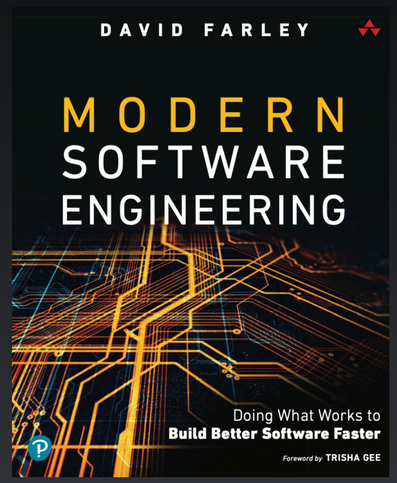
Solving the Hard Problems

Evolutionary Architecture & Design, Tackling Complexity in Software



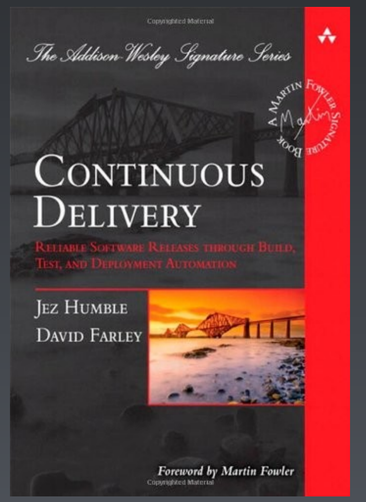
Dave Farley

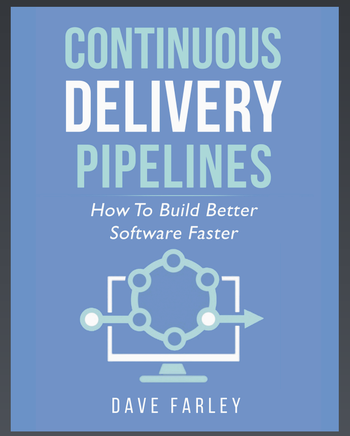
https://www.davefarley.net

@davefarley77

@davefarley77@techhub.social

https://bit.ly/CDonYT

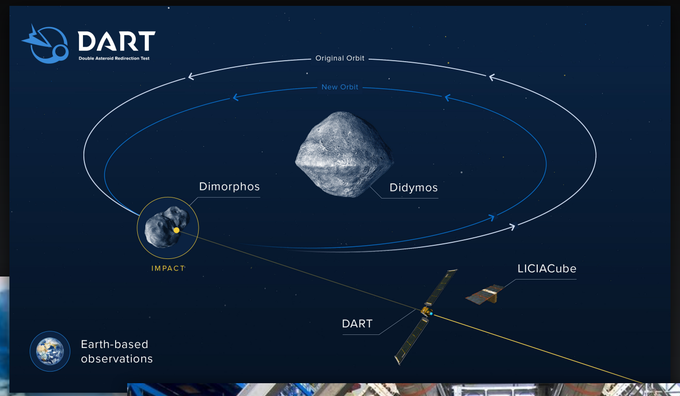




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http://www.continuous-delivery.co.uk

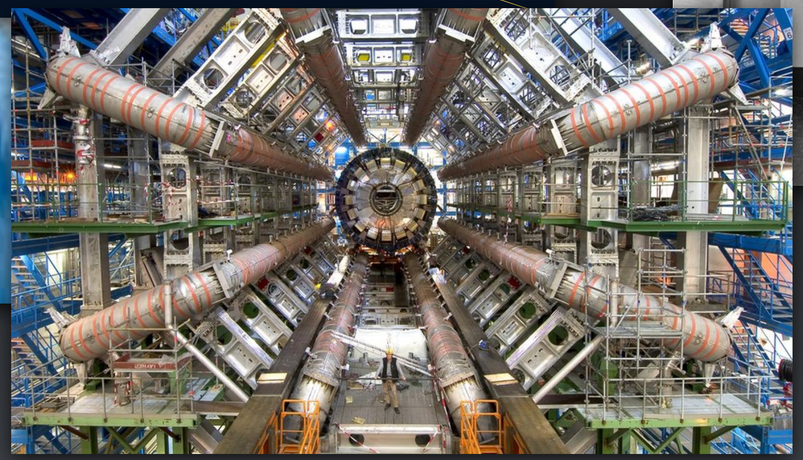












Engineering

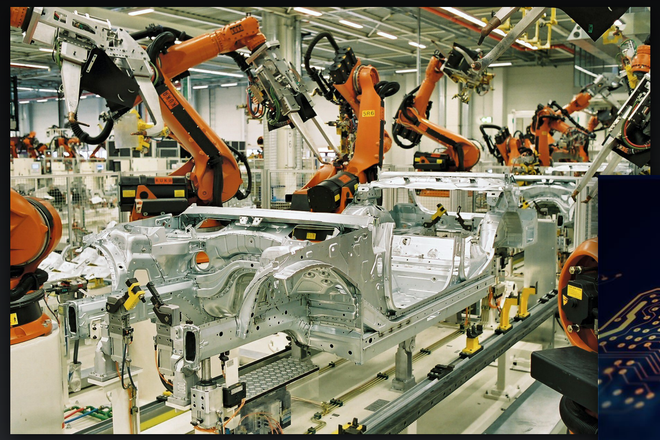
is How We Solve the Hard Problems!

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Put More Simply...

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Put More Simply...





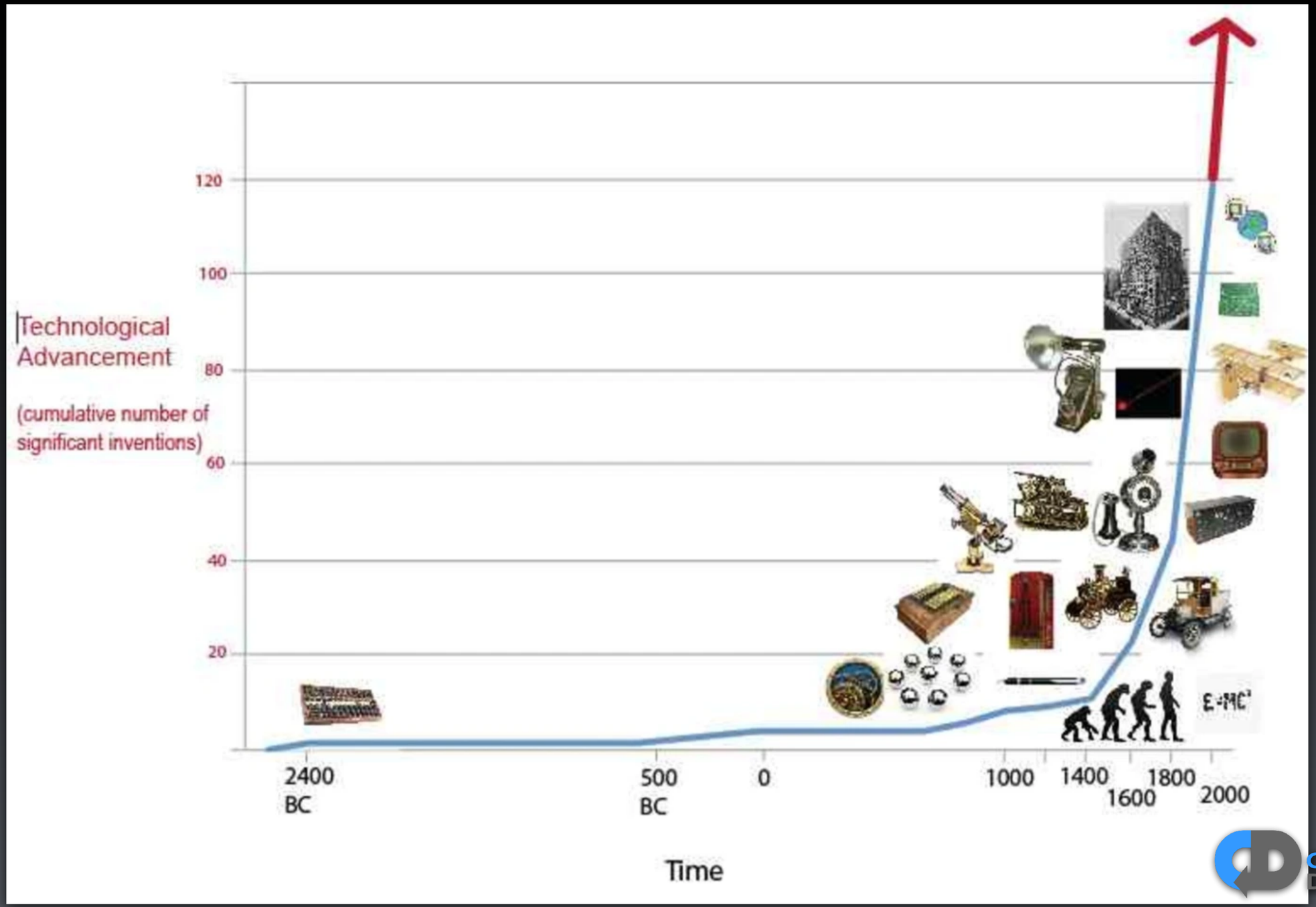




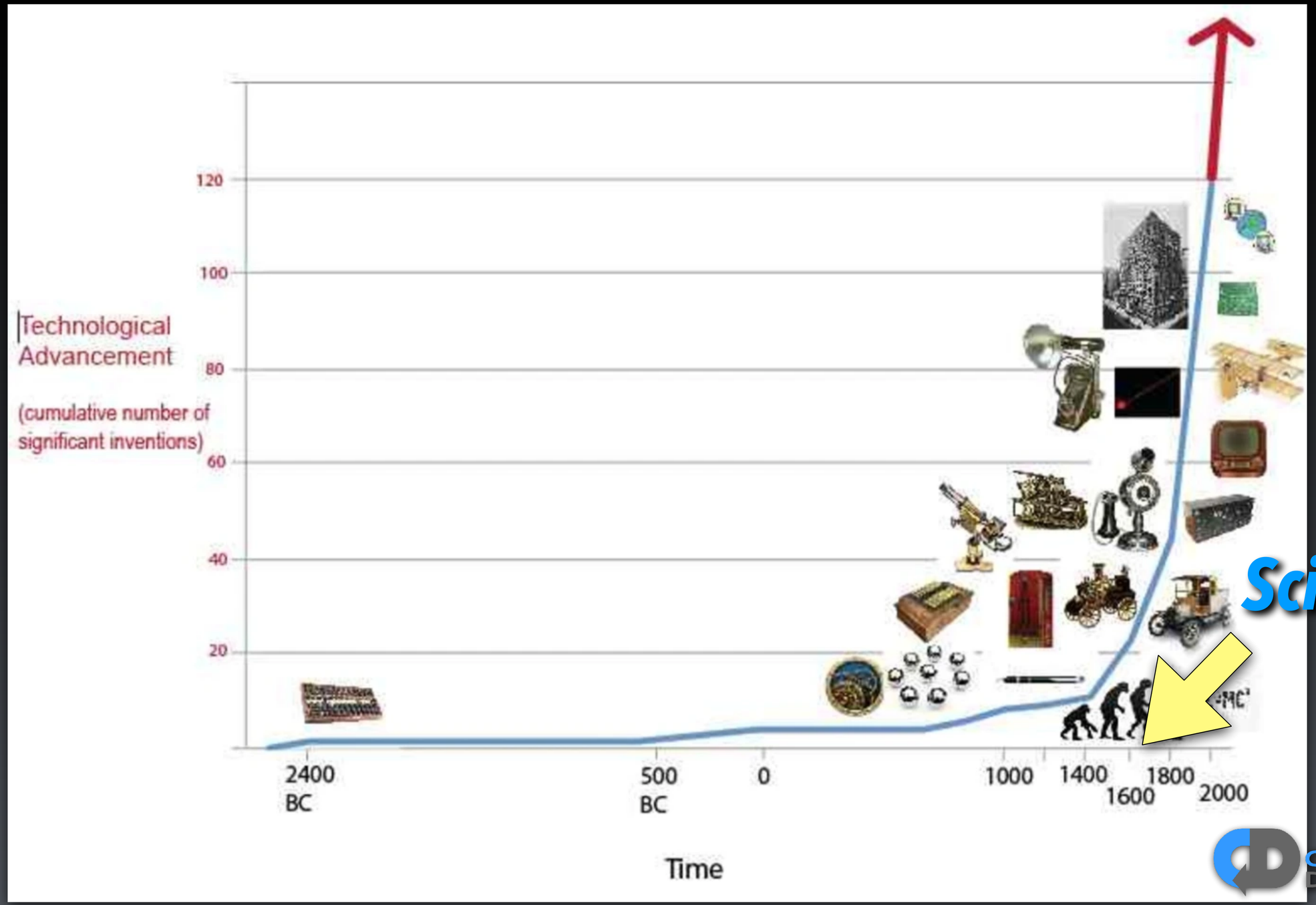
Engineering

The Foundation on Which Our High-Tech Culture is Built!

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In Software We Misunderstand Engineering All the Time!

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What is Engineering Really For?

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It's Not the Job of Engineering to Define Perfect Solutions!
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Engineering
Is There to Rule Out
The Bad Ideas!
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Delivery ltd

Complex Systems
Don’t Spring Fully Formed Into Existence



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Complex Systems
Don’t Spring Fully Formed Into Existence



Engineering:
An Experimental, Incremental Process of Trial & Error!

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So The Tools of Our Trade!

Are Not Really Languages and Frameworks

These are the Nuts & Bolts!

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The Tools of Our Trade!

Problem Solving

&

DESIGN!

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The Tools of Our Trade!

DESIGN!

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The Tools of Our Trade!

Incremental DESIGN!

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The Tools of Our Trade!

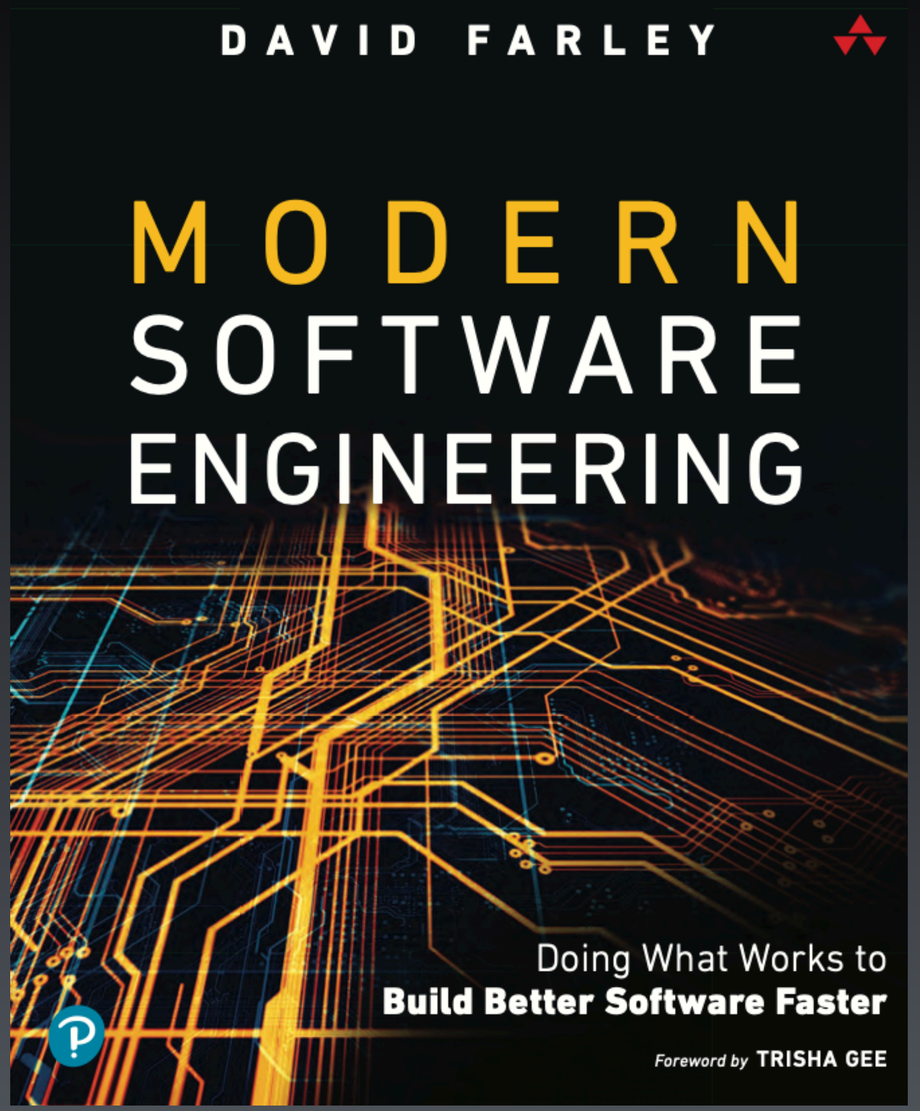
Software Engineering is DESIGN ENGINEERING!

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The Tools of Our Trade!

Continuous Delivery ltd

The Tools of Our Trade!



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The Power Tools of Our Trade!

Optimise for Learning

- Iteration
- Feedback
- Incremental
- Experimental
- Empirical



Optimise to Manage Complexity

- Modularity
- Cohesion
- Separation of Concerns
- Abstraction
- Coupling

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The Power Tools of Our Trade!

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Quality in Software is Measured by Ease of Change!

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But, How do We Design & Architect for Ease of Change?

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What do We Mean by SW Architecture?

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What is SW Architecture?

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What is SW Architecture?



Software architecture is the set of structures needed to reason about a software system and the discipline of creating such structures and systems.

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What is SW Architecture?



needed to reason about

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What is SW Architecture?

Architecture

Design

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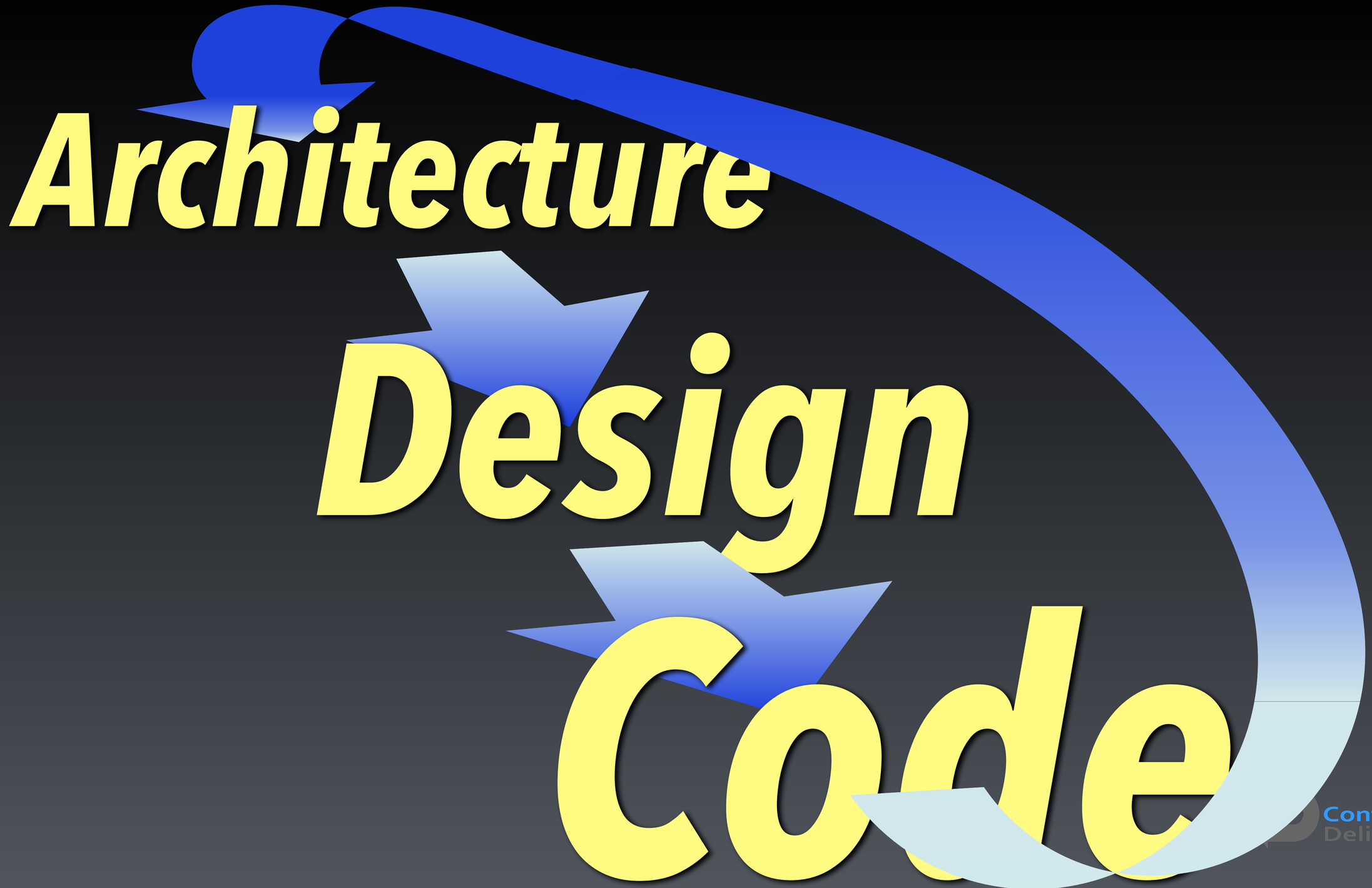
Architecture



Design

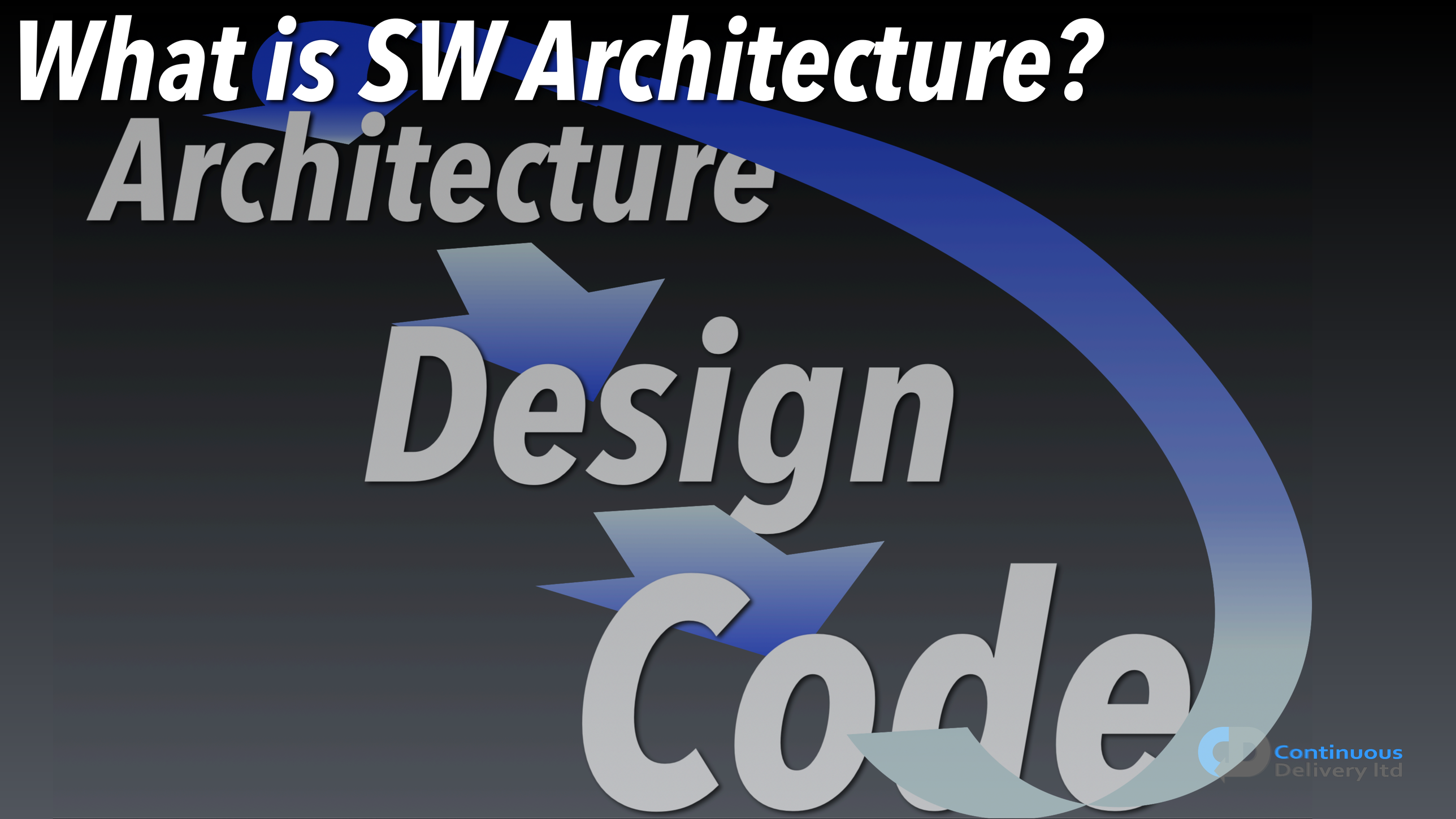
Code

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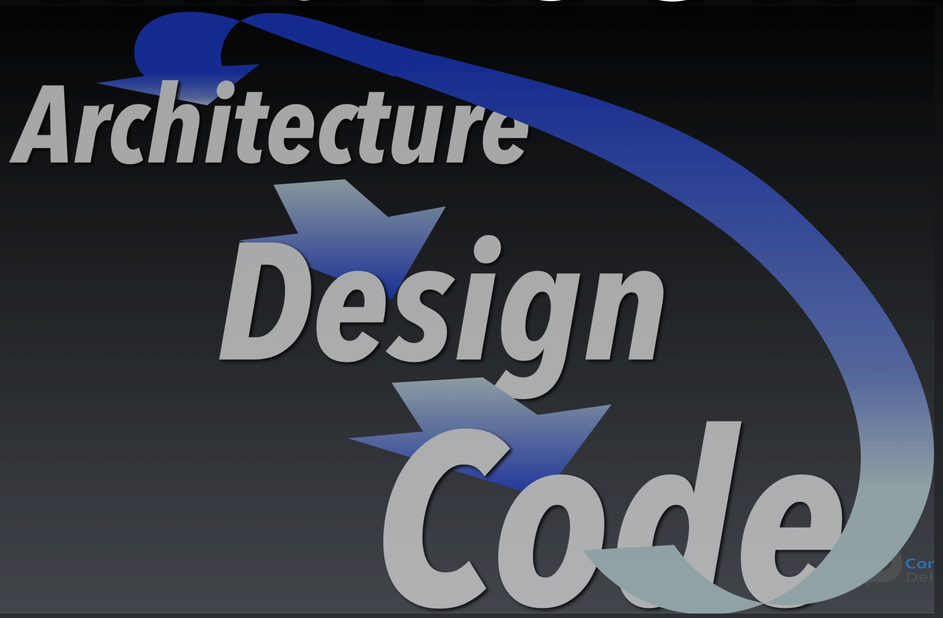


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What is SW Architecture?



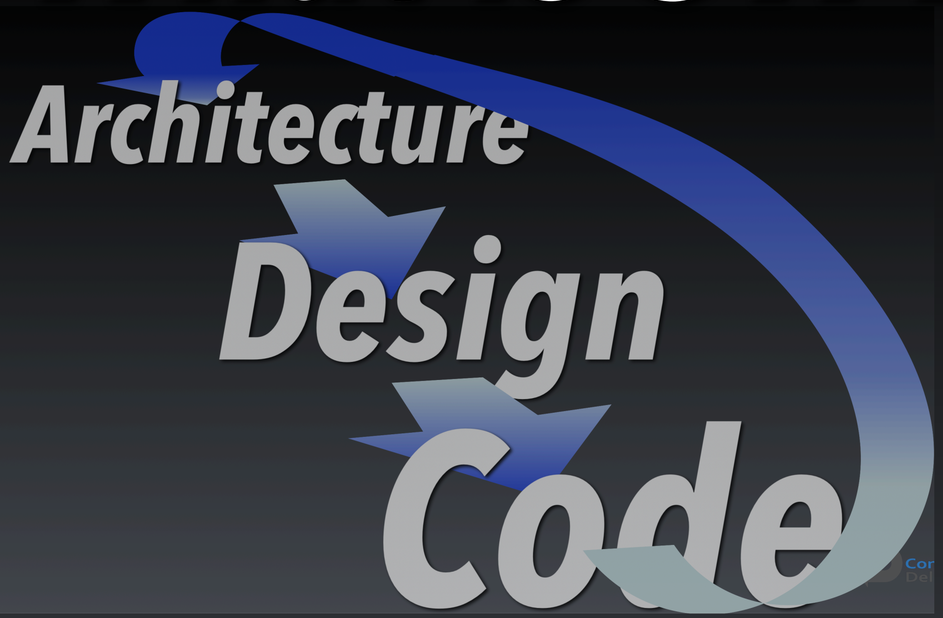
What is SW Architecture?



Continuous Architecture

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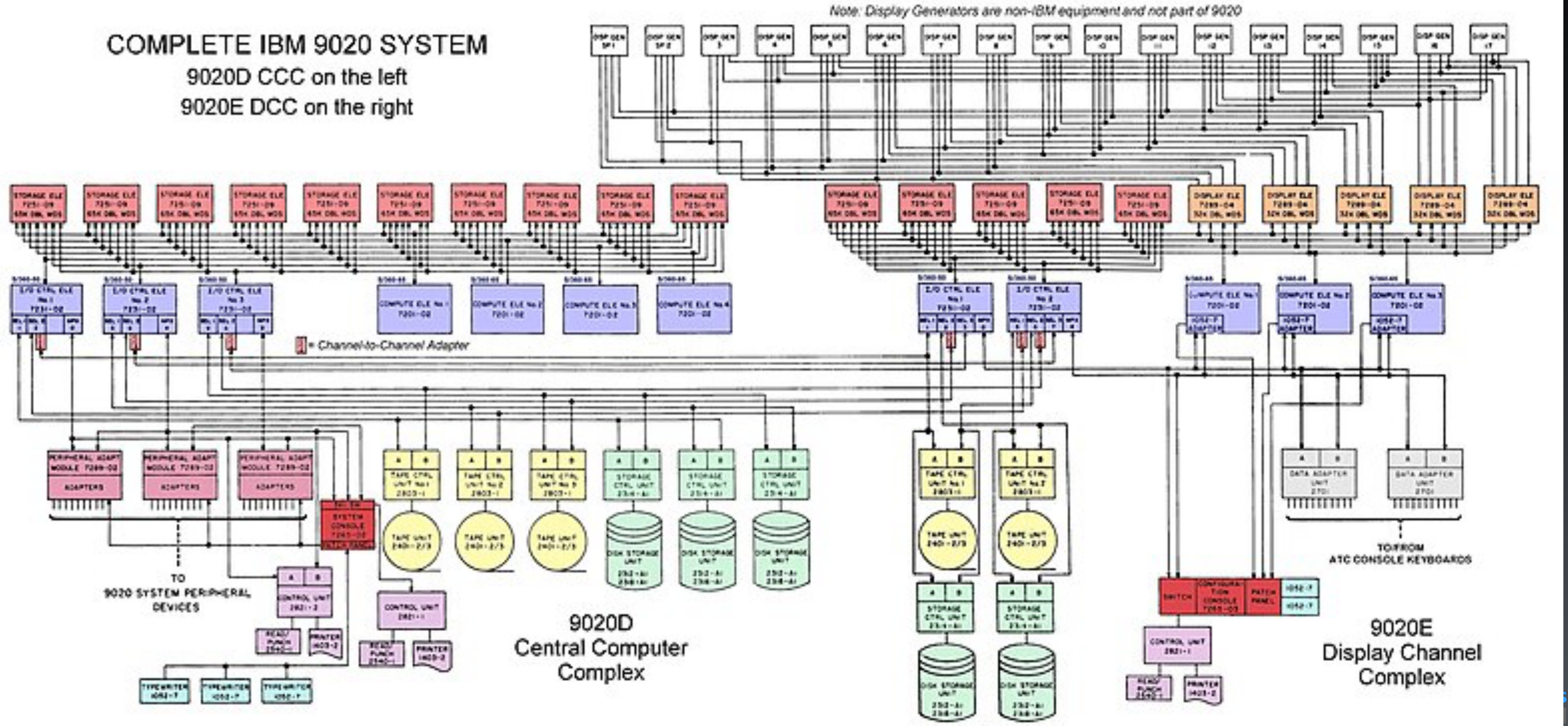
What is SW Architecture?



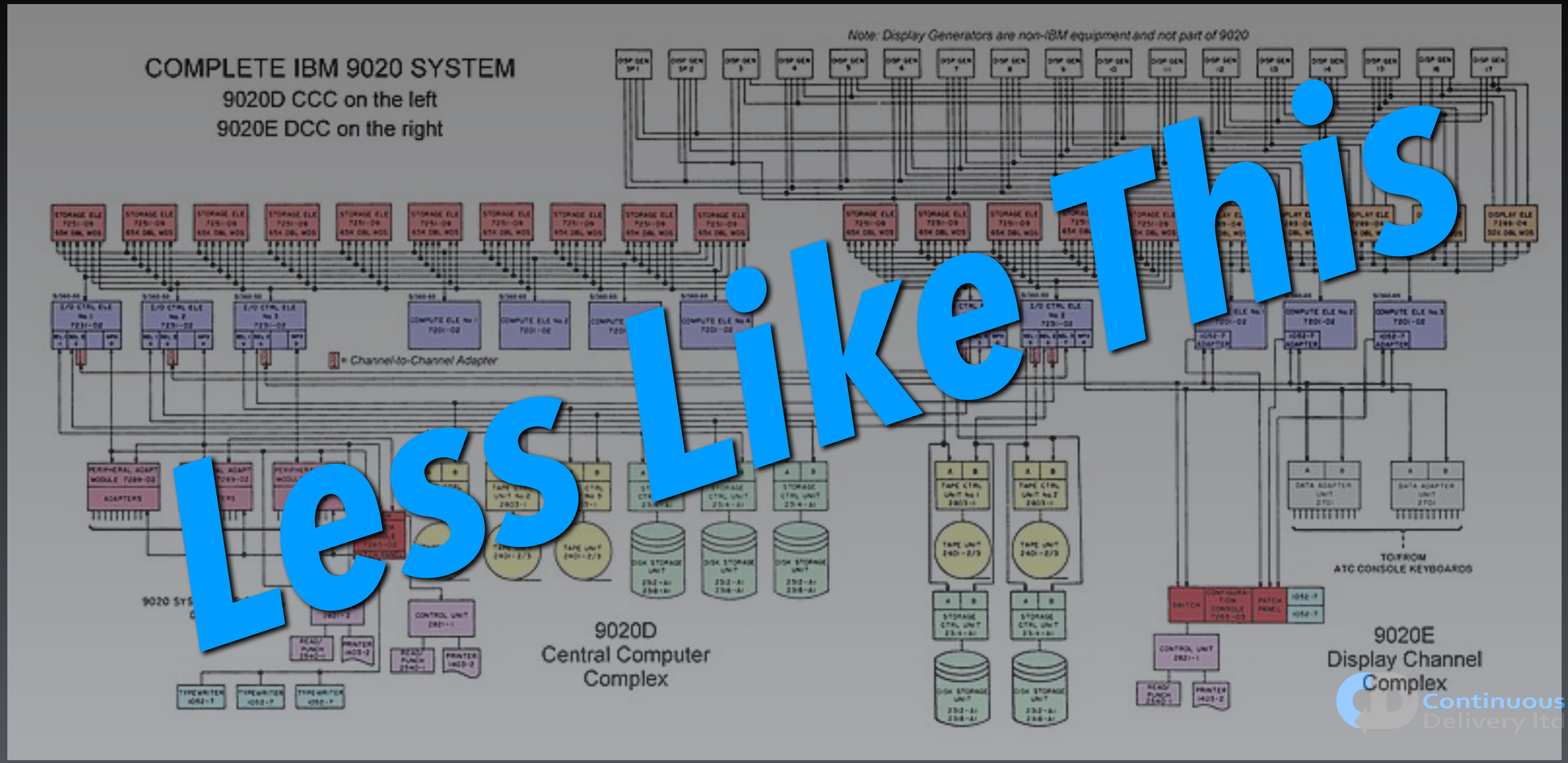
Continuous Architecture
Evolutionary Architecture

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What is SW Architecture?



What is SW Architecture?



Less Like This

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What is SW Architecture?

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What is SW Architecture?



More Like This

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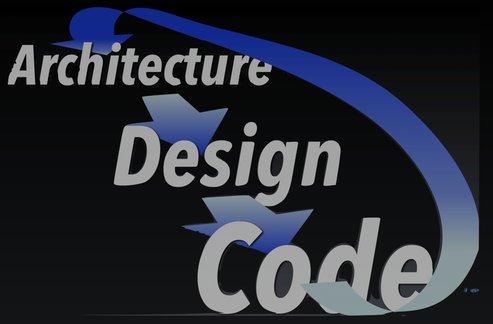
What is SW Architecture?



A Kind of Tourist Map / A Model of Our System(s)

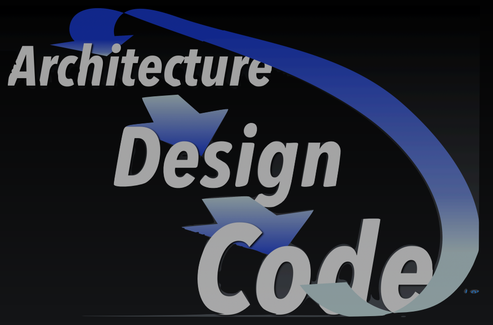
Accurate in Some Dimensions, But NOT Precise!

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Architecture
Design
Code


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Iteration



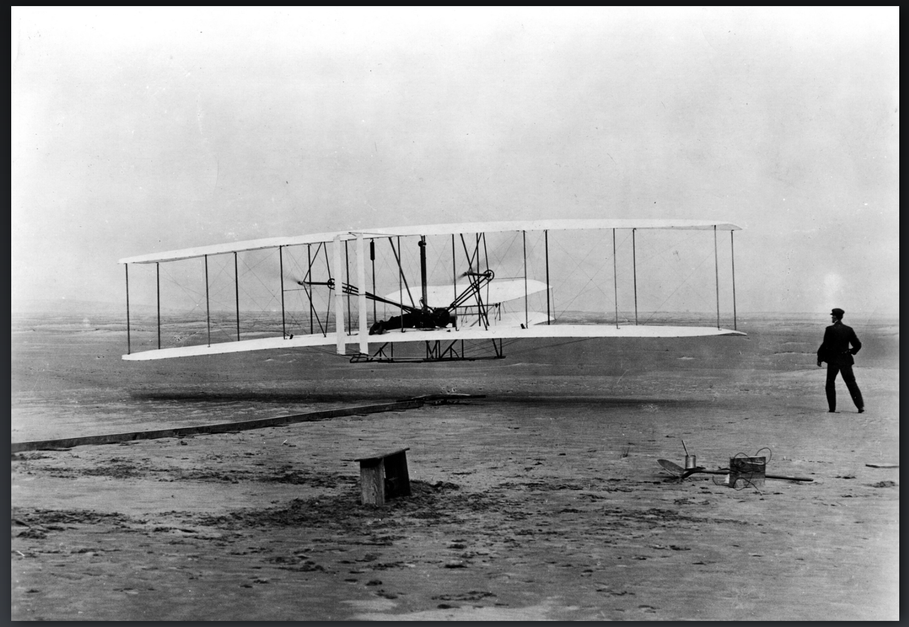
Fundamental to Engineering!



Iteration

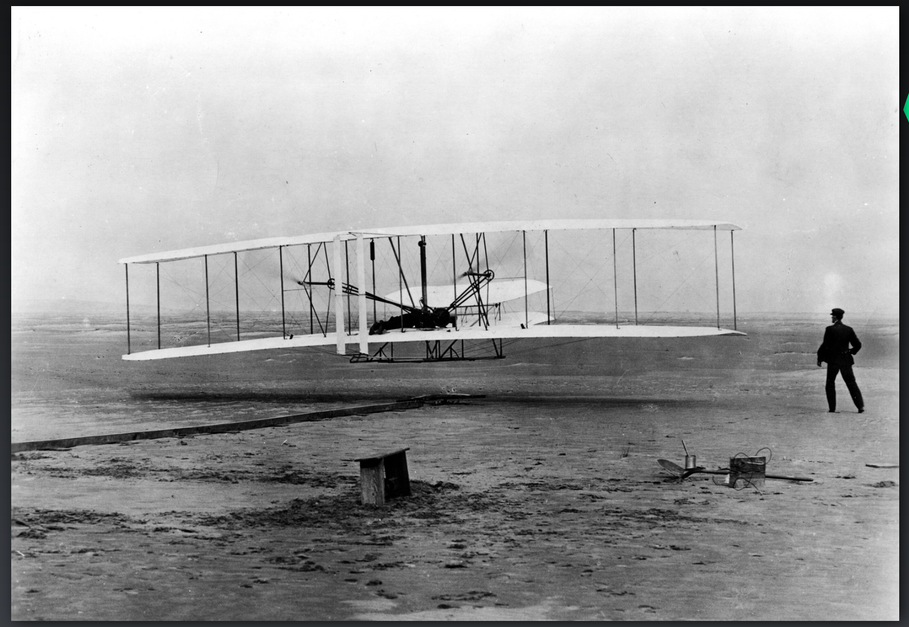


Iteration



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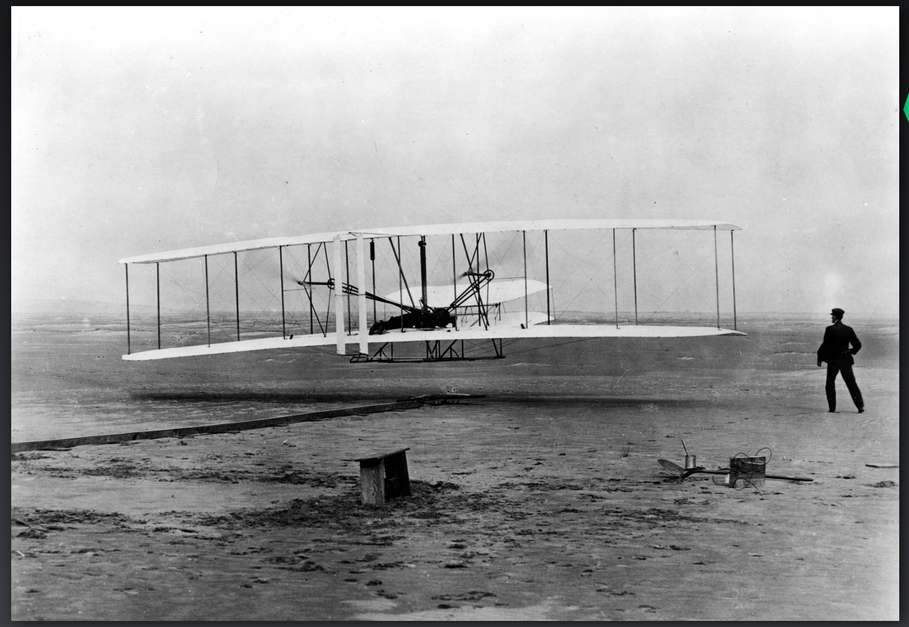
Iteration





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Iteration

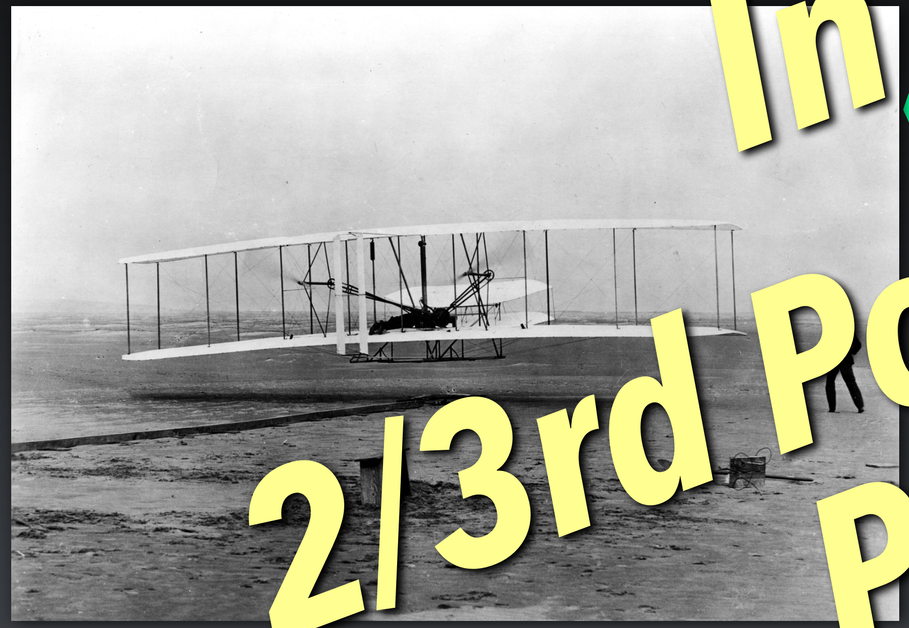






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Iteration







In 2017
2/3rd Population of the Planet Flew
With no Fatalities!

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Iteration



Iteration



The Goal

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Iteration



The Goal



Start

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Iteration



The Goal



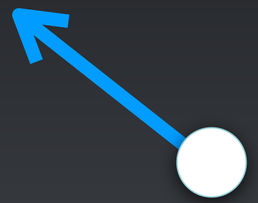
Start



Fitness Function

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Iteration



Start



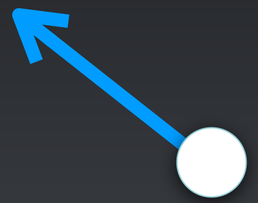
The Goal



Fitness Function

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Iteration

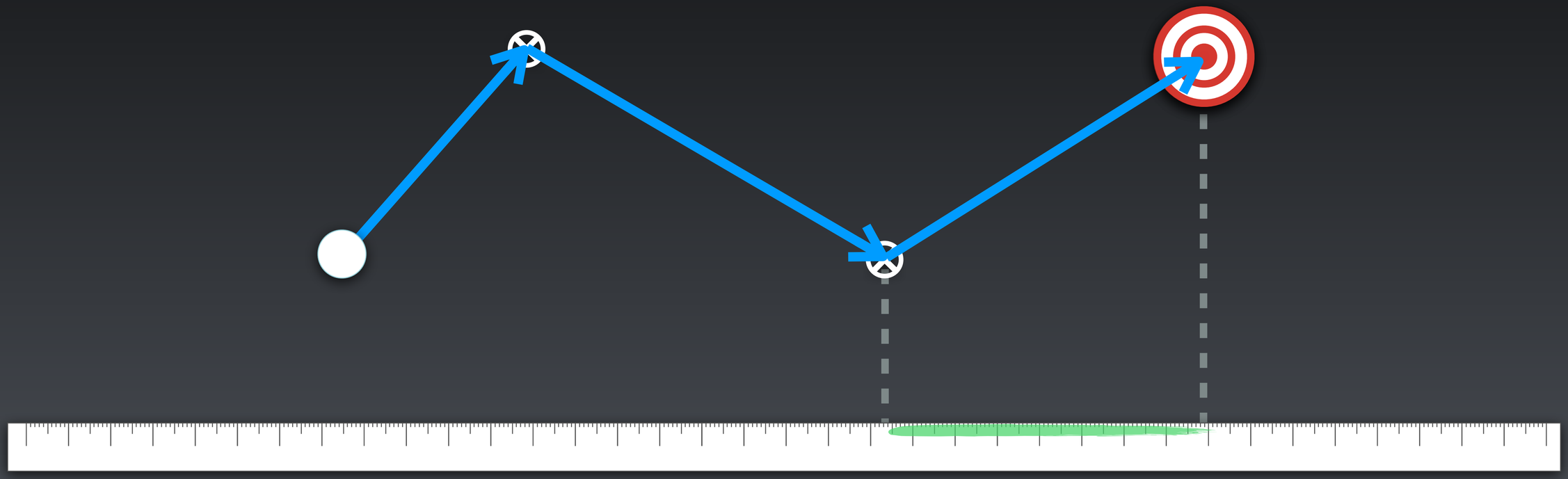






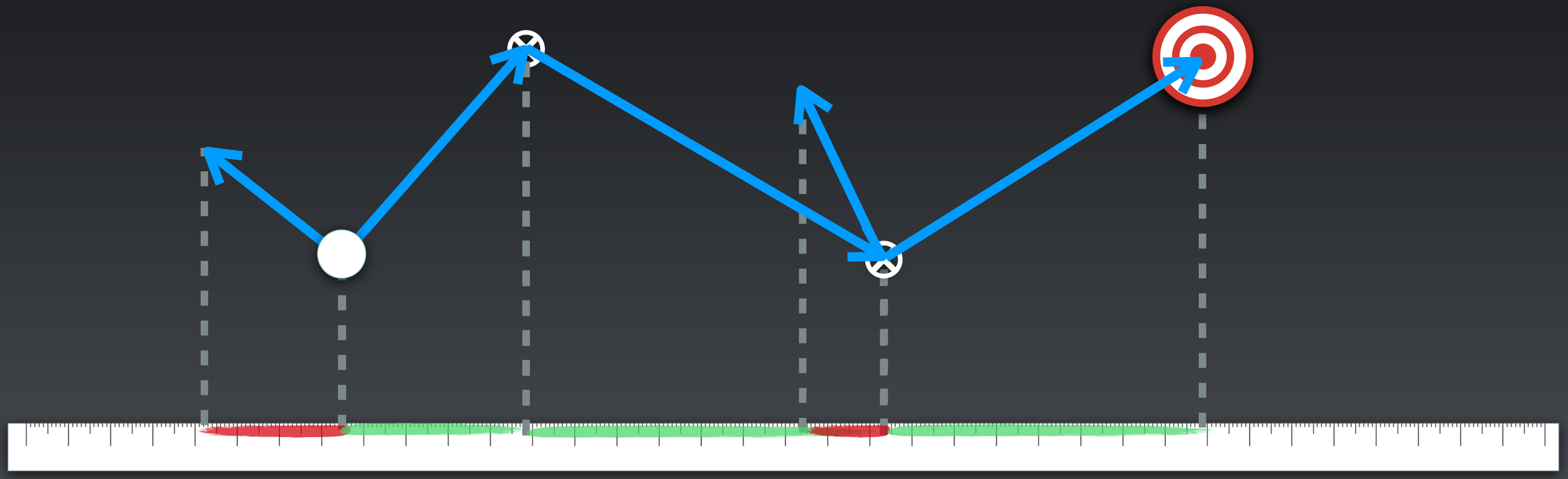
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Iteration



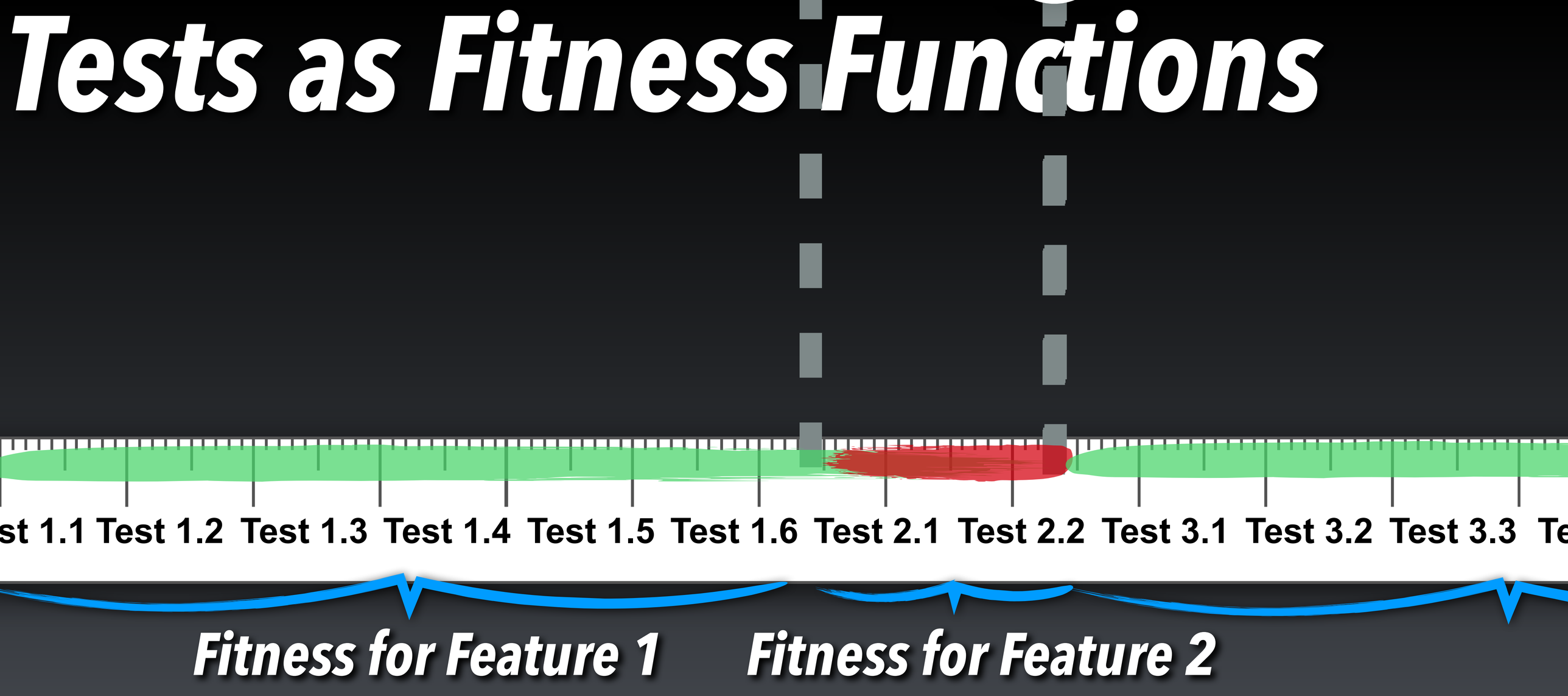
Continuous Delivery ltd

Tests as Fitness Functions



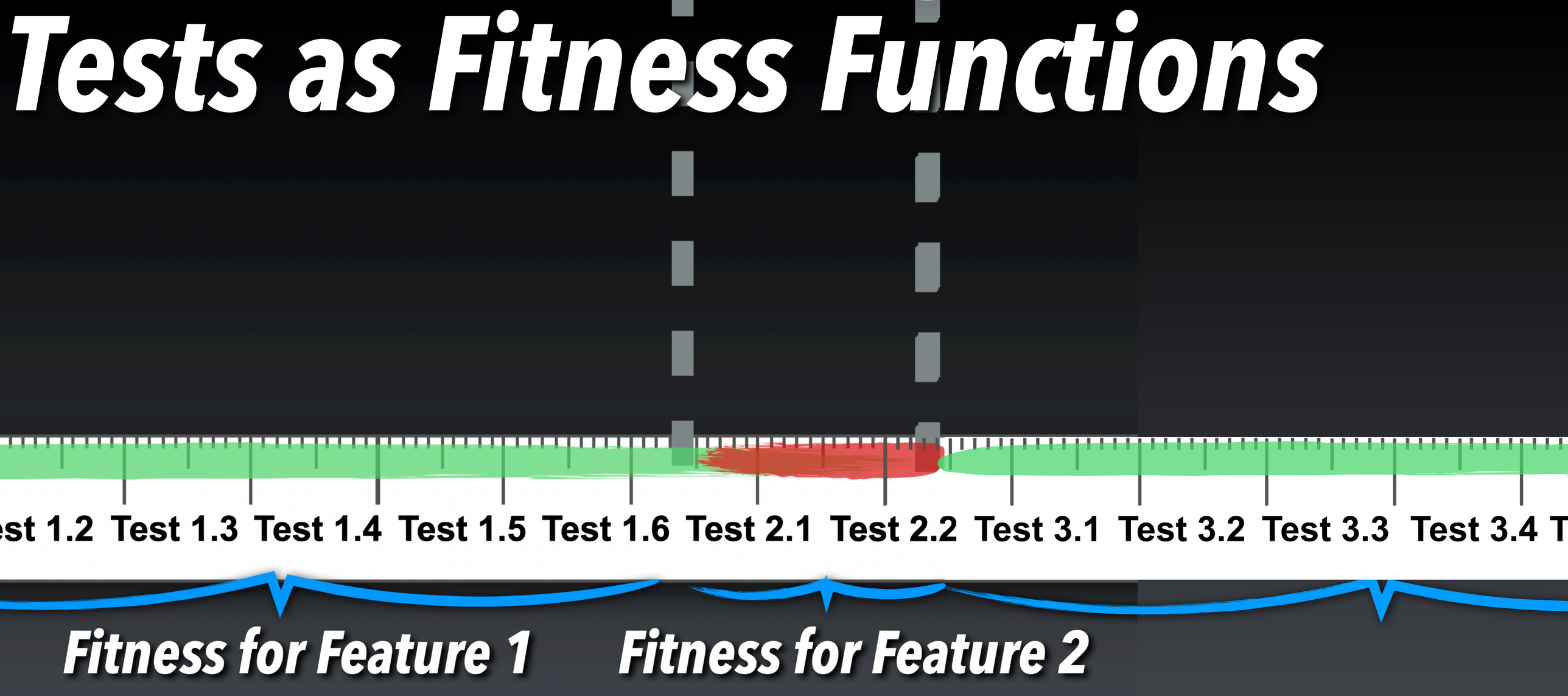
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Tests as Fitness Functions



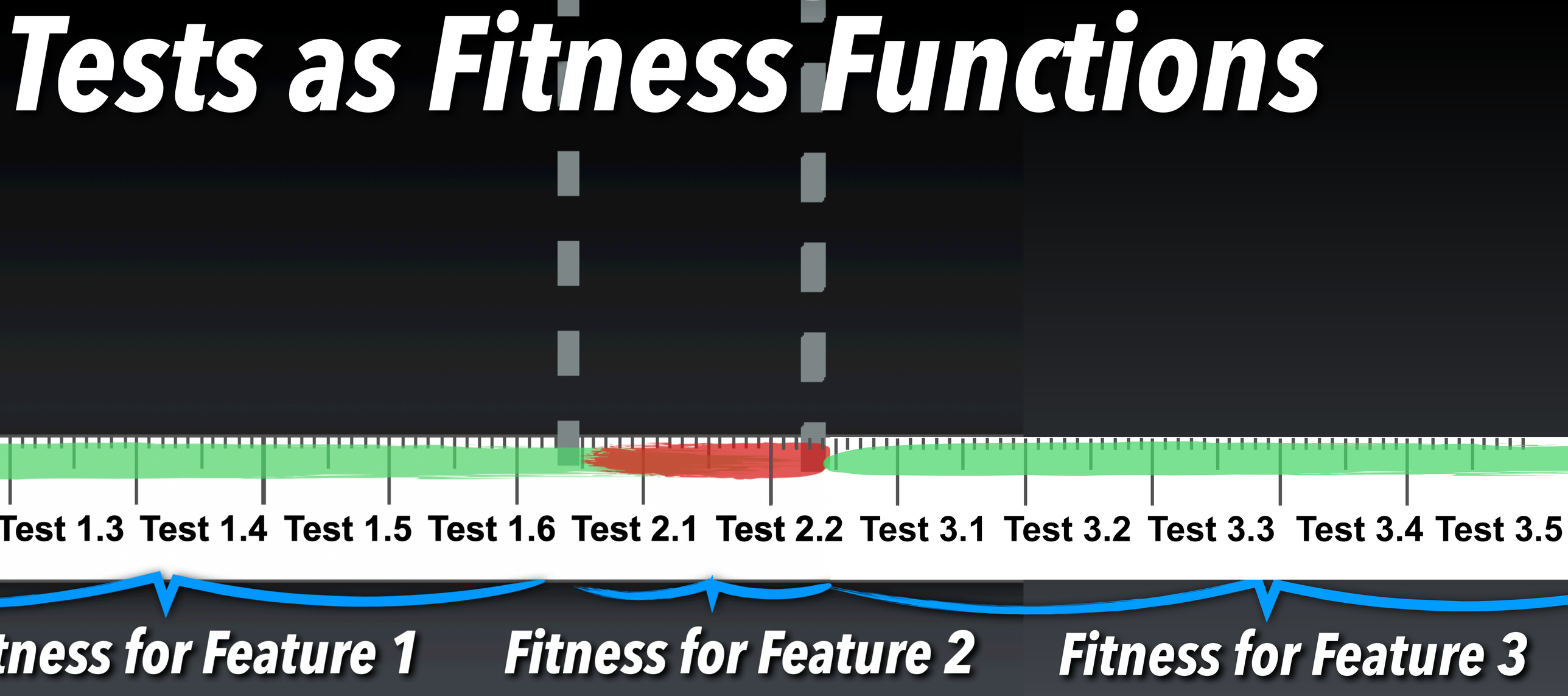
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Tests as Fitness Functions



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Tests as Fitness Functions



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How to Use The Power-Tools

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How to Use The Power-Tools

Optimise for Learning

Iteration
Feedback
Incremental
Experimental
Empirical

Optimise to Manage Complexity

Modularity
Cohesion
Separation of Concerns
Abstraction
Coupling

Continuous Delivery ltd

More Tools of the Trade - Guiderails

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More Tools of the Trade - Guiderails

Small Steps
Prioritise Testability
Architecture as a Snapshot
Maintain the Tourist Map
Prioritise Ease of Change

Separate Concerns
Adapt to Current Context
Don't Design Ahead
Platform As Abstraction
Manage Coupling

Continuous Delivery ltd

More Tools of the Trade - Guiderails

Small Steps
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Small Steps

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Small Steps

Continuous Delivery ltd

Small Steps



Continuous Delivery ltd

Small Steps



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Small Steps



Optimise for Learning

Iteration

Feedback

Incremental

Experimental

Empirical

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Small Steps



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Small Steps



Provide Freedom to be Wrong!

Improve Feedback

More Opportunities to Learn

Increase Confidence

Reduce Risk

Reduce Costs

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Big Steps - Bad Idea!

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Big Steps - Bad Idea!



$10,000

Reduce Flexibility

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Big Steps - Bad Idea!



$40,000



Reduce Flexibility
Reduce Learning
Less Tolerant of Mistakes
Cost More

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Big Steps - Bad Idea!





Reduce Flexibility
Reduce Learning
Less Tolerant of Mistakes
Cost More

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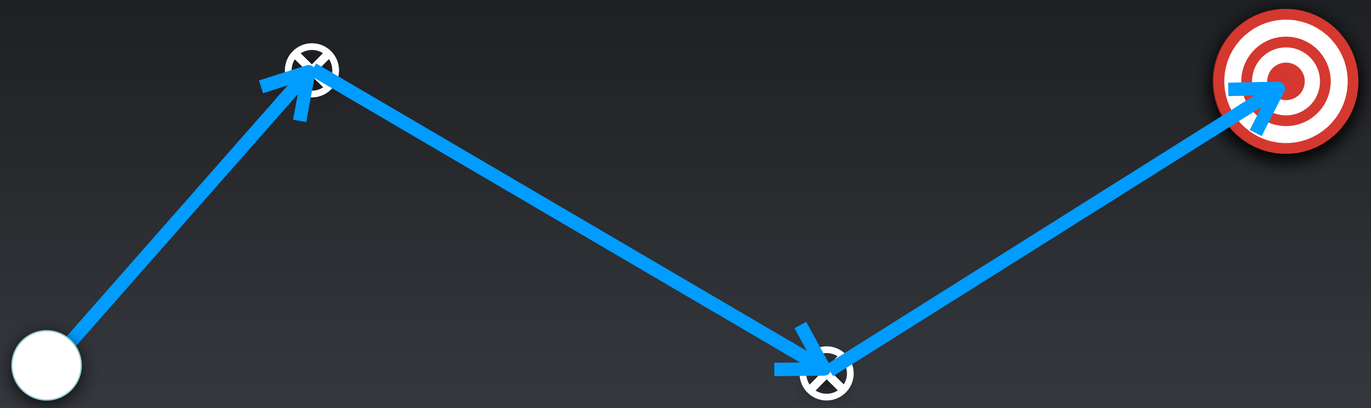
Small Steps





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Small Steps



$40

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Small Steps



Small Steps



- Increase Visibility
- Make Change Simpler
- Control the Variables
- Speed the Pace of Change

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Prioritise Testability

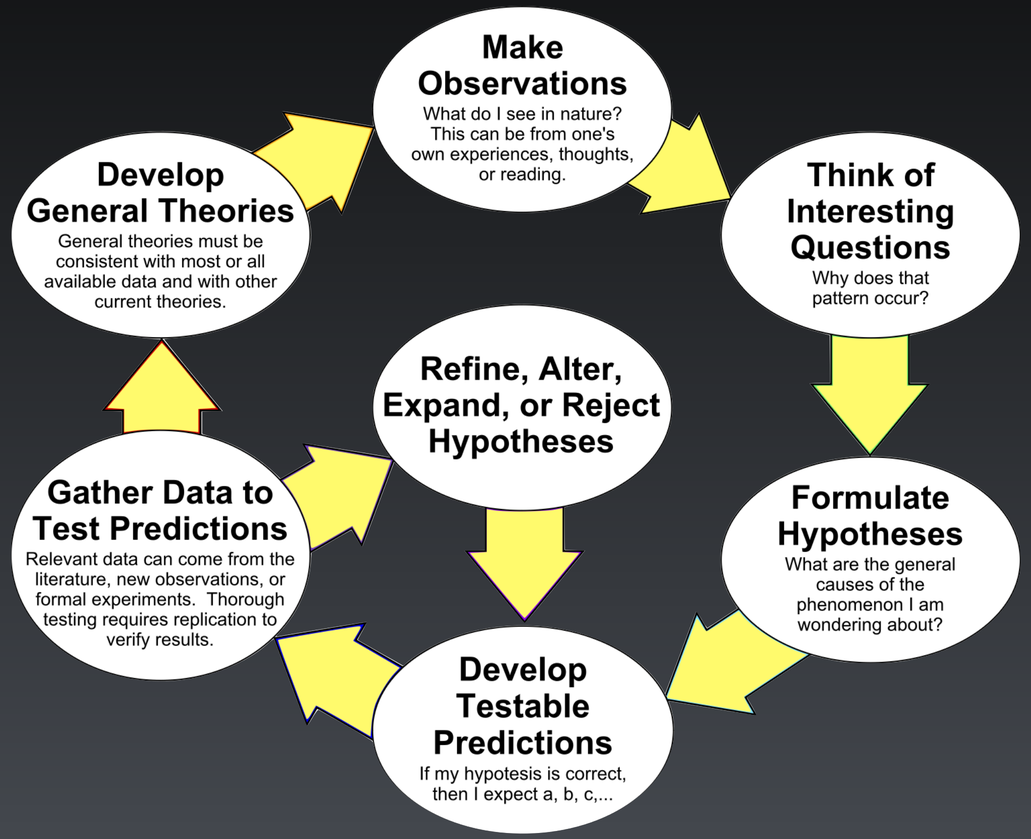
Continuous Delivery ltd

Prioritise Testability

Continuous Delivery ltd

Prioritise Testability

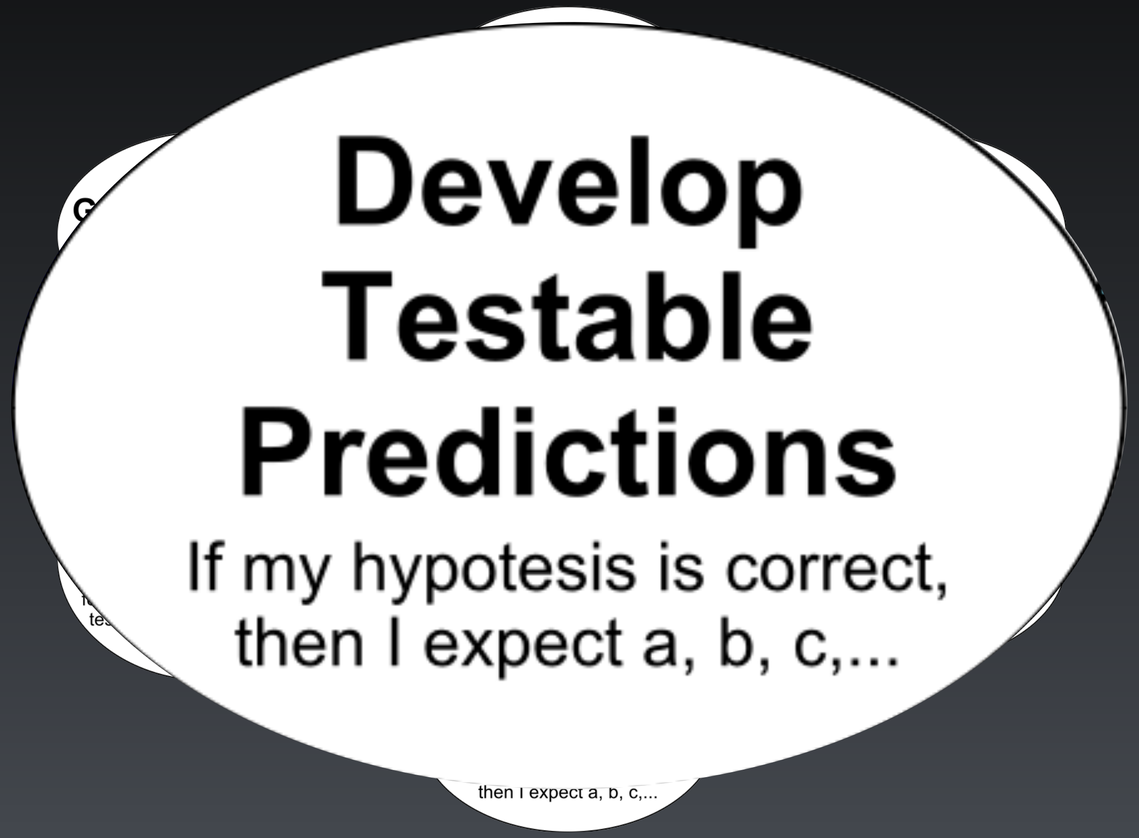
The Scientific Method as an Ongoing Process



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Prioritise Testability

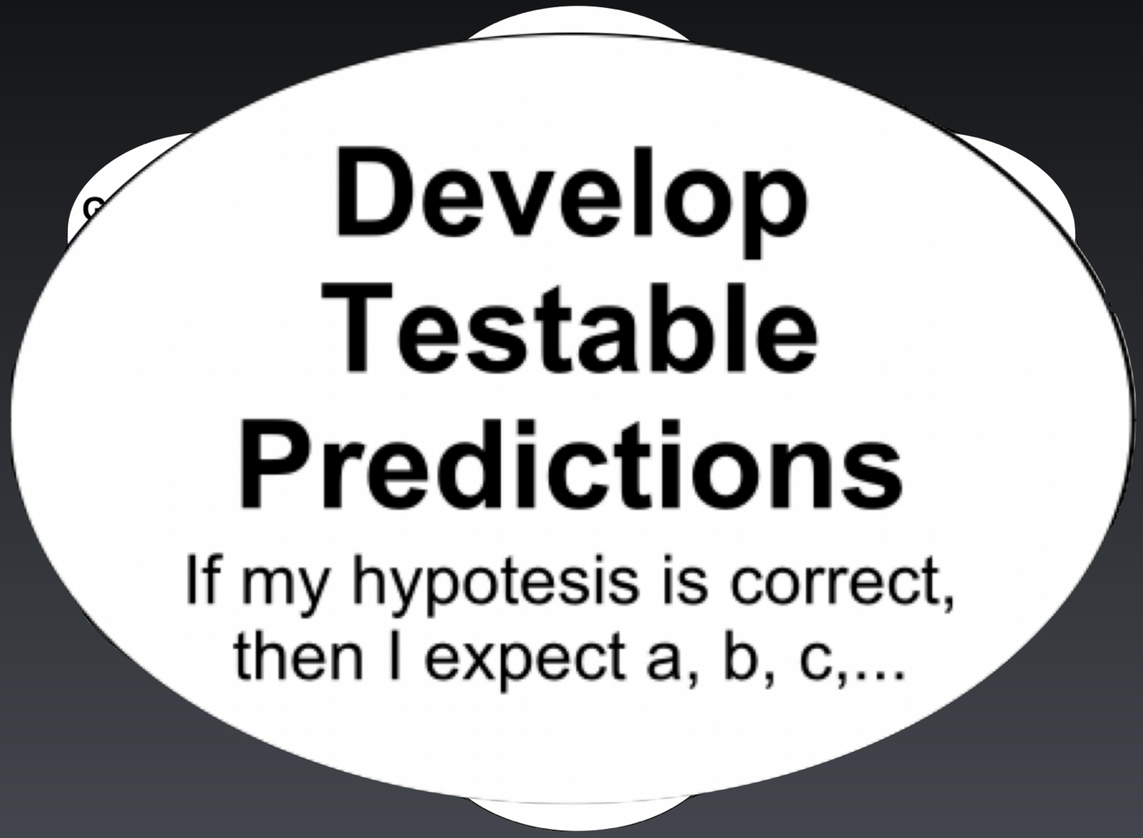
The Scientific Method as an Ongoing Process



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Prioritise Testability

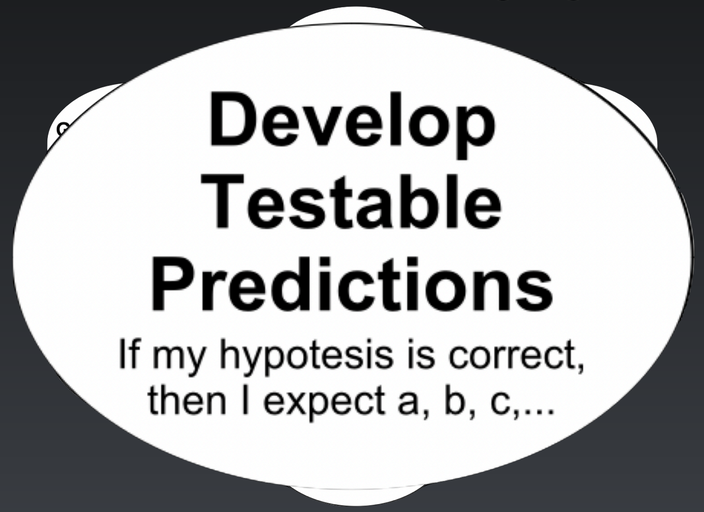
The Scientific Method as an Ongoing Process



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Prioritise Testability

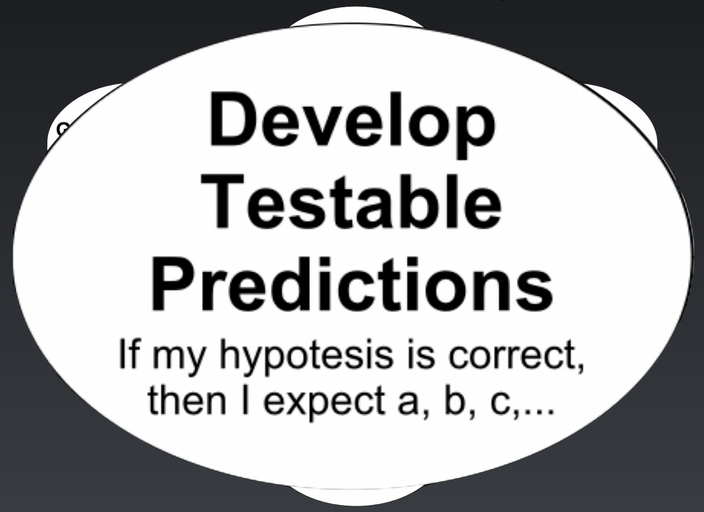
The Scientific Method as an Ongoing Process



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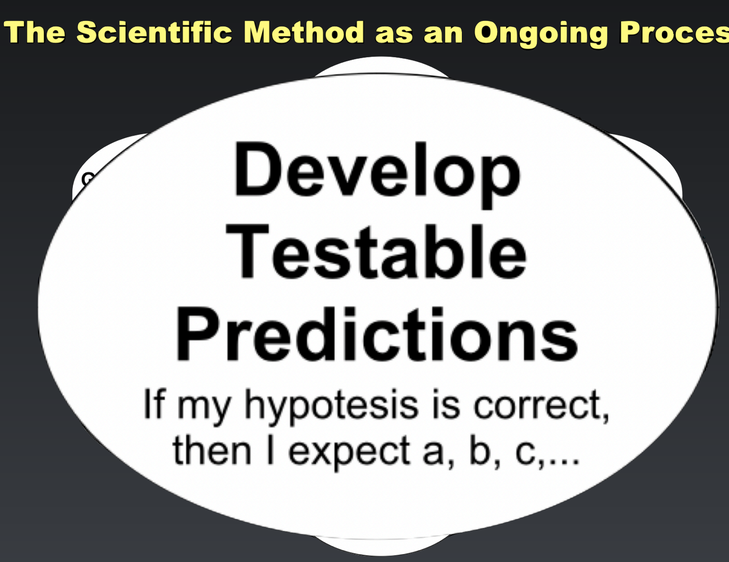
Prioritise Testability

The Scientific Method as an Ongoing Process



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Prioritise Testability



Optimise for Learning

Feedback

Incremental

Experimental

Optimise to Manage Complexity

Modularity

Cohesion

Separation of Concerns

Abstraction

Coupling

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Prioritise Testability

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Prioritise Testability

```
Feature: Addition
 In order to avoid silly mistakes
 As a math idiot
 I want to be told the sum of two numbers

 Scenario: Add two numbers
  Given I have entered 50 into the calculator
  And I have entered 70 into the calculator
  When I press add
  Then the result should be 120 on the screen
```

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Prioritise Specification

```
Feature: Addition
 In order to avoid silly mistakes
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 Scenario: Add two numbers
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  And I have entered 70 into the calculator
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Prioritise Specification

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Prioritise Specification

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 As a math idiot
 I want to be told the sum of two numbers

 Scenario: Add two numbers
  Given ~~I have entered 50 into the calculator~~
  And ~~I have entered 70 into the calculator~~
  When I ~~press~~ add 50 to 70
  Then the result should be 120 ~~on the screen~~

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Prioritise Specification

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Continuous Delivery ltd

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 Scenario: Add two numbers
  When I add 50 to 70
  Then the result should be 120
```

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Prioritise Specification

Continuous Delivery ltd

Prioritise Specification

Feature: Availability
In order to provide service when a failure occurs
As a book buyer
I want to be able to buy books when the system is under stress!

Scenario: Warehouse Outage
Given I have ordered the book "Modern SW Engineering:
And the Warehouse is out of commission
When I buy the book
Then then my order is confirmed
And I am informed that it will be delivered as soon as possible

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Prioritise Specification

Continuous Delivery ltd

Prioritise Specification

```
Feature: Latency
 In order to respond in a timely manner
 As a Financial Trader
 I want to have my trade confirmed in under 1ms

 Scenario: Add Trade to order-book
  Given I have placed a buy order for MSFT 100@418.3
  And my price is not matched
  When I place the order
  Then I am notified that my order is in the order-book within
  1ms of it being placed
```

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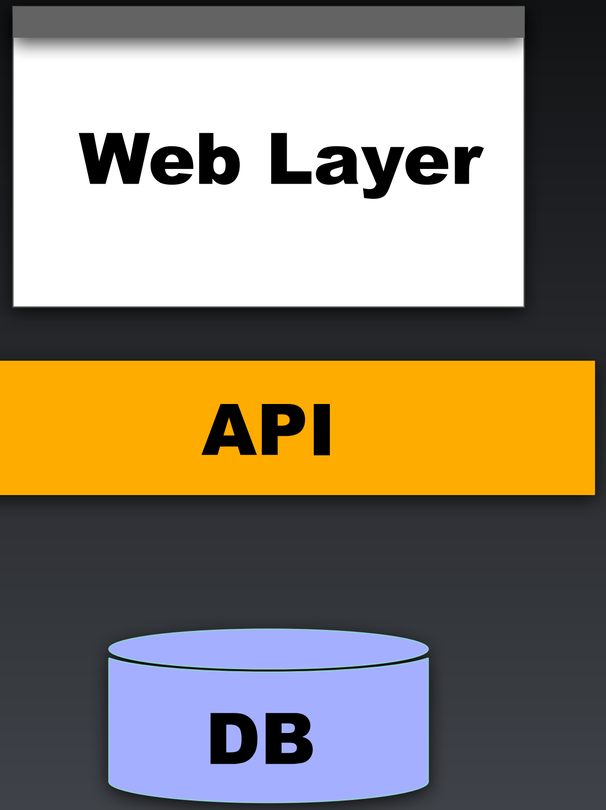
Architecture as a Snapshot

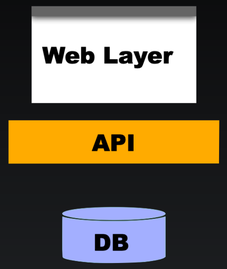
Continuous Delivery ltd

Architecture as a Snapshot

Continuous Delivery ltd

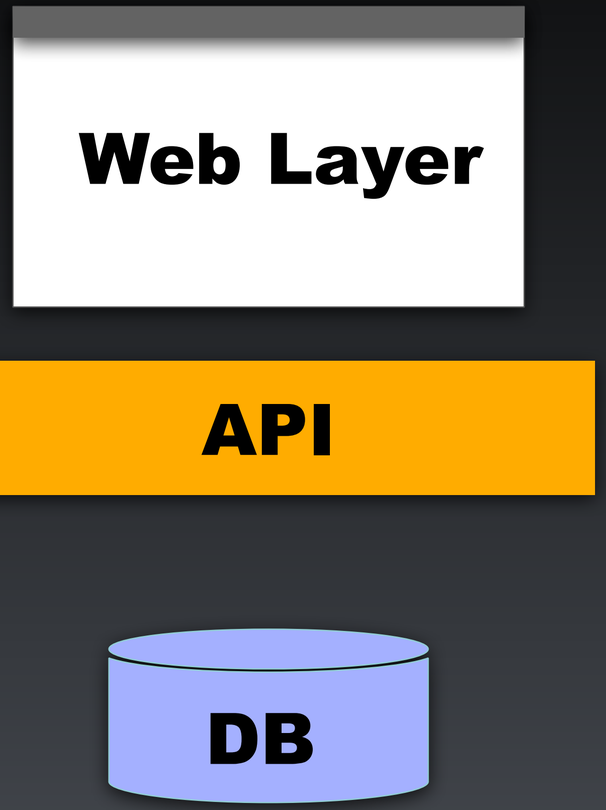
Architecture as a Snapshot





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Architecture as a Snapshot

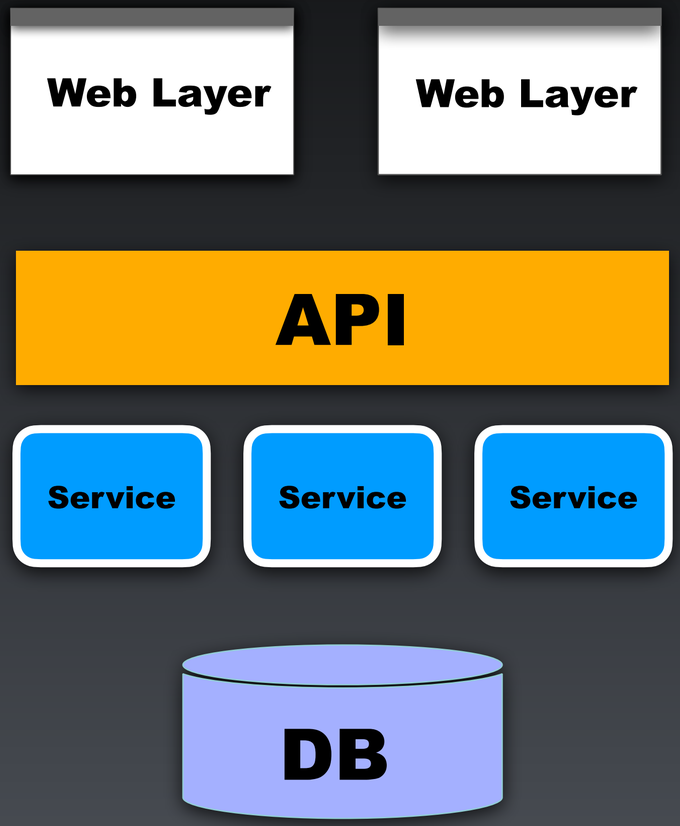




Continuous Delivery ltd

Architecture as a Snapshot

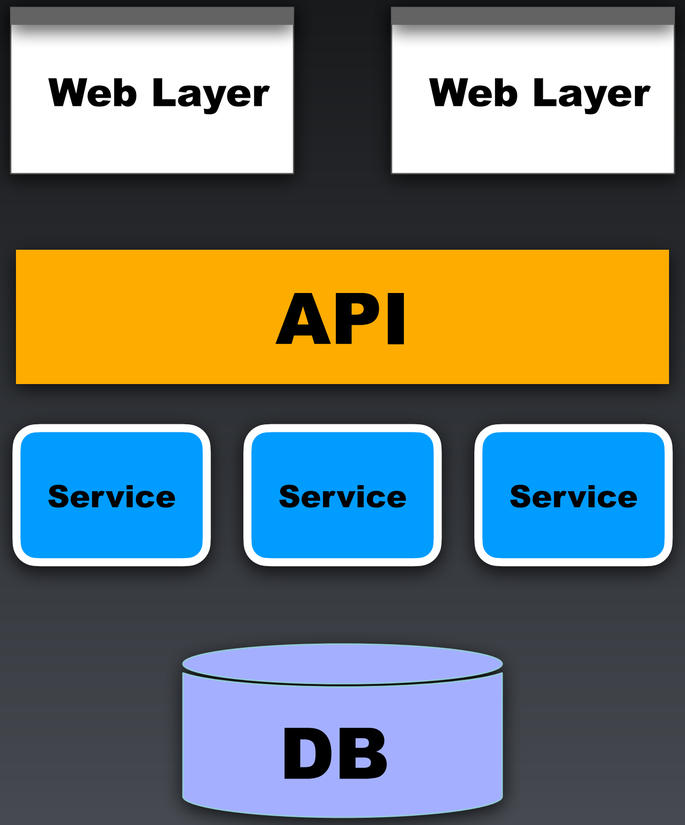




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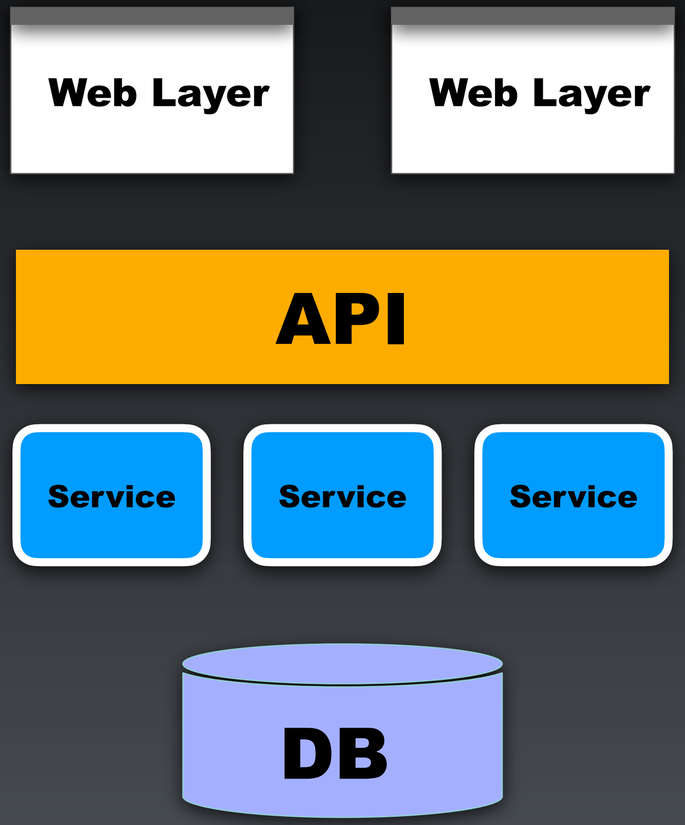
Architecture as a Snapshot

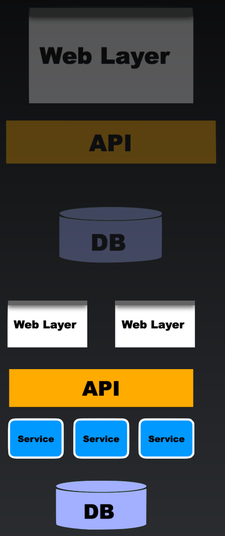




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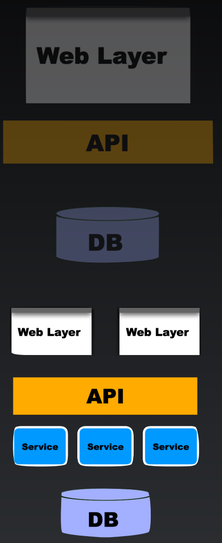
Architecture as a Snapshot

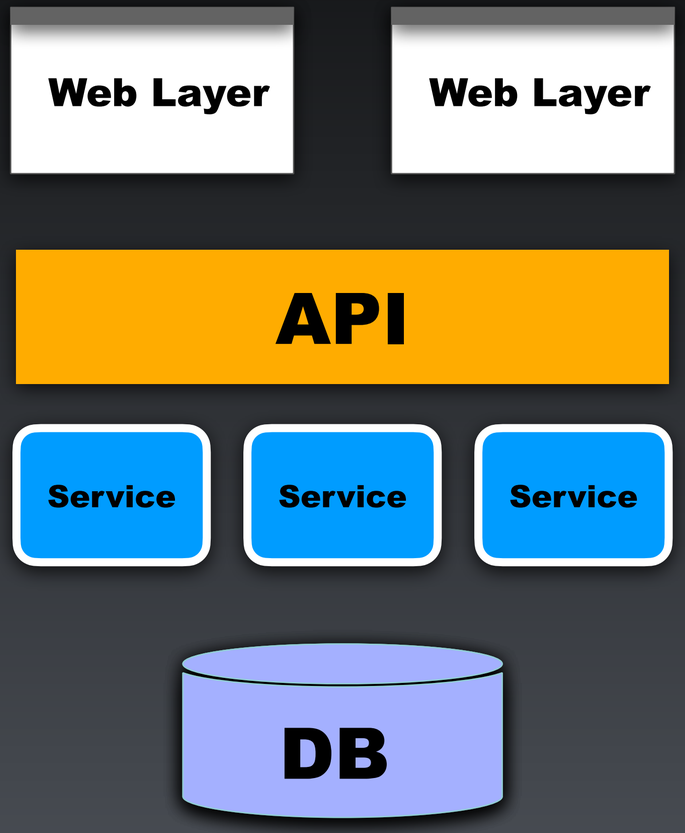




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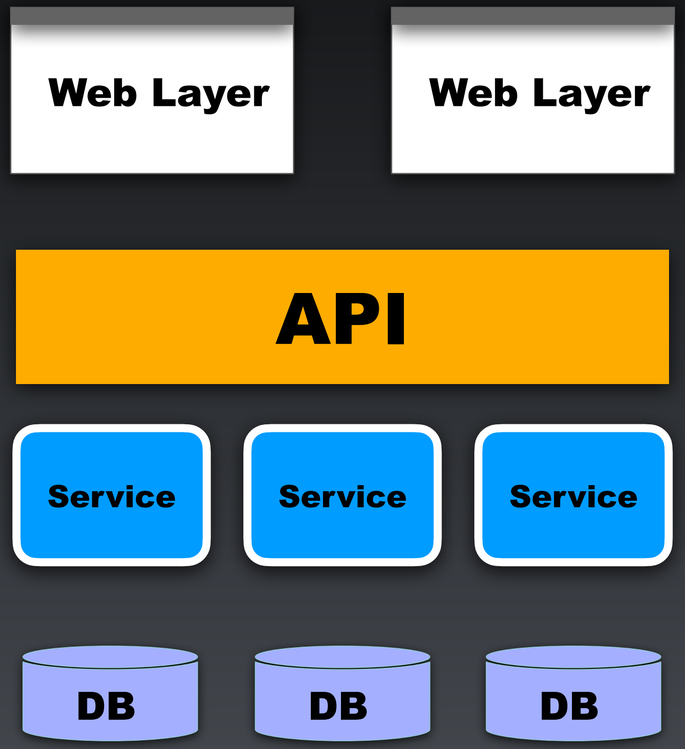
Architecture as a Snapshot

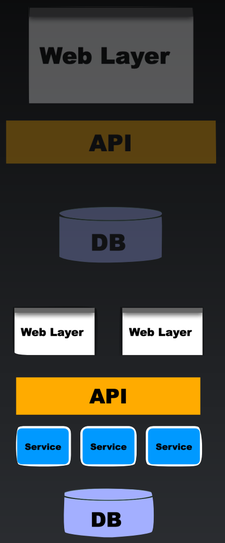




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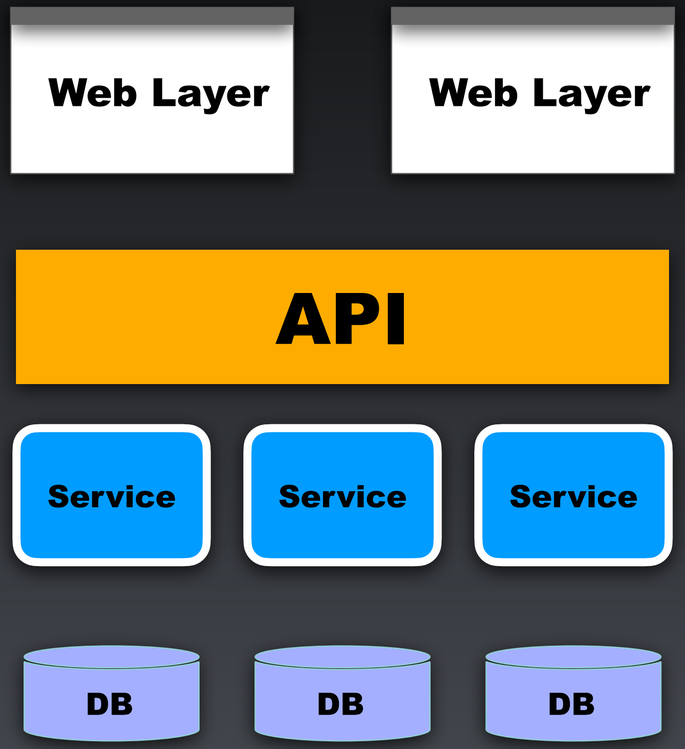
Architecture as a Snapshot

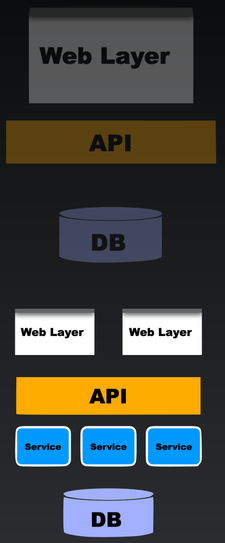




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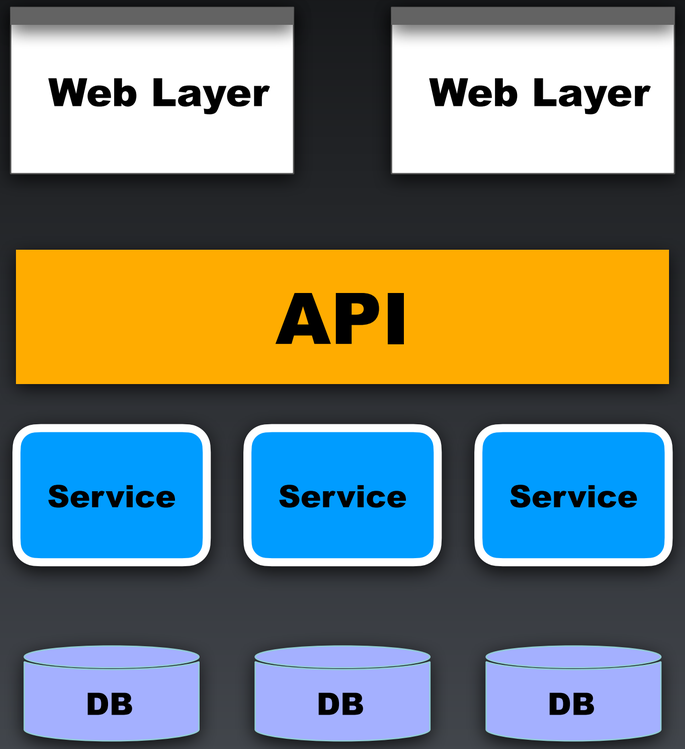
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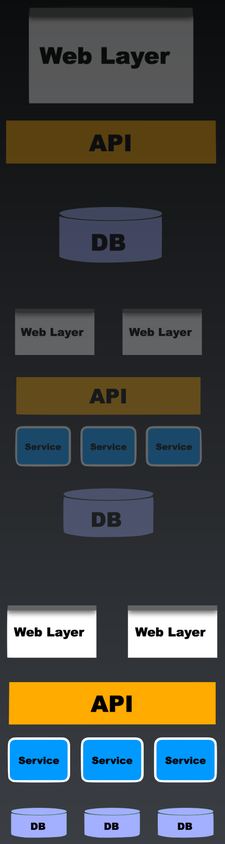




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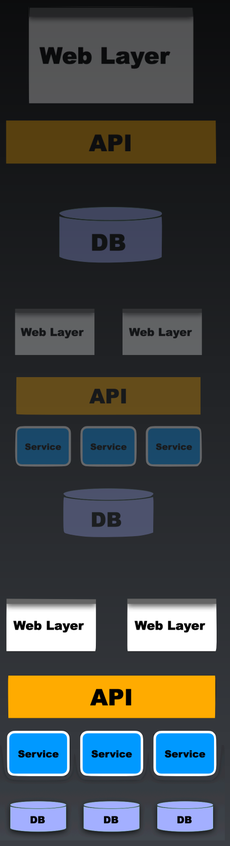
Architecture as a Snapshot





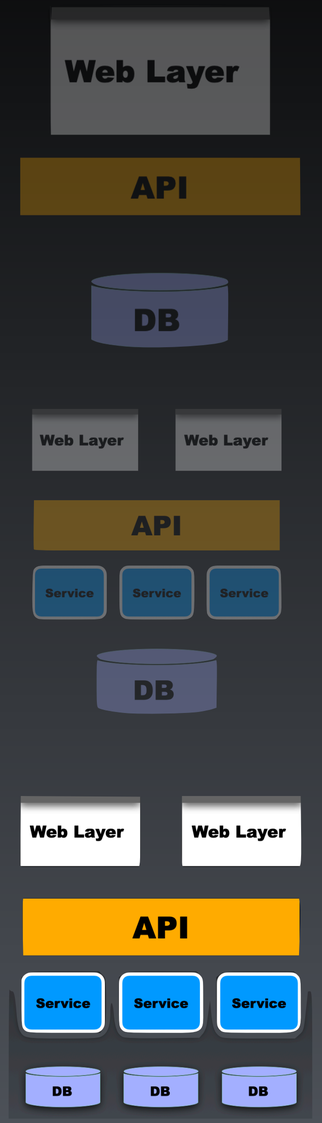
Continuous Delivery ltd

Architecture as a Snapshot



Continuous Delivery ltd

Architecture as a Snapshot



Optimise for Learning

Iteration

Feedback

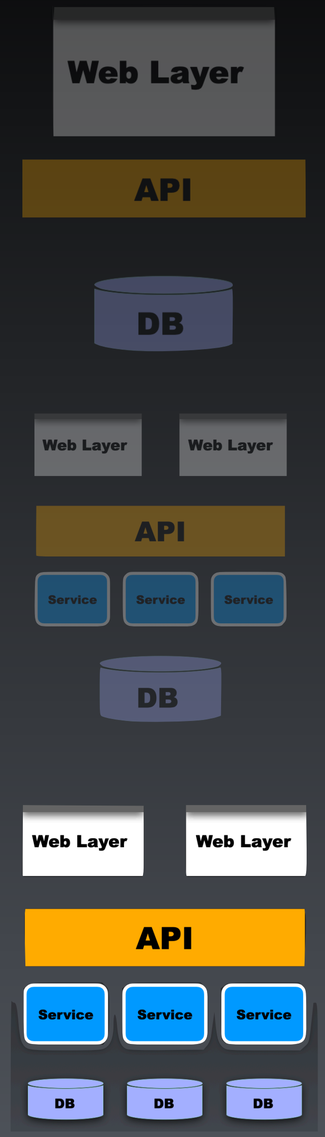
Incremental

Experimental

Empirical

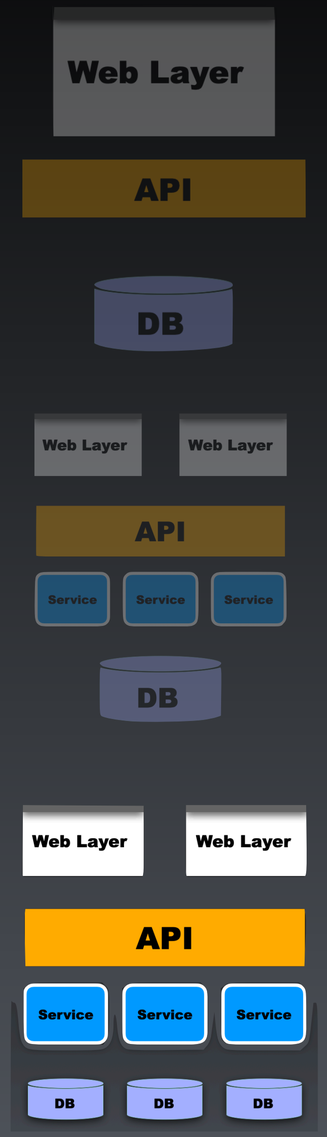
Continuous Delivery ltd

Architecture as a Snapshot



Continuous Delivery ltd

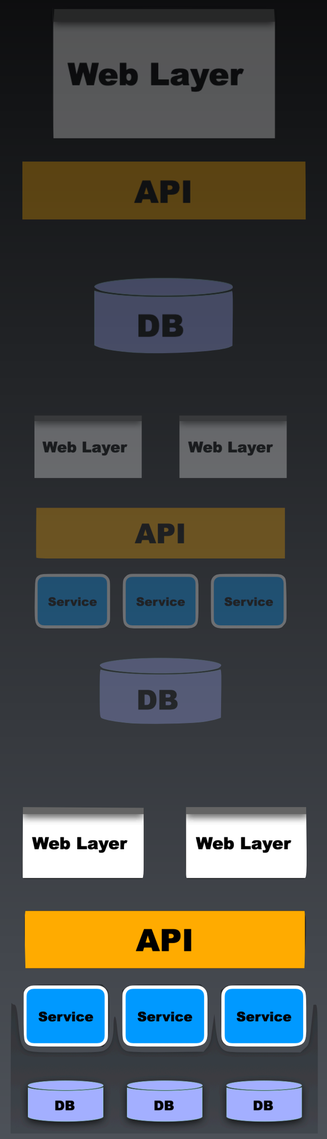
Architecture as a Snapshot



EVOLUTIONARY ARCHITECTURE

Continuous Delivery ltd

Architecture as a Snapshot

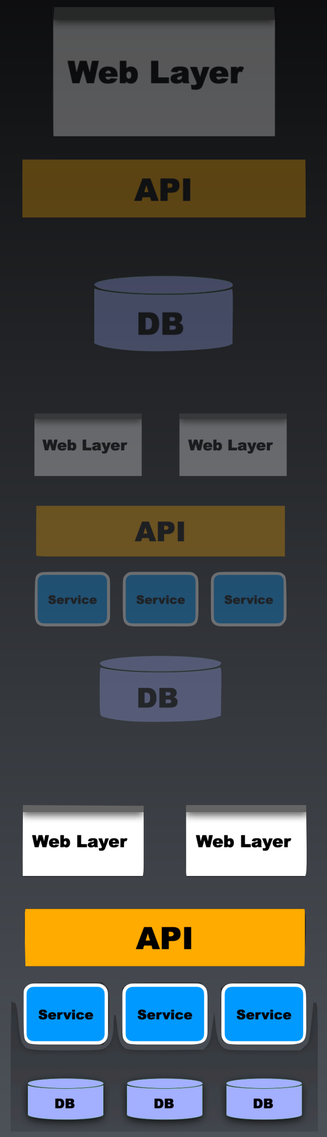


EVOLUTIONARY ARCHITECTURE

Progress in Small Steps

Continuous Delivery ltd

Architecture as a Snapshot



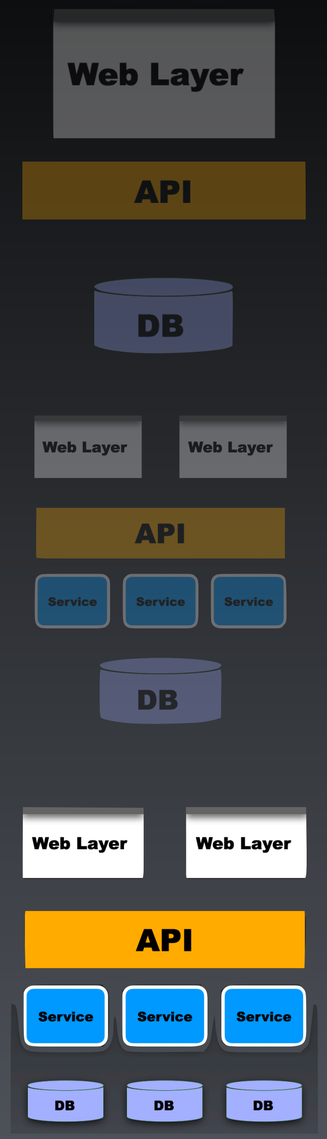
EVOLUTIONARY ARCHITECTURE

Progress in Small Steps

True at a Moment in Time

Continuous Delivery ltd

Architecture as a Snapshot



EVOLUTIONARY ARCHITECTURE

Progress in Small Steps

True at a Moment in Time

If it Can't Change it is Already DEAD!

Continuous Delivery ltd

Maintain the Tourist Map

Continuous Delivery ltd

Maintain the Tourist Map

Continuous Delivery ltd

Maintain the Tourist Map



Continuous Delivery ltd

Maintain the Tourist Map



Continuous Delivery ltd

Maintain the Tourist Map



Continuous Delivery ltd

Maintain the Tourist Map



Continuous Delivery ltd

Maintain the Tourist Map



Optimise for Learning

- Iteration
- Feedback
- Incremental
- Experimental

Optimise to Manage Complexity

- Modularity
- Cohesion
- Separation of Concerns
- Abstraction
- Coupling

Continuous Delivery ltd

Prioritise Ease of Change

Continuous Delivery ltd

Prioritise Ease of Change

Continuous Delivery ltd

Prioritise Ease of Change

Optimise for Learning

Iteration
Feedback
Incremental
Experimental
Empirical

Optimise to Manage Complexity

Modularity
Cohesion
Separation of Concerns
Abstraction
Coupling

Continuous Delivery ltd

Prioritise Ease of Change

Optimise for Learning

Iteration
Feedback
Incremental
Experimental
Empirical

Optimise to Manage Complexity

Modularity
Cohesion
Separation of Concerns
Abstraction
Coupling

Continuous Delivery ltd

Prioritise Ease of Change

Adopt Continuous Delivery!

Continuous Delivery ltd

Prioritise Ease of Change

Continuous Delivery ltd

Prioritise Ease of Change



Optimise for Learning

Iteration

Feedback

Incremental

Experimental

Empirical

Optimise to Manage Complexity

Modularity

Cohesion

Separation of Concerns

Abstraction

Coupling

Continuous Delivery ltd

Separate Concerns

Continuous Delivery ltd

Separate Concerns

Continuous Delivery ltd

Separate Concerns

Process & Store

Continuous Delivery ltd

Separate Concerns



Continuous Delivery ltd

Separate Concerns



Continuous Delivery ltd

Separate Concerns



Optimise for Learning

Feedback

Incremental

Experimental

Optimise to Manage Complexity

Modularity

Cohesion

Separation of Concerns

Abstraction

Coupling

Continuous Delivery ltd

Adapt to Current Context

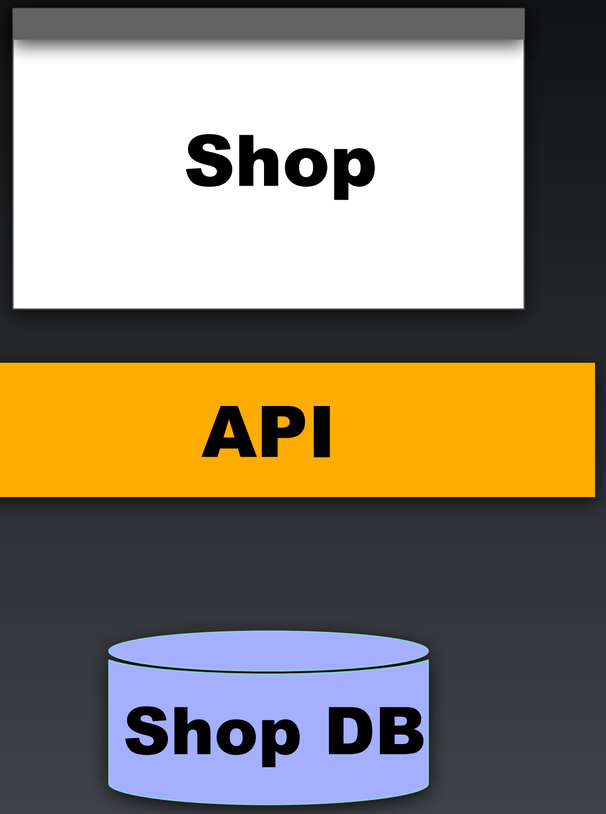
Continuous Delivery ltd

Adapt to Current Context

Continuous Delivery ltd

Adapt to Current Context

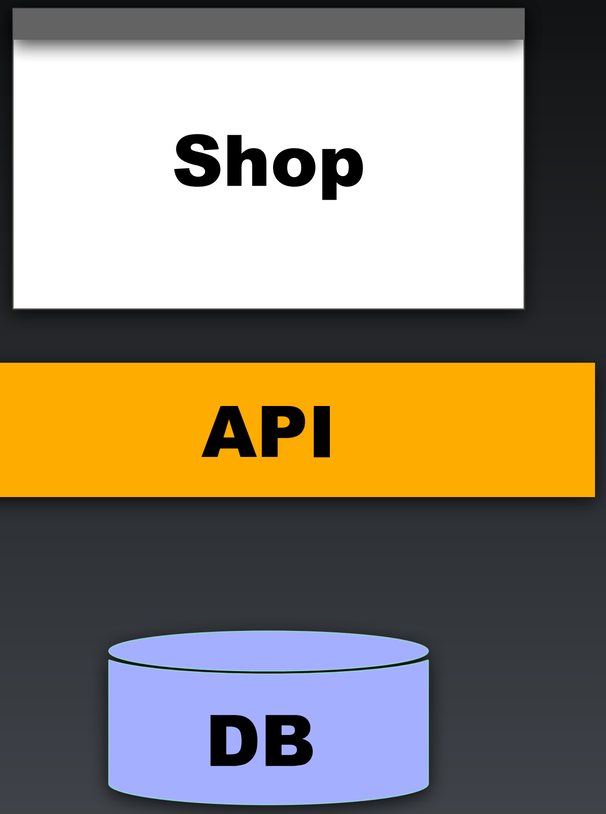
Customer - Place Order



Continuous Delivery ltd

Adapt to Current Context

Customer - Place Order

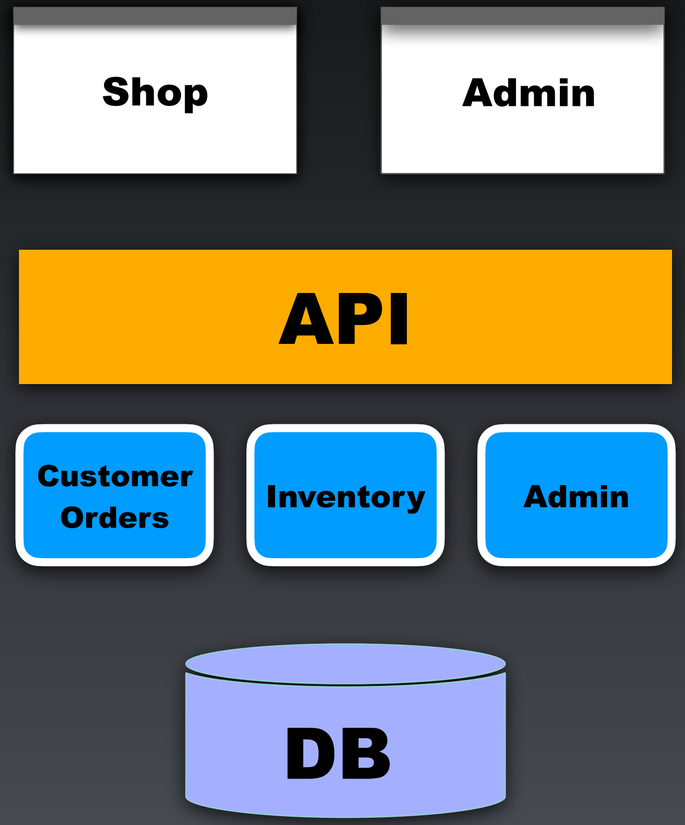


Continuous Delivery ltd

Adapt to Current Context

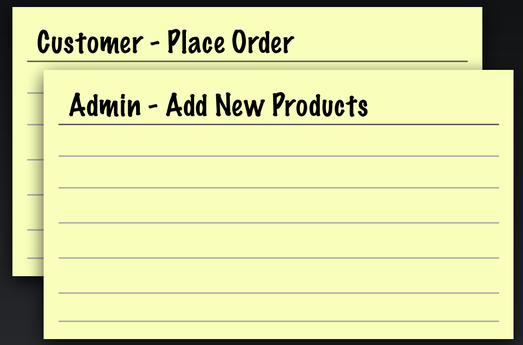
Customer - Place Order

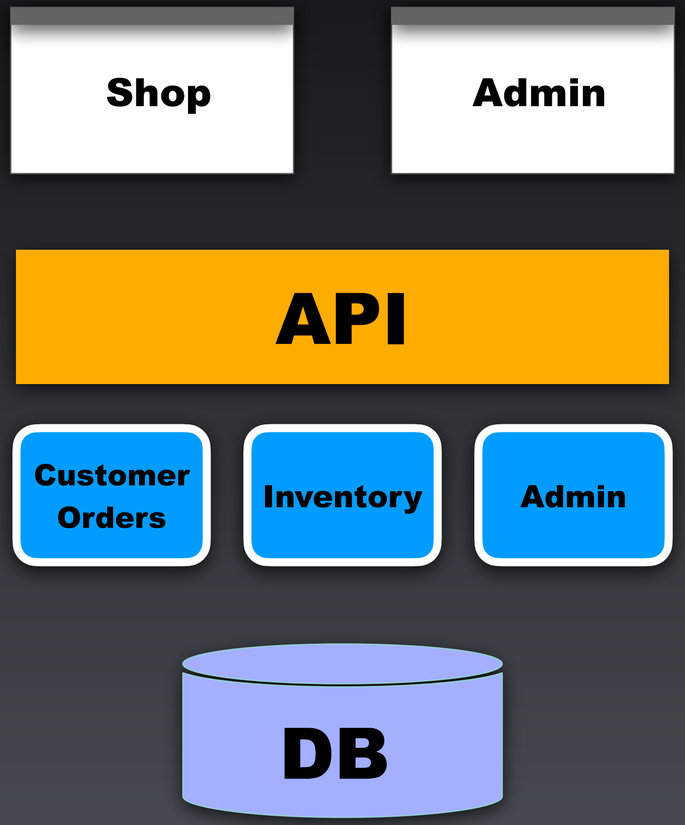
Admin - Add New Products



Continuous Delivery ltd

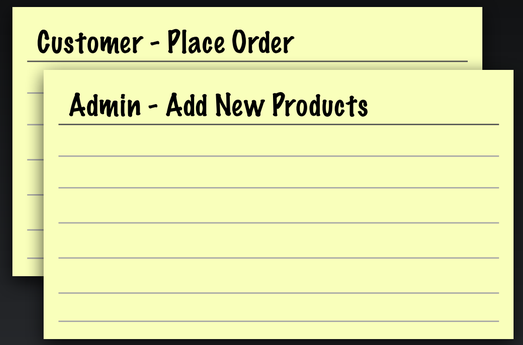
Adapt to Current Context

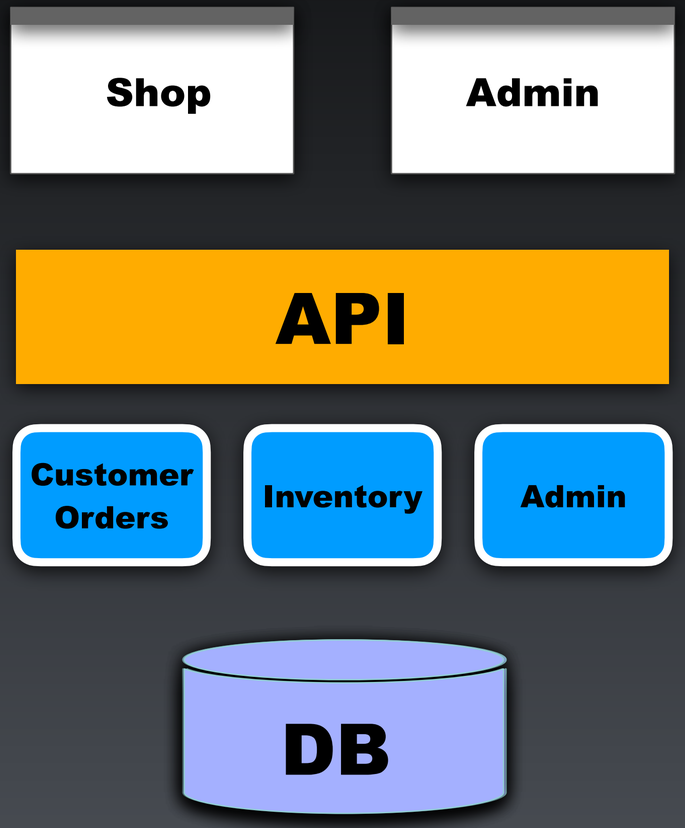




Continuous Delivery ltd

Adapt to Current Context





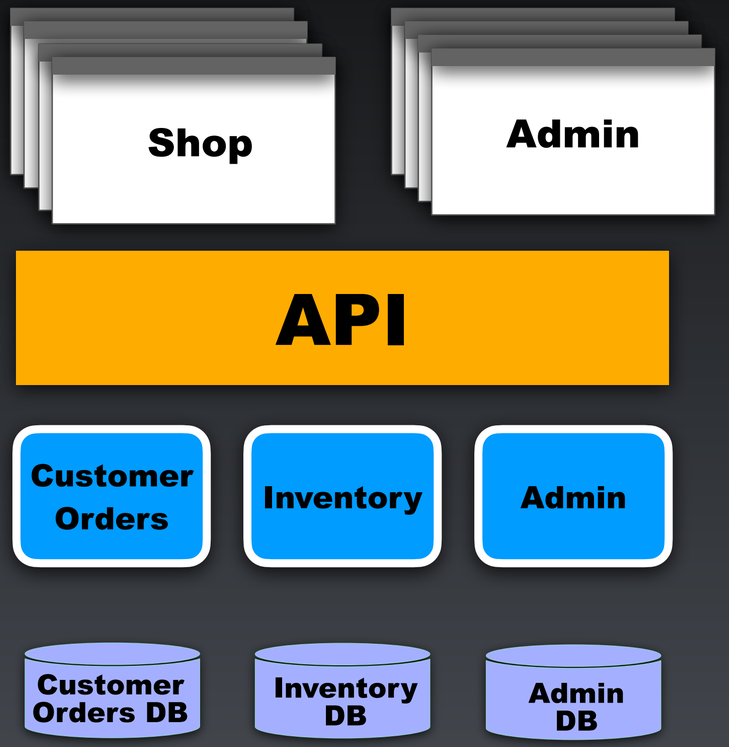
Continuous Delivery ltd

Adapt to Current Context

Customer - Place Order

Admin - Add New Products

Customer - Resilient in Face of Failure



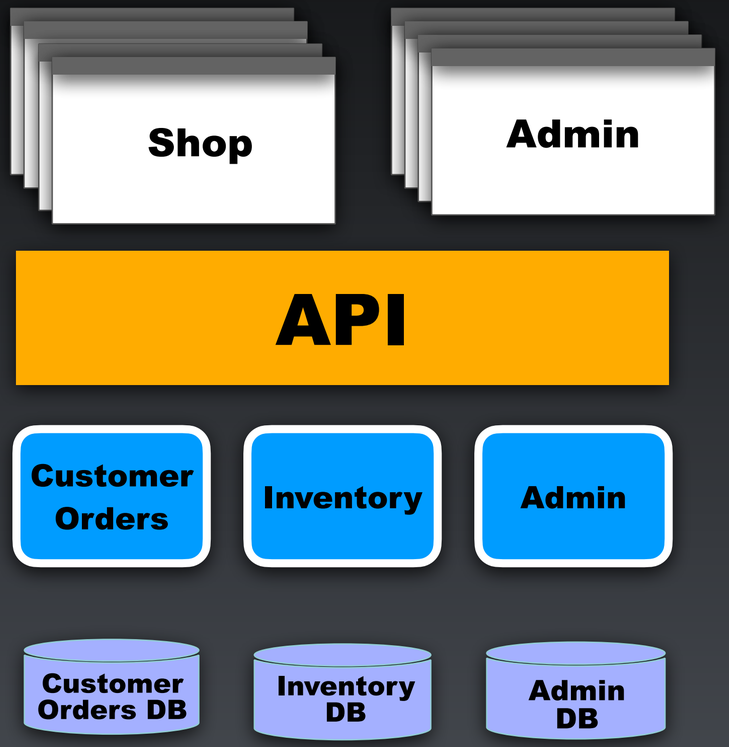
Continuous Delivery ltd

Adapt to Current Context

Customer - Place Order

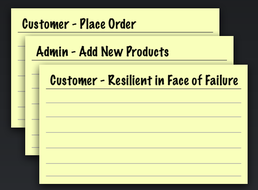
Admin - Add New Products

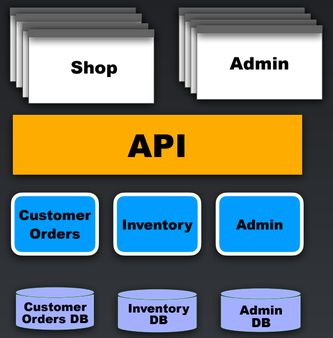
Customer - Resilient in Face of Failure



Continuous Delivery ltd

Adapt to Current Context





Optimise for Learning

Iteration

Feedback

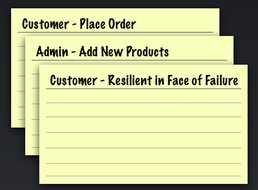
Incremental

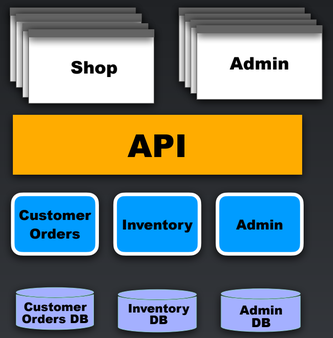
Experimental

Empirical

Continuous Delivery ltd

Adapt to Current Context





Enables...

Optimise for Learning

- Iteration
- Feedback
- Incremental
- Experimental
- Empirical

Optimise to Manage Complexity

- Modularity
- Cohesion
- Separation of Concerns
- Abstraction
- Coupling

Continuous Delivery ltd

Don't Design Ahead

Continuous Delivery ltd

Don't Design Ahead

Continuous Delivery ltd

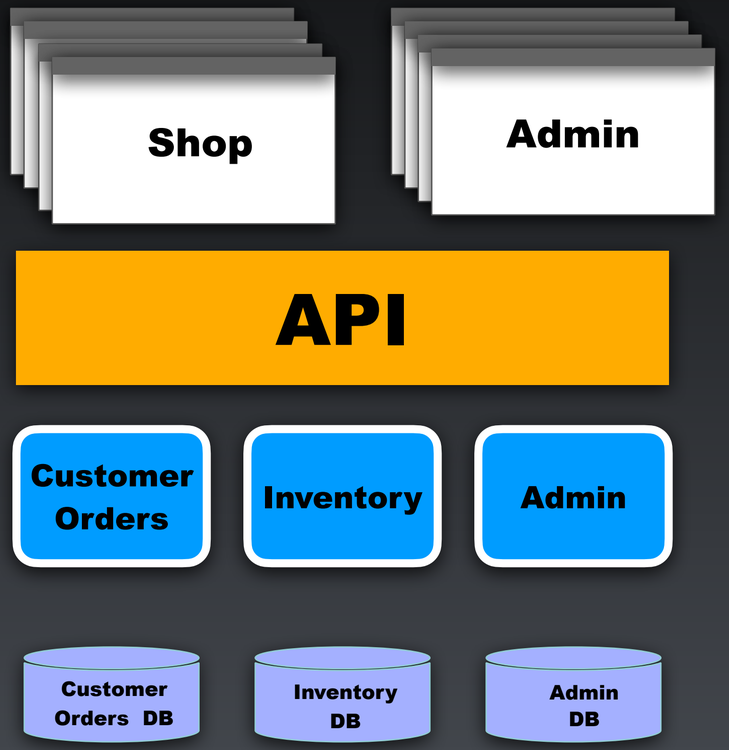
Don't Design Ahead

Customer - Place Order

Continuous Delivery ltd

Don't Design Ahead

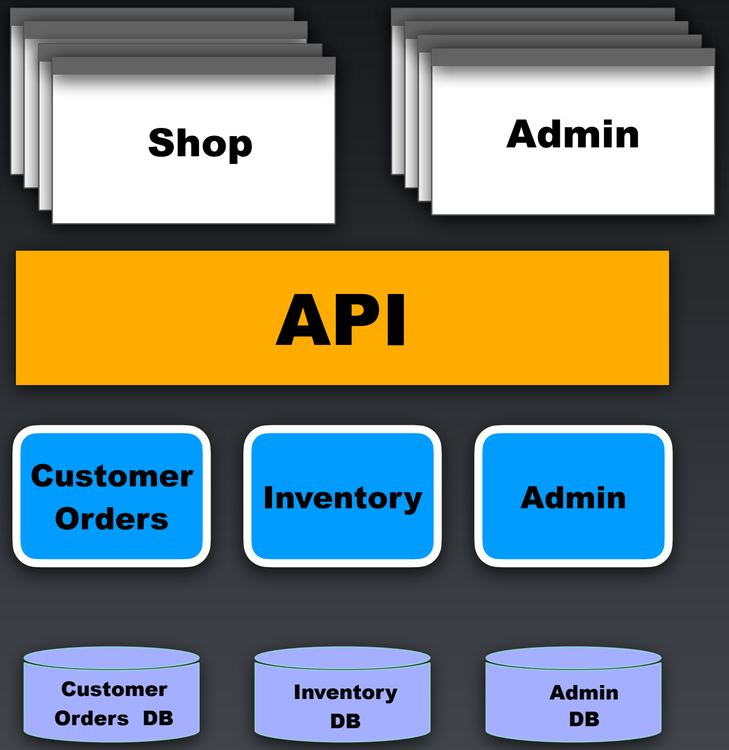
Customer - Place Order



Continuous Delivery ltd

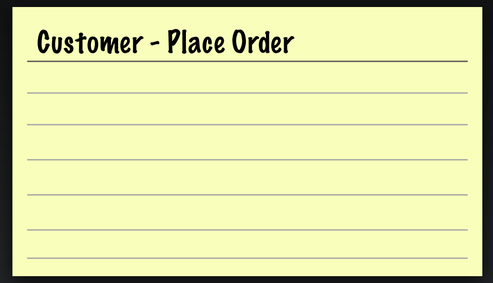
Don't Design Ahead

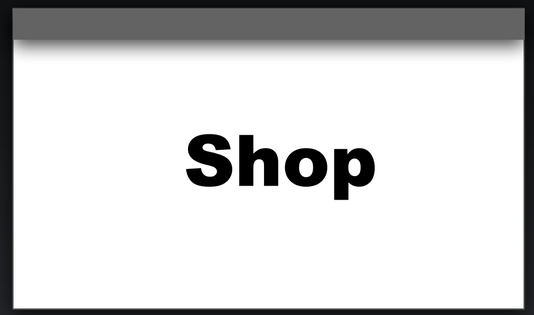
Customer - Place Order



Continuous Delivery ltd

Don't Design Ahead







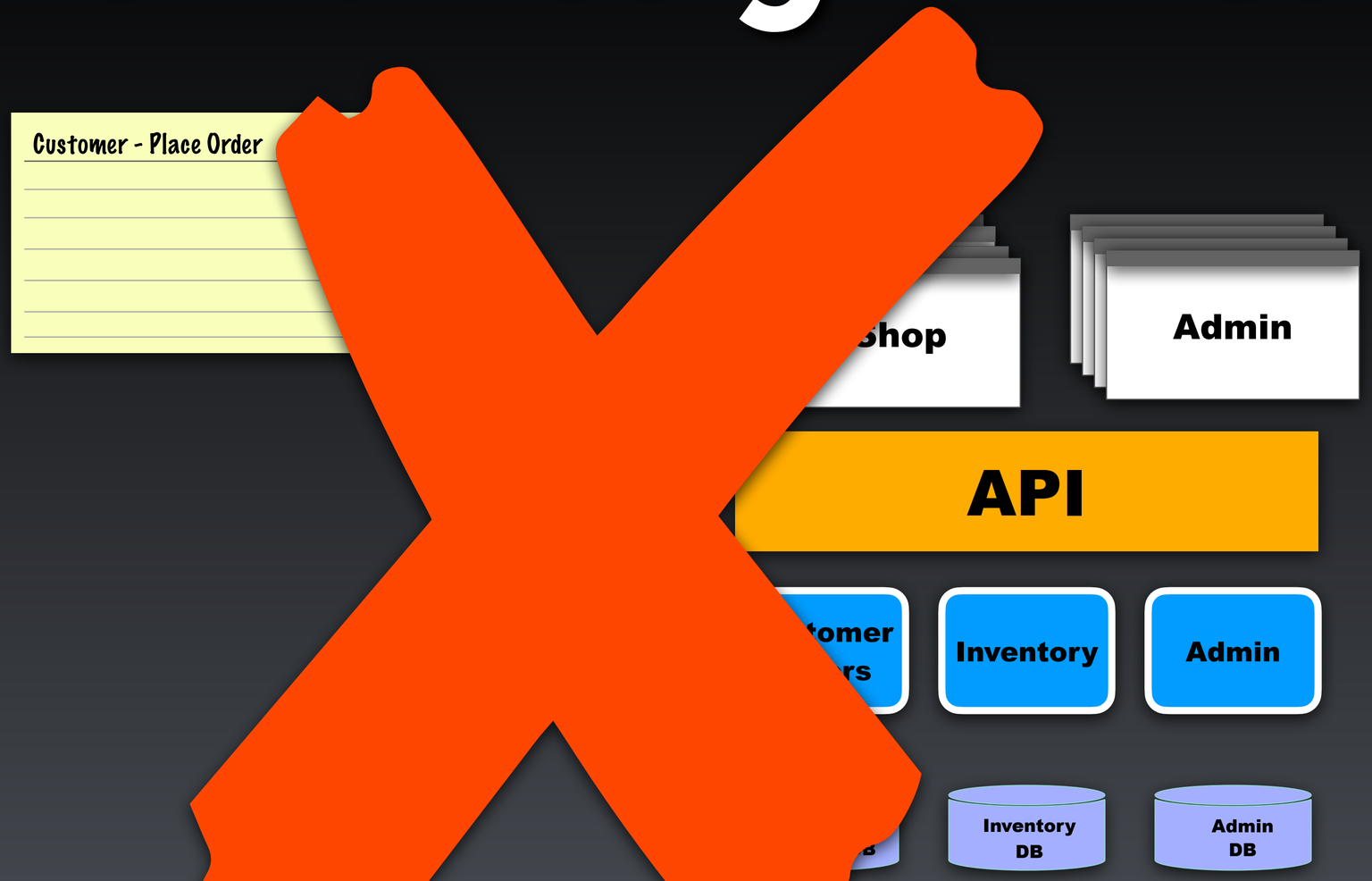


Continuous Delivery ltd

Don't Design Ahead

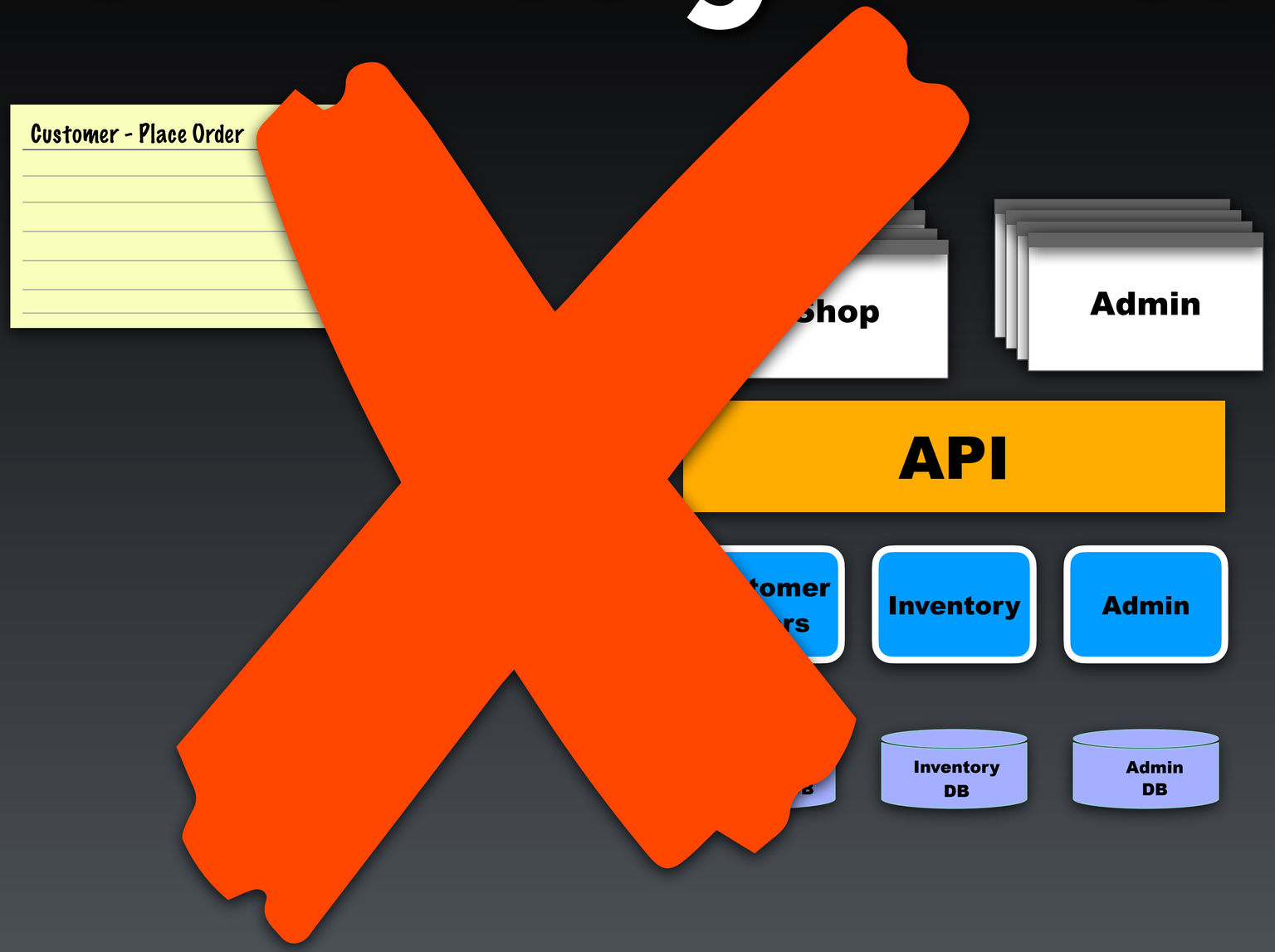
Continuous Delivery ltd

Don't Design Ahead



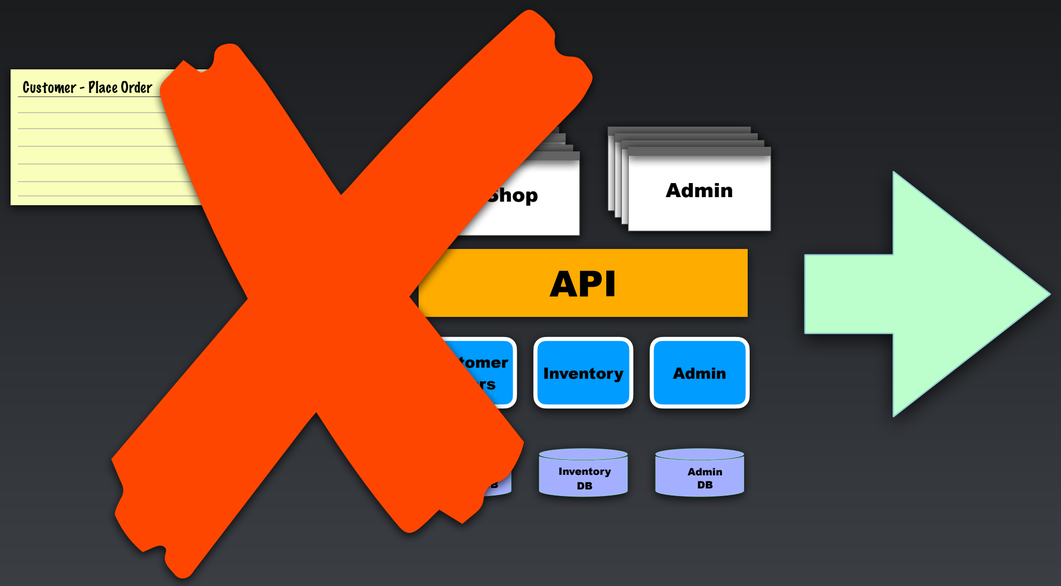
Continuous Delivery ltd

Don't Design Ahead



Continuous Delivery ltd

Don't Design Ahead



Optimise for Learning

Iteration

Feedback

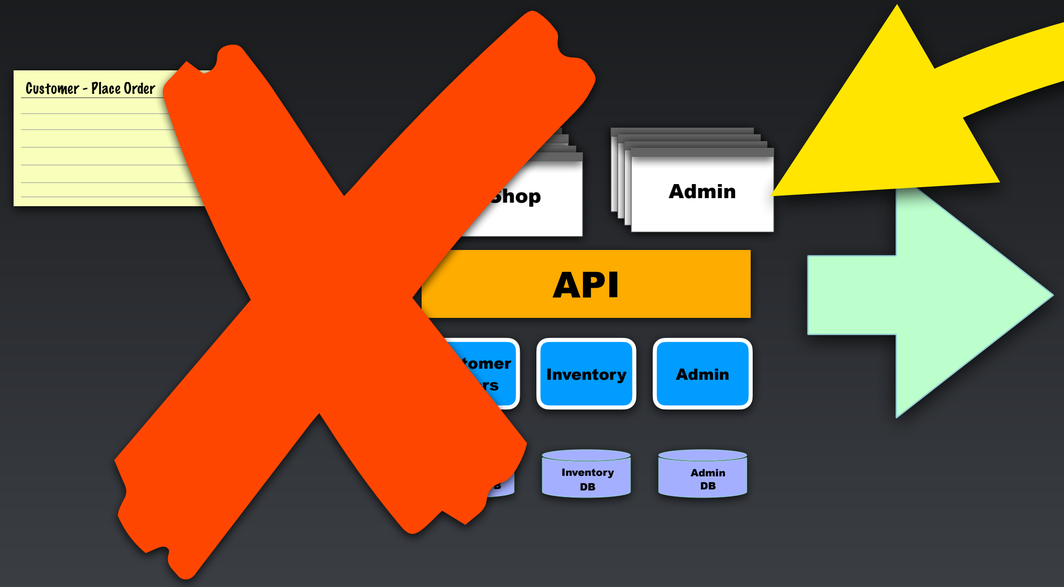
Incremental

Experimental

Empirical

Continuous Delivery ltd

Don't Design Ahead



Enables...

Optimise for Learning

- Iteration
- Feedback
- Incremental
- Experimental
- Empirical

Optimise to Manage Complexity

- Modularity
- Cohesion
- Separation of Concerns
- Abstraction
- Coupling

Continuous Delivery ltd

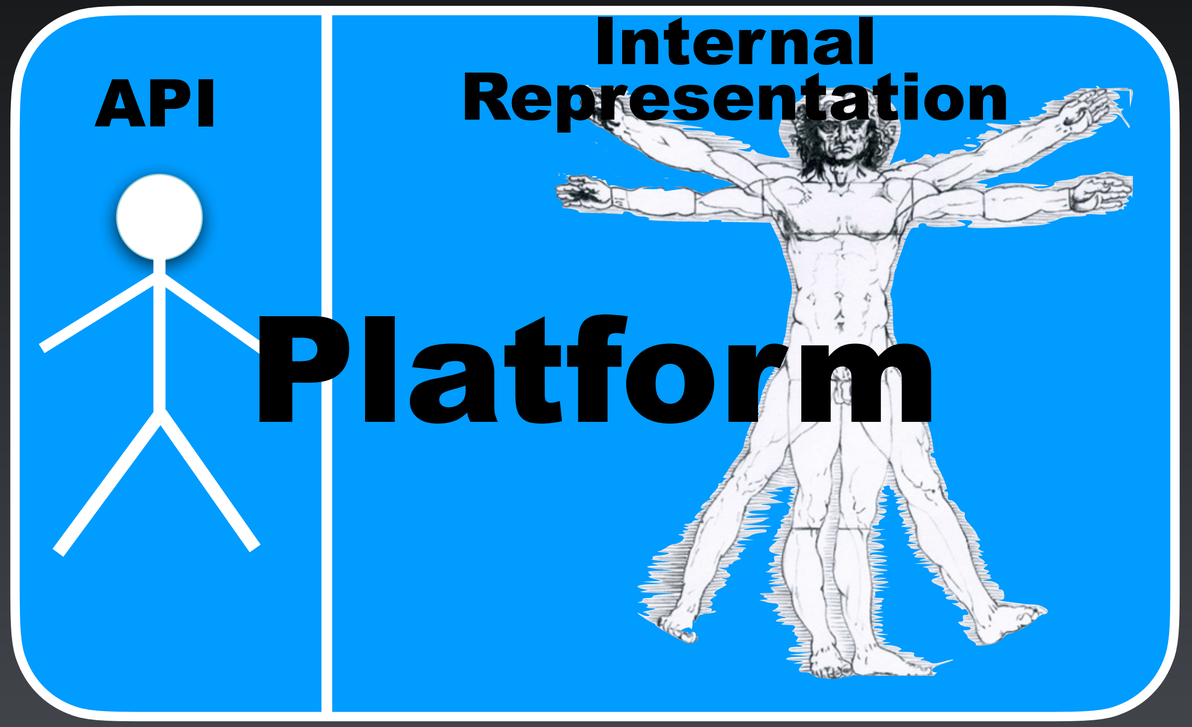
Platform As Abstraction

Continuous Delivery ltd

Platform as Abstraction

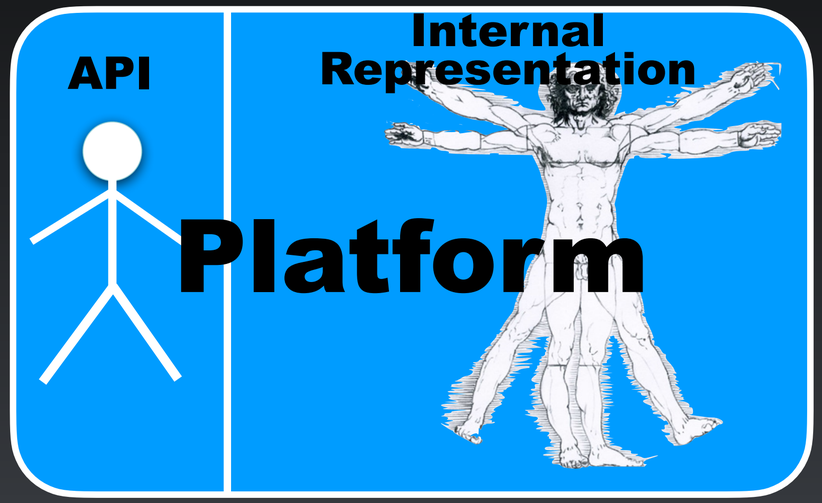
Continuous Delivery ltd

Platform as Abstraction



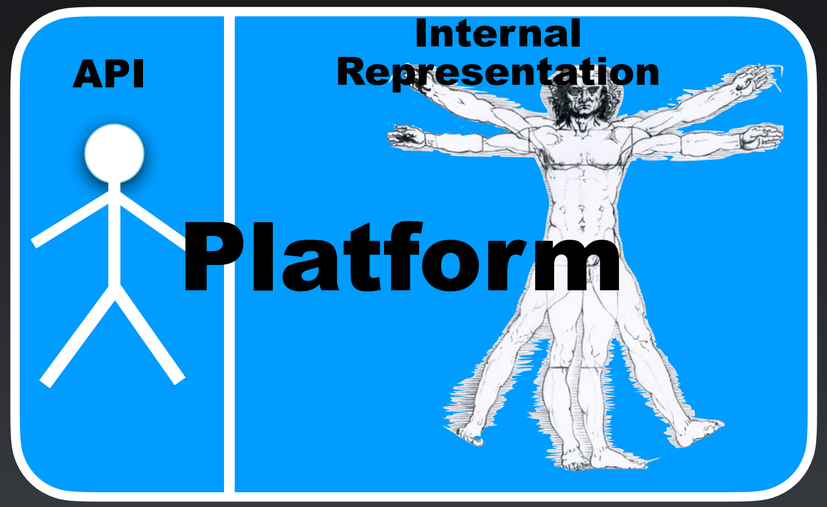
Continuous Delivery ltd

Platform as Abstraction



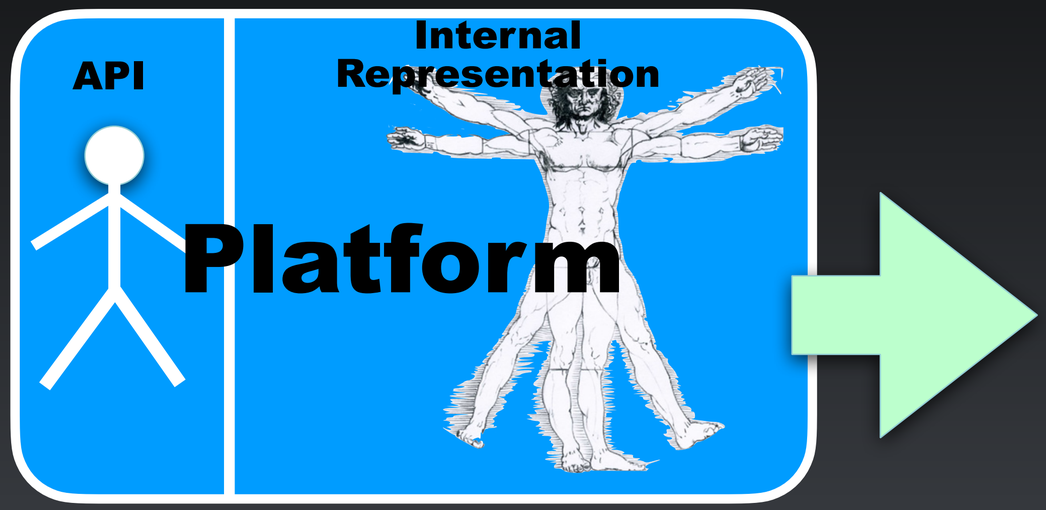
Continuous Delivery ltd

Platform as Abstraction



Continuous Delivery ltd

Platform as Abstraction



Optimise for Learning

Iteration

Incremental

Optimise to Manage Complexity

Modularity

Cohesion

Separation of Concerns

Abstraction

Coupling

Continuous Delivery ltd

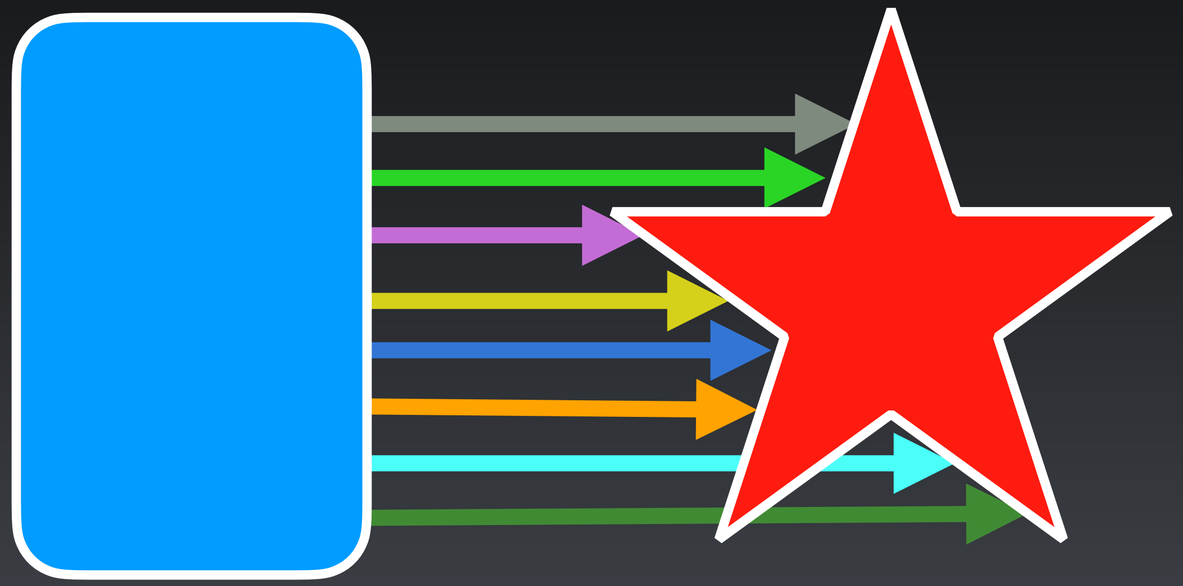
Manage Coupling

Continuous Delivery ltd

Manage Coupling

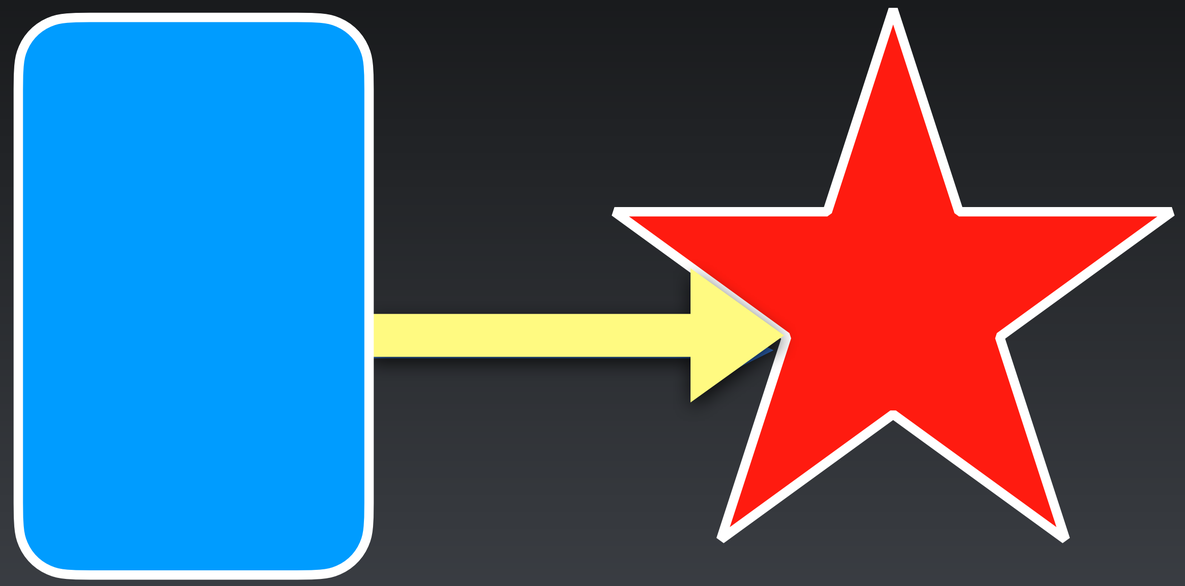
Continuous Delivery ltd

Manage Coupling



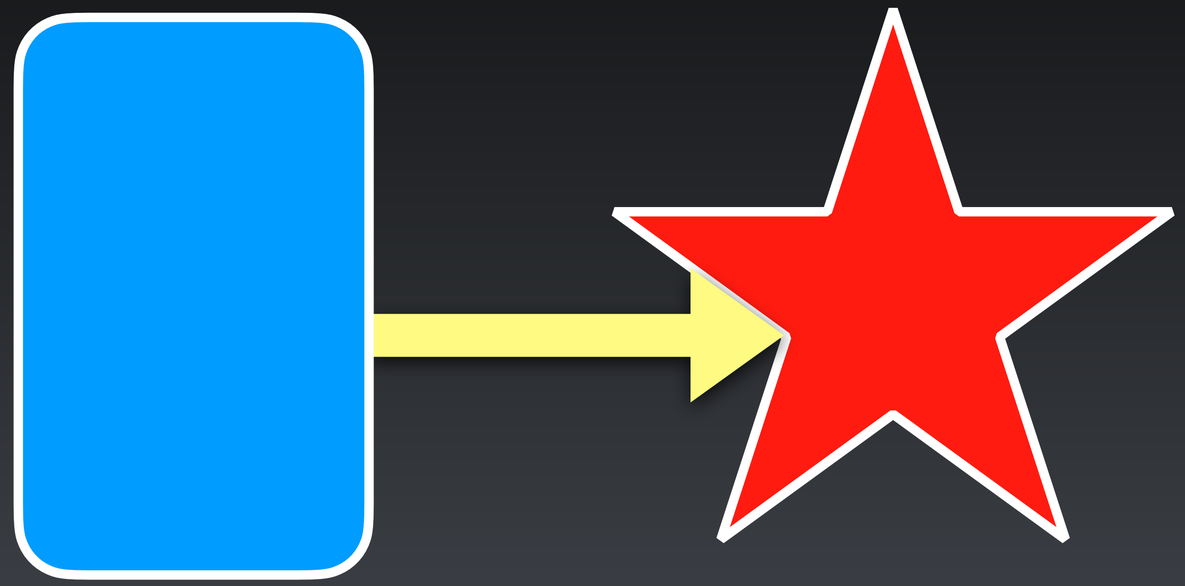
Continuous Delivery ltd

Manage Coupling



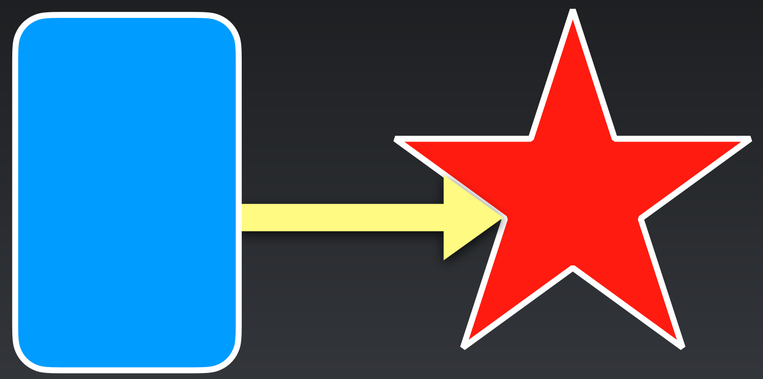
Continuous Delivery ltd

Manage Coupling



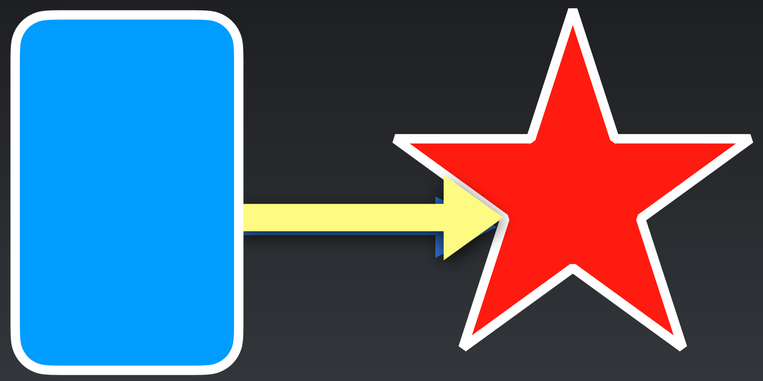
Continuous Delivery ltd

Manage Coupling



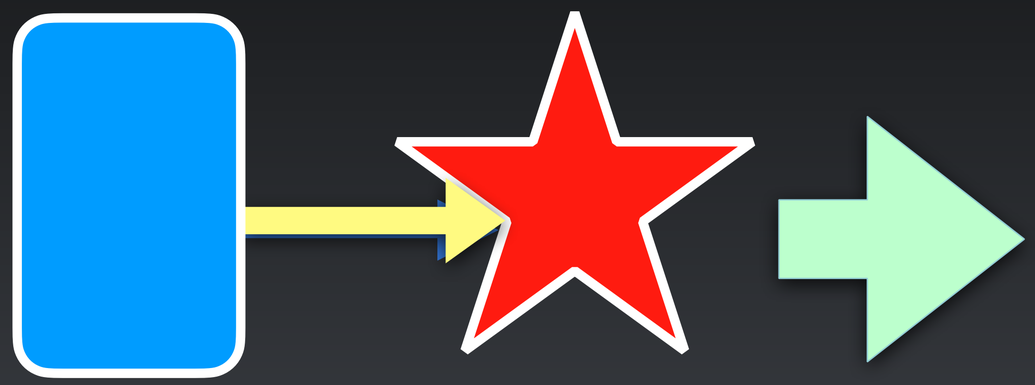
Continuous Delivery ltd

Manage Coupling



Continuous Delivery ltd

Manage Coupling



Optimise for Learning

Iteration

Feedback

Incremental

Experimental

Empirical

Optimise to Manage Complexity

Modularity

Cohesion

Separation of Concerns

Abstraction

Coupling

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Software Development Is Exploration & Discovery

Engineering Best Way to Explore & Discover

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Software Development

Engineering

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Software & Architecture

Best when

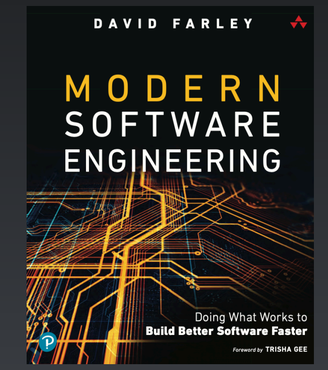
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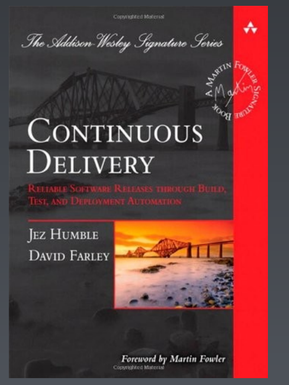
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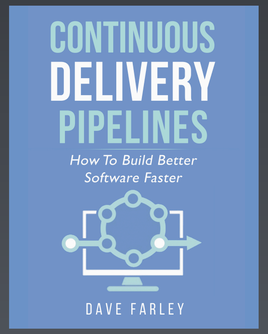
Q&A

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