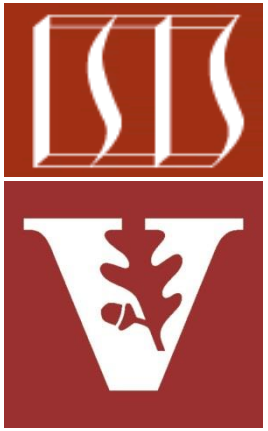
Android Concurrency Frameworks: Structure & Functionality

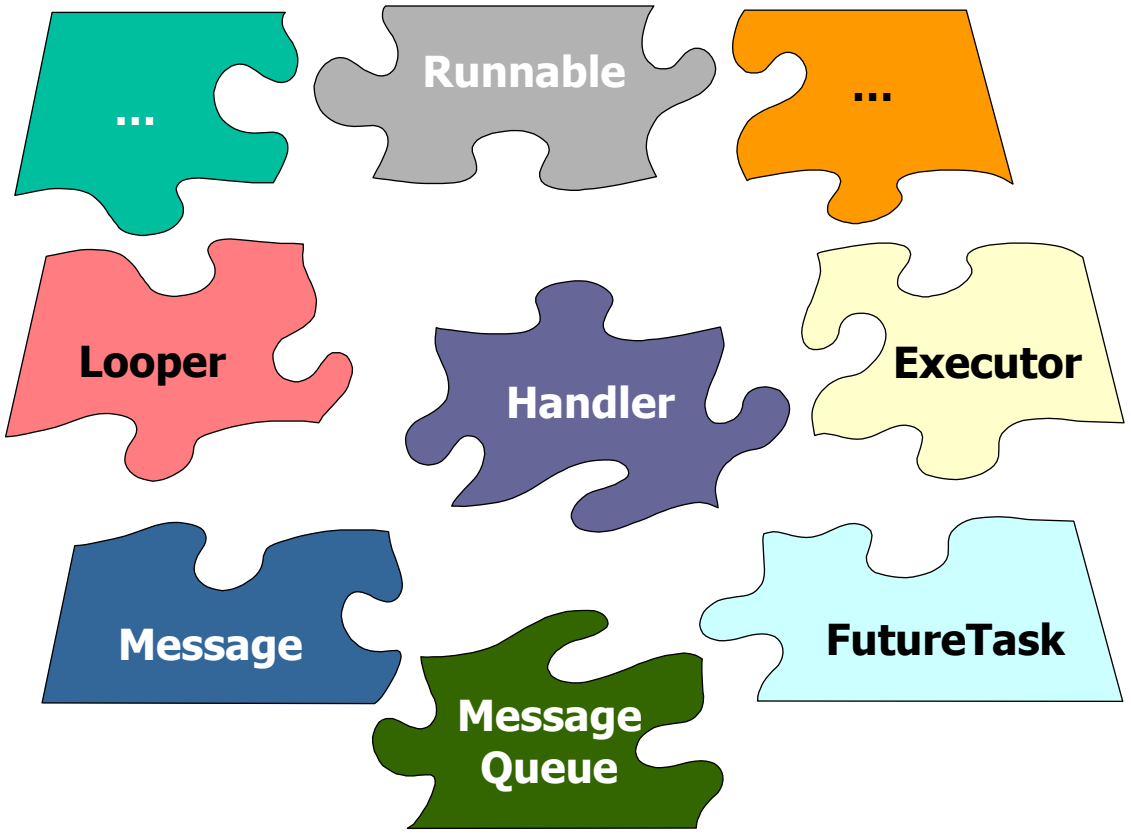


Douglas C. Schmidt
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

Institute for Software
Integrated Systems
Vanderbilt University
Nashville, Tennessee, USA

Learning Objectives in this Part of the Lesson

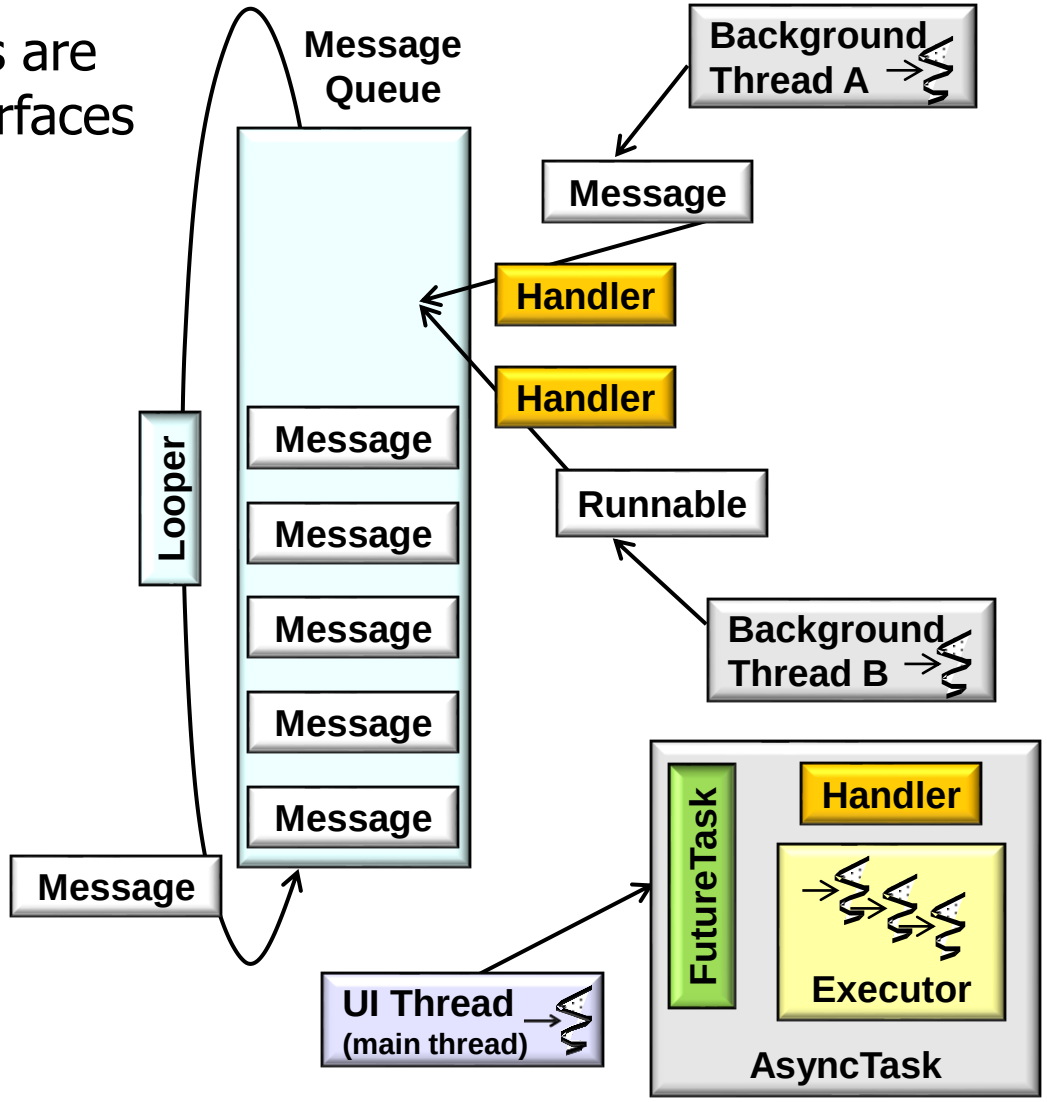
- Know the motivations for Android concurrency & concurrency frameworks
- Recognize the two types of Android concurrency frameworks
- Understand the structure & functionality of Android's concurrency frameworks



Elements of Android Concurrency Frameworks

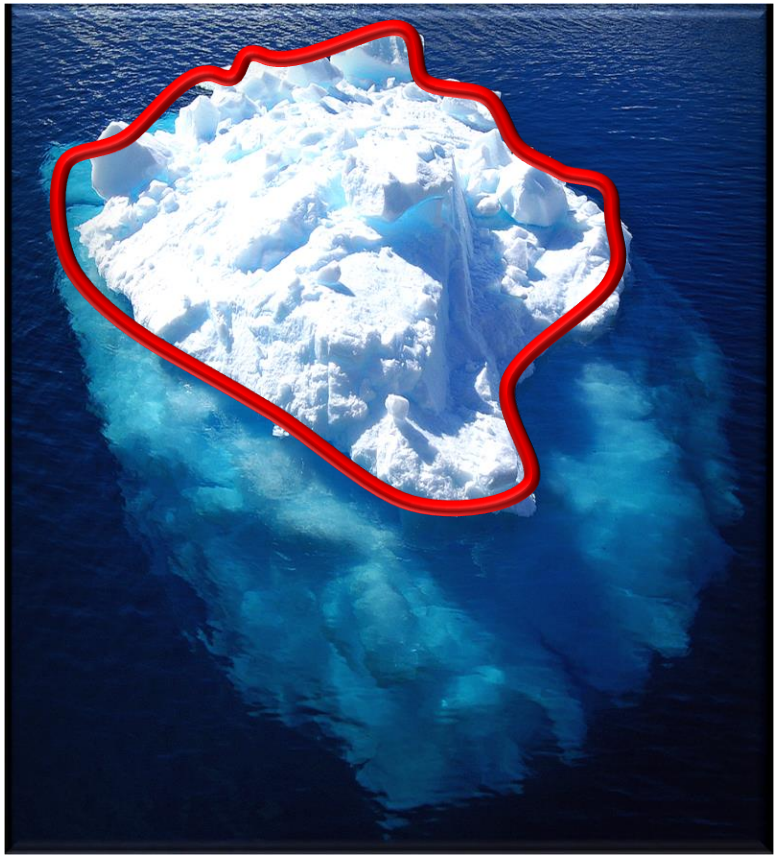
Elements of Android Concurrency Frameworks

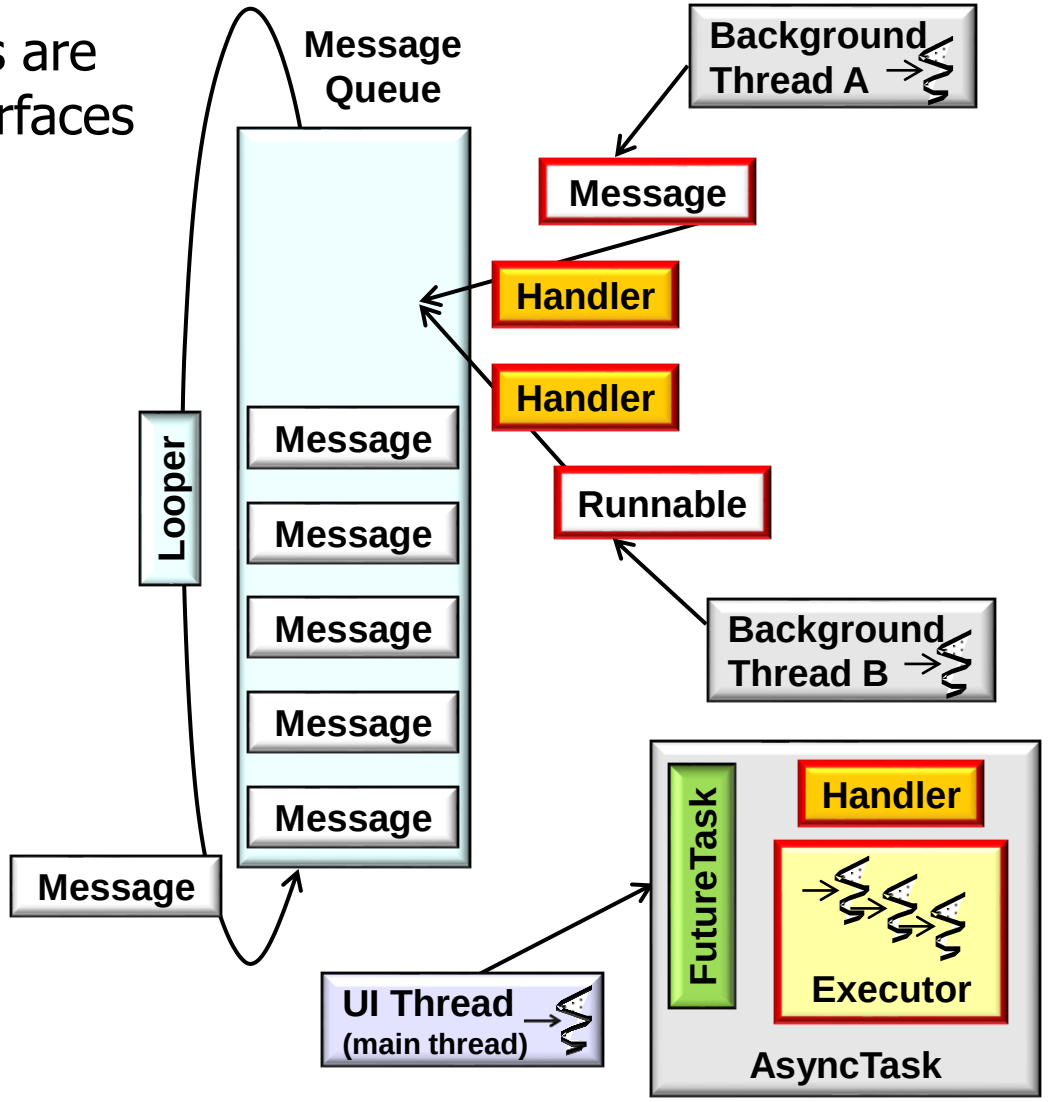
- Android's concurrency frameworks are built using reusable classes & interfaces



Elements of Android Concurrency Frameworks

- Android's concurrency frameworks are built using reusable classes & interfaces

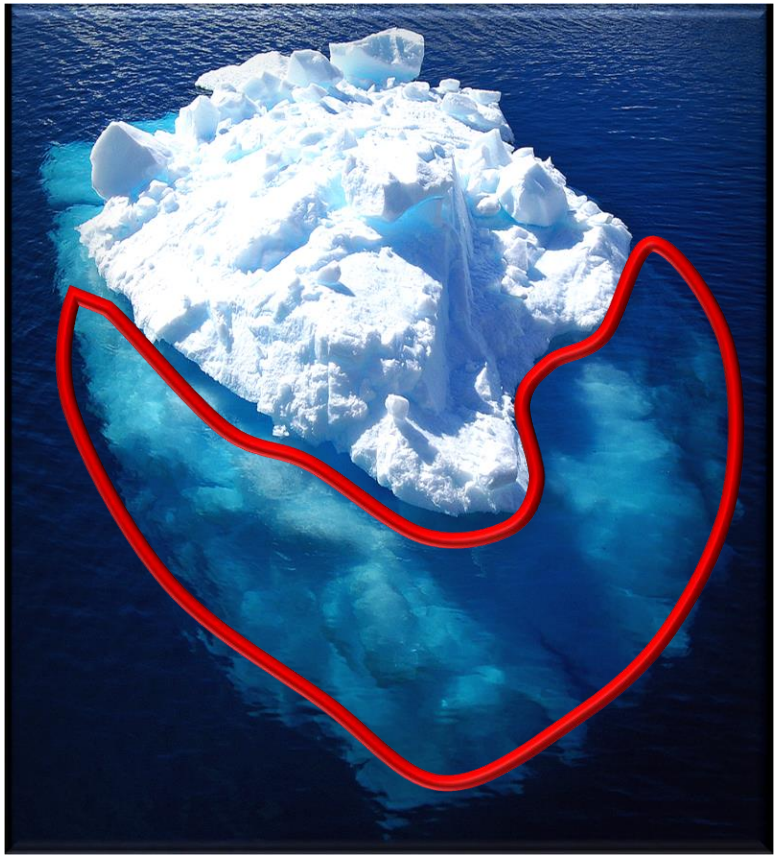


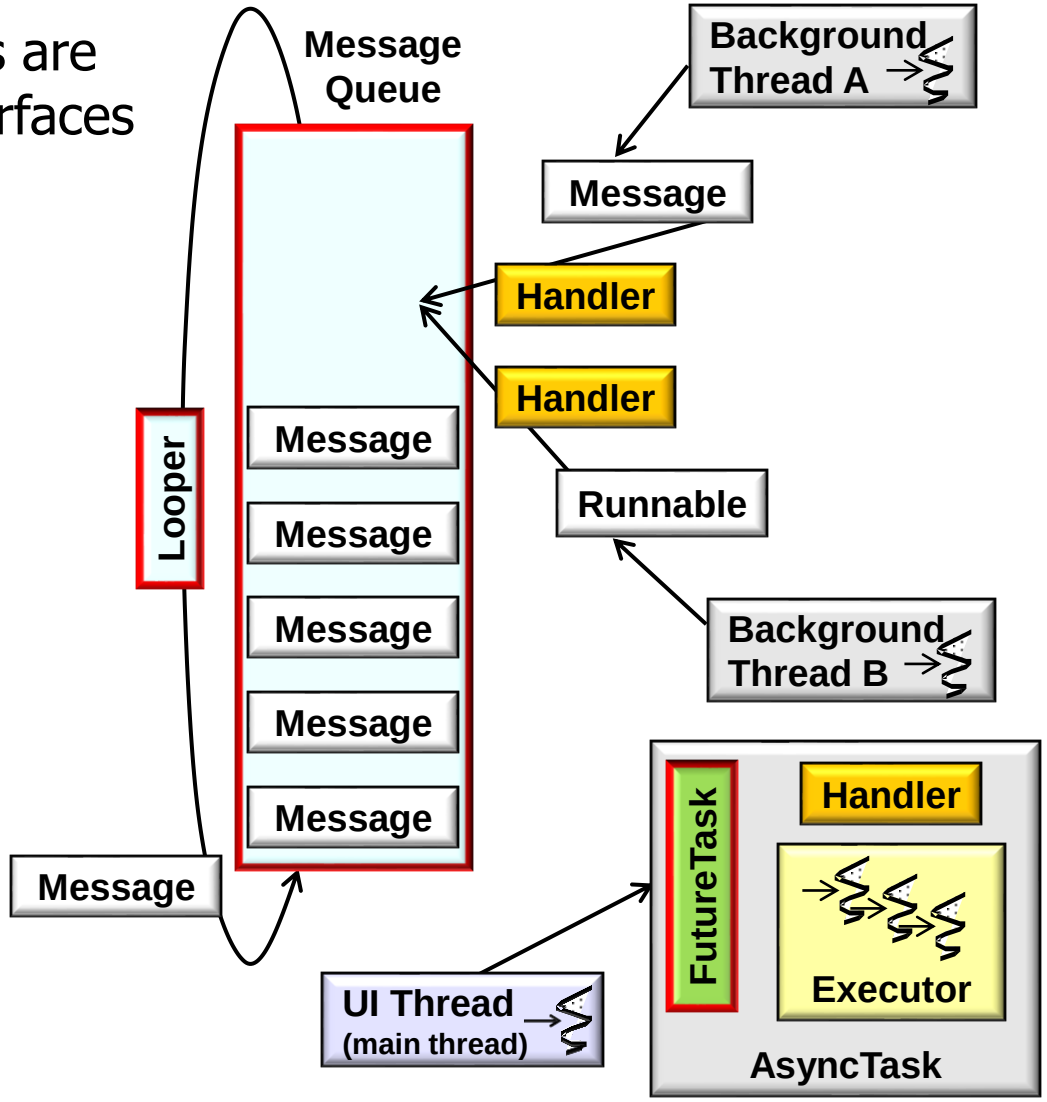


We focus on classes/interfaces used to write concurrent Android programs

Elements of Android Concurrency Frameworks

- Android's concurrency frameworks are built using reusable classes & interfaces



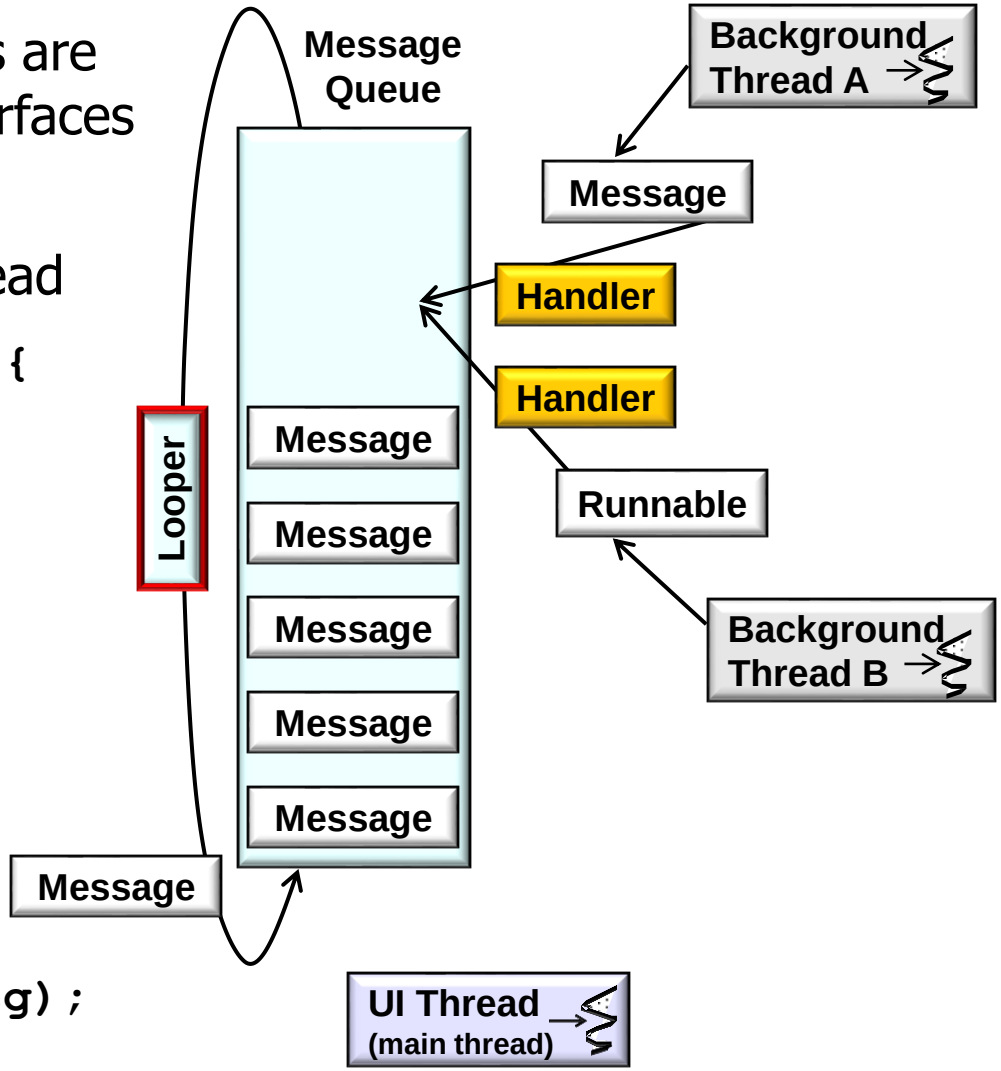


We'll also outline the implementation of Android's concurrency frameworks

Elements of Android Concurrency Frameworks

- Android's concurrency frameworks are built using reusable classes & interfaces
  - **Looper**
    - Run a message loop for a thread

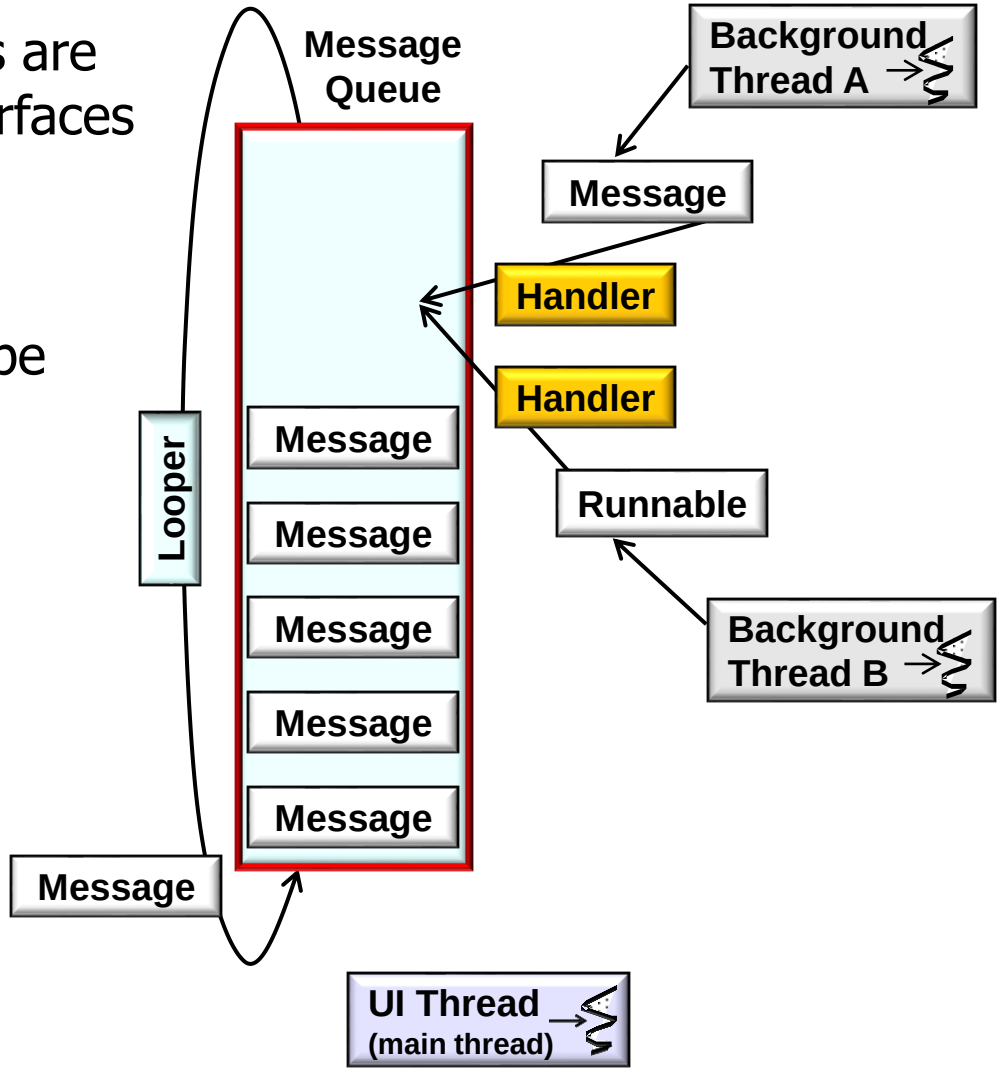
```
public static void loop() {
   final Looper me =
     myLooper();
   MessageQueue queue =
     me.mQueue;
   ...
     for (;;) {
       Message msg =
         queue.next();
       ...
       msg.target.
         dispatchMessage(msg);
       ...
    } ...
```



See developer.android.com/reference/android/os/Looper.html

Elements of Android Concurrency Frameworks

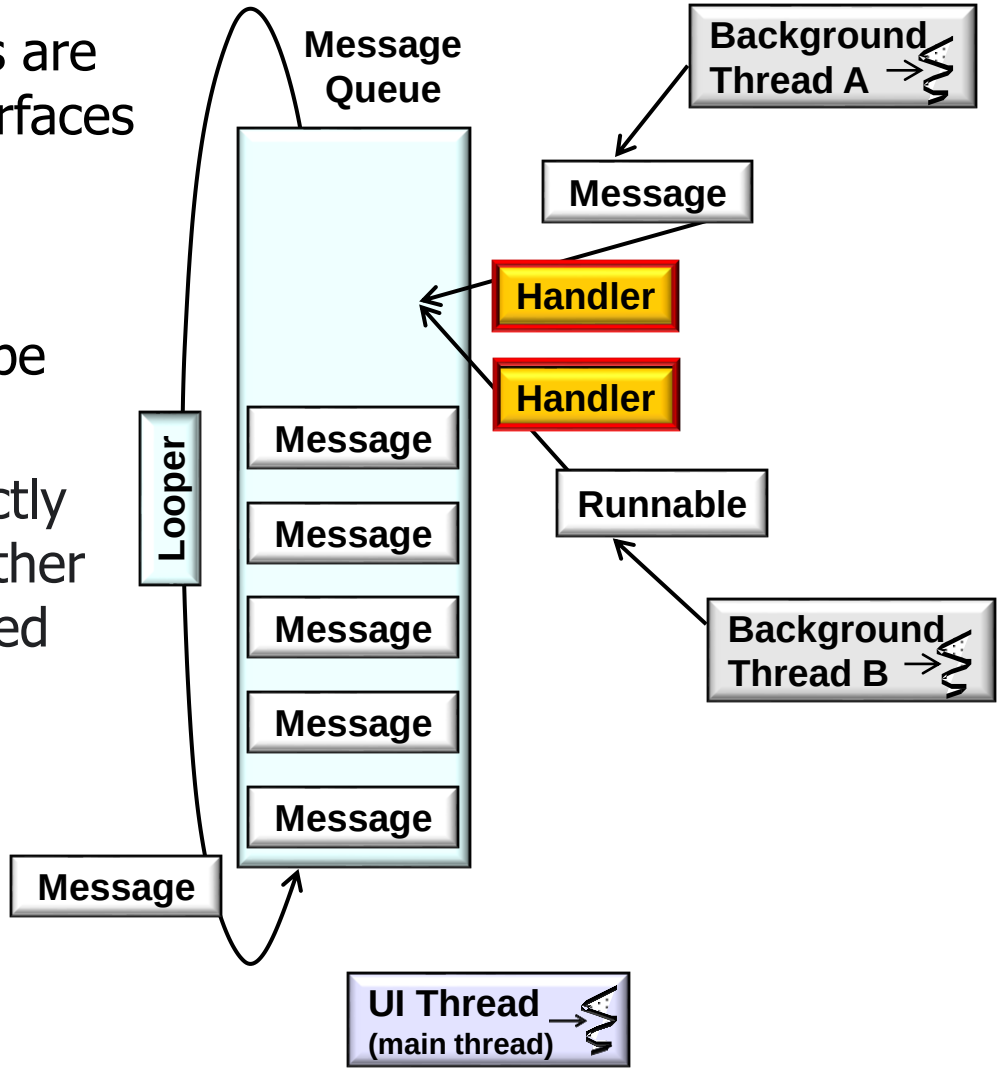
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - **MessageQueue**
    - Holds the list of messages to be dispatched by a looper



See developer.android.com/reference/android/os/MessageQueue.html

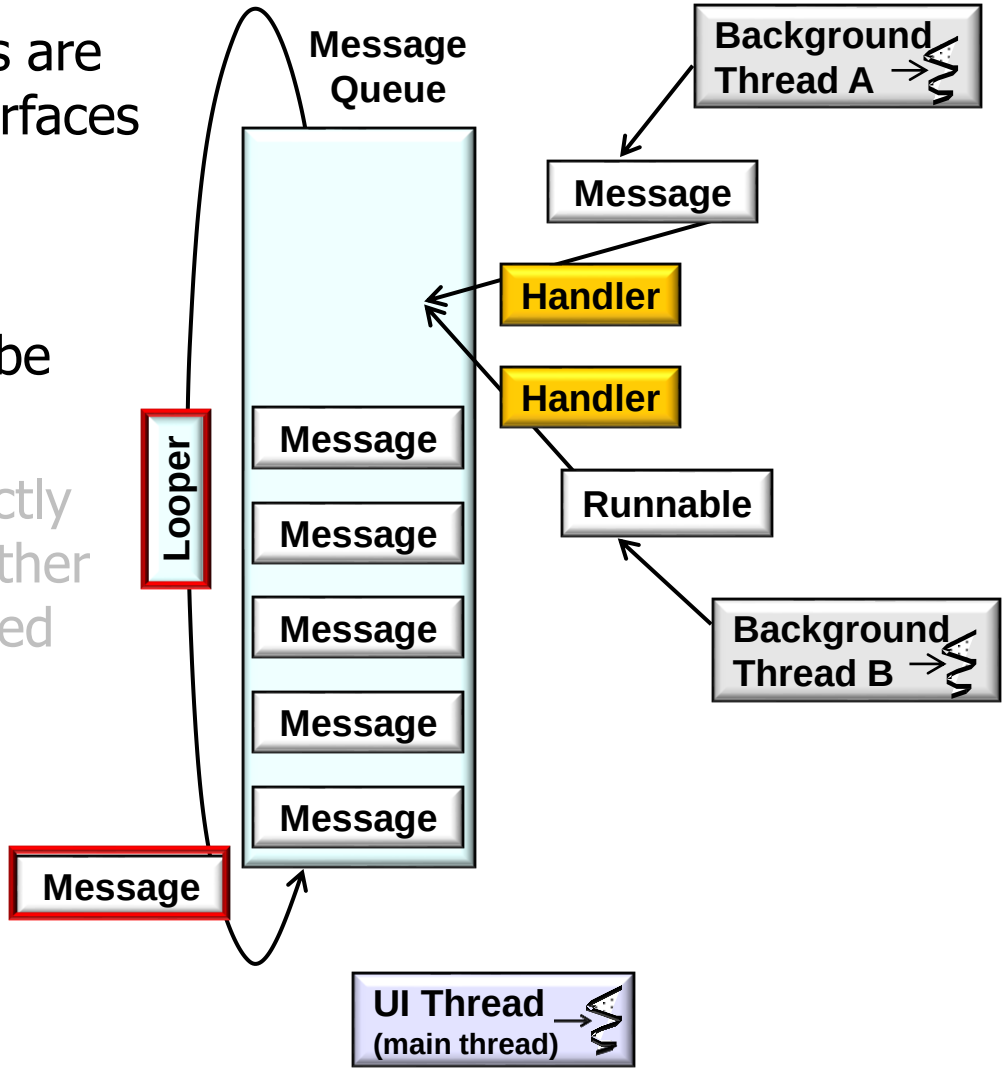
Elements of Android Concurrency Frameworks

- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - **MessageQueue**
    - Holds the list of messages to be dispatched by a looper
      - Messages aren't added directly to a message queue, but rather via handler objects associated with the looper



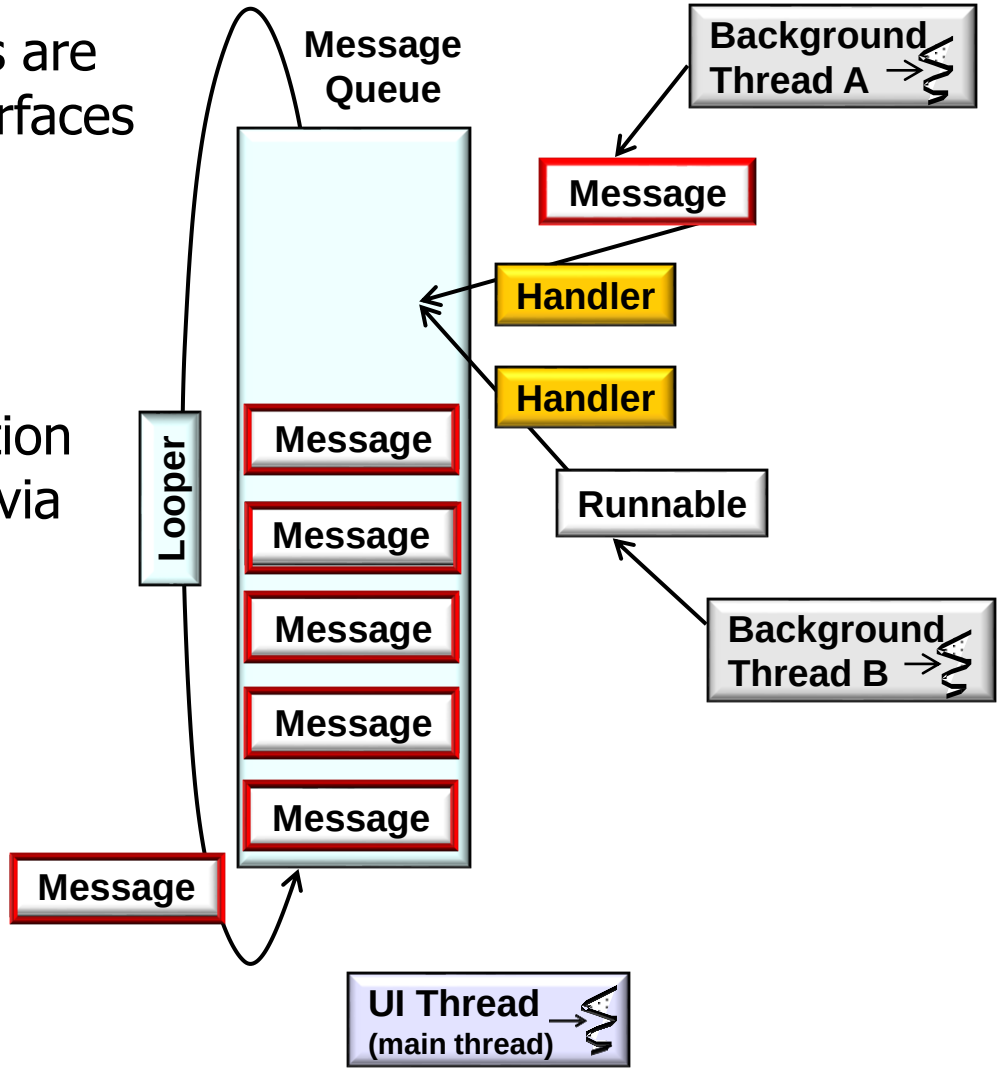
Elements of Android Concurrency Frameworks

- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - **MessageQueue**
    - Holds the list of messages to be dispatched by a looper
      - Messages aren't added directly to a message queue, but rather via handler objects associated with the looper
    - The looper blocks on the message queue until the next message is available



Elements of Android Concurrency Frameworks

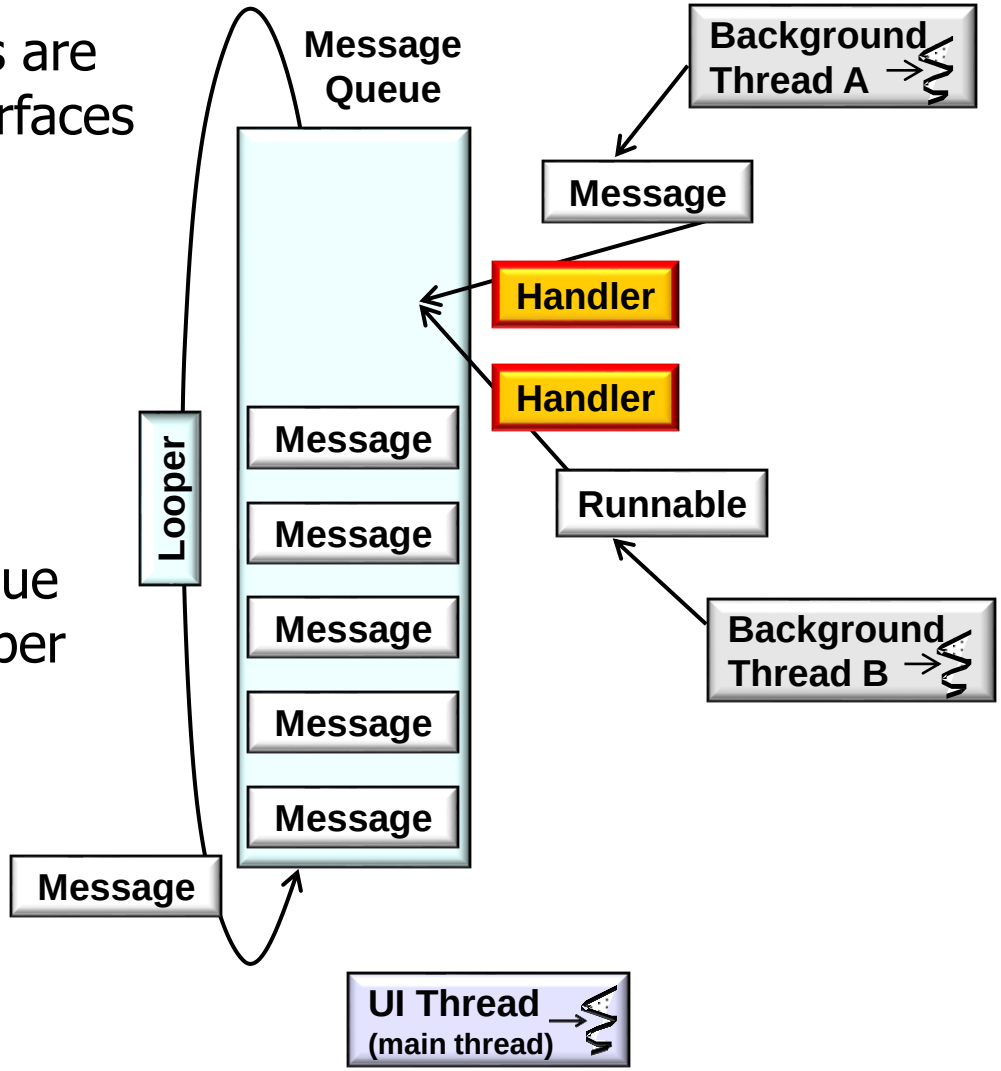
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - **Message**
    - Contains data & type information that can be sent to a handler via a message queue



See developer.android.com/reference/android/os/Message.html

Elements of Android Concurrency Frameworks

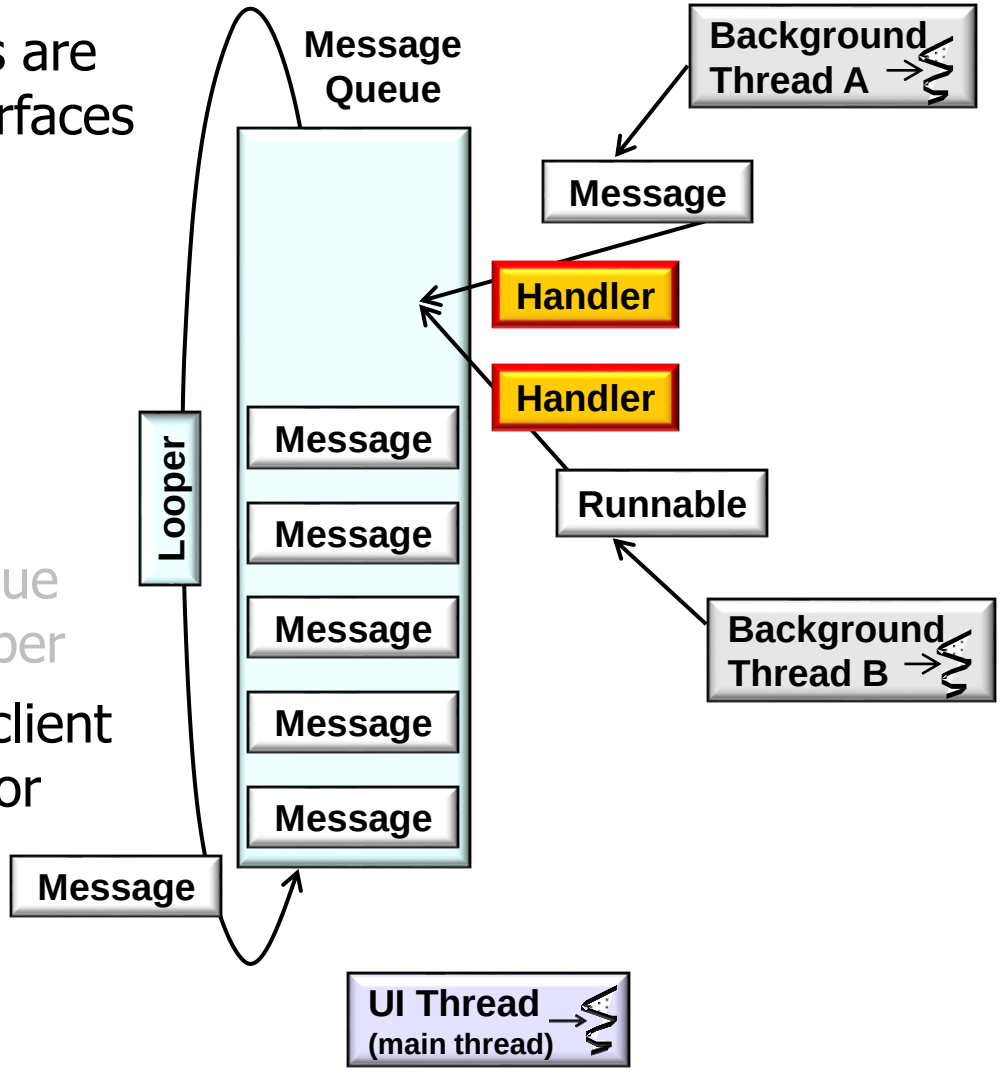
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - Message
  - **Handler**
    - Send/process messages & runnables in the message queue associated with a thread's looper



See developer.android.com/reference/android/os/Handler.html

Elements of Android Concurrency Frameworks

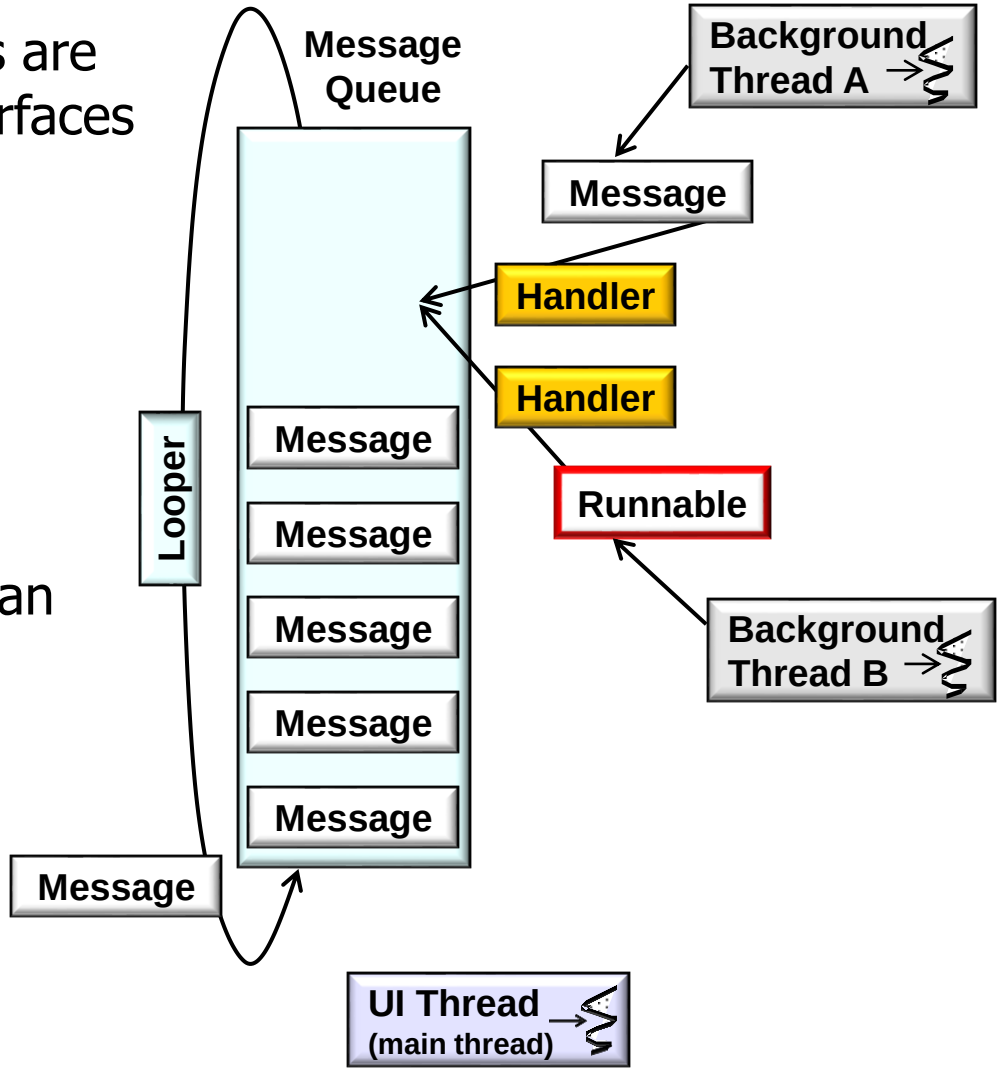
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - Message
  - **Handler**
    - Send/process messages & runnables in the message queue associated with a thread's looper
    - Plays the roles of a proxy for client thread & of a target adapter for dispatching in another thread



See en.wikipedia.org/wiki/Proxy_pattern & en.wikipedia.org/wiki/Adapter_pattern

Elements of Android Concurrency Frameworks

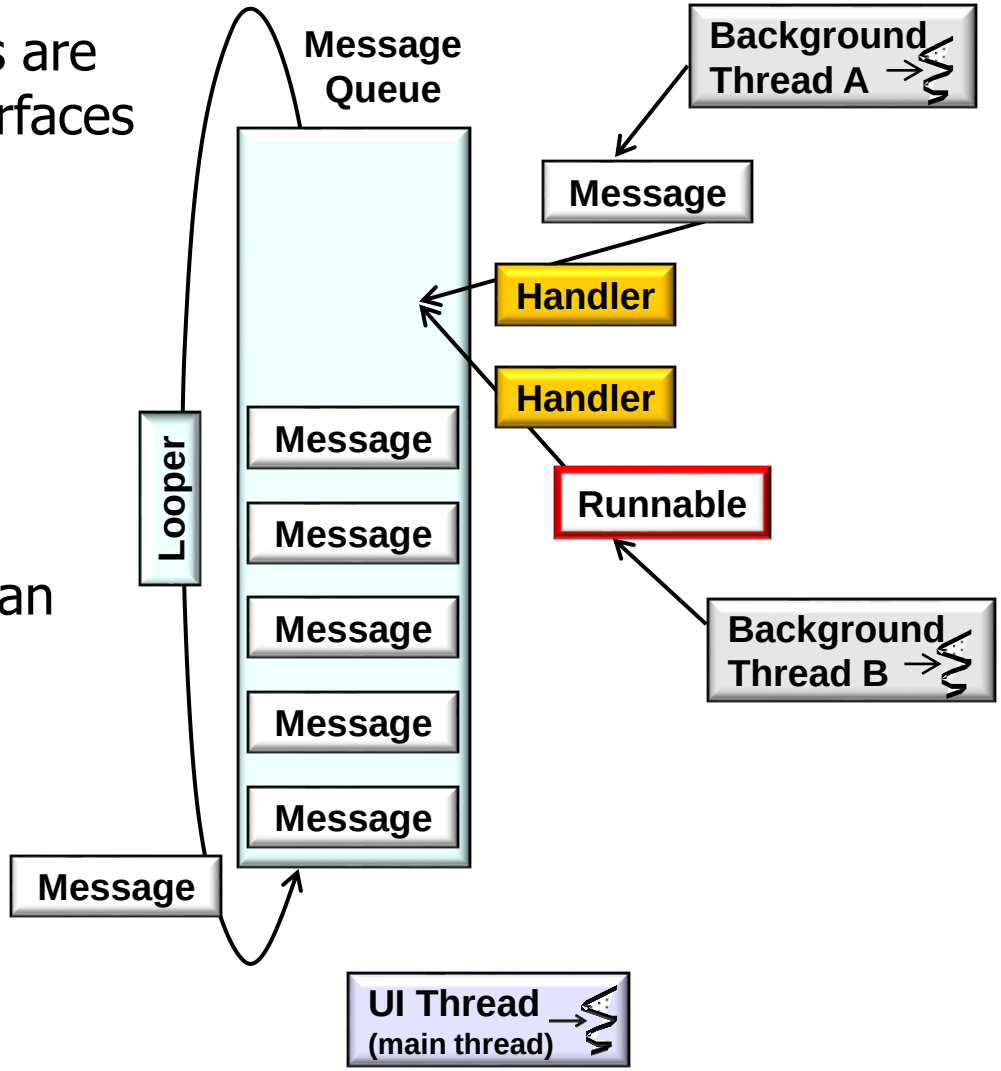
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - Message
  - Handler
  - **Runnable**
    - Represents a command that can be executed



See developer.android.com/reference/java/lang/Runnable.html

Elements of Android Concurrency Frameworks

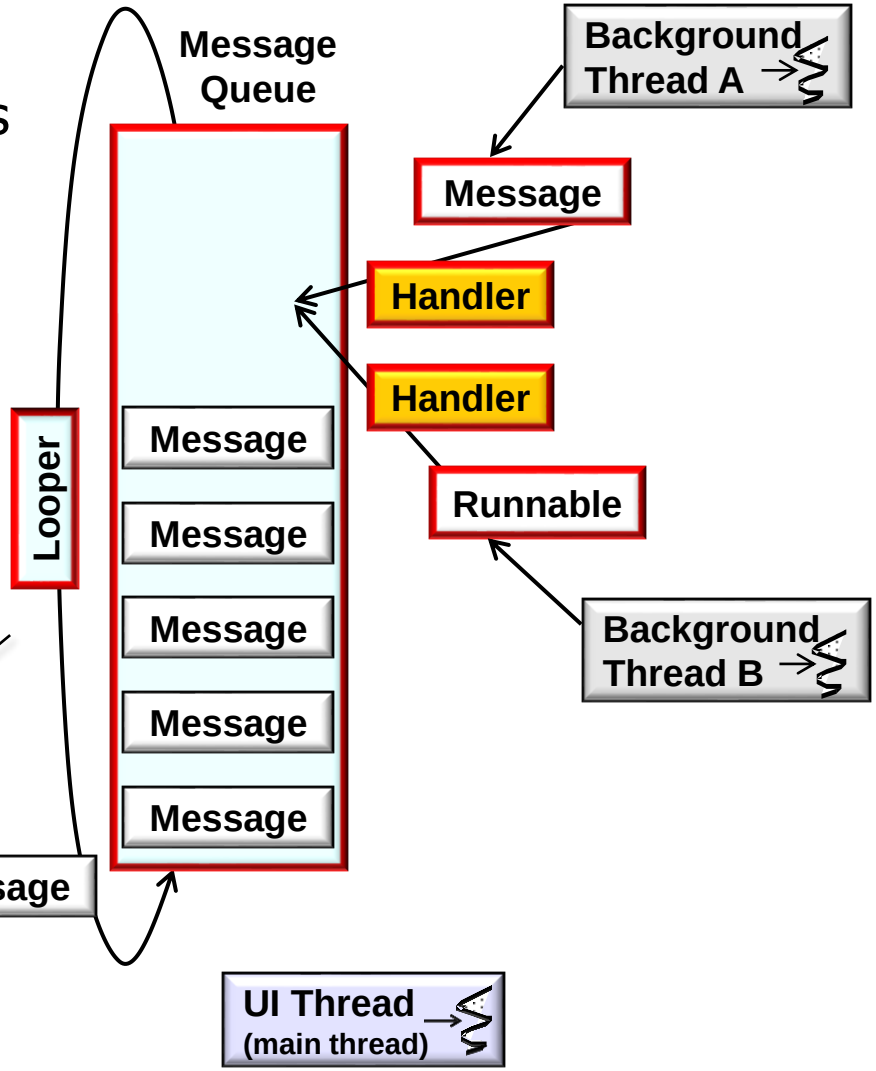
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - Message
  - Handler
  - **Runnable**
    - Represents a command that can be executed
      - This command is often run in a thread different than it was created in



See www.dre.vanderbilt.edu/~schmidt/PDF/CommandProcessor.pdf

Elements of Android Concurrency Frameworks

- Android's concurrency frameworks are built using reusable classes & interfaces
  - **Looper**
  - **MessageQueue**
  - **Message**
  - **Handler**
  - **Runnable**

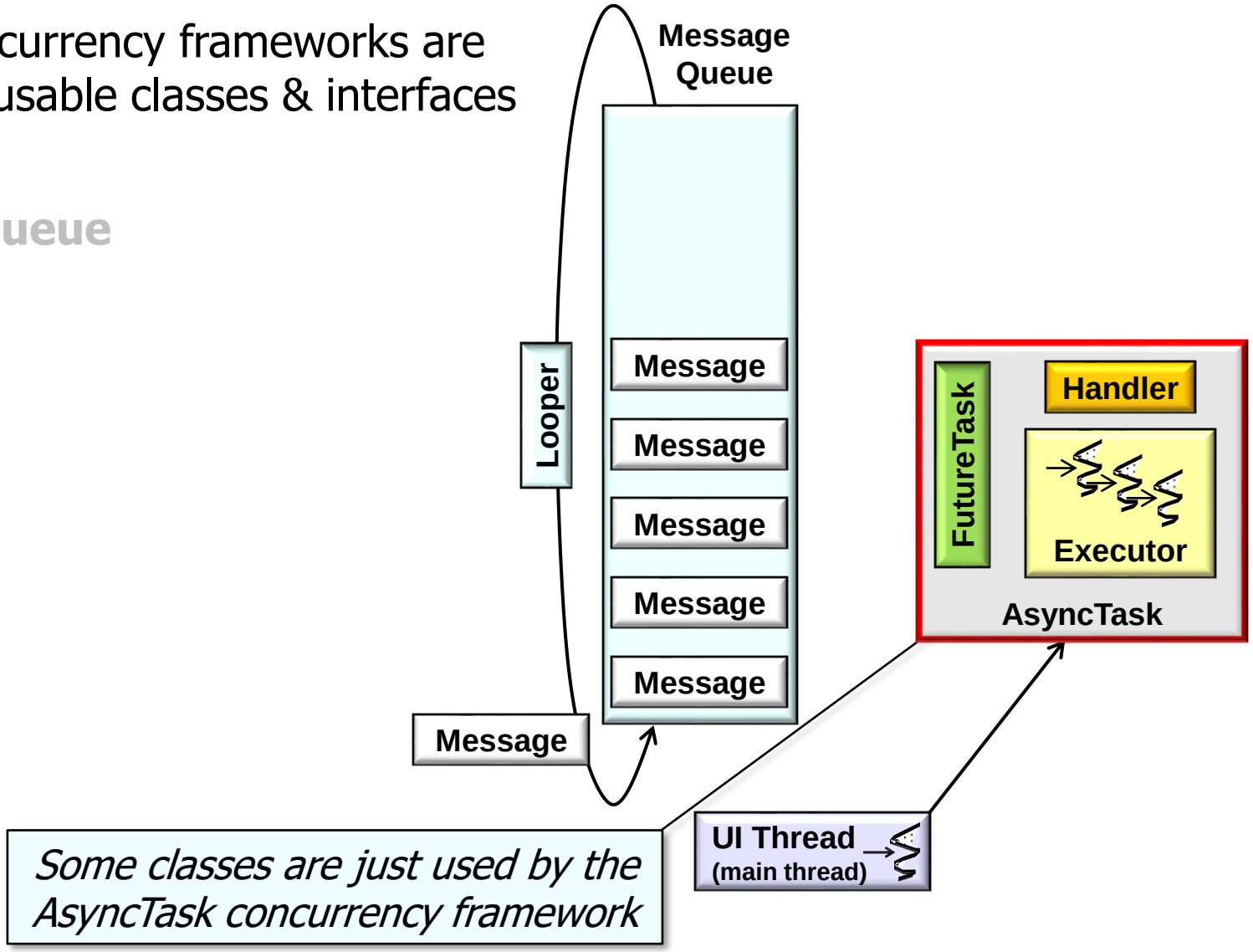


These classes are used by both the HaMeR & AsyncTask concurrency frameworks

The HaMeR framework exposes some classes to app developers directly, whereas the AsyncTask framework shields app developers from these classes

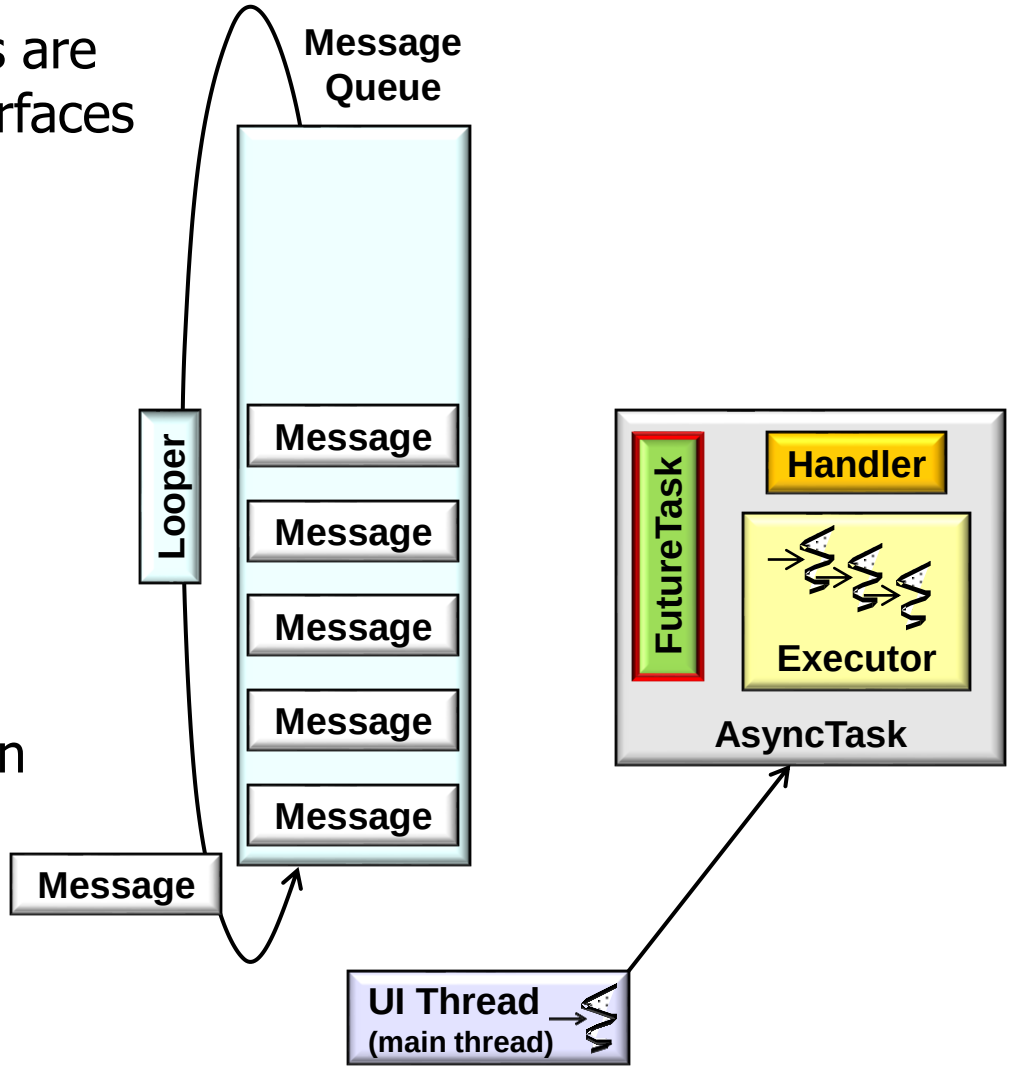
Elements of Android Concurrency Frameworks

- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - Message
  - Handler
  - Runnable



Elements of Android Concurrency Frameworks

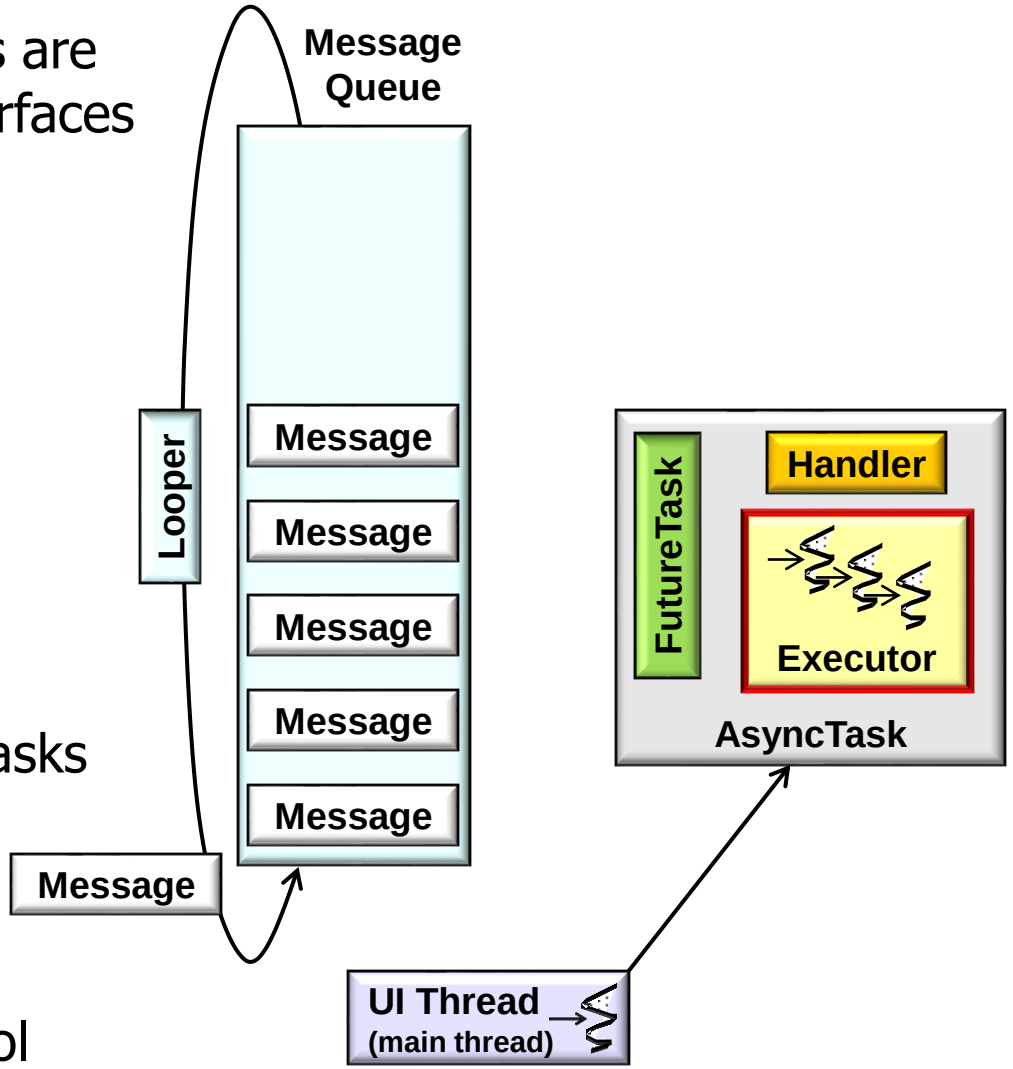
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - Message
  - Handler
  - Runnable
  - **FutureTask**
    - Can be used to
      - Start & cancel a computation that runs asynchronously
      - Query to see if a computation is done
      - Retrieve the result of the computation



See developer.android.com/reference/java/util/concurrent/FutureTask.html

Elements of Android Concurrency Frameworks

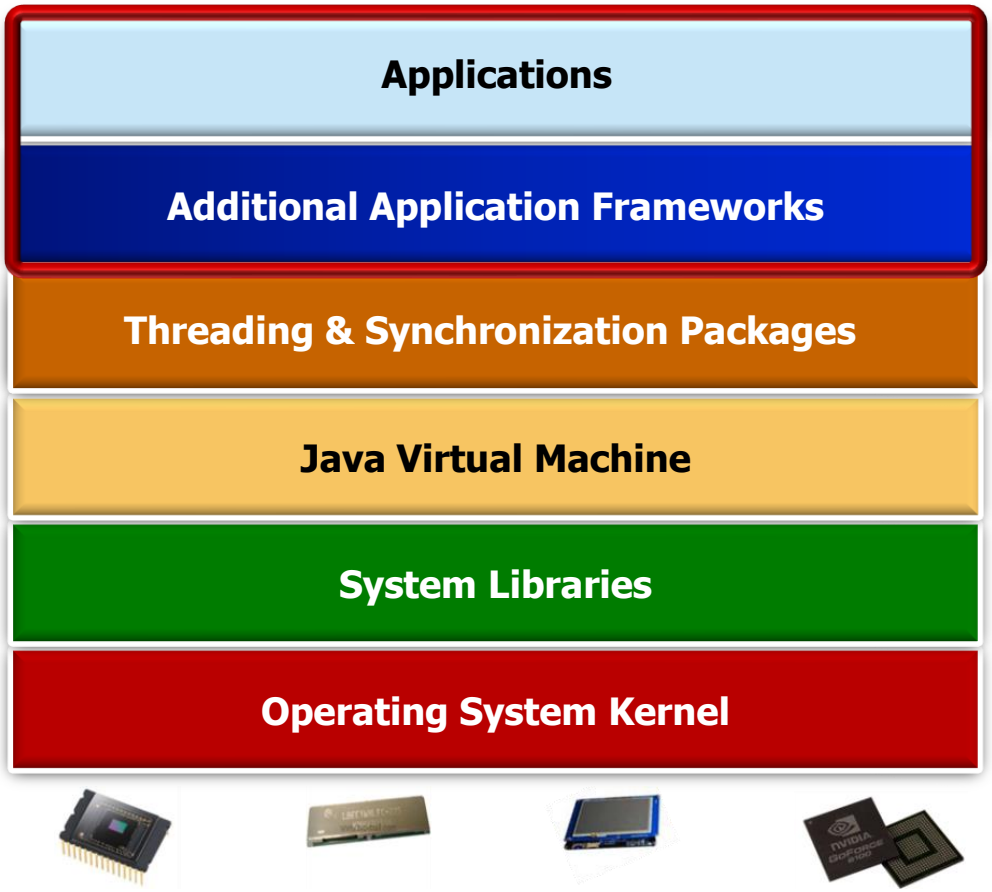
- Android's concurrency frameworks are built using reusable classes & interfaces
  - Looper
  - MessageQueue
  - Message
  - Handler
  - Runnable
  - FutureTask
  - **Executor framework**
    - Execute submitted runnable tasks either
      - Sequentially in one thread (in the background) or
      - Concurrently in a thread pool



See developer.android.com/reference/java/util/concurrent/Executor.html

Elements of Android Concurrency Frameworks

- These framework elements are used by Android's application frameworks & packaged/3rd-party applications



See source.android.com

End of Android Concurrency Frameworks: Structure & Functionality