Domain Driven Design tackling complexity in the heart of software

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In today's fast-paced software development landscape, managing complexity has become one of the most critical challenges for developers and architects alike. As systems grow in scope and functionality, the need for a structured approach to design that aligns with business goals and minimizes confusion becomes paramount. This is where Domain Driven Design (DDD) emerges as a powerful methodology. By focusing on the core domain and creating a shared language between technical teams and domain experts, DDD helps tame complexity and produce more maintainable, scalable, and robust software solutions.

Understanding Domain Driven Design (DDD)

What Is Domain Driven Design?

Domain Driven Design is an approach to software development that emphasizes deep understanding of the domain (the problem space) and models the software around that understanding. Introduced by Eric Evans in his seminal book Domain-Driven Design: Tackling Complexity in the Heart of Software, DDD advocates for collaboration between technical teams and domain experts to create a model that accurately reflects real-world concepts.

Key principles of DDD include:

- Focusing on the core domain and domain logic
- Building a ubiquitous language shared by developers and domain experts
- Using bounded contexts to manage complexity
- Emphasizing iterative modeling and refinement

The Core Philosophy of DDD

At its heart, DDD encourages teams to prioritize understanding the domain and encapsulating that understanding within the software. This involves:

- Breaking down complex systems into smaller, well-defined parts
- Ensuring clear communication through a shared language
- Aligning software structure with business processes
- Handling domain complexity through strategic design patterns

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Why Is DDD Essential in Tackling Software Complexity?

Complexity in Modern Software Systems

Modern software systems are inherently complex, often involving multiple interconnected components, diverse data sources, and evolving requirements. This complexity can lead to:

- Difficulties in maintaining and extending code
- Increased chances of bugs and inconsistencies
- Challenges in onboarding new team members
- Misalignment between technical solutions and business needs

How DDD Addresses This Complexity

Domain Driven Design offers a structured way to manage this complexity by:

- Creating clear boundaries within the system
- Focusing development efforts on the core domain
- Facilitating communication and shared understanding
- Promoting modularity and separation of concerns

By adopting DDD, teams can develop software that is more aligned with business objectives and easier to evolve over time.

Core Concepts of Domain Driven Design

Ubiquitous Language

One of the foundational elements of DDD, the ubiquitous language, is a common vocabulary shared by both developers and domain experts. This language is used in:

- Conversations
- Requirements gathering
- Code comments
- Class and method names

Benefits include:

- Reducing misunderstandings
- Ensuring clarity in communication
- Making the code more expressive and aligned with business concepts

Bounded Contexts

A bounded context defines a clear boundary within which a particular model applies. Different parts of a system may have their own models and language, which prevents ambiguity and conflict.

- Isolates different models to manage complexity
- Facilitates integration between contexts through well-defined interfaces
- Supports scalability and modularity

Entities and Value Objects

- Entities: Objects with a distinct identity that persists over time, e.g., Customer, Order
- Value Objects: Immutable objects defined by their attributes, e.g., Address, Money

This distinction helps in modeling the domain accurately and managing data consistency.

Aggregates

An aggregate is a cluster of domain objects that are treated as a unit for data changes. It enforces invariants and consistency rules, making the system more reliable.

Repositories and Domain Services

- Repositories: Abstractions for data persistence, allowing the domain model to focus on business logic
- Domain Services: Operations that don't naturally fit within entities or value objects but are part of the domain logic

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Implementing DDD to Tackle Complexity

Step 1: Collaborate with Domain Experts

Successful DDD implementation starts with close collaboration with domain experts to understand:

- Core business processes
- Pain points and bottlenecks
- Key concepts and terminology

This partnership ensures the model accurately reflects reality and avoids misinterpretations.

Step 2: Define Bounded Contexts

Identify different areas within your system that can be modeled independently. For example:

- Customer Management
- Order Processing
- Inventory Management

Each bounded context has its own model, language, and data schema, reducing overall complexity.

Step 3: Develop a Ubiquitous Language

Establish a shared vocabulary and ensure it is used consistently in:

- Discussions
- Documentation
- Code

This practice improves communication and reduces misunderstandings.

Step 4: Model the Domain

Create domain models that encapsulate core logic using entities, value objects, aggregates, and domain services. Use iterative refinement to improve the model over time.

Step 5: Implement Strategic Design Patterns

Apply patterns such as:

- Context Mapping for integration
- Anti-Corruption Layer to prevent external influence
- Domain Events to handle side effects and decouple components

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Benefits of Using DDD to Manage Complexity

Implementing DDD provides several tangible benefits:

- Enhanced Maintainability: Clear models and boundaries make the system easier to modify
- Better Scalability: Modular bounded contexts facilitate scaling development teams
- Aligned Development and Business Goals: Shared language and models ensure the software reflects business needs
- Reduced Technical Debt: Focused models prevent unnecessary complexity
- Increased Flexibility: Easier to adapt to changing requirements

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Common Challenges in Applying DDD and How to Overcome Them

While DDD offers significant advantages, it also presents challenges:

Challenge 1: Requires Deep Domain Knowledge

Solution: Invest time in collaboration, workshops, and continuous learning with domain experts.

Challenge 2: Can Be Overly Complex for Small Projects

Solution: Use DDD selectively, focusing on the most complex parts of the system while keeping simpler areas straightforward.

Challenge 3: Maintaining Consistency Across Bounded Contexts

Solution: Establish clear context mappings and integration patterns like domain events and anti-corruption layers.

Case Studies: DDD in Action

Case Study 1: E-commerce Platform

An e-commerce company adopted DDD to manage complex order processing, inventory, and customer management systems. By defining bounded contexts for each area and creating a ubiquitous language, they improved clarity, reduced bugs, and increased deployment frequency.

Case Study 2: Financial Services Application

A financial institution used DDD to model banking operations, compliance rules, and transaction processing. The strategic use of domain events and aggregates allowed for better auditability and scalability.

Future Trends in Domain Driven Design

As software systems evolve, DDD continues to adapt with emerging trends:

- Integration with microservices architecture to leverage bounded contexts
- Use of domain-specific languages (DSLs) for more expressive modeling
- Incorporation of event sourcing and CQRS patterns for handling complex workflows
- Enhanced tooling to support domain modeling and collaboration

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Conclusion

Domain Driven Design tackling complexity in the heart of software is a transformative approach that aligns technical solutions with business realities. By emphasizing collaboration, shared understanding, and strategic boundaries, DDD provides a robust framework for managing the intricacies of modern systems. While it requires investment and discipline, the payoff is a more maintainable, scalable, and meaningful software architecture capable of evolving alongside business needs. Embracing DDD enables teams to navigate complexity confidently, delivering value that truly resonates with the core domain.

Frequently Asked Questions

What is the core principle of Domain-Driven Design (DDD) in managing software complexity?

The core principle of DDD is to focus on the core domain and its logic, modeling it closely to the real-world business processes, which helps reduce complexity by aligning software design with domain understanding.

How does DDD help in breaking down complex systems into manageable parts?

DDD encourages dividing the system into bounded contexts, each representing a specific subdomain, which isolates complexity and allows teams to focus on smaller, more manageable models.

What role do Ubiquitous Language and collaboration play in tackling complexity with DDD?

Ubiquitous Language ensures that all stakeholders and developers share a common vocabulary, reducing misunderstandings and bridging gaps between technical and business teams, thus simplifying complex domain logic.

How do aggregates in DDD contribute to managing complexity?

Aggregates encapsulate related domain objects, enforcing consistency boundaries and reducing the cognitive load by limiting the scope of changes and interactions within the domain.

In what ways does DDD facilitate handling evolving requirements and complexity over time?

DDD promotes iterative modeling and continuous collaboration, allowing the domain model to evolve organically, thereby managing increasing complexity without overhauling the entire system.

Can DDD be applied to non-business or technical domains to reduce complexity?

While primarily designed for complex business domains, DDD principles like bounded contexts and clear modeling can be adapted to technical domains to improve clarity and manage complexity effectively.

What are common challenges faced when implementing DDD to tackle complexity?

Challenges include establishing a shared Ubiquitous Language, defining appropriate bounded contexts, maintaining model consistency, and ensuring team alignment, especially in large or distributed teams.

How does strategic design in DDD help in addressing complexity at an organizational level?

Strategic design aligns different bounded contexts and defines their interactions, enabling organizations to manage complex systems by clearly delineating responsibilities and reducing inter-context dependencies.

Additional Resources

Domain Driven Design Tackling Complexity in the Heart of Software

In the rapidly evolving landscape of software development, addressing complexity remains one of the most

formidable challenges faced by architects and developers alike. As systems grow in scope and intricacy, traditional design methodologies often struggle to maintain clarity, agility, and maintainability. Enter Domain Driven Design (DDD) — a paradigm that seeks to tame complexity by aligning software models closely with the core business domain, fostering a shared understanding among stakeholders, and emphasizing strategic design principles. This investigative review delves into how DDD tackles the multifaceted challenges of complexity within software systems, exploring its foundational concepts, practical implementations, and its role in modern software architecture.

Understanding the Roots of Complexity in Software Systems

Before examining how DDD addresses complexity, it's imperative to understand its origins and the nature of the problems it aims to solve.

The Evolution of Software Complexity

Software systems have evolved from simple scripts to sprawling, interconnected architectures. The growth in functionality, user bases, and integrations has led to:

- Structural Complexity: Large codebases with numerous modules, dependencies, and layers.
- Conceptual Complexity: Divergent mental models among stakeholders about how the system works.
- Operational Complexity: Challenges in deploying, scaling, and maintaining systems in production.

This multifaceted complexity often results in:

- Code fragility and difficulty in making changes
- Miscommunication among teams
- Increased technical debt

The Limitations of Conventional Approaches

Traditional software design methodologies—such as layered architecture, procedural programming, or object-oriented design—offer tools to manage parts of this complexity. However, they frequently fall short when confronted with:

- Domain intricacies that are hard to encapsulate
- Divergent stakeholder perspectives
- Evolving business requirements

These limitations underscore the necessity for a more strategic approach—one that centers the domain as the core driver of software design.

Fundamentals of Domain Driven Design

Domain Driven Design was introduced by Eric Evans in his seminal book Domain-Driven Design: Tackling Complexity in the Heart of Software (2003). It emphasizes a deep connection between the software model and the core business domain, fostering a shared language and understanding among developers and domain experts.

Core Principles of DDD

At its heart, DDD rests on several key principles:

- Focus on the Domain: Prioritize understanding and modeling the core business logic.
- Ubiquitous Language: Develop a common language shared by developers, domain experts, and stakeholders.
- Strategic Design: Divide the system into bounded contexts to manage complexity.
- Layered Architecture: Organize code into layers (domain, application, infrastructure) to promote separation of concerns.
- Aggregates and Entities: Use domain-specific patterns to encapsulate consistency boundaries.

Key Building Blocks

- Entities: Objects with a distinct identity that persists over time.
- Value Objects: Immutable objects representing descriptive aspects of the domain.
- Aggregates: Clusters of entities and value objects treated as a unit for data consistency.
- Repositories: Abstractions for data persistence, hiding underlying storage details.
- Services: Domain operations that don't naturally fit within entities or value objects.

How DDD Tackles Complexity: Strategic and Tactical Design

The strength of DDD in managing complexity lies in its combination of strategic and tactical design approaches.

Strategic Design: Bounded Contexts and Context Maps

One of DDD's pivotal strategies is the decomposition of large systems into bounded contexts—distinct parts of the system with explicit boundaries and models. This approach offers:

- Isolation of Concepts: Prevents domain concepts from leaking across boundaries.
- Simplification of Models: Each context can have its own language and implementation, reducing mental load.
- Clear Integration: Context maps define how different bounded contexts interact, reducing ambiguity.

Examples of bounded contexts include:

- Customer Management
- Ordering System
- Inventory Control
- Payment Processing

By defining these boundaries, developers can focus on a manageable subset of the domain, reducing cognitive overload and enabling teams to work more autonomously.

Tactical Design: Patterns for Managing Domain Complexity

Within each bounded context, DDD prescribes tactical patterns to implement the domain model effectively:

- Entities and Value Objects: Distinguishing between mutable, identity-driven objects and immutable descriptive data.

- Aggregates: Ensuring consistency within a boundary by controlling modifications through root entities.
- Repositories: Encapsulating data access, providing a clean API for the domain.
- Domain Services: Handling domain logic that doesn't naturally belong to entities.
- Factories: Encapsulating complex creation logic for aggregates.

These patterns serve to encapsulate complexity, enforce invariants, and promote a clear, expressive model.

Practical Impact: DDD in Modern Software Architectures

The application of DDD principles has profound implications for modern architectures, especially in complex domains such as finance, healthcare, logistics, and e-commerce.

Model-Driven Development & Microservices

- Microservices Architecture: DDD naturally aligns with microservices by allowing each bounded context to be implemented as an independent service. This decouples parts of the system, making complexity more manageable.
- Model-Driven Development: Emphasizing a rich domain model fosters code that closely reflects business processes, reducing ambiguity and simplifying maintenance.

Event-Driven Architectures

- Domain Events: DDD encourages modeling significant business occurrences as events, facilitating asynchronous communication between bounded contexts.
- This approach enhances scalability and resilience, essential for managing operational complexity.

Challenges and Limitations

Despite its strengths, DDD is not a silver bullet:

- Steep Learning Curve: Requires deep domain knowledge and discipline.
- Overhead in Modeling: Developing a comprehensive domain model takes time.
- Bounded Context Boundaries: Defining clear boundaries can be complex, especially in legacy systems.
- Organizational Buy-In: Success depends on aligning teams and stakeholders around shared language and goals.

Case Studies and Success Stories

Several organizations have successfully adopted DDD to handle complexity:

- Ericsson: Used DDD principles to modularize their telecom systems, reducing integration issues.
- NHS (UK National Health Service): Applied DDD to manage the complexity of healthcare records and workflows.
- Financial Institutions: Leveraged DDD to model intricate financial instruments and compliance domains.

These cases demonstrate how strategic domain modeling can lead to more maintainable, scalable, and aligned systems.

Conclusion: The Ongoing Relevance of DDD in Managing Software Complexity

As software systems continue to grow in complexity, the need for effective strategies to manage this intricacy becomes ever more critical. Domain Driven Design offers a compelling framework that places the business domain at the core of system development. Its emphasis on shared understanding, bounded contexts, and strategic modeling enables teams to break down complexity into manageable parts, foster clearer communication, and build systems that are more aligned with business needs.

While adopting DDD requires investment—in time, discipline, and cultural change—the benefits in terms of reduced technical debt, improved agility, and enhanced clarity often justify the effort. In a landscape where complexity is an unavoidable reality, DDD remains a vital approach for software professionals aiming to craft systems that are robust, adaptable, and truly reflective of their domains.

In the heart of software, where complexity resides, Domain Driven Design stands as a guiding beacon—helping teams map the chaos into comprehensible, maintainable, and scalable solutions.

Domain Driven Design Tackling Complexity In The Heart Of Software

domain driven design tackling complexity in the heart of software: *Domain-driven Design* Eric Evans, 2004 Domain-Driven Design incorporates numerous examples in Java-case studies taken from actual projects that illustrate the application of domain-driven design to real-world software development.

domain driven design tackling complexity in the heart of software: Domain-Driven Design Reference Eric Evans, 2014-09-22 Domain-Driven Design (DDD) is an approach to software development for complex businesses and other domains. DDD tackles that complexity by focusing the team's attention on knowledge of the domain, picking apart the most tricky, intricate problems with models, and shaping the software around those models. Easier said than done! The techniques of DDD help us approach this systematically. This reference gives a quick and authoritative summary of the key concepts of DDD. It is not meant as a learning introduction to the subject. Eric Evans' original book and a handful of others explain DDD in depth from different perspectives. On the other hand, we often need to scan a topic quickly or get the gist of a particular pattern. That is the purpose of this reference. It is complementary to the more discursive books. The starting point of this text was a set of excerpts from the original book by Eric Evans, Domain-Driven-Design: Tackling Complexity in the Heart of Software, 2004 - in particular, the pattern summaries, which were placed in the Creative Commons by Evans and the publisher, Pearson Education. In this reference, those original summaries have been updated and expanded with new content. The practice and understanding of DDD has not stood still over the past decade, and Evans has taken this chance to document some important refinements. Some of the patterns and definitions have been edited or rewritten by Evans to clarify the original intent. Three patterns have been added, describing concepts whose usefulness and importance has emerged in the intervening years. Also, the sequence and grouping of the topics has been changed significantly to better emphasize the core principles.

This is an up-to-date, quick reference to DDD.

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domain driven design tackling complexity in the heart of software: Hands-On Domain-Driven Design with .NET Core Alexey Zimarev, 2019-04-30 Solve complex business problems by understanding users better, finding the right problem to solve, and building lean event-driven systems to give your customers what they really want Key FeaturesApply DDD principles using modern tools such as EventStorming, Event Sourcing, and CQRSLearn how DDD applies directly to various architectural styles such as REST, reactive systems, and microservicesEmpower teams to work flexibly with improved services and decoupled interactionsBook Description Developers across the world are rapidly adopting DDD principles to deliver powerful results when writing software that deals with complex business requirements. This book will guide you in involving business stakeholders when choosing the software you are planning to build for them. By figuring out the temporal nature of behavior-driven domain models, you will be able to build leaner, more agile, and modular systems. You'll begin by uncovering domain complexity and learn how to capture the behavioral aspects of the domain language. You will then learn about EventStorming and advance to creating a new project in .NET Core 2.1; you'll also and write some code to transfer your events from sticky notes to C#. The book will show you how to use aggregates to handle commands and produce events. As you progress, you'll get to grips with Bounded Contexts, Context Map, Event Sourcing, and CQRS. After translating domain models into executable C# code, you will create a frontend for your application using Vue.js. In addition to this, you'll learn how to refactor your code and cover event versioning and migration essentials. By the end of this DDD book, you will have gained the confidence to implement the DDD approach in your organization and be able to explore new techniques that complement what you've learned from the book. What you will learnDiscover and resolve domain complexity together with business stakeholdersAvoid common pitfalls when creating the domain modelStudy the concept of Bounded Context and aggregateDesign and build temporal models based on behavior and not only dataExplore benefits and drawbacks of Event SourcingGet acquainted with CQRS and to-the-point read models with projectionsPractice building one-way flow UI with Vue.jsUnderstand how a task-based UI conforms to DDD principlesWho this book is for This book is for .NET developers who have an intermediate level understanding of C#, and for those who seek to deliver value, not just write code. Intermediate level of competence in JavaScript will be helpful to follow the UI chapters.

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bounded context and domain events. ● OpenAPI to define synchronous interfaces. ● AsyncAPI to define asynchronous interfaces. WHO THIS BOOK IS FOR This book is for software developers, architects, and technical leaders who want to learn how to build robust and maintainable software systems. Readers should have a basic understanding of software development principles and object-oriented programming concepts. TABLE OF CONTENTS 1. Introduction to Domain-Driven Design 2. Introduction to the Example Online Library 3. Why Strategic Design 4. Bounded Context and Domain 5. Domain Storytelling 6. Event Storming 7. Context Map 8. Overview of Strategic Design 9. Introduction to Tactical Design 10. Aggregate, Entity, and Value Object 11. Exposing Aggregates via APIs 12. Exposing Domain Events 13. Pitfalls in Tactical Design 14. Usage of Domain-Driven Design in a Greenfield 15. Domain-Driven Design in a Brownfield Project 16. Summary

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especially relevant in today's fast-paced, complex software landscape. This book begins with DDD fundamentals, including core principles, a shared language, and the distinction between strategic and tactical approaches, progressing to strategic concepts like bounded contexts, context mapping, and domain events. It explores the tactical Java implementation detailing entities, value objects, services, aggregates, and repositories. The book also explores testing strategies and architectural validation using ArchUnit/jMolecules. Further, it explores DDD across microservices, monoliths, and distributed systems, integrating with Clean Architecture and SQL/NoSQL data modeling to prevent impedance mismatch. It thoroughly covers applying DDD within Jakarta EE, Spring, Eclipse MicroProfile, and Quarkus. By the end, you will be equipped to model business logic more effectively, design systems that reflect real-world domains, and integrate DDD seamlessly into enterprise applications. You will gain clarity, confidence, and the tools needed to build software that delivers business value. WHAT YOU WILL LEARN ● Apply DDD from strategic to tactical design. ● Model aggregates, entities, and value objects in Java. ● Use DDD in monoliths, microservices, and distributed systems. ● Integrate DDD with Spring and Jakarta EE frameworks. ● Apply Clean Architecture principles alongside DDD. ● Structure data modeling for SQL and NoSQL systems. ● Apply bounded contexts, context mapping, and domain events for architecture. ● Unit/integration testing, validate design with ArchUnit/jMolecules. ● Build responsive microservices with Quarkus extensions, reactive programming. WHO THIS BOOK IS FOR This book is ideal for Java developers, software architects, tech leads, and backend engineers. It is especially valuable for professionals designing scalable enterprise systems or applying DDD in modern software architecture. TABLE OF CONTENTS 1. Understanding Domain-driven Design 2. Strategic DDD Concepts 3. Tactical DDD Implementation 4. Testing and Validating DDD Applications 5. DDD in Microservices, Monoliths, and Distributed Systems 6. Integrating DDD with Clean Architecture 7. DDD and Data Modeling 8. Enterprise Java with Jakarta EE 9. Enterprise Java with Spring 10. Eclipse MicroProfile and Domain-driven Design 11. Quarkus and Domain-driven Design 12. Code Design and Best Practices for DDD 13. Final Considerations

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Higginbotham helps you align every stakeholder on specific outcomes, design APIs that deliver value, and scale the design process from small teams to the entire organization. Higginbotham helps you bring an outside-in perspective to API design to reflect the voices of customers and product teams, map requirements to specific and well-organized APIs, and choose the right API style for writing them. He walks through a real-world example from the ground up, offering guidance for anyone designing new APIs or extending existing APIs. Deliver great APIs by getting your design processes right Gain agreement on specific outcomes from design teams, customers, and other stakeholders Craft job stories, conduct EventStorming, and model capabilities Identify the right APIs, and organize operations into coherent API profiles Choose the best styles for each project: REST, gRPC, GraphQL, or event-based async APIs Refine designs based on feedback from documenters, testers, and customers Decompose APIs into microservices Mature your API program, implementing design and management processes that scale This guide is invaluable for anyone involved in planning or building APIs--architects, developers, team leaders, managers in single and multi-team environments, and any technical or business professional delivering API-as-a-product offerings. Register your book for convenient access to downloads, updates, and/or corrections as they become available. See inside book for details.

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domain driven design tackling complexity in the heart of software: Mastering Microservices with Java Sourabh Sharma, 2019-02-26 Master the art of implementing scalable and reactive microservices in your production environment with Java 11 Key FeaturesUse domain-driven designs to build microservicesExplore various microservices design patterns such as service discovery, registration, and API GatewayUse Kafka, Avro, and Spring Streams to implement event-based microservicesBook Description Microservices are key to designing scalable, easy-to-maintain applications. This latest edition of Mastering Microservices with Java, works on Java 11. It covers a wide range of exciting new developments in the world of microservices, including microservices patterns, interprocess communication with gRPC, and service orchestration. This book will help you understand how to implement microservice-based systems from scratch. You'll start off by understanding the core concepts and framework, before focusing on the high-level design of large software projects. You'll then use Spring Security to secure microservices and test them effectively using REST Java clients and other tools. You will also gain experience of using the Netflix OSS suite, comprising the API Gateway, service discovery and registration, and Circuit Breaker. Additionally, you'll be introduced to the best patterns, practices, and common principles of microservice design that will help you to understand how to troubleshoot and debug the issues faced during development. By the end of this book, you'll have learned how to build smaller, lighter, and faster services that can be implemented easily in a production environment. What you will learnUse

domain-driven designs to develop and implement microservicesUnderstand how to implement microservices using Spring BootExplore service orchestration and distributed transactions using the SagasDiscover interprocess communication using REpresentational State Transfer (REST) and eventsGain knowledge of how to implement and design reactive microservicesDeploy and test various microservicesWho this book is for This book is designed for Java developers who are familiar with microservices architecture and now want to effectively implement microservices at an enterprise level. Basic knowledge and understanding of core microservice elements and applications is necessary.

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