

# Lab: Asynchronous tasks and Sensors

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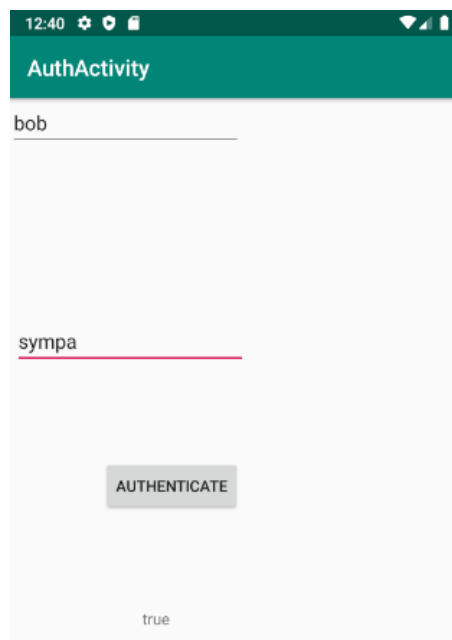
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This lab intends to work with HTTP request : a lot of Android applications need to interact with a remote server. A lot of libraries can help to do this, but the goal of this lab is to build your request by yourself. Before working with the service Flickr, we first setup a simple HTTP request that we will use to authenticate the user. Then, we will move to Flickr in order to display images in a ListView object.

## 1 Authentication with a simple asynchronous task

In this part, we intend to authenticate the user against a server. As we want to avoid to develop a server, we will use the service <https://httpbin.org/><sup>1</sup> that helps to perform tests with a remote service.

At the end, you should obtained the following result :



### 1.1 Authentication activity design

**Exercise 1** Create an activity Authentication, that displays two EditText : one for the login of the user, one for the password.

**Exercise 2** Create a button "Authenticate" for starting the authentication.

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1. Thanks to Ken Reitz!

## 1.2 Setup of an HTTP request

We will handle the authentication with an `HttpURLConnection` object. You can look at this code :

```
URL url = null;
try {
    url = new URL("http://www.android.com/");

    HttpURLConnection urlConnection = (HttpURLConnection) url.openConnection();
    try {
        InputStream in = new BufferedInputStream(urlConnection.getInputStream());
        String s = readStream(in);
        Log.i("JFL", s);
    } finally {
        urlConnection.disconnect();
    }
} catch (MalformedURLException e) {
    e.printStackTrace();
} catch (IOException e) {
    e.printStackTrace();
}
```

**Exercise 3** Put this code in your button. Where is the `readStream()` method? <sup>2</sup> Solve this problem.

**Exercise 4** Try to execute your code. You should have problems. Where to see these problems? When executed, an Android application sends all debug information to the logcat output of AndroidStudio. To understand what is the issue with your code, you should have a look at this output. Open the Logcat tab on the bottom part of AndroidStudio and choose the "Info" level of information (it will filter the verbose and debug output but will keep the Errors). Re-run your application and check the nature of the error. Try to solve the error(s) with the following hints :

- **Cleartext HTTP traffic not permitted**<sup>3</sup> : try using https
- **java.net.SocketException : socket failed : EPERM**<sup>4</sup> : add the INTERNET permission, clean and rebuild your application.
- **android.os.NetworkOnMainThreadException** : you are doing a long task in the main thread : this is not allowed! For now, you can simply use a Thread for which you override the `run()` method<sup>5</sup>.

At this point, you should see the result of the HTTP request in the Logcat output.

## 1.3 Authenticating

**Exercise 5** Open you web browser and test the url

<https://httpbin.org/basic-auth/bob/sympa> : you should be authorized only if you enter the login bob and the password sympy. This service is for test purpose : it implements a Basic Authentication mechanism that allows only "bob" with the password "sympa" to succeed.

2. You can have a look at the discussion here :

<https://stackoverflow.com/questions/8376072/whats-the-readstream-method-i-just-can-not-find-it-any>

3. <https://stackoverflow.com/questions/45940861/android-8-cleartext-http-traffic-not-permitted>

4. <https://stackoverflow.com/questions/56266801/java-net-socketexception-socket-failed-eperm-oper>

5. You can look at this page for starting a Thread : <http://tutorials.jenkov.com/java-concurrency/creating-and-starting-threads.html>

**Exercise 6** Replace the url by the url `""`. Test in your Android app by just replacing the url `www.android.com` by `https://httpbin.org/basic-auth/bob/sympa`. For now, your code do not send any login and password. Thus, you should obtain the following error :

```
java.io.FileNotFoundException: https://httpbin.org/basic-auth/bob/sympa
```

It is expected. Indeed, this request currently does not send any authentication parameters.

**Exercise 7** To solve this problem, add the following to your `URLConnection` object :

```
String basicAuth = "Basic " + Base64.encodeToString("bob:sympa".getBytes(),
    Base64.NO_WRAP);
connection.setRequestProperty ("Authorization", basicAuth);
```

**Exercise 8** Replace the credentials by the ones coming from the two `EditText`.

**Exercise 9** Refresh a `TextView` called "result" to display the result of the authentication. Before displaying the result from the JSON, try to display "My result here" in the `TextView`. You should<sup>6</sup> obtain this error :

```
CalledFromWrongThreadException:
```

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

This is due to the fact that you try to change a `TextView` (a graphical element) from outside of the main thread. It is not allowed, because it may crash the application because of concurrency accesses. A possible solution consists in using the `runOnUiThread` methods that sends a `Runnable` object to be executed in the main thread of the application. This `Runnable` will contain the code that should refresh the result `TextView` :

```
runOnUiThread(new Runnable() {
    @Override
    public void run() {
        // We refresh the result TextView
        ...
    }
})
```

Try to refresh the `TextView` with the string "My result here", just for testing. In the exercise we will replace this string by the real result.

**Exercise 10** The result obtained from the HTTP connection should contains something like :

```
{
    "authenticated": true,
    "user": "bob"
}
```

You can reinstantiate this string as a `JSONObject`. Use the constructor of a `JSONObject` by passing the String as a parameter. Get the value associated to "authenticated" and put it in a variable named "res". Now, you want to send the object "res" to the `Runnable` object that modifies the `TextView`. You have two possibilities :

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<sup>6</sup> It is not guaranteed : <https://stackoverflow.com/questions/15928551/no-error-calling-textview-settext-from-non-ui-thread-why>

- You can add a constructor to the object created by `new Runnable()`. In this case you should put the code in an inner class<sup>7</sup>. By creating explicitly a class, you can create a constructor that takes a parameter : you will send "res" as a parameter, and store it as an attribute and you will be able to use in the `run()` method.
- You can store "res" as an attribute "result" of the activity. Then, in the `run()` method of the `Runnable`, you can access such an attribute by writting `MainActivity.this.result`. It is possible because `Runnable` is an anonymous class embedded in `MainActivity` and thus, attributes of `MainActitivy` can be accessed using the notation `MainActivity.this`.

Of course, `httpbin.org` is just for demo purpose and you will never see the login/password in the url of the service :p

## 2 Asynchronous tasks for a real remote service : Flickr

In this section, we focus on doing better implementation of asynchronous task than using the class Thread. In the previous section you have performed a simple Thread. You may have experienced several difficulties : you have to start the Thread, override the constructor to send parameters to the Thread, run the modification of the UI outside of this Thread. This is particularly painful, but instructive.

In this part we will work on better implementations of asynchronous tasks with another use case that is more fun than authenticating a user : displaying photos from the Flickr database.

**Exercise 11** Create a new Android application called "Flickr app".

## 2.1 Discovering the API

We propose to use the Flickr service that provides an API for requesting images.



FIGURE 1 – Flickr by Paul Downey - CC-BY

Check the following JSON API from flickr in your web browser :

```
http://www.flickr.com/services/feeds/photos_public.gne?tags=trees&format=
json
```

If you look at this url at different time, you will see that the data is often updated. Maybe not for trees, but for cats, it's pretty sure :

```
http://www.flickr.com/services/feeds/photos_public.gne?tags=cats&format=
json
```

Do not poll this url too much because we (our IP) may be banned from Flickr. Images can be accessed using the media tag. Different sizes are available :

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7. Right button > Refactor > Extract to inner class

[https://live.staticflickr.com/65535/50652853707\\_e193d62b53\\_m.jpg](https://live.staticflickr.com/65535/50652853707_e193d62b53_m.jpg)  
[https://live.staticflickr.com/65535/50652853707\\_e193d62b53\\_s.jpg](https://live.staticflickr.com/65535/50652853707_e193d62b53_s.jpg)

**Exercise 12** Why the answer of the server is not really using the JSON format? What should be removed?

## 2.2 Request the JSON data using an AsyncTask

In this part, we intend to develop an AsyncTask responsible of getting the JSON data from the service.

**Exercise 13** We propose to develop a class that extends `AsyncTask<String, Void, JSONObject>`. Why choosing such a type?

**Exercise 14** Create a button "Get an image" in your activity. Override the `OnClickListener` with a new class `GetImageOnClickListener` that extends `View.OnClickListener`. In the `onClick`, start a new async task of type `AsyncFlickrJSONData`. Give, as a parameter the url :

[https://www.flickr.com/services/feeds/photos\\_public.gne?tags=trees&format=json](https://www.flickr.com/services/feeds/photos_public.gne?tags=trees&format=json)

**Exercise 15** Create the class `AsyncFlickrJSONData` that extends `AsyncTask<String, Void, JSONObject>`. Develop the following functionalities :

- In `doInBackground`, perform the HTTP connection, and reinstantiate the JSON object.
- In `onPostExecute`, Log the obtained JSON object in Logcat<sup>8</sup>

## 2.3 Downloading an image

**Exercise 16** Add image to your layout with id "image".

**Exercise 17** Decode the url of the first image by manipulating the `JSONObject` in the `onPostExecute` method of `AsyncFlickrJSONData`. You can use :

- `getJSONArray` for getting an array associated to a key;
- `getJSONObject` for getting an object associated to a key;
- `getString` for getting a String associated to a key.

```

JSONObject json → {
  "title": "Recent Uploads tagged cats",
  "link": "https://www.flickr.com/photos/tags/cats/",
  "items": [
    {
      "title": "Cat",
      "link": "https://www.flickr.com/photos/shalva1948/50722263646/",
      "media": {
        "m": "https://live.staticflickr.com/65535/50722263646_5cd996570a_m.jpg"
      },
      "date_taken": "2020-08-27T18:18:43-08:00",
      "description": " bla bla "
    },
    {
      "title": "Backyard Fun",
      "link": "https://www.flickr.com/photos/187672942@N04/50718069457/",
      "media": {
        "m": "https://live.staticflickr.com/65535/50718069457_d6ac981629_m.jpg"
      },
      "date_taken": "2020-10-09T02:14:14-08:00",
      "description": " bli bli "
    }
  ]
}

json.getString("title") → "Recent Uploads tagged cats"

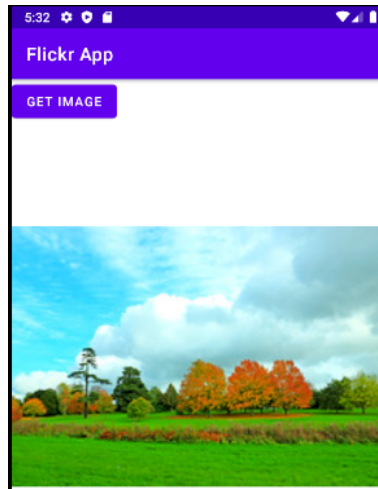
json.getJSONArray("items") → [ ... ]

json.getJSONArray("items").getJSONObject(1) → {
  "title": "Backyard Fun",
  "link": "https://www.flickr.com/photos/187672942@N04/50718069457/",
  "media": {
    "m": "https://live.staticflickr.com/65535/50718069457_d6ac981629_m.jpg"
  },
  "date_taken": "2020-10-09T02:14:14-08:00",
  "description": " bli bli "
}
  
```

8. Be careful : the string returned by Flickr contains an extra `"jsonFlickrFeed({...})"`. You should only keep the `{...}` and remove `"jsonFlickrFeed("` and the last `)"`. If not, the instantiation of the `JSONObject` will fail. You can use the method `subSequence` of the class `String`.

**Exercise 18** Create a class `AsyncBitmapDownloader` that extends `AsyncTask<String, Void, Bitmap>`. This class downloads an image given its input URL. To create the `Bitmap` object, you can use the `BitmapFactory` class that provides a method `decodeStream`, as shown below. When the bitmap is built, put it in your `ImageView`.

```
InputStream in = new BufferedInputStream(urlConnection.getInputStream());
Bitmap bm = BitmapFactory.decodeStream(in);
```



You should now be comfortable with `AsyncTask`. You should conclude that it is more convenient for separating the task and the update of the graphical interface between the different threads.

## 2.4 Displaying a list of images using Volley - the legacy `ListView` method

`ListView` is in the "legacy" way of implementing lists. As it is a little bit easier to use than `RecyclerView`, we propose to use them in this section. Two steps are proposed towards our goal :

- Step 1 : We display the list of URLs in a `ListView`.
- Step 2 : we replace these `TextView`s by images.

### 2.4.1 Displaying a list of the images URLs

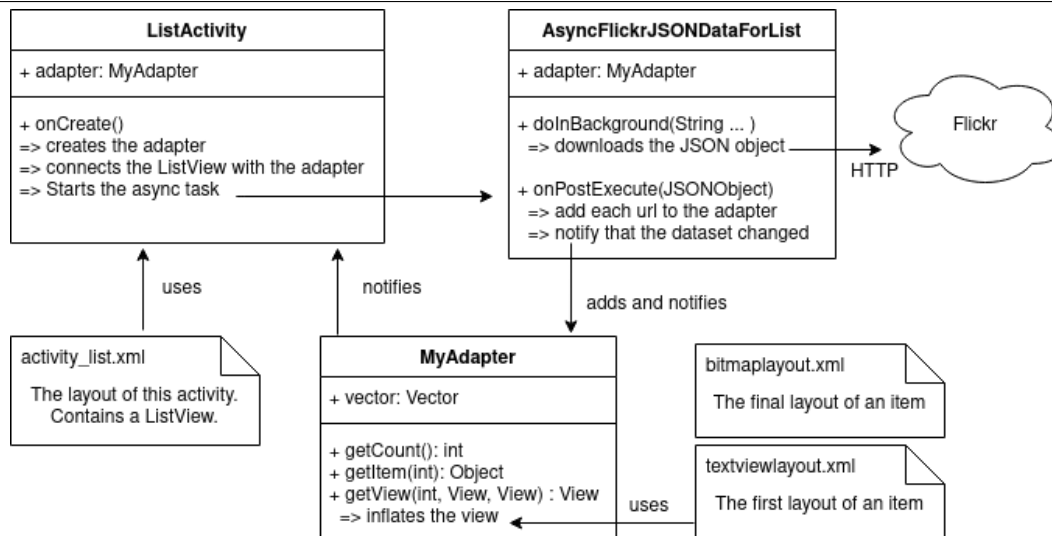
We recall that the list of images will be received from Flickr, as done in the previous section. We will decode again the JSON object but, instead of using the first image by calling `getJSONObject(0)`, we will iterate over all images and add them in an adapter. The adapter is connected to the list and we will notify the list that some data just arrived, in order to refresh the list.

The global overview of the needed classes are represented below :

**Exercise 19** Create a new Activity called `ListActivity`. Create the associated layout `activity_list.xml` with only one element `ListView` attached to the root. Put the id `list` for this `ListView`. On your main activity, create a new button that sends the user to `ListActivity`.

**Exercise 20** In `ListActivity` create an adapter of type `MyAdapter`. This class is a new class that extends `BaseAdapter`. In `ListActivity`, link your `ListView` with this adapter.

**Exercise 21** Generate the class `MyAdapter` that extends `BaseAdapter`. Create an attribute `vector` of type `Vector<String>`. This vector will store the url that we will get from the `JSONObject`. Add a method `add(String url)` that adds a received url in your vector. Implement the method `getCount`. The other method last important method `getView` will be implemented later. We can for now put a log call such as `Log.i("JFL", "TODO")` ;



**Exercise 22** We need now an async task that downloads the list of URL from Flickr and that populates our adapter with the obtained data. Duplicate the class `AsyncFlickrJSONData` and call it `AsyncFlickrJSONDataForList`. Review your code and perform the following modifications :

- `doInBackground` is obviously the same;
- `onPostExecute` should be adapted : instead of launching the download of the first image, this method should iterate over all images of the `JSONArray` contained in the received `JSONObject`. For each item we need to put the URL into the adapter : we need to have this adapter available in `AsyncFlickrJSONDataForList`. Pass `MyAdapter` as a parameter of the constructor `AsyncFlickrJSONDataForList` when called in the activity `ListActivity`. Store `MyAdapter` as an attribute. When adding an URL into the adapter add a log line with a call to `Log.i("JFL", "Adding to adapter url : " + url);`.

**Exercise 23** Add this stage, we can do a quick test of your code. Nothing will be displayed on the smartphone as the `getView` method is still not implemented, but you should observe in the logcat some logs. Check that you see :

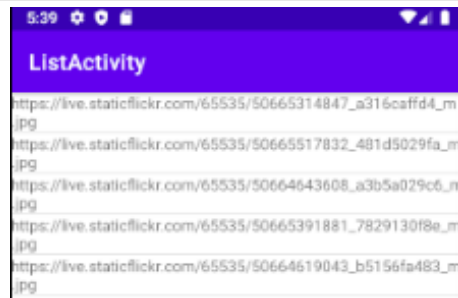
```

Adding to adapter url : https://live.staticflickr.com/65535/50664142118_...jpg
Adding to adapter url : https://live.staticflickr.com/65535/50664125043_...jpg
Adding to adapter url : https://live.staticflickr.com/65535/50664936462_...jpg
  
```

**Exercise 24** Nevertheless, you could have expected to see "TODO" in the logcat, because we put in the `getView` method the line `Log.i("JFL", "TODO");` (this method still returns null). Returning a null object is probably a bad idea but if we do not see "TODO" in the logcat, it means that the `getView` method is never called. How is it possible? It is due to the adapter that should inform the `ListView` that some new data has arrived. In `AsyncFlickrJSONDataForList`, after populating the adapter, make a call to the method `notifyDataSetChanged()` on the adapter. Make a new test. You should see a "TODO" appearing in the logcat. Great! But your code crash, because `getView` is not supposed to return a null object.

**Exercise 25** Implement `getView`. To make it simple, you can just inflate the layout `R.layout.textviewlayout`. This layout will contains a `LinearLayout` and a simple `TextView`. After inflating, get the `TextView` with `findViewById`. Then, replace the text with the text from the vector at position `i`. Test your new implementation. That's it!





### 2.4.2 Downloading images using Volley

Because downloading is painful, we propose in this part to use Volley, an helper called Volley is now available in Android. It handles multiple HTTP requests in a queue and simplifies the code, avoiding to develop an `AsyncTask`. It also provides a cache to speed up the download if the image has been already downloaded.

**Exercise 26** Add the following lines to the dependencies in `build.gradle` :

```
implementation 'com.android.volley:volley:1.1.1'
```

**Exercise 27** Have a look to this page of the documentation : <https://developer.android.com/training/volley/requestqueue?hl=zh-tw#singleton>. Import the class `MySingleton` in your project. Solve the missing imports. Now we can instantiate a request queue by doing :

```
// Get a RequestQueue
RequestQueue queue = MySingleton.getInstance(viewGroup.getContext()).
    getRequestQueue();
```

**Exercise 28** In the `getView` method of `MyAdapter` comment the code that inflates and modifies the `TextView`. Now, inflate from a new layout file `bitmaplayout.xml` a layout that contains an `ImageView`. This is this image that will be replaced when Volley has finished to download the image.

**Exercise 29** You need to create an `ImageRequest` object. Instantiate an object `ImageRequest` with the right parameters<sup>9</sup>. For the second parameter, see the next exercise.

**Exercise 30** The second parameter is the *response listener* i.e. the listener that is called when the request is finished. Its type will be `Response.Listener<Bitmap>`. Create this parameter using a lambda expression :

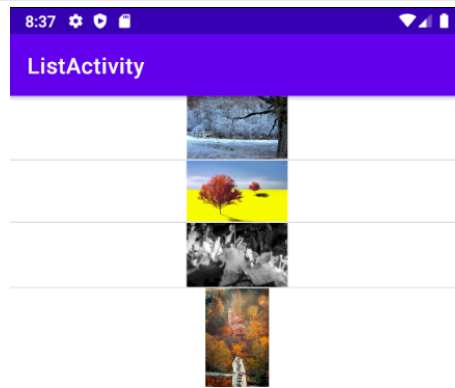
```
Response.Listener<Bitmap> rep_listener = response -> {
    // TODO
}
```

The code that goes here is very simple : `response` is of type `Bitmap` : it is the bitmap that Volley has downloaded. Thus this code is executed **when** the download has completed. The code to add in this lambda expression is the modification of the image just inflated previously with the method `setImageBitmap`.

**Exercise 31** Test your implementation : it works !

9. In case the constructor is deprecated, you can have a look here : <https://stackoverflow.com/questions/33271864/android-volley-imagerequest-deprecated>





## 2.5 Customize the type of image (bonus)

**Exercise 32** Tired of trees? Classical application have settings the user wish to modify. Android provide facilities for handling preferences. Customize the request to Flickr (currently asking for "cats") by adding a *PreferenceActivity* where the string can be edited. Add a preference to handle the caching of images or not.

## 3 Geolocalized images

**Exercise 33** Get the coordinate of your smartphone. Print these coordinates in the logs, for debug purpose.

**Exercise 34** Use the Flickr photos search API<sup>10</sup> to get geolocalized data. Several modifications in your code will be necessary. In particular, the JSON url will look like the following :

```
String url = new String("https://api.flickr.com/services/rest/" +  
                        "method=flickr.photos.search" +  
                        "&license=4" +  
                        "&api_key=xxxxxxxxxx" +  
                        "&has_geo=1&lat=" + lat +  
                        "&lon=" + lon + "&per_page=1&format=json");
```

<sup>10</sup>. <https://www.flickr.com/services/api/flickr.photos.search.html>