Authentication for Web APIs

using JSON Web Tokens

Frank Walsh, 2022

Agenda

- JSON Web Tokens (JWT)
- Authentication
  - Salting/hashing with Bcrypt
- Authentication Middleware
- Use Case – Login/Register for React App using JWT/Passport

Authentication for MovieDB API

Restrict access to authenticated users.

Provide **API** to login/register.

Users should only have to log in once:

Ideally identified and authenticated in subsequent requests.

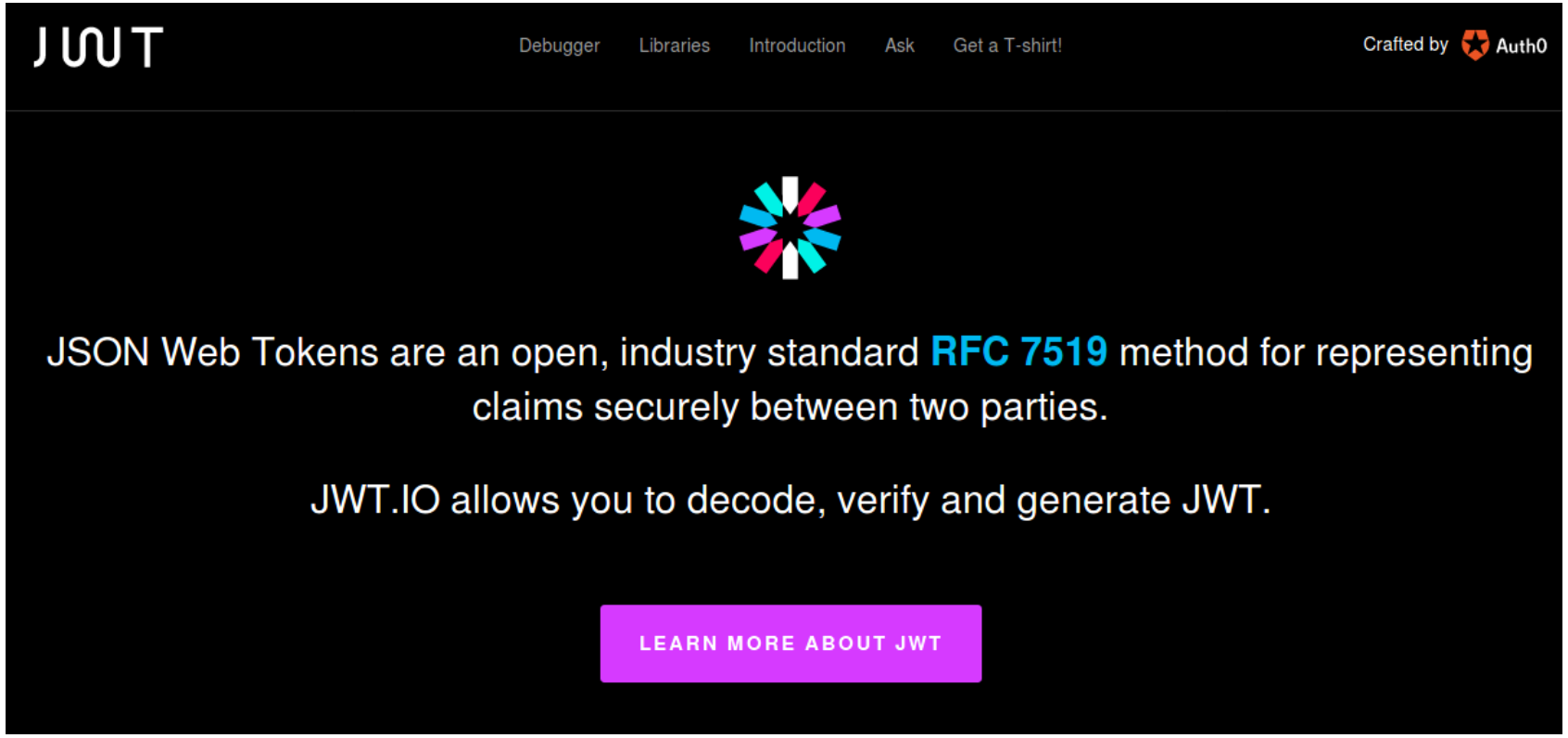
Username and Password authentication.

No clear case passwords like last week!!!

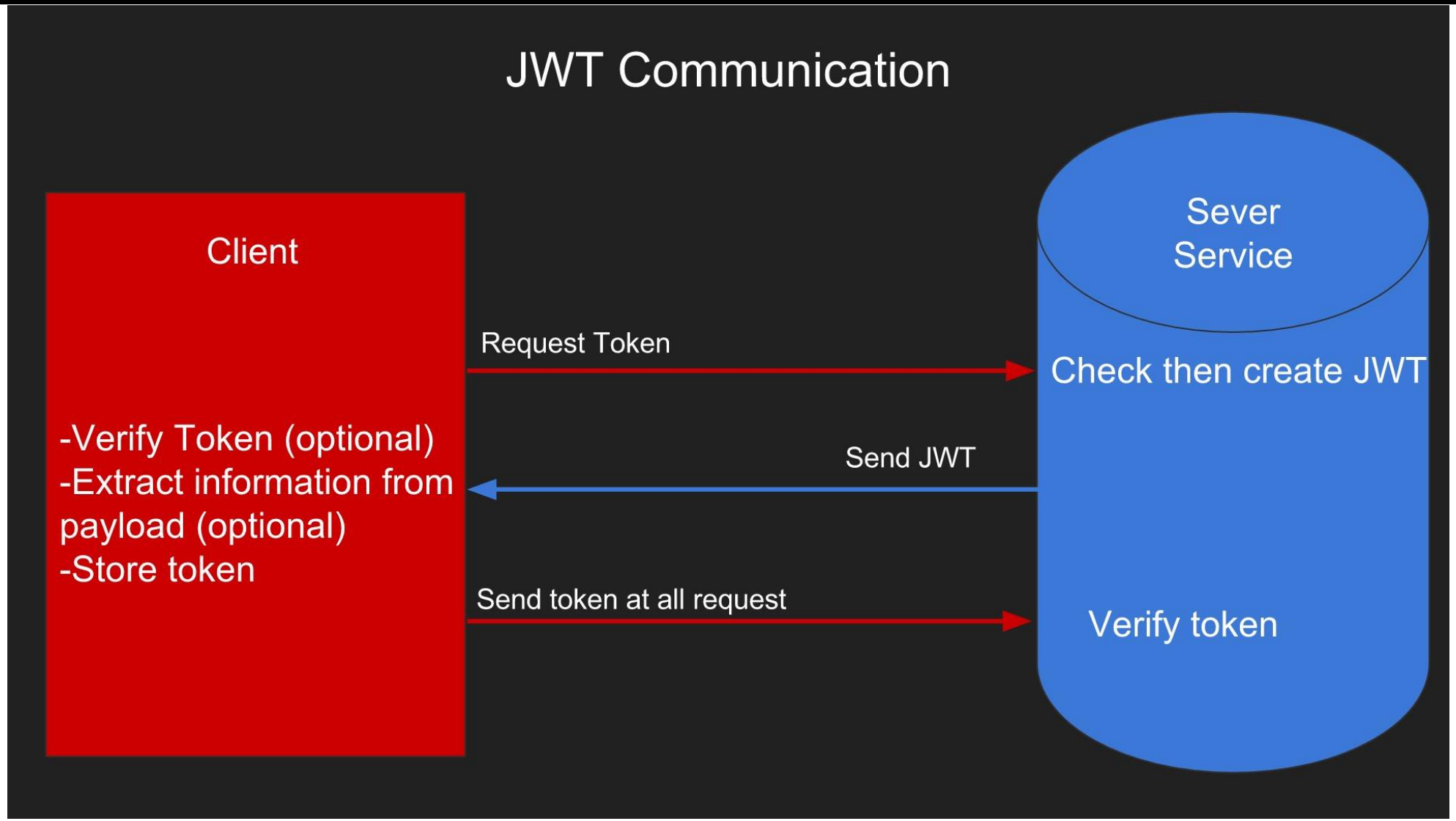
Hash/Salt all passwords in MongDB

Authentication options

- Many solutions for Auth
  - Cookies, basic-auth, JWT, Oauth.
  - Web-based Identity Federation/3rd Party (Firebase)
- JSON Web Tokens (JWT)
  - Tokens means no need to keep sessions or cookies
  - In keeping with REST stateless principle – token sent on each request
  - Token stored on client, usually in local storage of client.



JSON Web Tokens



JWT in Node/Express

- Use `jsonwebtoken` NPM module.
- Implementation of JSON Web Tokens RFC

jsonwebtoken DT

8.5.1 • Public • Published 3 years ago

Readme | Explore BETA | 10 Dependencies | 18,782 Dependents | 78 Versions

jsonwebtoken

Build	Dependency
build passing	Dependency Status

An implementation of JSON Web Tokens.

This was developed against `draft-ietf-oauth-json-web-token-08`. It makes use of node-jws

Install

```
$ npm install jsonwebtoken
```

Install

```
> npm i jsonwebtoken
```

Repository

github.com/auth0/node-jsonwebtoken

Homepage

github.com/auth0/node-jsonwebtoken#..

Weekly Downloads

8,922,766

Version License

Authentication/Security Scenarios

1. Register Account:

- Account signs up to access an API (email & password)
- Create a new account in database with encrypted password

2. Generate security token:

- Client sends email and password to authenticate
- Create a JWT Token and send JWT back to client
- Client stores JWT locally
- JWT used on every subsequent request to protected resource

3. Protect routes (e.g. /api/movies)

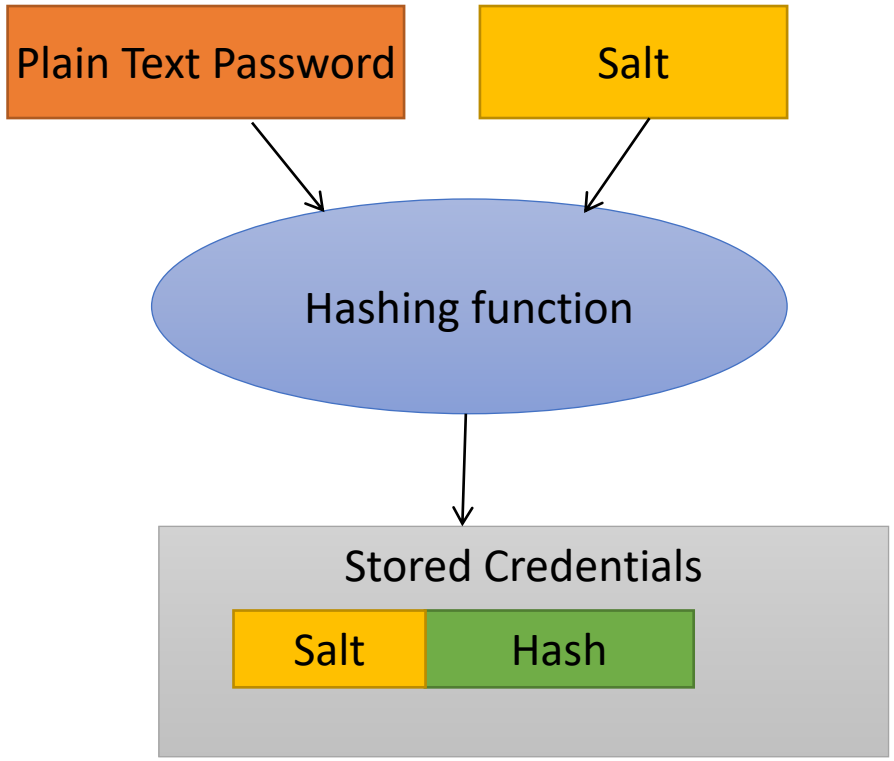
- Valid JWT token included in each request
- Token used to identify/validate account before passing request to core service

Web Authentication – credentials

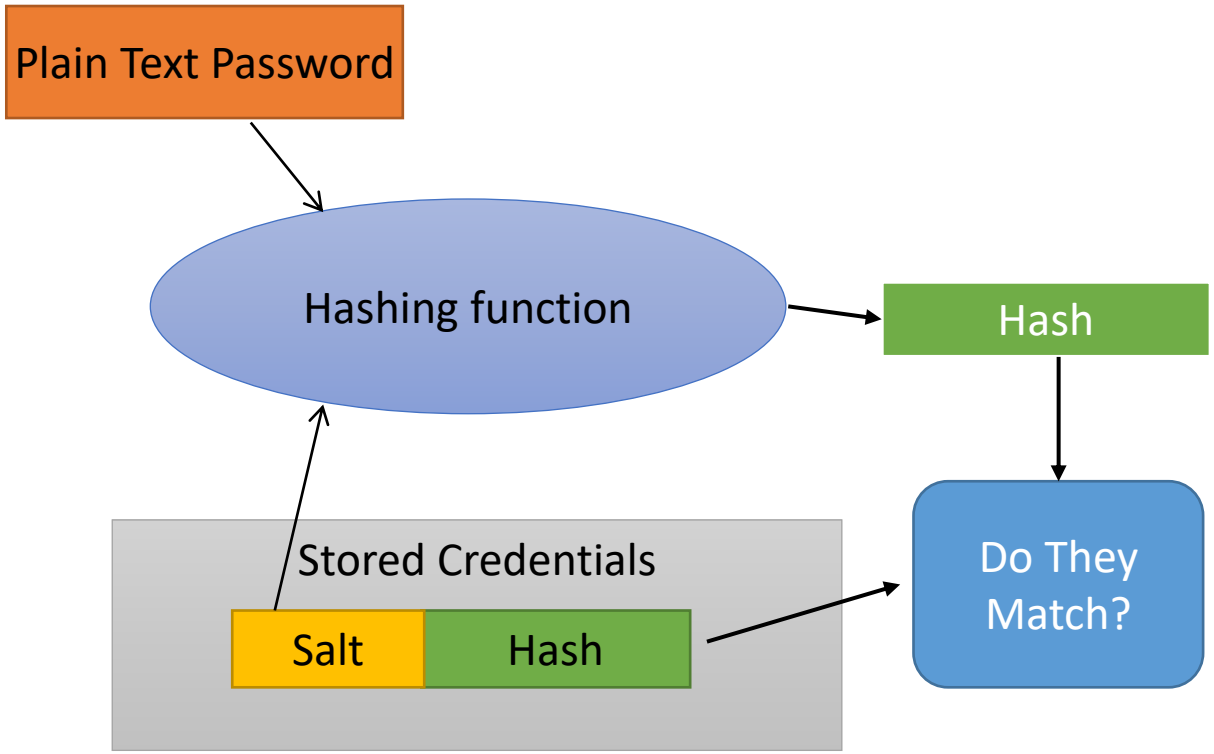
- Credentials should be stored securely in a centralised location
  - Should only be readable by suitably privileged accounts
  - **Credentials should not find their way into hidden fields, headers, cookies**
  - **Should not be "hard coded"**
- Passwords should be **"salted"** and **"hashed"**
  - Salting involves appending random bits to each password
  - Salted password is then hashed (i.e. one-way encrypted) for storage
- Objective is to store something derived from the password that allows an entered candidate password to be checked …
  - … but such that the password cannot be retrieved (by *anybody*, even an administrator)

Password Salting & Hashing

Password Creation



Password Verification



Why Salt?

- Frustrates dictionary attacks.
- Prevents duplicate passwords appearing as duplicates in password db (using different Salts)
- Protects users where same password is reused on different systems/sites.

Salting and Encrypting in Node.js/Express

bcryptjs DT

2.4.3 • Public • Published 5 years ago

Readme | Explore BETA | 0 Dependencies | 2,554 Dependents | 25 Versions

bcrypt.js

Optimized bcrypt in JavaScript with zero dependencies. Compatible to the C++ bcrypt binding on node.js and also working in the browser.

build error | npm v2.4.3 | downloads 5.5M/month | donate

Security considerations

Besides incorporating a salt to protect against rainbow table attacks, bcrypt is an adaptive function: over time, the iteration count can be increased to make it slower, so it remains resistant to brute-force search attacks even with increasing computation power. (see)

Install

```
> npm i bcryptjs
```

Repository

github.com/dcodeIO/bcrypt.js

Homepage

github.com/dcodeIO/bcrypt.js#readme

Weekly Downloads

1,338,915

- Several NPM packages available.
- Also in other languages (Java,python)

```
import Authenticator from './Authenticator';
import bcrypt from 'bcryptjs';

export default class extends Authenticator {

    async encrypt(password) {
        const salt = await bcrypt.genSalt(10);
        return bcrypt.hash(password, salt);
    }
```

Encrypting – Middleware Controller

User API: User Routes

- Update Account API to support following Endpoints
  - Use query string of URL to specify action:
    - register/authenticate

Route	GET	POST	PUT	DELETE
/api/accounts/security/token	N/A	Authenticate Account using Email/Password	N/A	N/A
/api/accounts/	Admin only	Register Account	N/A	N/A

Encryption and Token dependencies

Using Clean Architecture

Clean Architecture for Security/Encryption

- We'll continue to follow Clean Architecture approach as before…
  - Code Dependencies can only move from the outer layers inward.
  - To be flexible with project dependencies, use dependency injection to inject external infrastructure/frameworks into your layers
  - Use base Classes to define "contracts", the functional signatures of the desired service without implementation details.
- Services we need to provide here are:
  - Encryption:
    - Password encryption/Password compare
  - Security Token Management
    - Generate/decode Security Token.

Encryption: Hash/Salt Passwords & compare

- Define Encryption “Contract”
- Use **bcryptjs** package to hash and salt passwords before saving to repository
- For authentication, use **bcrypt** package compare clear case password(e.g. test123@&) to already encrypted password in the Repository.

```
export default class {
  encrypt(password) {
    throw new Error('ERR_METHOD_NOT_IMPLEMENTED');
  }
  compare(password, encryptedPassword) {
    throw new Error('ERR_METHOD_NOT_IMPLEMENTED');
  }
}
```

```
import Authenticator from './Authenticator';
import bcrypt from 'bcryptjs';

export default class extends Authenticator {

    async encrypt(password) {
        const salt = await bcrypt.genSalt(10);
        return bcrypt.hash(password, salt);
    }

    async compare(password, encryptedPassword) {
        try {
            // Compare password
            const result = await bcrypt.compare(password, encryptedPassword);
            return result;
        } catch (error) {
            return false;
        }
    }
}
```

Security Tokens: Using JWT

- Define Token Service “contract” as class
- Use jsonwebtoken package to provide concrete imeplementation

```
export default class {

    generate() {
        throw new Error('ERR_METHOD_NOT_IMPLEMENTED');
    }

    decode() {
        throw new Error('ERR_METHOD_NOT_IMPLEMENTED');
    }
```

```
import jwt from 'jsonwebtoken';
import Token  from './Token';

export default  class extends Token {
  generate(payload) {
    return jwt.sign(payload, process.env.JWT_SECRET_KEY );
  }
  decode(accessToken) {
    return jwt.verify(accessToken,  process.env.JWT_SECRET_KEY);
  }
}
```

Add to Dependencies

- We can add both authentication and token services as project dependency using dependency injection.

```
import Authenticator from '../security/BCryptAuthenticator';
import Token from '../security/JWTToken';

const buildDependencies = () => {
  const dependencies = {
  };

  dependencies.userSchema = userSchema;
  dependencies.authenticator = new Authenticator();
  dependencies.token = new Token();
```

/src/config/dependencies.js

1. registerAccount Service

- Update registerAccount to use authenticator dependency. Encrypt Password before persisting…

1. Get Authenticator from dependencies using destructuring

```
registerAccount: async (firstName, lastName, email, password, { accountsRepository, authenticator }) => {
   password = await authenticator.encrypt(password);
   const account = new Account(undefined, firstName, lastName, email, password);
   return accountsRepository.persist(account);
 }
```

2. Encrypt password before persisting

Authenticate Service

- Authenticate Service uses authenticator dependency.
- Uses email to extract account from Repository
- Uses authenticor to compare passwords
- **Client needs to keep token for subsequent messaging**
  - **store JWT in local storage.**

1. Get Authenticator from dependencies using destructuring

```
authenticate: async (email, password, { accountsRepository, authenticator, tokenManager }) => {
   const account = await accountsRepository.getByEmail(email);
   const result = await authenticator.compare(password, account.password);
   if (!result) {
     throw new Error('Bad credentials');
   }
   const token = tokenManager.generate({ email: account.email });
   return token;
 }
```

3. tokenManager used to generate JWT token, encoding the account email.

2. Get account from Repo using email and compare password to saved password

Registering Account

POST localhost:8080/api/accounts/

Params Authorization Headers (9) Body Pre-request Script Tests Settings

none form-data x-www-form-urlencoded raw binary GraphQL JSON

```
1 {"firstName":"Frank","lastName":"Zappa","email":"zap@zap2.com","password":"pass123@#4"}
```

Body Cookies Headers (7) Test Results Status: 201 Created

Pretty Raw Preview Visualize JSON


```
1 {
2     "id": "624c0e9b9ef1cac49a68cf29",
3     "firstName": "Frank",
4     "lastName": "Zappa",
5     "email": "zap@zap2.com",
6     "password": "$2a$10$irQylVnHZ6xxZaZie29Dqe7v1WluqdhzqiolnPFSQHzfSSKCr0s1C",
7     "favourites": []
8 }
```


Hashed/Salted value for password “pass123@#4"

Requesting Security Token

POST localhost:8080/api/accounts/security/token

Params Authorization Headers (9) Body Pre-request Script Tests Settings

none form-data x-www-form-urlencoded raw binary GraphQL JSON

```
1 {"email":"zap@zap2.com","password":"pass123@#4" }
```

Body Cookies Headers (7) Test Results Status: 200 OK Time:

Pretty Raw Preview Visualize JSON


```
1 {
2     "token": "BEARER eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJlbWFpbCI6InphcEB6YXAyLmNvbSIsImlhdCI6MTY0OTE1MTg4Mn0.
      B48ubG3CfYmuCyDE3gnS4lJbUlrkESlwo9gOQcczLCY"
3 }
```


JWT Token. This should be stored locally

Protecting API Routes using JWT

Protecting API Routes: Create Service and Controller

- Create a new service and controller that checks for and validates the JWT token
- Verify controller: Extracts token from request header and sends to service
- VerifyToken service: Accepts token, decodes email from token, and checks if belongs to an account

/authenticate/index.js

```
const verify = async (request, response, next) => {
    try {
    // Input     const authHeader = request.headers.authorization;
        // Treatment
    if (!authHeader || !authHeader.startsWith('Bearer ')) {
        response.status(403).json({message:"Forbidden"});
    }
      const accessToken = authHeader.split(" ")[1];
      const user = await accountService.verifyToken(accessToken, dependencies);
        //output
       next();
    }catch(err){
        //Token Verification Failed
        next(new Error(`Token Verification Failed ${err.message}`));
        }
    };
```

```
  verifyToken:   async (token,{accountsRepository, tokenManager}) =>
{
    const decoded = await tokenManager.decode(token);
    const user = await accountsRepository.getByEmail(decoded.email);
    if (!user) {
        throw new Error('Bad token');
    }
    return user.email;
}
```

Protecting API Routes: Add to route

- Import Controller into router
- Add to route…

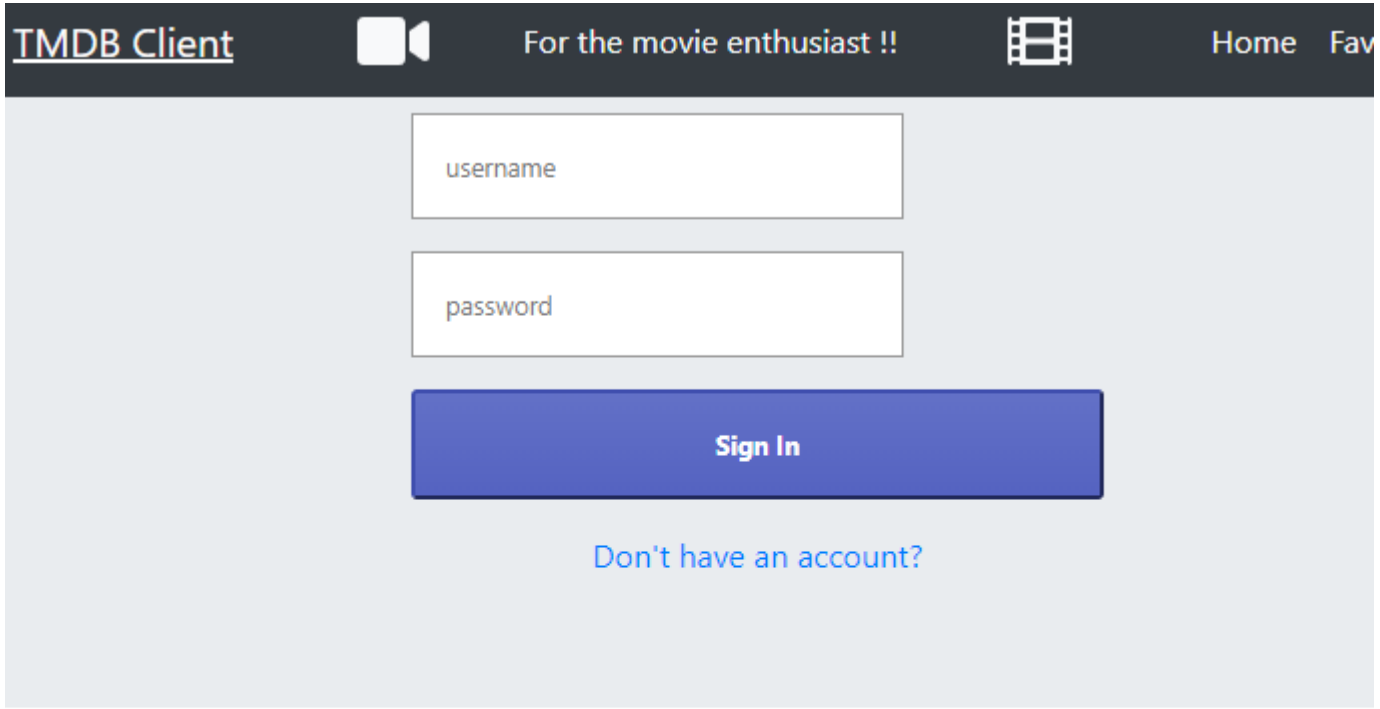
/authenticate/index.js

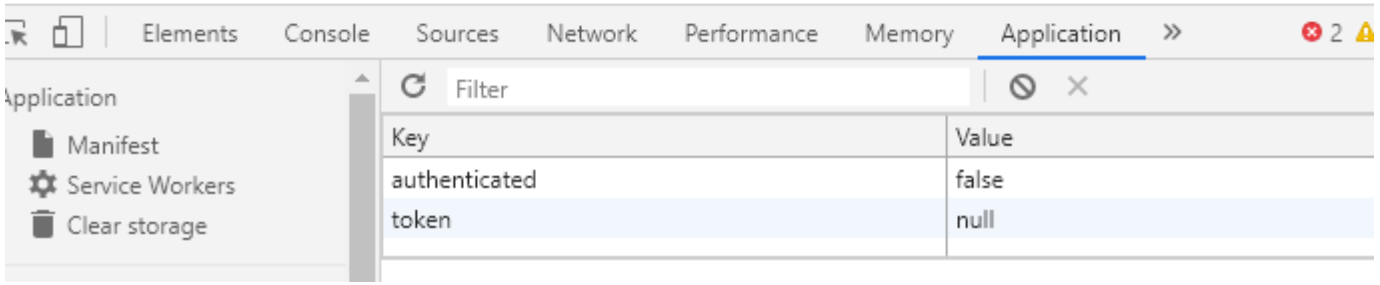
```
import express from 'express';
import MoviesController from '../controllers';
import AccountsController from '../../accounts/controllers';

const createMoviesRouter = (dependencies) => {
    const router = express.Router();
    // load controllers with dependencies
    const moviesController = MoviesController(dependencies);
    const accountsController = AccountsController(dependencies);

    router.route('/:id')
        .get(moviesController.getMovie);

    router.route('/')
        .get(accountsController.verifyToken,moviesController.find);

    router.route('/:id/reviews')
        .get(moviesController.getMovieReviews);

    return router;
};
export default createMoviesRouter;
```

React Apps and JWT

MovieDB App

- We want to:
  - Replace with calls to MovieDB API
  - Provide login/signin capabilities.
  - Only allow signed in users to see Movies and add stuff





Possible Architecture

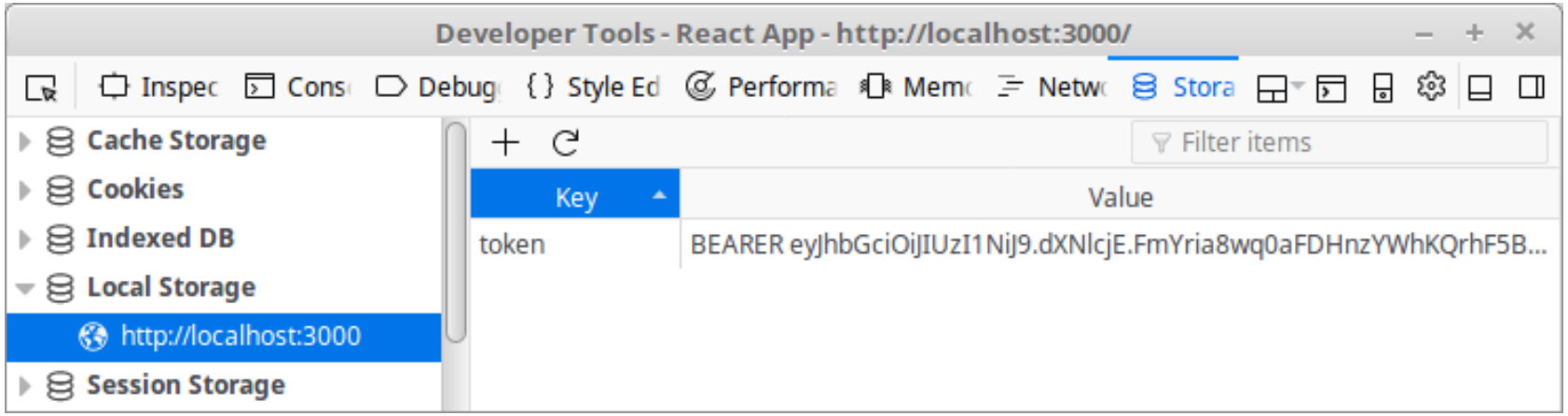
- Create-React-app uses Webpack development server.
- MovieDB API is an Express.js app.
- Configure Webpack server to "proxy" any unknown requests to Express app
  - Just need "**proxy":"http://localhost:8080"** entry in package.json.
- Removes Cross-Origin-Resource-Sharing (CORS) issues with the browser

JavaWebToken Storage

- Most browsers/devices have **local storage** .Can access using **localStorage** object.

```
localStorage.setItem('token', token);
```

```
const token =     localStorage.getItem('token');
```



Contexts

- Create an Authentication Context in MovieDB React App.
- As with Movie and Genre contexts, use it to pass data through the component tree
- Share authentication details between components

```
import React, { useState, createContext } from "react";
import { login, signup } from "../api/movie-api";

export const AuthContext = createContext(null);

const AuthContextProvider = (props) => {
  const existingToken = localStorage.getItem("token");
  const [isAuthenticated, setIsAuthenticated] = useState(false);
  const [authToken, setAuthToken] = useState(existingToken);
  const [userName, setUserName] = useState("");

  //Function to put JWT token in local storage.
  const setToken = (data) => {
    localStorage.setItem("token", data);
    setAuthToken(data);
  }

  const authenticate = async (username, password) => {
    const result = await login(username, password);
    if (result.token) {
      setToken(result.token)
      setIsAuthenticated(true);
      setUserName(username);
    }
  };
```

Use Context Provider in React App

```
<BrowserRouter>
  <AuthProvider>
    <AuthHeader />
    <ul>
      <li>
        <Link to="/">Home</Link>
      </li>
      <li>
        <Link to="/public">Public</Link>
      </li>
      <li>
        <Link to="/movies">Movies</Link>
      </li>
      <li>
        <Link to="/profile">Profile</Link>
      </li>
    </ul>
    <MovieProvider>
    <Switch>
      <Route path="/public" compone
      <Route path="/login" componen
      <Route path="/signup" compone
      <Route exact path="/" compone
      <PrivateRoute path="/movies"
      <PrivateRoute path="/profile"
      <Redirect from="*" to="/" />
    </Switch>
```

```
import React, { useContext} from "react";
import { Route, Redirect } from "react-router-dom";
import {AuthContext} from './authContext'

const PrivateRoute = props => {
  const context = useContext(AuthContext)
  // Destructure props from <privateRoute>
  const { component: Component, ...rest } = props;
  console.log(props.location)
  return context.isAuthenticated === true ? (
    <Route {...rest} render={props => <Component {...props} />} />
  ) : (
    <Redirect
      to={{
        pathname: "/login",
        state: { from: props.location }
      }}
    />
  );
};

export default PrivateRoute;
```

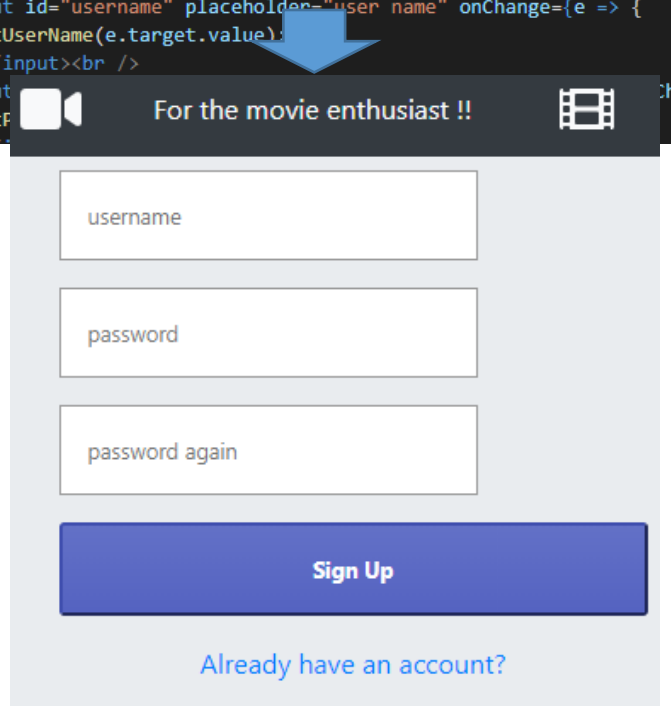
Import context and use it to check authentication status

Login/Register Component

```
import React, { useContext, useState } from "react";
import { Redirect } from "react-router-dom";
import { AuthContext } from './authContext';
import { Link } from "react-router-dom";

const LoginPage = props => {
  const context = useContext(AuthContext)
  const [userName, setUserName] = useState("");
  const [password, setPassword] = useState("");

  const login = () => {
    context.authenticate(userName, password);
  };

  // Set 'from' to path where browser is redirected after a successful login.
  // Either / or the protected path user tried to access.
  const { from } = props.location.state || { from: { pathname: "/" } };

  if (context.isAuthenticated === true) {
    return <Redirect to={from} />;
  }
  return (
    <>
      <h2>Login page</h2>
      <p>You must log in to view the protected pages </p>
      <input id="username" placeholder="user name" onChange={e => {
        setUserName(e.target.value);
      }}></input><br />
      <input                                                    hange={e => {
        setP
```

```
import LoginPage from './pages/loginPage';
import SignupPage from './pages/signupPage';
```

```
<Switch>
<Route exact path="/reviews/form" component={AddMovieReviewPa
<Route exact path="/login" component={LoginPage} />
<Route path="/signup" component={SignupPage} />
  <Route path="/reviews/:id" component={MovieReviewPage} />
```



Summary

- Create Authentication functionality using passwords
  - salt/hash passwords
  - compare passwords
- Implement user API to authenticate/signup users
  - Sign JWT tokens
- Use authentication controller to secure server-side routes
  - Add to middleware stack.

Additional: Passport

- Passport is authentication middleware
- Flexible and modular.
- Easy to retrospectively drop into an Express app.
- Lots of "strategies" for authentication
  - Username/Password
  - Facebook
  - Twitter

Search for Strategies

15,333

Passport

Simple, unobtrusive authentication for Node.js

Passport is authentication middleware for Node.js. Extremely flexible and modular, Passport can be unobtrusively dropped in to any Express-based web application. A comprehensive set of strategies support authentication using a username and password, Facebook, Twitter, and more.

app.js — vim

```
passport.authenticate('github');
```

Passport Overview

- Passport offers different authentication mechanisms as **Strategies**
  - You install just the modules you require for a particular strategy
- Authenticate by calling passport.authenticate()
  - specify which strategy to use.
- The **authenticate()** function signature is a standard Express middleware function…
  - Just drop it in..

```
app.use('/api/movies', passport.authenticate('jwt', {session: false}), moviesRouter
app.use('/api/genres', genresRouter);
```