

Working Doc. Spring6 MVC constructs focused on the RESTful API

written by Hong Le Nguyen 08.2024

Code to examples on Github :

<https://github.com/hong1234/spring-boot3-mvc-jdbc-restApi>

<https://github.com/hong1234/spring-boot3-mvc-jpa-restApi>

RestController ----

The `@RestController` annotation *applied at the class level* enables request mapping, request input binding, exception handling, and more.

```
@RestController
public class BookController {
    // ...
}
```

1)

Mapping (http-)request to endpoints (controller method)

`@RequestMapping` ---

You can use the `@RequestMapping` annotation to map requests to controllers methods. It has various attributes to match by URL, HTTP method, request parameters, headers, and media types.

You can use it at the class level to express shared mappings or at the method level to narrow down to a specific endpoint mapping.

```
// Get an book by ID
@RequestMapping(value = "/books/{id}", method = RequestMethod.GET)
public Book getBookById(@PathVariable("id") Integer id) {
    // ...
}
```

There are also HTTP method specific shortcut variants of `@RequestMapping`:

`@GetMapping` for GET (http method)

`@PostMapping` for POST

`@PutMapping` for PUT

`@DeleteMapping` for DELETE

`@PatchMapping` for PATCH

```
// Get an book by ID using shortcut for GET
@GetMapping("/books/{id}")
public Book getBookById(@PathVariable("id") Integer id) {
    return bookService.getBookById(id);
}
```

When applied at the class level, it applies to all handler methods as well.

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

In this case, it is marked with `"/api"`, meaning that all the methods have this prefix

2)

Send return value to client

@ResponseBody

You can use the `@ResponseBody` annotation on a method to have *the return serialized to the response body through an `HttpMessageConverter`*. The following listing shows an example:

```
// Get an book by ID
@GetMapping("/books/{id}", produces = "application/json")
@ResponseBody
@ResponseStatus(HttpStatus.OK)
public Book getBookById(@PathVariable("id") Integer id) {
    return bookService.getBookById(id);
}
```

`@ResponseBody` is also supported *at the class level*, in which case it is inherited by all controller methods.

```
@Controller
@ResponseBody
@RequestMapping("/api")
public class BookController {
```

`@RestController` is a meta-annotation marked with `@Controller` and `@ResponseBody`. Therefore, the above code is equivalent to

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

The `@RestController` also causes that the return value in the controller methods is serialized and written to the http- response body by an **HttpMessageConverter** => more 3b) page 6.

The "Accept" header in request is used to determine the format of data to be written in response body and the appropriate *HttpMessageConverter* that serializes the return value.

It's important to know that by default Spring Boot will produce an output in JSON format.

You can specify it explicitly by using the "produces" attribute of `@RequestMapping` annotation. For example:

```
@RestController
@RequestMapping("/api", produces="application/json")
public class BookController {
    @GetMapping("/books/{id}")
    @ResponseStatus(HttpStatus.OK)
    public Book getBookById(@PathVariable("id") Integer id) {
        return bookService.getBookById(id);
    }
}
```

The attribute `produces="application/json"` in the above code ensures that the client should send a request with an Accept header = "application/json" and the return value (Book object) will be converted to *JSON format* by the suitable converter.

The client will specify the "Accept" header to "application/json" in the http request :

```
curl --header "Accept: application/json" http://localhost:8000/api/books/1
```

@ResponseStatus

Normally, this annotation is used when a method has a void return type (or null return value). This annotation sends back the HTTP status code specified in the response.

3)

Binding data (from an incoming request) to to method arguments

@PathVariable

is used to retrieve data from the URL path.

```
@GetMapping("/books/{id}")
public Book getBookById( @PathVariable("id") Integer id ) {
```

@RequestParam

using the @RequestParam annotation to bind query parameters to a method argument in a controller.

Query parameters are the key-value pairs that appear after the ? in a request URL.

```
const searchUrl = 'http://localhost:8000/api/books/search?title=spring';

@GetMapping("/books/search")
@ResponseStatus(HttpStatus.OK)
public Iterable<Book> searchBooksByTitle( @RequestParam("title") String title ) {
    return bookService.searchBooksByTitle(title);
}
```

@RequestHeader

You can use the @RequestHeader annotation to bind a request header to a method argument in a controller.

The following example shows a request with headers:

```
Host          localhost:8000
Accept        text/html
Accept-Language en;q=0.3
Accept-Encoding gzip,deflate
...
```

The following example gets the value of the Accept-Encoding header:

```
@GetMapping("/demo")
public void handle( @RequestHeader("Accept-Encoding") String encoding ) {
    //...
}
```

@RequestBody

applying the annotation on the argument of a Controller method to indicate that *the http Request body is deserialized to a particular Java object* by a `HttpMessageConverter` => more 3b) page 6.

The "*Content-Type*" header in request is used to determine the format of data in request body and the corresponding `HttpMessageConverter`.

Assuming that the "Content-Type" header in request is "application/json":

```
curl -i -X POST -H "Content-Type: application/json" -d '{"title":"test", "desc":"test"}'
http://localhost:8000/api/books
```

In this case the `@RequestBody` annotation ensures that JSON in the request body is bound to the Book object

```
@RestController
@RequestMapping(path="/api", produces="application/json")
class BookController {

    @PostMapping(path="/books", consumes="application/json")
    @ResponseStatus(HttpStatus.CREATED)
    public void addBook( @RequestBody Book book ) {
        // ...
    }
}
```

Consumable Media Types

The *attribute consumes*="application/json" ensures that the client sends a request with the "Content-Type" header "application/json" and JSON data in a request body.

4)

Validating the target argument object

@Valid

Applying the `@Valid` annotation to the argument of method in the Controller class tells Spring MVC to perform validation on the target argument object *after* it's bound to the data from request and *before* the method is called.

```
import jakarta.validation.Valid;

@RestController
@RequestMapping(path="/api", produces="application/json")
public class BookController {
    ...

    @PostMapping("/books", consumes="application/json")
    public Book addBook( @Valid @RequestBody Book book ){
        return bookService.addBook(book);
    }
}
```

When the target argument fails to pass the validation, Spring throws a *MethodArgumentNotValidException* exception.

To trigger a validator, it is necessary to annotate the data you want to validate with *the validation annotations* , for example `@NotBlank`, `@Size` for **JSR-349 bean validation** => more 4b) page 7.

```
import jakarta.validation.constraints.*;

public class Book {
    ...

    @NotBlank(message = "Title is mandatory")
    @Size(min = 3, max = 50, message = "must be min 3, and max 50 characters long")
    private String title;
}
```

5)

Handling exceptions thrown from a `@RestController`

`@ExceptionHandler`

The `@ExceptionHandler` annotated method is *invoked when the specified exceptions are thrown from a `@RestController` or `@Controller`*.

We can define these methods either in a `@RestController` marked class or in a `@RestControllerAdvice` marked class.

```
@RestController
@RequestMapping(path="/api")
public class BookController {
    ...

    @ExceptionHandler(ResourceNotFoundException.class)
    public ErrorDetails resourceNotFoundException(ResourceNotFoundException e) { ... }
}
```

The `@RestControllerAdvice` annotation is used to define a class that will handle *exceptions globally across all controllers*. Its methods are annotated with `@ExceptionHandler` annotation.

```
@RestControllerAdvice
public class GlobalExceptionHandler {
    ...

    @ExceptionHandler(ResourceNotFoundException.class)
    public ErrorDetails resourceNotFoundException(ResourceNotFoundException e) { ... }
}
```

By default when the `DispatcherServlet` can't find a handler for a request it sends *a 404 response*. However if its property "throwExceptionIfNoHandlerFound" is set to true the `NoHandlerFoundException` is raised. Using the following two properties will make spring boot throw `NoHandlerFoundException`:

```
// src/main/resources/application.properties
spring.mvc.throw-exception-if-no-handler-found=true
spring.web.resources.add-mappings=false
```

A list of exception handlers related REST controller

handler/URL not found exception (thrown by `DispatcherServlet`) handler

```
@ExceptionHandler(NoHandlerFoundException.class)
public ErrorDetails handlerNotFoundException(NoHandlerFoundException e) {
    ...; return errorDetails; }
```

binding exceptions (thrown by `HttpMessageConverter`) handler

```
@ExceptionHandler(HttpMessageNotReadableException.class) // deserialize ex handler
public ErrorDetails validationException(HttpMessageNotReadableException e) {
    ...; return errorDetails; }

@ExceptionHandler(HttpMessageNotWritableException.class) // serialize ex handler
public ErrorDetails validationException(HttpMessageNotWritableException e) { ... }
```

validation exceptions (thrown by validators) handler

```
@ExceptionHandler(MethodArgumentNotValidException.class)
public ErrorDetails handleValidationExceptions(MethodArgumentNotValidException e) {
    ...; return errorDetails;}

```

handler for other Exceptions thrown from methods of @RestController

```
@ExceptionHandler
public ErrorDetails otherExceptions(Exception e) { ...; return errorDetails;}

@ExceptionHandler(ResourceNotFoundException.class)
public ErrorDetails resourceNotFoundException(ResourceNotFoundException e) { ... }

```

Note : we can collect information about data-binding and validation errors in object Errors errors as follows

```
import org.springframework.validation.Errors;

@RestController
@RequestMapping(...)
public class BookController {

    @PostMapping(path="/books", consumes="application/json")
    public Book addBook( @Valid @RequestBody Book book, Errors errors ) {
        if (errors.hasErrors())
            throw new ValidationException(createErrorString(errors));
    }
}

```

then we throw *our own exception*.

3b)

MappingJackson2HttpMessageConverter

implements `HttpMessageConverter` that can read and write JSON using Jackson 2.x's `ObjectMapper`. *By default, this converter supports application/json with UTF-8 character set.* This can be overridden by setting the `supportedMediaTypes` property.

Spring Mvc uses the methods of this converter

```
T read(Class<? extends T> clazz, HttpInputMessage inputMessage)

```

to deserialize (JSON) data from the http-request body and bind it to typed java object.

A *HttpMessageNotReadableException* thrown by `HttpMessageConverter` implementation when the `HttpMessageConverter.read(...)` method fails.

```
void write(T t, MediaType contentType, HttpOutputMessage outputMessage)

```

to serialize the object to (JSON) data and write it to the http-response body.

A *HttpMessageNotWritableException* thrown by `HttpMessageConverter` implementation when the `HttpMessageConverter.write(...)` method fails.

MappingJackson2HttpMessageConverter configuration in the Spring 6 MVC

The following example adds Jackson JSON converter with a *customized ObjectMapper* instead of the default one. You use `Jackson2ObjectMapperBuilder` to create `ObjectMapper` object easily, and customize the `ObjectMapper` so that it can serialize the `DateTime` object to the string "DD-MM-YYYY HH:mm".

```

@Configuration
@EnableWebMvc
public class WebMvcConfig implements WebMvcConfigurer {

    public static final String DATETIME_FORMAT = "dd-MM-yyyy HH:mm";

    @Bean
    public ObjectMapper objectMapper() {
        Jackson2ObjectMapperBuilder builder = new Jackson2ObjectMapperBuilder();
        DateTimeFormatter dateTimeFormatter = DateTimeFormatter.ofPattern(DATETIME_FORMAT);
        // serializers
        builder.serializers(new LocalDateTimeSerializer(dateTimeFormatter));
        builder.serializationInclusion(JsonInclude.Include.NON_NULL);
        // // deserializers
        builder.deserializers(new LocalDateTimeDeserializer(dateTimeFormatter));
        return builder.build();
    }

    @Bean
    public MappingJackson2HttpMessageConverter mappingJackson2HttpMessageConverter() {
        return new MappingJackson2HttpMessageConverter(objectMapper());
    }

    @Override
    public void configureMessageConverters(List<HttpMessageConverter<?>> converters) {
        converters.add(mappingJackson2HttpMessageConverter());
    }
}

```

Note: *Spring Boot* autoconfigures and registers the *MappingJackson2HttpMessageConverter* bean. To customize the *ObjectMapper* bean, you just need to configure it explicitly:

```

@Configuration
public class HttpConverterConfig {
    ...
    @Bean
    @Primary
    public ObjectMapper objectMapper() { ...

```

4b)

JSR-349 validator enable

The validation annotations defined in the *jakarta.validation.constraints.** package trigger the JSR-349 validator. If a (JSR-349) Bean Validation is present on the classpath (for example, *Hibernate Validator*), the *Validator* bean enables it as a global validator for use (for example with *@Valid* on controller method arguments).

```

// pom.xml
<dependency>
    <groupId>org.hibernate.validator</groupId>
    <artifactId>hibernate-validator</artifactId>
    <version>${hibernate.validator.version}</version>
</dependency>

```

```

@Configuration
@EnableWebMvc
public class WebMvcConfig implements WebMvcConfigurer {
    @Bean
    public Validator validator() {
        Validator validator = new LocalValidatorFactoryBean();
        return validator;
    }

    @Override
    public Validator getValidator() {
        return validator();
    }
}

```

Note: Spring Boot autoconfigures a default (hibernate-) validator if dependency *spring-boot-starter-validation* added to pom.xml file

```

<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-validation</artifactId>
</dependency>

```

Custom validator

Generally, when we need to validate user input, Spring MVC offers standard predefined validators. However, when we need to validate a more particular type of input, we have the ability to create our *own custom validator*. Creating a custom validator entails rolling out our *own annotation* and using it in our model to enforce the validation rules.

So let's create our custom validator that checks status options. The status *must* be a string with one of the values *Low, Medium, or High*.

The New Annotation

```

@Target({FIELD, PARAMETER })
@Retention(RetentionPolicy.RUNTIME)
@Documented
@Constraint(validatedBy = StatusValidator.class)
public @interface StatusValidation {
    //error message
    public String message() default "Invalid status: must be Low, Medium or High";
    //represents group of constraints
    public Class<?>[] groups() default {};
    //represents additional information about annotation
    public Class<? extends Payload>[] payload() default {};
}

```


Creating a Validator

```
public class StatusValidator implements ConstraintValidator<StatusValidation, String> {
    public boolean isValid(String colorName, ConstraintValidatorContext cxt) {
        List list = Arrays.asList(new String[]{"Low", "Medium", "High"});
        return list.contains(colorName);
    }
}
```

Apply the validation annotation to the domain field

```
@Data
public class Review {

    @NotBlank(message = "Email is mandatory")
    @Email(message="must be valid")
    private String email;
    ...

    @StatusValidation() // throws a MethodArgumentNotValidException exception.
    private String likeStatus;

}
```

Validating the model Review in Spring MVC after binding

```
@RestController
@RequestMapping(path="/api", produces="application/json")
public class BookController {

    @PostMapping(path="/reviews/{bookId} ", consumes="application/json")
    public Review addBookReview(@PathVariable("bookId") Integer bookId,
                                @Valid @RequestBody Review review){
        return bookService.addReviewToBook(bookId, review);
    }
}
```

Note : When the target argument fails to pass the validation, in our case `@StatusValidation`, Spring throws a *MethodArgumentNotValidException* exception.