Master of Information Security

MIS4203 – Independent Studies in Information Security

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Study Number – 03 – Mobile App Vulnerabilities

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University of Colombo School of Computing

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Problem

Android mobile application apk file and source code of the same application is given. We need to find the following vulnerabilities.

- Flawed Broadcast Receivers
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- Username Enumeration issue
- Developer Backdoors
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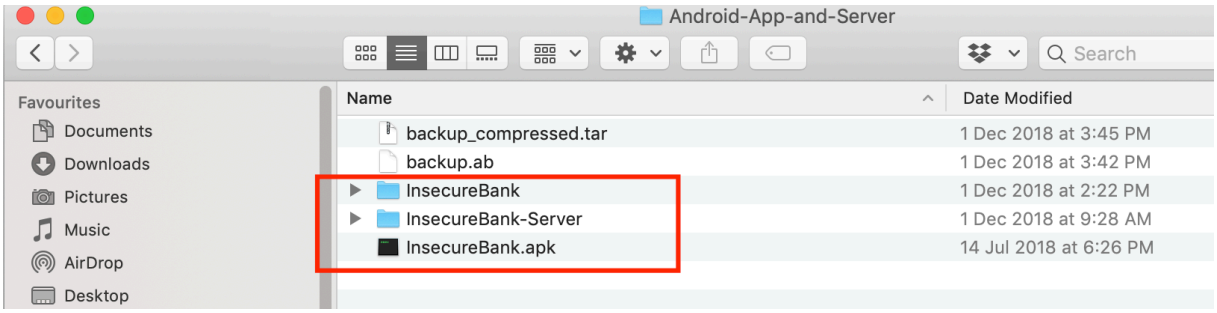
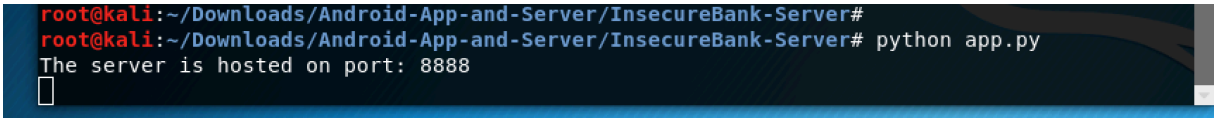
Approach

1. Download Android-App-Server file from LMS and then extract.
2. It include InsecureBank and InsecureBank-Server folders and InsecureBank.apk.
3. InsecureBank folder include the android app.
4. InsecureBank-Server include the python backend server for the InsecureBank android app.
5. Setup android app and backend server in your local machine.

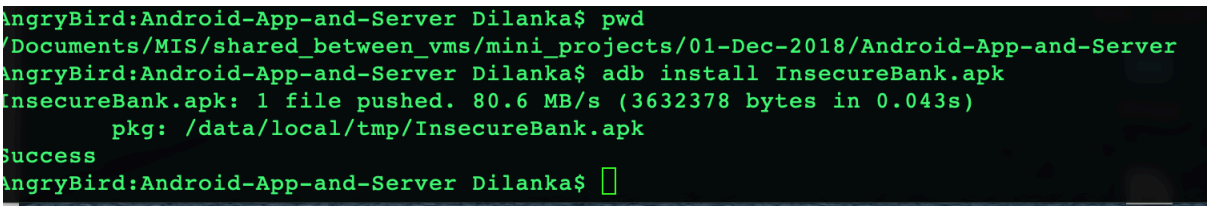
Downloaded Files from LMS:

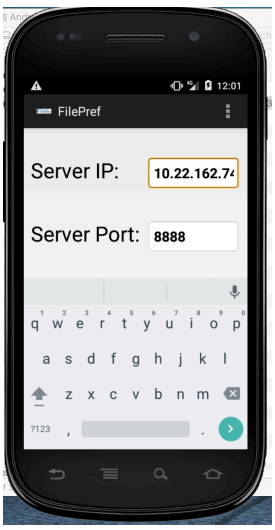


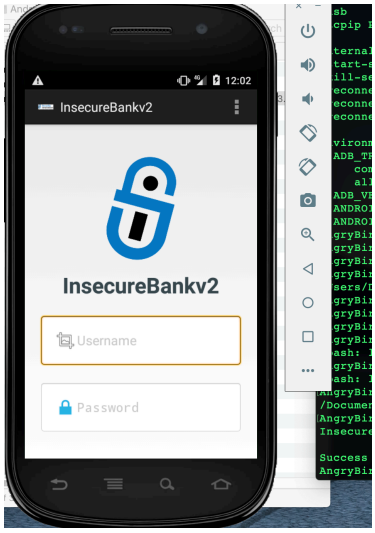
Up and running server in Kali-Linux VM:

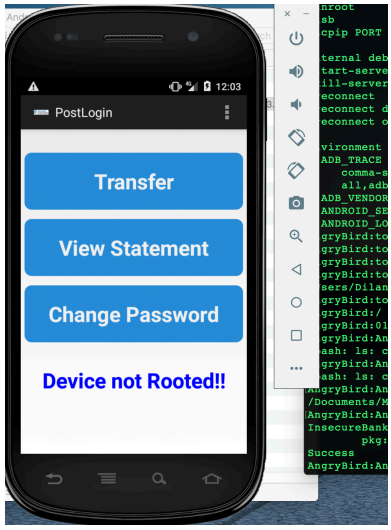


Install and running android application' apk file and running on android VDM.









6. Find following vulnerabilities in the InsecureBank bank application.

- Flawed Broadcast Receivers

```
<receiver
    android:name=".MyBroadCastReceiver"
    android:exported="true" >
    <intent-filter>
        <action android:name="theBroadcast" >
        </action>
    </intent-filter>
</receiver>
```

This broadcast receiver is found on AndroidManifest.xml as above screenshot. When mobile application exporting contents without restrictions, other applications can access those.

By default, broadcast receivers are exported in Android, as the result any application will be able to send an intent to the Broadcast Receiver of the application. To define which applications can send intents to mobile application's Broadcast Receiver set relevant permissions in the Android Manifest file. Here we cannot see any permission tag. So this is insecure.

```
private void broadcastChangepasswordSMS(String phoneNumber, String pass) {

    if(TextUtils.isEmpty(phoneNumber.toString().trim())) {

        System.out.println("Phone number Invalid.");
    }
    else
    {
        Intent smsIntent = new Intent();
        smsIntent.setAction("theBroadcast");
    //    String actdns= smsIntent.getAction().toString();
     //   Toast.makeText(getApplicationContext(),actdns , Toast.LENGTH_LONG).show();
        smsIntent.putExtra( name: "phonenumber", phoneNumber);
        smsIntent.putExtra( name: "newpass", pass);
        sendBroadcast(smsIntent);
    }

}
```

- Intent Sniffing and Injection

  Intent Sniffing

  In android, intents are created implicitly without proper restrictions according to the application requirement. Since this application is banking application, so that intents used in this application must be in secured way to access from only this application. But according to below screenshot of code of application, this application has bad standard code which is not secure. So malicious application can respond to this intend and perform action instead of legitimate action.

```
private void broadcastChangepasswordSMS(String phoneNumber, String pass) {

    if(TextUtils.isEmpty(phoneNumber.toString().trim())) {

        System.out.println("Phone number Invalid.");
    }
    else
    {
        Intent smsIntent = new Intent();
        smsIntent.setAction("theBroadcast");
    //   String actdns= smsIntent.getAction().toString();
     //  Toast.makeText(getApplicationContext(),actdns , Toast.LENGTH_LONG).show();
        smsIntent.putExtra( name: "phonenumber", phoneNumber);
        smsIntent.putExtra( name: "newpass", pass);
        sendBroadcast(smsIntent);
    }

}
```

So this application must be practice proper coding standards when creating intent:

Intent myIntent = new Intent (this, MyIntent.class);

Injection

Below highlighted code in initialising variable from the context of the view which is not secured as it is exported to other application as well. So anyone who can access the app via adb shell, can inject some other values to those with below given command. So it is insecure.

am broadcast -a theBroadcast -n com.android.insecurebankv2/com.android.insecurebankv2.MyBroadCastReceiver --es phonenumber 123456 –es newpass Pass@123!

```
public class MyBroadCastReceiver extends BroadcastReceiver {
    String usernameBase64ByteString;
    public static final String MYPREFS = "mySharedPreferences";

    @Override
    public void onReceive(Context context, Intent intent) {
        // TODO Auto-generated method stub

        String phn = intent.getStringExtra( name: "phonenumber");
        String newpass = intent.getStringExtra( name: "newpass");

        if (phn != null) {
            try {
                SharedPreferences settings = context.getSharedPreferences(MYPREFS, Context.MODE_WORLD_READABLE);
                final String username = settings.getString( s: "EncryptedUsername", s1: null);
                byte[] usernameBase64Byte = Base64.decode(username, Base64.DEFAULT);
                usernameBase64ByteString = new String(usernameBase64Byte, charsetName: "UTF-8");
                final String password = settings.getString( s: "superSecurePassword", s1: null);
                CryptoClass crypt = new CryptoClass();
                String decryptedPassword = crypt.aesDeccryptedString(password);
                String textPhoneno = phn.toString();
                String textMessage = "Updated Password from: "+decryptedPassword+" to: "+newpass;
                SmsManager smsManager = SmsManager.getDefault();
                System.out.println("For the changepassword - phonenumber: "+textPhoneno+" password is: "+textMessage);
                smsManager.sendTextMessage(textPhoneno, scAddress: null, textMessage, sentIntent: null, deliveryIntent: null);
            } catch (Exception e) {
                e.printStackTrace();
            }
        }
        else {
            System.out.println("Phone number is null");
        }
    }
```

- Weak Authorization mechanism

  No mechanism is used to user role mapping to this application. Proper mechanism is maintain user/role and permission matrix in database level to identify user permissions and user type.(for ex: which user has admin access, which user has high or low permissions). In this application only use flag which state in xml file as String.)

```
<?xml version="1.0" encoding="utf-8"?>
<resources>

    <string name="app_name">InsecureBankv2</string>
    <string name="hello_world">Hello world!</string>
    <string name="loginscreen_username">Username:</string>
    <string name="action_settings">Preferences</string>
    <string name="action_exit">Restart</string>
    <string name="loginscreen_password">Password:</string>
    <string name="title_activity_file_pref">FilePref</string>
    <string name="server_ip">Server IP:</string>
    <string name="server_port">Server Port:</string>
    <string name="pref_submit">Submit:</string>
    <string name="title_activity_setting_preferences">SettingPreferences</string>
    <string name="title_activity_login">LoginActivity</string>
    <string name="title_activity_log_main">LogMainActivity</string>
    <string name="title_activity_do_login">DoLogin</string>
    <string name="title_activity_login_action">LoginAction</string>
    <string name="title_activity_post_login">PostLogin</string>
    <string name="title_activity_wrong_login">WrongLogin</string>
    <string name="title_activity_do_transfer">DoTransfer</string>
    <string name="title_activity_view_statement">ViewStatement</string>
    <string name="is_admin">no</string>
    <string name="title_activity_change_password">ChangePassword</string>
    <string name="title_activity_exit">ExitActivity</string>
    <string name="action_kill">Exit Application</string>

</resources>
```

```
    <string name="title_activity_wrong_login">WrongLogin</string>
    <string name="title_activity_do_transfer">DoTransfer</string>
    <string name="title_activity_view_statement">ViewStatement</string>
    <string name="is_admin">yes</string>
    <string name="title_activity_change_password">ChangePassword</string>
    <string name="title_activity_exit">ExitActivity</string>
    <string name="action_kill">Exit Application</string>
```

- Local Encryption issues
  - Login username and password passed as plain text, as a proper security practice it should be encrypted or hided.

```
        */
        nameValuePairs.add(new BasicNameValuePair( name: "username", uname));
        nameValuePairs.add(new BasicNameValuePair( name: "newpassword", changePassword_text.getText().toString()));
        HttpResponse responseBody;
        httppost.setEntity(new UrlEncodedFormEntity(nameValuePairs));
        pattern = Pattern.compile(PASSWORD_PATTERN);
        matcher = pattern.matcher(changePassword_text.getText().toString());
```

  - User name and passwords are stored in shared preference. Reversible because of known secret key and IV and algorithm.

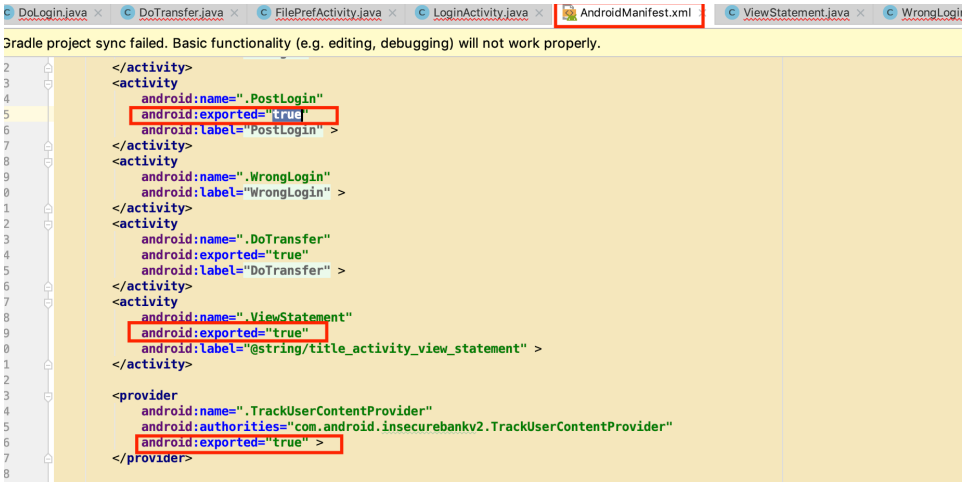
```
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <string name="EncryptedUsername">amFjaw==
    </string>
    <string name="superSecurePassword">1Ube3xborJSKSuxYG3TPUg==
    </string>
</map>
root@generic_x86:/data/data/com.android.insecurebankv2/shared_prefs #
```

```
The page that holds the logic for encryption and decryption used in the
@author Dinesh Shetty
*/
public class CryptoClass {

    //  The super secret key used by the encryption function
    String key = "This is the super secret key 123";
```

```
public static byte[] aes256encrypt(byte[] ivBytes, byte[] keyBytes, byte[] textBytes)
throws UnsupportedEncodingException,
NoSuchAlgorithmException,
NoSuchPaddingException,
InvalidKeyException,
InvalidAlgorithmParameterException,
IllegalBlockSizeException,
BadPaddingException {

    AlgorithmParameterSpec ivSpec = new IvParameterSpec(ivBytes);
    SecretKeySpec newKey = new SecretKeySpec(keyBytes,  algorithm: "AES");
    Cipher cipher = null;
    cipher = Cipher.getInstance("AES/CBC/PKCS5Padding");
    cipher.init(Cipher.ENCRYPT_MODE, newKey, ivSpec);
    return cipher.doFinal(textBytes);
}
```

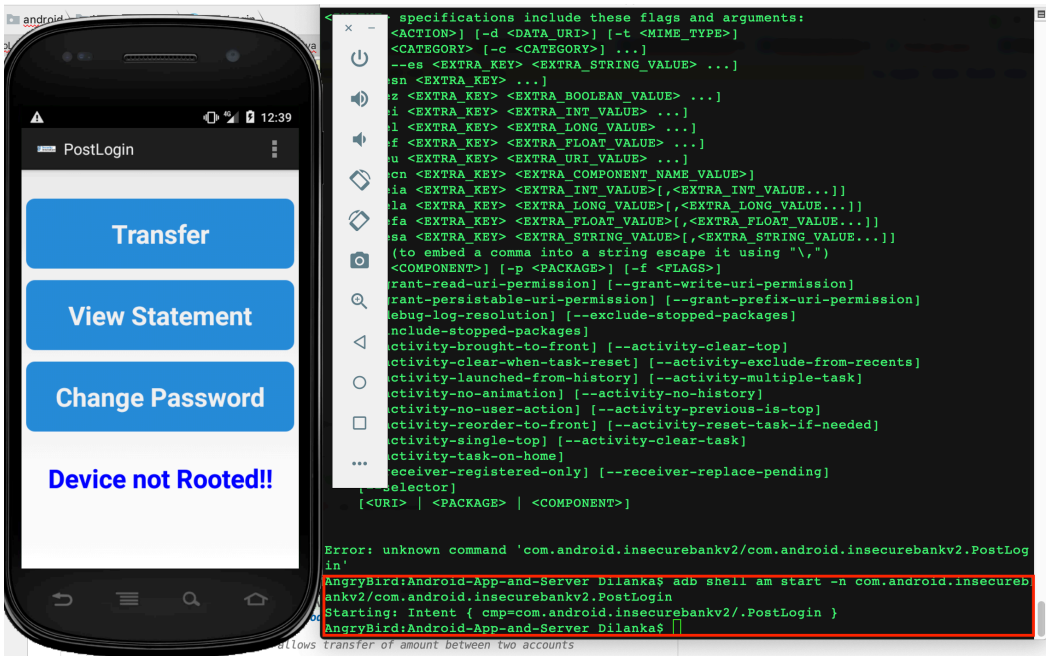
- Vulnerable Activity Components

  In android all the activity components are declared in AndroidManifest.xml file in application root. It is the best practice that important activities which should be secured ones make not exportable. But in this application all the activities which should be secured are exported. Which is vulnerable and allow bypass security authentication mechanism.



  For example, in above screenshot, post login activity is exportable and it is not secured as attacker can execute that activity directly bypassing the authentication.

adb shell am start -n com.android.insecurebankv2/com.android.insecurebankv2.PostLogin



- Root Detection and Bypass

  Root detection login is stated as below screenshot. According to that logic, it is checking whether some apk file exists or not. It it is exists application will be automatically rooted. So application and android manager never know this application is rooted.

  Note: even below code also has semantic error: instead of **if**(isrooted==**true**) it should be **if**(isrooted)

```
void showRootStatus() {
    boolean isrooted = doesSuperuserApkExist( s: "/system/app/Superuser.apk")||
            doesSUexist();
    if(isrooted==true)
    {
        root_status.setText("Rooted Device!!");
    }
    else
    {
        root_status.setText("Device not Rooted!!");
    }
}

private boolean doesSUexist() {
    Process process = null;
    try {
        process = Runtime.getRuntime().exec(new String[] { "/system/bin/which", "su" });
        BufferedReader in = new BufferedReader(new InputStreamReader(process.getInputStream()));
        if (in.readLine() != null) return true;
        return false;
    } catch (Throwable t) {
        return false;
    } finally {
        if (process != null) process.destroy();
    }

}

private boolean doesSuperuserApkExist(String s) {

    File rootFile = new File( pathname: "/system/app/Superuser.apk");
    Boolean doesexist = rootFile.exists();
    if(doesexist == true)
    {
        return(true);
    }
    else
    {
        return(false);
    }
}
```

- Insecure Content Provider access

  Broadcast receiver content provider is declared in AndroidManifest.xml file.

```
<provider
    android:name=".TrackUserContentProvider"
    android:authorities="com.android.insecurebankv2.TrackUserContentProvider"
    android:exported="true" >
</provider>
```

  When analysing TrackUserContentProvider.class, Below url can be found and which is users' history information.

  Content query –uri content://com.android.insecurebankv2.TrackUserContentProvider/trackerusers

```
static final String PROVIDER_NAME = "com.android.insecurebankv2.TrackUserContentProvider";
//   The Content provider that handles all the tracked user history
static final String URL = "content://" + PROVIDER_NAME + "/trackerusers";
static final Uri CONTENT_URI = Uri.parse(URL);
static final String name = "name";
static final int uriCode = 1;
static final UriMatcher uriMatcher;
private static HashMap < String, String > values;
private SQLiteDatabase db;
static final String DATABASE_NAME = "mydb";
static final String TABLE_NAME = "names";
static final int DATABASE_VERSION = 1;
static final String CREATE_DB_TABLE = " CREATE TABLE " + TABLE_NAME + " (id INTEGER PRIMARY KEY AUTOINCREMENT, " + " n
```

- Insecure WebView implementation

  App is insecure since it is enabled javascript, by default android app's java script is disabled. So this is vulnerable for malicious javascript executing or XSS attacks.

```
if (fileToCheck.exists()) {
    //Toast.makeText(this, "Statement Exists!!",Toast.LENGTH_LONG).show();

    WebView mWebView = (WebView) findViewById(R.id.webView1);
    //   Location where the statements are stored locally on the device sdcard
    mWebView.loadUrl("file://" + Environment.getExternalStorageDirectory() + "/Statements_" + uname +
    mWebView.getSettings().setJavaScriptEnabled(true);
    mWebView.getSettings().setSaveFormData(true);
    mWebView.getSettings().setBuiltInZoomControls(true);
    mWebView.setWebViewClient(new MyWebViewClient());
    WebChromeClient cClient = new WebChromeClient();
    mWebView.setWebChromeClient(cClient);
} else
```

  No url validation provided

```
/*
The class that manages the WebView functionality used in the application
@author Dinesh Shetty
*/
public class MyWebViewClient extends WebViewClient {
    @Override
    public boolean shouldOverrideUrlLoading(WebView view, String url) {
        view.loadUrl(url);
        return true;
    }
}
```

- Weak Cryptography implementation

  We can decompile the apk file or find the hard coded below information from the code.

  Key used for encryption:

```
The page that holds the logic for encryption and decryption used in the
@author Dinesh Shetty
*/
public class CryptoClass {

    //  The super secret key used by the encryption function
    String key = "This is the super secret key 123";
```

  Encryption algorithm information:

```
public static byte[] aes256encrypt(byte[] ivBytes, byte[] keyBytes, byte[] textBytes)
throws UnsupportedEncodingException,
NoSuchAlgorithmException,
NoSuchPaddingException,
InvalidKeyException,
InvalidAlgorithmParameterException,
IllegalBlockSizeException,
BadPaddingException {

    AlgorithmParameterSpec ivSpec = new IvParameterSpec(ivBytes);
    SecretKeySpec newKey = new SecretKeySpec(keyBytes,  algorithm: "AES");
    Cipher cipher = null;
    cipher = Cipher.getInstance("AES/CBC/PKCS5Padding");
    cipher.init(Cipher.ENCRYPT_MODE, newKey, ivSpec);
    return cipher.doFinal(textBytes);
}
```

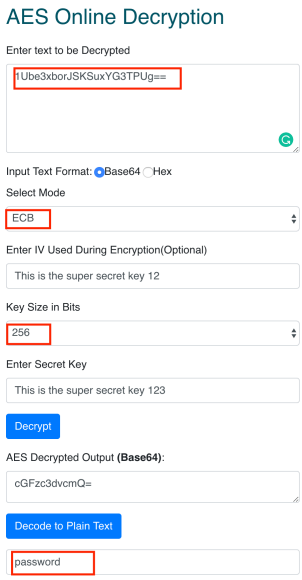
  Cipher text from the shared preference.xml file from the adb shell:

```
root@generic_x86:/data/data/com.android.insecurebankv2/shared_prefs # ls
com.android.insecurebankv2_preferences.xml
mySharedPreferences.xml
root@generic_x86:/data/data/com.android.insecurebankv2/shared_prefs #
root@generic_x86:/data/data/com.android.insecurebankv2/shared_prefs #
root@generic_x86:/data/data/com.android.insecurebankv2/shared_prefs #
```

```
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <string name="EncryptedUsername">amFjaw==
    </string>
    <string name="superSecurePassword">1Ube3xborJSKSuxYG3TPUg==
    </string>
</map>
root@generic_x86:/data/data/com.android.insecurebankv2/shared_prefs #
```

  Now we know key, IV and cipher text. So we can use reverse engineering tool to find the password as plain text.

  https://www.devglan.com/online-tools/aes-encryption-decryption



- Application Patching

  In this code, the login user is admin or not is checking by using String flag. If the attacker can access the relevant file from the adb shell, attacker can gain the admin rights to the application, do malicious things that attacker want and reverse it to the previous state without any trace.

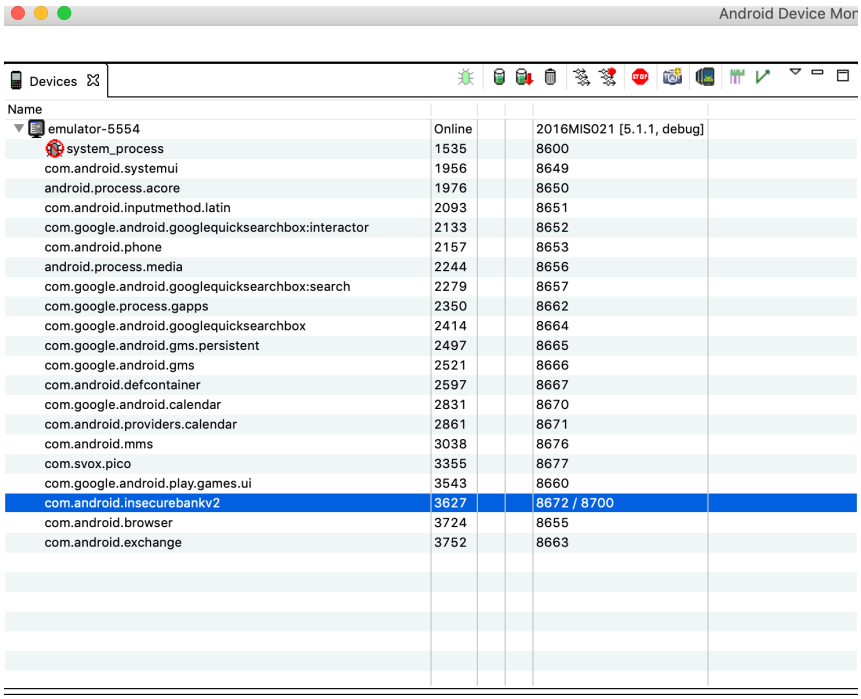
```
<?xml version="1.0" encoding="utf-8"?>
<resources>

    <string name="app_name">InsecureBankv2</string>
    <string name="hello_world">Hello world!</string>
    <string name="loginscreen_username">Username:</string>
    <string name="action_settings">Preferences</string>
    <string name="action_exit">Restart</string>
    <string name="loginscreen_password">Password:</string>
    <string name="title_activity_file_pref">FilePref</string>
    <string name="server_ip">Server IP:</string>
    <string name="server_port">Server Port:</string>
    <string name="pref_submit">Submit:</string>
    <string name="title_activity_setting_preferences">SettingPreferences</string>
    <string name="title_activity_login">LoginActivity</string>
    <string name="title_activity_log_main">LogMainActivity</string>
    <string name="title_activity_do_login">DoLogin</string>
    <string name="title_activity_login_action">LoginAction</string>
    <string name="title_activity_post_login">PostLogin</string>
    <string name="title_activity_wrong_login">WrongLogin</string>
    <string name="title_activity_do_transfer">DoTransfer</string>
    <string name="title_activity_view_statement">ViewStatement</string>
    <string name="is_admin">no</string>
    <string name="title_activity_change_password">ChangePassword</string>
    <string name="title_activity_exit">ExitActivity</string>
    <string name="action_kill">Exit Application</string>

</resources>
```

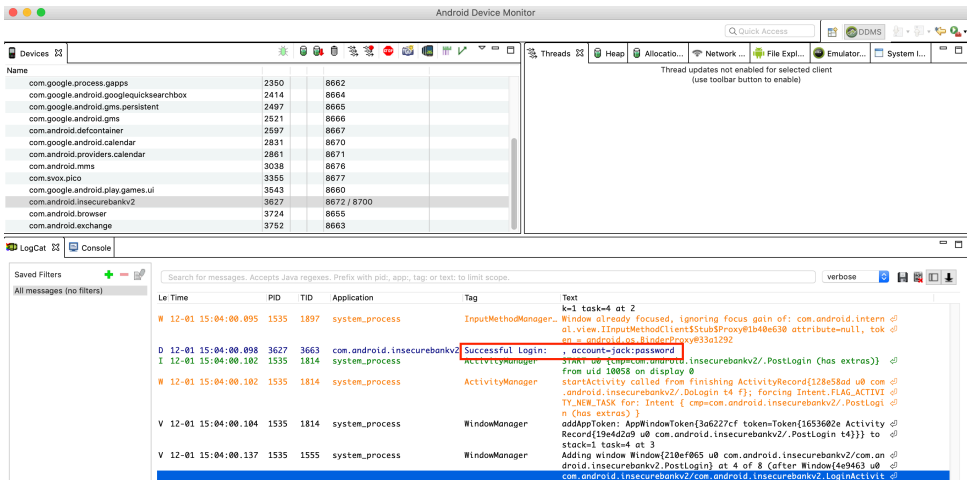
```
    <string name="title_activity_wrong_login">WrongLogin</string>
    <string name="title_activity_do_transfer">DoTransfer</string>
    <string name="title_activity_view_statement">ViewStatement</string>
    <string name="is_admin">yes</string>
    <string name="title_activity_change_password">ChangePassword</string>
    <string name="title_activity_exit">ExitActivity</string>
    <string name="action_kill">Exit Application</string>
```

- Sensitive Information in Memory

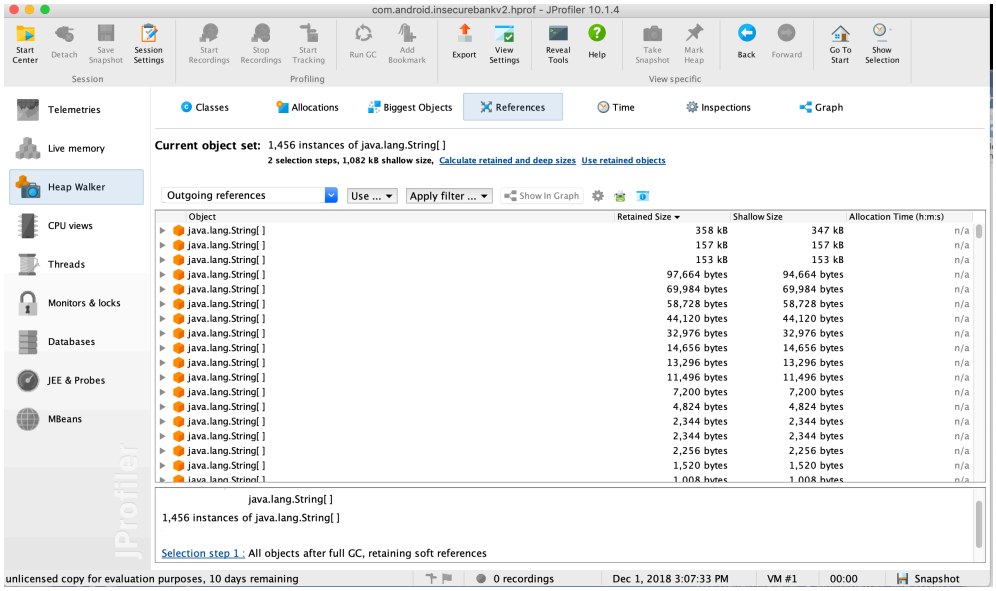
  Can use android application monitor as below screen.

```
/Users/Dilanka/Library/Android/sdk/tools
AngryBird:tools Dilanka$ monitor
-bash: monitor: command not found
AngryBird:tools Dilanka$ ls
NOTICE.txt              emulator                mksdcard
android                 emulator-check          monitor
bin                     lib                     package.x
AngryBird:tools Dilanka$ ./monitor
```



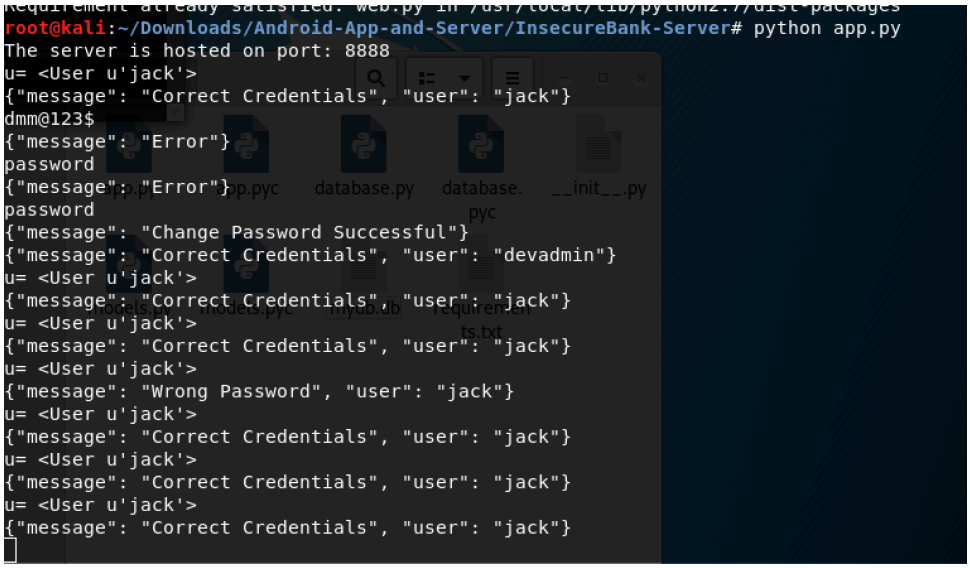


Further analysis can be done via tools such as JProfiler .

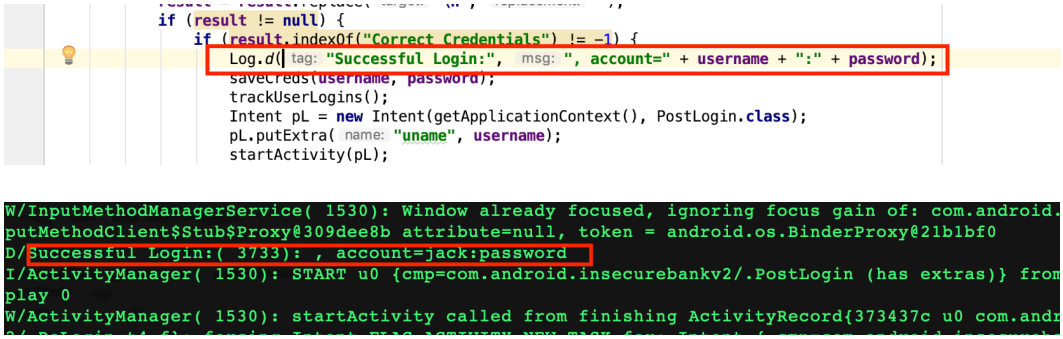


- Insecure Logging mechanism

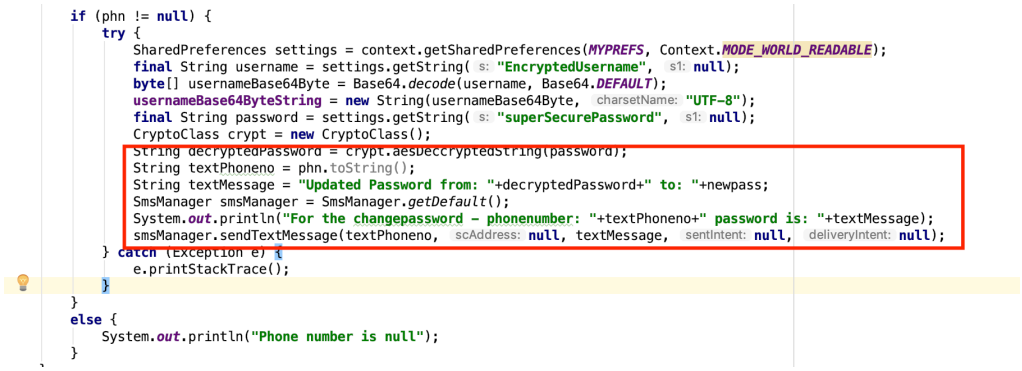
  Login credentials can be seen in server log/console which is insecure for the app.



  Password (Together with user name) is logged in plain text.



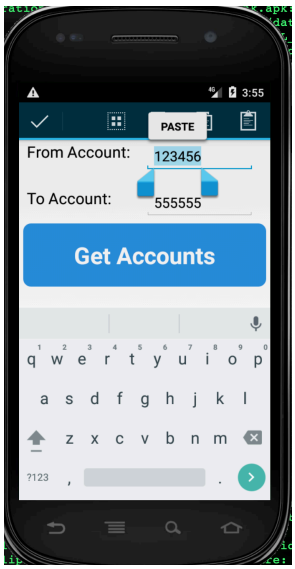
  Some information showed with non-standard way with normal Java print statements.



- Android Pasteboard vulnerability

  Information that we copied to the clipboard in this application can be read from the clipboard memory via below command:

  adb shell su u0_a58 service call clipboard 2 s16 com.android.insecurebankv2




```
AngryBird:Android-App-and-Server Dilanka$ adb shell su u0_a58 service call clipboard 2 s16 com.android.insecurebankv2
Result: Parcel(
  0x00000000: 00000000 00000001 00000001 ffffffff '................'
  0x00000010: 00000001 0000000a 00650074 00740078 '........e.x.t.'
  0x00000020: 0070002f 0061006c 006e0069 00000000 '/.p.l.a.i.n.....'
  0x00000030: 00000000 00000001 00000000 00000006 '................'
  0x00000040: 00320031 00340033 00360035 00000000 '1.2.3.4.5.6.....'
  0x00000050: 00000014 00000000 00000000 00000006 '................'
  0x00000060: 00000021 00000000 ffffffff 00000000 '!...............'
  0x00000070: 00000000                            '....            ')
AngryBird:Android-App-and-Server Dilanka$
```

- Application Debuggable
  - There is 'android:debuggable="true"' found in file "android/AndroidManifest.xml"
  - *Code sample*

    ```
    <application android:allowBackup="true"
    android:debuggable="true"
    android:icon="@mipmap/ic_launcher"
    android:label="@string/app_name"
    android:theme="@android:style/Theme.Holo.Light.
    DarkActionBar">
    ```

    To avoid this change code to android:debuggable="false"

```
<application
    android:allowBackup="true"
    android:debuggable="true"
    android:icon="@mipmap/ic_launcher"
    android:label="@string/app_name"
    android:theme="@android:style/Theme.Holo.Light.DarkActionBar">
    <!--
    android:theme="@style/AppTheme"-->
```

- Android keyboard cache issues
  - Android by default showing previous typed information as suggestions. But best practice is sensitive information should not behave like that. But examining AndroidManifest.xml file it is allowed. Developer has to disable it by using below code tag.

    `android:inputType="textNoSuggestions"`

```
<TextView android:id="@+id/textView_FromAccount"
    android:layout_width="wrap_content"
    android:text="From Account:"
    android:textSize="20sp"
    android:textColor="#000000"
    android:layout_height="wrap_content"
    android:layout_marginLeft="10dip"></TextView>
</FrameLayout>
<FrameLayout
    android:layout_height="wrap_content"
    android:layout_width="0dp"
    android:layout_weight="1">
<EditText android:layout_width="fill_parent"
    android:id="@+id/editText_from"
    android:layout_height="wrap_content"
    android:layout_marginLeft="00dip"
    android:layout_marginRight="20dip"
    android:layout_weight="1"
    android:singleLine="true">
</EditText>
```

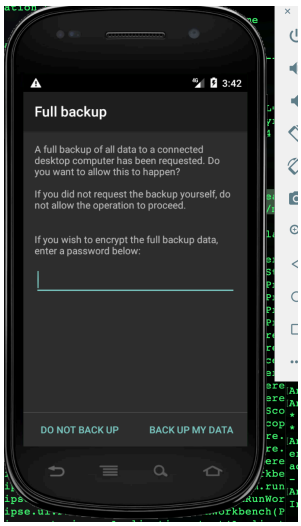
  - Once keyboard cache enabled, we can find it android sqllite database, user_dict database, words table. Then open the file user_dict.db words table using sqlite3 can be identified the what are the dictionary added words . That may lead to leak the sensitive information.

- Android Backup vulnerability
  - When examine AndroidManifest.xml file, This app is allowed to backup.

```
<application
    android:allowBackup="true"
    android:icon="@mipmap/ic_launcher"
    android:label="@string/app_name"
    android:theme="@android:style/Theme.Holo.Light.DarkActionBar">
    <!--
    android:theme="@style/AppTheme"-->
    <activity
```

Anyone can backup the application via below command:

```
AngryBird:Android-App-and-Server Dilanka$ adb backup -apk -shared com.android.insecurebankv2
Now unlock your device and confirm the backup operation...
```



Once you extracted the backup file, it will contain stored credentials, transaction logs and history. Mainly sharedPreferences related information.

- Runtime Manipulation

  When examin AndroidManifest.xml file. The sensitive activity is exportable which is doTransfer which can be directly manipulated and access since it is exportable. So it is vulnerable.

```
<activity
    android:name=".DoTransfer"
    android:exported="true"
    android:label="DoTransfer" >
</activity>
```

- Insecure SDCard storage

  This application can access the external storages in READ/WRITE mode. That means application can be saved bank related financial data in to external storage such as SD card. It will help to other apps including malicious apps or external users to access those data from the SD card.

```xml
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.android.insecurebankv2" >

    <uses-sdk
        android:minSdkVersion="11"
        android:targetSdkVersion="24" />

    <uses-permission android:name="android.permission.INTERNET" />
    <uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE" />
    <uses-permission android:name="android.permission.SEND_SMS" />

    <!--
     To retrieve OAuth 2.0 tokens or invalidate tokens to disconnect a user. This disconnect
     option is required to comply with the Google+ Sign-In developer policies
    -->
    <uses-permission android:name="android.permission.USE_CREDENTIALS" /> <!-- To retrieve the account name (email) as
    <uses-permission android:name="android.permission.GET_ACCOUNTS" /> <!-- To auto-complete the email text field in th
    <uses-permission android:name="android.permission.READ_PROFILE" />
    <uses-permission android:name="android.permission.READ_CONTACTS" />

    <android:uses-permission android:name="android.permission.READ_PHONE_STATE" />
    <android:uses-permission
        android:name="android.permission.READ_EXTERNAL_STORAGE"
        android:maxSdkVersion="18" />
    <android:uses-permission android:name="android.permission.READ_CALL_LOG" />

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:theme="@android:style/Theme.Holo.Light.DarkActionBar">
        <!--
        android:theme="@style/AppTheme"-->
        <activity
            android:name=".LoginActivity"
            android:label="InsecureBankv2" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
```

```
            try {
                jsonObject = new JSONObject(result);
                acc1 = jsonObject.getString( name: "from");
                acc2 = jsonObject.getString( name: "to");
                System.out.println("Message:" + jsonObject.getString( name: "message") + " From:" + from.getText().toString() + " To:" + to.getText().t
                final String status = new String( original: "\nMessage:" + "Success" + " From:" + from.getText().toString() + " To:" + to.getText().toStr
                try {
                    //  Captures the successful transaction status for Transaction history tracking
                    String MYFILE = Environment.getExternalStorageDirectory() + "/Statements_" + usernameBase64ByteString + ".html";
                    BufferedWriter out2 = new BufferedWriter(new FileWriter(MYFILE,  append: true));
                    out2.write(status);
                    out2.write( str: "<hr>");
                    out2.close();
                } catch (IOException e) {
                    e.toString();
                }
            } catch (JSONException e) {
                // TODO Auto-generated catch block
                e.printStackTrace();
            }
```

- Insecure HTTP connections
  - Less secure protocol is used comparatively and it is hard coded.

```
public class DoLogin extends Activity {
    String responseString = null;
    //  Stores the username passed by the calling intent
    String username;
    //  Stores the password passed by the calling intent
    String password;
    String result;
    String superSecurePassword;
    String rememberme_username, rememberme_password;
    public static final String MYPREFS = "mySharedPreferences";
    String serverip = "";
    String serverport = "";
    String protocol = "http://";
    BufferedReader reader;
    SharedPreferences serverDetails;
```

```
        // Create a new HttpClient and Post Header

        HttpClient httpclient = new DefaultHttpClient();
        HttpPost httppost = new HttpPost( uri: protocol + serverip + ":" + serverport + "/login");
        HttpPost httppost2 = new HttpPost( uri: protocol + serverip + ":" + serverport + "/devlogin");

        // Add your data
```

- Parameter Manipulation

  - Below highlighted code in initialising variable from the context of the view which is not secured as it is exported to other application as well. So anyone who can access the app via adb shell, can inject some other values to those with below given command. So it is insecure.
  - am broadcast -a theBroadcast -n com.android.insecurebankv2/com.android.insecurebankv2.MyBroadCastReceiver --es phonenumber 123456 –es newpass Pass@123!

```
public class MyBroadCastReceiver extends BroadcastReceiver {
    String usernameBase64ByteString;
    public static final String MYPREFS = "mySharedPreferences";

    @Override
    public void onReceive(Context context, Intent intent) {
        // TODO Auto-generated method stub

        String phn = intent.getStringExtra( name: "phonenumber");
        String newpass = intent.getStringExtra( name: "newpass");

        if (phn != null) {
            try {
                SharedPreferences settings = context.getSharedPreferences(MYPREFS, Context.MODE_WORLD_READABLE);
                final String username = settings.getString( s: "EncryptedUsername", s1: null);
                byte[] usernameBase64Byte = Base64.decode(username, Base64.DEFAULT);
                usernameBase64ByteString = new String(usernameBase64Byte, charsetName: "UTF-8");
                final String password = settings.getString( s: "superSecurePassword", s1: null);
                CryptoClass crypt = new CryptoClass();
                String decryptedPassword = crypt.aesDeccryptedString(password);
                String textPhoneno = phn.toString();
                String textMessage = "Updated Password from: "+decryptedPassword+" to: "+newpass;
                SmsManager smsManager = SmsManager.getDefault();
                System.out.println("For the changepassword - phonenumber: "+textPhoneno+" password is: "+textMessage);
                smsManager.sendTextMessage(textPhoneno, scAddress: null, textMessage, sentIntent: null, deliveryIntent: null);
            } catch (Exception e) {
                e.printStackTrace();
            }
        }
        else {
            System.out.println("Phone number is null");
        }
    }
```

- Hardcoded secrets

  Some hard coded credentials as comments not removed. Seems not code reviewed properly.

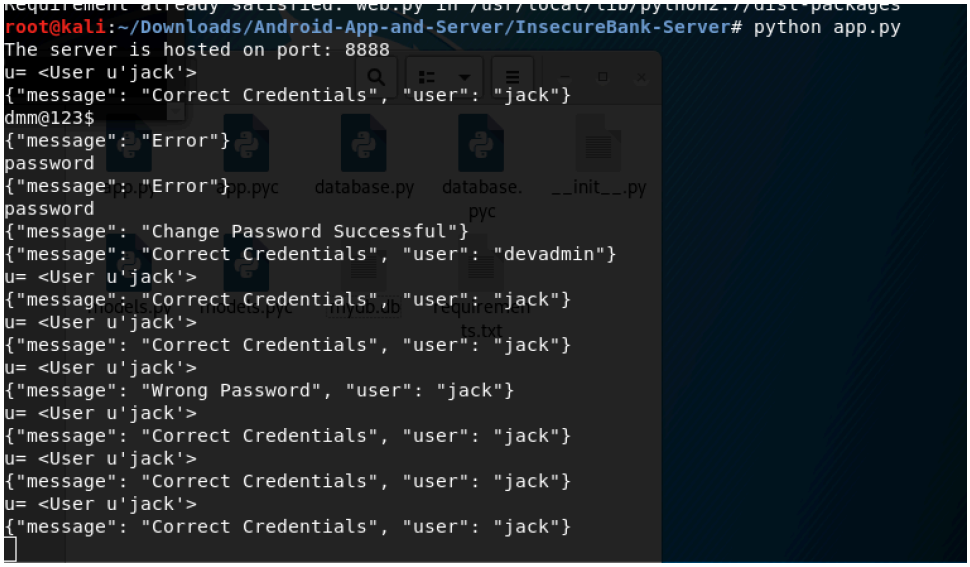
```
// Create a new HttpClient and Post Header

HttpClient httpclient = new DefaultHttpClient();
HttpPost httppost = new HttpPost( uri: protocol + serverip + ":" + serverport + "/login");
HttpPost httppost2 = new HttpPost( uri: protocol + serverip + ":" + serverport + "/devlogin");

// Add your data
List < NameValuePair > nameValuePairs = new ArrayList <~> ( initialCapacity: 2);

//              Delete below test accounts in production
//              nameValuePairs.add(new BasicNameValuePair("username", "jack"));
//              nameValuePairs.add(new BasicNameValuePair("password", "jack@123$"));

nameValuePairs.add(new BasicNameValuePair( name: "username", username));
nameValuePairs.add(new BasicNameValuePair( name: "password", password));
HttpResponse responseBody;
if (username.equals("devadmin")) {
    httppost2.setEntity(new UrlEncodedFormEntity(nameValuePairs));
    // Execute HTTP Post Request
    responseBody = httpclient.execute(httppost2);
} else {
    httppost.setEntity(new UrlEncodedFormEntity(nameValuePairs));
    // Execute HTTP Post Request
    responseBody = httpclient.execute(httppost);
}
```

Cryptographic information also hard coded:

```
//  The super secret key used by the encryption function
String key = "This is the super secret key 123";

//  The initialization vector used by the encryption function
byte[] ivBytes = {
    0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
};
```

- Username Enumeration issue

  Username and password can be brute forced by analysing api calls as below:



Code segment:

```
32  def login():
33      Responsemsg="fail"
34      user = request.form['username']
35      #checks for presence of user in the database #requires models.py
36      u = User.query.filter(User.username == request.form["username"]).first()
37      print "u=",u
38      if u and u.password == request.form["password"]:
39      Responsemsg="Correct Credentials"
40      elif u and u.password != request.form["password"]:
41      Responsemsg="Wrong Password"
42      elif not u:
43          Responsemsg="User Does not Exist"
44      else: Responsemsg="Some Error"
45      data = {"message" : Responsemsg, "user": user}
46      print makejson(data)
47      return makejson(data)
48
```

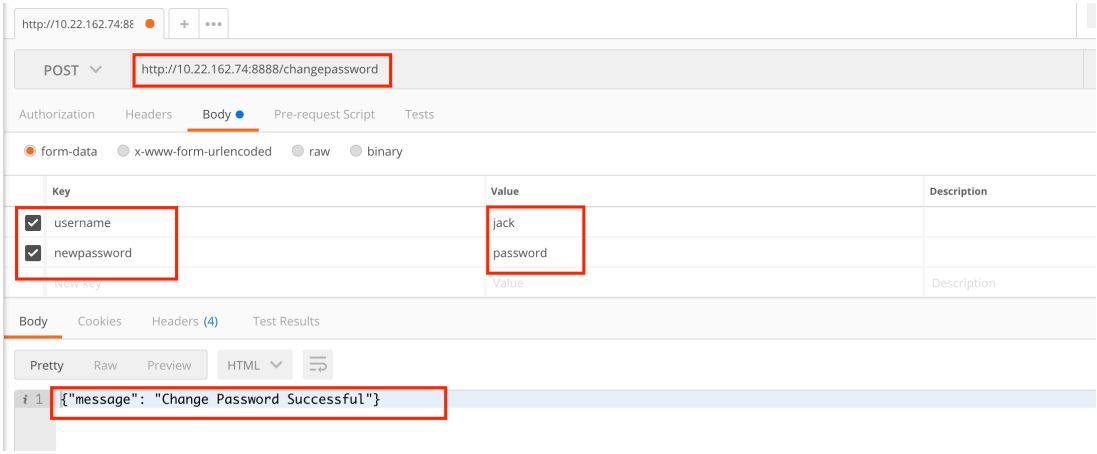
- Developer Backdoors
  - Hardcoded user (devadmin) can login with any password authentication:

```
HttpResponse responseBody;
if (username.equals("devadmin")) {
    httppost2.setEntity(new UrlEncodedFormEntity(nameValuePairs));
    // Execute HTTP Post Request
    responseBody = httpclient.execute(httppost2);
} else {
    httppost.setEntity(new UrlEncodedFormEntity(nameValuePairs));
    // Execute HTTP Post Request
    responseBody = httpclient.execute(httppost);
}
```

- Weak change password implementation

  - Only looking for the new password and change it directly without validation.
  - This can be considered as developer backdoor as someone can access the rest url directly and change the password without app. Rest endpoint must be secured, or validate with existing password of the user.

```
/*
The function that makes an HTTP Post to the server endpoint that handles the
change password operation.
*/
public void postData(String valueIWantToSend) throws ClientProtocolException, IOException, JSONException, InvalidKeyException, NoSuchAlgorithmException, NoSuchP
    HttpClient httpclient = new DefaultHttpClient();
    HttpPost httppost = new HttpPost( url: protocol + serverip + ":" + serverport + "/changepassword");
    List <NameValuePair> nameValuePairs = new ArrayList<>( initialCapacity: 2);

    /*
       Delete below test accounts once the application goes into production phase.
       nameValuePairs.add(new BasicNameValuePair("username", "jack"));
       nameValuePairs.add(new BasicNameValuePair("password", "Jack@123$"));
     */
    nameValuePairs.add(new BasicNameValuePair( name: "username", uname));
    nameValuePairs.add(new BasicNameValuePair( name: "newpassword", changePassword_text.getText().toString()));
    HttpResponse responseBody;
    httppost.setEntity(new UrlEncodedFormEntity(nameValuePairs));
    pattern = Pattern.compile(PASSWORD_PATTERN);
    matcher = pattern.matcher(changePassword_text.getText().toString());

    // Check if the password is complex enough
    boolean isStrong= matcher.matches();
    if (isStrong){
        responseBody = httpclient.execute(httppost);
        InputStream in = responseBody.getEntity().getContent();
        result = convertStreamToString( in );
        result = result.replace( target: "\n",  replacement: "");

        runOnUiThread(() -> {
```



Conclusion

According to above vulnerability analysis, there are many security issues found that this bank confidential information leak or attackable to attacker. So before release this application to production, it must be fixed above all issues and better to do proper code review.

********** End **********