Distributed Systems – Assignment 4

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ABSTRACT

For the final project we decided to tackle the task to design and develop a completely open sourced password managing solution. Because the first part of this course mainly focused on Android development, we decided to begin our journey by developing a simple backend server application and then concentrating on implementing a basic Android application, that allows to use the server we previously created.

All in all we are content with ourselves, as we think that we succeeded in developing a basic proof-of-concept application, that is already usable. Still, we want to keep the project alive and therefore mentioned a few ideas how the project can be improved in the future.

1. PROBLEM STATEMENT AND REQUIREMENTS

Everybody that uses a few different sites that use basic username/password authentication knows the problem: even though it is clear, that you should not use the same password on two different websites, almost everybody is too lazy or forgetful to use a different password on each website he uses.

To counter this problem and make it easier for everybody to use an unique password for every site, so called password managers exist. In the following paragraphs we list some examples of existing password managers and why we do not consider them to be a satisfying solution.

1.1 KeePass/KeePassX

KeePass is a free open source password manager, which helps you to manage your passwords in a secure way. You can put all your passwords in one database, which is locked with one master key or a key file. So you only have to remember one single master password or select the key file to unlock the whole database. The databases are encrypted using the best and most secure encryption algorithms currently known (AES and Twofish). [3]

1.1.1 Pros

- Free
- Open-Source
- Using tested and known encryption algorithms
- Available on a huge number of platforms
- Actively developed

1.1.2 Cons

- Two different main source trees (KeePass 2 and KeePass X)
- Passwords are stored in a file, thus to keep the password synchronized over more than one device, the password file itself has to be synchronized, which can be quite difficult
- Browser integration is complicated

1.2 LastPass

LastPass Password Manager is a freemium password management service developed by LastPass. It is available as a plugin for Internet Explorer, Mozilla Firefox, Google Chrome, Opera, and Safari. There is also a LastPass Password Manager bookmarklet for other browsers.[4] [5]

1.2.1 Pros

- Web application is free
- As far as we know it is using tested and known encryption algorithms
- Web application with plugins for all mayor browsers
- Android and iPhone application
- All passwords are distributed to all clients

1.2.2 Cons

- Mobile applications are not available for free users
- Closed source
- For profit company that could potentially have access to all of your passwords and therefore all your accounts
- US company

1.3 Other solutions

While we researched this topic we came across a few other possible solutions, but they all fell into one of the two categories we mentioned above: either they were offered by for profit companies or the were free or even open source, but there was no possibility to distribute the passwords to all possible clients (like a desktop computer, a laptop, an office computer, a smartphone and a tablet) a user owns.

2. REQUIREMENTS

Because of the reasons mentioned in the last section, we decided to develop a service that satisfies a larger number of our needs which include but are not limited to:

- Open source
- Using well-known and -tested cryptographic algorithms
- Available at least as a web application, a browser plugin and mobile applications for Android and iOS
- Possibility to distribute the stored passwords to all (or at least a majority) of all devices a user uses
- Not controlled by a company

To achieve this goal we decided to begin with developing a simple Android application, that offers a user to synchronize a list of passwords with a server. It should be possible for every user to host his own password database server if he has some basic system administrator knowledge to host a server and run a basic python application on it.

3. ARCHITECTURE

As we knew that it is not really viable to implement all our planned features, we decided to stay simple and just implement the most important features. This includes basic user management (login by a username and a password), password encryption and storage (encrypted with the master password).

3.1 Backend

For developing the backend we used

- Python [6]
- Flask [8] a python web microframework
- SQLAlchemy [7] a python ORM and the flask version Flask-SQLAlchemy [2]
- Flask-Restful [1] to provide a simple REST interface to the Android application

We currently provide the following REST endpoints to the Android application to communicate with the backend:

- TODO: add possbile requests from the readme

Basically at the moment the web application is just a simple wrapper around a SQLite database. Still, this was enough for us to develop the application.

3.2 Communication

TODO: Some source code and a basic description about AsyncTask and how HTTP requests were done

3.3 Interface

TODO: Describe the interface, maybe a state diagram and of course a few screenshots

4. IMPLEMENTATION

4.1 TODO: More implementation details

4.2 Cryptography

As we all know that cryptography is hard and a pain, we used the standard Java javax.crypto cryptography library to implement hashing, encryption and decryption.

We decided to use the well known AES symetric encryption cipher in CBC mode and used PKCS5 as the padding scheme:

```
1  public Encryption(Server server) {
2          ...
3          cipher = Cipher.getInstance("AES/CBC/
               PKCS5Padding");
4          ...
5      }
6
7      ...
8
9      public byte[] encrypt(String toEncrypt) {
10         ...
11         // Generate random IV
12
13     ...
14         cipher.init(Cipher.ENCRYPT_MODE, key);
15         byte[] encryptedString = cipher.doFinal(
               toEncrypt.getBytes("UTF-8"));
16         ...
17     }
18     ...
19 }
```

Listing 1: SensorWrapper class

At the moment we simply hash the password using the hashing algorithm SHA256 and transfer the hashed password to the server via the REST API. At the same time we use the same hash to de- and encrypt the users usernames and passwords, which of course is a fatal mistake. But for our purposes this suffices, as we do not want anyone to use our system in production yet.

It is important to mention, that we decided to encode all passwords with Base64 to make it easier to debug the connection because of the lack of any binary transfers.

4.3 Problems

4.3.1 Callback stuff

4.3.2 Long clicks

4.3.3 TODO: More problems

5. FURTHER PLANS

5.1 More Features

5.2

6. CONCLUSION

7. REFERENCES

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