Android Concurrency: Overview of Image Downloads App(s)

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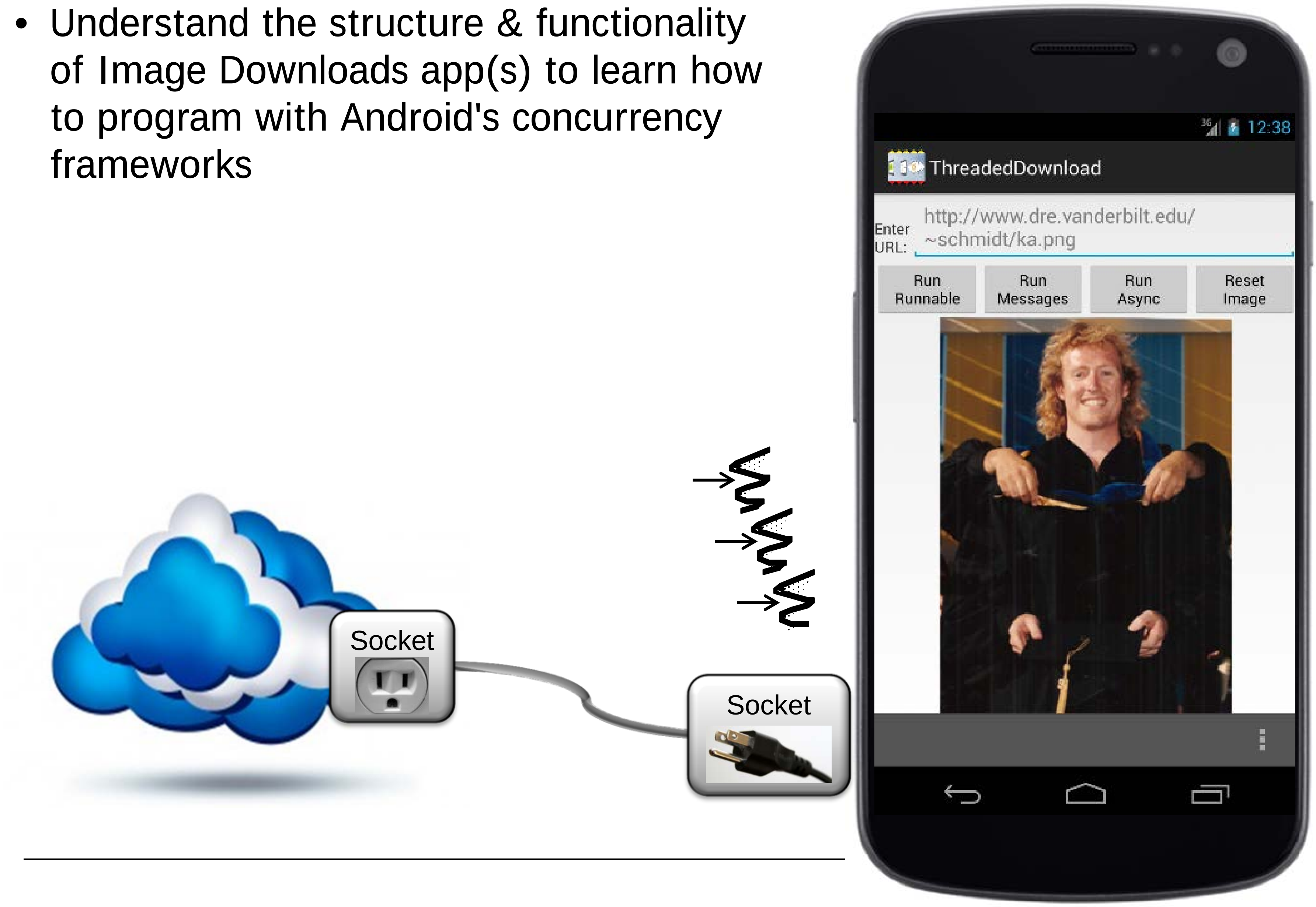
Learning Objectives in this Part of the Module

- Understand the structure & functionality of Image Downloads app(s) to learn how to program with Android's concurrency frameworks



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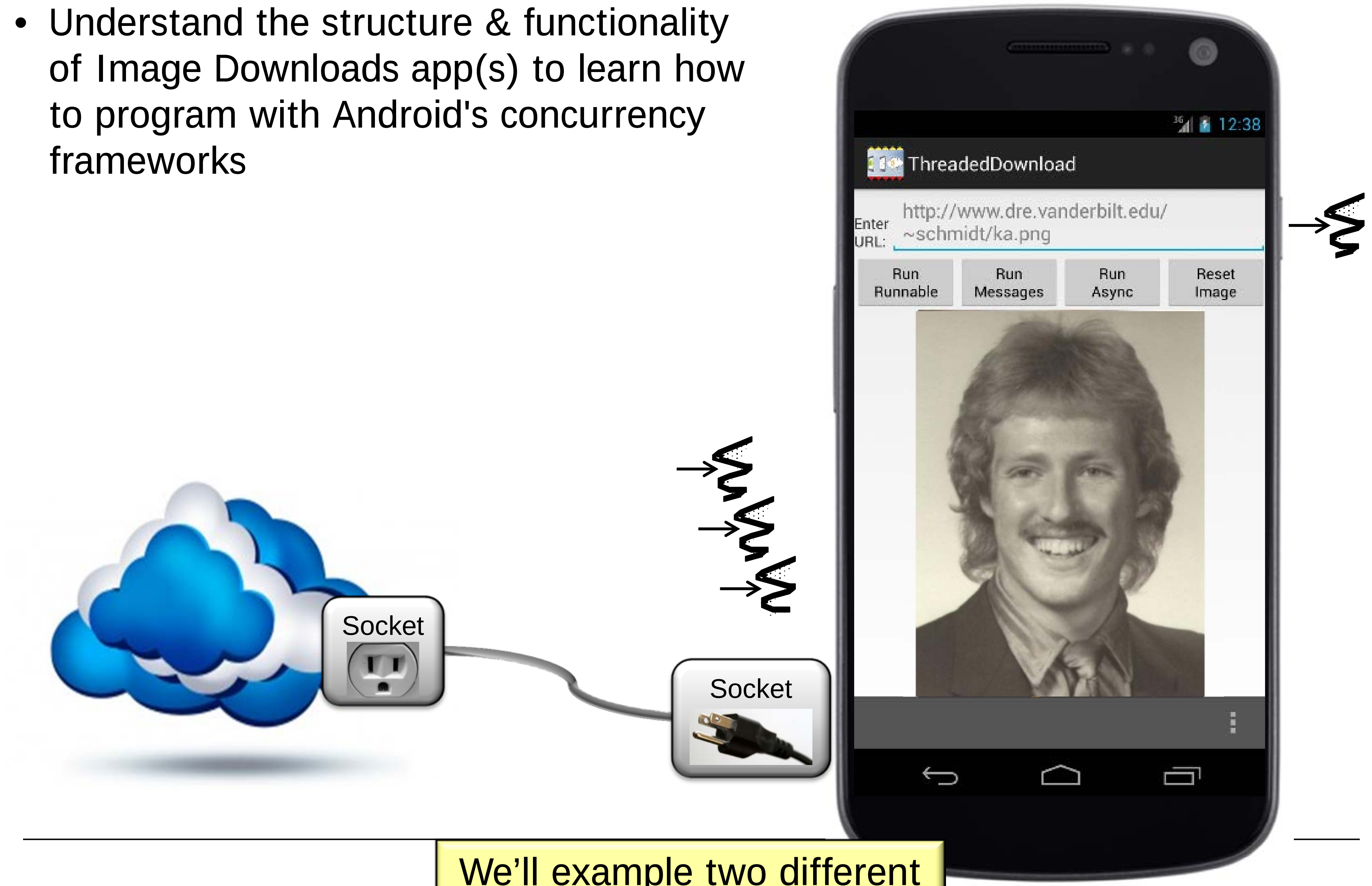
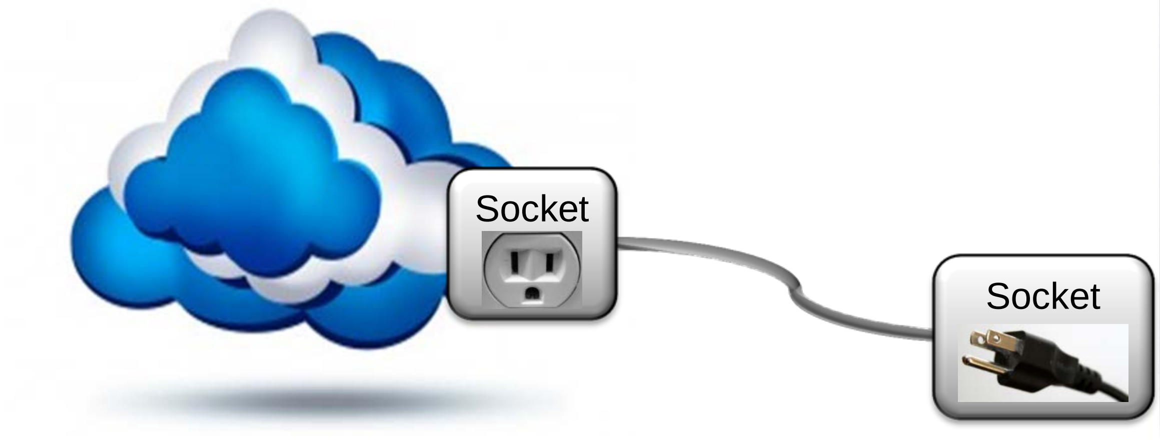


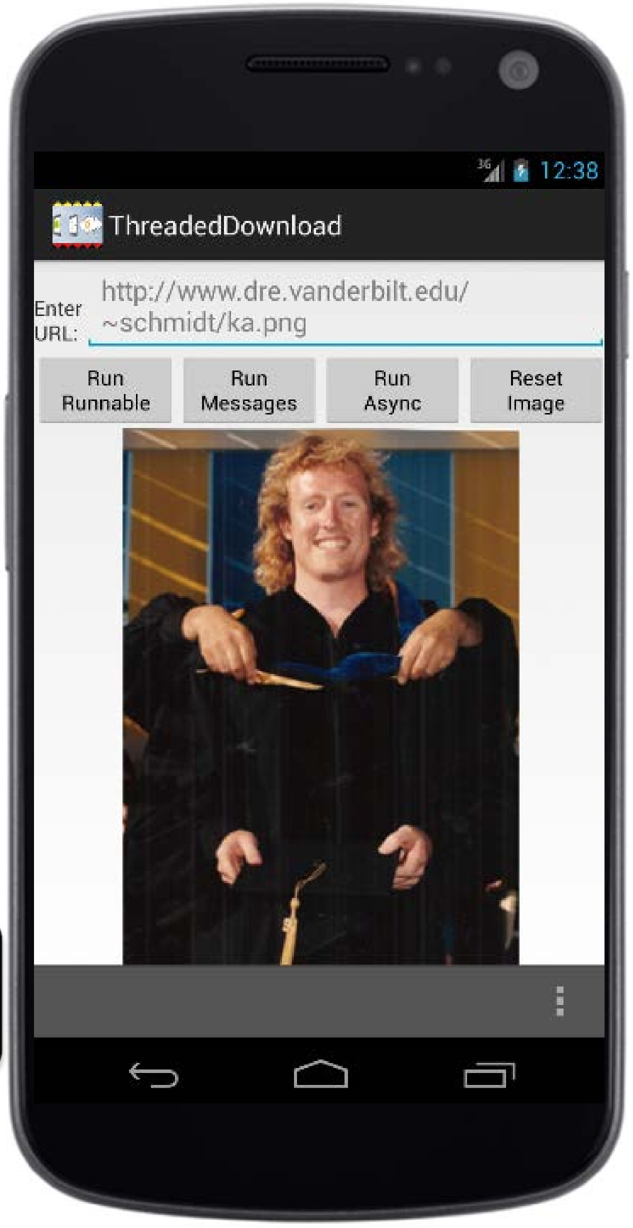
We'll example two different implementations of this app

Overview of the Image Downloads App

Overview of the Image Downloads App

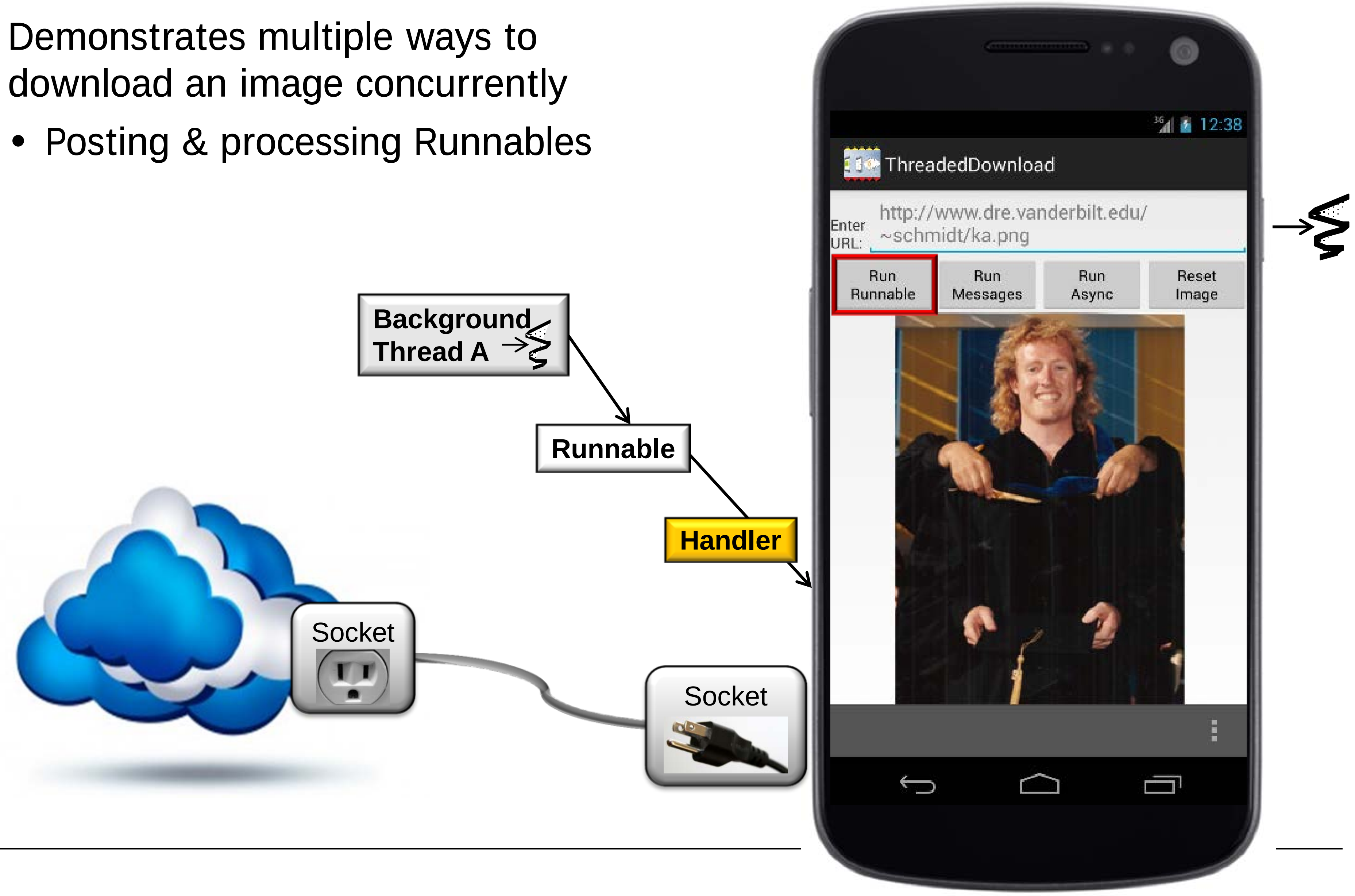
- Demonstrates multiple ways to download an image concurrently





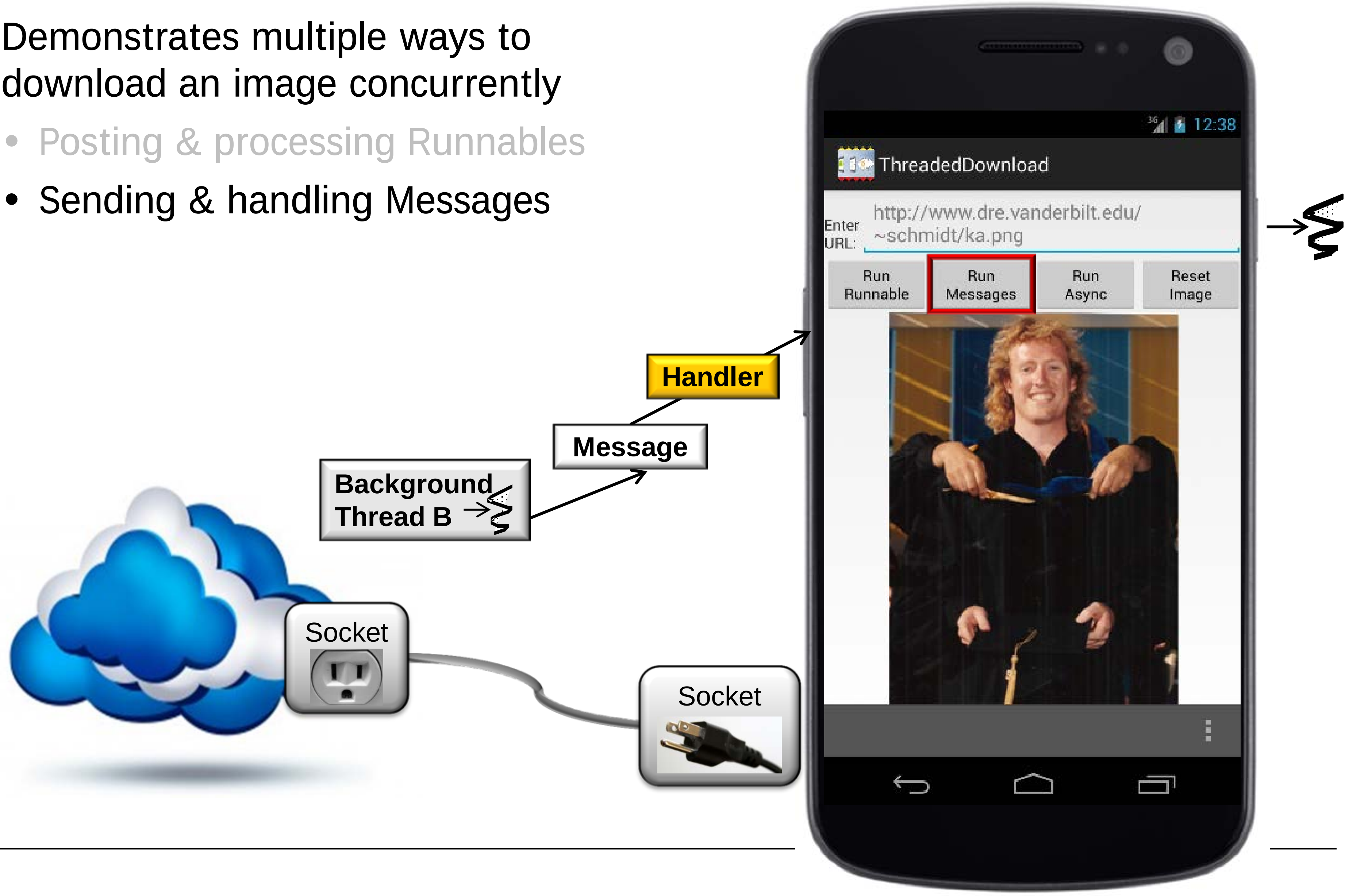
Overview of the Image Downloads App

- Demonstrates multiple ways to download an image concurrently
  - Posting & processing Runnables



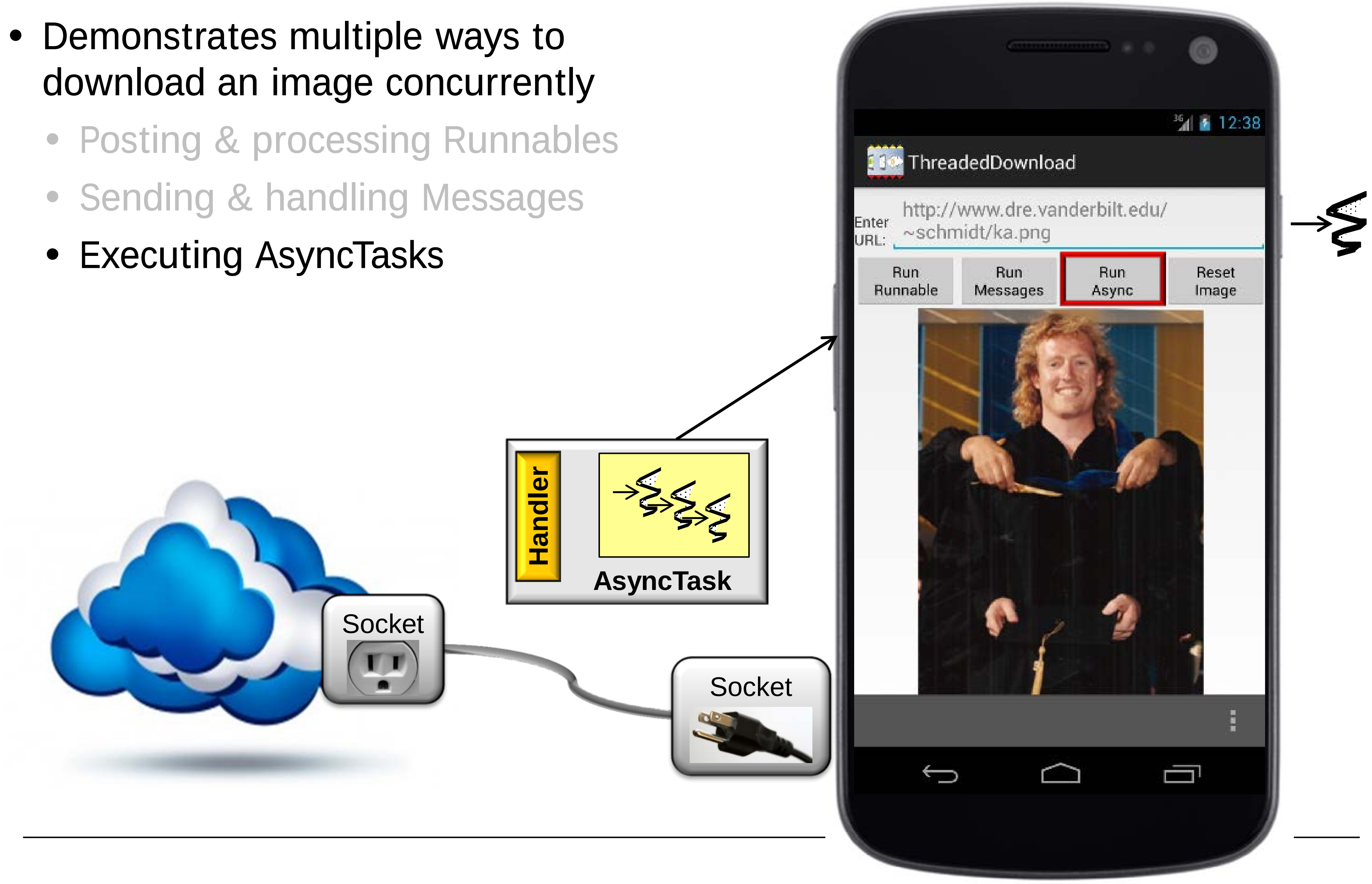
Overview of the Image Downloads App

- Demonstrates multiple ways to download an image concurrently
  - Posting & processing Runnables
  - Sending & handling Messages



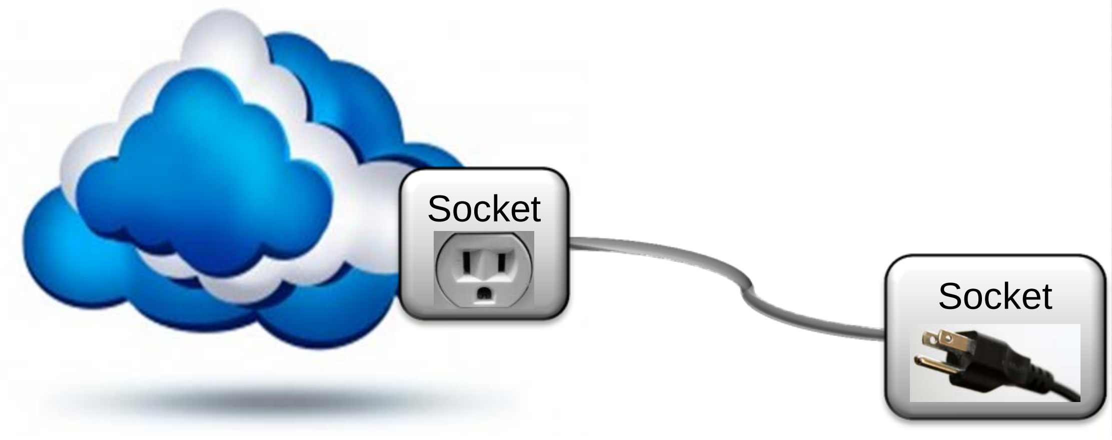
Overview of the Image Downloads App

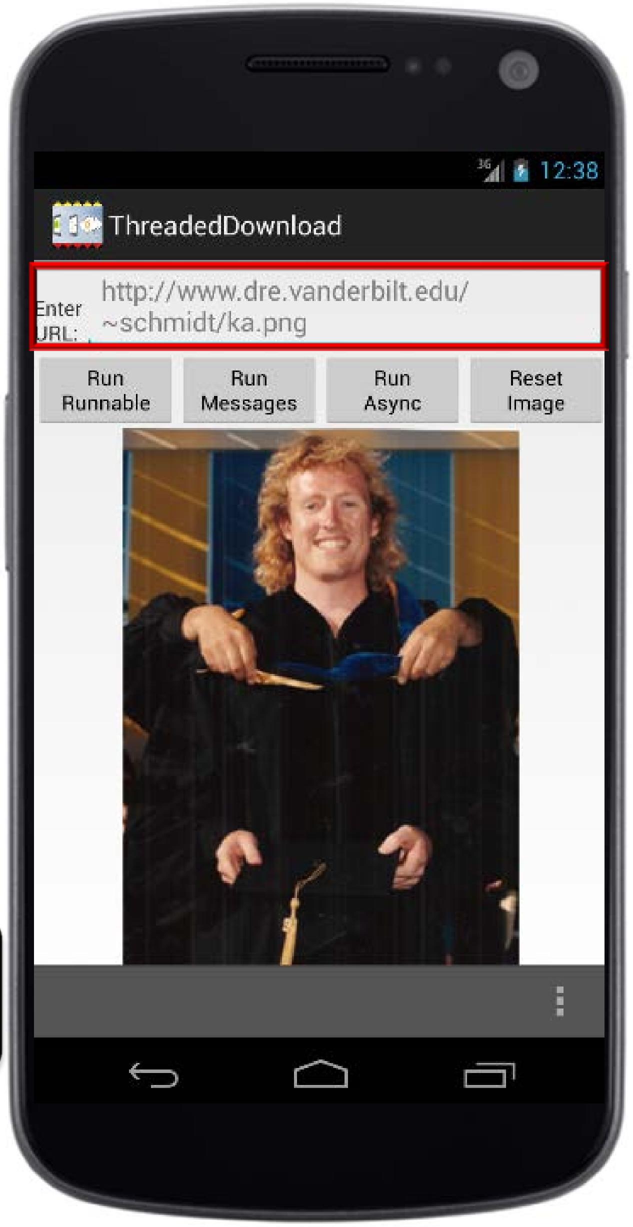
- Demonstrates multiple ways to download an image concurrently
  - Posting & processing Runnables
  - Sending & handling Messages
  - Executing AsyncTasks



Overview of the Image Downloads App

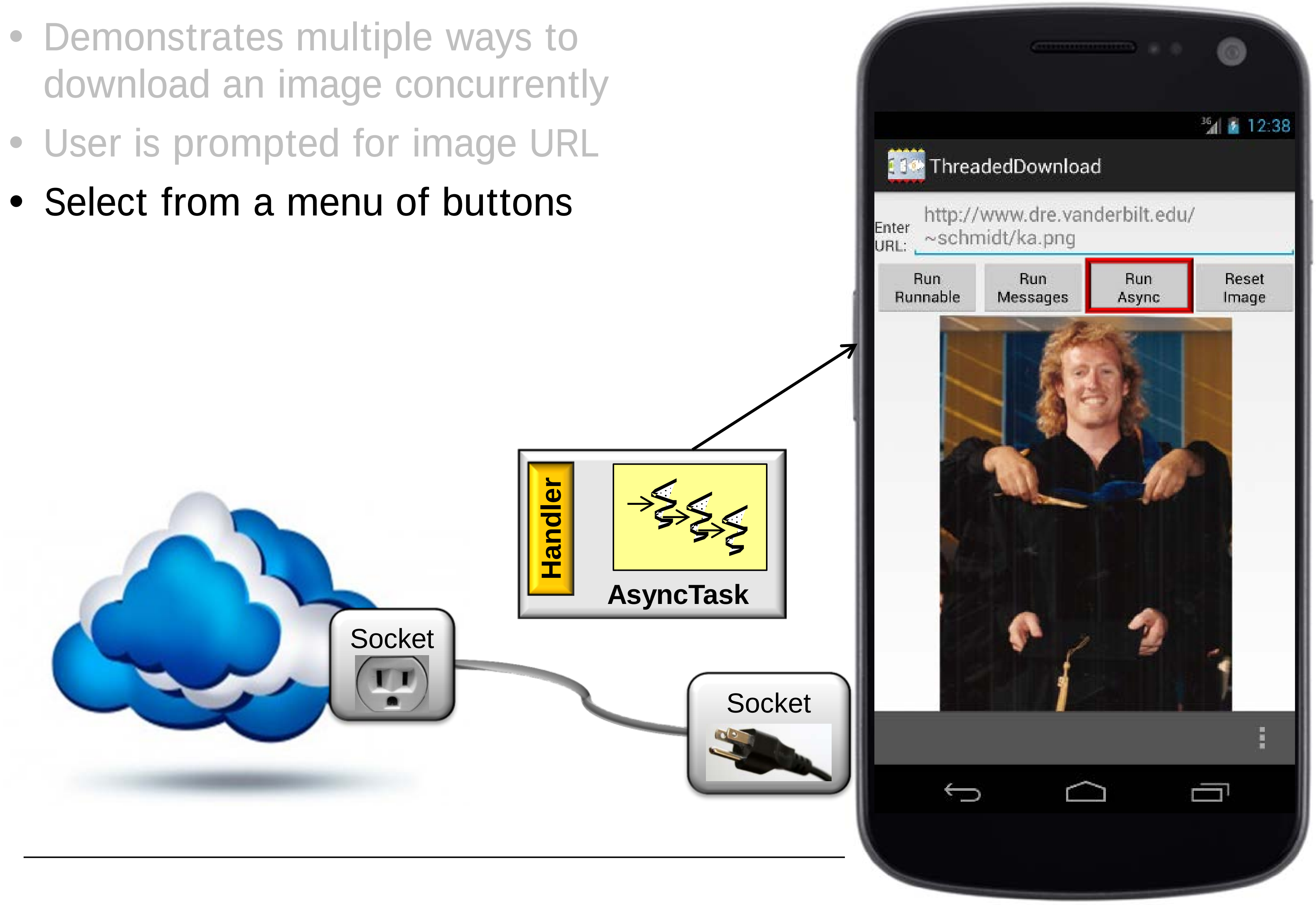
- Demonstrates multiple ways to download an image concurrently
- User is prompted for image URL





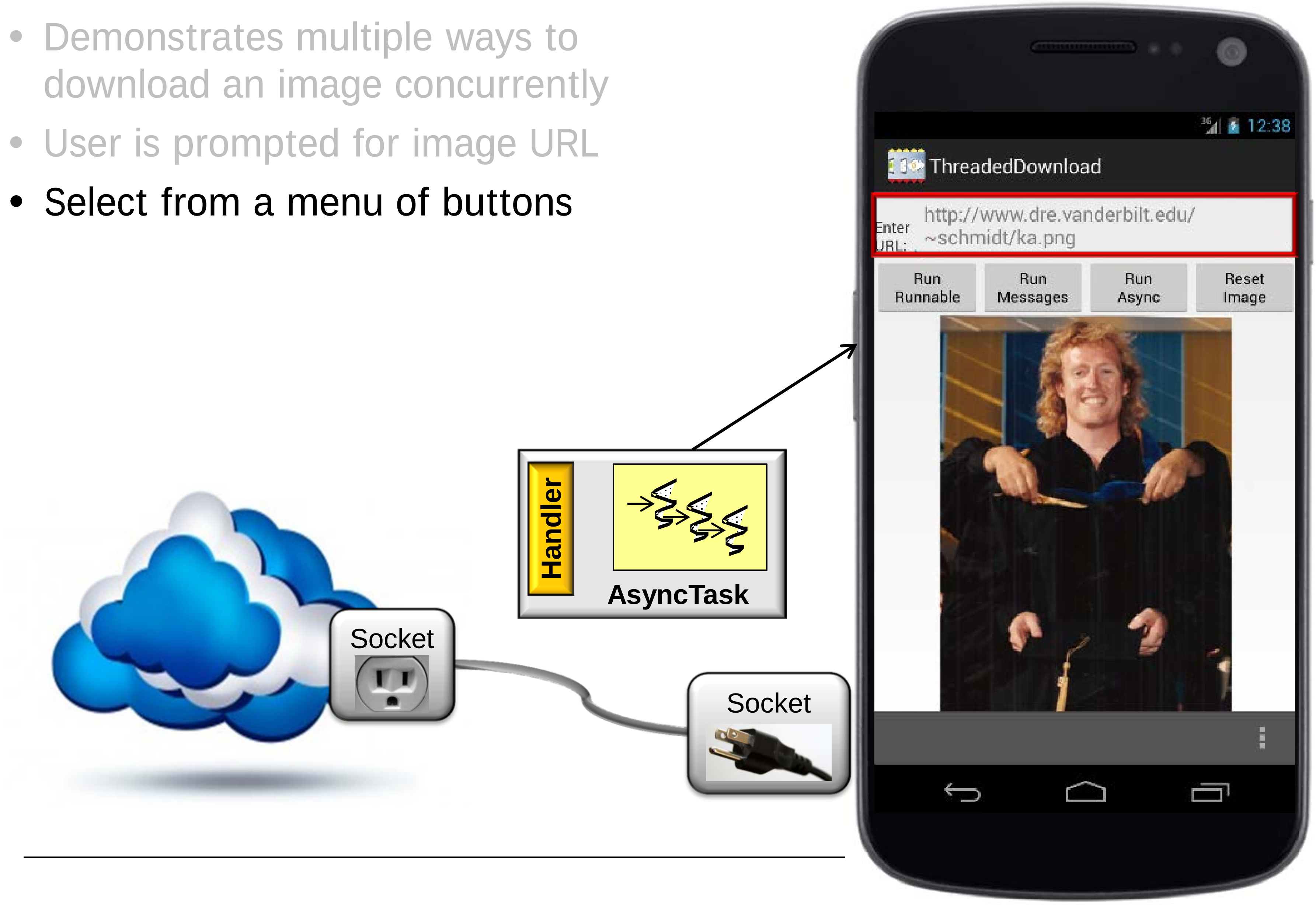
Overview of the Image Downloads App

- Demonstrates multiple ways to download an image concurrently
- User is prompted for image URL
- Select from a menu of buttons



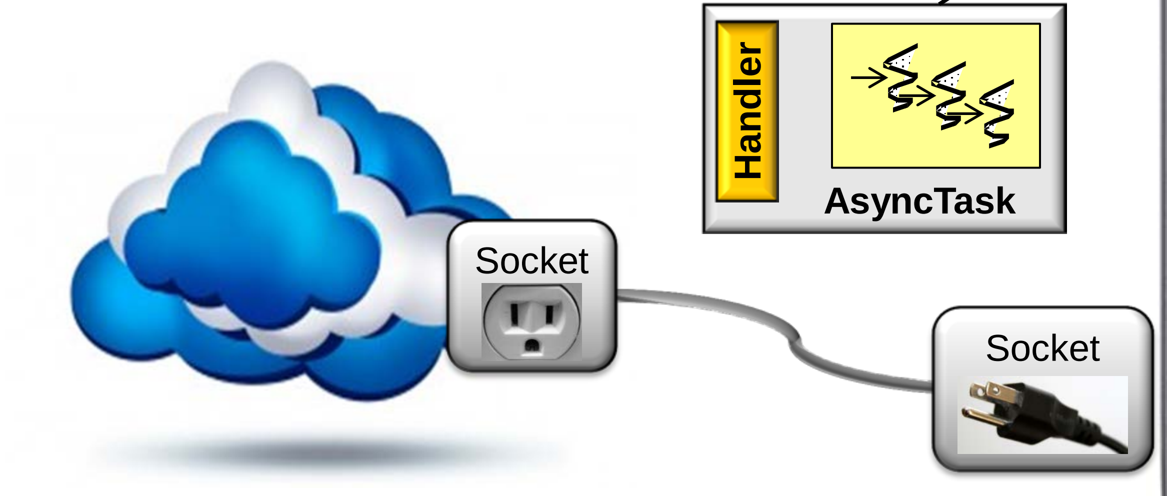
Overview of the Image Downloads App

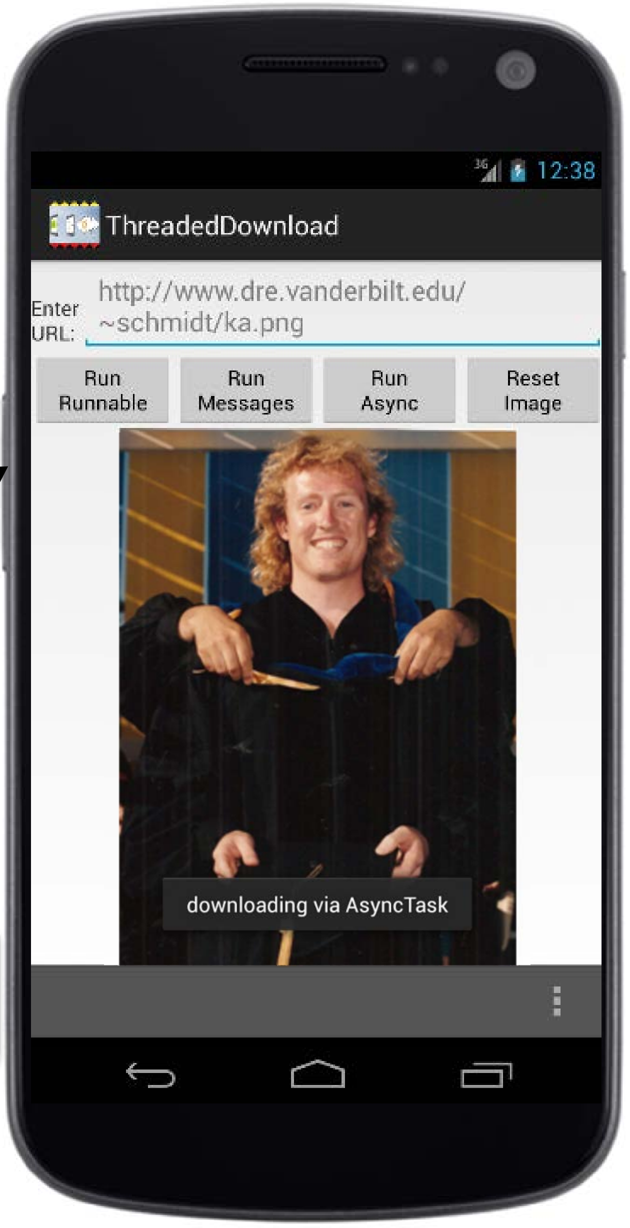
- Demonstrates multiple ways to download an image concurrently
- User is prompted for image URL
- Select from a menu of buttons



Overview of the Image Downloads App

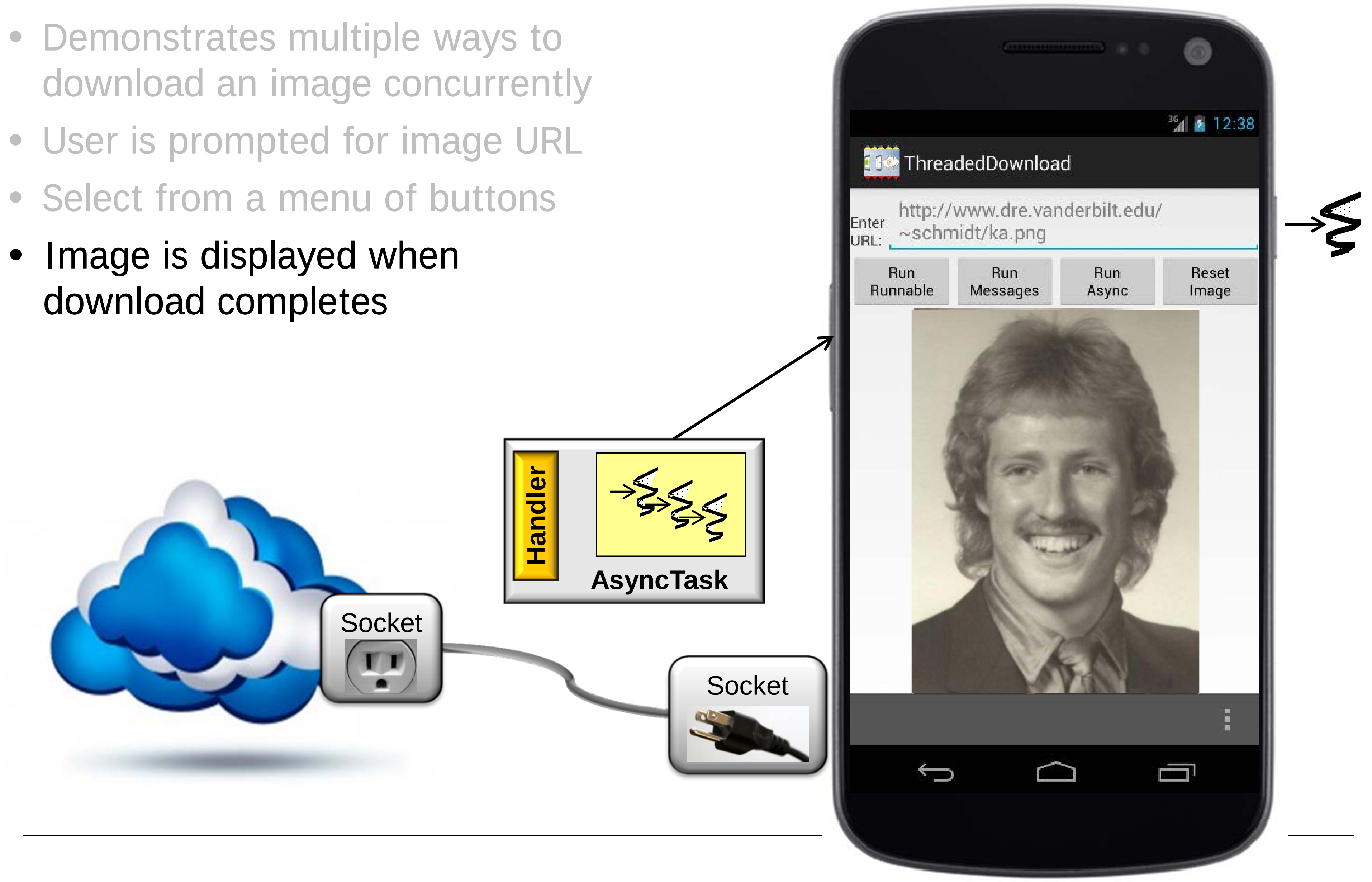
- Demonstrates multiple ways to download an image concurrently
- User is prompted for image URL
- Select from a menu of buttons
  - Toast is displayed when download begins





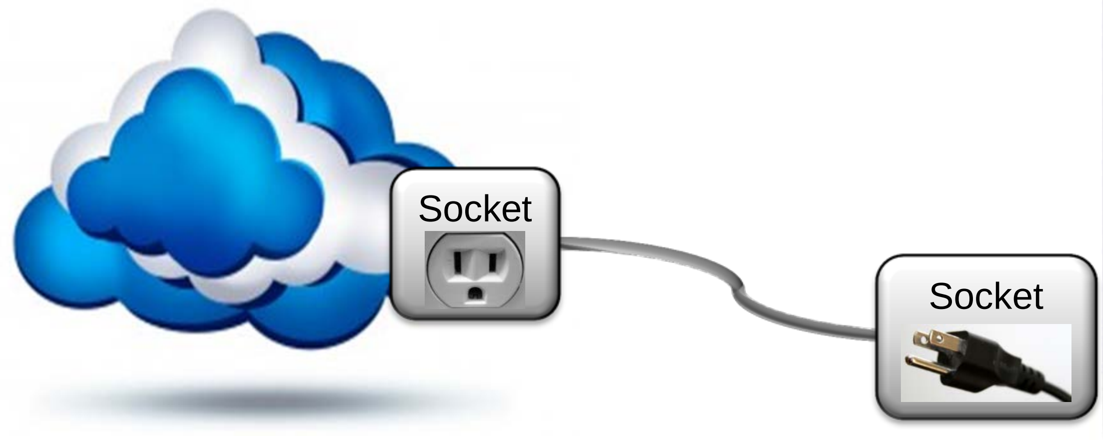
Overview of the Image Downloads App

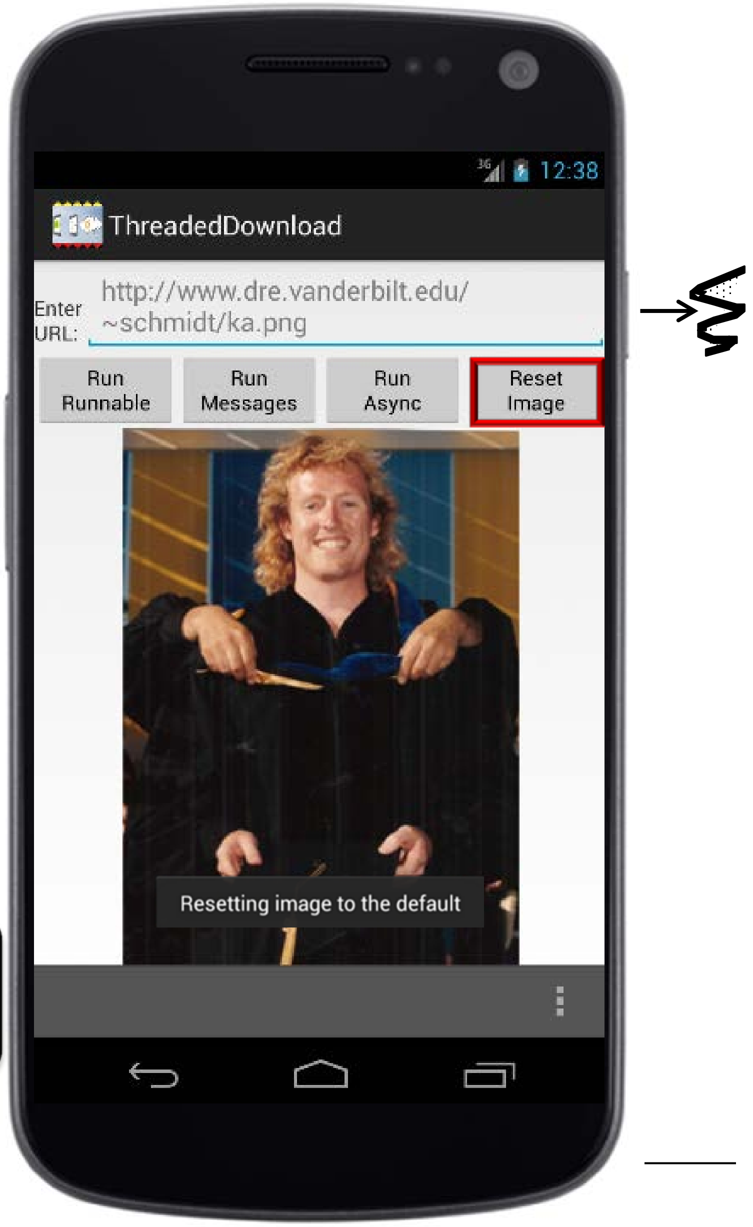
- Demonstrates multiple ways to download an image concurrently
- User is prompted for image URL
- Select from a menu of buttons
- Image is displayed when download completes



Overview of the Image Downloads App

- Demonstrates multiple ways to download an image concurrently
- User is prompted for image URL
- Select from a menu of buttons
- Image is displayed when download completes
- Default image can be reset

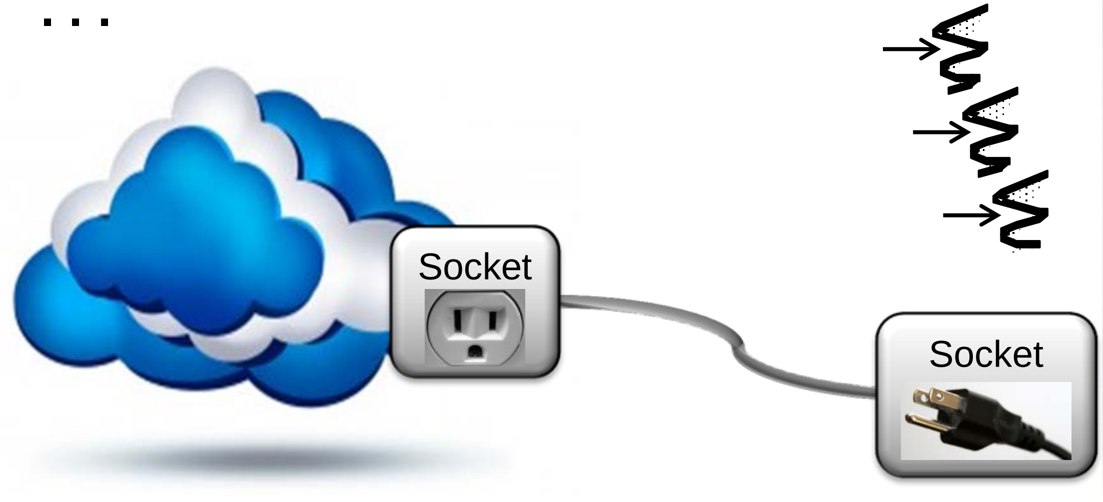


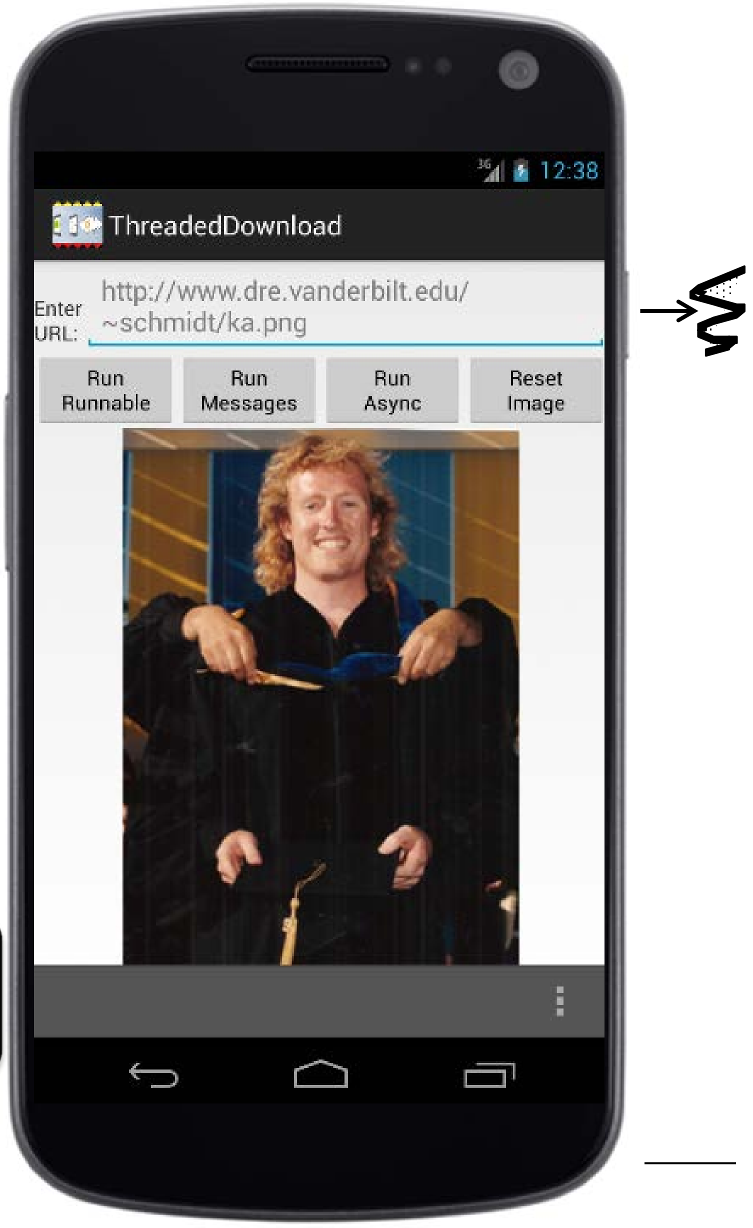

12:38
ThreadedDownload
Enter URL:
http://www.dre.vanderbilt.edu/~schmidt/ka.png
Run Runnable
Run Messages
Run Async
Reset Image
Resetting image to the default

Overview of the Image Downloads App

```
public class ImageDownloadsActivity
             extends Activity {
  ...
  public void runRunnable(View view) {
    /* App logic happens here */
  }

  public void runMessages(View view) {
    /* App logic happens here */
  }
  ...
```

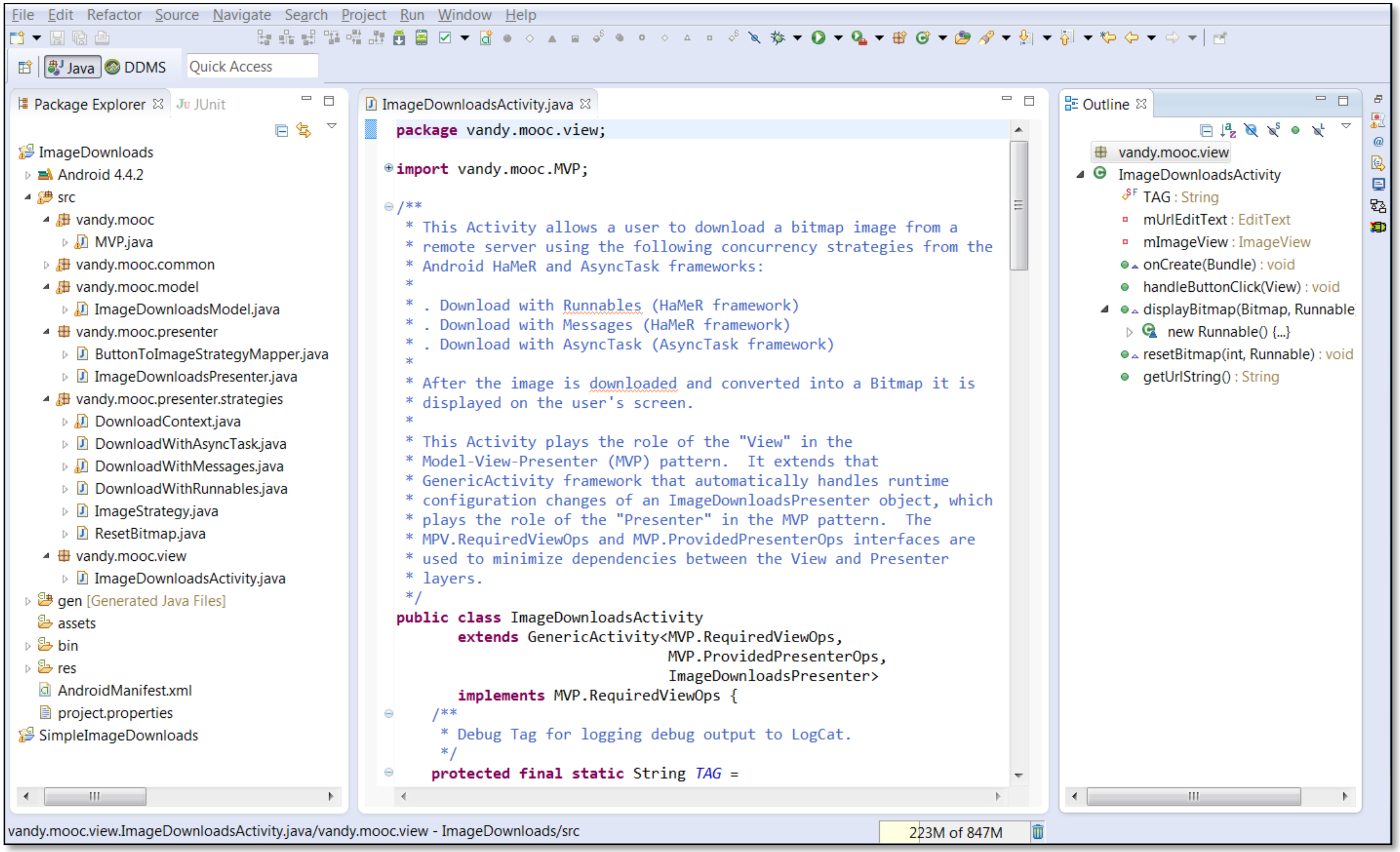




The Structure & Functionality of the Image Downloads Project

Image Downloads Structure & Functionality

- Image Downloads project


File Edit Refactor Source Navigate Search Project Run Window Help
Java DDMS Quick Access
Package Explorer JUnit
ImageDownloadsActivity.java
Outline

```
ImageDownloads
  Android 4.4.2
  src
    vandy.mooc
      MVP.java
    vandy.mooc.common
    vandy.mooc.model
      ImageDownloadsModel.java
    vandy.mooc.presenter
      ButtonToImageStrategyMapper.java
      ImageDownloadsPresenter.java
    vandy.mooc.presenter.strategies
      DownloadContext.java
      DownloadWithAsyncTask.java
      DownloadWithMessages.java
      DownloadWithRunnables.java
      ImageStrategy.java
      ResetBitmap.java
    vandy.mooc.view
      ImageDownloadsActivity.java
  gen [Generated Java Files]
  assets
  bin
  res
  AndroidManifest.xml
  project.properties
SimpleImageDownloads
```

```java
package vandy.mooc.view;

import vandy.mooc.MVP;

/**
 * This Activity allows a user to download a bitmap image from a
 * remote server using the following concurrency strategies from the
 * Android HaMeR and AsyncTask frameworks:
 *
 * . Download with Runnables (HaMeR framework)
 * . Download with Messages (HaMeR framework)
 * . Download with AsyncTask (AsyncTask framework)
 *
 * After the image is downloaded and converted into a Bitmap it is
 * displayed on the user's screen.
 *
 * This Activity plays the role of the "View" in the
 * Model-View-Presenter (MVP) pattern.  It extends that
 * GenericActivity framework that automatically handles runtime
 * configuration changes of an ImageDownloadsPresenter object, which
 * plays the role of the "Presenter" in the MVP pattern.  The
 * MPV.RequiredViewOps and MVP.ProvidedPresenterOps interfaces are
 * used to minimize dependencies between the View and Presenter
 * layers.
 */
public class ImageDownloadsActivity
       extends GenericActivity<MVP.RequiredViewOps,
                               MVP.ProvidedPresenterOps,
                               ImageDownloadsPresenter>
       implements MVP.RequiredViewOps {
    /**
     * Debug Tag for logging debug output to LogCat.
     */
    protected final static String TAG =
```

```
vandy.mooc.view
ImageDownloadsActivity
  TAG : String
  mUrlEditText : EditText
  mImageView : ImageView
  onCreate(Bundle) : void
  handleButtonClick(View) : void
  displayBitmap(Bitmap, Runnable
    new Runnable() {...}
  resetBitmap(int, Runnable) : void
  getUrlString() : String
```

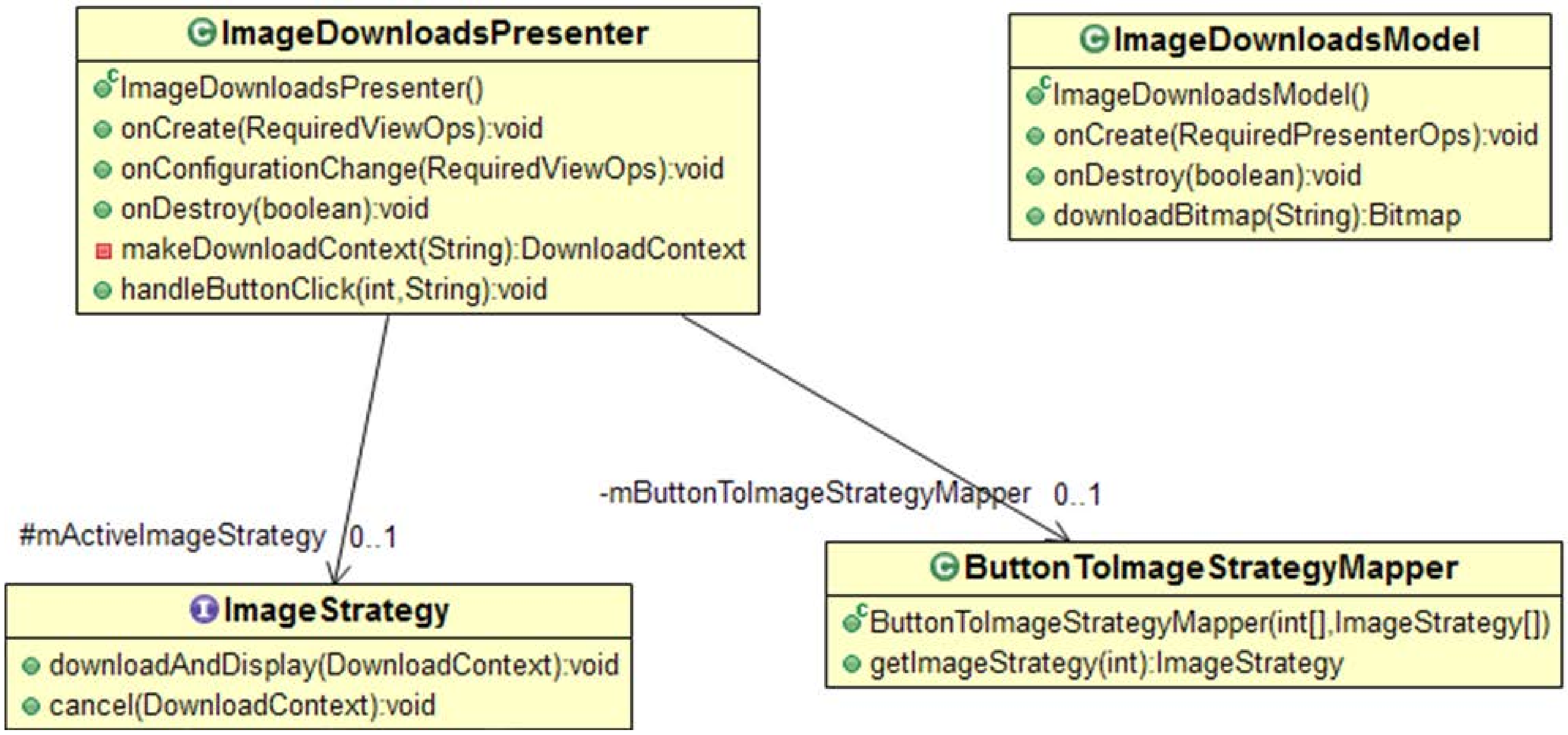
vandy.mooc.view.ImageDownloadsActivity.java/vandy.mooc.view - ImageDownloads/src   223M of 847M

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements:

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements:
  - Java source code


ImageDownloadsPresenter
ImageDownloadsPresenter()
onCreate(RequiredViewOps):void
onConfigurationChange(RequiredViewOps):void
onDestroy(boolean):void
makeDownloadContext(String):DownloadContext
handleButtonClick(int,String):void
ImageDownloadsModel
ImageDownloadsModel()
onCreate(RequiredPresenterOps):void
onDestroy(boolean):void
downloadBitmap(String):Bitmap
#mActiveImageStrategy 0..1
-mButtonToImageStrategyMapper 0..1
ImageStrategy
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
ButtonToImageStrategyMapper
ButtonToImageStrategyMapper(int[],ImageStrategy[])
getImageStrategy(int):ImageStrategy

The most creative & “free form” portion of an Android application

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements:
  - Java source code
  - Resources providing other files & static content used by Java code
    - e.g., bitmaps, UI layouts, internationalized strings, etc.

```
<LinearLayout
  android:layout_width=
    "fill_parent"
  android:layout_height=
    "wrap_content"
  android:orientation=
    "horizontal">
  <Button
    android:id="@+id/button1"
    android:layout_width=
      "wrap_content"
    android:layout_height=
      "wrap_content"
    android:onClick=
      “handleButtonClick"
    android:text=
      "@string/runRunnable" />
  ...
```

See developer.android.com/guide/topics/resources

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements:
  - Java source code
  - Resources providing other files & static content used by Java code
  - XML Manifest file containing info Android needs to execute the app

```
<manifest>  ...
  <application>
    <activity>
      <intent-filter>
       <action /> ... <data />
      </intent-filter> ...
    </activity>
    <service>
      <intent-filter> ...
      </intent-filter>
    </service>
    <receiver>
      <intent-filter> ...
      </intent-filter>
    </receiver>
    <provider>
      <grant-uri-permission />
    </provider> ...
```

See developer.android.com/guide/topics/manifest/manifest-intro.html

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info

```
<manifest ...
  package="vandy.mooc"
  ...
```

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
  - Grants permission to use the Internet

```
<manifest ...
  package="vandy.mooc"
  <uses-permission
   android:name=
     "android.permission.INTERNET">
  </uses-permission>
  ...
```

Android M now gives Internet permission to all apps by default

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
  - Grants permission to use the Internet
  - Indicates the main Activity & declares with Intents it handles

```
<manifest ...
  package="vandy.mooc"
  <application
    android:icon=
      "@drawable/ic_launcher"
    android:label=
      "@string/app_name"
    ...
    <activity android:name=
      "view.ImageDownloadsActivity"
      <intent-filter>
        <action android:name=
          "android.intent.
           action.MAIN" />
        ...
      </intent-filter>
    </activity>
  </application> ...
```

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
  - Grants permission to use the Internet
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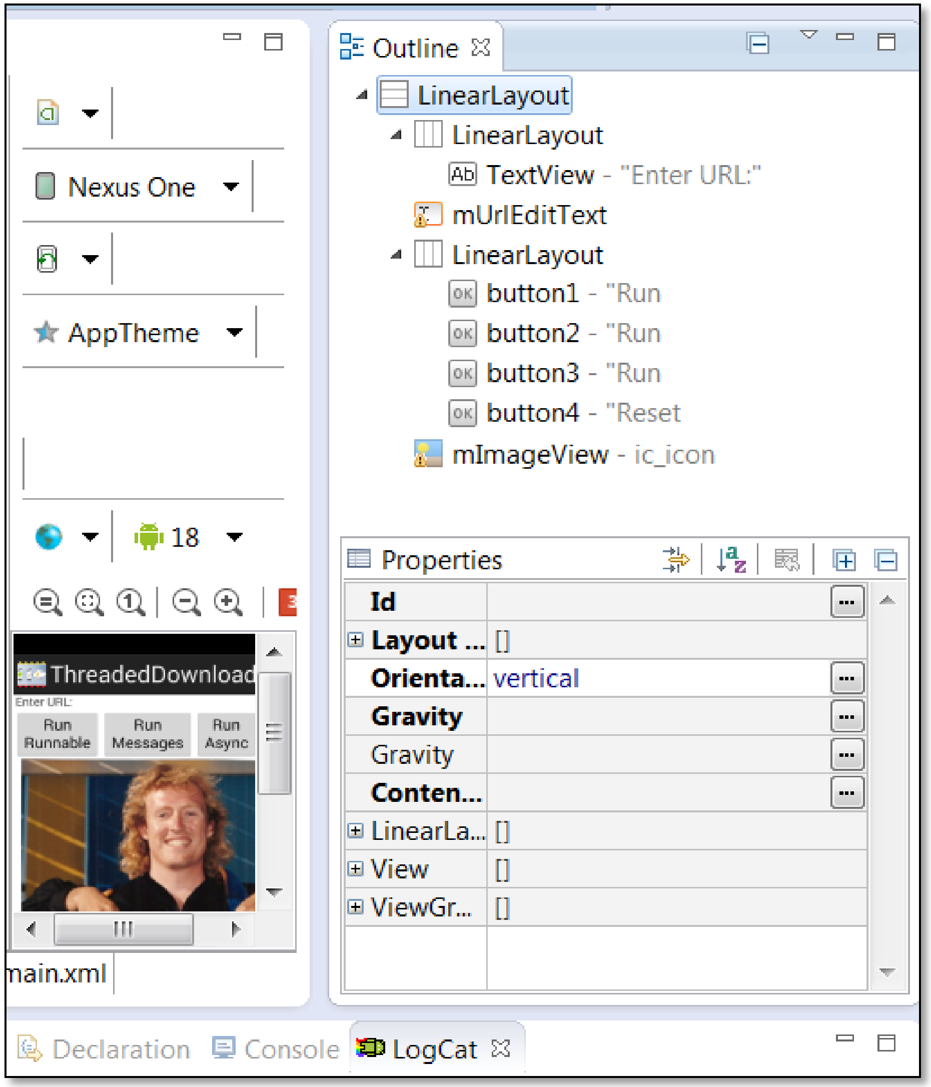
```
<manifest ...
  package="vandy.mooc"
  <application
    android:icon=
      "@drawable/ic_launcher"
    android:label=
      "@string/app_name"
    ...
    <activity android:name=
      "view.ImageDownloadsActivity"
      <intent-filter>
        <action android:name=
          "android.intent.
           action.MAIN" />
        ...
      </intent-filter>
    </activity>
  </application> ...
```

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
- The image_downloads_activity.xml resource file specifies app layout



```
LinearLayout
  LinearLayout
    TextView - "Enter URL:"
  mUrlEditText
  LinearLayout
    button1 - "Run
    button2 - "Run
    button3 - "Run
    button4 - "Reset
  mImageView - ic_icon
```

Id	
Layout ...	[]
Orienta...	vertical
Gravity	
Gravity	
Conten...	
LinearLa...	[]
View	[]
ViewGr...	[]

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
- The image_downloads_activity.xml resource file specifies app layout
  - Dictates how text & buttons appears on the screen

```
<TextView
  android:layout_width=
   "wrap_content"
  android:layout_height=
   "wrap_content"
  android:text="@string/location“
   ... />

<EditText
  android:id="@+id/mUrlEditText"
  android:layout_height=
   "wrap_content"
  android:hint="@string/defaultURL“
  .../>

<Button
  android:id="@+id/button1“
  ...
```

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
- The image_downloads_activity.xml resource file specifies app layout
  - Dictates how text & buttons appears on the screen
  - Maps methods to buttons

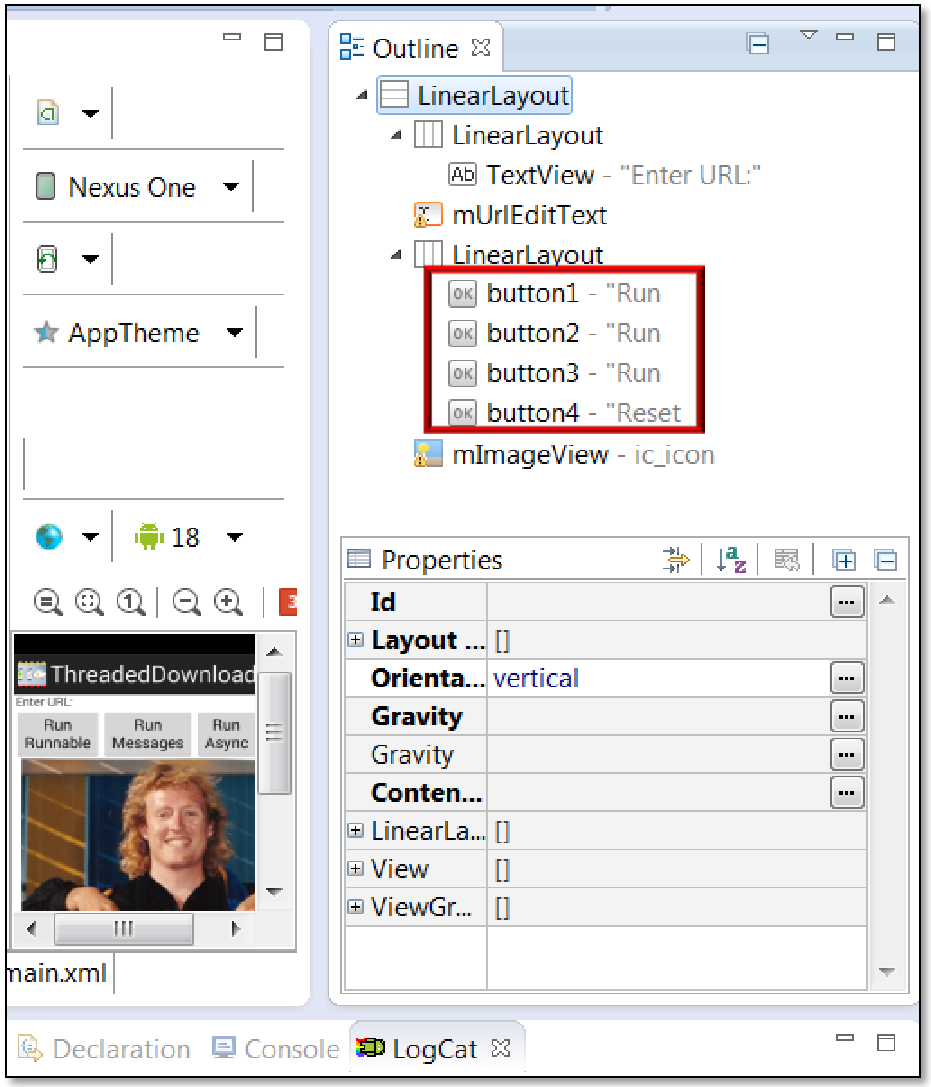


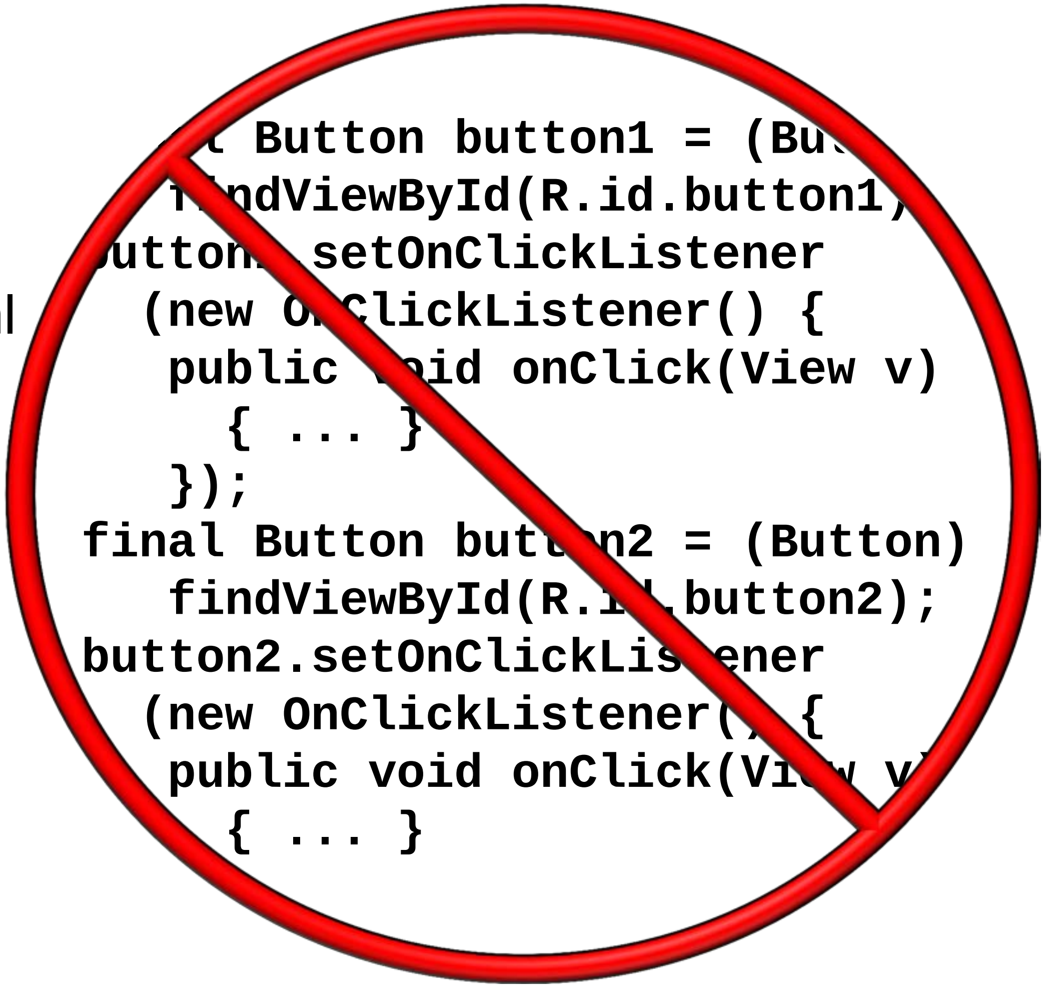
Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
- The image_downloads_activity.xml resource file specifies app layout
  - Dictates how text & buttons appears on the screen
  - Maps methods to buttons

```
<Button
  ...
  android:onClick="handleButtonClick"
  android:text="@string/runRunnable" />

<Button
  ...
  android:onClick="handleButtonClick"
  android:text="@string/runMessages" />

<Button
  ...
  android:onClick="handleButtonClick"
  android:text="@string/runAsyncTask" />

<Button
  ...
  android:onClick="handleButtonClick"
  android:text="@string/resetImage" />
```

Image Downloads Structure & Functionality

- Image Downloads project
- Three main elements
- XML Manifest file for Image Downloads app contains essential info
- The image_downloads_activity.xml resource file specifies app layout
  - Dictates how text & buttons appears on the screen
  - Maps methods to buttons
  - Avoids hard-coding UI components into class ImageDownloadsActivity



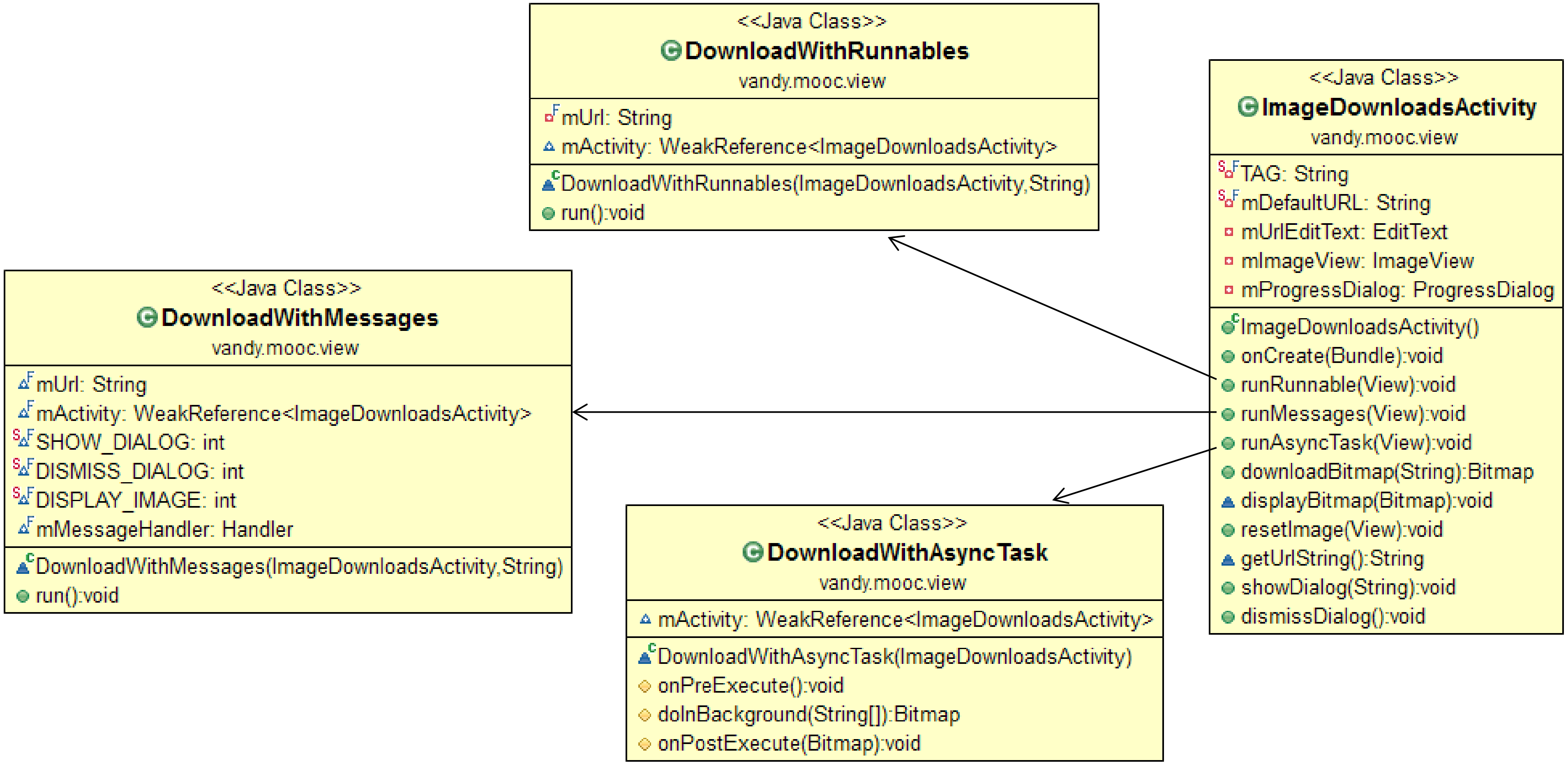
```
  t Button button1 = (Bu
    ndViewById(R.id.button1)
utton .setOnClickListener
  (new O ClickListener() {
    public  oid onClick(View v)
      { ... }
    });
final Button butt n2 = (Button)
    findViewById(R.i .button2);
button2.setOnClickLis ener
  (new OnClickListener( ) {
    public void onClick(Vi   v
      { ... }
```

There are drawbacks to this approach in more complex apps

Overview of Image Downloads Apps

Overview of SimpleImageDownloads

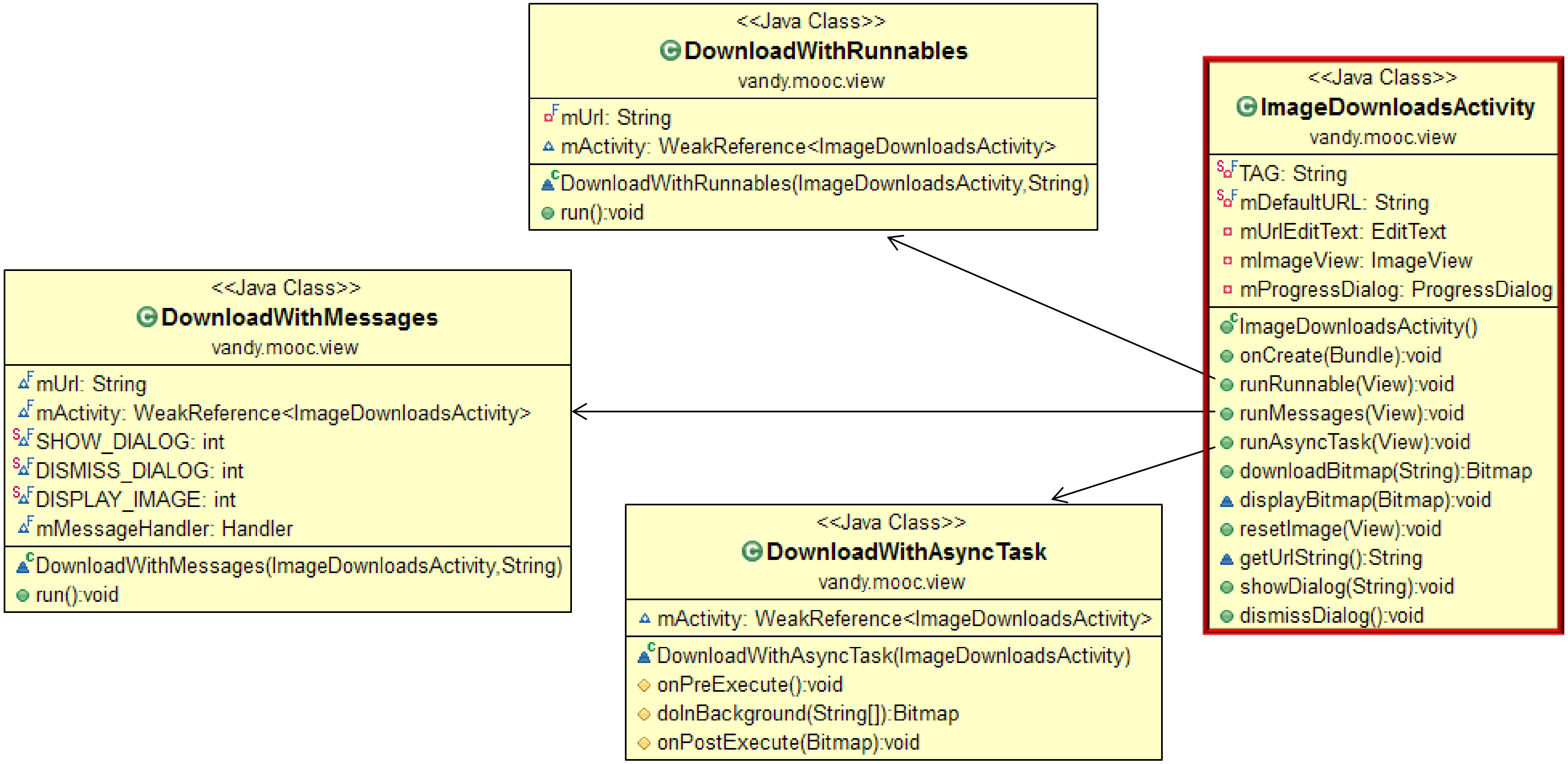
- Simple app showcasing Android HaMeR & AsyncTask concurrency frameworks



See github.com/douglascraigschmidt/POSA-15/tree/master/ex/SimpleImageDownloads

Overview of SimpleImageDownloads

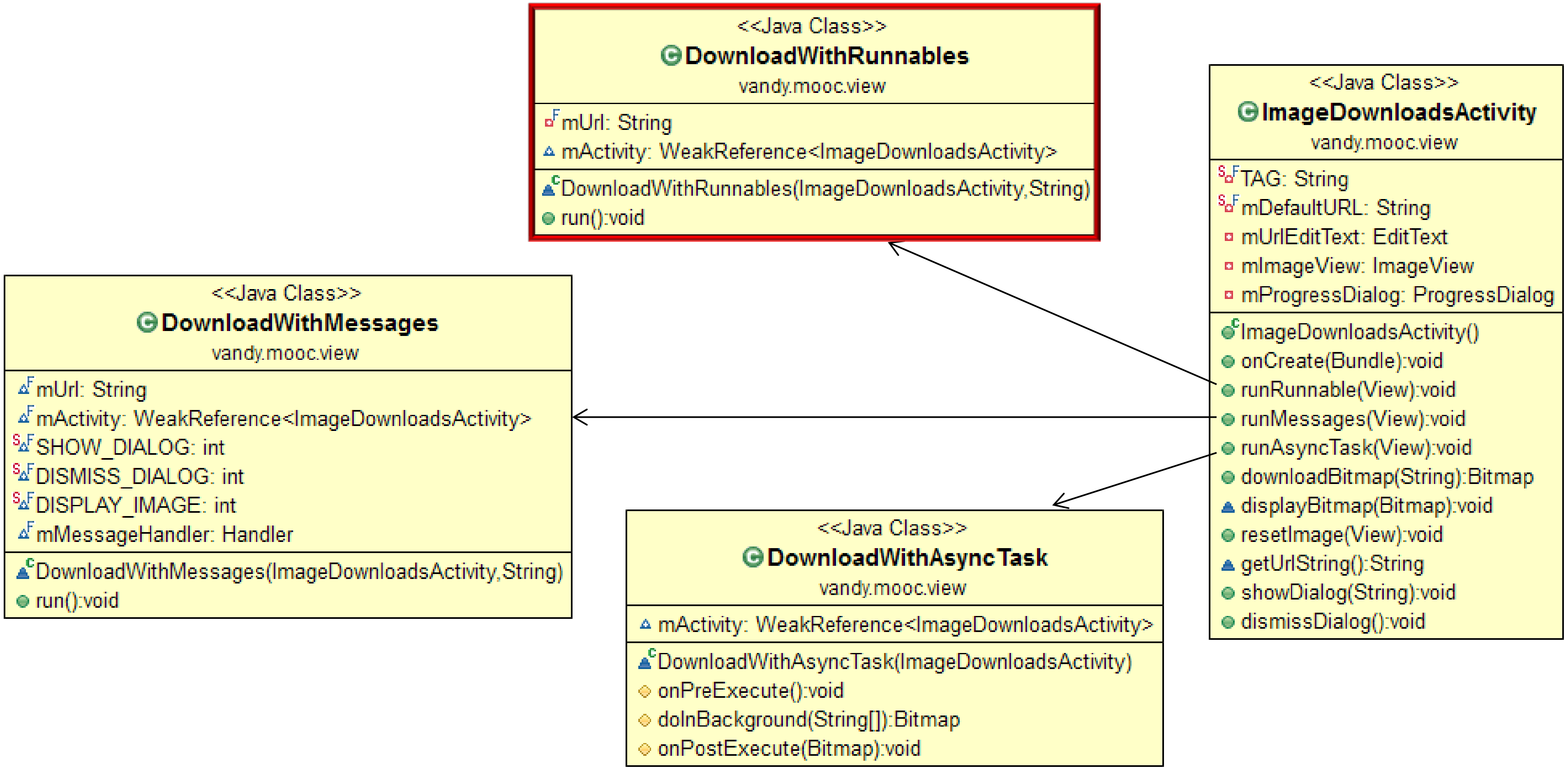
- Simple app showcasing Android HaMeR & AsyncTask concurrency frameworks



ImageDownloadsActivity is the only Activity defined in the app

Overview of SimpleImageDownloads

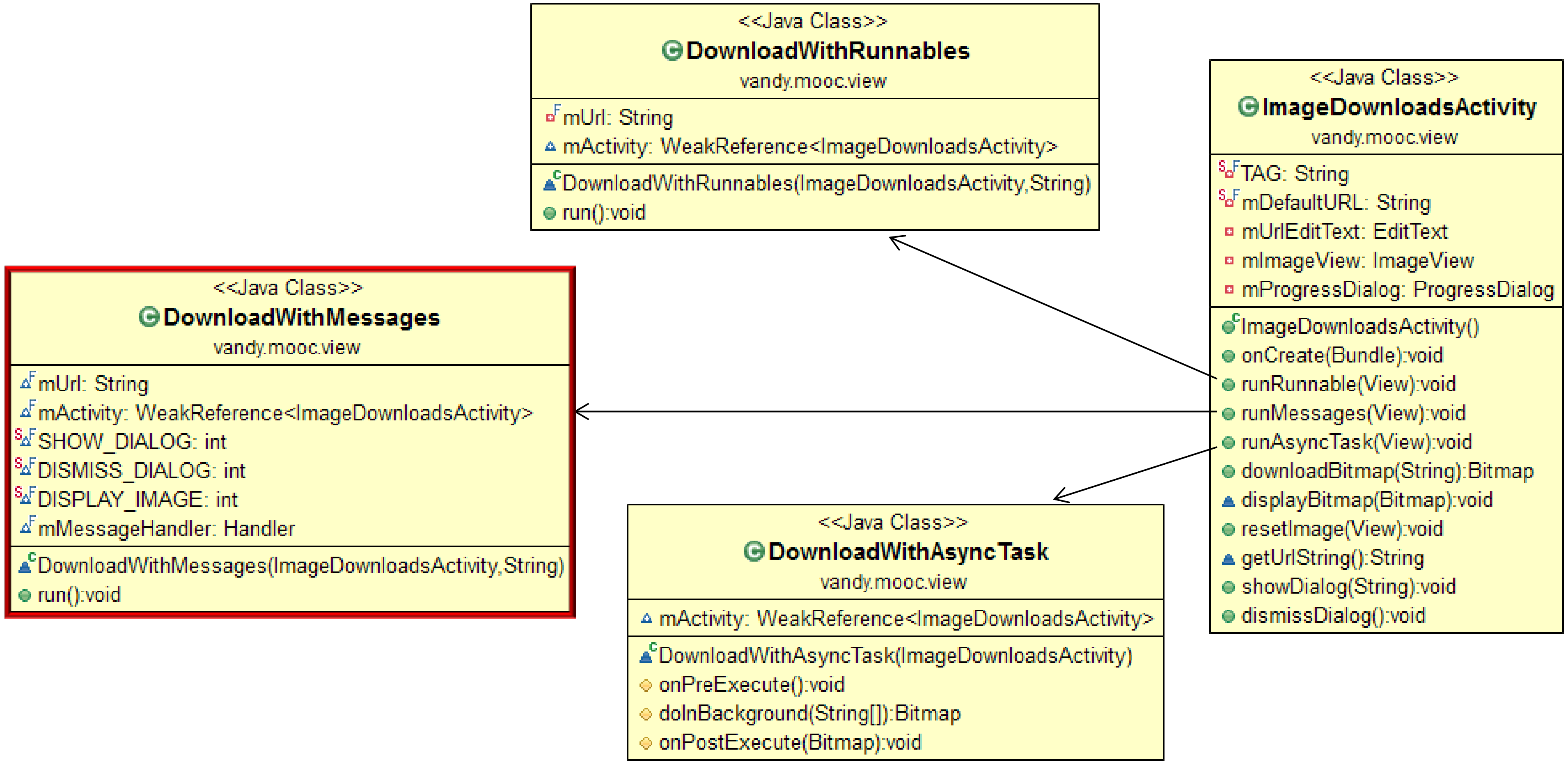
- Simple app showcasing Android HaMeR & AsyncTask concurrency frameworks



Downloads/Displays image via Handlers & Runnables

Overview of SimpleImageDownloads

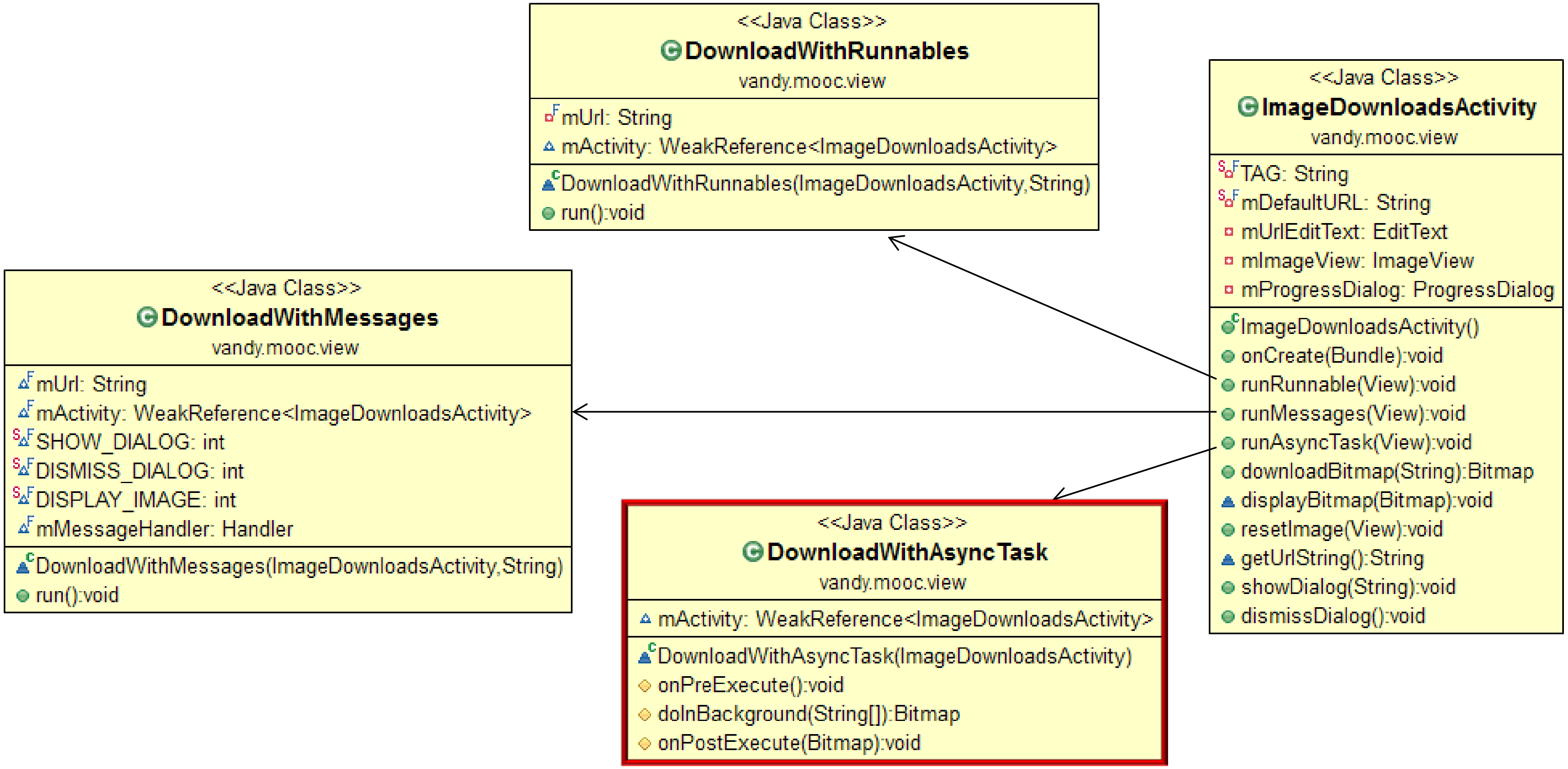
- Simple app showcasing Android HaMeR & AsyncTask concurrency frameworks



Downloads/Displays image via Handlers & Messages

Overview of SimpleImageDownloads

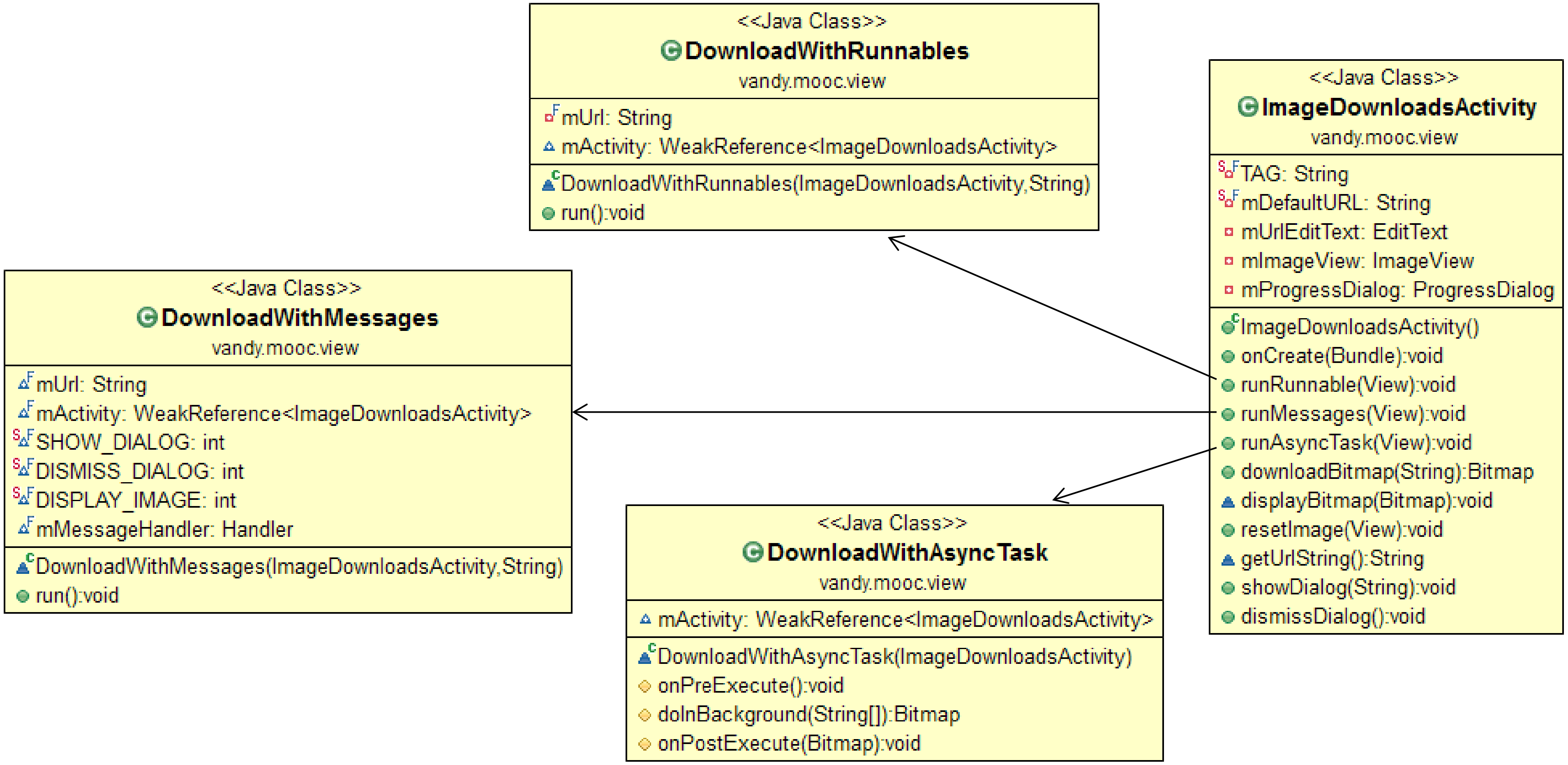
- Simple app showcasing Android HaMeR & AsyncTask concurrency frameworks



Downloads/Displays image via AsyncTask

Overview of SimpleImageDownloads

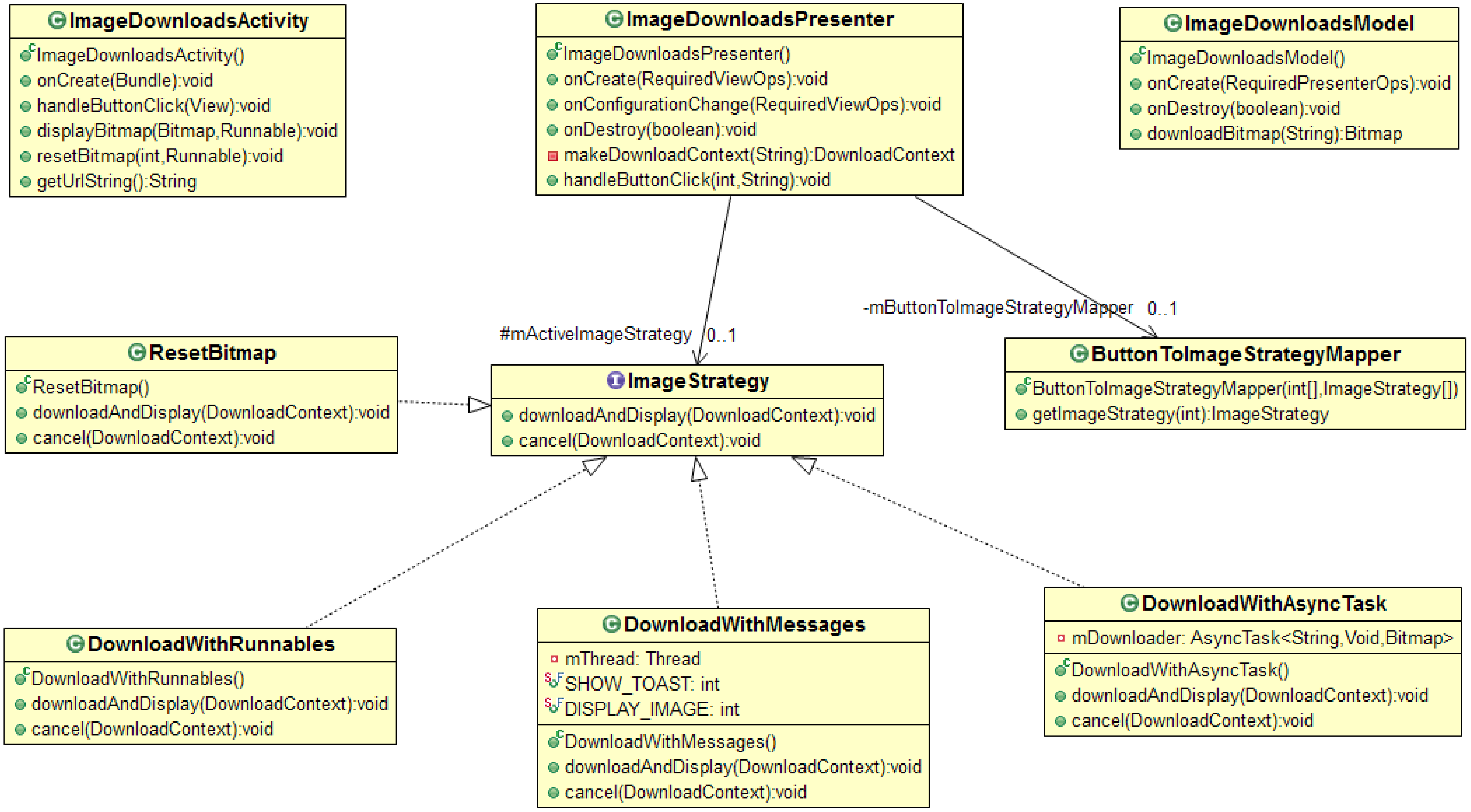
- Simple app showcasing Android HaMeR & AsyncTask concurrency frameworks



This solution doesn't handle runtime configuration changes

Overview of ImageDownloads

- This implementation is based on the *Model-View-Presenter* (MVP) pattern

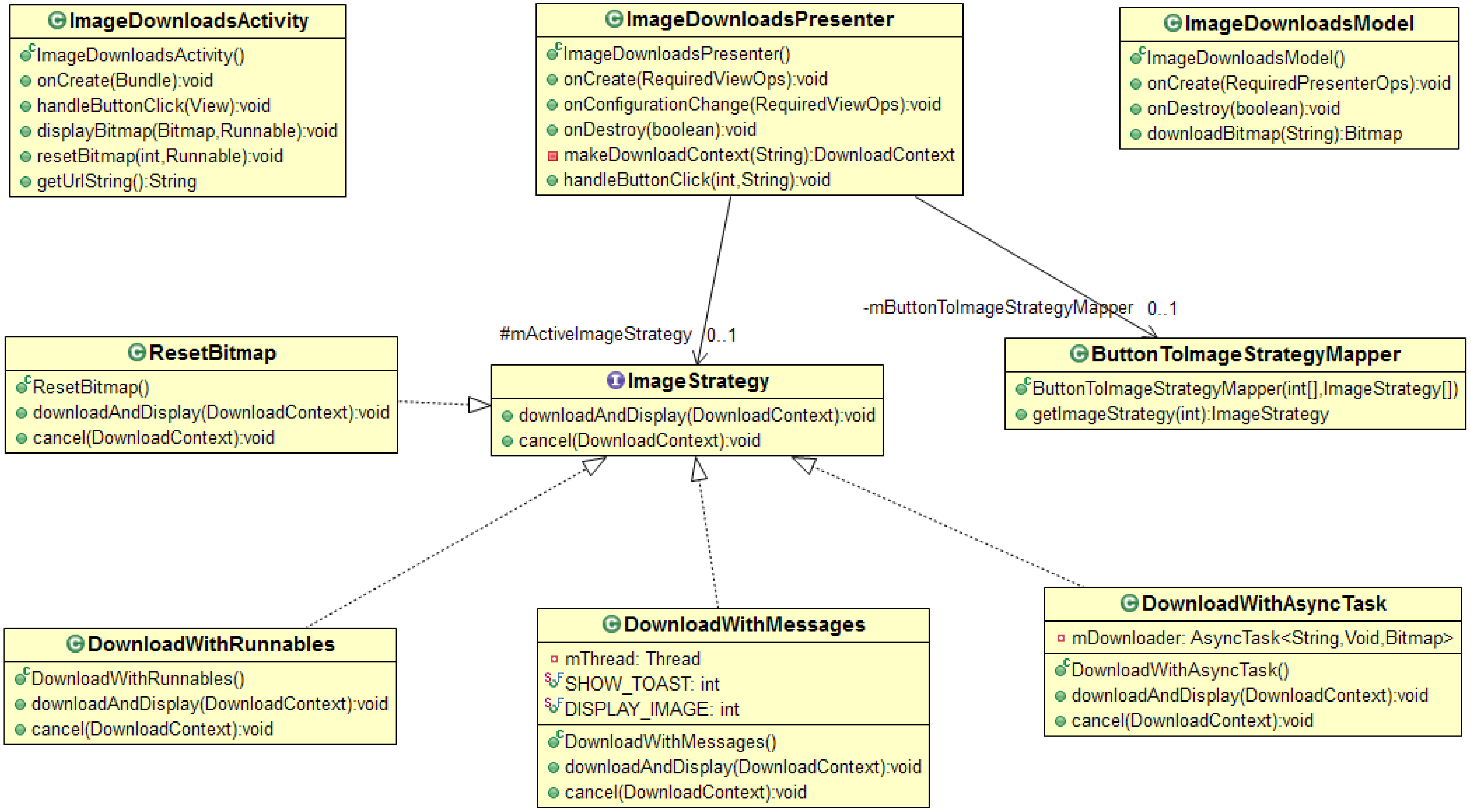


ImageDownloadsActivity
ImageDownloadsActivity()
onCreate(Bundle):void
handleButtonClick(View):void
displayBitmap(Bitmap,Runnable):void
resetBitmap(int,Runnable):void
getUrlString():String
ImageDownloadsPresenter
ImageDownloadsPresenter()
onCreate(RequiredViewOps):void
onConfigurationChange(RequiredViewOps):void
onDestroy(boolean):void
makeDownloadContext(String):DownloadContext
handleButtonClick(int,String):void
ImageDownloadsModel
ImageDownloadsModel()
onCreate(RequiredPresenterOps):void
onDestroy(boolean):void
downloadBitmap(String):Bitmap
#mActiveImageStrategy
0..1
-mButtonToImageStrategyMapper
0..1
ResetBitmap
ResetBitmap()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
ImageStrategy
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
ButtonToImageStrategyMapper
ButtonToImageStrategyMapper(int[],ImageStrategy[])
getImageStrategy(int):ImageStrategy
DownloadWithRunnables
DownloadWithRunnables()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithMessages
mThread: Thread
SHOW_TOAST: int
DISPLAY_IMAGE: int
DownloadWithMessages()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithAsyncTask
mDownloader: AsyncTask<String,Void,Bitmap>
DownloadWithAsyncTask()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void

See github.com/douglascraigschmidt/POSA-15/tree/master/ex/ImageDownloads

Overview of ImageDownloads

- This implementation is based on the *Model-View-Presenter* (MVP) pattern

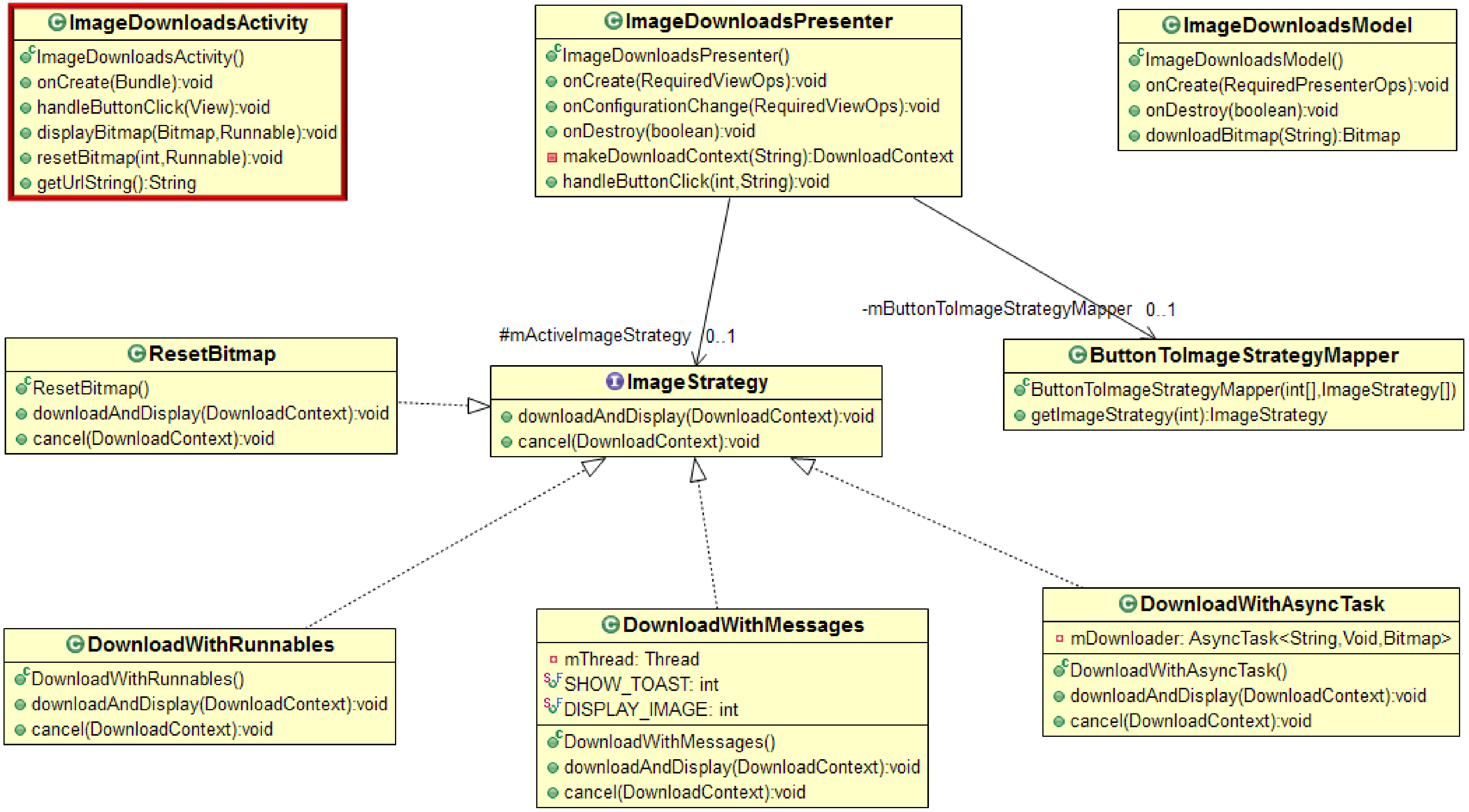


ImageDownloadsActivity
ImageDownloadsActivity()
onCreate(Bundle):void
handleButtonClick(View):void
displayBitmap(Bitmap,Runnable):void
resetBitmap(int,Runnable):void
getUrlString():String
ImageDownloadsPresenter
ImageDownloadsPresenter()
onCreate(RequiredViewOps):void
onConfigurationChange(RequiredViewOps):void
onDestroy(boolean):void
makeDownloadContext(String):DownloadContext
handleButtonClick(int,String):void
ImageDownloadsModel
ImageDownloadsModel()
onCreate(RequiredPresenterOps):void
onDestroy(boolean):void
downloadBitmap(String):Bitmap
#mActiveImageStrategy 0..1
-mButtonToImageStrategyMapper 0..1
ResetBitmap
ResetBitmap()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
ImageStrategy
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
ButtonToImageStrategyMapper
ButtonToImageStrategyMapper(int[],ImageStrategy[])
getImageStrategy(int):ImageStrategy
DownloadWithRunnables
DownloadWithRunnables()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithMessages
mThread: Thread
SHOW_TOAST: int
DISPLAY_IMAGE: int
DownloadWithMessages()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithAsyncTask
mDownloader: AsyncTask<String,Void,Bitmap>
DownloadWithAsyncTask()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void

This solution uses the MPV pattern to handle runtime configuration changes

Overview of ImageDownloads

- This implementation is based on the *Model-View-Presenter* (MVP) pattern



ImageDownloadsActivity
ImageDownloadsActivity()
onCreate(Bundle):void
handleButtonClick(View):void
displayBitmap(Bitmap,Runnable):void
resetBitmap(int,Runnable):void
getUrlString():String
ImageDownloadsPresenter
ImageDownloadsPresenter()
onCreate(RequiredViewOps):void
onConfigurationChange(RequiredViewOps):void
onDestroy(boolean):void
makeDownloadContext(String):DownloadContext
handleButtonClick(int,String):void
ImageDownloadsModel
ImageDownloadsModel()
onCreate(RequiredPresenterOps):void
onDestroy(boolean):void
downloadBitmap(String):Bitmap
-mButtonToImageStrategyMapper 0..1
#mActiveImageStrategy 0..1
ResetBitmap
ResetBitmap()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
ImageStrategy
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
ButtonToImageStrategyMapper
ButtonToImageStrategyMapper(int[],ImageStrategy[])
getImageStrategy(int):ImageStrategy
DownloadWithRunnables
DownloadWithRunnables()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithMessages
mThread: Thread
SHOW_TOAST: int
DISPLAY_IMAGE: int
DownloadWithMessages()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithAsyncTask
mDownloader: AsyncTask<String,Void,Bitmap>
DownloadWithAsyncTask()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void

The View layer handles interactions with the user

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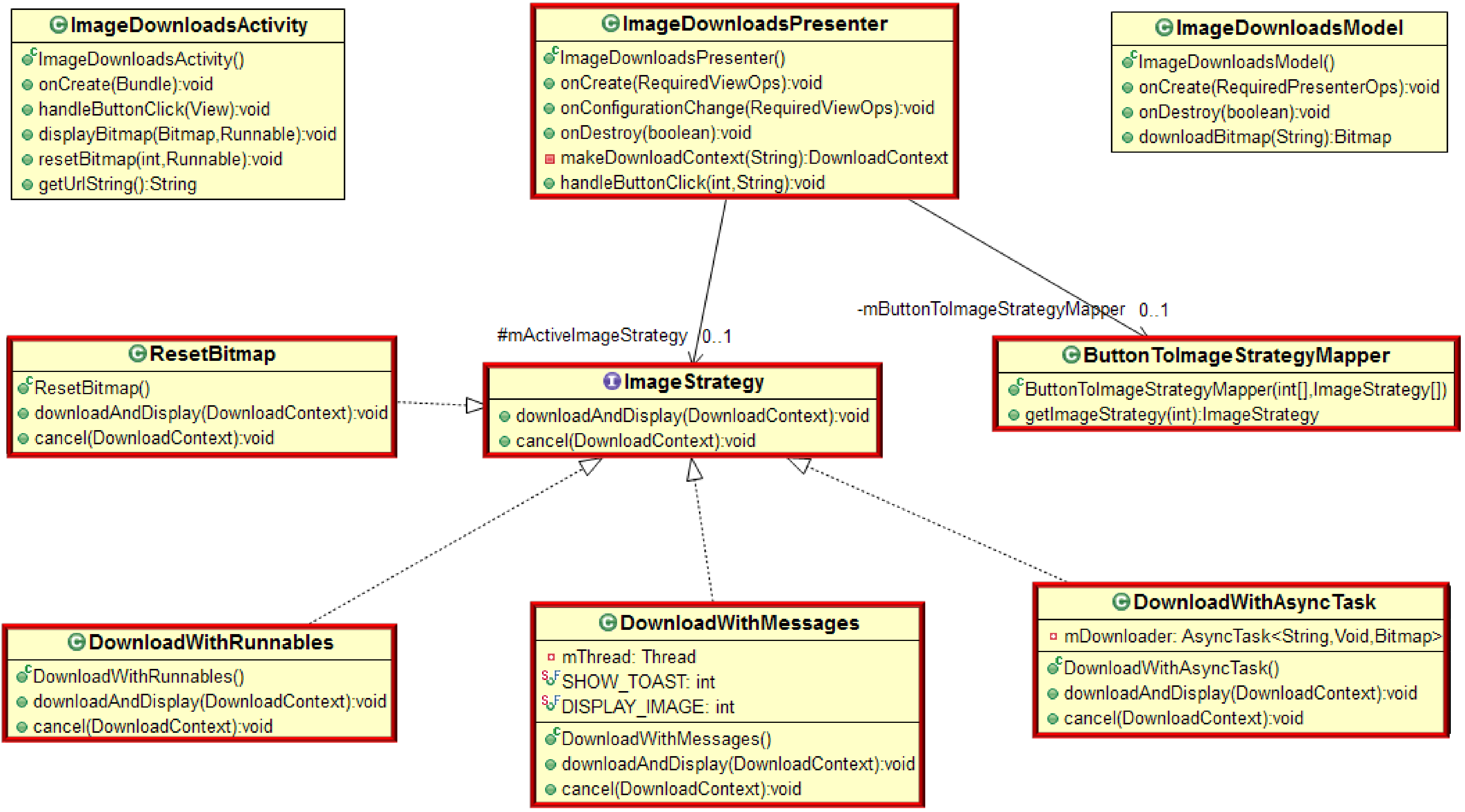

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ButtonToImageStrategyMapper(int[],ImageStrategy[])
getImageStrategy(int):ImageStrategy
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DownloadWithRunnables()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithMessages
mThread: Thread
SHOW_TOAST: int
DISPLAY_IMAGE: int
DownloadWithMessages()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void
DownloadWithAsyncTask
mDownloader: AsyncTask<String,Void,Bitmap>
DownloadWithAsyncTask()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void

The Presenter layer concurrently mediates interactions with the View & Model layers

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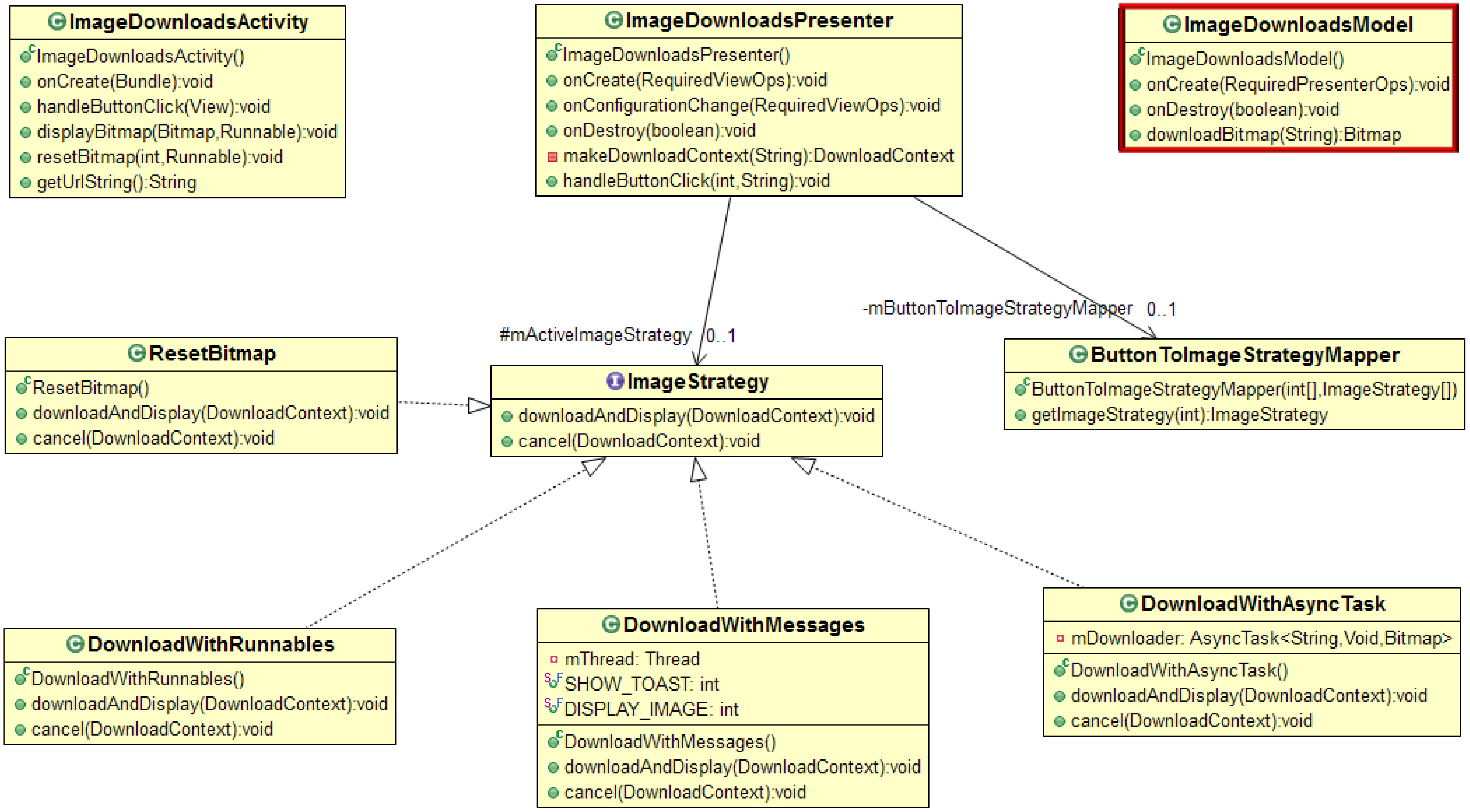
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DISPLAY_IMAGE: int
DownloadWithMessages()
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mDownloader: AsyncTask<String,Void,Bitmap>
DownloadWithAsyncTask()
downloadAndDisplay(DownloadContext):void
cancel(DownloadContext):void

The Model layer interacts with the remote web server