Mini-project-topics-in-network-security

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Explanation

The goal: Make a secure chat app by using a few methods of security such as encryption, authentication, and middleware file between client and server.

Introduction:
The first layer of security in our application is authentication, for which we have implemented Google Authentication. Through the Google Cloud Console, we manually specify which users are authorized to access the application. The second layer of security is a messaging system, where we employ the Advanced Encryption Standard (AES) algorithm to ensure the confidentiality of communications. We saved the data on DB. We will explain more about each one.

Design and implementation:
We used Next.js for backend and frontend, next.js is react framework that is recommended by react docs, for db we used upstash-redis, for css we chose tailwindcss.

Endpoints:
http://localhost:3000/login the login page (with your Google authentication)
http://localhost:3000/dashboard/ after login you will be redirected here
http://localhost:3000/dashboard/add here you can send post req to add friends
http://localhost:3000/dashboard/requests here you can accept/deny friend req.
http://localhost:3000/dashboard/chat/* here you can talk with your friend.

About our encryption method: AES: (Advanced Encryption Standard) is a symmetric key encryption algorithm, meaning the same key is used for both encryption and decryption. It was established by the U.S. National Institute of Standards and Technology (NIST) in 2001 and is widely used for secure data transmission.

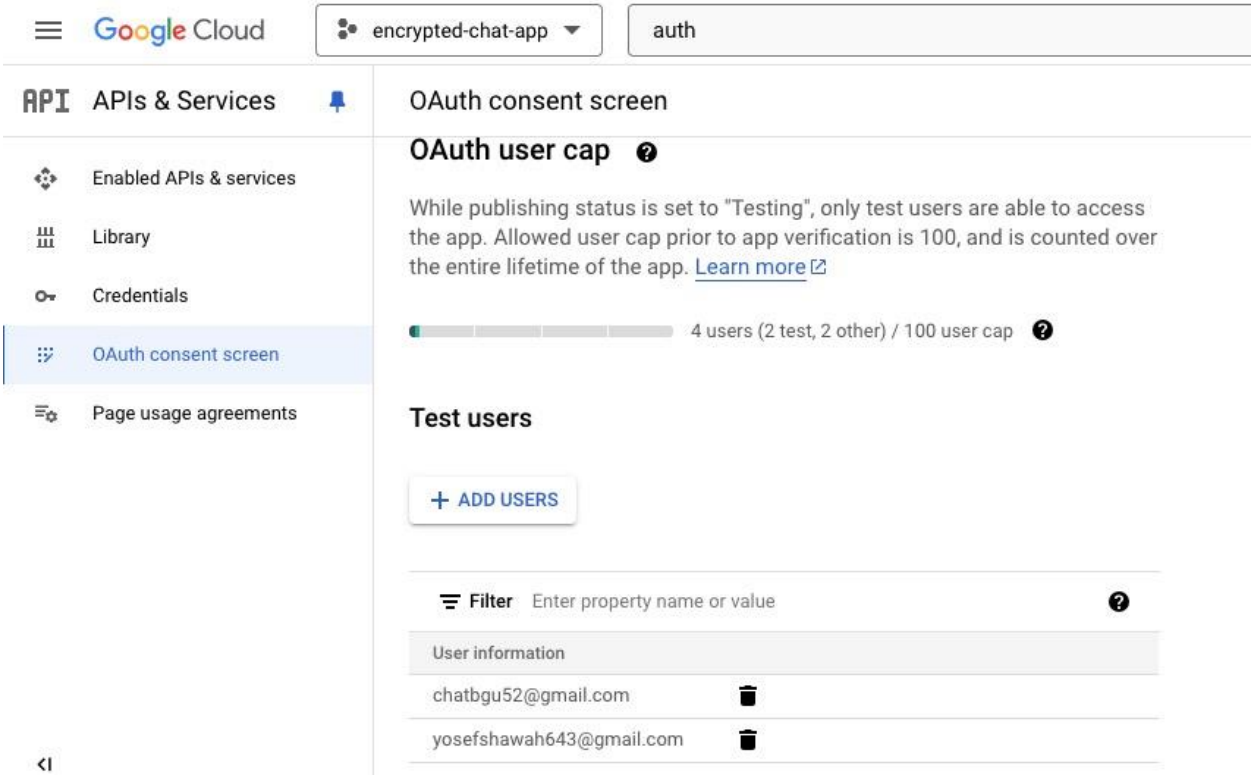
Key Features:

1. **Block Cipher**: AES operates on fixed-size blocks of data (128 bits or 16 bytes).
2. **Key Sizes**: It supports key sizes of 128, 192, or 256 bits, offering different levels of security.
3. **Rounds**: Depending on the key size, AES performs multiple transformation rounds (10, 12, or 14 rounds) to encrypt the data.
4. **Security**: AES is highly secure and resistant to most known attacks, making it a standard for protecting sensitive information worldwide.
5. **Efficiency**: It is fast and efficient in both hardware and software implementations.

AES is commonly used in applications like HTTPS, file encryption, and secure messaging.

Walkthrough:
After you clone the repo and install all the necessary dependences and start the app with '**yarn dev**', you can find the app at **http://localhost:3000/login**, to enter you have to use Gmail account after that you can start to add people that are already registered and send them messages note that both of the parties has to have the same encryption & decryption key so they can communicate with each other here how it goes with pictures:

Notice: only 2 accounts have access to the app



We write it in out project in a file (*called it .env*) there put the values of the authentications :
GOOGLE_CLIENT_ID
GOOGLE_SECRET_ID
(you can use this manual; https://www.balbooa.com/help/gridbox-documentation/integrations/other/google-client-id)

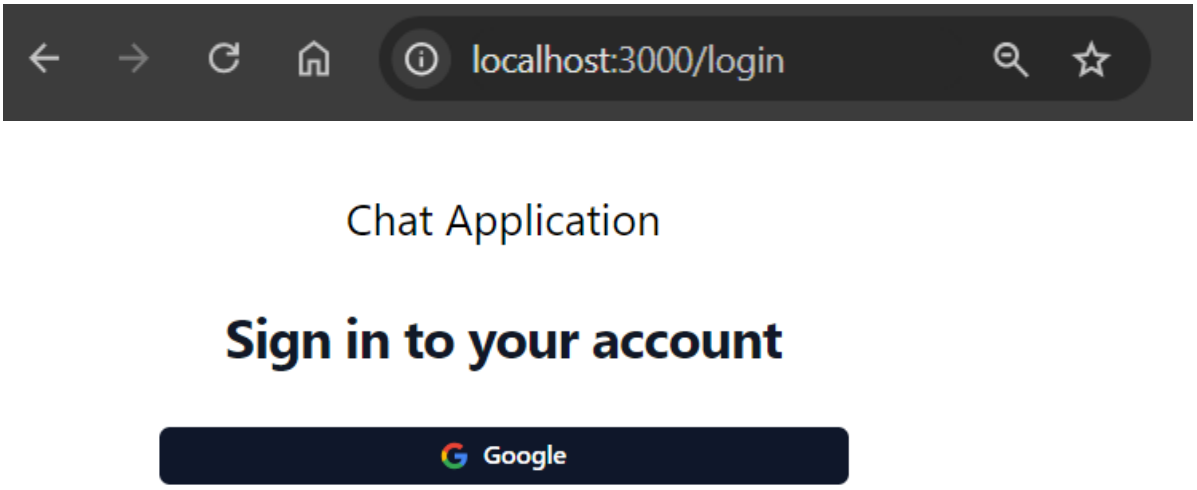
How Our Application looks like:
First, Operate the application:

- After you create the secret keys in a file.*(env.local for example)* (with all the authentication)
- After you install all the dependencies
- We run it in Visual Studio.

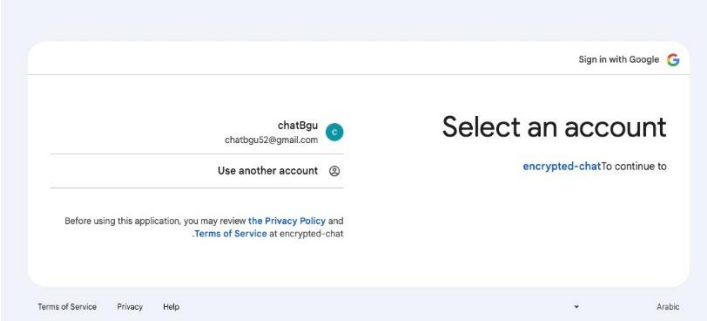
The output should be like this:

```
PS C:\Users\ofirz\nextjs-realtime-chat-master> yarn dev
yarn run v1.22.22
$ next dev
ready - started server on 0.0.0.0:3000, url: http://localhost:3000
info  - Loaded env from C:\Users\ofirz\nextjs-realtime-chat-master\.env
.local
warn  - You have enabled experimental feature (appDir) in next.config.j
s.
info  - Thank you for testing `appDir` please leave your feedback at ht
tps://nextjs.link/app-feedback
warn  - Experimental features are not covered by semver, and may cause
unexpected or broken application behavior. Use at your own risk.
```

After you run, open a browser and login: *http://localhost:3000/login*:

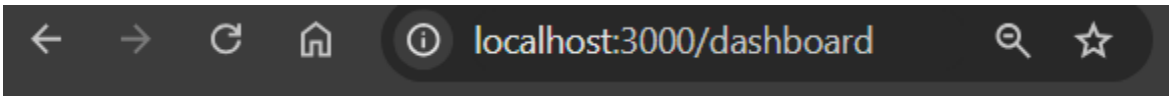


Run with Google:



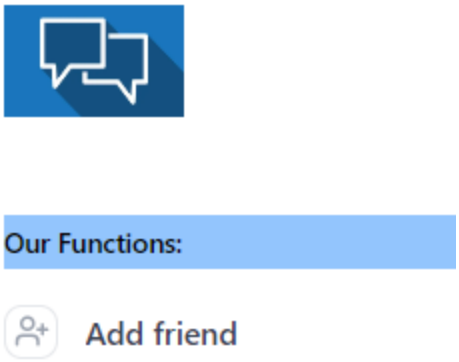
After it you will go to the main page.

The main page:

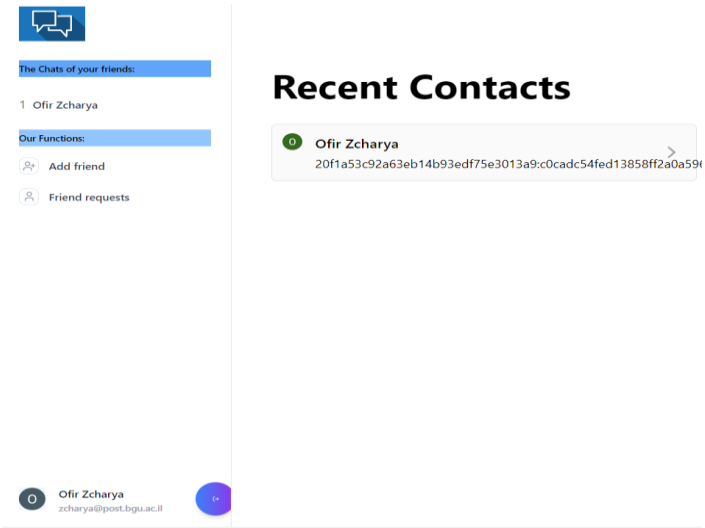


Looks like this:

Without friends:



With friends that you added:



Explaination about the left Side:

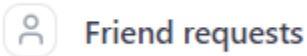
Left Side:

The Chats of your friends: all the friends that you added before in a list, counted from 1.

Our Functions:

- Add friend: If you want to add a new friend

- Friend Requests: If you receive a friend request and you want to add.

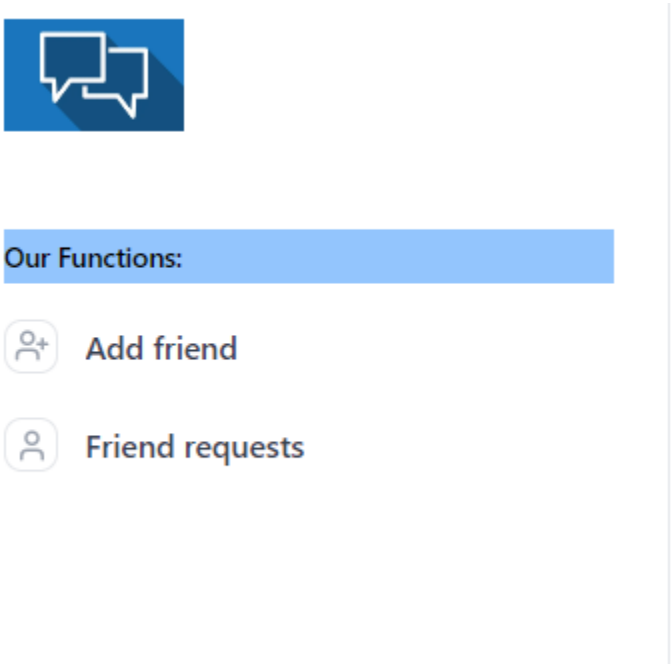


- LogOut: In a button in the bottom right corner.

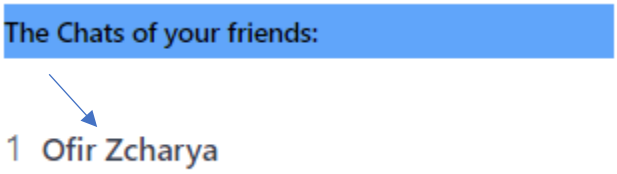
The Chats of your friends:

Put on the name of “The Chats of your friends”

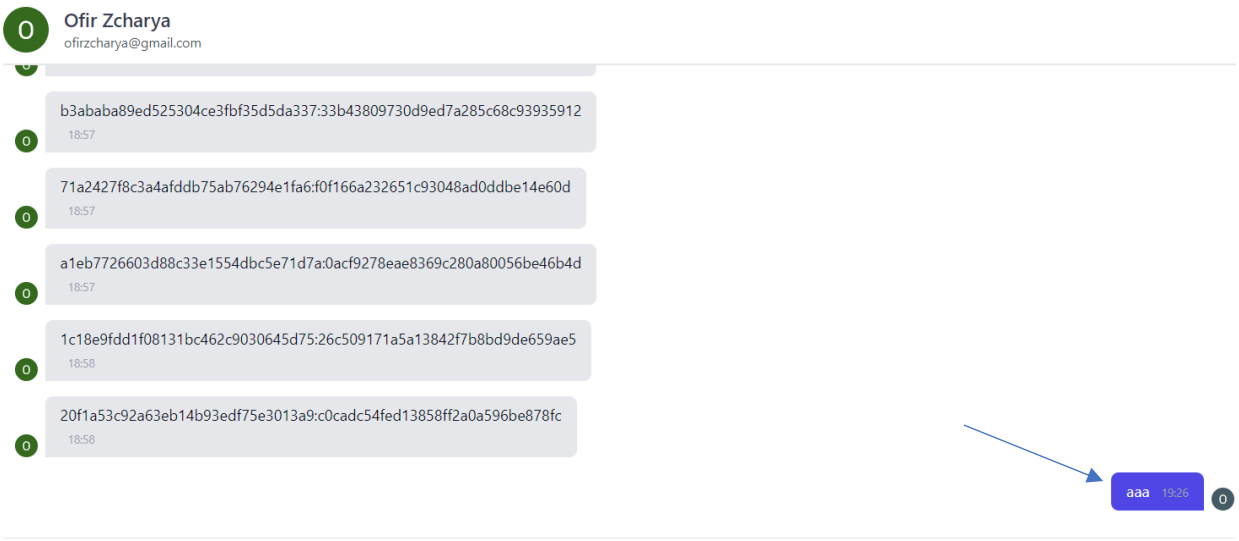
If you don’t have any friends, it will be like this:



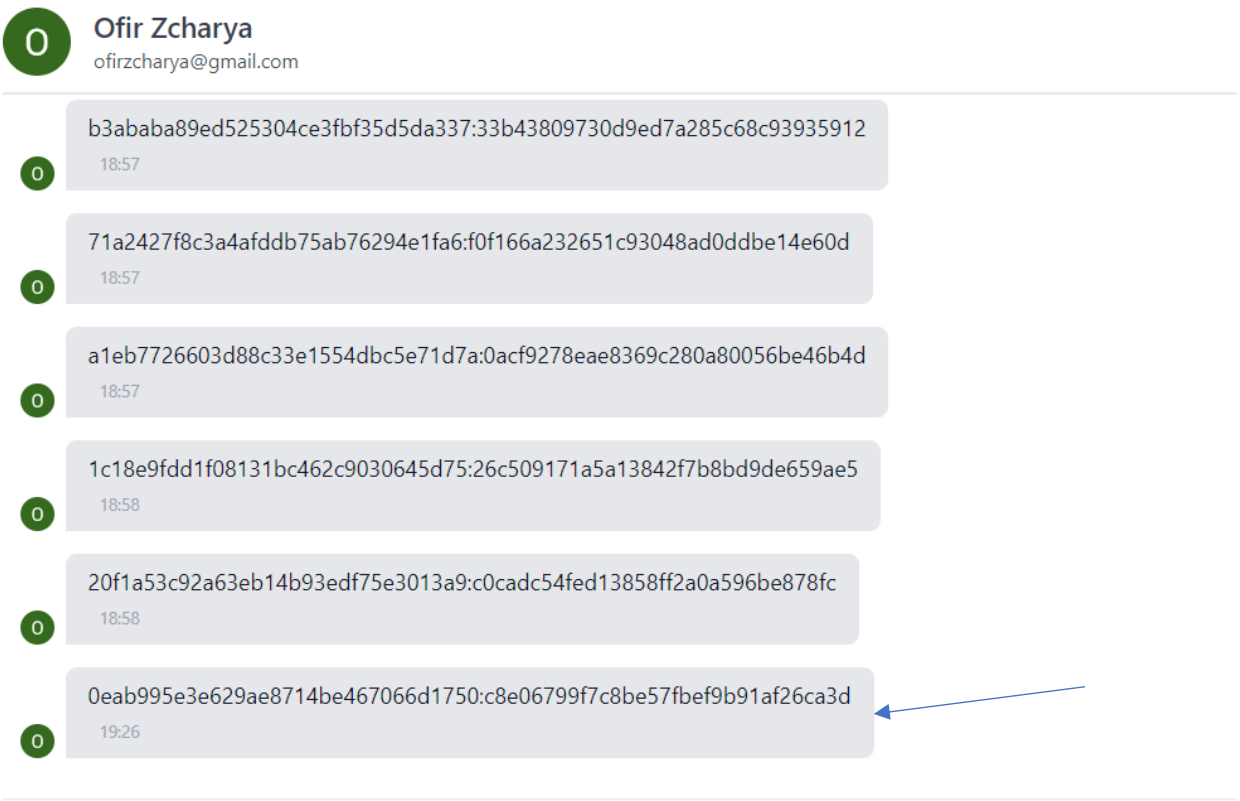
But, if you have at least one, it will be like this:



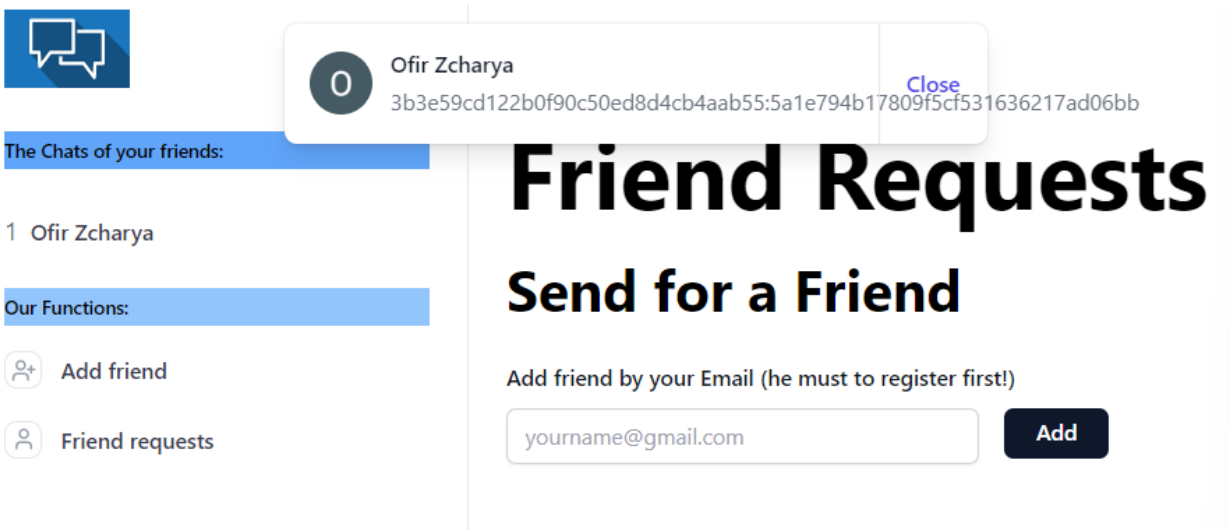
You will see all the messages are encrypted, unless you are in the chat now, and there you can see the messages without encryption.



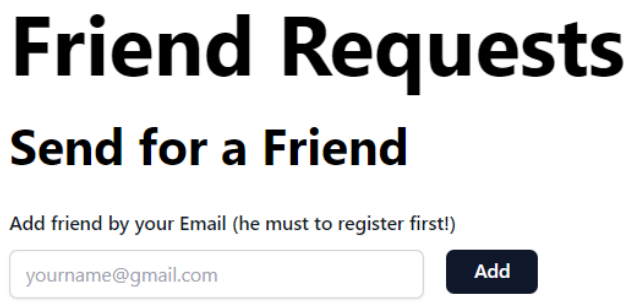
When you go back to the “Our Functions” and return to the chat, you will see the “aaa” encrypted as well: (If you want to write a message, just typing in the box and press “ENTER”)



If you are not in the chat, you will see a pop-up message, like this: (encrypted)

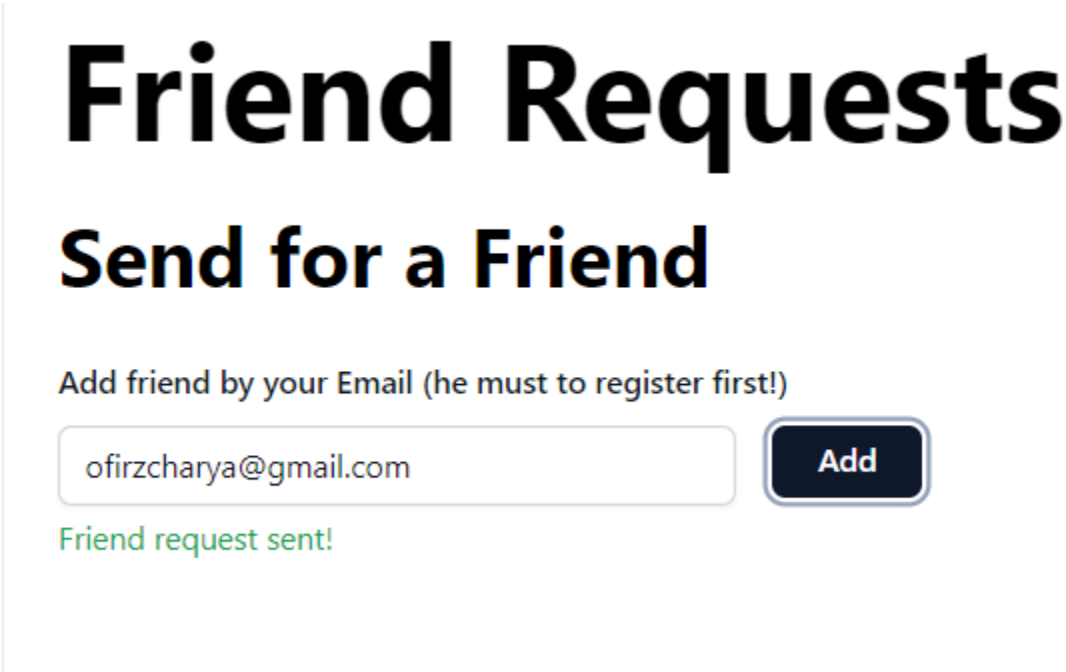

Ofir Zcharya
3b3e59cd122b0f90c50ed8d4cb4aab55:5a1e794b17809f5cf531636217ad06bb
Close
The Chats of your friends:
1 Ofir Zcharya
Our Functions:
Add friend
Friend requests
Friend Requests
Send for a Friend
Add friend by your Email (he must to register first!)
yourname@gmail.com
Add

Add friend:



You should type a friend email (only if he only registered)

When you add a friend: The sender

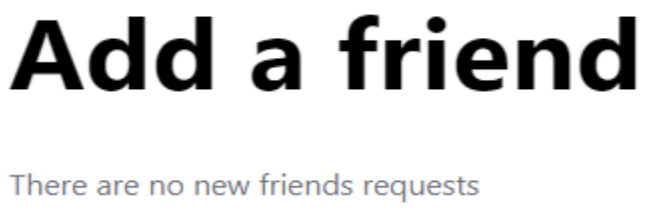


When you add a friend: The receiver

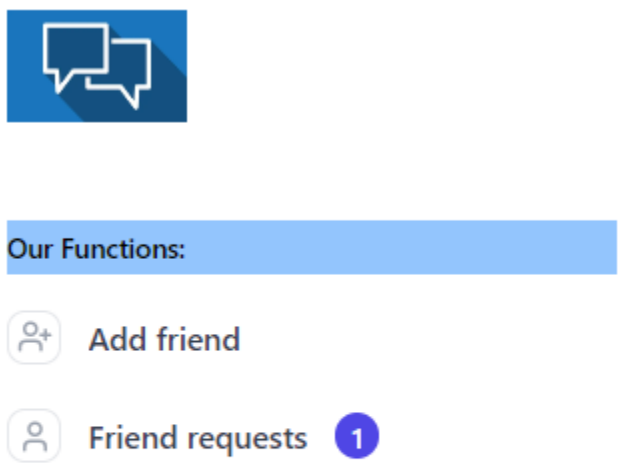
Press V to accept, Press X to deny.

Friend Requests:

If you don’t receive any requests: you will see like this:



If you have requests: you will see like this:



Logout:

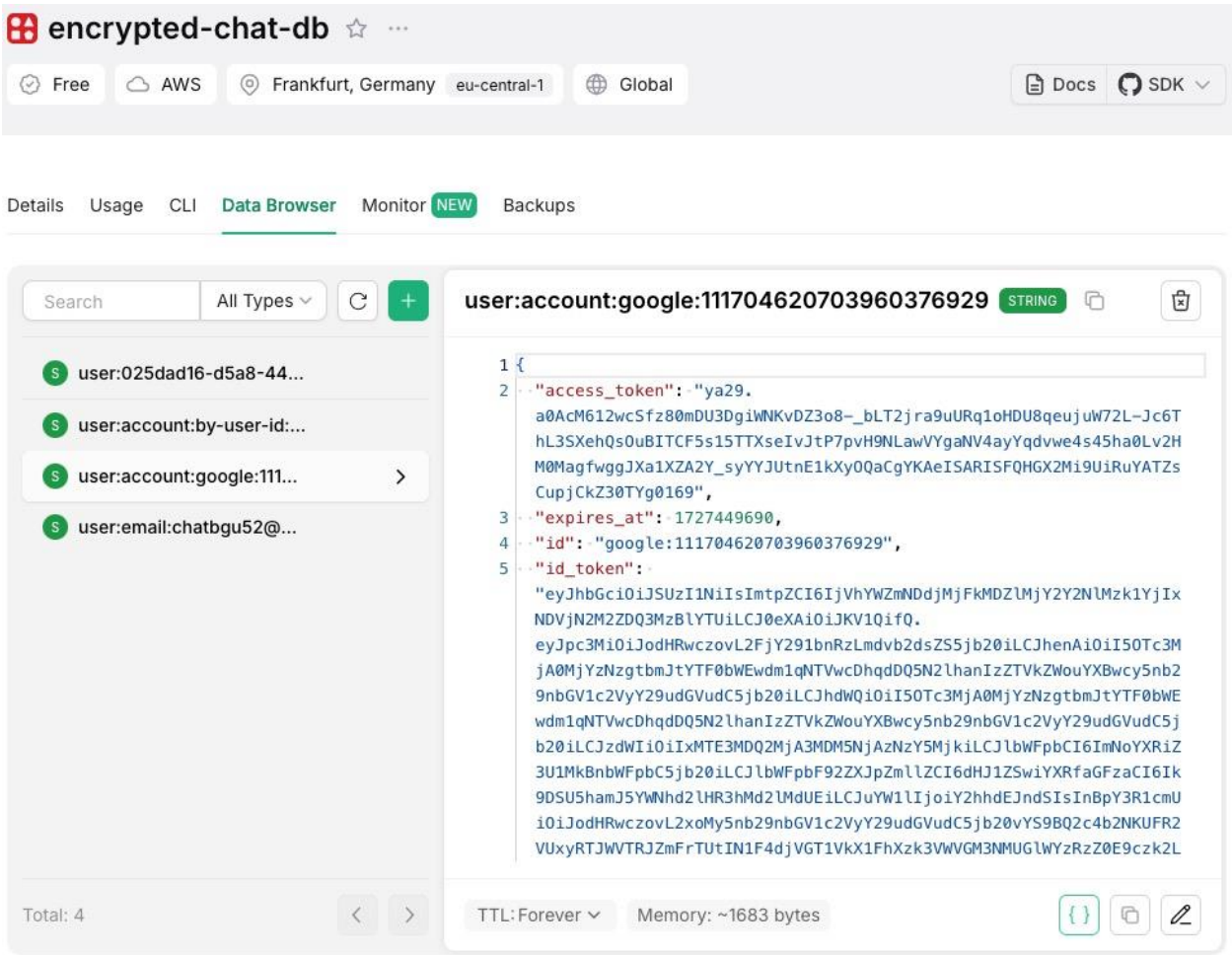
If you press logout, you will go to the login.

<u>The DB</u>:

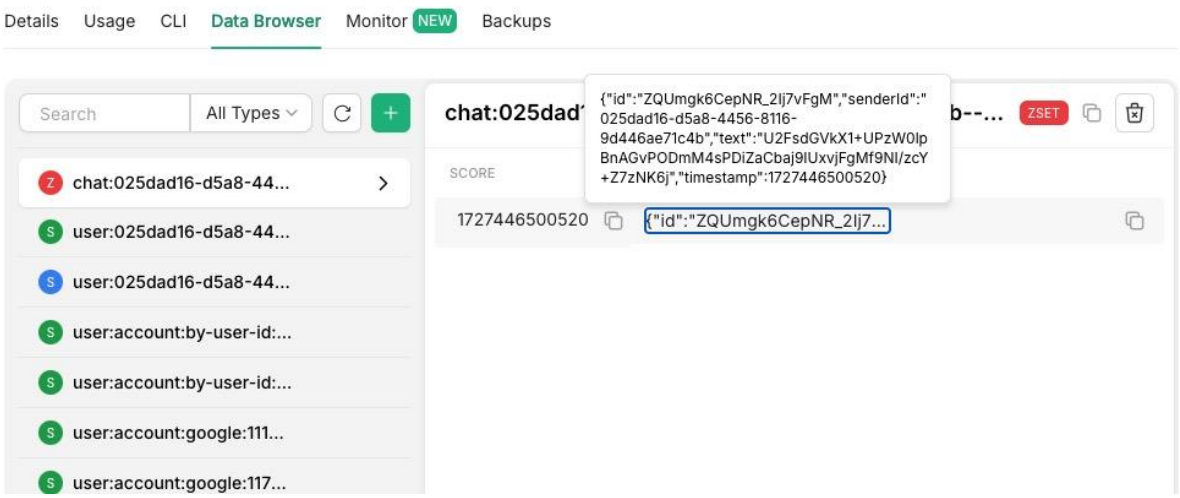
URL: https://console.upstash.com/login

First, when you logged in, Go to Redis -> DataBases -> Create database (put name and Type, we used Regional type). After it go to the REST API section in the website, and you will see UPSTASH_REDIS_REST_URL and UPSTASH_REDIS_REST_TOKEN, put them also in the secret keys file (*we called it ./env/local*)

Second, the db and the data browser: Notice here we save the users:



We can see the message text here:



Pay Attention! Because it is a secure chat application, we write the encrypted chat in the DB. That's mean the only when you in chat you can see the messages. If you look the messages outside the chat, there are encrypted messages.

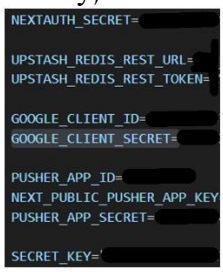
Pusher:

We use it because we want a realtime chat.

Enter also in the secret keys file (*we called it ./env/local*) the pusher keys:

PUSHER_APP_ID, NEXT_PUBLIC_PUSHER_APP_KEY and PUSHER_APP_SECRET.

Finally, the ./env/local file is like this:



Social engineering:
In the context of chat messaging, encryption plays a critical role in securing communication between users. We use the **AES (Advanced Encryption Standard)** algorithm to encrypt and decrypt messages, ensuring that only authorized parties with the correct decryption key can access the content of a message. AES is widely regarded for its robust security, efficiency, and adaptability across various platforms, making it an ideal choice for protecting sensitive information in a chat environment.

Despite the strong encryption used in our system, social engineering threats can compromise security by exploiting human vulnerabilities rather than technical ones. Here are some potential issues we've encountered that could expose our app to such attacks:

1. **Domain Spoofing (Apparent Domain Name):**
   A seemingly legitimate but deceptive domain name may trick users into believing they are accessing our secure application. Hackers can create phishing websites with similar-looking domain names to steal login credentials or other sensitive information, which can later be used to breach the system.

What we thought: We must ensure that our official domain is clearly communicated to users and implement security measures like SSL certificates and HTTPS to establish a secure connection, reassuring users they are on the authentic platform.

2. **Leaked Encryption and Decryption Keys:**
   If the encryption or decryption keys used in our AES-based messaging system are exposed, the security of the entire chat system is compromised. Once a hacker gains access to these keys, they can decrypt any message, bypassing all other protective layers.

What we thought: We encrypted the data all the way excepted when both users are in chat, but all the messages that store in the dbs are encrypted. That's why, hackers can still figure out when both users are in the chats and read the messages also.

Strengths and Weaknesses

- We are aware that we cannot ensure the complete safety of our app because there will always be hackers that are very competent in breaching our app.
- The site is very intuitive to use; how to add people and send messages and how to accept people it's all apparent and minimalistic to the use of the client.
- The site isn't deployed for us to communicate remotely we need to host it somewhere.
- We use middleware.ts to protect our sensitive routes such that no one without authorization can access chat routes without permission.

Summary

This project has enriched our knowledge on web Sockets and http requests a lot, and how to use encryption method and how to create schemas for the chat and Users and how to communicate between them.

Acknowledgements:

YouTube videos that helps in authentication and chat functionality without the encryption part.
https://shadcn.com for the buttons and tailwindcss for styling.
https://upstash.com/docs/introduction for DB, chat, and users.
https://pusher.com/ for Realtime message sending.
https://iconscout.com/icons for icons used in the app
Chatgpt & stackoverflow - with finding bugs and suggesting stuff.