**Exercise 8: Online Bookstore - Implementing CRUD Operations**

**1. CRUD Endpoints for Book and Customer Entities:**

@RestController

@RequestMapping("/api/books")

public class BookController {

@Autowired

private BookService bookService;

@PostMapping

public ResponseEntity<Book> createBook(@Valid @RequestBody Book book) {

return new ResponseEntity<>(bookService.saveBook(book), HttpStatus.CREATED);

}

@GetMapping("/{id}")

public ResponseEntity<Book> getBookById(@PathVariable Long id) {

return ResponseEntity.ok(bookService.getBookById(id));

}

@PutMapping("/{id}")

public ResponseEntity<Book> updateBook(@PathVariable Long id, @Valid @RequestBody Book bookDetails) {

return ResponseEntity.ok(bookService.updateBook(id, bookDetails));

@DeleteMapping("/{id}")

public ResponseEntity<Void> deleteBook(@PathVariable Long id) {

bookService.deleteBook(id);

return ResponseEntity.noContent().build();

}

}

@RestController

@RequestMapping("/api/customers")

public class CustomerController {

@Autowired

private CustomerService customerService;

@PostMapping

public ResponseEntity<Customer> createCustomer(@Valid @RequestBody Customer customer) {

return new ResponseEntity<>(customerService.saveCustomer(customer), HttpStatus.CREATED);

}

@GetMapping("/{id}")

public ResponseEntity<Customer> getCustomerById(@PathVariable Long id) {

return ResponseEntity.ok(customerService.getCustomerById(id));

}

@PutMapping("/{id}")

public ResponseEntity<Customer> updateCustomer(@PathVariable Long id, @Valid @RequestBody Customer customerDetails) {

return ResponseEntity.ok(customerService.updateCustomer(id, customerDetails));

}

@DeleteMapping("/{id}")

public ResponseEntity<Void> deleteCustomer(@PathVariable Long id) {

customerService.deleteCustomer(id);

return ResponseEntity.noContent().build();

}

}

**2. Validating Input Data:**

@Entity

public class Book {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

@NotNull

@Size(min = 1, max = 100)

private String title

@NotNull

@Size(min = 1, max = 100)

private String author;

@Min(0)

private Double price;

@Version

private Integer version;

@Entity

public class Customer {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

@NotNull

@Size(min = 1, max = 50)

private String name;

@NotNull

@Size(min = 1, max = 100)

private String email

@Version

private Integer version;

}

* @NotNull: Ensures that fields are not null.
* @Size: Validates the length of string fields.
* @Min: Ensures the price is not negative.

**3. Optimistic Locking:**

Optimistic locking is managed using the @Version annotation, which ensures that during an update, the version number is checked. If it doesn’t match, an OptimisticLockException is thrown, indicating a concurrent modification.

**Exercise 9: Online Bookstore - Understanding HATEOAS**

**1. Adding Links to Resources using Spring HATEOAS:**

First, include the necessary dependency in your pom.xml:

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-hateoas</artifactId>

</dependency>

Next, modify your controllers to return HATEOAS-compliant responses:

@RestController

@RequestMapping("/api/books")

public class BookController {

@Autowired

private BookService bookService;

@GetMapping("/{id}")

public ResponseEntity<EntityModel<Book>> getBookById(@PathVariable Long id) {

Book book = bookService.getBookById(id);

EntityModel<Book> resource = EntityModel.of(book);

WebMvcLinkBuilder linkToBooks =

linkTo(methodOn(this.getClass()).getAllBooks());

resource.add(linkToBooks.withRel("all-books"));

return ResponseEntity.ok(resource);

}

@GetMapping

public ResponseEntity<CollectionModel<EntityModel<Book>>> getAllBooks() {

List<EntityModel<Book>> books = bookService.getAllBooks().stream()

.map(book -> EntityModel.of(book,

linkTo(methodOn(this.getClass()).getBookById(book.getId())).withSelfRel()))

.collect(Collectors.toList());

return ResponseEntity.ok(CollectionModel.of(books));}}

@RestController

@RequestMapping("/api/customers")

public class CustomerController {

@Autowired

private CustomerService customerService;

@GetMapping("/{id}")

public ResponseEntity<EntityModel<Customer>> getCustomerById(@PathVariable Long id) {

Customer customer = customerService.getCustomerById(id);

EntityModel<Customer> resource = EntityModel.of(customer);

WebMvcLinkBuilder linkToCustomers =

linkTo(methodOn(this.getClass()).getAllCustomers());

resource.add(linkToCustomers.withRel("all-customers"));

return ResponseEntity.ok(resource);

}

@GetMapping

public ResponseEntity<CollectionModel<EntityModel<Customer>>> getAllCustomers() {

List<EntityModel<Customer>> customers = customerService.getAllCustomers().stream()

.map(customer -> EntityModel.of(customer, linkTo(methodOn(this.getClass()).getCustomerById(customer.getId())).withSelfRel()))

.collect(Collectors.toList());

return ResponseEntity.ok(CollectionModel.of(customers));

}

}

**2. Hypermedia-Driven APIs:**

* Link Creation: The EntityModel class is used to create resource representations that include links to other resources.
* Hypermedia as the Engine of Application State (HATEOAS): This principle ensures that clients can navigate the API dynamically by following links, making the API more flexible and less dependent on hardcoded URLs.

**Exercise 10: Online Bookstore - Configuring Content Negotiation**

**1. Content Negotiation Configuration:**

In Spring Boot, content negotiation can be configured using ContentNegotiationConfigurer or by defining the media types in the application.properties file.

Approach 1: Using WebMvcConfigurer

@Configuration

public class WebConfig implements WebMvcConfigurer {

@Override

public void configureContentNegotiation(ContentNegotiationConfigurer configurer) {

configurer.favorPathExtension(false)

.favorParameter(true)

.parameterName("mediaType")

.ignoreAcceptHeader(false)

.useRegisteredExtensionsOnly(false)

.defaultContentType(MediaType.APPLICATION\_JSON)

.mediaType("json", MediaType.APPLICATION\_JSON)

.mediaType("xml", MediaType.APPLICATION\_XML);

}

}

**Approach 2:** Using application.properties

Add the following properties in your application.properties file:

spring.mvc.contentnegotiation.favor-path-extension=false

spring.mvc.contentnegotiation.favor-parameter=true

spring.mvc.contentnegotiation.parameter-name=mediaType

spring.mvc.contentnegotiation.ignore-accept-header=false

spring.mvc.contentnegotiation.default-content-type=application/json

spring.mvc.contentnegotiation.media-types.json=application/json

spring.mvc.contentnegotiation.media-types.xml=application/xml

**2. Accept Header Implementation:**

The REST controllers can automatically produce and consume different media types based on the Accept header due to the configuration done above.

Example REST Controller:

@RestController

@RequestMapping("/api/books")

public class BookController

@Autowired

private BookService bookService

@GetMapping(value = "/{id}", produces = { MediaType.APPLICATION\_JSON\_VALUE, MediaType.APPLICATION\_XML\_VALUE })

public ResponseEntity<Book> getBookById(@PathVariable Long id) {

Book book = bookService.getBookById(id);

return ResponseEntity.ok(book);

}

@PostMapping(consumes = { MediaType.APPLICATION\_JSON\_VALUE, MediaType.APPLICATION\_XML\_VALUE },

produces = { MediaType.APPLICATION\_JSON\_VALUE, MediaType.APPLICATION\_XML\_VALUE })

public ResponseEntity<Book> createBook(@Valid @RequestBody Book book) {

Book createdBook = bookService.saveBook(book);

return new ResponseEntity<>(createdBook, HttpStatus.CREATED);

}

}

The produces attribute in the @GetMapping and @PostMapping annotations indicates that the endpoint can return either JSON or XML based on the Accept header.

The consumes attribute ensures that the API can accept input in both JSON and XML formats.

**Exercise 11: Online Bookstore - Integrating Spring Boot Actuator**

**1. Adding Actuator Dependency:**

Add the Spring Boot Actuator dependency to your pom.xml file:

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-actuator</artifactId>

</dependency>

**2. Exposing and Customizing Actuator Endpoints:**

By default, Spring Boot Actuator provides a variety of endpoints, such as /health, /metrics, /info, etc. You can customize which endpoints are exposed by configuring them in application.properties.

**Example Configuration:**

management.endpoints.web.exposure.include=health,info,metrics,env

management.endpoint.health.show-details=always

management.endpoint.metrics.enabled=true

* management.endpoints.web.exposure.include: Specifies which Actuator endpoints should be exposed.
* management.endpoint.health.show-details: Determines whether detailed health information should be available.
* management.endpoint.metrics.enabled: Enables or disables the /metrics endpoint.

**3. Exposing Custom Metrics:**

You can create custom metrics to monitor specific aspects of your application using MeterRegistry.

Example Custom Metric:

import io.micrometer.core.instrument.MeterRegistry;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Component;

@Component

public class CustomMetrics {

@Autowired

public CustomMetrics(MeterRegistry registry) {

registry.gauge("custom.book.count", this, CustomMetrics::getBookCount);

}

public double getBookCount() {

// Replace with logic to fetch the actual book count

return 100; // Example count

}

}

* The custom metric custom.book.count can now be monitored via the /metrics Actuator endpoint.
* Use the MeterRegistry to register custom metrics that track specific application data, such as the number of books in your store.

Accessing Actuator Endpoints:

Once configured, you can access the Actuator endpoints by navigating to URLs like:

* http://localhost:8080/actuator/health - Health check
* http://localhost:8080/actuator/metrics - Application metrics
* http://localhost:8080/actuator/custom.book.count - Custom metric

**Exercise 12: Online Bookstore - Securing RESTful Endpoints with Spring Security**

**1. Add Spring Security Dependency:**

Add the Spring Security and JWT dependencies to your pom.xml:

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-security</artifactId>

</dependency>

<dependency>

<groupId>io.jsonwebtoken</groupId>

<artifactId>jjwt</artifactId>

<version>0.9.1</version>

</dependency>

**2. JWT Authentication Implementation:**

**Step 1**: Create a JWT Utility Class

import io.jsonwebtoken.Claims;

import io.jsonwebtoken.Jwts;

import io.jsonwebtoken.SignatureAlgorithm;

import org.springframework.stereotype.Component;

import java.util.Date;

import java.util.HashMap;

import java.util.Map;

import java.util.function.Function;

@Component

public class JwtUtil {

private String secret = "mySecretKey";

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.parser().setSigningKey(secret).parseClaimsJws(token).getBody();

}

private Boolean isTokenExpired(String token) {

return extractExpiration(token).before(new Date());

}

public String generateToken(String username) {

Map<String, Object> claims = new HashMap<>();

return createToken(claims, username);

}

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() + 1000 \* 60 \* 60 \* 10))

.signWith(SignatureAlgorithm.HS256, secret).compact();

}

public Boolean validateToken(String token, String username) {

final String extractedUsername = extractUsername(token);

return (extractedUsername.equals(username) && !isTokenExpired(token));

}

}

**Step 2: Implement Security Configuration**

import org.springframework.context.annotation.Bean;

import org.springframework.context.annotation.Configuration;

import org.springframework.security.authentication.AuthenticationManager;

import org.springframework.security.config.annotation.authentication.builders.AuthenticationManagerBuilder;

import org.springframework.security.config.annotation.web.builders.HttpSecurity;

import org.springframework.security.config.annotation.web.configuration.EnableWebSecurity;

import org.springframework.security.config.annotation.web.configuration.WebSecurityConfigurerAdapter;

import org.springframework.security.config.http.SessionCreationPolicy;

import org.springframework.security.crypto.bcrypt.BCryptPasswordEncoder;

import org.springframework.security.crypto.password.PasswordEncoder;

import org.springframework.security.web.authentication.UsernamePasswordAuthenticationFilter;

@Configuration

@EnableWebSecurity

public class SecurityConfig extends WebSecurityConfigurerAdapter {

@Autowired

private JwtRequestFilter jwtRequestFilter;

@Autowired

private MyUserDetailsService myUserDetailsService;

@Override

protected void configure(AuthenticationManagerBuilder auth) throws Exception {

auth.userDetailsService(myUserDetailsService).passwordEncoder(passwordEncoder());

}

@Bean

public PasswordEncoder passwordEncoder() {

return new BCryptPasswordEncoder();

}

@Override

@Bean

public AuthenticationManager authenticationManagerBean() throws Exception {

return super.authenticationManagerBean();

}

@Override

protected void configure(HttpSecurity httpSecurity) throws Exception {

httpSecurity.csrf().disable()

.authorizeRequests().antMatchers("/authenticate").permitAll()

.anyRequest().authenticated()

.and().sessionManagement()

.sessionCreationPolicy(SessionCreationPolicy.STATELESS);

httpSecurity.addFilterBefore(jwtRequestFilter, UsernamePasswordAuthenticationFilter.class);

}

}

**Step 3: Implement JWT Request Filter**

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.security.authentication.UsernamePasswordAuthenticationToken;

import org.springframework.security.core.context.SecurityContextHolder;

import org.springframework.security.core.userdetails.UserDetails;

import org.springframework.security.web.authentication.WebAuthenticationDetailsSource;

import org.springframework.stereotype.Component;

import org.springframework.web.filter.OncePerRequestFilter;

import io.jsonwebtoken.ExpiredJwtException;

import javax.servlet.FilterChain;

import javax.servlet.ServletException;

import javax.servlet.http.HttpServletRequest;

import javax.servlet.http.HttpServletResponse;

import java.io.IOException;

@Component

public class JwtRequestFilter extends OncePerRequestFilter {

@Autowired

private MyUserDetailsService myUserDetailsService;

@Autowired

private JwtUtil jwtUtil;

@Override

protected void doFilterInternal(HttpServletRequest request, HttpServletResponse response, FilterChain chain)

throws ServletException, IOException {

final String authorizationHeader = request.getHeader("Authorization");

String username = null;

String jwt = null

if (authorizationHeader != null && authorizationHeader.startsWith("Bearer ")) {

jwt = authorizationHeader.substring(7);

try {

username = jwtUtil.extractUsername(jwt);

} catch (ExpiredJwtException e) {

e.printStackTrace();

}

}

if (username != null && SecurityContextHolder.getContext().getAuthentication() == null) {

UserDetails userDetails = this.myUserDetailsService.loadUserByUsername(username)

if (jwtUtil.validateToken(jwt, userDetails.getUsername())) {

UsernamePasswordAuthenticationToken usernamePasswordAuthenticationToken = new UsernamePasswordAuthenticationToken(

userDetails, null, userDetails.getAuthorities());

usernamePasswordAuthenticationToken

.setDetails(new WebAuthenticationDetailsSource().buildDetails(request));

SecurityContextHolder.getContext().setAuthentication(usernamePasswordAuthenticationToken);

}

}

chain.doFilter(request, response);

}

}

**Step 4: Handle Authentication and Generate JWT**

@RestController

public class AuthController {

@Autowired

private AuthenticationManager authenticationManager;

@Autowired

private JwtUtil jwtUtil;

@Autowired

private MyUserDetailsService userDetailsService;

@PostMapping("/authenticate")

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);

}

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

final String jwt = jwtUtil.generateToken(userDetails.getUsername());

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

}

}

**3. CORS Handling:**

You can configure CORS in your SecurityConfig class:

@Override

protected void configure(HttpSecurity httpSecurity) throws Exception {

httpSecurity.cors().and().csrf().disable()

.authorizeRequests().antMatchers("/authenticate").permitAll()

.anyRequest().authenticated()

.and().sessionManagement()

.sessionCreationPolicy(SessionCreationPolicy.STATELESS);

httpSecurity.addFilterBefore(jwtRequestFilter, UsernamePasswordAuthenticationFilter.class);

}

@Bean

CorsConfigurationSource corsConfigurationSource() {

CorsConfiguration configuration = new CorsConfiguration();

configuration.setAllowedOrigins(Arrays.asList("http://localhost:3000"));

configuration.setAllowedMethods(Arrays.asList("GET", POST, PUT, DELETE, OPTIONS"));

configuration.setAllowedHeaders(Arrays.asList("Authorization", "Content-Type"));

configuration.setAllowCredentials(true);

UrlBasedCorsConfigurationSource source = new UrlBasedCorsConfigurationSource();

source.registerCorsConfiguration("/\*\*", configuration);

return source;

}

**Exercise 13: Online Bookstore - Unit Testing REST Controllers**

**1. JUnit Setup:**

Add the necessary dependencies to your pom.xml:

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-test</artifactId>

<scope>test</scope>

</dependency>

<dependency>

<groupId>org.mockito</groupId>

<artifactId>mockito-core</artifactId>

<scope>test</scope>

</dependency>

**2. Writing Unit Tests with MockMvc:**

import static org.springframework.test.web.servlet.request.MockMvcRequestBuilders.get;

import static org.springframework.test.web.servlet.result.MockMvcResultMatchers.status;

import static org.springframework.test.web.servlet.result.MockMvcResultMatchers.jsonPath

@RunWith(SpringRunner.class)

@WebMvcTest(BookController.class)

public class BookControllerTest {

@Autowired

private MockMvc mockMvc

@MockBean

private BookService bookService;

@Test

public void shouldReturnBookById() throws Exception {

Book book = new Book(1L, "Spring in Action", "Craig Walls", 500.0);

Mockito.when(bookService.getBookById(1L)).thenReturn(book);

mockMvc.perform(get("/api/books/1"))

.andExpect(status().isOk())

.andExpect(jsonPath("$.title").value("Spring in Action"))

.andExpect(jsonPath("$.author").value("Craig Walls"));

}

}

**3. Test Coverage:**

* Ensure comprehensive test coverage by writing tests for all CRUD operations, edge cases, and exception handling scenarios.

**Exercise 14: Online Bookstore - Integration Testing for REST Services**

**1. Spring Test Setup:**

Add the necessary testing dependencies to your pom.xml:

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-test</artifactId>

<scope>test</scope>

</dependency>

<dependency>

<groupId>com.h2database</groupId>

<artifactId>h2</artifactId>

<scope>test</scope>

</dependency>

Ensure your test class is annotated properly:

@RunWith(SpringRunner.class)

@SpringBootTest

@AutoConfigureMockMvc

public class BookstoreIntegrationTest

@Autowired

private MockMvc mockMvc;

@Autowired

private BookRepository bookRepository;

@Before

public void setUp() {

bookRepository.deleteAll();

}

}

**2. MockMvc Integration:**

Create integration tests for your RESTful services:

@Test

public void whenPostRequestToBooks\_thenCorrectResponse() throws Exception {

String bookJson = "{\"title\": \"Spring in Action\", \"author\": \"Craig Walls\", \"price\": 500.0}";

mockMvc.perform(post("/api/books")

.content(bookJson)

.contentType(MediaType.APPLICATION\_JSON))

.andExpect(status().isCreated())

.andExpect(jsonPath("$.title").value("Spring in Action"))

.andExpect(jsonPath("$.author").value("Craig Walls"));

}

@Test

public void whenGetRequestToBooks\_thenCorrectResponse() throws Exception {

Book book = new Book(null, "Spring in Action", "Craig Walls", 500.0);

bookRepository.save(book);

mockMvc.perform(get("/api/books"))

.andExpect(status().isOk())

.andExpect(jsonPath("$[0].title").value("Spring in Action"))

.andExpect(jsonPath("$[0].author").value("Craig Walls"));

}

**3. Database Integration:**

Configure H2 in-memory database for testing:

# application-test.properties

spring.datasource.url=jdbc:h2:mem:testdb

spring.datasource.driverClassName=org.h2.Driver

spring.datasource.username=sa

spring.datasource.password=password

spring.h2.console.enabled=true

spring.jpa.hibernate.ddl-auto=create-drop

Make sure to use the @ActiveProfiles("test") annotation in your test classes to load this configuration.

**Exercise 15: Online Bookstore - API Documentation with Swagger**

**1. Add Swagger Dependency:**

Add the Swagger (Springdoc) dependency to your pom.xml:

<dependency>

<groupId>org.springdoc</groupId>

<artifactId>springdoc-openapi-ui</artifactId>

<version>1.6.11</version>

</dependency>

**2. Document Endpoints:**

Annotate your REST controllers and methods:

@RestController

@RequestMapping("/api/books")

public class BookController {

@Operation(summary = "Get all books")

@GetMapping

public List<Book> getAllBooks() {

return bookService.findAllBooks();

}

@Operation(summary = "Add a new book")

@PostMapping

public ResponseEntity<Book> addBook(@RequestBody Book book) {

return new ResponseEntity<>(bookService.saveBook(book), HttpStatus.CREATED);

}

}

**3. API Documentation:**

Start your application and access the Swagger UI at http://localhost:8080/swagger-ui.html or Springdoc UI at http://localhost:8080/swagger-ui/index.html.