CMSC436: Programming Handheld Systems
Lifecycle-Aware Components
Today’s Topics

Lifecycle-Aware Components
ViewModel
Live Data
Android App Behavior

Multiple entry points launched individually
Components started in many different orders
Android kills components on reconfiguration / low memory
Key Architectural Goals

Don’t store app data or state in your app components
Don’t design your app components so they depend on each other
Lifecycle-Aware Components

Links app components to their lifecycle events

LifeCycle – Represents Android lifecycle

LifecycleOwner – A component with an Android lifecycle

LifecycleObserver – Callbacks for listening to lifecycle changes
Lifecycle

Holds information about the lifecycle state of an Android component

State – Enum representing lifecycle states

Events – Enum representing lifecycle events (transitions between states)
Lifecycle.State

INITIALIZED - Initialized state for LifecycleOwner
CREATED - Created state for LifecycleOwner
DESTROYED - Destroyed state for LifecycleOwner
RESUMED - Resumed state for LifecycleOwner
STARTED - Started state for LifecycleOwner
Lifecycle.Event

ON_ANY - Constant matching all events
ON_CREATE - onCreate event of the LifecycleOwner
ON_DESTROY - onDestroy event of the LifecycleOwner
ON_PAUSE - onPause event of the LifecycleOwner
ON_RESUME - onResume event of the LifecycleOwner
ON_START - onStart event of the LifecycleOwner
ON_STOP - onStop event of the LifecycleOwner
Lifecycle State Model
Lifecycle Methods

```java
void addObserver(LifecycleObserver observer)
    Adds a LifecycleObserver that will be notified when the LifecycleOwner changes state

void removeObserver(LifecycleObserver observer)
    Removes the given observer from the observers list

Lifecycle.State getCurrentState()
    Returns the current state of the Lifecycle
```
LifecycleOwner

Represents a component with an Android lifecycle

An interface that returns a Lifecycle object from the getLifecycle() method
LifecycleObserver

Callbacks for listening to lifecycle changes to a LifecycleOwner

Our examples will use Java 8

Observe events with DefaultLifecycleObserver

Add "android.arch.lifecycle:common-java8:<version>" to module’s build.gradle file
DefaultLifecycleObserver Methods

```java
void onCreate(LifecycleOwner owner) {
    // Notifies that ON_CREATE event occurred.
}

void onStart(LifecycleOwner owner) {
    // Notifies that ON_START event occurred.
}

void onResume(LifecycleOwner owner) {
    // Notifies that ON_RESUME event occurred.
}
```
DefaultLifecycleObserver Methods

void onDestroy(LifecycleOwner owner)
    Notifies that ON_DESTROY event occurred

void onPause(LifecycleOwner owner)
    Notifies that ON_PAUSE event occurred

void onStop(LifecycleOwner owner)
    Notifies that ON_STOP event occurred
LifecycleObserver Methods

ON_CREATE, ON_START, ON_RESUME events are dispatched after the LifecycleOwner's related method returns

ON_PAUSE, ON_STOP, ON_DESTROY events are dispatched before the LifecycleOwner's related method is called
Today’s Topics

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ViewModel Responsibilities

Responsible for managing data for an Activity or a Fragment (owner)

Handles communication between the Activity or Fragment and the rest of the application
ViewModel Lifecycle

Associated with a scope (e.g., a Fragment or an Activity)

Retained as long as the scope is alive

Will not be destroyed if its owner is destroyed for a configuration change

The new instance of the owner will be reconnected to the existing ViewModel
ViewModel Implementation Rules

Should never access the View hierarchy or hold a reference to the Activity or the Fragment
void onCleared()

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

static ViewModelProvider
  of (FragmentActivity activity)

    Creates a ViewModelProvider, which retains
    ViewModels while a scope of given Activity is alive
Today’s Topics

Lifecycle-Aware Components
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Live Data
LiveData

Data holder observable within a given lifecycle

Observer paired with a LifecycleOwner

Observer notified when data changes, only if the LifecycleOwner is in active state

LifecycleOwner is considered active, if its state is STARTED or RESUMED

Designed to hold individual data fields of ViewModel
Can also be used to share data between components
LifecycleAwareTicker

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LifecycleAwareTicker
public class TickerDisplayActivity extends AppCompatActivity {
    private TextView mCounterView;
    private TickerViewModel mTickerViewModel;

    protected void onCreate(Bundle savedInstanceState) {
        ...
        mCounterView = findViewById(R.id.counter);
        // Get reference to TickerViewModel
        mTickerViewModel = ViewModelProviders.of(this).get(TickerViewModel.class);
        // Display initial Ticker value
        mCounterView.setText(String.valueOf(mTickerViewModel.getCounter().getValue()));
        // Observe changes to Ticker
        beginObservingTicker();
        // Tie TickerViewModel to Activity lifecycle
        mTickerViewModel.bindToActivityLifecycle(this);
    }
}
private void beginObservingTicker() {

    // Create Observer
    final Observer<Integer> tickerObserver = new Observer<Integer>() {
        @Override
        public void onChanged(final Integer integer) {
            mCounterView.setText(String.valueOf(integer));
        }
    };

    // Register observer
    mTickerViewModel.getCounter().observe(this, tickerObserver);
}
public class TickerViewModel extends ViewModel implements DefaultLifecycleObserver {
    ...
    private final MutableLiveData<Integer> mCounter = new MutableLiveData<>();

    public TickerViewModel() {
        // Set initial value
        mCounter.setValue(0);
    }

    LiveData<Integer> getCounter() {
        return mCounter;
    }

    void bindToActivityLifecycle(TickerDisplayActivity tickerDisplayActivity) {
        tickerDisplayActivity.getLifecycle().addObserver(this);
    }
    ...
}
public void onResume(@NonNull LifecycleOwner owner) {
    mTimer = new Timer();
    // Update the elapsed time every second.
    mTimer.scheduleAtFixedRate(new TimerTask() {
        public void run() {
            // setValue() cannot be called from a background thread so post to main thread.
            // noinspection ConstantConditions
            mCounter.postValue(mCounter.getValue() + 1);
        }
    }, ONE_SECOND, ONE_SECOND);
}

public void onPause(@NonNull LifecycleOwner owner) {
    mTimer.cancel();
}

...
Best Practices

Keep your UI controllers (activities and fragments) as lean as possible. They should not try to acquire their own data; instead, use a ViewModel to do that, and observe the LiveData to reflect the changes back to the views.

Try to write data-driven UIs where your UI controller’s responsibility is to update the views as data changes, or notify user actions back to the ViewModel.

Put your data logic in your ViewModel class. ViewModel should serve as the connector between your UI controller and the rest of your application.

Never reference a View or Activity context in your ViewModel. If the ViewModel outlives the activity (in case of configuration changes), your activity will be leaked and not properly garbage-collected.
Next Time

Graphics and Animation
Example Applications

LifecycleAwareTicker