Authentication

Objectives

- Define and differentiate between the terms "authentication" and "authorization" as they pertain to a client-server or Web application
- Describe the general mechanics and workflow of how JSON Web Tokens (JWTs) are used to authenticate users of a client-server (including Web) application
- Use a common tool to decode an encoded JWT to inspect its contents
- Recognize and interpret the HTTP response status codes commonly associated with authentication and authorization failures (i.e. 401 and 403)
- Write client code in Java that can authenticate with an authentication server to retrieve a JWT, and then use the JWT to authenticate subsequent requests to a Web API.
- Utilize the auth features of an application framework (Spring Boot Web API) to:
    - Specify that a particular resource requires authentication to be accessed
    - Specify that a particular resource can be accessed anonymously
    - Apply simple authorization rules for resources
    - Obtain the identity of an authenticated user

Authentication vs. Authorization

- Authentication is validating the user is who they claim to be
  - Front gate to any secure web application
  - Based on authentication, authorization can be granted
- Authorization is giving user permission to access specific resources or functions.
  - Only authorized to access certain pages in web site
  - Only authorized to perform certain actions on a database

Forms of authentication

- Something the user *knows* (Knowledge factor)
  - Password, partial password, pass phrase, PIN, challenge response
- Something the user *has* (Ownership factor)
  - Wrist band, ID card, security token, cell phone with built-in hardware token, software token
- Something the user *is* (Inherence factor)
  - Fingerprint, retinal pattern, DNA sequence, signature, face, voice, unique bio-electric signals
- *Where the user is located (Location)*

2FA or MFA

2 Factor Authentication or Multi-Factor Authentication involves using a combination of these elements to authenticate:

- Codes generated by smartphone apps
- Badges, USB devices, or other physical devices
- Soft tokens, certificates
- Fingerprints
- Codes sent to an email address
- Facial recognition
- Retina or iris scanning
- Behavioral analysis
- Risk score
- Answers to personal security questions

Most web applications require only a username and password

I CHANGED ALL MY PASSWORDS TO "INCORRECT".
SO WHENEVER I FORGET, IT WILL TELL ME "YOUR PASSWORD IS INCORRECT."
quickmeme.com

Strong password policy example

- Password must meet at least 3 out of the following 4 complexity rules
    - at least 1 uppercase character (A-Z)
    - at least 1 lowercase character (a-z)
    - at least 1 digit (0-9)
    - at least 1 special character (punctuation) — do not forget to treat space as special characters too
- at least 10 characters
- at most 128 characters
- not more than 2 identical characters in a row (e.g., 111 not allowed)

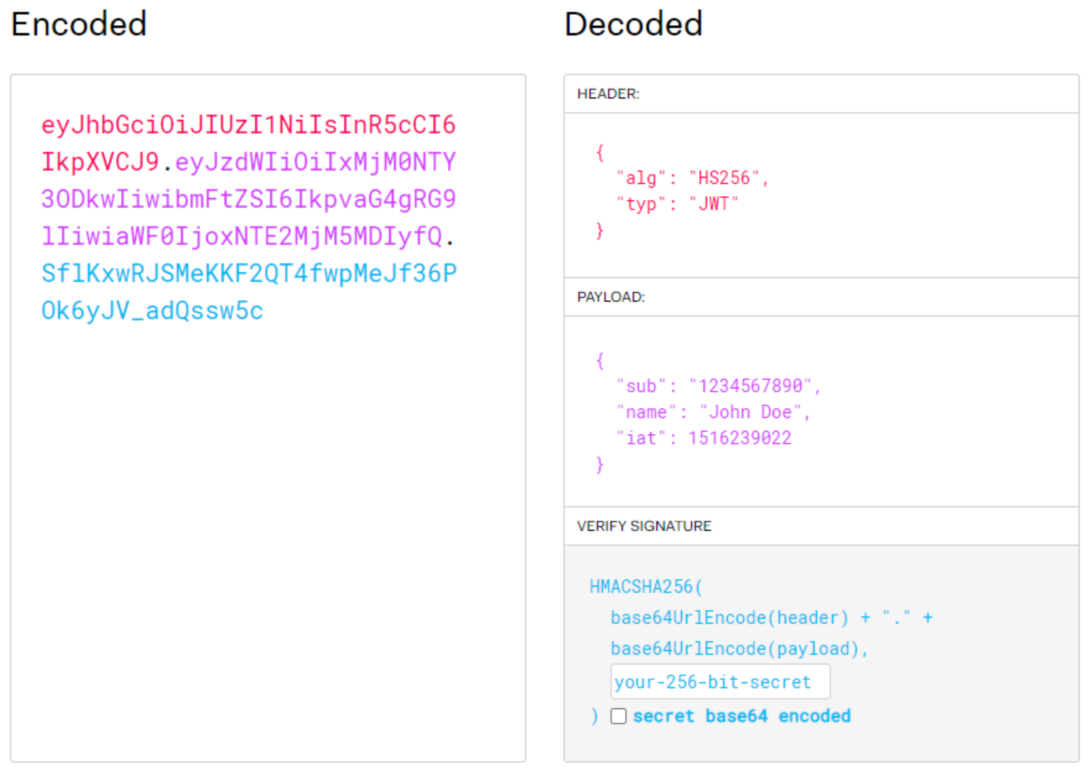
HTTP is stateless!

- Does not keep track of state between connections
  - Each request is executed independently, without knowledge of the requests executed before
  - Once transaction ends, connection between browser and server is lost
  - Log in, but how to keep track that you are authorized??

  - Each request must contain information about users identity

JWT – JSON Web Token

- String passed in header or url while making a network request to pass data safely
  - Separated by three dots
    - header.payload.signature
    - Header provides information about token
    - Payload is actual data of token (also called claims)
    - Signature is verification that data hasn't been tampered with



Encoded

```
eyJhbGciOiJIUzI1NiIsInR5cCI6
IkpXVCJ9.eyJzdWIiOiIxMjM0NTY
3ODkwIiwibmFtZSI6IkpvaG4gRG9
lIiwiaWF0IjoxNTE2MjM5MDIyfQ.
SflKxwRJSMeKKF2QT4fwpMeJf36P
Ok6yJV_adQssw5c
```

Decoded

HEADER:

```
{
  "alg": "HS256",
  "typ": "JWT"
}
```

PAYLOAD:

```
{
  "sub": "1234567890",
  "name": "John Doe",
  "iat": 1516239022
}
```

VERIFY SIGNATURE

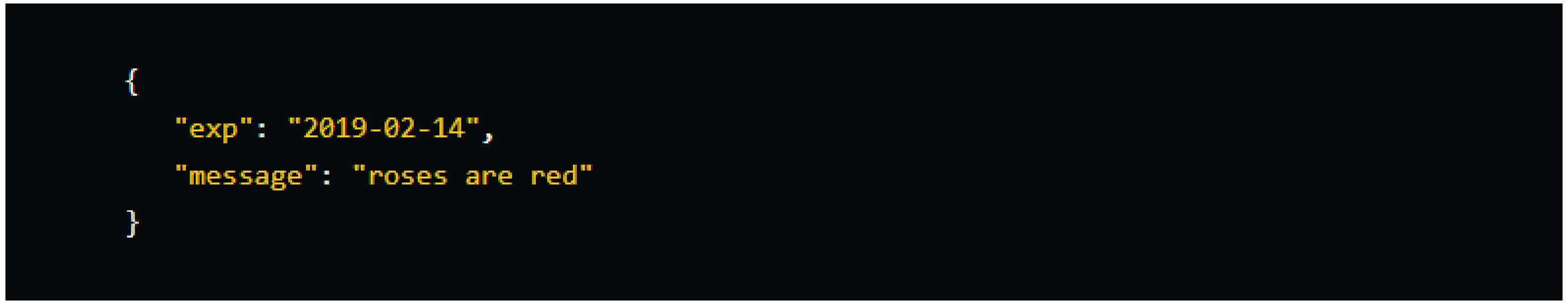
```
HMACSHA256(
  base64UrlEncode(header) + "." +
  base64UrlEncode(payload),
  your-256-bit-secret
) ☐ secret base64 encoded
```

Authentication with JWT

- Token is created and returned to client in response
    - Token must be supplied for every API request that requires authorization
    - Token goes in http header with word bearer, which indicates type of authentication

Claims

- Registered claims (predefined keys which are not mandatory but recommended)
- Public claims (required to be collision resistant)
- Private claims (custom key value pairs created to share information between parties – neither registered or public)



```
{
   "exp": "2019-02-14",
   "message": "roses are red"
}
```

Using JWTs in a client app

Instead of restTemplate.getForObject, we use

    restTemplate.exchange

RestTemplate exchange method needs 4 parameters

- String URL (“http://localhost:8080/login”)
- Http Method (HttpMethod.POST)
- HttpEntity object (entity) – contains headers and payload (can be JSON)
- Class response type (Map.class)

```
public ResponseEntity<Map> login(String credentials) throws
     AuthenticationServiceException {

 LoginDTO loginDTO = new LoginDTO(credentials);  // object that holds user
                                                 // name and password

 HttpHeaders headers = new HttpHeaders();

 headers.setContentType(MediaType.APPLICATION_JSON);

 HttpEntity<LoginDTO> entity = new HttpEntity<>(loginDTO, headers);

 ResponseEntity<Map> response = null;

 try {

     response = restTemplate.exchange(BASE_URL + "/login",
           HttpMethod.POST, entity, Map.class);

 } catch(RestClientResponseException ex) {
```

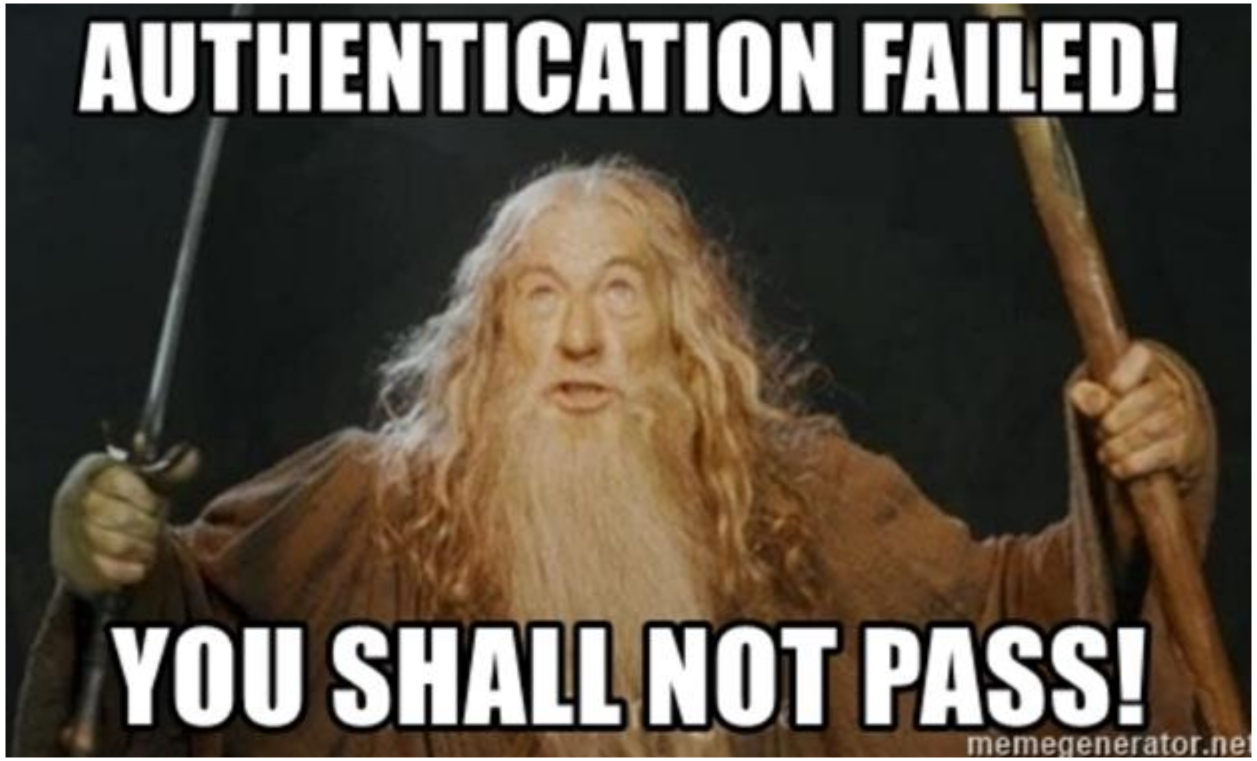
To use Token in Request

Pass the token in the bearer authentication header before making request:

```
Location location = null;
try {                 // Authorization: Bearer {AUTH_TOKEN} Header
    HttpHeaders headers = new HttpHeaders();
    headers.setBearerAuth(AUTH_TOKEN);
    HttpEntity entity = new HttpEntity<>(headers);
    location = restTemplate.exchange(BASE_URL + "/" + id,
       HttpMethod.GET, entity, Location.class).getBody();
} catch (RestClientResponseException ex) {
    throw new LocationServiceException(ex.getRawStatusCode() +
       " : " + ex.getResponseBodyAsString());
}
return location;
```

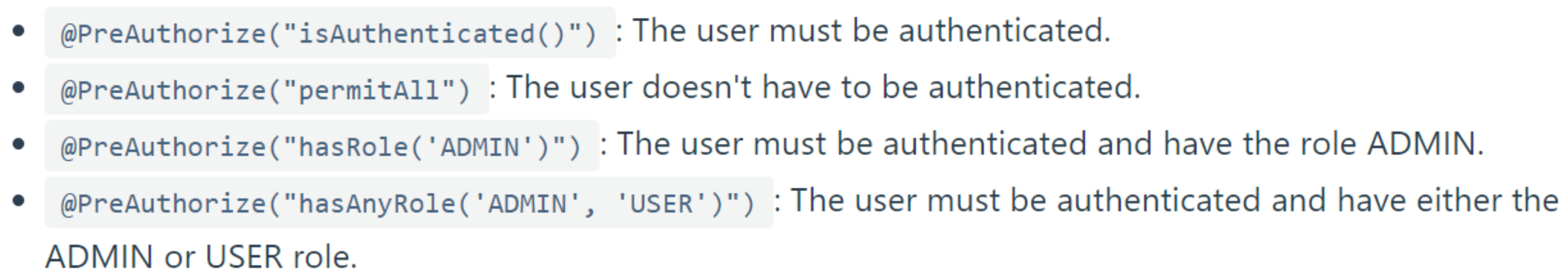
HTTP response codes

- 401 – Unauthorized
- 403 - Forbidden



Securing API methods

- @PreAuthorize annotation
  - Class level or method level in controller
  - Spring Expression Language argument



- `@PreAuthorize("isAuthenticated()")` : The user must be authenticated.
- `@PreAuthorize("permitAll")` : The user doesn't have to be authenticated.
- `@PreAuthorize("hasRole('ADMIN')")` : The user must be authenticated and have the role ADMIN.
- `@PreAuthorize("hasAnyRole('ADMIN', 'USER')")` : The user must be authenticated and have either the ADMIN or USER role.

User Identity

Certain situations require you to know the identity of the user. You can add a new argument Principal and Spring will resolve this for you.

```
@ResponseStatus(HttpStatus.CREATED)
   @RequestMapping(value = "", method = RequestMethod.POST)
   public Location add(@Valid @RequestBody Location location, Principal principal) {
       System.out.println(principal.getName());
       return dao.create(location);
   }
```

Let’s Code!