Programming with Android: Network Operations

Luca Bedogni Marco Di Felice

Dipartimento di Scienze dell'Informazione

Università di Bologna

Outline

Android: Network Operations

- In order to perform network operations (also the one described earlier), specific **permissions** must be set on the **AndroidManifest.xml**.

```
<uses-permission android:name="android.permission.INTERNET" />
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"
/>
```

- Failure in setting the permissions will cause the system to throw a **run-time** exception …

Android: Network Operations

- Before the application attempts to connect to the network, it should check to see whether a network connection is available using **getActiveNetworkInfo()** and **isConnected()** …

```
ConnectivityManager connMgr = (ConnectivityManager)
        getSystemService(Context.CONNECTIVITY_SERVICE);
    NetworkInfo networkInfo = connMgr.getActiveNetworkInfo();
    if (networkInfo != null && networkInfo.isConnected()) {
        // fetch data
    } else {
        // display error
    }
```

Android: WebView Usage

WebView → A **View** that displays web pages, including simple browsing methods (history, zoom in/out/ search, etc).

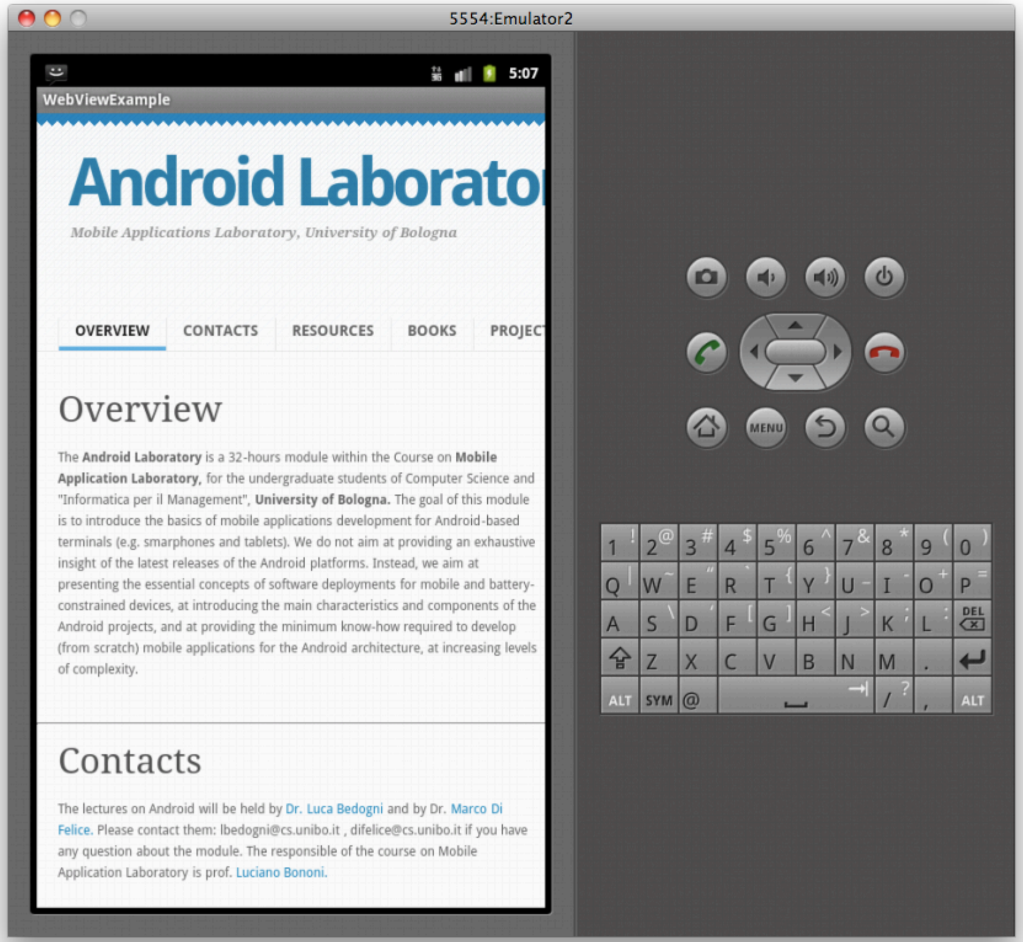
Implemented by the WebView class

```
public WebView(Context contex)
```

Main methods:

- public void **loadUrl**(String url) → load the HTML page at url
- public void **loadData**(String data, String mimeType, string encoding) → load the HTML page contained in data

Android: WebView Usage


5554:Emulator2

5:07

WebViewExample

Android Laborato

Mobile Applications Laboratory, University of Bologna

Overview

The **Android Laboratory** is a 32-hours module within the Course on **Mobile Application Laboratory**, for the undergraduate students of Computer Science and "Informatica per il Management", **University of Bologna.** The goal of this module is to introduce the basics of mobile applications development for Android-based terminals (e.g. smarphones and tablets). We do not aim at providing an exhaustive insight of the latest releases of the Android platforms. Instead, we aim at presenting the essential concepts of software deployments for mobile and battery-constrained devices, at introducing the main characteristics and components of the Android projects, and at providing the minimum know-how required to develop (from scratch) mobile applications for the Android architecture, at increasing levels of complexity.

Contacts

The lectures on Android will be held by Dr. Luca Bedogni and by Dr. Marco Di Felice. Please contact them: lbedogni@cs.unibo.it , difelice@cs.unibo.it if you have any question about the module. The responsible of the course on Mobile Application Laboratory is prof. Luciano Bononi.

Android: WebView Usage

By default, the WebView UI does not include any navigation button …However, **callbacks** methods are defined:

- public void **goBack**()
- public void **goForward**()
- public void **reload**()
- public void **clearHistory**()

Android: WebView Usage

It is possible to modify the visualization options of a WebView through the **WebSettings** class.

```
public WebSettings getSettings()
```

Some options:

- void **setJavaScriptEnabled**(boolean)
- void **setBuildInZoomControls**(boolean)
- void **setDefaultFontSize**(int)

Android: Download Manager

DownloadManager → System service that handles long-run HTTP downloads.

- The client can specify the file to be downloaded through an **URI** (path).
- Download is conducted in **background** (with retries)
- Broadcast Intent action is sent to notify when the download completes.

```
DownloadManager dm=(DownloadManager)
getSystemService(DOWNLOAD_SERVICE);
```

Android: Download Manager

- The Request class is used to specify a download request to the Download Manager.

```
Request request=new DownloadManager.Request(Uri.parse(address));
```

Main methods of the **DownloadManager**

- long **enqueue**(DownloadManager.Request)
- Cursor **query**(DownloadManager.Query)
- ParcelFileDescriptor **openDownloadedFile**(long)

Android: HTTP Classes

HTTP (HyperText Tranfer Protocol): Network protocol for exchange/transfer data (hypertext)

Request/Resonse Communication Model

MAIN COMMANDS

- HEAD
- GET
- POST
- PUT
- DELETE
- TRACE
- CONNECT

Android: HTTP Classes

HTTP (HyperText Tranfer Protocol): Network protocol for exchange/transfer data (hypertext)

Two implementations of HTTP Clients for Android:

- **`HTTPClient`** → Complete extendable HTTP Client suitable for web browser (not supported anymore?)
- **`HTTPUrlConnection`** → Light-weight implementation, suitable for client-server networking applications (recommended by Google)

In both cases, HTTP connections must be managed on a separate thread, e.g. using **AsynchTask** (not the UI thread!).

Android: HTTP (Abstract) Classes

- **HttpClient** → Interface for an HTTP client
- **HttpRequest** → Interface for an HTTP request
- **HttpResponse** → Interface for an HTTP response
- **ResponseHandler<T>** → Handler that creates an object <T> from an HTTP Response
- **HttpContext** → Context of the HTTP Request (request+response+data)

Android: HTTP Classes

- **HttpClient** → Interface for an HTTP client
  (DefaultHttpClient → implementation of an HttpClient)

```
HttpClient client=new DefaultHttpClient();
```

Main method:

The public method **execute**(…) performs an HTTP request, and allows to process an HTTP reply from the HTTP server.

One of the signature of **execute**()

```
abstract<T> T execute(HttpUriRequest request,
ResponseHandler <T> responseHandler)
```

Android: HTTP Classes

- **HttpRequest** → Interface for an HTTP request

Two implementations:

HttpGet → implements the **GET** HTTP method

```
HttpGet request=new HttpGet(String address);
```

```
HttpGet request=new HttpGet(URI address);
```

HttpPost → Implements the **POST** HTTP method

Android: HTTP Classes

- **ResponseHandler <T>** → Interface for creating an object <T> from an HttpResponse, obtained after having executed an HttpRequest.

Method to override

```
public abstract T handleResponse (HttpResponse res)
```

Generally, <T> is a String (HTML code) …

Android: HTTP Classes

- **HttpPost → Implements the POST HTTP method**

```
HttpPost request=new HttpPost(String address);
```

```
HttpPost request=new HttpPost(URI address);
```

Encapsulating a parameter …

```
List<NomeValuePair> par=new ArrayList<NomeValuePair>()
par.add(new BasicNameValuePair(“name”,”Marco”));
HttpEntity postEntity=new UrlEncodedFormEntity(par);
request.setEntity(postEntity);
```

Android: HTTP Classes

Basic HTTPClient Request-Response Application …

```
HttpClient client=new DefaultHttpClient();
HttpGet request=new HttpGet();
request.setURI(“http//www.cs.unibo.it”);
try {
  client.execute(request, responseHandler);
} catch (ClientProtocolException e) {
   e.printStackTrace();
} catch (IOException e) {
   e.printStackTrace();
}
```

Android: HTTP Classes

Basic HTTPClient Request-Response Application …

```
class MyResponseHandler implements ResponseHandler<String> {
        @Override
        public String handleResponse(HttpResponse response) {
            InputStream content=response.getEntity().getContent();
            byte[] buffer=new byte[1024];
            int numRead=0;
            ByteArrayOutputStream stream=new
ByteArrayOutputStream();
            while ((numRead=content.read(buffer))!=-1)
                stream.write(buffer, 0, numRead);
            content.close();
            String result=new String(stream.toByteArray());
            return result;
        }
     }
```

Android: HTTP Classes

HTTPUrlConnection → HTTP component to send and receive streaming data over the web.

1. Obtain a new **HttpURLConnection** by calling the **URL.openConnection()**

```
URL url = new URL("http://www.android.com/");
HttpURLConnection urlConnection = (HttpURLConnection)
                                  url.openConnection();
```

2. Prepare the request, set the options (e.g. session cookies)

3. For **POST** commands, invoke `setDoOutput(true).` Transmit data by writing to the stream returned by `getOutputStream().`

Android: HTTP Classes

HTTPUrlConnection → HTTP component to send and receive streaming data over the web.

4. Read the response (data+header). The response body may be read from the stream returned by **`getInputStream()`**.

```
InputStream in = new
BufferedInputStream(urlConnection.getInputStream());
```

5. Close the session when ending reading the stream through **`disconnect`**().

```
urlConnection.disconnect();
```

Android: TCP/IP Communication

TCP/UDP Communication → Android applications can use java.net.Socket facilities.

➢ Use socket-based programming like in Java …

Class **DatagramSocket** → UDP Socket

Classes **Socket/ServerSocket** → TCP socket

Read/Write on Sockets through **InputStream/OutputStream**