

SPRING & SPRING BOOT COMPLETE ROADMAP (PHASE-WISE)

PHASE 1 — Spring Core

1. Inversion of Control (IoC)

- What is IoC container?
- BeanFactory vs ApplicationContext
- How Spring manages objects
- Object creation vs retrieval
- XML config vs Java config

2. Dependency Injection (DI)

- Constructor Injection
- Setter Injection
- Field Injection (why not recommended)
- Circular dependency
- Autowiring modes (byType/byName)

3. Beans & Bean Lifecycle

- @Component, @Service, @Repository
- Bean initialization
- @PostConstruct, @PreDestroy
- BeanPostProcessor
- InitializingBean, DisposableBean
- Bean scopes (Singleton, Prototype, Request, Session)

4. Configuration & Bean Management

- @Configuration, @Bean
- @Lazy, @Primary, @Qualifier
- Environment abstraction
- PropertySource usage

5. AOP (Aspect-Oriented Programming)

- Cross-cutting concerns
- JoinPoint, Pointcut, Advice
- Types of Advices (@Before, @After, @AfterReturning, @AfterThrowing, @Around)
- Use cases: Logging, Security, Transactions
- Proxy pattern (JDK dynamic proxy vs CGLIB)

PHASE 2 — Spring MVC

1. Architecture & Flow

- DispatcherServlet, HandlerMapping, ViewResolver

2. Controller Layer

- @Controller vs @RestController
- @RequestMapping, @GetMapping, @PostMapping
- @PathVariable, @RequestParam, @RequestBody, @ResponseBody, ResponseEntity

3. Data Binding & Validation

- DTOs
- @Valid, @Validated
- JSR-380 annotations (@NotNull, @Size)
- Custom validators

4. Exception Handling

- @ExceptionHandler, @ControllerAdvice
- Global exception format

5. Filters & Interceptors

- HandlerInterceptor
- OncePerRequestFilter
- Authentication filter

PHASE 3 — Spring Boot

1. Spring Boot Basics

- Auto-configuration, Starters, Embedded Tomcat
- CommandLineRunner, ApplicationRunner

2. Configuration Management

- Properties, YAML
- Profiles
- @Value, @ConfigurationProperties

3. Logging

- Logback, logback-spring.xml
- Patterns, levels

4. Actuator

- Health, Metrics
- Custom indicators
- Prometheus + Grafana

5. Deployment

- JAR/WAR
- Maven/Gradle packaging
- External configuration

PHASE 4 — JPA + Hibernate

1. Basics

- Entity lifecycle
- Persistence Context
- Dirty checking
- Flush modes

2. Mappings

- @Entity, @Table
- @Id, @GeneratedValue
- @Column, @Transient
- @Embeddable, @Embedded

3. Relationships

- One-to-One, One-to-Many, Many-to-One, Many-to-Many
- Cascade, Fetch types

4. Queries

- JPQL, Named queries
- Criteria API, Specifications
- Native SQL

5. Performance

- N+1 issue
- Join fetch
- DTO projection
- Caching (1st, 2nd level, EhCache/Redis)

6. Transactions

- @Transactional
- Propagation, Isolation
- Rollback rules

7. Migration Tools

- Flyway basics
- Versioned & Repeatable migrations

PHASE 5 — Spring Security

1. Basics

- Authentication vs Authorization
- SecurityFilterChain
- Filter hierarchy

- UserDetailsService

2. Password Encoding

- BCrypt

- NoOp

- Salting

3. Authentication Types

- In-memory, JDBC, Custom table

- LDAP basics

4. JWT

- Structure

- Access/Refresh tokens

- Validation, Expiry

- Stateless auth

5. Method-Level Security

- @PreAuthorize, @PostAuthorize

6. CORS & CSRF

- Global config

- Differences

PHASE 6 — Microservices

1. REST Standards

- Idempotency

- Pagination

- Error formats

2. Communication

- RestTemplate, WebClient, Feign Client

3. Service Discovery

- Eureka Server & Client

- Load balancing

4. API Gateway

- Spring Cloud Gateway

- Filters

- Authentication at gateway

5. Config Server

- Centralized config

- Git-based properties
- Refresh scope

6. Resilience4j

- Circuit breaker
- Retry, Rate limiter
- Bulkhead
- Time limiter

7. Distributed Logging

- Sleuth + Zipkin/Jaeger
- TraceId, SpanId

PHASE 7 — Messaging

Kafka:

- Topics, Partitions
- Producers/Consumers
- Consumer groups
- Offsets
- Exactly-once semantics
- DLQ
- Kafka Template
- Kafka Streams basics

RabbitMQ:

- Exchanges, Queues
- Routing keys

PHASE 8 — Cloud Deployment (AWS)

- EC2
- RDS
- S3
- IAM
- Docker
- Kubernetes basics (Pods, Deployments, Services, ConfigMaps, Secrets)

PHASE 9 — Testing

- JUnit 5
- Mockito
- MockBean
- MockMvc

- @SpringBootTest
- TestContainers
- @DataJpaTest

PHASE 10 — Performance Optimization

- JVM tuning
- DB indexing, optimization
- HikariCP
- Caching
- Async processing

BONUS — DESIGN PATTERNS

Singleton, Builder, Factory, Proxy, Strategy, Template Method, Observer, Adapter, Repository, DTO pattern