Domain-Driven Data

O'Reilly Software Architecture Conference

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Build More, Grow More, Sleep More

Do more with the only fully-managed NoSQL database-as-a-service (DBaaS)

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Open for Data

A comprehensive portfolio of open source data services
Big Data
Get it?
A Brief History of Data
The Relational Database

- **order**
  - `order_id`
  - `customer_id`
  - `date`

- **customer**
  - `customer_id`
  - `email_address`
  - `name`

- **line_item**
  - `order_id`
  - `item_id`
  - `price`
  - `quantity`
ACID Guarantees

Relational databases guarantee atomicity, consistency, isolation and durability
The ACID guarantees provided by relational databases were (and often still are) critical for *systems of record*.
The World Wide Web
The introduction of the Web brought a whole new type of application with different constraints than systems of record
Mobile Apps

The introduction of mobile apps added to the growing number of systems of engagement.
Changing Constraints
Always On
Big Data
The CAP Theorem

- Consistency
- Availability
- Partition Tolerance
Horizontal Scaling
Horizontal scaling is scaling through the addition of commodity hardware.
Eventual Consistency

Given no new updates, each node in a distributed system will eventually have a consistent view of the data.
Enter "Not only SQL" (NoSQL)
key-value

graph

document

...more
Key-Value Stores
Opaque data accessed through **unique keys**
Document Databases
A variation on key-value stores with strictly defined values (e.g. JSON objects)
Graph Databases
Nodes and properties of nodes connected via edges
Domain-Driven Design (DDD)
Domain-Driven Design
Tackling Complexity in the Heart of Software
Domain-Driven Design
A collaboration between domain experts and software practitioners
Complexity is in the Domain

Complexity is in the domain, **not in the technology**
Models as Tools

Models are tools used to **solve problems** within the domain.
The Map is not the Territory
Don't confuse **models** with reality itself
Building Blocks of DDD and the Life Cycle of a Domain Object
Entities

Entities are defined by their identity.
Value Objects

Value objects encode attributes that describe things
Aggregates

Aggregates group related entities to minimize complexity
Repositories

A repository provides the *illusion* of an in-memory data store
Domain Layer

Order Aggregate

<table>
<thead>
<tr>
<th>Class</th>
<th>Attributes</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>- id : int</td>
<td>+ insertOrder(order:Order)</td>
</tr>
<tr>
<td></td>
<td>- customer : Customer</td>
<td>+ updateOrder(order:Order)</td>
</tr>
<tr>
<td></td>
<td>- date : Date</td>
<td>+ findOrderById(id:int) : Order</td>
</tr>
<tr>
<td></td>
<td>- lineItems : LineItem[1..*]</td>
<td>+ recentOrders([limit:int]) : Order[0..*]</td>
</tr>
<tr>
<td></td>
<td>+ total() : Money</td>
<td></td>
</tr>
</tbody>
</table>

Customer

<table>
<thead>
<tr>
<th>Class</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LineItem

<table>
<thead>
<tr>
<th>Class</th>
<th>Methods</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
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</table>

Infrastructure Layer

InMemoryOrderRepository

<table>
<thead>
<tr>
<th>Class</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>InMemoryOrderRepository</td>
<td>+ insertOrder(order:Order)</td>
</tr>
<tr>
<td></td>
<td>+ updateOrder(order:Order)</td>
</tr>
<tr>
<td></td>
<td>+ findOrderById(id:int) : Order</td>
</tr>
<tr>
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<td>+ recentOrders(limit:int) : Order[0..*]</td>
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</table>

RelationalMapperOrderRepository

<table>
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<tr>
<th>Class</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>RelationalMapperOrderRepository</td>
<td>+ insertOrder(order:Order)</td>
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<tr>
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<td>+ recentOrders(limit:int) : Order[0..*]</td>
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</tbody>
</table>
Choosing the Right Data Layer
Data Store

A repository cannot abstract the constraints of your data store
Object-Relational Impédance Mismatch

Object-oriented programming and relational databases use different models
Eric Evans on NoSQL
"This is the world of NoSQL to me, that we can choose a tool that fits well with the problem we're trying to solve." –Eric Evans (author of Domain-Driven Design)
Strategic Design
Bounded Context

Bounded contexts allow different domain models to be used within different contexts.
One Data Layer Per Bounded Context

Each bounded context should have its own data layer, and should not directly access a data layer belonging to another bounded context.
Data Systems

A data layer may be a database, or it can be a data system consisting of multiple databases.
Microservices as Bounded Context

Represent each bounded context as a microservice or a cluster of microservices.
Catalog
- Document Database
- Key/Value Store
- Graph Database
- Full Text Search

Shopping Cart
- Document Database
- Key/Value Store

Orders
- Relational Database
- Big Data Analytics (e.g. Apache Spark)
Alternative Architectures
Command Query Responsibility Segregation (CQRS)

Rather than update an entity in place, CQRS provides separate read and write models.
### Domain Layer

#### Read Model

**OrderQueryHandler**

- `findOrderById(id:int) : OrderDetails`
- `recentOrders([limit:int]) : OrderSummary[0..*]`

**OrderDetails**

- `getId() : int`
- `getCustomer() : Customer`
- `getDate() : Date`
- `getLineItems() : LineItem[1..*]`
- `getTotal() : Money`

**OrderSummary**

- `getId() : int`
- `getDate() : Date`
- `getTotal() : Money`

#### Write Model

**CreateOrder**

- `customer : Customer`
- `date : Date`
- `lineItems : LineItem[1..*]`

**AddLineItem**

- `orderId : int`
- `lineItem : LineItem`

**OrderCommandHandler**

- `handle(command:CreateOrder)`
- `handle(command:AddLineItem)`

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@BradleyHolt
Event Sourcing
The current application state is **computed from a sequence of events**
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