Data Storage: SQLite, Room, ViewModel, LiveData and Observer

Sensor Based Mobile Applications

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Outline

Room SQLite Database

LiveData, ViewModel, Observer

Lab

For more info:

https://developer.android.com/training/data-storage/room/

https://www.sqlite.org/

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

https://developer.android.com/jetpack/guide

https://developer.android.com/jetpack/compose/lists

Room SQLite Database

- Support for creating and using local SQLite databases on the device
  - A database is private to its application
  - Databases are stored on the device (or emulator) in `/data/data/<package>/databases`
- Room provides an abstraction layer over SQLite and consit of 3 major components
  - `@Database` extends `RoomDatabase`, provide access to the database
  - `@Dao` contains the methods used for accessing the database (CRUD operations)
  - `@Entity` represents a table (and relations) within the database

Dependencies

- in project build gradle, add `google()` in the list of repositories (should already be there by default)
- in module app build gradle, add in dependencies:

```
apply plugin: "kotlin-kapt"
dependencies {
  def roomVersion = "2.4.3"
  implementation "androidx.room:room-runtime:$roomVersion"
  annotationProcessor
      "androidx.room:room-compiler:$roomVersion"

  // To use Kotlin annotation processing tool (kapt)
  kapt "androidx.room:room-compiler:$roomVersion"
  // Kotlin Extensions and Coroutines support for Room
  implementation "androidx.room:room-ktx:$roomVersion"
  //...
}
```

@Entity

- data class with @Entity annotation

```
@Entity
data class User(
    @PrimaryKey(autoGenerate = true)
    val uid: Long,
    val firstname: String,
    val lastname: String) {
  //constructor, getter and setter are implicit :)
  override fun toString() = "$firstname $lastname
      ($uid)"
}
```

@Entity with relation

```kotlin
@Entity(foreignKeys = [ForeignKey(
        entity = User::class,
        onDelete = CASCADE,
        parentColumns = ["uid"],
        childColumns = ["user"])])
data class ContactInfo(
    val user: Long,
    val type: String, //e.g. phone, email, fb, twitter,...
    @PrimaryKey
    val value: String)
```

```kotlin
class UserContact {
    @Embedded
    var user: User? = null
    @Relation(parentColumn = "uid", entityColumn = "user")
    var contacts: List<ContactInfo>? = null
}
```

@Dao

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

  @Query("SELECT * FROM user WHERE user.uid = :userid")
  // the @Relation do the INNER JOIN for you ;)
  fun getUserWithContacts(userid: Long): LiveData<UserContact>

  @Insert(onConflict = OnConflictStrategy.REPLACE)
  suspend fun insert(user: User): Long

  @Update
  suspend fun update(user: User)

  @Delete
  suspend fun delete(user: User)
}

@Dao
interface ContactInfoDao { /* ... */ }
```

@Database

```kotlin
@Database(entities = [(User::class), (ContactInfo::class)],
    version = 1)
abstract class UserDB: RoomDatabase() {
  abstract fun userDao(): UserDao
  abstract fun contactDao(): ContactInfoDao

  companion object{
    private var sInstance: UserDB? = null
    @Synchronized
    fun get(context: Context): UserDB {
      if (sInstance == null) {
        sInstance =
            Room.databaseBuilder(context.applicationContext,
            UserDB::class.java, "users.db").build()
      }
      return sInstance!!
    }
  }
}
```

LiveData and ViewModel

- `LiveData` is an observable data holder class
- LiveData is lifecycle-aware, it will only updates app component observers that are in an active lifecycle state
- ViewModel is a class that is responsible for preparing and managing the data for a Composable function or an Activity or a Fragment.

LiveData and ViewModel

- in app build config, add dependencies:

```
def lifecycle_version = "2.5.1"
// ViewModel
implementation
    "androidx.lifecycle:lifecycle-viewmodel-ktx:$lifecycle_version"
// ViewModel utilities for Compose
implementation
    "androidx.lifecycle:lifecycle-viewmodel-compose:$lifecycle_version'
// LiveData
implementation
    "androidx.lifecycle:lifecycle-livedata-ktx:$lifecycle_version"
implementation
    "androidx.compose.runtime:runtime-livedata:$compose_version"
```

LiveData and ViewModel

```kotlin
class UserViewModel(application: Application):
    AndroidViewModel(application) {
    private val userDB = UserDB.get(application)

    fun getAll(): LiveData<List<User>> =
        userDB.userDao().getAll()

    fun insert(user: User) {
        viewModelScope.launch {
            userDB.userDao().add(user)
        }
    }

    /* fun update, delete, getDetails,... */
}
```

LiveData and ViewModel

```kotlin
class MainActivity : ComponentActivity() {
    companion object{
        private lateinit var userViewModel: UserViewModel
    }

    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        userViewModel = UserViewModel(application)
        setContent {
            MainAppNav(userViewModel)
        }
    }
}
```

LiveData and ViewModel

```kotlin
@Composable
fun InsertUser(userViewModel: UserViewModel) {
    // candiate for mutableStateListOf
    var fname by remember { mutableStateOf("") }
    var lname by remember { mutableStateOf("") }
    Column {
        TextField(value = fname, label = {
            Text(stringResource(R.string.fname)) },
            onValueChange = { fname = it })
        TextField(value = lname, label = {
            Text(stringResource(R.string.lname)) },
            onValueChange = { lname = it })
        Button(onClick = {
            userViewModel.insert(User(0, fname, lname))
        }) {
            Text(stringResource(R.string.insert))
        }
    }
}
```

LiveData and ViewModel

```kotlin
@Composable
fun ListUsers(userViewModel: UserViewModel, navController:
    NavController) {
    val userList =
        userViewModel.getAll().observeAsState(listOf())
    LazyColumn {
        item {
            Row {
                Text(stringResource(R.string.header))
            }
        }
        items(userList.value) {
            Text("User: $it", Modifier.clickable {
                navController.navigate("details/${it.uid}")
            })
        }
    }
}
```

LiveData and ViewModel

```kotlin
@Composable
fun MainAppNav(userViewModel: UserViewModel) {
  val navController = rememberNavController()
  NavHost(navController, startDestination = "main") {
    composable("main") {
      Column {
        InsertUser(userViewModel)
        ListUsers(userViewModel, navController)
      }
    }
    composable("details/{userId}") {
      val id = it.arguments?.getString("userId")?.toLong() ?: 0
      DetailView(userViewModel, id, navController)
    }
  }
}
```

Build gradle and details about navigation: https://developer.android.com/jetpack/compose/navigation

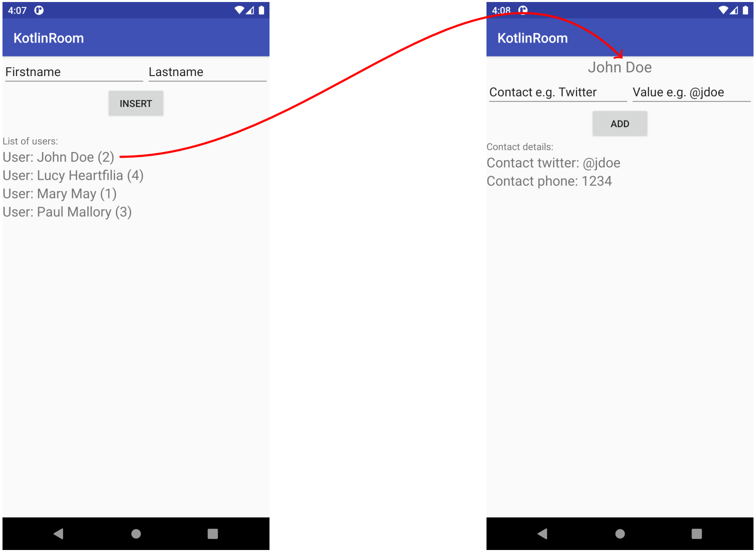
Lab_w1_d5 Room and LiveData

- Create an app that will use a simple Room SQLite database (at least two related tables). E.g.
  - Ice Hockey teams (name/created year) and their players (name/position)
  - Movies (title/year/director) and their actors (name/role)
  - Recipes (name/country of origin) and their ingredients (name/quantity)
  - Animals Families (English/Latin name) and their species (English/Latin name/area)
  - ...
- Create two views to insert data (one for each table) and LazyColumn to list the content (select from the two related tables).

Note: start easy with one table.

Hint: when modifying the database (entities, dao,...), before redeploying your app to emulator/debugging device, go to phone settings ⇒ App & notification, select your app ⇒ Storage & cache and clear both cache and storage (so you avoid database modification exception).

Lab_w1_d5 Room and LiveData


4:07

KotlinRoom

Firstname Lastname

INSERT

List of users:
User: John Doe (2)
User: Lucy Heartfilia (4)
User: Mary May (1)
User: Paul Mallory (3)

4:08

KotlinRoom

John Doe

Contact e.g. Twitter Value e.g. @jdoe

ADD

Contact details:
Contact twitter: @jdoe
Contact phone: 1234