Android Developer Fundamentals V2

Background Tasks

Lesson 7

AsyncTask

Contents

- Threads
- AsyncTask
- Loaders
- AsyncTaskLoader

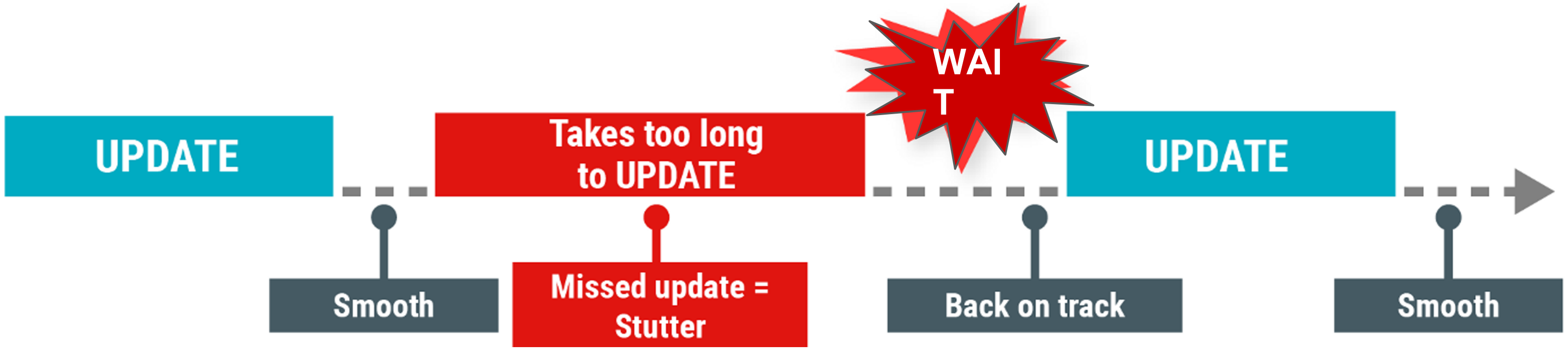
Threads

The main thread

- Independent path of execution in a running program
- Code is executed line by line
- App runs on Java thread called "main" or "UI thread"
- Draws UI on the screen
- Responds to user actions by handling UI events

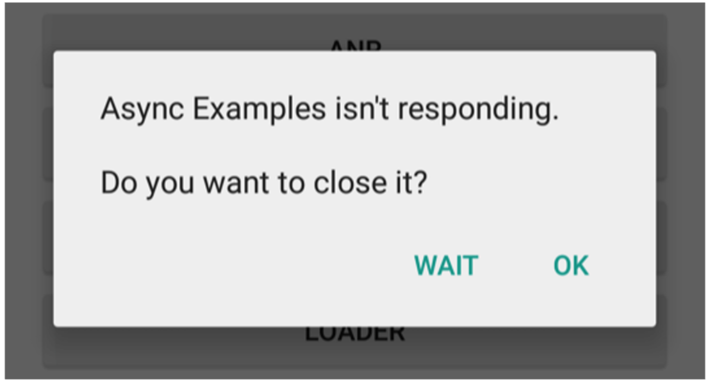
The Main thread must be fast

- Hardware updates screen every 16 milliseconds
- UI thread has 16 ms to do all its work
- If it takes too long, app stutters or hangs



Users uninstall unresponsive apps

- If the UI waits too long for an operation to finish, it becomes unresponsive
- The framework shows an Application Not Responding (ANR) dialog

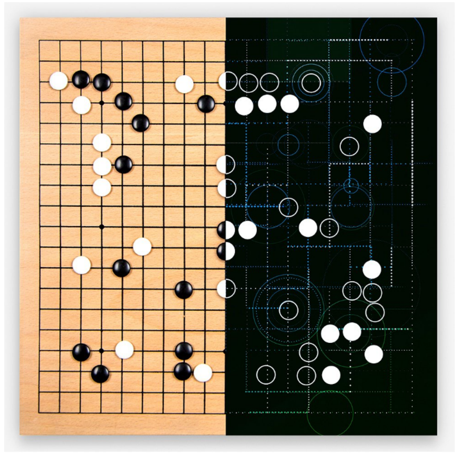


Async Examples isn't responding.

Do you want to close it?

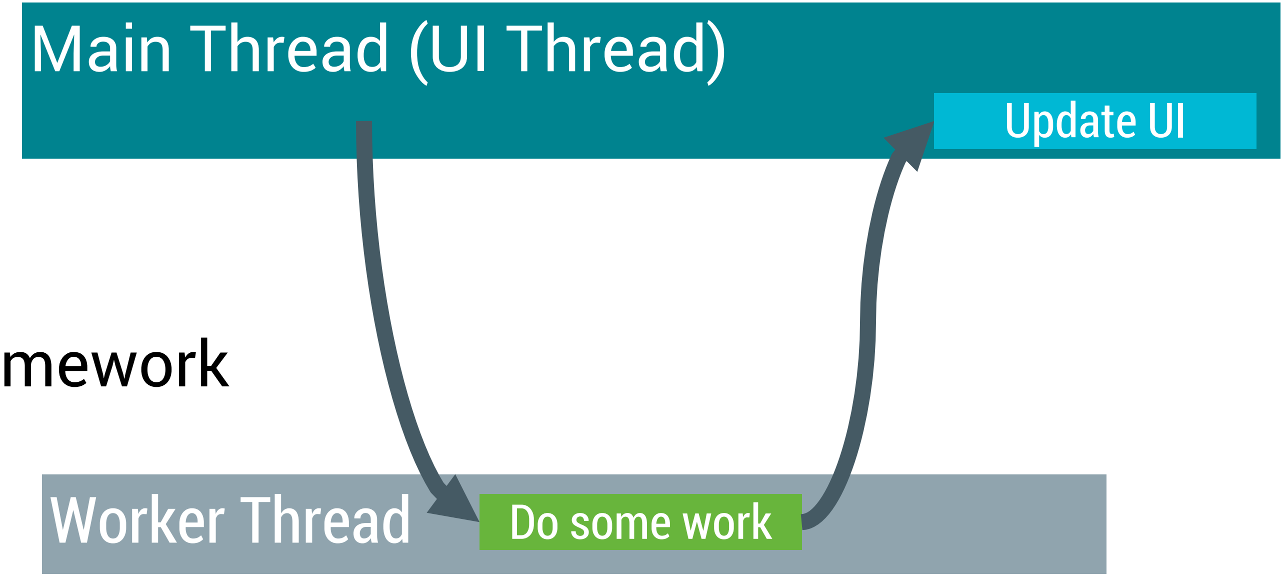
What is a long running task?

- Network operations
- Long calculations
- Downloading/uploading files
- Processing images
- Loading data



Background threads

Execute long running tasks on a **background thread**



- AsyncTask
- The Loader Framework
- Services

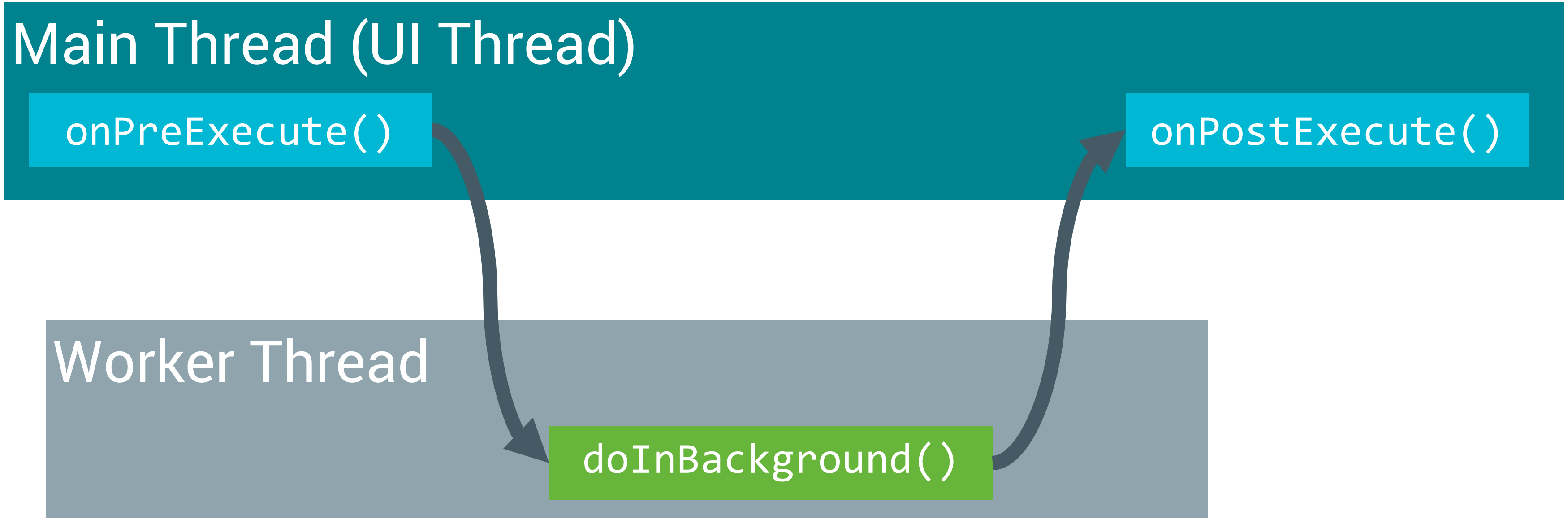
Two rules for Android threads

- Do not block the UI thread
    - Complete all work in less than 16 ms for each screen
    - Run slow non-UI work on a non-UI thread
- Do not access the Android UI toolkit from outside the UI thread
    - Do UI work only on the UI thread

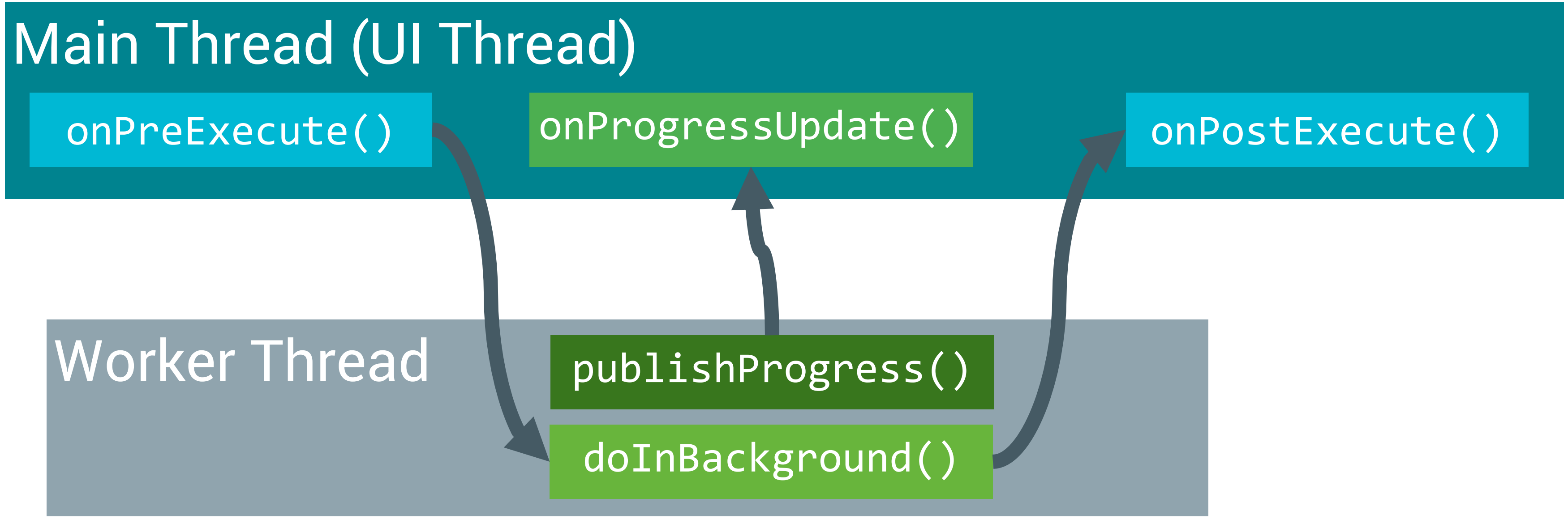
AsyncTask

What is AsyncTask?

Use AsyncTask to implement basic background tasks



AsyncTask helper methods



Override two methods

- `doInBackground()`—runs on a background thread
  - All the work to happen in the background
- `onPostExecute()`—runs on main thread when work done
  - Process results
  - Publish results to the UI

AsyncTask helper methods

- `onPreExecute()`
  - Runs on the main thread
  - Sets up the task

- `onProgressUpdate()`
  - Runs on the main thread
  - receives calls from `publishProgress()` from background thread

1. http://bit.ly/2HiXp2t

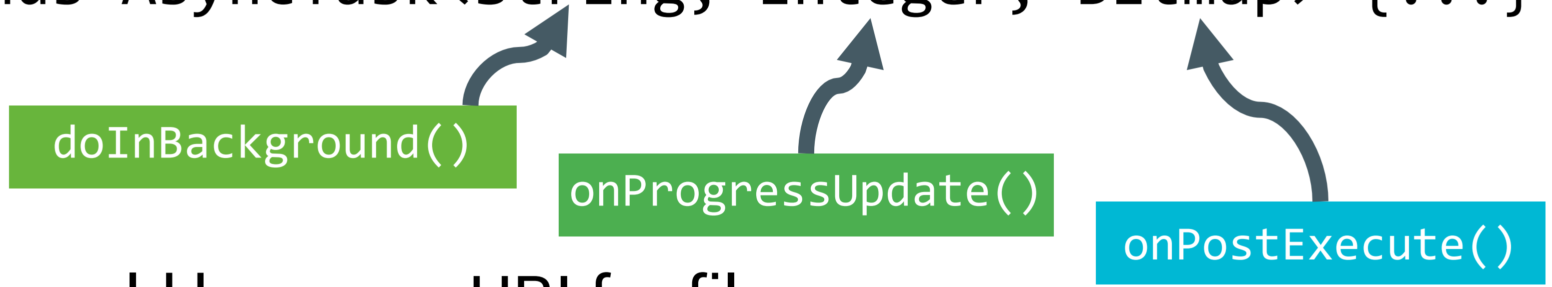
Creating an AsyncTask

1. Subclass AsyncTask
2. Provide data type sent to `doInBackground()`
3. Provide data type of progress units for `onProgressUpdate()`
4. Provide data type of result for `onPostExecute()`

```
private class MyAsyncTask
    extends AsyncTask<URL, Integer, Bitmap> {...}
```

MyAsyncTask class definition

```
private class MyAsyncTask
    extends AsyncTask<String, Integer, Bitmap> {...}
```



- String—could be query, URI for filename
- Integer—percentage completed, steps done
- Bitmap—an image to be displayed
- Use Void if no data passed

Override AsyncTask methods

```
protected void onPreExecute() {
    // display a progress bar
}
protected Bitmap doInBackground(String... query) {
    // Get the bitmap
    // Call publishProgress(…) to update the loaded data
    return bitmap;
}
```

Override AsyncTask methods

```
protected void onProgressUpdate(Integer... progress) {
    setProgressPercent(progress[0]);
}
protected void onPostExecute(Bitmap result) {
   // Do something with the bitmap
}
```

Start background work

```
public void loadImage (View view) {
    String imageUrl = mEditText.getText().toString();
    new MyAsyncTask(imageUrl).execute();
}
```

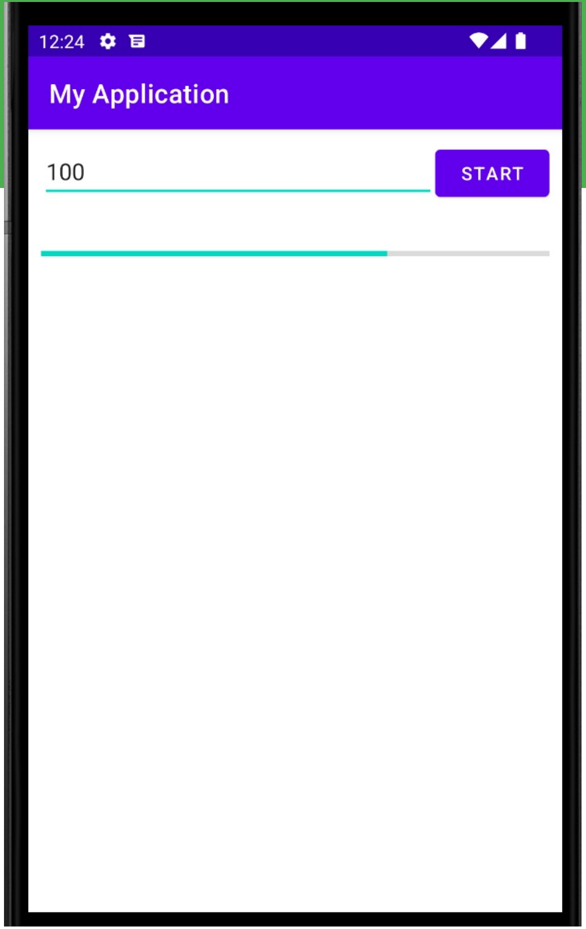
Limitations of AsyncTask

- When device configuration changes, Activity is destroyed
- AsyncTask cannot connect to Activity anymore
- New AsyncTask created for every config change
- Old AsyncTasks stay around
- App may run out of memory or crash

When to use AsyncTask

- Short or interruptible tasks
- Tasks that do not need to report back to UI or user
- Lower priority tasks that can be left unfinished
- Use AsyncTaskLoader otherwise

Demo AsyncTask



Loaders

What is a Loader?

- Execute tasks OFF the UI thread
- Provides asynchronous loading of data
- **Reconnects to Activity after configuration change**
- Can monitor changes in data source and deliver new data
- Callbacks implemented in Activity
- Many types of loaders available: AsyncTaskLoader, CursorLoader

LoaderManager

- Manages loader functions via callbacks
- Can manage multiple loaders: loader for database data, for AsyncTask data, for internet data…
- LoaderManager handles configuration changes for you

Get a loader with initLoader()

- Creates and starts a loader, or reuses an existing one, including its data
- Use restartLoader() to clear data in existing loader

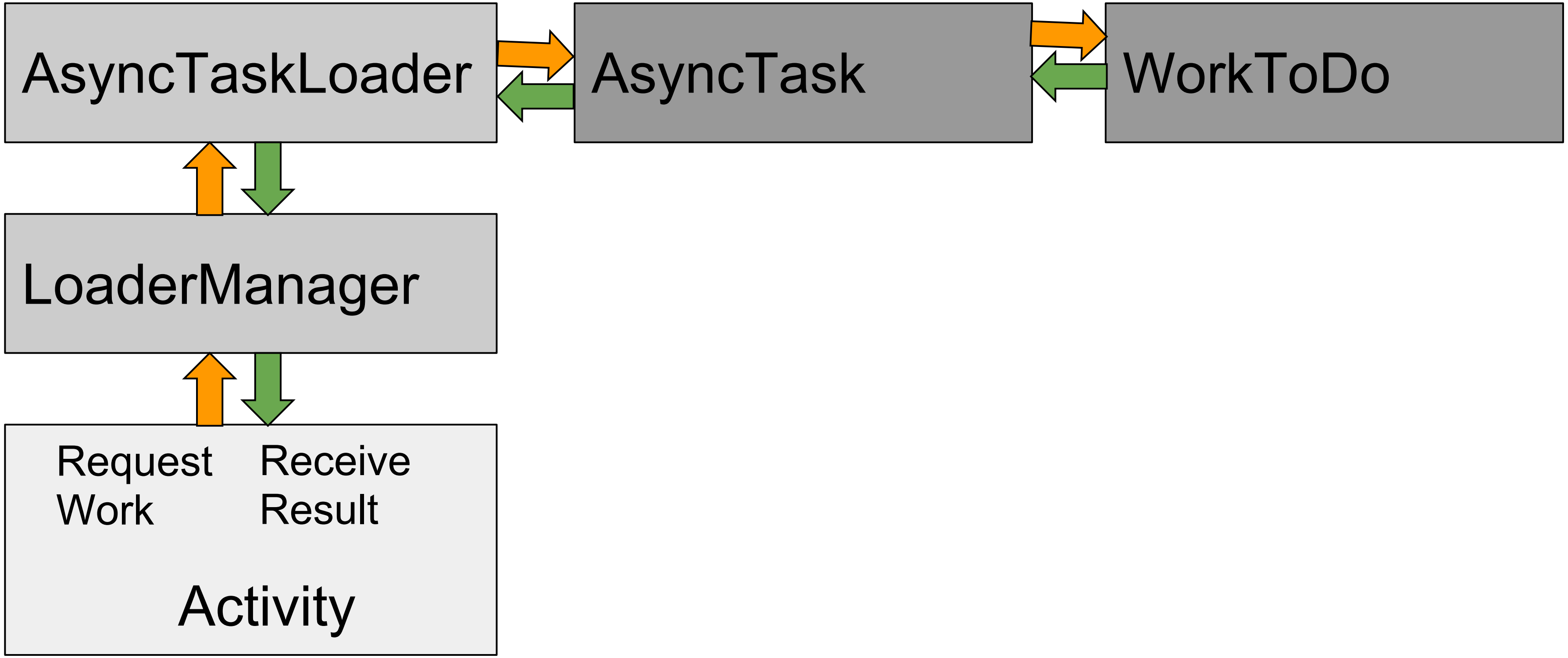
```
getLoaderManager().initLoader(Id, args, callback);

getLoaderManager().initLoader(0, null, this);
```

Implement loader callbacks in Activity

- `onCreateLoader()` — Create and return a new Loader for the given ID
- `onLoadFinished()` — Called when a previously created loader has finished its load
- `onLoaderReset()` — Called when a previously created loader is being reset making its data unavailable

Implementing AsyncTaskLoader

AsyncTaskLoader Overview



Steps for AsyncTaskLoader subclass

1. Subclass AsyncTaskLoader
2. Implement constructor
3. `loadInBackground()`
4. `onStartLoading()`

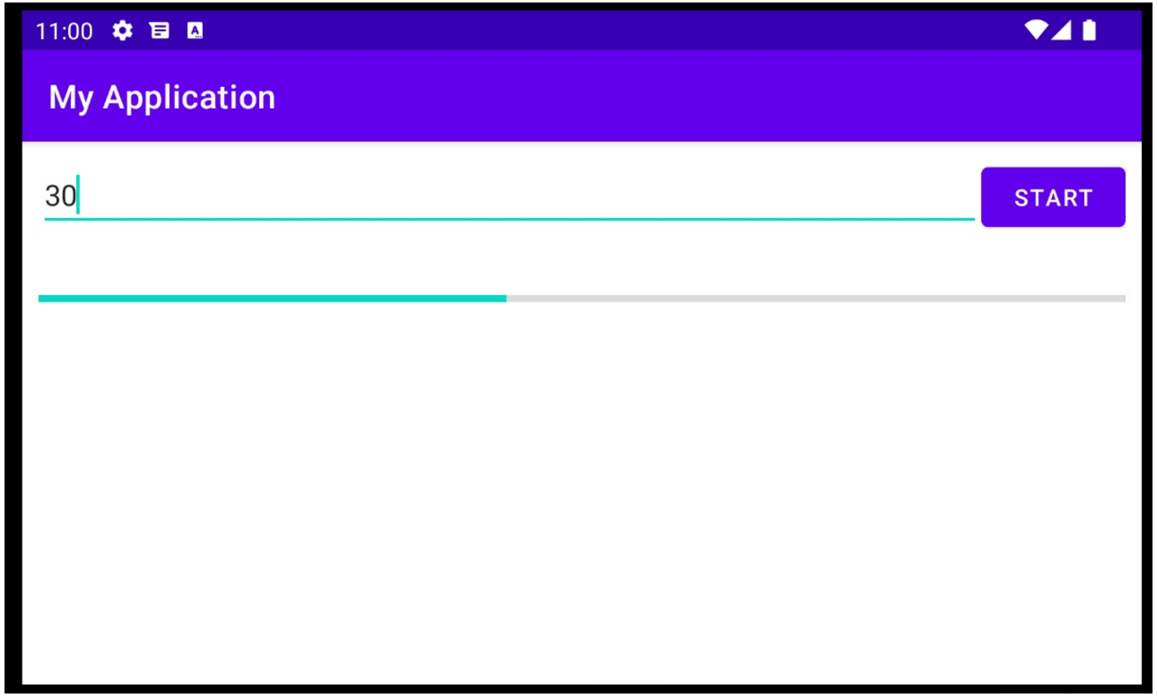
onStartLoading()

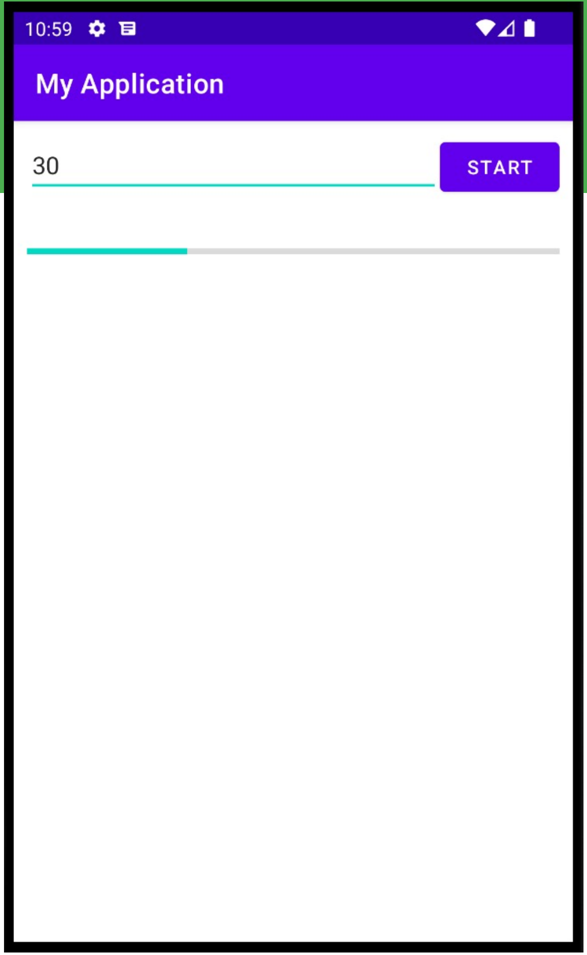
The LoaderManager invokes the `onStartLoading()` callback

- Check for cached data
- Call `forceLoad()` to load the data if there are changes or no cached data

```
 protected void onStartLoading() {  forceLoad();  }
```

Demo Loader





Demo Loader

```java
handler = new Handler(Looper.getMainLooper()){
    @Override
    public void handleMessage(@NonNull Message msg) {
        super.handleMessage(msg);

        int progress = msg.getData().getInt("progress");
        progressBar.setProgress(progress);
    }
};

MyLoader loader = (MyLoader) getLoaderManager().initLoader(1, null, this);
loader.setHandler(handler);
```

Demo Loader

```
public class MainActivity … implements LoaderManager.LoaderCallbacks<Void> {

     @Override
     public Loader<Void> onCreateLoader(int id, Bundle args) {
         return new MyLoader(this);
     }

     @Override
     public void onLoadFinished(Loader<Void> loader, Void data) {

     }

     @Override
     public void onLoaderReset(Loader<Bitmap> loader) {

     }
```

Demo Loader

```java
public Void loadInBackground() {
    for(int i = 1; i <= 100; i++) {
        try {
            Log.d("loadInBackground: ", i+"");
            Thread.sleep(1000);

            Message message = new Message();
            Bundle data = new Bundle();
            data.putInt("progress", i);
            message.setData(data);
            handler.sendMessage(message);
        } catch (InterruptedException e) {
            throw new RuntimeException(e);
        }
    }
}
```

Demo Loader

```java
protected void onStartLoading() {
    super.onStartLoading();
    forceLoad();
}
```

Learn more

- AsyncTask Reference
- AsyncTaskLoader Reference
- LoaderManager Reference
- Processes and Threads Guide
- Loaders Guide
- UI Thread Performance: Exceed the Android Speed Limit

What's Next?

- Concept Chapter: 7.1 AsyncTask and AsyncTaskLoader
- Practical: 7.1 AsyncTask

END