Coroutines - asynchrónnosť

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AsyncTask
Coroutines
Retrofit

Asynchronnosť

- je vážny problém
  - ako vykonávať niečo, čo môže dlho trvať, a event.
  - potrebujem výsledok z tohto procesu pre ďalší svoj výpocet
- v rôznych jazykoch sa riešit rôzne
  - Javascript: callback -> callback hell
  - Java: Thread, FutureTask, RxJava
  - GOlang: go rutiny
  - Android: AsyncTask
- v Kotline od verzie 1.3 existuje koncept coroutiny
  - nie ako knižnica
  - súčasť jazyka
- pochopiť koncept môžeme extra, bez Android environmentu
  - IntelliJ

Hádanka 1

```
fun main() {
    println("Start")
    val list = listOf<Int>(1,2,3,4,5,6,7,8,9,10)
    val newList = list.stream().map {
        Thread.sleep(1000)
        it*it     // return it * it
    }
    println("End")
    newList.forEach { // výpis kolekcie
        println(it.toString())
    }
}
```

```
08:59:32.832 Start
08:59:32.834 End    Start+0sec.
08:59:33.839 1
08:59:34.841 4
08:59:35.842 9
08:59:36.844 16
08:59:37.846 25
08:59:38.849 36
08:59:39.851 49
08:59:40.854 64
08:59:41.856 81
08:59:42.858 100
```

stream bez .collect() je *lenivá* kolekcia

Project:Coroutines1.zip

Hádanka 2

```
fun main() {
    println("Start")
    val list = listOf<Int>(1,2,3,4,5,6,7,8,9,10)
    val newList = list.stream().map {
        Thread.sleep(1000)
        it*it
    }.collect(Collectors.toList())
    println("End")
    newList.forEach { // výpis kolekcie
        println(it.toString())
    }
}
```

```
09:02:23.363  Start
09:02:33.389  End    Start+10sec.
09:02:33.389  1
09:02:33.389  4
09:02:33.389  9
09:02:33.389  16
09:02:33.389  25
09:02:33.389  36
09:02:33.390  49
09:02:33.390  64
09:02:33.390  81
09:02:33.390  100
```

Project:Coroutines1.zip

Hádanka 3

```
fun main() {
    println("Start")
    val list = listOf<Int>(1,2,3,4,5,6,7,8,9,10)
    val newList = list.parallelStream().map {
        Thread.sleep(1000)
        it*it
    }.collect(Collectors.toList())
    println("End")
    newList.forEach { // výpis kolekcie
        println(it.toString())
    }
}
```

parallelStream používa
toľko paralelizmu, koľko je #cores

```
Runtime.getRuntime()
.availableProcessors() == 4
```

```
09:04:06.410 Start
09:04:09.420 End
09:04:09.420 1
09:04:09.420 4
09:04:09.420 9
09:04:09.420 16
09:04:09.420 25
09:04:09.420 36
09:04:09.421 49
09:04:09.421 64
09:04:09.421 81
09:04:09.422 100
```

Start+3sec.

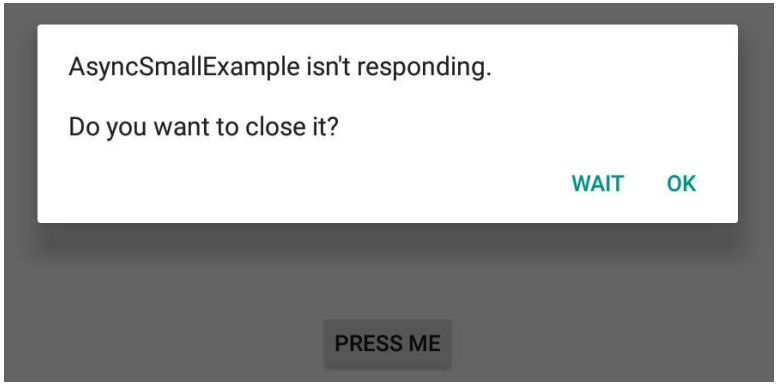
Project:Coroutines1.zip

Asynchrónne operácie

- nie je možné robiť časovo náročné operácie v hlavnom vlákne aplikácie
  - extra komplikovaný (matematický) výpočet
  - simuláciu procesu spomaľovanú napr. Thread.sleep(…)
  - trvajúce požiadavky (napr. http/sql-request), ktoré môžu trvať netriviálne dlho

- Takýto kód zablokuje hlavné vlákno, a ak vyvoláte GUI eventy (napr. pochabým klikaním v priebehu 20s), správca aplikácií usúdi, že aplikácia je mŕtva zavrie ju

```
fun buttonClick(view: View) {
  var i = 0
  while (i <= 20) {
    try {
        Thread.sleep(1000)
        i++
    }
    catch (e: Exception) {
        e.printStackTrace()
  }
}
```



Project:AsyncSmallExample.zip

Async Task
(doInBackground)

Parametrizovaná trieda AsyncTask je thread-wrapper rieši problém, existuje od API-3

```
                                typ parametrov, type progresu, typ výsledku
private inner class MyTask:AsyncTask<String, Int, String>() {

   override fun onPreExecute(){…}// vykoná sa pred doInBackground
   // celé jadro toho, čo sa má vykonávať v extra vlákne
   override fun doInBackground(vararg params: String): String {
      while (i in 0..20) {
         try {
            Thread.sleep(1000)
            publishProgress(i)
         } catch (e: Exception) { … }
         return "Button Pressed"
    }

    override fun onProgressUpdate(vararg values: Int?) { … }

    override fun onPostExecute(result:String){…}// po doInBackgr.
}
```

Project:AsyncSmallExample.zip

Async Task
(onPre/PostExecue)

```
private inner class MyTask : AsyncTask<String, Int, String>() {
    var color : Int = Color.BLACK
    override fun onPreExecute() {
        color =  ... Random Color ...
    }

    override fun doInBackground(vararg params:String):String {}
    // varargs je variabilný počet argumentov, ako ... v Jave
    override fun onProgressUpdate(vararg values: Int?) {
        myTextView.setTextColor(color) // beží v main threade
        val counter = values.get(0)
         myTextView.text = "Counter = $counter"
    }

    override fun onPostExecute(result:String) { "Button Pressed"
         myTextView.setTextColor(color)
         myTextView.text = result
    }
}
```

Project:AsyncSmallExample.zip

Async Task
(spustenie)

Štandardne sa rôzne inštancie AsyncTask spúšťajú sériovo, kým nedobehne jedna, ostatné čakajú vo fronte

```
val task1 = MyTask().execute()   // serial run of AsyncTask
```

Ak ich chceme spustiť viacero a paralelne, tak cez POOL_EXECUTOR

```
task = MyTask().executeOnExecutor(AsyncTask.THREAD_POOL_EXECUTOR)
```

Ale počet paralelne bežiacich AsyncTaskov je limitovaný, v závislosti od počtu jadier CPU

```
val cpu_cores = Runtime.getRuntime().availableProcessors()
```

Reálne väčším problémom, že napriek popularite a jednoduchosti používania AsyncTask je od Android 11 AsyncTask zastaralý (*deprecated*)
https://www.xda-developers.com/asynctask-deprecate-android-11/amp/?__twitter_impression=true

Z toho zatiaľ nie je jasné, či ho Google odstráni, ale ...

Project:AsyncSmallExample.zip

Alternatívy

Čo je alternatíva:

- RX-library
- Java's Concurrency framework
- Kotlin coroutines od verzie Kotlin 1.3

build.gradle:

- `implementation`
  `"org.jetbrains.kotlinx:kotlinx-coroutines-core:1.3.2"`

import

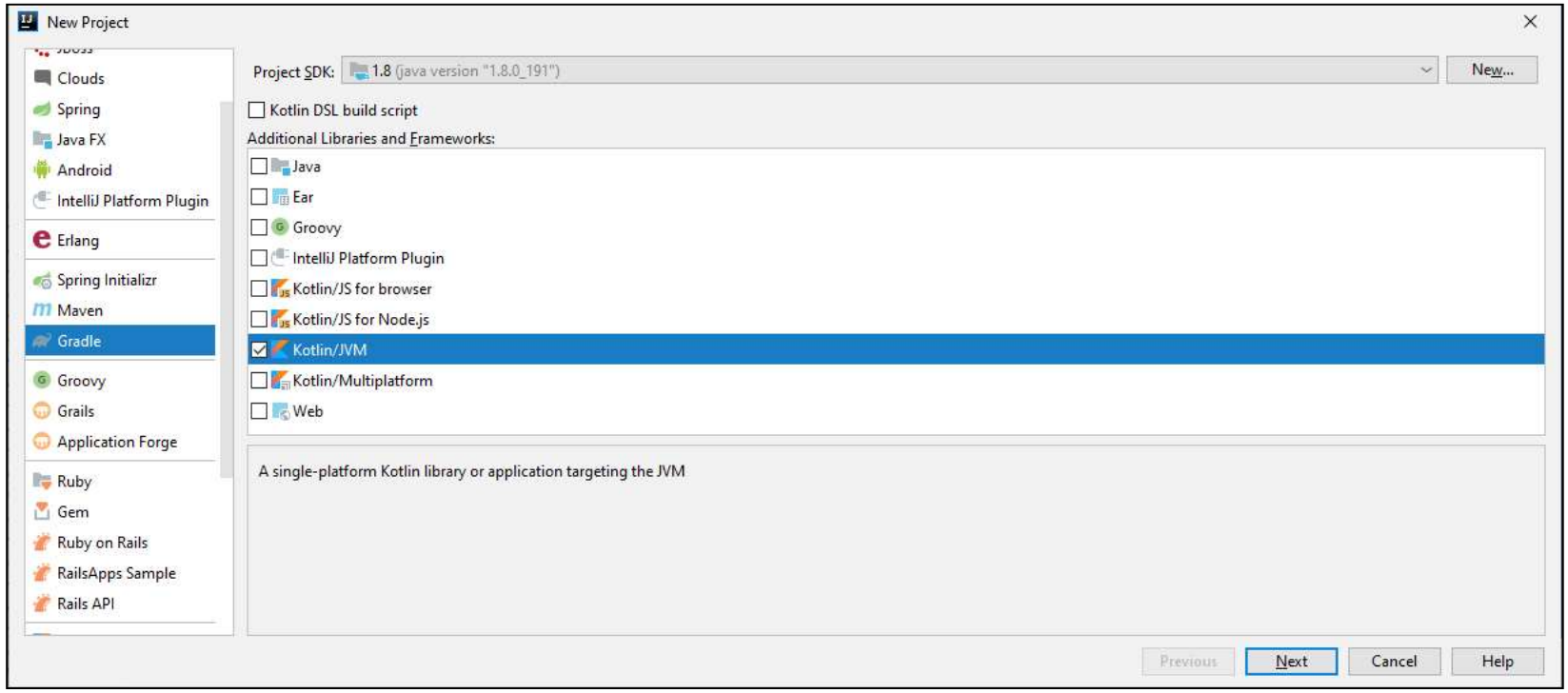
- `import kotlinx.coroutines.*`

tutorial:

- https://kotlinlang.org/docs/tutorials/coroutines/coroutines-basic-jvm.html

IntelliJ/Gradle/KotlinJVM1.8

V IntelliJ si vytvorte Gradle project/KotlinJVM

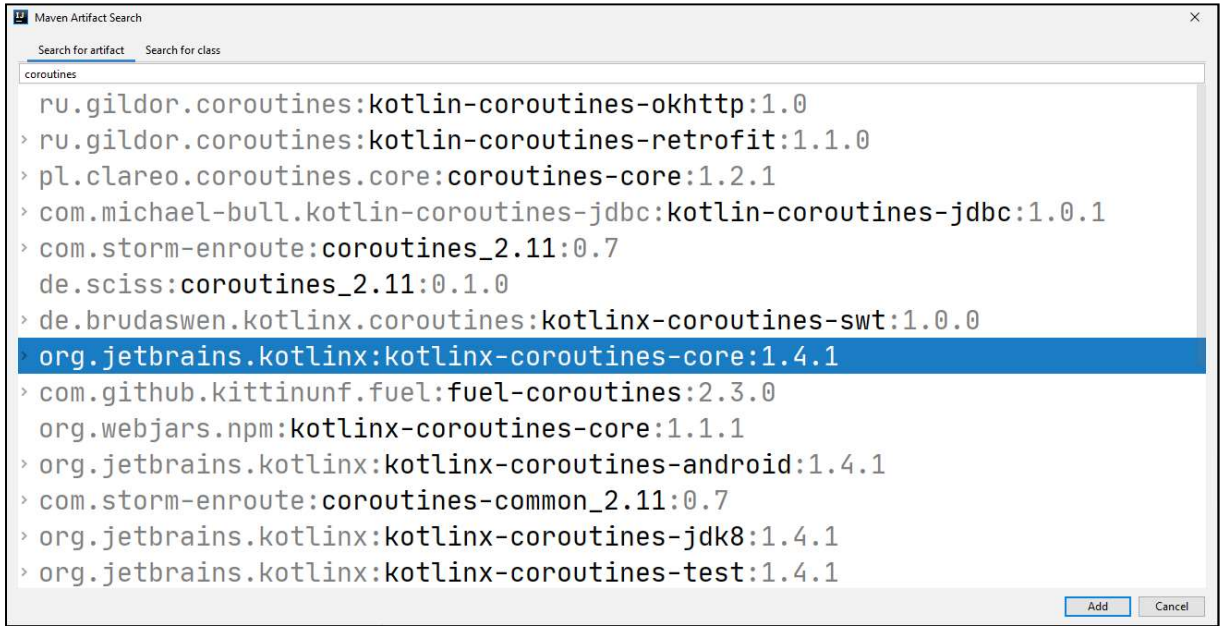


Pridanie Couroutine dependencies do build.gradle

- na súbore build.gradle, right click/Generate/Add Maven Artifact dependencies/Search for artifacts:”coroutines”, vyber
- org.jetbrains.kotlinx-coroutines-core:1.*.1

```
dependencies {
    implementation "org.jetbrains.kotlin:kotlin-stdlib-jdk8"
    compile 'org.jetbrains.kotlinx:kotlinx-coroutines-core:1.4.1'
}
```

nechajte syncovať Gradle, ~60sec.



Corutina

- je odľahčené vlákno
- non-preemptive multitasking
- 1958 zaviedli ich Donald Knuth a Melvin Conway
- vyskytujú sa v iných jazykoch, C#, javascript

`suspend` je modifikátor funkcie, ktorá sa vykonávaná v corutine, a môže byť pozdržaná

`await()` je čaká na hodnotu výpočtu bez blokovania corutiny.

Corutina

(Spustenie – blokujúce, neblokujúce)

.launch spustí novú corutinu podobne ako .start() Thread
.join počká na dokončenie spustenej korutiny, ako Thread

```
Log.d(TAG, "Start")
GlobalScope.launch {   // Start a coroutine, non-blocking
    delay(1000)        // wait 1s.
    Log.d(TAG, "Hello")
}
Thread.sleep(3000)     // wait for 3s.
Log.d(TAG, "Stop")
runBlocking {          // Start a coroutine, blocking
    delay(4000L)
}
Log.d(TAG, "Finish")
```

21:22:18.220 Start	
21:22:19.225 Hello	Start+1sec.
21:22:21.222 Stop	Start+3sec.
21:22:25.225 Finish	Start+7sec.

https://simply-how.com/kotlin-coroutines-by-example-guide

Coroutines1/Example1

Corutina

(suspend)

```
    Log.d(TAG, "Start")
    runBlocking {    // Start a coroutine, non-blocking
        printHello()
    }
    Log.d(TAG, "Finish")


suspend fun printHello() {
    delay(1000L)
    Log.d(TAG,"Hello")
}
```

```
21:27:34.083 Start
21:27:35.089 Hello     Start+1sec.
21:27:35.089 Finish    Start+1sec.
```

https://simply-how.com/kotlin-coroutines-by-example-guide

Coroutines1/Example2

GlobalScope/launch/delay

```
import kotlinx.coroutines.GlobalScope
import kotlinx.coroutines.delay
import kotlinx.coroutines.launch

fun main() {
    GlobalScope.launch {   // spusti na pozadí
        "world!".forEach {
            delay(200)
            print(it)
        }
    }
    print("Hello, ")
    Thread.sleep(2000)
}
```

```
12:46:15.811 Start
12:46:15.878 Hello,
12:46:16.106 w
12:46:16.318 o
12:46:16.519 r
12:46:16.721 l
12:46:16.924 d
12:46:17.130 !
12:46:17.882 Stop
```

Coroutines1/Example3

Corutina

(suspend)

```
Log.d(TAG,"The main program is started")
GlobalScope.launch {
    Log.d(TAG,"Background processing started")
    delay(1000L)
    Log.d(TAG,"Background processing finished")
}
Log.d(TAG,"The main program continues")
runBlocking {
    delay(2000L)
    Log.d(TAG,"The main program is finished")
}
```

```
12:54:03.422 Start main
12:54:03.491 Continue main
12:54:03.495 Start background
12:54:04.501 Finish background
12:54:05.513 Stop main
```

https://simply-how.com/kotlin-coroutines-by-example-guide

Coroutines1/Example4

Corutina

(async/await)

```
12:59:07.099 Start main
12:59:07.175 Awaiting computations...
12:59:08.192 Computation1 finished
12:59:09.188 Computation2 finished
12:59:09.188 The result is 3
12:59:09.189 Stop main
```

.async spustí novú corutinu ktorá počíta nejaký výsledok

.await čaká na tento výsledok

```
 runBlocking {
        val result1 = async { computation1() }
        val result2 = async { computation2() }
        Log.d(TAG, "Awaiting computations...")
        val result = result1.await() + result2.await()
        Log.d(TAG, "The result is $result")
} }
suspend fun computation1(): Int {
    delay(1000L) // simulated computation
    Log.d(TAG,"Computation1 finished")
    return 1 }
suspend fun computation2(): Int {
    delay(2000L)
    Log.d(TAG,"Computation2 finished")
    return 2 }
```

https://simply-how.com/kotlin-coroutines-by-example-guide

Coroutines1/Example5

Corutina

(cancel)

```
14:23:50.411 Start main
14:23:50.488 Processing 0 ...
14:23:51.499 Processing 1 ...
14:23:52.513 Processing 2 ...
14:23:53.520 Processing 3 ...
14:23:54.534 Processing 4 ...
14:23:55.546 Processing 5 ...
14:23:56.554 Processing 6 ...
14:23:57.568 Processing 7 ...
14:23:58.582 Processing 8 ...
14:23:59.597 Processing 9 ...
14:24:00.490 main: The user requests the cancellation
14:24:00.505 main: The batch is cancelled
```

```
runBlocking {
    val job = launch { // Emulate some batch processing
        repeat(30) { i ->
            Log.d(TAG, "Processing $i ...")
            delay(1000L)
        }
    }
    delay(10000L)
    Log.d(TAG, "main: The user requests the cancellation")
    job.cancelAndJoin()
       // cancel the job and wait for it's completion
    Log.d(TAG, "main: The batch is cancelled")
}
```

https://simply-how.com/kotlin-coroutines-by-example-guide

Coroutines1/Example6

Corutina

(withTimeout)

```
14:28:58.109 Start main
14:28:58.192 Processing 0 ...
14:28:59.205 Processing 1 ...
14:29:00.214 Processing 2 ...
14:29:01.227 Processing 3 ...
14:29:02.239 Processing 4 ...
14:29:03.249 Processing 5 ...
14:29:04.262 Processing 6 ...
14:29:05.267 Processing 7 ...
14:29:06.280 Processing 8 ...
14:29:07.293 Processing 9 ...
14:29:08.194 The processing return status is: null
```

```
runBlocking {
    val status = withTimeoutOrNull(10000L) {
        repeat(30) { i ->
            Log.d(TAG, "Processing $i ...")
            delay(1000L)
        }
        "Finished"
    }
    Log.d(TAG, "The processing return status is: $status")
}
```

https://simply-how.com/kotlin-coroutines-by-example-guide

Coroutines1/Example7

Kotlin Coroutines

praktické použitie

- Courotines:
- MVVM
  - download image
  - processing image, image filter, ...
- Retrofit
  - download json
  - upload json
- Room database
- Background expensive processing
- Coroutine flows + UI

Image download

from url

- download image from URL (retrofit + MVVM)
- process image

```
val coroutineScope = CoroutineScope(Dispatchers.Main)
coroutineScope.launch {
    val originalImage = coroutineScope.async(Dispatchers.IO) {
      URL(IMAGE_URL).openStream().use { // download image from URL
        BitmapFactory.decodeStream(it)
      }
    }
    val originalBitmap = originalImage.await() // wait for download
    val filteredImage = coroutineScope.async(Dispatchers.Default) {
       toBlackAndWhite(originalBitmap)
    }
    val filteredBitmap = filteredImage.await()
    progressBar.visibility = View.GONE
    imageView.setImageBitmap(filteredBitmap)
    imageView.visibility = View.VISIBLE
}
```

CoroutineImage

Process Image

- image processing

```
fun toBlackAndWhite(source: Bitmap): Bitmap {
  val w = source.width
  val h = source.height
  val bitmapArray = IntArray(w*h)
  source.getPixels(bitmapArray,0,w,0,0,w,h) // array from source
  (0 until h).forEach { y->
    (0 until w).forEach { x->
      val index = x+y*w  // index in 2D-matrix
      val R = Color.red(bitmapArray[index])
      val G = Color.green(bitmapArray[index])
      val B = Color.blue(bitmapArray[index])
      val grey = (R + G + B)/3
      bitmapArray[index] = Color.rgb(grey, grey, grey)
  }  }
  val bitmapOut = Bitmap.createBitmap(w,h,Bitmap.Config.RGB_565)
  bitmapOut.setPixels(bitmapArray, 0, w, 0, 0, w, h) // bitmap
  bitmapOut // return bitmap
}
```

CoroutineImage

Retrofit

- Retrofit je REST klient pre Android
- zjednodušuje download & upload JSON (GET/POST)
- používa napr. Gson converter
- build.gradle treba doplniť o

```
implementation 'com.squareup.retrofit2:retrofit:2.6.2'
implementation 'com.squareup.retrofit2:converter-gson:2.6.2'
```

- data class zodpovedajúci JSONu (mapovanie na json tagy):

```
data class Stat (
    @SerializedName("name")       /* -> */  val countryName: String?,
    @SerializedName("capital")    /* -> */  val capital: String?,
    @SerializedName("flagPNG")    /* -> */  val flag: String?,
    @SerializedName("latlng")     /* -> */  val latlng: Array<Float>?,
    @SerializedName("borders")    /* -> */  val borders: List<String>?,
    @SerializedName("alpha3Code") /* -> */  val code: String?
)
```

- REST API pre Retrofit

```
interface StatInterface {
    @GET("vlajky/staty.json")
    suspend fun get(): Response<List<Stat>>
}
```

CoroutineRetrofit

Coroutines+MVVM+Retrofit

(model)

https://dai.fmph.uniba.sk/courses/VMA/vlajky/staty.json

```
data class Stat(
    @SerializedName("name")        /* -> */  val countryName: String?,
    @SerializedName("capital")     /* -> */  val capital: String?,
    @SerializedName("flagPNG")     /* -> */  val flag: String?,
    @SerializedName("latlng")      /* -> */  val latlng: Array<Float>?,
    @SerializedName("borders")     /* -> */  val borders: List<String>?,
    @SerializedName("alpha3Code") /* -> */  val code: String?
)
```


```
/*
  {
    "alpha2Code": "SK",
    "alpha3Code": "SVK",
    "altSpellings": [
      "SK",
      "Slovak Republic",
      "Slovensk\u00e1 republika"
    ],
    "area": 49037,
    "borders": [
      "AUT",
      "CZE",
      "HUN",
      "POL",
      "UKR"
    ],
    "callingCodes": [
      "421"
    ],
    "capital": "Bratislava",
    "currencies": [
      {
        "code": "EUR",
        "name": "Euro",
        "symbol": "\u20ac"
      }
    ],
    "demonym": "Slovak",
        "flagPNG":
"https://raw.githubusercontent.com/DevTides/countries/master/svk.png",
```

```
    "gini": 26.0,
    "languages": [
      {
        "iso639_1": "sk",
        "iso639_2": "slk",
        "name": "Slovak",
        "nativeName": "sloven\u010dina"
      }
    ],
    "latlng": [
      48.66666666,
      19.5
    ],
    "name": "Slovakia",
    "nativeName": "Slovensko",
    "numericCode": "703",
    "population": 5426252,
    "region": "Europe",
    "regionalBlocs": [
      {
        "acronym": "EU",
        "name": "European Union"
      }
    ],
    "subregion": "Eastern Europe",
    "timezones": [
      "UTC+01:00"
    ],
```


CoroutineRetrofit

Coroutines+MVVM+Retrofit

(REST API - model)

```
interface StatInterface {
    @GET("vlajky/staty.json")
    suspend fun get(): Response<List<Stat>>
}

object StatService {
    private val BASE_URL = "https://dai.fmph.uniba.sk/courses/VMA/"

    fun get(): StatInterface =
        Retrofit.Builder()
                .baseUrl(BASE_URL)
                .addConverterFactory(GsonConverterFactory.create())
                .build()
                .create(StatInterface::class.java)
    }
}
```

https://dai.fmph.uniba.sk/courses/VMA/vlajky/staty.json

Coroutines+MVVM+Retrofit

(viewmodel)

```
class ListViewModel: ViewModel() {
    val service = StatService.get()
    lateinit var job: Job
    val staty = MutableLiveData<List<Stat>>()

    fun fetch() {
        job = CoroutineScope(Dispatchers.IO)
            .launch {
                val response = service.get()   // : Response<List<Stat>>
                withContext(Dispatchers.Main) {
                    if (response.isSuccessful)
                         staty.value = response.body()
                    else
                        Log.d("MODEL", "Error: ${response.message()}")
    }       }  }
    override fun onCleared() {
        super.onCleared()
        job.cancel()
}   }
```

CoroutineRetrofit

Coroutines+MVVM+Retrofit

(view)

```
class MainActivity : AppCompatActivity() {
    lateinit var viewModel: ListViewModel
    private val listAdapter = ListAdapter(arrayListOf())
    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        setContentView(R.layout.activity_main)
        viewModel = ViewModelProviders.of(this).get(ListViewModel::class.java)
        viewModel.fetch()
        listview.apply {
            layoutManager = LinearLayoutManager(context)
            adapter = listAdapter
        }
        observeViewModel()
    }
    fun observeViewModel() {
        viewModel.staty.observe(this, Observer { staty ->
            staty?.let {
                countriesList.visibility = View.VISIBLE
                listAdapter.updateCountries(it)
            }
        })
} }
```

CoroutineRetrofit

https://eu1.unwiredlabs.com/v2/process.php


```
{
   "token": "95b2941777892d",
   "mcc": 231,
   "mnc": 2,
   "cells": [{
      "lac": 1,
      "cid": 31441
   }],
   "address": 1
}
```



```
{
   "status": "ok",
   "balance": 97,
   "lat": 48.14875,
   "lon": 17.06679,
   "accuracy": 837,
   "address": "Botanická,
Švédske domky, Bratislava,
Karlova Ves, Bratislava,
Region of Bratislava, 841 04,
Slovakia"
}
```


GSM-Retrofit

V prednáške o polohe sme narazili na problém, že GSM súradnice prekladá do lat-long servis

- potrebujeme mu poslať a prečítať json-dáta, cez HTTP-POST
  - ak zavrhneme riešenie, že lepíme reťazce a vyhľadávame v nich podstringy
  - riešenie založené na json knižnici **`android.util.JsonReader/JsonWriter`**
  - riešenie založené na Gson knižnici (konvertuje json do objektu cez Java reflection model)
- nesmieme to robiť v hlavnom vlákne, lebo to môže trvať...
  - riešenie pomocou AsyncTask (old-school)
  - corutinovské riešenie (new-wave)

JSON to Kotlin Class

- build.gradle

GSMRetrofit

Výmena dát so serverom

Už sme videli výmenu dát klient-server

- cez parametre GET/POST requestu,
- cez obsah POST requestu,
- cez cookies

ešte uvidíme:

- cez JSON objekt
  - **`pomocou org.json.*`**
  - **`pomocou com.google.gson.*`**
- cez xml formát
  - **`pomocou org.xml.sax.*;`**
  - ~~pomocou DOM ste (asi) to robili na Prog – Java2~~
    `http://dai.fmph.uniba.sk/courses/java2/sl/xml.pdf`

LocationAPI.org

```
D/MyGSMLocation(19361): gsm cid: 396517
D/MyGSMLocation(19361): gsm lac: 1001
D/MyGSMLocation(19361): operator:23102
D/MyGSMLocation(19361): network: 23102
D/MyGSMLocation(19361): mcc: 231
D/MyGSMLocation(19361): mnc: 2
```

LocationAPI.org

API v2 Documentation

1. Usage
2. Test it out
3. Request body
4. Response body
5. Example Script - PHP
6. Example Script - Python

Usage

Requests are sent using POST to the following url:

```
http://locationapi.org/v2/process.php
```

- zaregistrujete sa napr. na 7-dňový trial, max. 50 requests/day
- dostanete kľúč (token), 95b2941777892d (keď toto čítate, asi už neplatí ☹
- skúste 95b2941777892d (7.dec 2017).

http://locationapi.org/site/page?view=apiv2

Request: 1 cell | 3 cells | 7 cells

```
{
    "token": "1445573628",
    "mcc": 231,
    "mnc": 2,
    "cells": [{
        "cid": 396517,
        "lac": 1001,
        "signal": -60,
        "tA": 13
    }]
}
```

Response:

```
{
    "status": "ok",
    "balance": 45,
    "lat": 48.16802,
    "lon": 17.11049,
    "accuracy": 1063,
    "message": "Accuracy is in BETA!"
}
```

Project:MyGSMLocation.zip

LocationAPI z aplikácie

- potrebujeme urobiť http-POST request na http://locationapi.org/v2/process.php
- keďže to niečo trvá, nesmieme to robiť v hlavnom vlákne – AsyncTask
- do tela dotazu (requestu) potrebujeme zakódovať (cellID, lac, mcc, mnc + môj token) hoc jednoduchý, ale predsa-len JSON objekt
- z tela odpovede (responsu) potrebujeme dekódovať hoc jednoduchý, ale JSON objekt, t.j. prečítať latitude-longitude

Request: 1 cell | 3 cells | 7 cells

```
1  {
2      "token": "1445573628",
3      "mcc": 231,
4      "mnc": 2,
5      "cells": [{
6          "cid": 396517,
7          "lac": 1001,
8          "signal": -60,
9          "tA": 13
10     }]
11 }
```

Response:

```
1  {
2      "status": "ok",
3      "balance": 45,
4      "lat": 48.16802,
5      "lon": 17.11049,
6      "accuracy": 1063,
7      "message": "Accuracy is in BETA!"
8  }
```

Project:MyGSMLocation.zip

Vytvorenie (malého) JSON objektu

(pre GET LocationAPI)

```
import android.util.JsonWriter
```

```
val sw = StringWriter()
val jw = JsonWriter(sw)
try {
   jw.beginObject()  -- {
     jw.name("token").value(token_locationAPIORG)
     jw.name("mcc").value(mcc)
     jw.name("mnc").value(mnc)
     jw.name("cells")
     jw.beginArray()   -- [
        .beginObject() -- {
                jw.name("cid").value(cid)
                jw.name("lac").value(lac)
                jw.name("signal").value(-60)
                jw.name("tA").value(13)
jw.endObject().endArray().endObject().close() -- } ] }
```

Request: 1 cell | 3 cells | 7 cells

```
1  {
2      "token": "1445573628",
3      "mcc": 231,
4      "mnc": 2,
5      "cells": [{
6          "cid": 396517,
7          "lac": 1001,
8          "signal": -60,
9          "tA": 13
10     }]
11 }
```

Project:MyGSMLocation.zip

Dekódovanie (malého) JSON

```
import android.util.JsonReader
```

```
val sr = StringReader(result)
val jr = JsonReader(sr)
jr.beginObject() -- {
   jr.nextName() -- skip: “status”
   jr.nextString()    -- skip: “ok”
   jr.nextName() -- skip: “balance”
   jr.nextInt()  -- skip: 45

   jr.nextName() -- skip: “lat”
   lat = jr.nextDouble()
   jr.nextName() -- skip: “lon”
   lng = jr.nextDouble()
   jr.nextName()  -- skip: “accuracy”
   accur = jr.nextInt()
```

Response:


```
1 {
2     "status": "ok",
3     "balance": 45,
4     "lat": 48.16802,
5     "lon": 17.11049,
6     "accuracy": 1063,
7     "message": "Accuracy is in BETA!"
8 }
```


Project:MyGSMLocation.zip

GSON
(fromJson)

```
{
 "id": "1547257485",
 "name": "Peter Borovansky",
 "first_name": "Peter",
 "last_name": "Borovansky",
 "link":"http://www.facebook.com/
          peter.borovansky",
 "username": "peter.borovansky",
 "gender": "male",
 "locale": "cs_CZ"
}
```

Idea: k JSON objektu definujeme zodpovedajúcu (1:1) java triedu

Obmedzenia (viac https://github.com/google/gson/blob/master/UserGuide.md):

- mená JSON tagov sa musia zhodovať s java menami polí v triede

```
class FBHeader {
   public String id = "";
   public String name = "";
   public String first_name = "";
   public String last_name = "";
   public String link = "";
   public String username = "";
   public String gender = "";
   public String locale = "";          }

Gson gson = new GsonBuilder().create();
FBHeader header = gson.fromJson(jsonstring, FBHeader.class);
```

```
import com.google.gson
```

FB Friends
(fromJson)

```
{ "data":
          [ { "name": "Zuzka B…", "id": "582749468" },
            { "name": "Lubica K…", "id": "583024903" },
            { "name": "Barbora F…", "id": "632007063" },
          ],
   "paging": { "next":"https://graph.facebook.com/15...}
```

```
class FBFriends {  // dvojica
   public FBPairs[] data = null;
   public FBPaging paging = null; }
class FBPairs {    // dvojica
   public String name = "";
   public String id = ""; }
class FBPaging {   // singleton
   public String next = ""; }
```

```
import com.google.gson
```

```
Gson gson = new GsonBuilder().create();
FBFriends friends = gson.fromJson(result, FBFriends.class);
if (friends != null) {
   if (friends.data != null)
        for (int i = 0; i < friends.data.length; i++)
           if (friends.data[i] != null)
                tv.append(friends.data[i].name + ",");
}
```

GSON – ako to funguje ?

Reflexivita

Ukázali sme

- `fromJson (do Javy)`

ale analogicky funguje

- `toJson (z Javy)`

`org.json`

`vs.`

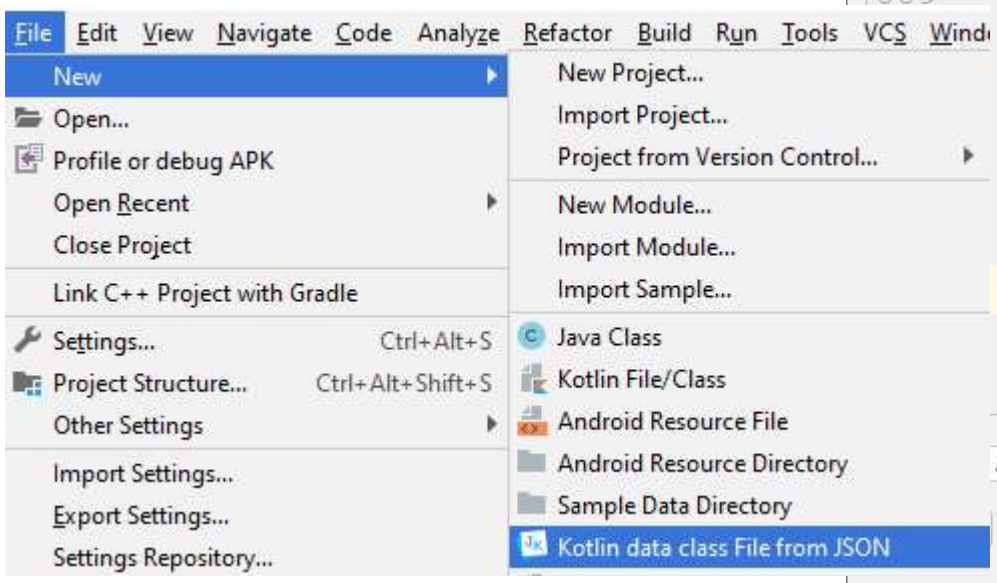
`com.google.gson`

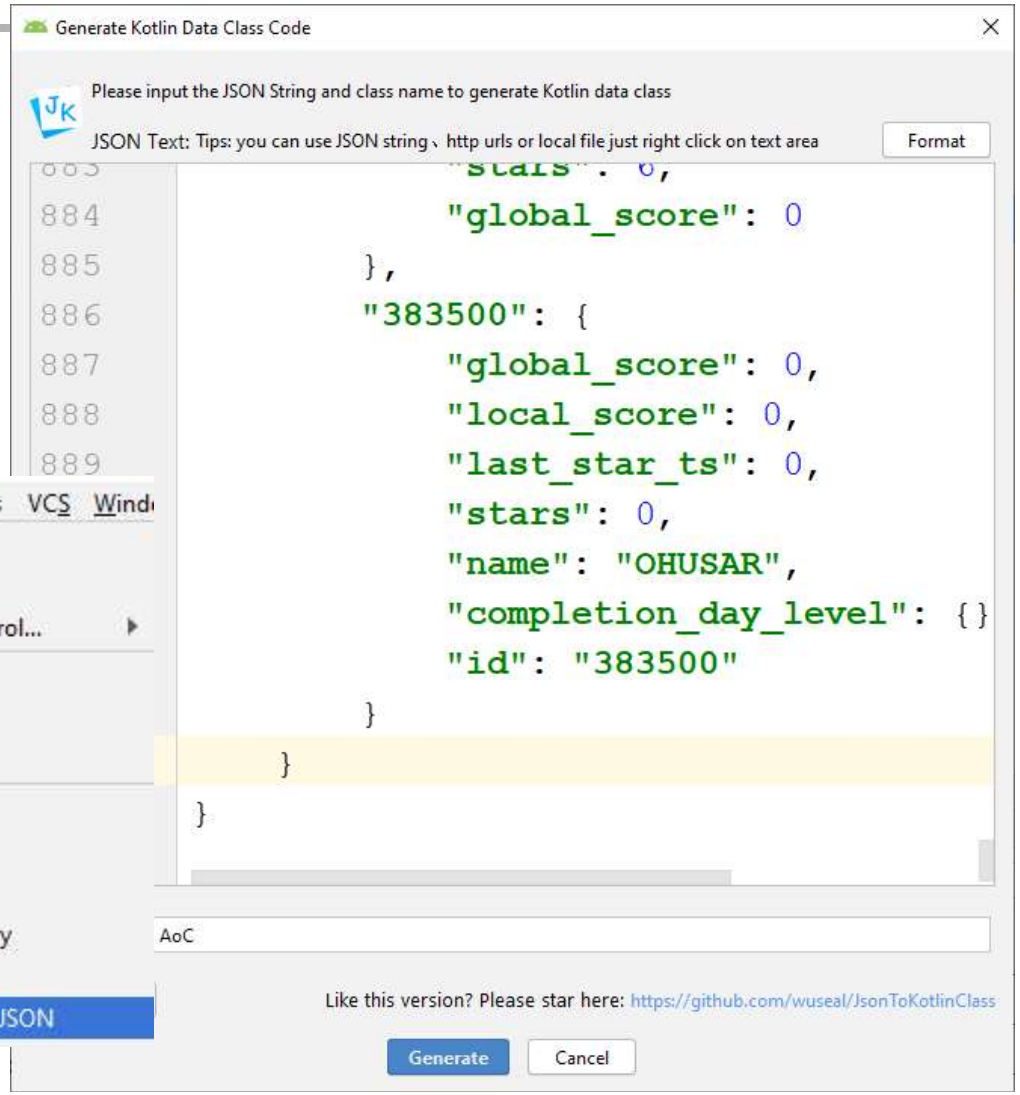
Zdroj: http://www.huffingtonpost.com/2012/06/17/mc-escher-birthday_n_1591432.html

Plugin JSON to Kotlin Class

- z daného JSON vytvorí definíciu Kotlin tried

- potom stačí zavolať fromJson prekonvertuje vám json-string do dátovej štruktúry





https://eu1.unwiredlabs.com/v2/process.php

GSM-Retrofit

```
{
   "token": "95b2941777892d",
   "mcc": 231,
   "mnc": 2,
   "cells": [{
      "lac": 1,
      "cid": 31441
   }],
   "address": 1
}
```

GSMRequest

```
{
   "status": "ok",
   "balance": 97,
   "lat": 48.14875,
   "lon": 17.06679,
   "accuracy": 837,
   "address": "Botanická,
Švédske domky, Bratislava,
Karlova Ves, Bratislava,
Region of Bratislava, 841 04,
Slovakia"
}
```

GSMResponse

- JSON to Kotlin Class
- build.gradle

```
implementation 'com.google.code.gson:gson:2.8.5’
implementation 'com.squareup.retrofit2:retrofit:2.6.2'
implementation 'com.squareup.retrofit2:converter-gson:2.6.2’
```

- toto si dáme vygenerovať pluginom JSON to Kotlin Class

ak interné mená zodpovedajú JSON tagom, tak neriešime `@SerializedName`

```
data class Cell(
    val cid: Int,
    val lac: Int
)
```

```
data class GSMRequest(
    val address: Int,
    val cells:   List<Cell>,
    val mcc:     Int,
    val mnc:     Int,
    val token:   String
)
```

```
data class GSMResponse(
    val accuracy: Int,
    val address:  String,
    val balance:  Int,
    val lat:      Double,
    val lon:      Double,
    val status:   String
)
```

GSMRetrofit

Rest API

```
interface RestApiInterface {
    @Headers("Content-Type: application/json")
    @POST("process.php")
    fun gsm2latlong(@Body gsmRequest: GSMRequest): Call<GSMResponse>
}
```

```
class RestApiService {
  fun gsm2latlong(gsmRequest: GSMRequest, onResult: (GSMResponse?) -> Unit){
    val retrofit = ServiceBuilder.get()
    retrofit.gsm2latlong(gsmRequest).enqueue(
      object : Callback<GSMResponse> {
        override fun onFailure(call: Call<GSMResponse>, t: Throwable) {
          onResult(null)                                          null
        }
        override fun onResponse(call: Call<GSMResponse>,
                                response: Response<GSMResponse>) {
          val resp = response.body()
          onResult(resp)                                          !=null
 }   } ) } }
```

GSMRetrofit

Service Builder

```
object ServiceBuilder {
    private val client = OkHttpClient.Builder().build()

    fun get(): RestApiInterface =
        Retrofit.Builder()
        .baseUrl("https://eu1.unwiredlabs.com/v2/")
        .addConverterFactory(GsonConverterFactory.create())
        .client(client)
        .build()
        .create(RestApiInterface::class.java)
}
```

Volanie - bez corutiny

```
val request = GSMRequest(
    token = "95b2941777892d",
    mcc = mcc,
    mnc = mnc,
    cells = listOf(Cell(lac = lac, cid = cid)),
    address = 1
)

    val apiService = RestApiService()
    val response = apiService.gsm2latlong(request) {
      response ->                    // toto je onResult
        if (response != null) {
            Log.d(TAG, "${response.lat}, ${response.lon}")
            latTV.text = response.lat.toString()
            longTV.text = response.lon.toString()
        } else
            Log.d(TAG, "response is null")
      }
```

GSMRetrofit

Volanie – s corutinou

```
val request = GSMRequest(
    token = "95b2941777892d",
    mcc = mcc,
    mnc = mnc,
    cells = listOf(Cell(lac = lac, cid = cid)),
    address = 1
)
CoroutineScope(Dispatchers.IO).launch {
    val apiService = RestApiService()
    val response = apiService.gsm2latlong(request) {
      response ->                // toto je onResult
        if (response != null) {
            Log.d(TAG, "${response.lat}, ${response.lon}")
            latTV.text = response.lat.toString()
            longTV.text = response.lon.toString()
        } else
            Log.d(TAG, "response is null")
      }
}
```

GSMRetrofit