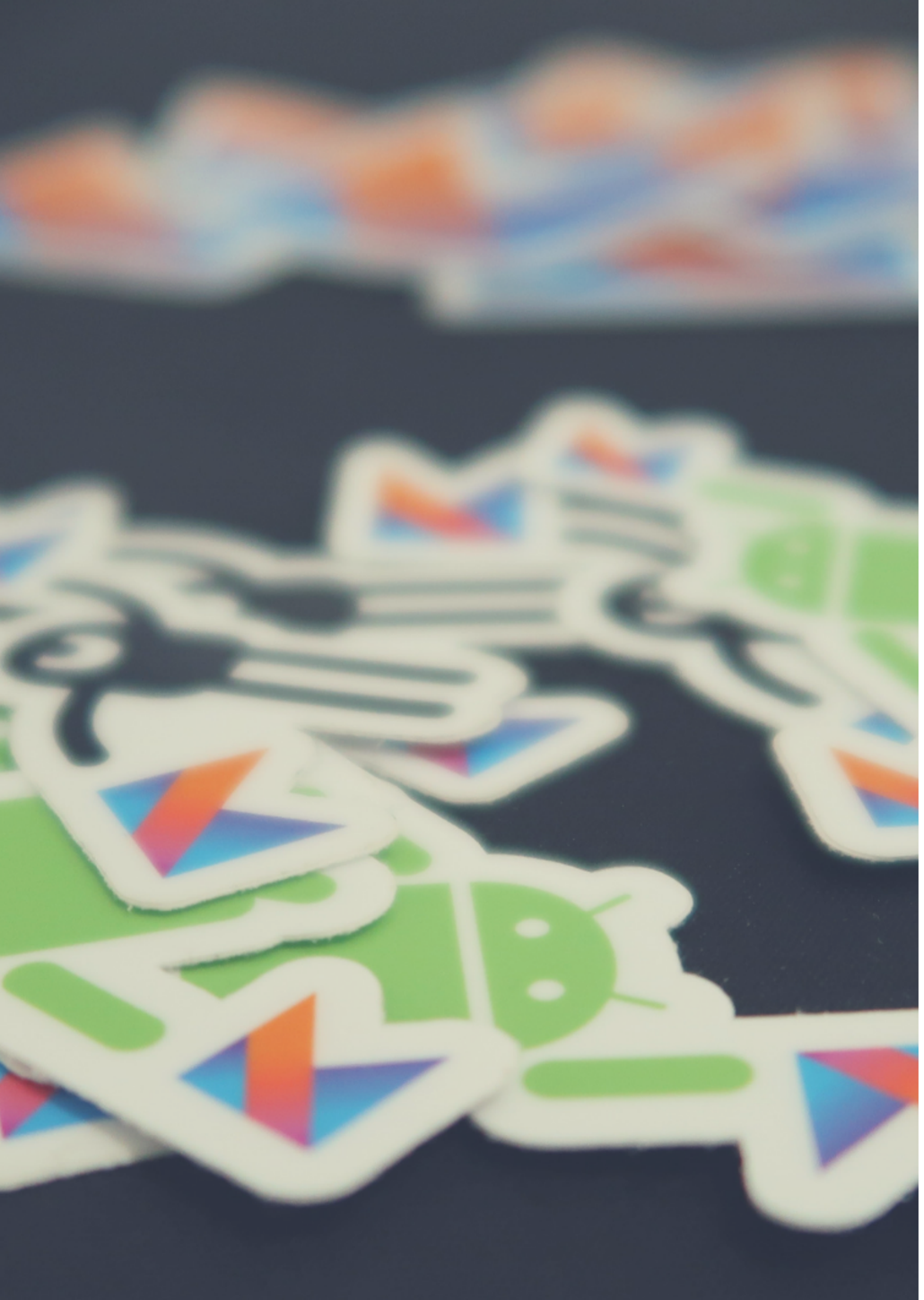
Android with Kotlin Bootcamp

Day 4 - Performing Background Work

Nate Ebel

Android Developer & Instructor

@n8ebel goobar.dev



Any questions from yesterday?

What are we learning today?

Saving local data using Room

MVVM Architecture with Android Jetpack

Async programming constructs

Kotlin Coroutines

Let’s check in on our “want to learns”

Any Questions?

Using Room for Local Database

Nate Ebel

Android Developer & Instructor

@n8ebel goobar.dev

Overview

Understand what Room is

Understand how to define a Room entity

Understand how to save data

Understand how to query data

Understand how to delete data

Why use Room?

Why Room?

Abstraction over SQLite

Full power of SQLite

Generate tables and interaction code via annotations

Key Room Components

Database

Entities

DAO

```
@Entity
data class User(
    @PrimaryKey val uid: Int,
    @ColumnInfo(name = "first_name") val firstName: String?,
    @ColumnInfo(name = "last_name") val lastName: String?
)
```

Define an Entity Table

Adding the @Entity annotation will generate a table corresponding to the annotated class

```
@Dao
interface UserDao {
    @Query("SELECT * FROM user")
    fun getAll(): List<User>

    @Query("SELECT * FROM user WHERE uid IN (:userIds)")
    fun loadAllByIds(userIds: IntArray): List<User>

    @Query("SELECT * FROM user WHERE first_name LIKE :first AND " +
           "last_name LIKE :last LIMIT 1")
    fun findByName(first: String, last: String): User

    @Insert
    fun insertAll(vararg users: User)

    @Delete
    fun delete(user: User)
}
```

Define a Data Access Object (DAO)

Annotate an interface with @Dao to convert interface methods into database interactions

```
@Database(entities = arrayOf(User::class), version = 1)
abstract class AppDatabase : RoomDatabase() {
    abstract fun userDao(): UserDao
}
```

Generate a Database

Annotate an abstract class with @Database - specifying supported @Entity types and any required @Dao interfaces

Room Interactions

Synchronous queries must be done off the main thread

Supports RxJava

Supports LiveData

Supports Kotlin coroutines

MVVM with Android Architecture Components

Nate Ebel

Android Developer & Instructor

@n8ebel goobar.dev

Overview

Understand the need for app architecture

Understand common architectural patterns

Understand Android Architecture Components

Understand Android ViewModel

Understand LiveData

Why is application architecture important?

Common Architectural Patterns

MVC

MVP

MVVM

MVI

Common Architectural Patterns

Model-View-Controller

Model-View-Presenter

Model-View-ViewModel

Model-View-Intent

Model-View-Controller

Controller accepts user interaction, which updates the model, which updates the view that the user sees

https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93presenter

Model-View-Presenter

Active presenter coordinates all interactions between the model/data layer and the view layer

https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93presenter

Model-View-ViewModel

ViewModel and Model interact while data from the ViewModel is bound to the View

https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93presenter

Model-View-ViewModel

ViewModel and Model interact while data from the ViewModel is bound to the View

https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93viewmodel

Model-View-Intent

An implementation of unidirectional data flow in which immutable models represent the current state of the UI, while intents representing desired actions are generated through View interactions and reduced/ processed by some controller which converts those intents back into new model states.

https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93viewmodel

MVVM on Android

Model

View

ViewModel

MVVM on Android

Repository/DB

Activity/Fragment

ViewModel

Android Architecture Components

ViewModel

LiveData

Android Architecture Components ViewModel

Designed to store and manage UI-related data in a lifecycle conscious way. The ViewModel class allows data to survive configuration changes such as screen rotations.

https://developer.android.com/topic/libraries/architecture/viewmodel

Android Architecture Components LiveData

Observable data holder class. Unlike a regular observable, LiveData is lifecycle-aware, meaning it respects the lifecycle of other app components, such as activities, fragments, or services.

https://developer.android.com/topic/libraries/architecture/livedata


Lunch

Writing Multithreaded Applications

Nate Ebel

Android Developer & Instructor

@n8ebel goobar.dev

Overview

Understand the Android threading model

Understand both short, and long-running tasks

Understand Threads, Executors, and AsyncTask

Explore RxJava and Coroutines

Understand Services and WorkManager

Main Thread

The default thread created for an application. It's the thread on which all UI updates/interactions happen and on which components are instantiated.

https://developer.android.com/guide/components/processes-and-threads

Blocking the Main Thread

Degraded performance

UI Jank

Activity Not Responding dialog

Crashes

Kinds of Work

Short-running

Load data from a local database

Processing a collection of local model objects

Making a network request for a small JSON response

Long-running

Downloading a large file

Uploading a large file

Building a machine learning model

Async Programming Constructs

Threads

Executors

AsyncTask

RxJava

Coroutines

Thread

- A thread of execution for a program
- May have multiple Threads running at once
- Extend a Thread directly
- Pass a Runnable to a thread
- Threads require memory and cpu resources

Handler

Allows submission of Runnables that will run on the Thread in which the Handler was created.

Citation: Author/Source, Title, Link/Short Url

ThreadPoolExecutor

ThreadPools restrict the number of Threads

Executor allows Runnable submission

ThreadPoolExecutor provides submission of Runnables which are then run across the pool of available threads

Efficient

Inconvenient to work with

AsyncTask

Originally very widely used in Android

An abstraction over Thread and Handler

Had a number of problems

Deprecated and no longer recommended

Coroutines

Kotlin’s default async primitives

Conceptually similar to “lightweight thread”

Asynchronously run code without blocking

Support structured concurrency

Long Running and Repeated Work

Service

WorkManager

Service

Core Android component for performing long-running tasks.

https://developer.android.com/guide/components/services

Service Types

Foreground

Background

Bound

Foreground Service

Performs work that is noticeable to the user, and will keep your Application active even if your UI is in the background.

https://developer.android.com/guide/components/services

Background Service

Performs work that is not noticeable to the user. Restrictions apply.

https://developer.android.com/guide/components/services

Bound Service

Support client/server interaction and interprocess communication with Application components.

https://developer.android.com/guide/components/services

When to use a Service?

WorkManager

Schedules reliable, configurable, asynchronous tasks that work consistently across Android API versions.

https://developer.android.com/topic/libraries/architecture/workmanager

WorkManager

Abstraction over multiple components such as JobScheduler and AlarmManager

WorkConstraints

Scheduling

Retry

Chaining

When to use WorkManager?

Kotlin Coroutines

Nate Ebel

Android Developer & Instructor

@n8ebel goobar.dev

Overview

- Understand what a coroutine is
- Understand structured concurrency
- Understand how to work with suspending functions
- Explore error handling
- Explore StateFlow and SharedFlow

Coroutine

A suspendible computation - conceptually similar to a thread, but not bound to a single thread and supporting the concept of *structured concurrency*.

https://kotlinlang.org/docs/coroutines-basics.html#structured-concurrency

Structured Concurrency

Ensures that computations are not lost, and do not leak. Enforces a scoped hierarchy to coroutines that are created.

https://kotlinlang.org/docs/coroutines-basics.html#structured-concurrency

Coroutine Scope

Controls the lifecycle of a coroutine. Avoids leaks, and supports cancellation. Enables scoping of asynchronous executions to the scope/lifecycles of other objects.

Coroutine Builders

runBlocking{}

withContext{}

launch{}

async{}

Error Handling

Cancelled coroutines throw CancellationException

Errors propagate to siblings and to parent context

try/catch

CoroutinesExceptionHandler

Flow

Represents a *cold* stream of asynchronously computed values

https://kotlinlang.org/docs/flow.html#flows

Types of Flow

StateFlow

SharedFlow

StateFlow

State-holder observable flow that emits the current and new state updates to its collectors. In Android, StateFlow is a great choice to maintain an observable UI state from a ViewModel.

https://developer.android.com/kotlin/flow/stateflow-and-sharedflow

SharedFlow

A hot flow that emits values to all consumers that collect from it. A great choice for emitting events to many possible consumers.

https://developer.android.com/kotlin/flow/stateflow-and-sharedflow

💡 Office Hours