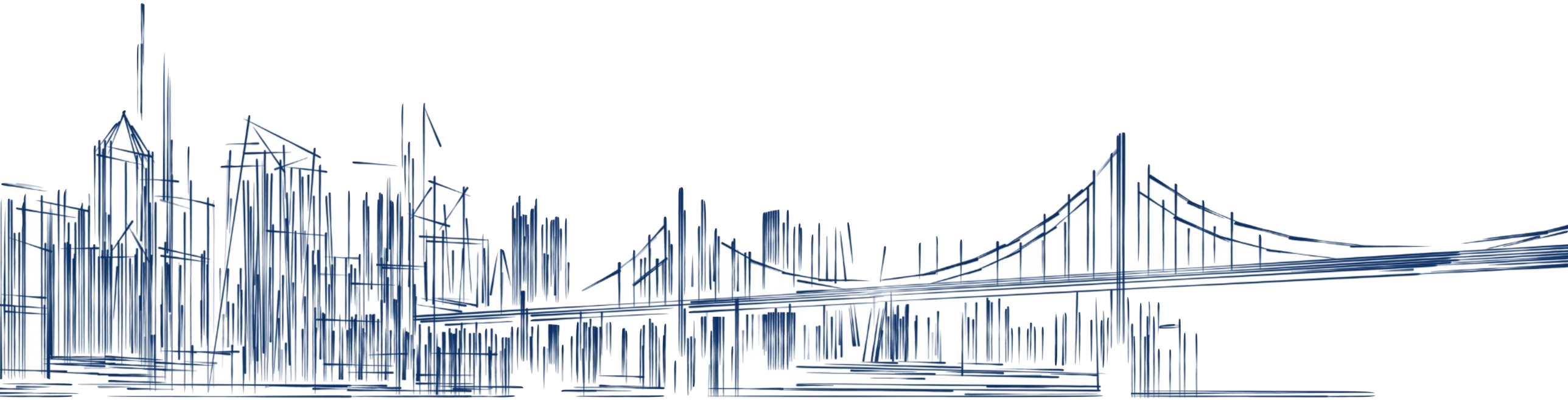

BOTTOM-UP ARCHITECTURE

BRIDGING THE ARCHITECTURE CODE GAP

Oliver Drotbohm odrotbohm oliver.drotbohm@broadcom.com

github.com/odrotbohm

odrotbohm

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Oliver Drotbohm

odrotbohm · he/him

Frameworks & Architecture Engineering @ VMware, OpenSource enthusiast, all things Spring, Java, data, DDD, REST, software architecture, drums & music.

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Learn how we count contributions

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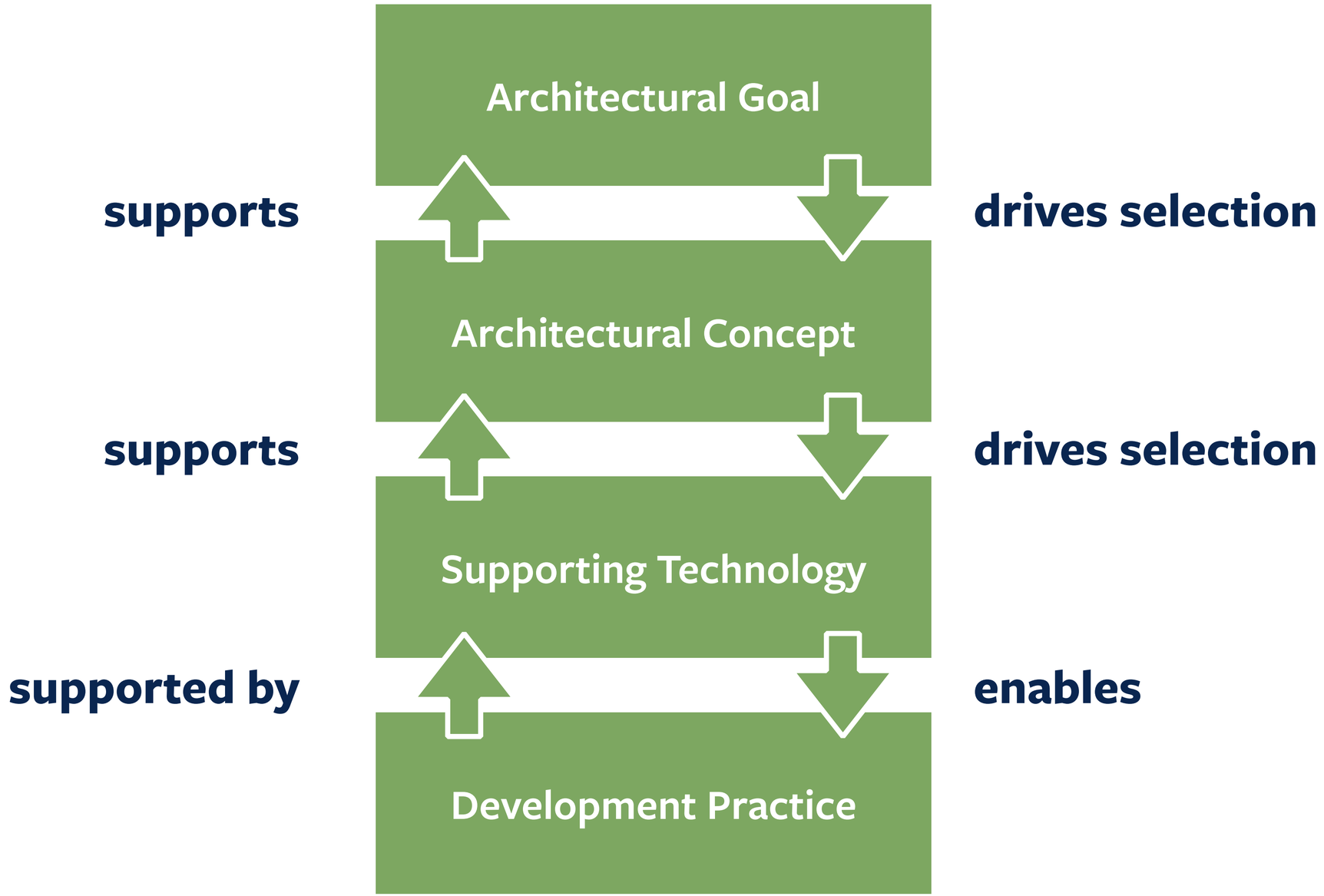
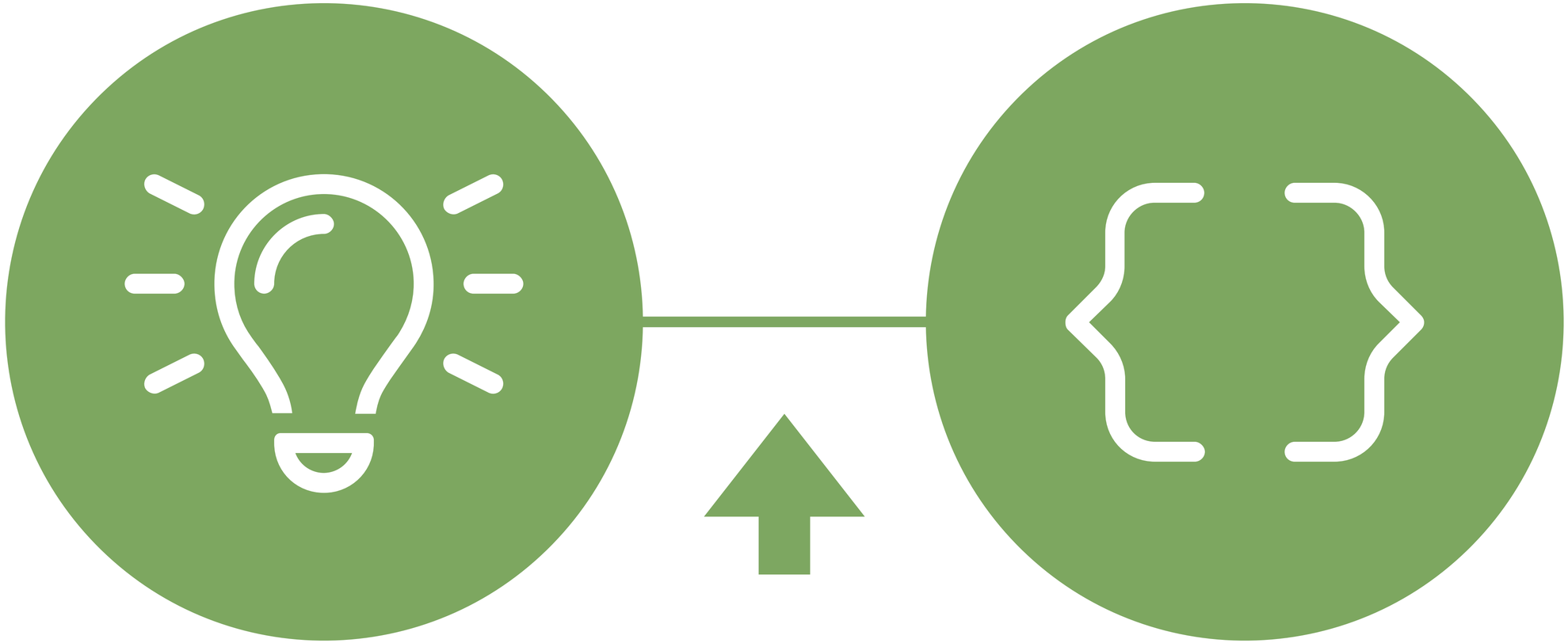
Activity overview

Contributed to spring-projects/spring-modulith,

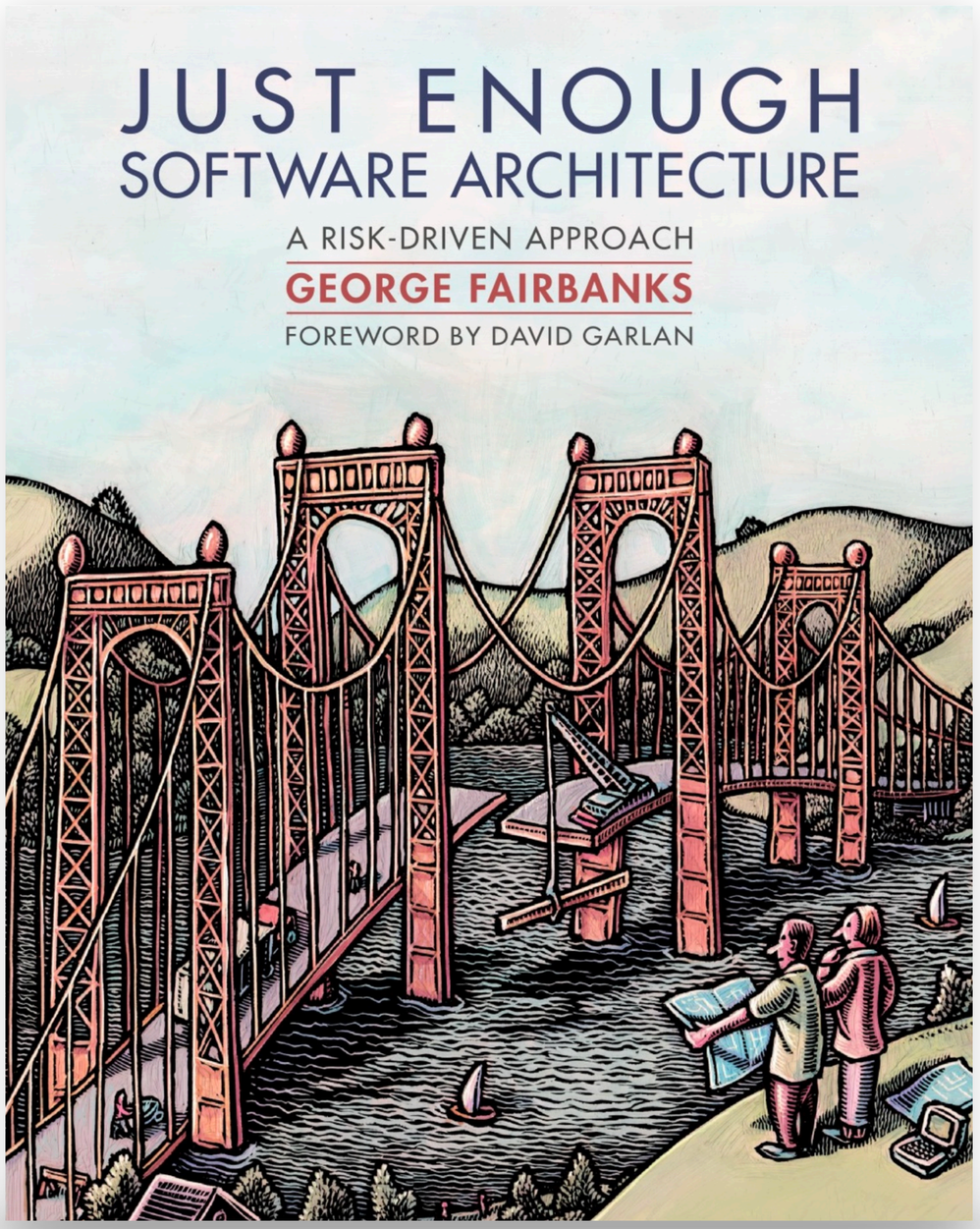
Code review

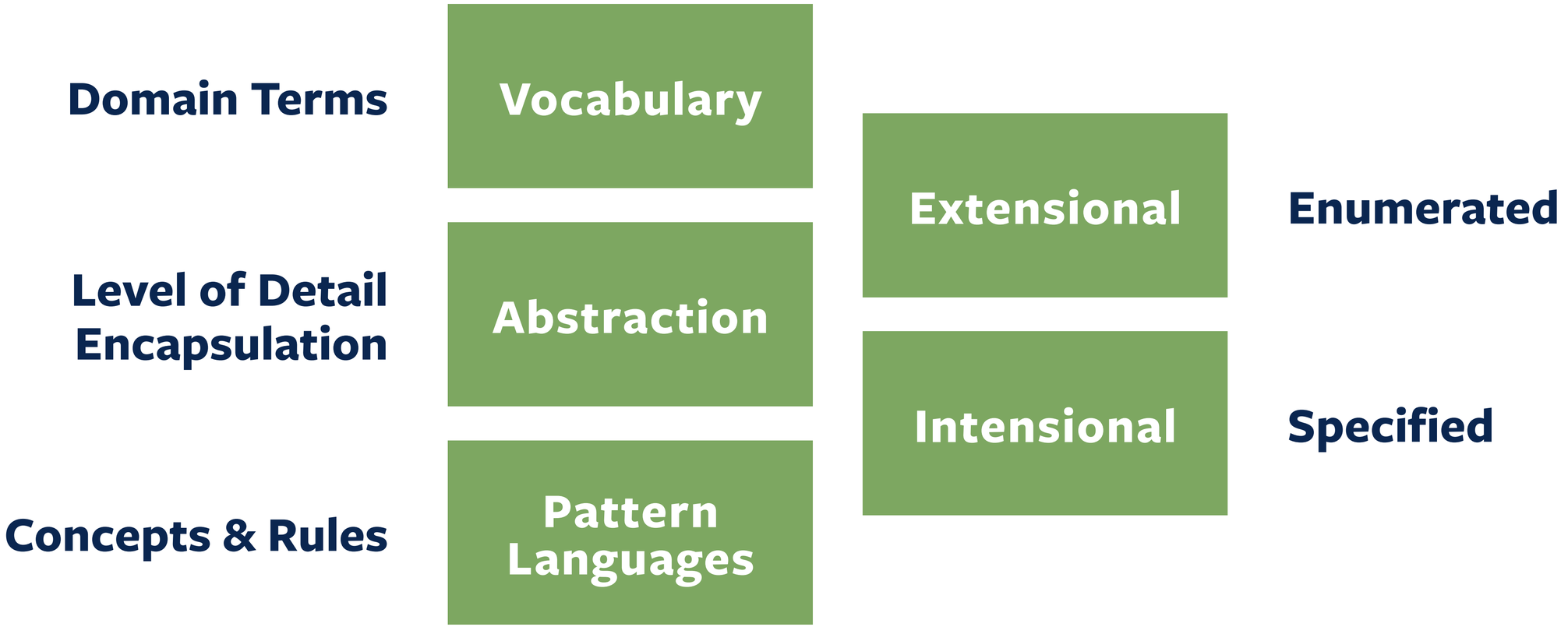

Architectural Goal
supports
drives selection
Architectural Concept
supports
drives selection
Supporting Technology
supported by
enables
Development Practice



"Architecture is a property of a system, not a description of its intended design."

— Stefan Tilkov in "Good Enough Architecture"


JUST ENOUGH
SOFTWARE ARCHITECTURE
A RISK-DRIVEN APPROACH
GEORGE FAIRBANKS
FOREWORD BY DAVID GARLAN


Domain Terms
Level of Detail
Encapsulation
Concepts & Rules
Vocabulary
Abstraction
Pattern Languages
Extensional
Intensional
Enumerated
Specified

Architecturally-Evident Code?

Extensional

Components / Modules

Invoicing,
Shipment

Deployables / Build modules / Packages

Domain language

EmailAddress,
ZipCode

Classes, methods, fields

Intensional

Concepts & Rules

ValueObject,
Entity,
Aggregate

Layers,
Rings

Naming conventions

What else? 🤔

Chunking

Hierarchization

Pattern languages


WPS WORKPLACE SOLUTIONS
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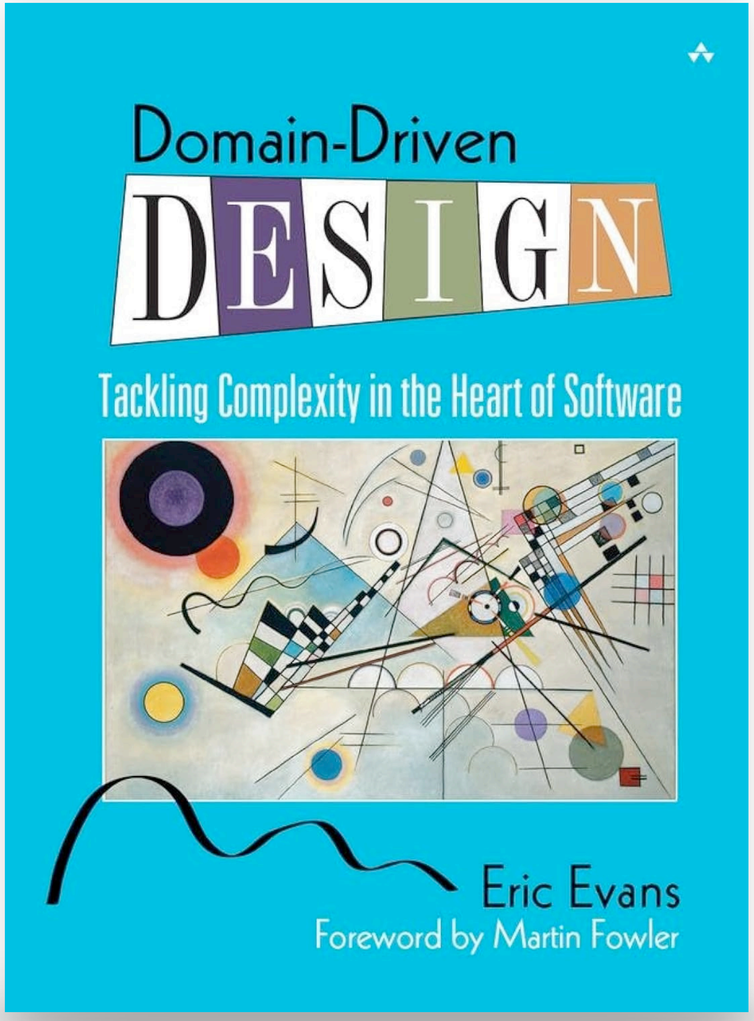
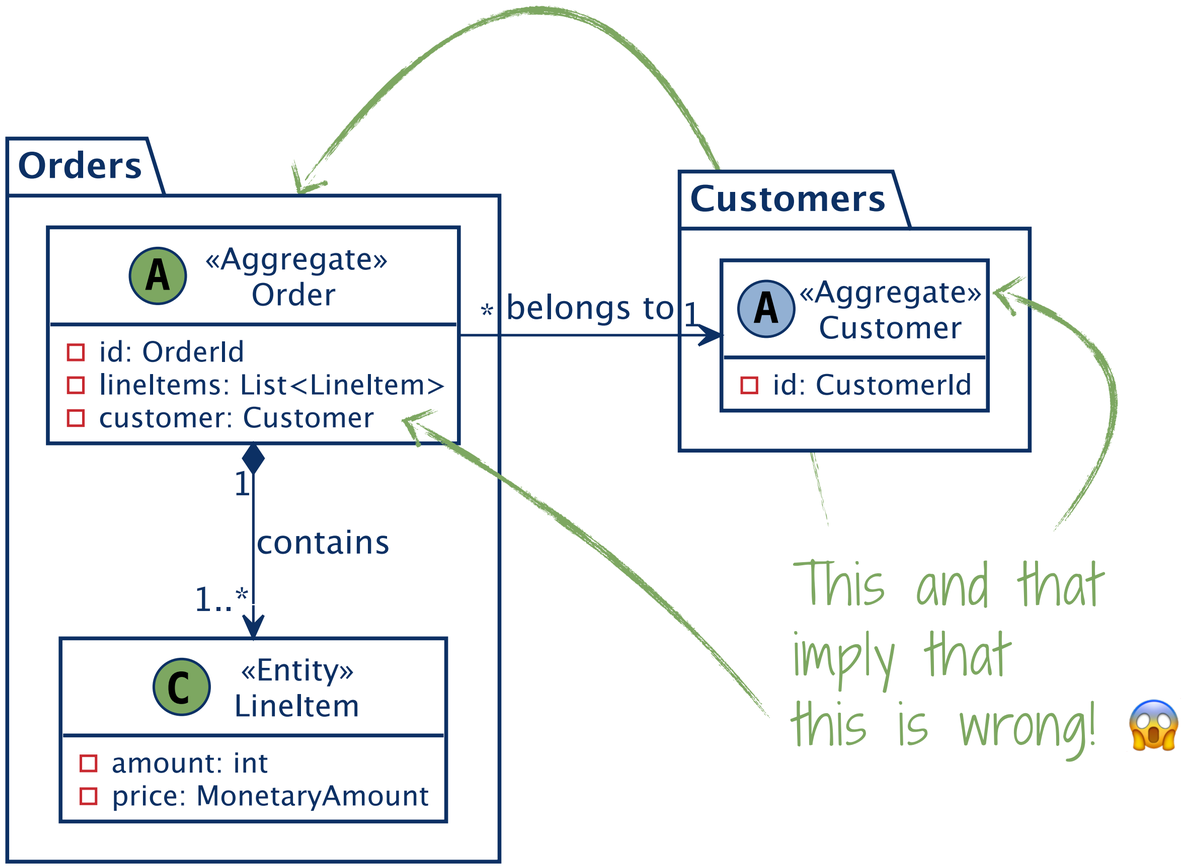
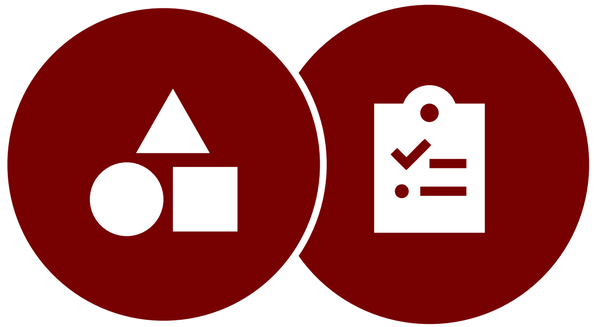
Carola Lilienthal
Sustainable Software Architecture
Analyze and Reduce Technical Debt


Domain-Driven
DESIGN
Tackling Complexity in the Heart of Software
Eric Evans
Foreword by Martin Fowler



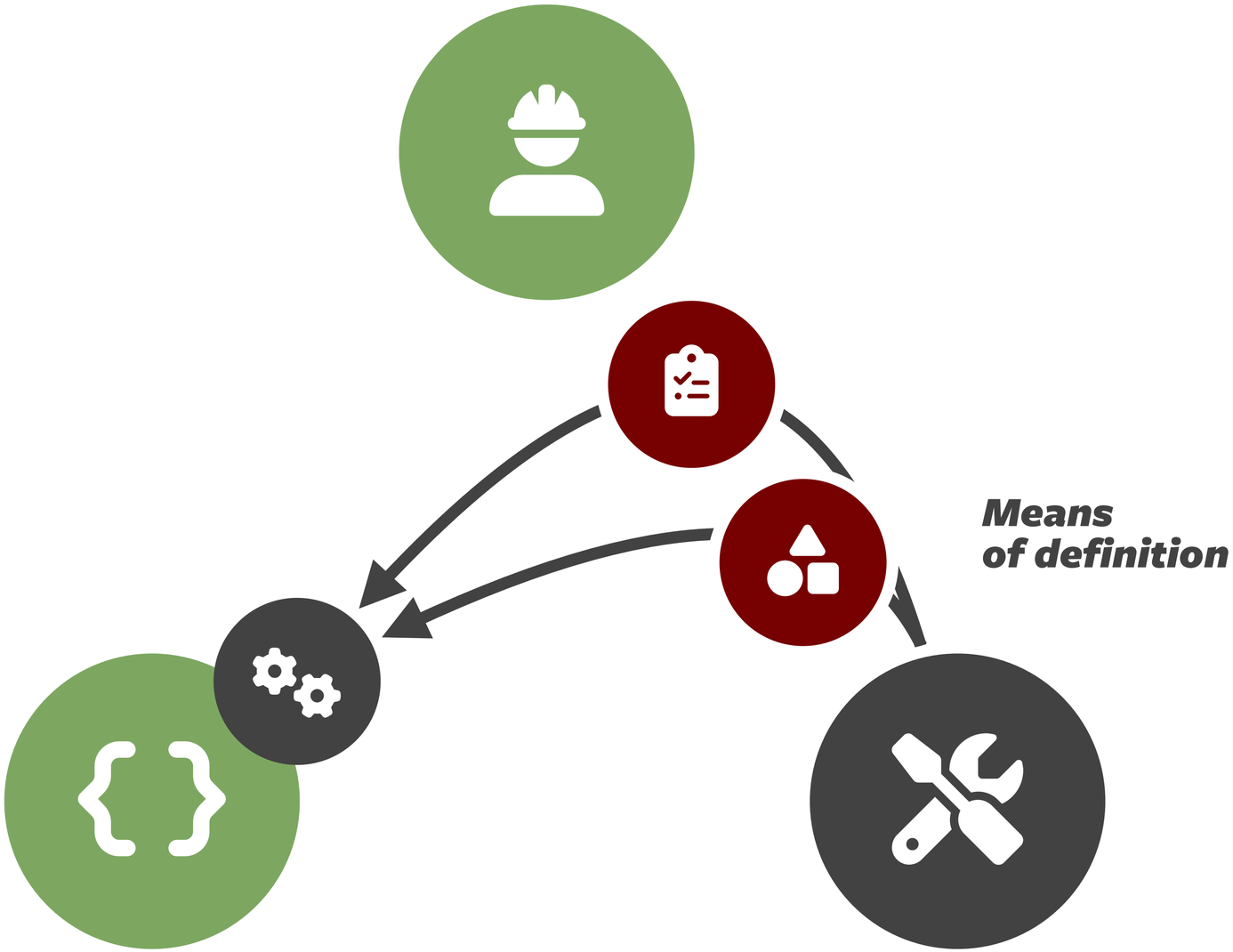


A simple Aggregate arrangement

Code

Architecture

Technology


Means
of definition

Your Software. Your Structures. Your Rules.

Establishing an Aggregate... in jQAssistant

```
MATCH
  (repo:Java:Type)
    -[:IMPLEMENTS_GENERIC]→ (superType)
    -[:OF_RAW_TYPE]→ (:Java:Type { fqn: "o.s.d.r.Repository"}),
  (superType)
    -[:HAS_ACTUAL_TYPE_ARGUMENT { index: 0 }]→ ()
    -[:OF_RAW_TYPE]→ (aggregateType)
SET
  aggregateType:Aggregate
RETURN
  repo, aggregateType
```

Reference to tech stack 😕

Establishes the concept

```
MATCH
  (aggregate:Aggregate)
    -[:DECLARES]→ (f:Field)
    -[:OF_TYPE]→ (fieldType:Aggregate)
WHERE
  aggregate <> fieldType
RETURN
  aggregate, fieldType
```

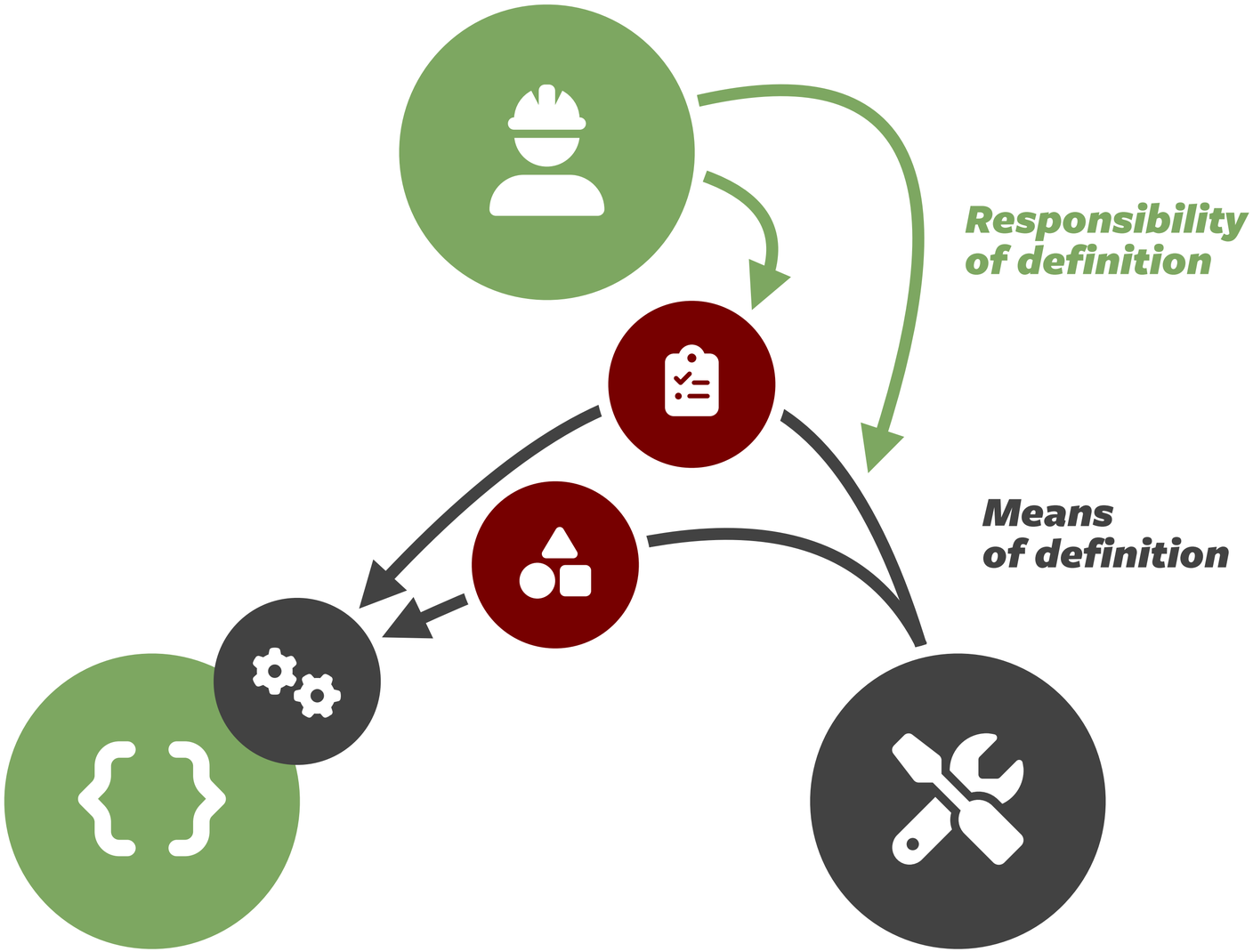
Establishes the rule

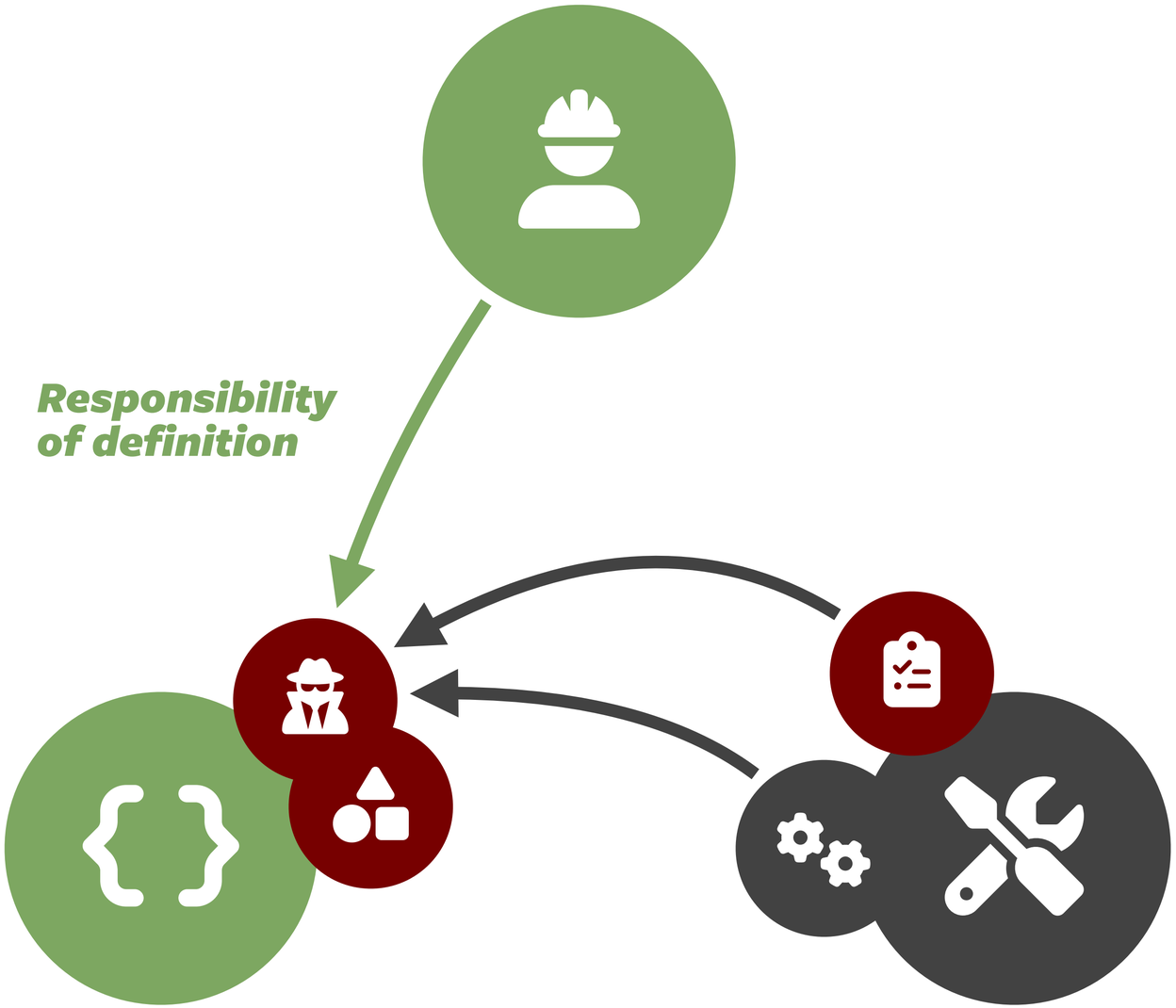
Establishing an Aggregate... in ArchUnit

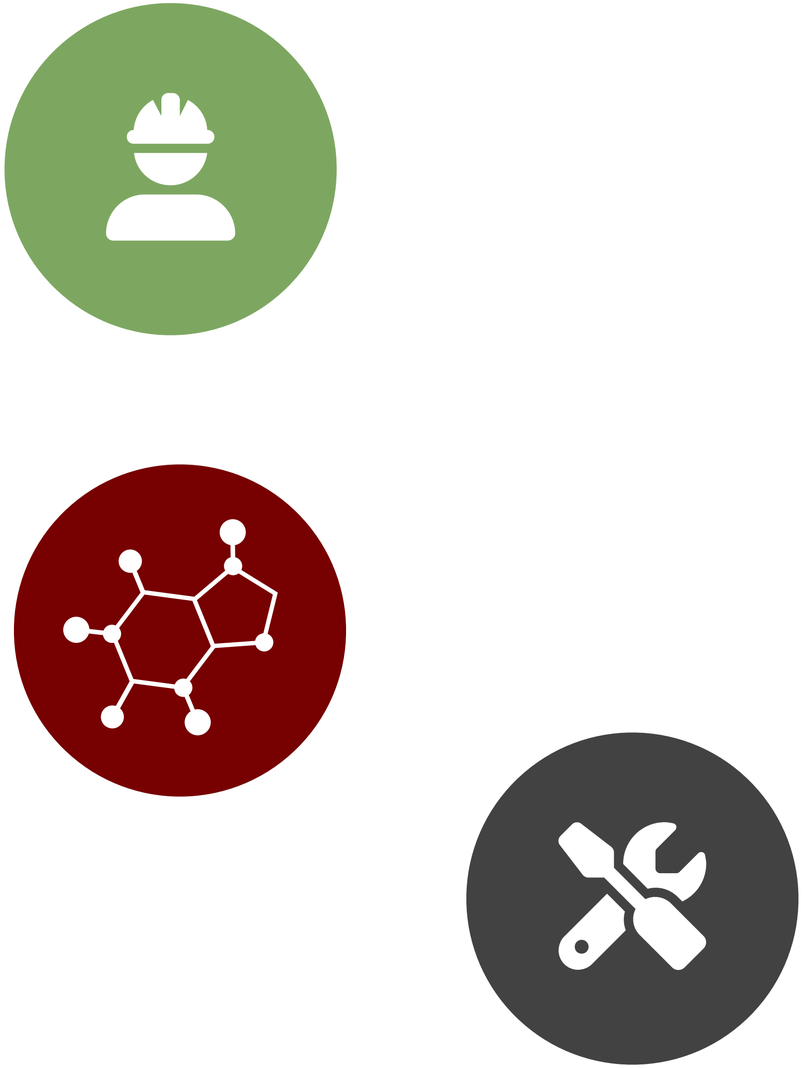
```java
@AnalyzeClasses(packagesOf = Application.class)
public class ArchitectureTest {

  @ArchTest
  void verifyAggregates(JavaClasses types) {

    var aggregates = new AggregatesExtractor();
    var aggregateTypes = aggregates.doTransform(types);

    all(aggregates)
      .should(notReferToOtherAggregates(aggregateTypes))
      .check(types);
  }
}
```

Establishes the concept

Establishes the rule


Responsibility
of definition
Means
of definition


Responsibility
of definition

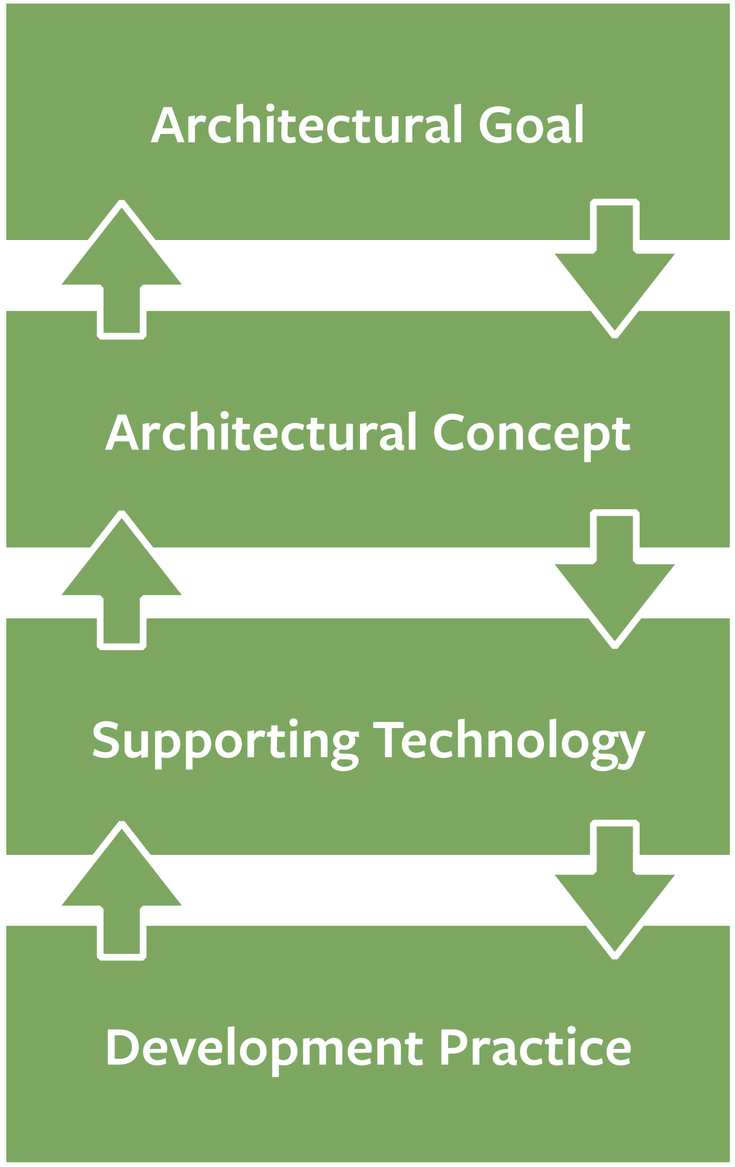


xMolecules

php

.NET

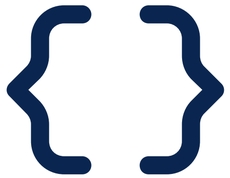
jMolecules



Understandability

DDD Building Blocks

jMolecules



Explicit concepts

```java
@Entity
@NoArgsConstructor(force = true)
@EqualsAndHashCode(of = "id")
@Table(name = "SAMPLE_ORDER")
@Getter
public class Order {

  private final @EmbeddedId OrderId id;

  @OneToMany(cascade = CascadeType.ALL)
  private List<LineItem> lineItems;
  private CustomerId customerId;

  public Order(CustomerId customerId) {
    this.id = OrderId.of(UUID.randomUUID());
    this.customerId = customerId;
  }

  @Value
  @RequiredArgsConstructor(staticName = "of")
  @NoArgsConstructor(force = true)
  public static class OrderId implements Serializable {
    private static final long serialVersionUID = …;
    private final UUID orderId;
  }
}
```

What is the role of this class in the overall arrangement?

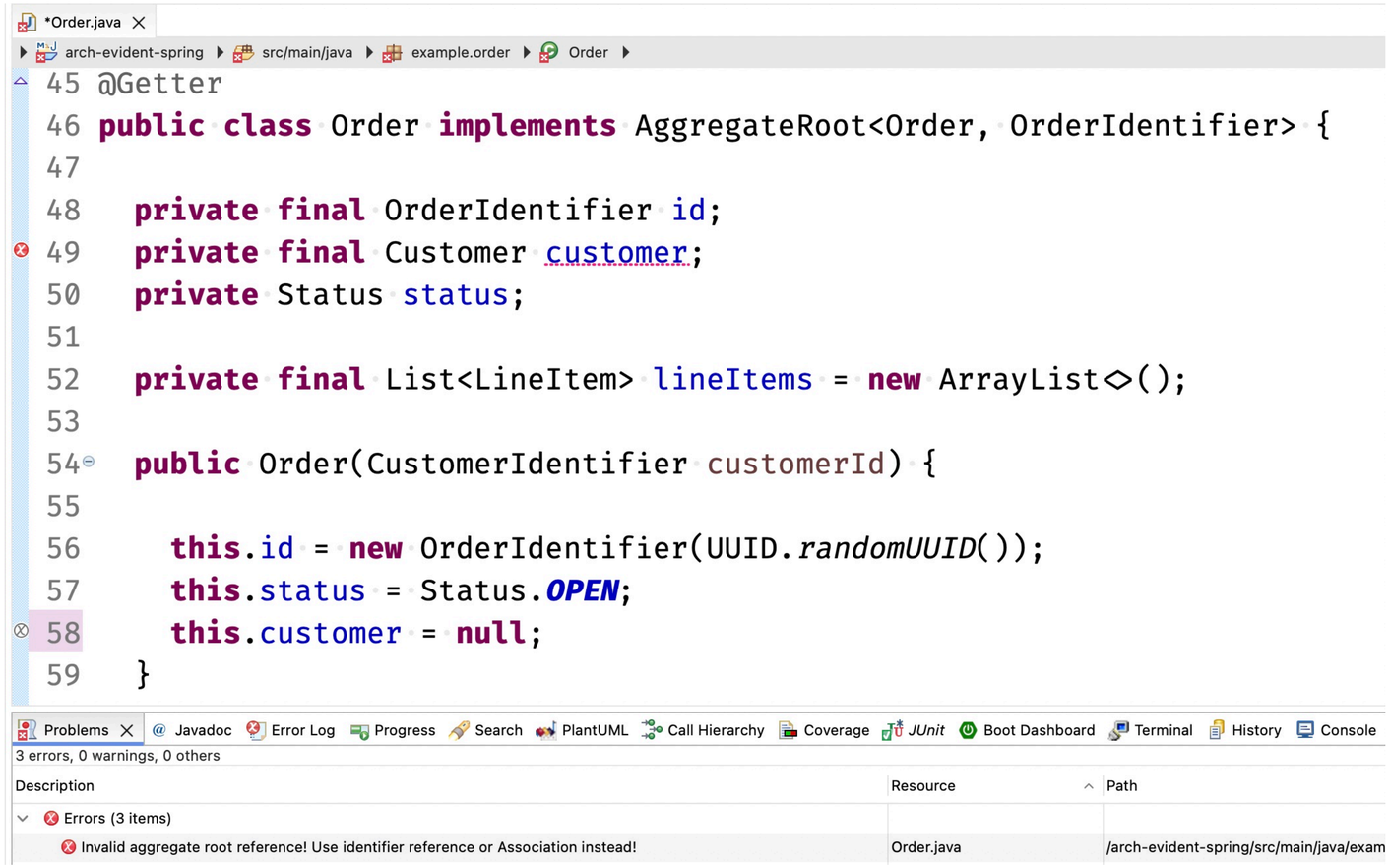
Conceptual Density

$$\frac{1}{N}$$

N = Number of source code elements needed to determine the architectural role of a piece of code

```java
@Entity
@NoArgsConstructor(force = true)
@EqualsAndHashCode(of = "id")
@Table(name = "SAMPLE_ORDER")
@Getter
public class Order implements o.j.d.t.AggregateRoot<Order, OrderId> {

  private final @EmbeddedId OrderId id;

  @OneToMany(cascade = CascadeType.ALL)
  private List<LineItem> lineItems;
  private CustomerId customerId;

  public Order(CustomerId customerId) {
    this.id = OrderId.of(UUID.randomUUID());
    this.customerId = customerId;
  }

  @Value
  @RequiredArgsConstructor(staticName = "of")
  @NoArgsConstructor(force = true)
  public static class OrderId implements o.j.d.t.Identifier {
    private static final long serialVersionUID = …;
    private final UUID orderId;
  }
}
```

Verification



☝️ **Invalid aggregate root reference!**
Use identifier or Association instead!

Eliminate Boilerplate


```java
@Entity
@NoArgsConstructor(force = true)
@EqualsAndHashCode(of = "id")
@Table(name = "SAMPLE_ORDER")
@Getter
public class Order {

  private final @EmbeddedId OrderId id;

  @OneToMany(cascade = CascadeType.ALL)
  private List<LineItem> lineItems;
  private CustomerId customerId;

  public Order(CustomerId customerId) {
    this.id = OrderId.of(UUID.randomUUID());
    this.customerId = customerId;
  }

  @Value
  @RequiredArgsConstructor(staticName = "of")
  @NoArgsConstructor(force = true)
  public static class OrderId implements Serializable {
    private static final long serialVersionUID = …;
    private final UUID orderId;
  }
}
```

```java
@Entity
@NoArgsConstructor(force = true)
@EqualsAndHashCode(of = "id")
@Table(name = "SAMPLE_ORDER")
@Getter
public class Order implements AggregateRoot<Order, OrderId> {

  private final @EmbeddedId OrderId id;

  @OneToMany(cascade = CascadeType.ALL)
  private List<LineItem> lineItems;
  private Association<Customer, CustomerId> customer;

  public Order(CustomerId customerId) {
    this.id = OrderId.of(UUID.randomUUID());
    this.customer = Association.forId(customerId);
  }

  @Value
  @RequiredArgsConstructor(staticName = "of")
  @NoArgsConstructor(force = true)
  public static class OrderId implements Identifier {
    private static final long serialVersionUID = …;
    private final UUID orderId;
  }
}
```

```java
@Entity
@NoArgsConstructor(force = true)
@EqualsAndHashCode(of = "id")
@Table(name = "SAMPLE_ORDER")
@Getter
public class Order implements AggregateRoot<Order, OrderId> {

  private final @EmbeddedId OrderId id;

  @OneToMany(cascade = CascadeType.ALL)
  private List<LineItem> lineItems;
  private Association<Customer, CustomerId> customer;

  public Order(CustomerId customerId) {
    this.id = OrderId.of(UUID.randomUUID());
    this.customer = Association.forId(customerId);
  }

  @Value
  @RequiredArgsConstructor(staticName = "of")
  @NoArgsConstructor(force = true)
  public static class OrderId implements Identifier {
    private static final long serialVersionUID = …;
    private final UUID orderId;
  }
}
```

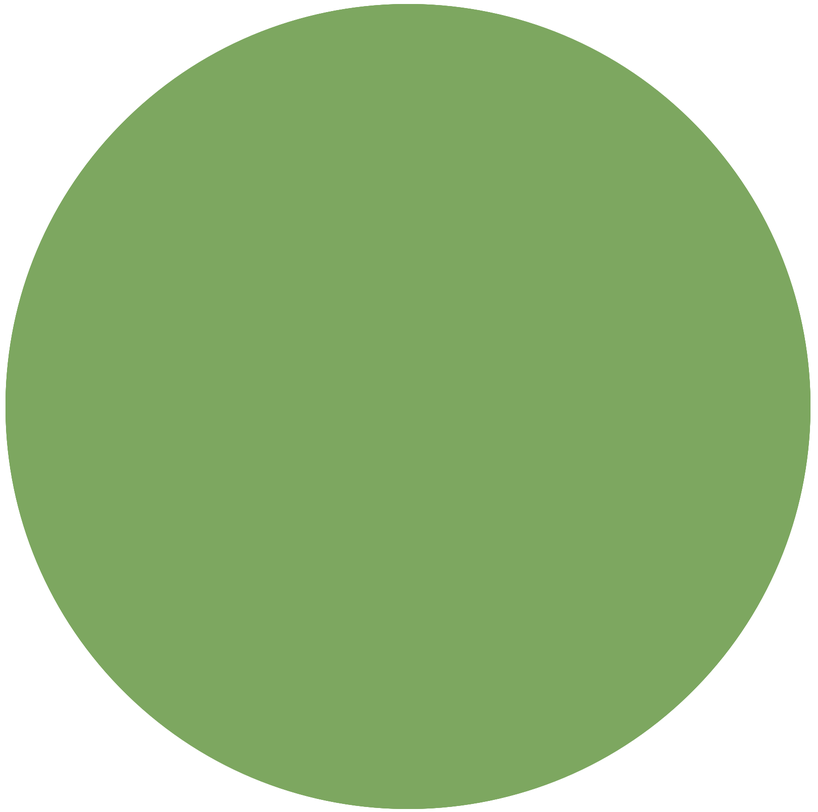
Meanwhile in your IDE…

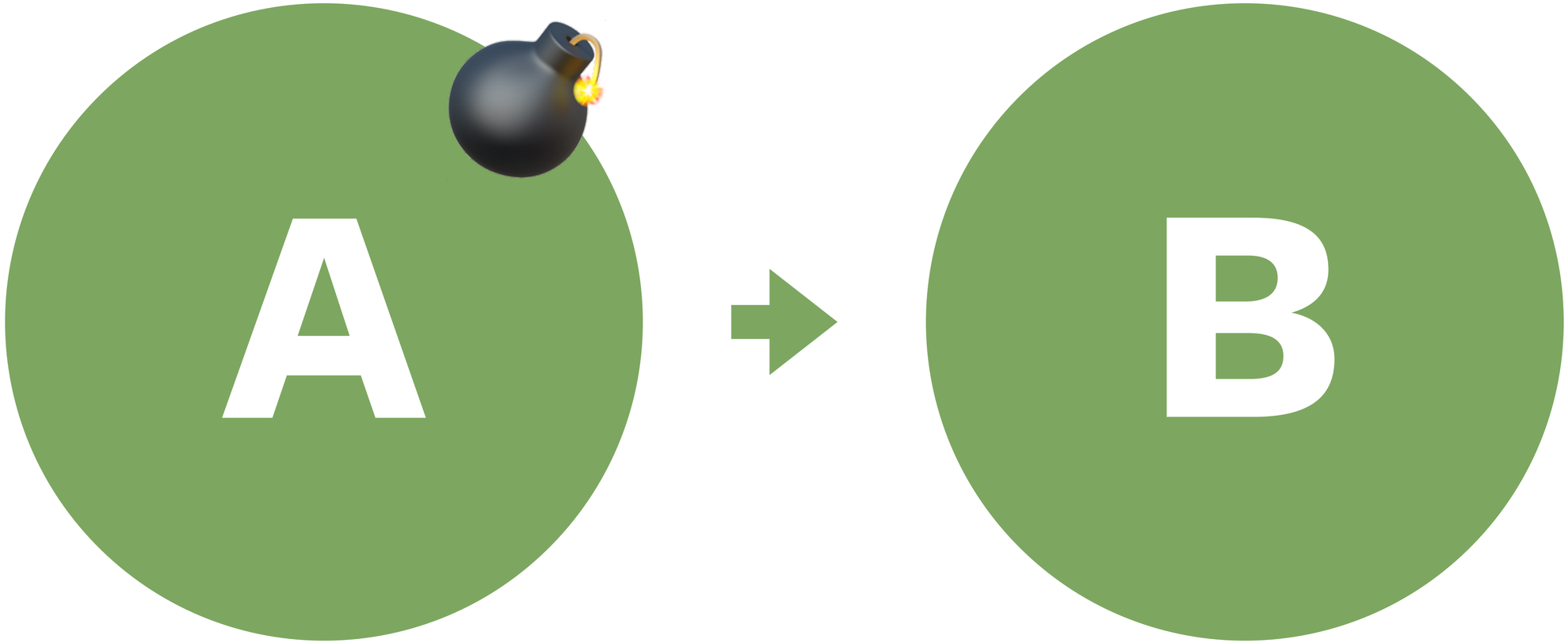
```
[INFO] ◻— example.order.Order
[INFO] ├— JPA - Adding @j.p.Entity.
[INFO] ├— JPA - Adding default constructor.
[INFO] ├— JPA - Adding nullability verification using new callback methods.
[INFO] ├— JPA - Defaulting id mapping to @j.p.EmbeddedId().
[INFO] ├— JPA - Defaulting lineItems mapping to @j.p.JoinColumn(…).
[INFO] ├— JPA - Defaulting lineItems mapping to @j.p.OneToMany(…).
[INFO] ├— Spring Data JPA - Implementing o.s.d.d.Persistable<e.o.Order$OrderIdentifier>.
[INFO] └— Spring JPA - customer - Adding @j.p.Convert(converter=…).
```

```java
@Entity
@NoArgsConstructor(force = true)
@EqualsAndHashCode(of = "id")
@Table(name = "SAMPLE_ORDER")
@Getter
public class Order {

  private final @EmbeddedId OrderId id;

  @OneToMany(cascade = CascadeType.ALL)
  private List<LineItem> lineItems;
  private CustomerId customerId;

  public Order(Customer customer) {
    this.id = OrderId.of(UUID.randomUUID());
    this.customerId = customer.getId();
  }

  @Value
  @RequiredArgsConstructor(staticName = "of")
  @NoArgsConstructor(force = true)
  public static class OrderId implements Serializable {
    private static final long serialVersionUID = …;
    private final UUID orderId;
  }
}
```

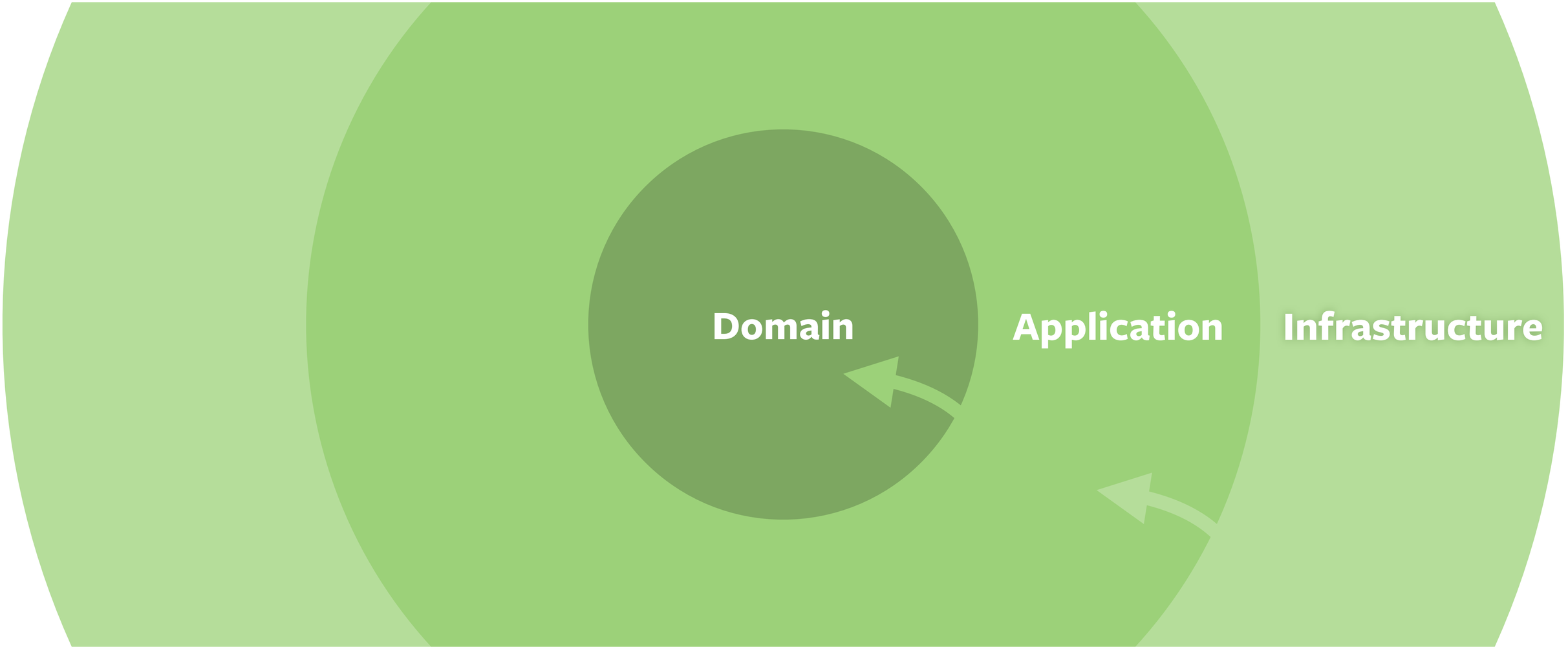
```java
@Table(name = "SAMPLE_ORDER")
@Getter
public class Order implements AggregateRoot<Order, OrderId> {

  private final OrderId id;
  private List<LineItem> lineItems;
  private Association<Customer, CustomerId> customer;

  public Order(CustomerId customerId) {
    this.id = OrderId.of(UUID.randomUUID());
    this.customer = Association.forId(customerId);
  }

  record OrderId(UUID orderId) implements Identifier {}
}
```

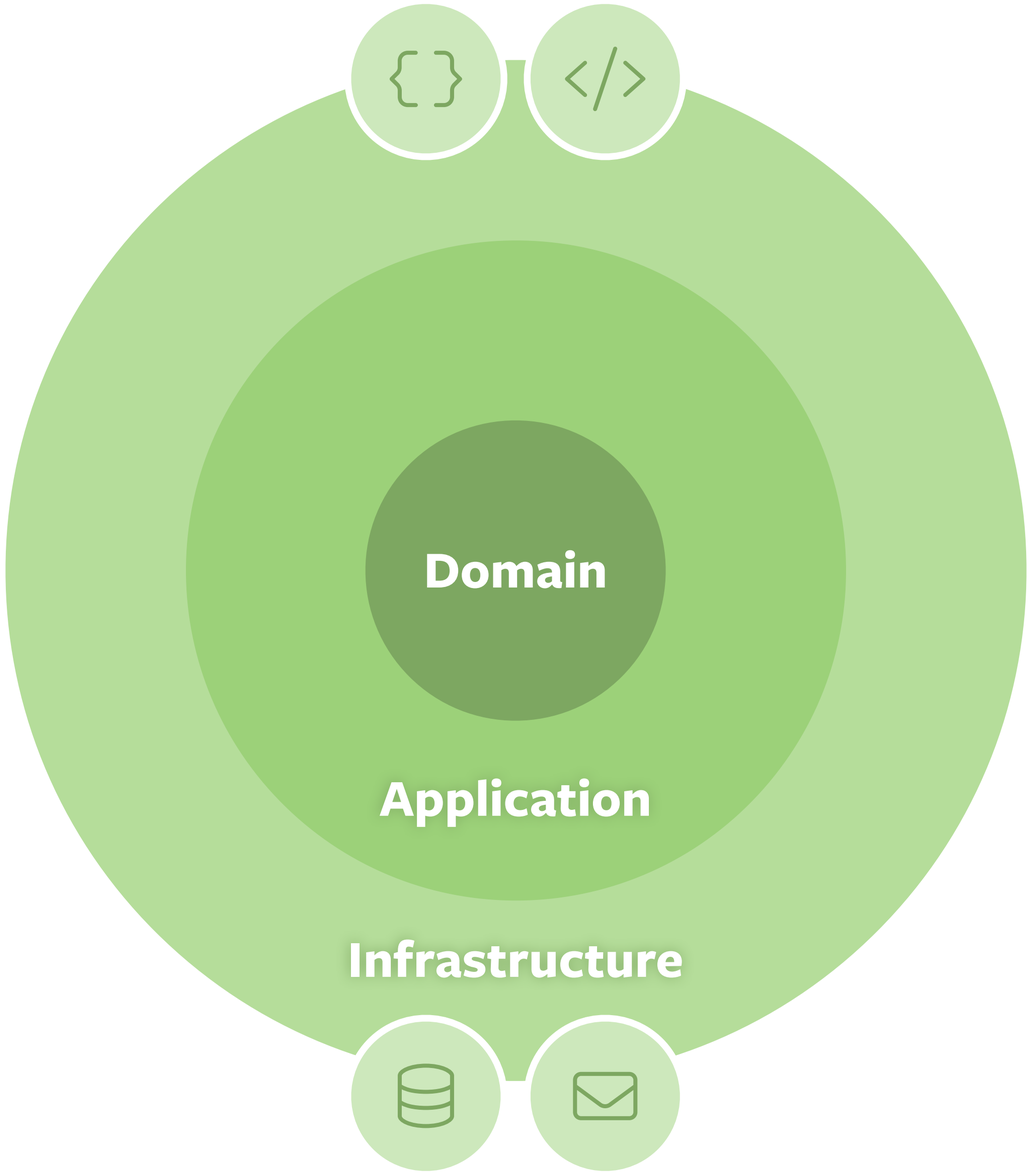
Decomposition

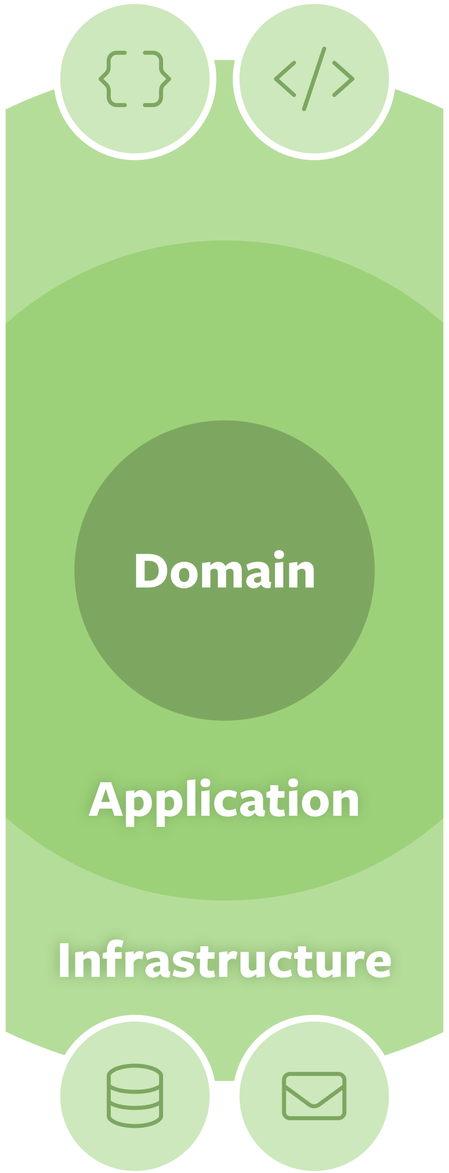




Risk of Change
Scope of Change?


Domain
Application
Infrastructure


Domain
Application
Infrastructure


Domain
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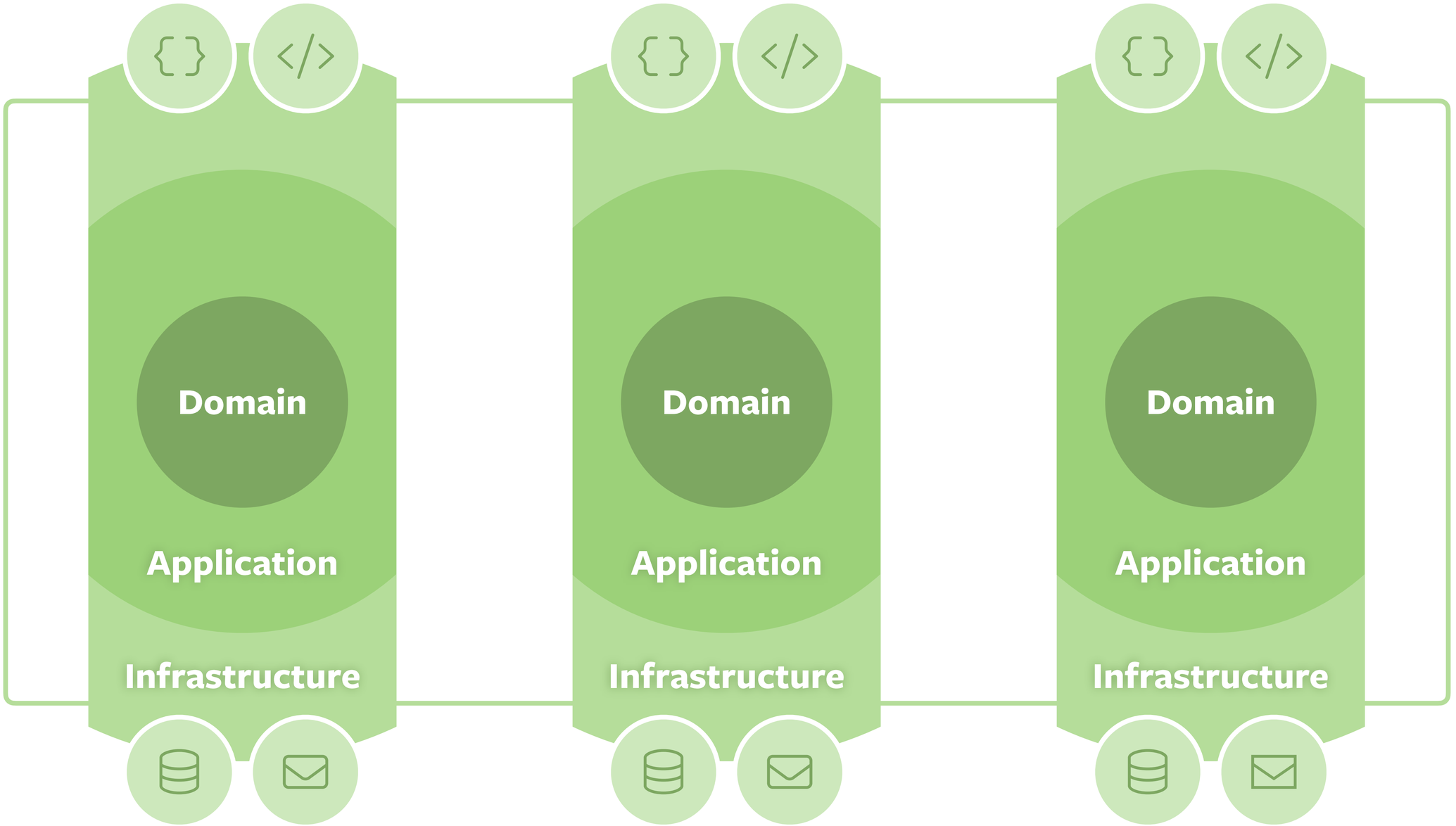
Infrastructure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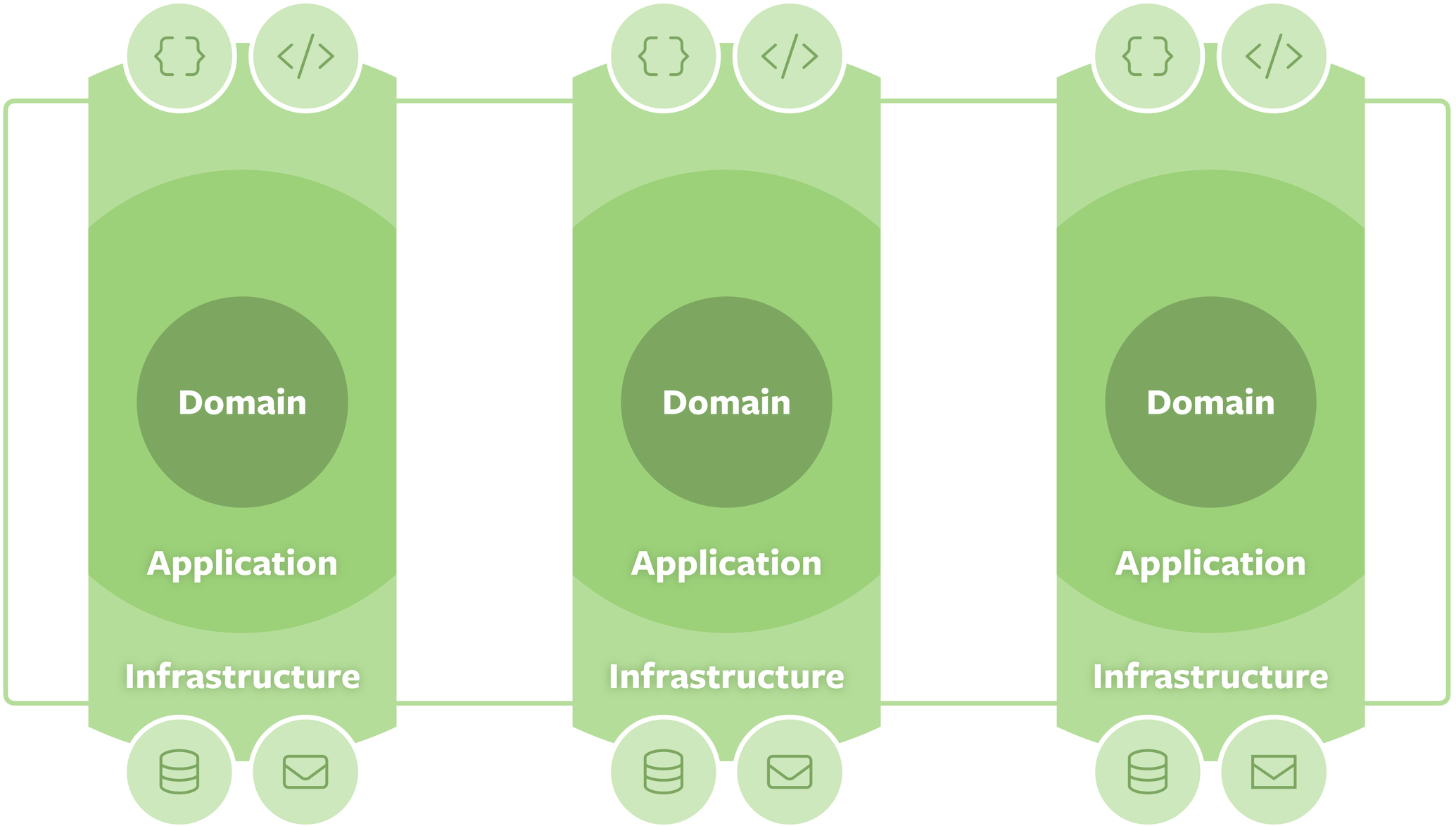
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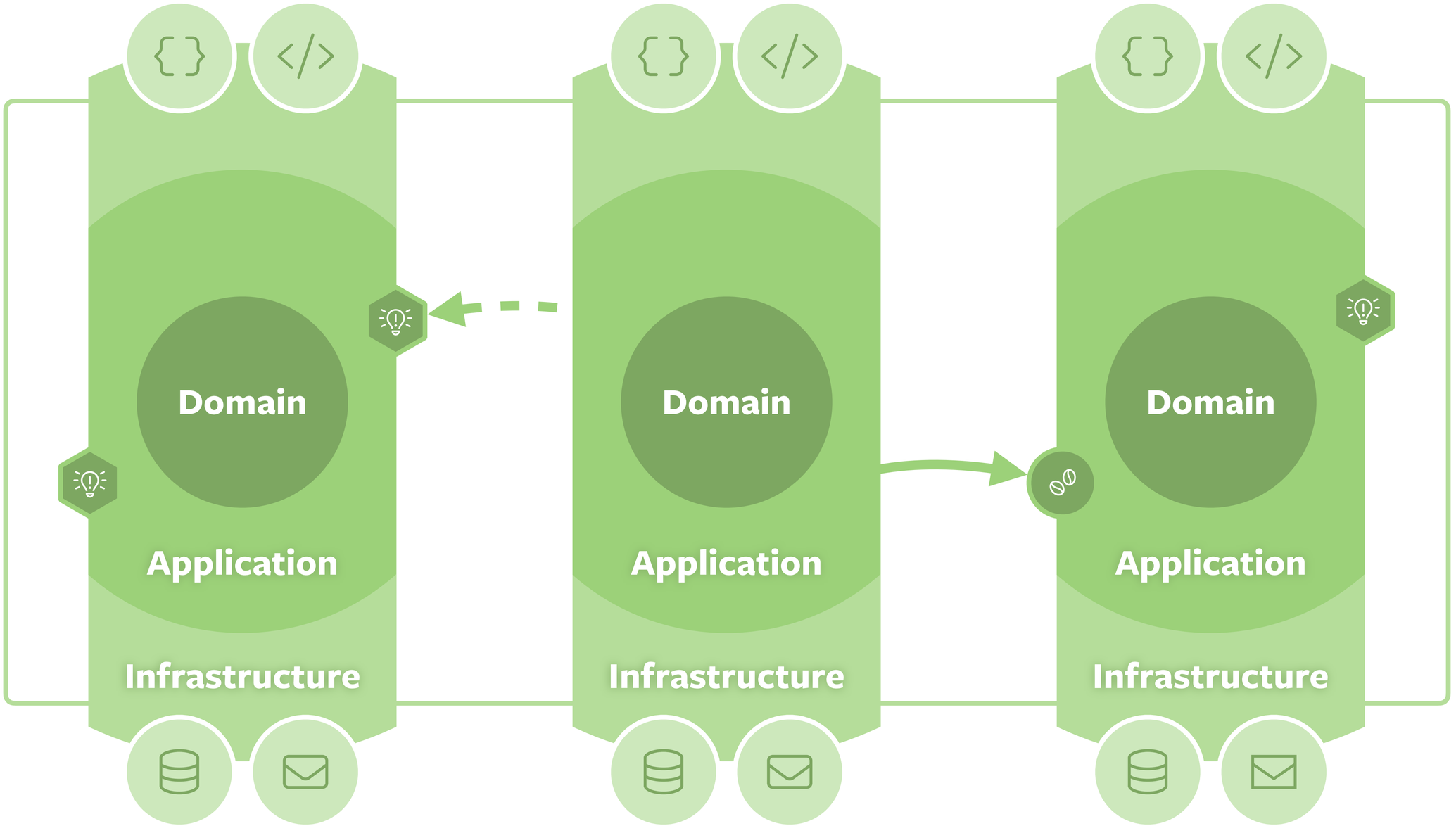
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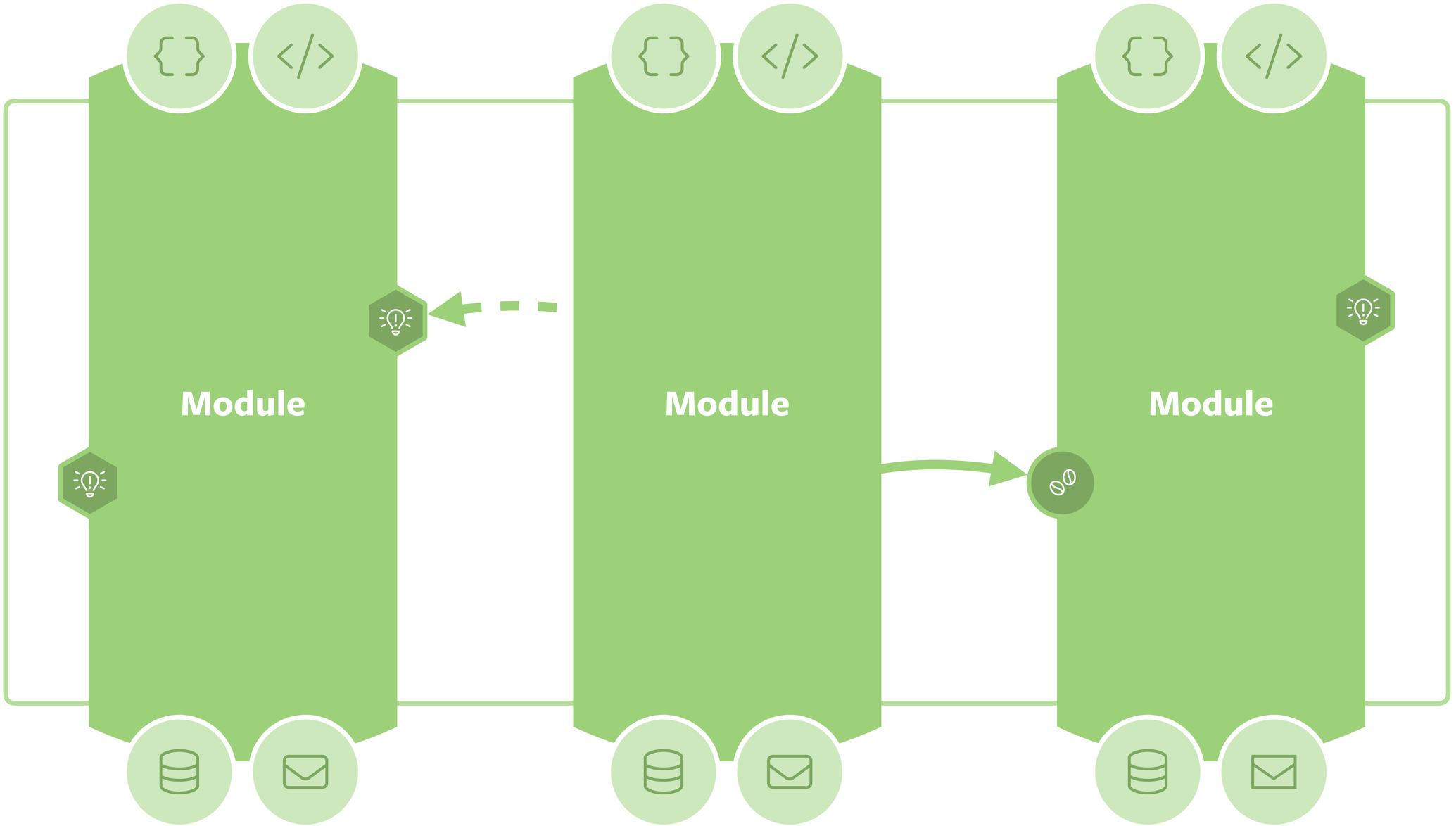
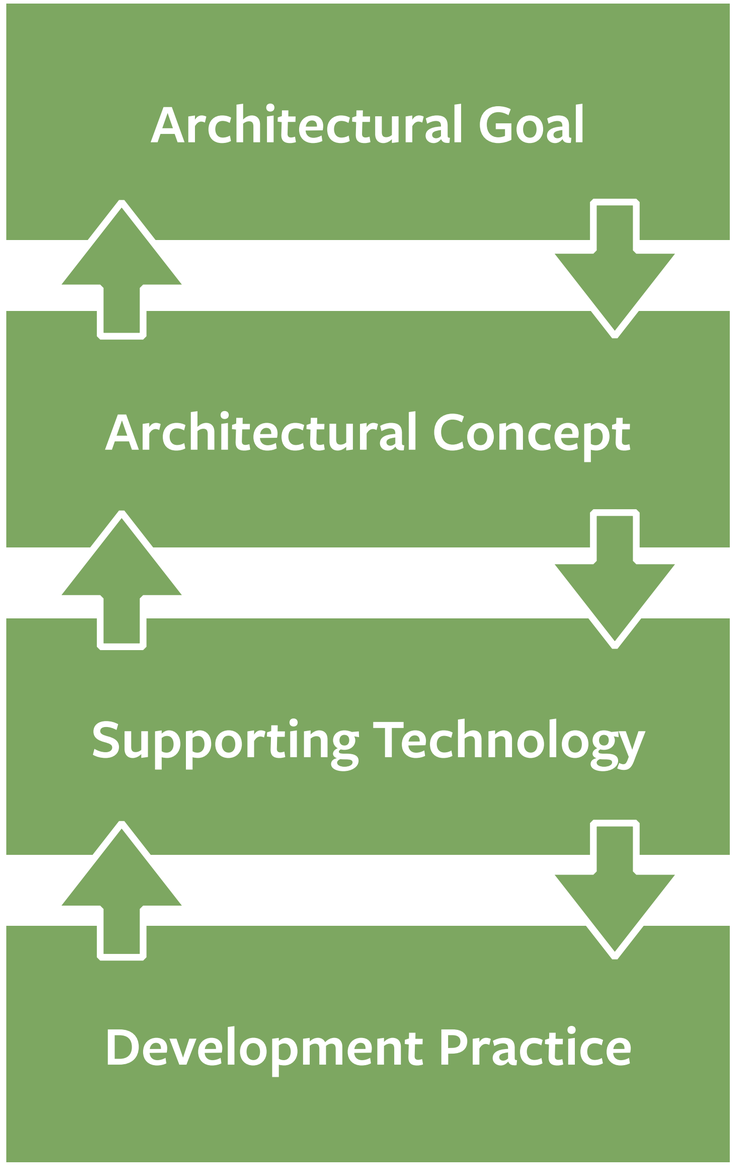

Module
Module
Module



Evolvability

Modules

Spring Modulith

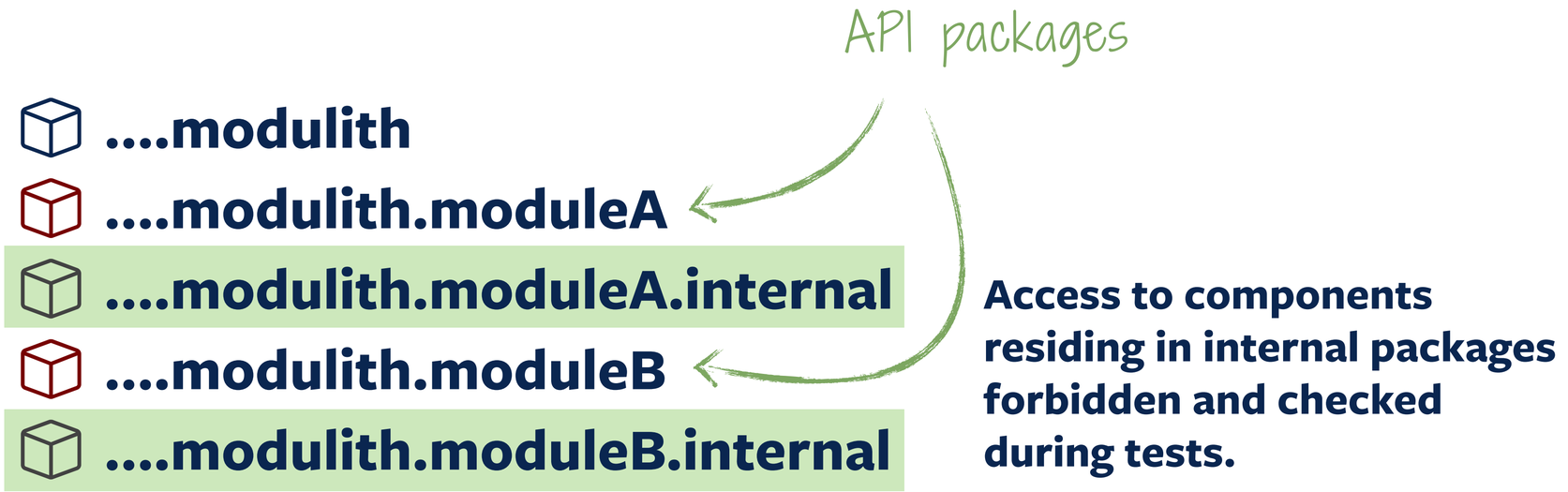
Spring Modulith

```
package com.acme.modulith

@SpringBootApplication
class MyApplication { … }
```

Standard Spring Boot Application

Package Conventions



Verification

```
package com.acme.modulith

@SpringBootApplication
class MyApplication { … }
```

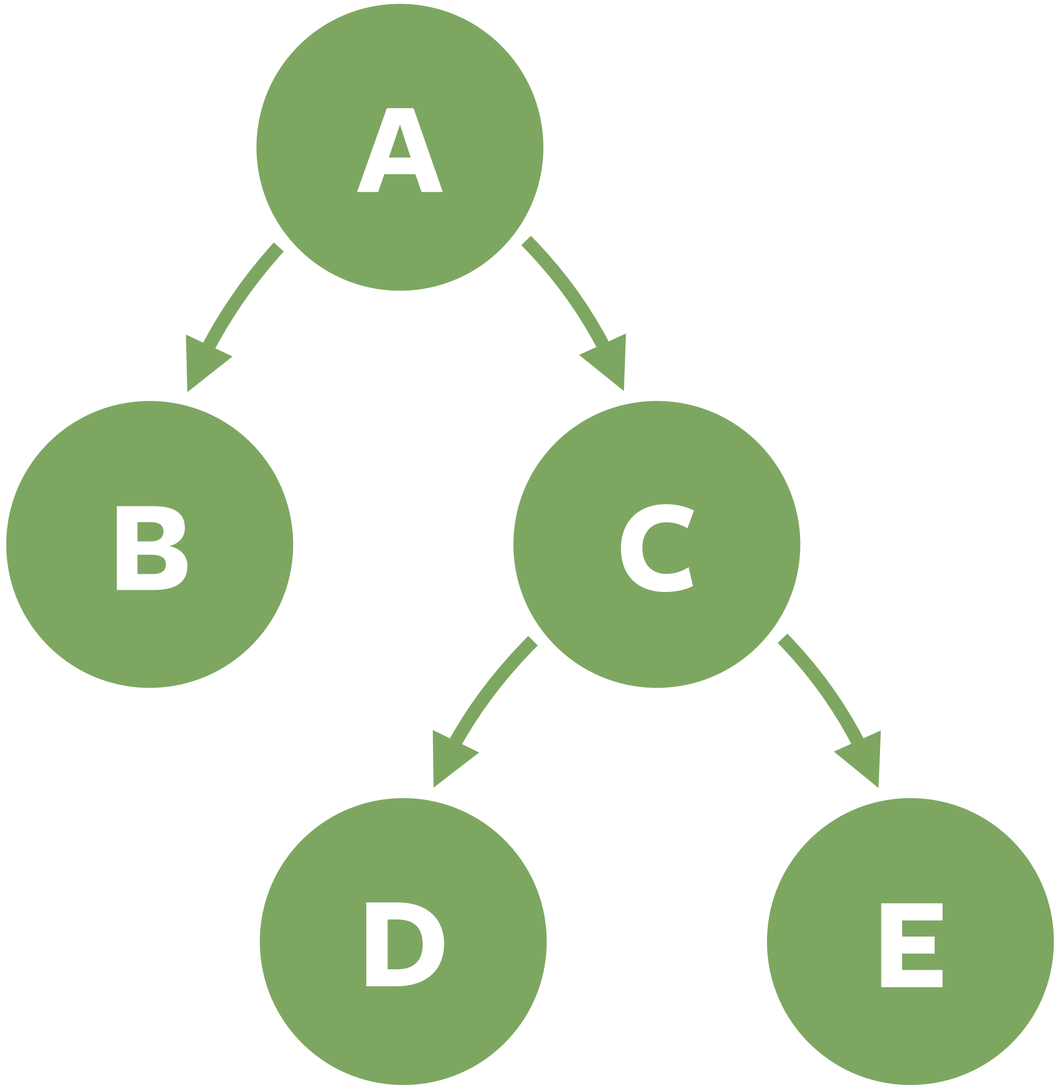
Standard Spring Boot Application

```
var modules =
  ApplicationModules.of(MyApplication.class);
modules.verify(…);
```

Verifies rules for MyApplication

	Module A	Module B	Module C
Web			
Business logic			
Data access			

	Module A	Module B	Module C
Web			
Business logic			
Data access			

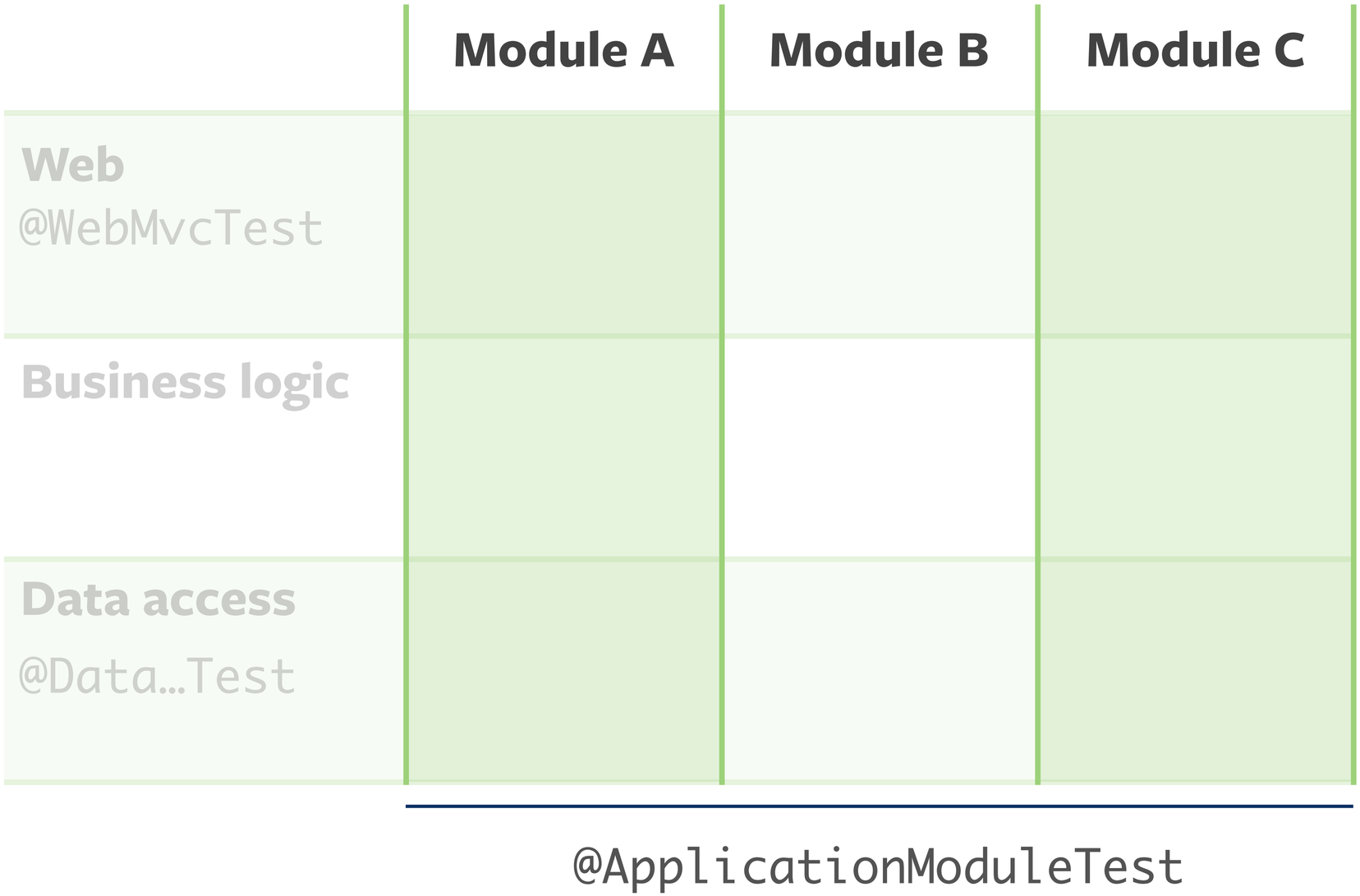


Unit of...

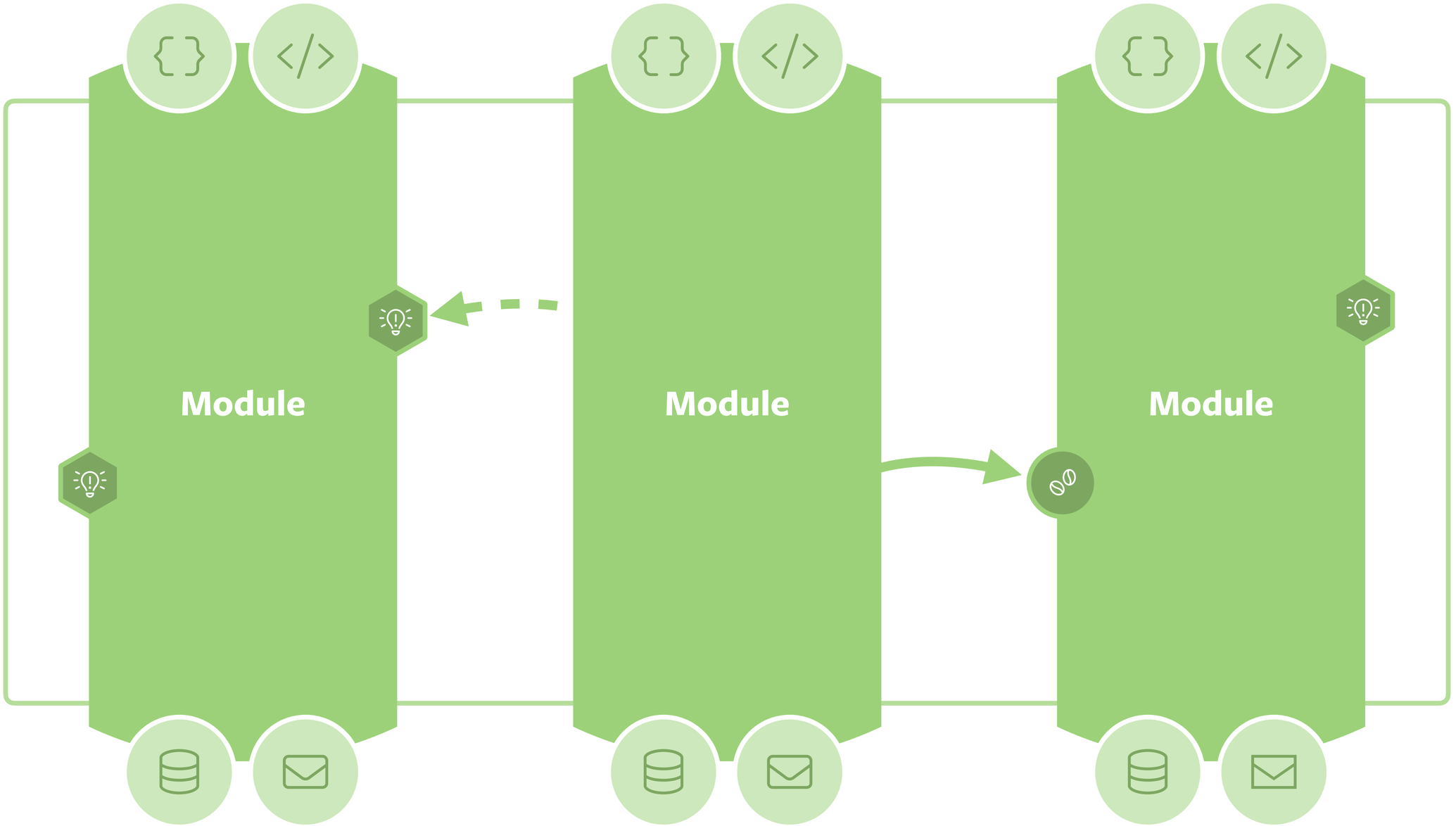
- Understanding
- Consistency
- Testing
- Documentation
- Observation

Testing

	Module A	Module B	Module C
Web `@WebMvcTest`			
Business logic			
Data access `@Data…Test`			

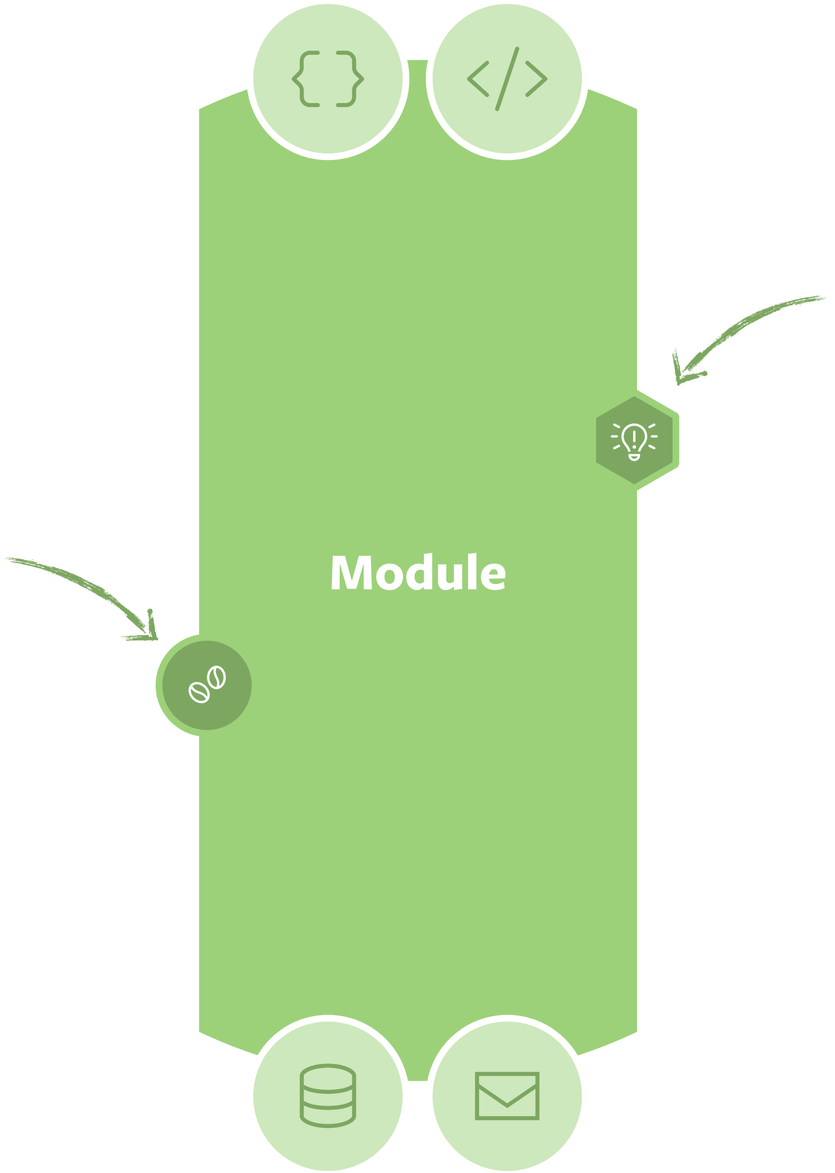

Module A
Module B
Module C
Web
@WebMvcTest
Business logic
Data access
@Data…Test
@ApplicationModuleTest

Subcutaneous Tests


Module
Module
Module

Stimulate the module by...

...invoking a business operation
...publishing an event listened to



```java
@ApplicationModuleTest
@RequiredArgsConstructor
class OrderIntegrationTests {

  private final OrderManagement orders;

  @Test
  void completionCausesEventPublished(Scenario scenario) {

    var order = new Order(new CustomerIdentifier(UUID.randomUUID()));

    scenario.stimulate(() -> orders.complete(order))

        .andWaitForEventOfType(OrderCompleted.class)
        .matchingMappedValue(OrderCompleted::id, order.getId())
        .toArrive();
  }
}
```

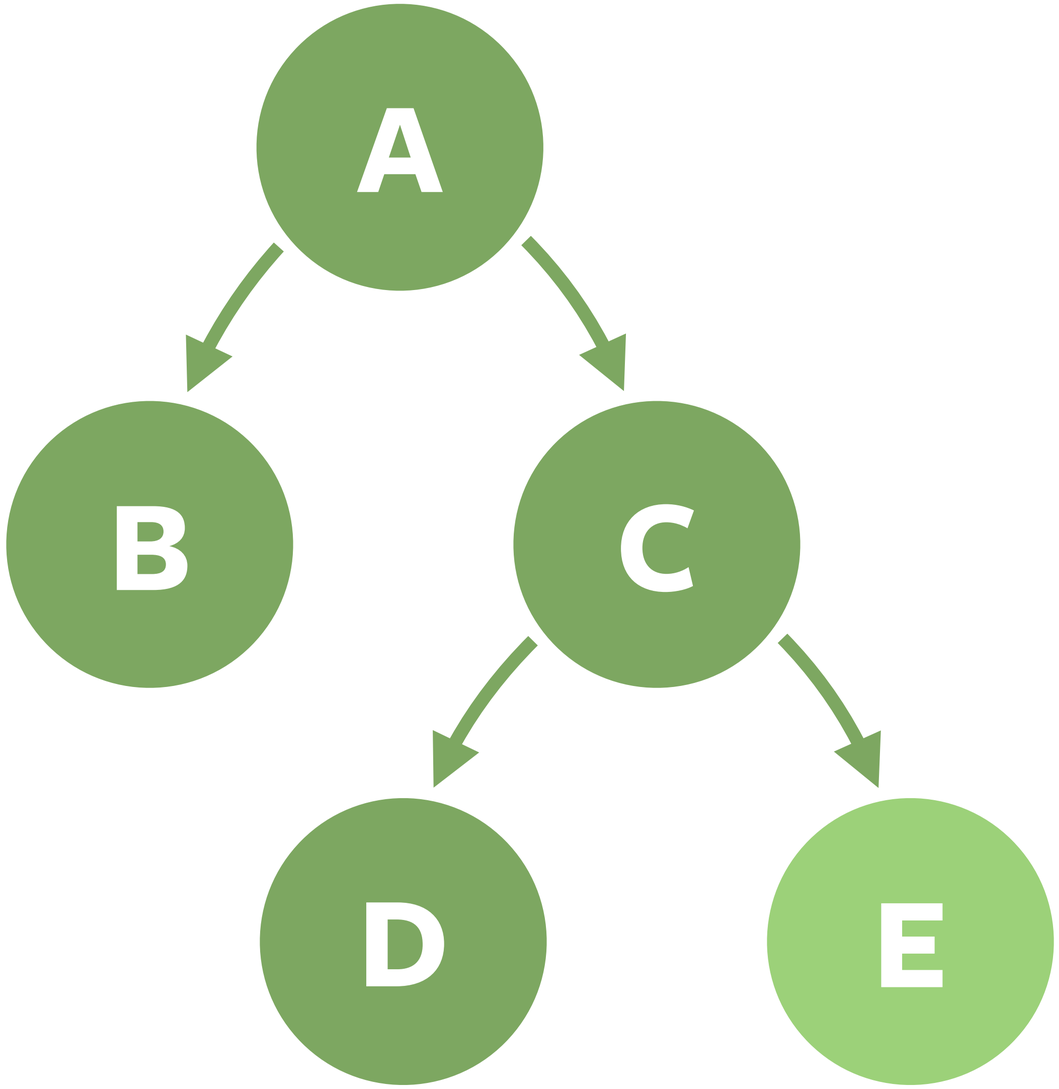
Test scoped to the module

Public API primary interaction target

Given
When
Then

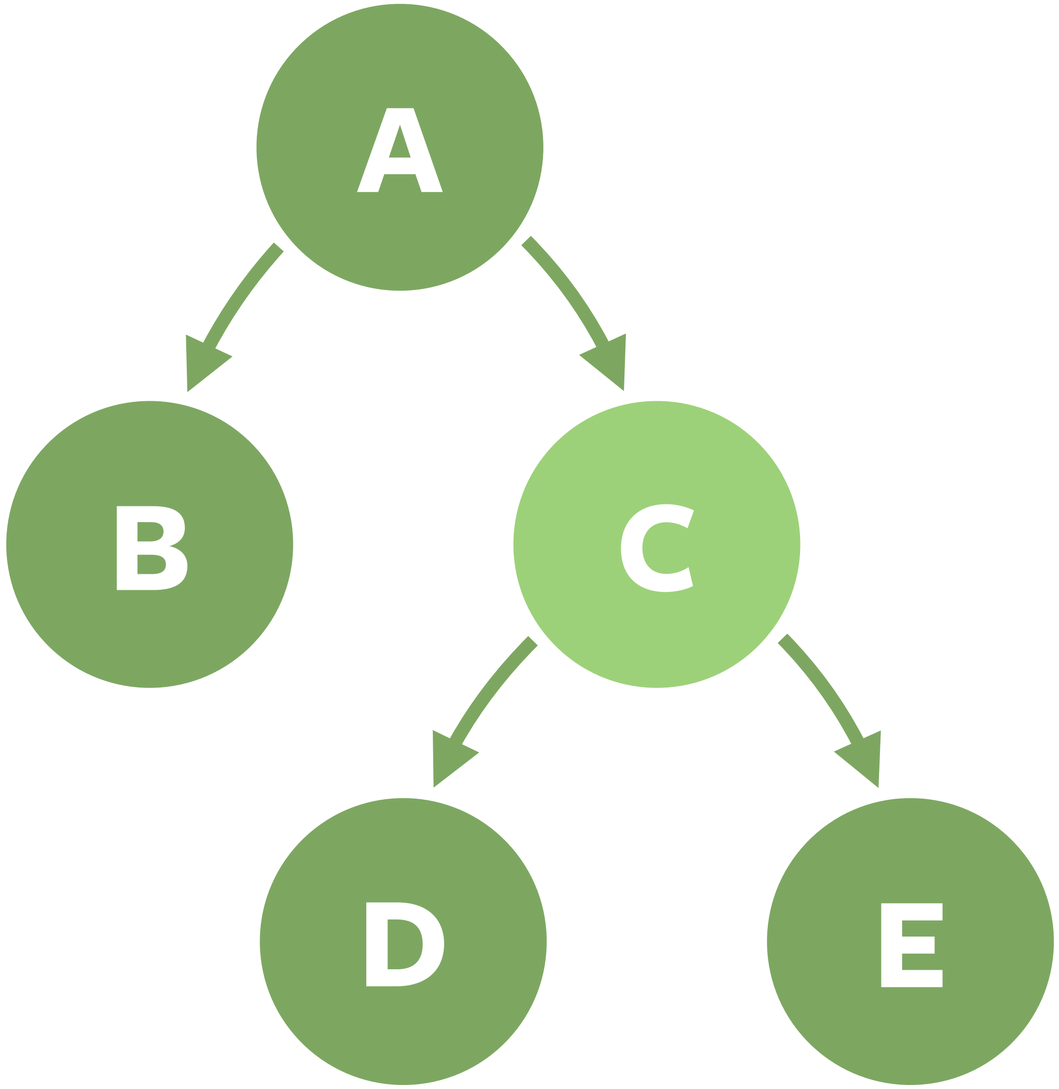
Stimulate module

Scope of Individual Tests



Unit of...

- Understanding
- Consistency
- Testing
- Documentation
- Observation



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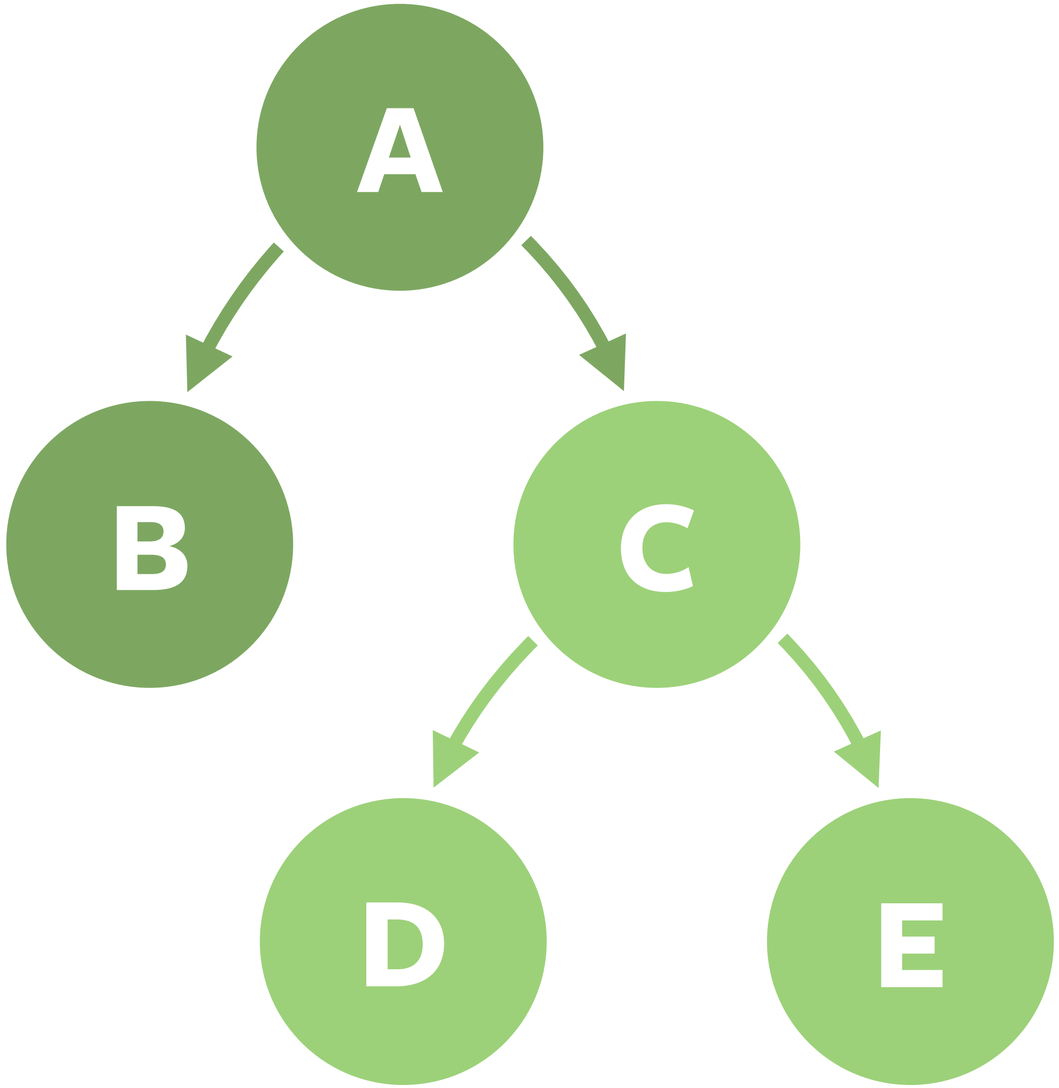

Unit of...

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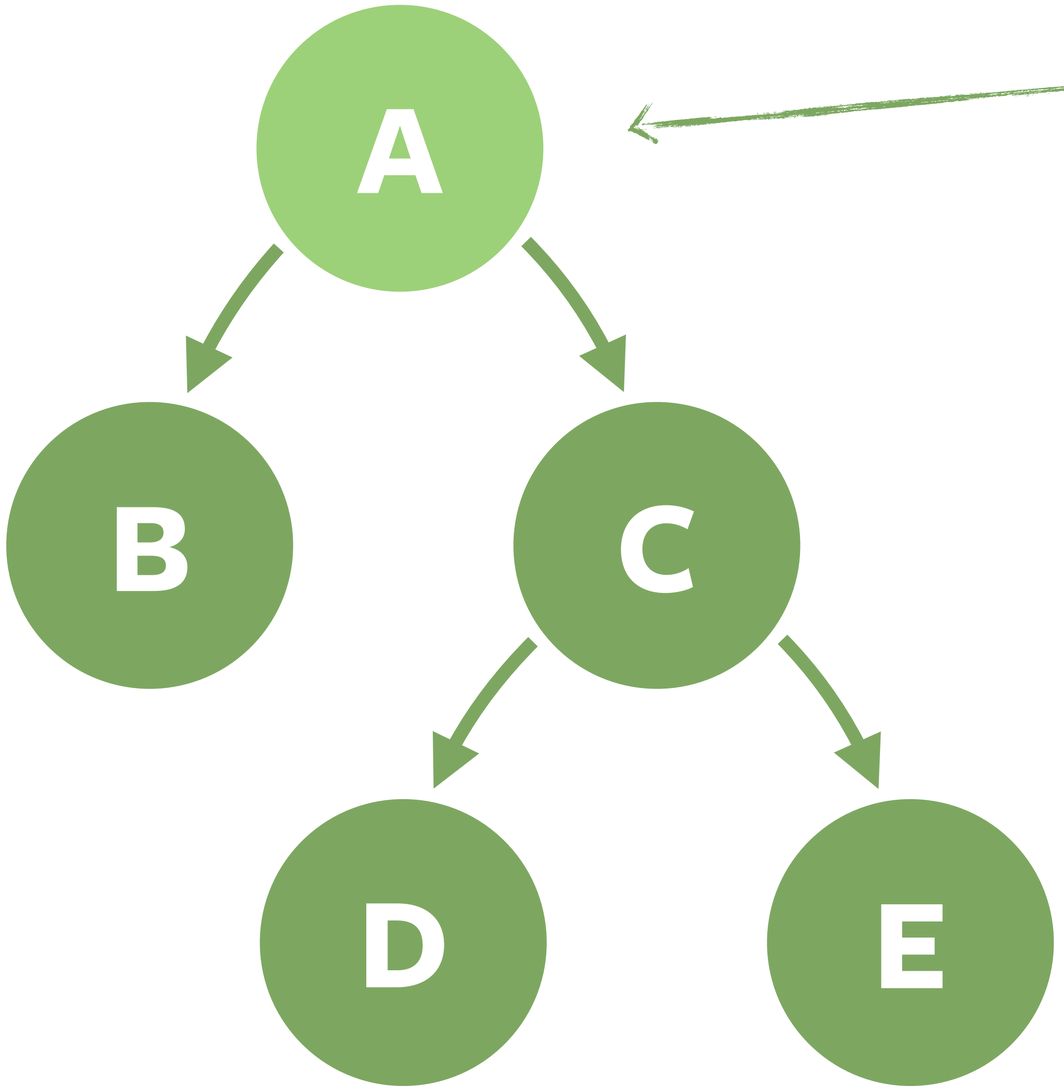
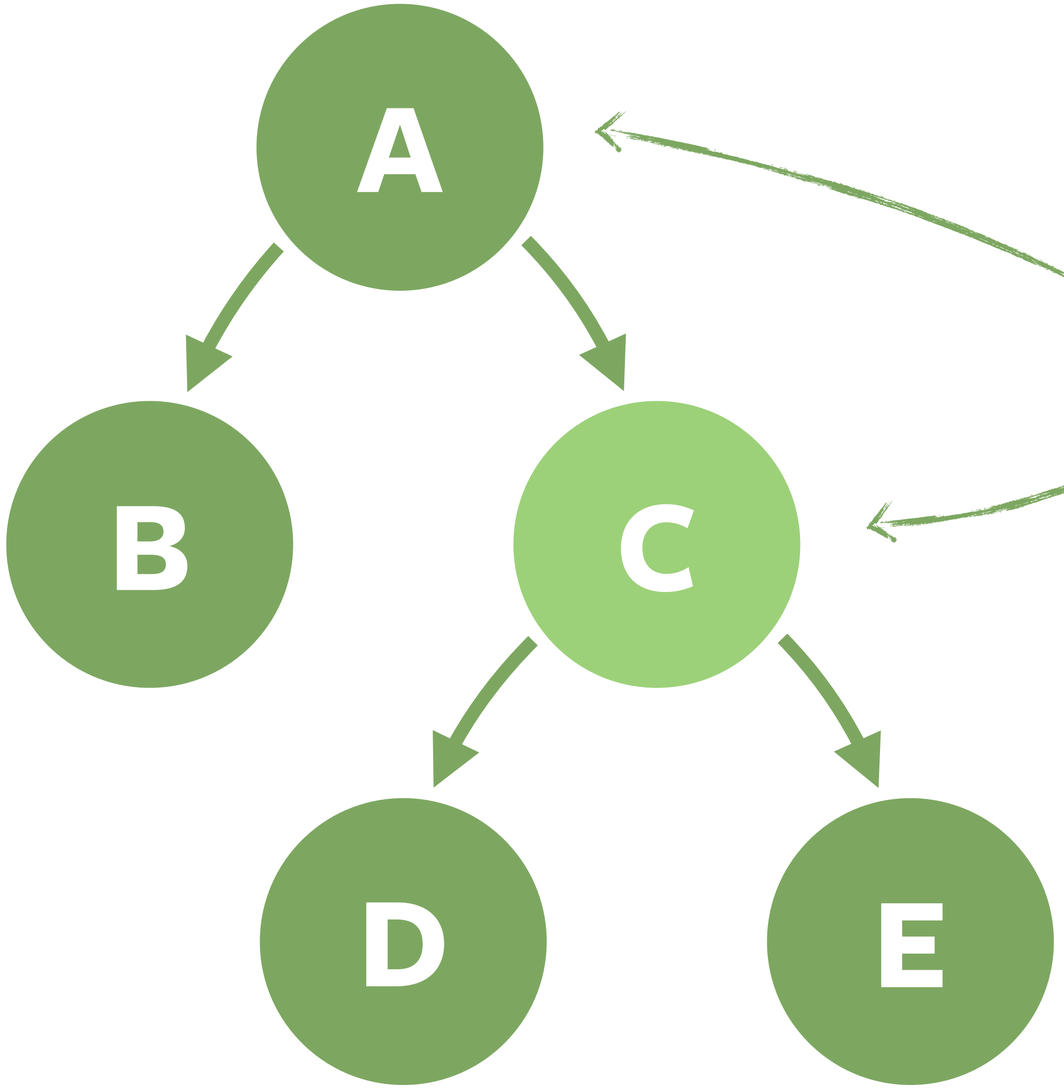
Scope of Test Execution



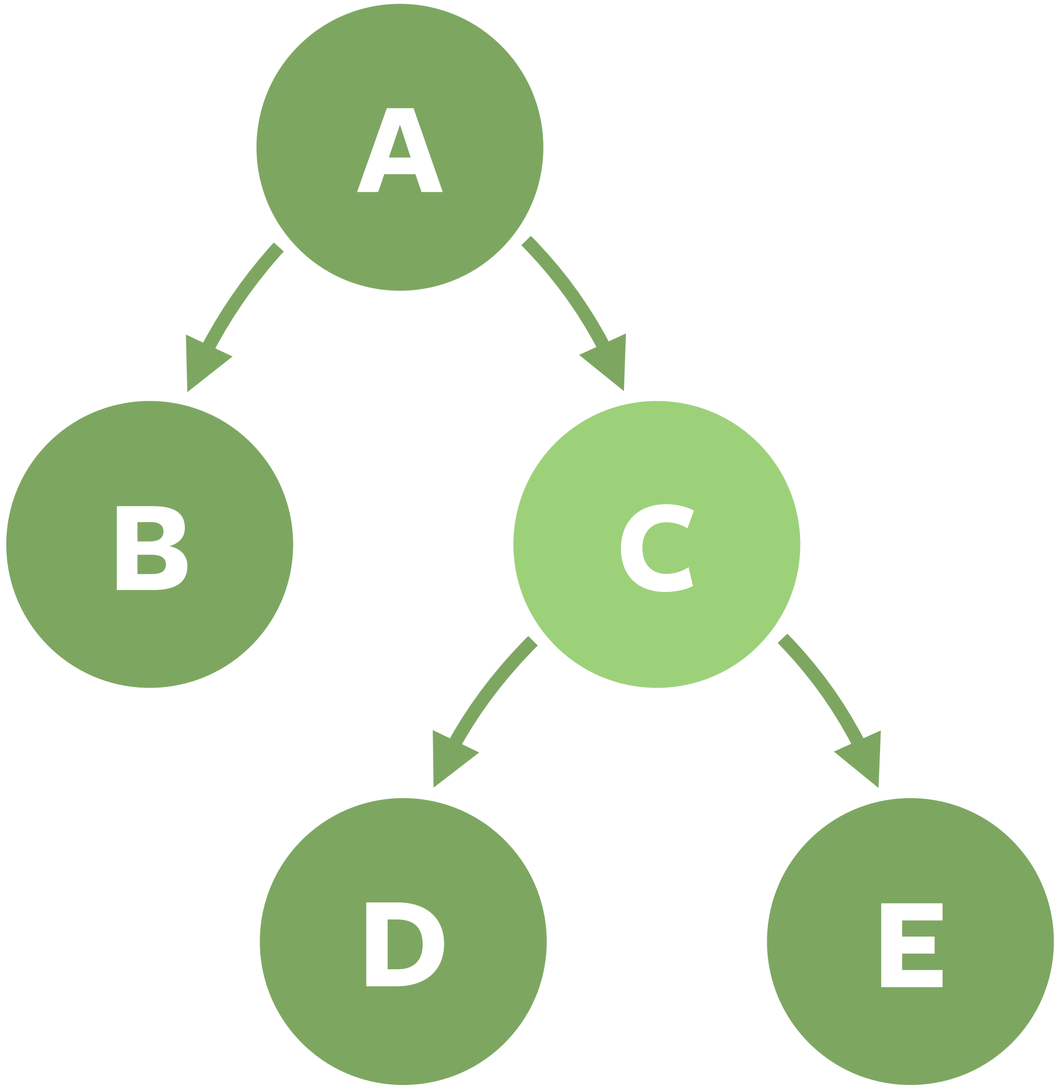
Change detected here.
We only need to test A!



Change detected in C.
We need to test C and A!

```
[INFO] -------------------------------------------------------
[INFO]  T E S T S
[INFO] -------------------------------------------------------
15:29:09.748 I ----- main : Using default file modification detector (uncommitted and unpushed changes).
15:29:10.054 I ----- main : ☕ example.inventory.Inventory
15:29:10.866 I ----- main : ⏸️  Test residing in module order not affected by changes!
[INFO] Running example.order.OrderIntegrationTests
[WARNING] Tests run: 4, Failures: 0, Errors: 0, Skipped: 4, Time elapsed: 0.002 s -- in example.order.OrderIntegrationTests
15:29:10.871 I ----- main : ⏸️  Test residing in module order not affected by changes!
[INFO] Running example.order.EventPublicationRegistryTests
[WARNING] Tests run: 1, Failures: 0, Errors: 0, Skipped: 1, Time elapsed: 0 s -- in example.order.EventPublicationRegistryTests
15:29:10.873 I ----- main : ▶️  Always executing tests in root modules.
[INFO] Running example.ApplicationTests
…
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 2.344 s -- in example.ApplicationTests
15:29:13.235 I ----- main : ▶️  Changes detected in module inventory, executing test.
[INFO] Running example.inventory.InventoryIntegrationTests
…
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.267 s -- in example.inventory.InventoryIntegrationTests
15:29:13.504 I ----- main : ▶️  Always executing tests in root modules.
[INFO] Running example.ModularityTests
[INFO] Tests run: 2, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.084 s -- in example.ModularityTests
…
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  5.458 s
[INFO] Finished at: 2024-09-08T15:29:13+02:00
[INFO] ------------------------------------------------------------------------
```

Documentation



Unit of...

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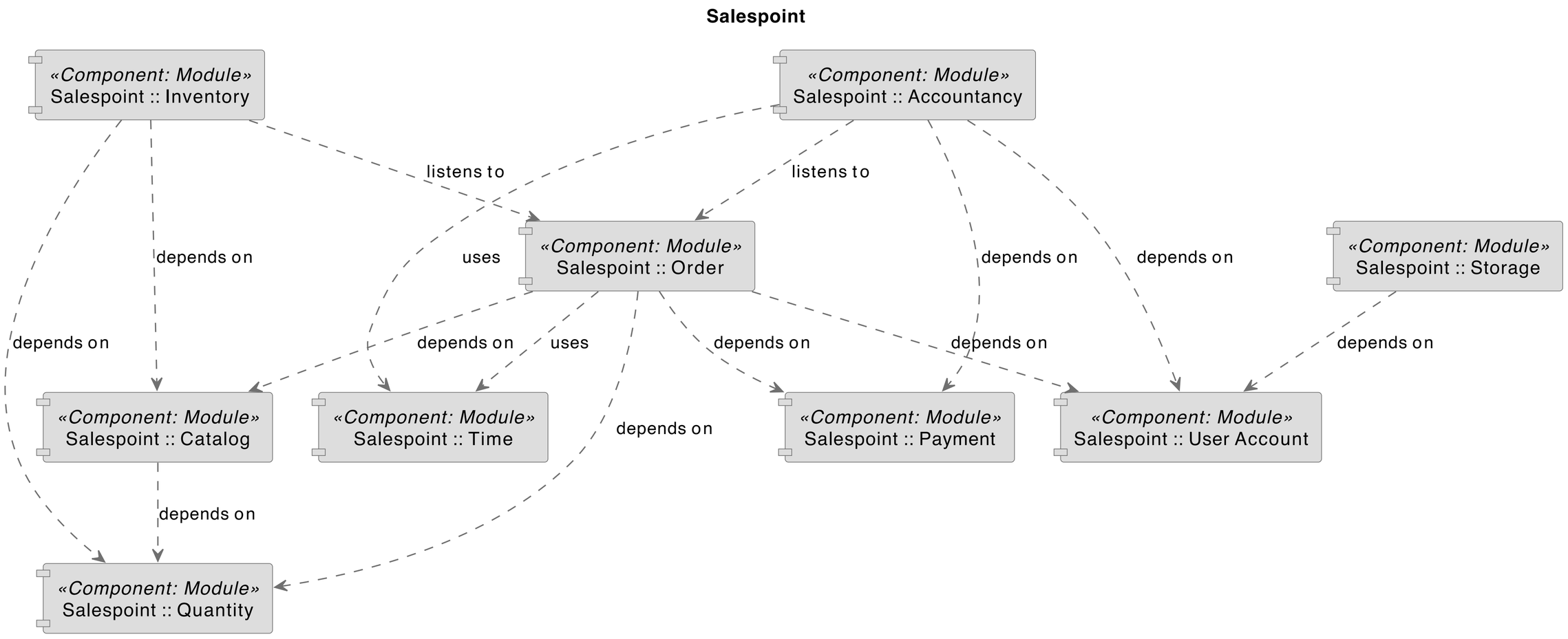
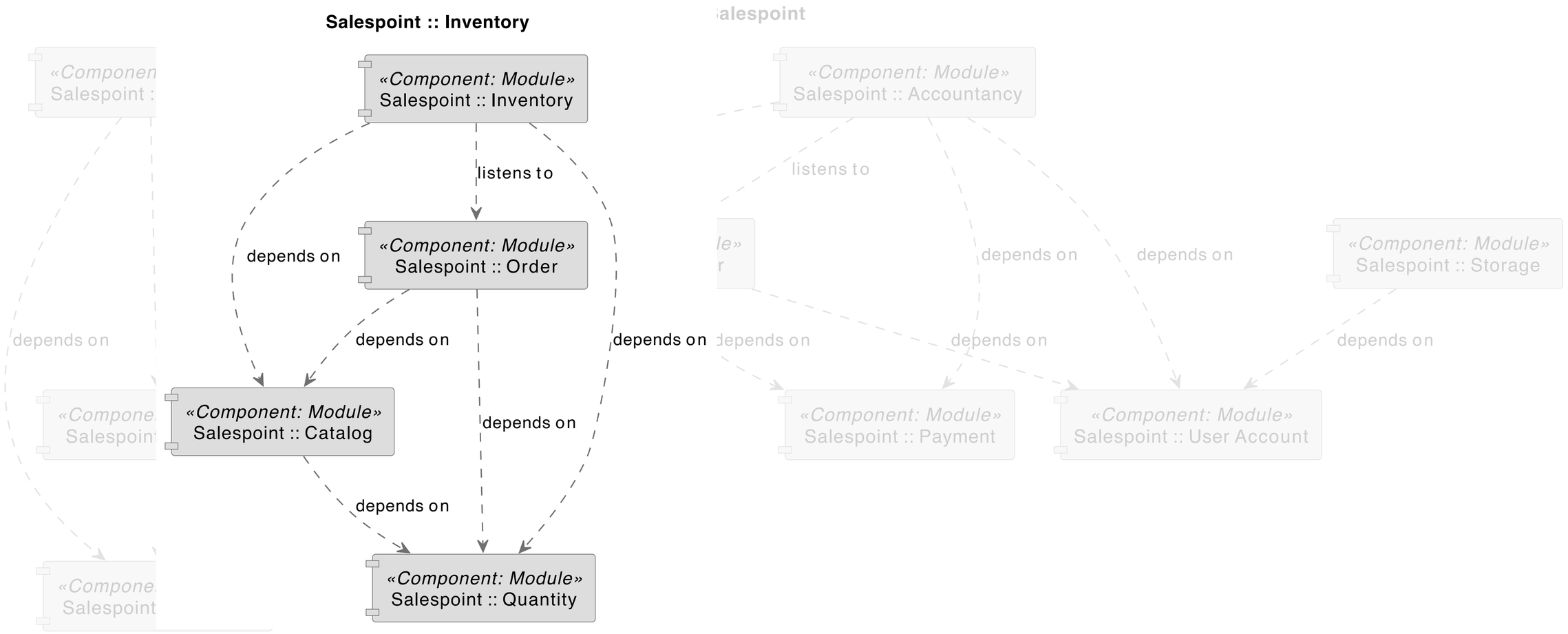
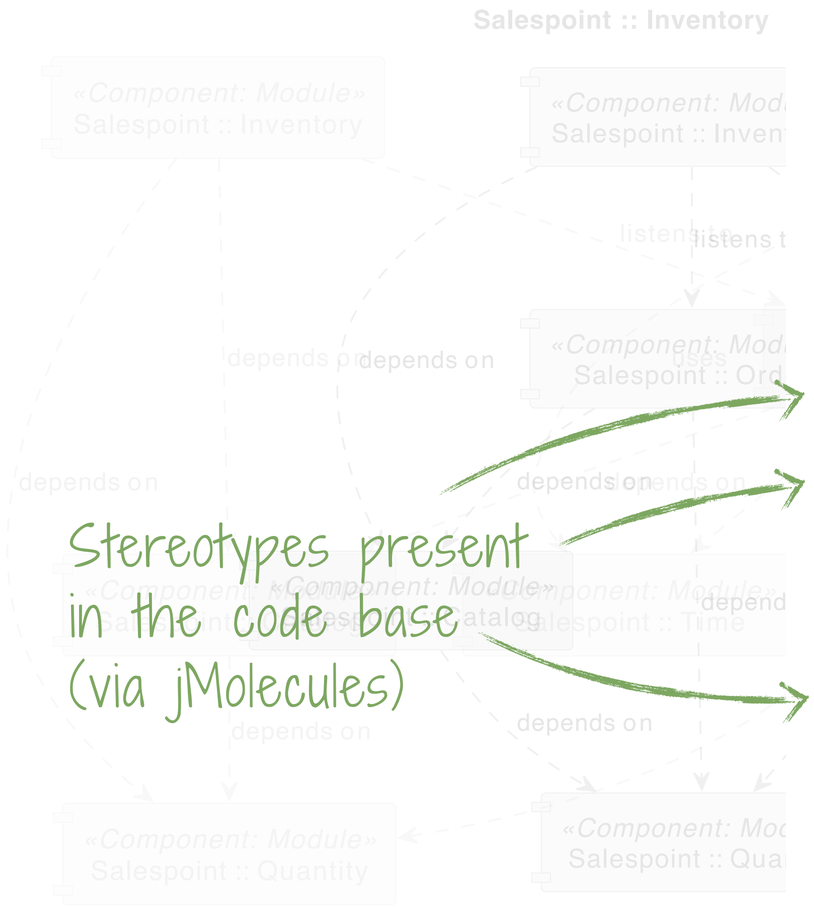

Salespoint
«Component: Module»
Salespoint :: Inventory
«Component: Module»
Salespoint :: Accountancy
«Component: Module»
Salespoint :: Order
«Component: Module»
Salespoint :: Storage
«Component: Module»
Salespoint :: Catalog
«Component: Module»
Salespoint :: Time
«Component: Module»
Salespoint :: Payment
«Component: Module»
Salespoint :: User Account
«Component: Module»
Salespoint :: Quantity
listens to
listens to
depends on
uses
depends on
depends on
depends on
depends on
depends on
uses
depends on
depends on
depends on
depends on
depends on


Salespoint :: Inventory
«Component: Module»
Salespoint :: Inventory
listens to
depends on
«Component: Module»
Salespoint :: Order
depends on
depends on
depends on
depends on
«Component: Module»
Salespoint :: Catalog
depends on
depends on
«Component: Module»
Salespoint :: Quantity
alespoint
«Component: Module»
Salespoint :: Accountancy
listens to
depends on
depends on
depends on
depends on
depends on
«Component: Module»
Salespoint :: Storage
«Component: Module»
Salespoint :: Payment
«Component: Module»
Salespoint :: User Account



Base package	`org.salespointframework.useraccount`
Spring components	*Services* • `o.s.u.UserAccountManagement` (via `o.s.u.PersistentUserAccountManagement`) *Others* • `o.s.u.AuthenticationManagement` (via `o.s.u.SpringSecurityAuthenticationManagement`)
Aggregate roots	• `o.s.u.UserAccount`
Value types	• `o.s.u.EncryptedPassword` • `o.s.u.UnencryptedPassword` • `o.s.u.Role`
Published events	• `o.s.u.UserAccountCreated` created by: ◦ `o.s.u.UserAccount.onCreate()`
Properties	• `salespoint.authentication.login-via-email` — `java.lang.Boolean`, default `false`. Enables the login procedure to use the email address to lookup a user instead of their username. Defaults to `false`.

Summary

Summary

- To strengthen the relationship between architecture and code, find means to represent architectural and design concepts in your codebase.
- Align software engineering practices with architectural abstractions.
- Understand how technology choices affect the overall architecture of the system.
- The scope of change drives decomposition.

Thank you!
Questions?

Oliver Drotbohm odrotbohm oliver.drotbohm@broadcom.com

Resources

- **Just Enough Software Architecture**
  George Fairbanks – Book
- **Architecture, Design, Implementation**
  Ammon H. Eden, Rick Kazman – Paper
- **Sustainable Software Architecture**
  Carola Lilienthal – Book
- **Software Architecture for Developers**
  Simon Brown – Books

Links

- **xMolecules**

  Project website

- **jMolecules**

  Project website

- **jMolecules Examples**

  Example project @ GitHub

- **Spring Modulith**

  Project website

- **Archictecturally Evident Spring**

  Example project @ GitHub