Upcoming Assignments

- Quiz Friday?
- Lab 5 due today
- Alpha Version due Friday, February 26
  - Inject one subtle defect (fault seeding)
  - To be reviewed by a few class members
  - Usability study by CPE 484 students

Background Processes

- One of the key differences between Android and iPhone is the ability to run things in the background on Android
  - Threads
    - Run something in the background while user interacts with UI
  - Services
    - Regularly or continuously perform actions that don't require a UI

Threads

- Recall that Android ensures responsive apps by enforcing a 5 second limit on Activities
- Sometimes we need to do things that take longer than 5 seconds, or that can be done while the user does something else

Threads

- Activities, Services, and Broadcast Receivers run on the main application thread
- We can start background/child threads to do things for us

```
private void methodInAndroidClass() {
   Thread thread = new Thread(null, doSomething, “Background”);
   Thread.start();
}
private Runnable doSomething = new Runnable() {
   public void run() {   /* do the something here */ }
};
```

```
private void methodInAndroidClass() {
   new Thread(){
      public void run() {/* do the something here */ }
   }.start();
}
```

Example

```
@Override
  public void onCreate(Bundle savedInstanceState) {
     super.onCreate(savedInstanceState);
     setContentView(R.layout.main);
     new Thread() {
        public void run() {
          String maps = null;
          try {
               URL updateURL = new URL("http://simexusa.com/cm/mapdata.txt");
               URLConnection conn = updateURL.openConnection();
               int contentLength = conn.getContentLength();
               InputStream is = conn.getInputStream();
               BufferedInputStream bis = new BufferedInputStream(is,1024);
               ByteArrayBuffer baf = new ByteArrayBuffer(contentLength);
               int current = 0;
               while((current = bis.read()) != -1){
                  baf.append((byte)current);
               }
               maps = new String(baf.toByteArray()); //Convert the Bytes read to a String.
          } catch (Exception e) { }
     }
     }.start();
}
```

Get data from web in background

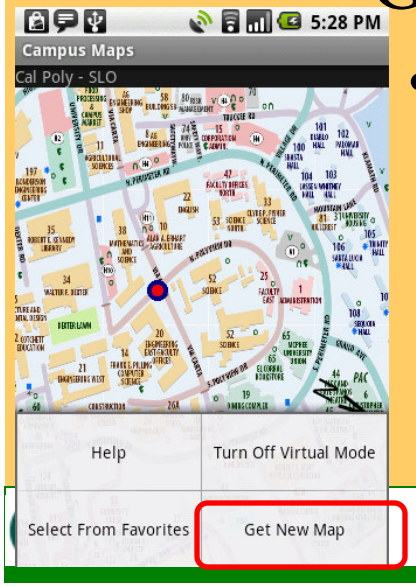
Now we want to display data on screen

```
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.main);
    TextView hello = (TextView)this.findViewByI
    hello.setText("testing");
    new Thread() {
        public void run() {
        String maps = null;
        try {
                URL updateURL = new URL("http://sim
                URLConnection conn = updateURL.open
                int contentLength = conn.getContentLeng
                InputStream is = conn.getInputStream();
                BufferedInputStream bis = new Buffered
                ByteArrayBuffer baf = new ByteArrayBu
                int current = 0;
                while((current = bis.read()) != -1){
                    baf.append((byte)current);
                }
                maps = new String(baf.toByteArray()); //Convert the Bytes read to a String.
        } catch (Exception e) {}
        TextView hello = (TextView)findViewById(R.id.hellotv);
        hello.setTe
    }}.start();
```

CalledFromWrongThreadException: Only the original thread that created a view hierarchy can touch its views.

Android Thread Constraints

- Child threads cannot access UI elements (views); these must be accessed through the main thread
- What to do?
  - Give results to main thread and let it use results
    - In Campus Maps I set a flag in the thread, then I added the menu item dynamically in Activity.onPrepareOptionsMenu



```
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.main);
    final TextView hello = (TextView)this.findViewById(R.id.hellotv);
    hello.setText("testing");
    new Thread() {
       public void run() {
       String maps = null;
       try {
             URL updateURL = new URL("http://simexusa.com/cm/mapdata.txt");
             URLConnection conn = updateURL.openConnection();
             int contentLength = conn.getContentLength();
             InputStream is = conn.getInputStream();
             BufferedInputStream bis = new BufferedInputStream(is,1024);
             ByteArrayBuffer baf = new ByteArrayBuffer(contentLength);
             int current = 0;
             while((current = bis.read()) != -1){
                baf.append((byte)current);
             }
             maps = new String(baf.toByteArray()); //Convert the Bytes read to a String.

       } catch (Exception e) {}
       hello.setText(maps);
    }}.start();
```

Post to GUI Thread

- Handler allows you to post Messages and Runnable objects to threads
  - These can be scheduled to run at some point in the future, or enqueued for another thread
  - We will use the latter

```
public class BackgroundDemos extends Activity {
    private Handler handler = new Handler();
    private String maps = null;
    TextView hello;
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
        hello = (TextView)this.findViewById(R.id.hellotv);
        hello.setText("testing");
        new Thread() {
            public void run() {
            try {
                    URL updateURL = new URL("http://simexusa.com/cm/mapdata.txt");
               //code omitted here
                    maps = new String(baf.toByteArray()); //Convert the Bytes read to a String.
                    handler.post(doUpdateMaps);
            } catch (Exception e) { } } }.start();
    }
    private Runnable doUpdateMaps = new Runnable() {
        public void run() {
            hello.setText(maps);
        }
    };}
```

Services

- Services are like Activities, but without a UI
- Services are not intended as background threads
  - Think of a media player where the song keeps playing while the user looks for more songs to play or uses other apps
  - Don't think of a cron job (e.g. run every day at 3am), use Alarms to do this
- Several changes in 2.0 related to Services
  - See http://android-developers.blogspot.com/2010/02/service-api-changes-starting-with.html

- Add to AndroidManifest.xml

```
<service android:enabled="true" android:name=".NewMapService"></service>
```

- Create the Service class

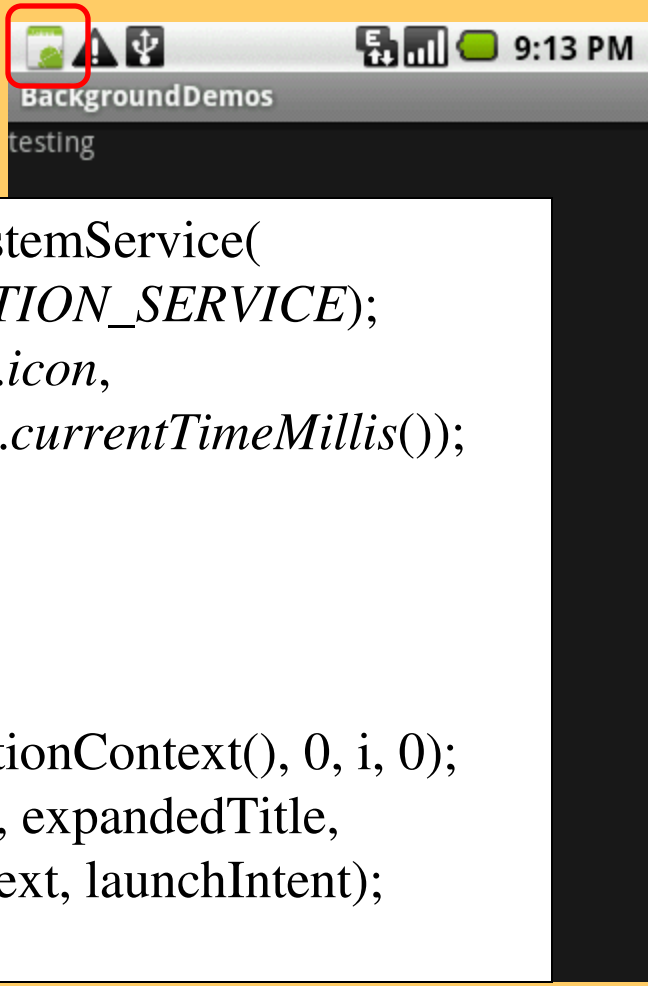
```
public class NewMapService extends Service {
    @Override
    public void onCreate() {
    }
    @Override
    public void onStart(Intent intent, int startId) {
        //do something
    }
    @Override
    public IBinder onBind(Intent intent) {
      return null;
    }
}
```

Start/Stop the Service

- Other alternatives in text

```
public class MyActivity extends Activity {
    @Override
    public void onCreate() {
            …
            startService(new Intent(this, NewMapService.class);
    }
    @Override
    public void onStop() {
            …
            stopService(new Intent(this, NewMapService.class));
   }
}
```

Status Bar Notifications




```
NotificationManager nm = (NotificationManager)getSystemService(
                                        Context.NOTIFICATION_SERVICE);
Notification notification = new Notification(R.drawable.icon,
                                        "NewMaps",System.currentTimeMillis());
String expandedTitle = "New Map Service";
String expandedText = "New Map Service is running";
Intent i = new Intent(this, NewMapService.class);
PendingIntent launchIntent = PendingIntent.getActivity(
                                            getApplicationContext(), 0, i, 0);
notification.setLatestEventInfo(getApplicationContext(), expandedTitle,
                                            expandedText, launchIntent);
nm.notify(1,notification);
```

```
nm.cancel(1);   //cancel a notification (id/parameters must match)
```

Other Notification

- Sounds
- Vibration
- Flashing lights
- Ongoing and Insistent