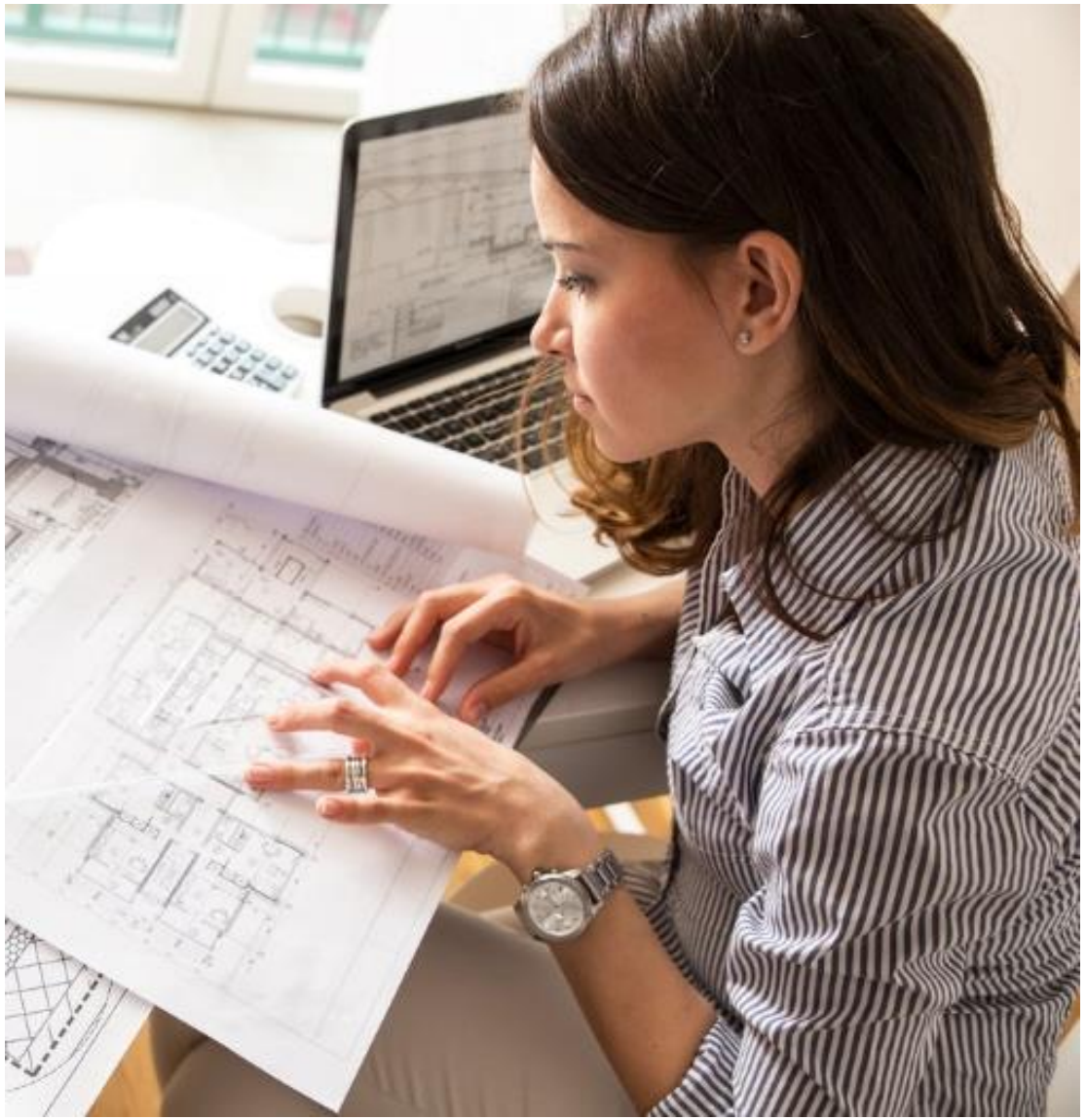
Clean Architecture

Patterns, Practices, and Principles

Matthew Renze
@matthewrenze
#hdc15



About Me

- Independent software consultant
- Education
  - B.S. in Computer Science (ISU)
  - B.A. in Philosophy (ISU)
- Training
  - Data Warehousing (Kimball Group)
  - ArcGIS, ArcSDE, and ArcGIS Server (ESRI)
  - Data Science Specialization (Johns Hopkins) [In progress]

IOWA STATE UNIVERSITY

KIMBALL GROUP

esri

JOHNS HOPKINS UNIVERSITY

Overview

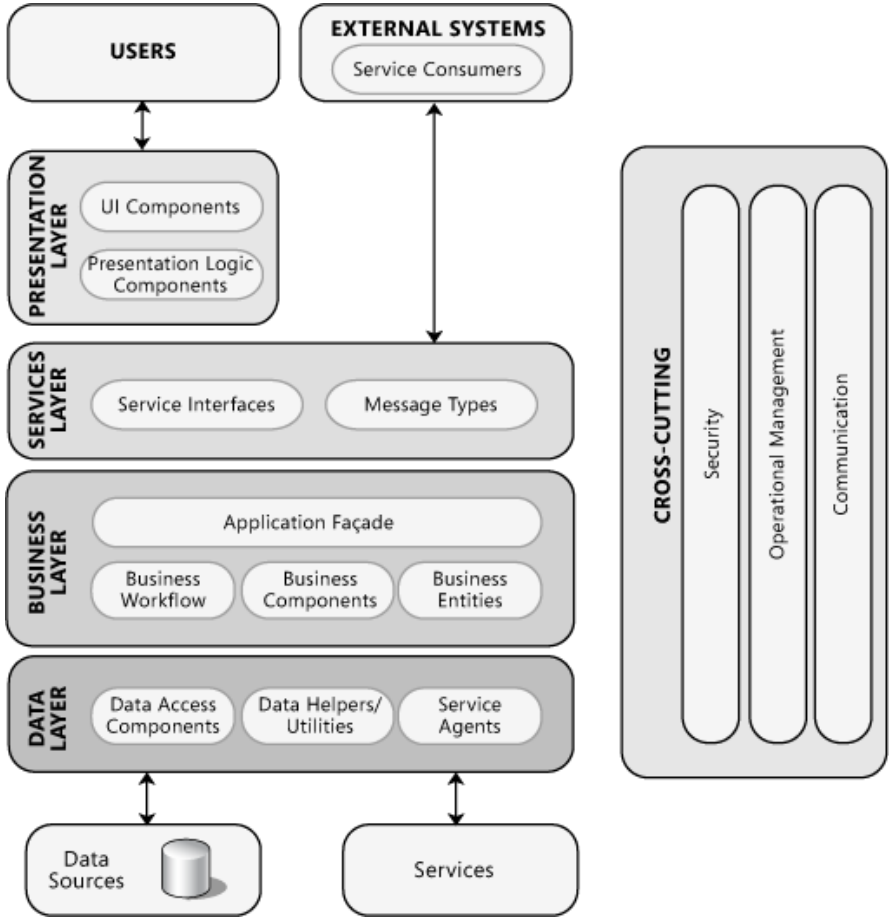
- Clean Architecture
- Domain-Centric Architecture
- Application Layer
- Commands and Queries
- Functional Organization
- Microservices

Focus

- Enterprise Architecture
- Line-of-Business Applications
- Modern equivalent of 3-Layer
- Generally applicable
- 6 Key Points
- Q & A

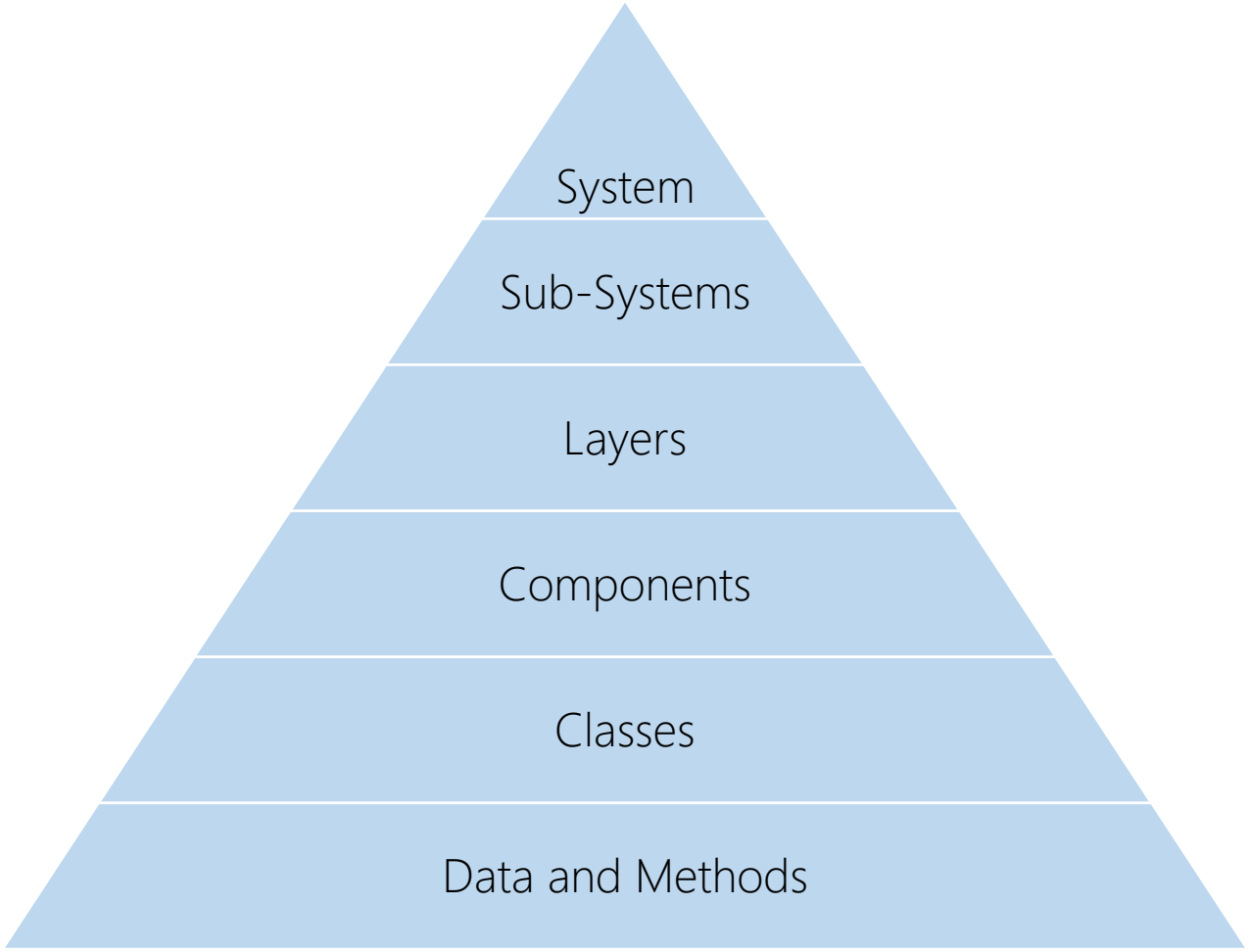
What is Software Architecture?

- High-level
- Structure
- Layers
- Components
- Relationships

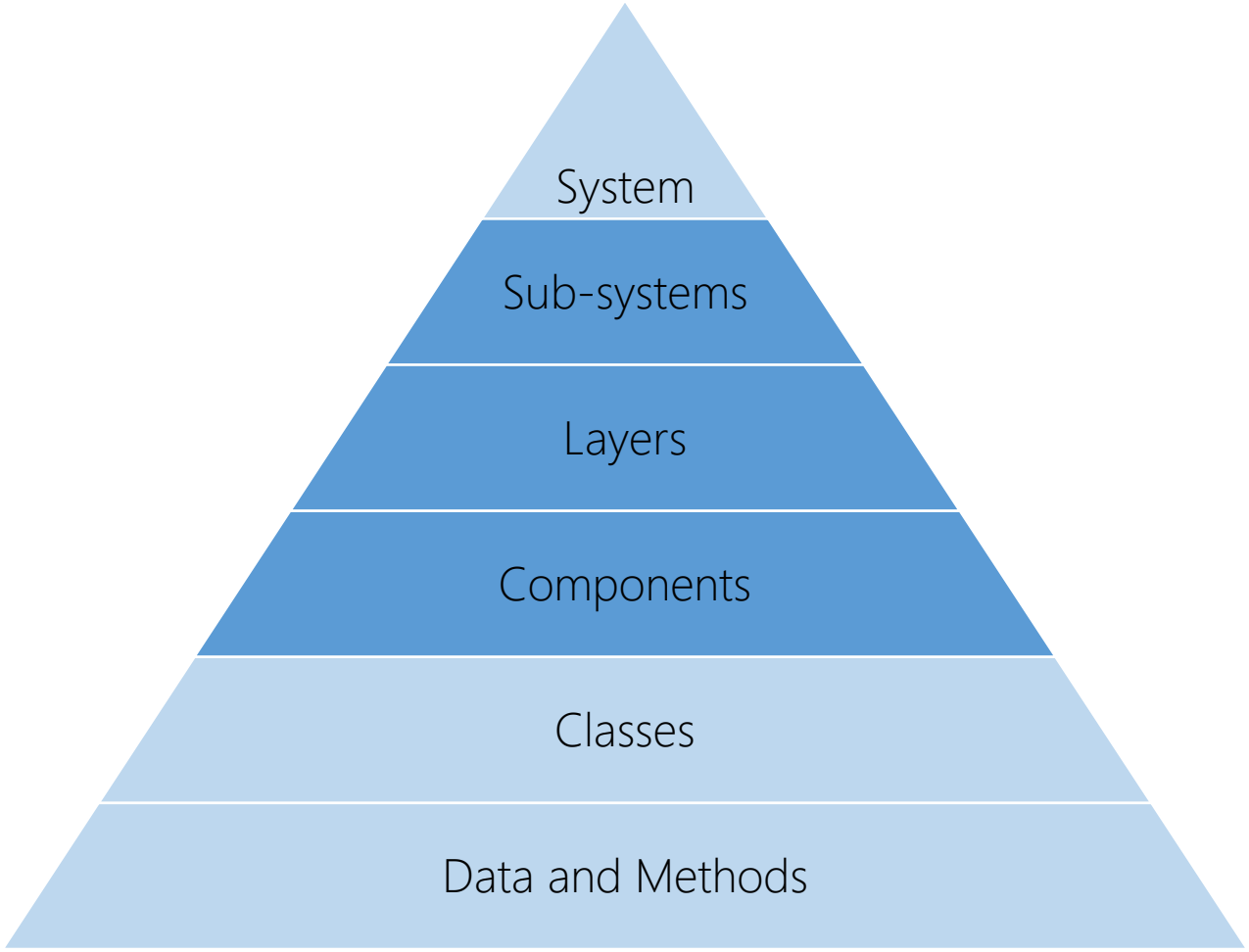


Source: http://msdn.microsoft.com/en-us/library/ff650706.aspx

Levels of Architectural Abstraction



Levels of Architectural Abstraction



Messy vs Clean Architecture

Messy vs Clean Architecture

Messy vs Clean Architecture

What is Bad Architecture?

- Complex
- Inconsistent
- Incoherent
- Ridged
- Brittle
- Untestable
- Unmaintainable

What is Clean Architecture?

- Simple
- Understandable
- Flexible
- Emergent
- Testable
- Maintainable

What is Clean Architecture?

Architecture that is designed for the inhabitants of the architecture, not for the architect, or the machine

Why is Clean Architecture Important?

- Cost/benefit
- Minimize cost to maintain
- Maximize business value

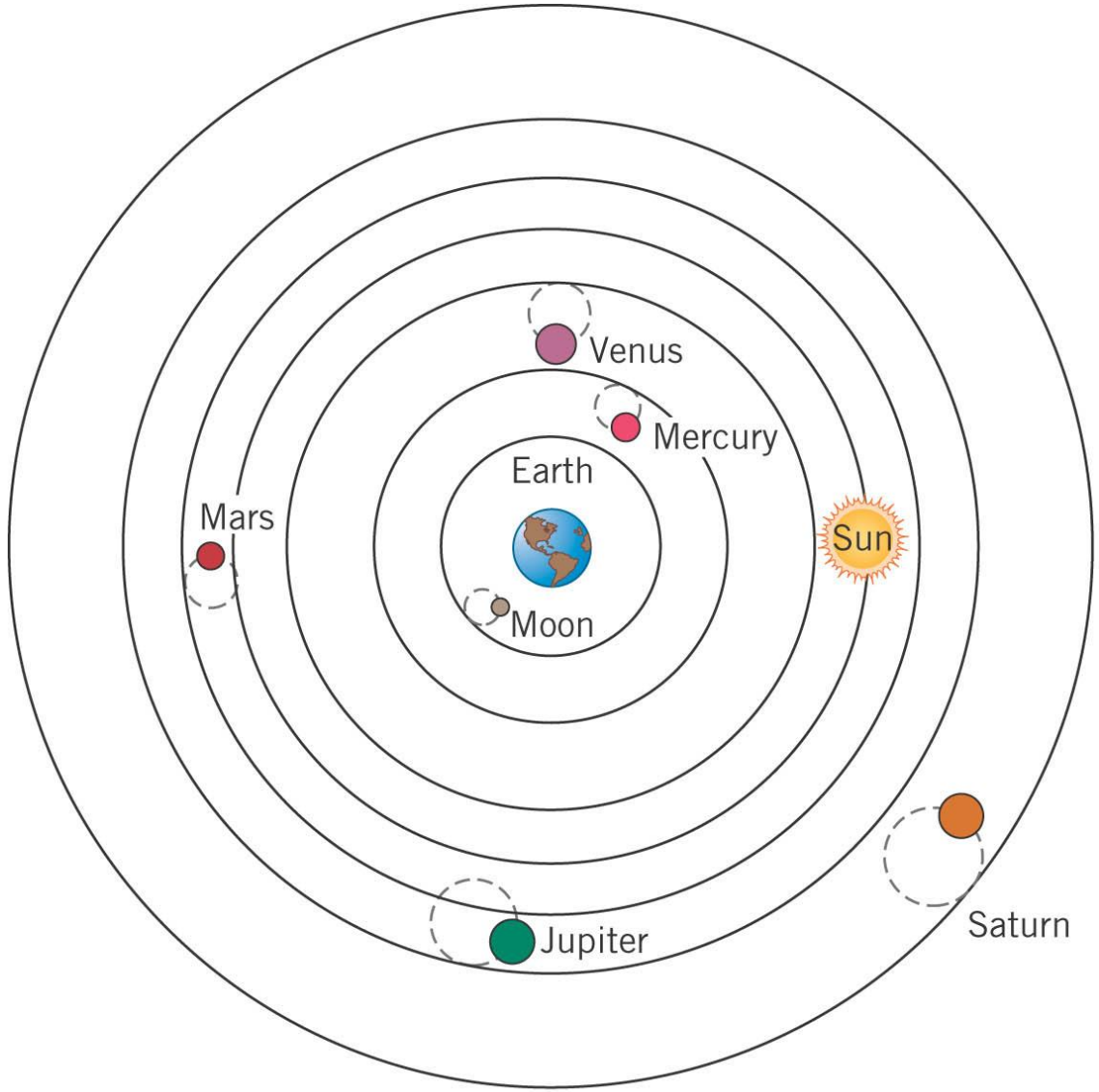
How Do We Create Clean Architecture?

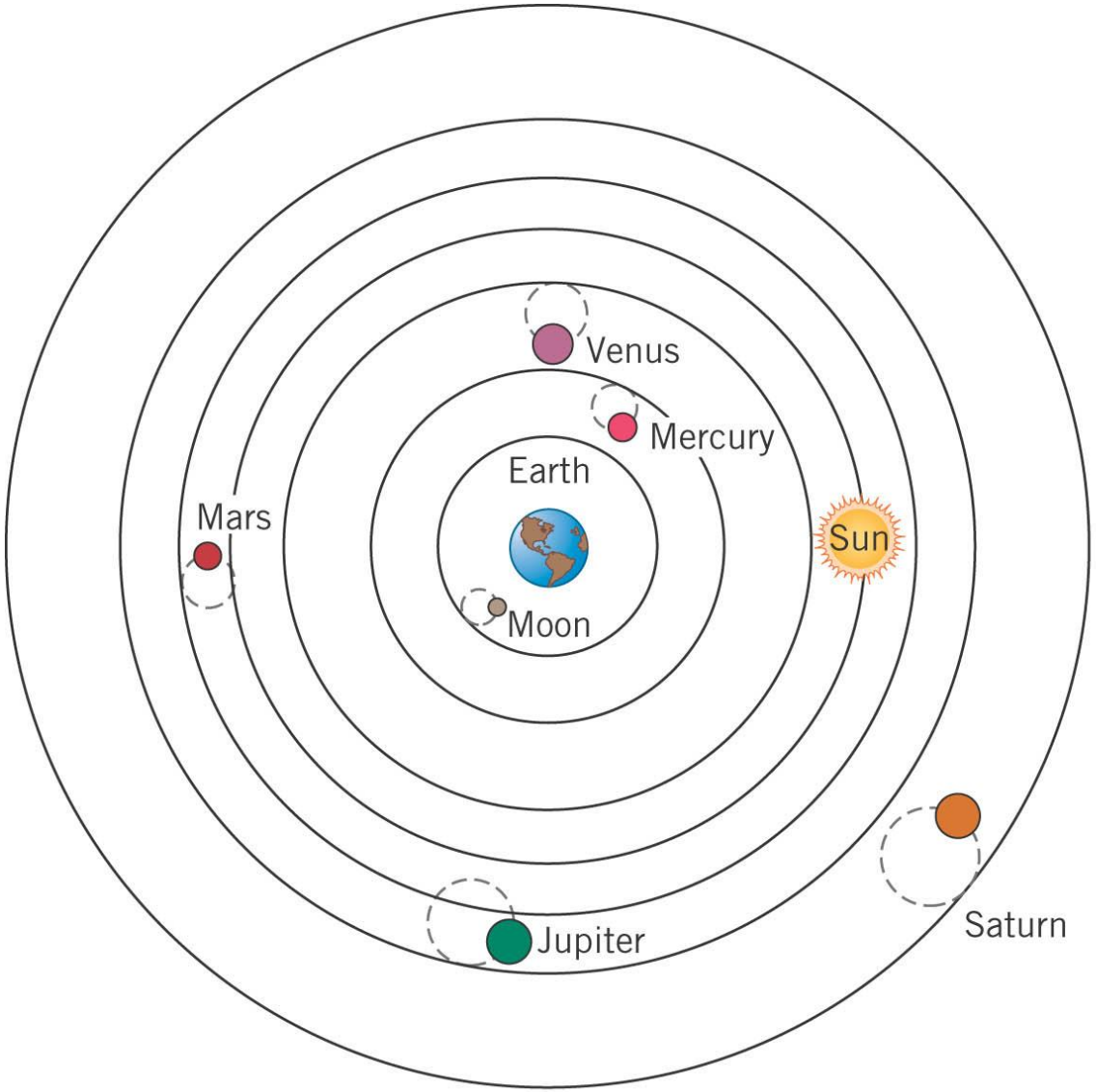
- Design for inhabitants first
- Focus on the domain
- Use an application layer
- Separate commands and queries
- Organize via functional cohesion
- Divide at bounded contexts

Decisions, Decisions, Decisions…

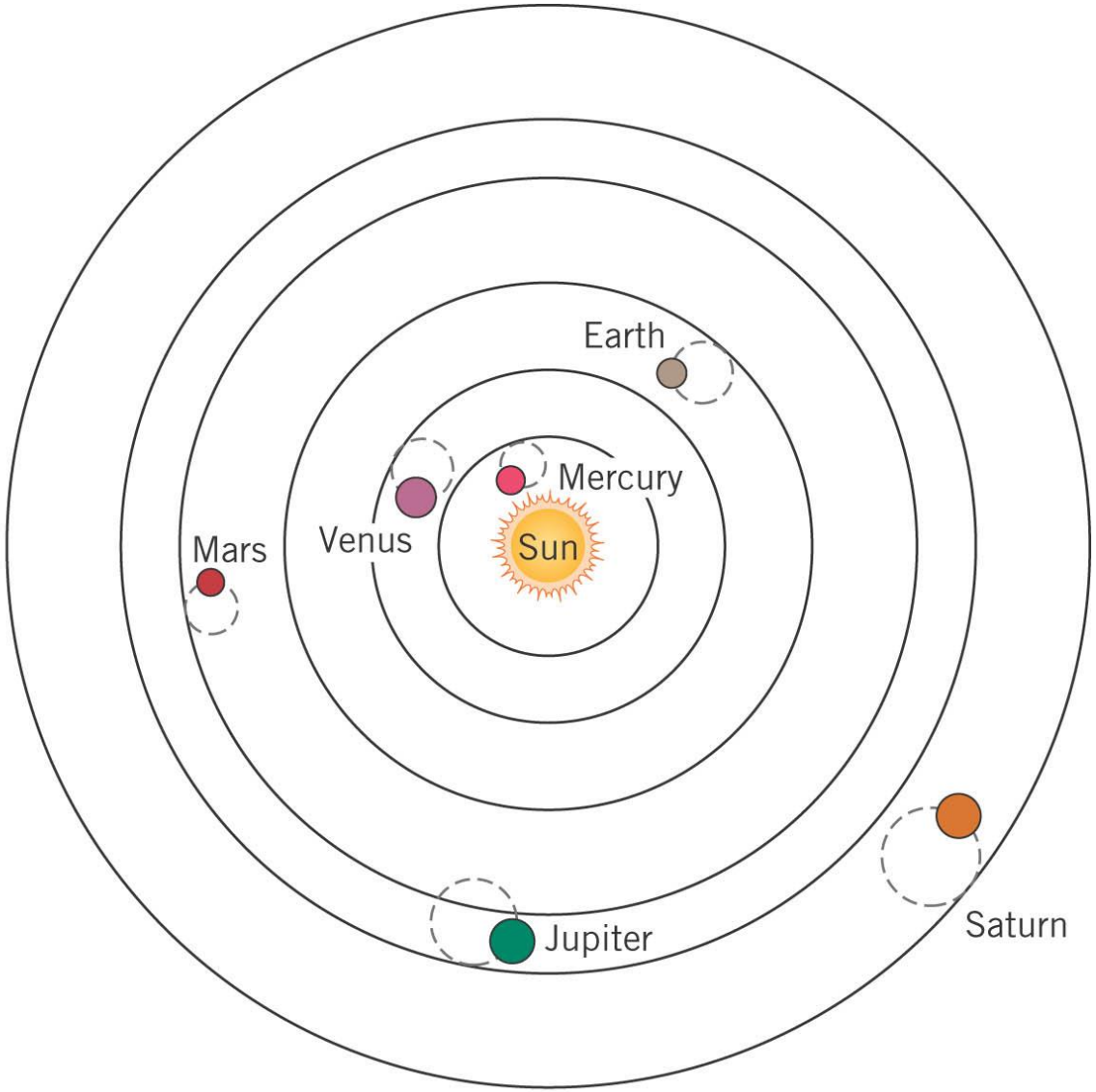
- Context is king
- All decisions are a tradeoff
- Use your best judgement

Domain-Centric Architecture


Venus
Mercury
Earth
Mars
Sun
Moon
Jupiter
Saturn

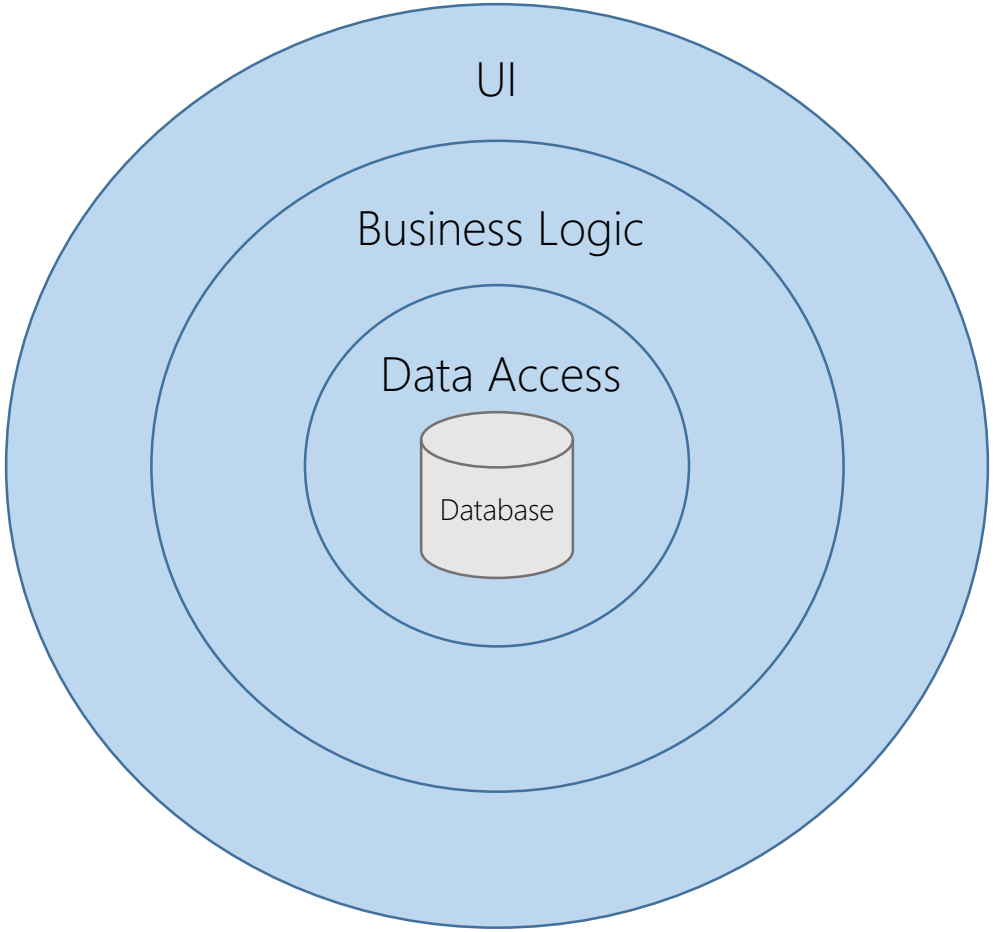


Geocentric Model

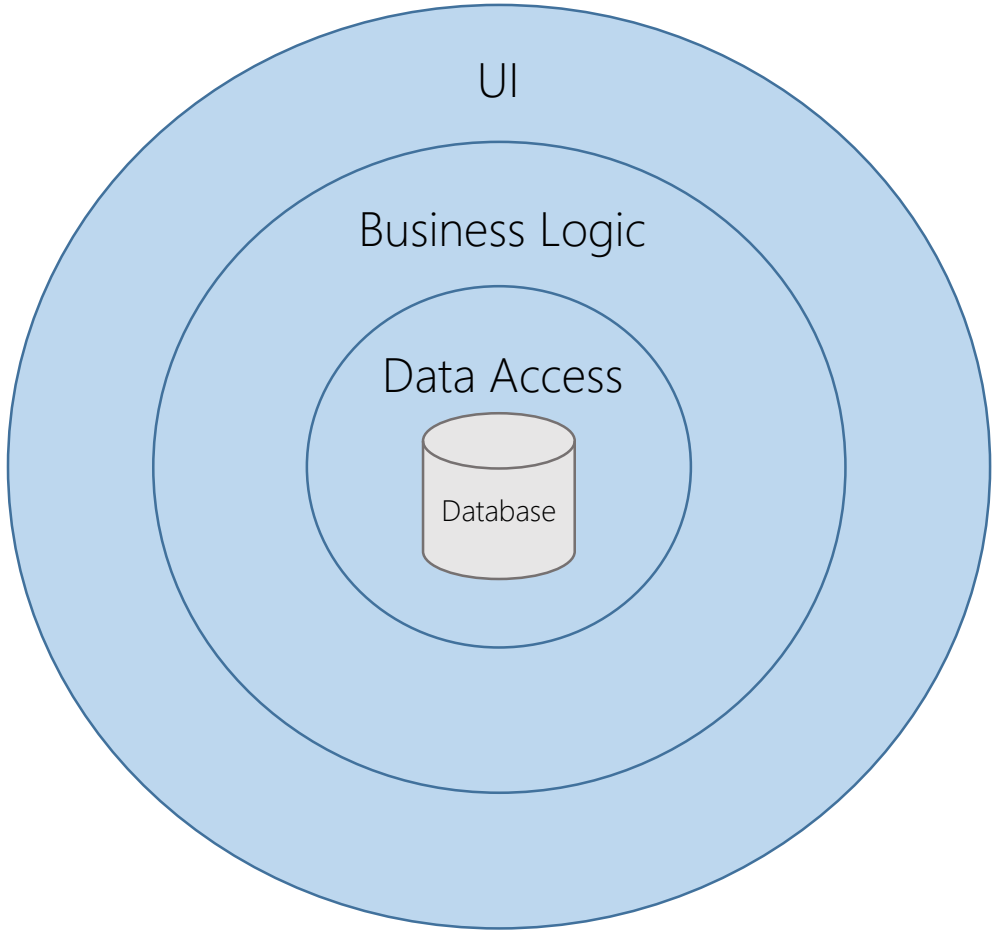


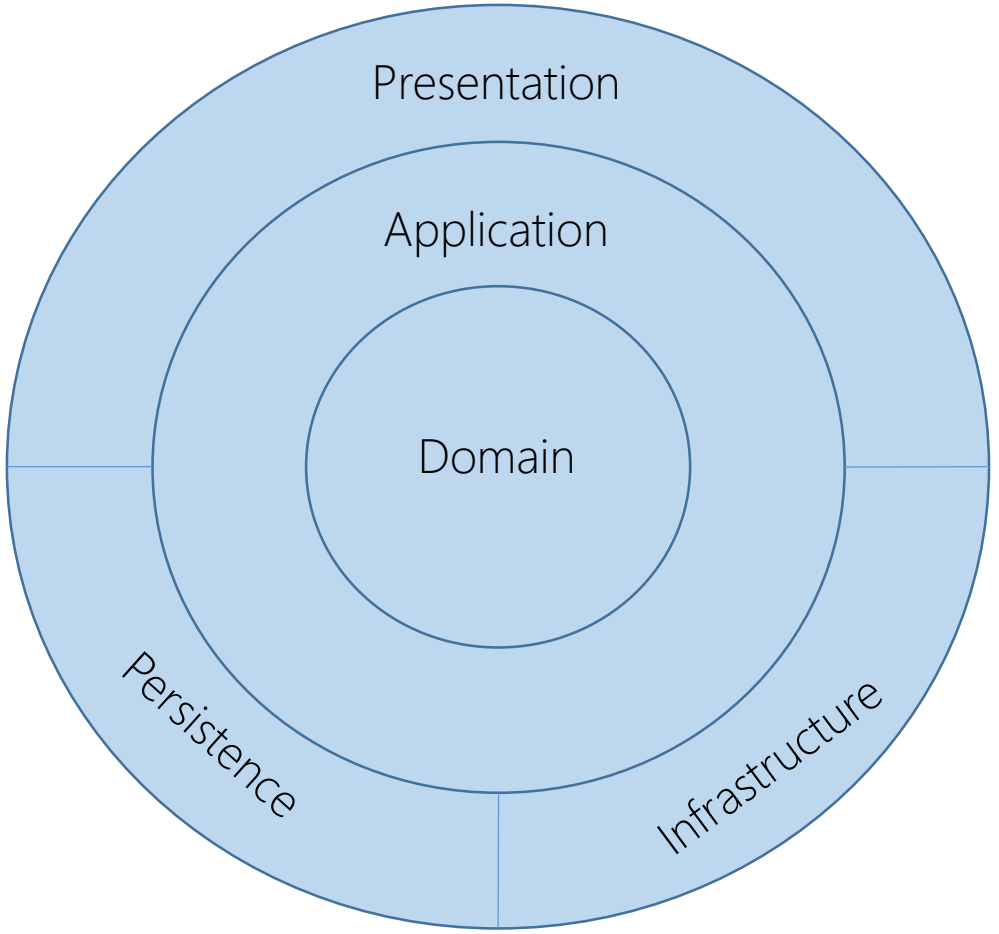
Heliocentric Model

Classic 3-Layer Database-centric Architecture



Database- vs. Domain-centric Architecture





"The first concern of the architect is to make sure that the house is usable, it is not to ensure that the house is made of brick."

– Uncle Bob

Essential vs. Detail

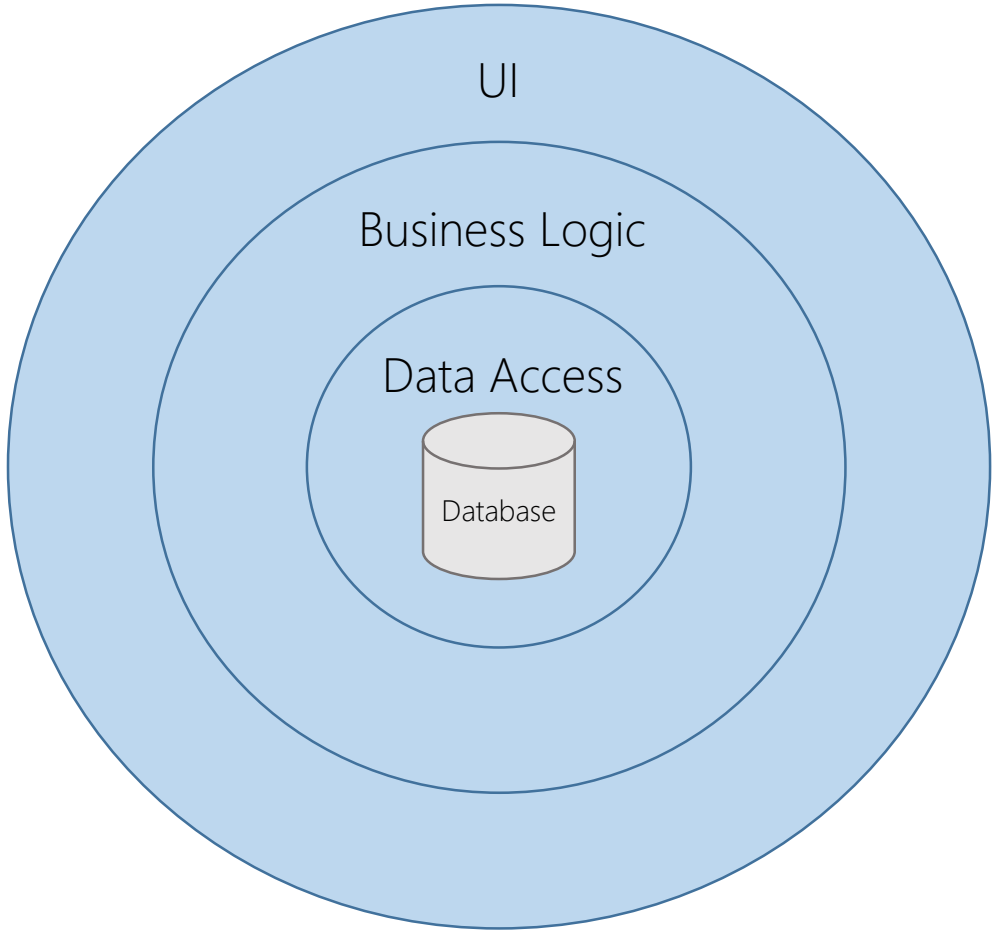
- Space is essential
- Usability is essential
- Building material is a detail
- Ornamentation is a detail

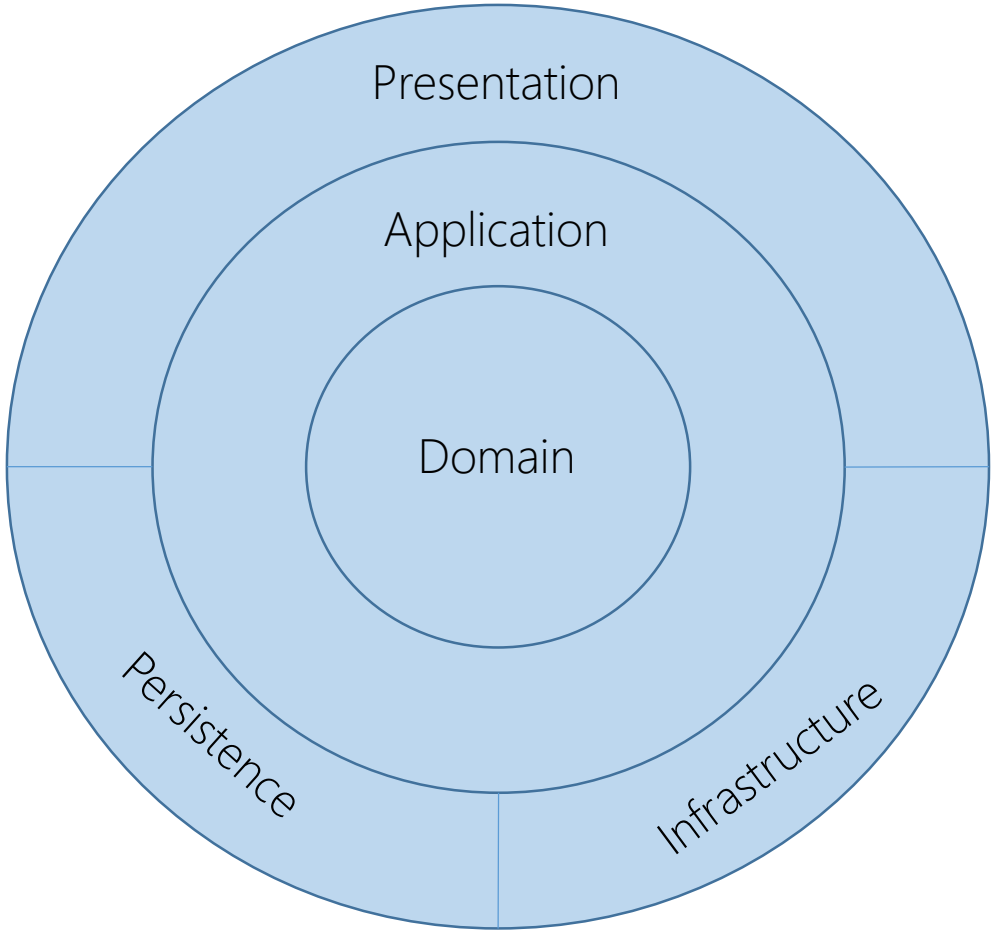
Source: http://www.whitegadget.com/attachments/pc-wallpapers/85254d1320380902-house-house-wallpaper.jpg

Essential vs. Detail

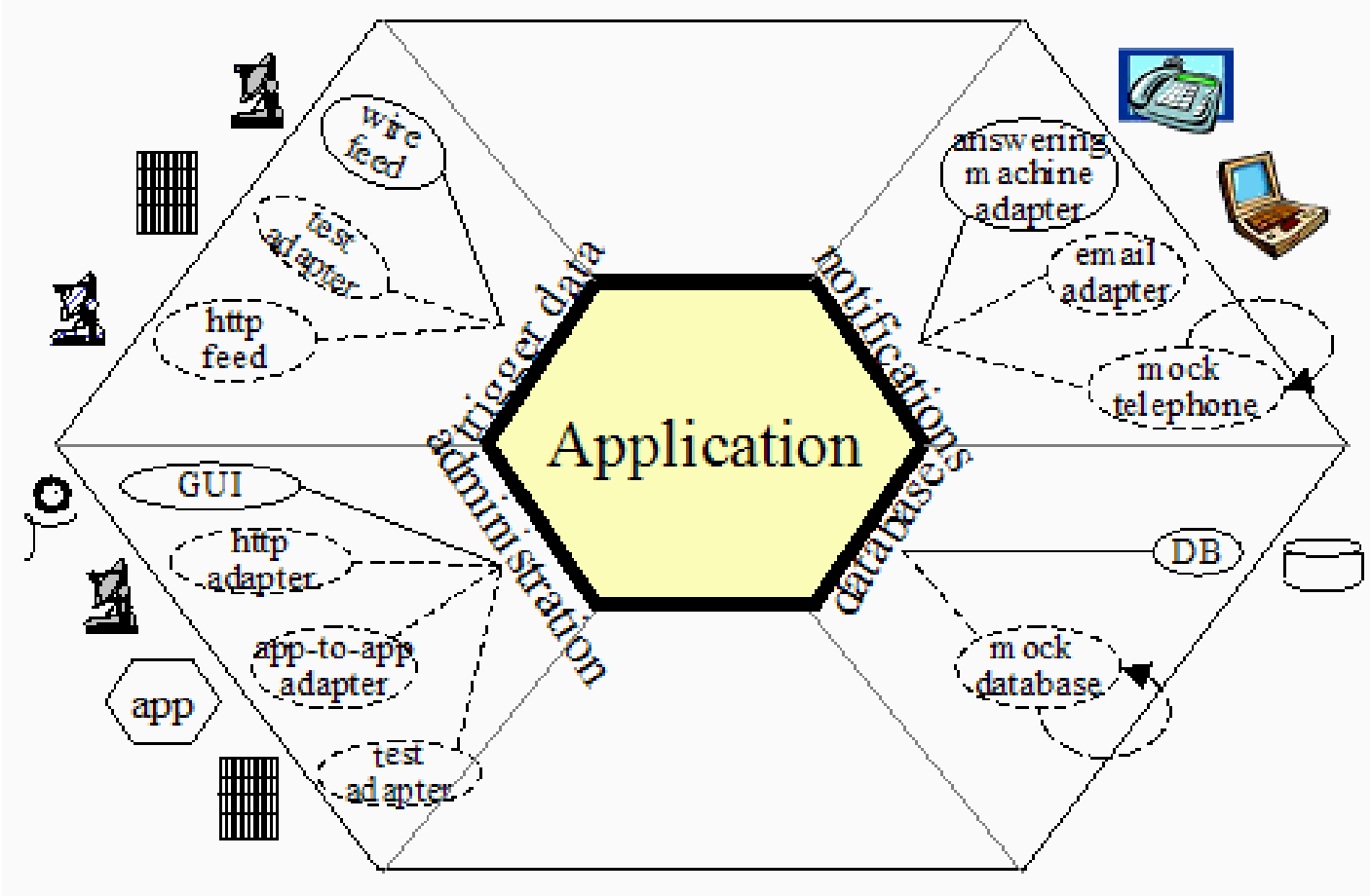
- Use cases are essential
- Domain is essential
- Presentation is a detail
- Persistence is a detail

Database- vs. Domain-centric Architecture

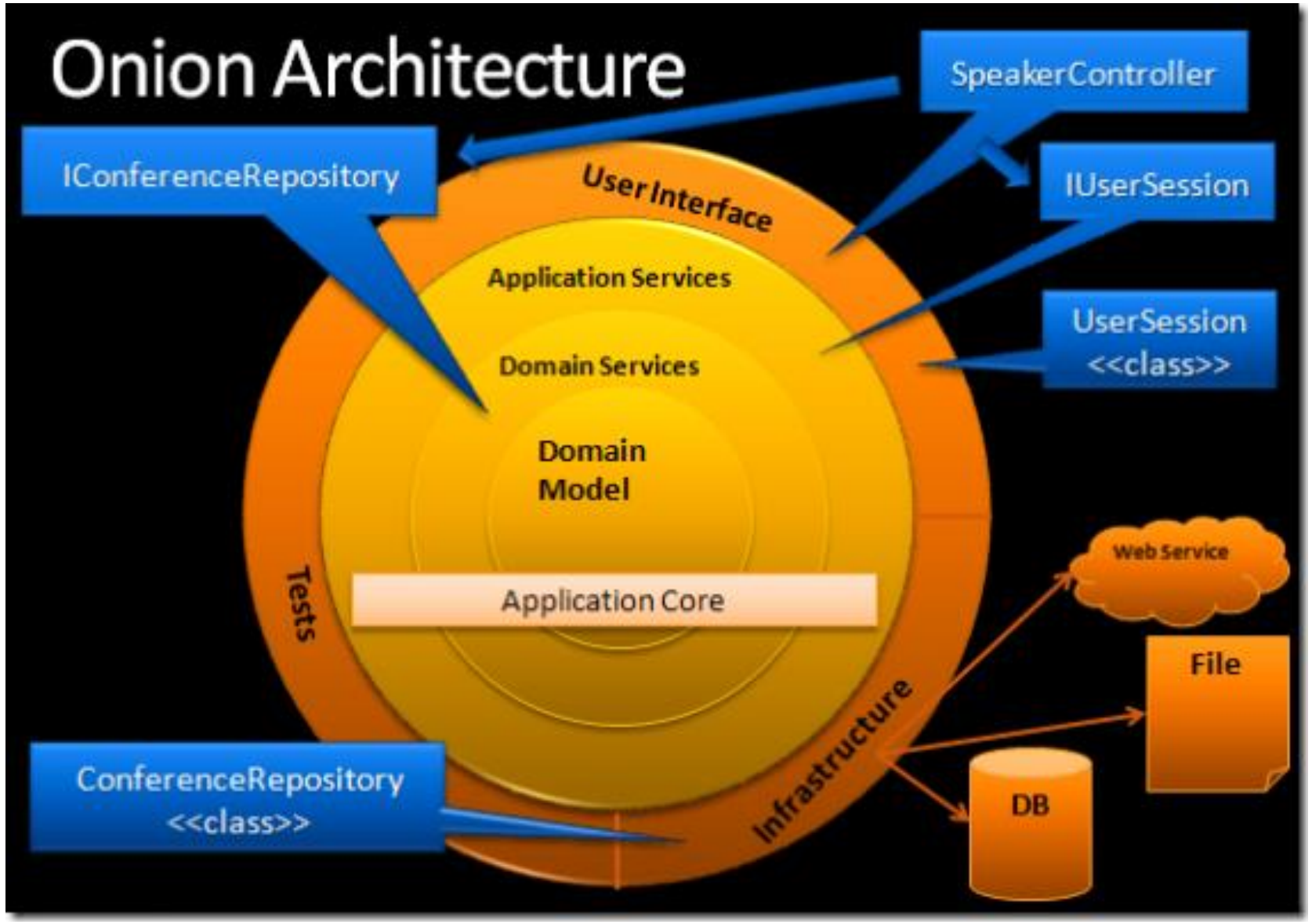




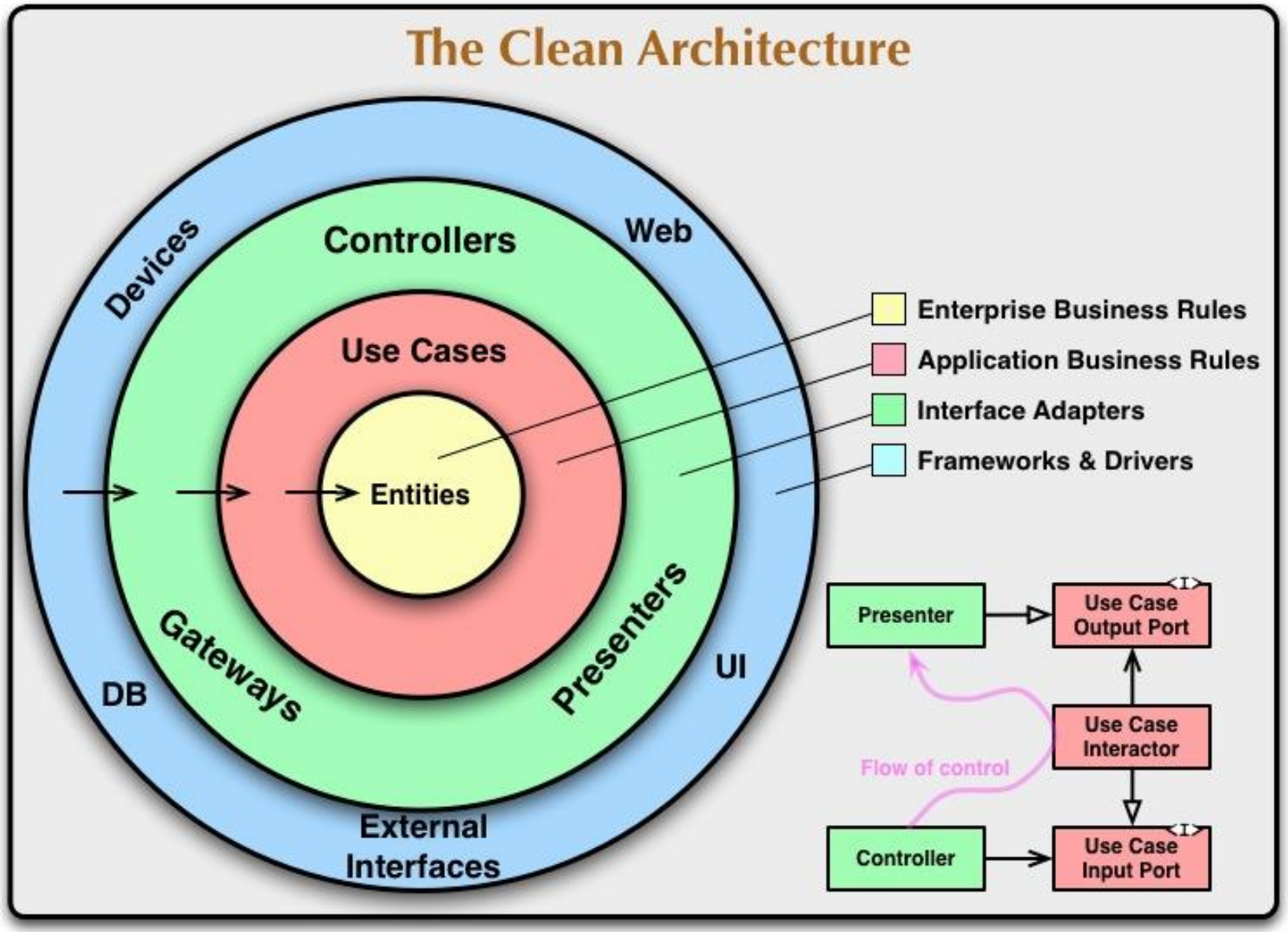
Hexagonal Architecture



Source: http://alistair.cockburn.us/Hexagonal+architecture

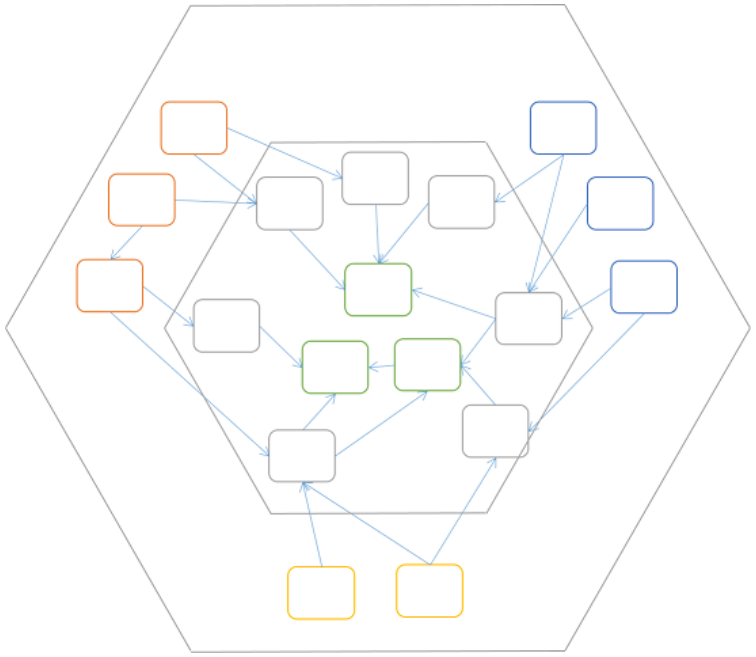


Source: http://jeffreypalermo.com/blog/the-onion-architecture-part-2/

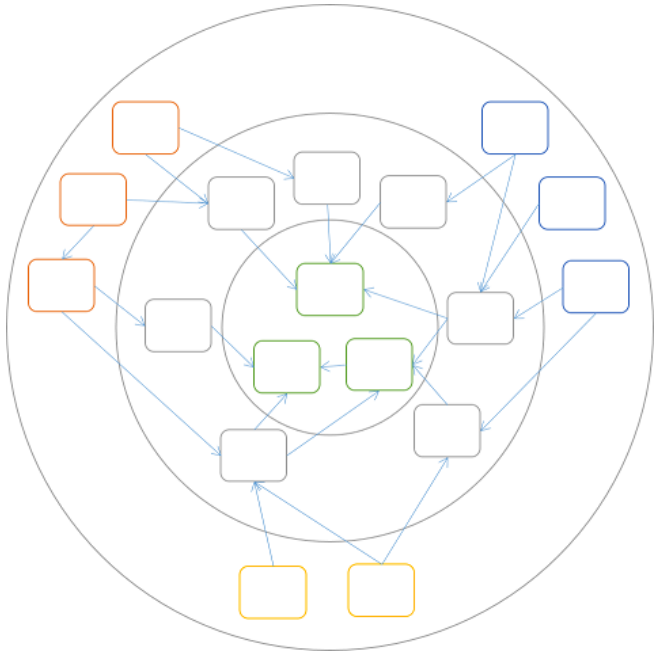


Source: http://blog.8thlight.com/uncle-bob/2012/08/13/the-clean-architecture.html

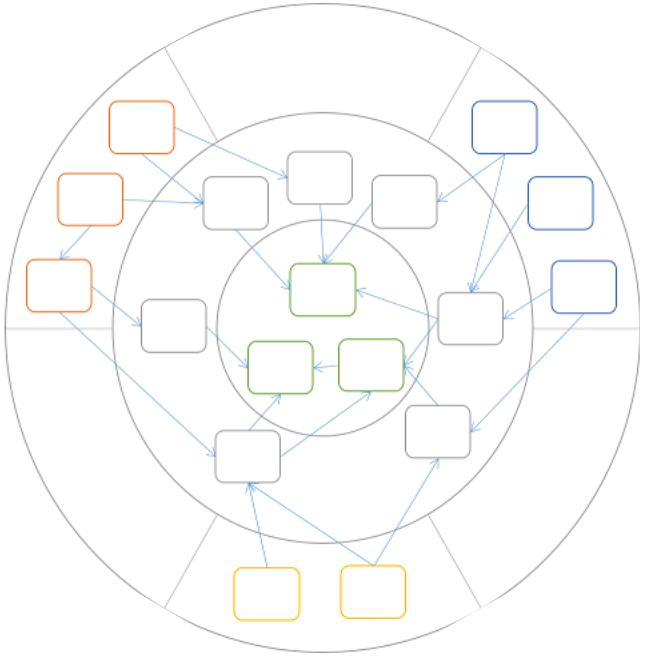
It's All the Same Thing



Hexagonal



Onion



Clean

http://blog.ploeh.dk/2013/12/03/layers-onions-ports-adapters-its-all-the-same/

Why Use Domain-Centric Architecture?

Pros

- Focus on essential
- Less coupling to details
- Necessary for DDD

Why Use Domain-Centric Architecture?

Pros

- Focus on essential
- Less coupling to details
- Necessary for DDD

Cons

- Change is difficult
- Extra layer
- Cost may not be justified

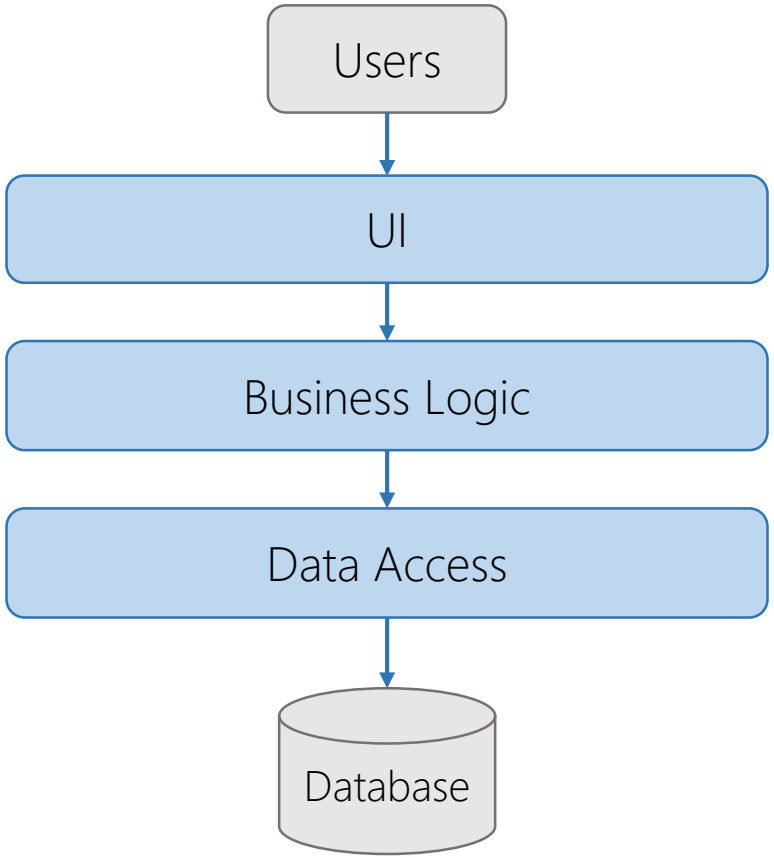
Application Layer

What are Layers?

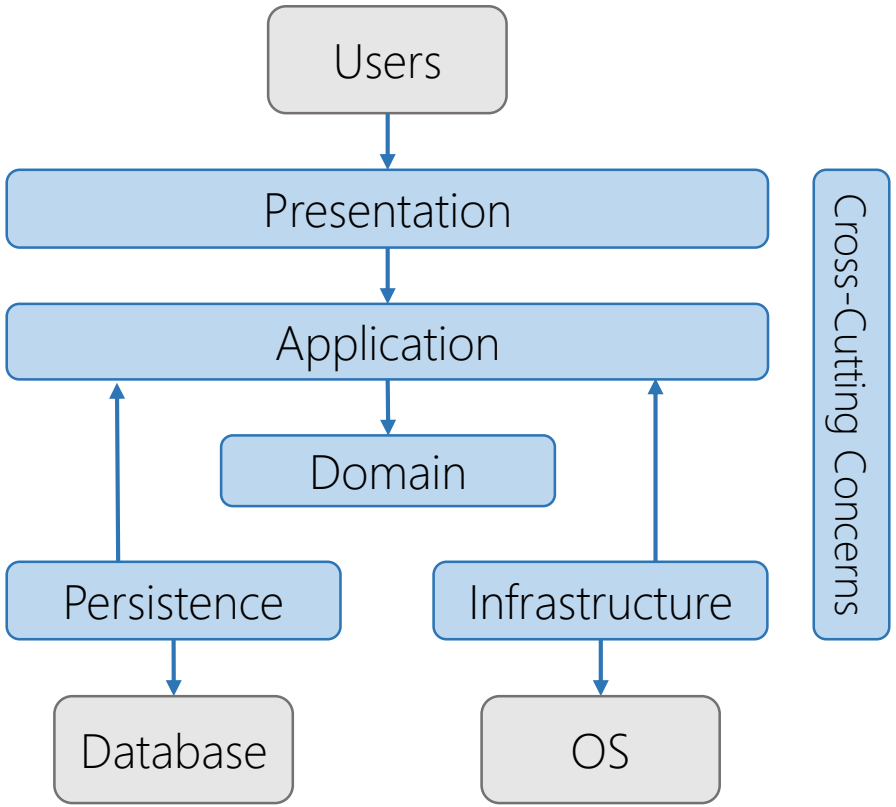
- Levels of abstraction
- Single-Responsibility Principle
- Developer roles / skills
- Multiple implementations
- Varying rates of change

Note: Layers vs. tiers

Classic 3-Layer Architecture

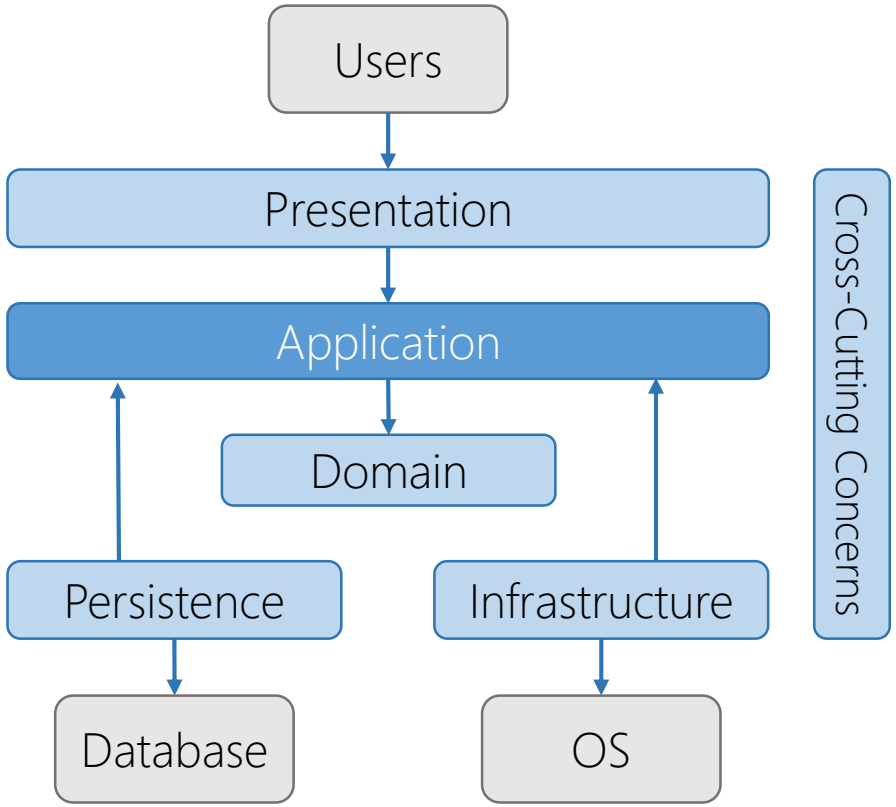


Modern 4-Layer Architecture



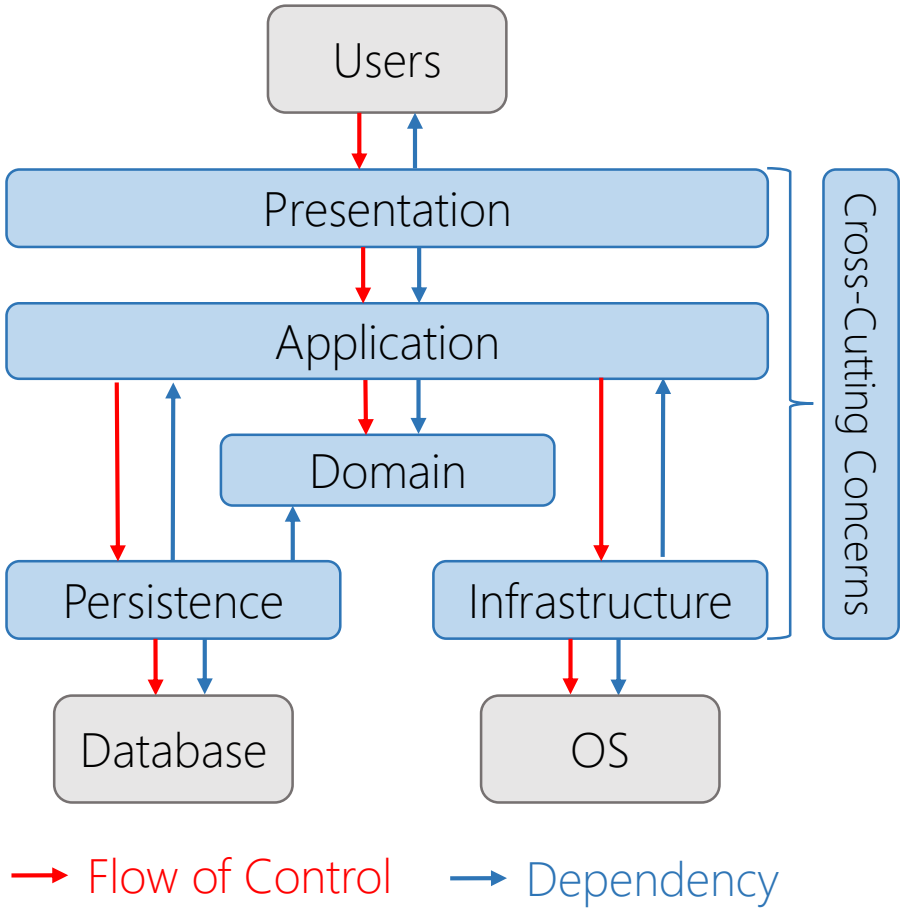
Application Layer

- Implements use cases
- High-level application logic
- Knows about lower layers
- No knowledge of upper layers
- Contains interfaces for details



Layer Dependencies

- Dependency inversion
- Inversion of control
- Independent deployability
- Flexibility and maintainability



Why Use an Application Layer?

Pros

- Focuses on use cases
- Very easy to understand
- Follows DIP

Why Use an Application Layer?

Pros

- Focuses on use cases
- Very easy to understand
- Follows DIP

Cons

- Additional cost
- Requires extra thought
- IoC is counter-intuitive

Commands and Queries

Command-Query Separation

Command

- Does something
- Modifies state
- Should not return a value

Command-Query Separation

Command

- Does something
- Modifies state
- Should not return a value

Query

- Answers a question
- Does not modify state
- Always returns a value

Command-Query Separation

Command

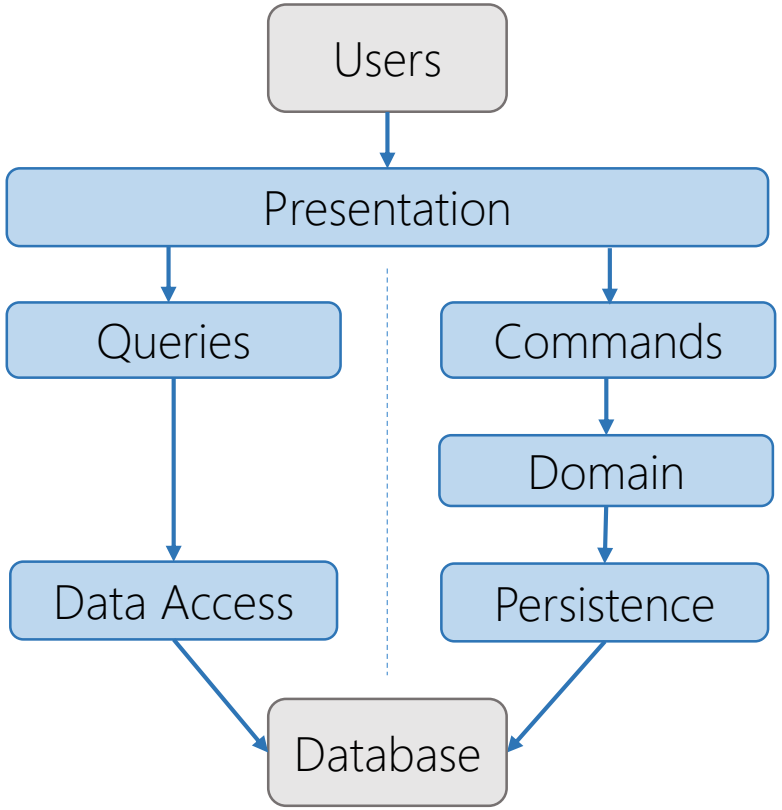
- Does something
- Modifies state
- Should not return a value *(ideally)*

Query

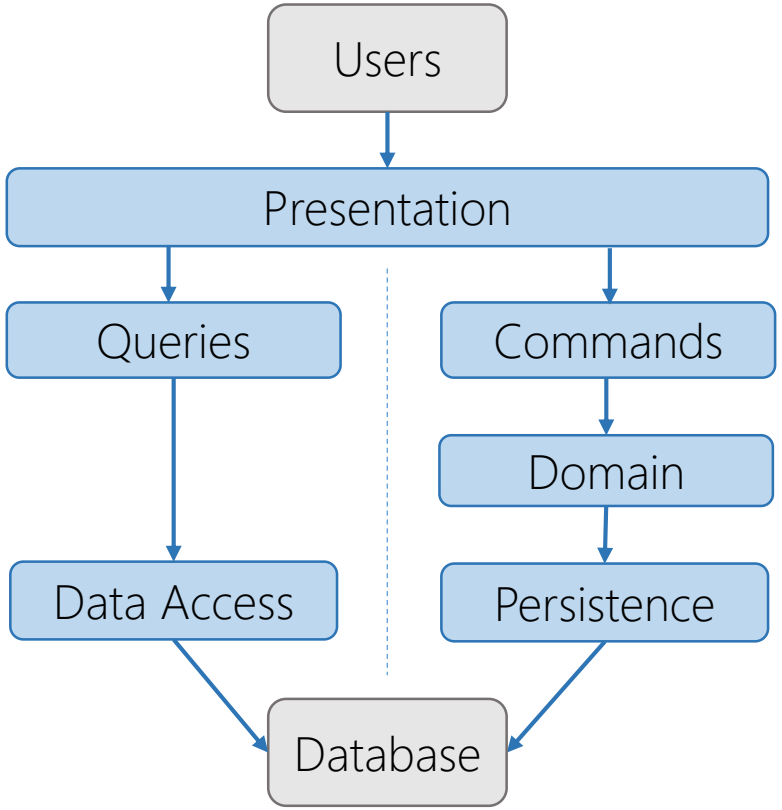
- Answers a question
- Does not modify state
- Always returns a value

Avoid mixing the two!

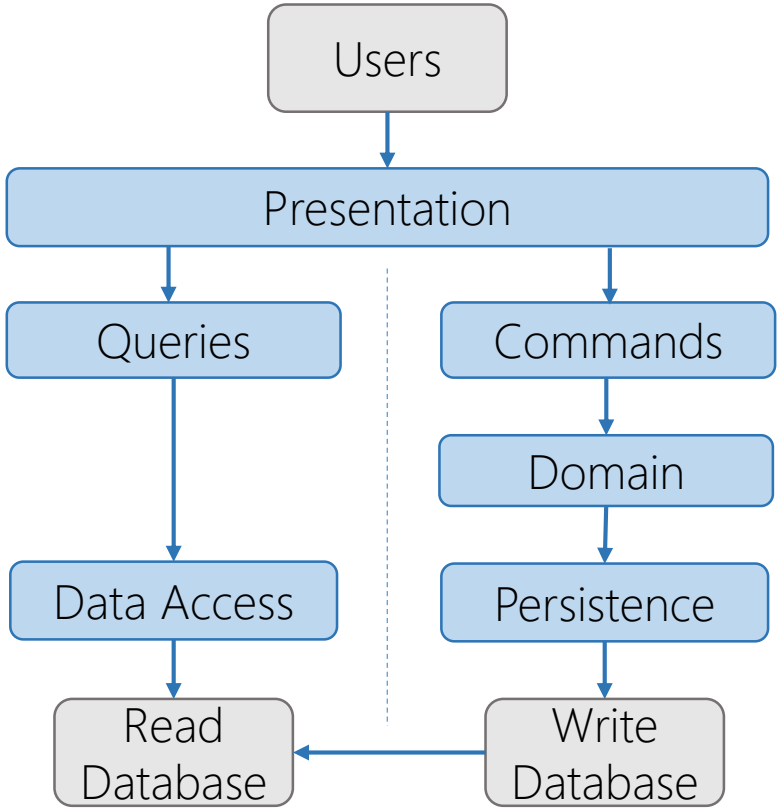
CQRS Architectures



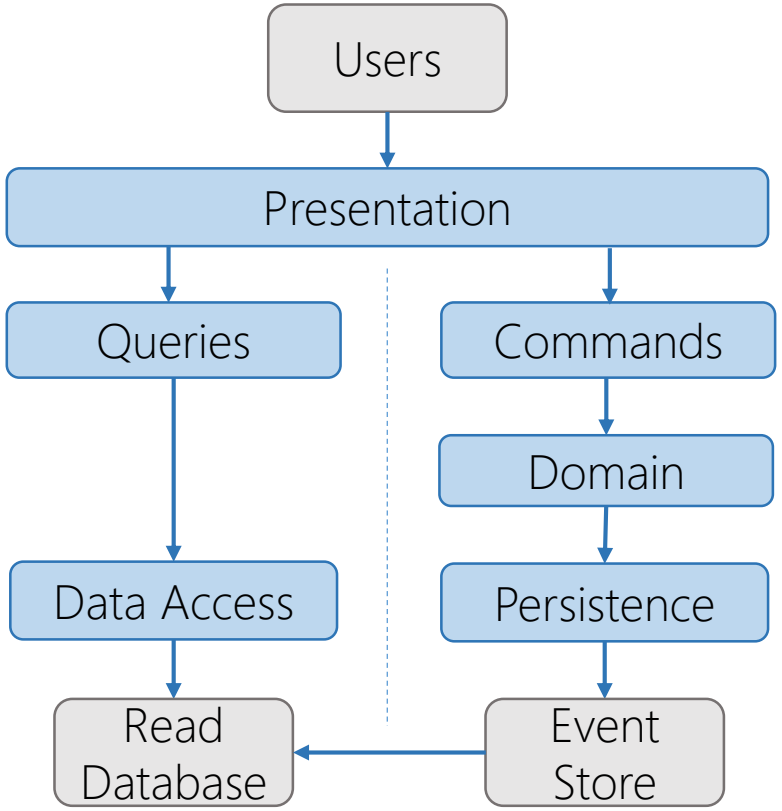
CQRS Type 1 – Single Database



CQRS Type 2 – Read/Write Databases

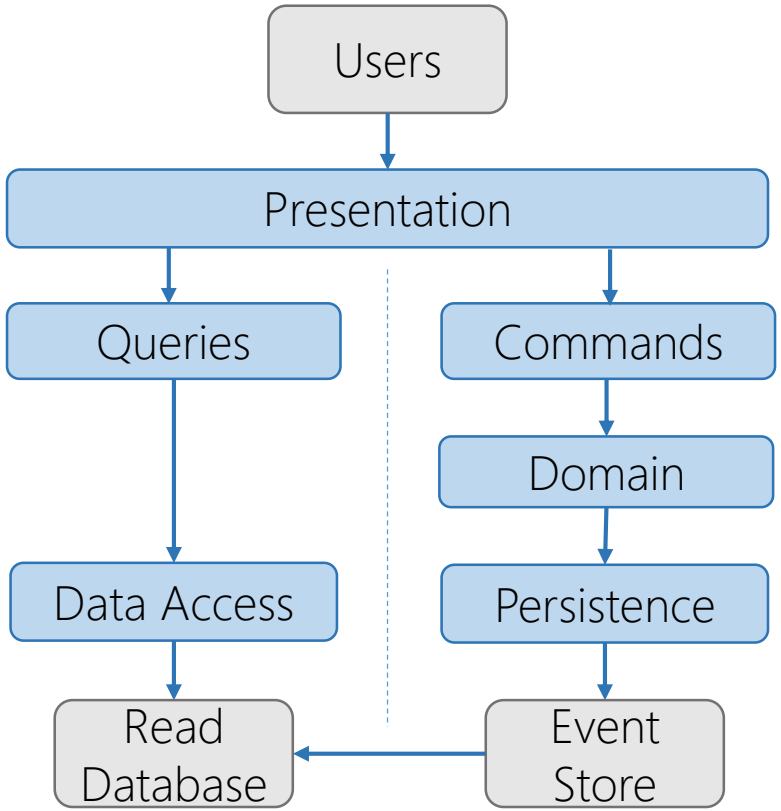


CQRS Type 3 – Event Sourcing



CQRS Type 3 – Event Sourcing

- Complete audit trail
- Point-in-time reconstruction
- Replay events
- Rebuild production database



Why Use CQRS?

Pros

- Efficient domain-centric design
- Simpler to understand
- Optimized performance

Why Use CQRS?

Pros

- Efficient domain-centric design
- Simpler to understand
- Optimized performance

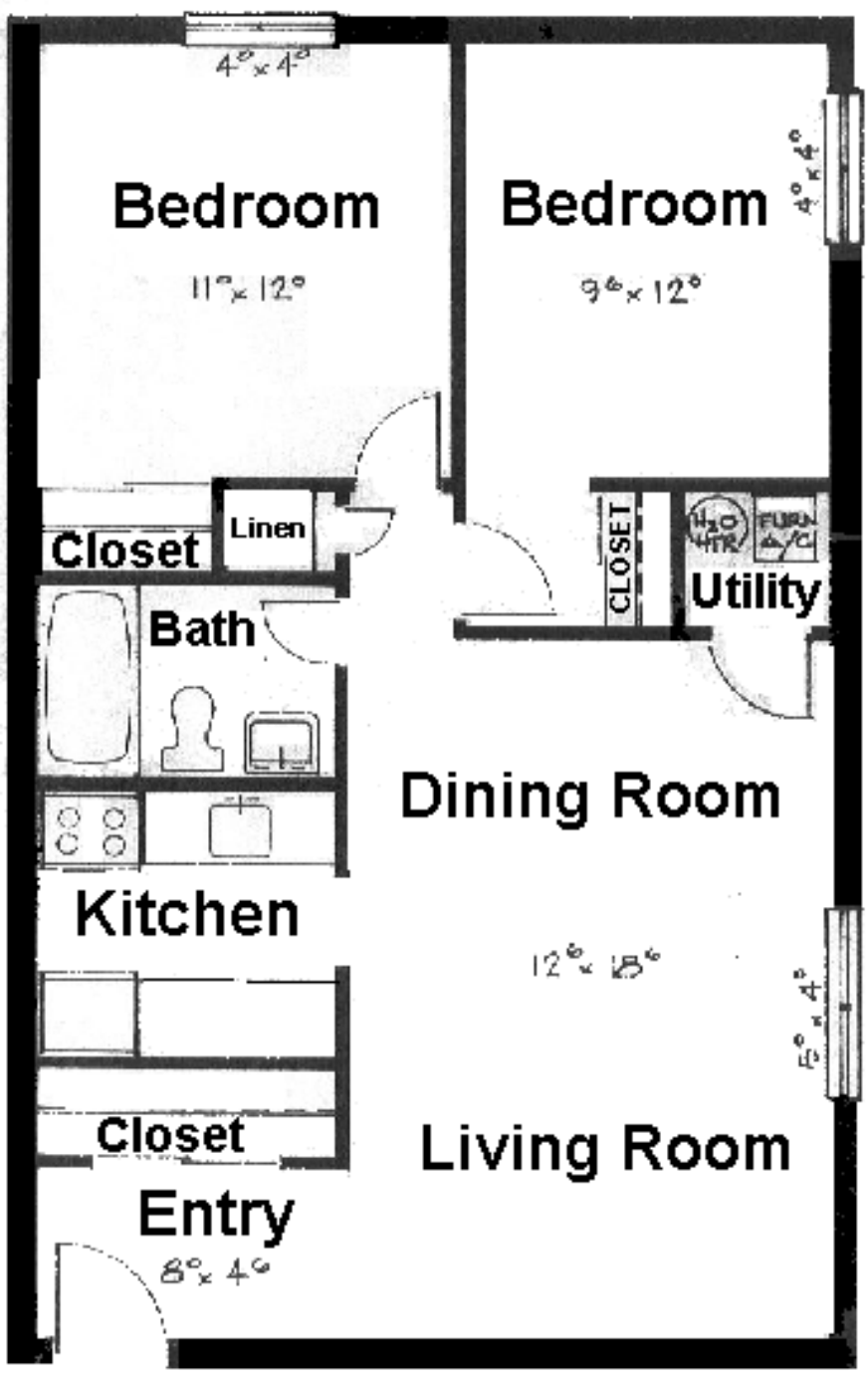
Cons

- Inconsistent design
- Type 2 is more complex
- Type 3 might be overkill

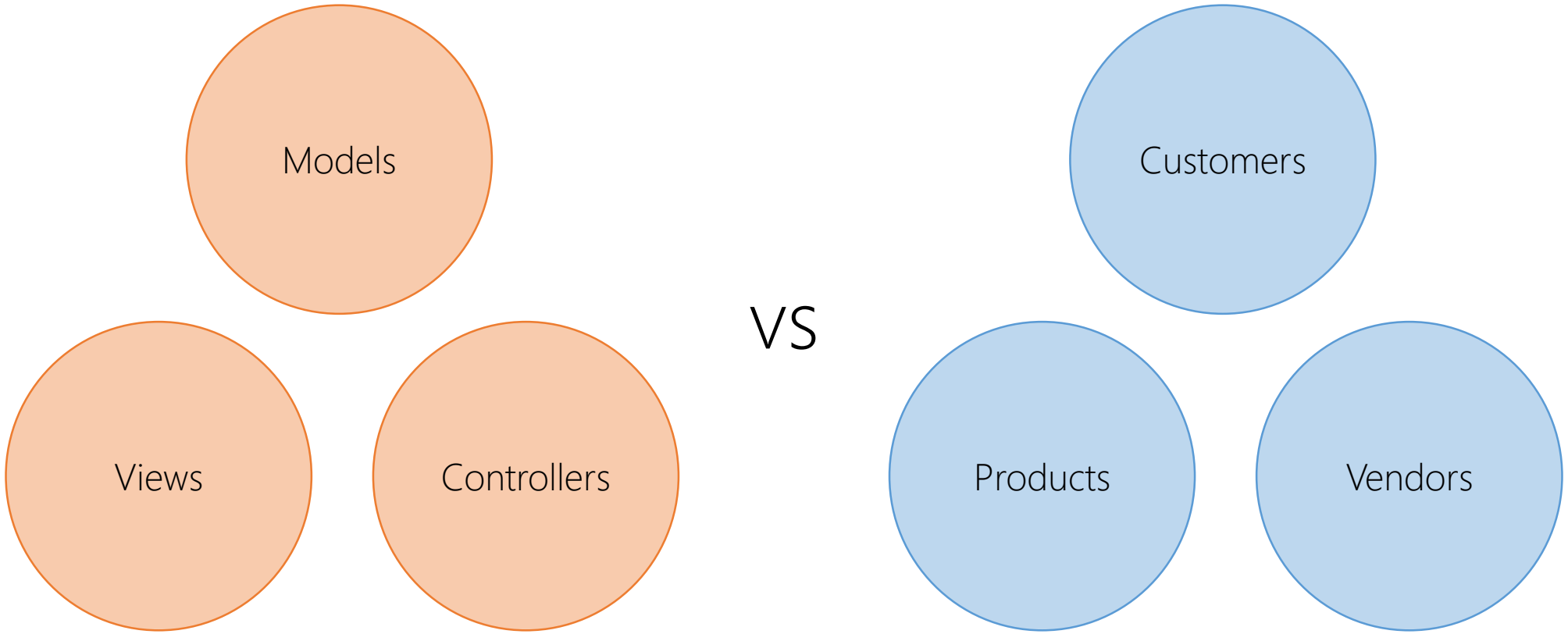
Functional Organization

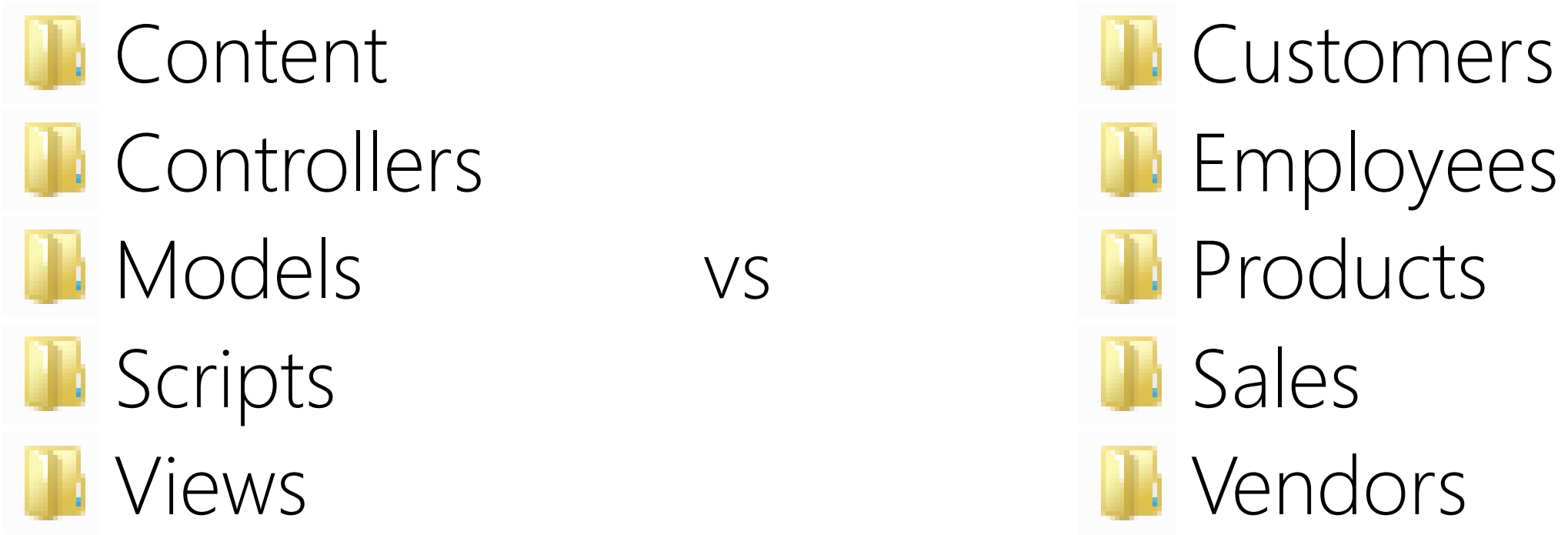
"The architecture should scream
the intent of the system!"

– Uncle Bob


4' x 4'
Bedroom
11' x 12'
Bedroom
9'6 x 12'
4' x 4'
Linen
Closet
Bath
CLOSET
H2O HTR
FURN A/C
Utility
Dining Room
Kitchen
12'6 x 15'
5' x 4'
Closet
Living Room
Entry
8' x 4'

Material	Quantity	Cost
Appliances	5	$5,000
Cabinets	10	$2,500
Doors	15	$750
Fixtures	12	$2,400
Floors	9	$4,000
Walls	20	$10,000
Windows	8	$2,500


Models
Views
Controllers
VS
Customers
Products
Vendors


Content
Controllers
Models
Scripts
Views
vs
Customers
Employees
Products
Sales
Vendors

So what?

Why Use Functional Organization

Pros

- Spatial locality
- Easy to navigate
- Avoid vendor lock-in

Why Use Functional Organization

Pros

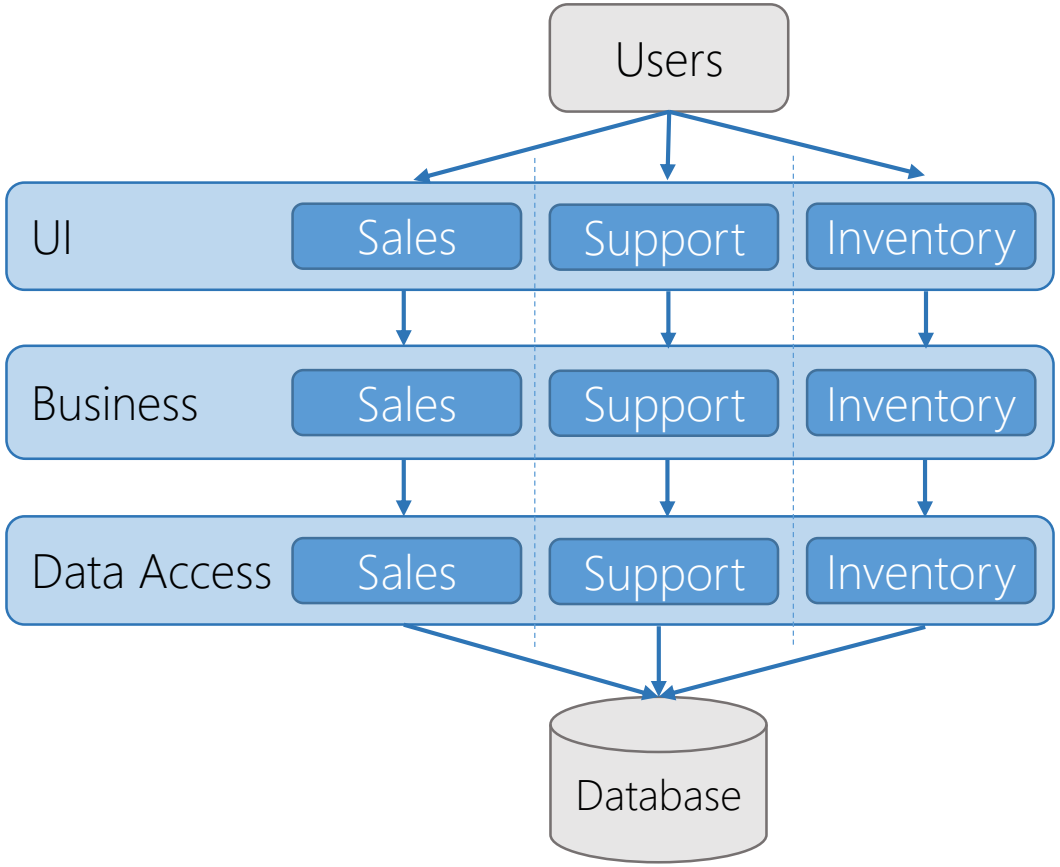
- Spatial locality
- Easy to navigate
- Avoid vendor lock-in

Cons

- Lose framework conventions
- Lose automatic scaffolding
- Categorical cohesion is easier

Microservices

Components


Users
UI
Sales
Support
Inventory
Business
Sales
Support
Inventory
Data Access
Sales
Support
Inventory
Database

Problem Domain

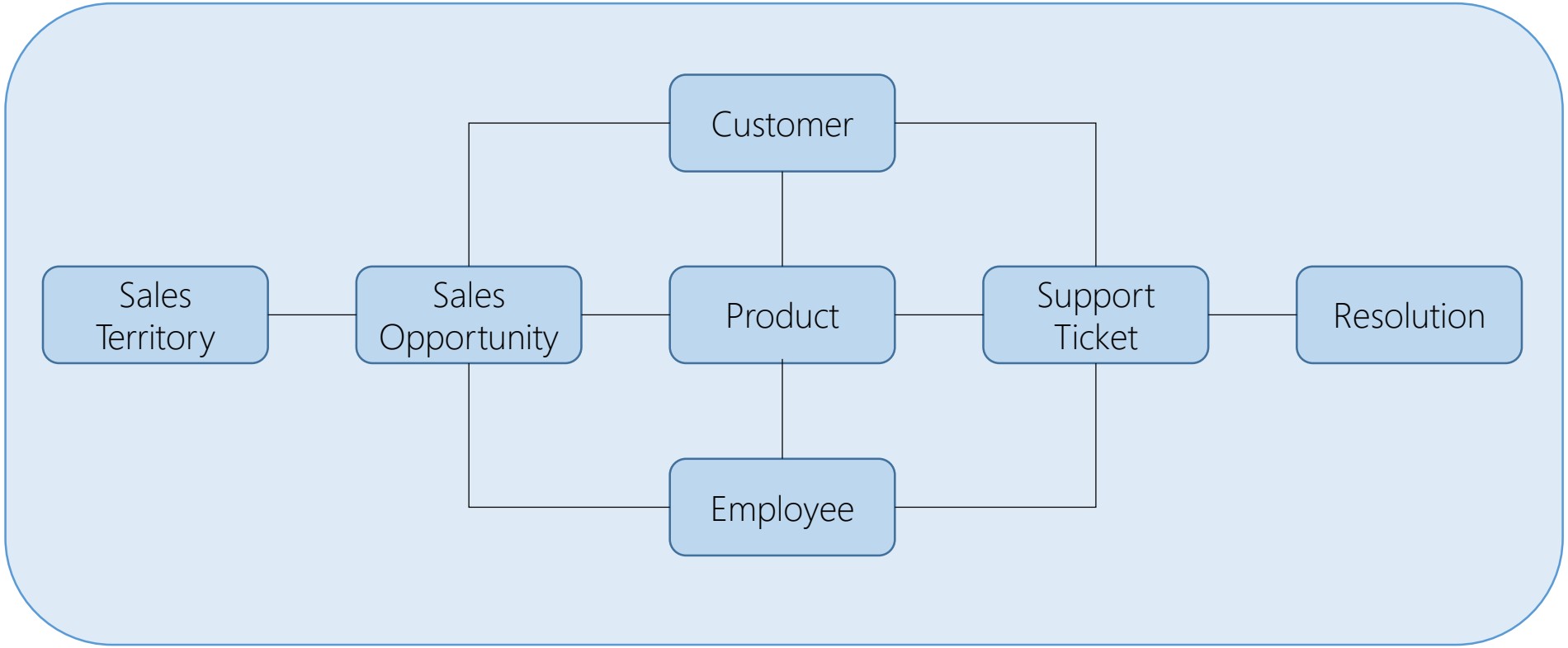
Sales

- Sales Opportunity
- Contact
- Sales Person
- Product
- Sales Territory

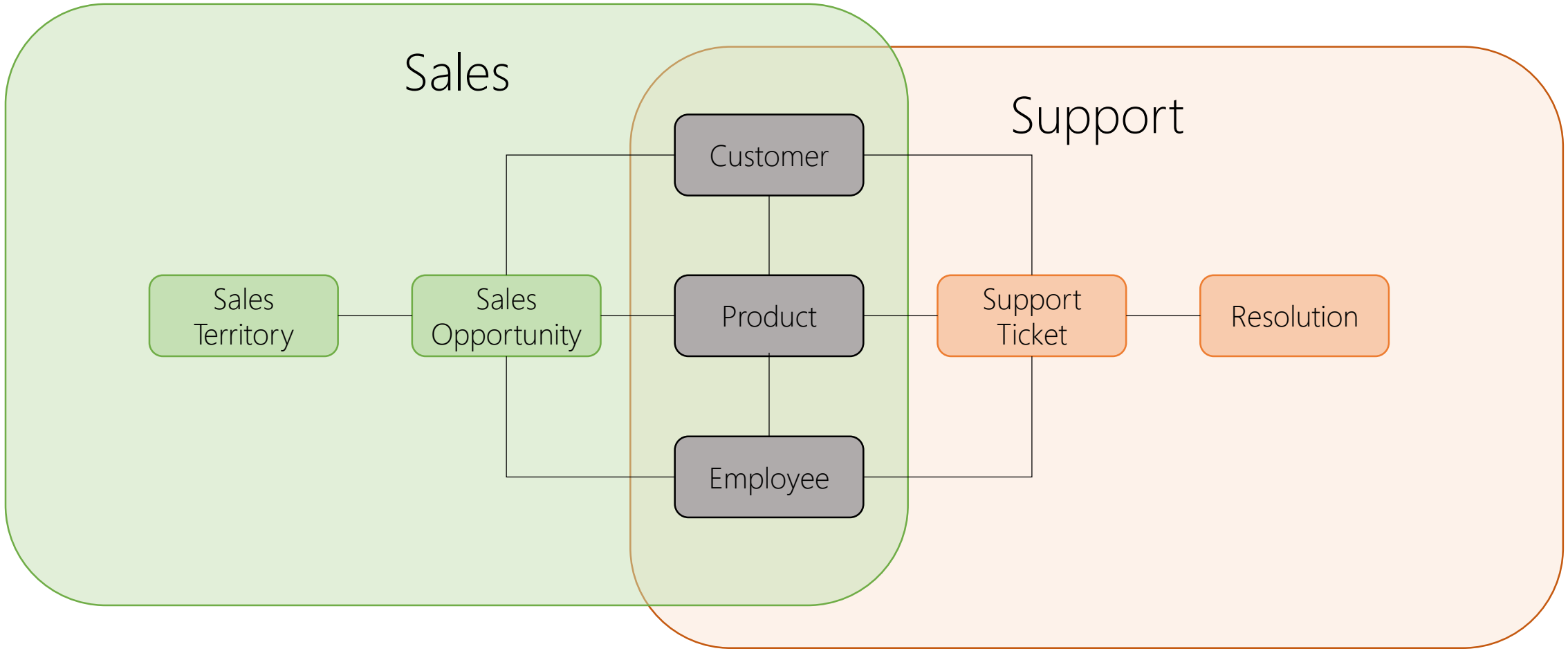
Support

- Support Ticket
- Customer
- Support Person
- Product
- Resolution

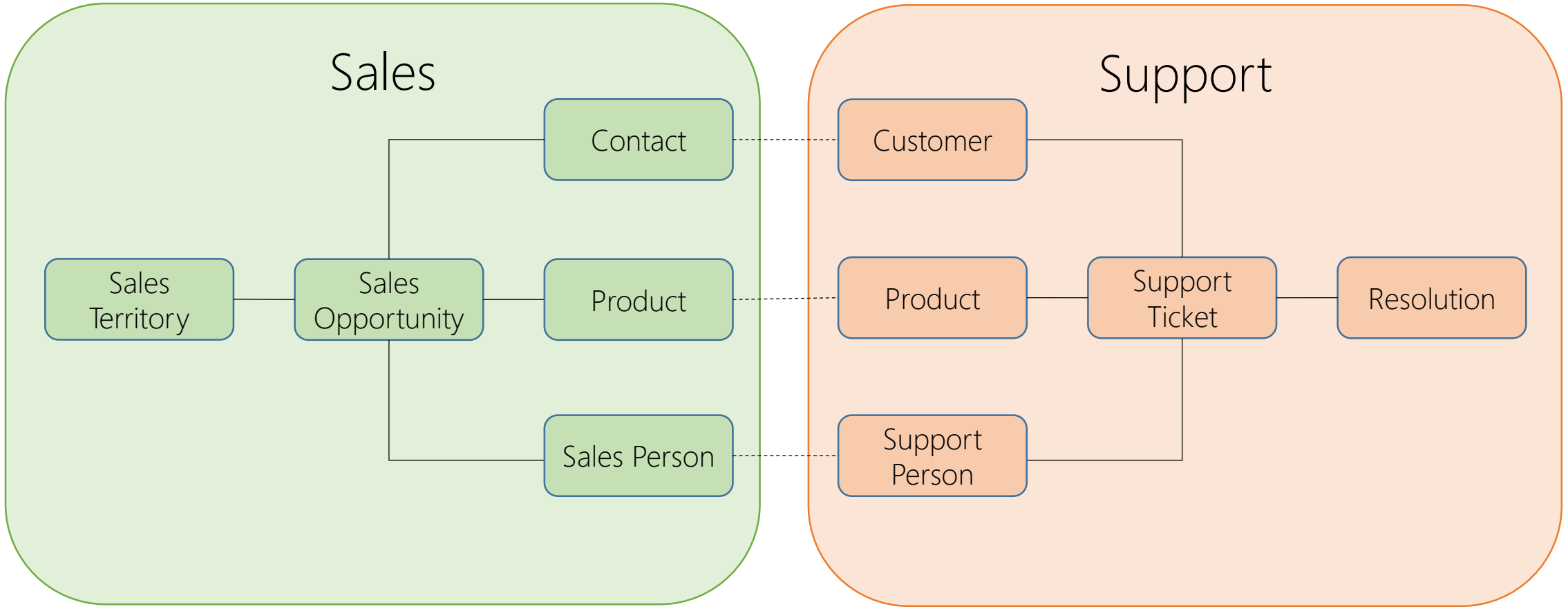
Single Domain Model



Bounded Contexts

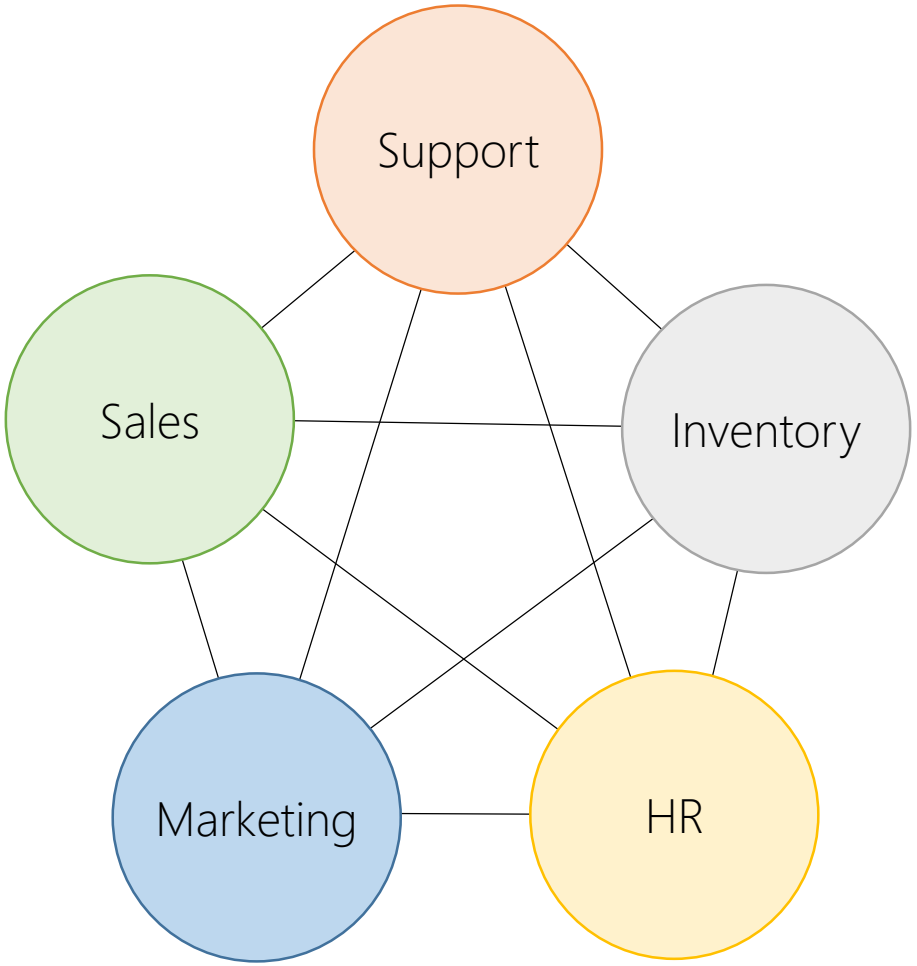


Bounded Contexts



Microservice Architectures

- Subdivide system
- Bounded contexts
- Small teams
- Independent
- Similar to SOA



Why Use Microservices?

Pros

- Less cost for large domains
- Smaller teams
- Independence

Why Use Microservices?

Pros

- Less cost for large domains
- Smaller teams
- Independence

Cons

- Only for large domains
- Higher up-front cost
- Distributed system costs

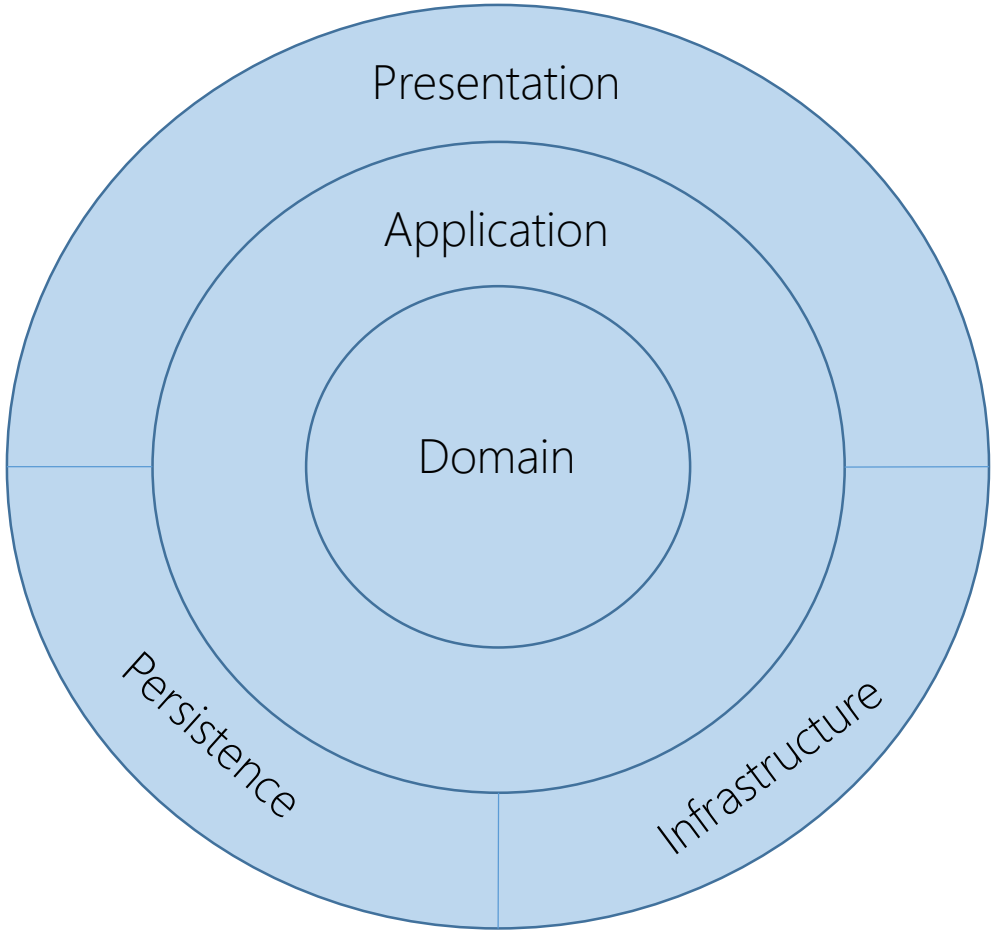
Conclusion

Summary

- Focus on the inhabitants

Summary

- Clean Architecture
- Domain-centric Architecture



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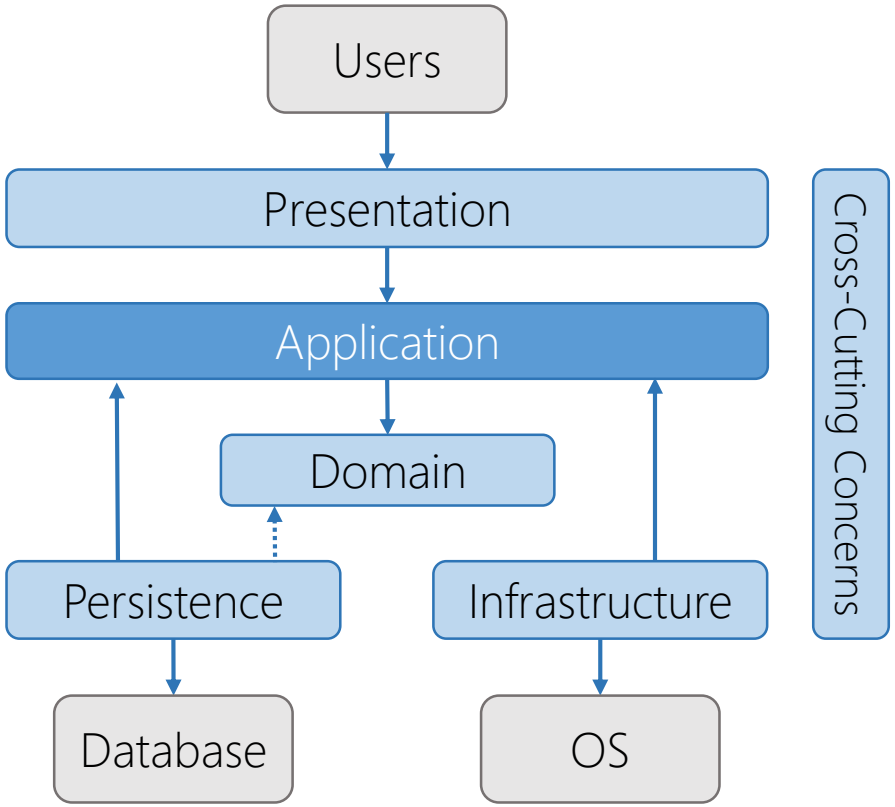
- Application Layer



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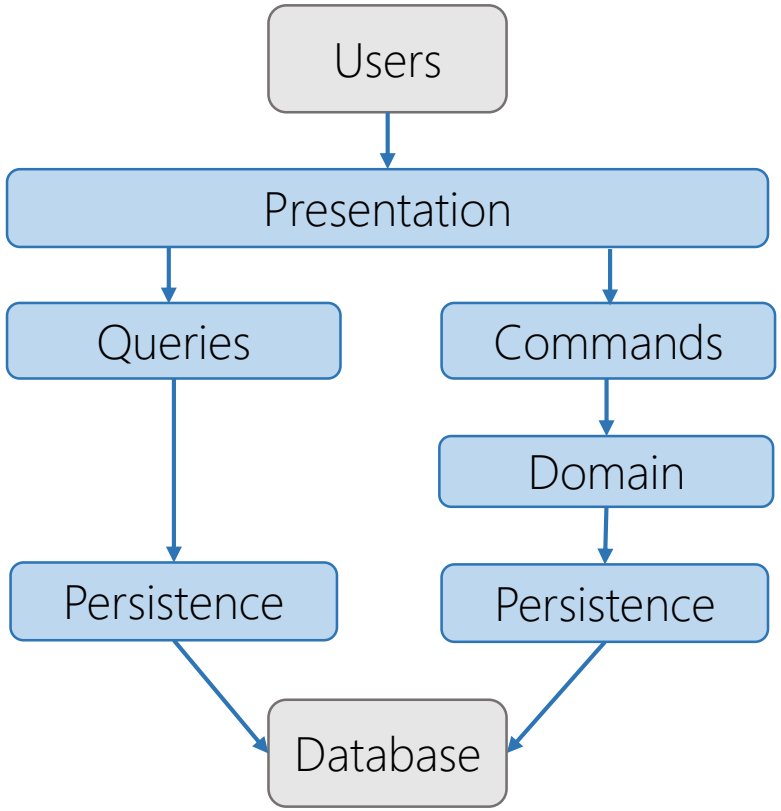

Summary

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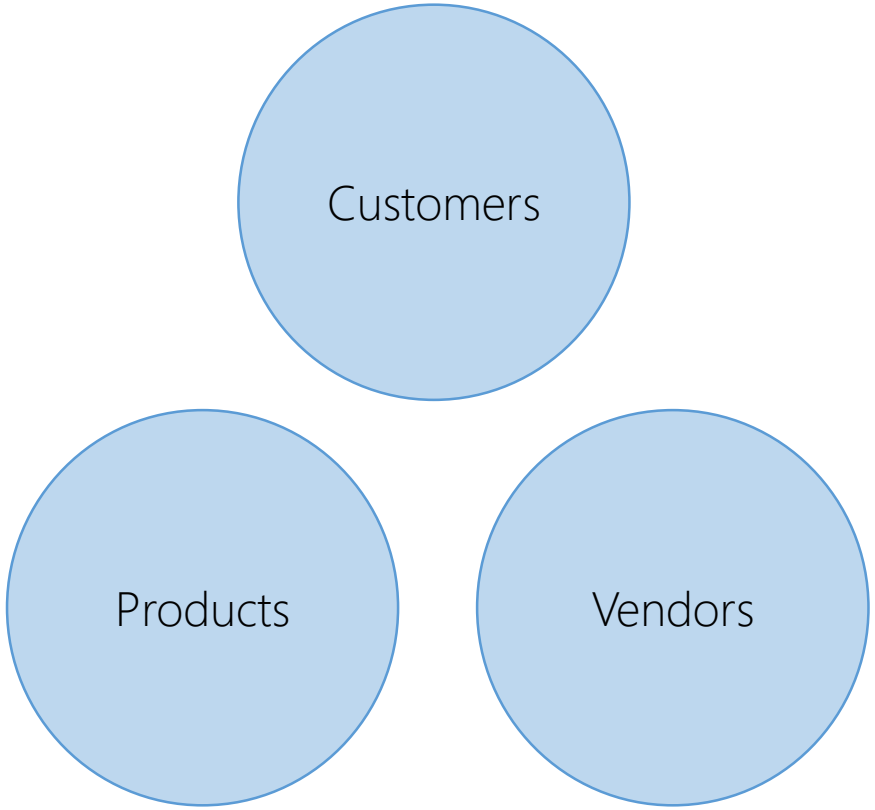
- Commands and Queries
- Functional Cohesion



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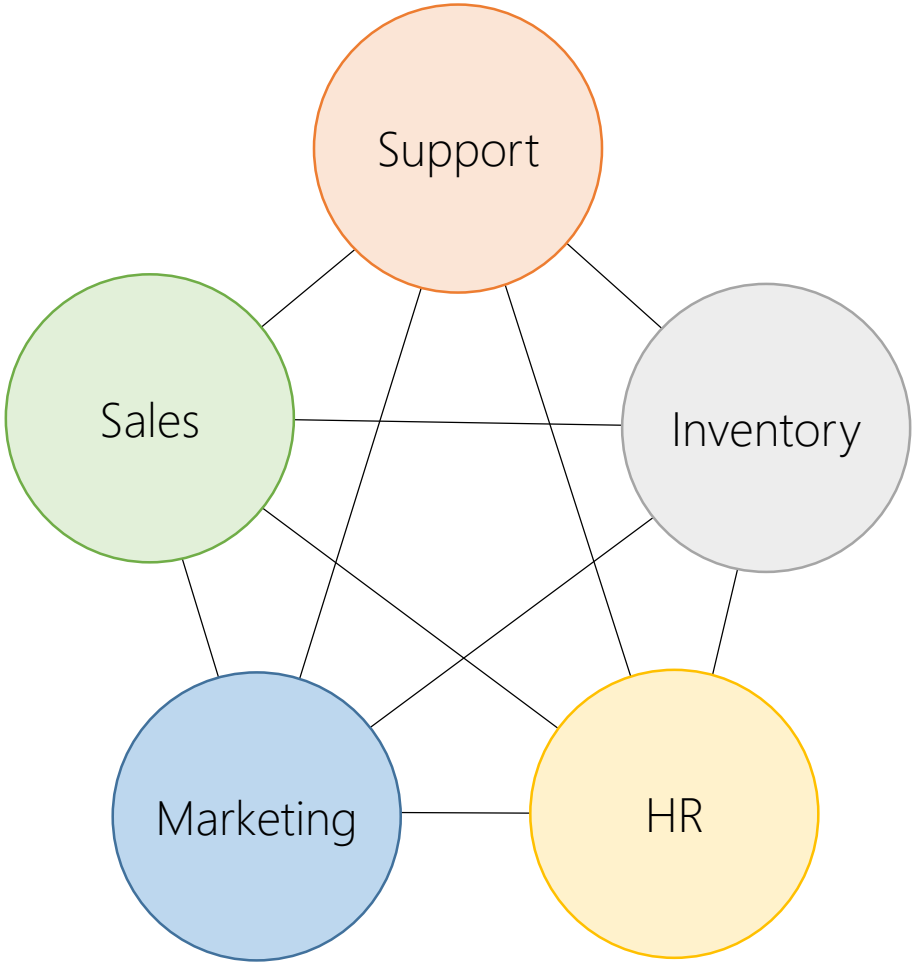
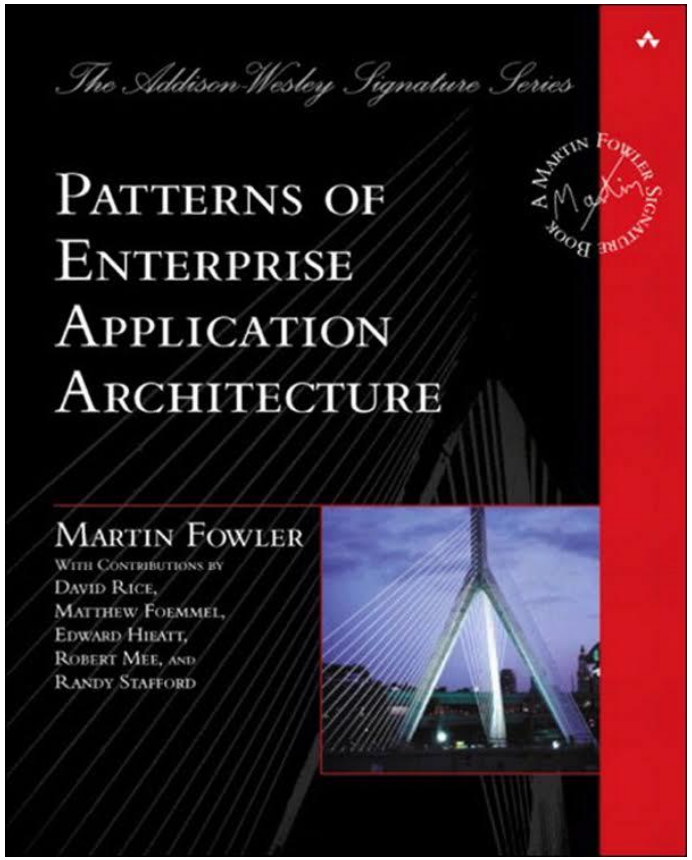
- Functional Cohesion
- Bounded Contexts



Where to Go Next?



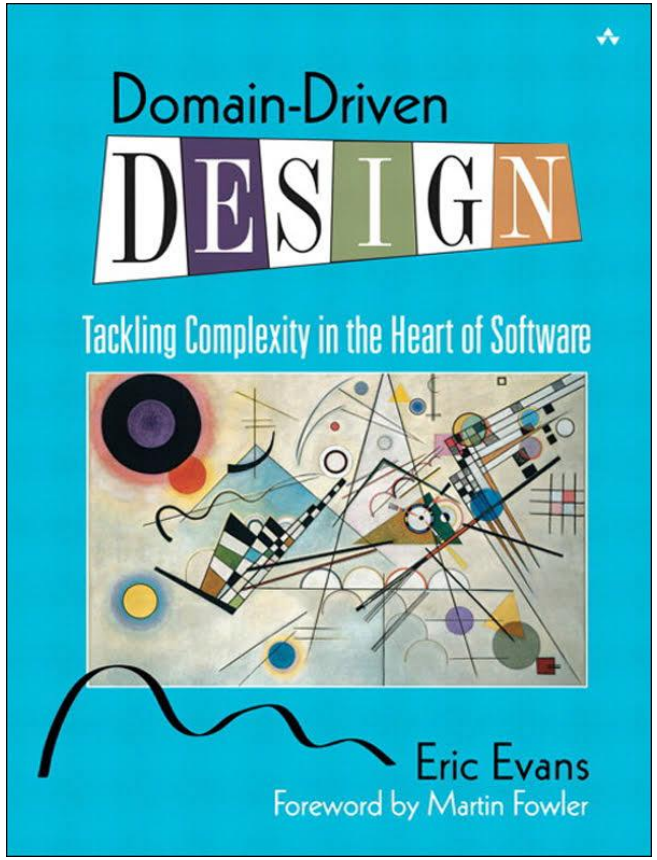
Martin Fowler

Where to Go Next?

http://cleancoders.com/

Robert C. Martin

Where to Go Next?



Eric Evans

Where to Go Next?

Greg Young

Udi Dahan

Feedback

- Feedback is very important to me
- One thing you liked?
- One thing I could improve?

Contact Info

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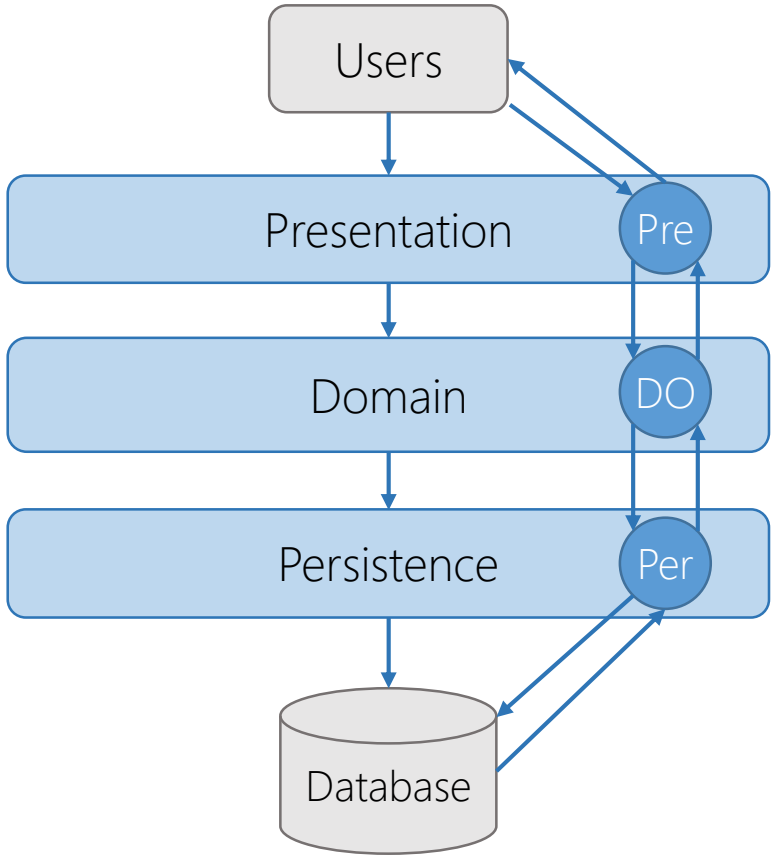
Renze Consulting
www.renzeconsulting.com

Layer Separation

- Separation of concerns
- Avoid abstraction leakage
- Multiple object representations
- Note: Add application layer and DTOs



Cost-Benefit of Layers

- Layers have a high cost
- Objects must be adapted
- Start with the minimum
- Typically 3-4 layers
- NOTE: Need to add application layer and DTOs