OTH-Regensburg
Übungen zur Vorlesung
Softwareentwicklung

Übung Nr. 9
Restful APIs mit JWT gesichert

Ziele:

- Erstellen Sie eine Spring Boot-Anwendung mit einer RESTful-API zur Benutzerverwaltung.
- Implementieren Sie Benutzerauthentifizierung und -autorisierung mit JWT-Token.
- Sichern Sie die API-Endpunkte mit JWT-Authentifizierung.
- Speichern Sie Benutzeranmeldeinformationen in einer Datenbank.

Aufgabe 1 – Erstellen eines neuen Projekts und der Abhängigkeiten

• Importieren Sie die folgenden Abhängigkeiten for Maven:

Spring Web
Spring Security
Spring Data JPA
H2
Spring Security JWT:

```
<dependency>
 <groupId>io.jsonwebtoken</groupId>
  <artifactId>jjwt-api</artifactId>
  <version>0.11.5</version>
</dependency>
<dependency>
  <groupId>io.jsonwebtoken</groupId>
  <artifactId>jjwt-impl</artifactId>
  <version>0.11.5</version>
</dependency>
<dependency>
  <groupId>io.jsonwebtoken</groupId>
  <artifactId>jjwt-jackson</artifactId>
  <version>0.11.5</version>
</dependency>
```

Fügen Sie der Datei application.properties diese Werte hinzu:

```
spring.messages.basename=messages
server.error.include-binding-errors=always

#DB
spring.datasource.url=jdbc:h2:mem:testdb;MODE=MySQL;NON_KEYWORDS=USER;
spring.datasource.driverClassName=org.h2.Driver
spring.datasource.username=sa
spring.datasource.password=password
spring.jpa.database-platform=org.hibernate.dialect.H2Dialect
#spring.data.jpa.repositories.bootstrap-mode=default

spring.jpa.defer-datasource-initialization=true
spring.jpa.hibernate.ddl-auto=update
spring.sql.init.mode=always

spring.h2.console.enabled=true
spring.h2.console.path=/h2-console

spring.devtools.restart.log-condition-evaluation-delta=false
security.jwt.secret-key="ITR.connectToATT(PabcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789P,
PabcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789P)";
# 1h in millisecond
security.jwt.expiration-time=3600000
```

Fügen Sie der Datei data.sql diese Werte hinzu:

```
INSERT INTO USER (email, password, login, active) VALUES ( 'thomas@gmail.com',
'$2a$12$8K4uC9YPl659Qnz6NUqy9e35xsoQ/OIsaVhIWRJP913VpsulQGZNy', 'thomas', 1);
INSERT INTO USER (email, password, login, active) VALUES ( 'anja@gmail.com',
'$2a$12$8K4uC9YPl659Qnz6NUqy9e35xsoQ/OIsaVhIWRJP913VpsulQGZNy', 'anja', 1);

INSERT INTO AUTHORITY (description) VALUES ( 'ADMIN');
INSERT INTO AUTHORITY (description) VALUES ( 'STUDENT');
```

Aufgabe 2- Erstellen Sie die User, Authority, Repository , MyUserDetailsService und DTO classes:

```
@Entity
public class User {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private Long id;
   private String username;
   private String password;
   // ... other fields as needed
}
```

```
public interface UserRepository extends JpaRepository<User, Long> {
   User findByUsername(String username);
}
```

```
public class Authority implements Serializable{

        @Id
        @GeneratedValue(strategy = GenerationType.IDENTITY)
        private Long id;

        private String description;

//getters and setters

}
```

```
public interface AuthorityRepository extends JpaRepository<Authority, Long> {

}
```

```
@Service
public class MyUserDetailsService implements UserDetailsService {
   @Autowired
   private UserRepository userRepository;

   @Override
   public UserDetails loadUserByUsername(String username) throws
UsernameNotFoundException {
      User user = userRepository.findByUsername(username);
      if (user == null) {
         throw new UsernameNotFoundException("User not found");
      }
      return new org.springframework.security.core.userdetails.User(user.getUsername(),
user.getPassword(), new ArrayList<>());
   }
}
```

```
public class AuthenticationRequest implements Serializable {

        private static final long serialVersionUID = 1L;

        private String username;
         private String password;

        //getters and setters
}
```

```
public class AuthenticationResponse implements Serializable {

        private static final long serialVersionUID = 1L;
        private final String jwt;

   public AuthenticationResponse(String jwt) {
      this.jwt = jwt;
   }

   public String getJwt() {
      return jwt;
   }
}
```

```
public class RegisterRequest implements Serializable{

        private static final long serialVersionUID = 1L;
        private String username;
        private String password;
        private String email;

        private ArrayList<Authority> myauthorities = new ArrayList<>() ;

//getters and setters
```

Aufgabe 3- Packet Config: SecurityConfig, JwtAuthenticationFilter und JwtService

```
@Configuration
@EnableWebSecurity
public class SecurityConfiguration {

		@Autowired
		MyUserDetailsService userDetailsService;

		@Autowired
		private JwtAuthenticationFilter jwtRequestFilter;

		 @Bean
		 public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

			  http.authorizeHttpRequests(rQ -> {
			  rQ.requestMatchers("/api/users ", "/api/users/authenticate").permitAll();

			  rQ.requestMatchers("/api/search", "/api/demo", "/api/profile").authenticated();

			 });

		 http.formLogin()
		  //.loginPage("/login") , if you want to have a customized login page....
		  .and()
		  .logout()
		  //where the user goes after the logout
		  .logoutSuccessUrl("/login")
		  .invalidateHttpSession(true)

		  .permitAll();


		 http
			.headers(headers -> headers
			   .frameOptions(frameOptions -> frameOptions
				  .sameOrigin())
			);

				http.csrf(AbstractHttpConfigurer::disable);

				http.addFilterBefore(jwtRequestFilter, UsernamePasswordAuthenticationFilter.class);

		   return http.build();
		 }


		 @Bean
		   public AuthenticationManager authenticationManager(
					AuthenticationConfiguration authenticationConfiguration) throws Exception {
			  return authenticationConfiguration.getAuthenticationManager();
		   }

		@Bean
		  public PasswordEncoder getPasswordEncoder() {
					return new BCryptPasswordEncoder();
					//return NoOpPasswordEncoder.getInstance();
		   }
}
```

```java
//class "Utils" used to manipulate the token, extracting important information from it like username, expiration date etc.
@Service
public class JwtService {

		@Value("${security.jwt.secret-key}")
		private String SECRET_KEY;
		@Value("${security.jwt.expiration-time}")
		private long Expiration_Time;
		//private final long Expiration_Time= 1000 * 60 * 60 * 10;
  private final String PREFIX= "Bearer ";


  private Key getSigningKey() {
		  byte[] keyBytes = this.SECRET_KEY.getBytes(StandardCharsets.UTF_8);
		  return Keys.hmacShaKeyFor(keyBytes);
		}

  public String extractUsername(String token) {
    return extractClaim(token, Claims::getSubject);
  }

  public Date extractExpiration(String token) {
    return extractClaim(token, Claims::getExpiration);
  }

  public <T> T extractClaim(String token, Function<Claims, T> claimsResolver) {
    final Claims claims = extractAllClaims(token);
    return claimsResolver.apply(claims);
  }

  private Claims extractAllClaims(String token) {
    return Jwts
        .parserBuilder()
        .setSigningKey(this.getSigningKey())
        .build()
        .parseClaimsJws(token)
        .getBody();
   }

  private Boolean isTokenExpired(String token) {
    return extractExpiration(token).before(new Date());
  }

  public String generateToken(UserDetails userDetails) {
    Map<String, Object> claims = new HashMap<>();
    return createToken(claims, userDetails.getUsername());
  }

  private String createToken(Map<String, Object> claims, String subject) {

    return Jwts.builder().setClaims(claims).setSubject(subject).setIssuedAt(new Date(System.currentTimeMillis()))
        .setExpiration(new Date(System.currentTimeMillis() + Expiration_Time))
        .signWith(getSigningKey())
        .compact();
  }

  public Boolean validateToken(String token, UserDetails userDetails) {
    final String username = extractUsername(token);
    return (username.equals(userDetails.getUsername()) && !isTokenExpired(token));
  }

 public String getSECRET_KEY() {
				return SECRET_KEY;
}

 public long getExpiration_Time() {
				return Expiration_Time;
}

 public String getPREFIX() {
				return PREFIX;
}

}
```

```
//Additional filter to intercept the request and check if there is a token on its header and validate it.
//If there is, then it will try to validate the token.
//If there is not, the user should authenticate himself in the sequence.

@Component
public class JwtAuthenticationFilter extends OncePerRequestFilter {

   @Autowired
   private MyUserDetailsService userDetailsService;

   @Autowired
   private JwtService jwtService;

   @Override
   protected void doFilterInternal(
                              jakarta.servlet.http.HttpServletRequest request,
                              HttpServletResponse response,
                              FilterChain chain)
         throws jakarta.servlet.ServletException, IOException {

               //this comes from the header of the request
      final String authorizationHeader = request.getHeader("Authorization");


      String username = null;
      String jwt = null;

      //if the authorization content in the header is not null and starts with "Bearer "...
      //let us extract from the header the token and the username...
      if (authorizationHeader != null && authorizationHeader.startsWith(jwtService.getPREFIX())) {
         jwt = authorizationHeader.substring(jwtService.getPREFIX().length());
         username = jwtService.extractUsername(jwt);
      }

      //if the user is not empty and the user is not yet authenticated, we will update the security context holder with the token
      if (username != null && SecurityContextHolder.getContext().getAuthentication() == null) {

               //trying to find the user in the DB
         UserDetails userDetails = this.userDetailsService.loadUserByUsername(username);

         //if the token is valid, we will proceed with the login...
         if (jwtService.validateToken(jwt, userDetails)) {


            UsernamePasswordAuthenticationToken usernamePasswordAuthenticationToken = new UsernamePasswordAuthenticationToken(
                  userDetails, null, userDetails.getAuthorities());

            //putting the information of the request object in the usernamePasswordAuthenticationToken
            usernamePasswordAuthenticationToken
                  .setDetails(new WebAuthenticationDetailsSource().buildDetails(request));

            //informing to the SecurityContextHolder that the user is authenticated

            SecurityContextHolder.getContext().setAuthentication(usernamePasswordAuthenticationToken);
         }
      }

      //continue with the chain of filters

      chain.doFilter(request, response);
   }

}
```

Aufgabe 4- Packet Controller: AuthenticationControler und DemoController

```
@RestController
@RequestMapping("/api")
public class AuthenticationController {

	@Autowired
	private AuthenticationManager authenticationManager;

	@Autowired
  MyUserDetailsService userDetailsService;

	@Autowired
	JwtService jwtServiceUtils;

	@Autowired
	BCryptPasswordEncoder encoder;

	@Autowired
	UserRepository userRepository;

	@Autowired
	AuthorityRepository authorityRepository;

	@PostMapping("/users")
	public ResponseEntity<AuthenticationResponse> register(@RequestBody RegisterRequest
				registerRequest){

			User user = new User();
			user.setActive(1);
			user.setEmail(registerRequest.getEmail());
			user.setLogin(registerRequest.getUsername());
			user.setMyauthorities(new ArrayList<Authority> ());

			for (int i = 0; i< registerRequest.getMyauthorities().size(); i++) {
				System.out.println("received auth "+i+ " "+ registerRequest.getMyauthorities().get(i).getId());
				Optional<Authority> authorityOp = authorityRepository.findById(registerRequest.getMyauthorities().get(i).getId());
				user.getMyauthorities().add(authorityOp.get());
				System.out.println(authorityOp.get().getDescription());

			}

			user.setPassword(encoder.encode(registerRequest.getPassword()));

			user = userRepository.save(user);

			System.out.println("saved the user per API..");

			System.out.println(user.getLogin());

			 UserDetails userDetails = userDetailsService.loadUserByUsername(user.getLogin());

			 String jwt = jwtServiceUtils.generateToken(userDetails);

			 return ResponseEntity.ok(new AuthenticationResponse(jwt));

	}


	@RequestMapping(value ="/users/authenticate", method=RequestMethod.POST)
	public ResponseEntity<?> createAuthenticationToken (@RequestBody AuthenticationRequest authenticationRequest) throws Exception{

			try {
				authenticationManager.authenticate(
					new UsernamePasswordAuthenticationToken(authenticationRequest.getUsername(),
						authenticationRequest.getPassword())
				);

			}catch (BadCredentialsException e) {
				 throw new Exception ("Incorrect username or password!", e);
			}

			UserDetails userDetails = userDetailsService.loadUserByUsername(authenticationRequest.getUsername());

			String jwt = jwtServiceUtils.generateToken(userDetails);

			return ResponseEntity.ok(new AuthenticationResponse(jwt));

	}


}
```

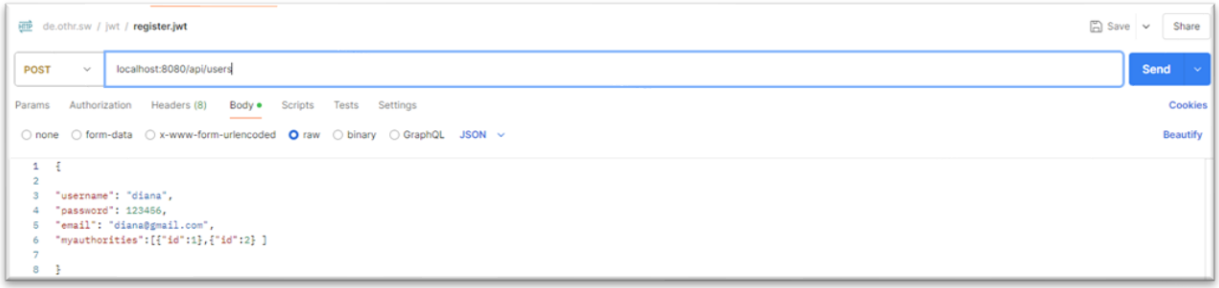
```
@RequestMapping("/api")

@RestController
public class DemoController {

		@GetMapping("/demo")
		public ResponseEntity<String> helloDemo(){


				return ResponseEntity.ok("User is authenticated and got this answer from Demo Endpoint!");
		}
```

Aufgabe 5 –Testen Sie die API mit Postman

5.1 User erstellen

- POST **/api/users** **Create a User**

- Legen Sie die HTTP-Methode fest: Wählen Sie „POST“ aus dem Dropdown-Menü.
- Legen Sie die Anforderungs-URL fest: Geben Sie die URL Ihres API-Endpunkts ein, z. B. http://localhost:8080/api/users.
- Konfigurieren Sie den Hauptteil der Anfrage in Postman wie unten



- Senden Sie die Anfrage: Klicken Sie auf die Schaltfläche „Senden“, um die Anfrage auszuführen.
- Überprüfen Sie die Antwort:
- Statuscode: Überprüfen Sie den HTTP-Statuscode im Antwortheader. Ein 200 OK zeigt eine erfolgreiche Anfrage an.
- Antworttext: Untersuchen Sie den JSON-Antworttext, um das Token zu überprüfen.
- Kopieren Sie den Text in den Anführungszeichen des Tokens und analysieren Sie ihn auf der folgenden Website:
  https://jwt.io/

5.2 User authentication

- GET **/api/users/authenticate** **Authenticates a User**

- Legen Sie die HTTP-Methode fest: Wählen Sie „GET“ aus dem Dropdown-Menü.
- Legen Sie die Anforderungs-URL fest: Geben Sie die URL Ihres API-Endpunkts ein, z. B. http://localhost:8080/api/users/authenticate
- Konfigurieren Sie den Hauptteil der Anfrage in Postman wie unten

- Untersuchen Sie den JWT-Antworttext, um das Token zu überprüfen.

5.3 Accessing a Resource with the Token from 5.2

- GET **/api/demo** **Access a Demo Endpoint with a JWT Token**

- Legen Sie die HTTP-Methode fest: Wählen Sie „GET“ aus dem Dropdown-Menü.
- Legen Sie die Anforderungs-URL fest: Geben Sie die URL Ihres API-Endpunkts ein, z. B. http://localhost:8080/api/demo
- Wählen Sie im Tab „Autorisierung“ das Attribut „Auth Type“ als „Bearer Token“
- Kopieren Sie das Token aus 5.2 (nur Inhalt innerhalb der Anführungszeichen) in das Feld „Token“.

- Klicken Sie auf „Senden“, um eine Antwort zu erhalten: