Einstieg

Softwaredebakel

VBS

- Schweizer Armee ohne krisensichere Logistik bis 2035
- Armee-Debakel: 300-Millionen-Projekt seit Monaten suspendiert

Kantonsverwaltung

- Wegen fehlerhafter Software braucht es mehr Haftplätze

Polizei

- Berner Polizisten beklagen sich über die neue IT

Crowdstrike

- Der Tag, an dem die IT weltweit verrückt spielte – ein Überblick

Kundenorientierung

Software soll den Kunden Mehrwert bringen

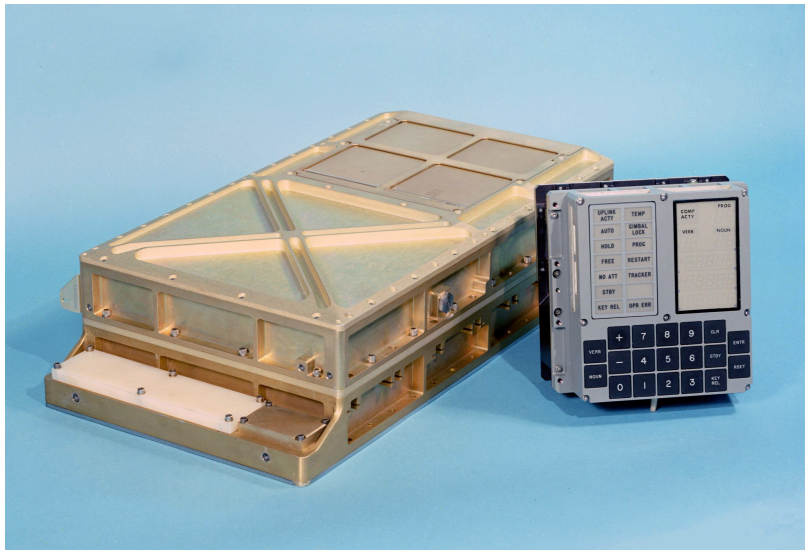
- Software soll stabil laufen
- Neue Features sollten schnell umgesetzt und nutzbar sein
- Softwaresysteme werden immer komplexer

Teamarbeit

Mehrere Personen arbeiten am selben Softwareprojekt

- Versionsverwaltung wird verwendet (Git, SVN)
- Konflikte entstehen und sind aufwendig

Ab 1961: Margaret Hamilton, Apollo Guidance Computer



2001: Manifesto for Agile Software Development

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

https://agilemanifesto.org/

Software Engineering / Software Architecture

> Software engineering is the application of an empirical, scientific approach to finding efficient, economic solutions to practical problems in software

(Farley, 2022, S.4)

> The goal of software architecture is to minimize the human resources required to build and maintain the required system

(Martin, 2018)

Übergang zwischen Software Entwicklung und Software Architektur ist fliessend

Learning

- Iteratives und inkrementelles Arbeiten
- Feedback
- Empirisches und experimentelles Arbeiten

(vgl. Farley, 2022, S.4)

Managing Complexity

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

(vgl. Farley, 2022, S.5)

Production Is Not Our Problem

- Softwareentwicklung ist meistens Kreativarbeit
- Die Herausforderung der "Produktion" existiert kaum

Space X Starship

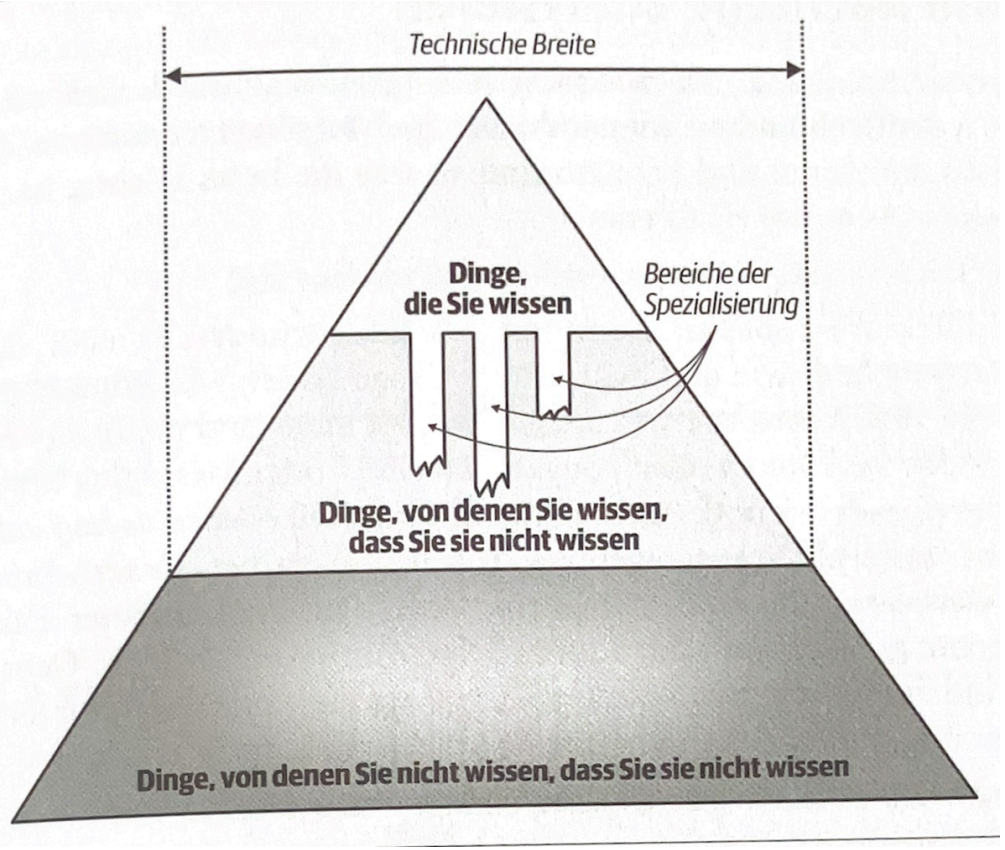
How Not to Land an Orbital Rocket Booser, 2017

WOW! Watch SpaceX Catch A Starship Booster In Air, 2024

Finanzierung: **ca 3 Mrd. Dollar**

Apollo-Programm: 1958 bis 1969, inflationsbereinigt: **163 Mrd. Dollar** (ohne Mercury und Gemini)

Lernen

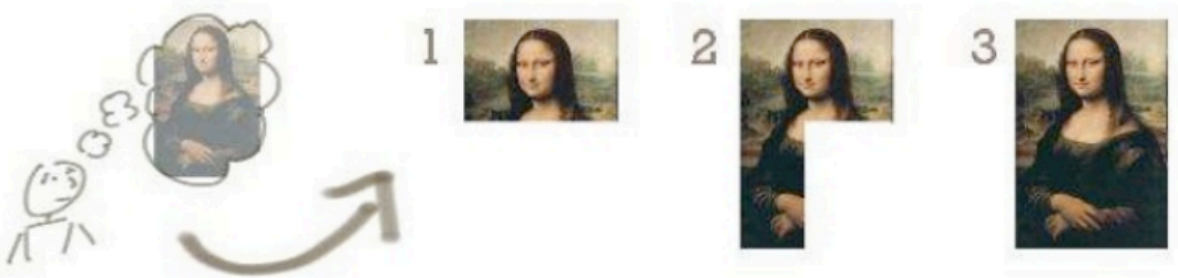


(Richards, 2021, S.29)

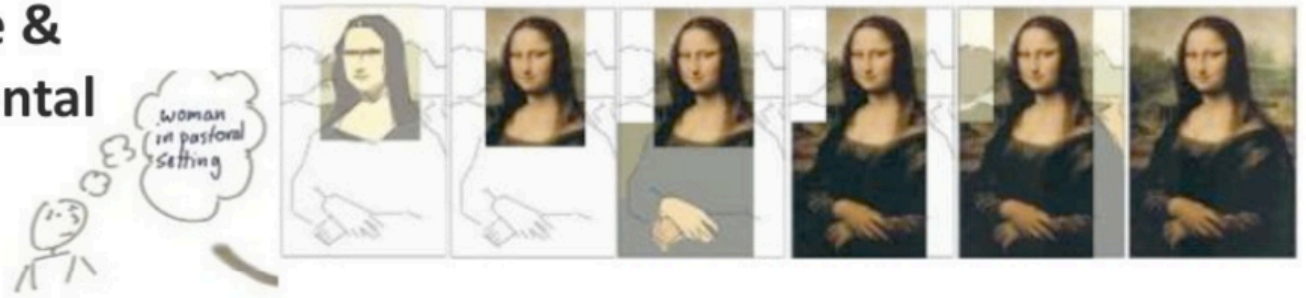
Iteratives und inkrementelles Arbeiten

Iterative

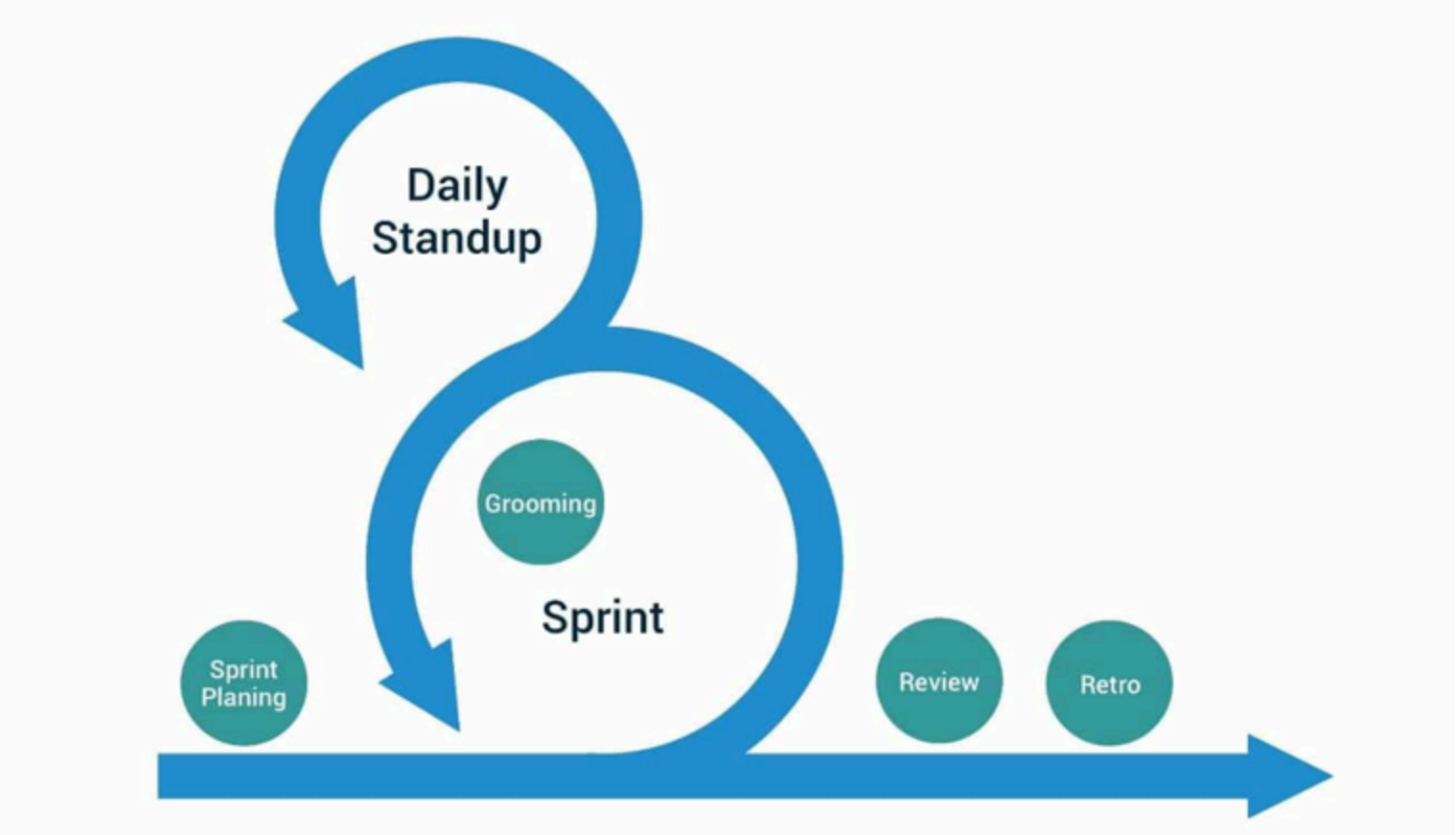
Incremental



Iterative & Incremental

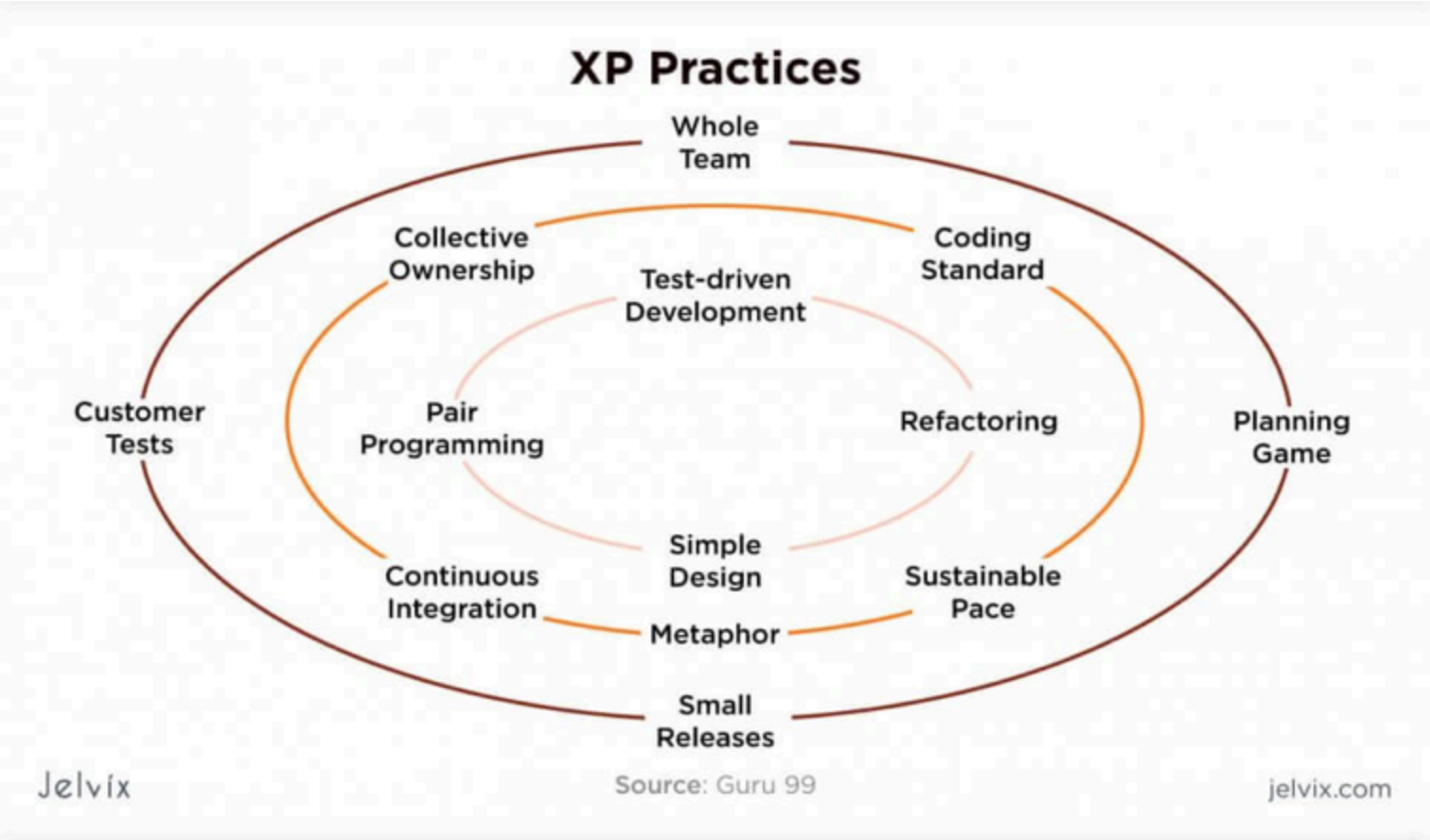


Iterationen



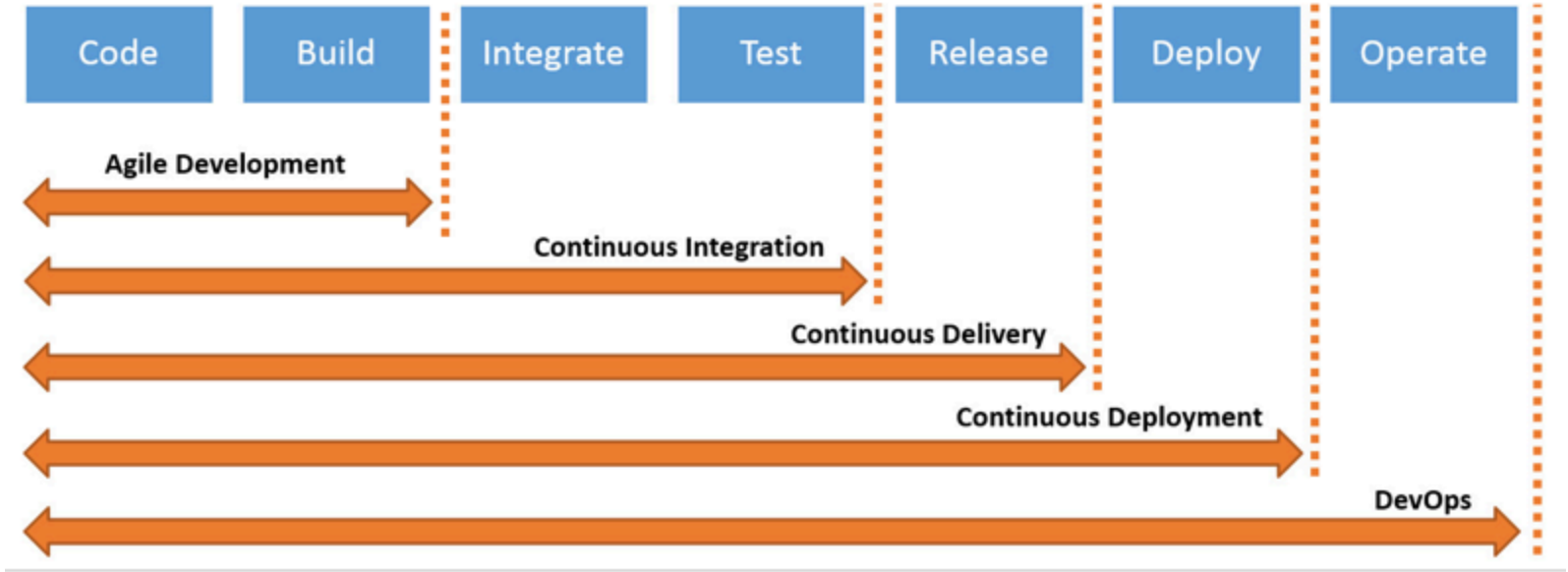
Embrace Change

Extreme Programming



Feedback

CI/CD


Code
Build
Integrate
Test
Release
Deploy
Operate
Agile Development
Continuous Integration
Continuous Delivery
Continuous Deployment
DevOps

Continuous Integration

- **Kein Branching**, alle Änderungen werden von allen Teammitgliedern **mehrmals täglich** in den Master Branch eingecheckt.
- Dieser Branch ist **jederzeit lauffähig**
- Dadurch werden die **Releases vereinfacht**
- Eine sehr hohe, **automatische Testabdeckung** ist zwingend

Continuous Deployment

- Ziel: **Releases werden vereinfacht**
- **Time to market ist kürzer**, neue Features sind sofort verfügbar
- Durch automatisierte Deployments ist der Aufwand initial höher, anschliessend jedoch sehr klein
- **Higher quality**, **Better products**
- Kaum mehr Release-Stress, **Happier teams**

https://www.continuousdelivery.com/

Modern Software Engineering

Deployment Pipelines

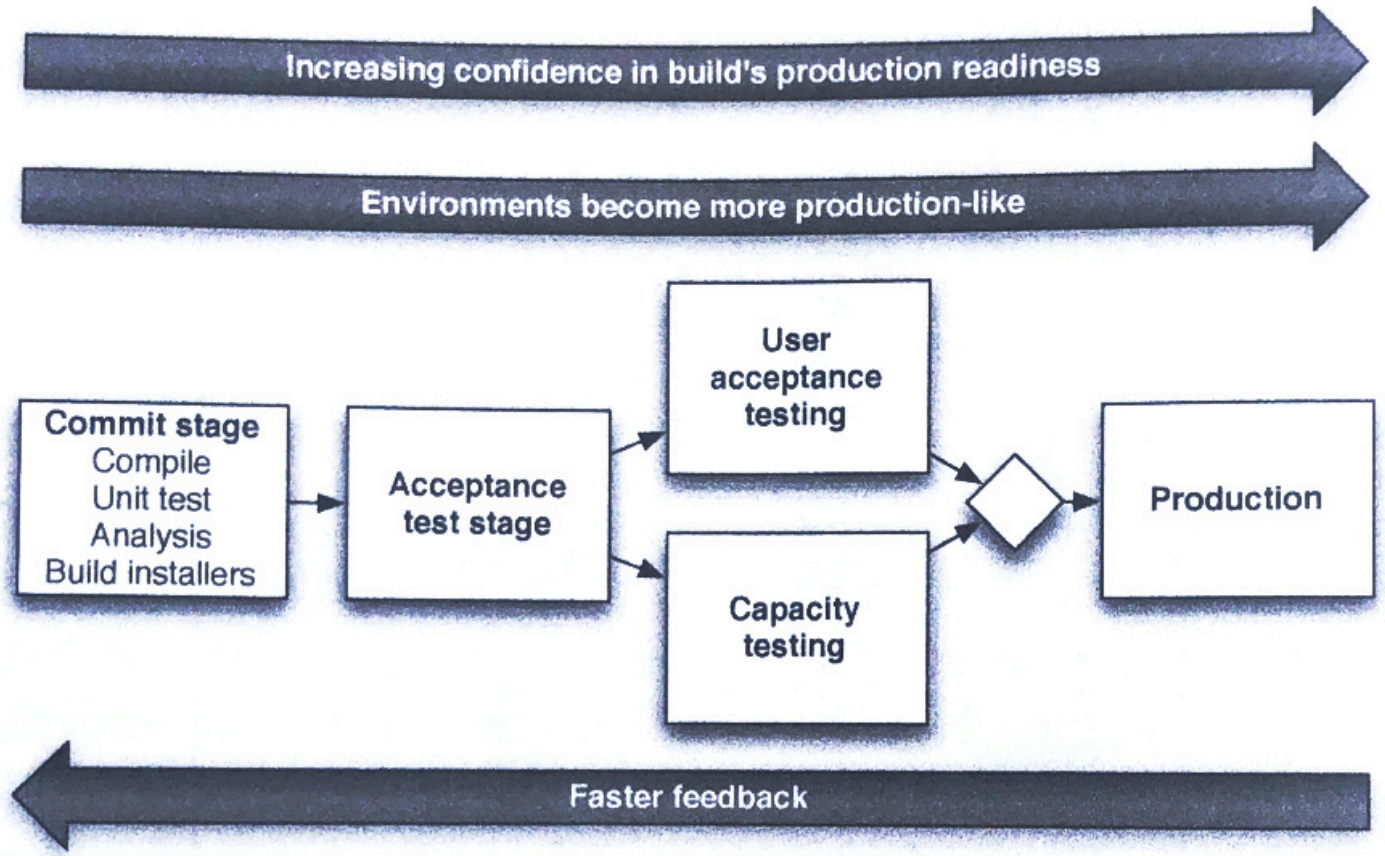
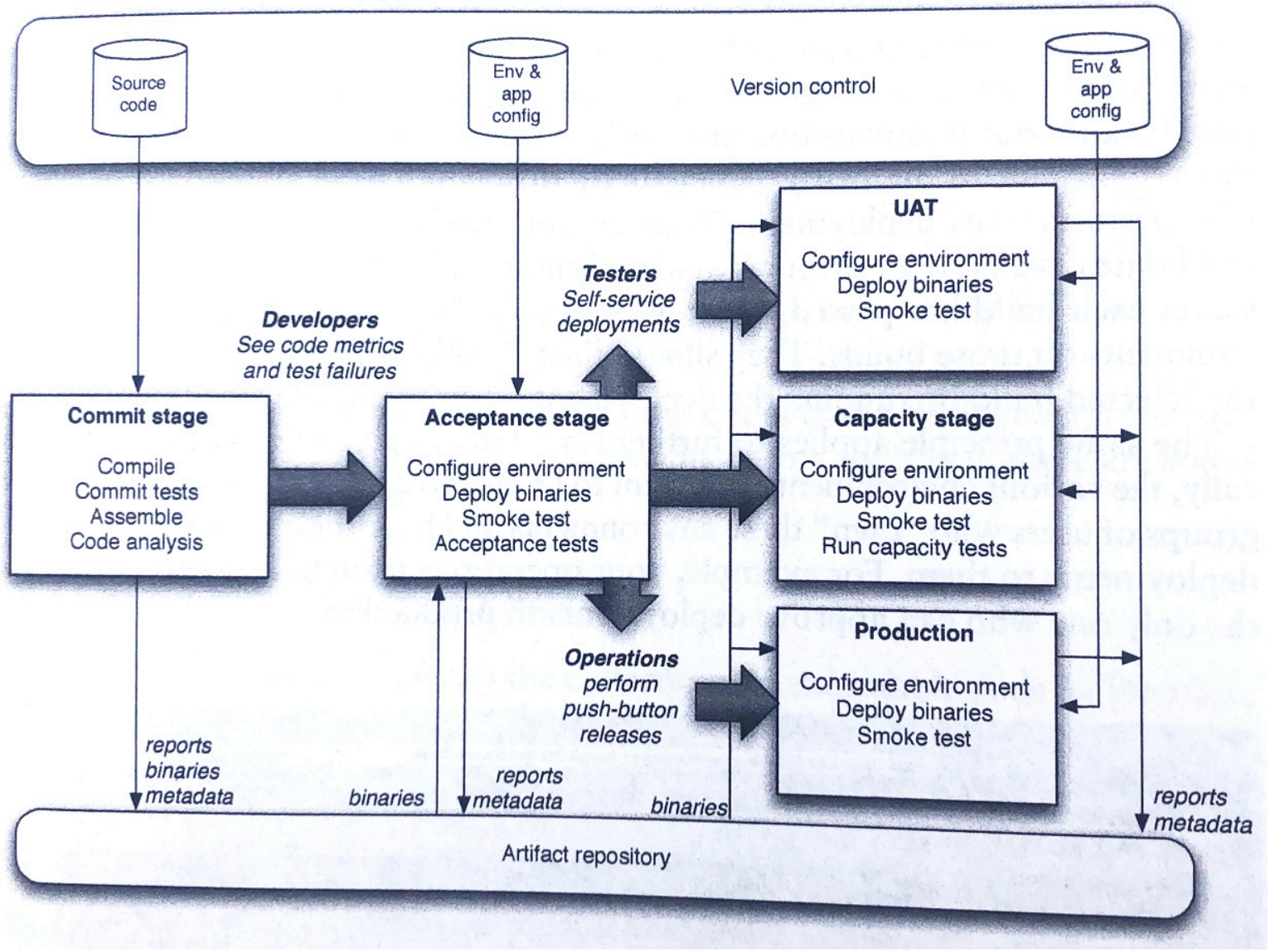
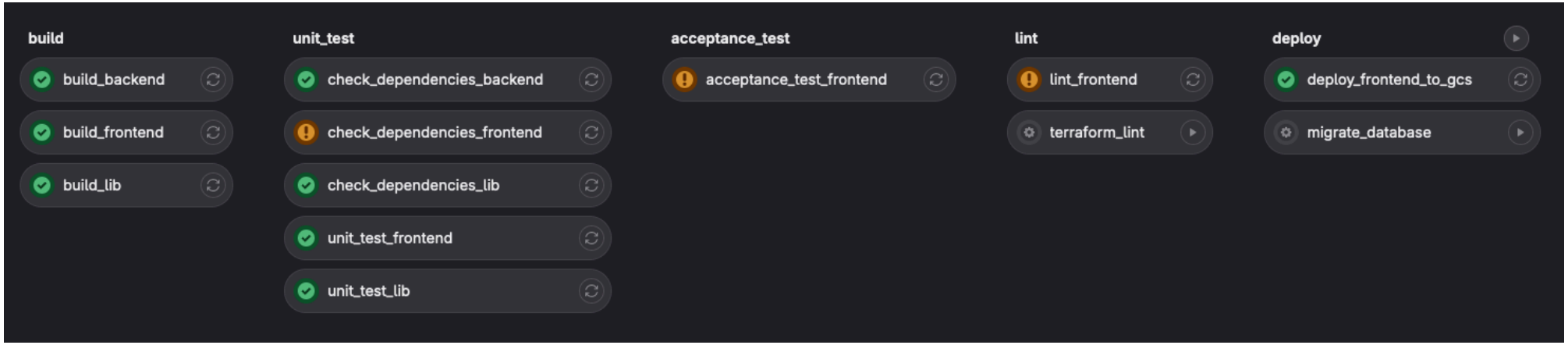


Figure 5.3 *Trade-offs in the deployment pipeline*

(Jez Humble, David Farley (2010): Continuous Delivery)



(Jez Humble, David Farley (2010): Continuous Delivery)


build
build_backend
build_frontend
build_lib
unit_test
check_dependencies_backend
check_dependencies_frontend
check_dependencies_lib
unit_test_frontend
unit_test_lib
acceptance_test
acceptance_test_frontend
lint
lint_frontend
terraform_lint
deploy
deploy_frontend_to_gcs
migrate_database

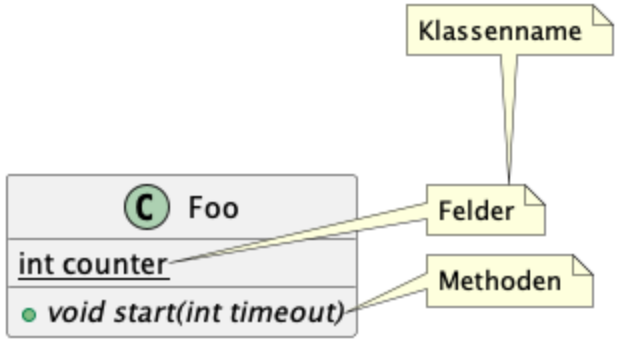
- Youtube: Continous Delivery - Deployment Pipelines
- Jez Humble, David Farley (2010): Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment
  Automation, Addison-Wesley Signature Series (Fowler)

Empirisches und experimentelles Arbeiten

Kommunikation

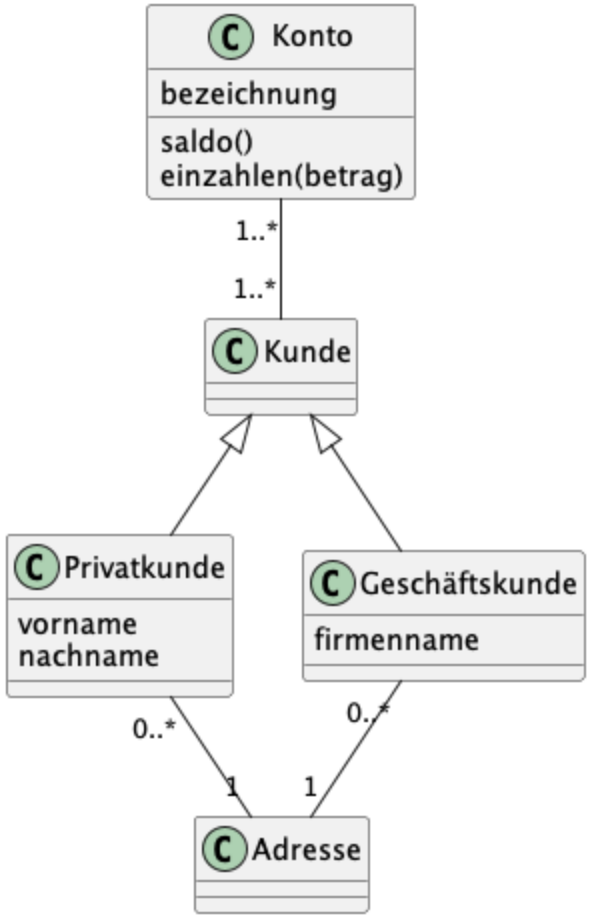
Domain Driven Design

UML Klassendiagramm



PlantUML

UML Klassendiagramm

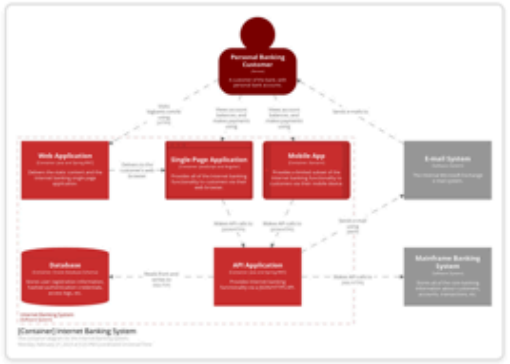


PlantUML

```
@startuml
class Konto {
    bezeichnung
    saldo()
    einzahlen(betrag)
}

class Kunde {
}

class Privatkunde {
    vorname
    nachname
}

class Geschäftskunde {
    firmenname
}

class Adresse {
}

Kunde <|-- Privatkunde
Kunde <|-- Geschäftskunde

Privatkunde "0..*" -- "1" Adresse
Geschäftskunde "0..*" -- "1" Adresse

Konto "1..*" -- "1..*" Kunde
@enduml
```

C4 Model

Level 1: A **System Context** diagram provides a starting point, showing how the software system in scope fits into the world around it.



Level 2: A **Container** diagram zooms into the software system in scope, showing the high-level technical building blocks.

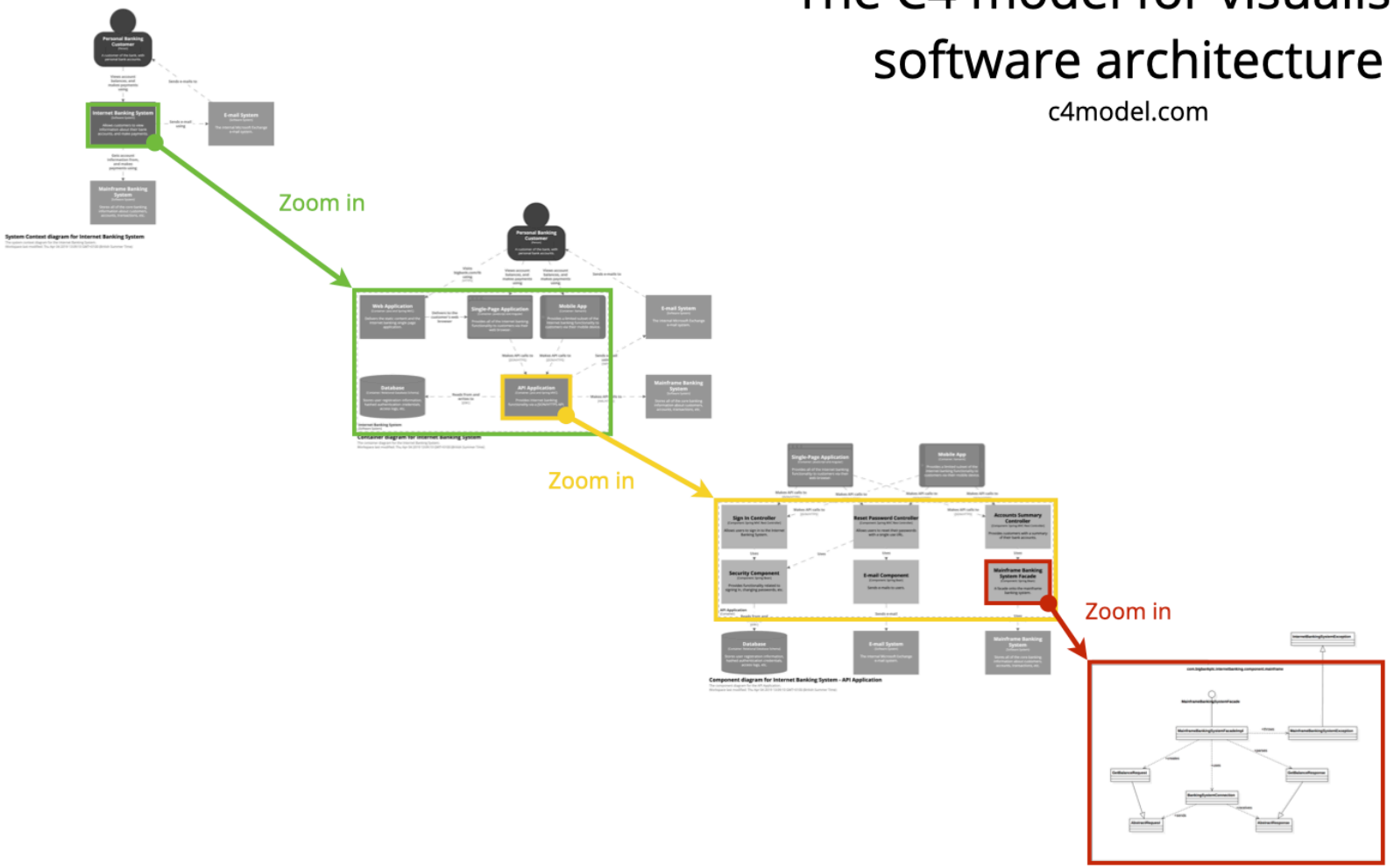
Level 3: A **Component** diagram zooms into an individual container, showing the components inside it.

Level 4: A **code** (e.g. UML class) diagram can be used to zoom into an individual component, showing how that component is implemented.

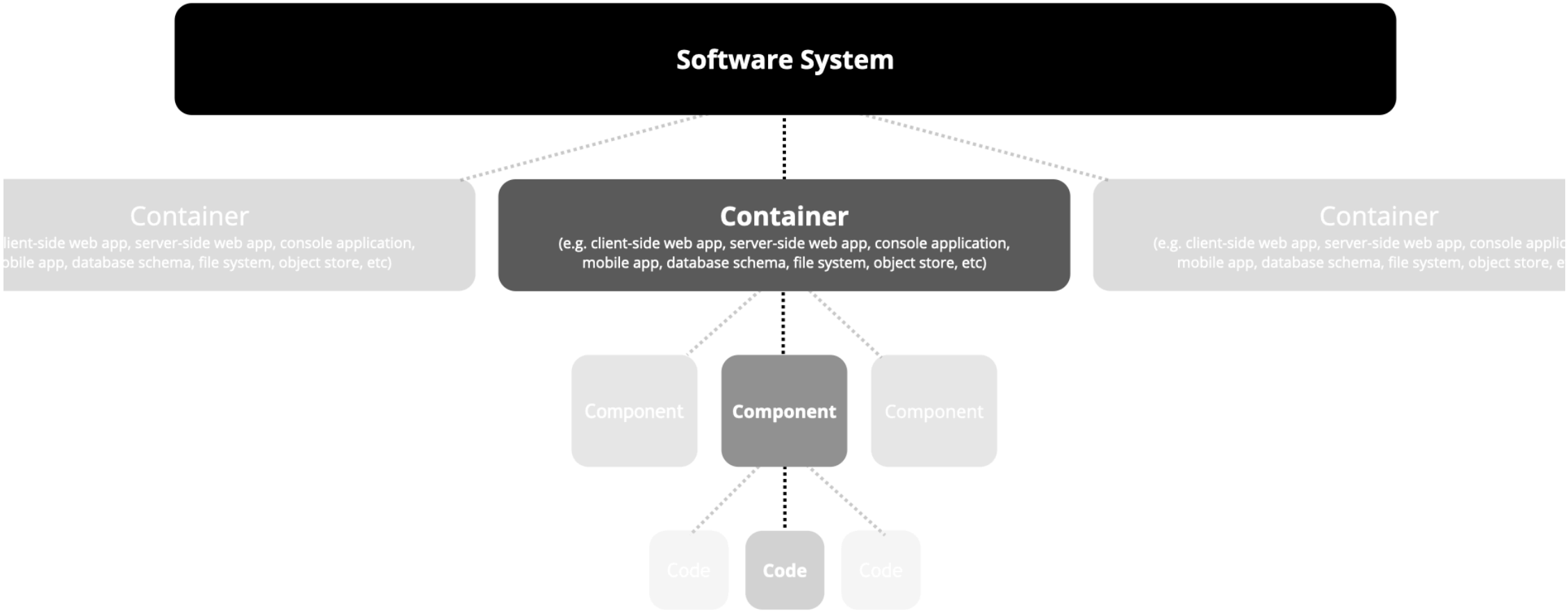
https://c4model.com/

The C4 model for visualising software architecture

c4model.com



Level 1	Level 2	Level 3	Level 4
Context	Containers	Components	Code

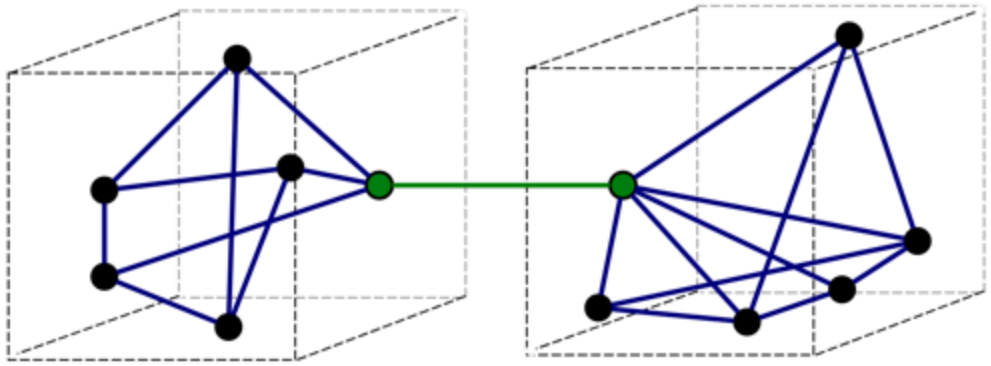


A **software system** is made up of one or more **containers** (applications and data stores), each of which contains one or more **components**, which in turn are implemented by one or more **code** elements (classes, interfaces, objects, functions, etc).

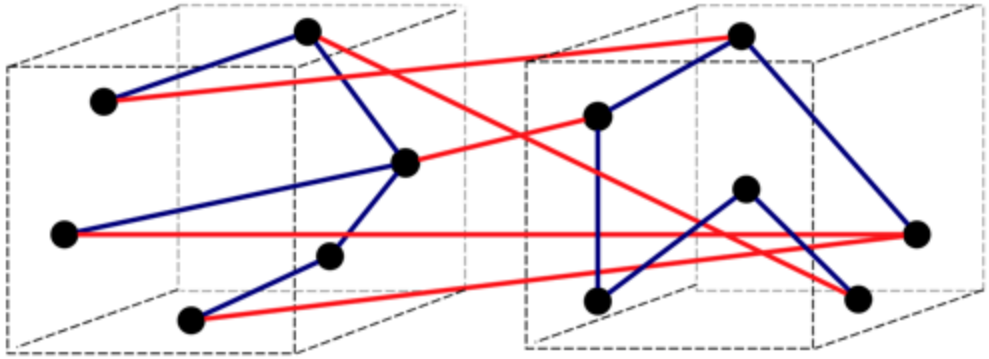
Komplexität

Modularity & Separation of Concerns

Cohesion & Coupling



a) Good (loose coupling, high cohesion)

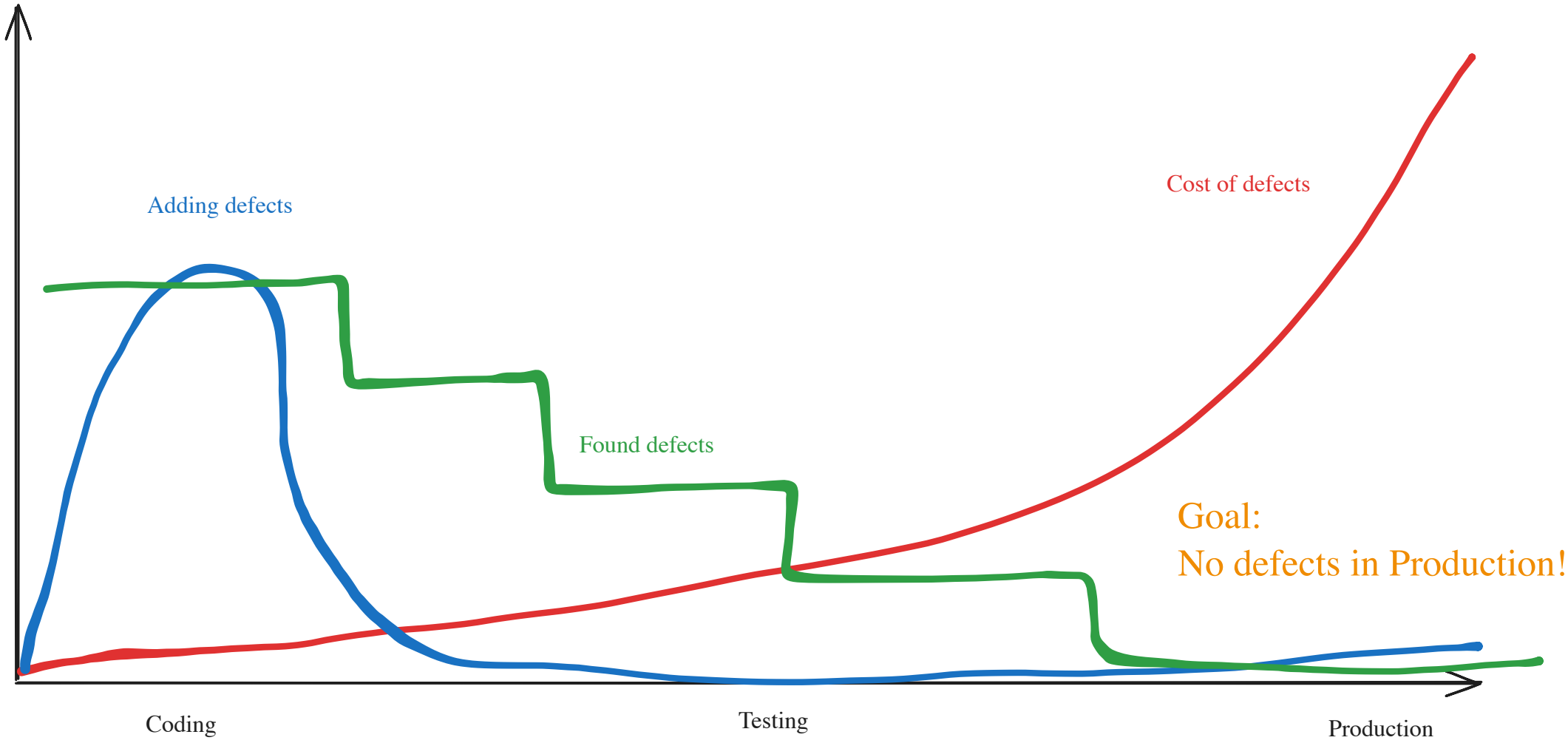


b) Bad (high coupling, low cohesion)

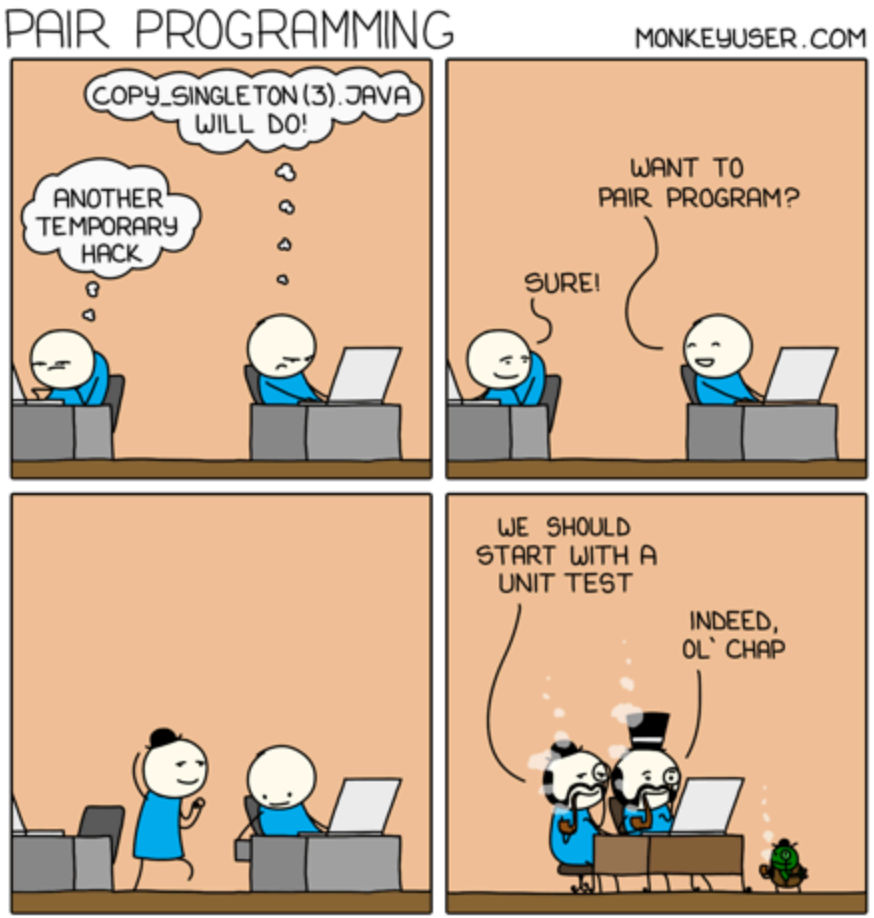
Abstraction

Testing

Kosten von Defekten

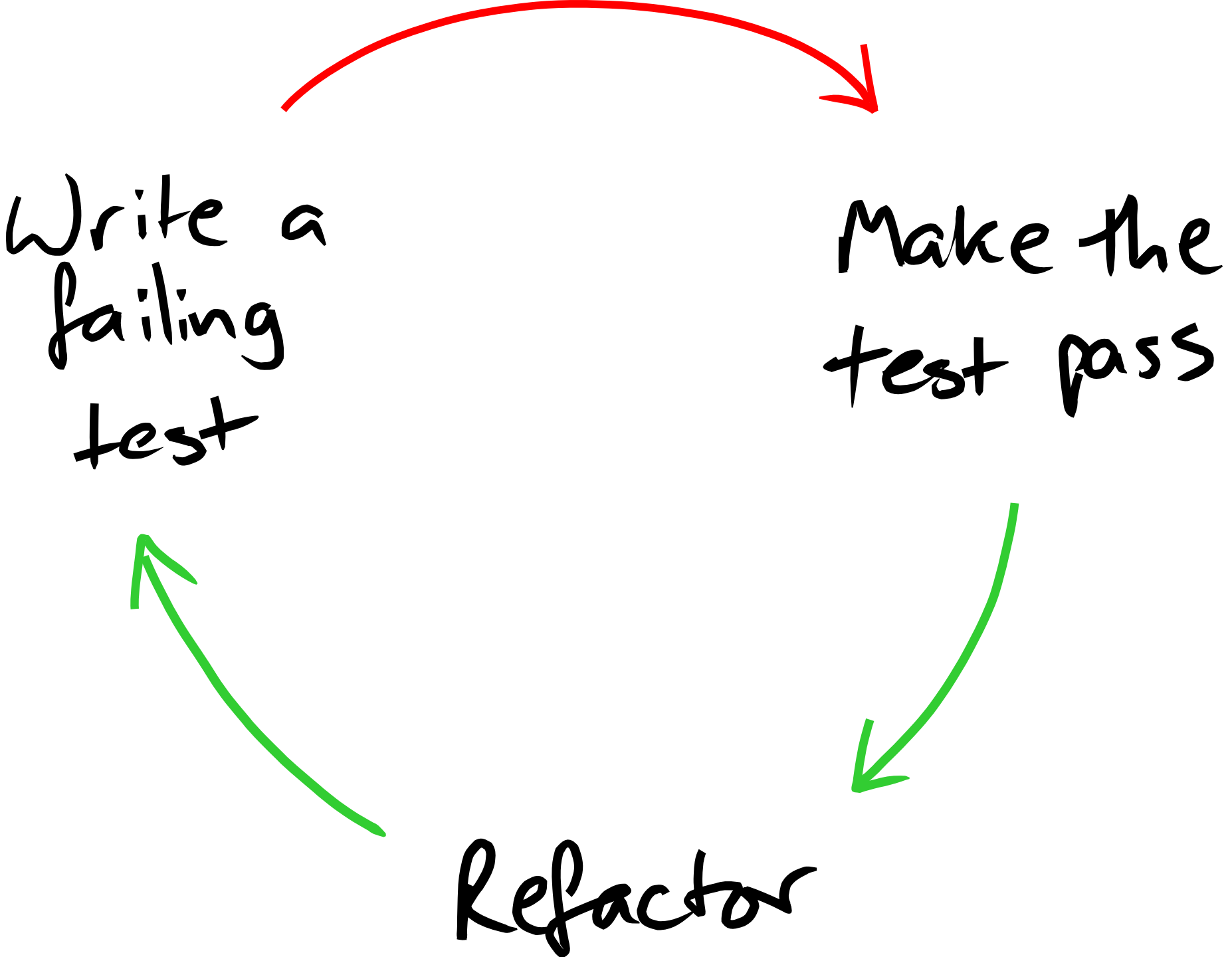


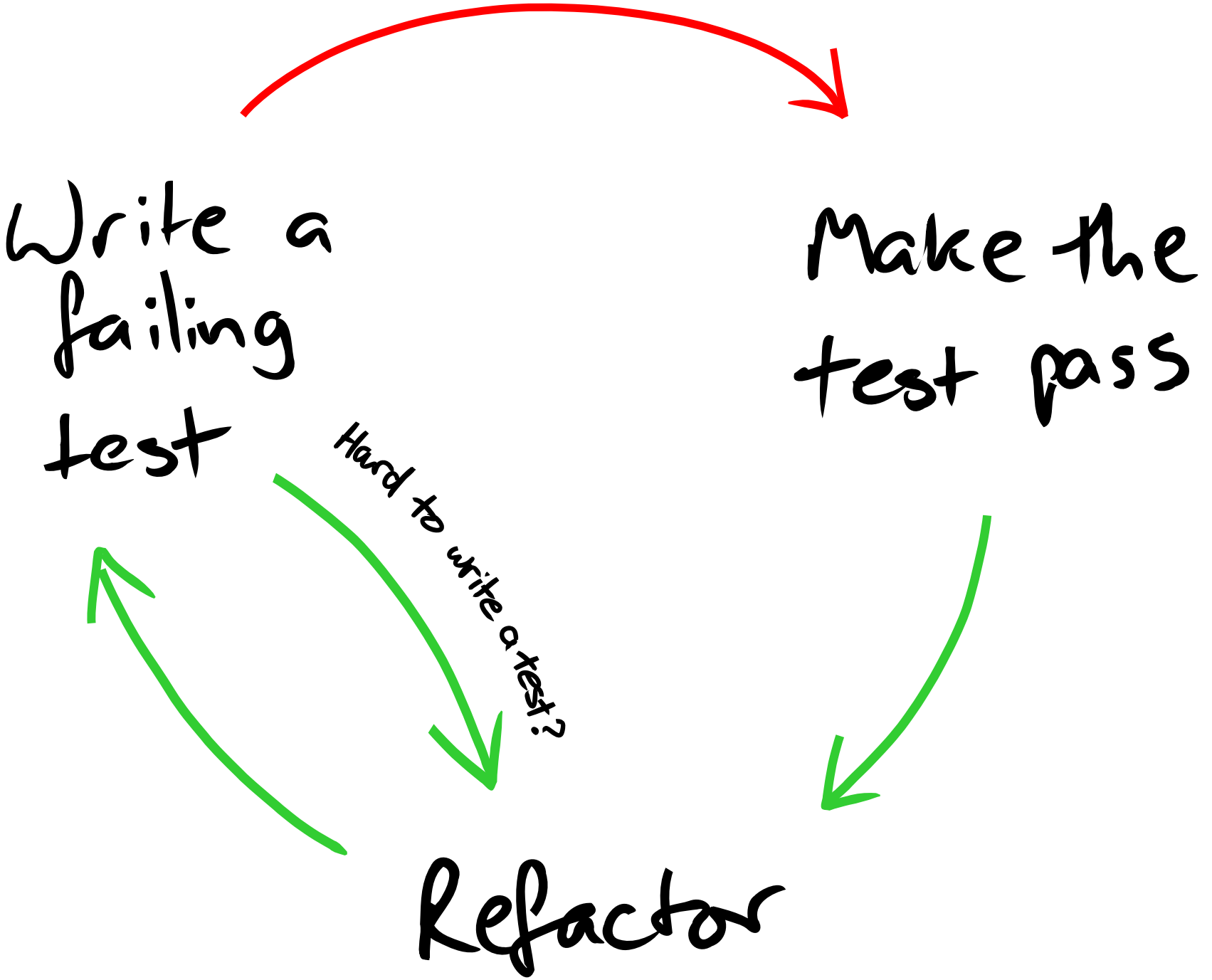
Pair Programming

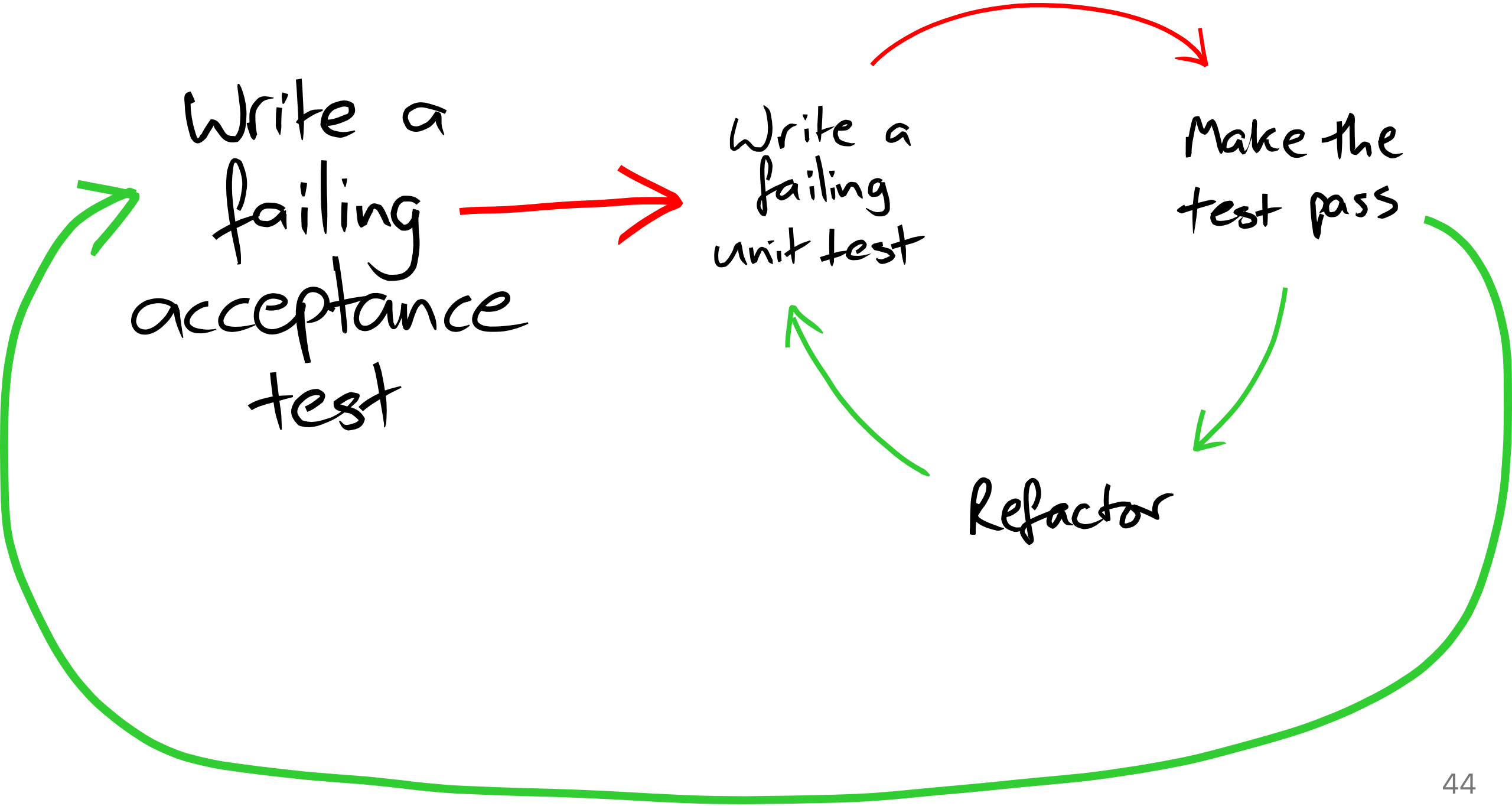


Test Driven Development (TDD)

- Test First: Fokus auf die Problemstellung und Schnittstelle
- Nur eigenen Code testen. Datenbanken, APIs oder Libraries werden nur im Rahmen von Integrationstests aufgerufen.
- Tests geben eine Rückmeldung zum Code: Wenn Code schwierig zu testen ist, sollte er vermutlich anders strukturiert
  werden.
- Humble Object: Code, der schwierig zu testen ist in einem minimalen Objekt isolieren

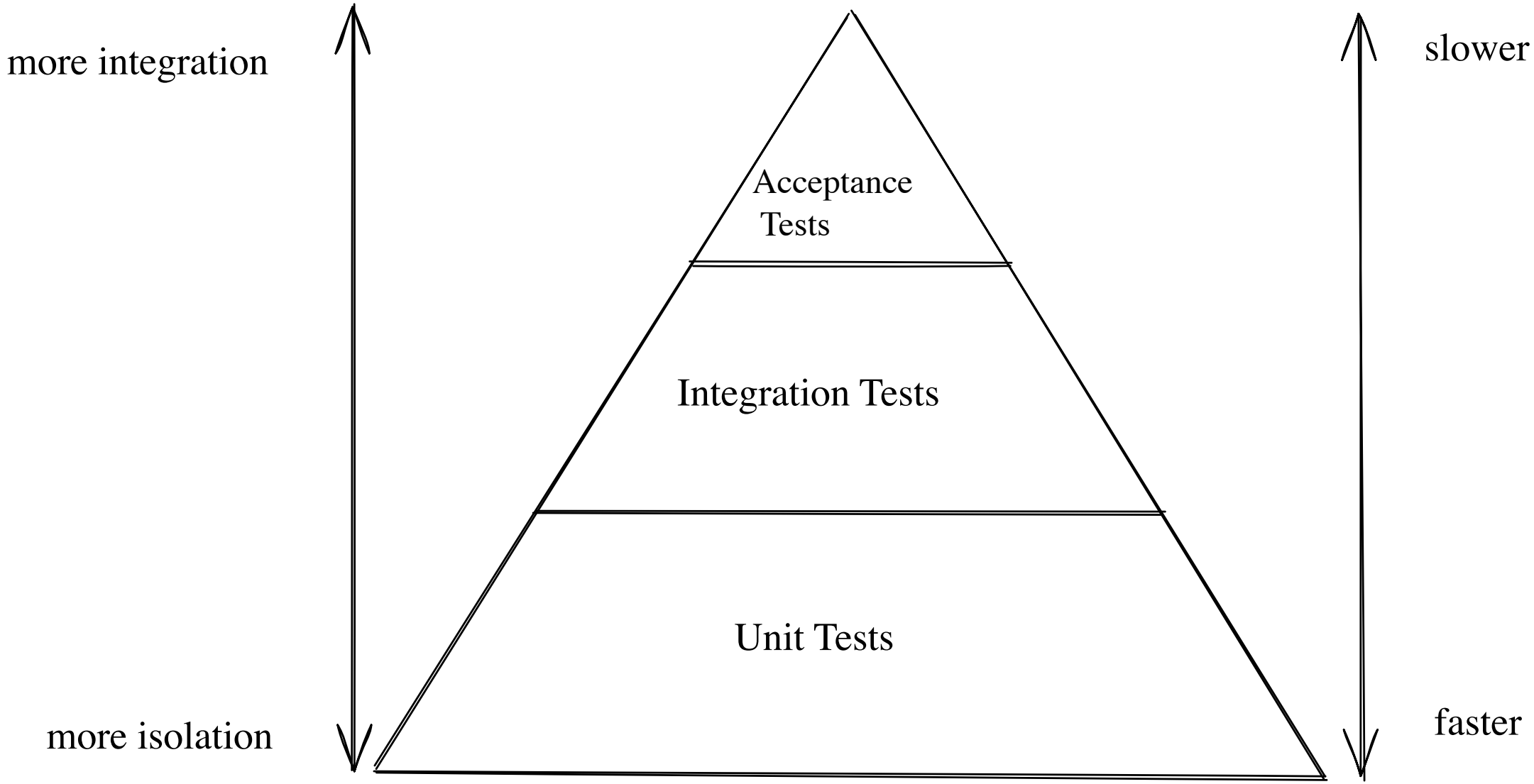

Write a failing test
Make the test pass
Refactor


Write a failing test
Make the test pass
Hard to write a test?
Refactor


Write a failing acceptance test
Write a failing unit test
Make the test pass
Refactor

Drei Abbildungen aus: Growing Object-Oriented Software by Nat Pryce and Steve Freeman

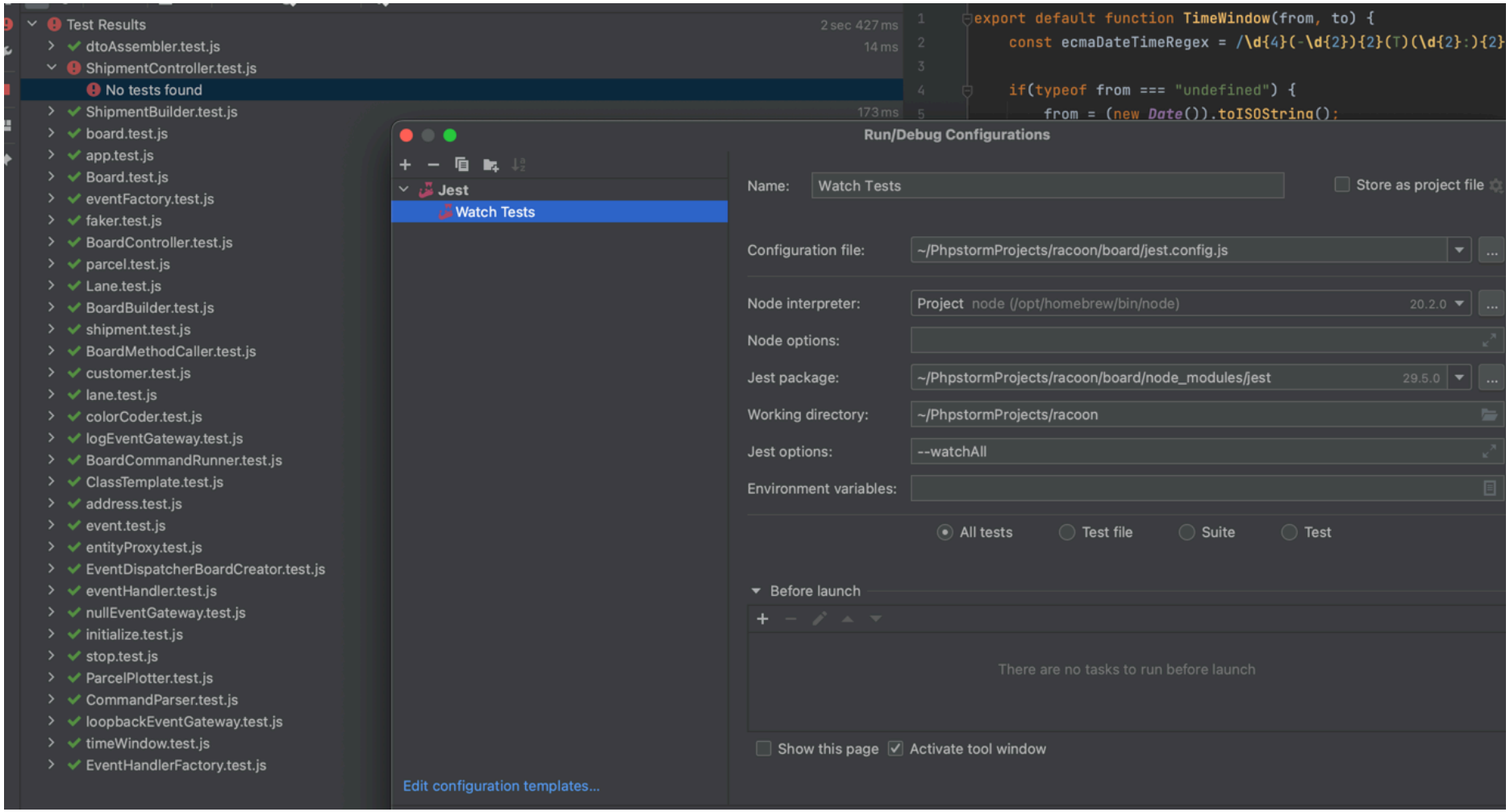
Testpyramide



Testing: AAA

- Arrange: Set up your data
- Act: Execute code under Test
- Assert: Verify that the result ist correct

IDE Integration



Testing: Further Reading

- How to write clear and robust unit tests: the dos and don'ts
- The Real Value of Testing

Why Should You Refactor?

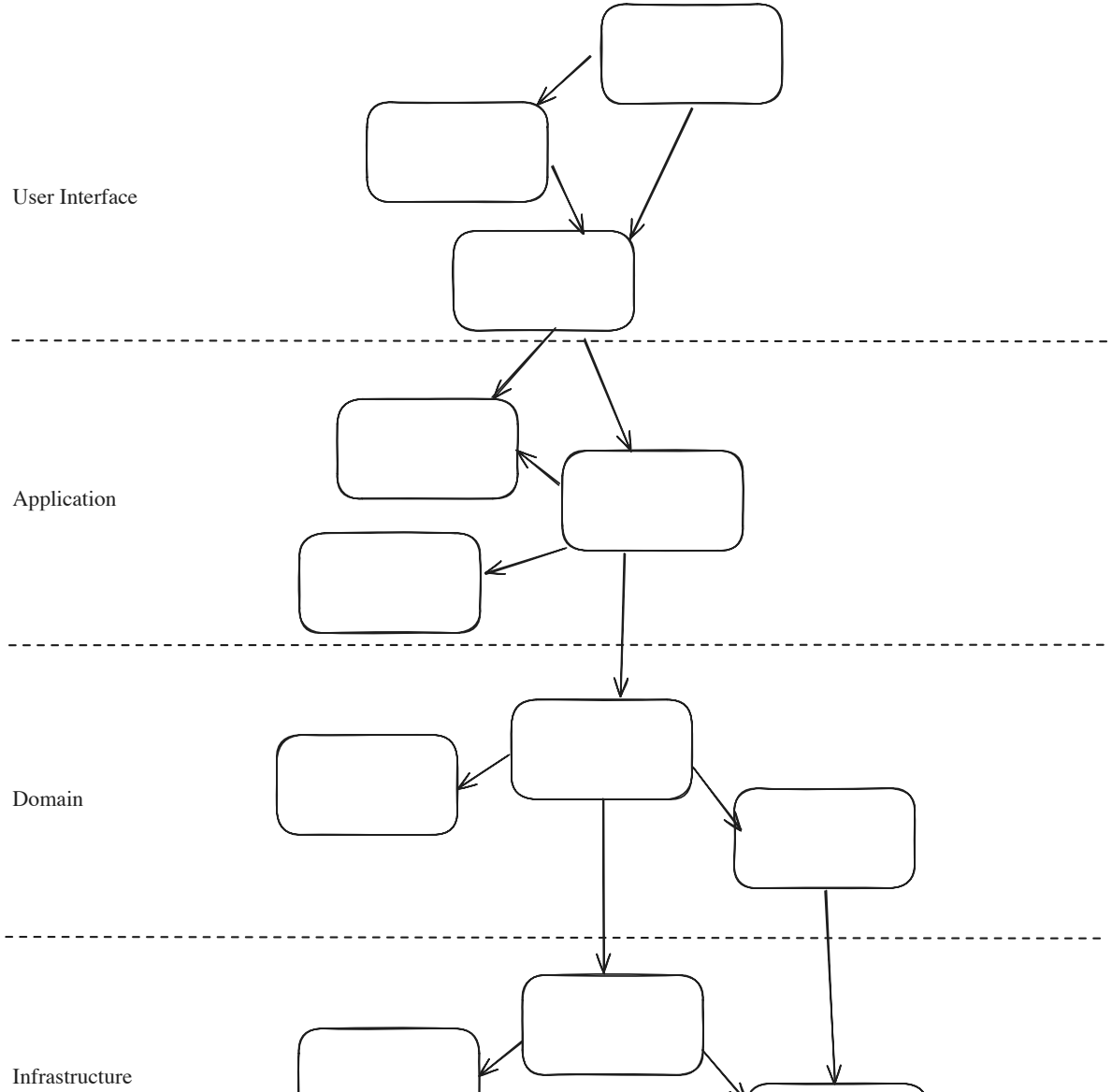
- Refactoring Improves the Design of Software
- Refactoring Makes Software Easier to Understand
- Refactoring Helps You Find Bugs
- Refactoring Helps You Program Faster

When Should You Refactor?

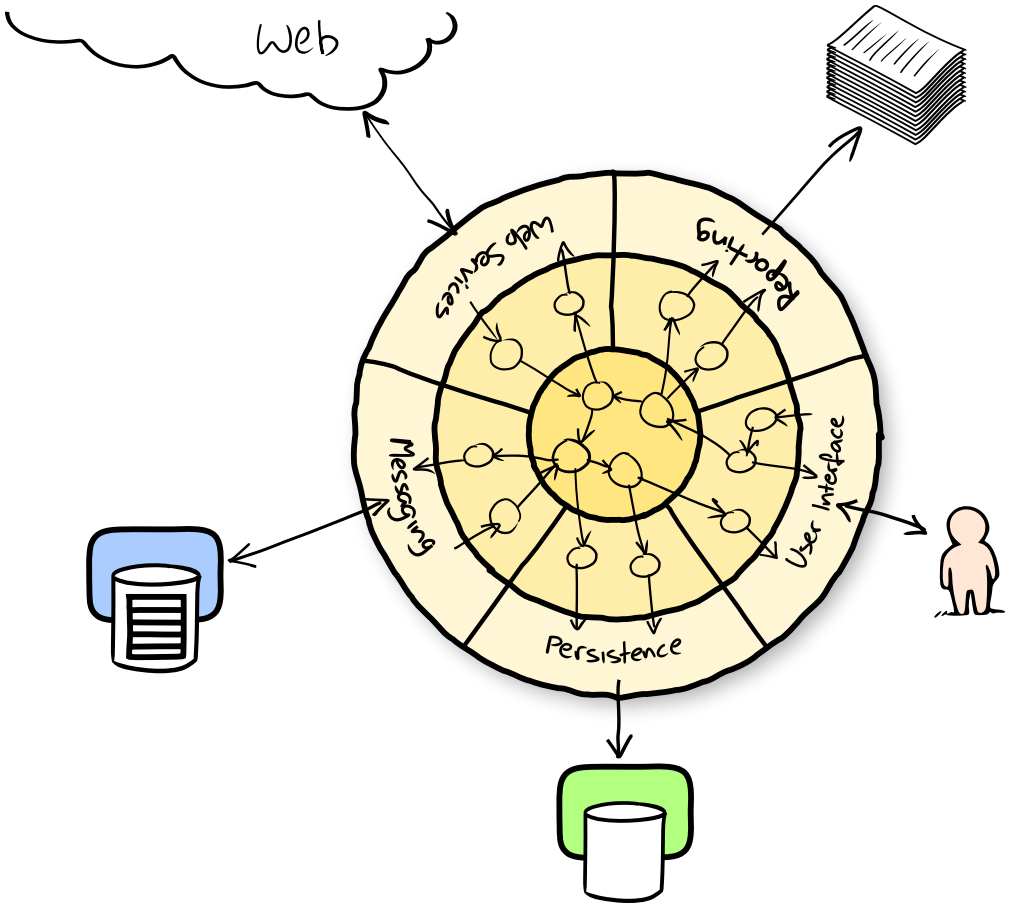
- The Rule of Three
- Refactor When You Add Functionality
- Refactor When You Need to Fix a Bug
- Refactor As You Do a Code Review

Architekturen

Schichtenarchitektur

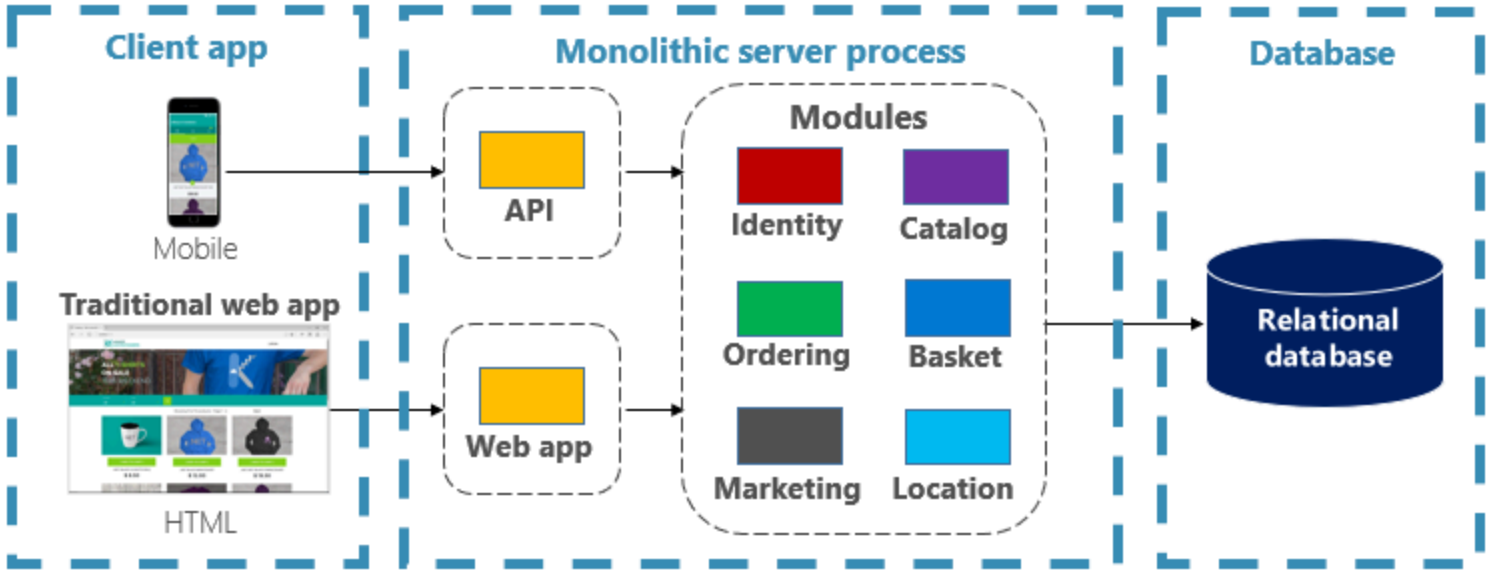


Ports and Adapters

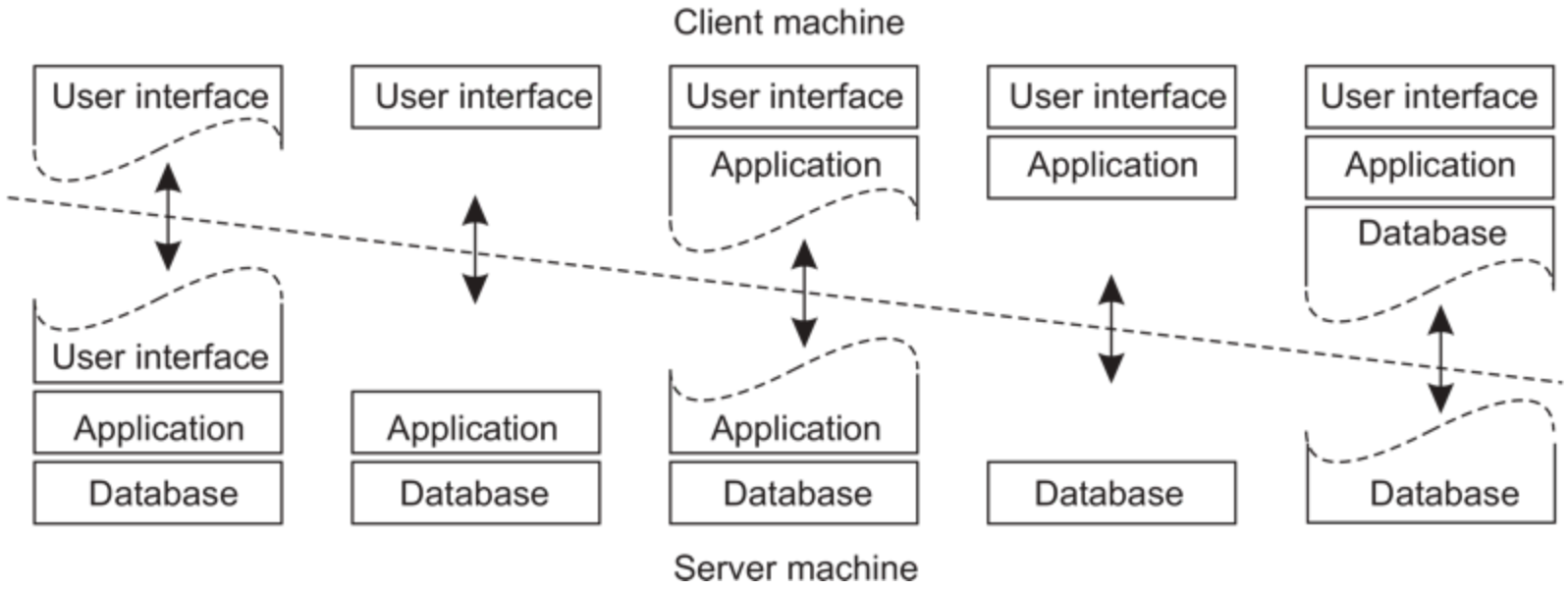


growing-object-oriented-software.com

Traditional Monolithic Design



Schichtenarchitektur im Client Server Modell



Microservices

martinfowler.com/articles/microservices.html

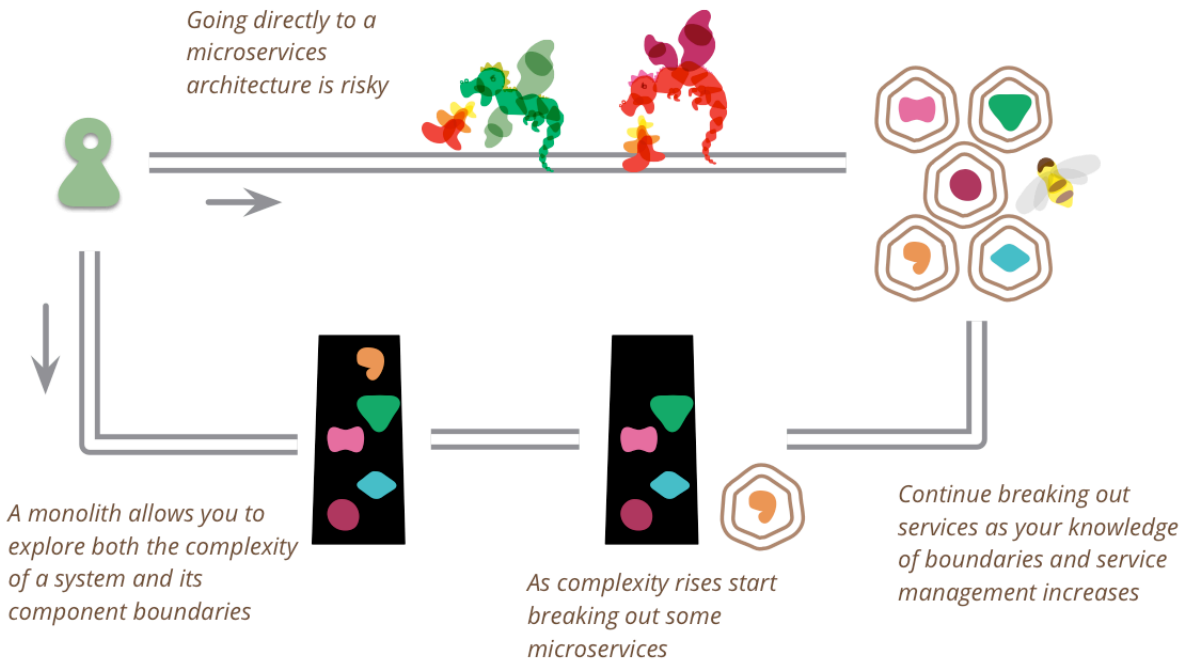
Microservices

- Maximale Skalierbarkeit
- Einzelne Services können von **kleinen[^1]** Teams **unabhängig entwickelt und deployed** werden
- Bessere Wart- und Erweiterbarkeit
- Unterschiedliche Technologien können eingesetzt werden
- Kommunikation nicht trivial
- Höhere Wahrscheinlichkeit eines Ausfalls
- **Hohe Komplexität**

[^1]: "We try to create teams that are no larger than can be fed by two pizzas"

Monolith First

- Vorsicht vor Cargo-Kult: Amazon, Google, Meta etc. haben heute andere Herausforderungen als Startups
- Technologien oder Architekturen wählen, "weil Google macht das auch so" ist ein schlechter Grund



martinfowler.com/bliki/MonolithFirst.html

Quellen

Farley, 2022
: David Farley (2022): Modern Software Engineering: Doing What Works to Build Better Software Faster, Addison-Wesley

Martin, 2018
: Robert C. Martin (2018): Clean Architecture: A Craftman's Guide to Software Structure and Design, Prentice Hall

Richards, 2021
: Mark Richards, Neal Ford (2021): Handbuch moderner Softwarearchitektur: Architekturstile, Patterns und Best
Practices, O'Reilly, 978-3-96009-149-3