Applying Aggregates and Associations

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DDD is for
solving complex problems

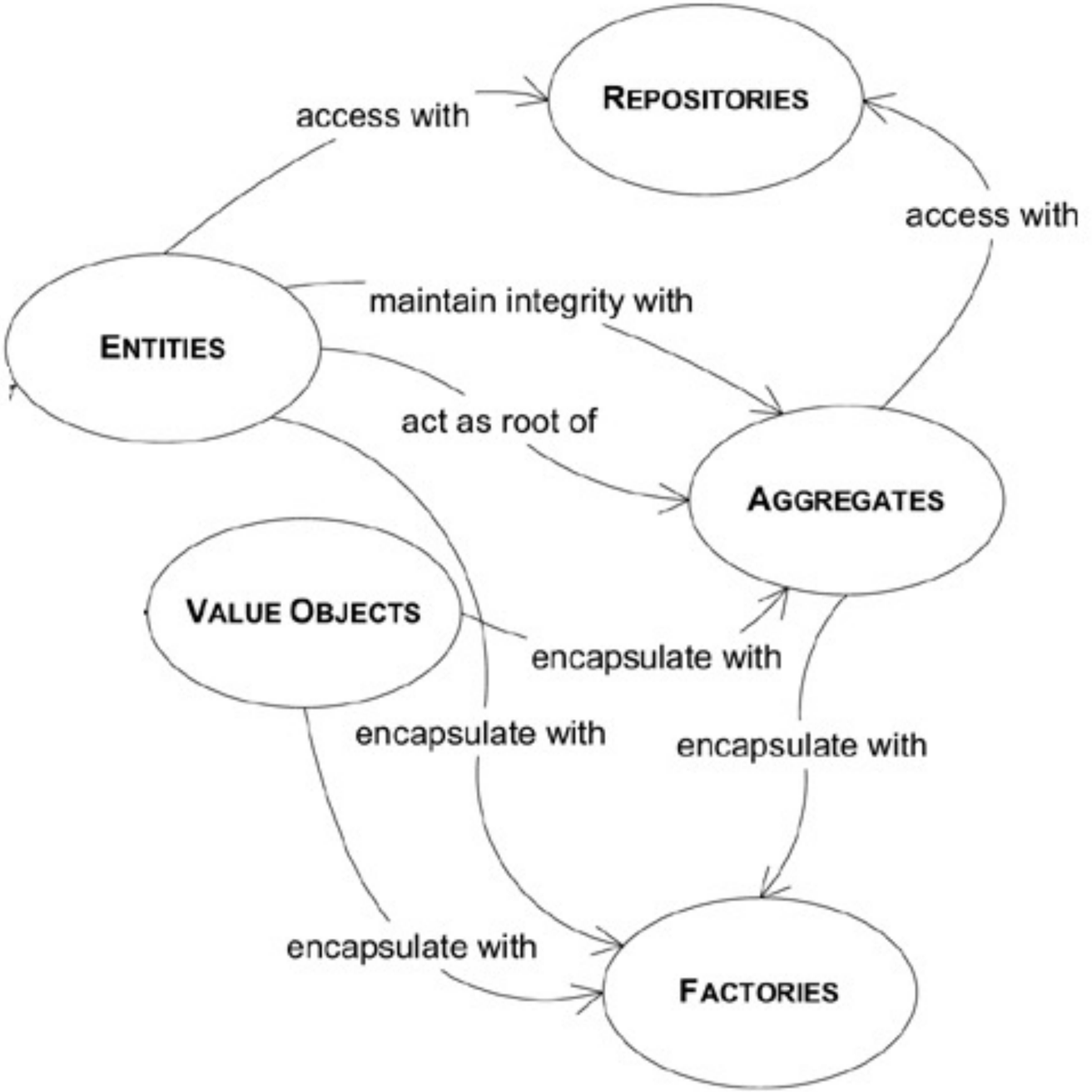
Overview

- Tackling data complexity
- What are aggregates?
- The importance of aggregate roots
- Invariants in aggregates
- Associations & relationships among entities
- Evolving the aggregate design in our sample solution
- Implementing aggregates in code

Tackling Data Complexity

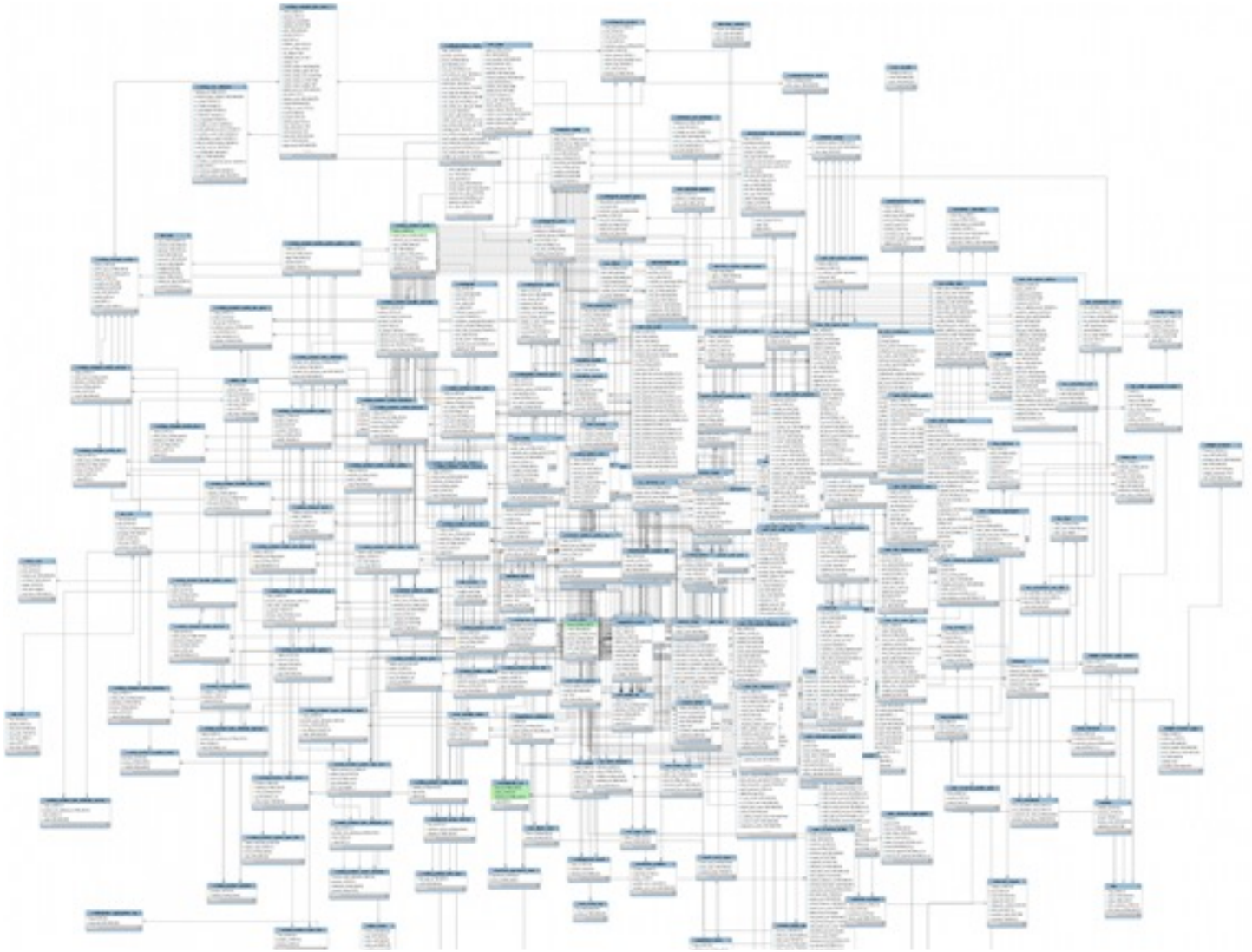
Large systems often lead to complex data models

Aggregates and Aggregate Root in the DDD Mind Map

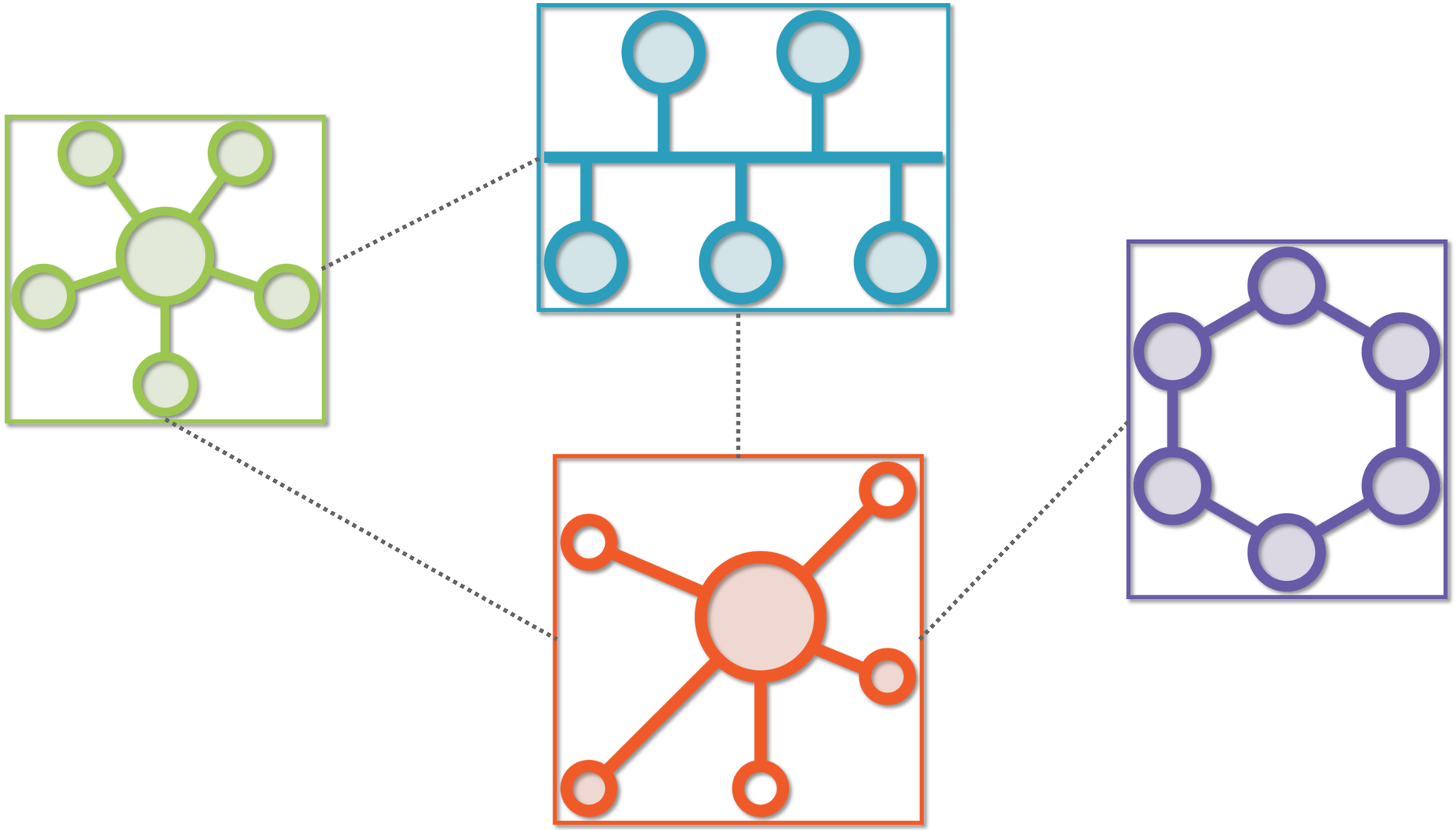


Source: Evans, Domain-Driven Design, p. 65

A Very Complex Model, Indeed



Smaller Models Can Still Interconnect

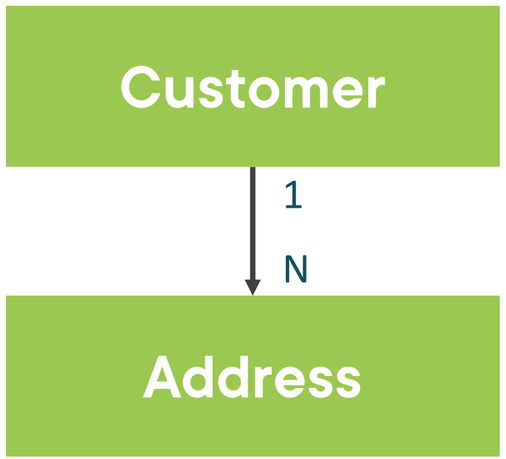


A big ball of mud!

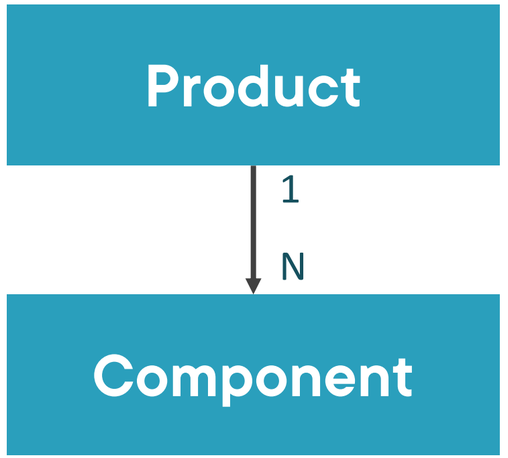
Introducing Aggregates and Aggregate Roots

Aggregates in Our Model

Customer Aggregate

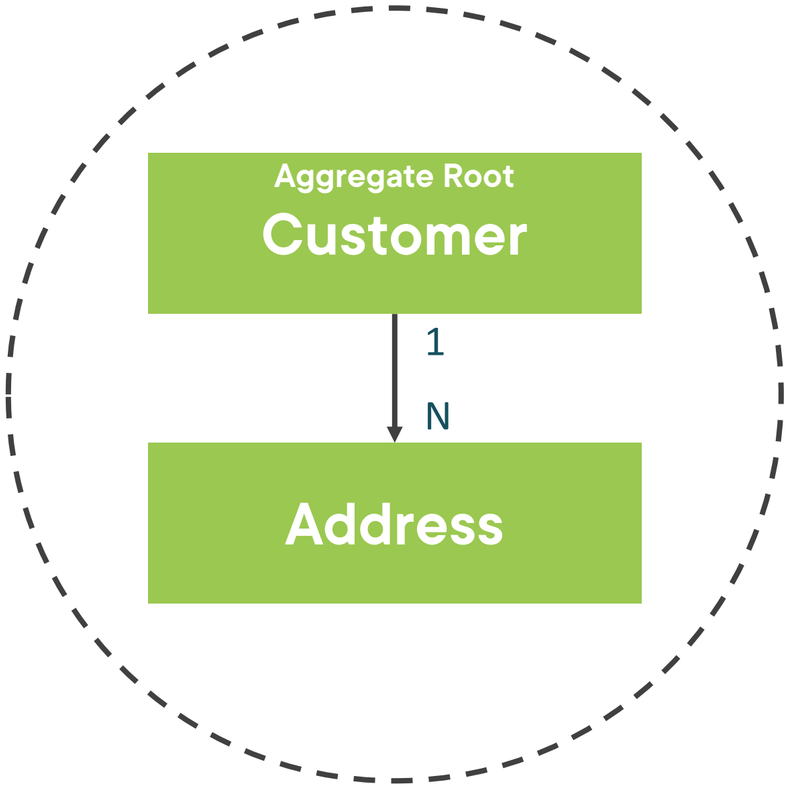


Product Aggregate

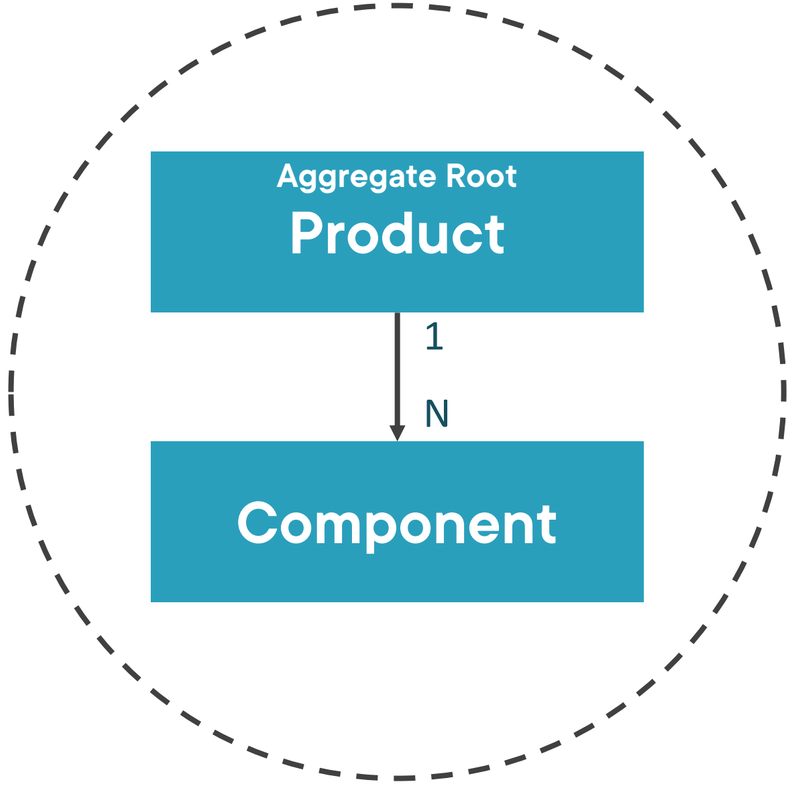


Aggregates in Our Model

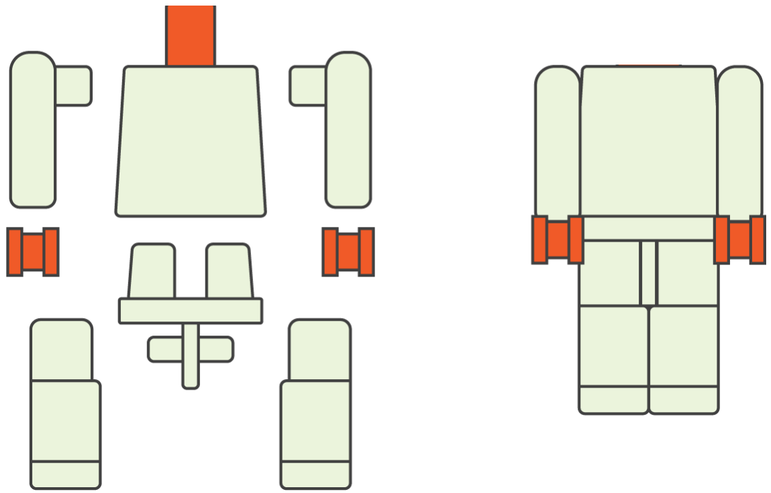
Customer Aggregate

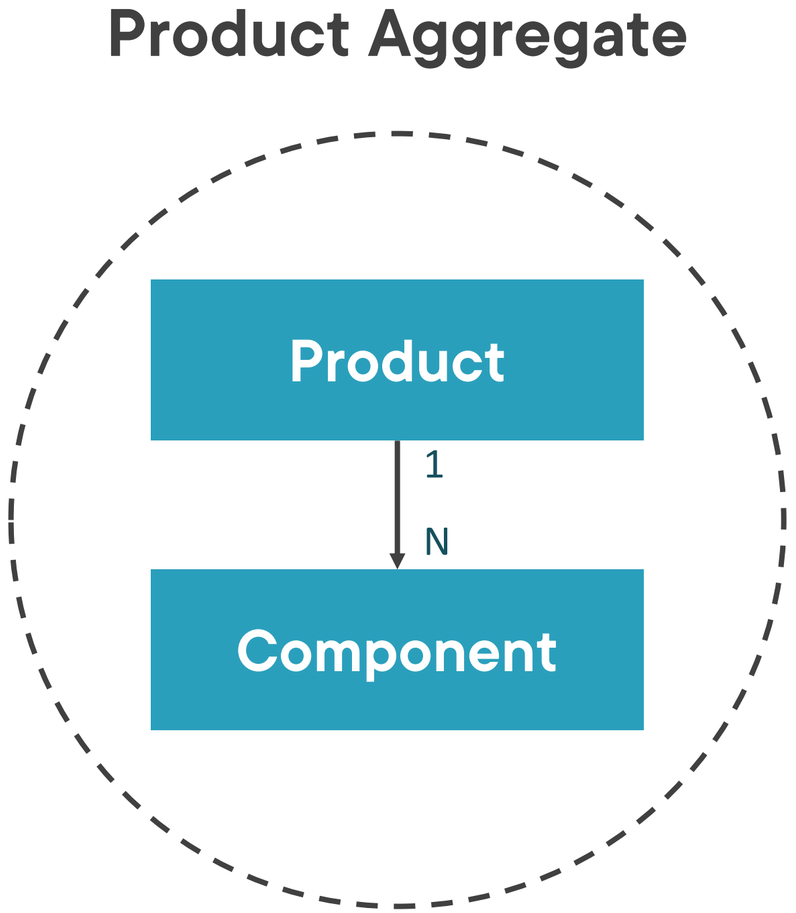


Product Aggregate

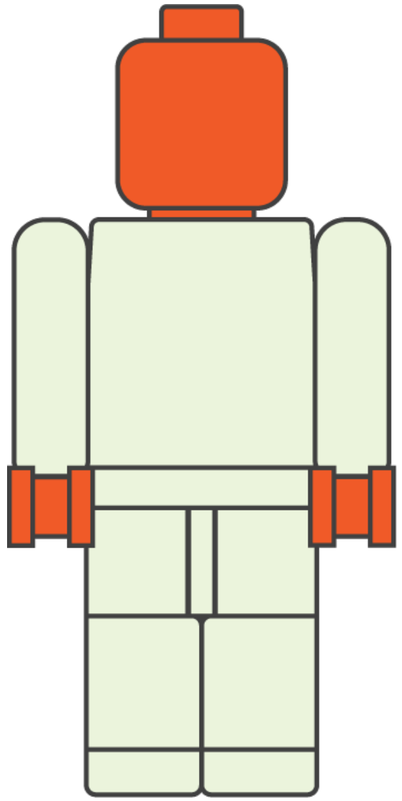


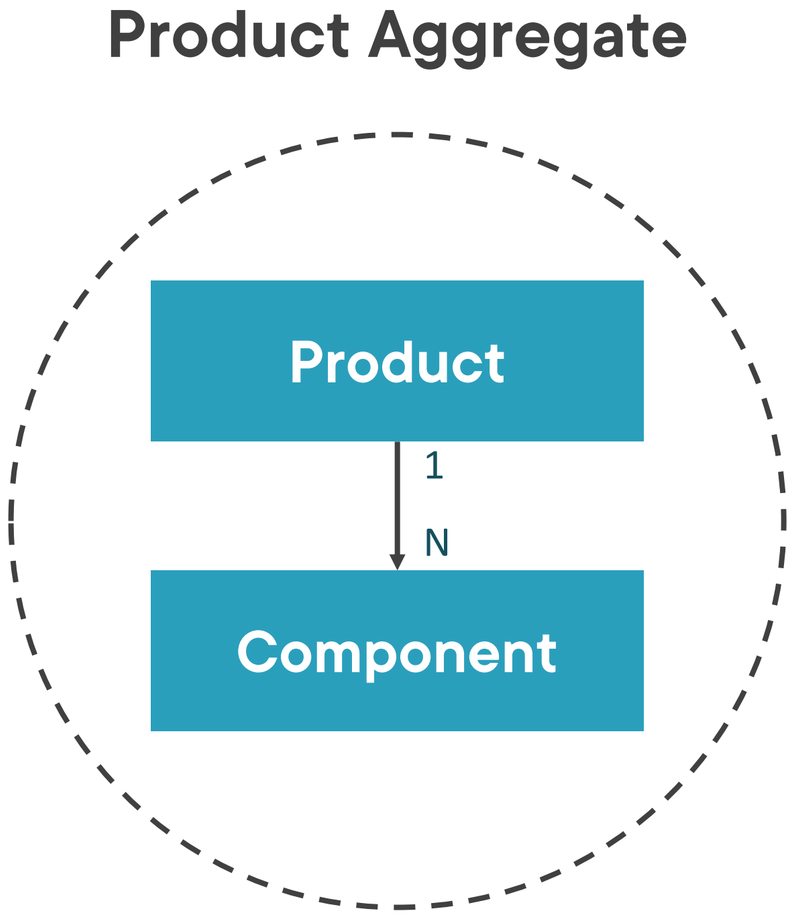
Aggregate Should Enforce Data Consistency





Aggregate Should Ensure a Product is Valid





Data Changes Should Follow ACID

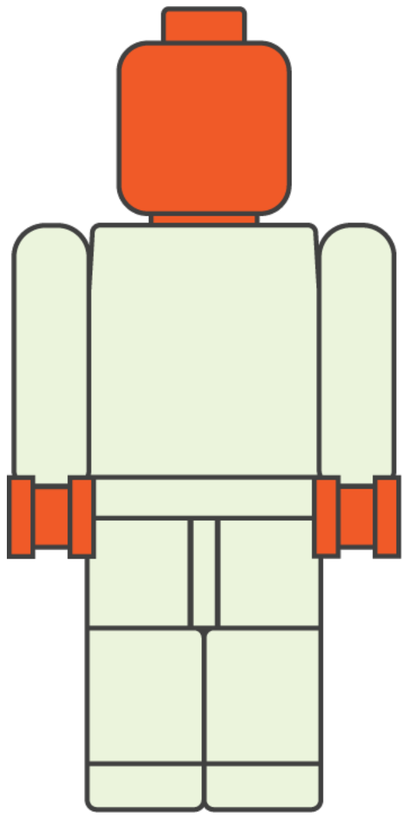
Atomic

Consistent

Isolated

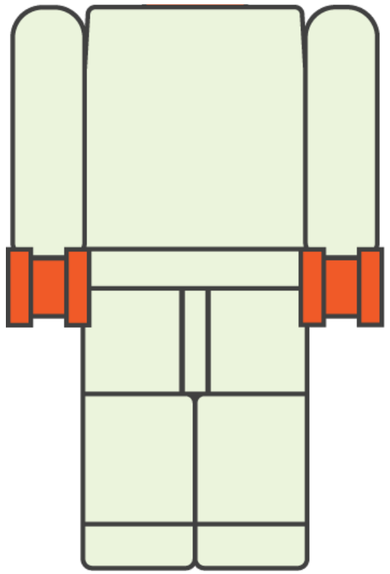
Durable

Aggregate Root is Responsible for Maintaining Invariants



- ✓ 2 arms
- ✓ 2 legs
- ✓ 1 body
- ✓ 2 hands
- ✓ 1 pelvis
- ✓ 1 head

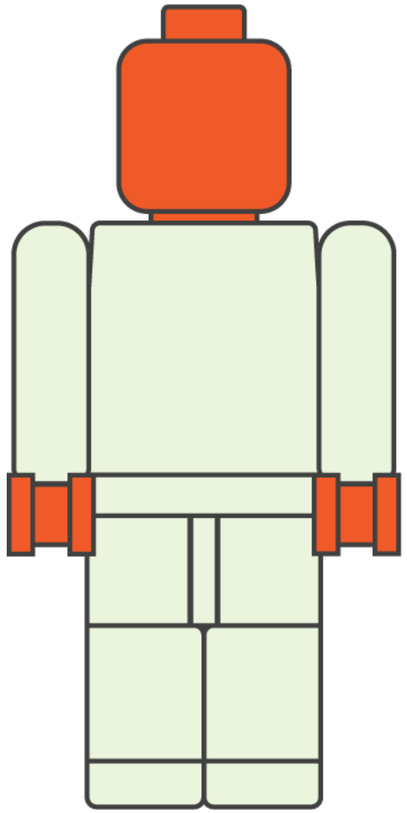
Aggregate Root is Responsible for Maintaining Invariants



- ✓ 2 arms
- ✓ 2 legs
- ✓ 1 body
- ✓ 2 hands
- ✓ 1 pelvis
- ✓ 1 head

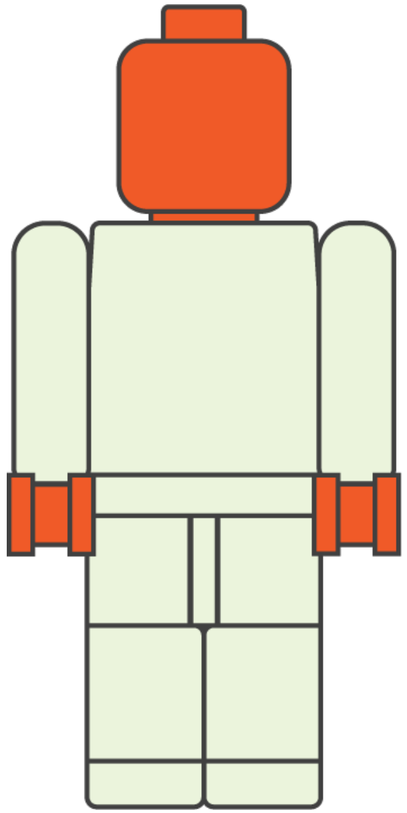
Deleting Is a Good Test to Discover Root

Deleting the Root Should Delete the Entire Aggregate



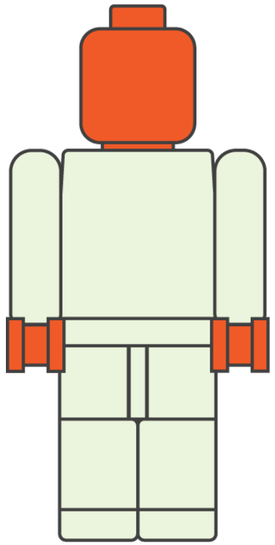
- ✓ **2 arms**
- ✓ **2 legs**
- ✓ **1 body**
- ✓ **2 hands**
- ✓ **1 pelvis**
- ✓ **1 head**

Deleting the Root Should Require Deleting the All the Objects in the Aggregate



- ✓ **2 arms**
- ✓ **2 legs**
- ✓ **1 body**
- ✓ **2 hands**
- ✓ **1 pelvis**
- ✓ **1 head**

How Are An Aggregate's Objects Affected?



Delete a MiniFig

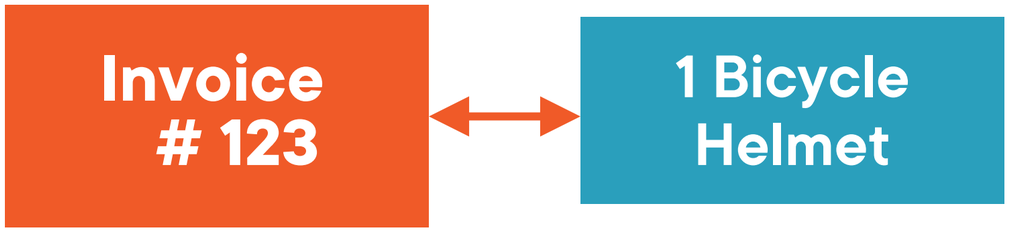
Delete a head component

An aggregate is a cluster of associated objects that we treat as a unit for the purpose of data changes.

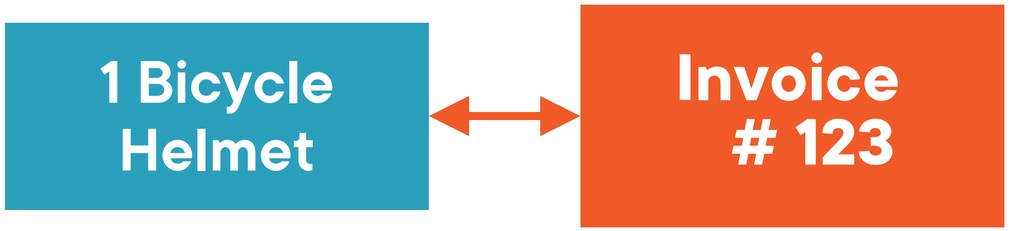
Eric Evans
Domain-Driven Design

Considering Associations in Aggregates

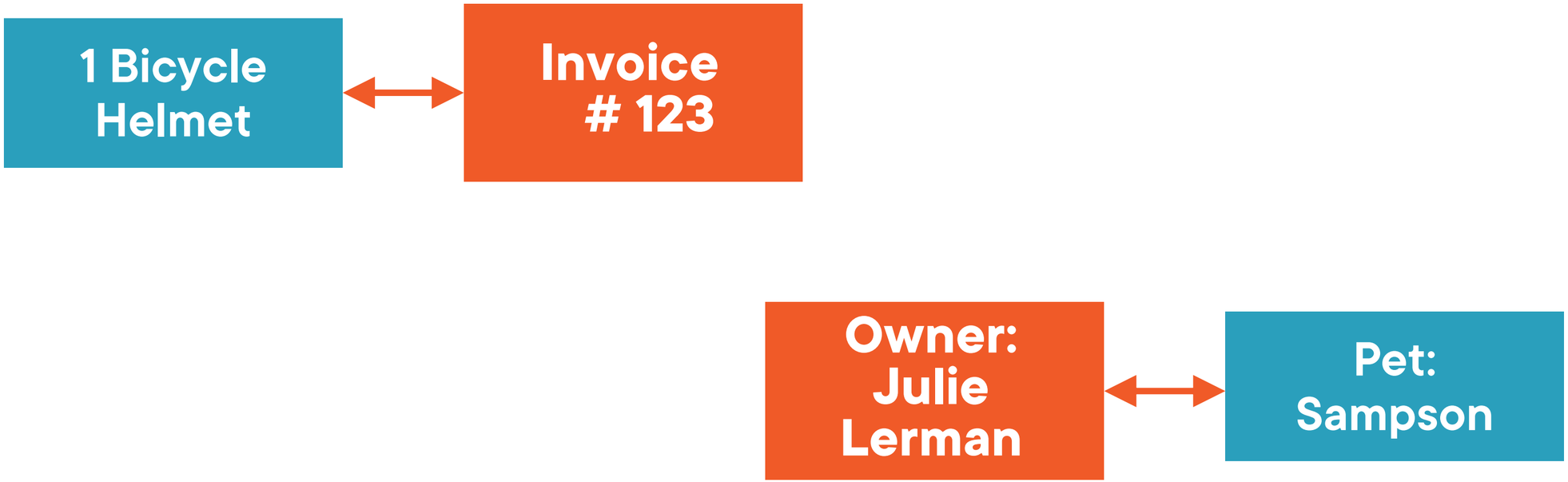
Bi-Directional Relationships



Bi-Directional Relationships

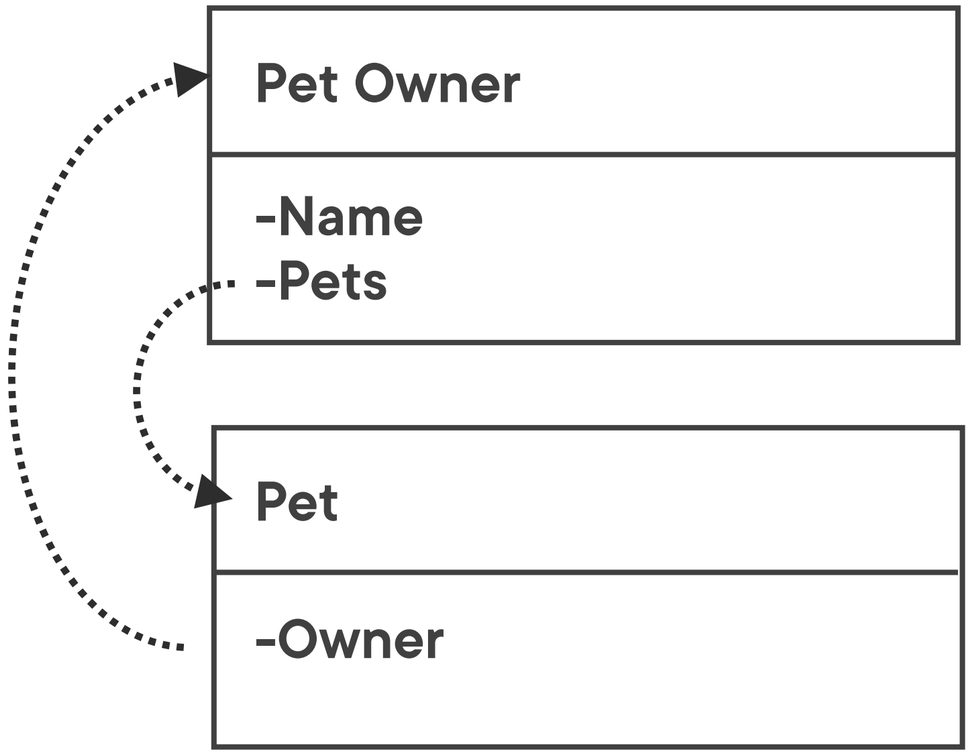


Bi-Directional Relationships



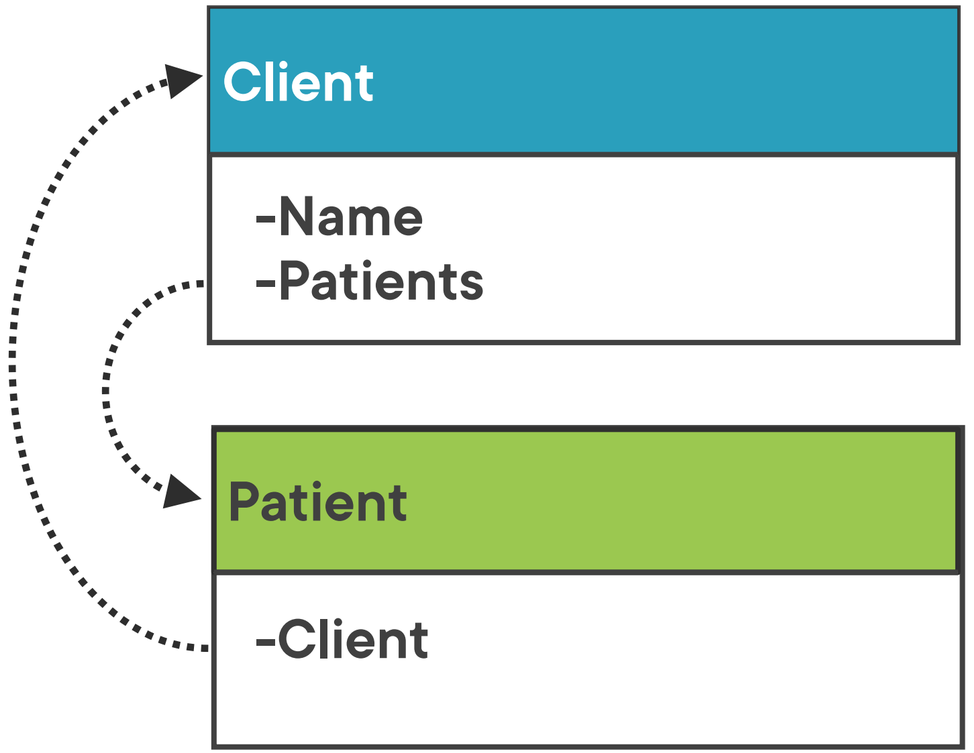
Bi-Directional Relationships

Bi-Directional Relationship Using Properties



Default to one-way associations

Bi-Directional Relationship Using Properties



A bidirectional association means that both objects can be understood only together. When application requirements do not call for traversal in both directions, adding a traversal direction reduces interdependence and simplifies the design.

Eric Evans

Navigation Property

Property that allows navigation from one end of an association to another. A navigation property does not carry data, but acts as a pointer.

Do I Need a Bi-Directional Relationship Here?

Which Single Direction Makes Sense?

Schedule an appointment?

Pay a bill?

Which Single Direction Makes Sense?

Schedule an appointment?

Pay a bill?

The One-Way Client:Patient Relationship in the Scheduling Bounded Context

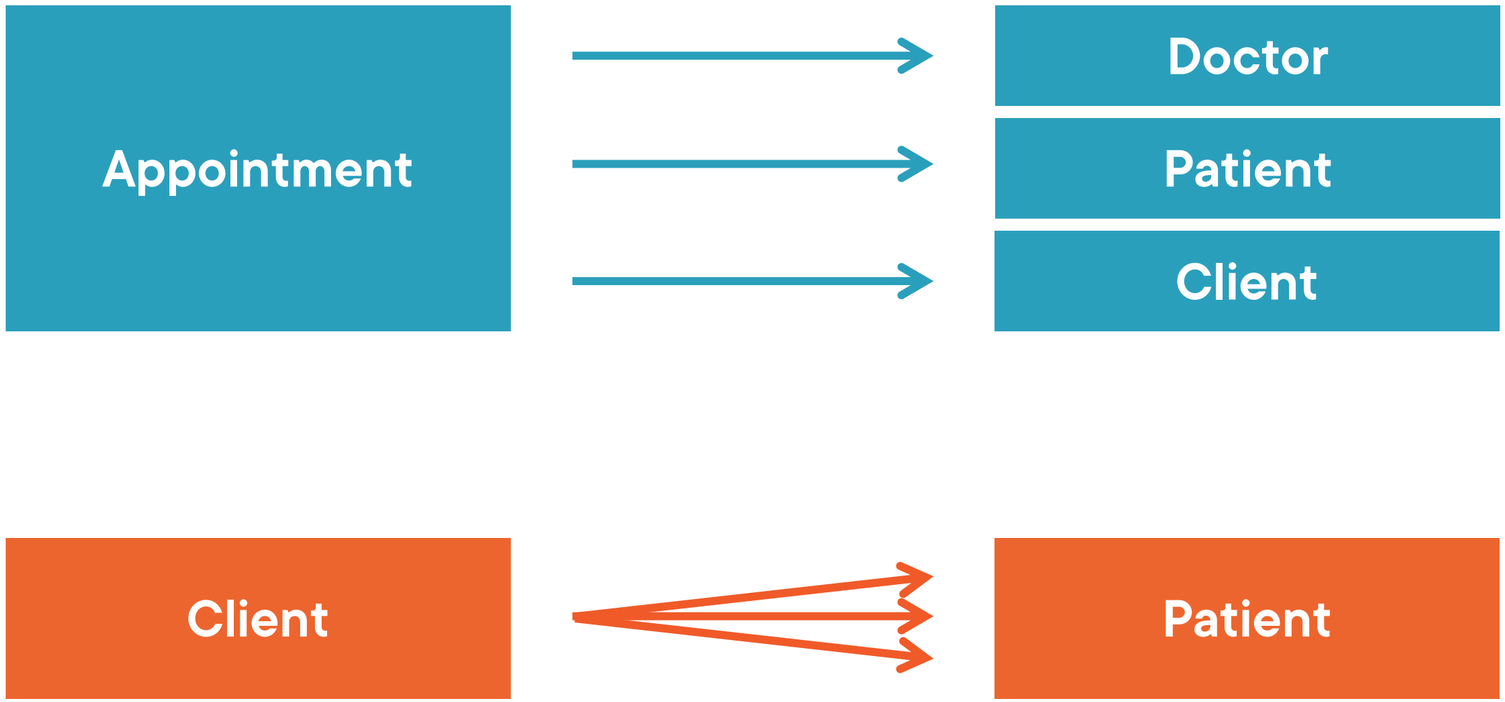
Client :Entity<Int>

-FullName
-Patients

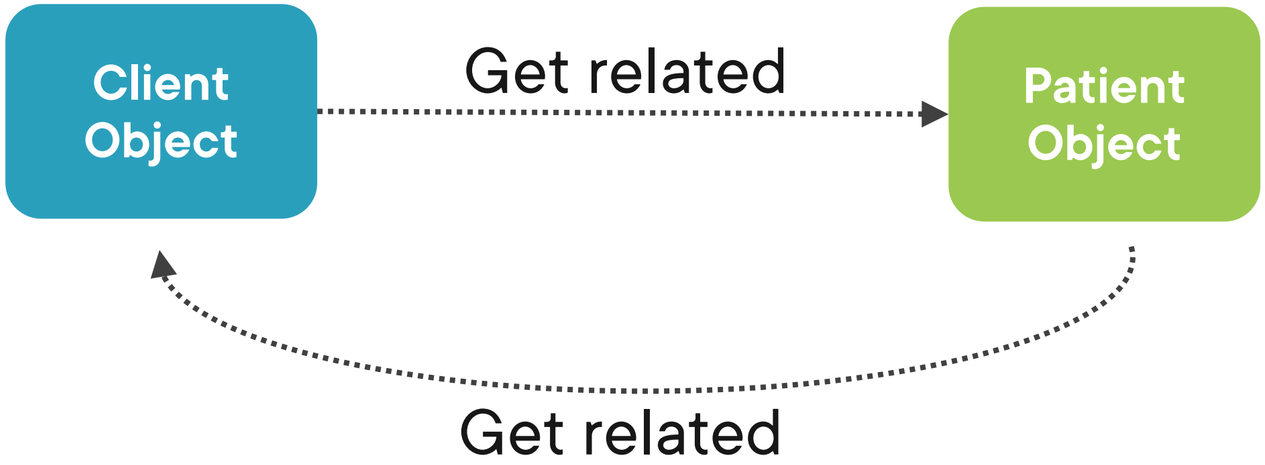
Patient :Entity<Int>

-AnimalType
-ClientId
-Gender
-Name
-PreferredDoctor

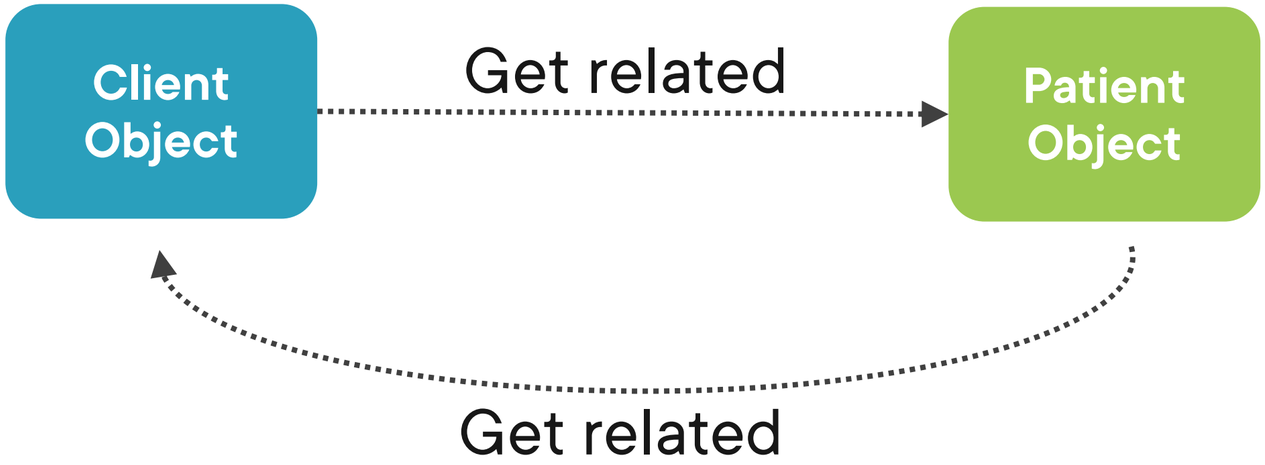
Uni-Directional Associations



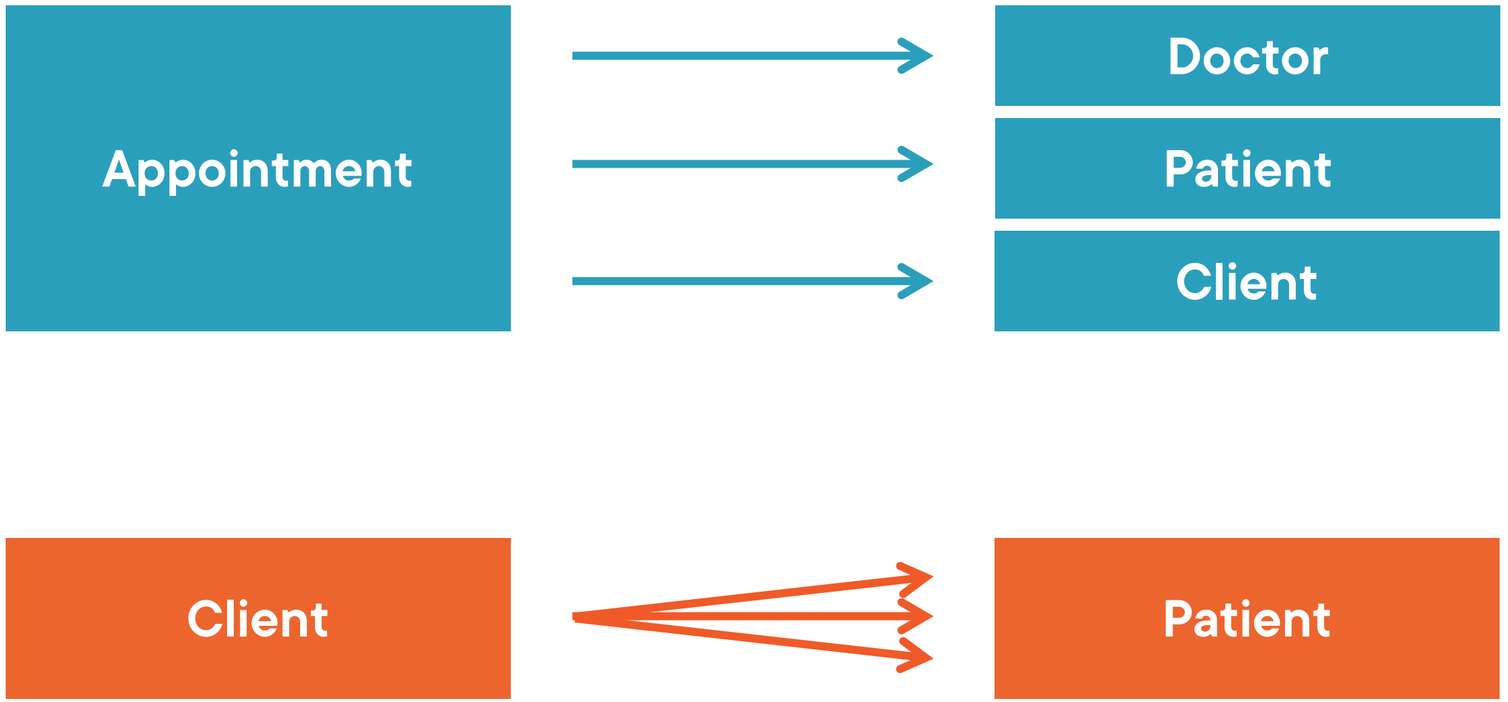
Serialization and Bi-Directional Navigations



Serialization and Bi-Directional Navigations



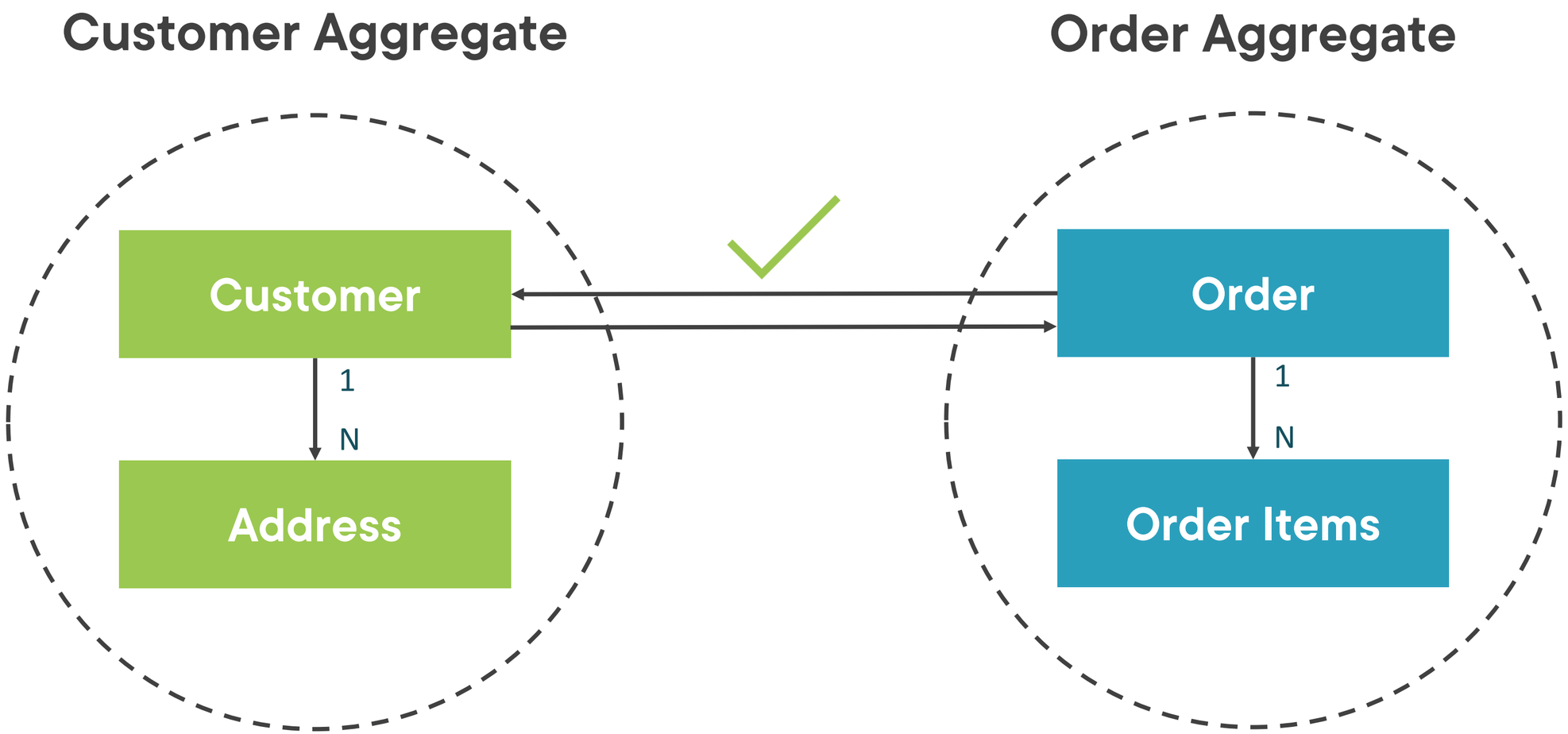
One-Way Associations Avoid Serialization Issues



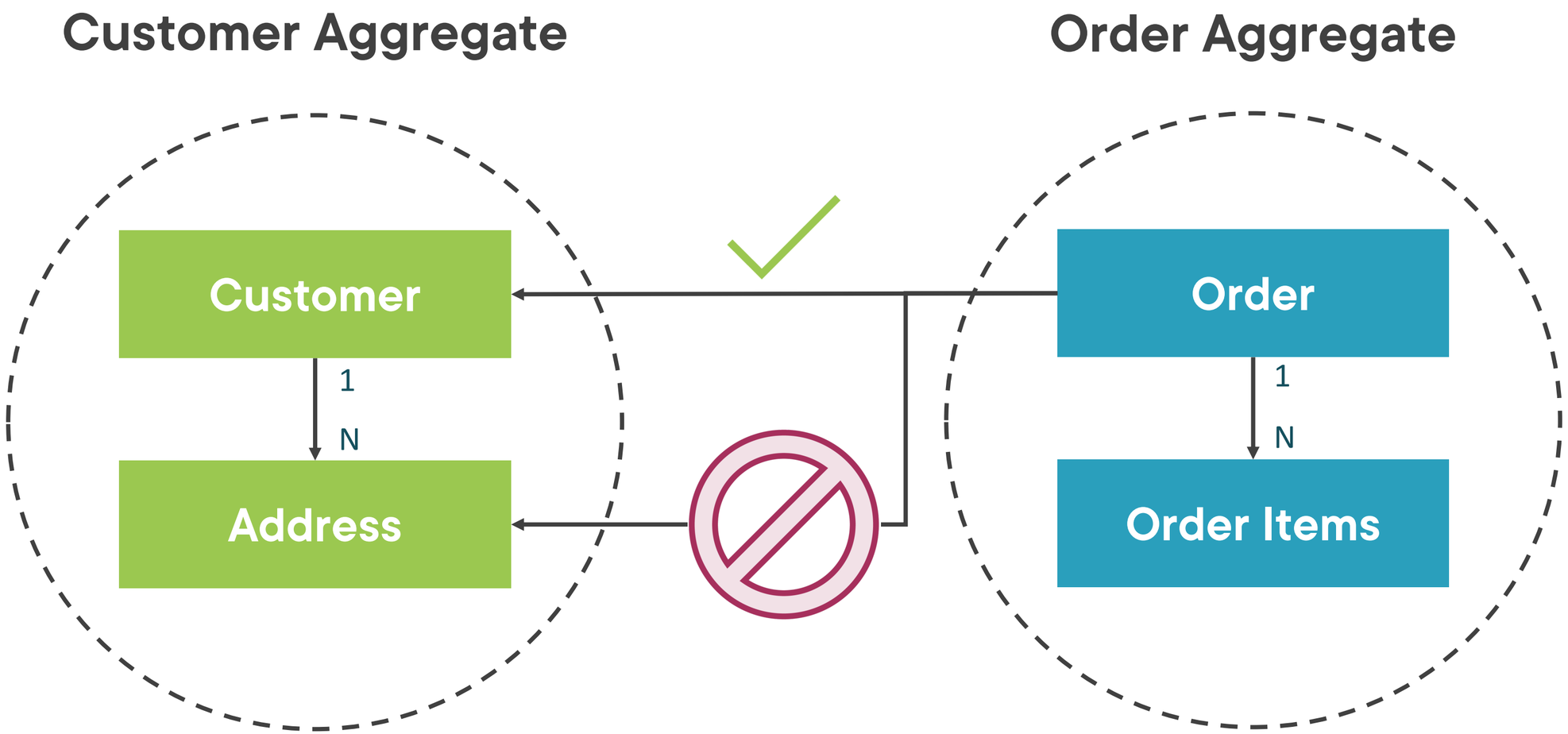
Handling Relationships that Span Aggregates

External objects should interact with only the aggregate root.

Enforcing Boundaries Between Aggregates

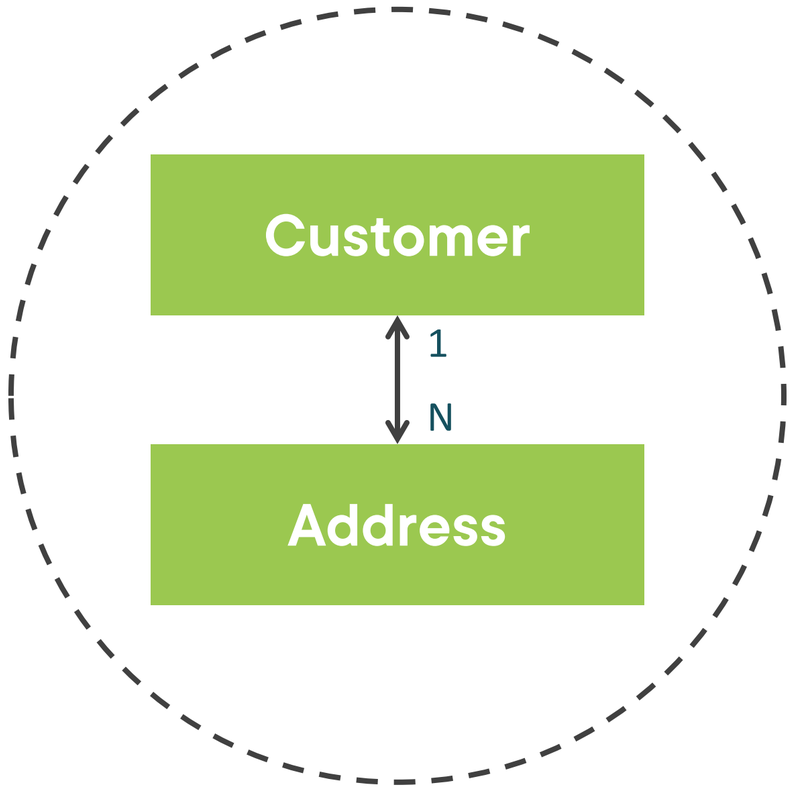


Enforcing Boundaries Between Aggregates

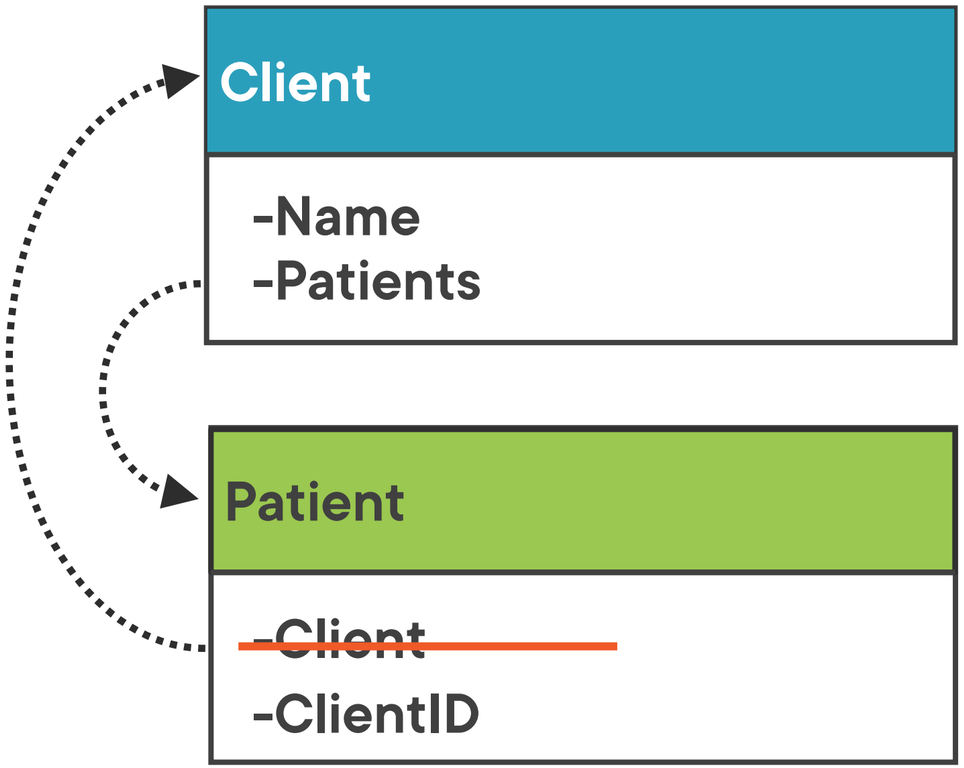


Object relationships are not the same as relationships between persisted data

Another Downside of Bi-Directional Navigation



Reference ID Value Can Save ORM Confusion



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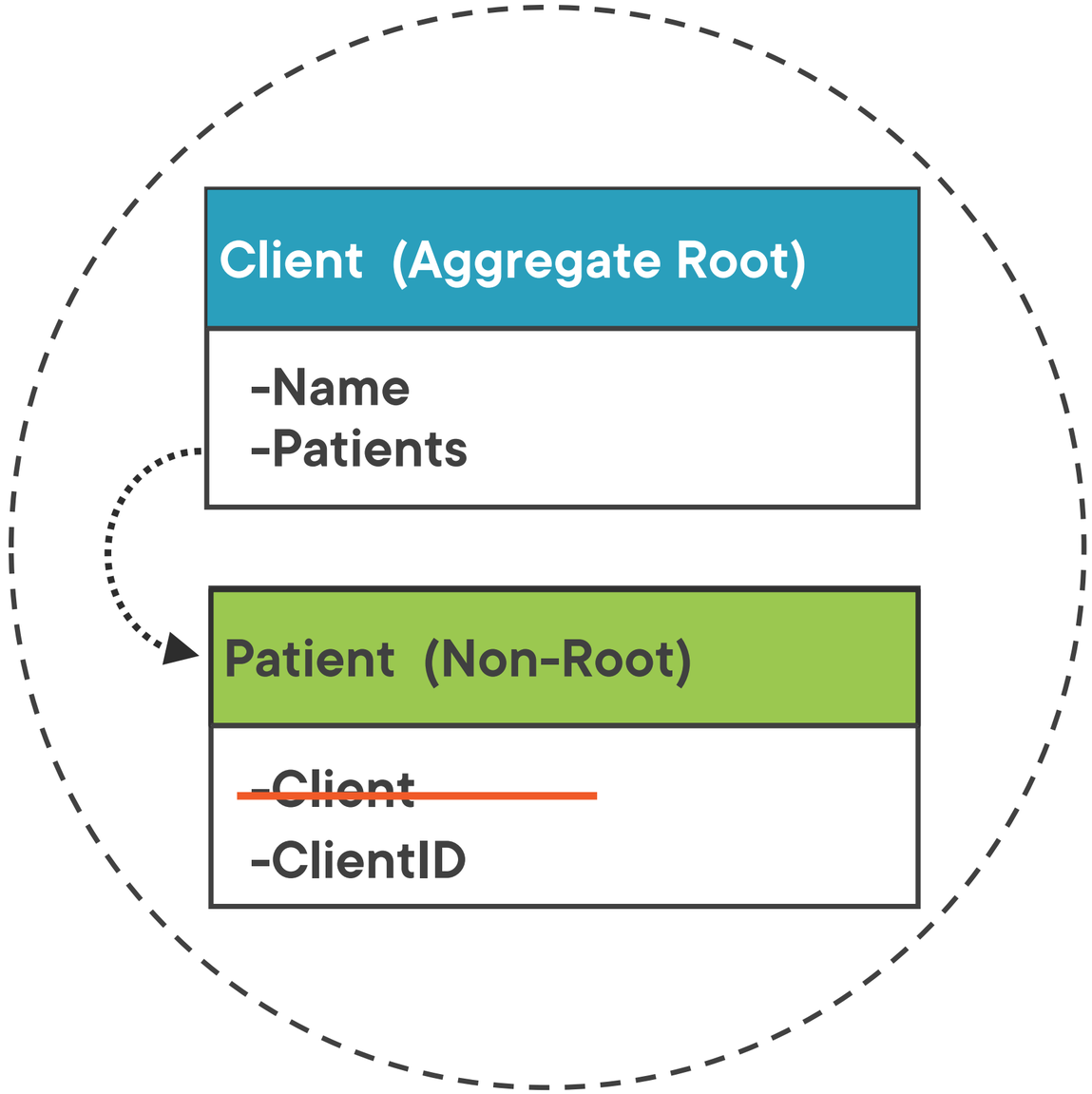
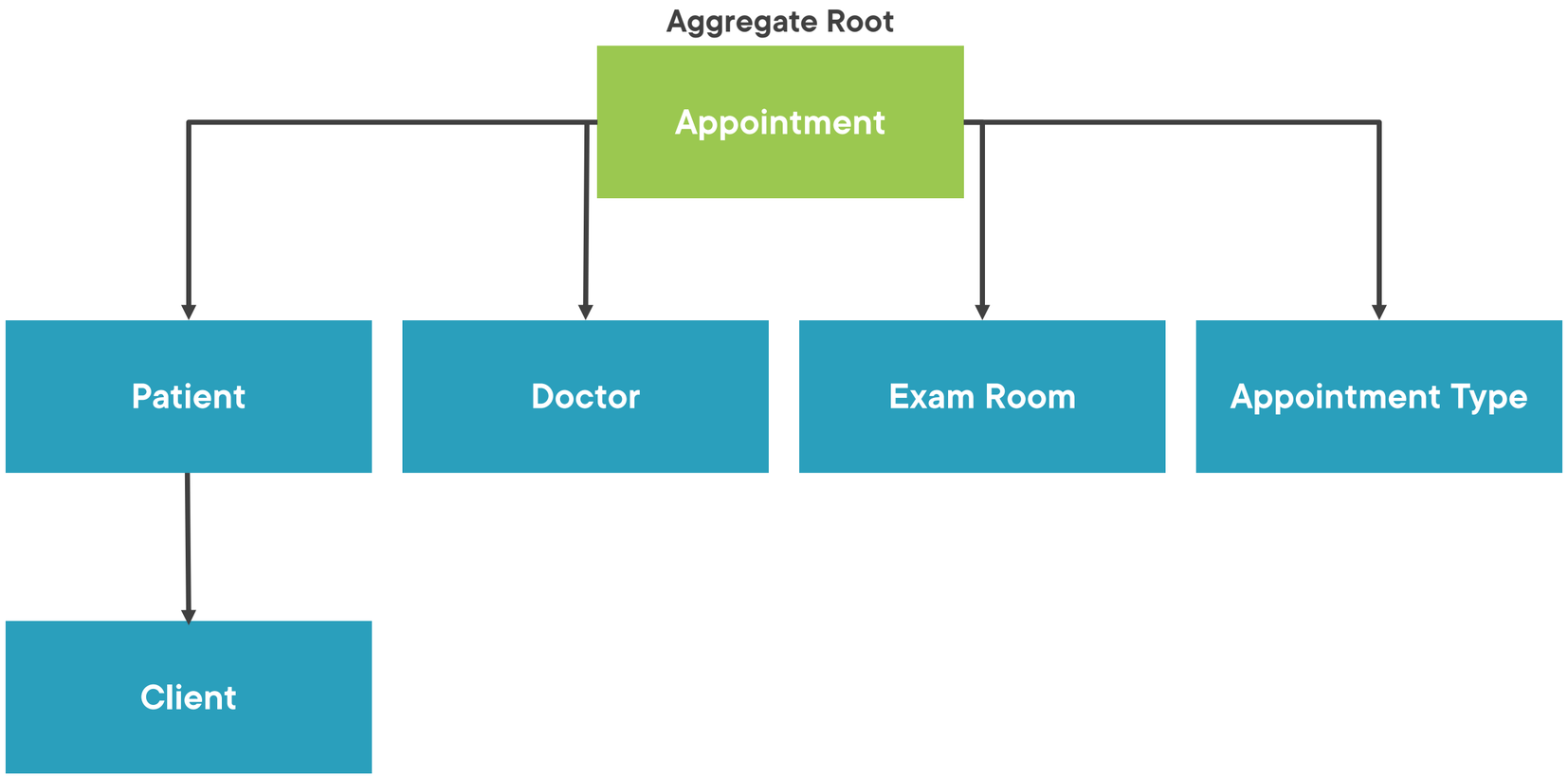
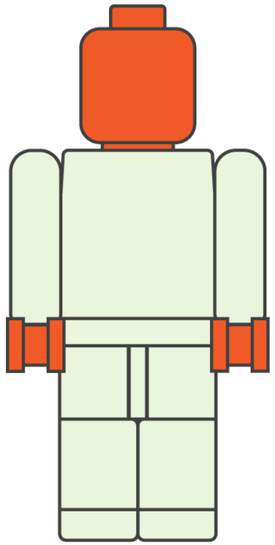


Evolving the Appointments Aggregate

Our First Draft Design: Appointment Aggregate



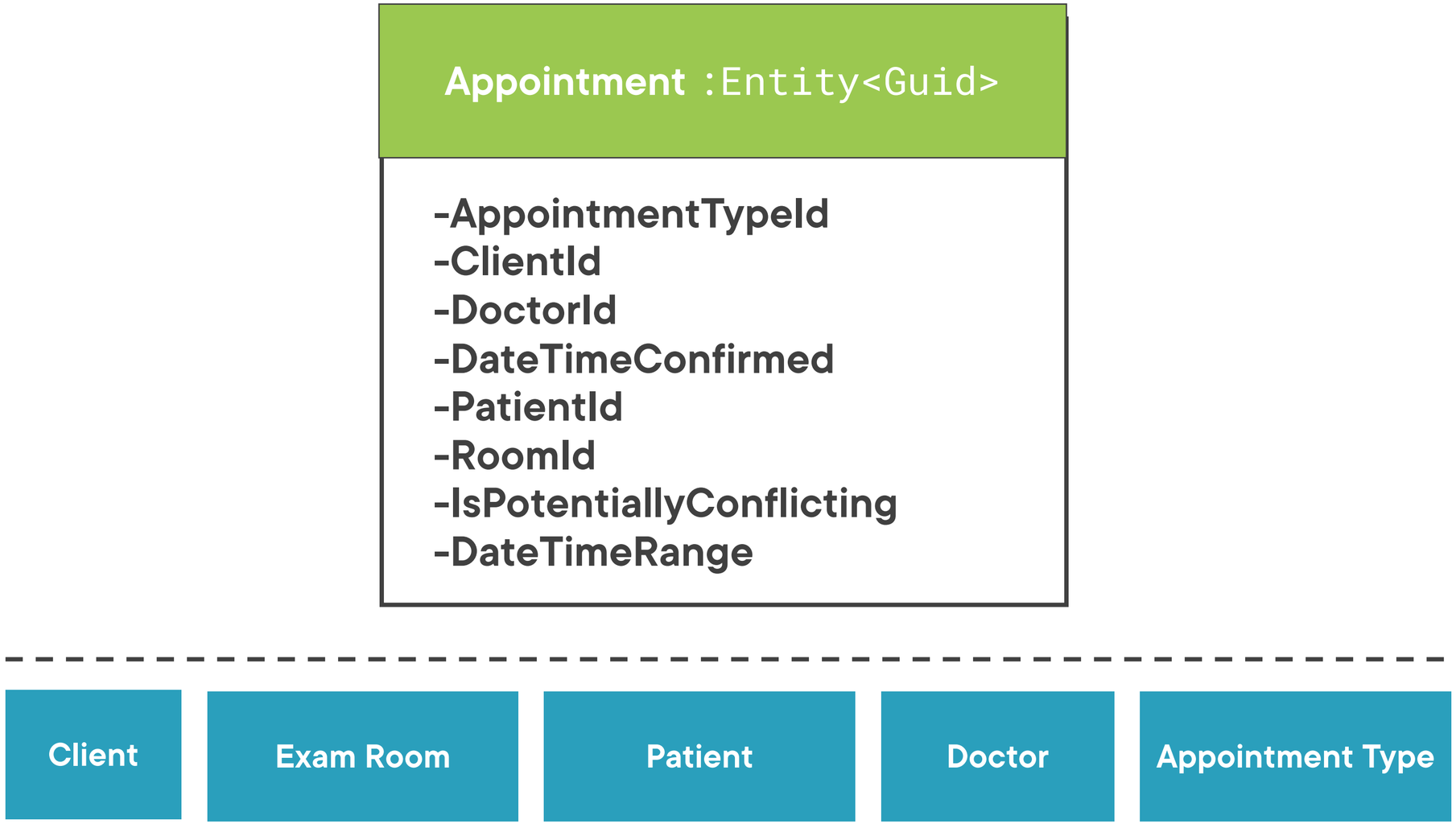
Recall a Test to Determine an Aggregate's Root



When you delete an aggregate's root, the other objects in the aggregate should get deleted

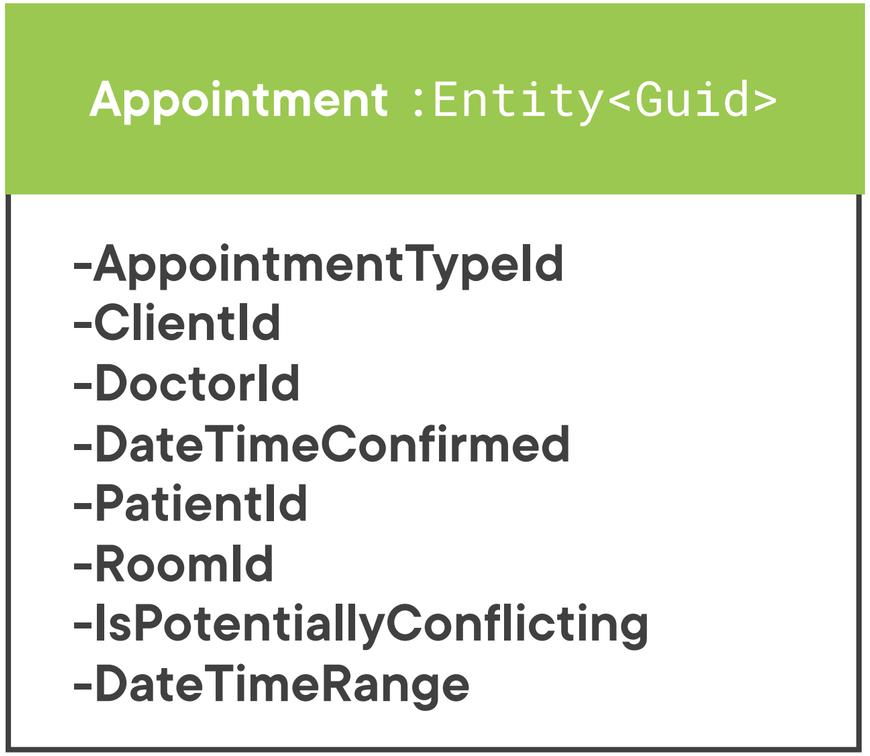
When you delete an appointment, should you also delete the patient, doctor, exam room, appointment type and client?

Our Revised Design



Using Invariants to Better Understand our Aggregate

Our Current Aggregate Design



Maintained in other bounded contexts

Aggregate root is responsible for maintaining the rules of the aggregate

But what is an invariant?

Speed of Light is an Invariant

1,079,252,849 km/h

670,616,629 mph

Invariant

A condition that should always be true for the system to be in a consistent state

Examples of Aggregate Invariants

Total items on purchase order do not exceed limit

Two appointments do not overlap one another

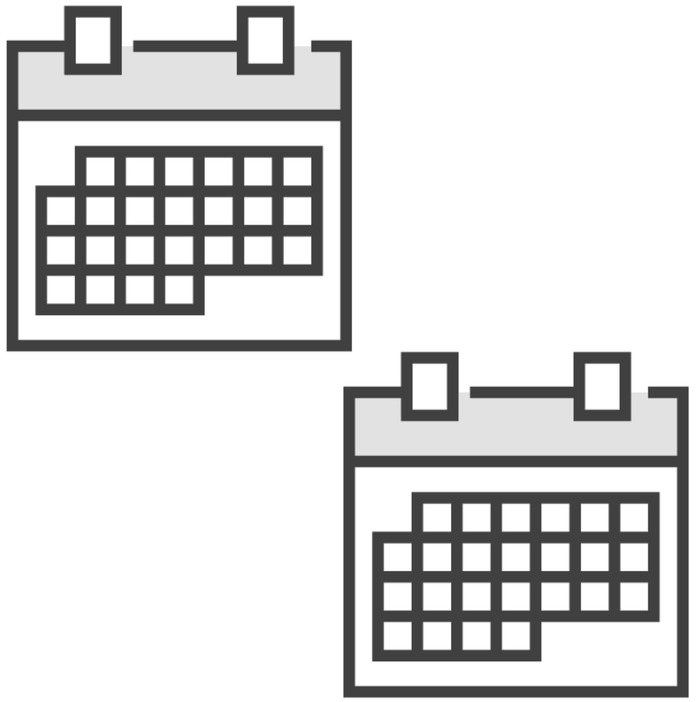
End date follows Begin date

Purchase Order (Root) Maintains this Invariant

Total items on purchase order do not exceed limit

Modeling Breakthroughs and Refactoring

Examining Invariants Leads to Discovery



Invariant:
Two appointments do not overlap one another

Aggregate Advice:
Appointments should not know about each other

Is appointment really a good aggregate root?

Source: wocintechchat.co/blog/wocintechphotos

It’s normal and expected for models to evolve as you learn more about the domain.

“Each refinement of code and model gives developers a clearer view. This clarity often creates the potential for a breakthrough of insights.”

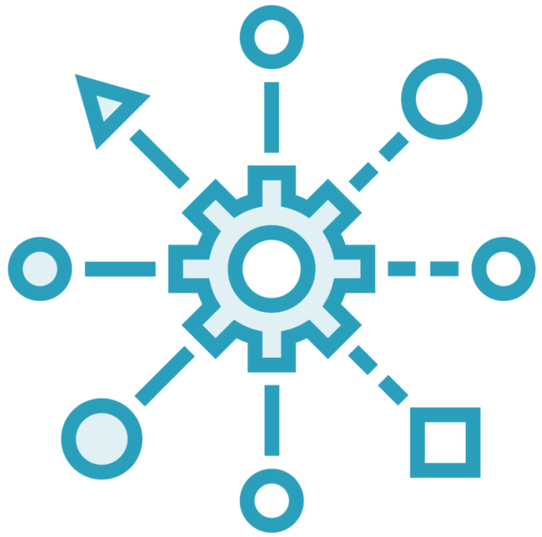
Eric Evans
Domain-Driven Design, Chapter 8

Recognizing Signs of a Misidentified Aggregate

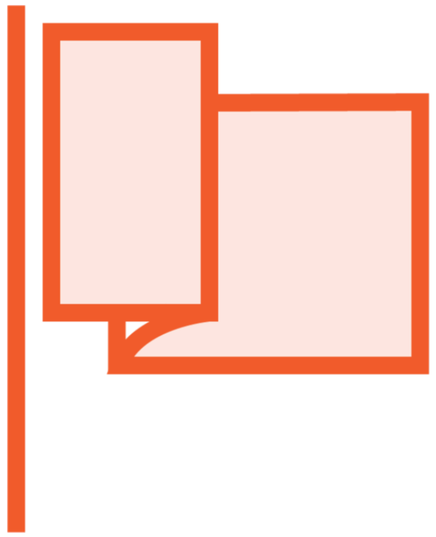
As our understanding of the domain evolved, schedule appeared to be a more appropriate aggregate root

Cross-aggregate invariants should not be enforced by any one aggregate.

Cross-Aggregate Invariants



Domain Services are one solution



Possible red flag about your domain model design

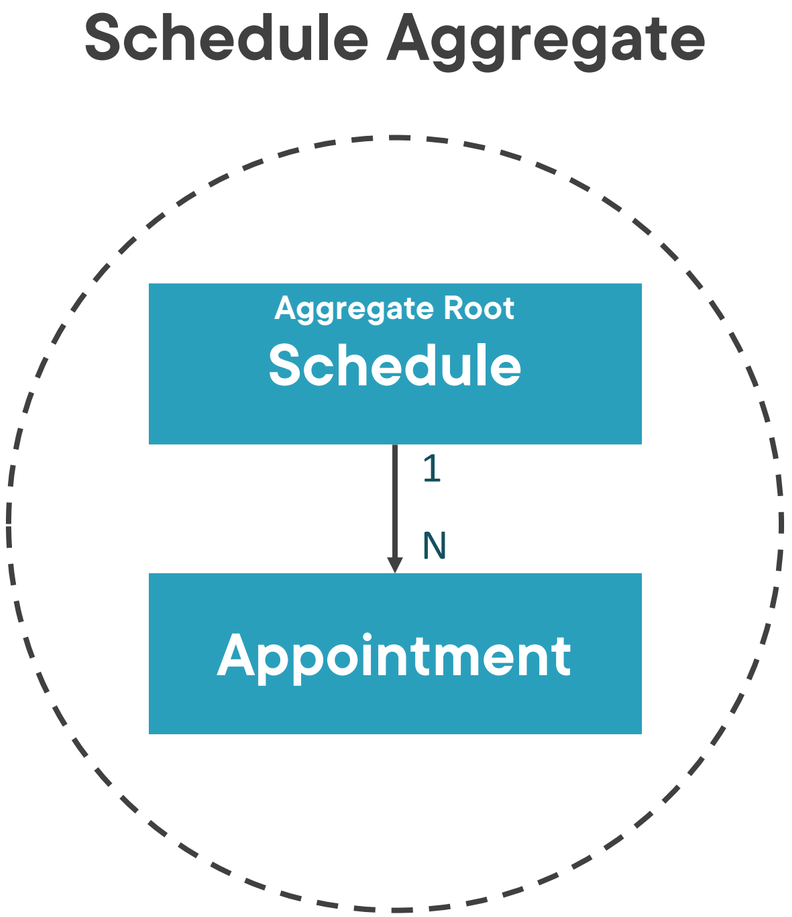
Our Red Flag

“Schedule”

Introducing:
The Schedule Aggregate

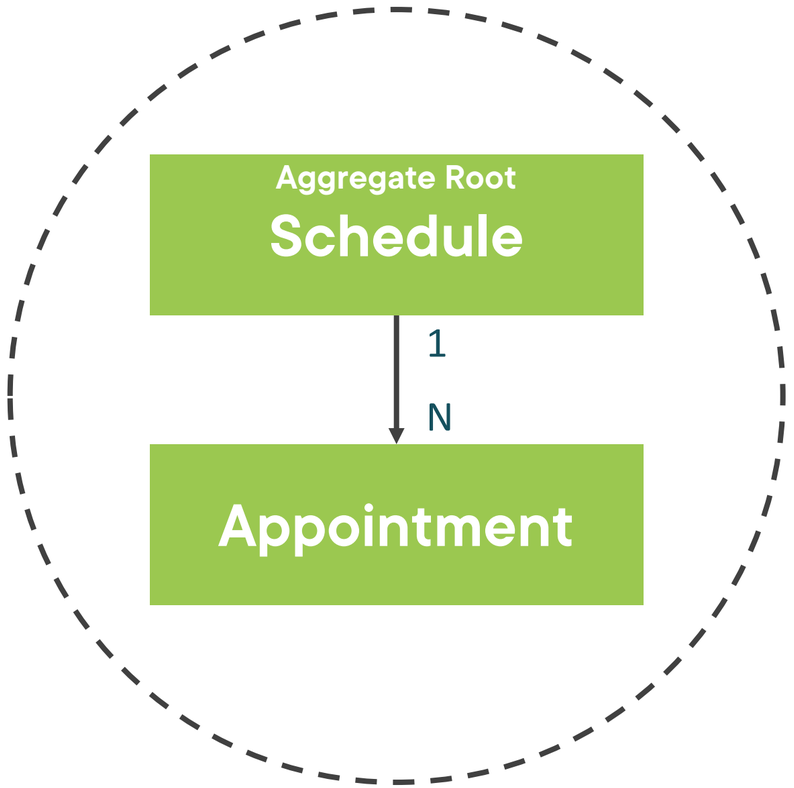
Considering Schedule as Our New Aggregate

Our Newly Revised Design



Does Schedule Make a Good Aggregate Root?

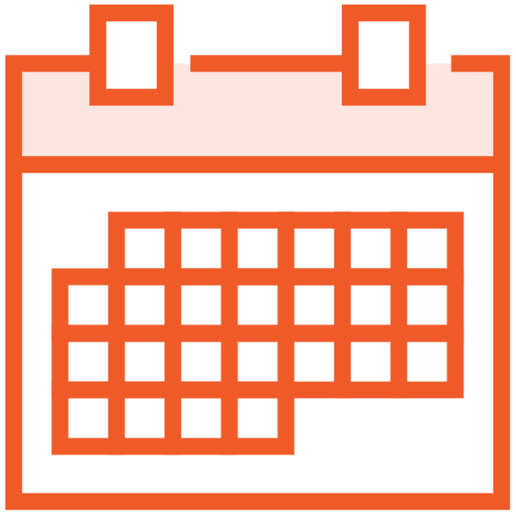
Schedule Aggregate



- **Enforces invariants**
- **Saving changes can save entire aggregate**
- **Cascading delete is okay**

Schedule as the Root Feels Right!

Each clinic has its own schedule



A schedule for a clinic has a series of appointments

Appointment :Entity<Guid>

-AppointmentTypeId
-ClientId
-DoctorId
-DateTimeConfirmed
-PatientId
-RoomId
-IsPotentiallyConflicting
-DateTimeRange

Appointment coordinates date, time, patient, doctor and more

Exploring the Schedule Aggregate in Our Application

Sharing Our Tips for Aggregate Design

Aggregate Tips

Aggregates are not always the answer

Aggregates can connect only by the root

Don’t overlook using FKs for non-root entities

Too many FKs to non-root entities may suggest a problem

“Aggregates of one” are acceptable

“Rule of Cascading Deletes”

Module Review with Key Terms

Key Terms from this Module

Aggregate

A transactional graph of objects

Aggregate Root

The entry point of an aggregate which ensures the integrity of the entire graph

Key Terms from this Module

Invariant

A condition that should always be true for the system to be in a consistent state

Key Terms from this Module

Associations

The modeled relationship between entities

Navigation Properties

An ORM term to describe properties that reference related objects

Unidirectional Relationships

Associations between two entities that can only be navigated in one direction

Key Takeaways

- Avoid big ball of mud models
- Break the model up into aggregates
- An aggregate represents a graph of objects in a transaction
- Aggregates encapsulate business rules and invariants
- Default to one-way relationships when modeling associations
- Don’t fear evolving the design of your aggregates as you learn more about the domain

Up Next:
Working with Repositories