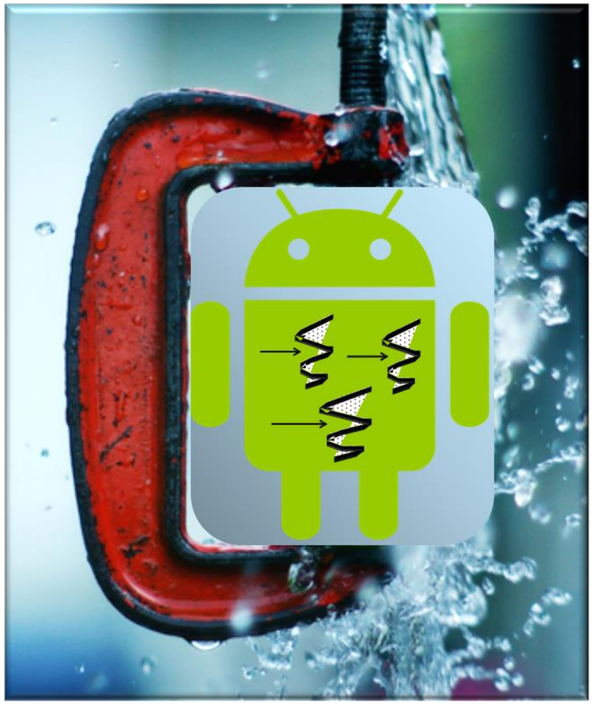
Android Concurrency Frameworks: Motivation

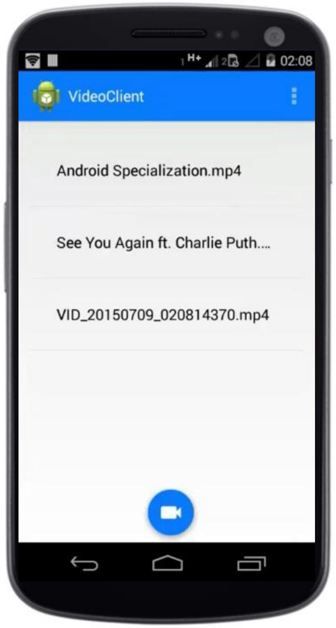
Douglas C. Schmidt
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

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

Learning Objectives in this Part of the Lesson

- Know the motivations for Android concurrency & its concurrency frameworks

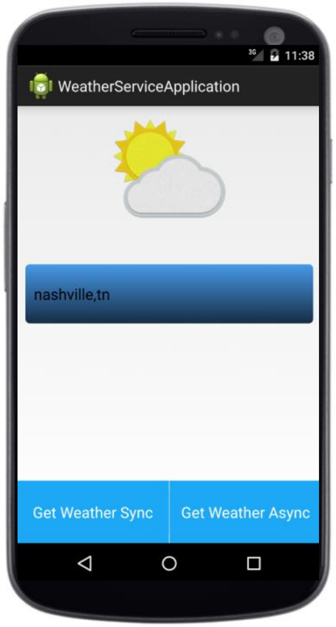




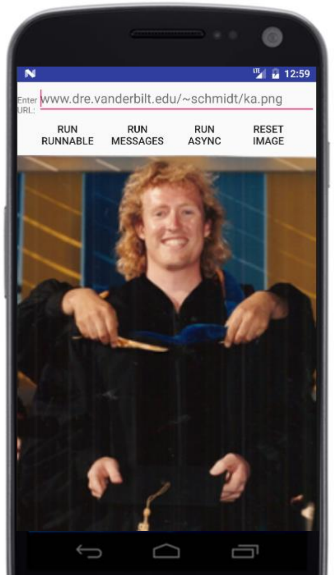
Android Specialization.mp4

See You Again ft. Charlie Puth....

VID_20150709_020814370.mp4



nashville,tn

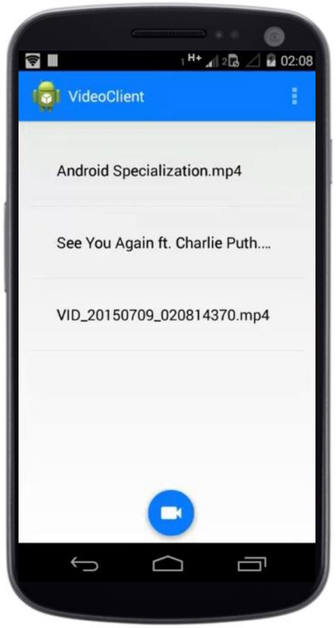


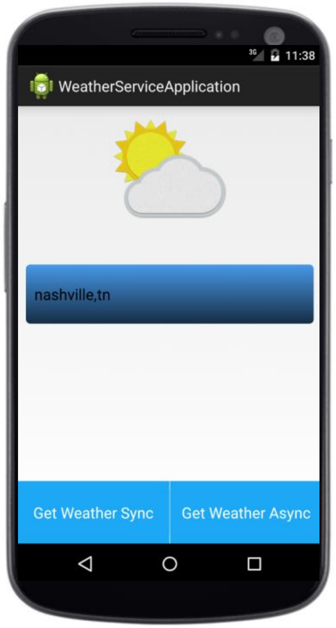
Enter URL: www.dre.vanderbilt.edu/~schmidt/ka.png

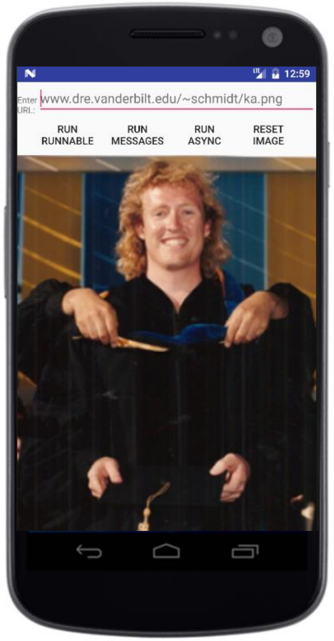
Motivation for Android Concurrency

Motivation for Android Concurrency

- Many Android apps require and/or benefit from concurrency

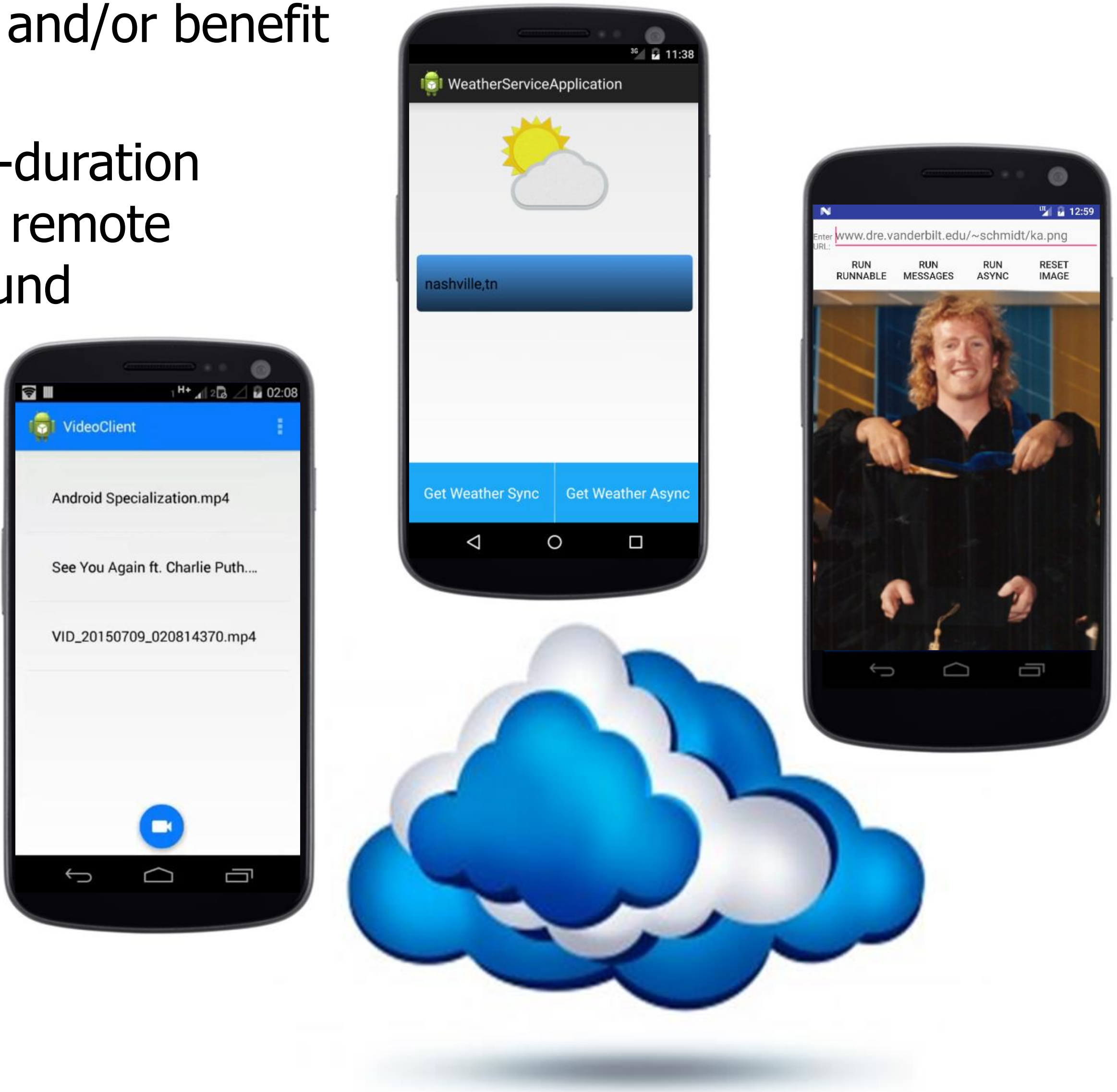

02:08
VideoClient
Android Specialization.mp4
See You Again ft. Charlie Puth....
VID_20150709_020814370.mp4





Motivation for Android Concurrency

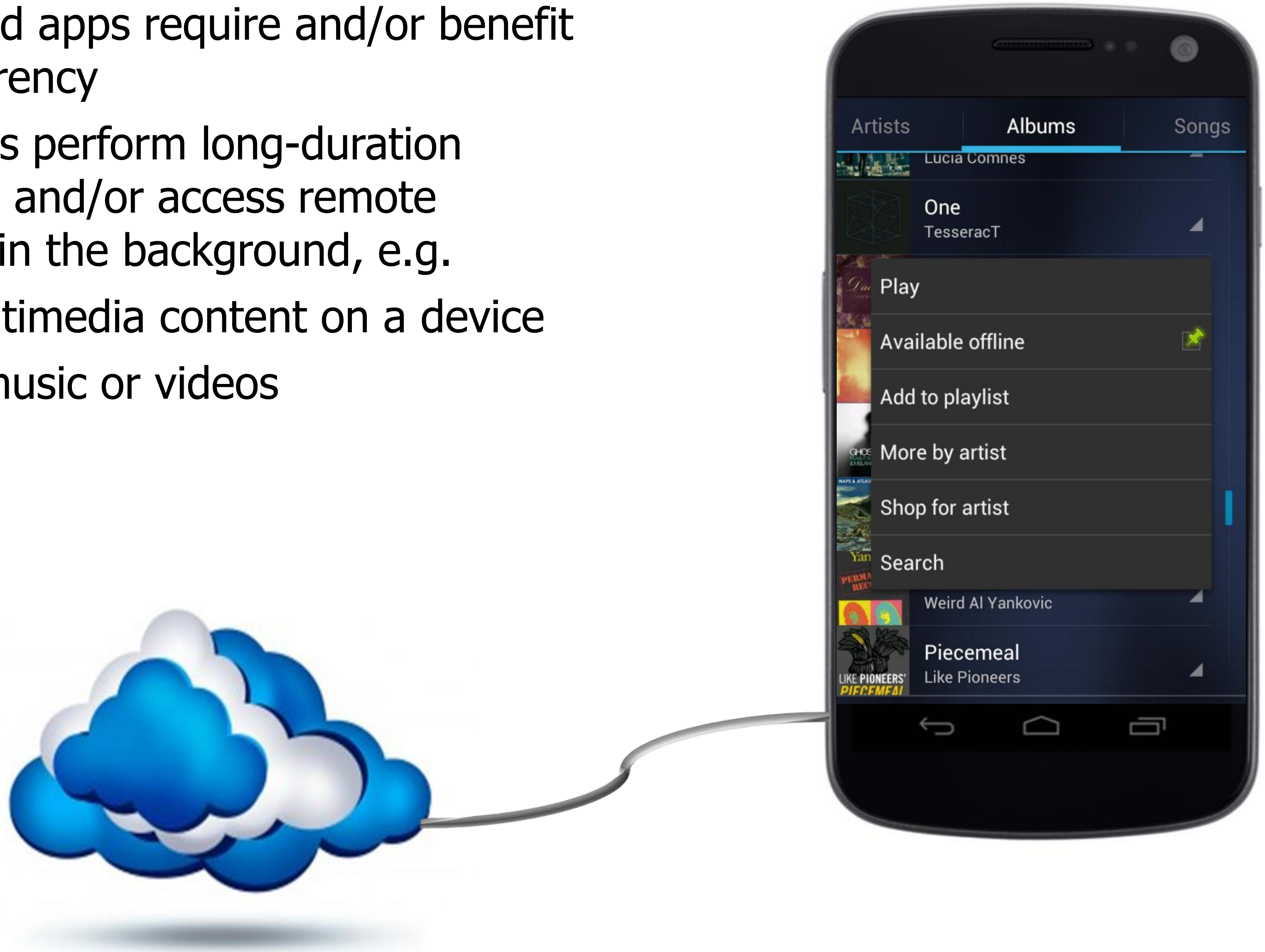
- Many Android apps require and/or benefit from concurrency
  - These apps perform long-duration operations and/or access remote resources in the background


02:08
VideoClient
Android Specialization.mp4
See You Again ft. Charlie Puth....
VID_20150709_020814370.mp4
11:38
WeatherServiceApplication
nashville,tn
Get Weather Sync
Get Weather Async
12:59
Enter URL:
www.dre.vanderbilt.edu/~schmidt/ka.png
RUN RUNNABLE
RUN MESSAGES
RUN ASYNC
RESET IMAGE

Often (but not always), apps interact with servers that reside in the cloud

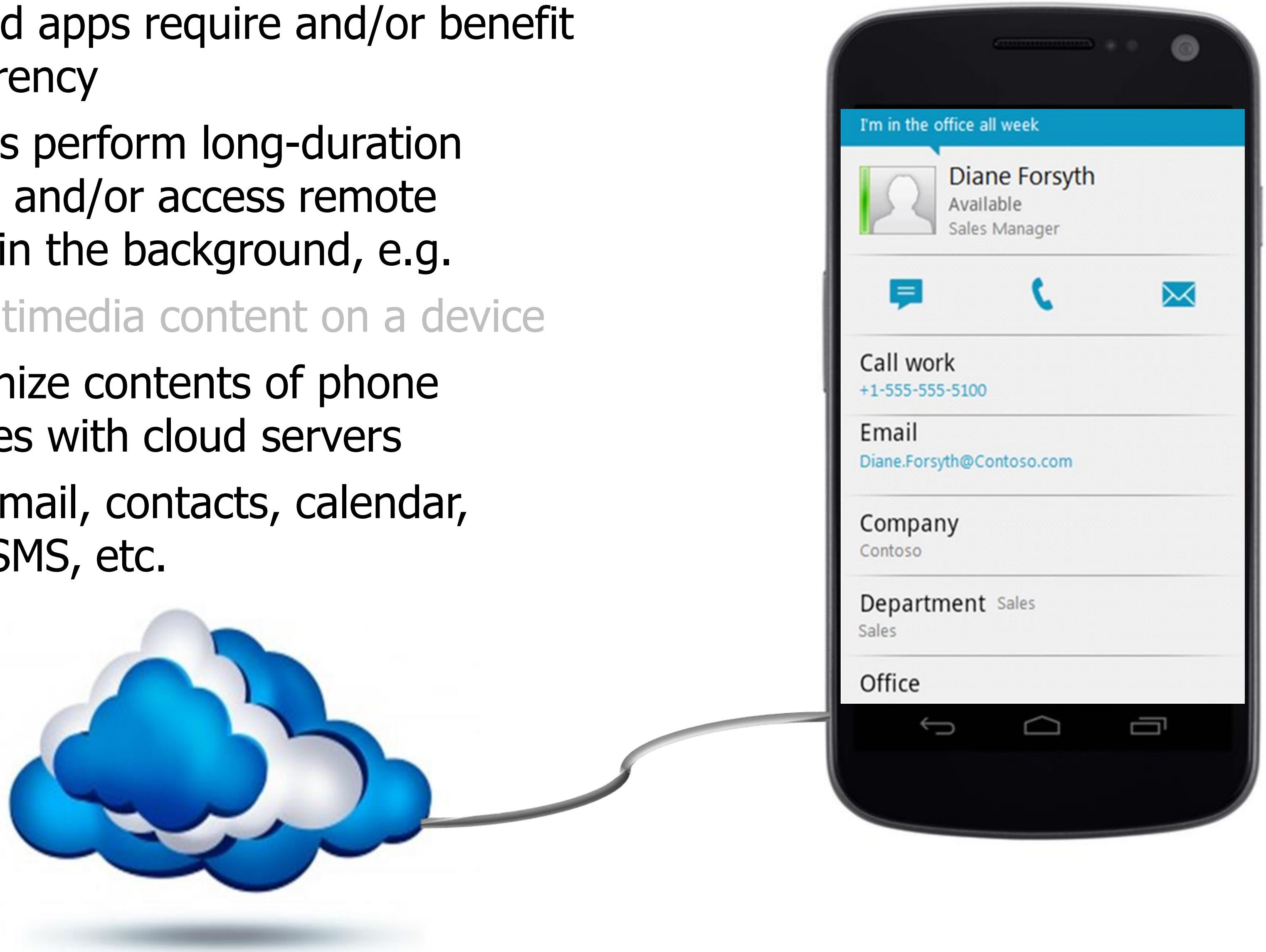
Motivation for Android Concurrency

- Many Android apps require and/or benefit from concurrency
  - These apps perform long-duration operations and/or access remote resources in the background, e.g.
    - Play multimedia content on a device
      - e.g., music or videos



Motivation for Android Concurrency

- Many Android apps require and/or benefit from concurrency
  - These apps perform long-duration operations and/or access remote resources in the background, e.g.
    - Play multimedia content on a device
    - Synchronize contents of phone databases with cloud servers
      - e.g., email, contacts, calendar, MMS/SMS, etc.



I'm in the office all week

Diane Forsyth
Available
Sales Manager

Call work
+1-555-555-5100

Email
Diane.Forsyth@Contoso.com

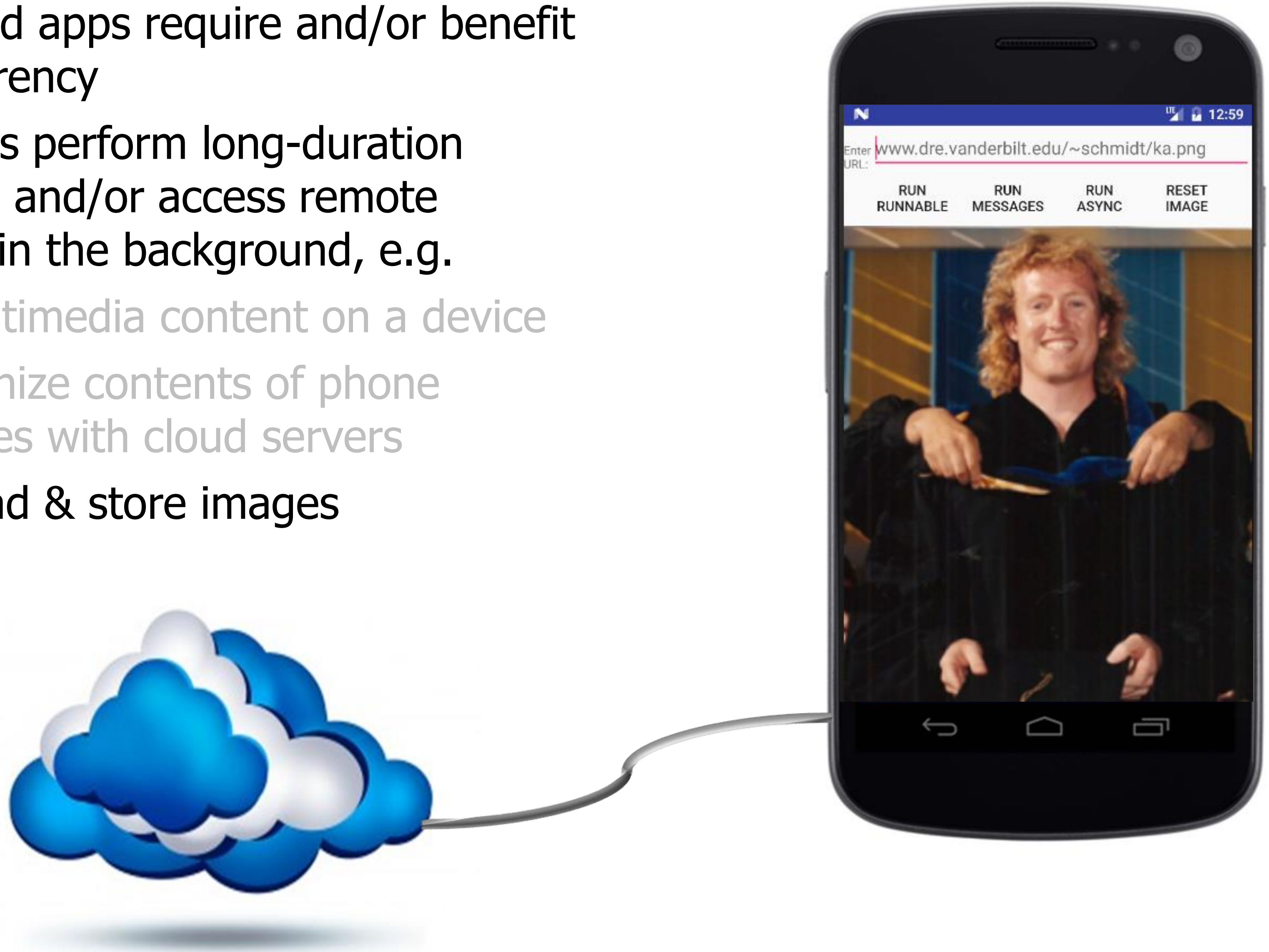
Company
Contoso

Department Sales
Sales

Office

Motivation for Android Concurrency

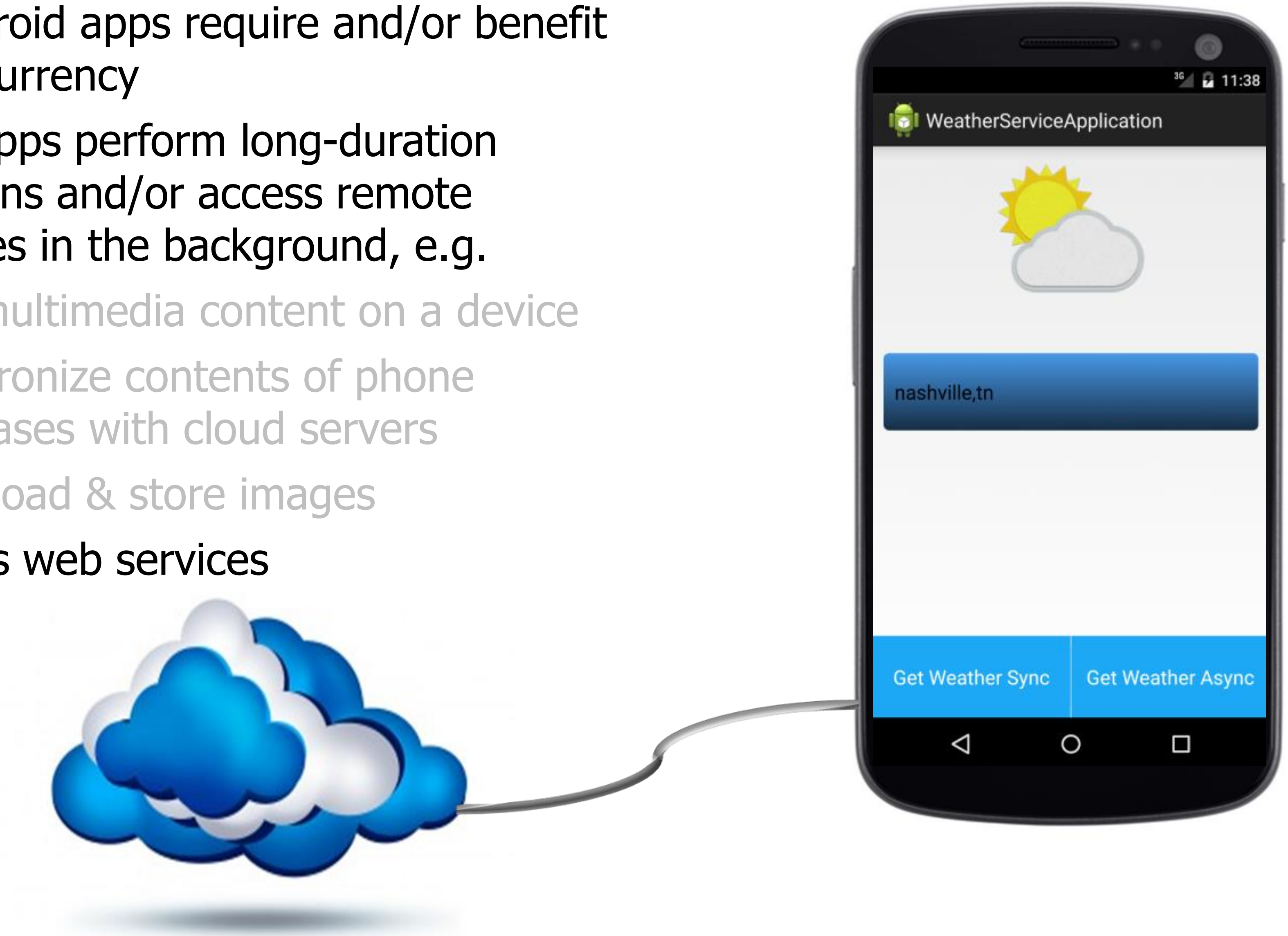
- Many Android apps require and/or benefit from concurrency
  - These apps perform long-duration operations and/or access remote resources in the background, e.g.
    - Play multimedia content on a device
    - Synchronize contents of phone databases with cloud servers
    - Download & store images



Enter URL: www.dre.vanderbilt.edu/~schmidt/ka.png

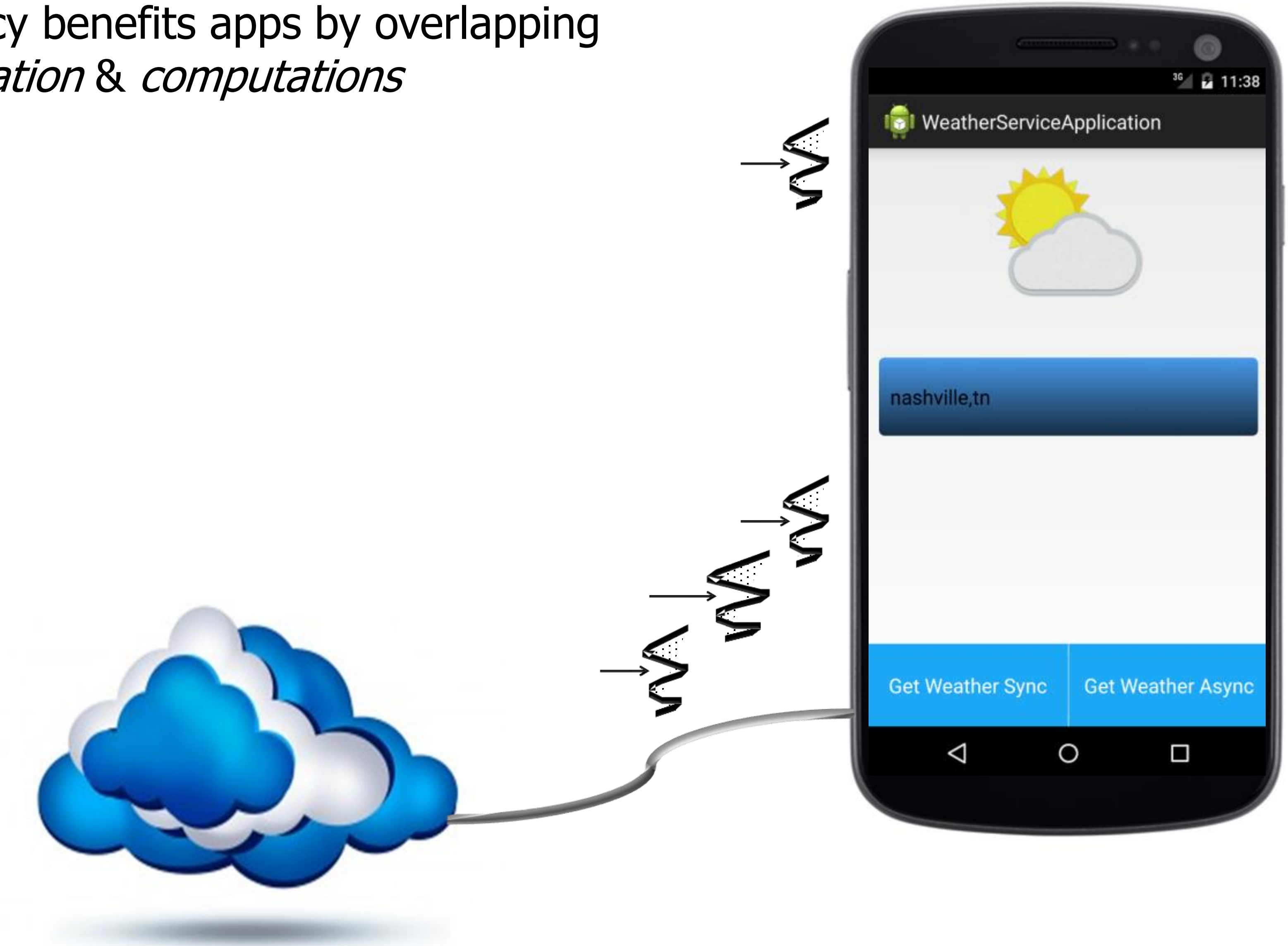
Motivation for Android Concurrency

- Many Android apps require and/or benefit from concurrency
  - These apps perform long-duration operations and/or access remote resources in the background, e.g.
    - Play multimedia content on a device
    - Synchronize contents of phone databases with cloud servers
    - Download & store images
    - Access web services



Motivation for Android Concurrency

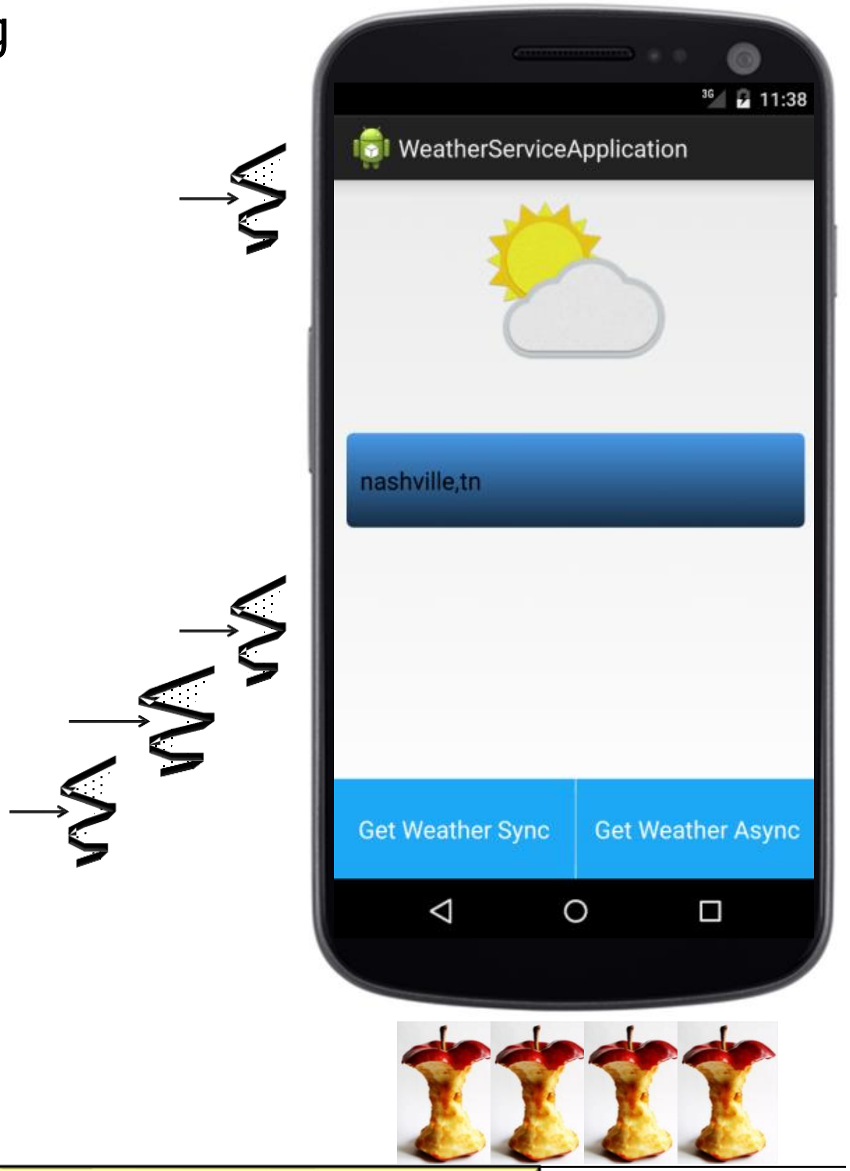
- Concurrency benefits apps by overlapping *communication* & *computations*



See earlier lessons on "*Motivation for Concurrency*"

Motivation for Android Concurrency

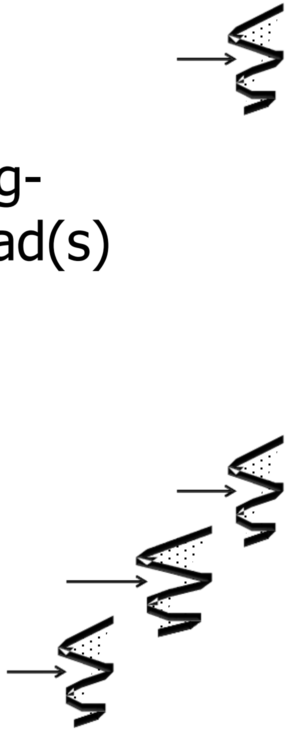
- Concurrency benefits apps by overlapping *communication* & *computations*, e.g.
  - Increase performance via multi-core parallelism

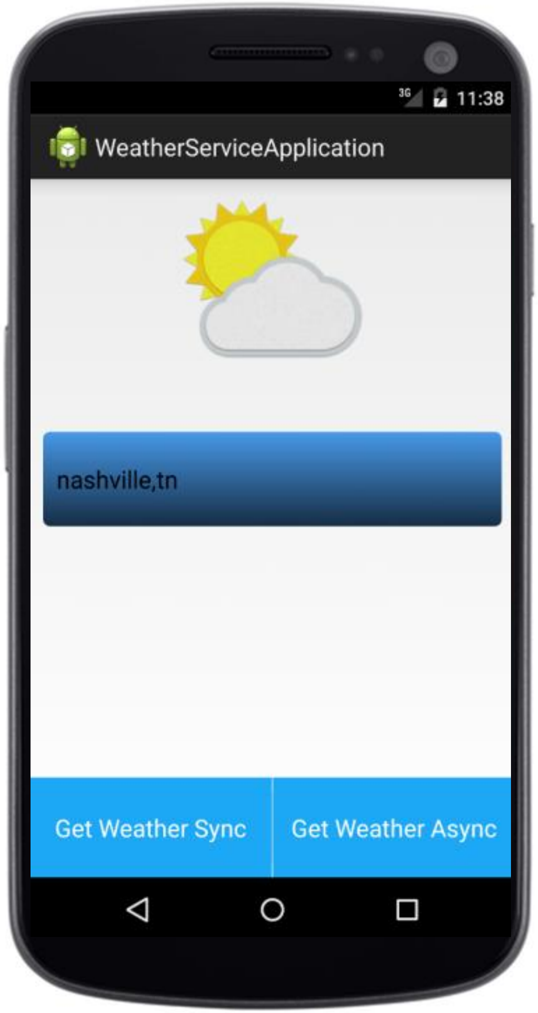


See developer.qualcomm.com/blog/multi-threading-android-apps-multi-core-processors-part-1-2

Motivation for Android Concurrency

- Concurrency benefits apps by overlapping *communication* & *computations*, e.g.
  - Increase performance via multi-core parallelism
  - Improve responsiveness by running long-duration operations in background thread(s)

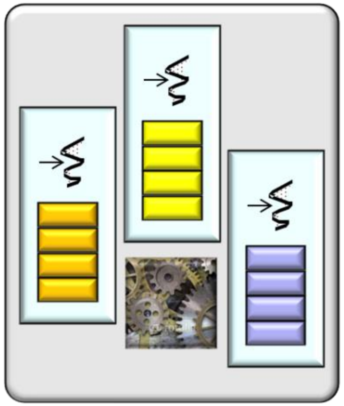


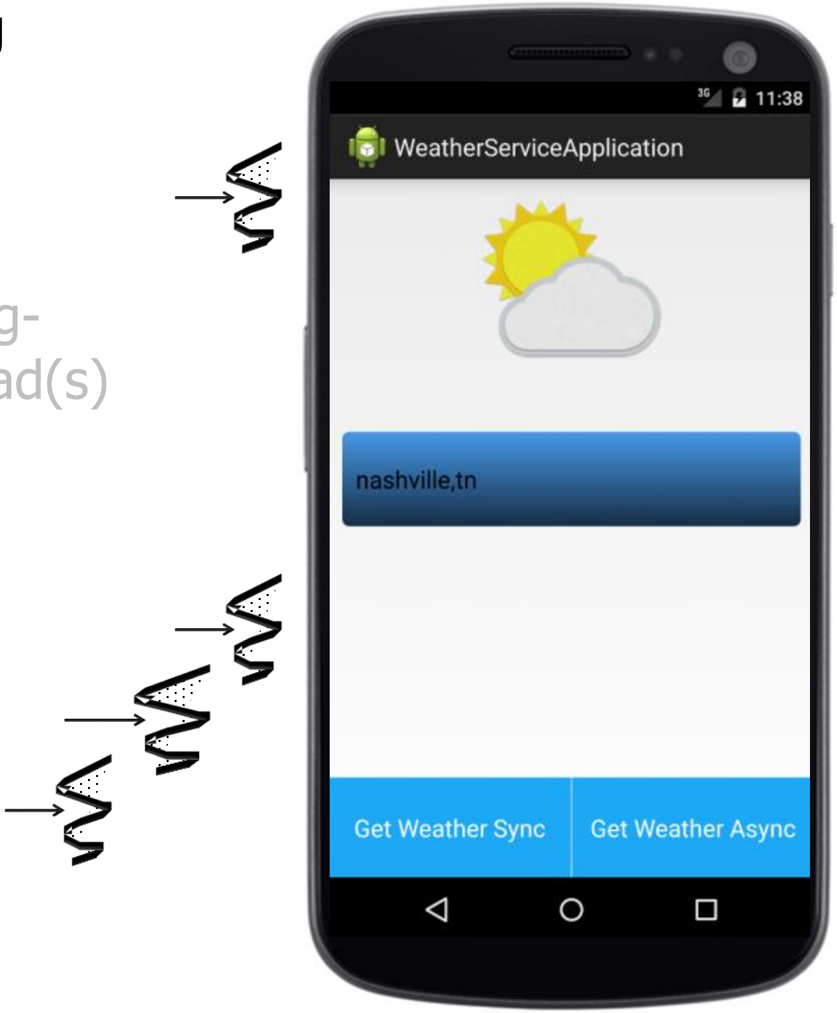


See developer.android.com/training/articles/perf-anr.html

Motivation for Android Concurrency

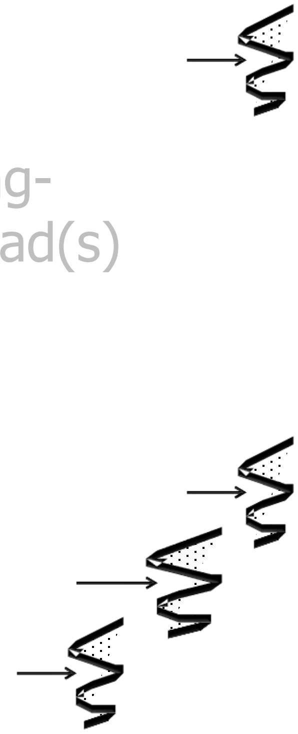
- Concurrency benefits apps by overlapping *communication* & *computations*, e.g.
  - Increase performance via multi-core parallelism
  - Improve responsiveness by running long-duration operations in background thread(s)
  - Simplify program structure by allowing threads to block synchronously

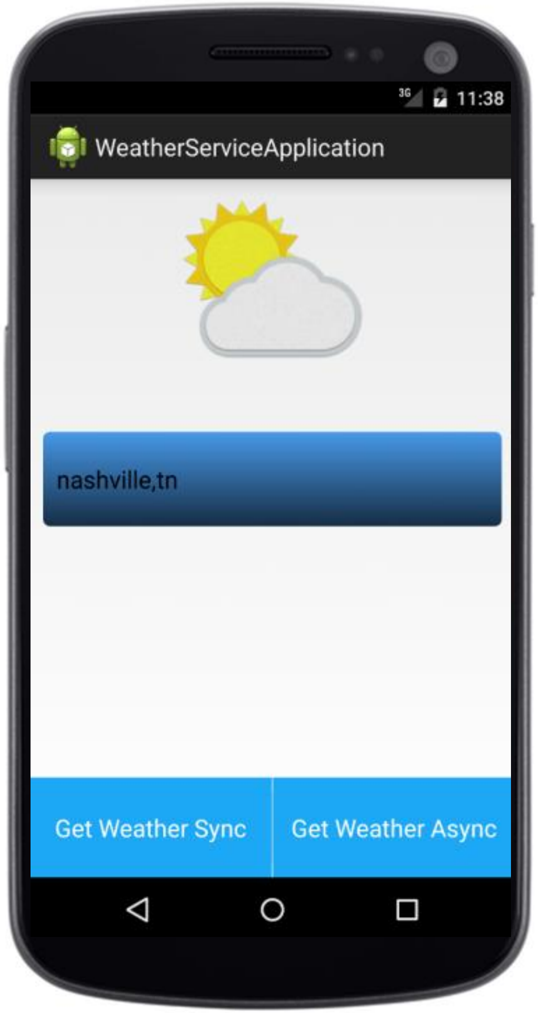




Motivation for Android Concurrency

- Concurrency benefits apps by overlapping *communication* & *computations*, e.g.
  - Increase performance via multi-core parallelism
  - Improve responsiveness by running long-duration operations in background thread(s)
  - Simplify program structure by allowing threads to block synchronously
    - Can yield more natural control flow & collaboration within an app





nashville,tn

See en.wikipedia.org/wiki/Control_flow

Motivating Android’s Concurrency Frameworks

Motivating Android Concurrency Frameworks

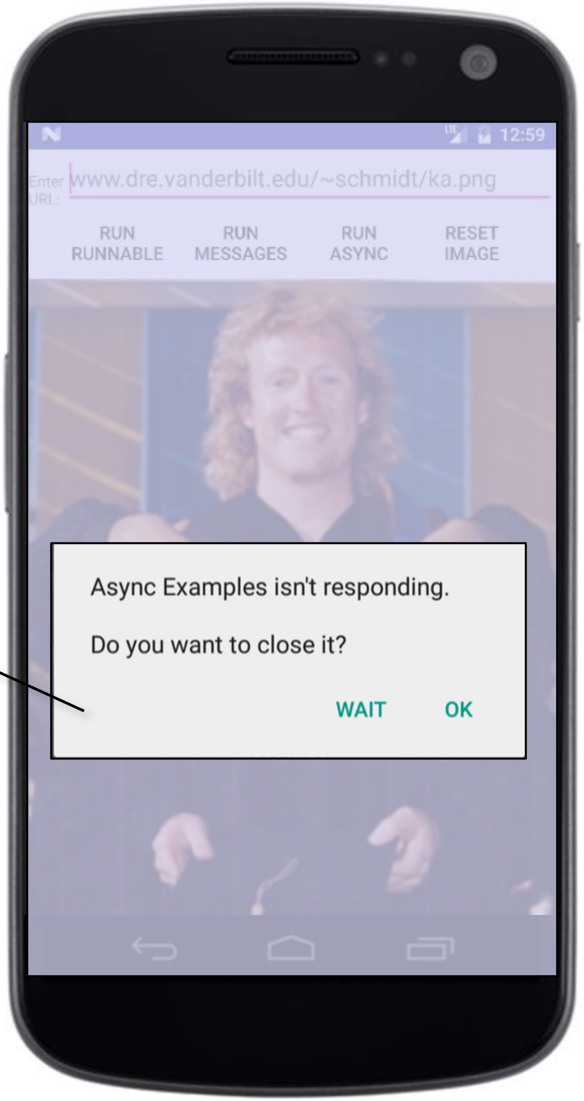
- Android's concurrency frameworks also address design constraints

See developer.android.com/guide/components/processes-and-threads.html#Threads

Motivating Android Concurrency Frameworks

- Android's concurrency frameworks also address design constraints, e.g.
  - "ANR" dialog is generated if the UI thread blocks too long

The UI thread can't block for more than several seconds, so it can't be used for long-duration operations



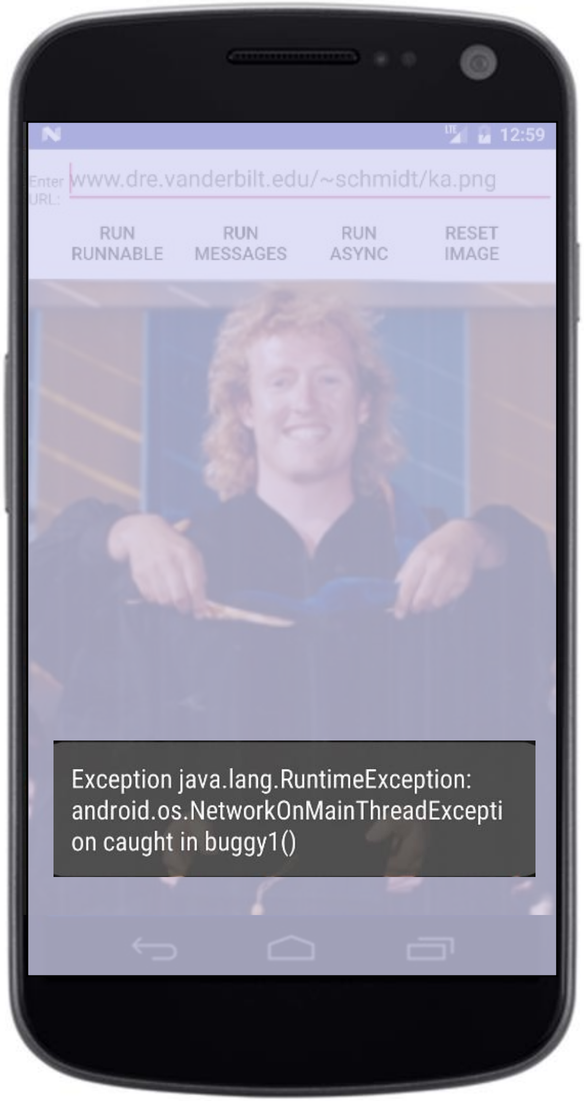
Async Examples isn't responding.

Do you want to close it?

See developer.android.com/training/articles/perf-anr.html

Motivating Android Concurrency Frameworks

- Android's concurrency frameworks also address design constraints, e.g.
  - "ANR" dialog is generated if the UI thread blocks too long
  - Network calls are disallowed on the UI thread by default

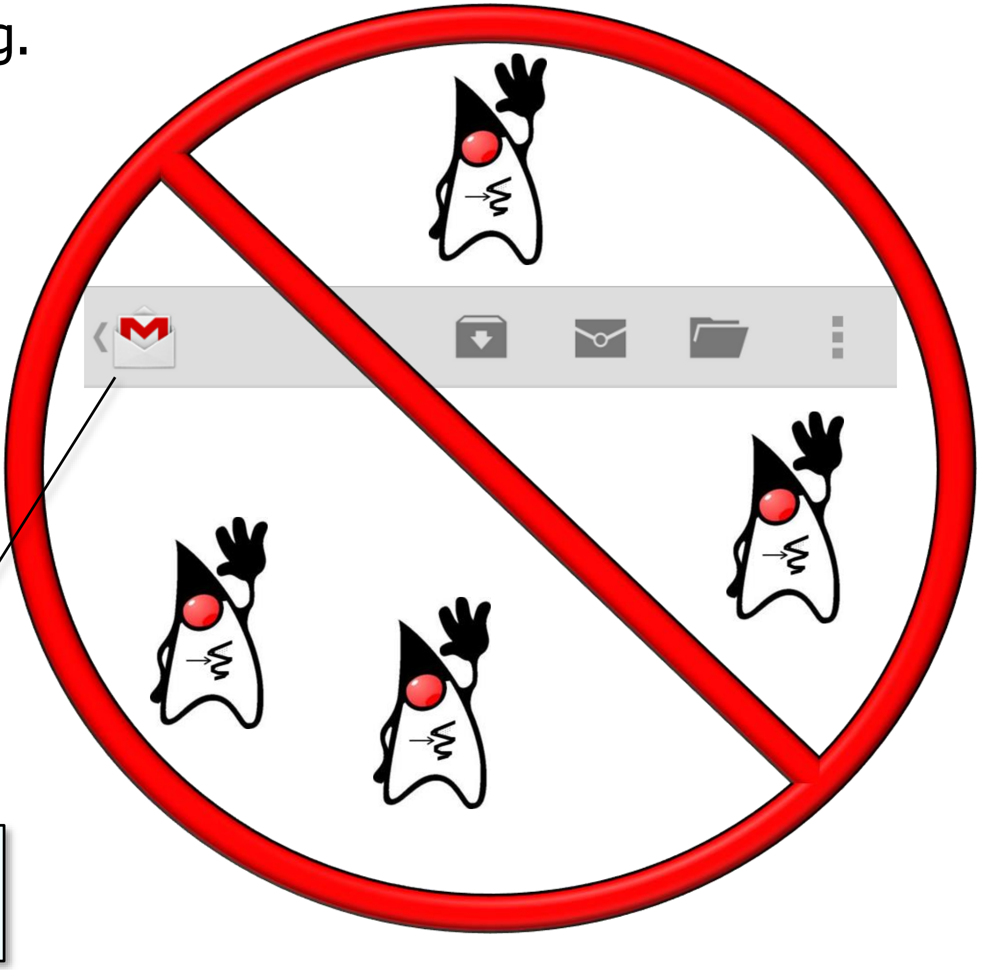


Exception java.lang.RuntimeException: android.os.NetworkOnMainThreadException caught in buggy1()

See blog.vogella.com/2012/02/22/android-strictmode-networkonmainthreadexception

Motivating Android Concurrency Frameworks

- Android's concurrency frameworks also address design constraints, e.g.
  - "ANR" dialog is generated if the UI thread blocks too long
  - Network calls are disallowed on the UI thread by default
  - Non-UI threads can't access UI toolkit components directly

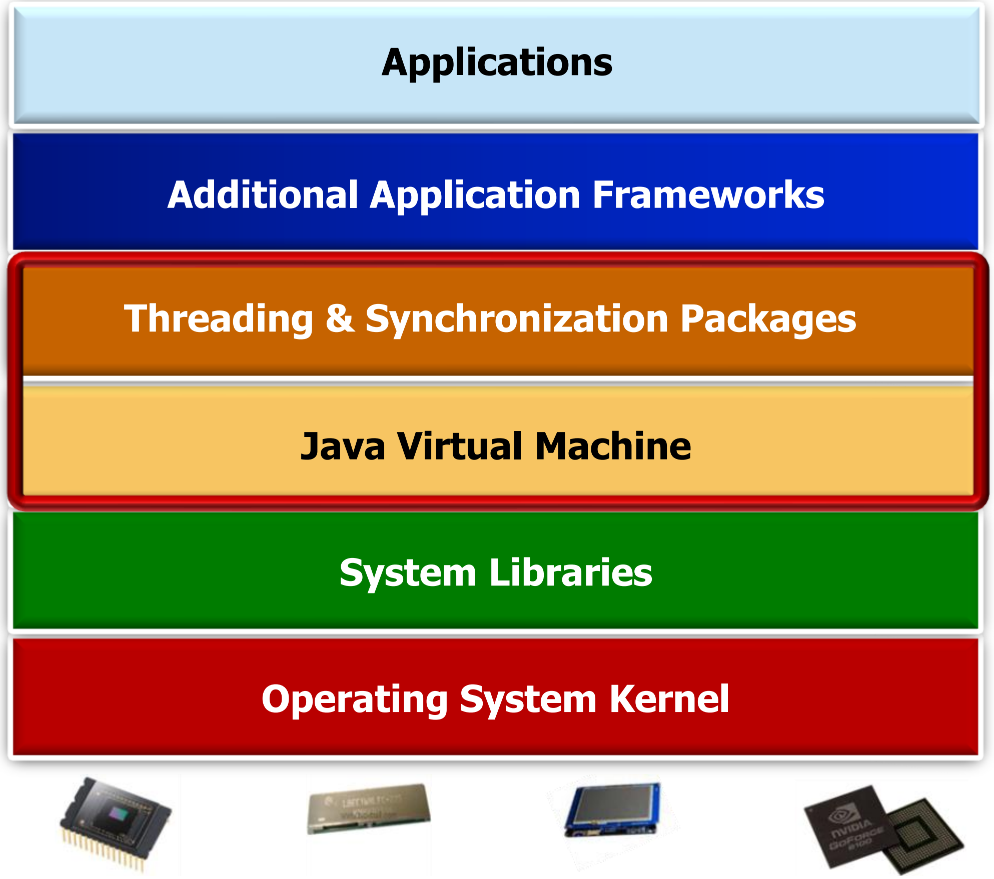


UI toolkit components aren't thread-safe

See android-developers.blogspot.com/2009/05/painless-threading.html

Motivating Android Concurrency Frameworks

- Android's concurrency frameworks also address design constraints, e.g.
  - "ANR" dialog is generated if the UI thread blocks too long
  - Network calls are disallowed on the UI thread by default
  - Non-UI threads can't access UI toolkit components directly



Applications

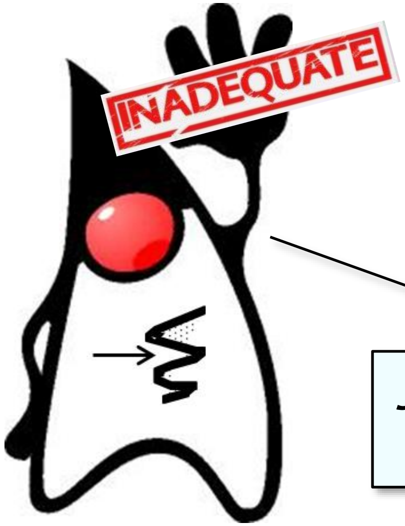
Additional Application Frameworks

Threading & Synchronization Packages

Java Virtual Machine

System Libraries

Operating System Kernel

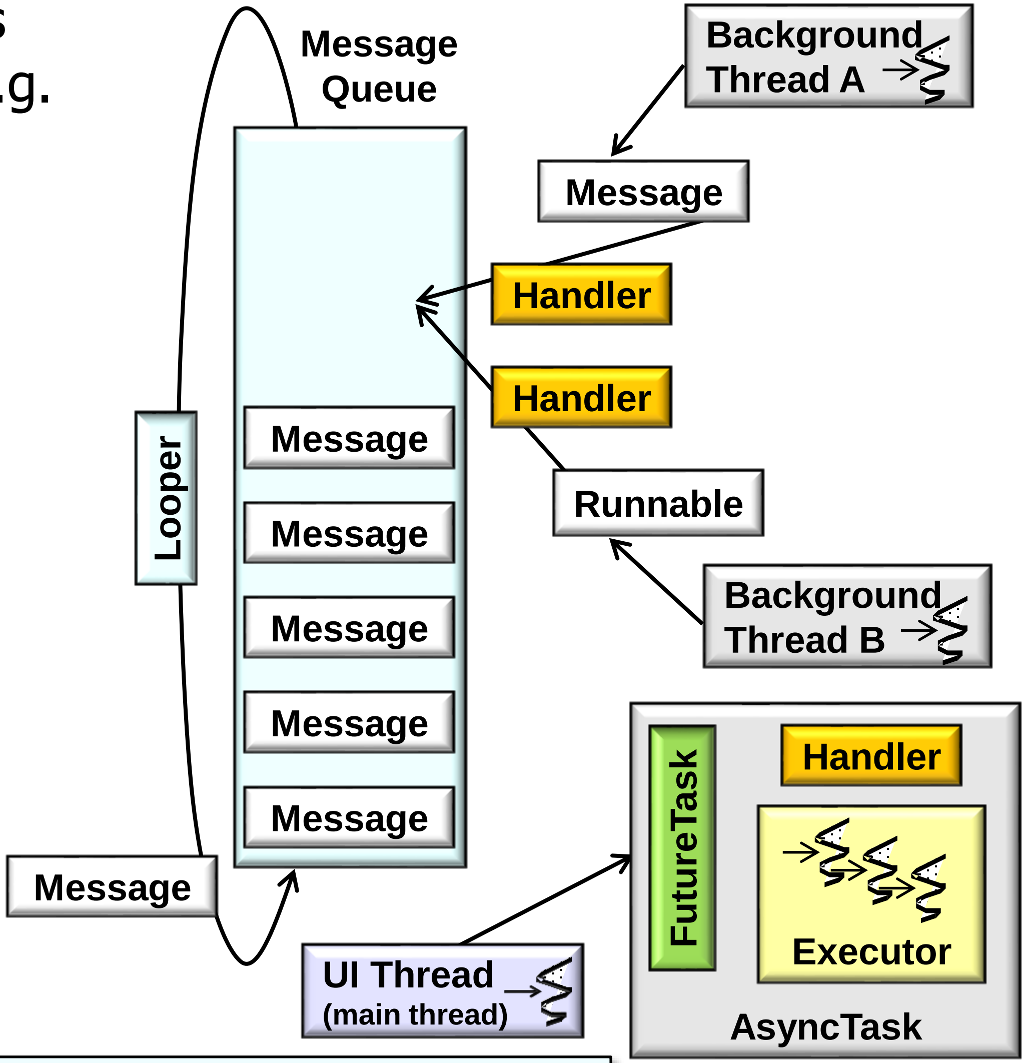


Java concurrency mechanisms alone cannot address these constraints!!

See www.dre.vanderbilt.edu/~schmidt/LiveLessons/CPiJava

Motivating Android Concurrency Frameworks

- Android's concurrency frameworks also address design constraints, e.g.
  - "ANR" dialog is generated if the UI thread blocks too long
  - Network calls are disallowed on the UI thread by default
  - Non-UI threads can't access UI toolkit components directly

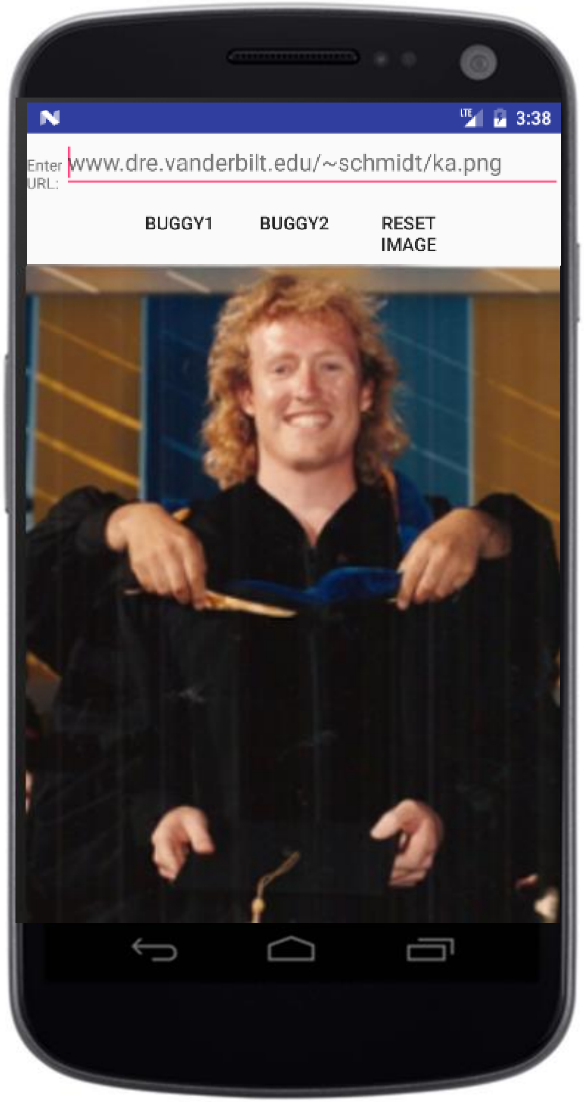


Android concurrency frameworks address these design constraints

See developer.android.com/guide/components/processes-and-threads.html#WorkerThreads

Motivating Android Concurrency Frameworks

- The "Buggy Downloader" app motivates the need for Android's concurrency frameworks

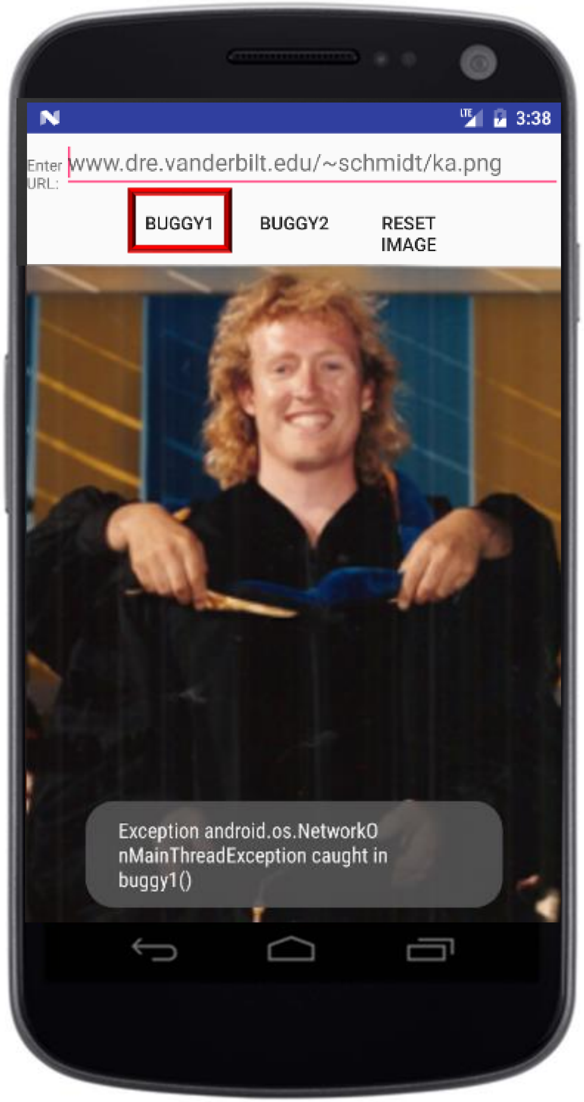


Enter URL: www.dre.vanderbilt.edu/~schmidt/ka.png

See github.com/douglascraigschmidt/POSA/tree/master/ex/M4/BuggyDownloader

Motivating Android Concurrency Frameworks

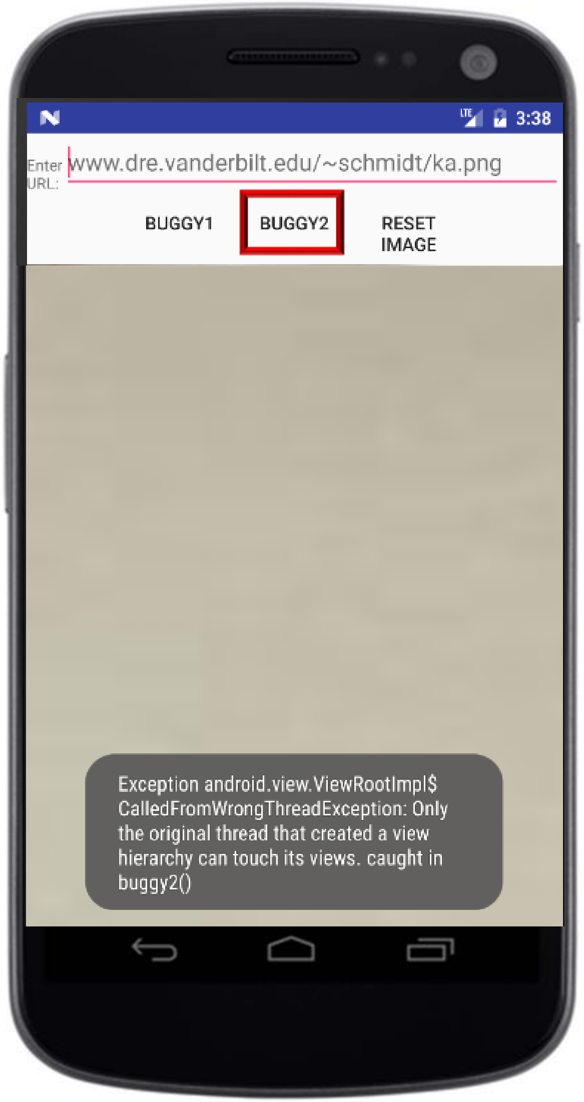
- The "Buggy Downloader" app motivates the need for Android's concurrency frameworks
  - "Buggy1" throws an exception since the image is downloaded in the UI thread



Exception android.os.NetworkOnMainThreadException caught in buggy1()

Motivating Android Concurrency Frameworks

- The "Buggy Downloader" app motivates the need for Android's concurrency frameworks
  - "Buggy1" throws an exception since the image is downloaded in the UI thread
  - "Buggy2" throws an exception since a UI component is accessed via a background thread



Exception android.view.ViewRootImpl$CalledFromWrongThreadException: Only the original thread that created a view hierarchy can touch its views. caught in buggy2()

End of Android Concurrency Frameworks: Motivation