CS3219-Auth-Guide

CS3219 Toolbox - Authentication and Authorization

The CS3219 SE Toolbox is a collection of guides and resources to help you get started with the various tools and technologies used CS3219 - Software Engineering Principles and Patterns.

The guides and resources below focus on authentication and authorization. We use JSON Web Tokens (JWT) and Auth0 as examples in this guide.

1. Introduction

This guide aims to help you learn the basics of different authentication and authorization mechanisms. For example, JSON Web Tokens (JWT) and Auth0. These technologies play a crucial role in securing web applications by ensuring that only authorized users can access certain resources.

^This text was generated with the help of ChatGPT.

1.1. Authentication vs Authorization

The table below summarizes the differences between authentication and authorization.

Authentication	Authorization
Verifies the identity of a user	Verifies whether a user has access to a resource
Usually done before authorization	Usually done after authentication
Authentication factors like passwords, tokens, biometrics, etc. are used	Factors like roles, permissions, access control lists, etc. are used
Eg. Logging in to a website	Eg. Accessing a file on a server, editing a document

There are many technologies used to implement authentication and authorization. Some of the most popular ones are:

- JSON Web Tokens (JWT): Supports both authentication and token-based authorization.

- OAuth (eg. Auth0): Primarily focused on authorization but often includes authentication as part of the process.
- OpenID Connect (OIDC): Supports both authentication and authorization and is often used for Single Sign-On.
- SAML: Primarily used for Single Sign-On and web-based authentication but also supports some aspects of authorization.
- ...etc

Each of these technologies can be used in various ways and integrated into different systems to address specific authentication and authorization requirements. The choice of technology depends on your use case and requirements.

In this guide, we will be focusing on JWT and Auth0 because they provide robust and widely adopted solutions for implementing authentication and authorization in web applications.

We will use both of these technologies to implement authentication and authorization in a sample web application. Section 2 will cover JWT and Section 3 will cover Auth0.

2. JSON Web Tokens (JWT)

A JSON Web Token (JWT) is an open standard for securely transmitting information between parties as a JSON object. This information can be verified and trusted because it is digitally signed.

In this section, we will be using JWT to implement authentication and authorization in a sample web application. We will also gain an understanding of managing public routes, ensuring the security of authenticated routes, and effectively employing the axios library to execute API requests while utilizing the authentication token.

We will put together a simple React app with a JSON Server (mock database) + Node backend. The app will have a login page and a conditionally rendered homepage. The login page will have a form to enter the username and password. The home page displays a message based on whether the user is logged in or not.

To get started fork/clone this repository: SE-Toolbox-Auth-React-JWT

As you can see, the project uses a separate React app for the frontend and a separate Node app for the backend. The React app will be served on `localhost:3000` and the Node app will be served on `localhost:8080`. The project file structure looks like this:

```
SE-Toolbox-Auth-React-JWT
├── frontend
    ├── React app
├── backend
    ├── Node app
```

> 📝**Note:** The app is not complete yet. As you read on you will complete it - but first lets look at the code that is already there.

2.1. Frontend Setup and Explanation

Prerequisites:

- If you haven't already, install NodeJS LTS
  - LTS vs18.17.0
  - npm v9.6.7
- Ensure you have an IDE installed (eg. This guide was made using VSCode)
- Install git
- (Optional) yarn
  - v1.22.19

In the frontend folder, install the dependencies:

```
npm install
```

This should install react-router-dom and axios. The react-router-dom package will be used to implement routing in our app. The axios package will be used to make API requests to the backend.

Frontend File Structure (for relevant files only)

```
frontend
├── public
├── src
    ├── Home.js
    ├── Login.js
    ├── App.js
    ├── NavBar.js
    ├── Register.js
├── package.json
├── package-lock.json
```

The frontend generally focuses on authorization-related code. That is, rendering components and managing what content is displayed based on the user's authentication status

The next few sections will explain the code in each of the files above. (You don't need to modify the original frontend code based on these explanations. The only exception is `index.js` .)

2.1.1. App.js

This code sets up the routing structure for your React application, allowing navigation between different components like Login, Register, Home, and NavBar. It also manages the `logoutUser` state, which controls the user's authentication status. The `react-router-dom` library is used for client-side routing, and components are conditionally rendered based on the current URL path.

1. In the app component, set up the user authentication state.

   ```
   function App() {
     const [logoutUser, setLogoutUser] = React.useState(false);
     // ...
   }
   ```

2. Render the app component and elements that make up your app UI.

   ```
   return (
    <BrowserRouter>
      <div className="App">
        <h2 style={headingStyle}>JWT Authentication</h2>
        <Routes>
          <Route
            path="/"
            element={
              <NavBar
                logoutUser={logoutUser}
                setLogoutUser={setLogoutUser}
              />
            }
          />
          <Route path="/login" element={<Outlet />} />
        </Routes>
        <Routes>
          <Route path="/login" element={<Login setLogoutUser={setLogoutUser} />} />
          <Route path="/register" element={<Register setLogoutUser={setLogoutUser} />} /
          <Route path="/" element={<Home logoutUser={logoutUser}/>} /> {}
        </Routes>
      </div>
    </BrowserRouter>
     );
   ```

   This is what the routing-related code does:

Component/Route	Description
`<BrowserRouter>`	Sets up client-side routing using the react-router-dom library.

Component/Route	Description
`<Routes>`	Serves as a container for defining the routes within your application.
`<Route path="/"> ... </Route>`	Represents the root URL ("/") and renders the NavBar component. It also passes the `logoutUser` and `setLogoutUser` props to NavBar.
`<Route path="/login" element={<Outlet />} />`	Defines a route path using `path="/login"` and provides `<Outlet />` as its element, creating a placeholder for child routes. This allows you to render different components based on the route path while maintaining a consistent layout structure. One of the outlets is found in `Home.js` .
`<Route path="/login" element={<Login setLogoutUser={setLogoutUser} />} />`	Represents the "/login" URL and renders the Login component while passing the `setLogoutUser` prop to it.
`<Route path="/register" element={<Register setLogoutUser={setLogoutUser} />} />`	Corresponds to the "/register" URL and renders the Register component while passing the `setLogoutUser` prop to it.
`<Route path="/" element={<Home logoutUser={logoutUser} />} />`	Represents the root URL ("/") and renders the Home component, passing the `logoutUser` prop to it.

^This text was generated with the help of ChatGPT.

2.1.2. Login.js

Login component is responsible for rendering a login form, handling user input, making a POST request to the backend server for authentication, and displaying error messages. It also manages the user's login state and provides a link to the registration page.

1. In the Login component, manage the component state with `useState` hooks.

```
const Login = ({ setLogoutUser }) => {
  const [username, setUsername] = useState("");
  const [password, setPassword] = useState("");
  const [error, setError] = useState("");
  const navigate = useNavigate();
  // ...
}
```

2. [Inside Login component] Handle user login by making a POST request to the backend server. Define a function `login` that is triggered when the login form is submitted.

```
const login = async (event) => {
 event.preventDefault();
 try {
     const response = await axios.post("http://localhost:8080/api/auth/login", {
     username,
     password,
   });

   console.log("response", response);
   localStorage.setItem(
     "login",
     JSON.stringify({
       userLogin: true,
       token: response.data.access_token,
     })
   );
   setError("");
   setUsername("");
   setPassword("");
   setLogoutUser(false);
   navigate("/");
   console.log("login successful");
 } catch (error) {
   if (error.response !== undefined) {
     setError(error.response.data.message);
   }
   console.log(error);
 }
  };
```

If the login is successful (no errors), it stores the user's login status and JWT token in the browser's local storage using localStorage.setItem, updates states, and navigates the user to the home page.

If there is an error (catch block), it checks if the error response exists (error.response) and updates the error state with the error message if available.

^This text was generated with the help of ChatGPT.

2.1.3. Register.js

This code defines a Register component responsible for rendering a user registration form, handling user input, making a POST request to the backend server for registration, and displaying error messages. It also manages the user's login state and provides a link to the login page.

1. In the Register component, manage the component state with `useState` hooks.

```
const Register = ({ setLogoutUser }) => {
  const [username, setUsername] = useState("");
  const [password, setPassword] = useState("");
  const [error, setError] = useState("");
  const navigate = useNavigate();
  // ...
};
```

2. [Inside Register component] Handle user registration by making a POST request to the backend server. Define a function `register` that is triggered when the registration form is submitted.

```
  const register = async (event) => {
 event.preventDefault();
 try {
   const response = await axios.post("http://localhost:8080/api/auth/register", {
     username,
     password,
   });

   console.log("response", response);
   localStorage.setItem(
     "login",
     JSON.stringify({
       userLogin: true,
       token: response.data.access_token,
     })
   );
   setError("");
   setUsername("");
   setPassword("");
   setLogoutUser(false);
   navigate("/");
   console.log("Registration successful");
 } catch (error) {
   if (error.response !== undefined) {
     setError(error.response.data.message);
   }
   console.error(error);
 }
  };
```

If the registration is successful (no errors), it stores the user's login status and JWT token in the browser's local storage using localStorage.setItem, updates states, and navigates the user to the home page.

If there is an error (catch block), it checks if the error response exists (error.response) and updates the error state with the error message if available.

^This text was generated with the help of ChatGPT.

2.1.4. Home.js

This code creates a dynamic Home component that adjusts its content based on whether a user is logged in or not. It encourages users to log in or register if they are not logged in and displays a personalized welcome message and additional content if they are logged in.

1. Check if the user is logged in or not.

   ```js
   const isLoginTrue = JSON.parse(localStorage.getItem("login"));
   ```

   Checks if the user is logged in by attempting to retrieve the “login” data from the browser’s local storage. Recall the login data is stored in local storage as described in Login.js and Register.js. It parses the stored JSON data into a JavaScript object.

2. Render the component based on the user’s authentication status. ```js const userNotLogin = () => (// This function renders content for users who are not logged in.);

const userLoggedIn = () => (// This function renders content for users who are logged in.);

~~~
3. Perform conditional rendering based on the user's authentication status.
```js
 return (
    <div style={containerStyle}>
      {isLoginTrue && isLoginTrue.userLogin ? (
        <>{userLoggedIn()}</>
      ) : (
        <>{userNotLogin()}</>
      )}
    </div>
  );
~~~

If the user is logged in, the userLoggedIn() function is called. Otherwise, the userNotLogin() function is called.

2.1.5. NavBar.js

This code defines a NavBar component that displays either a “Logout” or a “Login” link in the navigation bar based on the user’s login state. It retrieves and hydrates the user’s login status from local storage and provides a logout mechanism.

1. In the NavBar component, manage the component state with `useState` hooks.

   ```js
   const NavBar = ({ logoutUser, setLogoutUser }) => {
     const [login, setLogin] = useState("");
     // ...
   };
   ```

2. [Inside NavBar component] Retrieve the user's login status from local storage and hydrate the login state. ```js useEffect(() => { hydrateStateWithLocalStorage(); }, [logoutUser]);

const logout = () => { localStorage.removeItem("login"); setLogoutUser(true); };

const hydrateStateWithLocalStorage = () => { if (localStorage.hasOwnProperty("login")) { let value = localStorage.getItem("login"); try { value = JSON.parse(value); setLogin(value); } catch (e) { setLogin(""); } } };

~~~
- `useEffect` hook: Calls the `hydrateStateFromLocalStorage` function when the logoutUser
- `const hydrateStateFromLocalStorage = () => { ... }`: Defines a function that checks if
- `logout` function: Removes the "login" data from the browser's local storage and sets th

<sup> ^This text was generated with the help of [ChatGPT](https://chat.openai.com/). </sup

## 2.2. Backend Setup and Explanation
The frontend uses axios to make API requests to the backend. The backend is responsible fc

In the backend folder, install the dependencies:
```bash
npm install
~~~

This should install fs, body-parser, json-server, jsonwebtoken:

- fs: To read and write files.
- body-parser: To parse incoming request bodies.
- json-server: A lightweight and easy-to-use Node. js tool that simulates a RESTful API using a JSON file as the data source.
- jsonwebtoken: To generate JWT tokens.

This backend uses a mock REST API to store user data. The user data is stored in a JSON file called `users.json`. The JSON file contains an array of user objects. Each user object has a username and password field.

You can replace this mock REST API with a real database like MongoDB, PostgreSQL etc.

Backend File Structure (for relevant files only)

```
backend
├── server.js
├── users.json
├── package.json
├── package-lock.json
```

The backend generally focuses on authentication-related code. That is, generating JWT tokens, and verifying JWT tokens. It contains the following endpoints:

- `POST /api/auth/login` : Authenticates the user and generates a JWT token.
- `POST /api/auth/register` : Registers the user and generates a JWT token.

You may add more endpoints to the backend to suit your needs. For example, you may add an endpoint to retrieve user data from the database.

You will notice that the backend is not complete yet. In this section we will complete the backend `server.js` file.

2.2.1. server.js

This code defines the backend server and implements the authentication-related endpoints. It also implements a middleware function to verify JWT tokens.

Add the following code to the `server.js` file:

1. Import the necessary libraries.

    ```
    const fs = require('fs');
    const bodyParser = require('body-parser');
    const jsonServer = require('json-server');
    const jwt = require('jsonwebtoken');
    ```

2. Create a JSON server.

    ```
    /**
     * JSON Server is a lightweight and easy-to-use Node. js tool that simulates
     * a RESTful API using a JSON file as the data source.
     * You may replace the JSON server with your own API server and database.
     */
    const server = jsonServer.create();
    ```

3. Set up the JSON server.

    ```
    server.use(bodyParser.urlencoded({ extended: true }));
    server.use(bodyParser.json());
    server.use(jsonServer.defaults());
    ```

4. Define a secret key for signing JWT tokens.

    ```
    const SECRET_KEY = '123456789'; // Replace with your secret key or use env variable
    ```

5. Define expiration time for JWT tokens.

    ```
    const expiresIn = '1h';
    ```

6. Define a function to create a JWT token.

```
// Create a JWT token
function createToken(payload) {
  return jwt.sign(payload, SECRET_KEY, { expiresIn });
}
```

7. Define a function to check if the user is Authenticated.

```
// Check if the user is authenticated
function isAuthenticated({ username, password }) {
  const userdb = JSON.parse(fs.readFileSync('./users.json', 'UTF-8'));
  return (
 userdb.users.findIndex(
   (user) => user.username === username && user.password === password
 ) !== -1
  );
}
```

8. Define a function to check if the user is Registered.

```
// Check if the user is registered
function isRegistered({ username }) {
  const userdb = JSON.parse(fs.readFileSync('./users.json', 'UTF-8'));
  return (
 userdb.users.findIndex(
   (user) => user.username === username
 ) !== -1
  );
}
```

9. Define the API endpoint for user registration.

```
server.post('/api/auth/register', (req, res) => {
const { username, password } = req.body;
if (isRegistered({ username }) === true) {
  const status = 401;
  const message = 'Credentials already exist';
  res.status(status).json({ status, message });
  return;
}

fs.readFile('./users.json', (err, data) => {
    if (err) {
      const status = 401;
      const message = err;
      res.status(status).json({ status, message });
      return;
    }
    let userData = JSON.parse(data.toString());
    const last_item_id = userData.users[userData.users.length - 1].id;
    userData.users.push({ id: last_item_id + 1, username:username, password:password
    fs.writeFile('./users.json',
    JSON.stringify(userData),
    (err, result) => {
        if (err) {
            const status = 401;
            const message = err;
            res.status(status).json({ status, message });
            return;
        }
    });
});

const access_token = createToken({ username, password });
res.status(200).json({ access_token });
});
```

We will see what each line of code does below.

Code	Description
`server.post('/api/auth/register', (req, res) => { ... })`	Defines the POST /api/auth/register endpoint. It accepts a username and password in the request body and returns a JWT token if the registration is successful.
`const { username, password } = req.body;`	Destructures the username and password from the request body.
`if (isRegistered({ username }) === true) { ... }`	Checks if the user is already registered. If the user is already registered, it returns an error message.
`fs.readFile('./users.json', (err, data) => { ... })`	Reads the users.json file and parses it into a JavaScript object.
`userData.users.push({ id: last_item_id + 1, username:username, password:password });`	Adds the new user to the users array.
`fs.writeFile('./users.json', JSON.stringify(userData), (err, result) => { ... })`	Writes the updated users array to the users.json file.
`const access_token = createToken({ username, password });`	Creates a JWT token using the username and password.
`res.status(200).json({ access_token });`	Returns the JWT token in the response body.

Code	Description
`res.status(status).json({ status, message });`	In case of errors, returns an error message in the response body.

1. Define the API endpoint for user login.

```
server.post('/api/auth/login', (req, res) => {
  const { username, password } = req.body;
  if (isAuthenticated({ username, password }) === false) {
    const status = 401;
    const message = 'Incorrect username or password';
    res.status(status).json({ status, message });
    return;
  }
  const access_token = createToken({ username, password });
  res.status(200).json({ access_token });
});
```

We will see what each line of code does below.

Code	Description
`server.post('/api/auth/login', (req, res) => { ... })`	Defines the POST /api/auth/login endpoint. It accepts a username and password in the request body and returns a JWT token if the login is successful.
`const { username, password } = req.body;`	Destructures the username and password from the request body.
`if (isAuthenticated({ username, password }) === false) { ... }`	Checks if the user is authenticated. If the user is not authenticated, it returns an error message.
`const access_token = createToken({ username, password });`	Creates a JWT token using the username and password.
`res.status(200).json({ access_token });`	Returns the JWT token in the response body.
`res.status(status).json({ status, message });`	In case of errors, returns an error message in the response body.

1. Run the server.

```
server.listen(8080, () => {
  console.log('Running Auth API Server');
});
```

Your completed server.js file should look like this:

```
const fs = require('fs');
const bodyParser = require('body-parser');
const jsonServer = require('json-server');
const jwt = require('jsonwebtoken');
/**
 * JSON Server is a lightweight and easy-to-use Node. js tool that simulates
 * a RESTful API using a JSON file as the data source.
 * You may replace the JSON server with your own API server and database.
 */
const server = jsonServer.create();

server.use(bodyParser.urlencoded({ extended: true }));
server.use(bodyParser.json());
server.use(jsonServer.defaults());

const SECRET_KEY = '123456789'; // Replace with your secret key or use env variable

const expiresIn = '1h';

// Create a JWT token
function createToken(payload) {
  return jwt.sign(payload, SECRET_KEY, { expiresIn });
}

// Check if the user is authenticated
function isAuthenticated({ username, password }) {
  const userdb = JSON.parse(fs.readFileSync('./users.json', 'UTF-8'));
  return (
    userdb.users.findIndex(
      (user) => user.username === username && user.password === password
    ) !== -1
  );
}
// Check if the user is registered
function isRegistered({ username }) {
  const userdb = JSON.parse(fs.readFileSync('./users.json', 'UTF-8'));
  return (
    userdb.users.findIndex(
      (user) => user.username === username
    ) !== -1
  );
}

// API endpoint for user registration
server.post('/api/auth/register', (req, res) => {
    const { username, password } = req.body;
    if (isRegistered({ username }) === true) {
      const status = 401;
      const message = 'Credentials already exist';
      res.status(status).json({ status, message });
```

```
        return;
      }

      fs.readFile('./users.json', (err, data) => {
          if (err) {
            const status = 401;
            const message = err;
            res.status(status).json({ status, message });
            return;
          }
          let userData = JSON.parse(data.toString());
          const last_item_id = userData.users[userData.users.length - 1].id;
          userData.users.push({ id: last_item_id + 1, username:username, password:password }
          fs.writeFile('./users.json',
          JSON.stringify(userData),
          (err, result) => {  // WRITE
              if (err) {
                  const status = 401;
                  const message = err;
                  res.status(status).json({ status, message });
                  return;
              }
          });
      });

      const access_token = createToken({ username, password });
      res.status(200).json({ access_token });
});

server.post('/api/auth/login', (req, res) => {
    const { username, password } = req.body;
    if (isAuthenticated({ username, password }) === false) {
      const status = 401;
      const message = 'Incorrect username or password';
      res.status(status).json({ status, message });
      return;
    }
    const access_token = createToken({ username, password });
    res.status(200).json({ access_token });
});

server.listen(8080, () => {
    console.log('Running Auth API Server');
});
```

2.3. Putting it all together

Now that we have completed the frontend and backend, we can put it all together and test it out.

1. Start the backend server.

```
cd backend
node server.js
```

You should see the following message in the terminal:

```
Running Auth API Server
```

2. Open a new terminal. Start the frontend.

```
cd frontend
npm start # or yarn start
```

3. Open your browser and navigate to `localhost:3000` . You should see the login page. Some example users have been created for you already (see backend/users.json). For example, you may use the following credentials to login:

```
username: abc@example.com
password: 12345678
```

4. After logging in, you should see the home page with a welcome message. You may also logout by clicking on the “Logout” button in the navigation bar.
5. You may also try logging in with an invalid username or password to see the error message.
6. Register a new user by clicking on the “Register” link in the login page. Notice that the `users.json` file is updated with the new user data upon registraion.
7. Try registering a user with an existing username to see the error message.

Yay! You have successfully implemented authentication and authorization in a sample web application using JWT. You may now use this as a reference to implement authentication and authorization in your own web applications.

> 🔍 **Further Exploration:** This is a very basic implementation of authentication and authorization. You can add more features to it to suit your needs. For example, you may add an endpoint to retrieve user data from the database. This would require changes to
>
> - the frontend (to make the API request)
> - the frontend (to display the user data)
> - the backend (to handle the API request and return the user data)
> - the backend (to verify the JWT token and return the user data)
>
> Think about how you would verify the JWT token and return user data from the database. You can use the `jsonwebtoken` library to verify the JWT token and the `fs` library to read the `users.json` file.

3. Auth0

Auth0 is a flexible, drop-in solution to add authentication and authorization services to your applications. Your team and your users can securely authenticate with passwords, social identity providers, or enterprise identity providers to get seamless, SSO access to applications.

Auth0's Universal Login is the recommended and most secure way to start using their login system. It redirects users to the login page, authenticates through Auth0's servers, and returns them to your app. You can begin with a basic username and password setup and easily integrate additional login methods as needed for your app.

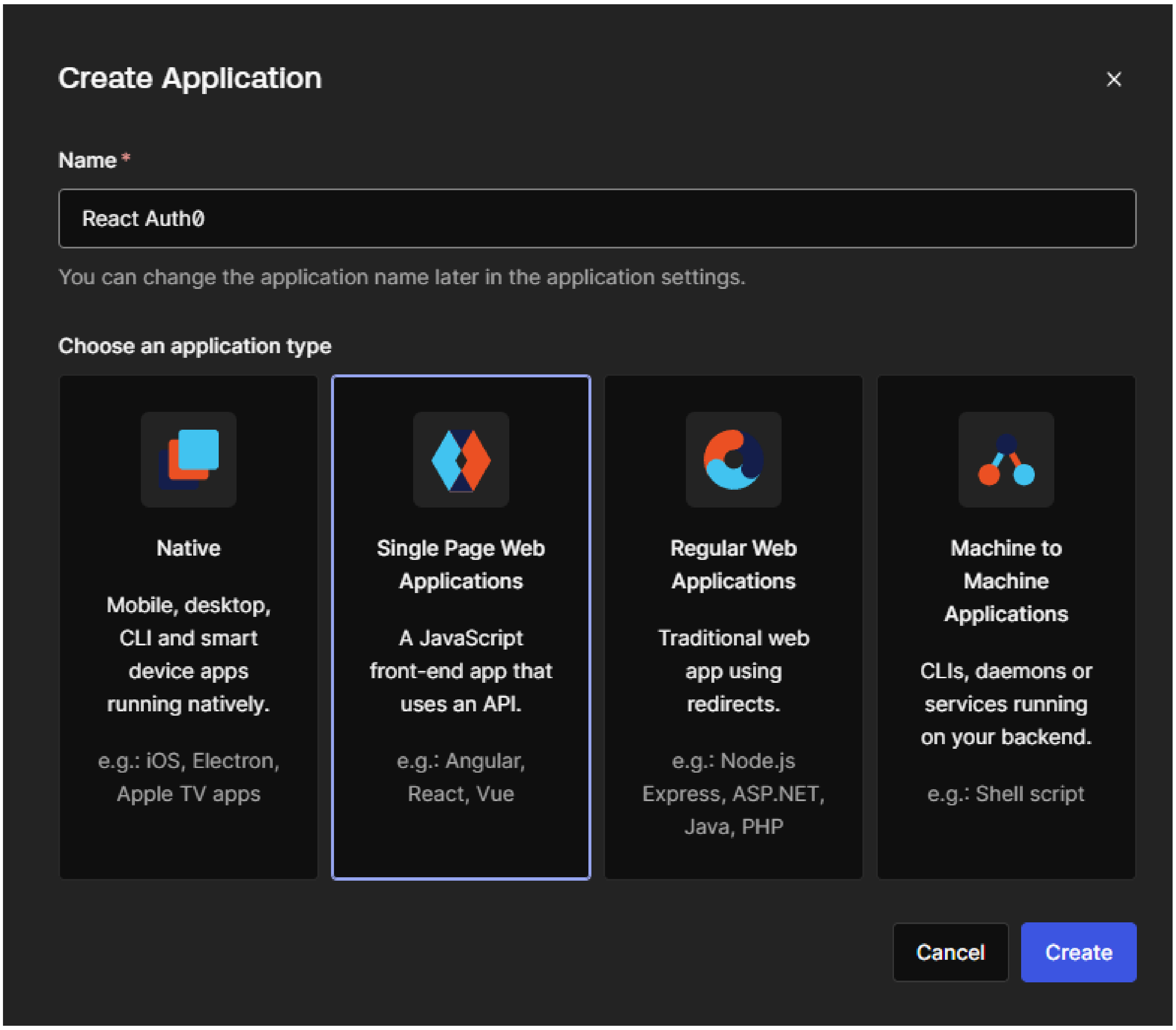
In this section, we will add authentication and authorization to a sample ReactJS web application using Auth0.

Auth0 provides several platform integrations. For this guide, we will use the React SDK.

> 📝**Note:** This guide only provides insight into the ReactJS SDK for Auth0. However, Auth0 provides many different SDKs for different platforms. You may explore other SDKs according to your needs.

## 3.1. Create Auth0 Account and Configure App

1. Create an Auth0 account here. If you already have an account, then login.
2. Create a new app on your Auth0 dashboard. Select type of App as "Single Page Web Applications" and click on "Create".



Create Application

Name *

React Auth0

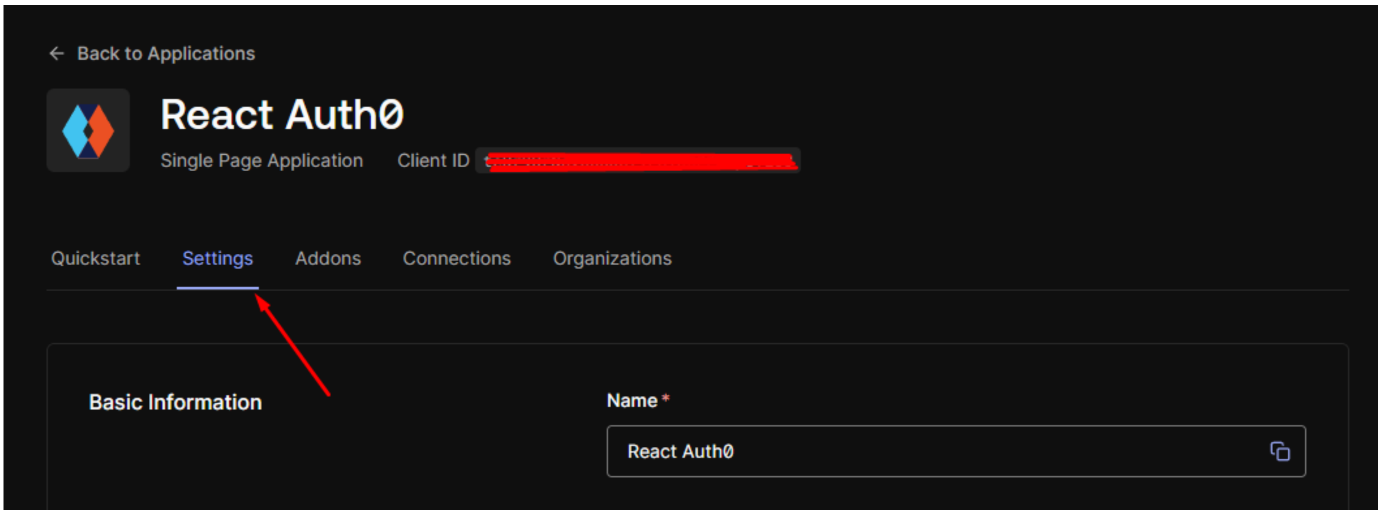
You can change the application name later in the application settings.

Choose an application type

Native	Single Page Web Applications	Regular Web Applications	Machine to Machine Applications
Mobile, desktop, CLI and smart device apps running natively.	A JavaScript front-end app that uses an API.	Traditional web app using redirects.	CLIs, daemons or services running on your backend.
e.g.: iOS, Electron, Apple TV apps	e.g.: Angular, React, Vue	e.g.: Node.js Express, ASP.NET, Java, PHP	e.g.: Shell script

Figure 3.1: Create Auth0 App

1. Select the technology you are using. In this case, we will select “React”.
2. Click on “Create Application”. You will be redirected to a Quick Start page. Click on Settings:



React Auth0

Single Page Application Client ID [redacted]

Basic Information

Name *

React Auth0

Figure 3.2: Go to the settings of your Auth0 app.

1. Specify the URL where Auth0 should redirect the user after a successful login. For this app, set the URL for **Allowed Callback URLs** to `http://localhost:3000` .
2. Specify the URL to which Auth0 should redirect the user after they log out. Set the URL for **Allowed Logout URLs** to `http://localhost:3000` .
3. Define the origins (URLs) from which Auth0 will accept authentication requests. Ensures the login persists when one leaves the app or refreshes the page. Set the URL for **Allowed Web Origins** to `http://localhost:3000` .

> 📝**Note:** When you configure these Auth0 settings with `http://localhost:3000` , you are specifying that your Auth0 authentication and logout processes should interact with the web application running locally on your machine at that specific URL. You can change these settings later when you deploy your app to a different URL.

1. Scroll down and click on “Save Changes”.

Your Auth0 app is now configured. You can now use the Auth0 SDK to add authentication and authorization to your app. If you want to add additional login methods, you can do so from the “Connections” tab on your Auth0 dashboard.

3.2. Clone and Setup the Sample App

Fork/clone the sample app from this repository: SE-Toolbox-Auth-React-Auth0

In the project folder, install the dependencies:

```
npm install
```

This should install `@auth0/auth0-react` for you. This is the Auth0 SDK for React.

File Structure (for relevant files only)

```
your-project-folder
├── public
├── src
  ├── NavBar.js
  ├── Profile.js
  ├── App.js
  ├── index.js
├── package.json
├── package-lock.json
```

`index.js` needs to be completed for this app to work. We will first go throught the code in the other files and then complete `index.js` .

3.2.1. App.js

App.js provides the structure of the React application with two components, NavBar and Profile, rendered inside the App component. The NavBar appears at the top, and the Profile appears below it with a margin to separate them.

```
import React from 'react';
import Profile from './Profile';
import NavBar from './NavBar';

function App() {
  return (
    <div>
      <NavBar />
      <div style=> {/* Add margin for separation */}
        <Profile />
      </div>
    </div>
  );
}

export default App;
```

3.2.2. NavBar.js

This code creates a Navbar component for a web application that adapts its appearance and functionality based on whether the user is authenticated. It uses the `useAuth0` hook for authentication handling. The main things to take note of in this file are:

1. [Inside NavBar component] `const { isAuthenticated, loginWithPopup, logout } = useAuth0();` uses destructuring to extract specific properties and functions from the `useAuth0` hook. It retrieves information on whether the user is authenticated, a function to initiate the login process, and a function to initiate the user logout.
2. [Inside NavBar component] `{isAuthenticated ? (...) : (...)}` conditionally renders the login and logout buttons based on the user's authentication status.

3.2.3. Profile.js

This code creates a Profile component that displays user profile information when the user is authenticated. It uses the `useAuth0` hook to access user data. The main things to take note of in this file are:

1. [Inside Profile component] `const { user, isAuthenticated } = useAuth0();` uses destructuring to extract specific properties from the `useAuth0` hook. It retrieves information on whether the user is authenticated and the user data.
2. [Inside Profile component] `return isAuthenticated && (...)` conditionally renders the user profile information based on the user's authentication status. If the user is authenticated, it

renders the content inside the parentheses. If not, it returns null (nothing is rendered).

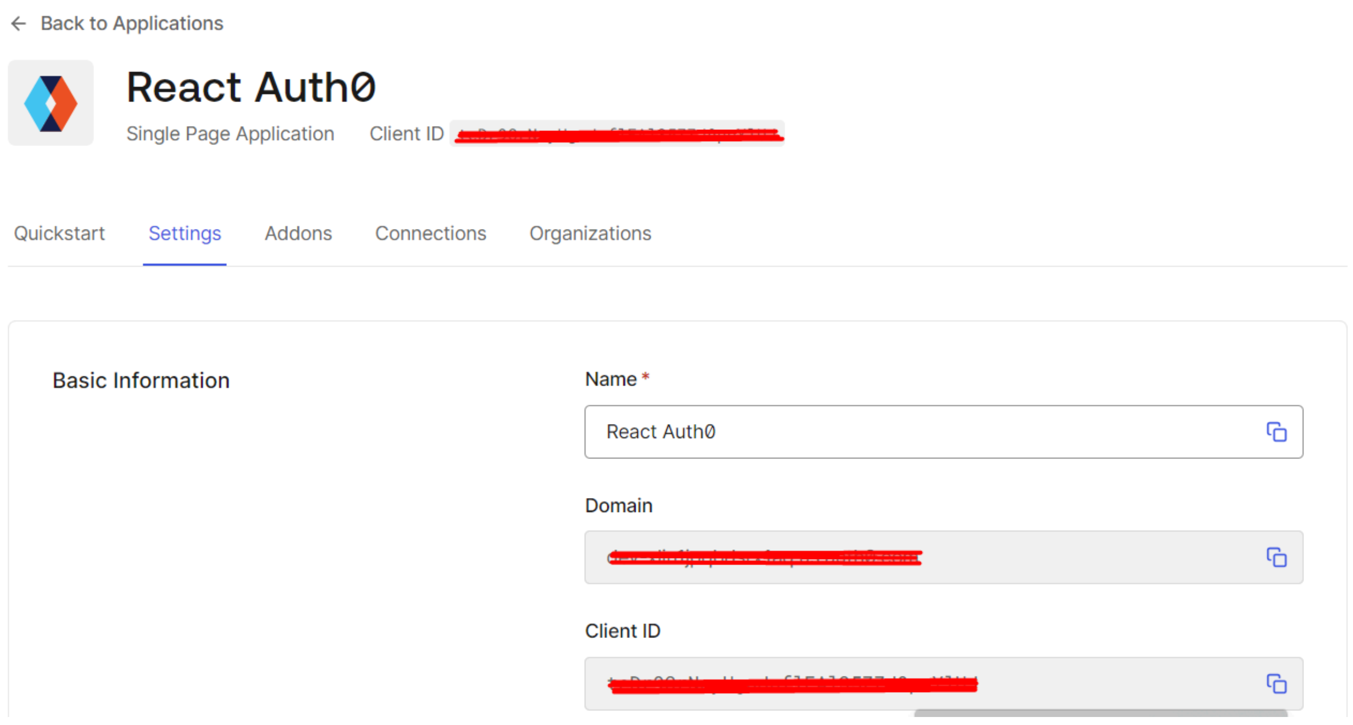
3.2.4. index.js

Now that we have seen the code in the other files, we can complete the `index.js` file. This file is responsible for rendering the App component and wrapping it with the Auth0Provider component. The Auth0Provider component provides the Auth0Context to the App component. The Auth0Context contains the `useAuth0` hook that we used in the other files.

There are some environment variables that we need to define before we can complete the `index.js` file. Navigate to your project root folder and create a `.env` file. Add the following environment variables to the `.env` file:

```
REACT_APP_AUTH0_DOMAIN=<YOUR AUTH0 DOMAIN>
REACT_APP_AUTH0_CLIENT_ID=<YOUR AUTH0 CLIENT ID>
REACT_APP_AUTH0_CALLBACK_URL=http://localhost:3000
```

You can obtain the values for these environment variables from your Auth0 app settings. Navigate to your Auth0 dashboard and click on "Applications". Click on the application you created earlier and go to settings. You should be able to find the domain and client ID there.



React Auth0

Single Page Application Client ID [redacted]

Basic Information

Name *

React Auth0

Domain

[redacted]

Client ID

[redacted]

Figure 3.2.4.1. Application settings in Auth0

Now that we have defined the environment variables, we can complete the `index.js` file.

1. Import the necessary libraries.

```
import { Auth0Provider } from "@auth0/auth0-react";
import React from "react";
import ReactDOM from "react-dom";
import App from "./App";
```

2. Obtain the domain and client ID from the environment variables.

```
const domain = process.env.REACT_APP_AUTH0_DOMAIN;
const clientId = process.env.REACT_APP_AUTH0_CLIENT_ID;
```

3. Create the entry point for the React application.

```
ReactDOM.render(
 // Next lines of code go here
 );
```

4. [Inside ReactDOM.render] Wrap the App component with the Auth0Provider component.

```
<Auth0Provider
        domain={domain}
        clientId={clientId}
        redirectUri={window.location.origin}
    >
        <App />
    </Auth0Provider>,
    document.getElementById("root")
```

- `<Auth0Provider ... >` : Wraps the App component with the Auth0Provider component. It takes the following props:
    - `domain` : The Auth0 domain.
    - `clientId` : The Auth0 client ID.
    - `redirectUri` : The URL to redirect to after login. In this case, it is the current URL.
- `<App />` : Renders the App component. The entire application (and child components) are rendered with the authentication context provided by the Auth0Provider component.
- `document.getElementById("root")` : Renders the App component in the root element of the HTML document.

This code sets up Auth0 authentication for the React application by configuring the Auth0Provider component with the necessary Auth0 domain and client ID. It then renders the main App component, ensuring that all components within the app have access to authentication-related functionality provided by Auth0.

^This text was generated with the help of ChatGPT.

You final index.js file should look like this:

```
// Wrap the entire app in Auth0Provider component
import { Auth0Provider } from "@auth0/auth0-react";
import React from "react";
import ReactDOM from "react-dom";
import App from "./App";

const domain = process.env.REACT_APP_AUTH0_DOMAIN;
const clientId = process.env.REACT_APP_AUTH0_CLIENT_ID;

ReactDOM.render(
    <Auth0Provider
        domain={domain}
        clientId={clientId}
        redirectUri={window.location.origin}
    >
        <App />
    </Auth0Provider>,
    document.getElementById("root")
    );
```

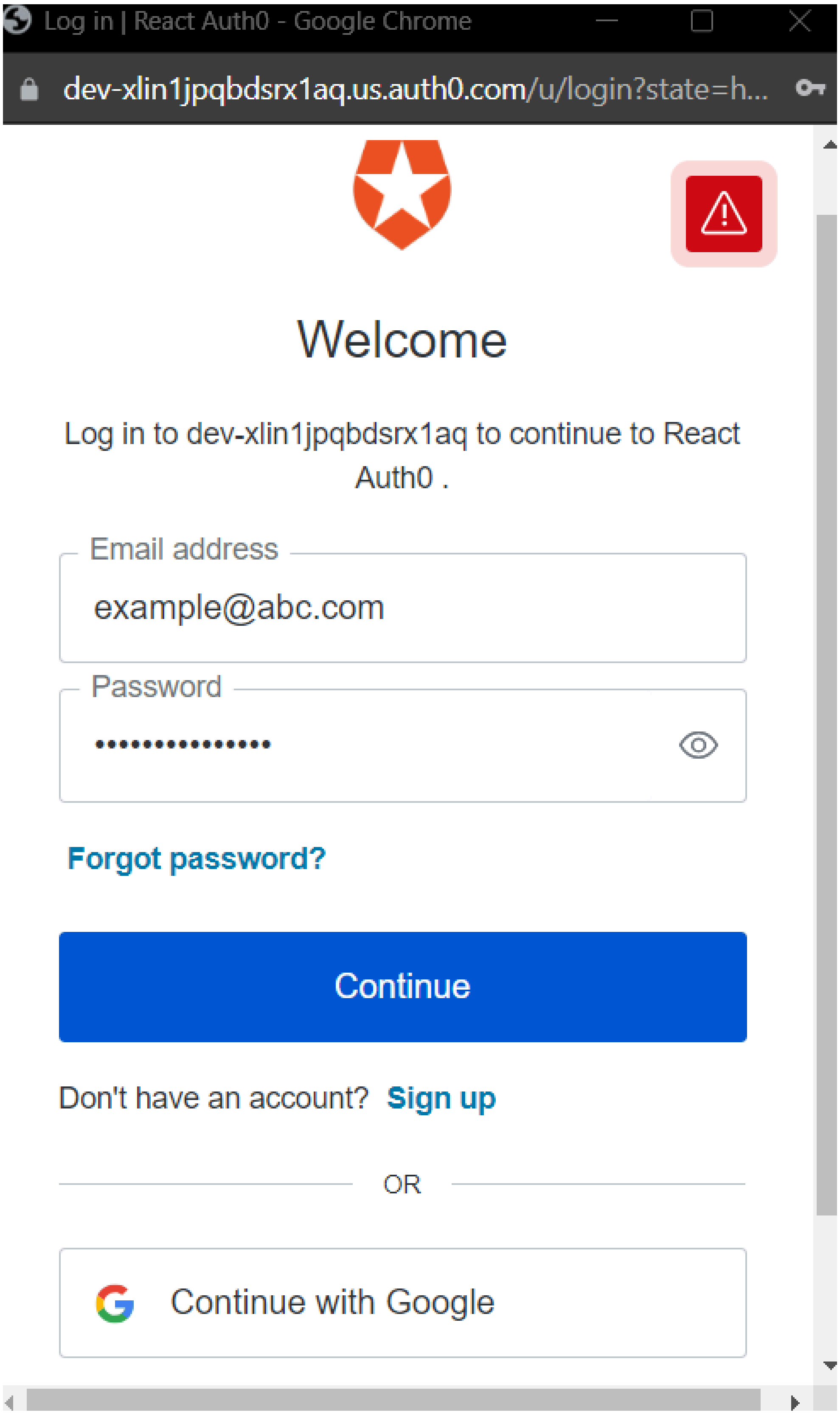
3.3. Putting it all together

Now that we have added `index.js` and the environment variables, we can test out the app.

1. Navigate to the root directory of the app and start the app.

    ```
    npm start # or yarn start
    ```

2. Open your browser and navigate to `localhost:3000` . You should see the login page.
3. Click on the “Login” button. Auth0 login should appear. You can create a new account - or login with a social account that you have added under ‘Connections’ in your Auth0



Log in | React Auth0 - Google Chrome

dev-xlin1jpqbdsrx1aq.us.auth0.com/u/login?state=h...

Welcome

Log in to dev-xlin1jpqbdsrx1aq to continue to React Auth0 .

Email address

example@abc.com

Password

•••••••••••••••

Forgot password?

Continue

Don't have an account? Sign up

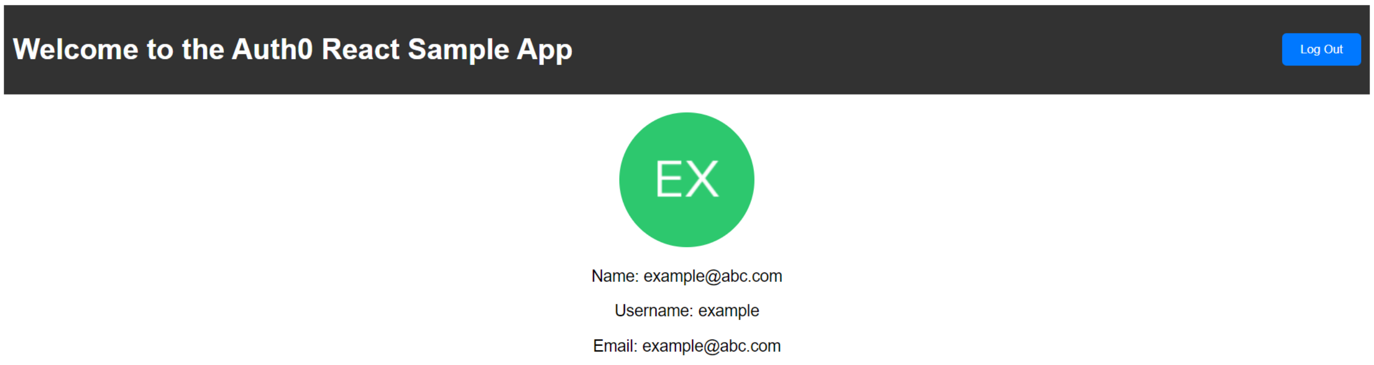
OR

Continue with Google

dashboard.

Figure 3.3.1. Login with Auth0

1. After logging in, you should see the profile page. You may logout by clicking on the "Logout" button in the navigation bar.



Name: example@abc.com

Username: example

Email: example@abc.com

Figure 3.3.2. Profile page

Yay! You have successfully implemented authentication and authorization in a sample web application using Auth0. You may now use this as a reference to implement authentication and authorization in your own web applications.

> 🔍 **Further Exploration:** This is a very basic implementation of authentication and authorization. You may add more features and define more routes according to your needs. Explore Auth0 to find out how you can define different user roles (like Maintainer, Admin etc.) and how you may define your application routes based on these roles.

4. References

The following resources were used to create this guide:

- This video tutorial on Authentication with JWT and React
- This article on JWT-based login for React-Express Apps
- This blogpost on React JWT Authentication (without Redux) example
- This article on Authenticating React Apps with Auth0
- React Router Dom Docs
- Auth0 Docs
- Parts of this guide were generated with the help of ChatGPT.
- Parts of this guide were generated with the help of GitHub Copilot.