



MAHARISHI UNIVERSITY OF MANAGEMENT

*CS 545 – Web Application Architecture
Diversity Arising from Unity*

Muhyieddin K. Al-Tarawneh

2021

*Maharishi's Ninth Year of Invincibility
Global Raam Raj*

CS545: Web Application Architecture

Diversity Arising from Unity

Main Objectives of WAA








In this course, we will explore the principles of a well-designed Enterprise Web Application using an N-tier Architecture. Most enterprise software applications are built in this way: as an N-tier application. You will learn that a well-designed N-tier application follows good software architecture principles.

The Spring Framework is the technology that we will use to investigate the concepts of a Web Application Architecture, also using React js for the Frontend.

Also, in an Enterprise-level work environment, professional success is highly correlated with the ability to work in a team environment. In this course, we will develop team skills by organizing into groups of 3 or 4 at the start of the course. Teams will work as a unit, discussing course material, collaborating on labs and developing the course project.

CS-545: Web Application Architecture Calendar

CS 545 - WAA

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Date	07/19/2021	07/20/2021	07/21/2021	07/22/2021	07/23/2021	07/24/2021	
Week1	Lesson 1 - Introduction to WAA & Spring framework	Lesson 2 - Spring framework & Spring MVC	Lesson 3 - Spring MVC Validation	Lesson 5 - Spring Boot & Thymeleaf	Lesson 4 -Web 2.0 RESTful services	Review	BackEnd
pm	Lab 	Lab 	Lab 	Lab 	Lab 		
Date	07/26/2021	07/27/2021	07/28/2021	07/29/2021	07/30/2021	07/31/2021	
Week 2	Lesson 6 - Spring JPA	Lesson 7 - Spring JPA	Review	Midterm Exam	Lesson 8 - Security- JWT & Cross-cutting	Midterm Solution	BackEnd
pm	Lab 	Lab 	--- 	--- 	Lab 	---	
Date	08/02/2021	08/03/2021	08/04/2021	08/05/2021	08/06/2021	08/07/2021	
Week 3	Lesson 9 - Introduction React & Components	Lesson 10 - Fetching data + React Hooks	Lesson 11 - SPA with Routing	Lesson 12 - State management with Redux	Review	Final Exam	FrontEnd
pm	Lab 	Lab 	Lab 	Lab 	Project Descrip.	 --- 	
Date	08/09/2021	08/10/2021	08/11/2021	08/12/2021	08/13/2021	08/14/2021	
Week 4	Lesson 13 - Microservices & Spring Cloud -	Project	Project	Project	Project Submission		
pm	Project 	---	---	---			

Course Objectives

The following outlines the knowledge that you will gain, how you will attain it and how you will be evaluated.

What you will Learn	How you will learn	How you will be Assessed
Develop Web applications based on core Java Web technologies (3,4,5)	<ul style="list-style-type: none"> • Lecture • Demo • Assigned Reading • Assigned Lab <ul style="list-style-type: none"> Team collaboration Individual submission • Student-led review 	<ul style="list-style-type: none"> • Quiz[daily]: self-Assessment • Exam #1
Design applications using fundamental principles of a Web framework (3,4,5)	<ul style="list-style-type: none"> • Lecture • Demo • Assigned Reading • Assigned Lab <ul style="list-style-type: none"> Team collaboration Individual submission • Student-led review 	<ul style="list-style-type: none"> • Quiz[daily]: self-Assessment • Exam #1
Organize and Structure an N-tier web Enterprise application (3,4,5)	<ul style="list-style-type: none"> • Lecture • Demo • Assigned Reading • Assigned Lab <ul style="list-style-type: none"> Team collaboration Individual submission • Student-led review 	<ul style="list-style-type: none"> • Quiz[daily]: self-Assessment • Exam #2
Make use of multiple presentation technologies to enhance the capabilities of an enterprise web application (3,4,5)	<ul style="list-style-type: none"> • Lecture • Demo • Assigned Reading • Assigned Lab <ul style="list-style-type: none"> Team collaboration Individual submission • Student-led review 	<ul style="list-style-type: none"> • Quiz[daily]: self-Assessment • Exam #2 •
Synthesize & Integrate the entire course content (3,4,5,6)	<ul style="list-style-type: none"> • Develop a Proof of concept application through a team-based project 	<ul style="list-style-type: none"> • Presentation • Project Assessment
Connect Science of Consciousness and Technologies learned. (2,4)	<ul style="list-style-type: none"> • Individual Students reading aloud Main Points for daily lesson • Daily lecture augmented with fuller examples of technology & Consciousness relationships 	<ul style="list-style-type: none"> • Essay questions on Exams • Writing an “original” main point in the daily status report

*The numbers in parentheses refer to the MUM Essential Learning Outcomes that are best supported by this course objective; they appear in **boldface** in the list below.

1. Holistic development of consciousness and health
2. **Consciousness-Based understanding (Knowledge)**
3. **Creative and critical thinking**
4. **Communication**

5. Scientific and quantitative reasoning
6. Collaboration and leadership
7. Sustainable local and global citizenship

Lesson Topics:

- Lesson 1 Introduction to Java Web Fundamentals and Spring Framework**
Core web concepts[HTTP,etc]. Intro to Java Servlet technology. JSPs as a solution to MVC pattern. Web application architectures.
- Lesson 2 Spring framework & Spring MVC**
Introduction to Spring & Spring MVC W/R to N-Tier architecture
- Lesson 3 Validation**
Integration of domain object validation through JSR 303
- Lesson 4 Spring Boot**
A look at Spring Boot; Thymeleaf
- Lesson 5 Web 2.0 - REST & Ajax**
A look at Spring MVC support for “simple” Web 2.0 technologies
- Lesson 6 Spring JPA: Persistence and Transactions**
Introduction to ORM through Spring Data
- Lesson 7 Spring JPA: Persistence and Transactions**
ORM relationships
- Lesson 8 Security – JWT & Cross-cutting Concerns**
Cross-cutting concerns: Servlet filters, Spring MVC interceptors, AOP – an emphasis on Spring Security
- Lesson 9 Introduction React & React Components**
What is SPA, React library, Components, Props
- Lesson 10 Fetching Data & React Hooks**
Fetching data with axios library, using React hooks for various functionalities
- Lesson 11 SPA with Routing**
Multi-page feeling, Routing
- Lesson 12 State management with Redux**
Redux library, redux toolkit, creating slices.
- Lesson 13 Introduction to Microservices and Spring Cloud**
Spring cloud, Eureka, API gateways with Zuul.

References:

Head First Servlets and JSP (Passing the Sun Certified Web Component Developer Exam)

by Bryan Basham, Kathy Sierra, Bert Bates

ISBN: 0596005407

Edition: 1st or 2nd edition

Publisher: O'Reilly Media, Inc.

Spring MVC: Beginner's Guide

by Amuthan G

ISBN: 9781785880636

Packt Publishing; 2nd edition (2016)

Learning React, 2nd Edition

Alex Banks, Eve Porcello

ISBN: 9781492051725

Publisher: O'Reilly Media, Inc.(2020)

Building RESTful Web Services with Spring 5 - Second

Raja CSP Raman, Ludovic Demailly

ISBN: 978-1788475891

Packt Publishing; 2nd edition (2018)

Spring Framework Reference:

<https://docs.spring.io/spring-framework/docs/5.0.0.M1/spring-framework-reference/pdf/spring-framework-reference.pdf>

React Documentation:

<https://reactjs.org/docs/getting-started.html>

Exam

- The mid-term Exam will be on July 29th, 2021 including the following material (lesson 1-7)
- The final Exam will be on August 13th, 2021 covering the following material (lesson 8-12), the main focus will be on the topics from lesson (9-12).

Labs

For the lab submission, there's special requirement.

- 1) You must submit your lab using .docx, .pdf, or zip them in a .rar file.
- 2) Do not copy from a colleague or any other source, lab assignment plagiarism is considered an academic misconduct.
- 3) All lab assignments must be submitted by the announced deadline, unless an extension to the deadline has been approved by the course instructor.

Final Project

Please see project documentation for more information.

Form Participation

It is required for students to ask and answer at least a question on Teams form weekly. *(this will be eliminated if only one student exists in the class.)*

Grading

Evaluation Modality	Value
Mid-term Exam	25%
Final Exam	25%
Project	30%
Labs	20%

We will use the following grading scale:

Range	Letter Grade
93-100	A
90 - 92	A-
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
0 - 69	NC

Lesson 1

Introduction to Web Application Architecture

Fundamentals

Home of All the Laws of Nature

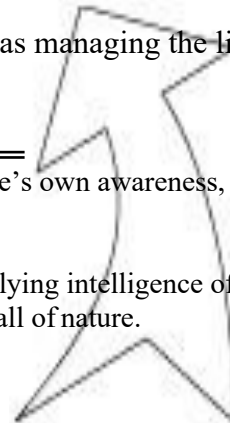
The basic structure of a web application is a client machine sending a request to a web server, which sends a response for the request. The evolution of web apps includes increasing dynamic *Nature continually evolves to more advanced states.*

MAIN POINTS

1. Servlets are the basis of dynamic web applications. Servlets process information from a request object and generate new information in a response object. *For every action in nature there is always a reaction.*
2. Web containers manage the life cycle of servlets. *The unified field manages the entire universe.*
3. The web container generates a servlet from a JSP file the first time the JSP is requested from a web application. Since a JSP is essentially a servlet, one should understand servlets to effectively deal with JSPs. *Actions in accord with fundamental levels of knowledge insure success in dealing with more expressed values.*
4. An EL expression is a compact expression of a systematic evaluation of the page, request, session and application scopes. *The laws of nature are compact expressions that control the infinite diversity of the manifest creation.*
5. The JSP Standard Tag Library provides convenient action tags for many common operations on a JSP page. JSTL combined with the EL could satisfy JSP needs. *Using a JSP action is analogous to the efficient use of some law of nature.*
6. When you use JSP pages according to a Model 2 architecture, there is a servlet that acts as a controller (**process of knowing**) that sets attribute values based on computations and results from a business model (**knower**), then dispatches the request to the servlet generated by the JSP page (**known**). The JSP servlet then retrieves the attribute values and inserts them into the designated places in the HTML being sent to the browser.

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. The HTTP protocol is the organizing intelligence that defines the basic architecture of all web applications.
 2. The web container is responsible for calling the service methods as well as managing the lifecycle of the servlet and exchanging all information over the network.
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3. **Transcendental consciousness** is the blissful nature of pure consciousness, one's own awareness, which is the home of all the laws of nature.
 4. **Wholeness moving within itself:** In unity consciousness, one senses the underlying intelligence of pure consciousness, your own Awareness, as being the underlying intelligence of all of nature.



Lesson 2

Inside Java MVC Frameworks Appreciating All levels of Life

Spring MVC is a framework that enforces the Model 2 JSP architecture. It is built on top of servlets. It hides much of the complexity of those technologies and makes developing the presentation layer of web applications simpler and easier. *The great diversity of the universe is structured in layers starting from the most basic interactions of the unified field—awareness being aware of itself.*

MAIN POINTS

1. Frameworks make Web development easier and more effective by providing a secure and reliable foundation on which to build upon. *The simplest form of awareness, Transcendental Consciousness, provides a strong foundation for a rewarding and successful life.*
2. ALL OO constructs of Java are defined by the circular and reflexive aspects of their fundamental design. *In this case, we see a clear example of the concept of self-referral that characterizes all of Life at its basis*
3. Variations on the Reflection API usage coupled with annotations allow us to apply best practices W/R to Java Object construction and lifecycle management. *Understanding more fundamental aspects of “**any thing**” makes us able to put those principles to proper use* *Transcendental Consciousness is the ultimate fundamental aspect in creation.*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. Frameworks provide a platform to build application more effectively.
2. The Reflection API makes use of the reflexive aspect of the Java language in support of a frameworks inner workings.

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3. **Transcendental consciousness** is the fundamental basis for success in life.
 4. **Wholeness moving within itself:** In unity consciousness, one appreciates the inherent values of an object on the surface of the object.



Lesson 3

Spring & Spring MVC Web Application Framework Infinite Diversity Arising from Unity

Spring MVC is a framework that enforces the Model 2 JSP architecture. It is built on top of servlets. It hides much of the complexity of those technologies and makes developing the presentation layer of web applications simpler and easier. *The great diversity of the universe is structured in layers starting from the most basic interactions of the unified field—awareness being aware of itself.*

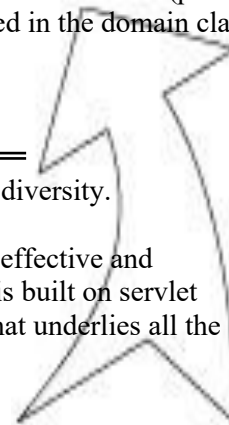
MAIN POINTS

1. An N Tier Architecture separates an application into layers thereby supporting a separation of concerns making any application more efficient, modular and scalable. *Life is structured in layers. It is a structure that is both stable and flexible, consistent yet variable and it encompasses an infinite range of possibilities*
2. The basic ingredients of a Spring MVC application include web pages for the view (the known), the back end domain logic and data (knower or underlying intelligence), and the Spring framework and Dispatcher Servlet and managed beans as the controller to connect the view and model. *Complete Knowledge is the wholeness of knower, known, and process of knowing.*
3. Annotations are metadata that allow the knowledge about the creation of an object to reside with the object itself. *The self-referral nature of Transcendental Consciousness makes all our actions clearer and more powerful*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. Spring MVC is a framework for building the presentation layer of a web application.
2. Spring MVC is an MVC framework, which is a good example of the Vedic science principle that knowledge is the wholeness of knower, known, and process of knowing. Most of the Spring MVC framework is the connection (process of knowing or controller) between the web pages (known or view) and the underlying logic contained in the domain classes (knower or model).

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3. **Transcendental consciousness** is the unified state of awareness that underlies all diversity.
 4. **Wholeness moving within itself:** A master Spring MVC developer is maximally effective and efficient because he/she understands the underlying mechanics of how Spring MVC is built on servlet technologies. In unity consciousness, one appreciates the inherent underlying unity that underlies all the diversity of the universe.



Lesson 4

Spring Tag Libraries

Do Less and Accomplish More

Data binding is a necessary yet time consuming effort. The Spring MVC Tag Library eases this burden by providing tools to take care of it automatically.

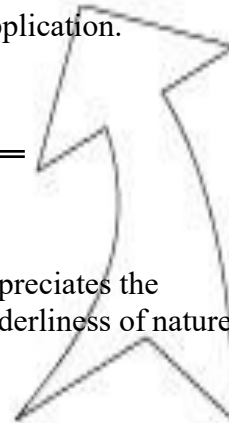
MAIN POINTS

1. The Spring MVC tag library facilitates JSP development with specialized Form tags. *The practice of the TM technique, by structuring the laws of nature in one's life makes everything go more smoothly.*
2. Spring MVC tag library automatically binds form elements to Model data. *The practice of the TM technique, in a simple automatic way structures communication between outer and inner values enlivening all aspects of life.*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. Automatic form data binding is important and powerful feature of the Spring MVC framework
2. This binding capability assists in the development of a well-structured application.

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3. **Transcendental consciousness** naturally eliminates stresses and strains.
 4. **Wholeness moving within itself:** In unity consciousness one directly appreciates the underlying silence of pure consciousness and the resulting efficiency and orderliness of nature.



Lesson 5

Managing State

Greater Success with Greater Breadth of Awareness

HTTP is a stateless protocol. Web applications must explicitly manage any required state information from one request to the next. As awareness becomes broader actions are more successful because they take into account a wider range of considerations, similar to the increased power of more global scopes of container memory.

MAIN POINTS

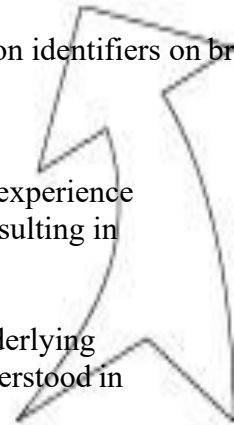
1. State information can be stored in request, session, or context/application scope, and also as hidden fields or cookies. *Deeper levels of consciousness are more powerful and have broader scope.*
2. Understanding the function and capability of the POST, Redirect and GET, leads to a combination that overcomes an inherent weakness in web applications. *The development of consciousness, increases awareness and eliminates the restrictions that cause inherent weakness.*
3. Session Tracking is an important part of session management. It provides basic continuity to a web application. *At the level of the unified field there is a continuous frictionless flow of information.*
4. Spring MVC is “Open for extension, closed for modification”. Spring provides a myriad of opportunities to change the behavior of an application based on the framework. *Likewise, Pure Consciousness offers infinite variety & possibilities. They both represent good design.*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. State information can be stored on the server in the session, and on the browser with cookies.
2. Sessions are managed by the container, which typically use cookies to store session identifiers on browsers.

3. **Transcendental consciousness** is the direct experience of the unified field. This experience brings orderliness and removes impurities and stresses from memory and thought, resulting in broader awareness and more powerful thoughts.

4. **Wholeness moving within itself:** In unity consciousness, one appreciates the underlying unbounded awareness that is your own Self in everything you see. Everything is understood in terms of this unbounded value.



Lesson 6

Validation

Avoid the Danger that has not yet come

Form Validation is a necessary & important effort. The Spring MVC Validation makes this easy by providing tools to take care of it automatically.

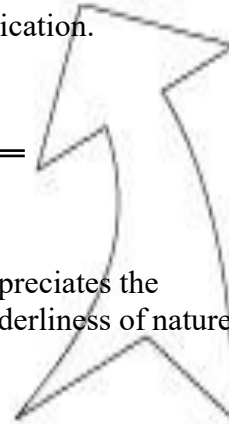
MAIN POINTS

1. Validation checks the correctness of data against business rules. This prevents problems in the business model from arising. *In Cosmic Consciousness, life is lived stress-free; problem-free.*
2. Custom validation allows for handling more complex, extraordinary verification issues. *A quality of Cosmic Consciousness is the ability to know what is true and right in every situation.*
3. Handler Mapping & Chaining aids in organizing functionality in layers. As a result the design is simpler & more consistent. *Life is structured in layers. This orderliness within us and around us allows us to enjoy more efficiency in our life.*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. Validation is an important and powerful feature of the Spring MVC framework
2. Validation capability assists in the development of a well-structured application.

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3. **Transcendental consciousness** naturally eliminates stresses and strains.
 4. **Wholeness moving within itself:** In unity consciousness one directly appreciates the underlying silence of pure consciousness and the resulting efficiency and orderliness of nature.



Lesson 7

Views & View Resolvers

Harmonizing Diversity

View Resolvers are the technology that allows for many different views. It is the responsibility of the View Resolver to map the correct view. *The increased alertness of Transcendental Consciousness makes one more capable in decision making.*

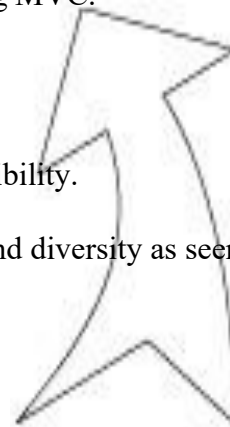
MAIN POINTS

1. Spring MVC Views and View Resolvers offer a variety of ways to manage the presentation of data. *Life is the expression of the field of all possibilities resulting in a veritable explosion of variety in Nature.*
2. A well-defined exception and error handling approach is important for simplifying the development of web applications. *The removal of obstacles is an important aspect of the process of evolution.*
3. All websites have something in common: they are made of pages that share similar structures. *A facet of SCI is that Order is found everywhere*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. View Resolvers are critical to providing presentation flexibility in Spring MVC.
2. Exception handling makes error management painless.

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3. **Transcendental consciousness** leads to increased adaptability and flexibility.
 4. **Wholeness moving within itself:** in unity consciousness, differences and diversity as seen in harmony.



Lesson 8

REST & Ajax

Frictionless Flow of Information

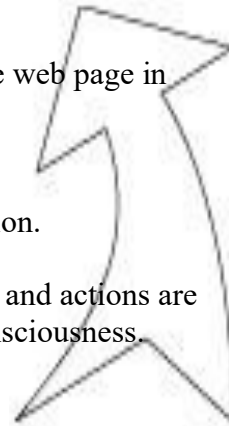
REST is a Simple HTTP client/server mechanism to exchange data through Uniform Resource Identifiers. Ajax is a technique that uses a set of technologies to allow synchronous or asynchronous update of a web page without having to send the entire web page to the browser. *At the level of the unified field there is immediate and frictionless flow of information.*

MAIN POINTS

1. REST gets access to information on the web through the ubiquitous URI. Everything on the web is available through a URI. *Everything in creation is known through understanding and experience of the Unified Field of Consciousness.*
2. Ajax uses Javascript in a browser to access data or functionality residing on a server and then quickly and efficiently selectively update the browser. *Nature is maximally efficient.*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. REST requires no tools, is easy to learn and is fast and efficient.
 2. Ajax communicates with the server to get information on how to update the web page in the browser
-
3. **Transcendental consciousness** is the field of frictionless flow of information.
 4. **Wholeness moving within itself:** In unity consciousness one's perceptions and actions are experienced in terms of the frictionless and spontaneous flow of pure bliss consciousness.



Lesson 10

Persistence and Transactions

Tapping the source of Pure Knowledge

Enterprise applications generally require persistence, transactions, concurrency, security and other services. The Spring framework provides convenient standard APIs such as JPA to support these complex middleware services.

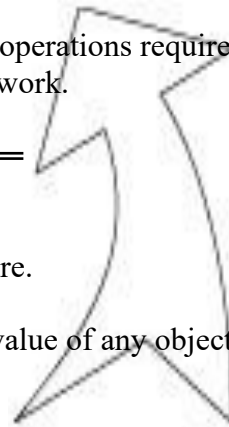
MAIN POINTS

1. An N Tier Architecture separates an application into layers thereby supporting a separation of concerns making any application more efficient, modular and scalable. *Life is structured in layers. It is a structure that is both stable and flexible, consistent yet variable and it encompasses an infinite range of possibilities*
2. JPA is a specification not an implementation. It provides a consistent, reliable mechanism for data storage and retrieval that alleviates the application developer from the details involved in the persistence layer. *The mechanism of transcending allows the individual to tap into Transcendental Consciousness and enlivens its qualities in activity.*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. A layered architecture adds needed structure to complex business applications.
2. JPA persistence and transaction functionality are common but complex operations required in an enterprise application, and are supported in a convenient manner by the Spring framework.

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3. **Transcendental consciousness** develops support of all the laws of nature.
 4. **Wholeness moving within itself:** In unity consciousness, the ultimate value of any object dominates one's perception



Lesson 11

Security & Cross-cutting Concerns

Unity is an underlying principle in Nature

Cross-cutting technologies in Spring are a powerful way to provide common functionality across different aspects of an application. They seamlessly integrate into existing functionality. *Transcendental Consciousness is characterized by Complete Harmony.*

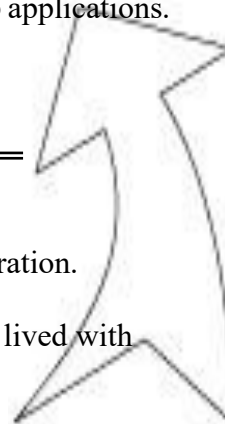
MAIN POINTS

The different technologies [Filter, Interceptor, and AOP] available in Spring, together provide a thorough solution to cross cutting concerns. *Creative intelligence enhances and strengthens uniquely differing values in life in a comprehensive way.*

Authentication & Authorization underlie the entire web application. They provide a shield that makes the application invulnerable. *Transcendental Consciousness is characterized by the quality of invincibility, which means one cannot be overcome or overpowered.*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. Spring cross-cutting concerns integrate seamlessly into Spring web applications.
 2. Security is a fundamental and necessary aspect of any web application.
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3. **Transcendental consciousness** is characterized by complete integration.
 4. **Wholeness moving within itself:** In unity consciousness, life is lived with truthfulness without fear or doubt.



Lesson 12

Project Introduction: Web Development and the Development Process

Acting from the Level of All the Laws of Nature

Large software systems should follow good software design and architecture principles. the RUP software engineering process. *Actions in accord with the laws of nature will be maximally progressive and successful.*

MAIN POINTS

1. Good development process has core ingredients use-case driven, iterative, emphasis on testing. Development processes represent the structuring laws that guide successful development of large software systems. *Life unfolds according to the structuring Laws of Nature which are enlivened by Transcendental Consciousness.*
2. A good design reflects re-usability and adaptability and most importantly traceability of requirements. A good web design promotes stability in the business application and flexibility in the presentation layer. *The Field of Pure Creative Intelligence is characterized by the qualities of stability and flexibility*

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

1. This project gives a sense of how a web application should be structured and developed according to standard software engineering and architecture practices for large systems.
2. By using good design principles a large system can be readily adapted. A new presentation layer can be added without modifying the underlying business system.

3. **Transcendental consciousness** is the experience of pure consciousness, the unified field of physics. Just by having this experience one gains this wholeness of knowledge and actions will be accord with all the laws of nature.

4. **Wholeness moving within itself:** The software architect appreciates the underlying architecture structuring all the individual system components. In unity consciousness, one sees the underlying presence and activity of pure consciousness in all perceptions and actions.

