Java)
```

require(), *check()*, *error()* functions throw exceptions.

```
check(condition) { "error message" } // throws
```

The *try-catch-finally* blocks work the same as in Java.

```
try { … } catch (e: MyE…) { … } finally { … }
```

Null safety revisted

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Smart casts (implicit) and safe casts, using *A as? B*.

```
val b: B = a as? B // or null if not A is B
```

Early returns *x?*, combined with the Elvis operator *?:*

```
var n = users[userId]?.friends?.size ?: -1
```

```
n = list.sumOf { (e as? String)?.length ?: 0 }
```

If any part is null, evaluation stops, "returns" null.

Hands-on, 15': Intermediate topics

Refactor the example on p. 22 and add features.

- Create two subclasses of *Contact*, *Dev* and *Suit*.
- Add a way to set a dev's programming language.
- Prevent contacts from being instantiated directly.
- Extend *Project* to filter the team by devs or suits.
- Give* suits a "manager", devs a "maker" schedule.

*A property *schedule* of type *String* is good enough.

Libraries and APIs

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Libraries distribute reusable code for common tasks.

The Kotlin standard library is imported by default.

```
println("nice"); // part of kotlin.* library
```

Other packages, classes, etc. have to be imported.

```
import kotlin.time.* // or .Duration, etc.

val pause: Duration = 15.minutes
```

Summary

We saw the basics of programing in Kotlin.

It's similar to Java, with a more concise syntax.

Combining proven concepts and an elegant library.

Next: Getting Started with Android.

Challenge: Advanced topics

Study these concepts, we might meet them later on*.

- Special classes like *data*, *enum* and *value* classes.
- Properties *fields*, delegated *by*, *lazy* initialisation.
- Generics *in*, *out*, *where*, co- and contravariance.
- Coroutines, for asynchronous, concurrent tasks.
- Scope functions *let*, *apply*, *run*, *also*, and *with*.

*In existing code, without implementation aspects.

Feedback or questions?

Write me on Teams or email

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Thanks for your time.