Managing Data in Microservices

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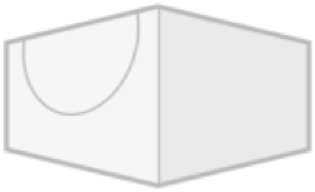
Background

- VP Engineering at Stitch Fix
  - Combining "Art and Science" to revolutionize apparel retail
- Consulting "CTO as a service"
  - Helping companies scale engineering organizations and technology
- Director of Engineering for Google App Engine
  - World's largest Platform-as-a-Service
- Chief Engineer / Distinguished Architect at eBay
  - Multiple generations of eBay's infrastructure

Stitch Fix

Create Your Style Profile.



Get Five Hand-picked Items.

Keep What You Like.
Send Back the Rest.

Stitch Fix

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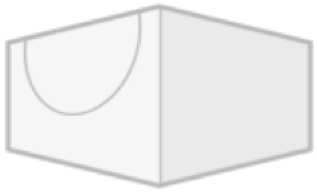

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How do you prefer clothes to fit the top half of your body?

- Mostly Tight / Form Fitting
- Prefer Fitted / Showing my Figure
- Straight
- Mostly Loose
- Oversized

ear for pants, jeans, and skirts?

an waist

Skirts L

Stitch Fix

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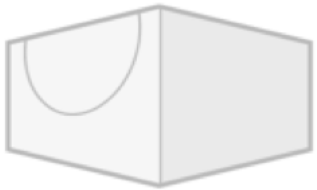

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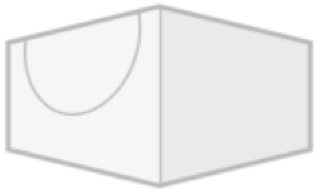

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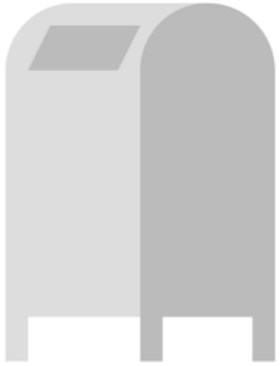
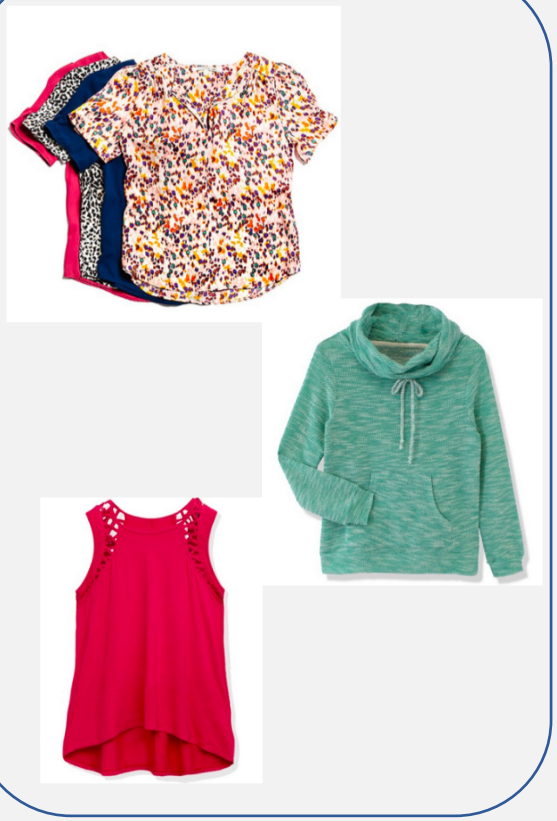


Combining Art and [Data] Science

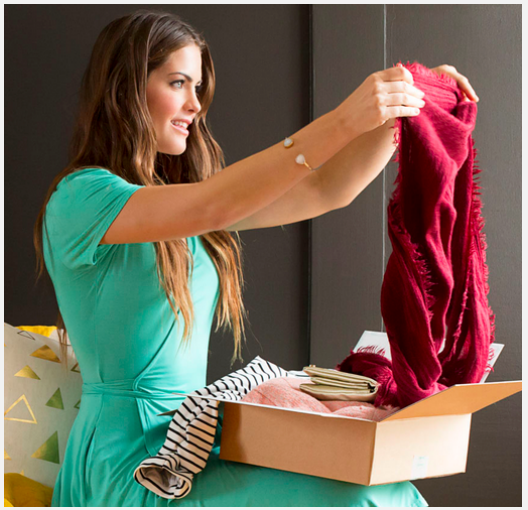
- 1:1 Ratio of Data Science to Engineering
  - Almost 100 software engineers
  - Almost 100 data scientists and algorithm developers
  - Unique in our industry
- Apply intelligence to *every* part of the business
  - Buying
  - Inventory management
  - Logistics optimization
  - Styling recommendations
  - Demand prediction
- Humans and machines augmenting each other

Styling at Stitch Fix

Inventory

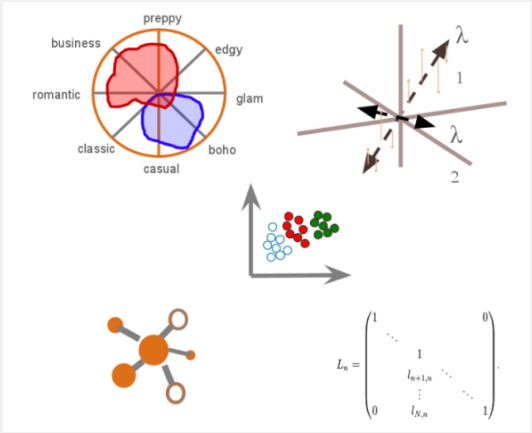


Personal styling



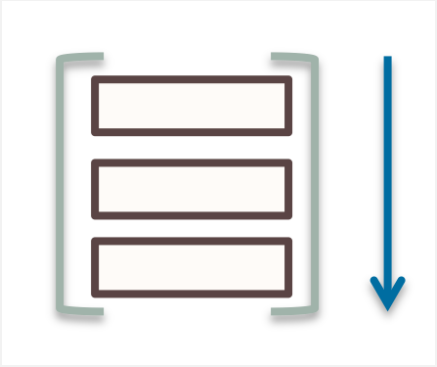
Personalized Recommendations

Inventory



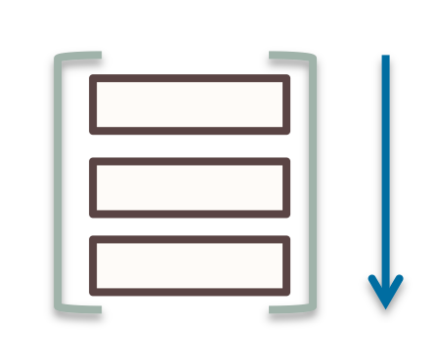
Machine learning

Algorithmic recommendations



Expert Human Curation

Algorithmic recommendations

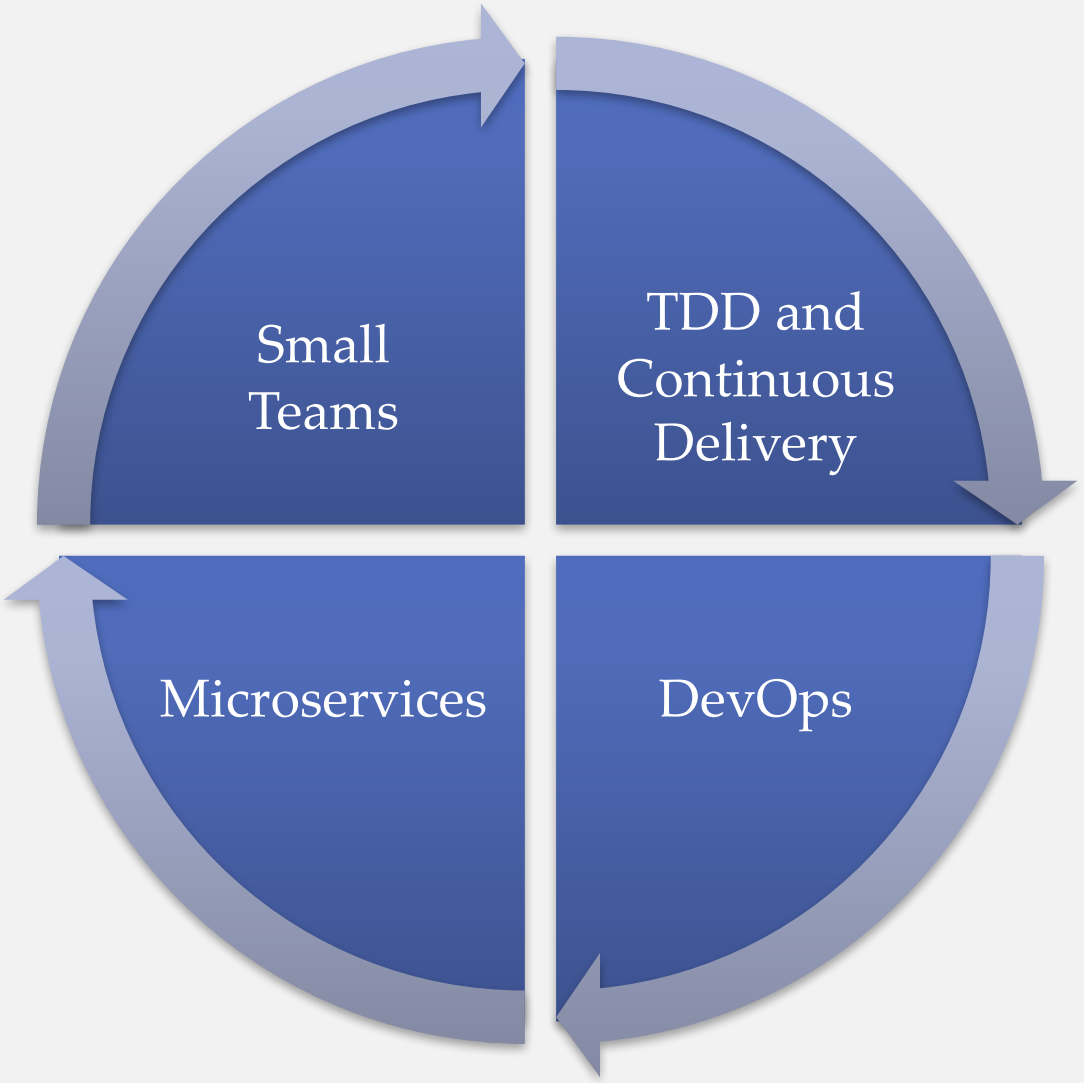


Human curation

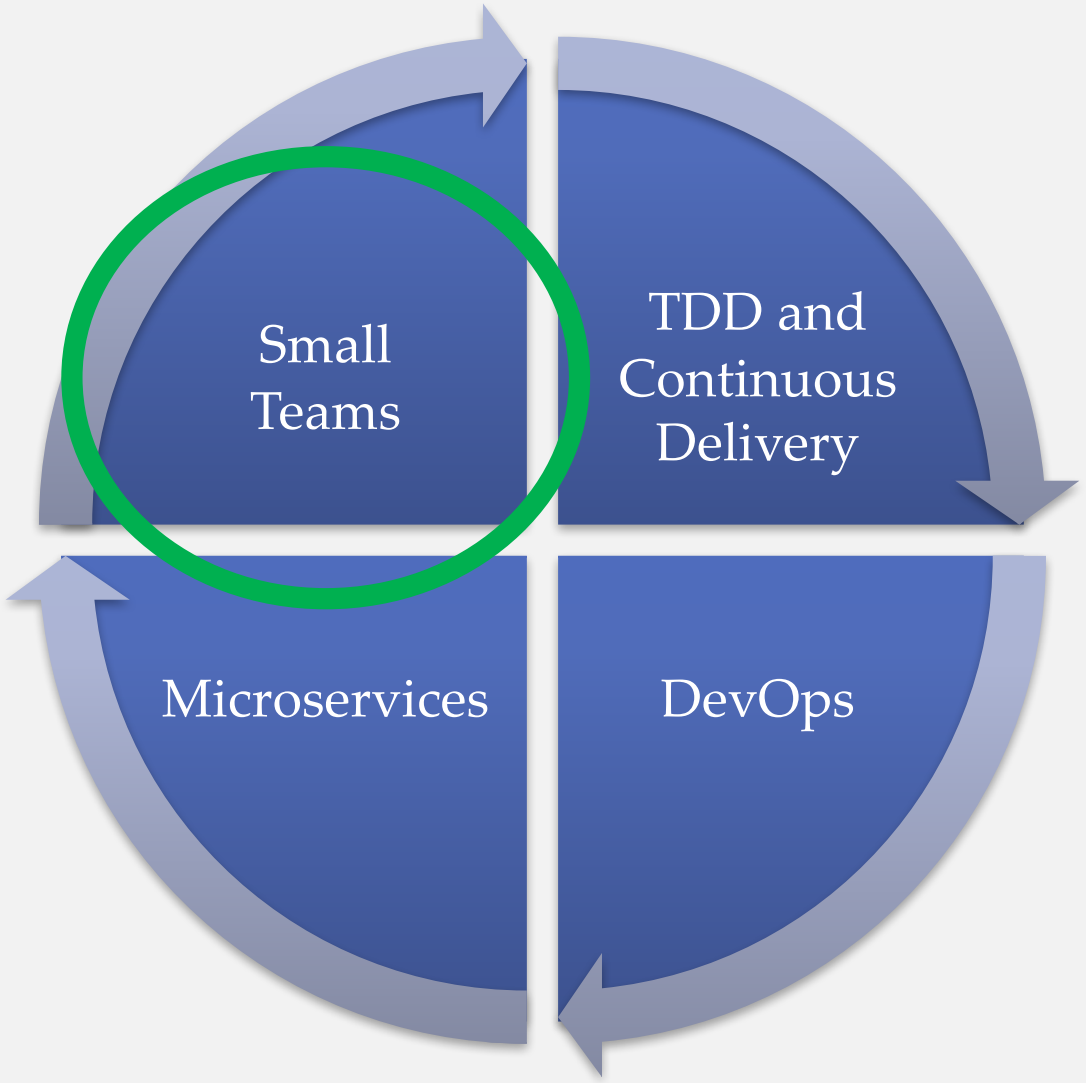
How do we work, and why does it work?

Modern Software Development

Modern Software Development



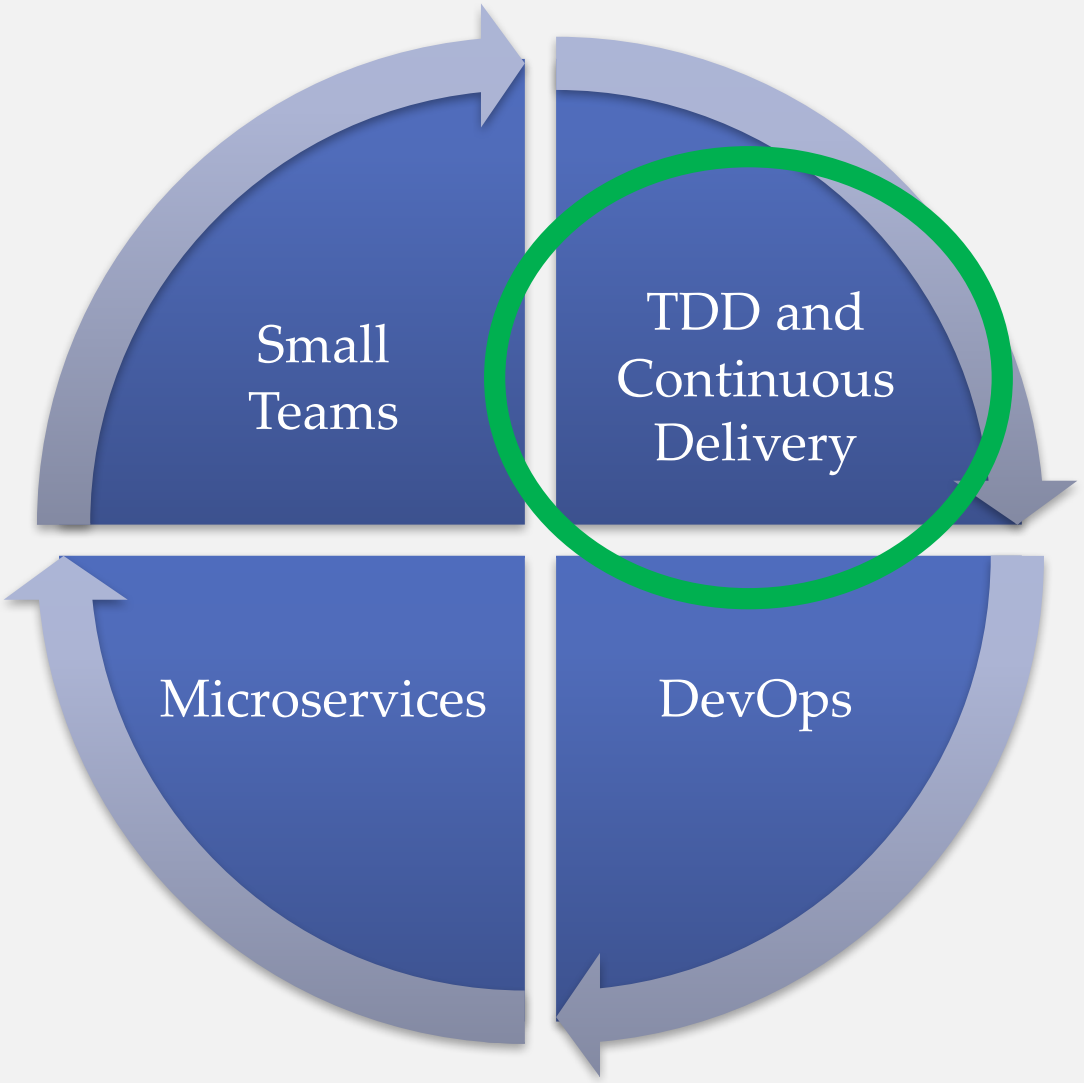
Modern Software Development



Small "Service" Teams

- Teams Aligned to Business Domains
  - Clear, well-defined area of responsibility
  - Single service or set of related services
- Cross-functional Teams
  - All skill sets needed to do the job
- Depend on other teams for supporting services, libraries, and tools

Modern Software Development



Test-Driven Development

- Tests help you go faster
  - Tests "have your back"
  - Development velocity
- Tests make better code
  - Confidence to break things
  - Courage to refactor mercilessly
- Tests make better systems
  - Catch bugs earlier, fail faster

"We don't have time to do it right!"

"Do you have time to do it **twice**?"

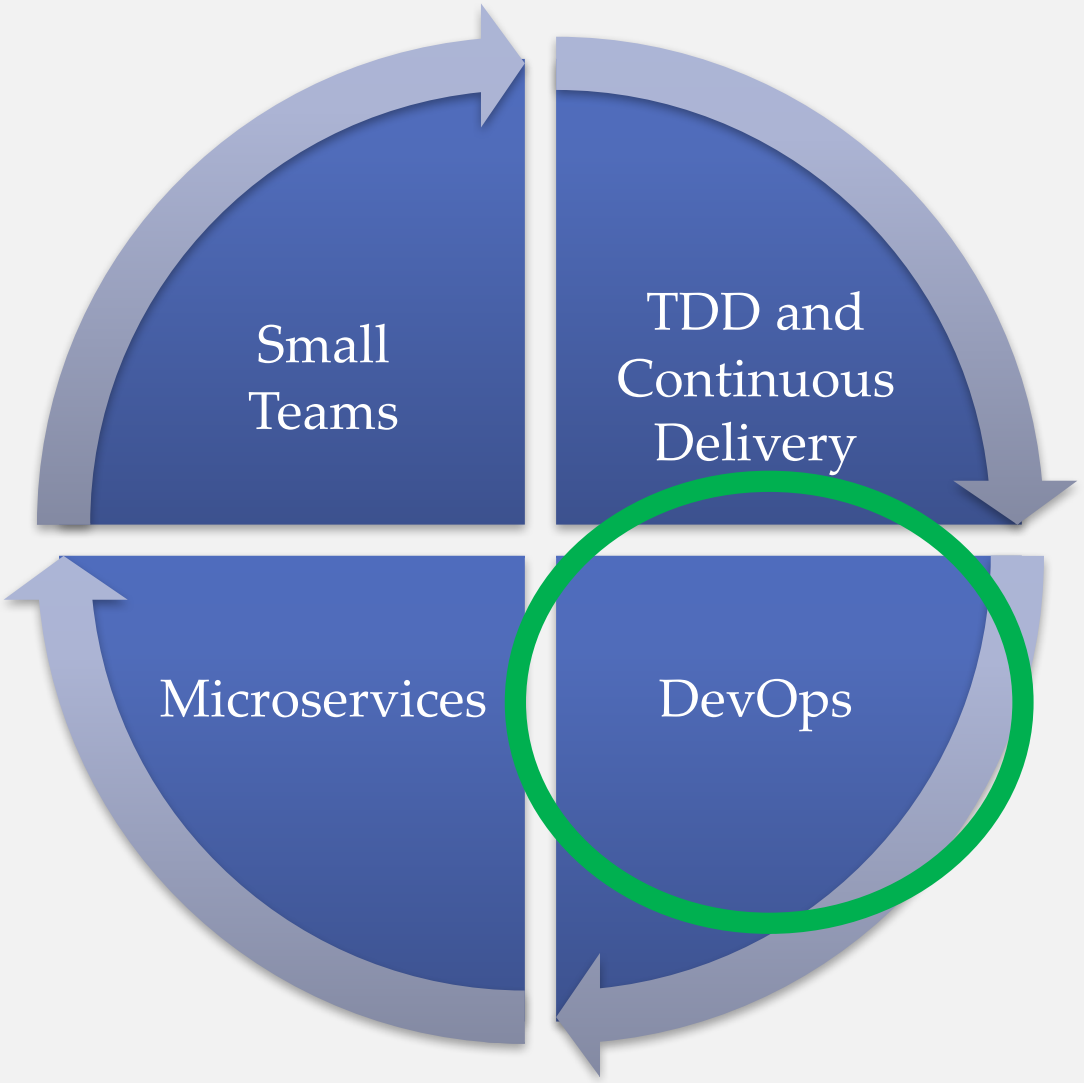
Test-Driven Development

- Do it right (enough) the first time
  - The more constrained you are on time and resources, the more important it is to build solid features
  - Build one great thing instead of two half-finished things
- Right ≠ Perfect (80 / 20 Rule)
- ➔ Basically no bug tracking system (!)
  - Bugs are fixed as they come up
  - Backlog contains features we want to build
  - Backlog contains technical debt we want to repay

Continuous Delivery

- Most applications deployed multiple times per day
- More solid systems
  - Release smaller units of work
  - Smaller changes to roll back or roll forward
  - Faster to repair, easier to understand, simpler to diagnose
- Rapid experimentation
  - Small experiments and rapid iteration are cheap

Modern Software Development



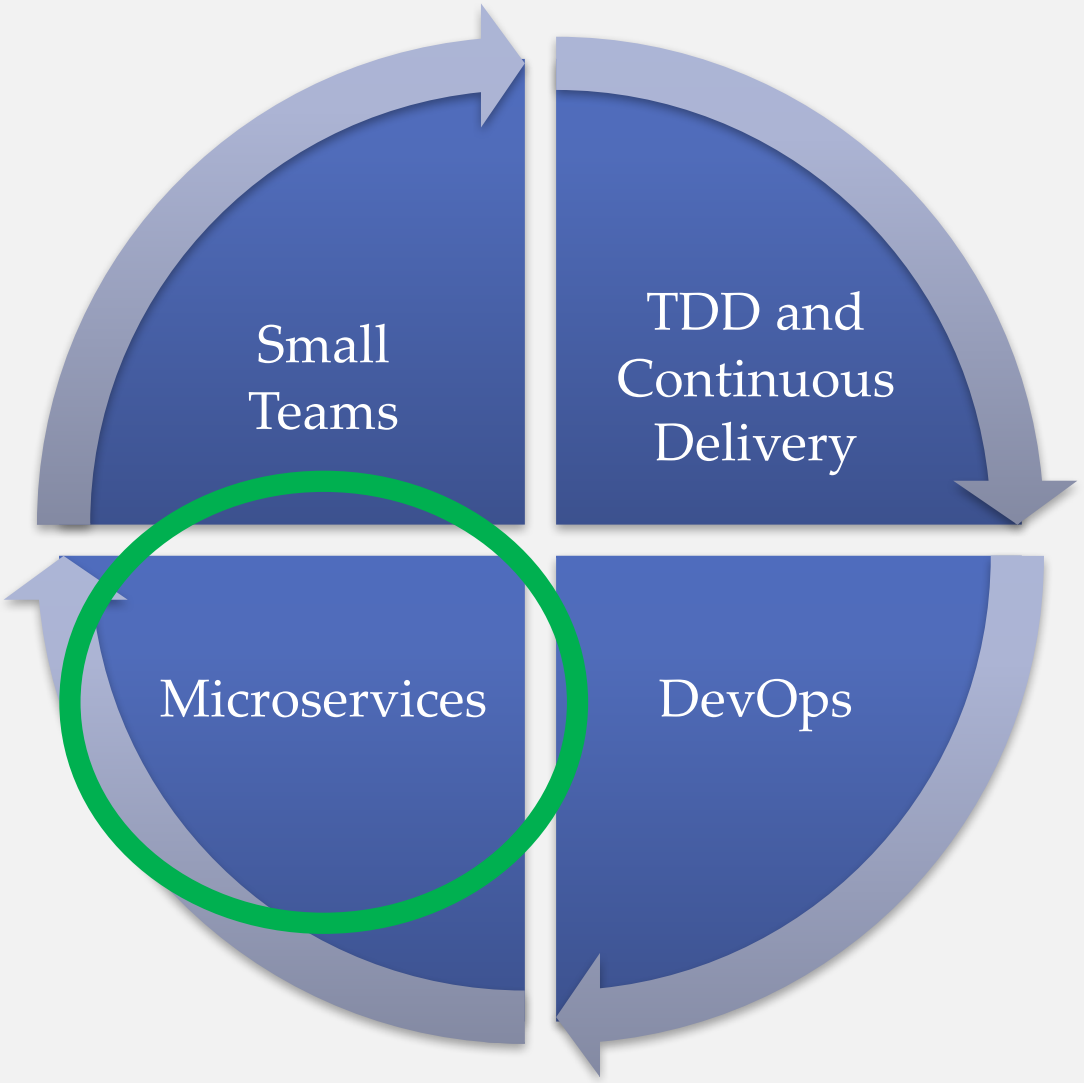
DevOps

- End-to-end Ownership
  - Team owns service from design to deployment to retirement
- Responsible for
  - Features
  - Quality
  - Performance
  - Operations
  - Maintenance

You Build It, You Run It.

-- Werner Vogels

Modern Software Development



Evolution to Microservices

- eBay
  - 5th generation today
  - Monolithic Perl → Monolithic C++ → Java → microservices
- Twitter
  - 3rd generation today
  - Monolithic Rails → JS / Rails / Scala → microservices
- Amazon
  - Nth generation today
  - Monolithic Perl / C++ → Java / Scala → microservices

First Law of Distributed Object Design:

Don't distribute your objects!

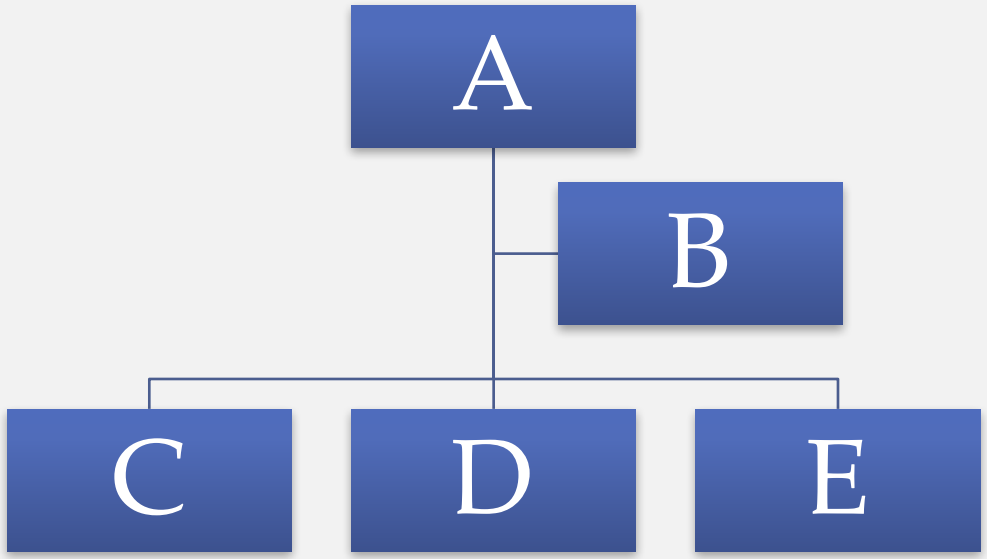
-- Martin Fowler

If you don't end up regretting your early technology decisions, you probably over-engineered.

-- me

Microservices

- Single-purpose
- Simple, well-defined interface
- Modular and independent

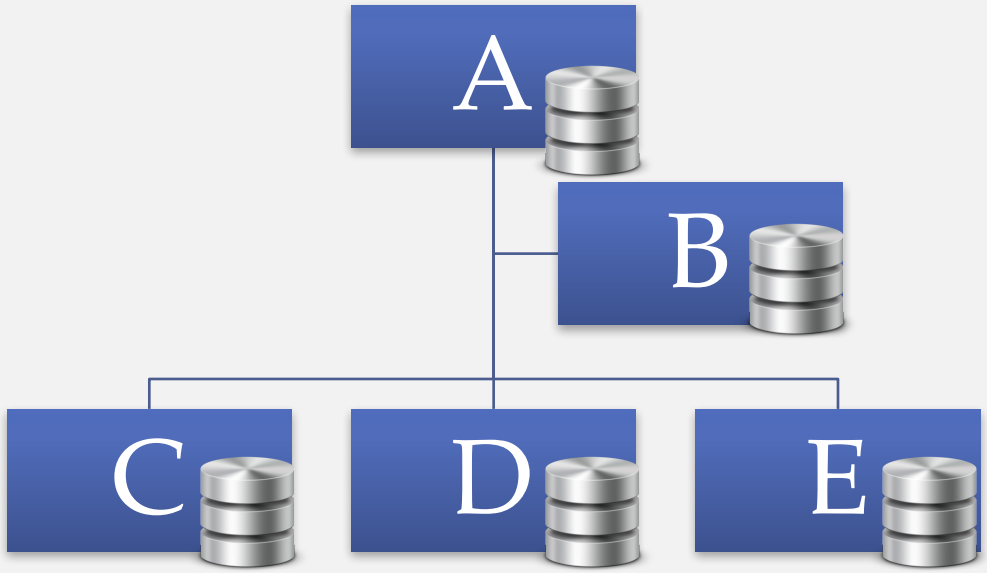


Microservices are nothing more than SOA done properly.

-- me

Microservices

- Single-purpose
- Simple, well-defined interface
- Modular and independent
- **Isolated persistence (!)**



Microservice Persistence

- Approach 1: Operate your own data store
  - Store to your own instance(s) of {Postgres, MySQL, etc.}, owned and operated by the service team
- Approach 2: Use a persistence service
  - Store to your own schema in {Dynamo, RDS, Spanner, etc.}, operated as a service by another team or by a third-party provider
  - Isolated from all other users of the service
- ➔ Only external access to data store is through published service interface

Events as First-Class Construct

- "A significant change in state"
  - Statement that some interesting thing occurred
  - 0 | 1 | N consumers subscribe to the event, typically asynchronously
- Traditional 3-tier system
  - Presentation ➔ interface / interaction
  - Application ➔ stateless business logic
  - Persistence ➔ database
- Fourth fundamental building block
  - **State changes ➔ events**

Events as First-Class Construct

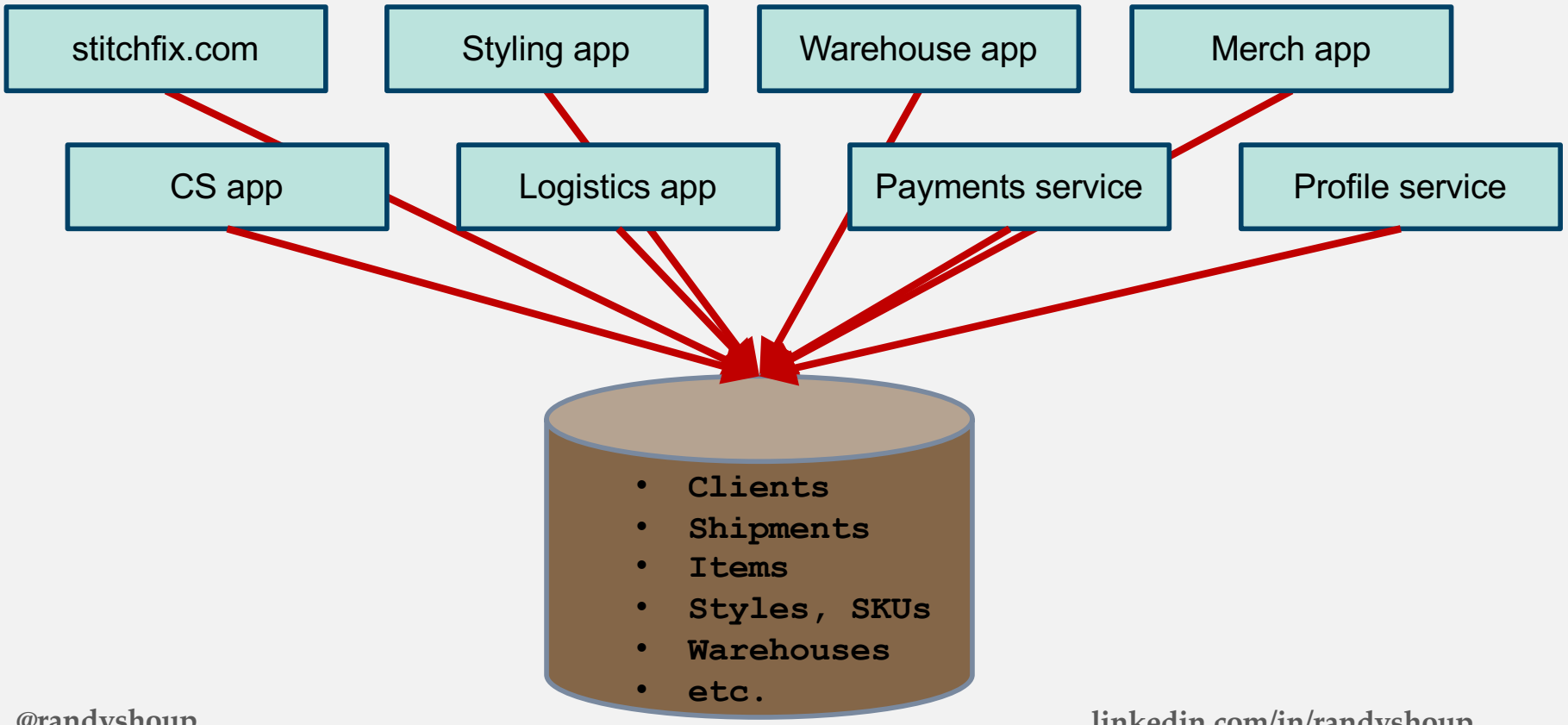
- Events represent how the real world works
  - Finance
  - Software development process
  - Any "workflow"

Microservices and Events

- Events are a first-class part of a service interface
- A service interface includes
  - Synchronous request-response (REST, gRPC, etc)
  - Events the service produces
  - Events the service consumes
  - Bulk reads and writes (ETL)
- The interface includes *any mechanism for getting data in or out of the service (!)*

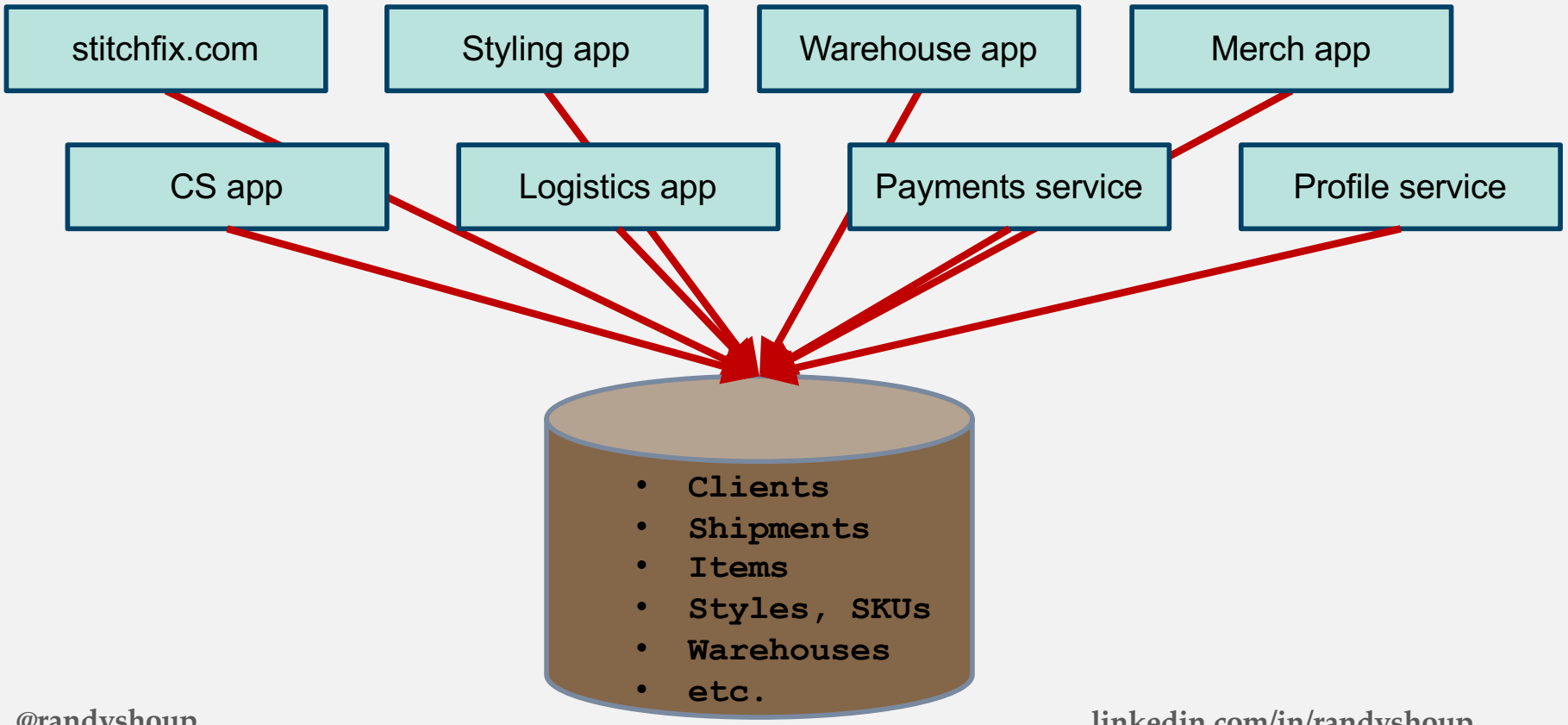
Extracting Microservices

- Problem: Monolithic shared DB



Extracting Microservices

- Decouple applications / services from shared DB



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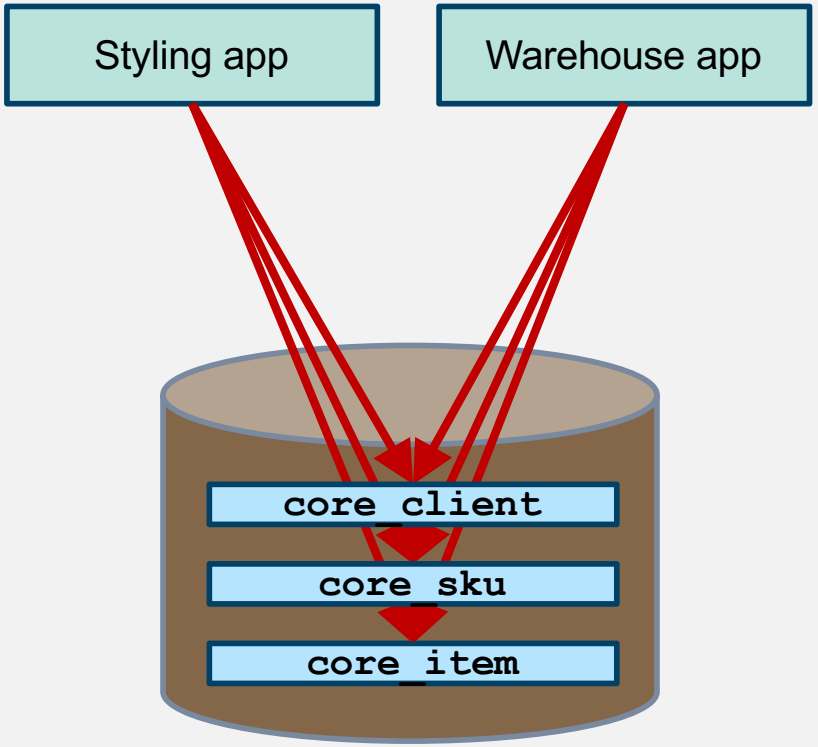
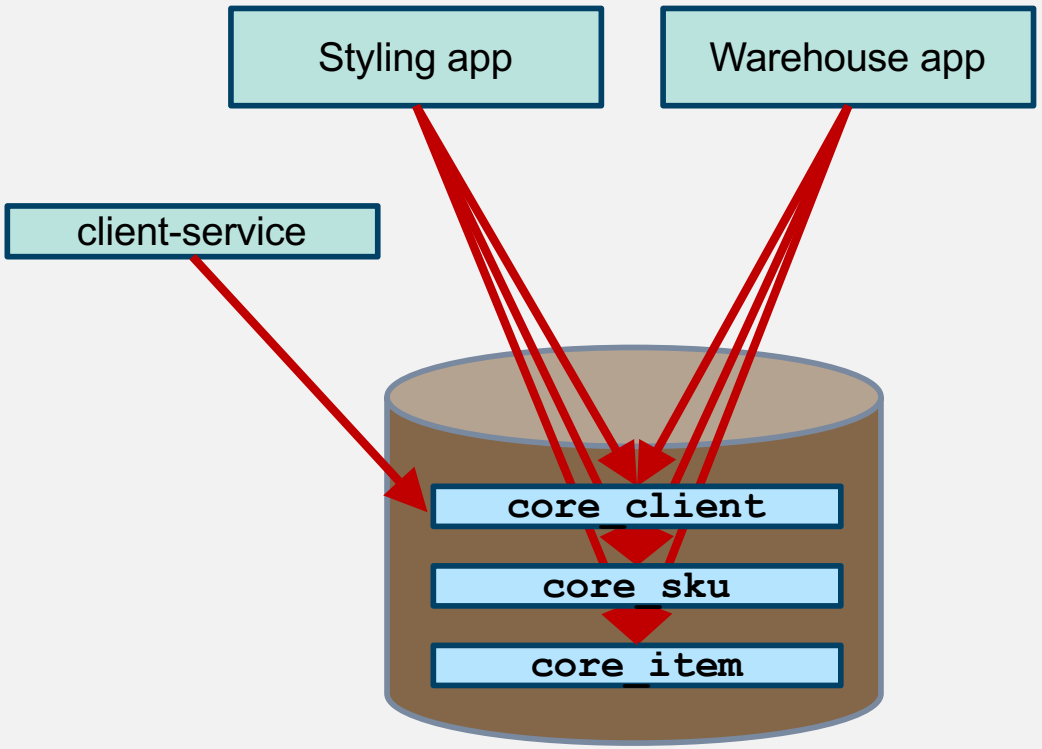


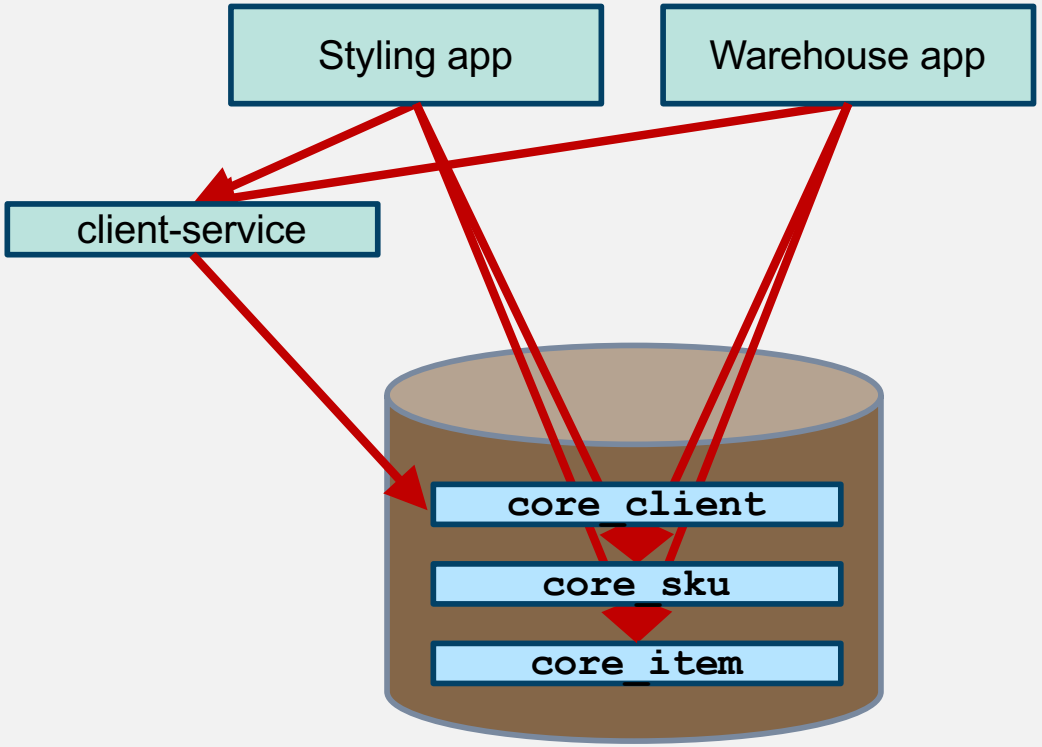
Extracting Microservices

- Step 1: Create a service



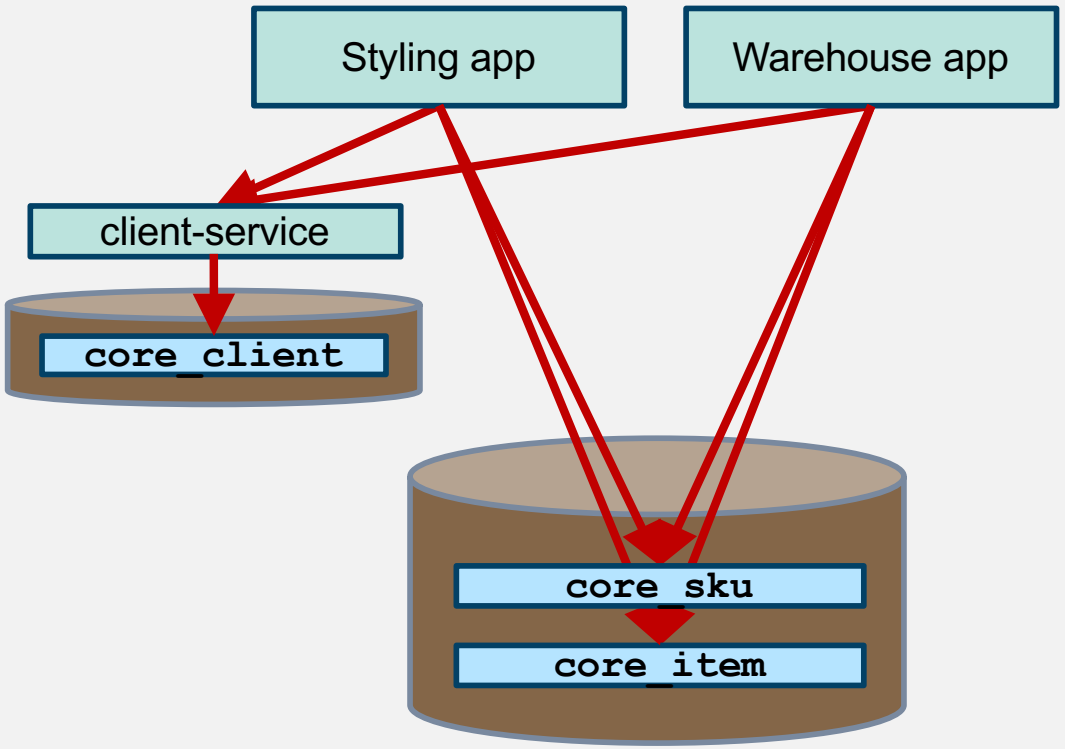
Extracting Microservices

- Step 2: Applications use the service



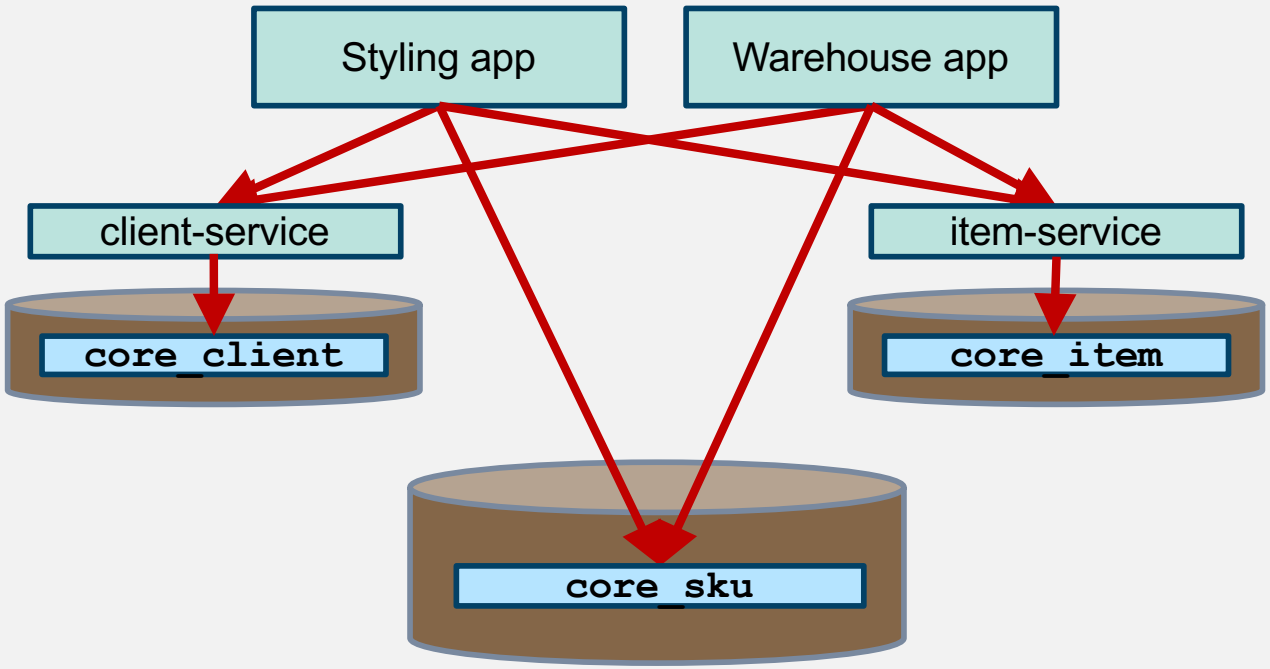
Extracting Microservices

- Step 3: Move data to private database



Extracting Microservices

- Step 4: Rinse and Repeat



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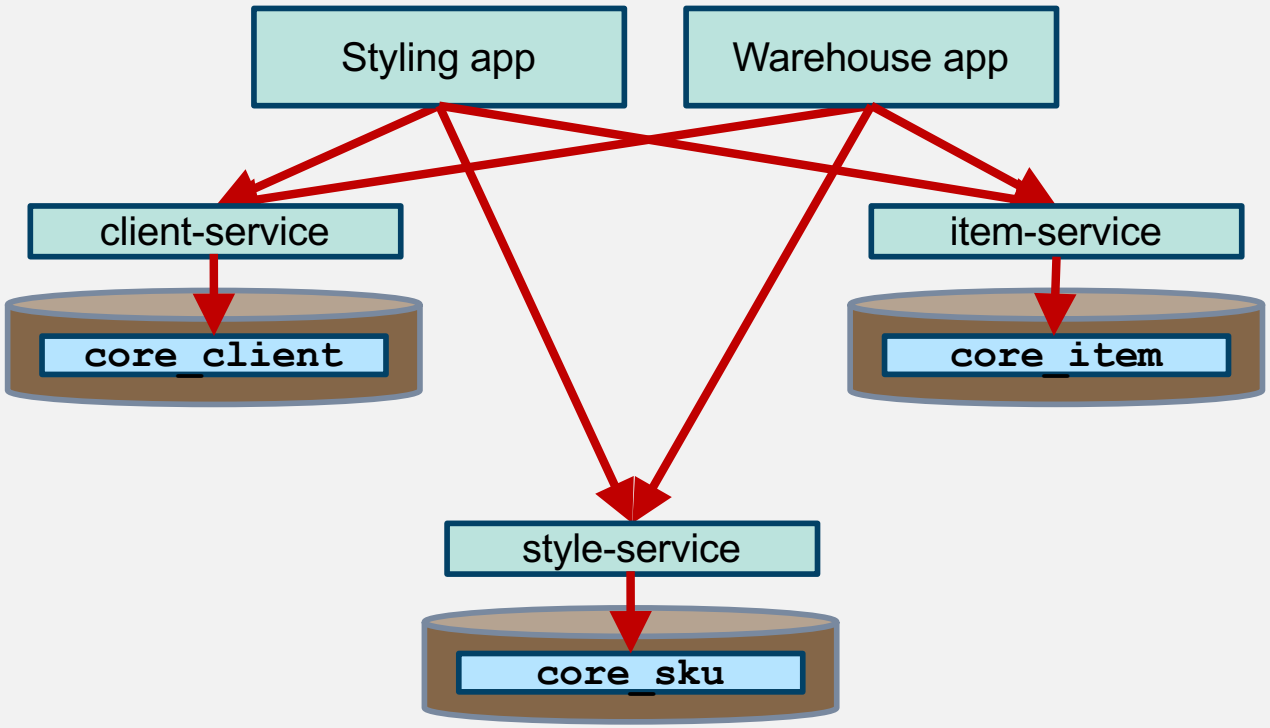

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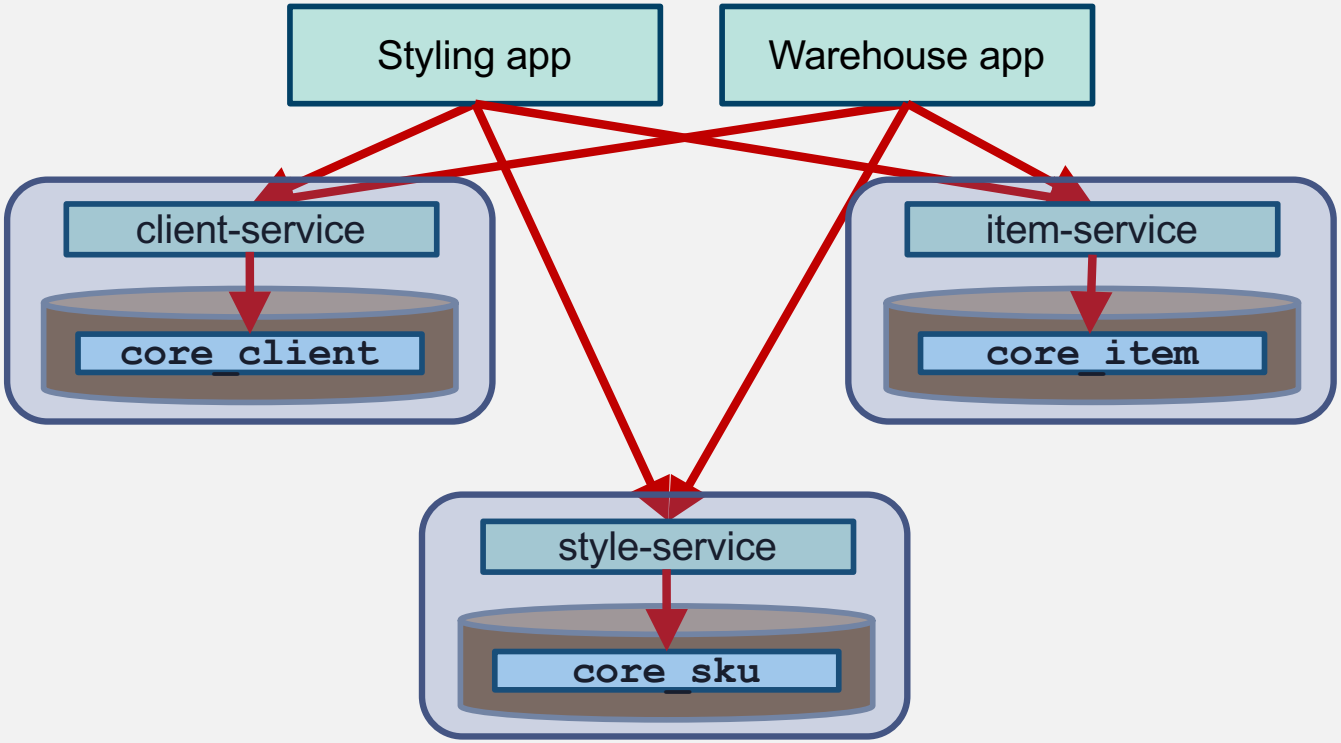
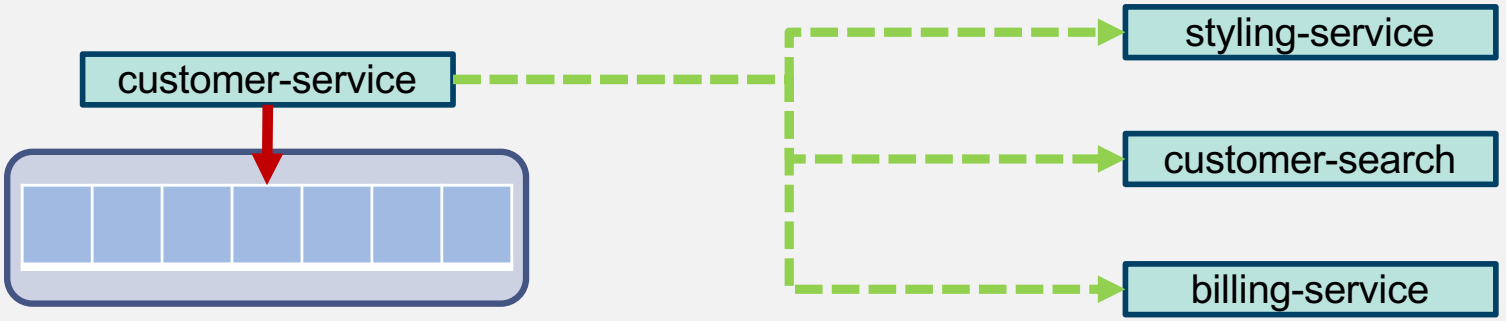


Microservice Techniques: Shared Data

- Problem
  - Monolithic database makes it easy to leverage shared data
  - Where does shared data go in a microservices world?

Microservice Techniques: Shared Data

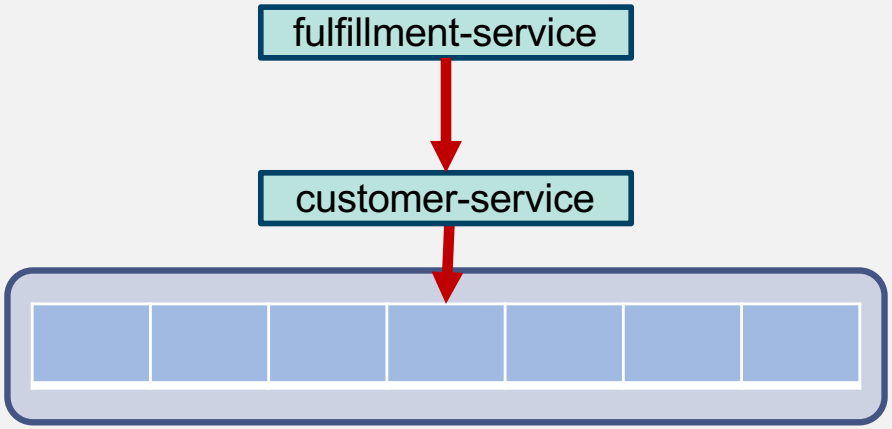
- Principle: Single System of Record
  - Every piece of data is owned by a single service
  - That service is the **canonical system of record** for that data



- Every other copy is a **read-only, non-authoritative cache**

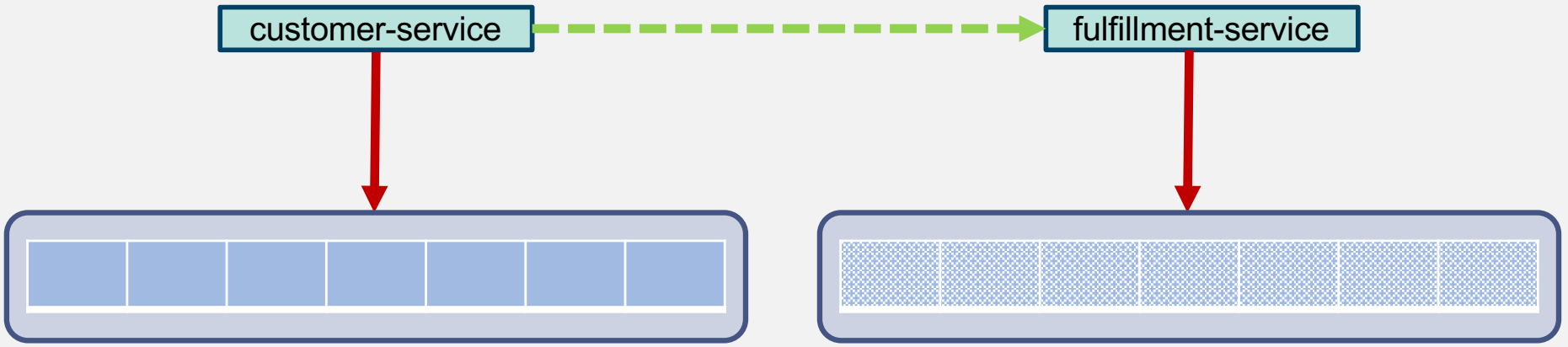
Microservice Techniques: Shared Data

- Approach 1: Synchronous Lookup
  - Customer service owns customer data
  - Fulfillment service calls customer service in real time



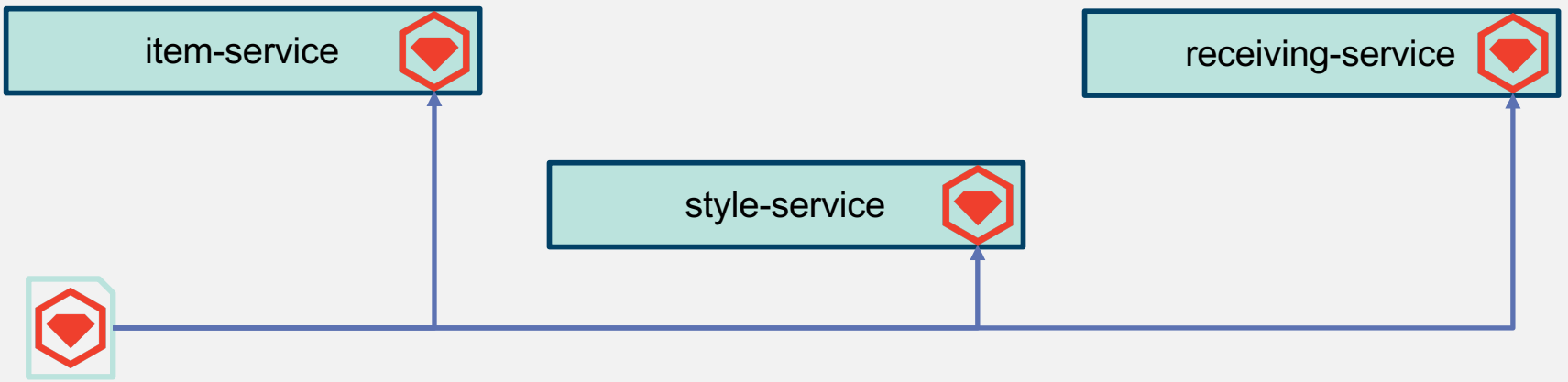
Microservice Techniques: Shared Data

- Approach 2: Async event + local cache
  - Customer service owns customer data
  - Customer service sends `address-updated` event when customer address changes
  - Fulfillment service consumes event, caches current customer address



Microservice Techniques: Shared Data

- Approach 3: Shared metadata library
  - Read-only metadata, basically immutable
  - E.g., size schemas, colors, fabrics, US States, etc.

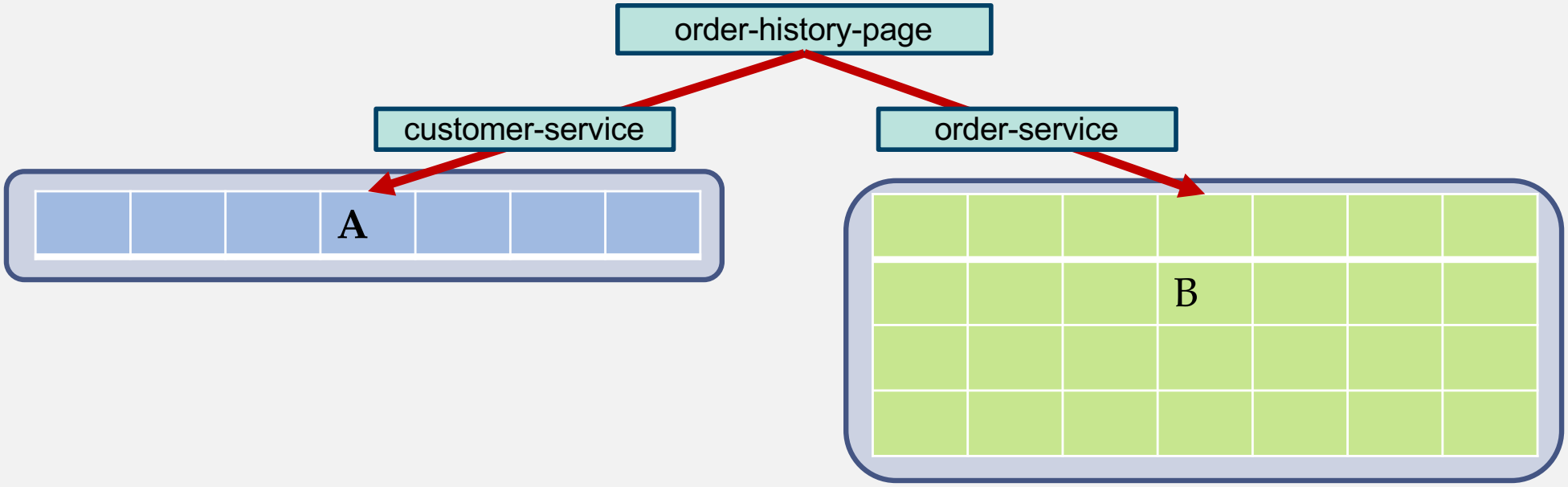


Microservice Techniques: Joins

- Problem
  - Monolithic database makes joins very easy
  - Splitting the data into separate services makes joins very hard

Microservice Techniques: Joins

- Approach 1: Join in Client Application
  - Get a single customer from `customer-service`
  - Query matching orders for that customer from `order-service`



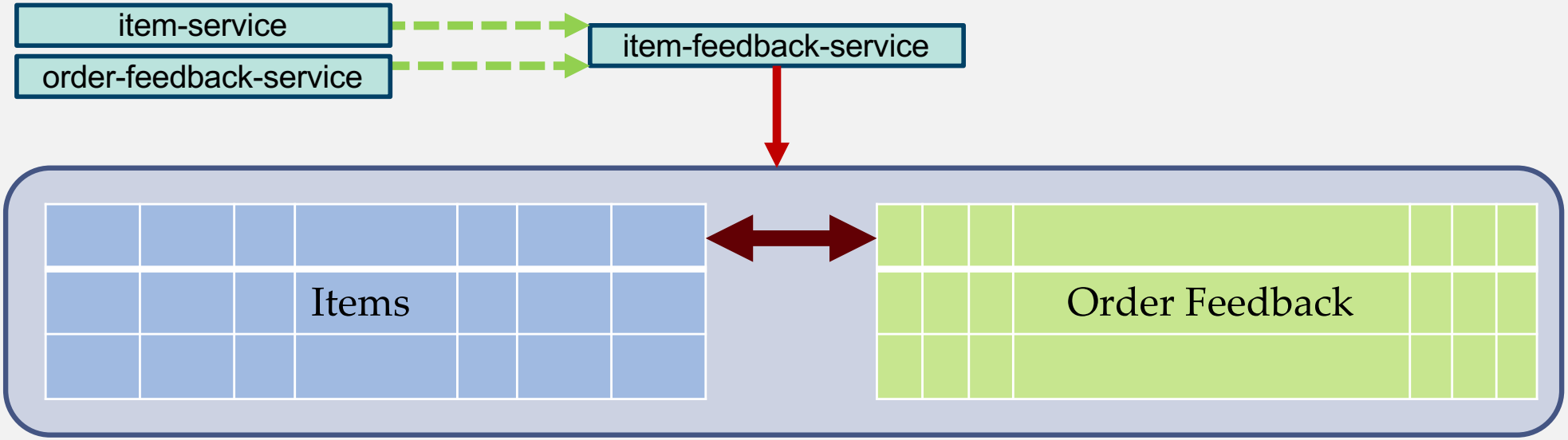
- Best for single A, multiple Bs (1:N join)

Microservice Techniques: Joins

- Many common systems do this
  - Web application "mashup"

Microservice Techniques: Joins

- Approach 2: "Materialize the View"
  - Listen to events from `item-service` and `order-feedback-service`
  - Maintain denormalized join of items and order feedback in local storage



- Best for high cardinality A and B (M:N join)

Microservice Techniques: Joins

- Many common systems do this
  - Most NoSQL approaches
  - "Materialized view" in database systems
  - Search engines
  - Analytic systems
  - Log aggregators

Microservice Techniques: Workflows and Sagas

- Problem
  - Monolithic database makes transactions across multiple entities easy
  - Splitting data across services makes transactions very hard

Microservice Techniques: Workflows and Sagas

- Transaction ➔ Saga
  - Model the transaction as a state machine of atomic events
- Reimplement as a workflow

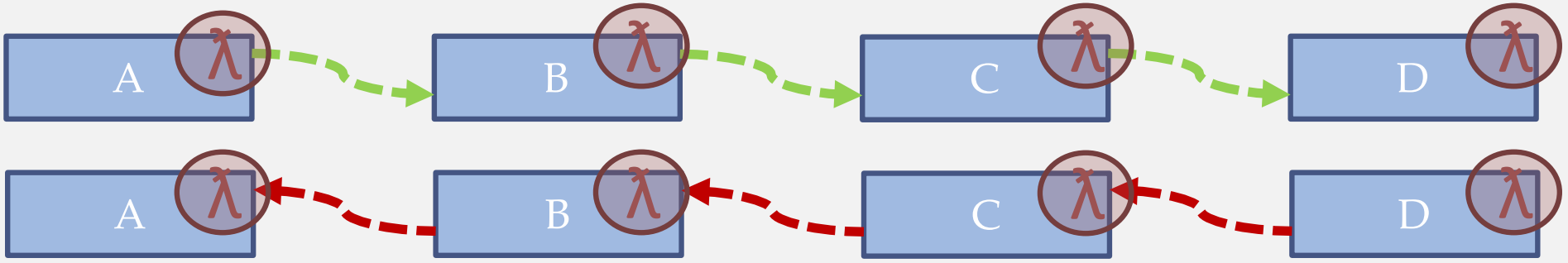
- Roll back by applying compensating operations in reverse

Microservice Techniques: Workflows and Sagas

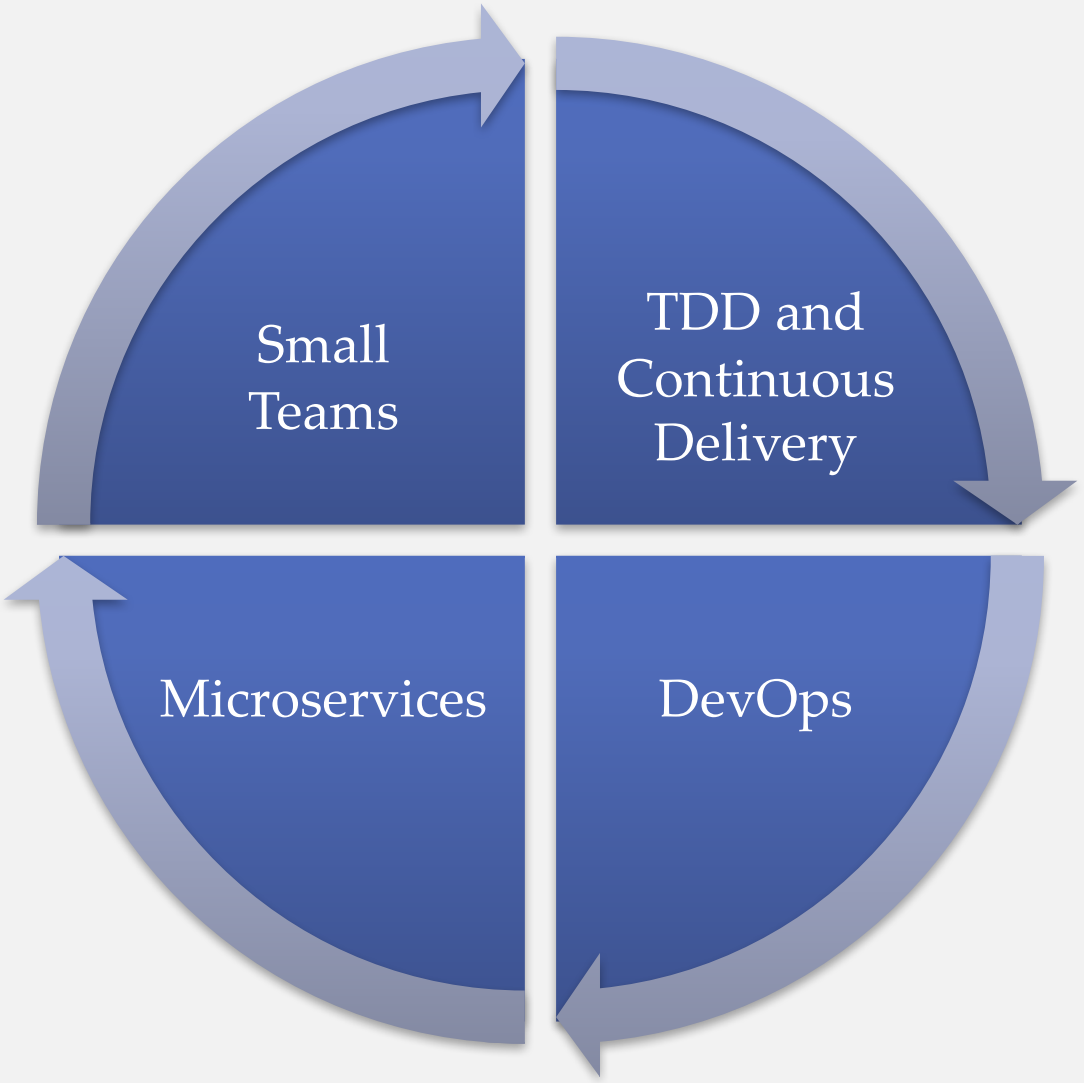
- Many common systems do this
  - Payment processing
  - Expense approval
  - Any multi-step workflow

Microservice Techniques: Workflows and Sagas

- Ideal use for Functions as a Service ("Serverless")
  - Very lightweight logic
  - Stateless
  - Triggered by an event



Modern Software Development



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  - **Hiring everywhere!**
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  - Application development, Platform engineering, Data Science

- Please contact me
  - @randyshoup
  - linkedin.com/in/randyshoup