The AsyncTask Framework: Usage Considerations

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Learning Objectives in this Part of the Lesson

- Recognize the capabilities provided by the Android AsyncTask framework
- Know which methods are provided by AsyncTask class
- Understand what black-box & white-box framework are... & how AsyncTask implements both types of frameworks
- Learn how the AsyncTask Interrupted program works
- Appreciate AsyncTask usage considerations
AsyncTask Usage Considerations
AsyncTask Usage Considerations

- AsyncTask allows UI & background threads to communicate

1. execute(url)
2. onPreExecute()
3. execute(future)
4. doInBackground()
5. onProgressUpdate()
6. onPostExecute()

Its onPreExecute(), onProgressUpdate(), & onPostExecute() methods *always* run in the context of the UI thread!
AsyncTask Usage Considerations

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These methods are strongly connected via AsyncTask framework classes
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AsyncTask Usage Considerations

- AsyncTask allows UI & background threads to communicate
- Unlike HaMeR framework, no direct manipulation of handlers, messages, runnables, or threads
AsyncTask Usage Considerations

- AsyncTask embodies key characteristics of a framework

See [www.dre.vanderbilt.edu/~schmidt/PDF/Queue-04.pdf](http://www.dre.vanderbilt.edu/~schmidt/PDF/Queue-04.pdf)
AsyncTask Usage Considerations

- AsyncTask embodies key characteristics of a framework, e.g.
  - Inversion of control

![AsyncTask Diagram]

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2. `onPreExecute()`
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AsyncTask Usage Considerations

- AsyncTask embodies key characteristics of a framework, e.g.
  - Inversion of control
  - Domain-specific structure & functionality

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2. onPreExecute()
3. execute(future)
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```

- FutureTask
- Executor
- Looper
- Message Queue
- Handler
- UI Thread (main thread)
AsyncTask Usage Considerations

- AsyncTask embodies key characteristics of a framework, e.g.
  - Inversion of control
  - Domain-specific structure & functionality
  - Semi-complete portions of apps

```
AsyncTask
execute()
cancel()
onPreExecute()
doInBackground()
onProgressUpdate()
onPostExecute()
onCancelled()
```

```
ImageDownloadTask
onPreExecute()
doInBackground()
onProgressUpdate()
onPostExecute()
onCancelled()
```
AsyncTask Usage Considerations

• AsyncTask embodies key characteristics of a framework, e.g.
  • Inversion of control
  • Domain-specific structure & functionality
• Semi-complete portions of apps
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AsyncTask
execute()
cancel()
onPreExecute()
 doInBackground()
onProgressUpdate()
onPostExecute()
onCancelled()
```

```
ImageDownloadTask
onPreExecute()
 doInBackground()
onProgressUpdate()
onPostExecute()
onCancelled()
```
AsyncTask Usage Considerations

- AsyncTask has elements of both black-box & white-box frameworks

```
Threaded
Download

: Threaded
Download

: Download
Task

: Executor

: Worker
Runnable

executeOnExecutor(executorStrategy, params)

onPreExecute()

onPostExecute()

execute()

call()

doInBackground()

postResult()

UI \rightarrow \leftarrow \text{Thread}

\text{Background Threads}
```
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  - Its hook methods are elements of a white-box framework
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  - Its hook methods are elements of a white-box framework
  - Its executor strategy is an element of a black-box framework
AsyncTask Usage Considerations

• There are trade-offs between each approach
• White-box frameworks are generally easier to develop...
AsyncTask Usage Considerations

- There are trade-offs between each approach
  - White-box frameworks are generally easier to develop...
  - ... but harder to use
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    • ... but easier to use

See en.wikipedia.org/wiki/Plug-in_(computing)
AsyncTask Usage Considerations

• AsyncTask uses several GoF patterns
AsyncTask Usage Considerations

- AsyncTask uses several GoF patterns
- *Template Method* is used for its white-box capabilities

```java
AsyncTask
execute()
cancel()
onPreExecute()
*doInBackground*
onProgressUpdate()
onPostExecute()
onCancelled()
```

See [en.wikipedia.org/wiki/Template_method_pattern](en.wikipedia.org/wiki/Template_method_pattern)
AsyncTask Usage Considerations

- AsyncTask uses several GoF patterns
  - *Template Method* is used for its white-box capabilities

AsyncTask

- execute()
- cancel()
- onPreExecute()
- doInBackground()
- onProgressUpdate()
- onPostExecute()
- onCancelled()

ImageDownloadTask

- onPreExecute()
- doInBackground()
- onProgressUpdate()
- onPostExecute()
- onCancelled()
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AsyncTask Usage Considerations

- AsyncTask uses several GoF patterns
  - *Template Method* is used for its white-box capabilities
  - *Strategy* is used for its black-box capabilities
  - *Facade* is used to simplify access to the Java Executor framework

See en.wikipedia.org/wiki/Facade_pattern
AsyncTask Usage Considerations

- AsyncTask also uses several POSA patterns
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- AsyncTask also uses several POSA patterns
- Half-Sync/Half-Async is used to coordinate between the UI thread & background thread(s)

See [www.dre.vanderbilt.edu/~schmidt/PDF/HS-HA.pdf](http://www.dre.vanderbilt.edu/~schmidt/PDF/HS-HA.pdf)
AsyncTask Usage Considerations

- AsyncTask also uses several POSA patterns
  - *Half-Sync/Half-Async* is used to coordinate between the UI thread & background thread(s)
  - *Pooling* is used to manage multiple instances of threads, which allows for reuse when AsyncTasks release threads they no longer need

See [www.kircher-schwanninger.de/michael/publications/Pooling.pdf](http://www.kircher-schwanninger.de/michael/publications/Pooling.pdf)
AsyncTask Usage Considerations

• AsyncTask has traps & pitfalls

See bon-app-etit.blogspot.com/2013/04/the-dark-side-of-asynctask.html
AsyncTask Usage Considerations

- AsyncTask has traps & pitfalls
  - Cancellation
    - Cancellation is voluntary, just like Thread.interrupt()
AsyncTask Usage Considerations

• AsyncTask has traps & pitfalls
  • Cancellation
  • Dependency on Activity
    • Memory leaks occur if there’s a strong references to enclosing Activity

See medium.com/@zhangqichuan/memory-leak-in-android-4a6a7e8d7780
AsyncTask Usage Considerations

- AsyncTask has traps & pitfalls
  - Cancellation
  - Dependency on Activity
  - Losing results if/when runtime configurations change
    - e.g., Activity associated with an AsyncTask may be destroyed

See commonsware.com/blog/2010/09/10/asynctask-screen-rotation.html
AsyncTask Usage Considerations

• AsyncTask has traps & pitfalls
  • Cancellation
  • Dependency on Activity
  • Losing results if/when runtime configurations change
• Portability
  • Concurrency semantics of AsyncTask execute() have changed over time

Before API 1.6 (Donut):
• In the first version of AsyncTask, the tasks were executed serially, so a task won't start before a previous task is finished. This caused quite some performance problems. One task had to wait on another one to finish.

API 1.6 to API 2.3 (Gingerbread):
• The Android developers team decided to change this so that AsyncTasks could run parallel on a separate worker thread. There was one problem. Many developers relied on the sequential behavior and suddenly they were having a lot of concurrency issues.

API 3.0 (Honeycomb) until now
• "Hmmm, developers don't seem to get it? Let's just switch it back." The AsyncTasks where executed serially again. However, they can run parallel via executeOnExecutor(Executor).

executeOnExecutor(Executor)
AsyncTask Usage Considerations

- AsyncTask has traps & pitfalls
  - Cancellation
  - Dependency on Activity
  - Losing results if/when runtime configurations change
  - Portability

The Model-View Presenter (MVP) pattern addresses some of these issues

See [en.wikipedia.org/wiki/Model-view-presenter](en.wikipedia.org/wiki/Model-view-presenter)
AsyncTask Usage Considerations

- AsyncTask has traps & pitfalls
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  - Dependency on Activity
  - Losing results if/when runtime configurations change
  - Portability

Other issues can be addressed only by understanding Android patterns & APIs

See developer.android.com/training/articles/perf-anr.html#Avoiding
End of the AsyncTask Framework: Usage Considerations