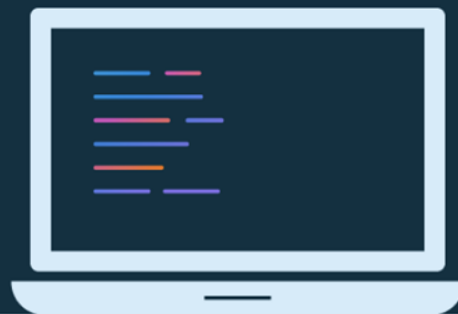




# Lesson 8:

## App architecture (UI layer)



# About this lesson

## Lesson 8: App architecture (UI layer)

- [Android app architecture](#)
- [ViewModel](#)
- [Data binding](#)
- [LiveData](#)
- [Transform LiveData](#)
- [Summary](#)

# Android app architecture

# Avoid short-term hacks

- External factors, such as tight deadlines, can lead to poor decisions about app design and structure.
- Decisions have consequences for future work (app can be harder to maintain long-term).
- Need to balance on-time delivery and future maintenance burden.

# Examples of short-term hacks

- Tailoring your app to a specific device
- Blindly copying and pasting code into your files
- Placing all business logic in activity file
- Hardcoding user-facing strings in your code

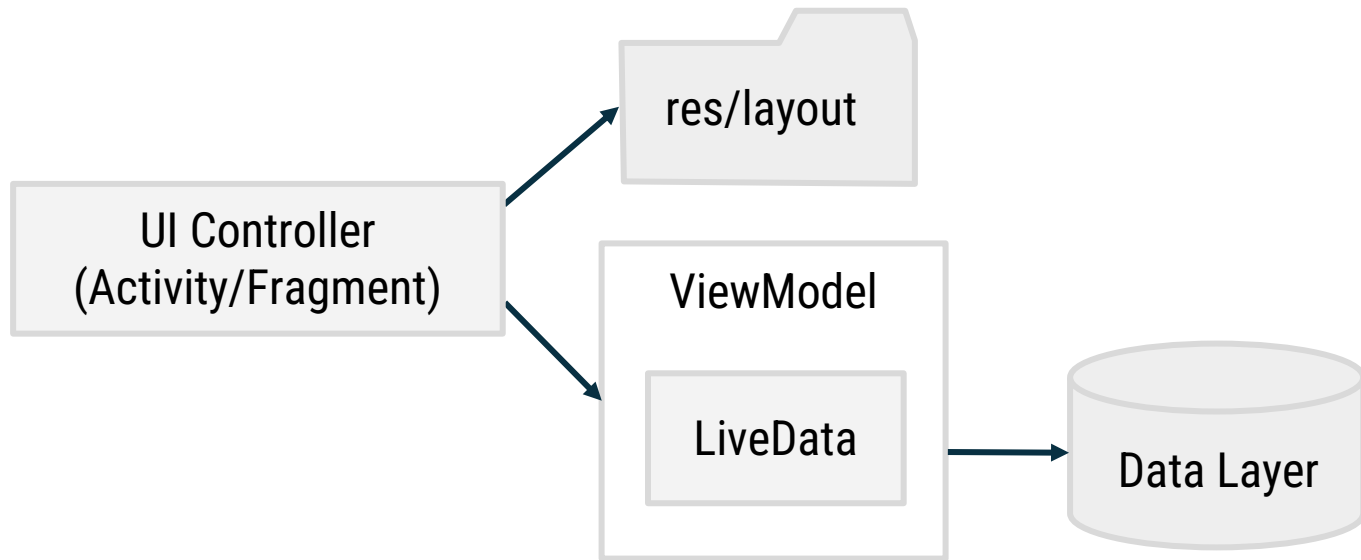
# Why you need good app architecture

- Clearly defines where specific business logic belongs
- Makes it easier for developers to collaborate
- Makes your code easier to test
- Lets you benefit from already-solved problems
- Saves time and reduces technical debt as you extend your app

# Android Jetpack

- Android libraries that incorporate best practices and provide backward compatibility in your apps
- Jetpack comprises the `androidx.*` package libraries

# Separation of concerns





# Architecture components

- Architecture design patterns, like MVVM and MVI, describe a loose template for what the structure of your app should be.
- Jetpack architecture components help you design robust, testable, and maintainable apps.

# ViewModel

# Gradle: lifecycle extensions

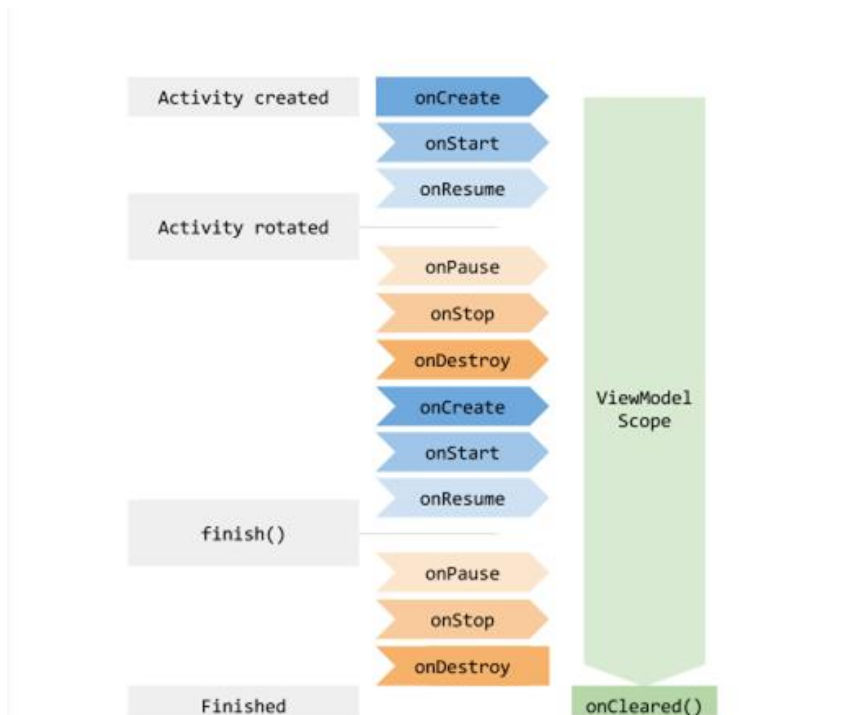
In `app/build.gradle` file:

```
dependencies {  
    implementation "androidx.lifecycle:lifecycle-viewmodel-ktx:$lifecycle_version"  
    implementation "androidx.activity:activity-ktx:$activity_version"  
}
```

# ViewModel

- Prepares data for the UI
- Must not reference activity, fragment, or views in view hierarchy
- Scoped to a lifecycle (which activity and fragment have)
- Enables data to survive configuration changes
- Survives as long as the scope is alive

# Lifetime of a ViewModel



# Kabaddi Kounter



# ViewModel class

abstract class ViewModel

## Summary

### Public constructors

`<init>()`

ViewModel is a class that is responsible for preparing and managing the data for an [Activity](#) or a [Fragment](#).

### Protected methods

open [Unit](#)

`onCleared()`

This method will be called when this ViewModel is no longer used and will be destroyed.

### Extension properties

From [androidx.lifecycle](#)

[CoroutineScope](#)

`viewModelScope`

[CoroutineScope](#) tied to this [ViewModel](#).

# Implement a ViewModel

```
class ScoreViewModel : ViewModel() {  
    var scoreA : Int = 0  
    var scoreB : Int = 0  
    fun incrementScore(isTeamA: Boolean) {  
        if (isTeamA) {  
            scoreA++  
        }  
        else {  
            scoreB++  
        }  
    }  
}
```



# Load and use a ViewModel

```
class MainActivity : AppCompatActivity() {  
    // Delegate provided by androidx.activity.viewModels  
    val viewModel: ScoreViewModel by viewModels()  
  
    override fun onCreate(savedInstanceState: Bundle?) {  
        ...  
        val scoreViewA: TextView = findViewById(R.id.scoreA)  
        scoreViewA.text = viewModel.scoreA.toString()  
    }  
}
```

# Using a ViewModel

Within `MainActivity onCreate()`:

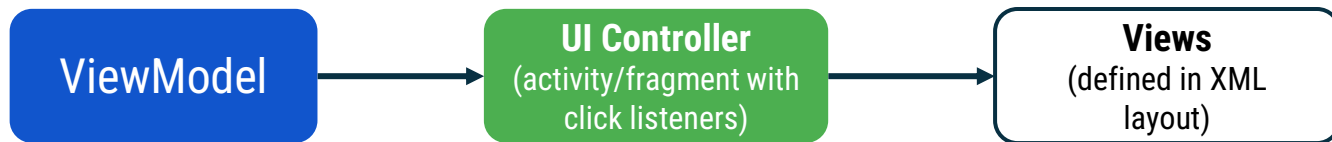
```
val scoreViewA: TextView = findViewById(R.id.scoreA)
val plusOneButtonA: Button = findViewById(R.id.plusOne_teamA)

plusOneButtonA.setOnClickListener {
    viewModel.incrementScore(true)
    scoreViewA.text = viewModel.scoreA.toString()
}
```

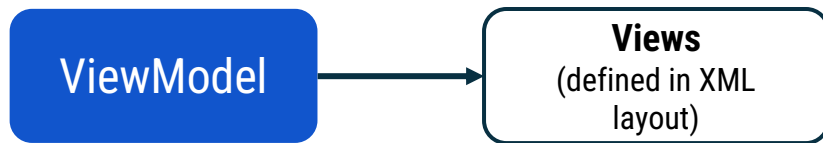
# Data binding

# ViewModels and data binding

- App architecture without data binding



- ViewModels can work in concert with data binding



# Data binding in XML revisited

Specify ViewModels in the `data` tag of a binding.

```
<layout>
  <data>
    <variable>
      name="viewModel"
      type="com.example.kabaddikounter.ScoreViewModel" />
    </data>
    <ConstraintLayout ../>
  </layout>
```

# Attaching a ViewModel to a data binding

```
class MainActivity : AppCompatActivity() {  
  
    val viewModel: ScoreViewModel by viewModels()  
  
    override fun onCreate(savedInstanceState: Bundle?) {  
        super.onCreate(savedInstanceState)  
        val binding: ActivityMainBinding = DataBindingUtil.setContentView(this,  
            R.layout.activity_main)  
  
        binding.viewModel = viewModel  
        ...  
    }  
}
```

# Using a ViewModel from a data binding

In `activity_main.xml`:

```
<TextView
    android:id="@+id/scoreViewA"
    android:text="@{viewModel.scoreA.toString()}" />

...
```

# ViewModels and data binding

```
override fun onCreate(savedInstanceState: Bundle?) {  
    ...  
    val binding: ActivityMainBinding = DataBindingUtil.setContentView(this,  
        R.layout.activity_main)  
  
    binding.plusOneButtonA.setOnClickListener {  
        viewModel.incrementScore(true)  
        binding.scoreViewA.text = viewModel.scoreA.toString()  
    }  
}
```

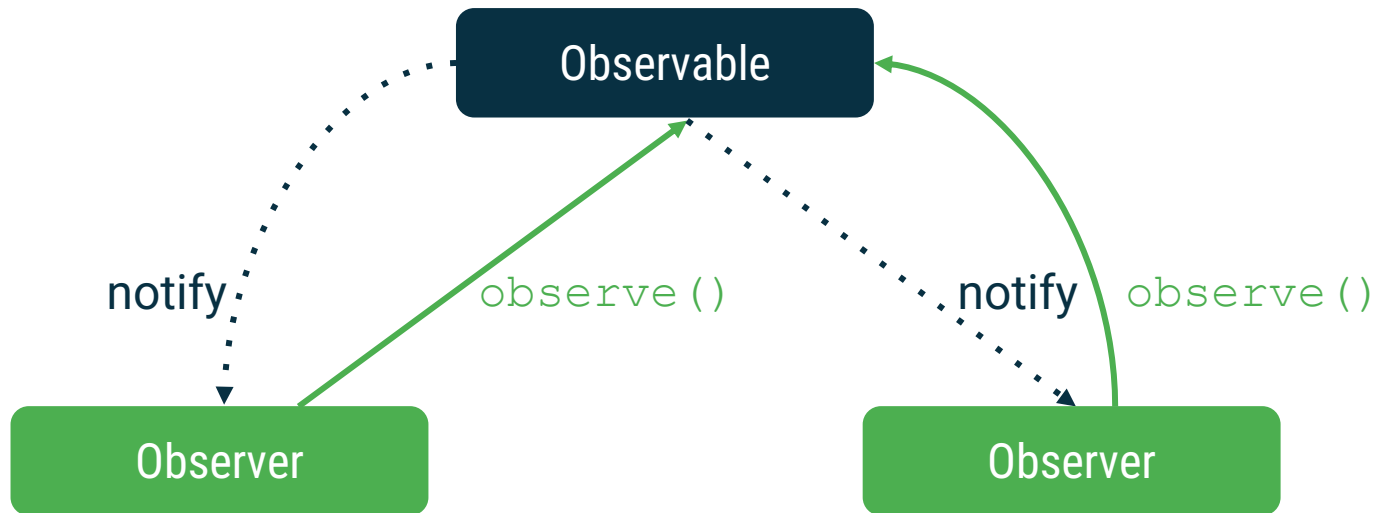


# LiveData

# Observer design pattern

- Subject maintains list of observers to notify when state changes.
- Observers receive state changes from subject and execute appropriate code.
- Observers can be added or removed at any time.

# Observer design pattern diagram



# LiveData

- A lifecycle-aware data holder that can be observed
- Wrapper that can be used with any data including lists (for example, `LiveData<Int>` holds an `Int`)
- Often used by ViewModels to hold individual data fields
- Observers (activity or fragment) can be added or removed
  - `observe(owner: LifecycleOwner, observer: Observer)`
  - `removeObserver(observer: Observer)`

# LiveData versus MutableLiveData

LiveData<T>	MutableLiveData<T>
<ul style="list-style-type: none"><li>● <code>getValue()</code></li></ul>	<ul style="list-style-type: none"><li>● <code>getValue()</code></li><li>● <code>postValue(value: T)</code></li><li>● <code>setValue(value: T)</code></li></ul>

T is the type of data that's stored in `LiveData` or `MutableLiveData`.

# Use LiveData in ViewModel

```
class ScoreViewModel : ViewModel() {  
  
    private val _scoreA = MutableLiveData<Int>(0)  
    val scoreA: LiveData<Int>  
        get() = _scoreA  
  
    fun incrementScore(isTeamA: Boolean) {  
        if (isTeamA) {  
            _scoreA.value = _scoreA.value!! + 1  
        }  
        ...  
    }  
}
```

# Add an observer on LiveData

Set up click listener to increment `ViewModel` score:

```
binding.plusOneButtonA.setOnClickListener {  
    viewModel.incrementScore(true)  
}
```

Create observer to update team A score on screen:

```
val scoreA_Observer = Observer<Int> { newValue ->  
    binding.scoreViewA.text = newValue.toString()  
}
```

Add the observer onto `scoreA LiveData` in `ViewModel`:

```
viewModel.scoreA.observe(this, scoreA_Observer)
```

# Two-way data binding

- We already have two-way binding with `ViewModel` and `LiveData`.
- Binding to `LiveData` in XML eliminates need for an observer in code.



# Example layout XML

```
<layout>
  <data>
    <variable>
      name="viewModel"
      type="com.example.kabaddikounter.ScoreViewModel" />
    </data>
  <ConstraintLayout ...>
    <TextView ...
      android:id="@+id/scoreViewA"
      android:text="@{viewModel.scoreA.toString()}" />
    ...
  </ConstraintLayout>
</layout>
```

# Example Activity

```
class MainActivity : AppCompatActivity() {  
    val viewModel: ScoreViewModel by viewModels()  
    override fun onCreate(savedInstanceState: Bundle?) {  
        super.onCreate(savedInstanceState)  
        val binding: ActivityMainBinding = DataBindingUtil  
            .setContentView(this, R.layout.activity_main)  
  
        binding.viewModel = viewModel  
        binding.lifecycleOwner = this  
  
        binding.plusOneButtonA.setOnClickListener {  
            viewModel.incrementScore(true)  
        }  
        ...  
    }  
}
```

# Example ViewModel

```
class ScoreViewModel : ViewModel() {  
    private val _scoreA = MutableLiveData<Int>(0)  
    val scoreA : LiveData<Int>  
        get() = _scoreA  
    private val _scoreB = MutableLiveData<Int>(0)  
    val scoreB : LiveData<Int>  
        get() = _scoreB  
    fun incrementScore(isTeamA: Boolean) {  
        if (isTeamA) {  
            _scoreA.value = _scoreA.value!! + 1  
        } else {  
            _scoreB.value = _scoreB.value!! + 1  
        }  
    }  
}
```

# Transform LiveData

# Manipulating LiveData with transformations

LiveData can be transformed into a new LiveData object.

- `map()`
- `switchMap()`

# Example LiveData with transformations

```
val result: LiveData<String> = Transformations.map(viewModel.scoreA) {  
    x -> if (x > 10) "A Wins" else ""  
}
```

# Summary

# Summary

In Lesson 8, you learned how to:

- Follow good app architecture design, and the separation-of-concerns principle to make apps more maintainable and reduce technical debt
- Create a `ViewModel` to hold data separately from a UI controller
- Use `ViewModel` with data binding to make a responsive UI with less code
- Use observers to automatically get updates from `LiveData`



# Learn More

- [Guide to app architecture](#)
- [Android Jetpack](#)
- [ViewModel Overview](#)
- [Android architecture sample app](#)
- [ViewModelProvider](#)
- [Lifecycle Aware Data Loading with Architecture Components](#)
- [ViewModels and LiveData: Patterns + AntiPatterns](#)

# Pathway

Practice what you've learned by completing the pathway:

[Lesson 8: App architecture \(UI layer\)](#)

