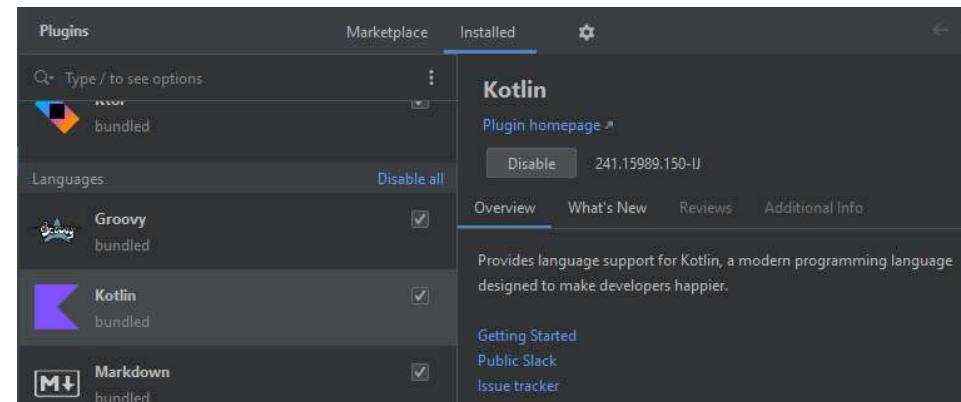


Kotlin

Peter Borovanský, KAI, I-18, borovan(a)ii.fmph.uniba.sk



The screenshot shows the 'New Project' dialog in IntelliJ IDEA. On the left, a sidebar lists various project types: Java, Java Enterprise, JBoss, Clouds, Spring, Java FX, Android, IntelliJ Platform Plugin, Erlang, Spring Initializer, Maven, Gradle, Groovy, Grails, Application Forge, Kotlin, Clojure, Static Web, Node.js and NPM, Flash, Haskell module, and Empty Project. The 'Kotlin' option is highlighted with a blue selection bar and has a red arrow pointing to it from the bottom-left. On the right, a list of targets for the selected 'Kotlin' project type is shown, including JVM | IDEA, JS | IDEA, Native | Gradle, Multiplatform Library | Gradle, JS Client and JVM Server | Gradle, Mobile Android/iOS | Gradle, and Mobile Shared Library | Gradle. A second red arrow points to the 'JVM | IDEA' item in this list. A third red arrow points to the top of the right-hand list area.

Kotlin Plugin in IntelliJ

File/Settings/Plugins
MarketPlace/Kotlin

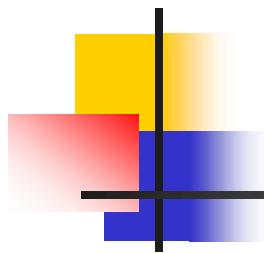
Plugin od JetBrains



How to Update the Kotlin Plugin in IntelliJ

Donn Felker - Freelancing for ...

<https://www.youtube.com/playlist?list=PLVUm4IewkTXqwzuRXZisWg7shMTiQhUtz>



Kotlin

Kotlin is the New Official Language of Android



Modern Android development with Kotlin (September 2017) Part 1

It is really hard to find one project that covers all the things that are new in Android Development, so I decided to write one. In this article we will use the following:



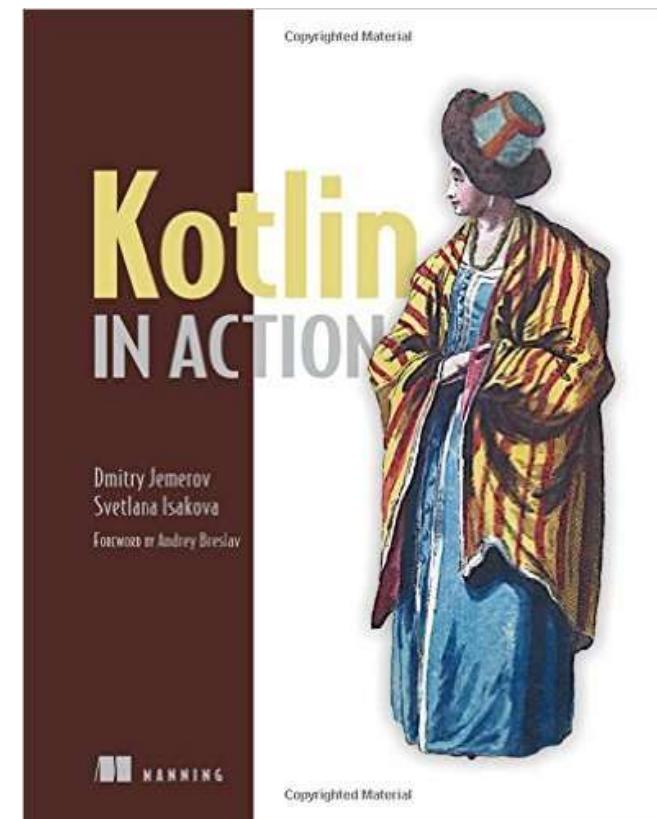
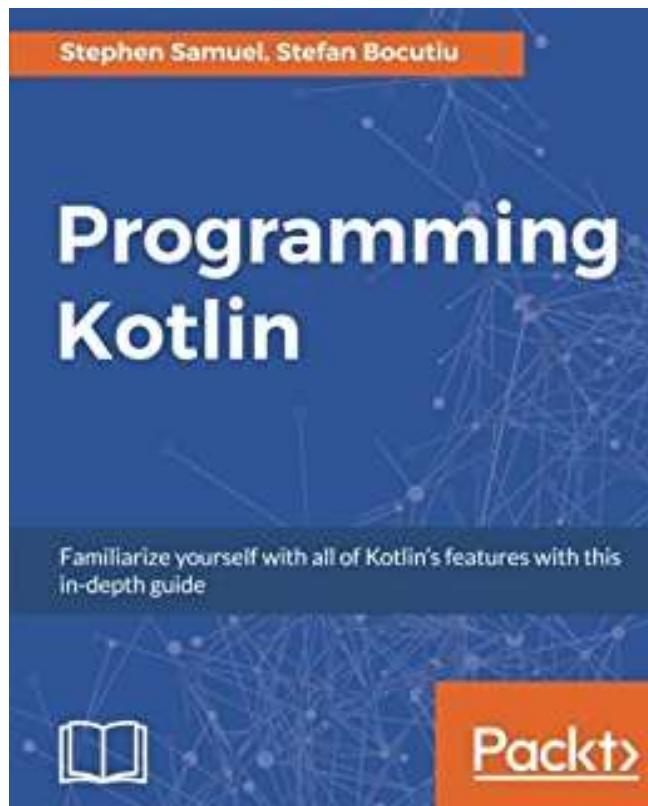
Rýchly nadhľad
nad vlastnosťami
jazyka Kotlin, dotyk
s prvými aplikáciami

Literatúra

serioznejšie čítanie

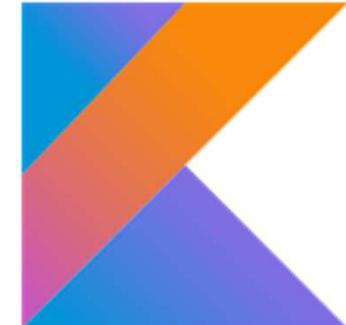


- Kotlin in Action
<https://www.manning.com/books/kotlin-in-action>
- Programming in Kotlin
<https://www.packtpub.com/application-development/programming-kotlin>

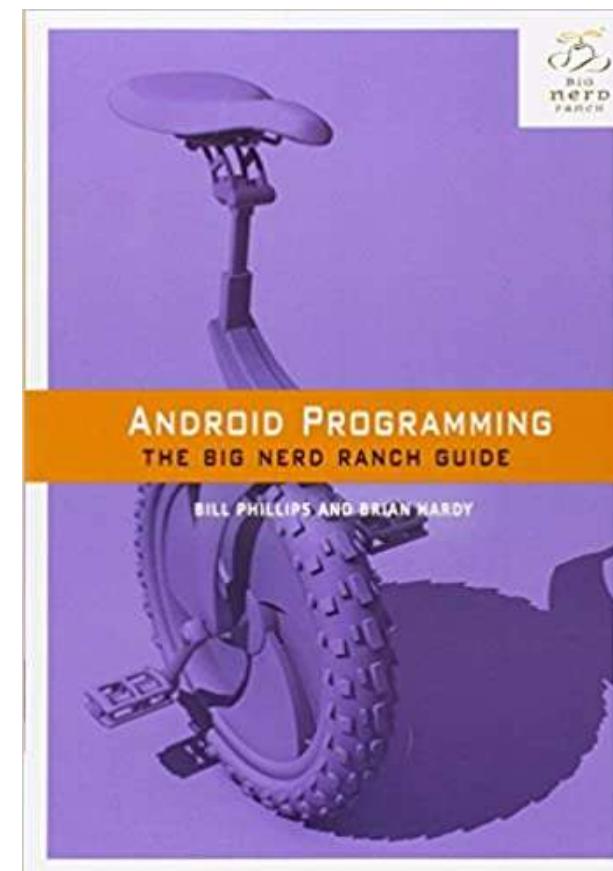
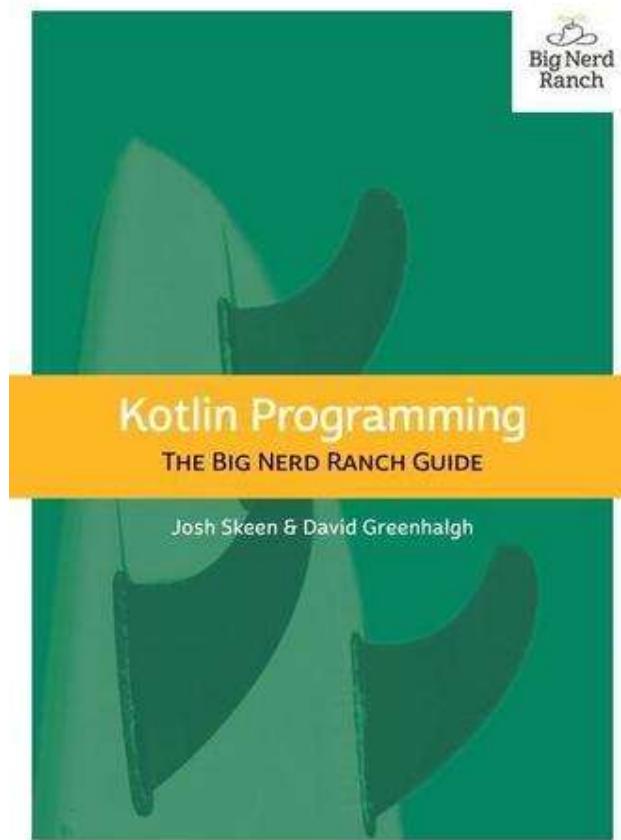


Literatúra

for nerds



- Kotlin Programming – The Big Nerd Ranch Guide
<https://www.amazon.com/Kotlin-Programming-Nerd-Ranch-Guide/dp/0135161630>
- Android Programming: The Big Nerd Ranch Guide (4th Edition)
<https://www.bignerdranch.com/books/android-programming-the-big-nerd-ranch-guide-4th/>



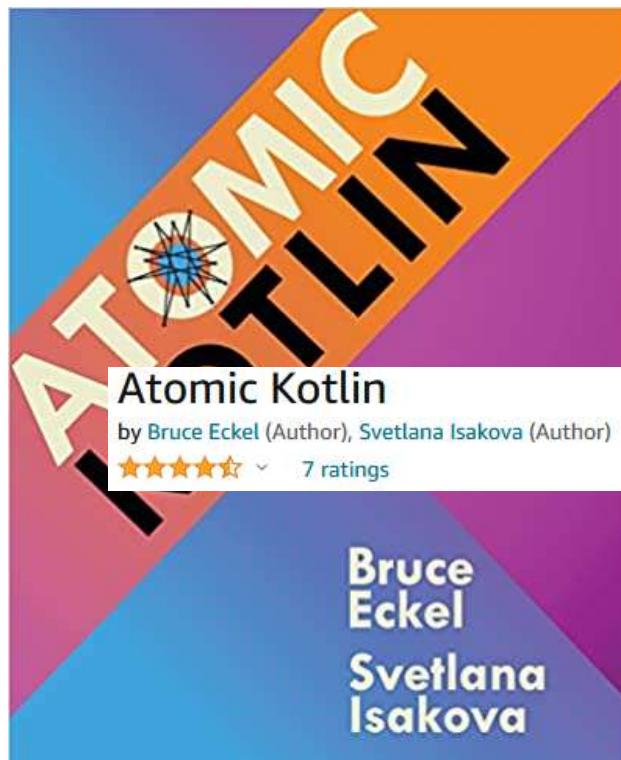


Literatúra

nežný úvod

Bruce Eckel, Svetlana Isakova: Atomic Kotlin - ideálne pre začiatočníkov
<https://www.amazon.com/Atomic-Kotlin-Bruce-Eckel/dp/0981872557>

Marcin Moskala: Effective Kotlin – Best Practices - ideálne pre pokročilejších
<https://www.amazon.com/Effective-Kotlin-practices-Marcin-Moskala/dp/8395452837>



Individual training

If you are an individual looking to upgrade your skill set, with our workshops you'll have an incredible chance to do it.
Registration for the best Kotlin [OPEN WORKSHOPS](#) with **Marcin Moskala** is already open!



Kotlin Coroutines

A workshop focused on advanced practical skills like generics, reflection, annotation processing, and KSP, practiced on implementing projects like custom mocking library, object serialization, dependency injection.

Dates: 26-27th of October 2023

Times: 9:00-17:00 UTC+2

Fee: 300 euros

[More Info](#)



Kotlin for Developers

Focused on the Kotlin JVM ecosystem, the training prepares for general programming and backend development (e.g. in Spring and Ktor).

Dates: 22-24th of November 2023

Times: 9:00-17:00 UTC+1

Fee: 400 euros

[More Info](#)

Literatúra

ideálne pre „youtuberov“



<https://www.youtube.com/playlist?list=PLVUm4IewkTXqwzuRXZisWg7shM>

The screenshot shows a YouTube channel page for a Kotlin programming course. On the left, there's a thumbnail for a course titled "The Kotlin Programming Language Course for Beginners" with 134 videos and 32,965 views. Below it, a note says the playlist is 9+ hour-long. To the right is a list of 6 video thumbnails from a playlist titled "How to Install the IntelliJ IDE for Kotlin Development". Each video is by "Donn Felker - Freelancing for Software Developers". The videos cover topics like creating files, updating plugins, and creating variables.

YouTube SK

Search

How to Install the IntelliJ IDE for Kotlin Development

Donn Felker - Freelancing for Software Developers

How to Create a Kotlin File in IntelliJ

Donn Felker - Freelancing for Software Developers

How to Update the Kotlin Plugin in IntelliJ

Donn Felker - Freelancing for Software Developers

"Hello World" in Kotlin - Your First Kotlin Program

Donn Felker - Freelancing for Software Developers

How to Create Variables in Kotlin

Donn Felker - Freelancing for Software Developers

How to Create Read-Only Variables in Kotlin

Donn Felker - Freelancing for Software Developers

PLAY ALL

134 videos 32,965 views • Last updated on 19 Mar 2021

In this course, you will learn the Kotlin programming language from the ground up. Over 9 hours of content, 130+ lessons.

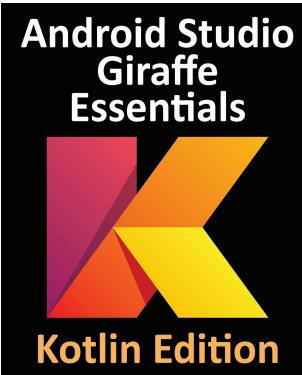
This playlist contains all 134 lessons. If you prefer to watch this as a single 9+ hour-long single video, you can do so here:

<https://www.youtube.com/watch?v=wuiT4...>

Topics include, but are not limited to:

Android Studio Essentials -

 Developing Android Apps Using Android Studio 2022.3.1 and Kotlin,
Neil Smyth



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Kotlin vs. Swift

- <https://kotlinlang.org/> [Kotlin Playground \(https://play.kotlinlang.org/\)](https://play.kotlinlang.org/)
- Swift is like Kotlin (<http://nilhcem.com/swift-is-like-kotlin/>)

Swift

```
print("Hello, world!")
```

prekladový slovník
pre iOSákov

Swift

```
var myVariable = 42
myVariable = 50
let myConstant = 42
```

Kotlin

```
println("Hello, world!")
```

Constants

Kotlin

```
var myVariable = 42
myVariable = 50
val myConstant = 42
```

Kotlin Playground

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



The screenshot shows the Kotlin Playground interface. On the left, there's a sidebar with navigation links:

- Examples
- Kotlin Koans 2/42
- Kotlin in Action
 - Chapter 1
 - Chapter 2
 - 2.1
 - 1_HelloWorld.kt
 - 2_Functions.kt
 - 4_1_StringTemplate...
 - 4_2_StringTemplate...
 - 4_3_StringTemplate...

A red arrow points from the "1_HelloWorld.kt" link in the sidebar to the same file name in the main code editor area. The code editor shows the following Kotlin code:

```
package ch02.ex1_1_HelloWorld

fun main(args: Array<String>) {
    println("Hello, world!")
}
```

Below the code editor, a yellow box contains the text:

Cvičenie - 1
Pošli screenshot s Koans, dostaneš
Math.floor(3*% /100)

The right sidebar shows the progress of the "Kotlin Koans" section:

- Examples
- Kotlin Koans 22/42
 - Introduction
 - Conventions
 - Collections
 - Introduction
 - Filter map
 - All Any and other predi...
 - FlatMap
 - Max min
 - Sort
 - Sum
 - GroupBy

Progress:30%

Kotlin

- Introduction
 - ✓ Hello, world!
 - ✓ Named arguments
 - ✓ Default arguments
 - ✓ Lambdas
 - ✓ Strings
 - ✓ Data classes
 - ✓ Nullable types
 - ✓ Smart casts
 - ✓ Extension functions
 - ✓ Object expressions
 - ✓ SAM conversions
 - ✓ Extensions on collecti
- ▶ Introduction
- ▼ Conventions
 - ✓ Comparison
 - ✓ In range
 - ✓ Range to
 - ✓ For loop
 - ✓ Operators overloading
 - ✓ Destructuring declarat
 - ✓ Invoke

MY KOAN IS TO
COMPREHEND THE
SOUND OF ONE
HAND CLAPPING.

MINE IS TO
FIGURE OUT HOW
THIS SMART CARD
WORKS.

Progress:48%

Kotlin

Progress:78%

- ▶ Introduction
- ▶ Conventions
- ▼ Collections
 - ✓ Introduction
 - ✓ Filter map
 - ✓ All Any and other predicates
 - ✓ FlatMap
 - ✓ Max min
 - ✓ Sort
 - ✓ Sum
 - ✓ GroupBy
 - ✓ Partition
 - ✓ Fold
 - ✓ Compound tasks
 - ✓ Get used to new style

TestShop.kt
Shop.kt

Čo sa naučíte na play.kotlinlang.org

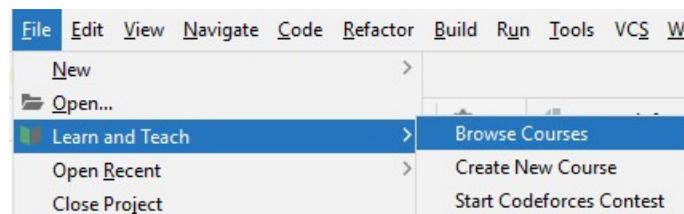
<https://play.kotlinlang.org/koans/>

Cvičenie - 1
Pošli screenshot s Koans, dostaneš
 $\text{Math.floor}(3 * \% / 100)$

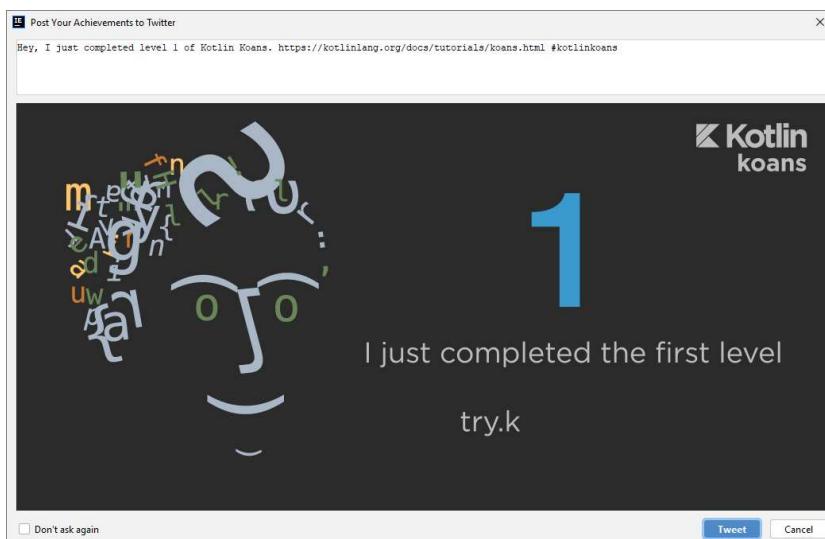
IntelliJ EDU

JetBrains Academy/EduTools Plugin

- možnosť sledovať/vytvárať kurzy, chce to IntelliJ aspoň 2021.2



- Game of Koans budeme robit' na cvičení...



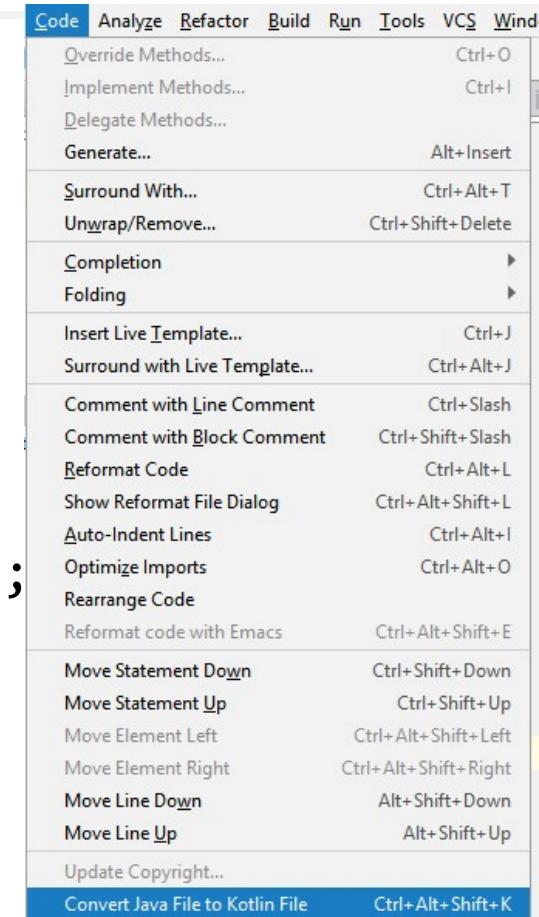
A screenshot of the JetBrains Academy/EduTools plugin interface. The top navigation bar shows 'Plugins', 'Marketplace' (selected), and 'Installed'. The 'Marketplace' tab has a search bar for 'JetBrains' and a dropdown for 'Sort By: Relevance'. Two plugins are listed: 'JetBrains Academy' (3.5M installs) and 'JetBrains IDE Services' (2.5M installs). The 'JetBrains Academy' card includes an 'Install' button and a date '2024.8-2024.1-2081'. Below the Marketplace tab are tabs for 'Overview', 'What's New', 'Reviews', and 'Additional Info'. The main content area shows a 'Select Course' dialog with sections for 'All Courses' (Marketplace, Hyperskill, Coursera), 'My Courses' (0 in progress), and a list of courses. The 'Kotlin Koans' course is selected, showing its details: 'Kotlin Koans' by JetBrains s.r.o., rating 4.8, 29745 reviews, and a 'Start' button. Other courses listed include 'AtomicKotlin', 'Introduction to Python', 'Kotlin Koans', 'Learn Rust', 'Scala Tutorial', '100 Days of Code - The Complete Python ...', 'Introduction to IDE Code Refactoring in Ko...', 'Python GUI with Tkinter', and 'New Language Features in Java 9-17'. The right side of the dialog shows 'Programming Languages' (Kotlin, English, Featured) and 'Course Details' (3.9, 36,955 learners, updated Apr 5, 2023). A note at the bottom states: 'By clicking the "Start" button, you acknowledge that this course is distributed by JetBrains s.r.o. and you agree to the Developer's license terms and the JetBrains Plugin Marketplace Agreement.' A 'Settings' link is also present.

<https://plugins.jetbrains.com/plugin/10081-edutools/docs/learner-start-guide.html>

Java -> Kotlin

„klasický“ Java kód pre Fibonacciho s memoizáciou

```
public class Fib {  
    static Integer[] table = new Integer[100];  
    private static int fib(int n) {  
        Integer result = table[n];  
        if (result == null) {  
            if (n < 2)  
                result = 1;  
            else  
                result = fib(n - 2) + fib(n - 1);  
            table[n] = result;  
        }  
        return result;  
    }  
    public static void main(String[] args) {  
        for(int i = 0; i<20; i++)  
            System.out.println("fib(" + i + ")=" + fib(i));  
    }  
}
```



Automatická konverzia do Kotlinu

Java -> Kotlin

výsledok automatickej konverzie

Čo nás prekvapilo

```
object fib {
    internal var table = arrayOfNulls<Int>(100)
    private fun fib(n: Int): Int {
        var result: Int? = table[n]
        if (result == null) {
            if (n < 2)
                result = 1
            else
                result = fib(n - 2) + fib(n - 1)
            table[n] = result
        }
        return result
    }
    @JvmStatic fun main(args: Array<String>) {
        for (i in 0..19)
            println("fib(" + i + ")=" + fib(i))
    }
}
```

Už nenájdete pôvodný zdroják

DÚ podobne vygenerované sa neuznajú

Kotlinish verzia

```
import java.math.BigInteger

val table = mutableMapOf<Int, BigInteger>() // HashMap

fun fib(n: Int): BigInteger = table.getOrPut(n) {
    if (n <= 2)
        BigInteger.ONE
    else
        fib(n - 1) + fib(n - 2)
}

fun main() {
    println(fib(1024))
}
```



fibonacci 1024

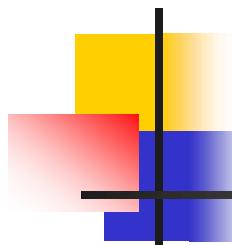
NATURAL LANGUAGE MATH INPUT EXTENDED KEYBOARD EXAMPLES UPLOAD RANDOM

450669963367781981310438323572886049367860596218604830803023 ·
149600030645708721396248792609141030396244873266580345011219 ·
530209367425581019871067646094200262285202346655868899711089 ·
246778413354004103631553925405243

Decimal approximation

4.506699633677819813104383235728860493678605962186048308030... ×
 10^{213}

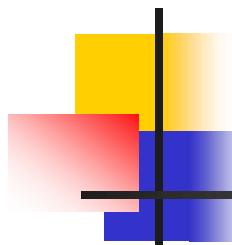
More digits



if je výraz

- `if` je výraz

```
fun binCifSum(n : Int) : Int =  
    if (n <= 0) 0  
    else binCifSum(n/2) + if (n % 2 == 0) 0 else 1  
    else binCifSum(n/2) + (n % 2 == 0)  
  
fun binCifSumClassic(n : Int) : Int {  
    if (n <= 0) return 0  
    else if (n % 2 == 0) return binCifSumClassic(n / 2)  
    else return 1 + binCifSumClassic(n / 2)  
}  
  
fun main(args:Array<String>) : Unit {  
    for (n in 0..10)  
        println("binCifSum $n je ${binCifSum(n)}")  
}
```



when je switch, tiež je to výraz

```
val kategoria =
    if (vek < 6) "predskolsky"
    else if (vek <= 11) "1.stupen"
    else if (vek <= 18) "2.stupen"
    else "mimo"

val kategoria1 =
    when (vek) {
        in 0..5 -> "predskolsky"
        in 5..11 -> "1.stupen"
        in 12..18 -> "2.stupen"
        else -> "mimo"
    }

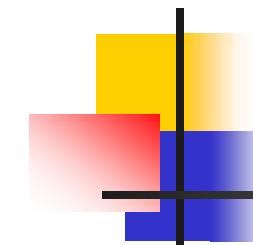
var kategoria2 = "mimo"
when (vek) {
    in 0..5 -> kategoria2 = "predskolsky"
    in 5..11 -> kategoria2 = "1.stupen"
    in 12..18 -> kategoria2 = "2.stupen"
}
```

For/foreach cyklus

```
for (x in 1..10) println(x) // 1, 2, ..., 10
for (x in (1..10).toList()) println(x) // 1, 2, ..., 10
for (x in (10 downTo 1).toList()) println(x) // 10, 9, ..., 1
for (x in 10 downTo 1) println(x) // 10, 9, ..., 1
for (x in 1 until 10) println(x) // 1, 2, ..., 9
for (x in 1 until 10 step 2) println(x) // 1, 3, 5, 7, 9
for (x in listOf(2,3,5,7,11,13)) println(x)

for (x in 'a'..'z') println(x) // a, b, ..., z
for ((index, value) in ('a'..'z').withIndex())
    println("[\$index]=\$value") // [0]=a, [1]=b, ...

val map=mapOf(1 to "gula", 2 to "zelen", 3 to "zalud", 4 to "srdce")
for ((key, value) in map) println("[\$key]=\$value")
    // [1]=gula, [2]=zelen, [3]=zalud, [4]=srdce
```



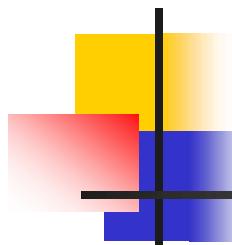
Cykly

```
fun main(args: Array<String>) {
    for(a in args)
        print("$a, ")

    for (c in 'A'..'F')
        println(Integer.toBinaryString(c.code()))

    for (c in ' '..'z')
        if (c in 'a'..'z' || c in 'A'..'Z')
            print(c)

    for (c in ' '..'z')
        when (c) {
            in '0'..'9' -> println("digit")
            in 'a'..'z', in 'A'..'Z' -> println("letter")
        }
}
```



Operátory porovnania

- podobne ako Java <=, <, >=, >, !=

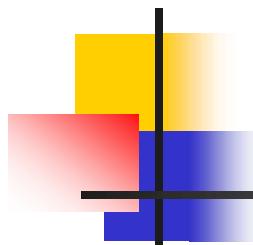
ale

== je porovnanie hodnôt

==== je porovnanie referencií

```
val a = "kot"  
val b = "lin"  
val c = (a+b).trim()  
val d = "kotlin"  
println("c==d ${c==d}, c====d ${c=====d}")
```

c==d true, c=====d false



Kolekcie

```
val set = hashSetOf(2, 3, 5, 7, 11, 13, 17)
val list = arrayListOf(-1, 0, 1)
val map = hashMapOf("sedma" to 7, "osma" to 8, "dolnik" to 11,
                    "hornik" to 12, "kral" to 13, "eso" to 15)
```

```
println(set)    println(set.javaClass)
println(list)   println(list.javaClass)
println(map)    println(map.javaClass)
```

```
[17, 2, 3, 5, 7, 11, 13]
class java.util.HashSet
[-1, 0, 1]
class java.util.ArrayList
{kral=13, eso=15, sedma=7, osma=8,
 dolnik=11, hornik=12}
class java.util.HashMap
```

```
for(x in list)                      // cyklus cez list
    for(y in set)                    // cyklus cez set
        for((key, value) in map)      // cyklus cez map
            println("$x $y $key $value")
```

Kotlin Notebook

The screenshot shows an IDE interface with a central code editor window displaying a Kotlin notebook script. The code uses various Kotlin collections (set, list, map) and prints their Java class names. Below the code, the output of the execution is shown, listing pairs of integers (e.g., 1 2, 1 3, etc.) followed by their corresponding Java class names (osma, dolnik, kral, hornik, eso, sedma). A warning message at the top of the code editor states: "This Kotlin notebook is located inside the sources root, which may lead to problems. Move it outside the sources root." The top navigation bar includes a context menu with options like New, Cut, Copy, Paste, Find Usages, and Analyze. The bottom status bar indicates the process finished with exit code 0.

New >

- Cut Ctrl+X
- Copy Ctrl+C
- Copy Path/Reference...
- Paste Ctrl+V
- Find Usages Alt+F7
- Find in Files... Ctrl+Shift+F
- Replace in Files... Ctrl+Shift+R
- Analyze >
- Refactor >
- Clean Python Compiled Files

01 main

Project

- 0.kt
- 1.kt
- 2.kt
- 3.kt
- 4.kt
- 5.kt
- 6.kt
- 7.kt
- 8.kt
- 9.kt
- 10.kt
- 11.kt
- 12.kt
- 13.kt
- 14.kt
- 15.kt
- BigFibonacci.kt
- ctc.kt
- ctc_OLDSCCHOOL.kt
- Cvicienie.kt
- Cvicienie2021.kt
- Fibonacci.kt
- FibonacciJ
- Formulas.kt
- JavaToKotlin.kt
- KotlinNotebook.ipynb
- PripravaNaCvicienie.kt
- PripravaNaCvicienie2021.kt
- quads.kt
- Rodinka.kt
- TRO.kt

In 5

```
1 val set = hashSetOf(2, 3, 5, 7, 11, 13, 17)
2 val list = arrayListOf(-1, 0, 1)
3 val map = hashMapOf("sedma" to 7, "osma" to 8, "dolnik" to 11,
4                     "hornik" to 12, "kral" to 13, "eso" to 15)
5 println(set); println(set.javaClass)
6 println(list); println(list.javaClass)
7 println(map); println(map.javaClass)
8
9 for(x in list)
10     for(y in set)
11         for((key, value) in map)
12             println("$x $y $key $value")
```

Executed at 2023.08.28 10:34:10 in 832ms

- 1 2 osma 8
- 1 2 dolnik 11
- 1 2 hornik 12
- 1 3 kral 13
- 1 3 eso 15
- 1 3 sedma 7
- 1 3 osma 8
- 1 3 dolnik 11
- 1 3 hornik 12
- 1 5 kral 13
- 1 5 eso 15
- 1 5 sedma 7
- 1 5 osma 8
- 1 5 dolnik 11
- 1 5 hornik 12

Run _1Kt

```
NULL=APerson(first=Gomez, name=Addams, age=150, father=null, mother=null), APerson(first=Morticia, name=Addams, age=150, father=null, mother=null), APerson(first=Fester, name=Addams, age=174, father=null, mother=null), APerson(first=Wednesday, name=Addams, age=12, father=Gomez, mother=Morticia)
```

Process finished with exit code 0

IDE project settings can be added to Git
View Files Always Add Don't Ask Again

01 src KotlinNotebook.ipynb 20:1 CRLF UTF-8 4 spaces

Číselné funkcie, String template

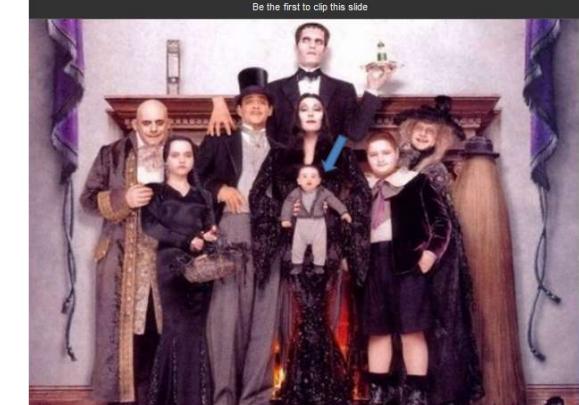
```
fun fib(n: Int): Int {  
    return if (n < 2) 1 else fib(n-1) + fib(n-2)  
}  
  
fun fib1(n: Int): Int {  
    fun fib(n: Int, a : Int = 0, b : Int = 1): Int {  
        return if (n < 0) a else fib(n-1, b, a+b)  
    }  
    return fib(n)  
}  
  
fun main(args: Array<String>) {  
    val lst = listOf(1,2,3,4,5,6,7,8,9,10)  
    println(lst.map { n -> fib(n) })  
    println(lst.map { fib1(it) })  
    lst.forEach { println("fib($it) = ${fib1(it)}") }  
    for(i in 1..11) println("fib($i) = ${fib1(i)}")  
    println("Maximum: ${lst.map { fib(it) }.max()}" )  
}
```

Funkcie a it

```
val fcia = { x:Int, y : Int -> println("sucet $x+$y"); x+y}  
val proc = { x:Int, y : Int -> println("sucet $x+$y")}
```

```
println(fcia(12,7))  
proc(13,9)  
println({ x:Int -> x+1 }(2))  
; // inak neopochopi, že nejde o blok, ale Lambda konštantu  
{ x:Int -> println(x)}(4)  
    // preto jasnejší zápis  
run {{ x:Int -> println(x)}(4)}
```

```
val delta = 5  
println(ListOf(1,2,3)  
      .map { it + delta}    // x -> x + delta, clojure  
      .filter {it % 2 == 0} )
```

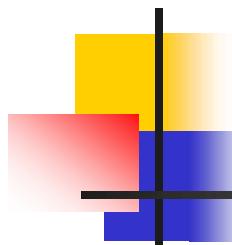


Addams Kotlin family

```
data class Person(val first : String, val name: String,
                 val age: Int? = null,
                 val father : Person?, val mother : Person?)
```

Data class je class s predgenerovanými equals, hashCode, toString, copy

```
fun main(args: Array<String>) {
    val father = Person("Gomez", "Addams", 156, null, null)
    val mother = Person("Morticia", "Addams", 136, null, null)
    val daughter = Person("Wednesday", "Addams", 46, father, mother)
    val son = Person("Pugsley", "Addams", 36, father, mother)
    val family = listOf( father, mother, daughter, son,
                         Person("Fester", "Addams", 174, null, null), // uncle
                         Person("Pubert", "Addams", null, null, null) // on the picture
    )
    val oldest = family.maxBy { it.age ?: 0 }
    println("The oldest is: $oldest")
}
```



Funkcionály

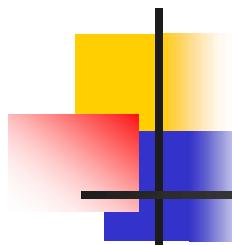
```
println(family.map { it.first }) // mapToObj  
println(family.filter { it.age?:0 > 100 } )  
println(family.all { it.age?:0 < 100 } )  
println(family.all { it.name == "Dracula" } )  
println(family.groupBy { it.father } )  
println(family.filter { it.age ==  
    (family.maxBy { person: APerson -> person.age ?: 0 }.age?: 0) } )  
println(family.filter { it.age ==  
    (family.map { it.age?:0 }.max()) } )
```

Ak by .age bol Int, nie Int?

```
it.age == family.maxBy { person: Person -> person.age }?:0 } )
```

```
val numbers = mapOf(0 to "zero", 1 to "one")  
for((father, persons) in family.groupBy { it.father })  
    println("${persons.size} ma otca $father")
```

```
println(listOf("a", "aba", "b", "ba", "abba").groupBy { it.length } )  
println(listOf("a", "aba", "b", "ba", "abba").flatMap { it.toList() } ) 1.kt
```

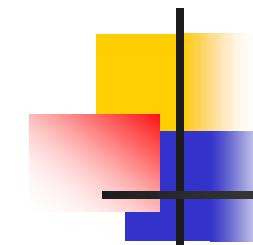


Funkcie

```
class Book(val title: String, val authors: List<String>)
val books = listOf(
    Book("Action in Kotlin", listOf("Dmitry Jemerov", "Svetlana Isakova")),
    Book("Mort", listOf("Terry Pratchett")),
    Book("Good Omens", listOf("Terry Pratchett", "Neil Gaiman")),
    Book("Discworld", listOf("Terry Pratchett", "Paul Kidby")))
println(books.flatMap { it.authors }.toSet())

listOf(1, 2, 3, 4)
    .asSequence()
        .map { print("map($it) "); it * it }
        .filter { print("filter($it) "); it % 2 == 0 }
    .toList()

val nats = generateSequence(1) { it + 1 }
println(nats.takeWhile { it <= 100 }.sum())
println(nats.takeWhile { it <= 10 }.reduce({ x:Int, y : Int -> x*y}))
```



Collection vs. sequence

```
val collection = (-100..100)
    .filter {it % 2 == 0}
    .map { it * 2 }
    .map { it/it }
    .take(10)
println(collection)
java.lang.ArithmetricException
```

```
val sequence = (-100..100)
    .asSequence()
    .filter {it % 2 == 0}
    .map { it * 2 }
    .map { it/it }
    .take(10)
println(sequence.toList())
[1, 1, 1, 1, 1, 1, 1, 1, 1, 1]
```

Kolekcie:

- vyhodnocujú sa dravo -eager
- každá transformácia sa aplikuje na celú kolekciu
- vytvorí sa nová kolekcia
- dobré pre veľké kolekcie

Sekvencie:

- vyhodnocujú sa lenivo -lazy
- každá transformácia sa aplikuje element-po-elemente
- nevytvorí sa nová kolekcia
- vhodné pre veľké kolekcie