

CS3300 Introduction to Software Engineering

Lecture 09: Tools of the Trade #5

Spring, Spring Boot

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Java Frameworks

- Framework is a platform for developing applications
- Provides a foundation on which developers can build programs for a specific platform.
 - For example, a framework may include predefined classes and functions that can be used to process input, manage hardware devices, and interact with system software.
 - Streamlines development process
- Java framework is a body of reusable prewritten code acting as templates used by developers to create apps using the Java programming language
- Fast, efficient

Framework vs. API

- Framework serves as a foundation for programming, while an API provides access to the elements supported by the framework.
- Framework includes an API
- May also include code libraries, compiler and other programs needed for software development

Spring

- Most popular, powerful, lightweight and open-source application development framework used for Java Enterprise Edition (JEE). Other frameworks include Hibernate, JSF, Struts etc.
- JEE is built upon Java SE (Standard Edition) . Provides functionalities like web application development, servlets etc.
- JEE provides APIs for running large scale applications

Advantages of Spring

- MVC architecture. Distinction division between models (data), controllers (application logic) and views(user interface).
- Framework of frameworks. Can easily integrate with other frameworks like Struts, Hibernate etc.
- Flexibility
- One stop-shop for all enterprise applications. But modular, allows you to pick which modules you need.
- Allows loose coupling among modules
- Easier to test
- Increases efficiency due to reduction in application development time

Inversion of Control (IoC)

- Principle in software engineering which transfers the control of objects or portions of a program to a container or framework. Most often used in the context of object-oriented programming. The architecture helps in decoupling the execution of a task from its implementation.
- In Spring, objects configured in XML file and Spring container is responsible for creation and deletion of objects by parsing XML file.
- Example of a highly coupled class

```
public class CustomerBusinessLogic
{
    DataAccess _dataAccess;

    public CustomerBusinessLogic()
    {
        _dataAccess = new DataAccess();
    }

    public string GetCustomerName(int id)
    {
        return _dataAccess.GetCustomerName(id);
    }
}
```

```
public class DataAccess
{
    public DataAccess()
    {
    }

    public string GetCustomerName(int id) {
        return "Dummy Customer Name"; // get it
    }
}
```

- *CustomerBusinessLogic* and *DataAccess* classes are tightly coupled. Changes in the *DataAccess* class will lead to changes in the *CustomerBusinessLogic* class. For example, if we add, remove or rename any method in the *DataAccess* class then we need to change the *CustomerBusinessLogic* class accordingly.
- The *CustomerBusinessLogic* class creates an object of the *DataAccess* class using the **new** keyword. There may be multiple classes which use the *DataAccess* class and create its objects. So, if you change the name of the class, then you need to find all the places in your source code where you created objects of *DataAccess* and make the changes throughout the code.
- Because the *CustomerBusinessLogic* class creates an object of the concrete *DataAccess* class, it cannot be tested independently (TDD). The *DataAccess* class cannot be replaced with a mock class.

Inversion of Control (IoC)

Using Factory pattern of the IoC principle => Loosely coupled design

```
public class CustomerBusinessLogic
{
    public CustomerBusinessLogic()
    {
    }

    public string GetCustomerName(int id)
    {
        DataAccess _dataAccess = DataAccessFactory.GetDataAccessObj();

        return _dataAccess.GetCustomerName(id);
    }
}
```

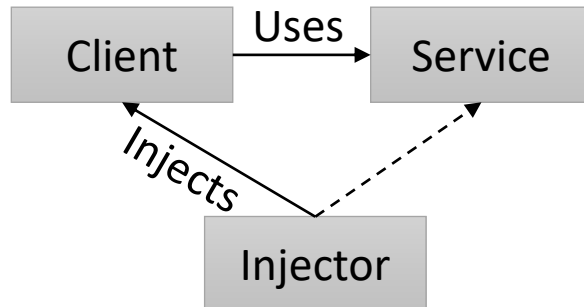
The *CustomerBusinessLogic* class uses the *DataAccessFactory.GetDataAccessObj()* method to get an object of the *DataAccess* class instead of creating it using the new keyword. Thus, we have inverted the control of creating an object of a dependent class from the *CustomerBusinessLogic* class to the *DataAccessFactory* class.

first step towards achieving fully loose coupled design.

```
public class DataAccessFactory
{
    public static DataAccess GetDataAccessObj()
    {
        return new DataAccess();
    }
}
```


Dependency Injection (DI)

- Dependency Inversion Principle (DIP): A high-level module (depends on other modules) should not depend on low-level modules (*DataAccess* Class). Both should depend on abstraction.
 - Abstraction in OOPS to create an interface which is non-concrete, meaning we cannot create an object of the interface or abstract class.
- Dependency Injection (DI) is a design pattern used to implement IoC. It allows the creation of dependent objects outside of a class and provides those objects to a class through different ways.
- Increases possibility to reuse classes and test independently of other classes while unit testing
- DI pattern includes 3 class types:



Injector class creates an object of service class, injects it to a client object. Hence, separates the responsibility of creating an object of service class out of the client class.

Spring Boot

- Spring Boot provides a good platform for Java developers to develop a stand-alone and production-grade spring application that you can **just run**.
- Dependencies and configurations are managed by Spring Boot.
- Normally to run application, you need: hardware + OS + Server +Application file (.war for web applications). With Spring Boot: server embedded (Tomcat), executable files generated automatically.
- Features:
 - Provides with a starter project for the application along with auto configuration
 - Does not generate XML file but configuration can be modified

DEMO TIME!!

- Create a simple Web app using SpringBoot
- We needed Express in Node.js to establish the server. Spring Boot has Tomcat server embedded– very convenient

WHAT IF WE HAD TO CREATE THE SAME APP WITHOUT SPRING BOOT

- We have Spring framework
- Setup and manage all maven dependencies and versions in pom.xml manually – very extensive
- Define Web.xml file to configure web related front controller
- Define a Spring context XML file to define component scans
- Install Tomcat or configure Tomcat maven plugin
- Deploy and run application IN TOMCAT

Spring Boot Starter Projects

- Goal is to help you get a project up and running quickly
 - Web application: Spring-Boot-Starter-Web
 - REST API: Spring-Boot-Starter-Web
 - Talk to database using JPA- Spring-Boot-Starter-Data-JPA
 - Talk to database using JDBC- Spring-Boot-Starter-JDBC
 - Secure web application- Spring-Boot-Starter-Security
- Manage list of maven dependencies & versions for different apps:
 - Spring-Boot-Starter-Web: Frameworks needed by typical web applications. Spring-webmvc, spring-web, spring-boot-starter-tomcat, spring-boot-starter-json

Spring Boot Auto Configuration

- Starter defines dependencies
- Auto configurations provides basic configuration to run application using frameworks defined in your maven dependencies
- Decided based on:
 - Which frameworks are in class path?
 - What is the existing configuration? (*Maven Dependencies – `springframework.boot.autoconfigure`* – classes that will be checked)
 - Type *`logging.level.org.springframework=DEBUG`* in *`application.properties`* to see what is being auto-configured.

Next Class

- TOTT #6
- Google App Engine & Google APIs
- Get your Laptops!!