Android Common Services & Apps (Part 1):
Overview of Object-Oriented Frameworks

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Learning Objectives in this Part of the Lesson

• Understand what an object-oriented framework is in the context of Java & Android
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• Understand what an object-oriented framework is in the context of Java & Android

• Recognize common examples of Java & Android frameworks
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• Understand what an object-oriented framework is in the context of Java & Android
• Recognize common examples of Java & Android frameworks

This topic is important since all Android apps run within one or more frameworks
Overview of Object-Oriented Frameworks
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A framework is an integrated set of components that provide a reusable architecture for a family of related applications.

See www.dre.vanderbilt.edu/~schmidt/frameworks.html
Overview of Object-Oriented Frameworks

- Frameworks have 3 characteristics
Overview of Object-Oriented Frameworks

- Frameworks have 3 characteristics
- Exhibit “inversion of control” (IoC) via callbacks

See en.wikipedia.org/wiki/Inversion_of_control
Overview of Object-Oriented Frameworks

- Frameworks have 3 characteristics
- Exhibit “inversion of control” (IoC) via callbacks, i.e.
  - Framework controls the main execution thread
Overview of Object-Oriented Frameworks

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  - Exhibit “inversion of control” (IoC) via callbacks, i.e.
    - Framework controls the main execution thread
  - Decides how & when to run application code
Overview of Object-Oriented Frameworks

- Frameworks have 3 characteristics
  - Exhibit “inversion of control” (IoC) via callbacks, i.e.
    - Framework controls the main execution thread
    - Decides how & when to run application code
  - This inversion of control is often called the “Hollywood Principle”

See [www.dre.vanderbilt.edu/~schmidt/Coursera/articles/hollywood-principle.txt](http://www.dre.vanderbilt.edu/~schmidt/Coursera/articles/hollywood-principle.txt)
Frameworks have 3 characteristics

- Exhibit “inversion of control” (IoC) via callbacks, i.e.

- An example is an Android looper that dispatches a handler, which then dispatches a runnable.
Overview of Object-Oriented Frameworks

- Frameworks have 3 characteristics
- Exhibit “inversion of control” (IoC) via callbacks, i.e.

  e.g., an Android looper dispatches a handler, which then dispatches a runnable

The runnable dispatched via IoC doesn’t know/care how/why it was called back
Overview of Object-Oriented Frameworks

- Frameworks have 3 characteristics
  - Exhibit “inversion of control” (IoC) via callbacks
  - Integrated domain-specific structure & functionality

Domain-specific functionality for concurrent Android programs
Overview of Object-Oriented Frameworks

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  - Integrated domain-specific structure & functionality
    - e.g., provide capabilities that can be reused in one or more domain(s)

Android’s frameworks focus on domains associated with mobile apps & services
Overview of Object-Oriented Frameworks

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Application-specific functionality can systematically reuse framework components
Overview of Object-Oriented Frameworks

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  - Provide a “semi-complete application”
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    - *Hook methods* plug app logic into the framework

*Hook methods* implement patterns that customize framework components

Domain-specific functionality for concurrent Android programs
Overview of Object-Oriented Frameworks

• Frameworks have 3 characteristics
  • Exhibit “inversion of control” (IoC) via callbacks
  • Integrated domain-specific structure & functionality
  • Provide a “semi-complete application”
    • Hook methods plug app logic into the framework
  • Mediate interactions among common abstract & variant concrete classes/interfaces

e.g., Java Runnable is an abstract interface providing basis for concrete variants

Domain-specific functionality for concurrent Android programs
Overview of Frameworks in Android & Java
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- Android & Java provide many frameworks
Overview of Frameworks in Android & Java

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  - **Android**
    - Android activity framework controls the main thread

See developer.android.com/training/multiple-threads/communicate-ui.html
Overview of Frameworks in Android & Java

- Android & Java provide many frameworks

  - **Android**
    - Android activity framework controls the main thread
    - An application’s lifecycle methods are called back by Android’s activity framework

See [developer.android.com/training/basics/activity-lifecycle](http://developer.android.com/training/basics/activity-lifecycle)
Overview of Frameworks in Android & Java

• Android & Java provide many frameworks
  • **Android**
    • Android activity framework controls the main thread
    • An application’s lifecycle methods are called back by Android’s activity framework
      • e.g., `onCreate()`, `onStart()`, `onStop()`, `onDestroy()`, etc.

See developer.android.com/training/basics/activity-lifecycle
Overview of Frameworks in Android & Java

- Android & Java provide many frameworks
  - **Android**
    - Android activity framework controls the main thread
    - An application’s lifecycle methods are called back by Android’s activity framework
    - A listener for button clicks is called back by Android’s GUI framework

```
final Button button = (Button) findViewById(R.id.loadButton);
button.setOnClickListener(new OnClickListener() {
    @Override
    public void onClick(View v) {
        ...
    }
});
```

```
public void onClick(View v) {
    ...
}
```

A GUI component sending an event to its registered listener

GUI Component (a button)

ClickListener Object

ClickListener Object
Overview of Frameworks in Android & Java

- Android & Java provide many frameworks
  - Android
  - Java
    - A thread calls back to the run() hook method of a Runnable

See docs.oracle.com/javase/tutorial/essential/concurrency/runthread.html
Overview of Frameworks in Android & Java

- Android & Java provide many frameworks
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    - A thread calls back to the run() hook method of a Runnable
    - The ExecutorService calls back to the call() hook method of a Callable

See docs.oracle.com/javase/tutorial/essential/concurrency/executors.html
Overview of Frameworks in Android & Java

- Android & Java provide many frameworks
  - Android
  - Java
    - A thread calls back to the run() hook method of a Runnable
    - The ExecutorService calls back to the call() hook method of a Callable
    - Completable future & fork-join pool frameworks

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html
• Most code you write in this course will use one or more frameworks
Overview of Frameworks in Android & Java

- Most code you write in this course will use one or more frameworks
- Some of your solutions will implement your own framework

All Android apps run inside of one or more frameworks.
Overview of Frameworks in Android & Java

- Frameworks use Java’s inheritance & polymorphism features
Overview of Frameworks in Android & Java

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See our Java For Android MOOC for more info on inheritance & polymorphism
Overview of Frameworks in Android & Java

- Frameworks use Java’s inheritance & polymorphism features, e.g.
- Abstract classes & interfaces provide extension mechanisms

```java
public interface Runnable {
    public void run();
}
```
Overview of Frameworks in Android & Java

- Frameworks use Java’s inheritance & polymorphism features, e.g.
  - Abstract classes & interfaces provide extension mechanisms
  - Concrete implementations of abstract classes & interfaces are passed to framework

```java
public interface Runnable {
    public void run();
}

new Thread(new Runnable() {
    public void run() {
        System.out.println("hello world");
    }
}.start();
```

Anonymous instance of an anonymous inner class
Overview of Frameworks in Android & Java

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```java
public interface Runnable {
    public void run();
}

new Thread(new Runnable() {
    public void run() {
        System.out.println("hello world");
    }
}).start();

new Thread(() ->
        System.out.println("hello world")).start();
```

See www.drdobbs.com/jvm/lambda-expressions-in-java-8/240166764
End of Common Services & Apps (Part 1): Overview of Object-Oriented Frameworks