Mongo Repository End-to-End Application

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Chapter 1. Introduction

This lecture takes what you have learned in establishing a MongoDB data tier using Spring Data MongoDB and shows that integrated into an end-to-end application with API CRUD calls and finder calls using paging. It is assumed that you already know about API topics like Data Transfer Objects (DTOs), JSON and XML content, marshalling/unmarshalling using Jackson and JAXB, web APIs/controllers, and clients. This lecture will put them all together.

> Due to the common component technologies between the Spring Data JPA and Spring Data MongoDB end-to-end solution, this lecture is about 95% the same as the Spring Data JPA End-to-End Application lecture. Although it is presumed that the Spring Data JPA End-to-End Application lecture precedes this lecture — it was written so that was not a requirement. However, if you have already mastered the Spring Data JPA End-to-End Application topics, you should be able to quickly breeze through this material because of the significant similarities in concepts and APIs.

1.1. Goals

The student will learn:

- to integrate a Spring Data MongoDB Repository into an end-to-end application, accessed through an API
- to make a clear distinction between Data Transfer Objects (DTOs) and Business Objects (BOs)
- to identify data type architectural decisions required for a multi-tiered application
- to understand the need for paging when working with potentially unbounded collections and remote clients

1.2. Objectives

At the conclusion of this lecture and related exercises, the student will be able to:

1. implement a BO tier of classes that will be mapped to the database
2. implement a DTO tier of classes that will exchange state with external clients
3. implement a service tier that completes useful actions
4. identify the controller/service layer interface decisions when it comes to using DTO and BO classes
5. implement a mapping tier between BO and DTO objects
6. implement paging requests through the API
7. implement page responses through the API

Chapter 2. BO/DTO Component Architecture

2.1. Business Object(s)/@Documents

For our Books application — I have kept the data model simple and kept it limited to a single business object (BO) `@Document` class mapped to the database using Spring Data MongoDB annotations and accessed through a Spring Data MongoDB repository.

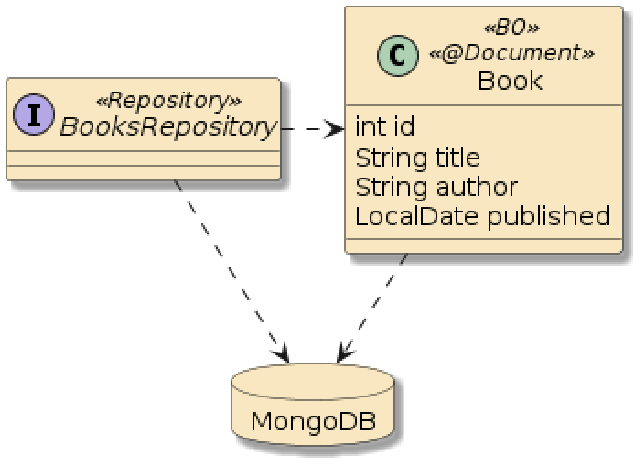


Figure 1. BO Class Mapped to DB as Spring Data MongoDB @Document

The business objects are the focal point of information where we implement our business decisions.

The primary focus of our BO classes is to map business implementation concepts to the database.

The following snippet shows some of the optional mapping properties of a Spring Data MongoDB `@Document` class.

BO Class Sample Spring Data MongoDB Mappings

```
import org.springframework.data.annotation.Id;
import org.springframework.data.mongodb.core.mapping.Document;
import org.springframework.data.mongodb.core.mapping.Field;

@Document(collection = "books") ①
...
public class Book {
    @Id ②
    private String id;
    @Field(name="title") ③
    private String title;
    private String author;
    private LocalDate published;
...
```

① `@Document.collection` used to define the DB collection to use — otherwise uses name of class

② `@Id` used to map the document primary key field to a class property

③ `@Field` used to custom map a class property to a document field — the example is performing what the default would have done

2.2. Data Transfer Object(s) (DTOs)

The Data Transfer Objects are the focal point of interfacing with external clients. They represent state at a point in time. For external web APIs, they are commonly mapped to both JSON and XML.

For the API, we have the decision of whether to reuse BO classes as DTOs or implement a separate set of classes for that purpose. Even though some applications start out simple, there will come a point where database technology or mappings will need to change at a different pace than API technology or mappings.

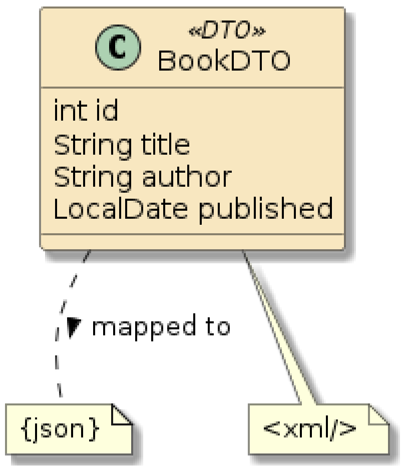


Figure 2. DTO

For that reason, I created a separate `BooksDTO` class to represent a sample DTO. It has a near 1:1 mapping with the `Book` BO. This 1:1 representation of information makes it seem like this is an unnecessary extra class, but it demonstrates an initial technical separation between the DTO and BO that allows for independent changes down the road.

The primary focus of our DTO classes is to map business interface concepts to a portable exchange format.

2.3. BookDTO Class

The following snippet shows some of the annotations required to map the `BookDTO` class to XML using Jackson and JAXB. Jackson JSON requires very few annotations in the simple cases.

DTO Class Sample JSON/XML Mappings

```
@JacksonXmlRootElement(localName = "book", namespace = "urn:ejava.db-repo.books")
@XmlRootElement(name = "book", namespace = "urn:ejava.db-repo.books") ②
@XmlAccessorType(XmlAccessType.FIELD)
@NoArgsConstructor
...
public class BookDTO { ①
    @JacksonXmlProperty(isAttribute = true)
    @XmlAttribute
    private String id;
    private String title;
    private String author;
    @XmlJavaTypeAdapter(LocalDateJaxbAdapter.class) ③
    private LocalDate published;
...
```

① Jackson JSON requires very little to no annotations for simple mappings

② XML mappings require more detailed definition to be complete

③ JAXB requires a custom mapping definition for java.time types

2.4. BO/DTO Mapping

With separate BO and DTO classes, there is a need for mapping between the two.

- map from DTO to BO for requests
- map from BO to DTO for responses

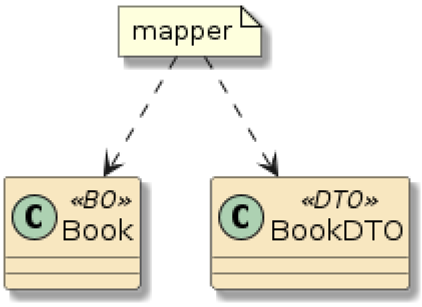


Figure 3. BO to DTO Mapping

We have several options on how to organize this role.

2.4.1. BO/DTO Self Mapping

- The BO or the DTO class can map to the other
  - Benefit: good encapsulation of detail within the data classes themselves
  - Drawback: promotes coupling between two layers we were trying to isolate

Avoid unless users of DTO will be tied to BO and are just exchanging information.

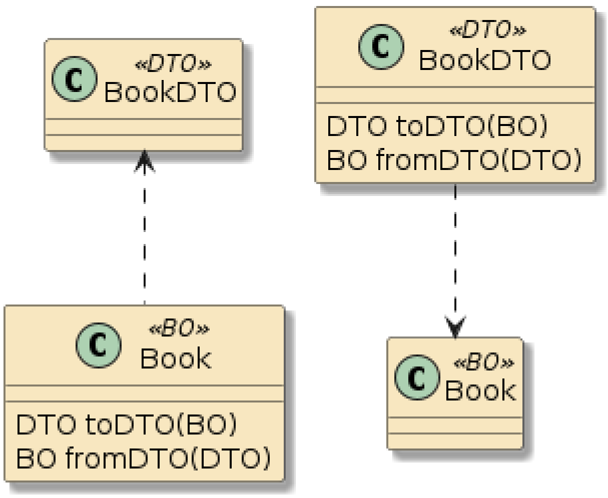


Figure 4. BO to DTO Self Mapping

2.4.2. BO/DTO Method Self Mapping

- The API or service methods can map things themselves within the body of the code
  - Benefit: mapping specialized to usecase involved
  - Drawback:
    - mixed concerns within methods.
    - likely have repeated mapping code in many methods

Avoid.

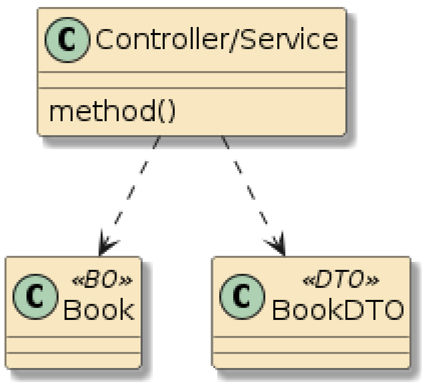


Figure 5. BO to DTO Method Self Mapping

2.4.3. BO/DTO Helper Method Mapping

- Delegate mapping to a reusable helper method within the API or service classes
  - Benefit: code reuse within the API or service class
  - Drawback: potential for repeated mapping in other classes

This is a small but significant step to a helper class

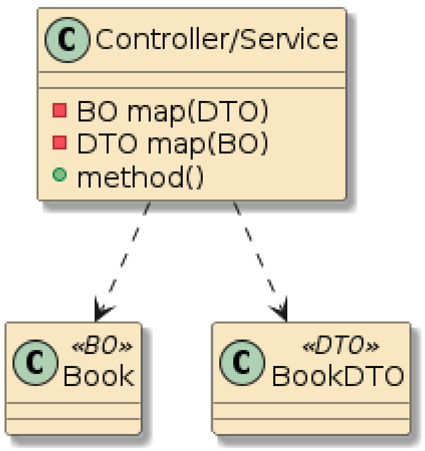


Figure 6. BO/DTO Helper Method Mapping

2.4.4. BO/DTO Helper Class Mapping

- Create a separate interface/class to inject into the API or service classes that encapsulates the role of mapping
  - Benefit: Reusable, testable, separation of concern
  - Drawback: none

Best in most cases unless good reason for self-mapping is appropriate.

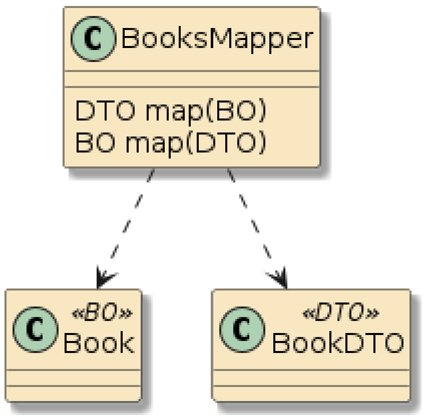


Figure 7. BO/DTO Helper Class Mapping

2.4.5. BO/DTO Helper Class Mapping Implementations

Mapping helper classes can be implemented by:

- brute force implementation

    - Benefit: likely the fastest performance and technically simplest to understand
    - Drawback: tedious setter/getter code
- off-the-shelf mapper libraries (e.g. Dozer, Orika, MapStruct, ModelMapper, JMapper) [1] [2]
    - Benefit: declarative language and inferred DIY mapping options
    - Drawbacks:
        - relies on reflection and other generalizations for mapping which add to overhead
        - non-trivial mappings can be complex to understand

[1] *"Performance of Java Mapping Frameworks"*, Baeldung

[2] *"any tool for java object to object mapping?"*, Stack Overflow

Chapter 3. Service Architecture

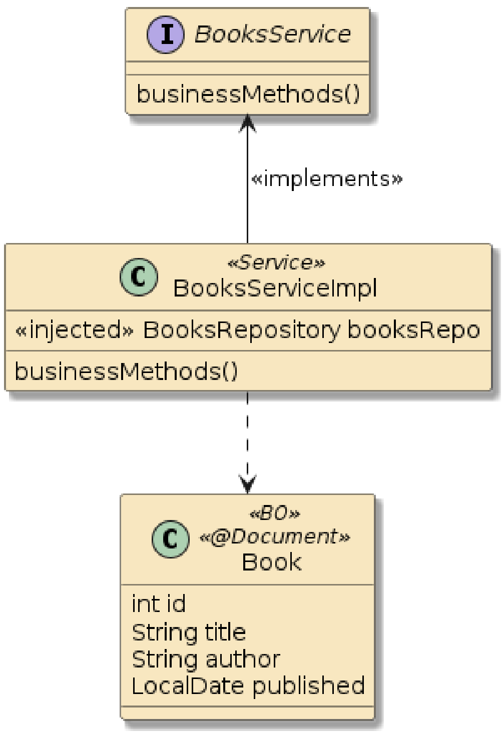
Services — with the aid of BOs — implement the meat of the business logic.

The service

- implements an interface with business methods
- is annotated with `@Service` component in most cases to self-support auto-injection
- injects repository component(s)
- interacts with BO instances

Example Service Class Declaration

```
@RequiredArgsConstructor
@Service
public class BooksServiceImpl
      implements BooksService {
  private final BooksMapper mapper;
  private final BooksRepository booksRepo;
  ...
```



3.1. Injected Service Boundaries

Container features like `@Secured`, `@Async`, etc. are only implemented at component boundaries. When a `@Component` dependency is injected, the container has the opportunity to add features using *"interpose"*. As a part of interpose — the container implements proxy to add the desired feature of the target component method.

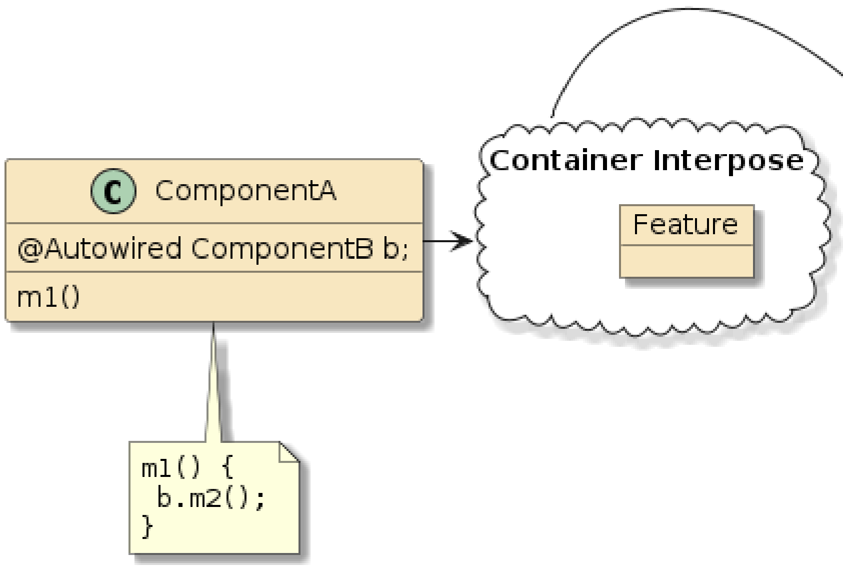


Figure 8. Container Interpose

Therefore it is important to arrange a component boundary wherever you need to start a new characteristic provided by the container. The following is a more detailed explanation of what not to do and do.

3.1.1. Buddy Method Boundary

The methods within a component class are not typically subject to container interpose. Therefore a call from m1() to m2() within the same component class is a straight Java call.

No Interpose for Buddy Method Calls

Buddy method calls are straight Java calls without container interpose.

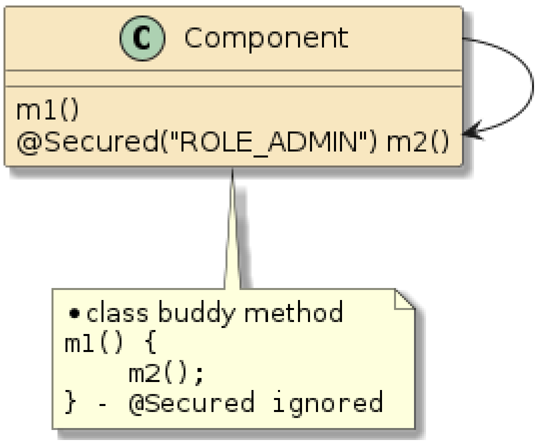


Figure 9. Buddy Method Boundary

3.1.2. Self Instantiated Method Boundary

Container interpose is only performed when the container has a chance to decorate the called component. Therefore, a call to a method of a component class that is self-instantiated will not have container interpose applied — no matter how the called method is annotated.

No Interpose for Self-Instantiated Components

Self-instantiated classes are not subject to container interpose.

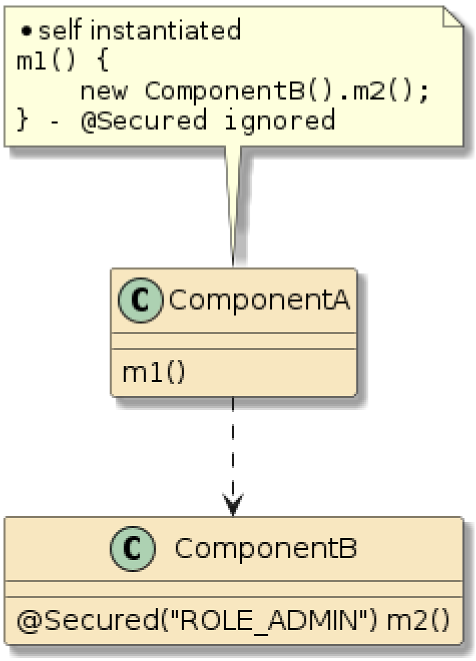


Figure 10. Self Instantiated Method Boundary

3.1.3. Container Injected Method Boundary

Components injected by the container are subject to container interpose and will have declared characteristics applied.

Container-Injected Components have Interpose

Use container injection to have declared features applied to called component methods.

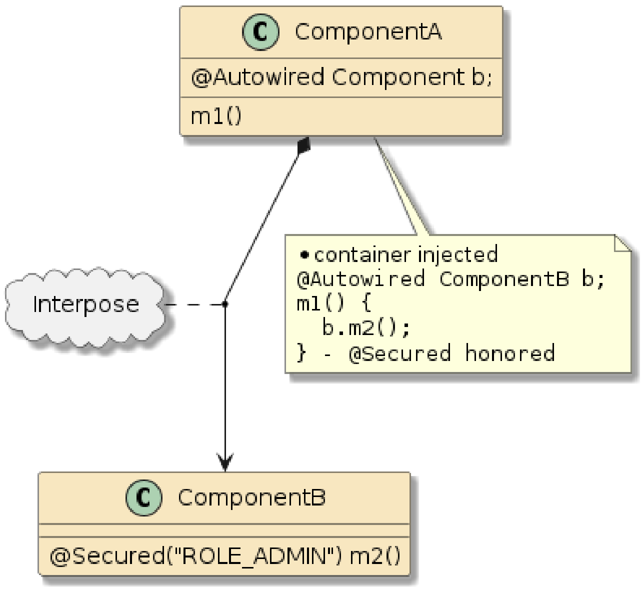
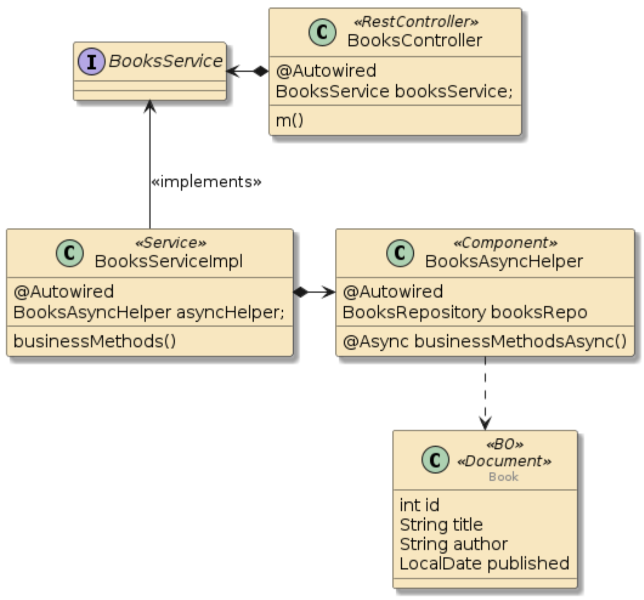


Figure 11. Container Injected Method Boundary

3.2. Compound Services

With `@Component` boundaries and interpose constraints understood — in more complex security, or threading solutions, the logical `@Service` many get broken up into one or more physical helper `@Component` classes.



«RestController» BooksController
@Autowired BooksService booksService;
m()
BooksService
«implements»
«Service» BooksServiceImpl
@Autowired BooksAsyncHelper asyncHelper;
businessMethods()
«Component» BooksAsyncHelper
@Autowired BooksRepository booksRepo
@Async businessMethodsAsync()
«BO» «Document» Book
int id
String title
String author
LocalDate published

Figure 12. Single Service Expressed as Multiple Components

Each helper `@Component` is primarily designed around start and end of container augmentation. The remaining parts of the logical service are geared towards implementing the outward facing facade, and integrating the methods of the helper(s) to complete the intended role of the service. An example of this would be large loops of behavior.

```
for (...) { asyncHelper.asyncMethod(); }
```

To external users of `@Service` — it is still logically, just one `@Service`.

Conceptual Services may be broken into Multiple Physical Components

Conceptual boundaries for a service usually map 1:1 with a single physical class. However, there are cases when the conceptual service needs to be implemented by multiple physical classes/`@Components`.

Chapter 4. BO/DTO Interface Options

With the core roles of BOs and DTOs understood, we next have a decision to make about where to use them within our application between the API and service classes.

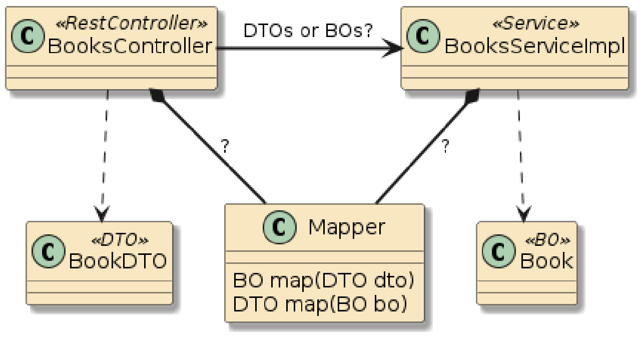


Figure 13. BO/DTO Interface Decisions

- @RestController external interface will always be based on DTOs.
- Service's internal implementation will always be based on BOs.
- Where do we make the transition?

4.1. API Maps DTO/BO

It is natural to think of the `@Service` as working with pure implementation (BO) classes. This leaves the mapping job to the `@RestController` and all clients of the `@Service`.

- Benefit: If we wire two `@Services` together, they could efficiently share the same BO instances between them with no translation.
- Drawback: `@Services` should be the boundary of a solution and encapsulate the implementation details. BOs leak implementation details.

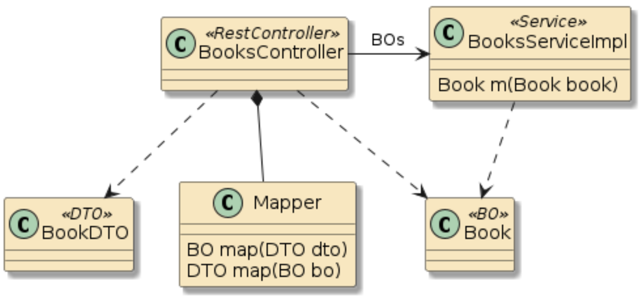


Figure 14. API Maps DTO to BO for Service Interface

4.2. @Service Maps DTO/BO

Alternatively, we can have the `@Service` fully encapsulate the implementation details and work with DTOs in its interface. This places the job of DTO/BO translation to the `@Service` and the `@RestController` and all `@Service` clients work with DTOs.

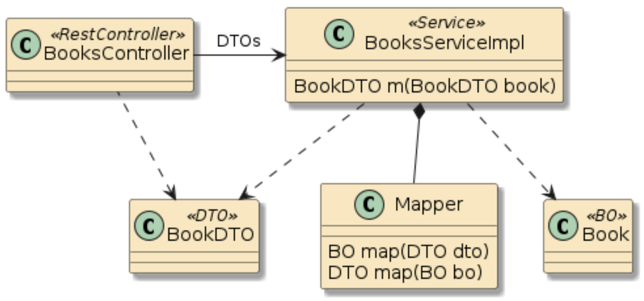
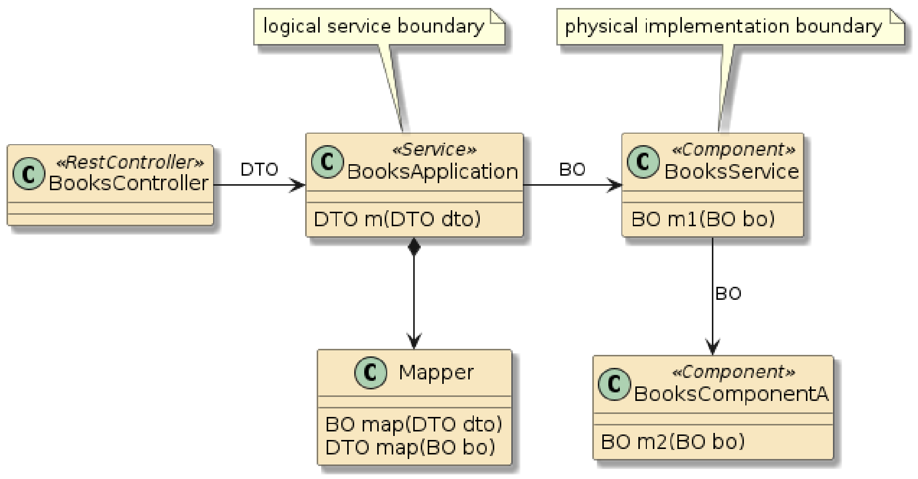


Figure 15. Service Maps DTO in Service Interface to BO

- Benefit: `@Service` fully encapsulates implementation and exchanges information using DTOs designed for interfaces.
- Drawback: BOs go through a translation when passing from `@Service` to `@Service` directly.

4.3. Layered Service Mapping Approach

The later DTO interface/mapping approach just introduced — maps closely to the Domain Driven Design (DDD) "Application Layer". However, one could also implement a layering of services.



- outer `@Service` classes represent the boundary to the application and interface using DTOs
- inner `@Component` classes represent implementation components and interface using native BOs

Layered Services Permit a Level of Trust between Inner Components

When using this approach, I like:

- all normalization and validation complete by the time DTOs are converted to BOs in the Application tier
- BOs exchanged between implementation components assume values are valid and normalized

Chapter 5. Implementation Details

With architectural decisions understood, lets take a look at some of the key details of the end-to-end application.

5.1. Book BO

We have already covered the `Book` BO `@Document` class in a lot of detail during the MongoTemplate lecture. The following lists most of the key business aspects and implementation details of the class.

Book BO Class with Spring Data MongoDB Database Mappings

```
package info.ejava.examples.db.mongo.books.bo;
...
@Document(collection = "books")
@Builder
@With
@ToString
@EqualsAndHashCode
@Getter
@AllArgsConstructor
public class Book {
    @Id
    private String id;
    @Setter
    @Field(name="title")
    private String title;
    @Setter
    private String author;
    @Setter
    private LocalDate published;
}
```

5.2. BookDTO

The BookDTO class has been mapped to Jackson JSON and Jackson and JAXB XML. The details of Jackson and JAXB mapping were covered in the API Content lectures. Jackson JSON required no special annotations to map this class. Jackson and JAXB XML primarily needed some annotations related to namespaces and attribute mapping. JAXB also required annotations for mapping the LocalDate field.

The following lists the annotations required to marshal/unmarshal the BooksDTO class using Jackson and JAXB.

BookDTO Class with JSON and XML Mappings

```
package info.ejava.examples.db.repo.jpa.books.dto;
...
```

```
@JacksonXmlRootElement(localName = "book", namespace = "urn:ejava.db-repo.books")
@XmlRootElement(name = "book", namespace = "urn:ejava.db-repo.books")
@XmlAccessorType(XmlAccessType.FIELD)
@Data @Builder
@NoArgsConstructor @AllArgsConstructor
public class BookDTO {
    @JacksonXmlProperty(isAttribute = true)
    @XmlAttribute
    private int id;
    private String title;
    private String author;
    @XmlJavaTypeAdapter(LocalDateJaxbAdapter.class) ①
    private LocalDate published;
 ...
}
```

① JAXB requires an adapter for the newer LocalDate java class

5.2.1. LocalDateJaxbAdapter

Jackson is configured to marshal LocalDate out of the box using the ISO_LOCAL_DATE format for both JSON and XML.

ISO_LOCAL_DATE format

```
"published" : "2013-01-30"  //Jackson JSON
<published xmlns="">2013-01-30</published> //Jackson XML
```

JAXB does not have a default format and requires the class be mapped to/from a string using an `XmlAdapter`.

LocalDateJaxbAdapter Class

```
@XmlJavaTypeAdapter(LocalDateJaxbAdapter.class)
private LocalDate published;

public static class LocalDateJaxbAdapter extends XmlAdapter<String, LocalDate> {
    @Override
    public LocalDate unmarshal(String text) {
        return LocalDate.parse(text, DateTimeFormatter.ISO_LOCAL_DATE);
    }
    @Override
    public String marshal(LocalDate timestamp) {
        return DateTimeFormatter.ISO_LOCAL_DATE.format(timestamp);
    }
}
```

5.3. Book JSON Rendering

The following snippet provides example JSON of a `Book` DTO payload.

Book JSON Rendering

```
{
 "id":"609b316de7366e0451a7bcb0",
 "title":"Tirra Lirra by the River",
 "author":"Mr. Arlen Swift",
 "published":"2020-07-26"
}
```

5.4. Book XML Rendering

The following snippets provide example XML of `Book` DTO payloads. They are technically equivalent from an XML Schema standpoint, but use some alternate syntax XML to achieve the same technical goals.

Book Jackson XML Rendering

```
<book xmlns="urn:ejava.db-repo.books" id="609b32b38065452555d612b8">
  <title xmlns="">To a God Unknown</title>
  <author xmlns="">Rudolf Harris</author>
  <published xmlns="">2019-11-22</published>
</book>
```

Book JAXB XML Rendering

```
<ns2:book xmlns:ns2="urn:ejava.db-repo.books" id="609b32b38065452555d61222">
    <title>The Mermaids Singing</title>
    <author>Olen Rolfson IV</author>
    <published>2020-10-14</published>
</ns2:book>
```

5.5. Pageable/PageableDTO

I placed a high value on paging when working with unbounded collections when covering repository find methods. The value of paging comes especially into play when dealing with external users. That means we will need a way to represent Page, Pageable, and Sort in requests and responses as a part of DTO solution.

You will notice that I made a few decisions on how to implement this interface

1. I am assuming that both sides of the interface using the DTO classes are using Spring Data. The DTO classes have a direct dependency on their non-DTO siblings.
2. I am using the Page, Pageable, and Sort DTOs to directly self-map to/from Spring Data types. This

makes the client and service code much simpler.

```
Pageable pageable = PageableDTO.of(pageNumber, pageSize, sortString).toPageable();
①
Page<BookDTO> result = ...
BooksPageDTO resultDTO = new BooksPageDTO(result); ①
```

① using self-mapping between paging DTOs and Spring Data (`Pageable` and `Page`) types

3. I chose to use the Spring Data types in the `@Service` interface and performed the Spring Data to DTO mapping in the `@RestController`. I did this so that I did not eliminate any pre-existing library integration with Spring Data paging types.

```
Page<BookDTO> getBooks(Pageable pageable); ①
```

① using Spring Data (`Pageable` and `Page`) and business DTO (`BookDTO`) types in `@Service` interface

I will be going through the architecture and wiring in these lecture notes. The actual DTO code is surprisingly complex to render in the different formats and libraries. These topics were covered in detail in the API content lectures. I also chose to implement the PageableDTO and sort as immutable — which added some interesting mapping challenges worth inspecting.

5.5.1. PageableDTO Request

Requests require an expression for Pageable. The most straight forward way to accomplish this is through query parameters. The example snippet below shows pageNumber, pageSize, and sort expressed as simple string values as part of the URI. We have to write code to express and parse that data.

Example Pageable Query Parameters

```
①
/api/books/example?pageNumber=0&pageSize=5&sort=published:DESC,id:ASC
②
```

① `pageNumber` and `pageSize` are direct properties used by `PageRequest`

② `sort` contains a comma separated list of order compressed into a single string

Integer `pageNumber` and `pageSize` are straight forward to represent as numeric values in the query. Sort requires a minor amount of work. Spring Data Sort is an ordered list of property and direction. I have chosen to express property and direction using a ":" separated string and concatenate the ordering using a ",". This allows the query string to be expressed in the URI without special characters.

5.5.2. PageableDTO Client-side Request Mapping

Since I expect code using the PageableDTO to also be using Spring Data, I chose to use self-mapping between the `PageableDTO` and Spring Data `Pageable`.

The following snippet shows how to map Pageable to PageableDTO and the PageableDTO properties to URI query parameters.

Building URI with Pageable Request Parameters

```
PageRequest pageable = PageRequest.of(0, 5,
    Sort.by(Sort.Order.desc("published"), Sort.Order.asc("id")));
PageableDTO pageSpec = PageableDTO.of(pageable); ①
URI uri=UriComponentsBuilder
   .fromUri(serverConfig.getBaseUrl())
   .path(BooksController.BOOKS_PATH).path("/example")
   .queryParams(pageSpec.getQueryParams()) ②
   .build().toUri();
```

① using PageableDTO to self map from Pageable

② using PageableDTO to self map to URI query parameters

5.5.3. PageableDTO Server-side Request Mapping

The following snippet shows how the individual page request properties can be used to build a local instance of PageableDTO in the @RestController. Once the PageableDTO is built, we can use that to self map to a Spring Data Pageable to be used when calling the @Service.

```
public ResponseEntity<BooksPageDTO> findBooksByExample(
    @RequestParam(value="pageNumber",defaultValue="0",required=false) Integer
pageNumber,
    @RequestParam(value="pageSize",required=false) Integer pageSize,
    @RequestParam(value="sort",required=false) String sortString,
    @RequestBody BookDTO probe) {

    Pageable pageable = PageableDTO.of(pageNumber, pageSize, sortString) ①
                                  .toPageable(); ②
```

① building PageableDTO from page request properties

② using PageableDTO to self map to Spring Data Pageable

5.5.4. Pageable Response

Responses require an expression for Pageable to indicate the pageable properties about the content returned. This must be expressed in the payload, so we need a JSON and XML expression for this. The snippets below show the JSON and XML DTO renderings of our Pageable properties.

Example JSON Pageable Response Document

```
  "pageable" : {
    "pageNumber" : 1,
    "pageSize" : 25,
    "sort" : "title:ASC,author:ASC"
  }
```

Example XML Pageable Response Document

```
<pageable xmlns="urn:ejava.common.dto" pageNumber="1" pageSize="25" sort=
"title:ASC,author:ASC"/>
```

5.6. Page/PageDTO

Pageable is part of the overall Page<T>, with contents. Therefore, we also need a way to return a page of content to the caller.

5.6.1. PageDTO Rendering

JSON is very lenient and could have been implemented with a generic PageDTO<T> class.

```
{"content":[ ①
  {"id":"609cffbc881de53b82657f17", ②
   "title":"An Instant In The Wind",
   "author":"Clifford Blick",
   "published":"2003-04-09"}],
 "totalElements":10, ①
 "pageable":{"pageNumber":3,"pageSize":3,"sort":null}} ①
```

① content, totalElements, and pageable are part of reusable PageDTO

② book within content array is part of concrete Books domain

However, XML — with its use of unique namespaces, requires a sub-class to provide the type-specific values for content and overall page.

```
<booksPage xmlns="urn:ejava.db-repo.books" totalElements="10"> ①
  <wstxns1:content xmlns:wstxns1="urn:ejava.common.dto">
    <book id="609cffbc881de53b82657f17"> ②
      <title xmlns="">An Instant In The Wind</title>
      <author xmlns="">Clifford Blick</author>
      <published xmlns="">2003-04-09</published>
    </book>
  </wstxns1:content>
  <pageable xmlns="urn:ejava.common.dto" pageNumber="3" pageSize="3"/>
</booksPage>
```

① totalElements mapped to XML as an (optional) attribute

② booksPage and book are in concrete domain urn:ejava.db-repo.books namespace

5.6.2. BooksPageDTO Subclass Mapping

The `BooksPageDTO` subclass provides the type-specific mapping for the content and overall page. The generic portions are handled by the base class.

BooksPageDTO Subclass Mapping

```
@JacksonXmlRootElement(localName="booksPage", namespace="urn:ejava.db-repo.books")
@XmlRootElement(name="booksPage", namespace="urn:ejava.db-repo.books")
@XmlType(name="BooksPage", namespace="urn:ejava.db-repo.books")
@XmlAccessorType(XmlAccessType.NONE)
@NoArgsConstructor
public class BooksPageDTO extends PageDTO<BookDTO> {
    @JsonProperty
    @JacksonXmlElementWrapper(localName="content", namespace="urn:ejava.common.dto")
    @JacksonXmlProperty(localName="book", namespace="urn:ejava.db-repo.books")
    @XmlElementWrapper(name="content", namespace="urn:ejava.common.dto")
    @XmlElement(name="book", namespace="urn:ejava.db-repo.books")
    public List<BookDTO> getContent() {
        return super.getContent();
    }
    public BooksPageDTO(List<BookDTO> content, Long totalElements,
            PageableDTO pageableDTO) {
        super(content, totalElements, pageableDTO);
    }
    public BooksPageDTO(Page<BookDTO> page) {
        this(page.getContent(), page.getTotalElements(),
             PageableDTO.fromPageable(page.getPageable()));
    }
}
```

5.6.3. PageDTO Server-side Rendering Response Mapping

The `@RestController` can use the concrete DTO class (`BookPageDTO` in this case) to self-map from a Spring Data `Page<T>` to a DTO suitable for marshaling back to the API client.

PageDTO Server-side Response Mapping

```
Page<BookDTO> result=booksService.findBooksMatchingAll(probe, pageable);

BooksPageDTO resultDTO = new BooksPageDTO(result); ①
ResponseEntity<BooksPageDTO> response = ResponseEntity.ok(resultDTO);
```

① using `BooksPageDTO` to self-map Sing Data `Page<T>` to DTO

5.6.4. PageDTO Client-side Rendering Response Mapping

The `PageDTO<T>` class can be used to self-map to a Spring Data `Page<T>`. Pageable, if needed, can be obtained from the `Page<T>` or through the `pageDTO.getPageable()` DTO result.

PageDTO Client-side Response Mapping

```
BooksPageDTO pageDTO = request.exchange()
        .expectStatus().isOk()
        .returnResult(BooksPageDTO.class)
        .getResponseBody().blockFirst();
Page<BookDTO> page = pageDTO.toPage(); ①
Pageable pageable = ... ②
```

① using `PageDTO<T>` to self-map to a Spring Data `Page<T>`

② can use `page.getPageable()` or `pageDTO.getPageable().toPageable()` obtain `Pageable`

Chapter 6. BookMapper

The `BookMapper @Component` class is used to map between `BookDTO` and `Book` BO instances. It leverages Lombok builder methods — but is pretty much a simple/brute force mapping.

6.1. Example Map: BookDTO to Book BO

The following snippet is an example of mapping a `BookDTO` to a `Book` BO.

Map BookDTO to Book BO

```
@Component
public class BooksMapper {
    public Book map(BookDTO dto) {
        Book bo = null;
        if (dto!=null) {
            bo = Book.builder()
                    .id(dto.getId())
                    .author(dto.getAuthor())
                    .title(dto.getTitle())
                    .published(dto.getPublished())
                    .build();
        }
        return bo;
    }
    ...
```

6.2. Example Map: Book BO to BookDTO

The following snippet is an example of mapping a `Book` BO to a `BookDTO`.

Map Book BO to BookDTO

```
    ...
    public BookDTO map(Book bo) {
        BookDTO dto = null;
        if (bo!=null) {
            dto = BookDTO.builder()
                    .id(bo.getId())
                    .author(bo.getAuthor())
                    .title(bo.getTitle())
                    .published(bo.getPublished())
                    .build();
        }
        return dto;
    }
    ...
```

Chapter 7. Service Tier

The BooksService `@Service` encapsulates the implementation of our management of Books.

7.1. BooksService Interface

The `BooksService` interface defines a portion of pure CRUD methods and a series of finder methods. To be consistent with DDD encapsulation, the `@Service` interface is using DTO classes. Since the `@Service` is an injectable component, I chose to use straight Spring Data pageable types to possibly integrate with libraries that inherently work with Spring Data types.

BooksService Interface

```
public interface BooksService {
    BookDTO createBook(BookDTO bookDTO); ①
    BookDTO getBook(int id);
    void updateBook(int id, BookDTO bookDTO);
    void deleteBook(int id);
    void deleteAllBooks();

    Page<BookDTO> findPublishedAfter(LocalDate exclusive, Pageable pageable);②
    Page<BookDTO> findBooksMatchingAll(BookDTO probe, Pageable pageable);
}
```

① chose to use DTOs in `@Service` interface

② chose to use Spring Data types in pageable `@Service` finder methods

7.2. BooksServiceImpl Class

The `BooksServiceImpl` implementation class is implemented using the `BooksRepository` and `BooksMapper`.

BooksServiceImpl Implementation Attributes

```
@RequiredArgsConstructor ① ②
@Service
public class BooksServiceImpl implements BooksService {
    private final BooksMapper mapper;
    private final BooksRepository booksRepo;
```

① Creates a constructor for all final attributes

② Single constructors are automatically used for Autowiring

I will demonstrate two methods here — one that creates a book and one that finds books. There is no need for any type of formal transaction here because we are representing the boundary of consistency within a single document.

MongoDB 4.x Does Support Multi-document Transactions

Multi-document transactions are now supported within MongoDB (as of version 4.x) and Spring Data MongoDB. When using declared transactions with Spring Data MongoDB, this looks identical to transactions implemented with Spring Data JPA. The programmatic interface is fairly intuitive as well. However, it is not considered a best, early practice. Therefore, I will defer that topic to a more advanced coverage of MongoDB interactions.

7.3. createBook()

The `createBook()` method

- accepts a `BookDTO`, creates a new book, and returns the created book as a `BookDTO`, with the generated ID.
- calls the mapper to map from/to a BooksDTO to/from a `Book` BO
- uses the `BooksRepository` to interact with the database

BooksServiceImpl.createBook()

```
public BookDTO createBook(BookDTO bookDTO) {
    Book bookBO = mapper.map(bookDTO); ①

    //insert instance
    booksRepo.save(bookBO); ②

    return mapper.map(bookBO); ③
}
```

① mapper converting DTO input argument to BO instance

② BO instance saved to database and updated with primary key

③ mapper converting BO entity to DTO instance for return from service

7.4. findBooksMatchingAll()

The `findBooksMatchingAll()` method

- accepts a `BookDTO` as a probe and `Pageable` to adjust the search and results
- calls the mapper to map from/to a BooksDTO to/from a `Book` BO
- uses the `BooksRepository` to interact with the database

BooksServiceImpl Finder Method

```
public Page<BookDTO> findBooksMatchingAll(BookDTO probeDTO, Pageable pageable) {
    Book probe = mapper.map(probeDTO); ①
    ExampleMatcher matcher = ExampleMatcher.matchingAll(); ②
    Page<Book> books = booksRepo.findAll(Example.of(probe, matcher), pageable); ③
    return mapper.map(books); ④
}
```

① mapper converting DTO input argument to BO instance to create probe for match

② building matching rules to `AND` all supplied non-null properties

③ finder method invoked with matching and paging arguments to return page of BOs

④ mapper converting page of BOs to page of DTOs

Chapter 8. RestController API

The `@RestController` provides an HTTP Facade for our `@Service`.

@RestController Class

```
@RestController
@Slf4j
@RequiredArgsConstructor
public class BooksController {
    public static final String BOOKS_PATH="api/books";
    public static final String BOOK_PATH= BOOKS_PATH + "/{id}";
    public static final String RANDOM_BOOK_PATH= BOOKS_PATH + "/random";

    private final BooksService booksService; ①
```

① `@Service` injected into class using constructor injection

I will demonstrate two of the operations available.

8.1. createBook()

The `createBook()` operation

- is called using `POST /api/books` method and URI
- passed a BookDTO, containing the fields to use marshaled in JSON or XML
- calls the `@Service` to handle the details of creating the Book
- returns the created book using a BookDTO

createBook() API Operation

```
@RequestMapping(path=BOOKS_PATH,
        method=RequestMethod.POST,
        consumes={MediaType.APPLICATION_JSON_VALUE, MediaType.APPLICATION_XML_VALUE},
        produces={MediaType.APPLICATION_JSON_VALUE, MediaType.APPLICATION_XML_VALUE})
public ResponseEntity<BookDTO> createBook(@RequestBody BookDTO bookDTO) {

    BookDTO result = booksService.createBook(bookDTO); ①

    URI uri = ServletUriComponentsBuilder.fromCurrentRequestUri()
            .replacePath(BOOK_PATH)
            .build(result.getId()); ②
    ResponseEntity<BookDTO> response = ResponseEntity.created(uri).body(result);
    return response; ③
}
```

① DTO from HTTP Request supplied to and result DTO returned from `@Service` method

② URI of created instance calculated for `Location` response header

③ DTO marshalled back to caller with HTTP Response

8.2. findBooksByExample()

The `findBooksByExample()` operation

- is called using "POST /api/books/example" method and URI
- passed a BookDTO containing the properties to search for using JSON or XML
- calls the `@Service` to handle the details of finding the books after mapping the `Pageable` from query parameters
- converts the `Page<BookDTO>` into a `BooksPageDTO` to address marshaling concerns relative to XML.
- returns the page as a `BooksPageDTO`

findBooksByExample API Operation

```
@RequestMapping(path=BOOKS_PATH + "/example",
        method=RequestMethod.POST,
        consumes={MediaType.APPLICATION_JSON_VALUE, MediaType.APPLICATION_XML_VALUE},
        produces={MediaType.APPLICATION_JSON_VALUE, MediaType.APPLICATION_XML_VALUE})
public ResponseEntity<BooksPageDTO> findBooksByExample(
        @RequestParam(value="pageNumber",defaultValue="0",required=false) Integer
pageNumber,
        @RequestParam(value="pageSize",required=false) Integer pageSize,
        @RequestParam(value="sort",required=false) String sortString,
        @RequestBody BookDTO probe) {

    Pageable pageable=PageableDTO.of(pageNumber, pageSize, sortString).toPageable();①
    Page<BookDTO> result=booksService.findBooksMatchingAll(probe, pageable); ②

    BooksPageDTO resultDTO = new BooksPageDTO(result); ③
    ResponseEntity<BooksPageDTO> response = ResponseEntity.ok(resultDTO);
    return response;
}
```

① `PageableDTO` constructed from page request query parameters

② `@Service` accepts DTO arguments for call and returns DTO constructs mixed with Spring Data paging types

③ type-specific `BooksPageDTO` marshalled back to caller to support type-specific XML namespaces

8.3. WebClient Example

The following snippet shows an example of using a WebClient to request a page of finder results form the API. WebClient is part of the Spring WebFlux libraries — which implements reactive streams. The use of WebClient here is purely for example and not a requirement of anything created. However, using WebClient did force my hand to add JAXB to the DTO mappings since

Jackson XML is not yet supported by WebFlux. RestTemplate does support both Jackson and JAXB XML mapping - which would have made mapping simpler.

WebClient Client

```
@Autowired
private WebClient webClient;
...
UriComponentsBuilder findByExampleUriBuilder = UriComponentsBuilder
        .fromUri(serverConfig.getBaseUrl())
        .path(BooksController.BOOKS_PATH).path("/example");
...
//given
MediaType mediaType = ...
PageRequest pageable = PageRequest.of(0, 5, Sort.by(Sort.Order.desc("published")));
PageableDTO pageSpec = PageableDTO.of(pageable); ①
BookDTO allBooksProbe = BookDTO.builder().build(); ②
URI uri = findByExampleUriBuilder.queryParams(pageSpec.getQueryParams()) ③
                                 .build().toUri();
WebClient.RequestHeadersSpec<?> request = webClient.post()
        .uri(uri)
        .contentType(mediaType)
        .body(Mono.just(allBooksProbe), BookDTO.class)
        .accept(mediaType);
//when
ResponseEntity<BooksPageDTO> response = request
        .retrieve()
        .toEntity(BooksPageDTO.class).block();
//then
then(response.getStatusCode().is2xxSuccessful()).isTrue();
BooksPageDTO page = response.getBody();
```

① limiting query rsults to first page, ordered by "release", with a page size of 5

② create a "match everything" probe

③ pageable properties added as query parameters

WebClient/WebFlex does not yet support Jackson XML

WebClient and WebFlex does not yet support Jackson XML. This is what primarily forced the example to leverage JAXB for XML. WebClient/WebFlux automatically makes the decision/transition under the covers once an `@XmlRootElement` is provided.

Chapter 9. Summary

In this module we learned:

- to integrate a Spring Data MongoDB Repository into an end-to-end application, accessed through an API
- implement a service tier that completes useful actions
- to make a clear distinction between DTOs and BOs
- to identify data type architectural decisions required for DTO and BO types
- to setup proper container feature boundaries using annotations and injection
- implement paging requests through the API
- implement page responses through the API