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CMSC436: Programming Handheld Systems

The Activity Class

Today's Topics

The Activity class

The Task Backstack

The Activity lifecycle

Starting an Activity

Handling configuration changes

The Activity Class

Provides a visual interface for user interaction

Each Activity typically supports one focused thing a user can do, such as

- Viewing an email message
- Showing a login screen

Activities and Application

Applications often comprise several Activities

User interaction results in navigating across these Activities

Android’s Navigation Support

Tasks

The Task Backstack

Suspending and resuming Activities

Tasks

A set of related Activities

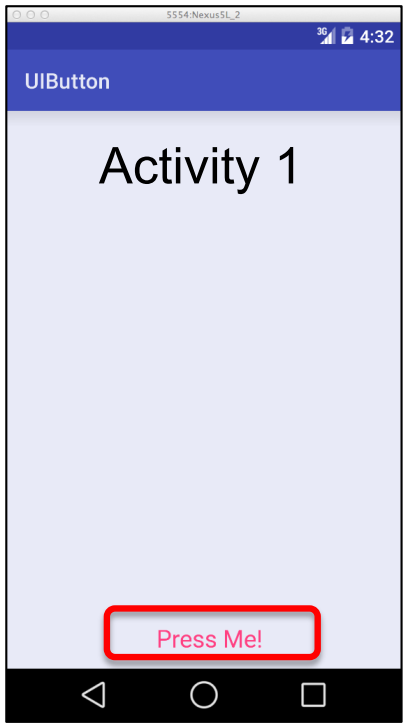
- These Activities can be from different applications

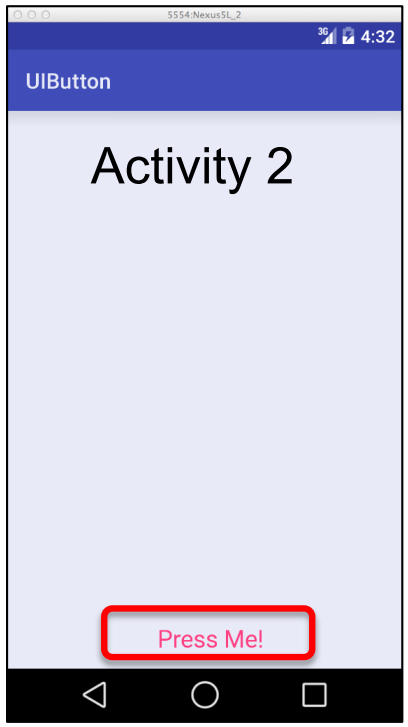
Most Tasks start at the home screen

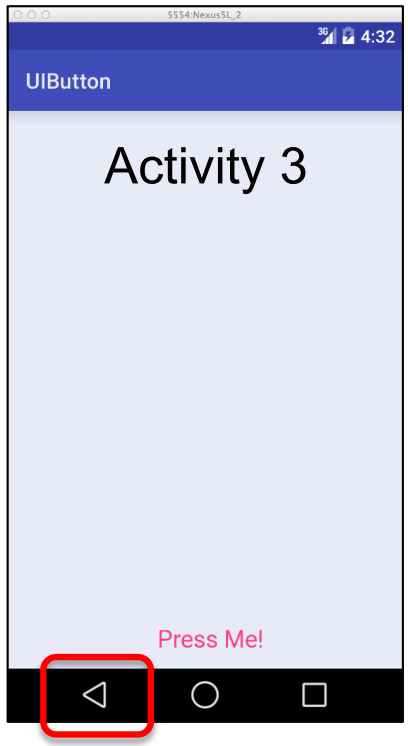
Task Backstack

When an Activity is launched, it goes on top of the backstack

When the Activity is destroyed, it is popped off the backstack







Activity 3
Activity 2
Activity 1

Task Backstack

The Activity Lifecycle

Activities are created, suspended, resumed and destroyed as necessary when an application executes

Some of these actions depend on user behavior

- e.g., User hits back button

Some depend on Android

- e.g., Android can kill Activities when it needs their resources

Activity Lifecycle States

Resumed/Running—Visible, user interacting

Paused—Visible, user not interacting, can be terminated (in older versions of Android)

Stopped—Not visible, can be terminated

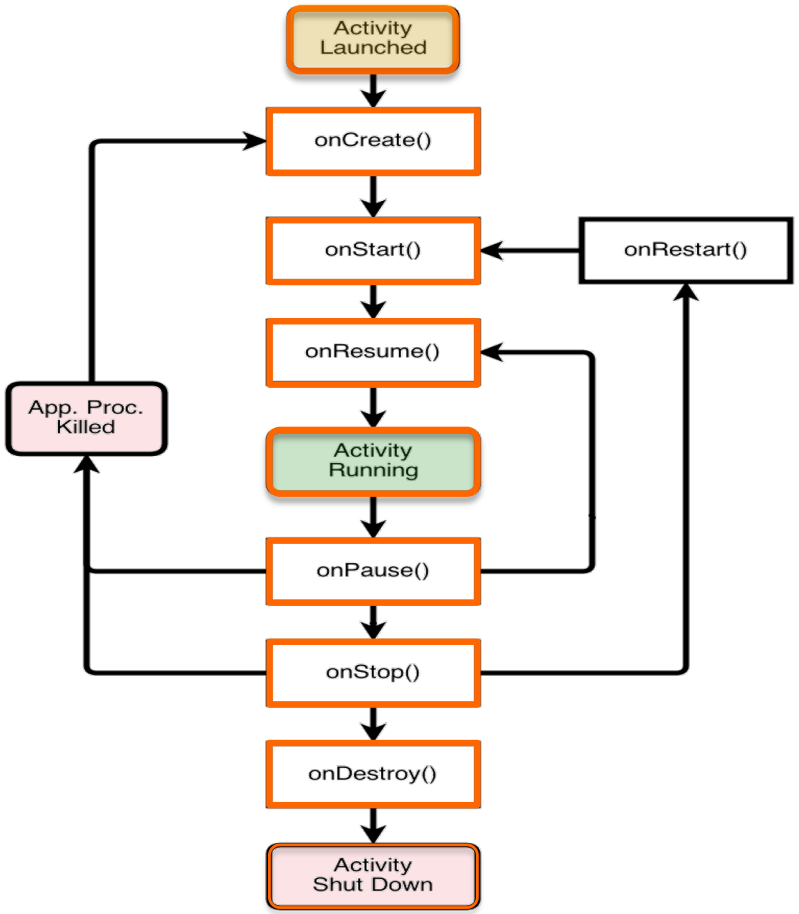
The Activity Lifecycle Methods

Android announces Activity lifecycle state changes to Activities by calling specific Activity methods

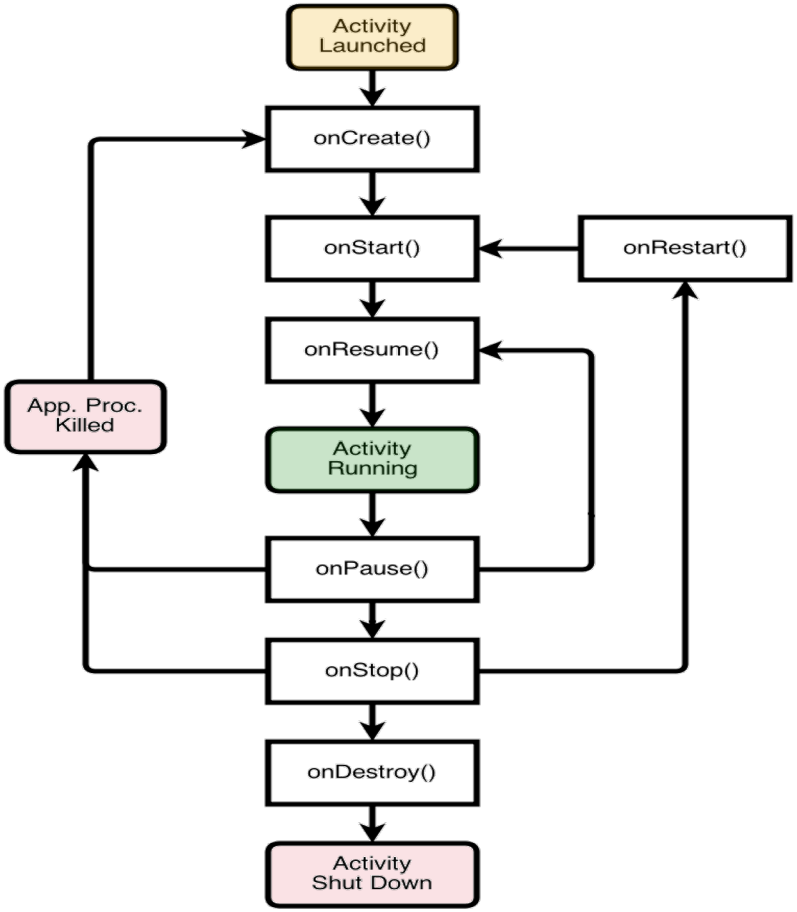
Some Activity Callback Methods

```
protected open fun onCreate(savedInstanceState: Bundle?): Unit
protected open fun onStart(): Unit
protected open fun onResume(): Unit
protected open fun onPause(): Unit
protected open fun onRestart(): Unit
protected open fun onStop(): Unit
protected open fun onDestroy(): Unit
```

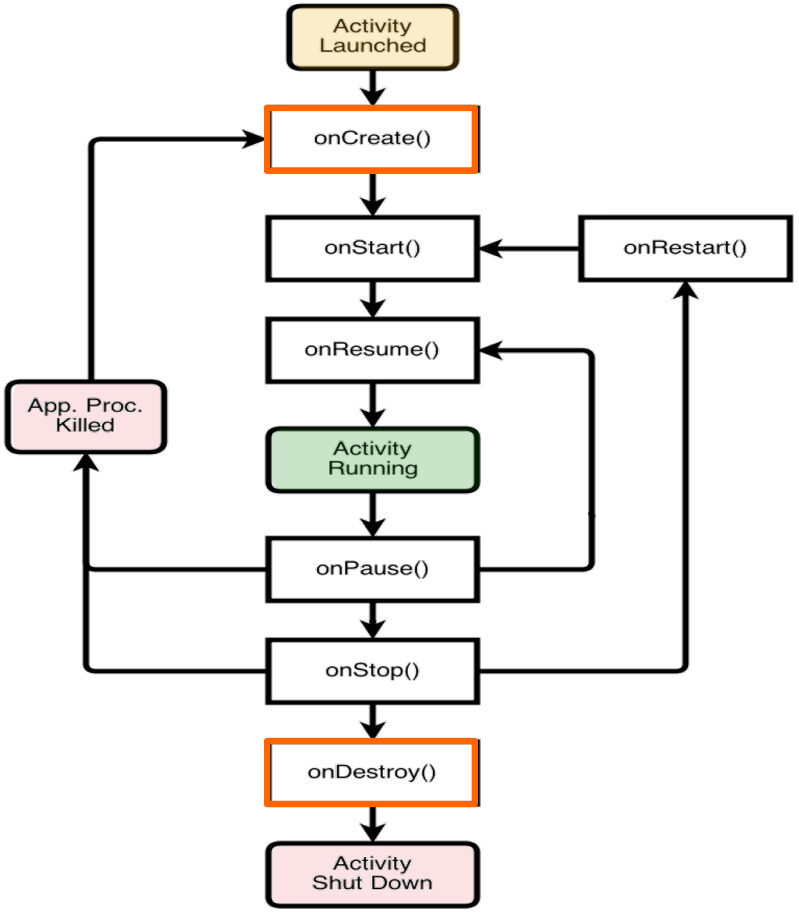
The Activity Lifecycle



The Activity Lifecycle

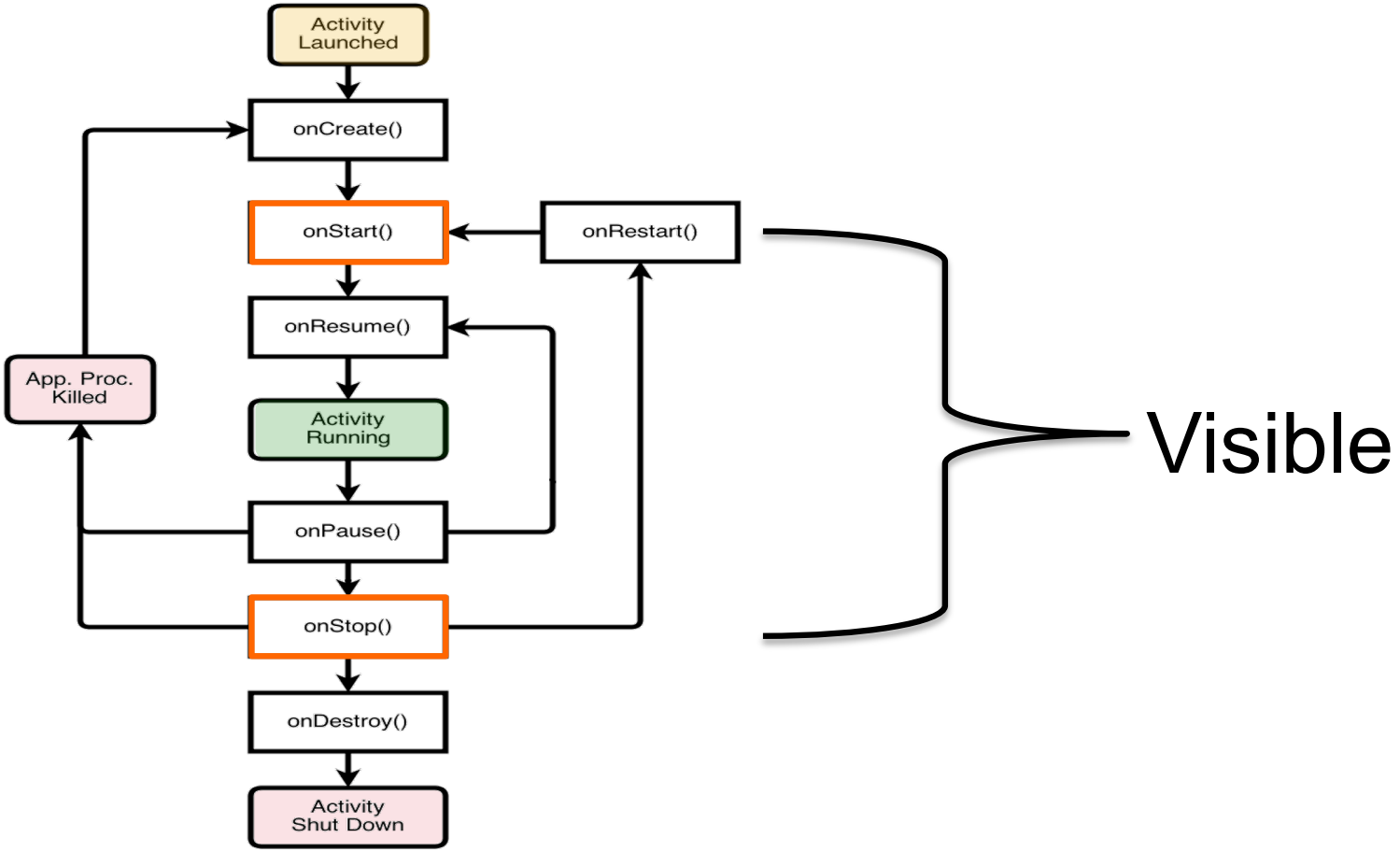


The Activity Lifecycle

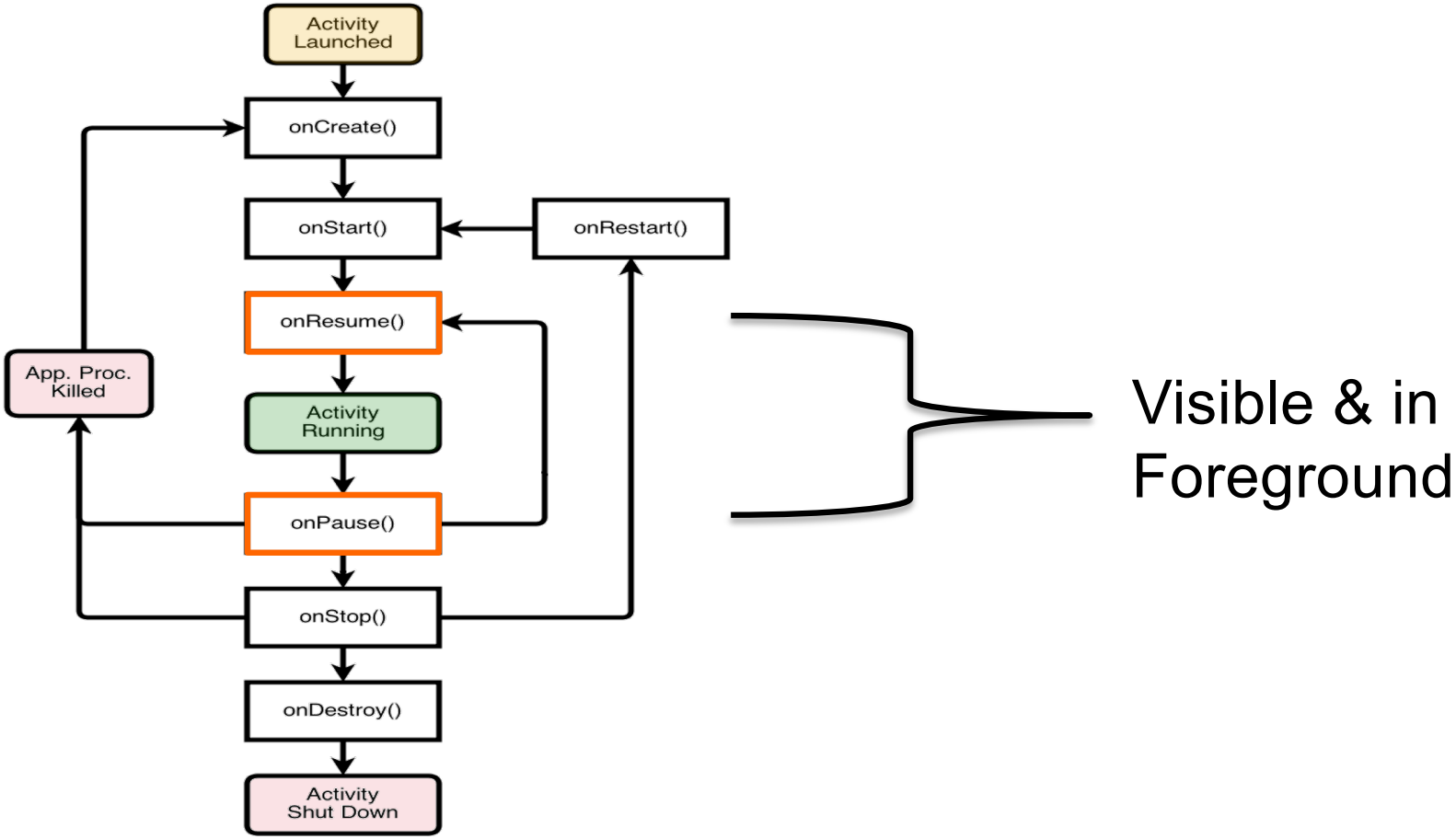


Entire Lifetime

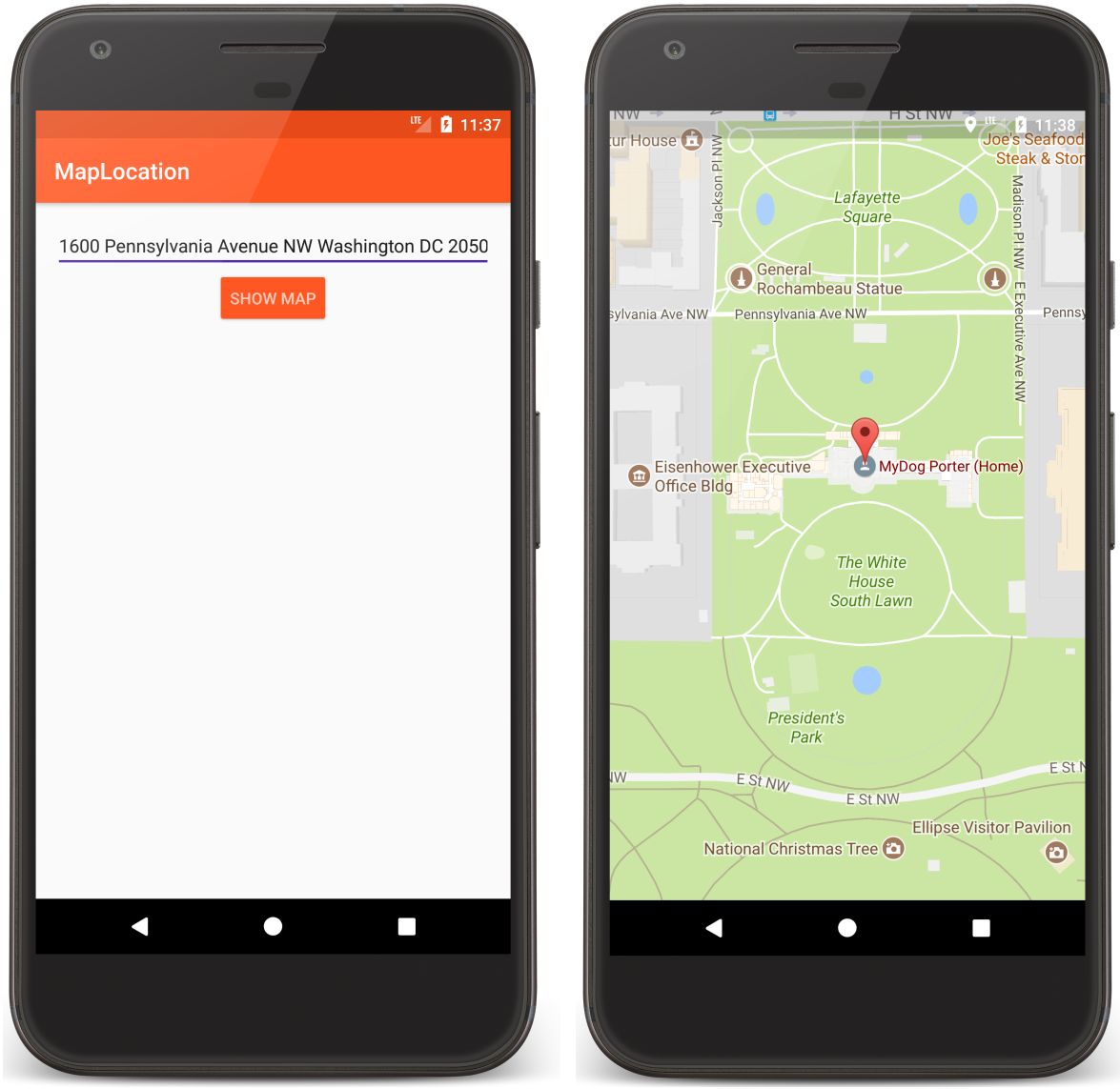
The Activity Lifecycle



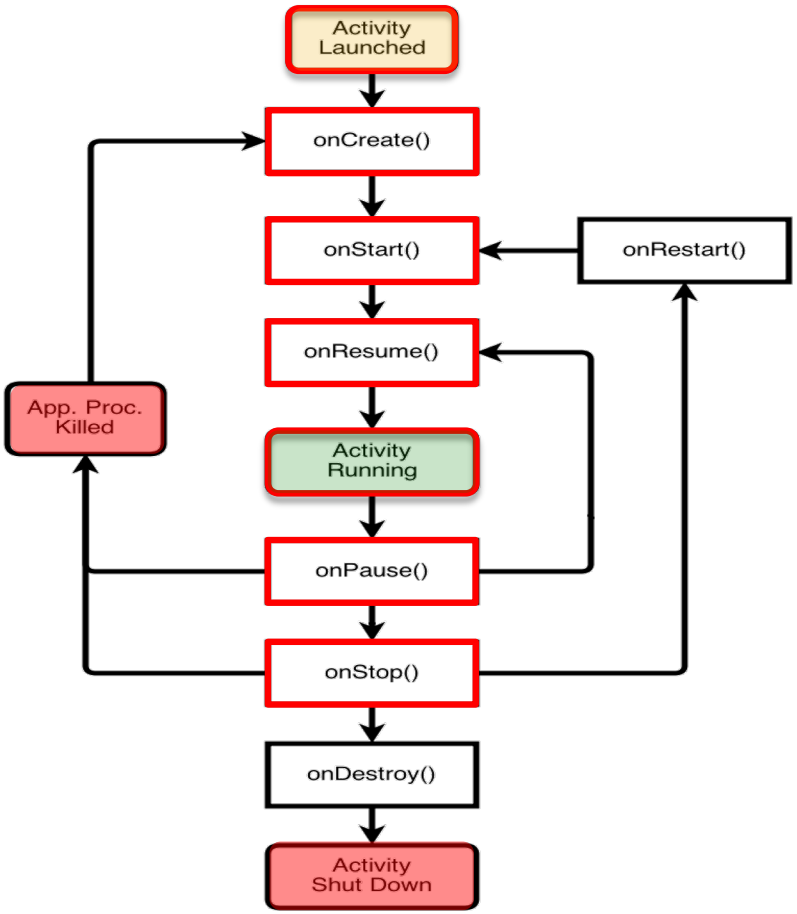
The Activity Lifecycle



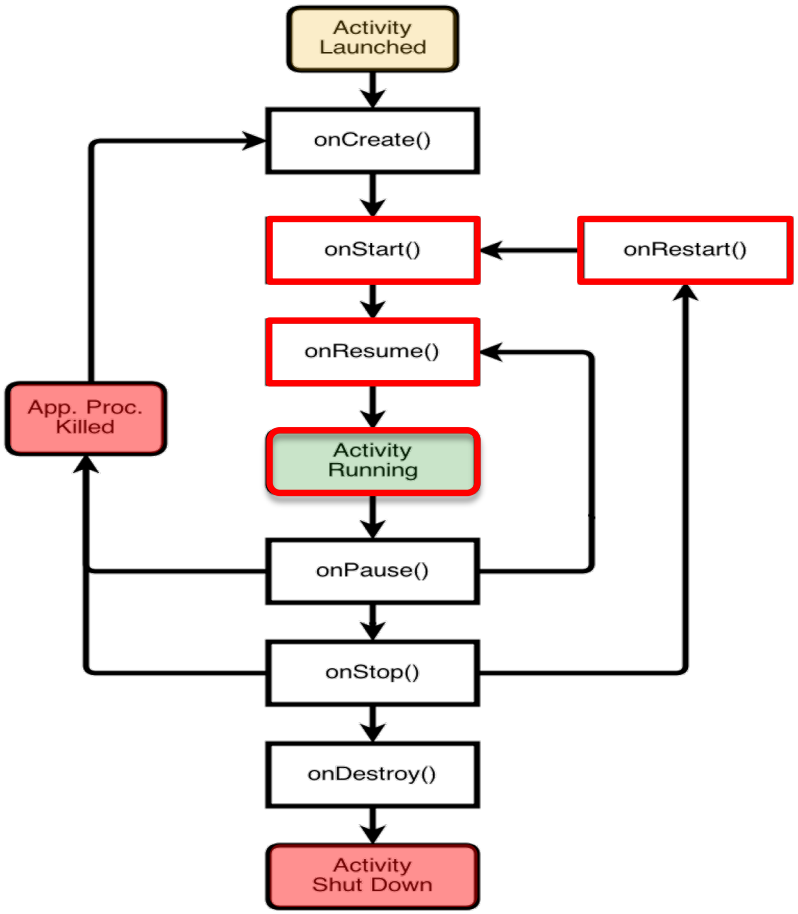
MapLocation



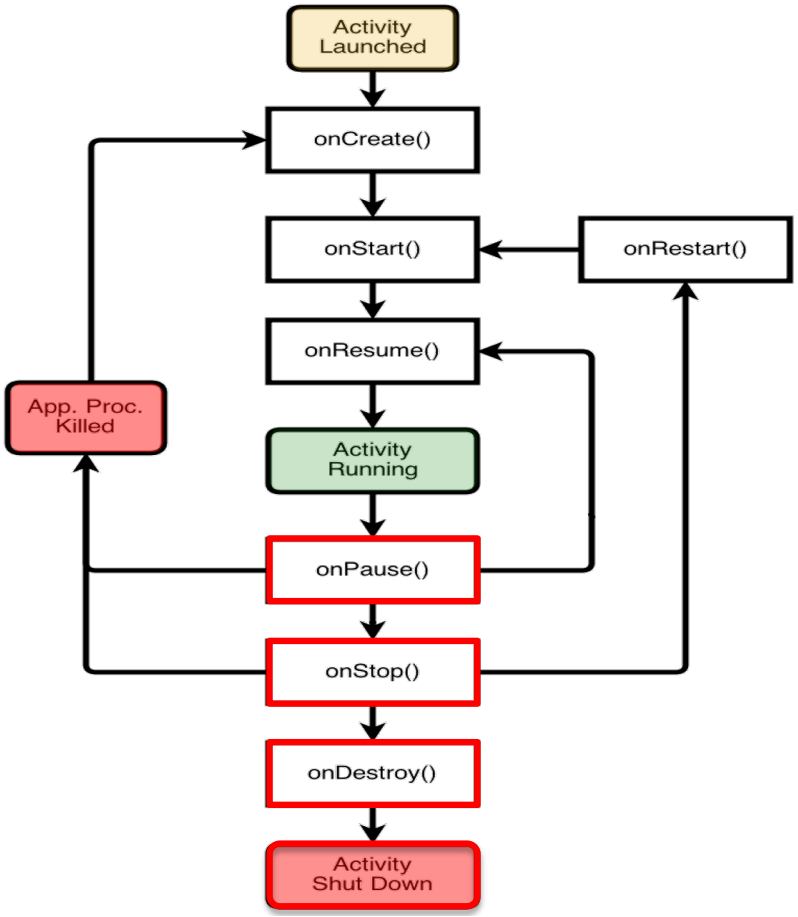
The Activity Lifecycle: MapLocation



The Activity Lifecycle: MapLocation



The Activity Lifecycle: MapLocation



onCreate()

- Called when Activity is created
- Sets up initial state
  - Call super.onCreate()
  - Set the Activity's content view
  - Retain references to UI views as necessary
  - Configure views as necessary

MapLocation.kt

```
class MapLocation : Activity() {
    companion object {
        const val TAG = "MapLocation"
    }

    // UI elements
    private lateinit var addrText: EditText
    private lateinit var button: Button

    override fun onCreate(savedInstanceState: Bundle?) {
        /* Required call through to Activity.onCreate()
        Restore any saved instance state, if necessary */
        super.onCreate(savedInstanceState)

        // Set content view
        setContentView(R.layout.main)
```

MapLocation.kt

```
// Initialize UI elements
        addrText = findViewById(R.id.location)
        button = findViewById(R.id.mapButton)
        // Link UI elements to actions in code
        button.setOnClickListener { processClick() }
    }
    // Called when user clicks the Show Map button
    private fun processClick() {
        try {
            // Process text for network transmission
            var address = addrText.text.toString()
            address = address.replace(' ', '+')

            // Create Intent object for starting Google Maps application
            val geoIntent = Intent(Intent.ACTION_VIEW,
                                   Uri.parse("geo:0,0?q=$address"))
```

MapLocation.kt

```
        geoIntent.resolveActivity(packageManager)?.let {
                // Use the Intent to start Google Maps application using
                // Activity.startActivity()
                startActivity(geoIntent)
            }

        } catch (e: Exception) {
            // Log any error messages to LogCat using Log.e()
            Log.e(TAG, e.toString())
        }
    }
```

onStart()

- Activity is about to become visible
- Typical actions
  - Start visible-only behaviors
  - Loading persistent application state

onResume()

- Activity is visible and about to start interacting with user
- Typical actions
  - Start foreground-only behaviors

onPause()

- Focus about to switch to another Activity
- Typical actions
  - Shutdown foreground-only behaviors
  - Save persistent state

onStop()

- Activity is no longer visible to user
  - may be restarted later
- Typical actions
  - Save persistent state
  - Do CPU-intensive save procedures
- Note: Pre-Honeycomb - this method may not be called if Android kills your application

onRestart()

- Called if the Activity has been stopped and is about to be started again
- Typical actions
  - Special processing needed only after having been stopped

onDestroy()

Activity is about to be destroyed

Typical actions

- Release Activity-wide resources

Note: may not be called if Android kills your application

```
override fun onStart() {
        super.onStart()
        Log.i(TAG, "The activity is visible and about to be started.")
    }

    override fun onRestart() {
        super.onRestart()
        Log.i(TAG, "The activity is visible and about to be restarted.")
    }

    override fun onResume() {
        super.onResume()
        Log.i(TAG,
         "The activity is visible and has focus (it is now \"resumed\")")
    }
```

```
    override fun onPause() {
        super.onPause()
        Log.i(TAG, "Another activity is taking focus (this activity is about
         to be \"paused\")")
    }

    override fun onStop() {
        super.onStop()
        Log.i(TAG, "The activity is no longer visible (it is now \"stopped\")")
    }

    override fun onDestroy() {
        super.onDestroy()
        Log.i(TAG, "The activity is about to be destroyed.")
    }
}
```

Starting Activities

Create an Intent object matching the Activity to start

Starting Activities

Pass newly created Intent to methods, such as:

startActivity()

startActivityForResult()

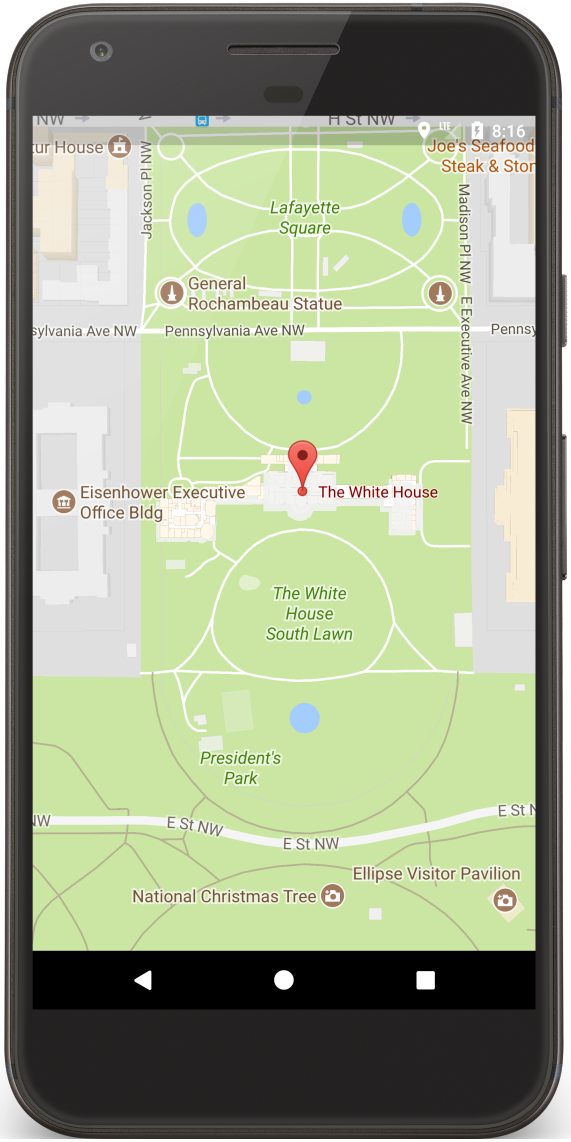
- Invokes a callback method, onActivityResult(), when the called Activity finishes to return a result to the calling Activity

```
// Called when user clicks the Show Map button
private fun processClick() {
    try {
     …
        // Create Intent object for starting Google Maps application
        val geoIntent = Intent(Intent.ACTION_VIEW,
                               Uri.parse("geo:0,0?q=$address"))

        geoIntent.resolveActivity(packageManager)?.let {
             // Use the Intent to start Google Maps application using
             // Activity.startActivity()
            startActivity(geoIntent)
        }
```

MapLocationFromContacts

Similar to MapLocation, but gets address from Contacts database



MapLocationFromContacts

StartActivityForResult()

```
private fun startContactsApp() {

    // Create Intent object for picking data from
    // Contacts database
    val intent = Intent(Intent.ACTION_PICK)
    intent.type = CONTENT_ITEM_TYPE

    intent.resolveActivity(packageManager)?.let {
    // Use intent to start Contacts application
    // Variable PICK_CONTACT_REQUEST identifies this operation
        startActivityForResult(intent, PICK_CONTACT_REQUEST)
    }
}
```

Activity.setResult()

The started Activity can set its result by calling Activity.setResult()

```
fun setResult(resultCode: Int): Unit

fun setResult(resultCode: Int, data: Intent!): Unit
```

Activity.setResult()

resultCode - an Int

- RESULT_CANCELED
- RESULT_OK
- RESULT_FIRST_USER
  - Custom resultCodes can be added

```
override fun onActivityResult(requestCode: Int, resultCode: Int, data: Intent){

    if (resultCode == RESULT_OK && requestCode == PICK_CONTACT_REQUEST) {
        …
            if (null != formattedAddress) {
…
             // Create Intent object for starting Google Maps application
                val geoIntent = Intent(Intent.ACTION_VIEW,
                                Uri.parse("geo:0,0?q=$formattedAddress"))
            // Use the Intent to start Google Maps application using
            //Activity.startActivity()
                startActivity(geoIntent)
            }
        }
        …
```

Configuration Changes

Keyboard, orientation, locale, etc.

Device configuration can change at runtime

On configuration changes, Android usually kills the current Activity & then restarts it

Configuration Changes

- Activity restarting should be fast
- Options
  - Save Activity state in Bundle
  - Retain a separate Object
  - Manually handle the configuration change (not usually recommended)

Saving Activity State

Android saves some information such as View state in a Bundle

You must save other state yourself

Saving Activity State

Android calls onSaveInstanceState(Bundle)

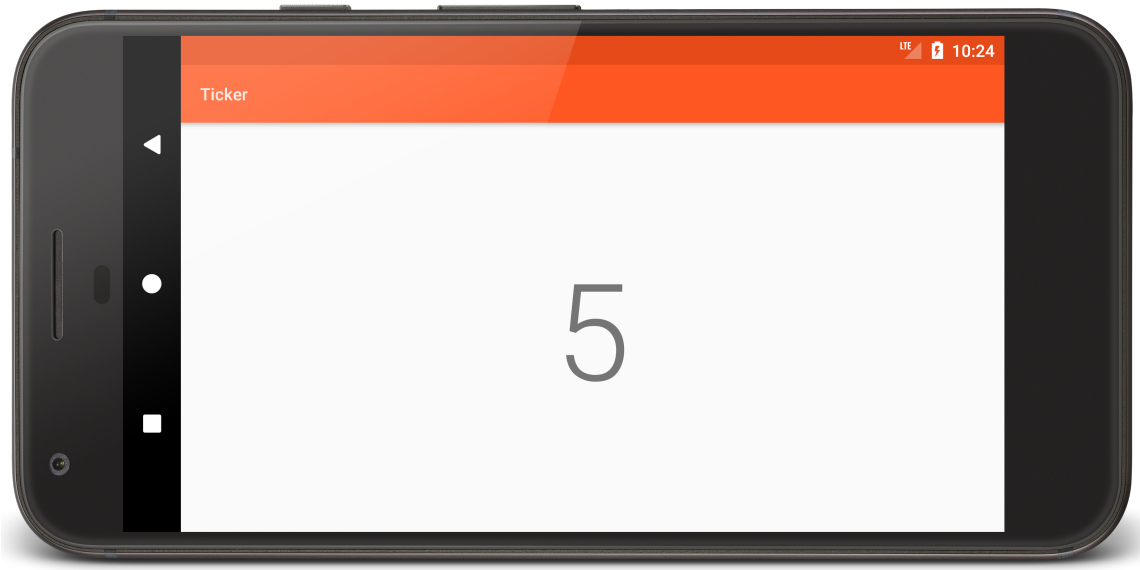
- after onStop() for API 28+
- before onStop() for API <28

Save Activity instance state to system-provided Bundle

Saving Activity State

When Activity is restarted, you can restore Activity state from a system-provided Bundle in:

- onCreate(Bundle)
- onRestoreInstanceState(Bundle), which is called between onStart() and onPostCreate()



Ticker

```
class TickerDisplayActivity : Activity() {
    companion object {
        private const val COUNTER_KEY = "COUNTER_KEY"
        private const val DELAY: Long = 1000
    }

    private lateinit var mCounterView: TextView
    private lateinit var mUpdater: Runnable
    private var mCounter = 0
```

```
override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)

         setContentView(R.layout.activity_ticker_display)

        mCounterView = findViewById(R.id.counter)

        savedInstanceState?.let { mCounter = it.getInt(COUNTER_KEY) }

         …
}
```

```
// Save instance state
public override fun onSaveInstanceState(bundle: Bundle) {

     // Save mCounter value
    bundle.putInt(COUNTER_KEY, mCounter)

     // call superclass to save any view hierarchy
    super.onSaveInstanceState(bundle)
}
```

Retaining an Object

- Hard to recompute data can be cached to speed up handling of configuration changes
- Current recommendation is to store state in a Fragment
- We'll come back to this in a later lesson

Manual Reconfiguration

Can prevent system from restarting Activity

Declare the configuration changes your Activity handles in AndroidManifest.xml file, e.g.,

```
<activity android:name=".MyActivity“
    android:configChanges=
        "orientation|screensize|keyboardHidden”…>
```

Manual Reconfiguration

When configuration changes,

Activity’ s onConfigurationChanged() method is called

Passed a Configuration object specifying the new device configuration

Manual Reconfiguration Caveat

- Should generally avoid manual approach
  - Hard to get right
  - Fragile to system changes

Next

The Intent Class

Example Applications

MapLocation

MapLocationFromContacts

Ticker