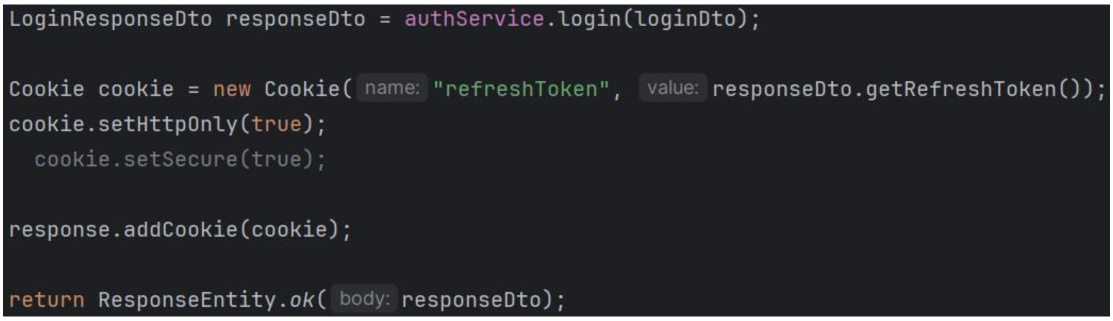
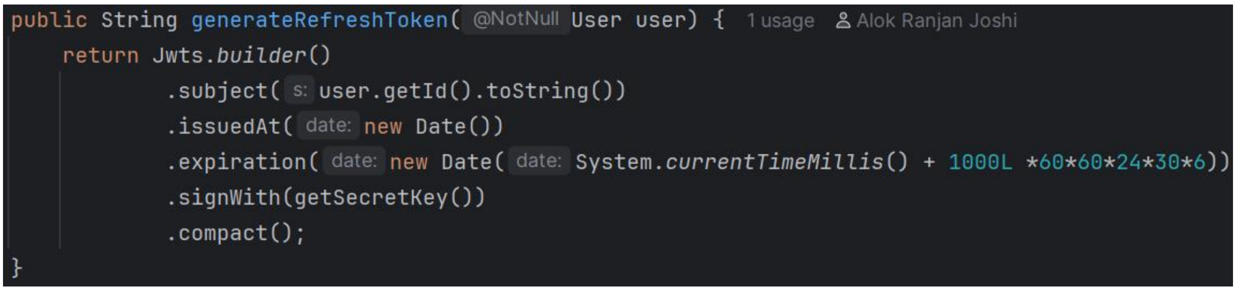
- 2 types of tokens should be there: **access token** (short validity; around 10 min) and **refresh token** (long validity; like 6 months)
    - When the *access token* is expired, the **refresh token** will be used to get a new *access token.*
    - Usually, **refresh token** is stored in the cookies, and get the *refresh token* from the cookies from backend (not in request payload) and validate the *refresh token*;
    - If the *refresh token* is valid then generate one new **access token** and return in response.
    - Use **http-only** cookies to store refresh token.



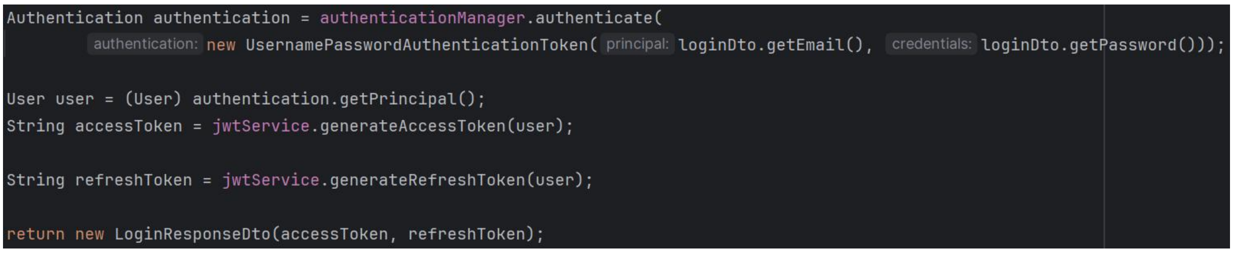
```
LoginResponseDto responseDto = authService.login(loginDto);

Cookie cookie = new Cookie( name: "refreshToken",  value: responseDto.getRefreshToken());
cookie.setHttpOnly(true);
  cookie.setSecure(true);

response.addCookie(cookie);

return ResponseEntity.ok( body: responseDto);
```

- Just keep **user id** in the refresh token, no need to keep everything there.



```
public String generateRefreshToken( @NotNull User user) {  1 usage  Alok Ranjan Joshi
    return Jwts.builder()
            .subject( s: user.getId().toString())
            .issuedAt( date: new Date())
            .expiration( date: new Date( date: System.currentTimeMillis() + 1000L *60*60*24*30*6))
            .signWith(getSecretKey())
            .compact();
}
```

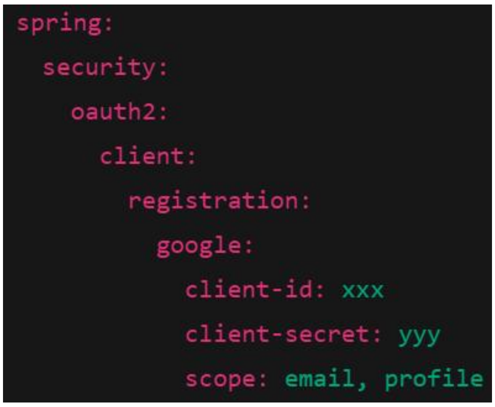
- **Login service method** should get the user from **principal** not from ***database***



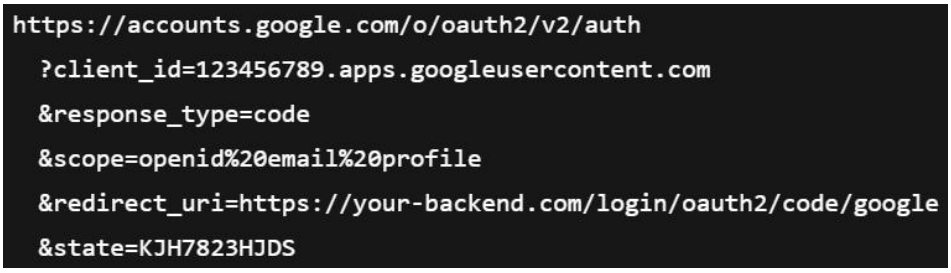
```
Authentication authentication = authenticationManager.authenticate(
        authentication: new UsernamePasswordAuthenticationToken( principal: loginDto.getEmail(),  credentials: loginDto.getPassword()));

User user = (User) authentication.getPrincipal();
String accessToken = jwtService.generateAccessToken(user);

String refreshToken = jwtService.generateRefreshToken(user);

return new LoginResponseDto(accessToken, refreshToken);
```

    - For this, **user** should be stored as principal instead of **username.**

Frontend & Backend in Google OAUTH2 (in general)

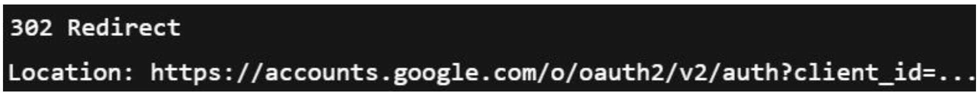
- In case of **"sign in with google",** There are 2 backends involved
  - Our own backend
  - Google's backend
- After clicking on that "sign in with google" button, the ***frontend*** triggers one request which is:
  - **GET /oauth2/authorization/google** (this is our backend's path; not google's)
  - We don't write this end point by our self; this is **auto-created** by Spring Security OAuth2 Client.
  - Internally it is handled by: **OAuth2AuthorizationRequestRedirectFilter**
- Now, our backend reads from ***application.yml*** file
  - 

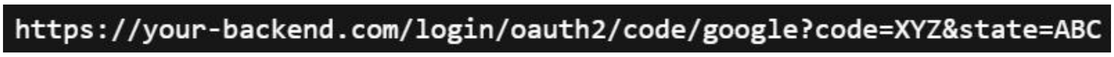
```
spring:
  security:
    oauth2:
      client:
        registration:
          google:
            client-id: xxx
            client-secret: yyy
            scope: email, profile
```

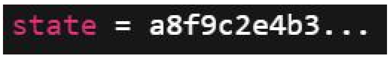
  - Now, our backend knows about:
    - which provider (google)
    - client_id
    - scopes
    - redirect_uri template
- Now, our backend will build a **url having proper query parameters which will be sent as response to which the browser will redirect.**
  - The URL will look something like this
  - 

```
https://accounts.google.com/o/oauth2/v2/auth
  ?client_id=123456789.apps.googleusercontent.com
  &response_type=code
  &scope=openid%20email%20profile
  &redirect_uri=https://your-backend.com/login/oauth2/code/google
  &state=KJH7823HJDS
```

  - Note: **redirect_uri** is present in this URL.

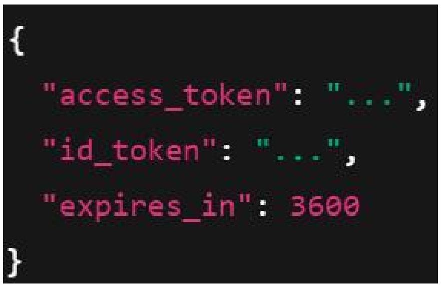
- Now, our Backend responds with one thing only
  - 

    ```
    302 Redirect
    Location: https://accounts.google.com/o/oauth2/v2/auth?client_id=...
    ```
  - It is browser's rule: **If response status is 3xx and Location header is present → automatically navigate to that URL.**
  - There is no involvement of ***frontend*** in this case.
- Now, the browser redirects to **accounts.google.com** …. page directly.
  - Here there is no role of our backend, it is completely backed by **Google's backend**.
- Now, the user will interact with the ***google's UI*** and give the necessary permissions of the required details.
- Then, Google will authenticate the user and redirect **the browser** to ***our backend's path*** Using the same **redirect_uri** that your backend sent earlier
  - 

    ```
    https://your-backend.com/login/oauth2/code/google?code=XYZ&state=ABC
    ```
  - This full path (not just backend's domain) is registered in Google console.
  - Note: **state** & **code** is present here.
  - **NOTE ---**
  - So, in the Google Console you can register as many URIs you want, that will be treated as the allowed redirect URIs
  - And you need to pass the **redirect_uri** in the response so that google will get to know to which **uri** it has to redirect.
  - First Google will check if the given **uri** in the request URL is present in the access list, if present then it'll redirect back to that URI after authenticating the user.
- Now, our backend's end point "**/login/oauth2/code/google**" will receive the request.
  - This endpoint is ALSO **auto-created** by Spring Security OAuth2 Client
  - Handled by: **OAuth2LoginAuthenticationFilter**
- Now, our backend validate the **state**
  - state is a random, unpredictable value generated by YOUR backend before redirecting the user to Google.
  - 

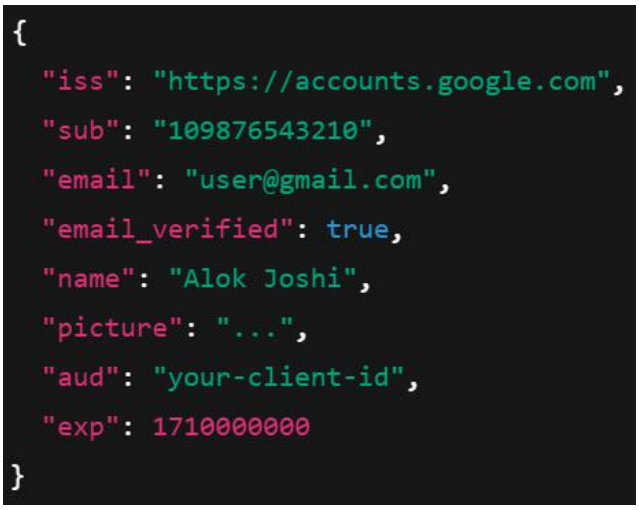
    ```
    state = a8f9c2e4b3...
    ```
  - If the **state** matches, then continue; otherwise **reject**.
- Now **our Backend** exchanges **code** with **tokens**
  - code is an authorization code issued by Google after the user successfully authenticates and consents.

  - Think of it as a one-time, short-lived voucher that your backend can exchange for token.
  - Backend makes **server-to-server** call.
  - It sends **client_id, client_secret, code, redirect_uri** and receives **access_token, id_token, expires_in**



```
{
  "access_token": "...",
  "id_token": "...",
  "expires_in": 3600
}
```

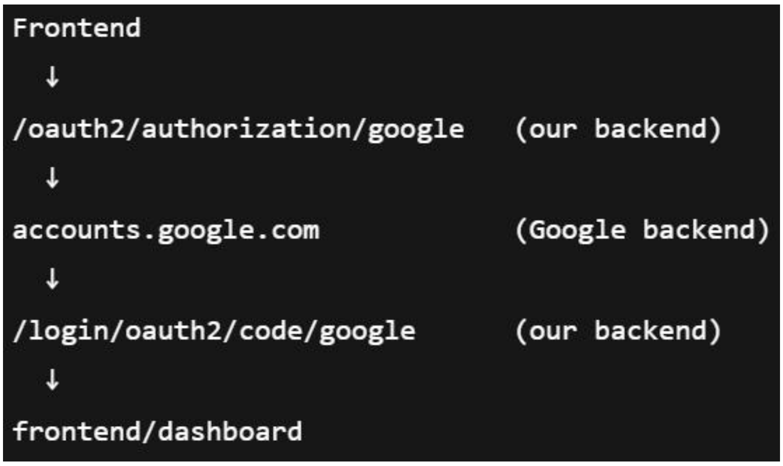
  - **id_token** is a JWT which contains the user details within it like the below



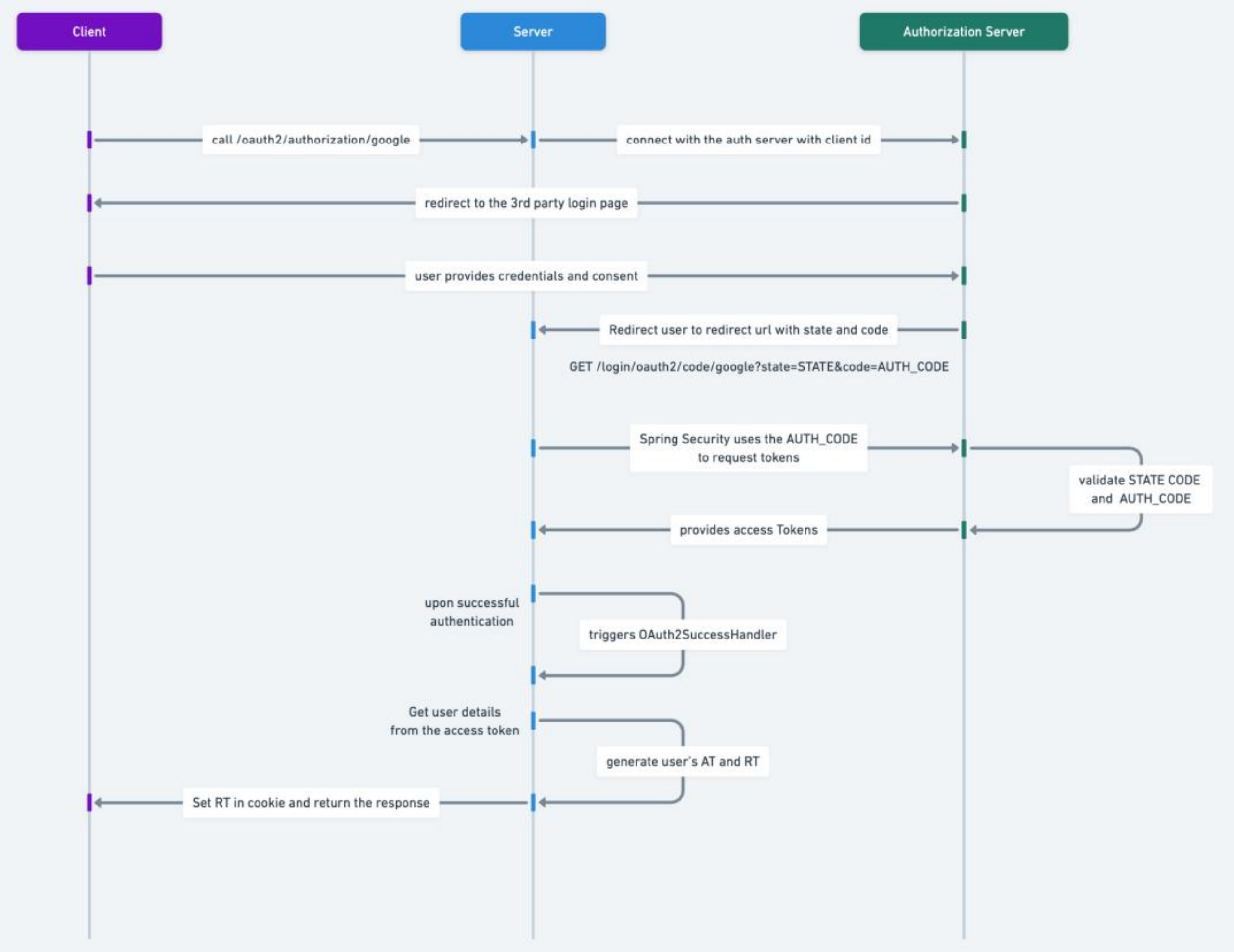
```
{
  "iss": "https://accounts.google.com",
  "sub": "109876543210",
  "email": "user@gmail.com",
  "email_verified": true,
  "name": "Alok Joshi",
  "picture": "...",
  "aud": "your-client-id",
  "exp": 1710000000
}
```

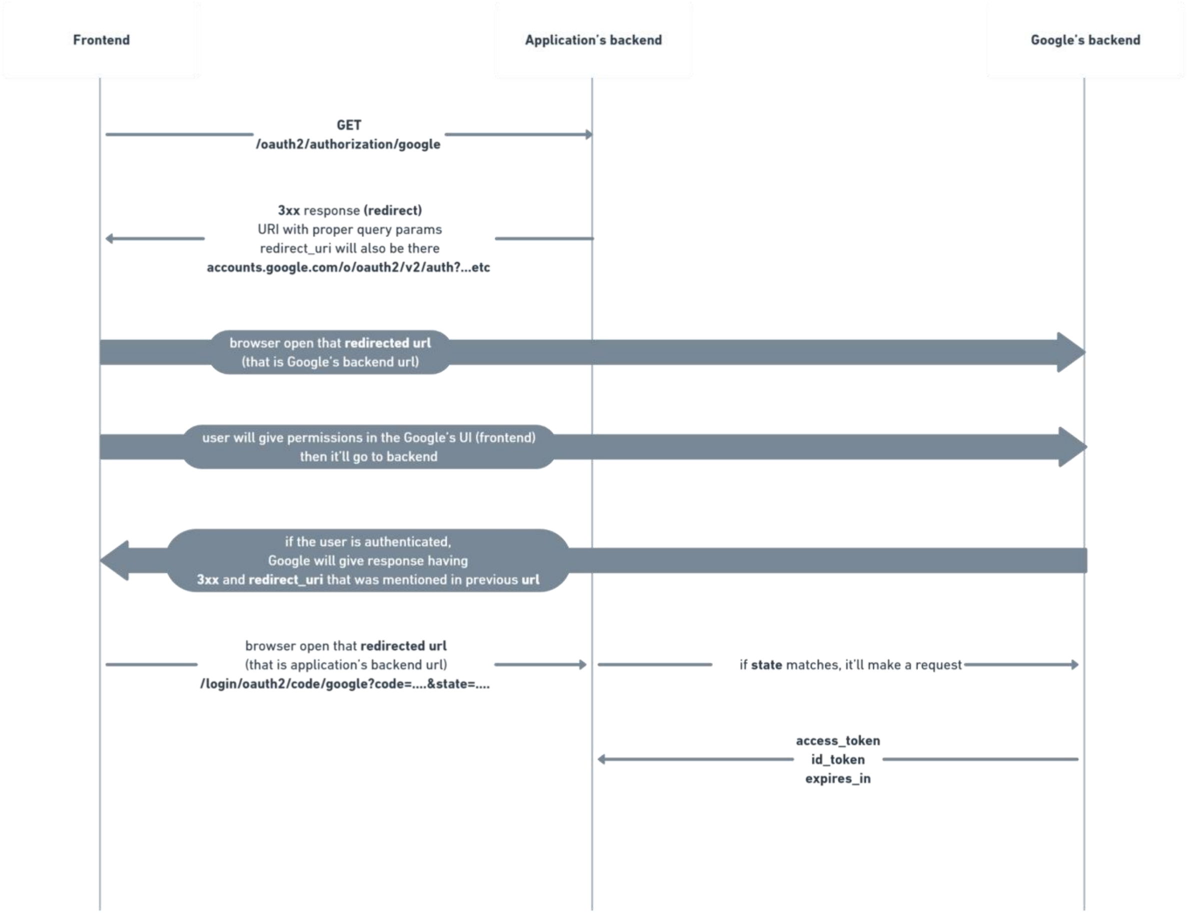
  - You "use" only the authorization code; the **access_token** is returned because **OAuth** requires it, but if you don't call Google APIs, it is perfectly normal that it is never used.

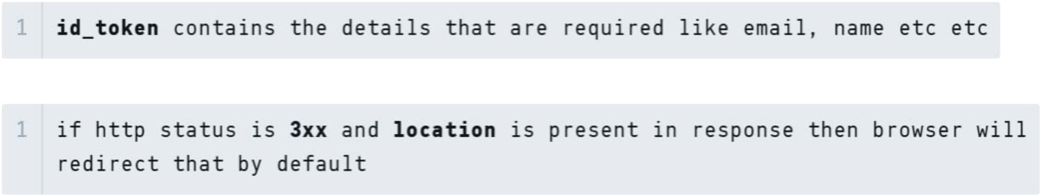
- Now, you can implement the normal login in our backend after getting those details.
- In one sentence:
  - In Google OAuth login, the frontend only triggers navigation. The backend **constructs the authorization request**, redirects the **browser to Google**, and later receives the **authorization code**. Google authenticates the user, validates the redirect URI against its allow-list, and redirects back **to the backend**. The backend validates **state**, exchanges the **code for tokens**, extracts user identity, and then performs normal application login logic.



```
Frontend
  ↓
/oauth2/authorization/google    (our backend)
  ↓
accounts.google.com             (Google backend)
  ↓
/login/oauth2/code/google       (our backend)
  ↓
frontend/dashboard
```


Client
Server
Authorization Server
call /oauth2/authorization/google
connect with the auth server with client id
redirect to the 3rd party login page
user provides credentials and consent
Redirect user to redirect url with state and code
GET /login/oauth2/code/google?state=STATE&code=AUTH_CODE
Spring Security uses the AUTH_CODE to request tokens
validate STATE CODE and AUTH_CODE
provides access Tokens
upon successful authentication
triggers OAuth2SuccessHandler
Get user details from the access token
generate user's AT and RT
Set RT in cookie and return the response


Frontend
Application's backend
Google's backend
GET
/oauth2/authorization/google
3xx response (redirect)
URI with proper query params
redirect_uri will also be there
accounts.google.com/o/oauth2/v2/auth?...etc
browser open that redirected url
(that is Google's backend url)
user will give permissions in the Google's UI (frontend)
then it'll go to backend
if the user is authenticated,
Google will give response having
3xx and redirect_uri that was mentioned in previous url
browser open that redirected url
(that is application's backend url)
/login/oauth2/code/google?code=....&state=....
if state matches, it'll make a request
access_token
id_token
expires_in



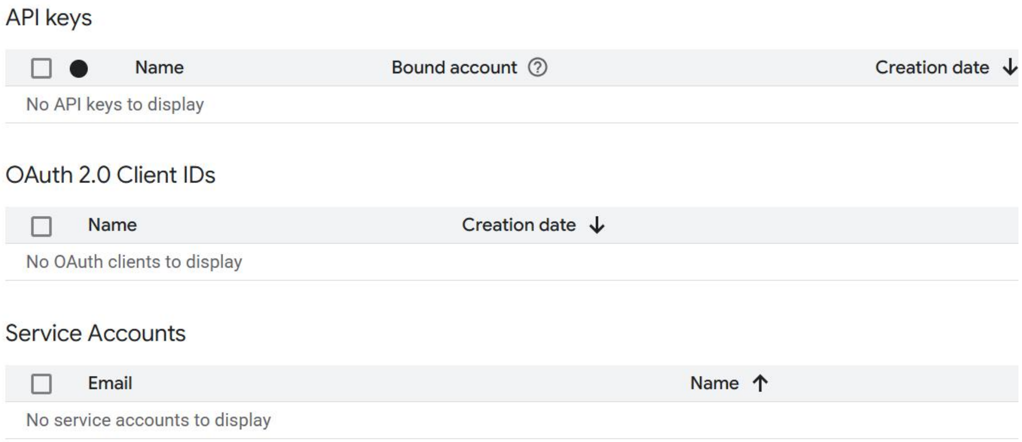
```
id_token contains the details that are required like email, name etc etc
```

```
if http status is 3xx and location is present in response then browser will
redirect that by default
```

➢ Steps

➢ Google Console Setup

- ➢ Select the project in Google Console; and go to Dashboard
- ➢ API & Services >> Credentials



API keys

□	●	Name	Bound account ⓘ	Creation date ↓
No API keys to display				

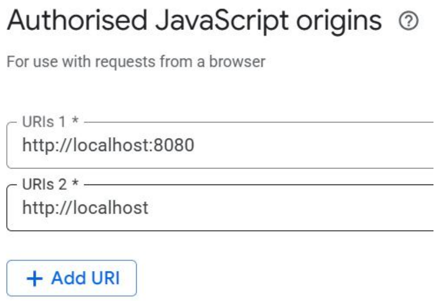
OAuth 2.0 Client IDs

□	Name	Creation date ↓
No OAuth clients to display		

Service Accounts

□	Email	Name ↑
No service accounts to display		

- ➢ **Create Credentials >> OAuth Client ID**
- ➢ **Configure Consent Screen**
  - You need to configure all the things separately.
  - Audience: either you can setup some test user or publish. Publish means anyone can try to login.
  - Data access: it is the scopes like which data do you want to access from google.
  - Clients: create the OAuth2 client;



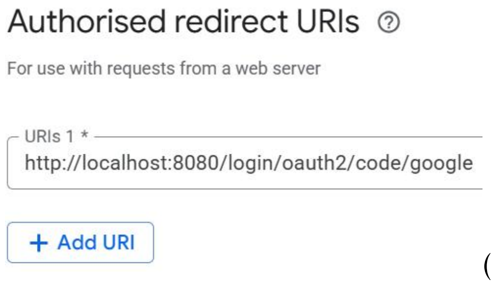
Authorised JavaScript origins ⓘ

For use with requests from a browser

URIs 1 *: http://localhost:8080

URIs 2 *: http://localhost

- It means Requests coming from a browser whose origin is "http://localhost:8080" are allowed to start OAuth.



Authorised redirect URIs ⓘ

For use with requests from a web server

URIs 1 *: http://localhost:8080/login/oauth2/code/google

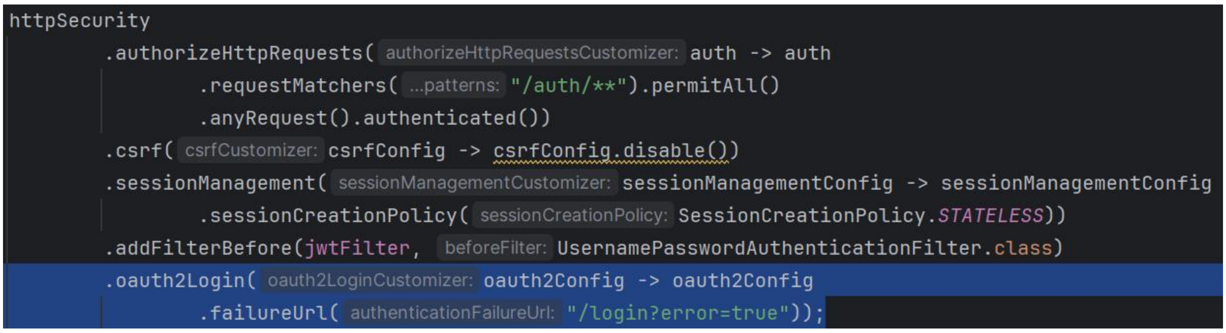
(default URL of spring security)

- After creating the **Client**, you'll get the **client id** and **client secret**, copy those and paste in the *application.properties* or *application.yml* file.

- ------------------------------------ Google Console set-up done ------------------------------------

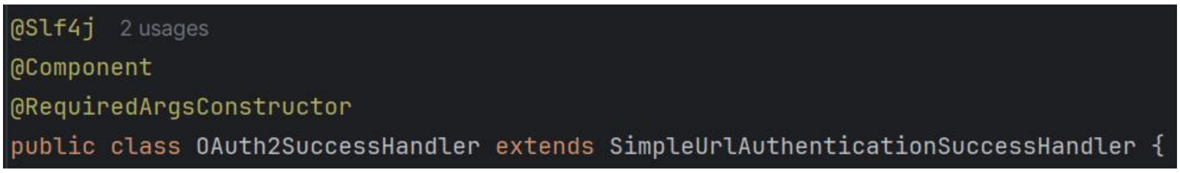
- **Application codes**

- Add the **oauth2Login** filter in the custom filter chain



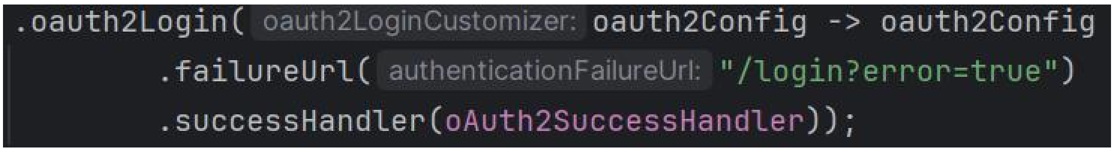
```
httpSecurity
        .authorizeHttpRequests( authorizeHttpRequestsCustomizer: auth -> auth
                .requestMatchers( ...patterns: "/auth/**").permitAll()
                .anyRequest().authenticated())
        .csrf( csrfCustomizer: csrfConfig -> csrfConfig.disable())
        .sessionManagement( sessionManagementCustomizer: sessionManagementConfig -> sessionManagementConfig
                .sessionCreationPolicy( sessionCreationPolicy: SessionCreationPolicy.STATELESS))
        .addFilterBefore(jwtFilter,  beforeFilter: UsernamePasswordAuthenticationFilter.class)
        .oauth2Login( oauth2LoginCustomizer: oauth2Config -> oauth2Config
                .failureUrl( authenticationFailureUrl: "/login?error=true"));
```

- You need to also add the **success** handler, otherwise even after getting the response from authorization server (google in our case) it'll not do the required things after authenticating the user.
    - There is a class **SimpleUrlAuthenticationSuccessHandler**, that decides what to do after the authentication success.
    - Authentication can be of any type i.e. **OAuth**, **Form login**, **Username/password login** ..etc
    - This class contains one method **onAuthenticationSuccess** which is executed after the authentication gets succeeded.
    - So, if we create a **Bean** of a class extending **SimpleUrlAuthenticationSuccessHandler** class and overriding the method **onAuthenticationSuccess** then we can handle the authentication success case.
    - I created the below class:



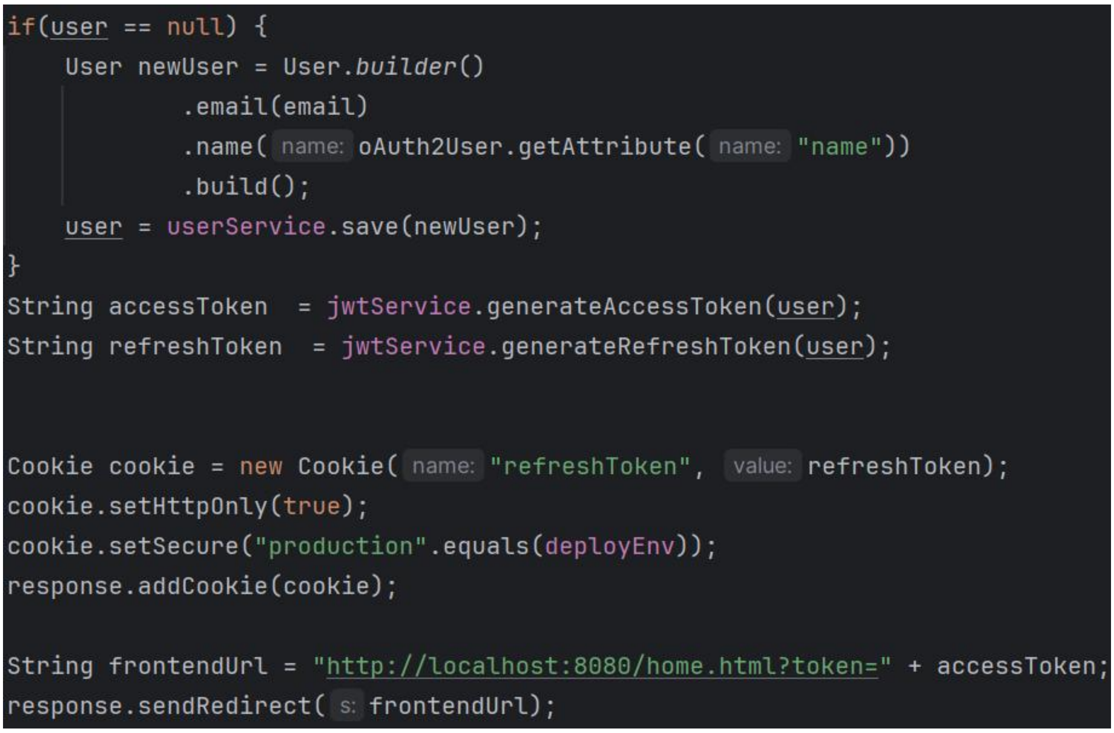
```
@Slf4j  2 usages
@Component
@RequiredArgsConstructor
public class OAuth2SuccessHandler extends SimpleUrlAuthenticationSuccessHandler {
```

- Now just add that class's object in the SecurityFilterChain



```
.oauth2Login( oauth2LoginCustomizer: oauth2Config -> oauth2Config
        .failureUrl( authenticationFailureUrl: "/login?error=true")
        .successHandler(oAuth2SuccessHandler));
```

- I just checked if the user is present in the database, if present then do signup otherwise just create **access** and **refresh** token and send in response.

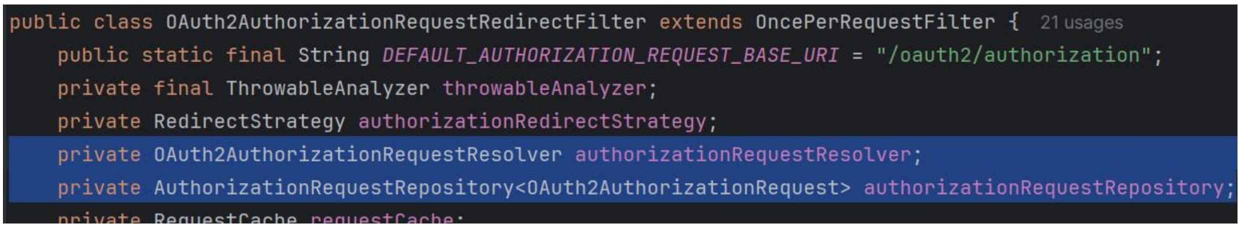


```
if(user == null) {
    User newUser = User.builder()
            .email(email)
            .name( name: oAuth2User.getAttribute( name: "name"))
            .build();
    user = userService.save(newUser);
}
String accessToken  = jwtService.generateAccessToken(user);
String refreshToken  = jwtService.generateRefreshToken(user);


Cookie cookie = new Cookie( name: "refreshToken",  value: refreshToken);
cookie.setHttpOnly(true);
cookie.setSecure("production".equals(deployEnv));
response.addCookie(cookie);

String frontendUrl = "http://localhost:8080/home.html?token=" + accessToken;
response.sendRedirect( s: frontendUrl);
```

-
    - It is inside the **onAuthenticationSuccess** method.
    - **response.sendRedirect()** will send a redirect-response so that the browser will redirect to this specific url.
    - **home.html** is nothing but a static file.
- F

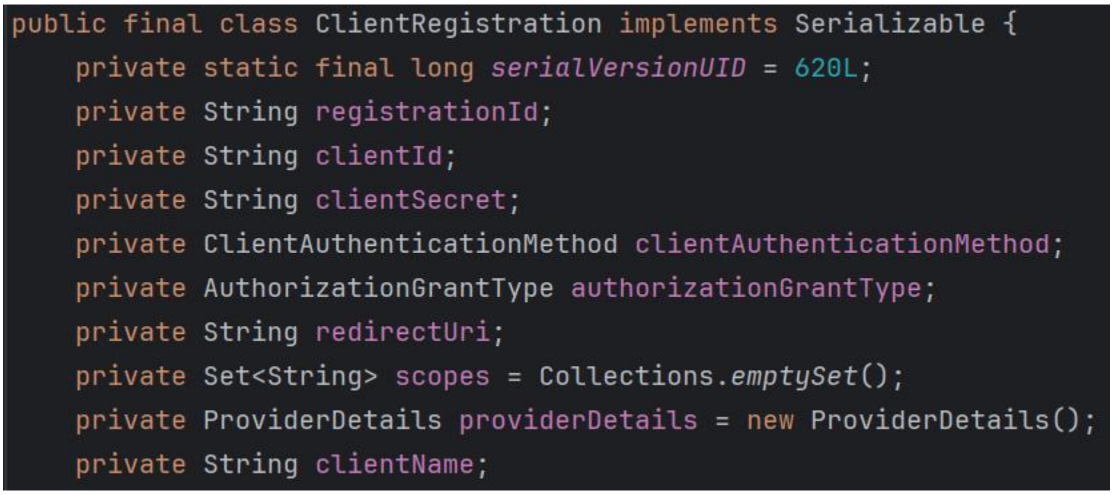
➢ OAuth2 flow in Spring Security

- There are 2 filters which are important:
  - **OAuth2AuthorizationRequestRedirectFilter**
    - backend to google before authentication
  - **OAuth2LoginAuthenticationFilter**
    - google to backend after authentication
- OAuth2AuthorizationRequestRedirectFilter consists of 2 things
  - One is to create the final object which is having ***state, client id, client secret, redirect uri*** etc etc every details that should be present in the request (for backend to google redirect).
    - This final object is of type **OAuth2AuthorizationRequest**
  - Another is to save that object while the control goes to google.
  - It generates the default oauth login end point, like **/oauth2/authorization/google**

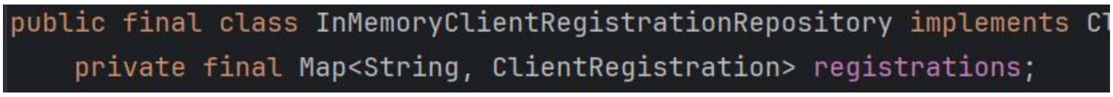


```
public class OAuth2AuthorizationRequestRedirectFilter extends OncePerRequestFilter {  21 usages
    public static final String DEFAULT_AUTHORIZATION_REQUEST_BASE_URI = "/oauth2/authorization";
    private final ThrowableAnalyzer throwableAnalyzer;
    private RedirectStrategy authorizationRedirectStrategy;
    private OAuth2AuthorizationRequestResolver authorizationRequestResolver;
    private AuthorizationRequestRepository<OAuth2AuthorizationRequest> authorizationRequestRepository;
    private RequestCache requestCache;
```

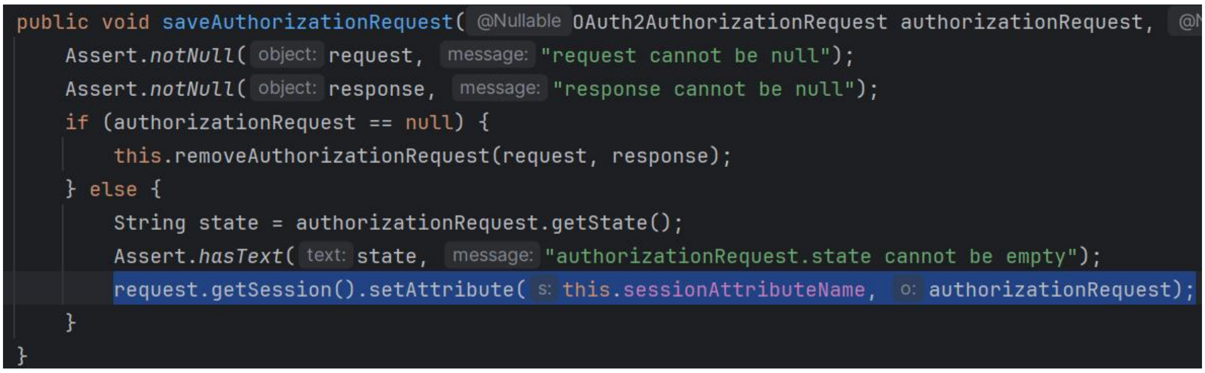
- There is a class called **ClientRegistration**,
  - It contains everything like *clientId, clientSecret, registrationId* (google, github ..etc), *redirectUri*
  - It doesn't contains **state** because it is generated after starting the application after reading the **application.yml** or **application.properties** file.
  - Here *redirectUri* will be in format
    - "{baseUrl}/login/oauth2/code/{registrationId}"



```
public final class ClientRegistration implements Serializable {
    private static final long serialVersionUID = 620L;
    private String registrationId;
    private String clientId;
    private String clientSecret;
    private ClientAuthenticationMethod clientAuthenticationMethod;
    private AuthorizationGrantType authorizationGrantType;
    private String redirectUri;
    private Set<String> scopes = Collections.emptySet();
    private ProviderDetails providerDetails = new ProviderDetails();
    private String clientName;
```

- The objects of **ClientRegistration** are stored in **ClientRegistrationRepository**.
  - **InMemoryClientRegistrationRepository** implements **ClientRegistrationRepository** is having one *Map* of *registrationId* to *ClientRegistration*
    - github : clientRegistration
    - google : clientRegistration
    - …. like this
  - 

```
public final class InMemoryClientRegistrationRepository implements Cl
    private final Map<String, ClientRegistration> registrations;
```

- Now it comes **OAuth2AuthorizationRequestResolver**
  - It create objects of type **OAuth2AuthorizationRequest** using **ClientRegistration** object.
  - It contains **state** as well and remaining things that ClientRegistration contains.
  - Here the *redirectUri* will be in the form:
    - "http://localhost:8080/login/oauth2/code/google"
    - It is complete URL.
- Now, the final object is there, it just needs to be stored in a safe place for future use. **AuthorizationRequestRepository** is used to store that.
  - It doesn't store in any *map* or *list*, it just store the AuthorizationRequest object in the ***session*** of the ***request*** object.
  - 

```
public void saveAuthorizationRequest( @Nullable OAuth2AuthorizationRequest authorizationRequest,  @N
    Assert.notNull( object: request,  message: "request cannot be null");
    Assert.notNull( object: response,  message: "response cannot be null");
    if (authorizationRequest == null) {
        this.removeAuthorizationRequest(request, response);
    } else {
        String state = authorizationRequest.getState();
        Assert.hasText( text: state,  message: "authorizationRequest.state cannot be empty");
        request.getSession().setAttribute( s: this.sessionAttributeName,  o: authorizationRequest);
    }
}
```

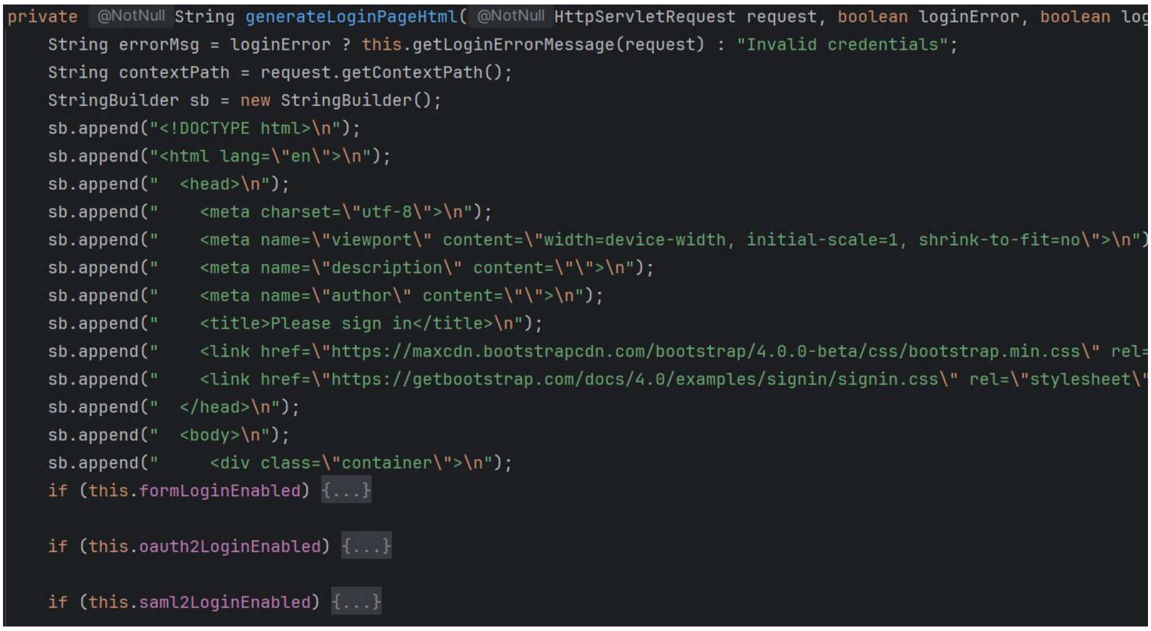
- Now, everything is done; our backend will send a redirect response to frontend, after seeing which the browser will redirect to that particular url (accounts.google.com ….)
- OAuth2LoginAuthenticationFilter
  - It contains an object of type **AuthorizationRequestRepository** and get the **OAuth2AuthorizationRequest** object from it.
  - It gets the response from OAuth2 provider and validate that with **OAuth2AuthorizationRequest** object, like **state** matching and all.
  - If any mismatch is there then it'll reject that.

- Then it create one token of type **OAuth2LoginAuthenticationToken** (just like UsernamePasswordAuthenticationToken in DaoAuthenticationProvider) and call the **authenticationManager.authenticate()** method.
- Now just like username password authentication flow, this **authenticate()**method call delegates to AuthenticationProvider's **authenticate()** method and here the AuthenticationProvider is **OAuth2LoginAuthenticationProvider** .
- **OAuth2LoginAuthenticatoinProvider** is the one who exchange the **code** to get the **tokens** .
  - It is done with the help of **DefaultAuthorizationCodeTokenResponseClient**

➢ ---

➢ Now, where is the filter that create the default login page for username password login form, oauth2 default login page.

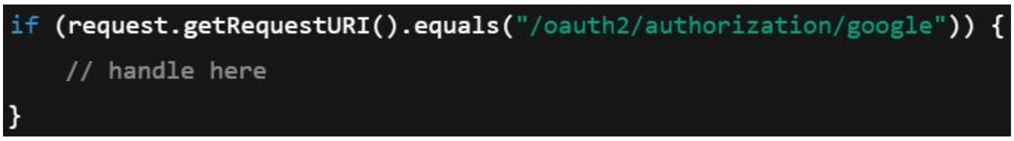
- The filter is **DefaultLoginPageGeneratingFilter**
- It generates the default login pages.



```
private  @NotNull String generateLoginPageHtml( @NotNull HttpServletRequest request, boolean loginError, boolean log
    String errorMsg = loginError ? this.getLoginErrorMessage(request) : "Invalid credentials";
    String contextPath = request.getContextPath();
    StringBuilder sb = new StringBuilder();
    sb.append("<!DOCTYPE html>\n");
    sb.append("<html lang=\"en\">\n");
    sb.append("  <head>\n");
    sb.append("    <meta charset=\"utf-8\">\n");
    sb.append("    <meta name=\"viewport\" content=\"width=device-width, initial-scale=1, shrink-to-fit=no\">\n")
    sb.append("    <meta name=\"description\" content=\"\">\n");
    sb.append("    <meta name=\"author\" content=\"\">\n");
    sb.append("    <title>Please sign in</title>\n");
    sb.append("    <link href=\"https://maxcdn.bootstrapcdn.com/bootstrap/4.0.0-beta/css/bootstrap.min.css\" rel=
    sb.append("    <link href=\"https://getbootstrap.com/docs/4.0/examples/signin/signin.css\" rel=\"stylesheet\"
    sb.append("  </head>\n");
    sb.append("  <body>\n");
    sb.append("     <div class=\"container\">\n");
    if (this.formLoginEnabled) {...}

    if (this.oauth2LoginEnabled) {...}

    if (this.saml2LoginEnabled) {...}
```

➢ **NOTE** --

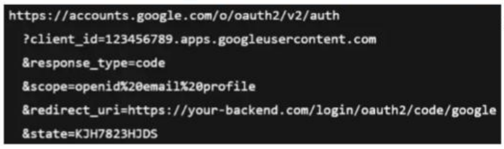
- The redirected URIs are matches at the **filter** level, not **servlet level**. Spring Security is completely ***filter based***.



```
if (request.getRequestURI().equals("/oauth2/authorization/google")) {
    // handle here
}
```

OAuth2 work-flow in general (I am taking **google** as OAuth2 provider)

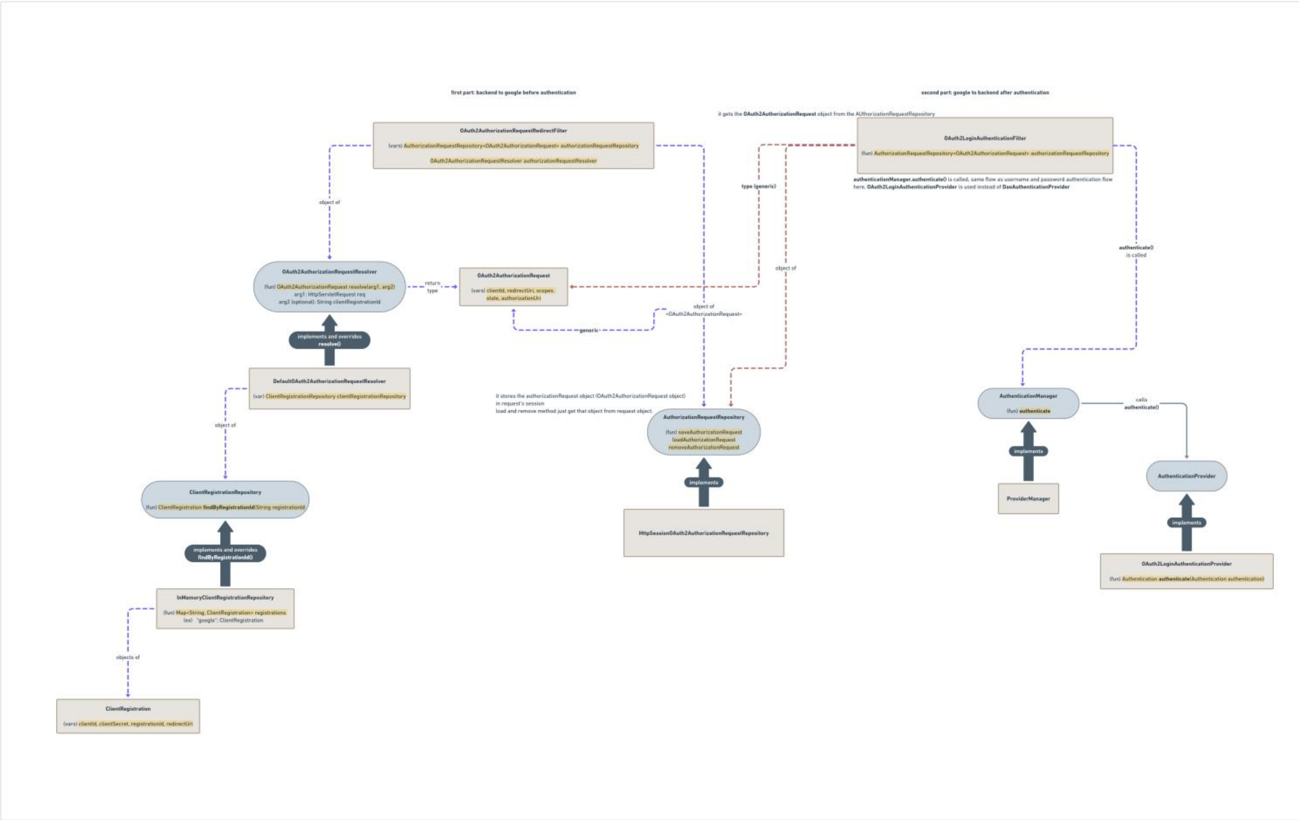
- 2 backend are involved here: **google's backend, our application backend**
- first, when the **signin with google** (or any other provider) button is clicked in the frontend, it'll call a **GET** request to **Application Backend**
    - in spring, this url is: **oauth2/authorization/google**
- now, **Application Backend** creates a proper url having client_id, client_secret, redirect_uri, state etc etc.
    - note **redirect_uri** and **state** here, it'll be used later....



```
https://accounts.google.com/o/oauth2/v2/auth
  ?client_id=123456789.apps.googleusercontent.com
  &response_type=code
  &scope=openid%20email%20profile
  &redirect_uri=https://your-backend.com/login/oauth2/code/google
  &state=KJH7823HJDS
```

status code **3xx** (which is meant for redirect)

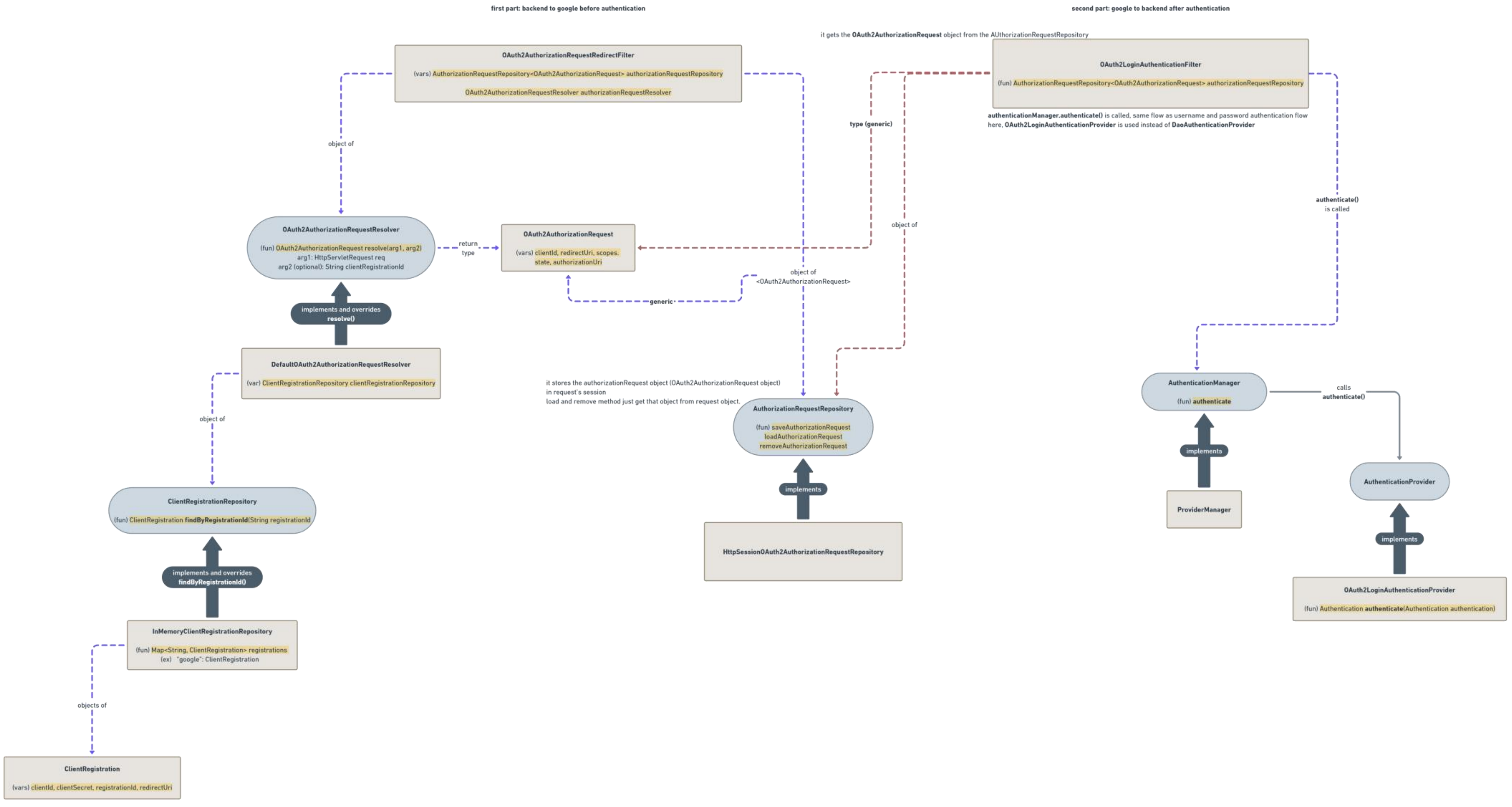
    -
    - `every browser's default behaviour is that it the response contains http status code` **`3xx`** `and there is a` **`location`** `field there, then it'll redirect it to that location; there is no involvement of frontend here, its completely at the browser level.`
- now the browser will redirect to **accounts.google.com/.....** and user will get a screen to select the google account, and grant the consents.
- After authenticating successfully, **google** will send a response (**3xx** and **location**) and location will contain that **redirect_uri** which was sent earlier.
- so now, browser will redirect to that **redirect_uri** which goes to **Application Backend**.
    - this **redirect_uri** will be
        - "https://www.your-backend.com/**login/oauth2/code/google?code=abc&state=xyz** "
- now this **state** will be checked, it should match with the **state** that was send to google before authentication.
- if validation are successful, then **application backend** will use that **code** and make one **POST** request to google to get the **tokens**.


first part: backend to google before authentication
OAuth2AuthorizationRequestRedirectFilter
(vars) AuthorizationRequestRepository<OAuth2AuthorizationRequest> authorizationRequestRepository
OAuth2AuthorizationRequestResolver authorizationRequestResolver
object of
OAuth2AuthorizationRequestResolver
(fun) OAuth2AuthorizationRequest resolve(arg1, arg2)
arg1: HttpServletRequest req
arg2 (optional): String clientRegistrationId
return type
OAuth2AuthorizationRequest
(vars) clientId, redirectUri, scopes, state, authorizationUri
generic
object of <OAuth2AuthorizationRequest>
implements and overrides resolve()
DefaultOAuth2AuthorizationRequestResolver
(var) ClientRegistrationRepository clientRegistrationRepository
object of
ClientRegistrationRepository
(fun) ClientRegistration findByRegistrationId(String registrationId
implements and overrides findByRegistrationId()
InMemoryClientRegistrationRepository
(fun) Map<String, ClientRegistration> registrations
(ex) "google": ClientRegistration
objects of
ClientRegistration
(vars) clientId, clientSecret, registrationId, redirectUri
AuthorizationRequestRepository
(fun) saveAuthorizationRequest
loadAuthorizationRequest
removeAuthorizationRequest
implements
HttpSessionOAuth2AuthorizationRequestRepository
second part: google to backend after authentication
OAuth2LoginAuthenticationFilter
(fun) AuthorizationRequestRepository<OAuth2AuthorizationRequest> authorizationRequestRepository
type (generic)
object of
authenticate() is called
AuthenticationManager
(fun) authenticate
calls authenticate()
implements
ProviderManager
AuthenticationProvider
implements
OAuth2LoginAuthenticationProvider
(fun) Authentication authenticate(Authentication authentication)

it stores the authorizationRequest object (OAuth2AuthorizationRequest object)
in request's session
load and remove method just get that object from request object.

it gets the **OAuth2AuthorizationRequest** object from the AUthorizationRequestRepository

authenticationManager.authenticate() is called, same flow as username and password authentication flow here, **OAuth2LoginAuthenticationProvider** is used instead of **DaoAuthenticationProvider**



first part: backend to google before authentication

second part: google to backend after authentication

it gets the **OAuth2AuthorizationRequest** object from the AUthorizationRequestRepository

authenticationManager.authenticate() is called, same flow as username and password authentication flow here, **OAuth2LoginAuthenticationProvider** is used instead of **DaoAuthenticationProvider**

it stores the authorizationRequest object (OAuth2AuthorizationRequest object)
in request's session
load and remove method just get that object from request object.

OAuth2AuthorizationRequestRedirectFilter
(vars) AuthorizationRequestRepository<OAuth2AuthorizationRequest> authorizationRequestRepository
OAuth2AuthorizationRequestResolver authorizationRequestResolver
object of
OAuth2AuthorizationRequestResolver
(fun) OAuth2AuthorizationRequest resolve(arg1, arg2)
arg1: HttpServletRequest req
arg2 (optional): String clientRegistrationId
return type
OAuth2AuthorizationRequest
(vars) clientId, redirectUri, scopes, state, authorizationUri
generic
object of
<OAuth2AuthorizationRequest>
implements and overrides resolve()
DefaultOAuth2AuthorizationRequestResolver
(var) ClientRegistrationRepository clientRegistrationRepository
object of
ClientRegistrationRepository
(fun) ClientRegistration findByRegistrationId(String registrationId
implements and overrides findByRegistrationId()
InMemoryClientRegistrationRepository
(fun) Map<String, ClientRegistration> registrations
(ex) "google": ClientRegistration
objects of
ClientRegistration
(vars) clientId, clientSecret, registrationId, redirectUri
AuthorizationRequestRepository
(fun) saveAuthorizationRequest
loadAuthorizationRequest
removeAuthorizationRequest
implements
HttpSessionOAuth2AuthorizationRequestRepository
OAuth2LoginAuthenticationFilter
(fun) AuthorizationRequestRepository<OAuth2AuthorizationRequest> authorizationRequestRepository
type (generic)
object of
authenticate() is called
AuthenticationManager
(fun) authenticate
calls authenticate()
implements
ProviderManager
AuthenticationProvider
implements
OAuth2LoginAuthenticationProvider
(fun) Authentication authenticate(Authentication authentication)

Made with Whimsical

Part-1: application backend to oauth2 provider's backend

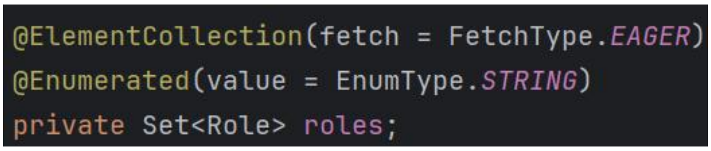
- First the request come to **OAuth2AuthorizationRequestRedirectFilter**
- It contains 2 parts:
  - one part builds the **OAuth2AuthorizationRequest** object (which is the final object which will be sent to oauth2 provider)
  - another part will save that object when the control goes to OAuth2 provider.
- **ClientRegistration** is a class that contains all the details of the Client i.e. client id, client secret, registrationId, redirectUri etc; but it *doesn't contain the state.*
  - here **redirectUri** is in the form: *"{baseUrl}/login/oauth2/code/{registrationId}"*
- There is a repository that stores all the **ClientRegistration** objects, which is **ClientRegistrationRepository**.
  - It contains a method **findByRegistrationId** which gives the ClientRegistration object for the particular registrationId (registrationId is nothing but "google", "facebook", "github")
- So, now we have all the objects os **ClientRegistration**, but we need to make the object proper to send in the request to OAuth2 provider.
  - because it has only templates kind of things. like you can see **redirectUri** is just a template, there is no **state** present here.
  - So, there is a **resolver** class which is named as **DefaultOAuth2AuthorizatoinRequestResolver** which takes the **ClientRegistration** object and create a **OAuth2AuthorizationRequest** object which contains fully ready values that can be sent to OAuth2 provider directly.
  - here **state** will be present.
  - here the **redirectUri** will be in the form of: "http://localhost:8080/login/oauth2/code/google"
- Now, everything is completed, just the request has to be sent to OAuth2 provider; but we need to keep the object somewhere to validate after getting the response from OAuth2 provider.
  - So, there is a repository **AuthorizationRequestRepository** is there to store the **OAuth2AuthorizationRequest** object.
  - it doesn't store those objects in any list or map, it just creates one attribute in the **request** object and store there.

Part-2: oauth2 provider to application's backend

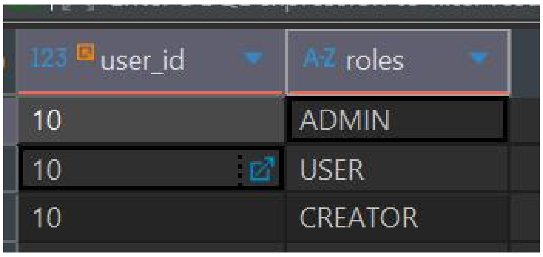
- **OAuth2LoginAuthenticationFilter** is the first filter in this case.
- it gets the **OAuth2AuthorizationObject** from the **AuthorizationRequestRepository** .
- then it validate the details from the response of OAuth2 provider with the OAuth2AuthorizationObject, for example **state** will be checked.
- if any mismatch is there, then it'll reject it.
- after that it'll simply call the **authenticate()** method of **authenticationManager**, just like we do in case of **username and password authentication**.
  - here the authentication token will be of type: **OAuth2LoginAuthenticationToken**
- then this **authentication()** method call will be delegated to **AuthenticationProvider**'s **authenticaion()** method and in case of OAuth2, the *AuthenticationProvider* is **OAuth2LoginAuthenticationProvider**.
- this **OAuth2LoginAuthenticationProvider** exchange the **code** that was gotten from OAuth2 provider's response and get the **tokens** like id_token, accessToken etc etc.
- this **id_token** contains the necessary details about the user that we want like username, email etc etc.
- after that it just store the authentication object in security context and we can get the details using **getPrincipal()** method just like username and password authentication.

➢ Authorization

➢ @ElementCollection

- If we write this annotation on a field inside the entity, it'll create a separate table in database and store those.
- It is only used in case of collections like **list, set** ..etc.
- You can say it is like **one-to-many** relation type, but that's not correct;
  - In case of relation (one-to-many or many-to-one), both the entities are having their own **primary keys**, but in this case, the field that is being stores as a collection is not having any primary key.
- Relation are created where both the entities are independent and both are having their own primary keys, but **@ElementCollection** just store the values not the new entity.
- 

```
@ElementCollection(fetch = FetchType.EAGER)
@Enumerated(value = EnumType.STRING)
private Set<Role> roles;
```

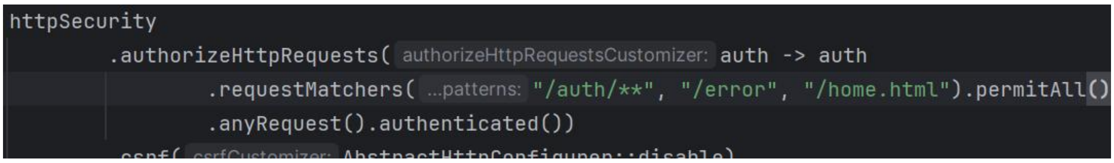
- Here **Role** is just a enum, not an entity and it doesn't have its own identity.
- 

user_id	roles
10	ADMIN
10	USER
10	CREATOR

- It is the **user_roles** table which is created due to **@ElementCollection**, it doesn't have any primary key; it just map the **user_id** to a particular value.
- As I have set **@Enumerated** here for **EnumType.STRING**, so the values are being stored in the database; otherwise the ordinals i.e. 0,1,2,… would have been stored.

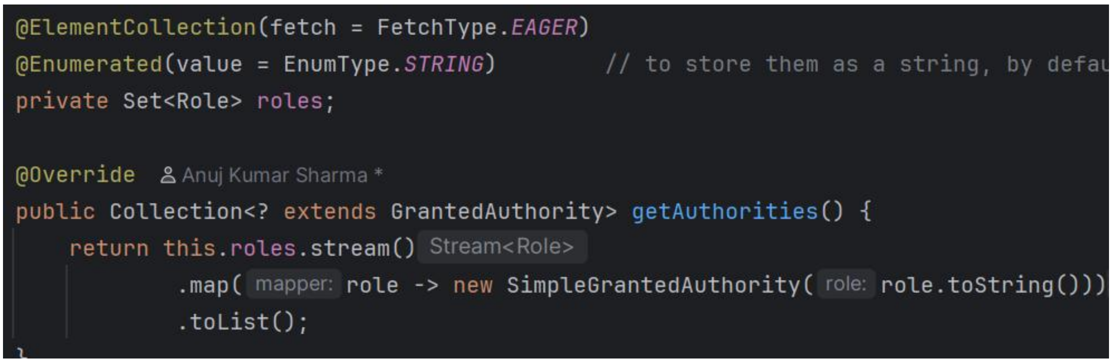
➢ Role is the main concept for **authorization**. Depending upon the role of the user, it'll be decided that what are the thing he/she can access.

➢ We can the particular *routes* as authorized for some particular type of users

- 

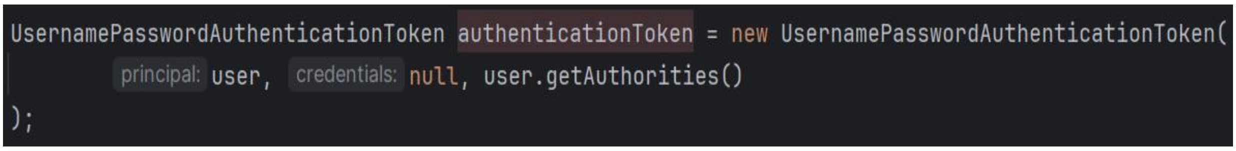
```
httpSecurity
        .authorizeHttpRequests( authorizeHttpRequestsCustomizer: auth -> auth
                .requestMatchers( ...patterns: "/auth/**", "/error", "/home.html").permitAll()
                .anyRequest().authenticated())
        .csrf( csrfCustomizer: AbstractHttpConfigurer::disable)
```

    - Here we are simply writing **permitAll** and remaining request as authenticated.

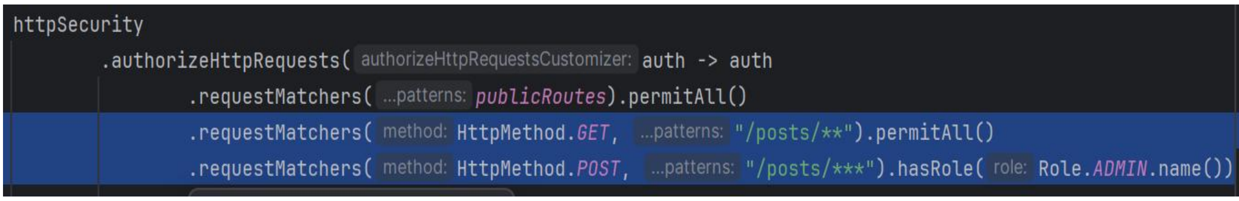
- 

```
@ElementCollection(fetch = FetchType.EAGER)
@Enumerated(value = EnumType.STRING)        // to store them as a string, by defau
private Set<Role> roles;

@Override   Anuj Kumar Sharma *
public Collection<? extends GrantedAuthority> getAuthorities() {
    return this.roles.stream() Stream<Role>
            .map( mapper: role -> new SimpleGrantedAuthority( role: role.toString()))
            .toList();
}
```

  - Here just return the **SimpleGrantedAuthority** type of object.
  - Because the return type is something that extends **GrantedAuthority** and SimpleGrantedAuthority is the basic implementation of GrantedAuthority.

- In the JWT filter while creating the **UsernamePasswordAuthenticationToken**, make sure to set the **authorities** field, otherwise no user will be having any authorities.
  - Spring Security calls **auth.getAuthorities()** (auth is the Authentication object) and validate the authorities.
  - 

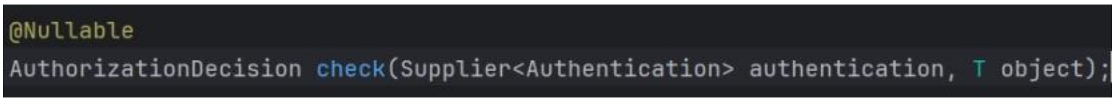
```
UsernamePasswordAuthenticationToken authenticationToken = new UsernamePasswordAuthenticationToken(
        principal: user,  credentials: null, user.getAuthorities()
);
```

- You can also set authorization for different type of request i.e. GET, POST, ..etc
  - 

```
httpSecurity
        .authorizeHttpRequests( authorizeHttpRequestsCustomizer: auth -> auth
                .requestMatchers( ...patterns: publicRoutes).permitAll()
                .requestMatchers( method: HttpMethod.GET,  ...patterns: "/posts/**").permitAll()
                .requestMatchers( method: HttpMethod.POST,  ...patterns: "/posts/***").hasRole( role: Role.ADMIN.name())
```

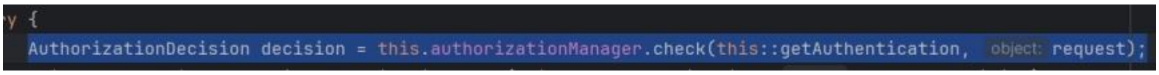
- F

- **The flow happens like the below**
  - **AuthorizationFilter** is the first one that comes in case of authorization.
  - Just like AuthenticationManager, one interface **AuthorizationManager** is also there that contains one method **check()**

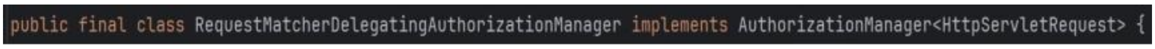
    ```
    @Nullable
    AuthorizationDecision check(Supplier<Authentication> authentication, T object);
    ```

  - **AuthorizationFilter** is having the method **doFilter** which calls this **check()** method of **AuthorizationManager**

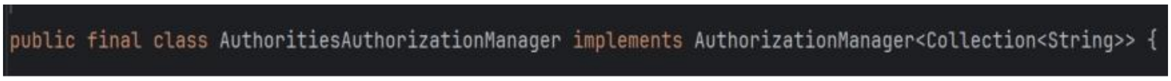
    ```
    y {
      AuthorizationDecision decision = this.authorizationManager.check(this::getAuthentication,  object: request);
    ```

  - The class **RequestMatcherDelegatingAuthorizationManager** implements **AuthorizationManager** passing the generics as **HttpServletRequest** so it get called.

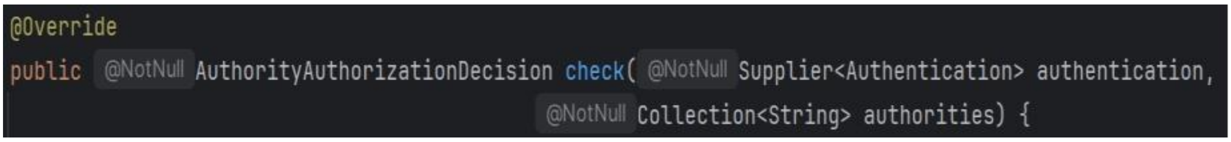
    

    ```
    public final class RequestMatcherDelegatingAuthorizationManager implements AuthorizationManager<HttpServletRequest> {
    ```

  - After this, **check()** method of this *RequestMatcherDelegatingAuthorizationManager* calls the **check()** method of **AuthoritiesAuthorizationManager** (it is another child class of **AuthorizationManager** and it implements marking the generics as **Collection<String>**) and here the authorities are checked.

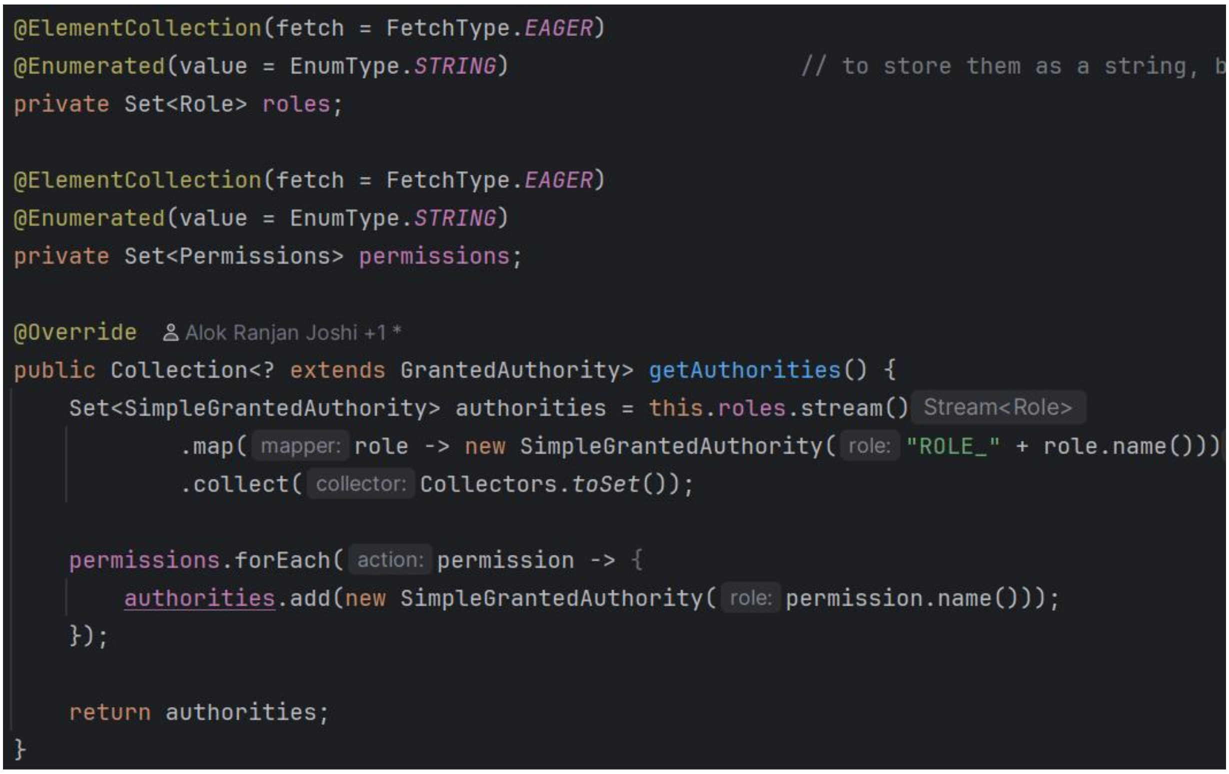
    ```
    public final class AuthoritiesAuthorizationManager implements AuthorizationManager<Collection<String>> {
    ```

  - 

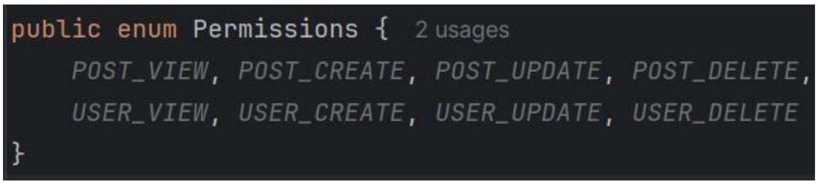
    ```
    @Override
    public @NotNull AuthorityAuthorizationDecision check( @NotNull Supplier<Authentication> authentication,
                                                          @NotNull Collection<String> authorities) {
    ```

    - It gets the **authentication** object and **authorities**
    - Here **authorities** means the authorities required to access the *route.*
    - It'll fetch the **authorities** from the **authentication** object, and check if any of those authorities is present in the ***required authorities*** list.
- F

- **hasRole** vs **hasAuthorities**
  - **hasRole(“ADMIN”)** is just a syntactic sugar for **hasAuthorities(“ROLE_ADMIN”)**
  - If you are storing the roles with the prefix **ROLE_** then **hasRole()** is handy.
  - For example: ROLE_USER, ROLE_ADMIN … are the roles present inside database.
    - Here we can just write **hasRole(“USER”)** --- it’ll automatically add the prefix ROLE_ and check i.e. it’ll be checked as **ROLE_USER**.
    - If you write **hasAuthorities(“USER”)** then it’ll be checked as **USER** only.
- **Role** is kind of top-level authorization like which type of user can access what. **Authority** is bottom level authorization, like more granular authorization.
  - Lets suppose USER, ADMIN are the roles.
  - USER can view the things, you can give it the authorities like VIEW_POST, VIEW_USER
  - ADMIN can do everything, so you can give it the authorities like CREATE_POST, DELETE_POST etc etc.
  - In simpler terms, **role** is top level permissions; after role **authorities** decide the low level permissions.
- I created one **Authority** enum and implemented the below:

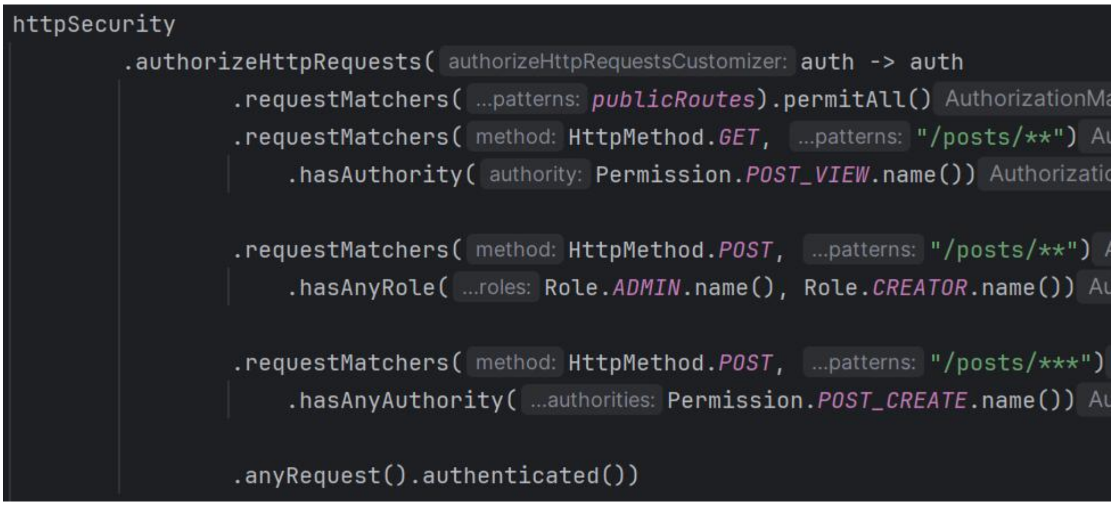


```
@ElementCollection(fetch = FetchType.EAGER)
@Enumerated(value = EnumType.STRING)                    // to store them as a string, b
private Set<Role> roles;

@ElementCollection(fetch = FetchType.EAGER)
@Enumerated(value = EnumType.STRING)
private Set<Permissions> permissions;

@Override  Alok Ranjan Joshi +1 *
public Collection<? extends GrantedAuthority> getAuthorities() {
    Set<SimpleGrantedAuthority> authorities = this.roles.stream() Stream<Role>
            .map( mapper: role -> new SimpleGrantedAuthority( role: "ROLE_" + role.name()))
            .collect( collector: Collectors.toSet());

    permissions.forEach( action: permission -> {
        authorities.add(new SimpleGrantedAuthority( role: permission.name()));
    });

    return authorities;
}
```



```
public enum Permissions {  2 usages
    POST_VIEW, POST_CREATE, POST_UPDATE, POST_DELETE,
    USER_VIEW, USER_CREATE, USER_UPDATE, USER_DELETE
}
```

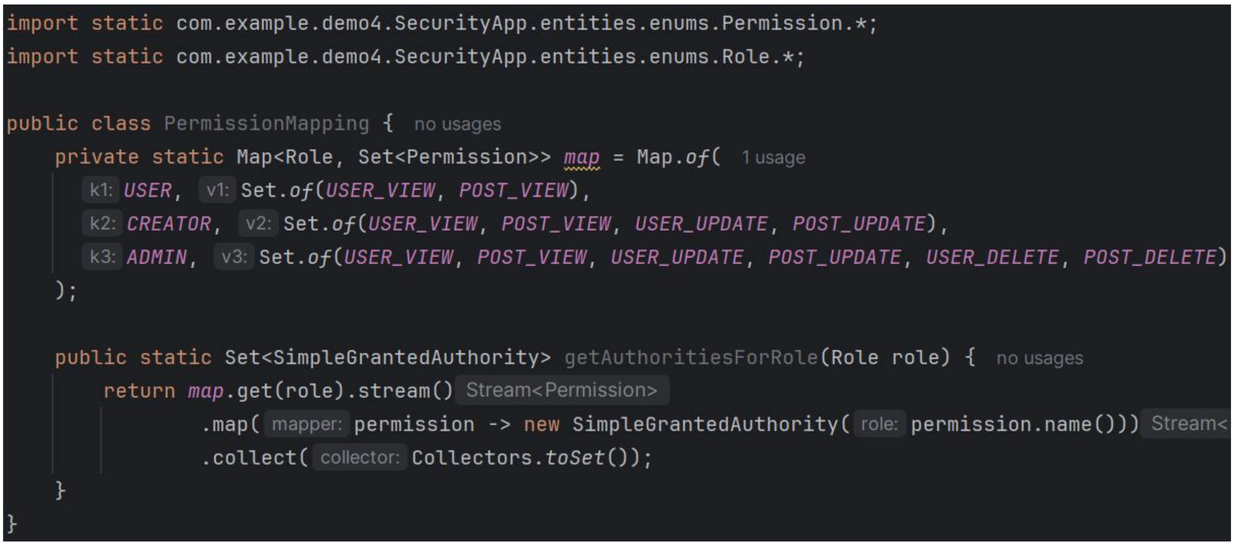
- Now you have to add those authorization in the custom filter chain



```
httpSecurity
        .authorizeHttpRequests( authorizeHttpRequestsCustomizer: auth -> auth
                .requestMatchers( ...patterns: publicRoutes).permitAll() AuthorizationMa
                .requestMatchers( method: HttpMethod.GET,  ...patterns: "/posts/**") Au
                    .hasAuthority( authority: Permission.POST_VIEW.name()) Authorizatic

                .requestMatchers( method: HttpMethod.POST,  ...patterns: "/posts/**") A
                    .hasAnyRole( ...roles: Role.ADMIN.name(), Role.CREATOR.name()) Au

                .requestMatchers( method: HttpMethod.POST,  ...patterns: "/posts/***")
                    .hasAnyAuthority( ...authorities: Permission.POST_CREATE.name()) Au

                .anyRequest().authenticated())
```

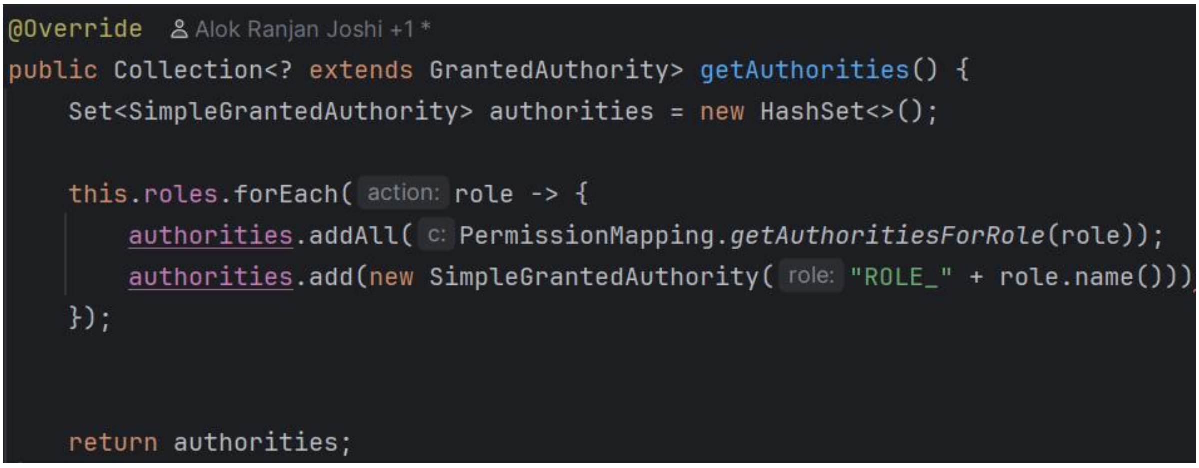
- You can write **hasAuthority() or hasAnyAuthority()** and **hasRole() or hasAnyRole()** with the same ***requestMatchers()***, you need to write one ***requestMathcer()*** for ***role*** or ***authority***.
- You can give multiple authorities like this way.

- Otherwise you can create a hard-coded maps of **roles** with **permissions** like some particular role user can have some particular set of permissions.



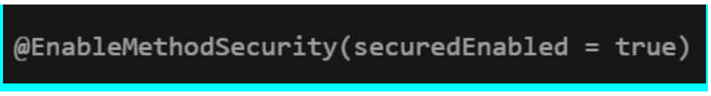
```
import static com.example.demo4.SecurityApp.entities.enums.Permission.*;
import static com.example.demo4.SecurityApp.entities.enums.Role.*;

public class PermissionMapping {  no usages
    private static Map<Role, Set<Permission>> map = Map.of(  1 usage
        k1: USER,  v1: Set.of(USER_VIEW, POST_VIEW),
        k2: CREATOR,  v2: Set.of(USER_VIEW, POST_VIEW, USER_UPDATE, POST_UPDATE),
        k3: ADMIN,  v3: Set.of(USER_VIEW, POST_VIEW, USER_UPDATE, POST_UPDATE, USER_DELETE, POST_DELETE)
    );

    public static Set<SimpleGrantedAuthority> getAuthoritiesForRole(Role role) {  no usages
        return map.get(role).stream() Stream<Permission>
                .map( mapper: permission -> new SimpleGrantedAuthority( role: permission.name())) Stream<
                .collect( collector: Collectors.toSet());
    }
}
```

- NOTE: You can import **enum values** directly using **import static**
- Now you don't need to store the ***permissions*** in the database.



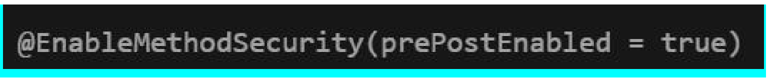
```
@Override  Alok Ranjan Joshi +1 *
public Collection<? extends GrantedAuthority> getAuthorities() {
    Set<SimpleGrantedAuthority> authorities = new HashSet<>();

    this.roles.forEach( action: role -> {
        authorities.addAll( c: PermissionMapping.getAuthoritiesForRole(role));
        authorities.add(new SimpleGrantedAuthority( role: "ROLE_" + role.name()))
    });


    return authorities;
```

- As we can see, writing this many logic in the **WebSecurityConfig** is creating overhead and messy.
    - In case of real world project, there will be so many paths, roles, permissions and if we write all those authorization then it'll be very complicated.
    - Therefore **@Secured** and **@PreAuthorize** and **@PostAuthorize** are used.
    - These are used for **method level authorization**, we just need to write these with the methods.
    - **@EnableMethodSecurity** is required to use these annotations. Just write once on any **Component** class (you can write with any class having *@Configuration* or *@Component*)
    - For using **@Secured**, you need to write



```
@EnableMethodSecurity(securedEnabled = true)
```

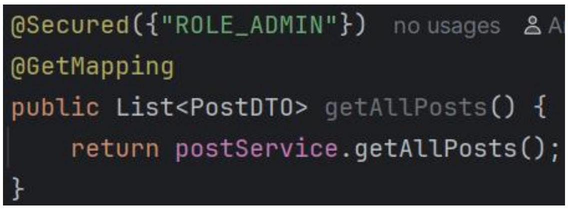
    - For using **@PreAuthorize** or **@PostAuthorize**, you need to write



```
@EnableMethodSecurity(prePostEnabled = true)
```

        - By default **prePostEnabled** is **true** only, so even if you don't mention this explicitly, it'll work.

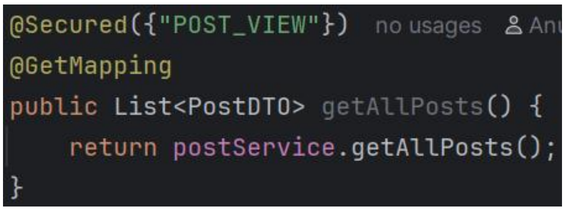
- **@Secured**
    - It'll only work for **roles**, i.e. having **ROLE_** prefix.
    - It'll not work for any other permissions like POST_VIEW, POST_DELETE etc etc.
    - **ROLE_** must be there otherwise it'll not work.



```
@Secured({"ROLE_ADMIN"})  no usages  A
@GetMapping
public List<PostDTO> getAllPosts() {
    return postService.getAllPosts();
}
```

        - Now the users having roles other than **ADMIN** will not be able to access this.

    - NOTE: You need to write **ROLE_ADMIN** here, only **ADMIN** will not work.

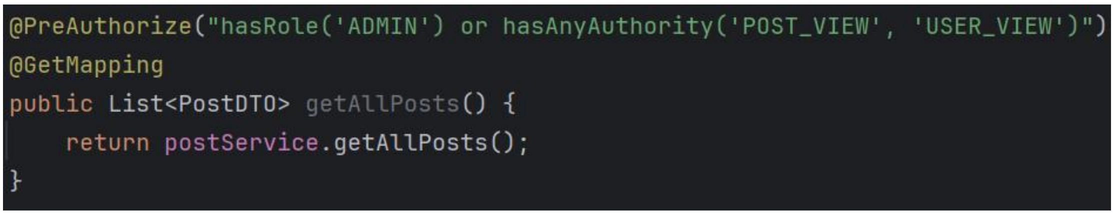


```
@Secured({"POST_VIEW"})  no usages  An
@GetMapping
public List<PostDTO> getAllPosts() {
    return postService.getAllPosts();
}
```

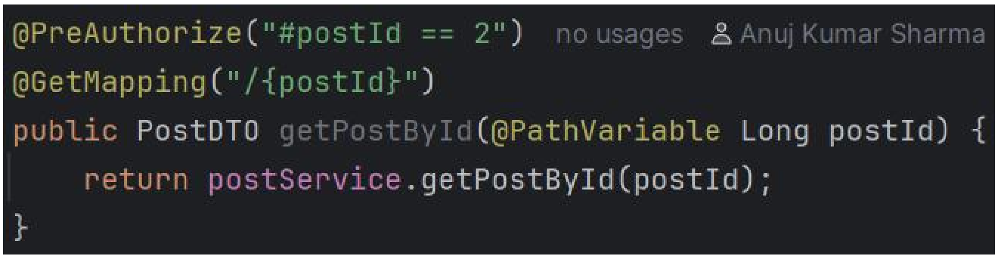
        - I wrote this POST_VIEW and tried to access the posts from the user who has POST_VIEW permission. But it didn't work.

- So, permissions having prefix **ROLE_** will only work in case of **@Secured**

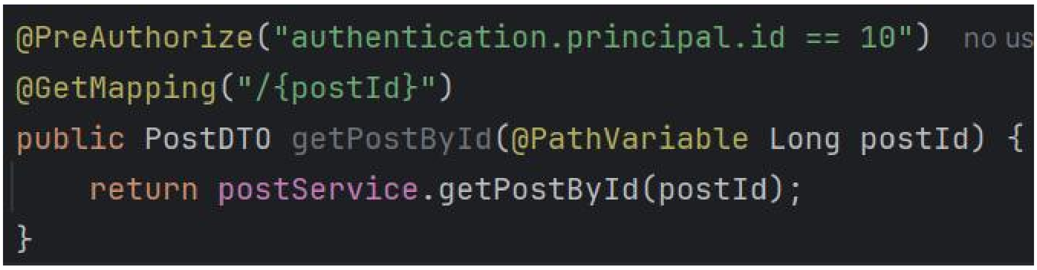
@PreAuthorized

- It is widely used; @Secured is used very rarely (negligible)
- It can access the **arguments of the method**.
- It supports **role, permissions, conditions** (and, or etc), **parameters** (method arguments)
- You can write **hasRole**, **hasAnyRole**, **hasAuthority**, **hasAnyAuthority** …etc etc inside it.
- 

```
@PreAuthorize("hasRole('ADMIN') or hasAnyAuthority('POST_VIEW', 'USER_VIEW')")
@GetMapping
public List<PostDTO> getAllPosts() {
    return postService.getAllPosts();
}
```

  - We can write the query like this. You can use **and** or **or** and write multiple filters (authorizing filters; not spring filters…) here.
- 

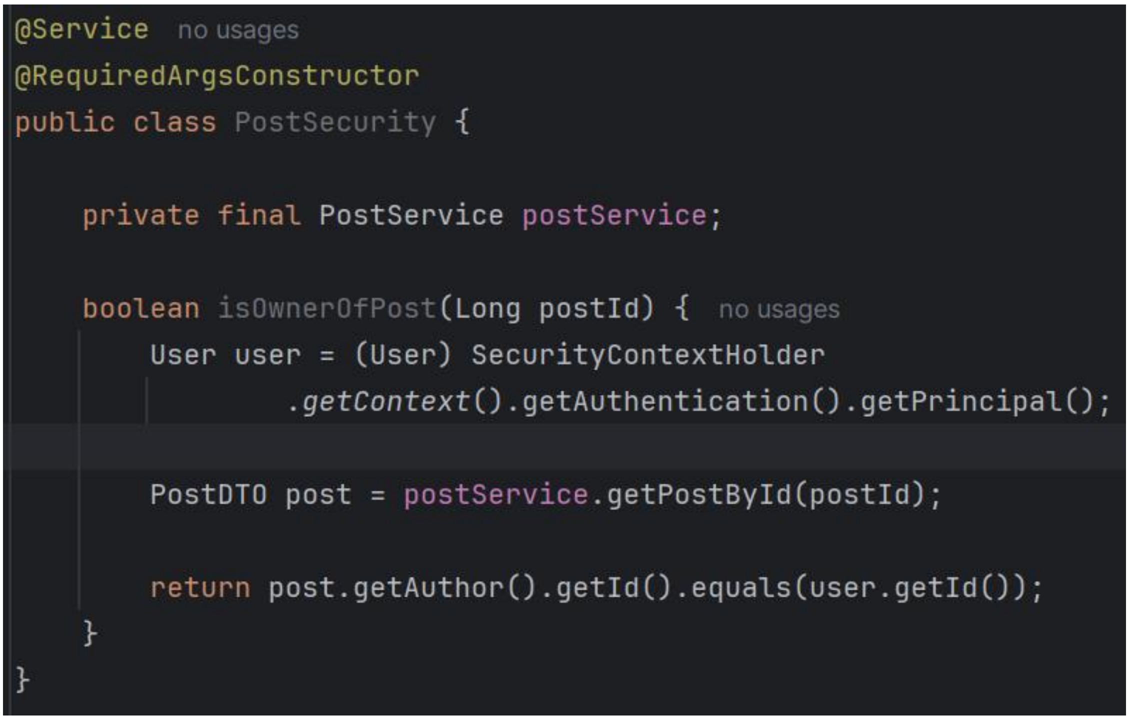
```
@PreAuthorize("#postId == 2")  no usages  Anuj Kumar Sharma
@GetMapping("/{postId}")
public PostDTO getPostById(@PathVariable Long postId) {
    return postService.getPostById(postId);
}
```

  - You can also access the method arguments using #
  - In here I accessed *postId* using **#postId**
- Also you can access **authentication** object inside **@PreAuthorize**.
  - 

```
@PreAuthorize("authentication.principal.id == 10")  no us
@GetMapping("/{postId}")
public PostDTO getPostById(@PathVariable Long postId) {
    return postService.getPostById(postId);
}
```

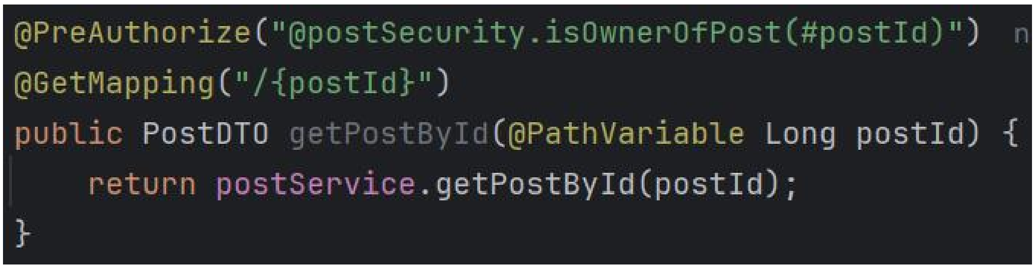
  - NOTE: here don’t make getter function call;
  - Just write **authentication.principal.id** or something like that.
  - But, if the **authentication** is null, then it’ll fail ***silently***.

- You can also create Security service for authorization; and it is recommended.
    - I want to display the post that was searched by **postId**, only if the user is the author of this post.



```
@Service  no usages
@RequiredArgsConstructor
public class PostSecurity {

    private final PostService postService;

    boolean isOwnerOfPost(Long postId) {  no usages
        User user = (User) SecurityContextHolder
                .getContext().getAuthentication().getPrincipal();

        PostDTO post = postService.getPostById(postId);

        return post.getAuthor().getId().equals(user.getId());
    }
}
```

- Created one service **PostSecurity** and wrote this method inside that.



```
@PreAuthorize("@postSecurity.isOwnerOfPost(#postId)")  n
@GetMapping("/{postId}")
public PostDTO getPostById(@PathVariable Long postId) {
    return postService.getPostById(postId);
}
```

- The bean of **PostSecurity** can be accessed by **@postSecurity** inside the **@PreAuthorize** , and the argument *postId* can be accessed as **#postId**
- **p** will be ***small*** in **@postSecurity** because the bean name will be **postSecurity** by default.

- You can write **@Secured**, **@PreAuthorize, @PostAuthorize** anywhere; but it is the best practice to use those at **controller** level; because in case of unauthorized condition, the control should not even go to the method.
- F
- F
- F
- F
- F

- F
- F
- F

- F
- F
- F
- F
- F