**Lesson 2. Building a Spring Boot Web App.**

Book and authors example code (Many to Many):

Book:

@ManyToMany  
@JoinTable(name = "author\_book", joinColumns = @JoinColumn(name="book\_id"),  
 inverseJoinColumns = @JoinColumn(name = "author\_id"))  
private Set<Author> authors = new HashSet<>();

Author:

@ManyToMany(mappedBy = "authors")  
private Set<Book> books = new HashSet<>();

Do not forget ID column:

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

Implement equal and hash

Spring data repositories:

* Provides an implementation of the repository pattern
* Concept is originally from Eric Evans’ book Domain Driven Design
* A Repository has methods for retrieving domain objects should delegate a specialized Repository object such that alternative storage implementation may be interchanged
* This is important. It allows you to easily substitute the persistence layer

**Lesson 3. Dependency Injection with the Spring Framework.**

SOLID OOP principles:

Single Responsibility Principle:

* Every Class should have a single responsibility.
* There should never be more than one reason for a class to change.
* Your classes should be small. No more than a screen full of code.
* Avoid ‘god’ classes.
* Split big classes into smaller classes.

Open/Closed Principle:

* Your classes should be open for extension
* But closed for modification
* You should be able to extend a classes behavior, without modifying it.
* Use private variables with getters and setters - ONLY when you need them.
* Use abstract base classes

Liskov Subsitution Principle:

* By Barbara Liskov, in 1998
* Objects in a program would be replaceable with instances of their subtypes WITHOUT altering the correctness of the program.
* Violations will often fail the “Is a” test.
* A Square “Is a” Rectangle
* However, a Rectangle “Is Not” a Square

Interface Segregation Principle:

* Make fine grained interfaces that are client specific
* Many client specific interfaces are better than one “general purpose” interface
* Keep your components focused and minimize dependencies between them
* Notice relationship to the Single Responsibility Principle?
* ie avoid ‘god’ interfaces

Dependency Inversion Principle:

* Abstractions should not depend upon details
* Details should not depend upon abstractions
* Important that higher level and lower level objects depend on the same abstract interaction
* This is not the same as Dependency Injection - which is how objects obtain dependent objects

**Dependency Injection** is where a needed dependency is injected by another object. The class being injected has no responsibility in instantiating the object being injected.

Types of dependency injection:

* By class properties –least preferred
  + using private properties is EVIL (Impossible to test)
* By setters – area of much debate
* By Constructor – Most preferred

Concrete classes vs interfaces:

* DI can be done with Concrete Classes or with Interfaces
* Generally DI with Concrete Classes should be avoided
* DI via Interface is highly preferred
  + Allows runtime to decide implementation to inject
  + Follows Interface segregation principle of SOLID
  + Makes core more testable

Inversion of control is a technique to allow dependencies to be injected at runtime. Dependencies are not predetermined.

DI refers much to the composition of your classes (you compose your classes with DI in mind). IoC is the runtime environment of your code (Spring Framework’s IoC container)

Use controller as a target and service as a dependency. Use autowired for property and setter based injections. Using autowired for constructor based injection is not mandatory. To get bean from context, first get the context by saving app run function value to a variable and then use getBean method.

Use qualifier annotations to help determine which dependency to use. Method signature example:

public ConstructorInjectedController(@Qualifier("constructorGreetingService") GreetingService greetingService)

With setter you could use @Qualifier in function level or as in constructor.

In property based DI if you use dependency name as a concrete class, then spring will use that concrete class. If @Primary has been set, then dependency will be the class annotated with @Primary annotation.

You could use @Primary technique when you have multiple beans of the same type and you want one of them to go in by default.

**Spring Profiles.** Profiles are something that we can set at runtime which configure Spring how it wires up things so when we set an active profile, Spring is going to bring all beans and then beans that are marked with that Profile and beans of a different profile Spring is going to ignore it. So this is a very important feature we can do things like running multiple data sources if we had two different MYSQL databases or a very common development scenario is to use a primary or development in memory H2 database and MySQL later down the road.

Use @Profile annotation with service. And

spring.profiles.active=es

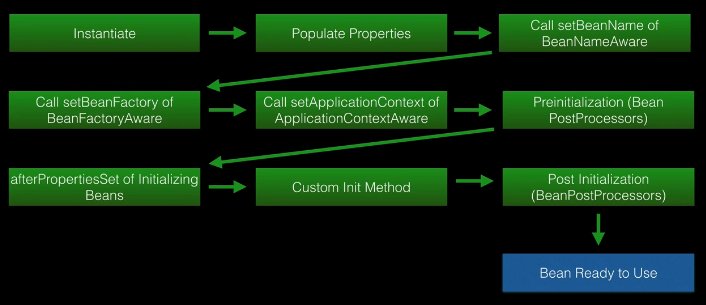
in application properties to set spring profile.

You can specify beans with Default to be added into the Spring context when there are no other beans of that type available so this is a very special case. You could use arrays of profiles:

@Profile({"en", "default"})

Default is only active when no other profiles are active (Only and only. That is important!)

**Spring Bean Life Cycle.**



Callback interfaces. Spring has two interfaces you can implement for call back events:

* InitializingBean.afterPropertiesSet()
  + called after properties are set
* DisposableBean.destroy()
  + called during bean destruction in shutdown

Life Cycle Annotations:

* Spring has two annotations you can use to hook into the bean life cycle
* @PostConstruct annotated methods will be called after the bean has been constructed, but before is returned to the requesting object
* @PreDestroy is called just before the bean is destroyed by the container

Bean Post processors:

* Gives you a mean to tap into the Spring context life cycle and interact with beans as they are processed
* Implement interface BeanPostProcessor
  + postProcessBeforeInitialization – called before bean initialization method
  + postProcessAfterInitialization – called after bean initialization

Aware interfaces:

* Spring has over 14 Aware interfaces
* These are used to access the Spring Framework infrastructure
* These are largely used within the framework
* Rarely used by Spring developers

Release plugin configuration:

<**build**>  
 <**plugins**>  
 <**plugin**>  
 <**groupId**>org.springframework.boot</**groupId**>  
 <**artifactId**>spring-boot-maven-plugin</**artifactId**>  
 </**plugin**>  
 <**plugin**>  
 <**groupId**>org.apache.maven.plugins</**groupId**>  
 <**artifactId**>maven-release-plugin</**artifactId**>  
 <**configuration**>  
 <**goals**>install</**goals**>  
 <**autoVersionSubmodules**>true</**autoVersionSubmodules**>  
 <**checkModificationExcludes**>  
 <**checkModificationExclude**>pom.xml</**checkModificationExclude**>  
 </**checkModificationExcludes**>  
 </**configuration**>  
  
 </**plugin**>  
 </**plugins**>  
 </**build**>  
  
 <**scm**>  
 <**developerConnection**>scm:git:https://github.com/avgasanov/sfg-pet-clinic.git</**developerConnection**>  
 <**tag**>HEAD</**tag**>  
</**scm**>

**Lesson 4. Spring Framework Configuration**

* XML Based Configuration
  + Introduced in Spring Framework 2.0
  + Common in legacy Spring Applications
  + Still supported in Spring Framework 5.x
* Annotation Based Configuration
  + Introduced in Spring Framework 3
  + Picked up via ‘Component Scans’
  + Refer to class level annotations
    - @Controller, @Service, @Component, @Repository
* Java Based Configuration
  + Introduced in Spring Framework 3
  + Uses Java Classes to define Spring Beans
  + Configuration classes are defined with @Configuration annotation
  + Beans are declared with @Bean annotation
* Groovy Bean Definition DSL Configuration
  + Introduced in Spring Framework 4
  + Allows you to declare beans in Groovy
  + Borrowed from Grails

Industry trend is to favor Java Based Configuration

Spring Framework Stereotypes

* Stereotype – a fixed general image or set of characteristics which represent a particular type of person or thing
* Spring stereotypes are used to define Spring Beans in the Spring context
* Available Stereotypes - @Component, @Controller, @RestController, @Repository, @Service

Component is the highest level, everything elsee inherits from the Component so when Spring encounters just the Component annotation, that is going to wire it up as a Spring Bean, it is going to hold true for all the other annotations. Controller is used to indicate Spring MVC Controller. @Repository is the annotation that indicates that you are accessing the data layer where Service is intended to be a backing up for that controller. @RestController is a convenience annotation representing @Controller and @ResponseBody

Spring Component scan will work for packages down the package where @SpringBootApplication annotation is defined. Use @ComponentScan(basePackages = {“pack”,…}) for Component scanning in outside packages.

Spring Configuration. Use @Configuration and @Bean to define bean inside configuration class.

Spring Boot Annotations:

* @SpringBootApplication
* @Configuration – Declares class as Spring Configuration
* @EnableAutoConfiguration
* @ComponentScan

Auto-configuration will bring a lot of configuration classes in supplied Spring Boot Jars. You can specify classes to exclude with: @EnableAutoConfiguration(exclude={DataSourceAutoConfiguration.class})

Spring Bean Scopes:

* Singleton – (default) Only one instance of the bean is created in the IoC container
* Prototype – A new instance is created each time the bean is requested.
* Request – A single instance per http request. Only valid in the context of a web-aware Spring ApplicationContext
* Session – A single instance per http session. Only valid in the context of a web-aware Spring ApplicationContext
* Global-session – A single instance per global session. Typically Only used in a Portlet context. Only valid in the context of a web-aware Spring ApplicationContext.
* Application – bean is scoped to the lifecycle of a ServletContext. Only valied in the context of a web aware.
* Websocket – Scopes a single bean definition to the lifecycle of a WebSocket. Only valid in the context of a web-aware Spring ApplicationContext.
* Custom scope – spring scopes are extensible, and you can define your own scope by implementing Spring’s “Scope” interface
* You cannot override the built in Singleton and Prototype Scopes

In Java configuration use @Scope annotation. In XML configuration scope is an XML attribute of the “bean” tag.

To implement Pre loading:

* Create class that implements CommandLineRunner interface
* Add @Component annotation
* implement interface method

**Lesson 5. External Properties with Spring Framework**

Process:

1. Create properties file:
   1. guru.username=John
2. Create Java Configuration class
   1. annotate with @Configuration
   2. and @PropertySource(“classpath:filename.properties”)
   3. add PlaceHolderConfigurer bean:
3. @Bean  
   public static PropertySourcesPlaceholderConfigurer properties() {  
    PropertySourcesPlaceholderConfigurer propertySourcesPlaceholderConfigurer  
    = new PropertySourcesPlaceholderConfigurer();  
    return propertySourcesPlaceholderConfigurer;  
   }
   1. add fields with @Value(“${property.name}”)
   2. use these fields

To get system variables use Environment (from spring framework)

Use propertysources with string array, or PropertySources with PropertySource array

YAML

You could use – application-de.properties (de – profile name) to use profile specific properties in application. Or you could also use YAML:

--- #new file separator

spring:

profiles: de

#THE rest of the properties

**Lesson 6. Web development with Spring MVC.**

Thymeleaf is a Java template Engine. Open Source Project Released in 2011. Using Apache License 2.0 Open Source License. Features:

* Produce XML, XHTML and HTML5
* replacement for JSPs
* Natural template engine
* not tied to web environment.
* not a web framework.

Thymeleaf templates are valid HTML documents you can view in the browsers. JSP files are not valid HTML. Slower than JSP, Freemarker and Velocity. Spring 5 no longer supports Velocity.

**8. JPA Data Modeling with Spring and Hibernate.**

Owning side. The Owning side in the relationship will hold the foreign key in the database. One to One is the side where the foreign key is specified. OneToMany and ManyToOne is the Many side. mappedBy is used to define the field with “owns” the reference of the relationship

Fetch Type. JPA 2.1 Fetch Type Defaults:

* OneToMany – Lazy
* ManyToOne – Eager
* ManyToMany – Lazy
* OneToOne – Eager

JPA Cascade Types Control how state changes are cascaded from parent objects to child objects. JPA Cascade Types:

* PERSIST – Save operations will cascade to related entities
* MERGE – related entities are merged when the owning entity is merged
* REFRESH – related entities are refreshed when the owning entity is refreshed.
* REMOVE – Removes all related entities when the owning entity is deleted
* DETACH – detaches all related entities if a manual detach occurs
* ALL – Applies all the above cascade options

By default, no operations are cascaded.

Embeddable types. JPA / Hibernate support embeddable types. These are used to define a common set of properties. For example, an order might have a billing address, and a shipping address. An embeddable type could be used for the address properties.

Inheritance.

MappedSuperclass – Entities inherit from a super class. A database table IS NOT created for the super class

Single Table – (Hibernate Default) – One Table is used for all subclasses.

Joined Table – Base class and subclasses have their own tables. Fetching subclass entities require a join to the parent table.

Table Per Class – Each subclass has its own table.

Create and Update Timestamps. JPA supports @PrePersist and @PreUpdate which can be used to support audit timestamps via JPA lifecycle callbacks. Hibernate provides @CreationTimestamp and @UpdateTimestamp

Database initialization using Spring. Hibernate DDL Auto.

Hibernate property is set by the Spring property spring.jpa.hibernate.ddl-auto. Options are: none, validate, update, create, create-drop. Spring will use create-drop for embedded databases (hsqlm h2, derby) or none.

Data can be loaded from import.sql. Must be on root of class path. Only executed if Hibernate’s ddl-auto property is set to create or create-drop.

Spring JDBC. Spring’s DataSource initializer via Spring Boot will by default load schema.sql and data.sql from the root of the classpath. Spring Boot will also load from schem-${platform}.sql and data-${platform}.sql. Must set spring.datasource.platform. May conflict with Hibernate’s DDL Auto property. Should use setting of “none” or “validate”.

**9. Project Lombok.**

How Lombook works? Hooks in via the Annotation processor API. The AST (raw source code) is passed to Lombok for code generation before java continues. Thus, producec properly compiled Java code in conjuction with the Java compiler.

Project Lombook Features:

@Getter – creates getter methods for all properties

@Setter – creates setter for all non-final properties

@ToString – generates String of classname, and each field separated by commas. Optional parameter to include field names. Optional parameter to include call to the super toString method.

@EqualsAndHashCode – generates implementation of equals and hashCode. By default will use all non-static, non-transient properties. Can optionally exclude specific properties.

@NoArgsConstructor – generates no args constructor. Will cause compiler error if there are final fields. Can optionally force, which will initialize final fields with 0/false/null.

@RequiredArgsConstructor – generates a constructors for all fields that are final or marked @NonNull. Constructor will throw a NullPointerException if any @NonNull fields are null.

@Data – Generates typical boilerplate code for POJOs. Combines - @Getter, @Setter, @ToString, @EqualsAndHashCode, @RequiredArgsConstructor. No constructor is generated if constructors have been explicitly declared.

@Value – The immutable variant of @Data. All fields are made private and final by default.

@NonNull – set on parameter of method or constructor and a NullPointerException will be thrown if parameter is null

@Builder – implements the builder pattern for object creation.

@SneakyThrows – throws checked exception without declating in calling method’s throws clause

@Syncronized – a safer implementation of Java’s synchronized.

@Log – creates a Java util logger

@Slf4j – Creates a SLF4J logger. Recommended – SLF4J is a generic logging façade. Spring Boot’s default logger is LogBack.

<dependency>  
 <groupId>org.projectlombok</groupId>  
 <artifactId>lombok</artifactId>  
</dependency>

Load plugin for InteliJ: Lombok Plugin.

**10. Testing Spring Framework Applications.**

Code Under Test - This is the code (or application) you are testing

Test Fixture – “A test fixture is a fixed state of a set of objects used as a baseline for running tests. The purpose of a test fixture is to ensure that there is a well known and fixed environment in which tests are run so that results are repeatable”. Includes: input data, mock objects, loading database with known data, etc

Unit Tests / Unit Testing - Code written to test code under test. Designed to test specific sections of code. Percentage of lines of code tested is code coverage. Ideal coverage is in the 70-80% range. Should be ‘unity’ and execute very fast. Should have no external dependencies, ie no database, no Spring context, etc

Integration Tests - Designed to test behaviors between objects and parts of the overall system. Much larger scope. Can include the Spring Context, database, and message brokers. Will run much slower than unit tests

Functional Tests - Typically means you are testing the running application. Application is live, likely deployed in a known environment. Functional touch points are tested, i.e. Using a web driver, calling web services, sending / receiving messages, etc.

TDD - Test Driven Development - Write tests first, which will fail, then code to ‘fix’ test.

BDD - Behavior Driven Development - Builds on TDD and specifies that tests of any unit of software should be specified in terms of desired behavior of the unit. Often implemented with DSLs to create natural language tests. JBehave, Cucumber, Spock, example: given, when, then.

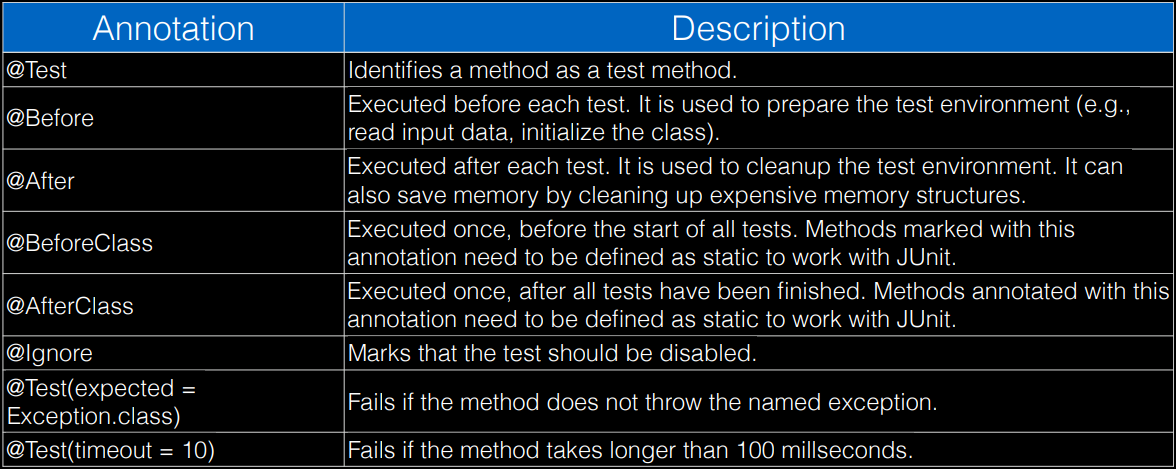
Mock - A fake implementation of a class used for testing. Like a test double.

Spy - A partial mock, allowing you to override select methods of a real class.

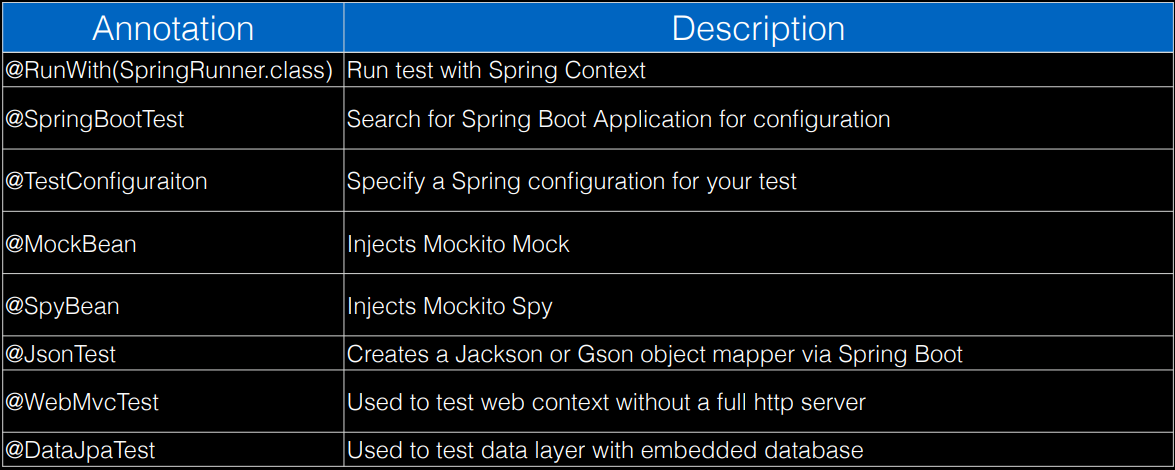
Generally, you will want the majority of your tests to be unit tests. Bringing up the Spring Context makes your tests exponentially slower. Try to test specific business logic in unit tests. Use Integration Tests to test interactions. Think of a pyramid. Base is unit tests, middle is integration tests, top is functional tests.

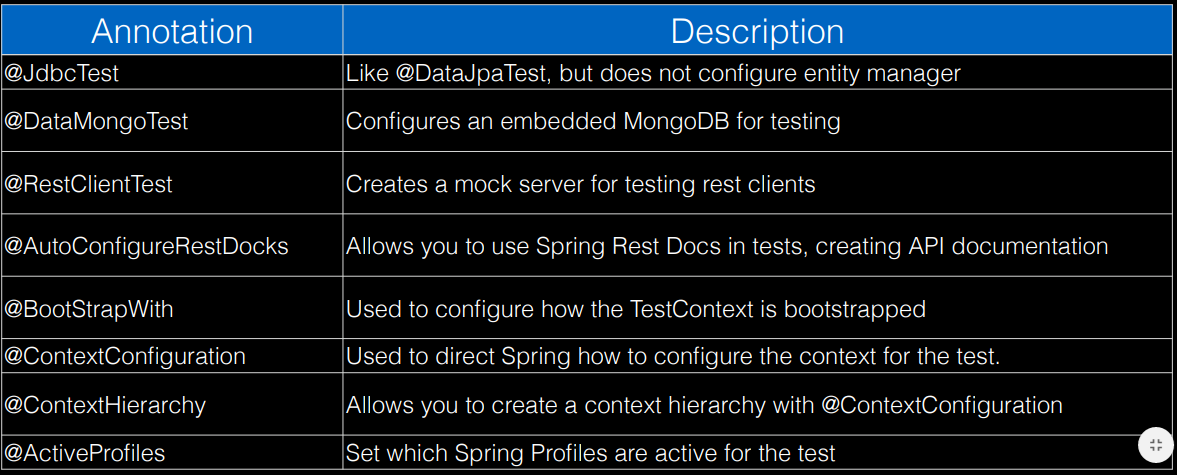
Using spring-boot-starter-test (default from Spring Initializr will load the following dependencies:

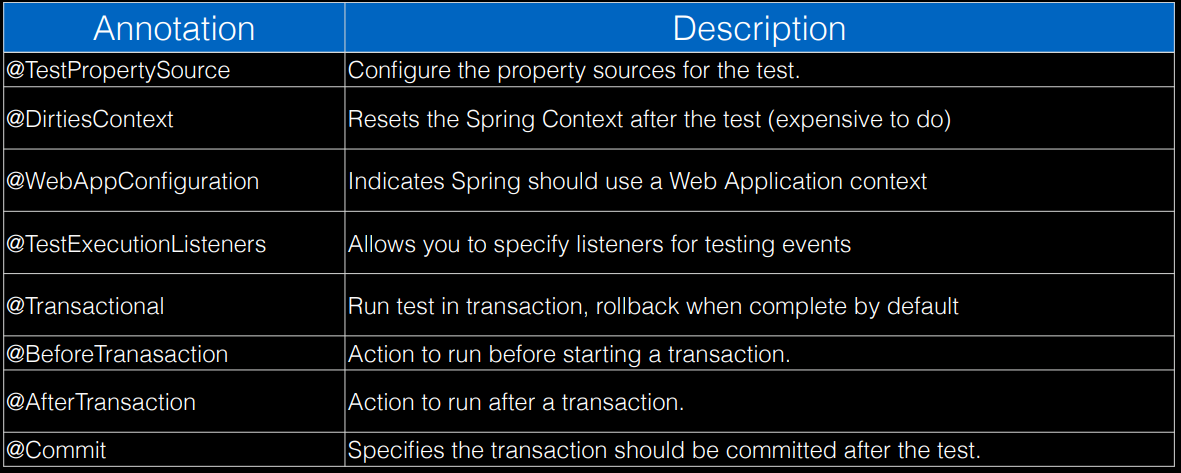
* JUnit - The de-facto standard for unit testing Java applications
* Spring Test and Spring Boot Test - Utilities and integration test support for Spring Boot applications
* AssertJ - A fluent assertion library
* Hamcrest - A library of matcher objects
* Mockito - A Java mocking framework
* JSONassert - An assertion library for JSON
* JSONPath - XPath for JSON

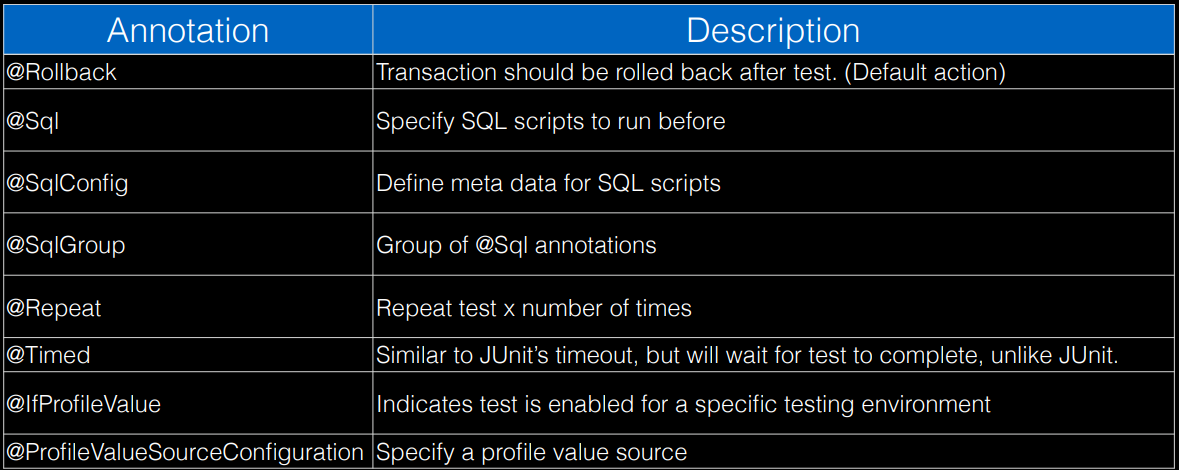


Spring Boot annotations:









**Section 12. Validation and Constraints with Spring MVC.**

HTTP 4xx Client errors – generally checked exceptions.

@ResponseStatus – allows you to annotate custom exceptions classes to indicate to the framework the HTTP status you want returned when that exception is thrown. It is global to the application.

@ExceptionHandler works at the controller level. Allows you to define custom exception handling. Can be used with @ResponseStatus for just returning a http status. Can be used to return a specific view. Also can take total control and work with the Model and View. ‘Model’ cannot be a parameter of an ExceptionHandler method.

HandlerExceptionResolver is an interface you can implement for custom exception handling. Used internally by Spring MVC. Model is not passed. Spring has 3 implementations for this interface:

* ExceptionHandlerExceptionResolver – matches uncaught exceptions to @ExceptionHandler
* ResponseStatusExceptionResolver – Looks for uncaught exceptions matching @ResponseStatus
* DefaultHandlerExceptionResolver – converts standard Spring Exceptions to HTTP status codes (internal to Spring MVC).

You can provide your own implementations of HandlerExceptionResolver. Typically implemented with Spring’s Ordered interface to define order the handlers will run in. Custom implementations are uncommon due to Spring robust exception handling.

SimpleMappingExceptionResolver – a spring bean you can define to map exceptions to specific views. You only define the exception class name (no package) and the view name. You can optionally define a default error page.

@ControllerAdvice

JSR 303 produced standard validation annotations.

Standard validators:

* AssertFalse
* AssertTrue
* DecimalMax
* DecimalMin
* Digits
* Future
* Max
* Min
* NotNull
* Null
* Past
* Pattern
* Size

Hibernate Validators:

* CreditCardNumber
* Currency
* EAN
* Email
* Length
* LunhCheck
* Mod10Check
* Mod11Check
* NotBlank
* NotEmpty
* ParameterScriptAssert
* Range
* SafeHtml
* ScriptAssert
* URL

Locale Detection. Default behavior is to use Accept-Language header. Can be configured to use system, a cookie, or a custom parameter. Custom parameter is useful to allow user to select language.

Locale Resolvers. AcceptHeaderLocaleResolver is the Spring Boot Default. Optionally, can use FixedLocaleResolver. Uses the locale of the JVM. Available: CookieLocaleResolver, SessionLocaleResolver.

**Section 27. Content Negotiation.**

Content Negotiating View Resolver:

* Used by Spring MVC to determine view handler to use
* Auto Configured by Spring Boot
* The Content Negotiating View Resolver will determine the view to use to render the data of the model to the client

Content Type:

* View to use is determined by Content Type in HTTP Header
* application/json, application/xml, text/html
* If view for requested Content Type is not found, HTTP Status 406 Not Acceptable is returned.