Spring Boot Deployment with Microservices, Docker, Kubernetes and Cloud – Course Outline

1 Duration

- 10 days (80 hours)

2 Objectives

At end of this workshop, participants will able to :

- Get detail understanding of how to deploy Spring Boot apps, monitor, optimize and troubleshoot
- Get overall understanding of Microservices concepts, architecture and design patterns
- Understand and implement key patterns - Service Registry, Discovery, API Gateway, Circuit Breakers
- Get understanding of Docker and Kubernetes fundamentals, architecture, features and usage
- Get understanding of Cloud Computing with AWS and how to deploy apps into cloud and optimize
- Design and develop web apps / services using Spring Boot and deploy as Docker containers into K8s

Note: *This course is designed for beginner to intermediate level.*

3 Audience

Developers who are interested to learn and build standalone scalable web apps/APIs with Spring Boot and deploy as micro services with Docker and Kubernetes into cloud

4 Pre-requisite

- Good knowledge on Java programming
- Knowledge on Spring Framework / Spring Boot
- Familiarity on Maven build tool and XML/JSON

5 Hardware & Network Requirements

- Desktop/Laptop with minimum 8GB RAM
- Open Internet connection (minimum 2 Mbps per user) and Local Admin Access

6 Software Requirements

- Windows / Linux / Mac OS
- Open JDK 8
- Eclipse 4.8+ / STS 4+ / Intellij IDE
- Git 2.3+
- Maven 3.4+
- Tomcat 9
- MySQL Server 8+ &
- MySQL Workbench 8+
- Mongo DB 4.4+
- Kafka 2.7+
- Docker 20+
- Kubernetes Minikube 1.16+
- Postman 8+ and Putty 0.74

7 Outline

Day 1

Module-1: Recap Spring Boot

- Spring Framework Overview
- Spring Boot Overview
- Create Spring Boot Application
- Spring Boot Features

Module-2: Build App with REST and Data Access Support

- Spring REST Overview
- Spring Boot support for Spring REST
- Spring Boot support for Data Access
- Sample web application with REST API and data access using Spring Boot

Module-3: Deployment, Monitoring and Management

- Deploying Spring Boot Apps
- Deployment Configurations
- Monitoring Spring Boot Apps
- Actuator Overview
- Endpoints
- Remote Shell
- Metrics
- Auditing and Tracing

Day 2

Module-4: Intro to Performance Tuning

- Introduction to Performance Tuning
- Java Platform Overview
- JVM Architecture and Internals

Module-5: Performance Bottlenecks, Analysis and Monitoring Tools

- Potential Performance Bottlenecks
    - Memory Leaks
    - High CPU Utilization
    - Thread Concurrency Issues
    - Garbage Collection Overhead
    - Network Latency/Timeouts
- Management and Monitoring Tools Overview
    - Java VisualVM
    - JConsole
- Detecting Memory Leaks - Heap Dump Analysis
- Detecting reasons for High CPU Utilization

Module-6: Detecting Performance Bottlenecks and Profiling Tools

- Profiling
  - Memory Profiling
  - CPU Profiling
- Profiling Tools
  - Java VisualVM
  - Java Mission Control
  - JProfiler
  - YourKit
- Detecting Garbage Collection Overhead - GC Log Analyzer
- Detecting Concurrency Issues - Thread Dump Analysis

Day 3

Module-7: Tuning of Spring Boot Applications

- JVM Tuning
  - Memory Tuning
  - GC Tuning
  - JIT Tuning
- Code Optimization
- Caching - EhCache, MemCache, Redis, etc
- Load Balancing
- Distributed Computing

Module-8: Introduction to Microservices

- Architectural Styles Overview
- Monolith Architecture
- Service Oriented Architecture (SOA)
- Distributed Architecture
- Microservice Based Architecture (MSA)
- Compare and contrast different architectural styles
- Microservice characteristics
- Microservice Concepts Overview
- Benefits and limitations
- Microservice Reference Architecture

Day 4

Module-9: Introduction to Microservices Architecture and Design

- Microservices Architecture
- Domain Driven Design
  - Domain
  - Business Rules
  - Bounded Context
  - Repository
- Monolith to Microservices Migration Strategies

- Microservice Design Patterns
    - Service Decomposition
    - Cross Cutting Concerns (Microservice Chasis, Externalized Configuration)
    - Service Discovery
    - API Gateway
    - Communication Styles (Messaging, Remote Procedure Invocation)
    - Data Management (Saga, Event Sourcing, Application Event)
    - Database Querying (API Composition, CQRS)
    - Transactional Messaging
    - UI Patterns
    - Reliability (Circuit Breaker)
    - Observability (Distributed Tracing, Log Aggregation)
    - Security
    - Testing
    - Deployment

Day 5

Module-10: Microservices Implementation with Spring Boot

- Microservices Patterns Overview
- Microservices development with Spring Boot
- Kafka message system overview
- Inter service communication with Kafka
- Data Management implementation
- Microservices Testing strategies and sample implementation with Unit / Integration Testing
- Microservices Security implementation with OAuth2 and JWT
- Sample Microservices based application applying above concepts

Day 6

Module-11: Docker Overview

- Introduction to Docker
- Docker Architecture
- Virtual Machines vs Containers
- Docker Setup and Configuration
- Components -Docker Engine, Docker File, Images, Docker Registry, Docker Compose
- Create Docker File for Spring Boot application
- Build Docker image
- Deployment workflow
- Hands-on exercise to package spring boot applications into Docker images and deploy
- **Demo/Lab:** Verifying Docker Installation
- **Demo/Lab:** Pull and Run standard docker images
- **Demo/Lab:** Manage docker image and container life cycle
- **Demo/Lab:** Create Docker File for sample web application
- **Demo/Lab:** Build Docker Image for sample web application
- **Demo/Lab:** Run sample web application Docker Image locally
- **Demo/Lab:** Tag Docker Image build for sample web application
- **Demo/Lab:** Create DockerHub Account
- **Demo/Lab:** Upload (Push) Docker Image to DockerHub registry
- **Demo/Lab:** Download (Pull) Docker Image from DockerHub registry and run

Day 7

Module-12: Kubernetes Overview

- Kubernetes Overview
- Kubernetes Architecture
- Kubernetes Setup and Configuration
- Components
    - Master Components
    - Node Components
    - Client Components
- Kubernetes Objects
- Kubernetes Manifests
- Kubernetes Containers
- Kubernetes Workloads
    - Pods
    - Deployments
    - Jobs, Cron Jobs
    - Replica Sets
    - Stateful Sets
    - Daemon Sets
- Services and Load Balancing
- Kubernetes Monitoring with Dashboard
- **Demo/Lab:** Verifying Kubernetes Installation
- **Demo/Lab:** Enable and access Kubernetes dashboard
- **Demo/Lab:** Create pod and deploy into K8s
- **Demo/Lab:** Create multi container pod and deploy into K8s
- **Demo/Lab:** Create deployment for sample web application with replication
- **Demo/Lab:** Create deployment for different kinds of workloads
- **Demo/Lab:** Create service to access the application internally
- **Demo/Lab:** Create service to access the application externally
- **Demo/Lab:** Create service to access the application with load balancing

Day 8

Module-13: Kubernetes Advanced Concepts

- Storage Volumes
- Networking
- Service Discovery with K8s
- API Gateway with K8s
- Circuit Breaker with K8s
- Auto Scaling and Load Balancing with K8s
- Security with K8s
- **Demo/Lab:** Store container data in the host file system with local path
- **Demo/Lab:** Store container data in the host file system with Persistent Volume Claim
- **Demo/Lab:** Create custom pod networking and share data between them
- **Demo/Lab:** Create and deploy sample application into K8s with auto scaling
- **Demo/Lab:** Create and deploy sample Microservice into K8s with service discovery
- **Demo/Lab:** Create and deploy sample Microservice into with API Gateway
- **Demo/Lab:** Create and deploy sample Microservice into with Circuit Breaker
- **Demo/Lab:** Create ConfigMap to store configuration data
- **Demo/Lab:** Create Secrets to store confidential data

Day 9

Module-14: Introduction to Cloud Computing and AWS

- What is Cloud Computing?
- Cloud Computing Concepts
- Cloud Computing Architecture
- Cloud Service Models - SaaS vs PaaS vs IaaS
- Cloud Deployment Models - Private, Public, Community, Hydrid
- Benefits and Limitations
- AWS Services Overview
- AWS Management Console Overview
- Availability Zones/Regions
- AWS Pricing Overview

Module 15: Design and Implement Cloud Compute

- Cloud Compute Overview
- Amazon EC2 (Elastic Cloud Compute) Overview
- Amazon AMI (Amazon Machine Image)
- EC2/ AMI CLI
- Elastic IPs, Security Groups, Key Pairs, Placement Groups
- **Hands-on Practical Labs:**
  - Launching EC2 instance with Windows and Linux OS
  - Attaching EBS volume and Configuring Security Groups
  - How to upgrade / downgrade EC2 instance types
  - Monitoring EC2 instance basic health metrics and logs
  - Creating EBS Snapshot and Restore
  - Creating custom AMIs and manage life cycle

Day 10

Module 16: Load Balancing and Auto Scaling

- Load Balancers Overview
- Elastic Load Balancer
- Auto Scaling Overview
- **Hands-on Practical Labs:**
  - Creating and configuring Elastic Load Balancer to load balance the EC2 instances with sample webapp
  - Creating and configuring Auto Scaling Groups to scale EC2 instances based on configured rules

Module 17: Amazon EKS Overview

- Elastic Kubernetes Service overview
- Cluster creation and management
- Workload deployment and management
- Storage Management
- Network Management
- Security
- **Demo / Labs:**
  - Provisioning K8s cluster with Amazon EKS service
  - Deploying different kinds of workloads into Amazon EKS cluster
  - Monitoring and Managing the Workloads and Cluster