MVC is an abbreviation for a design pattern. What does it stand for and what is the idea behind it?

Model View Controller pattern (MVC pattern).

The MVC pattern divides the system into three kinds of components. Each component in the system has specific responsibilities. Let's see these three components of this pattern:

Model: The model in the MVC pattern is responsible for maintaining data for the view so that it can be rendered in any view template.

View: The view in the MVC pattern is responsible for rendering the model to a readable format to the user. There are several technologies that provide the view, such as JSP, JSF page, PDF, XML, and so on.

Controller: This is an actual actionable component in the MVC pattern. In Software, the controller code controls the interaction between the view and model. Interactions such as form submission or clicking a link are part of the controller in an enterprise application.

MVC pattern is all about separation of concerns.

User interacts with the **Controller** component through the **View** component, and the **Controller** component triggers the actual action to prepare the **Model** component. That **Model** component propagates the changes to the **View**, and finally, the **View** component renders the model in front of the **User**. This is the whole idea behind the implementation of the MVC pattern.

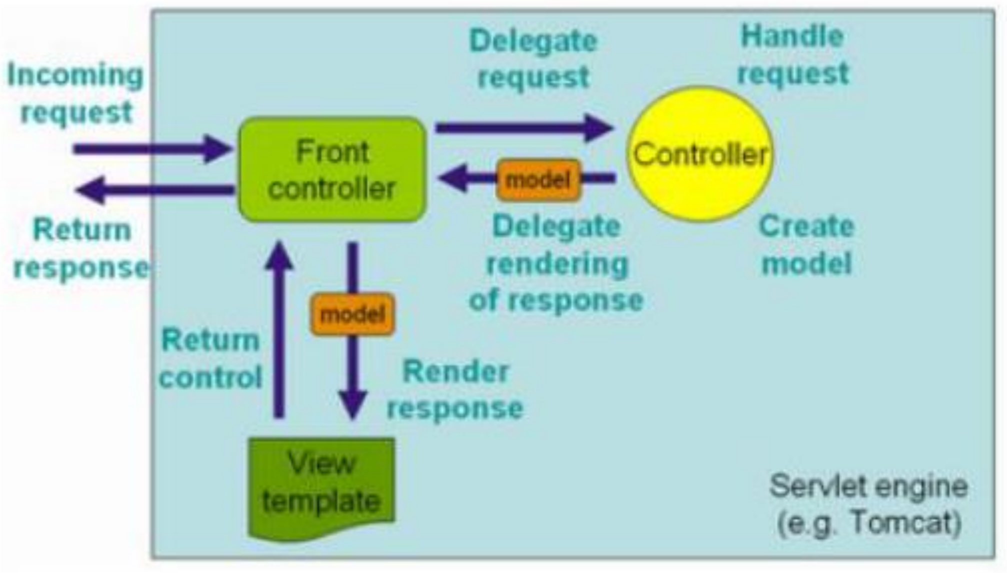
Advantages:

- Reuse of model and controllers with different views
- Reduced coupling between the model, view and controller
- Separation of concerns

Do you need spring-mvc.jar in your classpath or is it part of spring-core?

You need spring-mvc.jar in your classpath. It is not part of the spring-core. However, springmvc includes spring-core.

What is the DispatcherServlet and what is it used for?



Spring MVC, is designed around the **front controller** pattern where a **central Servlet**, the **DispatcherServlet**, **provides** a **shared** algorithm for **request processing**, w**hile actual work is performed by configurable delegate components** (@Controller).

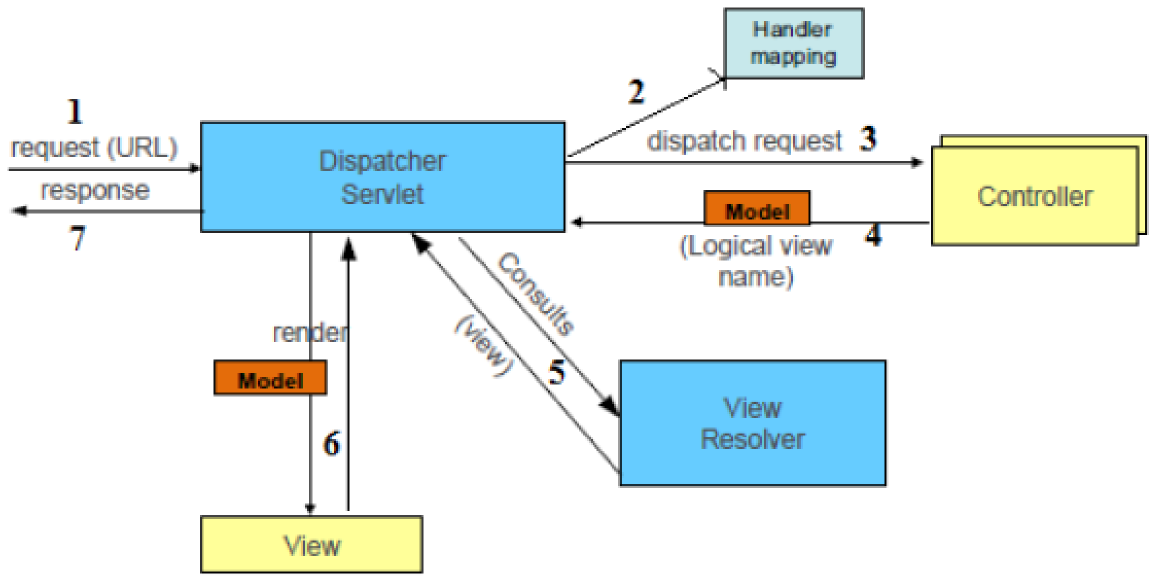
The duties of the DispatcherServlet consist of:

- Receives requests and delegates them to registered handlers
- Resolves views by mapping view-names to View instances
- Resolves exceptions that occur during handler mapping or execution

The front controller design pattern allows for centralizing matters, like security and error handling, that are to be applied to the entire application.

A Spring web application may define multiple dispatcher servlets, each of which has its own namespace, its own Spring application context and its own set of mappings and handlers.

Request Processing Lifecycle



1. Request lands at Spring's DispatcherServlet
2. DispatcherServlet delegates that request to the Spring MVC controller, that is, application controller. Spring's DispatcherServlet takes help of the **handler mappings** configured in the web application. **Handler mapping decides the particular controller** by using the URL and request parameters.
3. Once a particular application controller is decided DispatcherServlet dispatches that request to the selected controller.
4. Spring MVC's controller executes the business logic by using business services of the application and it creates the model which wraps the information to be carried back to the user. Spring MVC's controller **also returns a logic view name along with the model**.
5. DispatcherServlet takes the help of the **view resolver.** According to the configured **ViewResolver**, it resolves the actual view name instead of the logic view name.
6. Spring MVC's DispatcherServlet renders the model to the view.
7. Finally, that information creates a response, and returns it to the user's browser by DispatcherServlet.

Is the DispatcherServlet instantiated via an application context?

The DispatcherServlet is not instantiated via an application context. It is instantiated before any application context is created.

In a Servlet 3.0 environment, the container looks for any classes in the classpath that implement the **javax.servlet.ServletContainerInitializer** interface; if any are found, they’re used to configure the servlet container.

Spring supplies an implementation of that interface called **SpringServletContainerInitializer** that, in turn, seeks out any classes that implement **WebApplicationInitializer** and delegates to them for configuration.

Spring 3.2 introduced a convenient base implementation of **WebApplicationInitializer** called **AbstractAnnotationConfigDispatcherServletInitializer**.

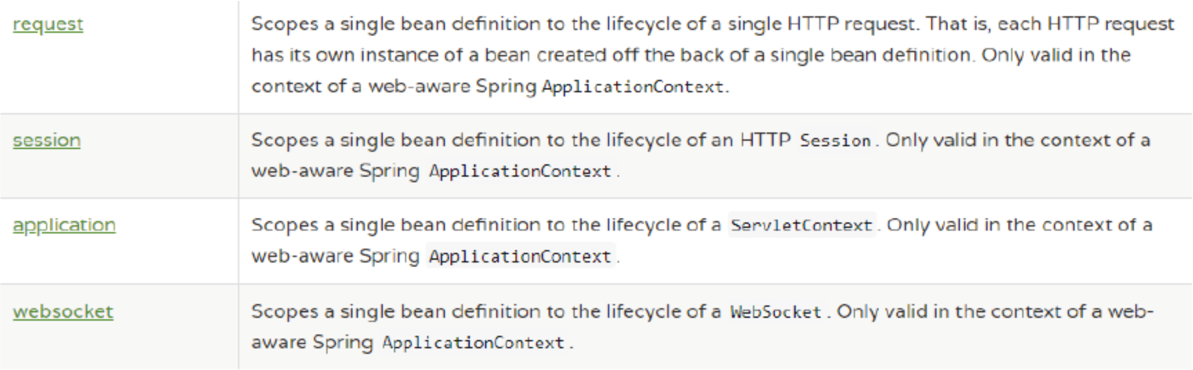
AbstractAnnotationConfigDispatcherServletInitializer creates both a **DispatcherServlet** and a **ContextLoaderListener**.

DispatcherServlet can be instantiated in 2 different ways and in both it is initialized by the servlet container:

- XML: web.xml is the root file of any web application, placed in the WEB-INF directory. It has a servlet specification, and contains all the servlet configuration to be bootstrapped.
- Java: by extending AbstractAnnotationConfigDispatcherServletInitializer.

What is a web application context? What extra scopes does it offer?

Web application context, specified by the WebApplicationContext interface, is a Spring application context for a web applications. It has all the properties of a regular Spring application context, given that the WebApplicationContext interface extends the ApplicationContext interface, and add a method for retrieving the standard Servlet API ServletContext for the web application.



request	Scopes a single bean definition to the lifecycle of a single HTTP request. That is, each HTTP request has its own instance of a bean created off the back of a single bean definition. Only valid in the context of a web-aware Spring `ApplicationContext`.
session	Scopes a single bean definition to the lifecycle of an HTTP `Session`. Only valid in the context of a web-aware Spring `ApplicationContext`.
application	Scopes a single bean definition to the lifecycle of a `ServletContext`. Only valid in the context of a web-aware Spring `ApplicationContext`.
websocket	Scopes a single bean definition to the lifecycle of a `WebSocket`. Only valid in the context of a web-aware Spring `ApplicationContext`.

What is the @Controller annotation used for?

The @Controller annotation is a specialization of the @Component annotation. In a web application, the **controllers work between the web layer and the core application layer**. In the Spring MVC framework, controllers are also more like POJO classes with methods; these **methods are known as handlers**, because these are annotated with the @RequestMapping annotation.

You could also use the **@Component** annotation instead of **@Controller** to create Spring beans in a web application, but in this case, that bean does not have the capability of the Spring MVC framework such as **exception handling at web layer**, **handler mapping**, and so on.

How is an incoming request mapped to a controller and mapped to a method?

When a request is issued to the application:

- DispatcherServlet of the application receives the request.
- DispatcherServlet maps the request to a method in a controller.
- DispatcherServlet holds a list of classes implementing the HandlerMapping interface.
- DispatcherServlet dispatches the request to the controller.
- The method in the controller is executed.

/articles/new

Dispatcher servlet: /

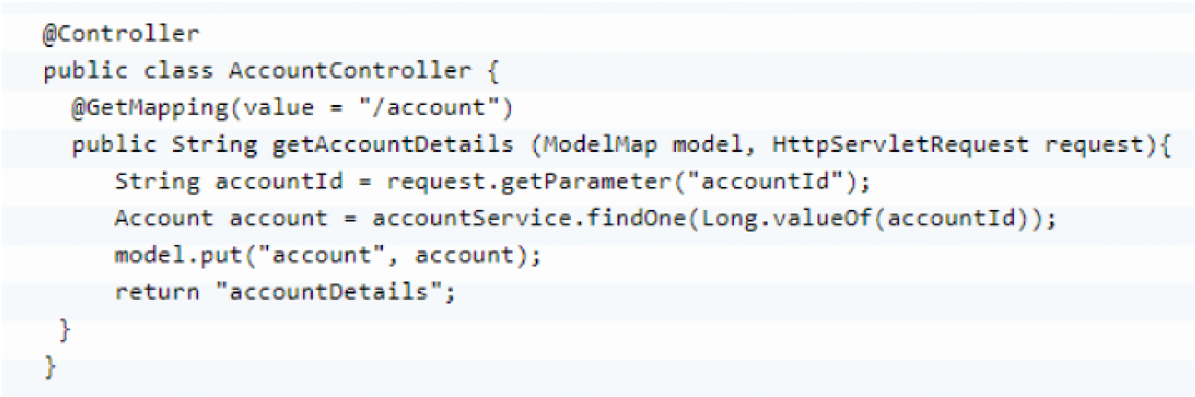
Controller: /articles

Method: /new

What is the difference between @RequestMapping and @GetMapping?

@GetMapping is a composed annotation that acts as a shortcut for @RequestMapping(method = RequestMethod.GET).

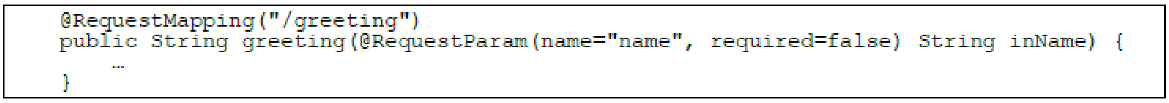
What is @RequestParam used for?



```
@Controller
public class AccountController {
  @GetMapping(value = "/account")
  public String getAccountDetails (ModelMap model, HttpServletRequest request){
      String accountId = request.getParameter("accountId");
      Account account = accountService.findOne(Long.valueOf(accountId));
      model.put("account", account);
      return "accountDetails";
 }
}
```

The @RequestParam annotation is used to annotate parameters to handler methods in order to bind request parameters to method parameters.

Assume there is a controller method with the following signature and annotations:

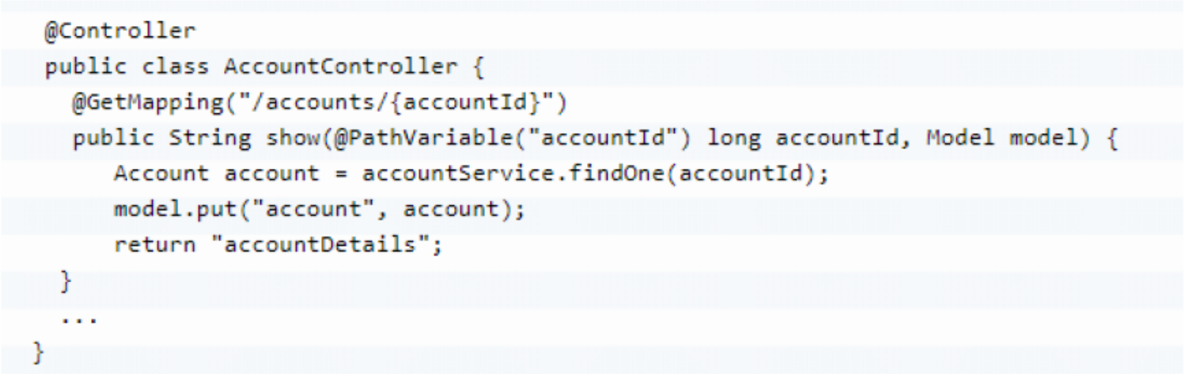


```
@RequestMapping("/greeting")
public String greeting(@RequestParam(name="name", required=false) String inName) {
    …
}
```

If then a request is sent to the URL http://localhost:8080/greeting?name=Ivan then the inName method parameter will contain the string “Ivan”.

What are the differences between @RequestParam and @PathVariable?

Spring MVC allows you to pass parameters in the URI instead of passing them through request parameters. The passed values can be extracted from the request URLs. It is based on URI templates. It allows clean URLs without request parameters. The following is an example:



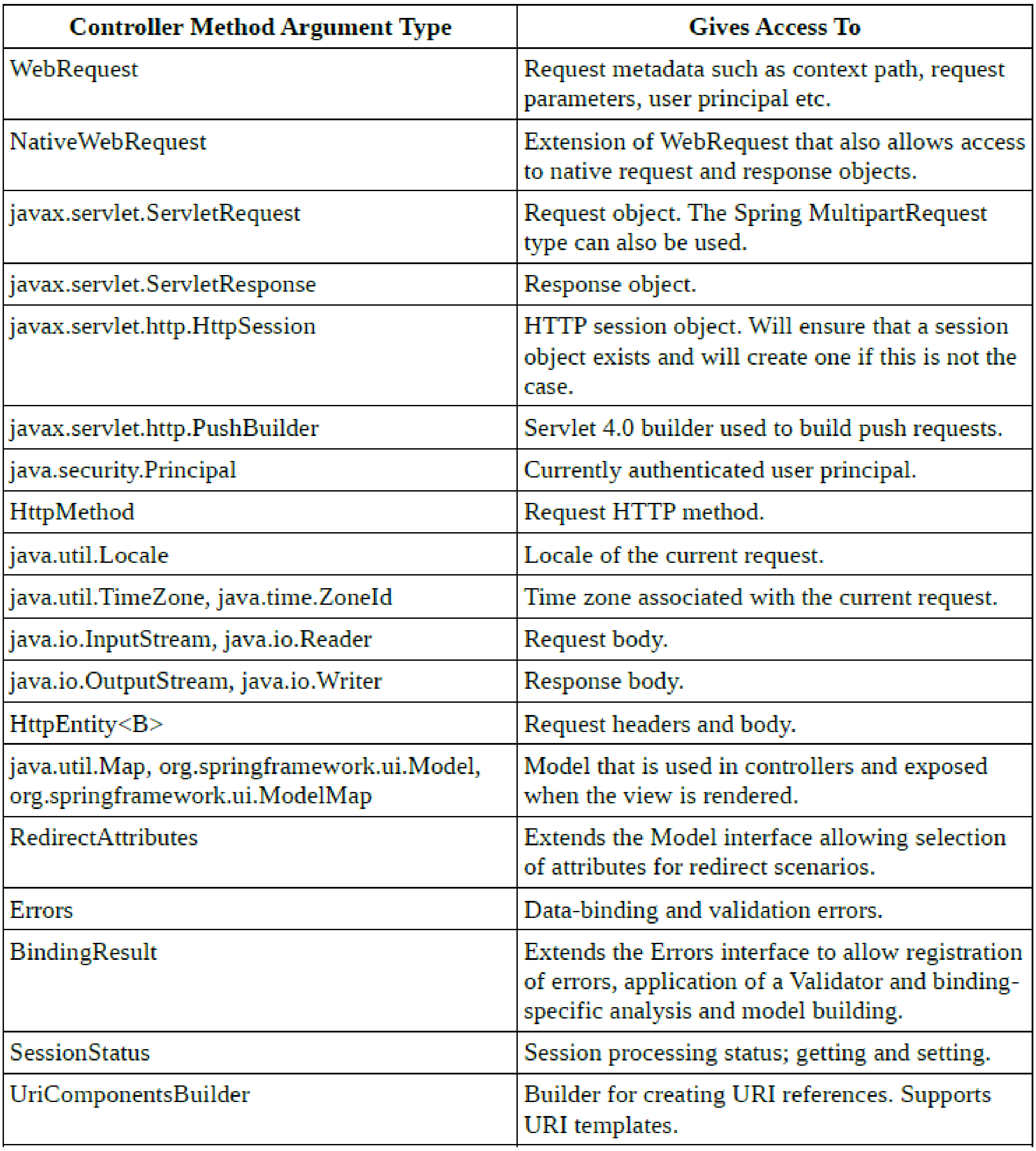
```
@Controller
public class AccountController {
  @GetMapping("/accounts/{accountId}")
  public String show(@PathVariable("accountId") long accountId, Model model) {
      Account account = accountService.findOne(accountId);
      model.put("account", account);
      return "accountDetails";
  }
  ...
}
```

Difference

The difference between the @RequestParam annotation and the @PathVariable annotation is that they map different parts of request URLs to handler method arguments.

What are some of the parameter types for a controller method?

Controller method arguments of a type not included in the table below will as default be handled as if annotated with @RequestParam if the type is a simple type or handled as if annotated with @ModelAttribute otherwise.



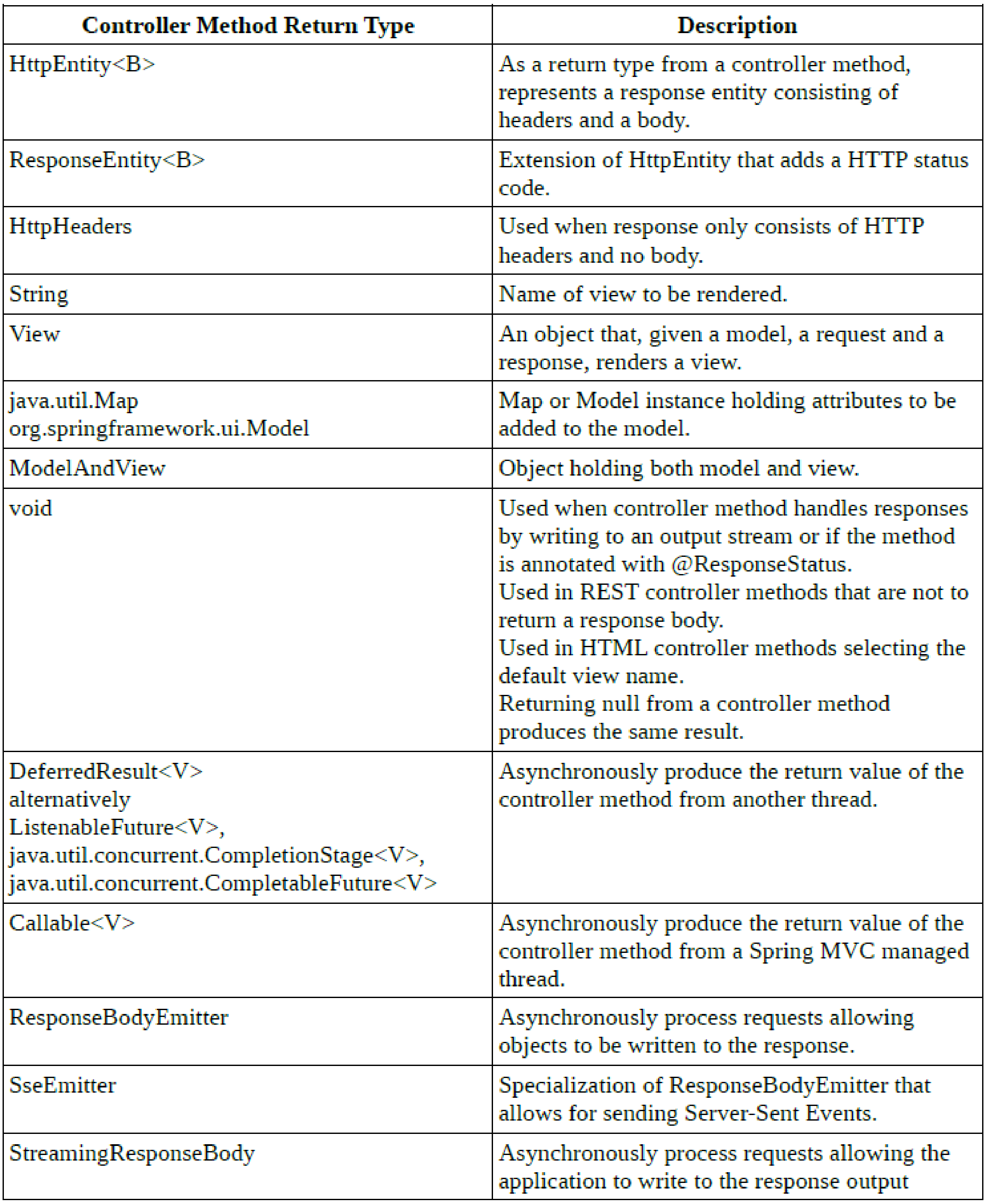
Controller Method Argument Type	Gives Access To
WebRequest	Request metadata such as context path, request parameters, user principal etc.
NativeWebRequest	Extension of WebRequest that also allows access to native request and response objects.
javax.servlet.ServletRequest	Request object. The Spring MultipartRequest type can also be used.
javax.servlet.ServletResponse	Response object.
javax.servlet.http.HttpSession	HTTP session object. Will ensure that a session object exists and will create one if this is not the case.
javax.servlet.http.PushBuilder	Servlet 4.0 builder used to build push requests.
java.security.Principal	Currently authenticated user principal.
HttpMethod	Request HTTP method.
java.util.Locale	Locale of the current request.
java.util.TimeZone, java.time.ZoneId	Time zone associated with the current request.
java.io.InputStream, java.io.Reader	Request body.
java.io.OutputStream, java.io.Writer	Response body.
HttpEntity<B>	Request headers and body.
java.util.Map, org.springframework.ui.Model, org.springframework.ui.ModelMap	Model that is used in controllers and exposed when the view is rendered.
RedirectAttributes	Extends the Model interface allowing selection of attributes for redirect scenarios.
Errors	Data-binding and validation errors.
BindingResult	Extends the Errors interface to allow registration of errors, application of a Validator and binding-specific analysis and model building.
SessionStatus	Session processing status; getting and setting.
UriComponentsBuilder	Builder for creating URI references. Supports URI templates.

What other annotations might you use on a controller method parameter? (You can ignore form-handling annotations for this exam)

The following table lists annotations that can be applied to arguments of controller methods.

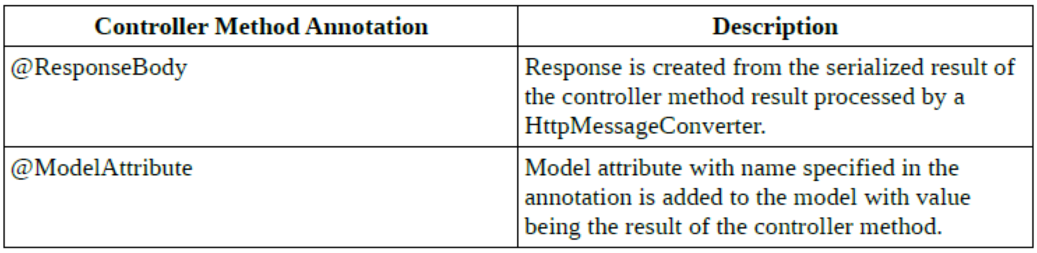
Controller Method Argument Annotation	Function
@PathVariable	Binds a part of the URL, a path segment, to a handler method argument.
@MatrixVariable	Binds a name-value pair in a part of the URL, a path segment, to a handler method argument.
@RequestParam	Binds a query string parameter to a handler method arguments.
@RequestHeader	Binds a request header to a handler method argument.
@CookieValue	Binds the value of a HTTP cookie to a handler method argument.
@RequestBody	Binds the body of a request to a handler method argument.
@RequestPart	Binds a part of a "multipart/form-data" request to a handler method argument.
@ModelAttribute	Binds a named model attribute to a handler method argument or the return value of a handler method.
@SessionAttributes	Causes selected model attributes to be stored in the HTTP Servlet session between requests.
@SessionAttribute	Binds a session attribute to a handler method argument.
@RequestAttribute	Binds a request attribute to a handler method argument.

What are some of the valid return types of a controller method?



Controller Method Return Type	Description
HttpEntity<B>	As a return type from a controller method, represents a response entity consisting of headers and a body.
ResponseEntity<B>	Extension of HttpEntity that adds a HTTP status code.
HttpHeaders	Used when response only consists of HTTP headers and no body.
String	Name of view to be rendered.
View	An object that, given a model, a request and a response, renders a view.
java.util.Map org.springframework.ui.Model	Map or Model instance holding attributes to be added to the model.
ModelAndView	Object holding both model and view.
void	Used when controller method handles responses by writing to an output stream or if the method is annotated with @ResponseStatus. Used in REST controller methods that are not to return a response body. Used in HTML controller methods selecting the default view name. Returning null from a controller method produces the same result.
DeferredResult<V> alternatively ListenableFuture<V>, java.util.concurrent.CompletionStage<V>, java.util.concurrent.CompletableFuture<V>	Asynchronously produce the return value of the controller method from another thread.
Callable<V>	Asynchronously produce the return value of the controller method from a Spring MVC managed thread.
ResponseBodyEmitter	Asynchronously process requests allowing objects to be written to the response.
SseEmitter	Specialization of ResponseBodyEmitter that allows for sending Server-Sent Events.
StreamingResponseBody	Asynchronously process requests allowing the application to write to the response output

Annotations which can be applied to controller methods that affect the result returned:



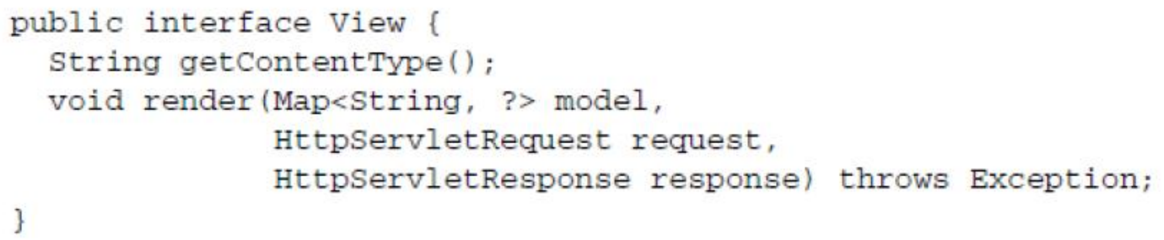
Controller Method Annotation	Description
@ResponseBody	Response is created from the serialized result of the controller method result processed by a HttpMessageConverter.
@ModelAttribute	Model attribute with name specified in the annotation is added to the model with value being the result of the controller method.

What is a View and what's the idea behind supporting different types of View?

View is responsible for presenting the data of the application to the user. The user interacts with the view.

Spring MVC provides several view resolvers to support multiple view technologies, such as JSP, Velocity, FreeMarker, JSF, Tiles, Thymeleaf, and so on.

The View interface's job is to take the model, as well as the servlet request and response objects, and render output into the response.



```
public interface View {
  String getContentType();
  void render(Map<String, ?> model,
              HttpServletRequest request,
              HttpServletResponse response) throws Exception;
}
```

How is the right View chosen when it comes to the rendering phase?

The dispatcher servlet holds a list of view resolvers which, depending on how the dispatcher servlet is configured, will contain one or all Spring beans that implement the **ViewResolver** interface. As part of the request-processing process, when a **ModelAndView** is to be rendered and there is a viewname available from the **ModelAndView**, then each **ViewResolver** known to the dispatcher servlet is asked to resolve the named view until there is a resolve that succeeds. If the view-name cannot be resolved, then an exception will be thrown otherwise the view will be rendered.

If there is no view-name available from the ModelAndView object, then the dispatcher servlet assumes there is a View available from the ModelAndView.

View Resolution Sequence

1. Controller returns logical view name to DispatcherServlet
2. ViewResolvers are asked in sequence (based on their Order)
3. If ViewResolver matches the logical view name then returns which View should be used to render the output. If not, it returns null and the chain continues to the next ViewResolver
4. Dispatcher Servlet passes the model to the Resolved View and it renders the output

What is the Model?

An instance of an object that implements the Model interface from the Spring framework is a collection of key-value pairs. The contents of the model represents the state of the application and contains information that will be used when rendering the view. The value-objects contained in the model may also contain business logic implemented in the classes instantiated to create those objects.

Why do you have access to the model in your View? Where does it come from?

When rendering a view, information to display is taken from the model. For example, if the current view in the application is to display customer information then the view may refer to keys such as customerFirstName, customerLastName, customerStreet, customerCity etc. Values are retrieved from the model by requesting a value for a certain key.

The model is passed as a parameter to the view when the dispatcher servlet asks the selected view to render itself as part of processing a request.

What is the purpose of the session scope?

A session-scoped Spring bean is a bean which exists for the lifetime of a HTTP session. This enables creating, for instance, a session-scoped Spring bean that contains a shopping cart. The bean instance will remain the same during all requests the user makes within one and the same HTTP session.

What is the default scope in the web context?

In any context the default bean scope is singleton.

Why are controllers testable artifacts?

Spring MVC controllers can be implemented using plain Java classes annotated with @Controller that do no need to extend any base classes nor implement any particular interfaces. This enables simple instantiation of controllers in tests that can then test the controller in isolation.

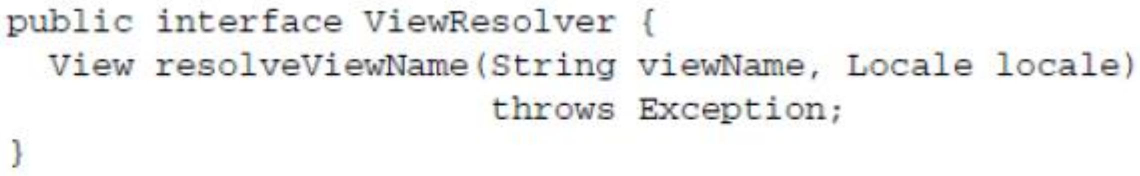
However, when writing such a unit test, much remains untested: for example, request mappings, data binding, type conversion, validation, and much more. Furthermore, other controller methods such as @InitBinder, @ModelAttribute, and @ExceptionHandler may also be invoked as part of the request processing lifecycle.

The goal of Spring MVC Test is to provide an effective way to test controllers by performing requests and generating responses **through the actual DispatcherServlet**.

Spring MVC Test builds on the familiar “mock” implementations of the Servlet API available in the spring-test module. This allows performing requests and generating responses without the need for running in a Servlet container.

What does a ViewResolver do?

The controller returns the model to the front controller along with the logical view name. The front controller resolves to the actual view by using the configured view resolver. You have to configure the view resolver according to the view technology that you use in your web application. DispatcherServlet consults with the configured view resolver, and resolves the physical path of the view.



```
public interface ViewResolver {
  View resolveViewName(String viewName, Locale locale)
                            throws Exception;
}
```