Android lecture 5

Threading, Coroutines

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Background processing

“Some people, when confronted with a problem, think, “I know, I’ll use threads,” and then two they hav erpoblesms.”

https://nedbatchelder.com/blog/201204/two_problems.html

Background processing

- Threads
- Handler
- ~~AsyncTask~~ - Deprecation in Android 11 (API-30)
- ~~Loader~~ deprecated Android 9 (API-28)
- Kotlin coroutines
- RxJava

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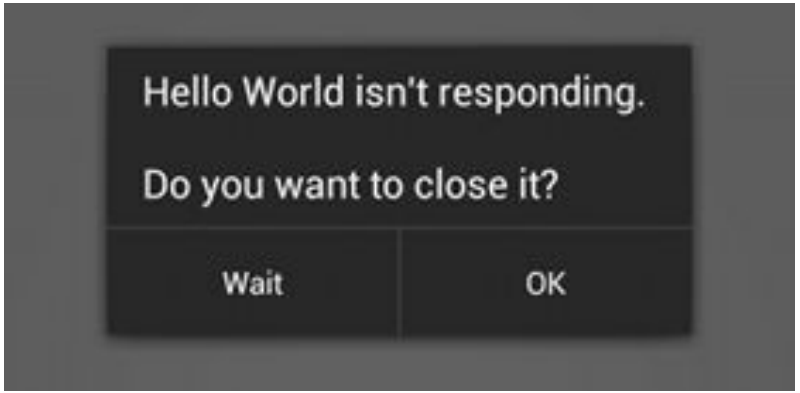
Motivation



Keep your application responsive

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Background processing

- Avoid long running operations on Main/UI thread
  - Files, database, network
- Most component runs on Main thread by default
- 5 second to ANR (10s BroadcastReceiver)

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Background processing

- Main thread = UI thread
- Never block UI thread

Background processing - issues

- Activities can be restarted
- Memory leaks
- Crashes

Thread

- java.lang.Thread

```
Thread() {
    override fun run() {
        // Long running operation
            . . .
    }
}.start()
```

- Standard java thread
- Simple way how to offload work to the background
- UI can’t be updated from background

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Handler

- android.os.Handler
- Sends and processes messages
- Instance is bound to thread/message queue of the thread creating it
  - Scheduling messages and Runnables to be executed at some point in future
  - Enqueue an action to be performed on different thread

Handler

Receiving message on UI thread

- Overriding `handleMessage(Message)`

```
val handler = object : Handler() {
    override fun handleMessage(msg: Message?) {
        txt_username_value.text =
                msg.data.getString("data_key")
    }
}
```

Send message from background

- Obtain message is more effective than create new instance
- Requires reference to handler

```
val message = handler.obtainMessage()
message.arg1 = 1001
handler.sendMessage(message)
```

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Looper and Handler

- Looper
  - Class that runs a message loop for a thread
  - UI thread has its own Looper
    - Looper.getMainLooper()
- Handler
  - Provides interaction with the message loop

HandlerThread

- Holds a queue of task
- Other task can push task to it
- The thread processes its queue, one task after another
- When queue is empty, it blocks until something appears

Async task - DEPRECATED

- android.os.AsyncTask
- Simplify running code on background
- `AsyncTask<Params, Progress, Result>`
  - Params - The type of the parameters sent to the task upon execution
  - Progress - type of progress unit published during background operation
  - Result - type of result of background operation

AsyncTask - methods

- `onPreExecute()`
  - UI thread, before executing, show progress bar
- `doInBackground(Params...)`
  - Background thread
  - `publishProgress(Progress...)`
  - Returns Result
- `onProgressUpdate(Progress...)`
  - UI thread
  - For updating progress, params are values passed in `publishProgress`
  - `onPostExecute(Result)`
  - UI thread
  - Returned value from `doInBackground` is passed as parameter

AsyncTask - canceling

- `cancel(boolean)` - Cancel execution of task
- `isCancelled()` - call often in `doInBackground` to stop background processing as quick as possible
- `onCancelled(Result)` - called instead of `onPostExecute()` in case task was cancelled

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Memory leaks

- Activity runs AsyncTask which takes long time, meanwhile configuration change happens
- Anonymous and non-static inner class still keeps reference to Activity => Activity can’t be garbage collected => activity leaks

Memory leaks - Solutions

- Disable configuration changes in manifest
  - Don’t do this, it just hides another bugs
- ~~Retain activity instance~~
  - ~~Using `onRetainNonConfigurationInstance()` and `getLastNonConfigurationInstance()` deprecated~~
- WeakReference to activity/fragment or views
- Task as static inner class
- TaskFragment
  - Fragment without UI and called `setRetainInstance(true)`
- ~~AsyncTaskLoader~~
- ViewModel + LiveData

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Kotlin coroutines intro

Kotlin coroutines

- Lightway thread
- Uses suspending functions

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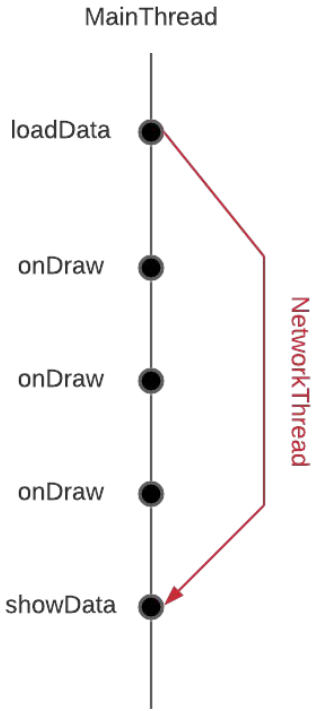
Suspend function

- Function which is able to suspend it’s execution without blocking thread

```
suspend fun loadData() { delay(10_000) }
```

- Suspend lambda
- suspend/resume
  - Internally pass Continuation object as callback
  - Uses finite state machine under the hood
- Can be called only from other suspend function or in coroutine created by coroutine builder



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Suspend functions

- `suspend` does not mean to run function on background

Suspend function

Suspend functions should be main-safe

CorotutineDispatcher

- All coroutines run in dispatcher
- Coroutine can **suspend** themselves
- Knows how to **resume** suspended coroutines

CoroutineDispatcher

Dispatchers.Main	**Dispatchers.IO**	**Dispatchers.Default**
Main thread, interact with UI, light work	Disk and network IO off the main thread	CPU intensive work
• Call suspend functions • Call UI functions • Updating LiveData	• Database • R/W files • Networking	• Sorting list • Parsing JSON • DiffUtils

https://medium.com/androiddevelopers/coroutines-on-android-part-i-getting-the-background-3e0e54d20bb

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CoroutineDispatcher

```
override suspend fun getUser(username: String): User? = withContext(Dispatchers.IO) {
    return@withContext GithubServiceFactory.githubService.getUser(username).body()
}
```

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Coroutine scope

- Keep track of all coroutines running inside
- Not possible to start coroutine outside of some scope
- If scope cancels, coroutines cancels
- GlobalScope - lifetime of whole application
- `ViewModel.viewModelScope` - extension property
  - Cancel coroutines started by current view model when it is cleared

```
class UserViewModel: ViewModel() {

   fun fetchData(username: String) {
      viewModelScope.launch {
         state.value = LoadInProgress
         fetchDataSuspend(username)
      }
   }
}
```

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Coroutine scope

Avoid leaking coroutines

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Coroutine scope builders

- Creates new coroutine scope inside current one
- Cancellation is propagated from parent to children's
- For parallel work decomposition
- `coroutineScope` vs. `supervisorScope`
  - coroutineScope - cancels if any of its children fail
  - supervisorScope - still run if some children fail
  - Suspends until coroutines complete

Coroutines - starting

- launch
  - Fire and forget - do not return result to caller
  - Usually bridge from regular function into coroutines
  - Return Job for cancellation
  - Do not block current thread
- async/await
  - Start computation asynchronously
  - Creates coroutine and return it’s future result (Deferred)
  - Await - wait until coroutine finishes and return result to the caller
  - Thrown exceptions are not signaled until await is called
- runBlocking
  - Blocks until coroutine finishes
  - Handy for initial refactoring

Demo time

- Implement github network repository

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Libraries, gradle plugins, etc...

Android jetpack

- Set of libraries from google
- https://developer.android.com/jetpack
- Groups
  - Foundation
    - AppCompat, Android KTX, Multidex, Test
  - Architecture
    - Data binding, Lifecycles, LiveData, Navigation, Paging, Room, ViewModel, WorkManager
  - Behavior
    - Download manager, Media & playback, Notifications, Permissions, Preferences, Sharing, Slices
  - UI
    - Animations & transitions, Auto, Emoji, Fragment, Layout, Palette, TV, Wear OS

DexCount plugin

- Computes methods count in APK
- Visualize count in nice chart
- https://github.com/KeepSafe/dexcount-gradle-plugin

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Retrofit

- A type-safe HTTP client for Android and Java
- Simplify communication with some API service
- Configurable
  - OkHTTP 3 client - compression, timeouts
  - Supports multiple convertors
    - Gson
    - Jackson
    - Moshi
    - Protobuf
    - Wire
- https://square.github.io/retrofit/

OkHttp

- An HTTP & HTTP/2 client for Android and Java applications
- Supports sync/async calls
- Supports multiple addresses per URL (Load balancing, failover)
- http://square.github.io/okhttp/

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Dagger

- Dependency injection framework
- Decouple code
- Better testing
- https://dagger.dev/android.html

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Hilt

- Dependency injection for Android
- Based on Dagger
- https://developer.android.com/training/dependency-injection/hilt-android

Flipper

- Debug platform by Facebook
- Inspect
  - ViewHiearchy
  - Database
  - Shared preferences
  - Network traffic
- https://fbflipper.com/

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LeakCannary

- Helps with finding memory leaks
- https://github.com/square/leakcanary

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Ktor

- Multiplatform http client/server
- https://ktor.io

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Kotlinx.serialization

- Data serialization/deseralization
  - Json
  - Protocol buffers
- https://kotlinlang.org/docs/serialization.html

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Thank you
Q&A

Feedback is appreciated

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