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

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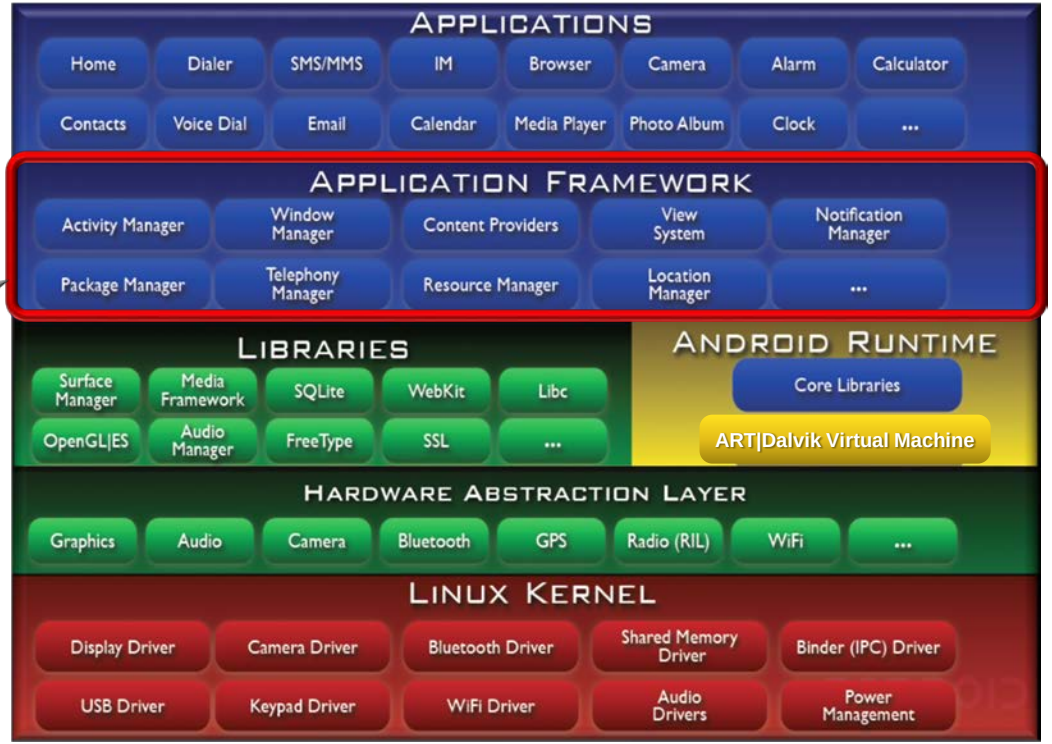
Learning Objectives in this Part of the Lesson

- 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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- 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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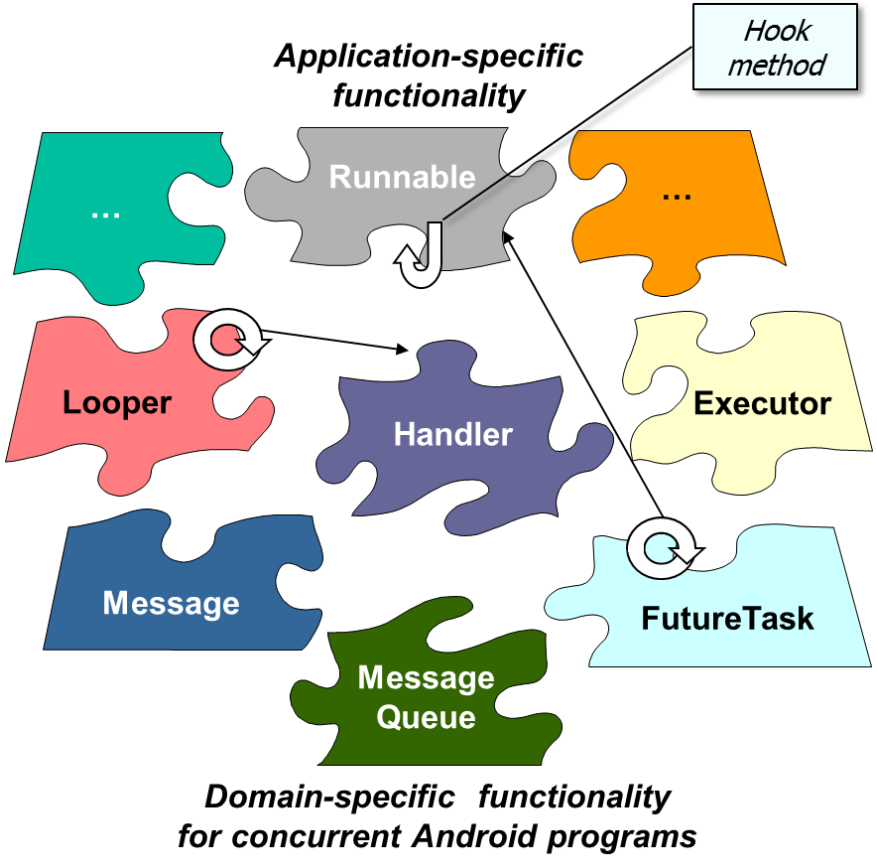
- A framework is an integrated set of components that provide a reusable architecture for a family of related applications



See www.dre.vanderbilt.edu/~schmidt/frameworks.html

Overview of Object-Oriented Frameworks

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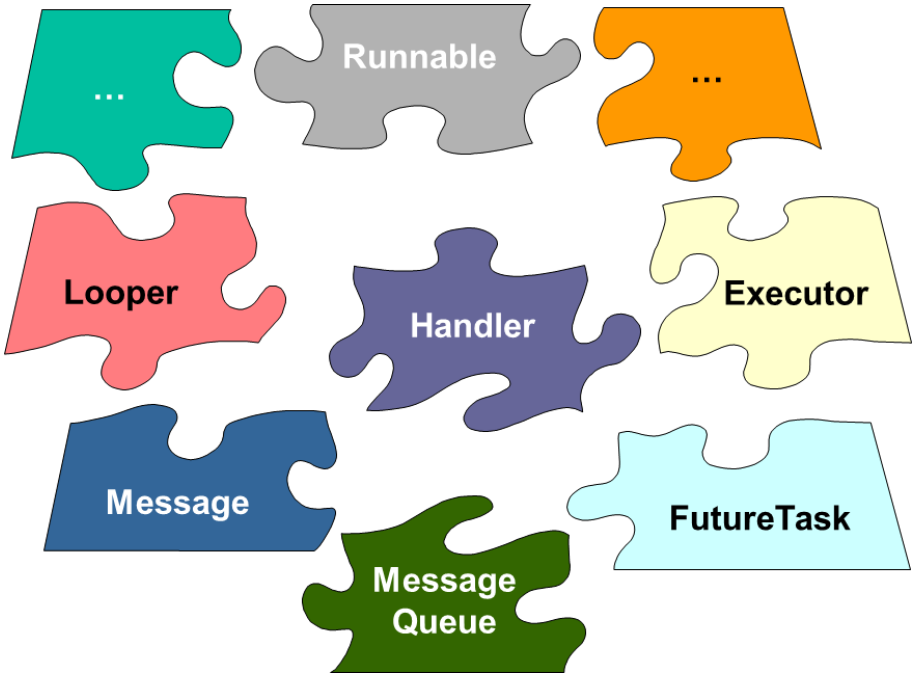
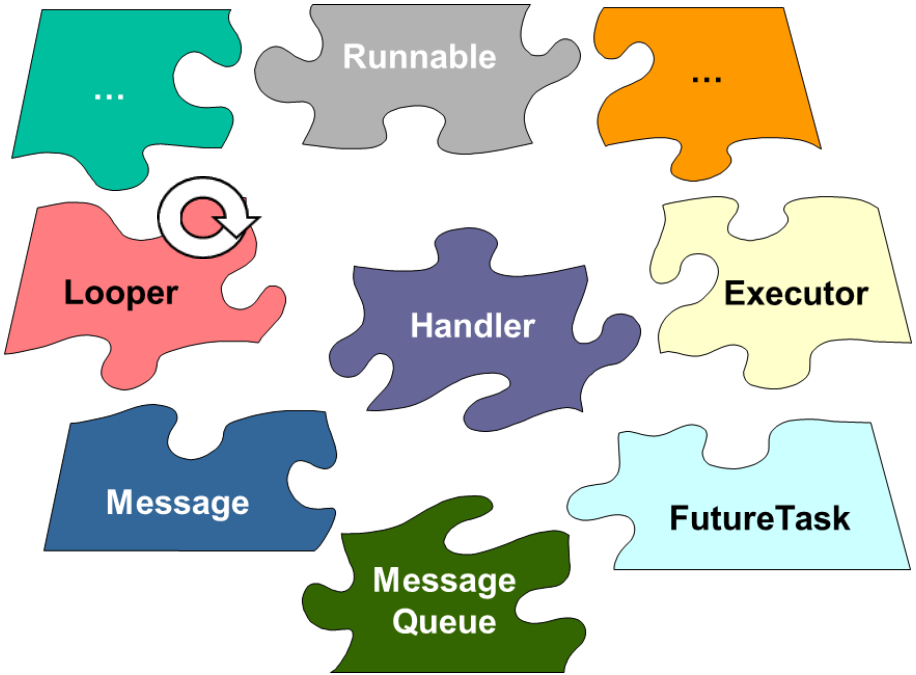
  - Exhibit “inversion of control” (IoC) via callbacks



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



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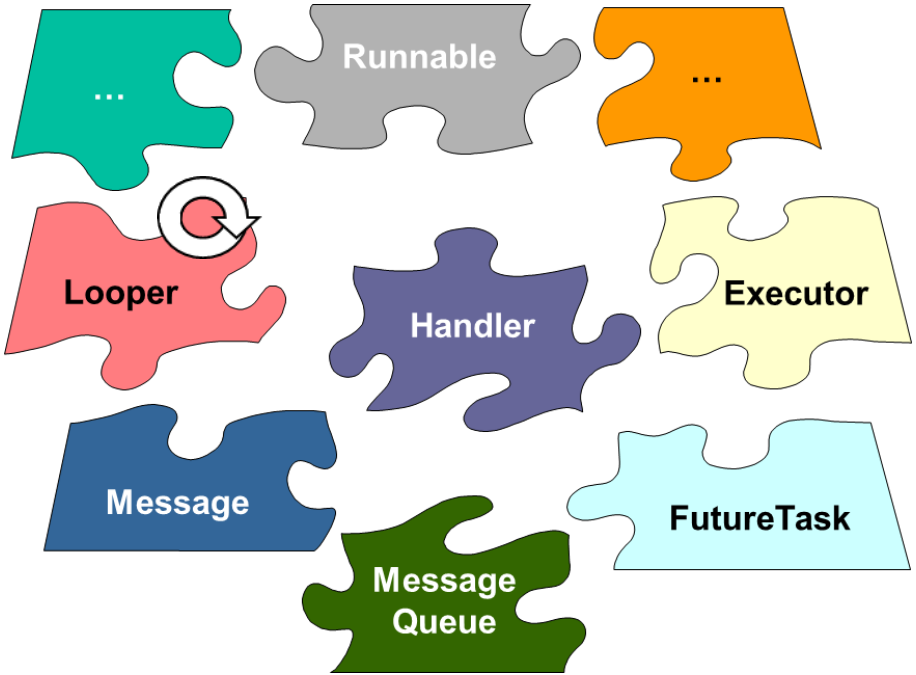
    - Framework controls the main execution thread
    - Decides how & when to run application code



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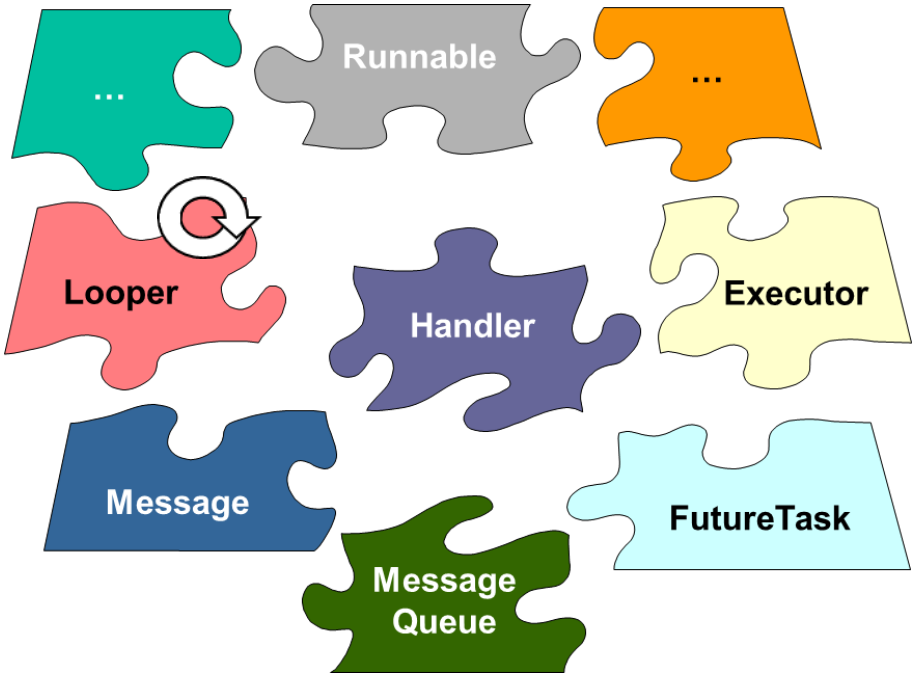
    - Framework controls the main execution thread
    - Decides how & when to run application code
    - This inversion of control is often called the “Hollywood Principle”



See www.dre.vanderbilt.edu/~schmidt/Coursera/articles/hollywood-principle.txt

Overview of Object-Oriented Frameworks

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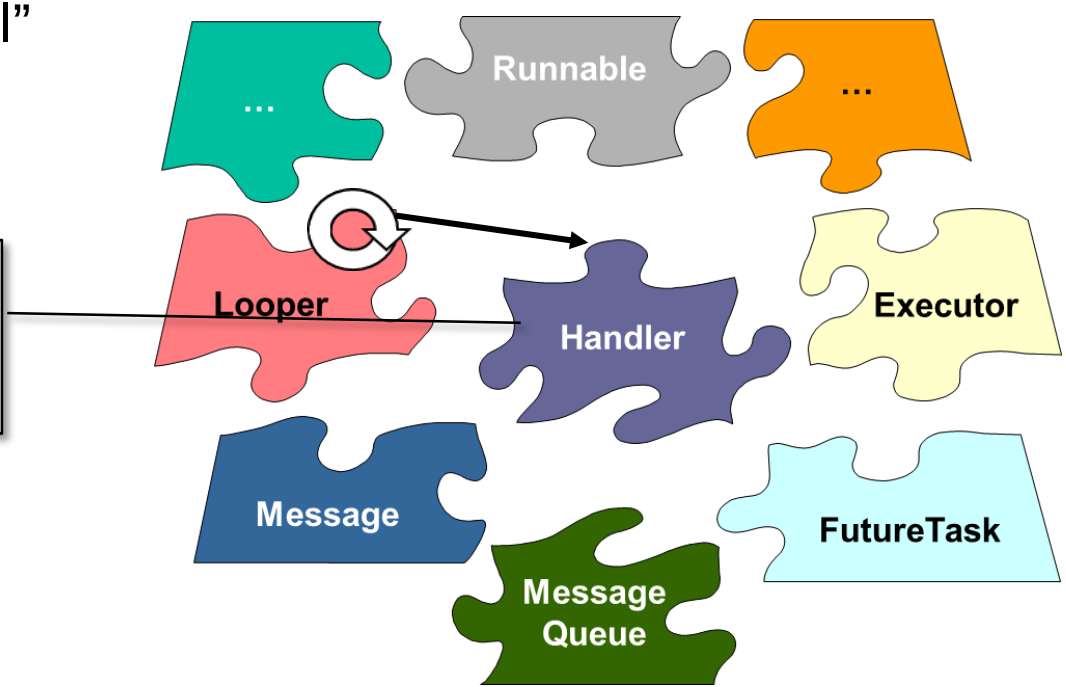
e.g., an Android looper dispatches a handler, which then dispatches a runnable



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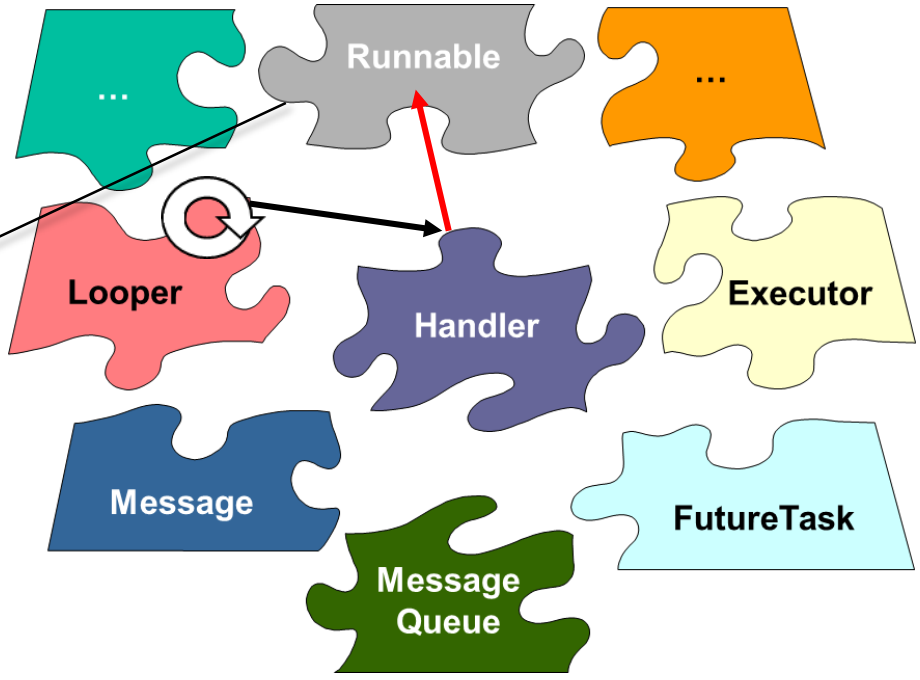
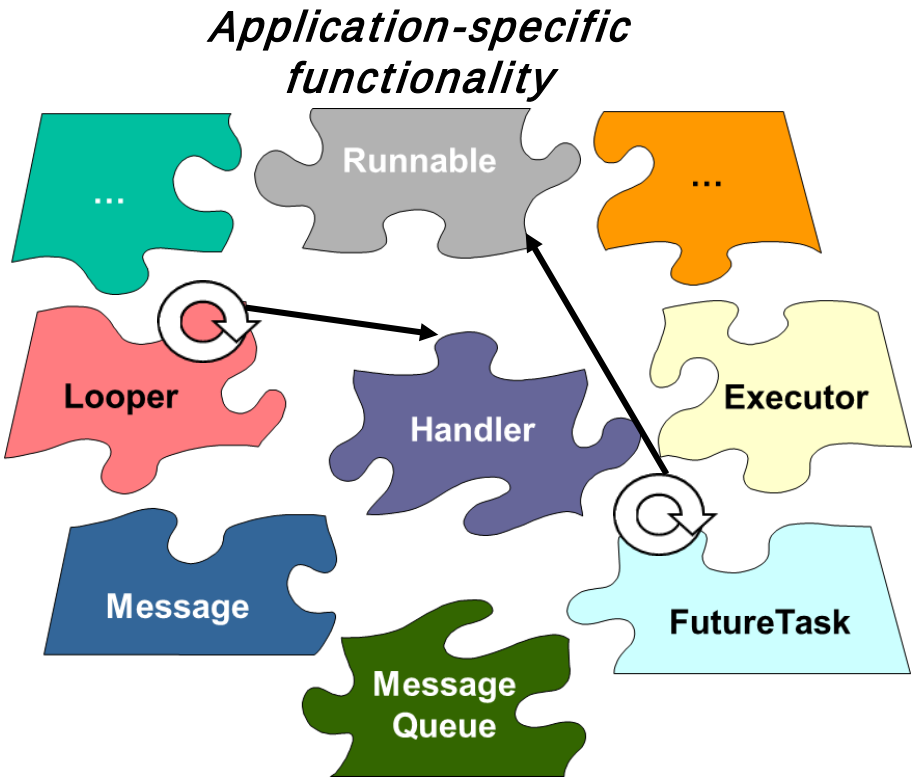


The runnable dispatched via IoC doesn't know/care how/why it was called back

Overview of Object-Oriented Frameworks

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



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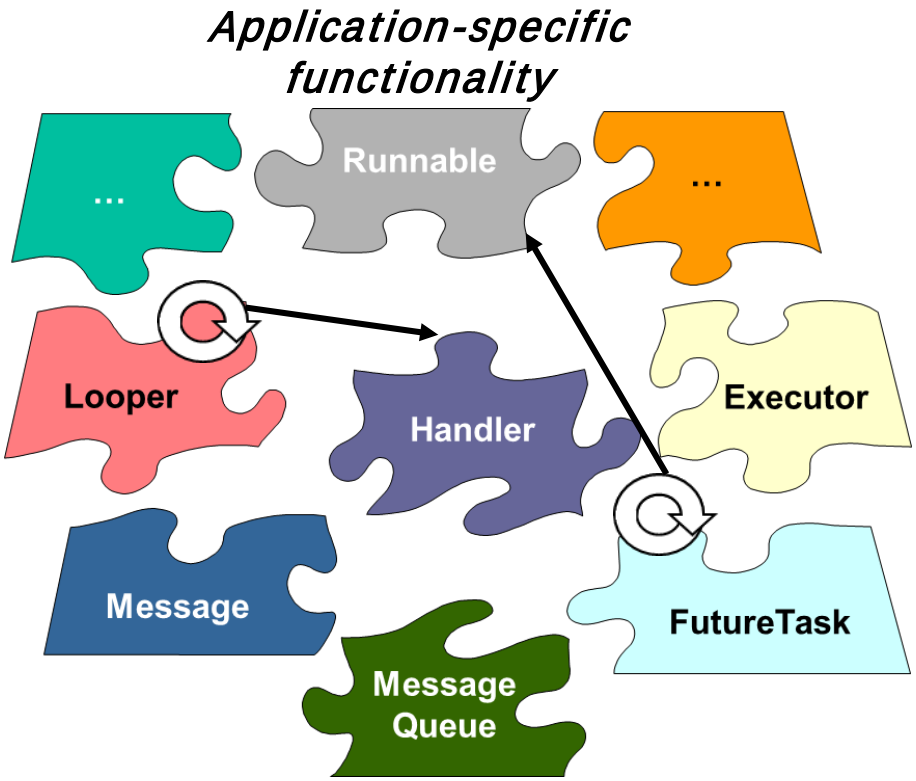

Android's frameworks focus on domains associated with mobile apps & services

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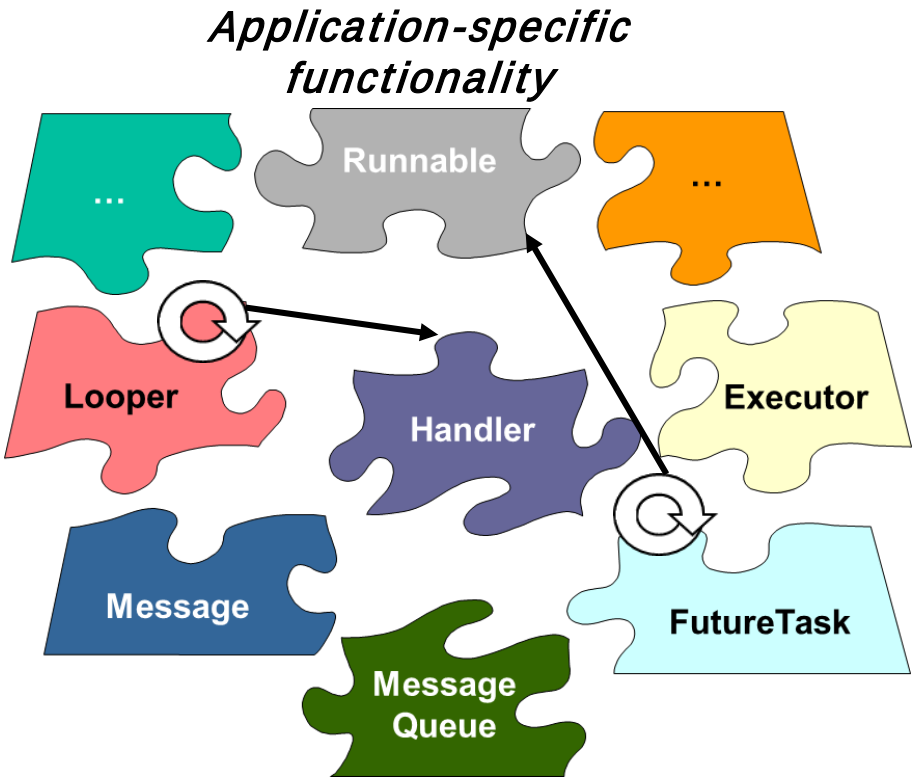

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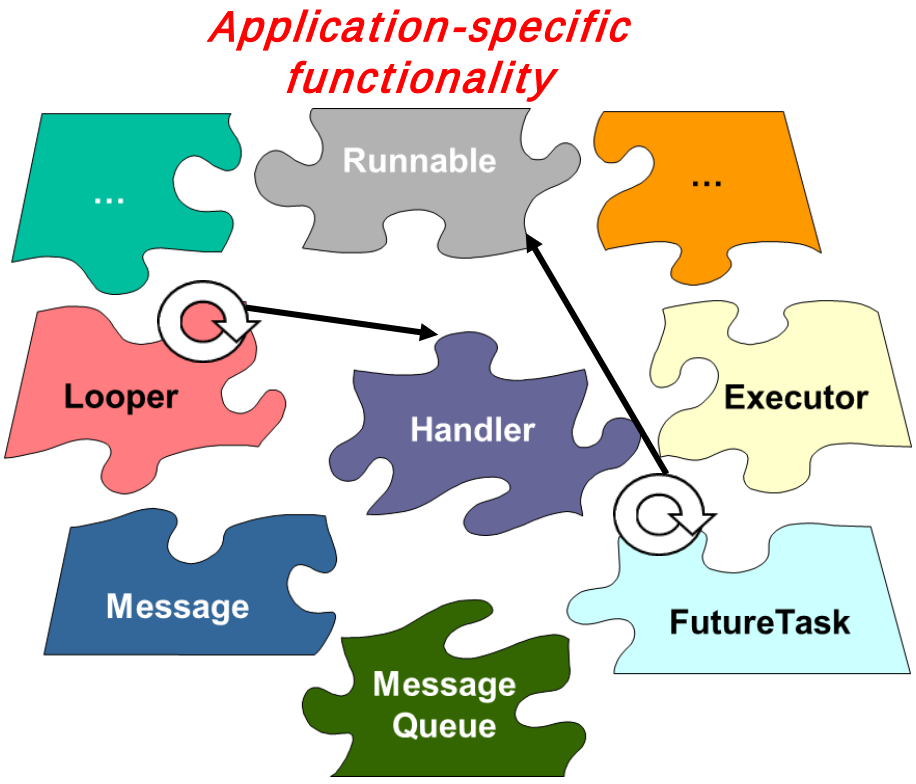
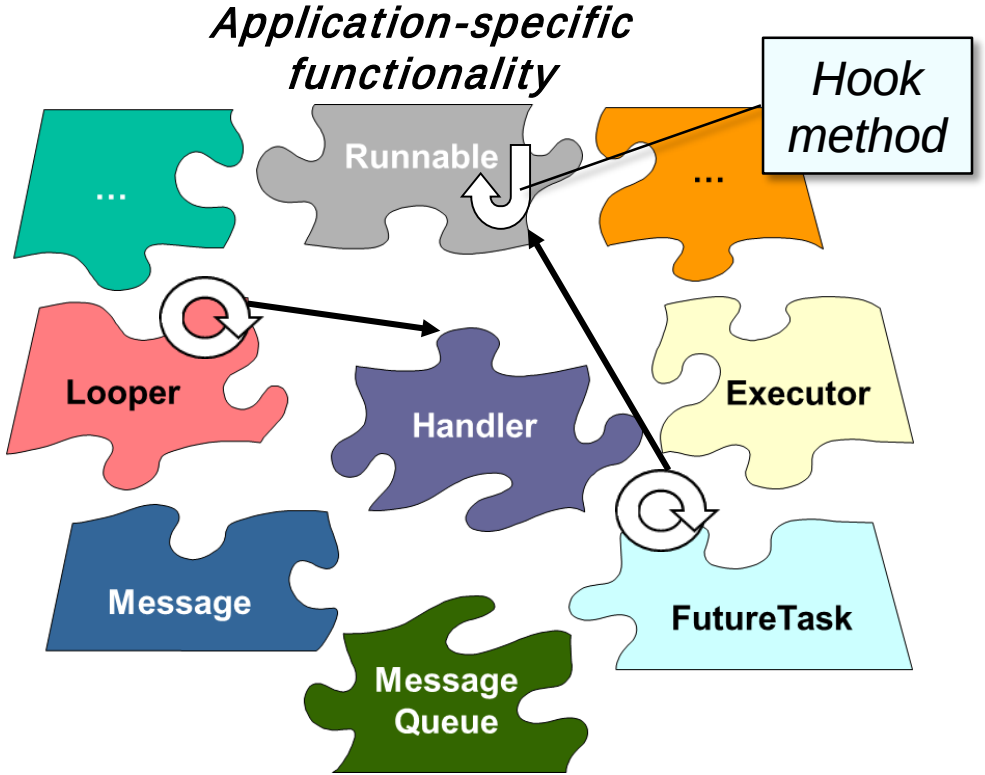


Application-specific functionality can systematically reuse framework components

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"



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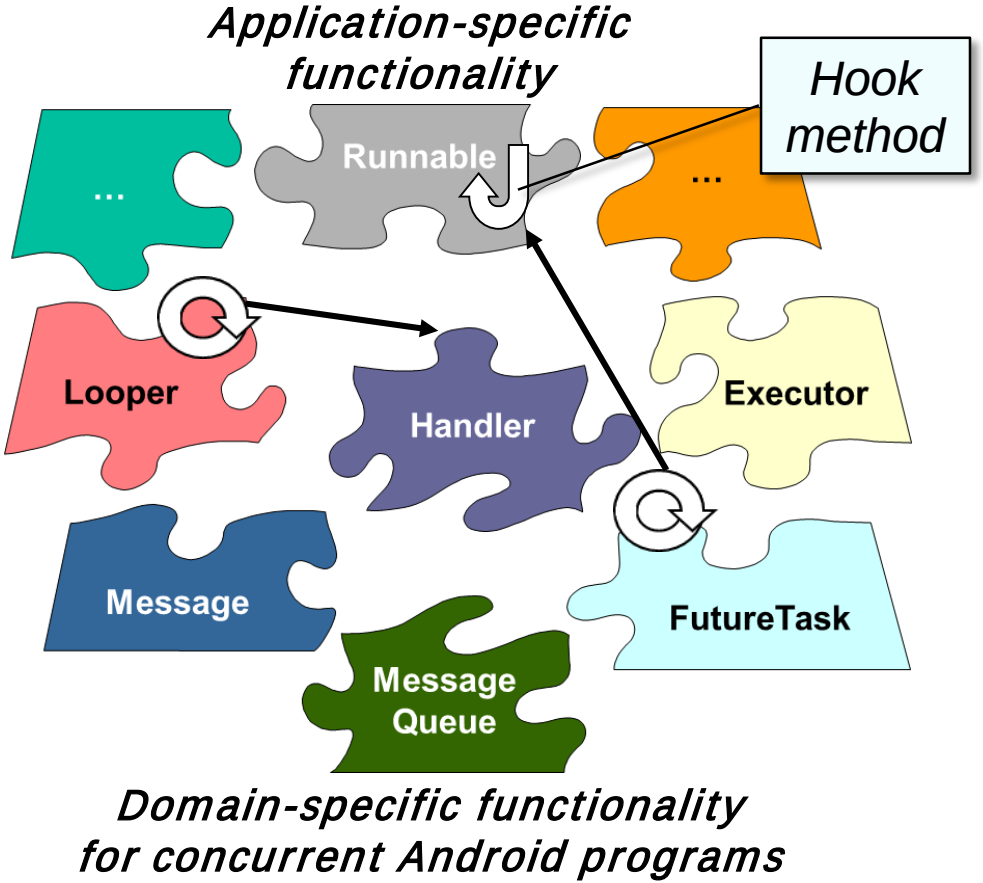
- Frameworks have 3 characteristics
  - Exhibit "inversion of control" (IoC) via callbacks
  - Integrated domain-specific structure & functionality
  - Provide a "semi-complete application"
    - *Hook methods* plug app logic into the framework



Hook methods implement patterns that customize framework components

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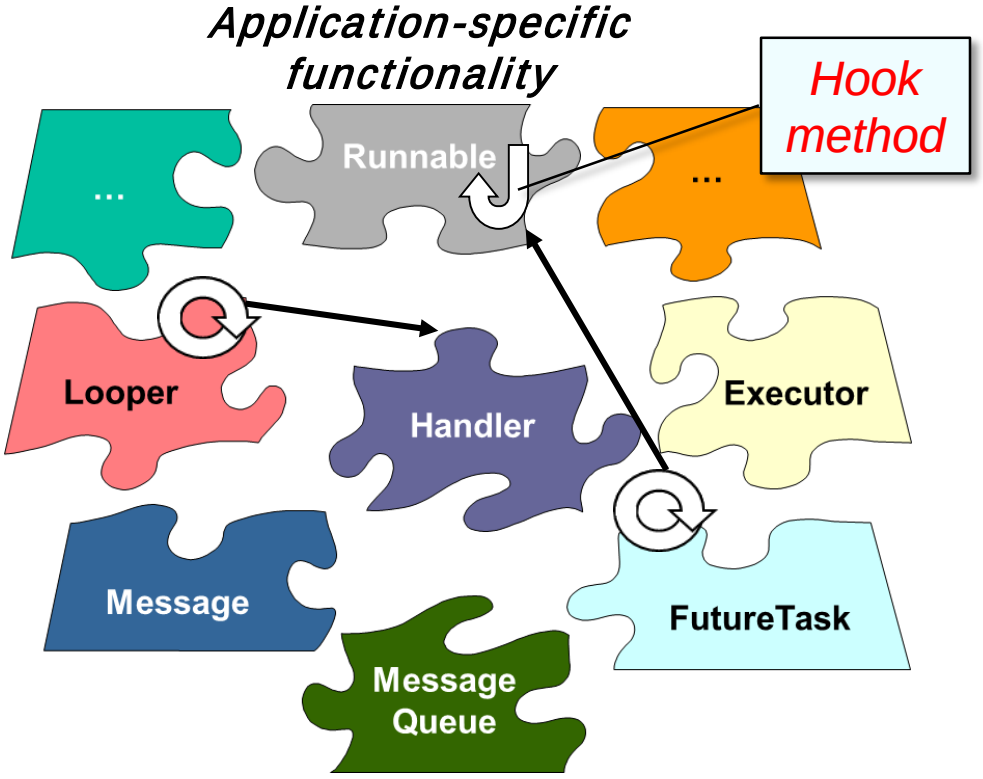
- Frameworks have 3 characteristics
  - Exhibit "inversion of control" (IoC) via callbacks
  - Integrated domain-specific structure & functionality
  - Provide a "semi-complete application"
    - *Hook methods* plug app logic into the framework
    - Mediate interactions among *common* abstract & *variant*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



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

Overview of Frameworks in Android & Java

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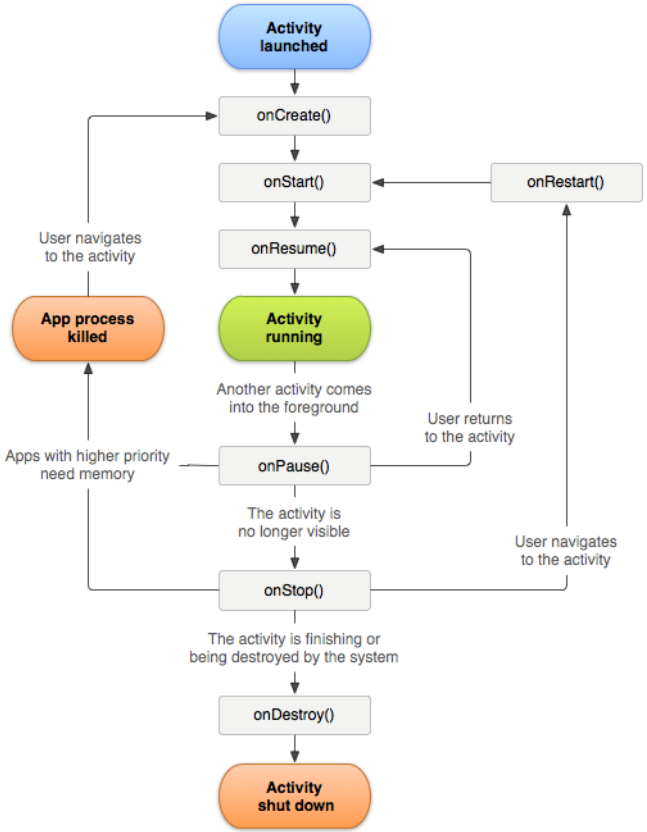
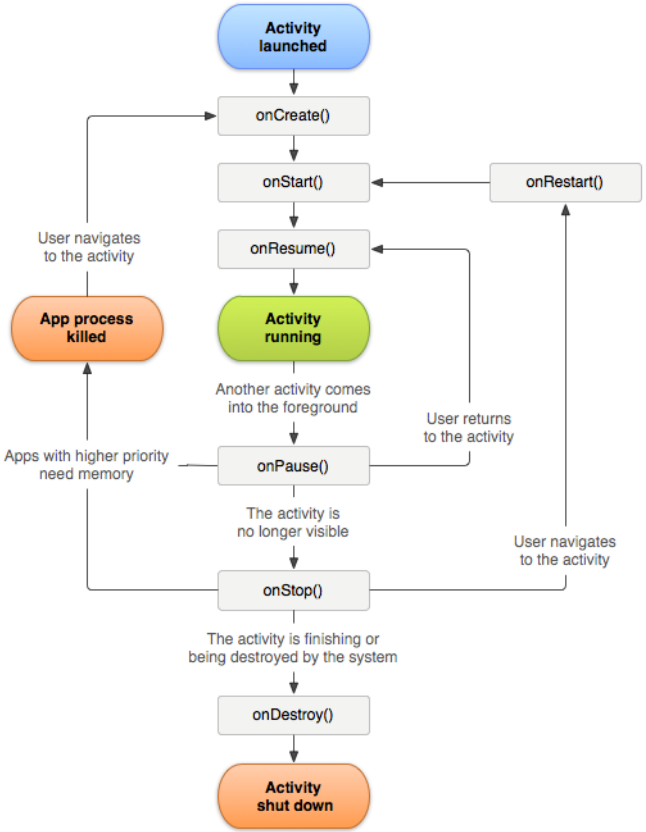
  - **Android**
    - Android activity framework controls the main thread



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

Overview of Frameworks in Android & Java

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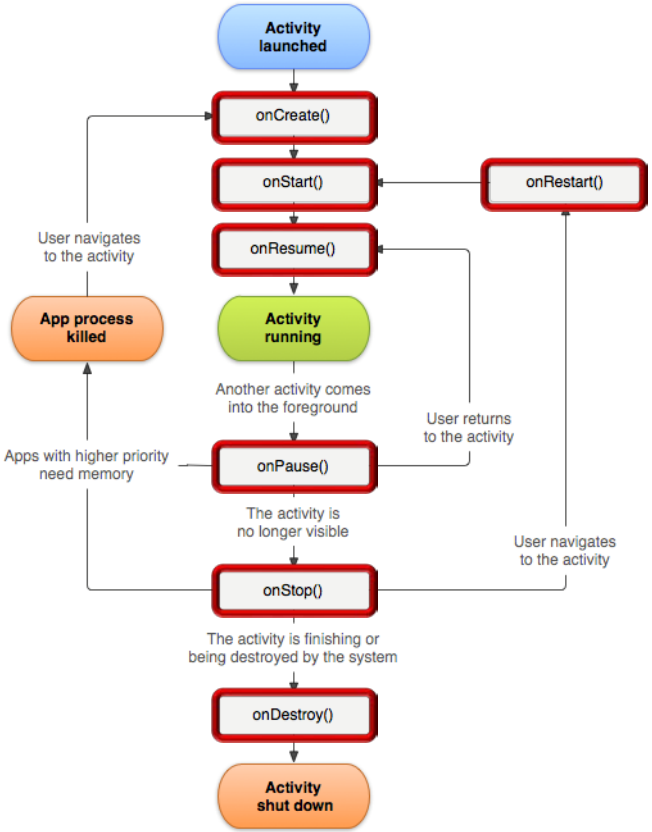
    - Android activity framework controls the main thread
    - An application's lifecycle methods are called back by Android's activity framework
      - e.g., onCreate(), onStart(), onStop(), onDestroy(), etc.



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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) {
       ...
  }});
```

A GUI component sending an event to its registered listener

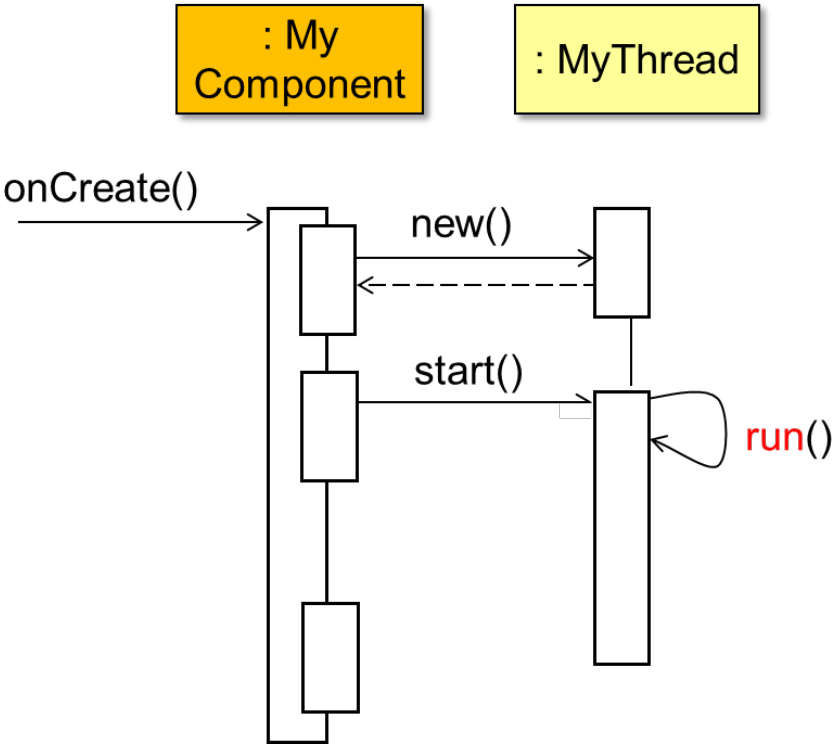
GUI Component (a button)

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

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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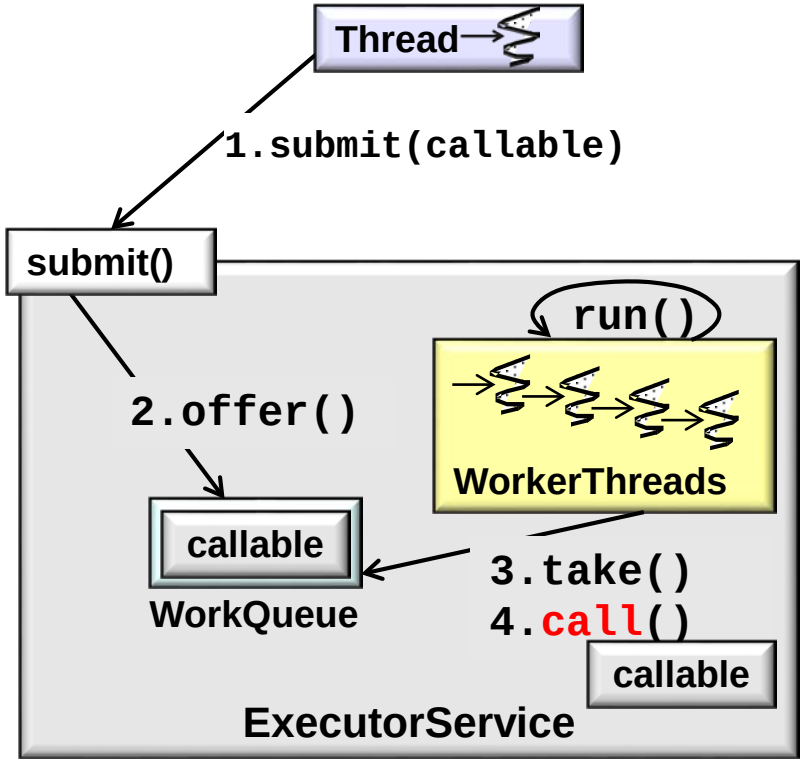
    - The ExecutorService calls back to the call() hook method of a Callable



See docs.oracle.com/javase/tutorial/essential/concurrency/executors.html

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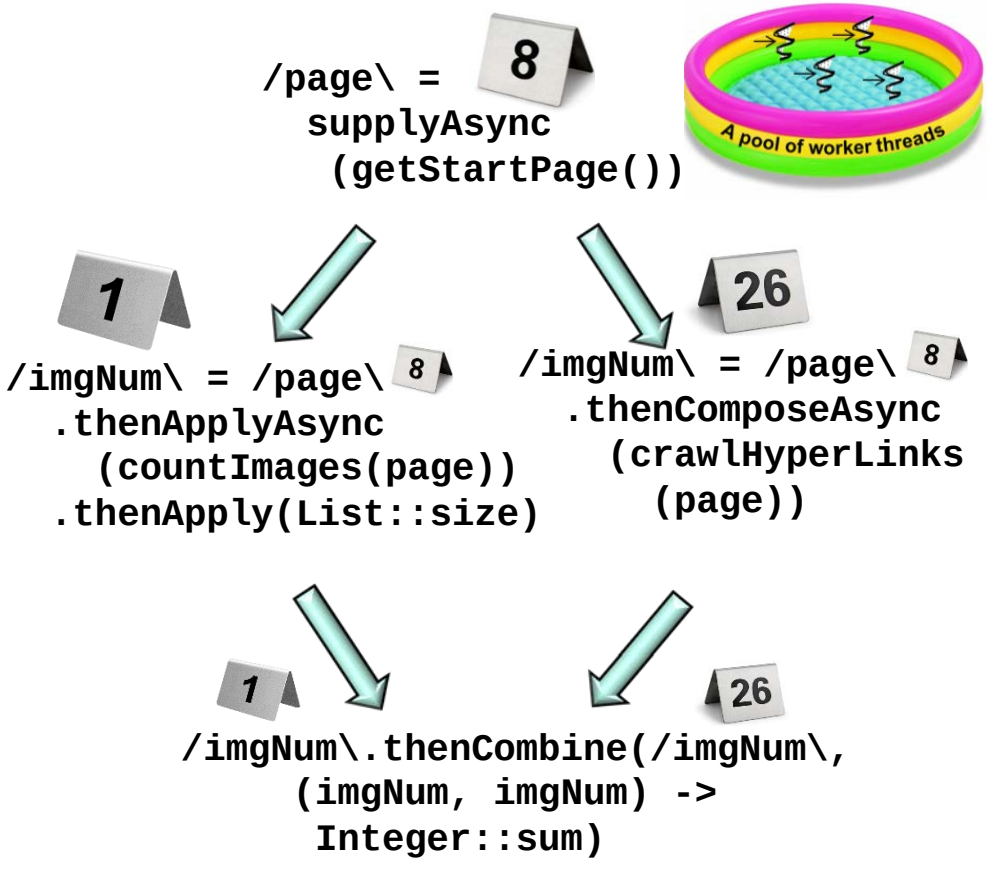
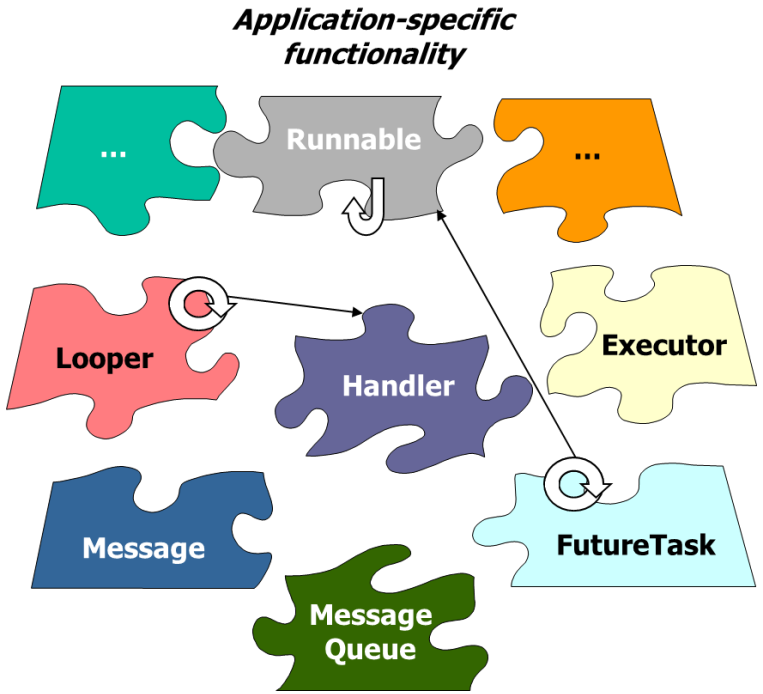
- Android & Java provide many frameworks
  - Android
  - **Java**
    - A thread calls back to the run() hook method of a Runnable
    - The ExecutorService calls back to the call() hook method of a Callable
    - Completable future & fork-join pool frameworks



See docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html

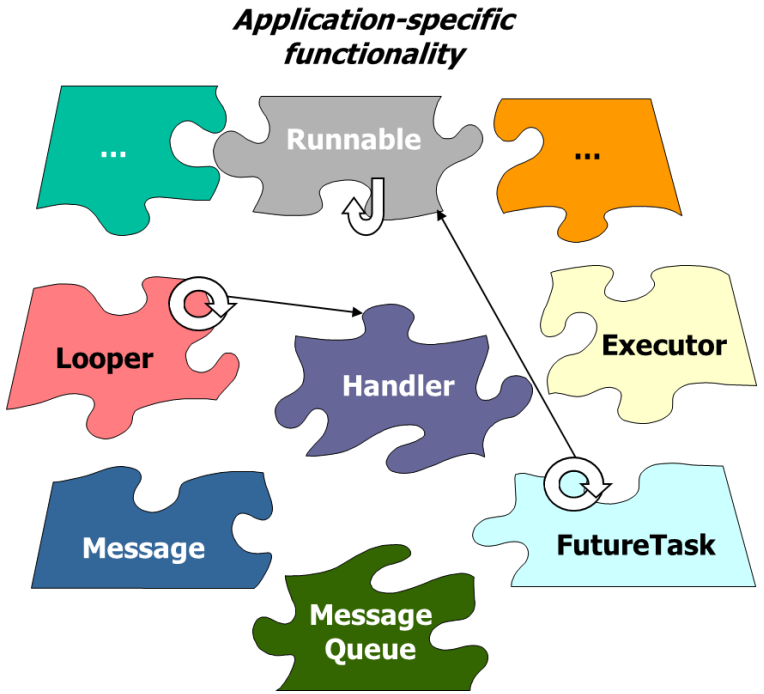
Overview of Frameworks in Android & Java

- Most code you write in this course will use one or more frameworks



Overview of Frameworks in Android & Java

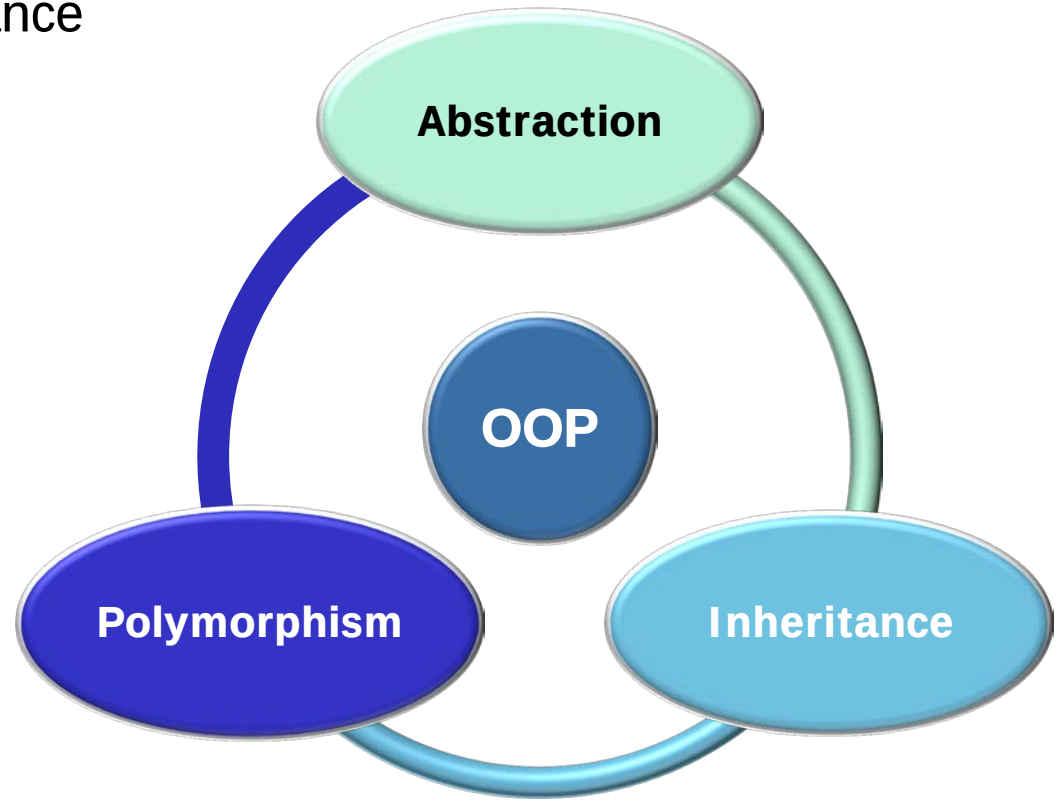
- Most code you write in this course will use one or more frameworks
  - Some of your solutions will implement your own framework



All Android apps run inside of one or more frameworks

Overview of Frameworks in Android & Java

- Frameworks use Java's inheritance & polymorphism features



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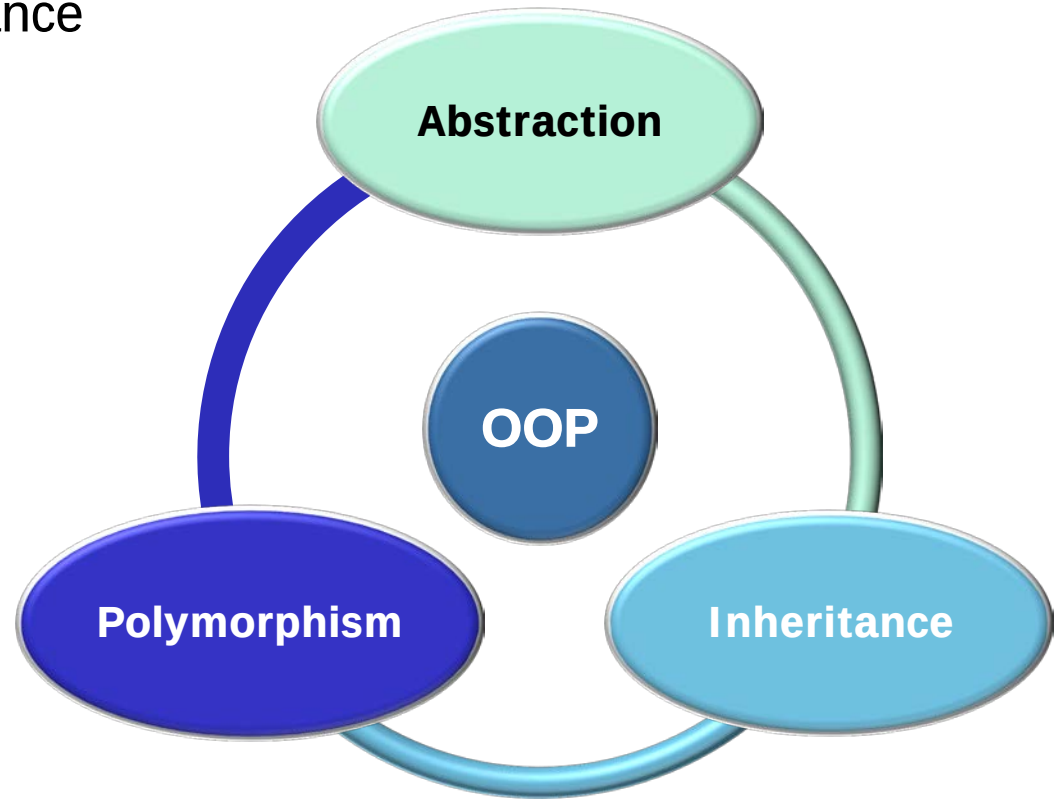

See our *Java For Android* MOOC for more info on inheritance & polymorphism

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  - Abstract classes & interfaces provide extension mechanisms

```
public interface Runnable {
  public void run();
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  - Concrete implementations of abstract classes & interfaces are passed to framework

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

Anonymous instance of an anonymous inner class

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Anonymous instance of a lambda expression

```
new Thread(() ->
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```

See www.drdobbs.com/jvm/lambda-expressions-in-java-8/240166764

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