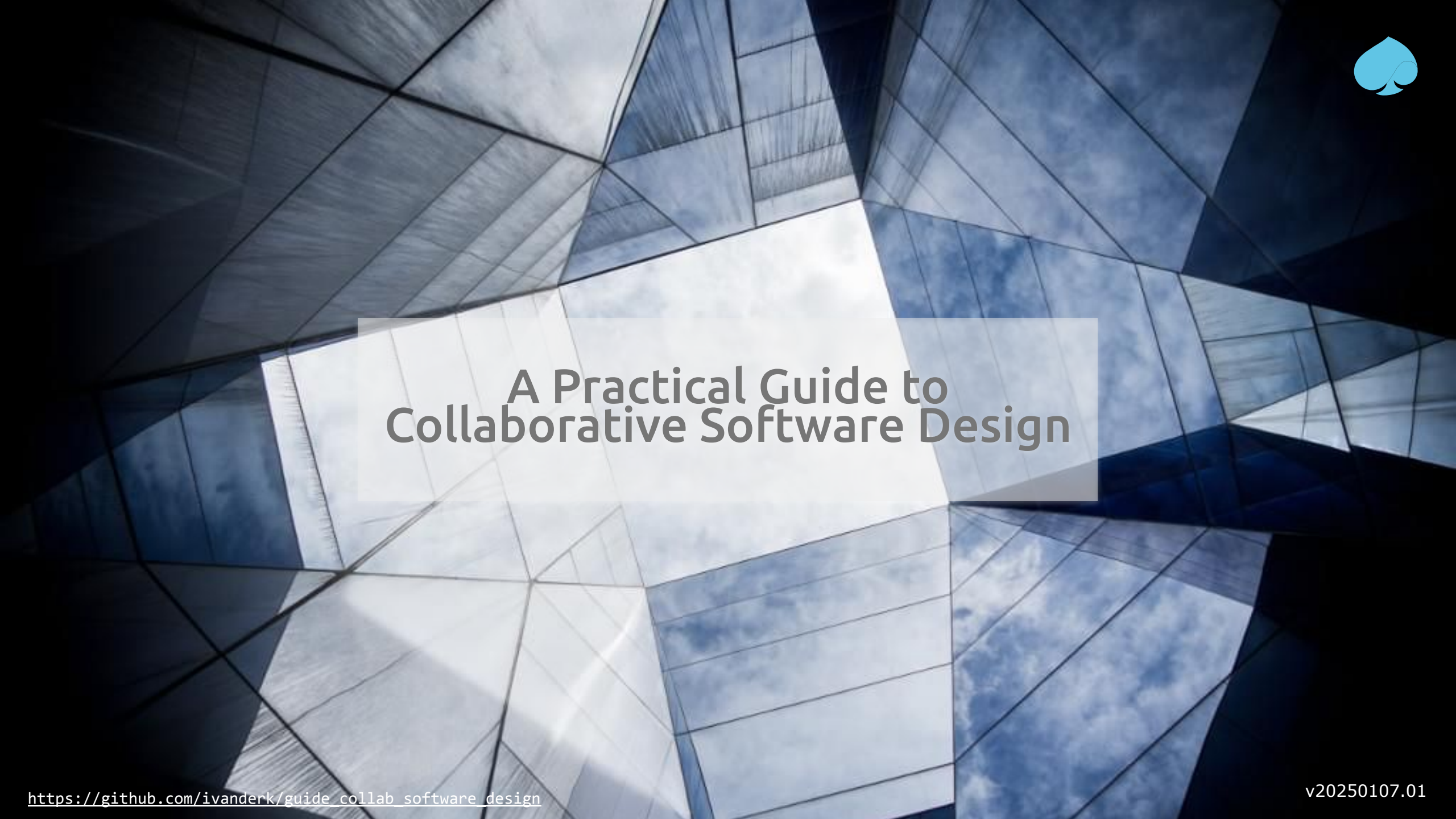
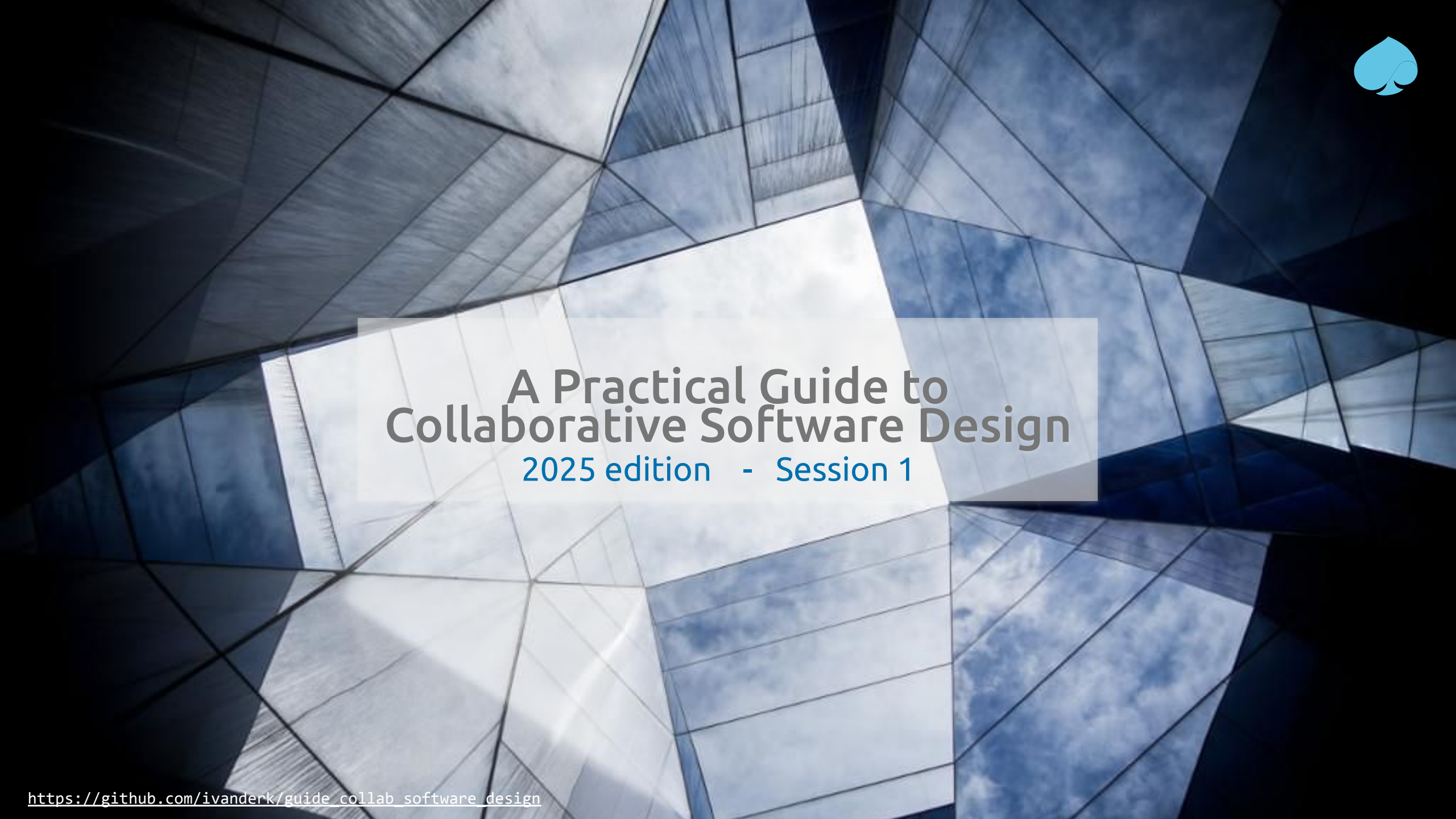


A Practical Guide to Collaborative Software Design

https://github.com/ivanderk/guide_collab_software_design

v20250107.01

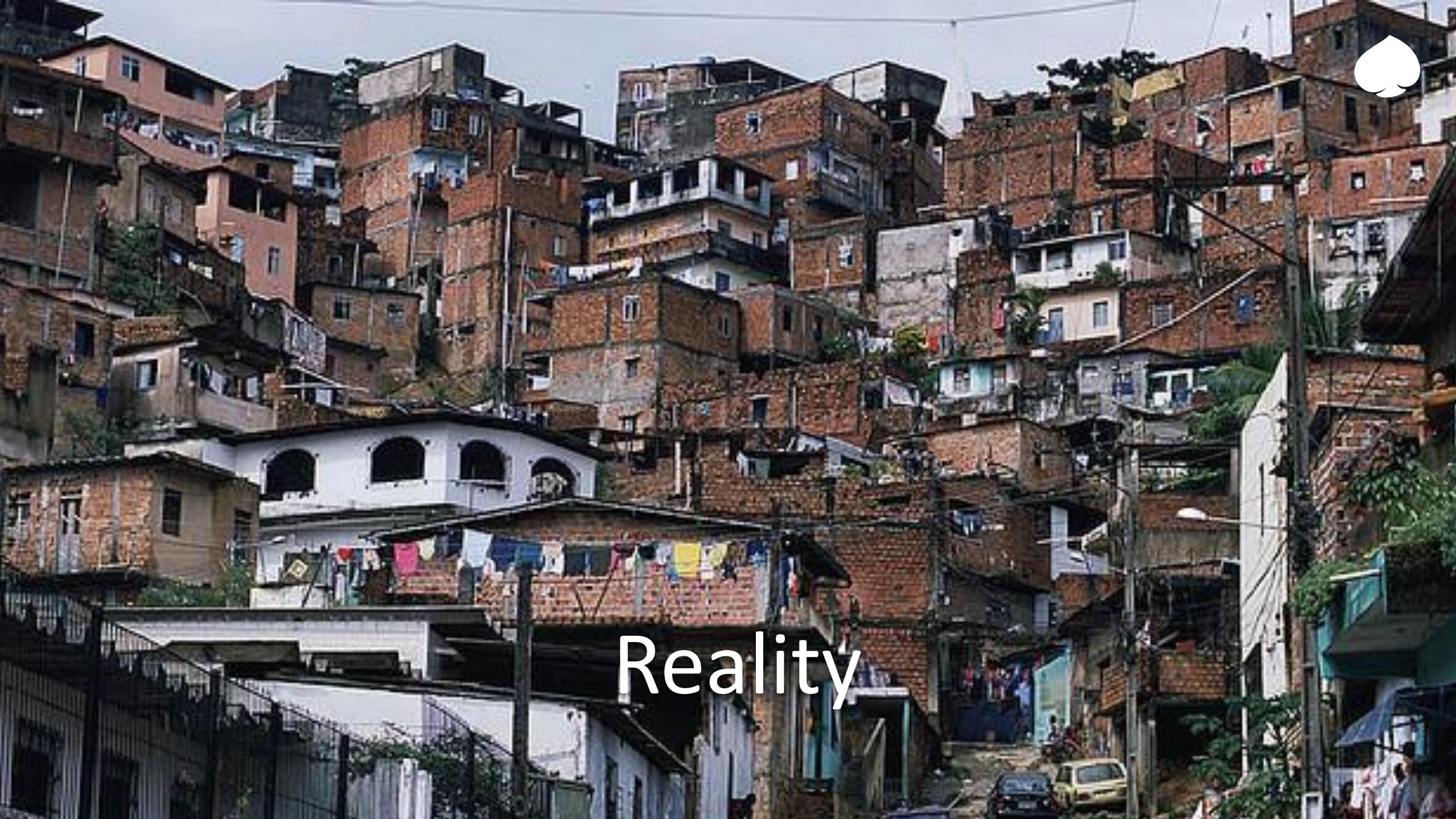


A Practical Guide to Collaborative Software Design

2025 edition - Session 1

https://github.com/ivanderk/guide_collab_software_design


How it was supposed to be


Reality

1 Architecture and Software Design

2 Mindset and practices

Today

3 Models

4 How to Design

5 Next Steps &
Further reading and viewing…

In theory, there is no difference between theory and practice; In practice, there is.

Software Engineering: it's a Craft, should be a Culture and needs to be about People

Manifesto for Software Craftsmanship

Raising the bar.

As aspiring Software Craftsmen we are raising the bar of professional software development by practicing it and helping others learn the craft. Through this work we have come to value:

Not only working software,
but also **well-crafted software**

Not only responding to change,
but also **steadily adding value**

Not only individuals and interactions,
but also **a community of professionals**

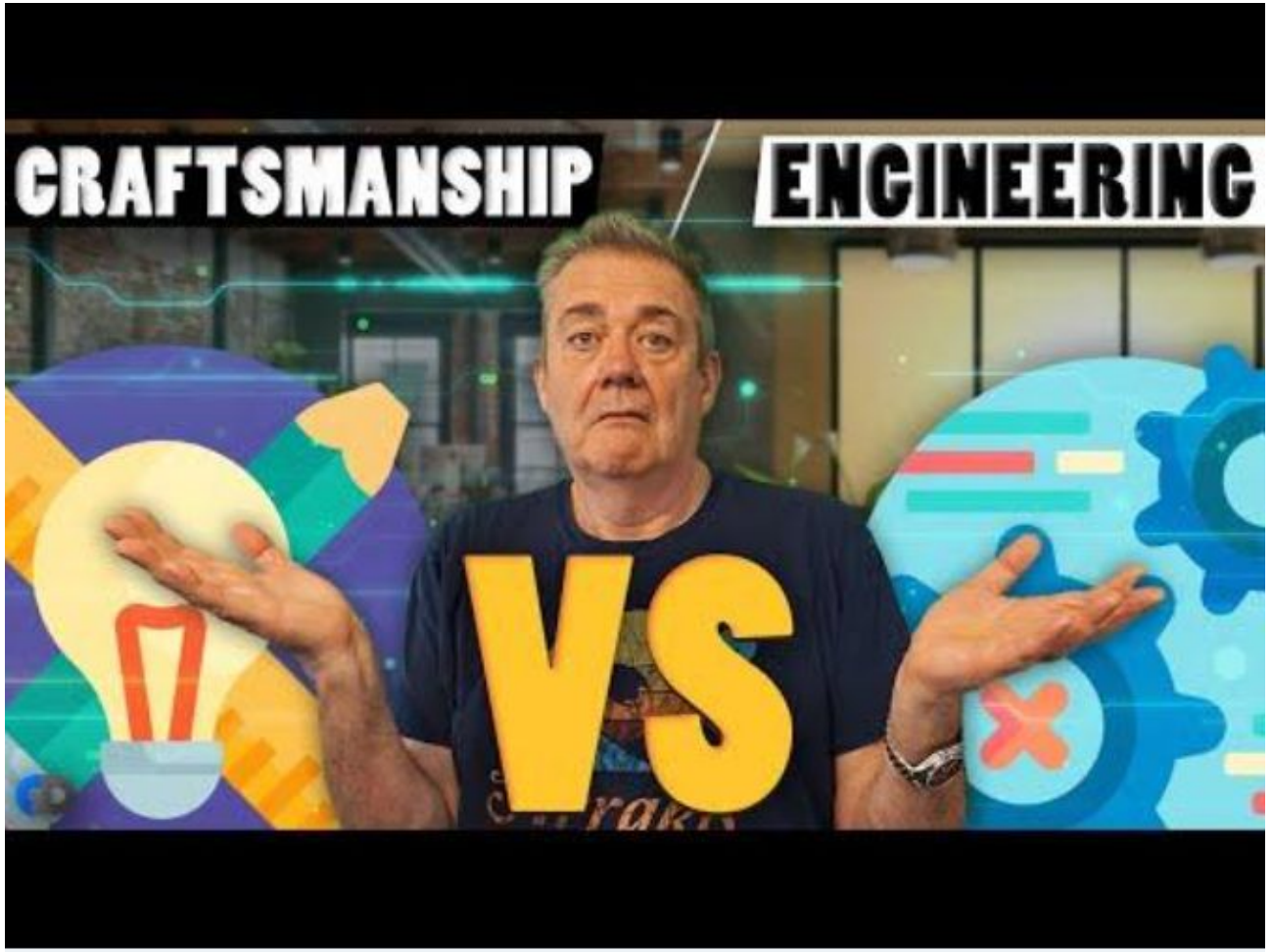
Not only customer collaboration,
but also **productive partnerships**

That is, in pursuit of the items on the left we have found the items on the right to be indispensable.

”..Software engineering should INDEED BE CONSIDERED A CRAFT and must also be valued by its beauty…

…SOFTWARE CRAFTSMANSHIP NEEDS TO BE A CULTURE…”

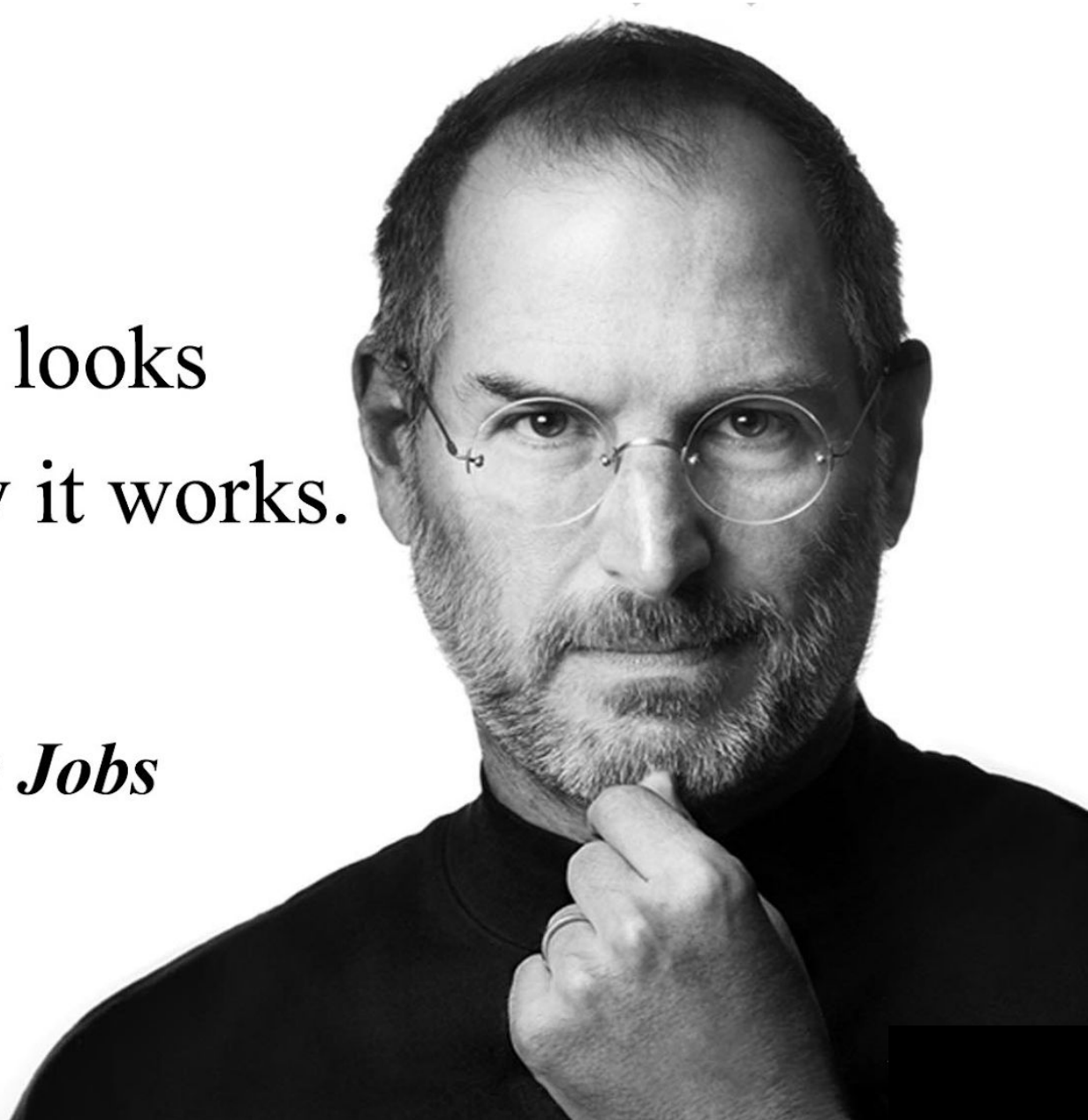
Software Engineering: it's a Craft, should be a Culture and needs to be about People



Software Craftsmanship vs Software Engineering
youtube.com

Design is not just what it looks
and feels like. Design is how it works.

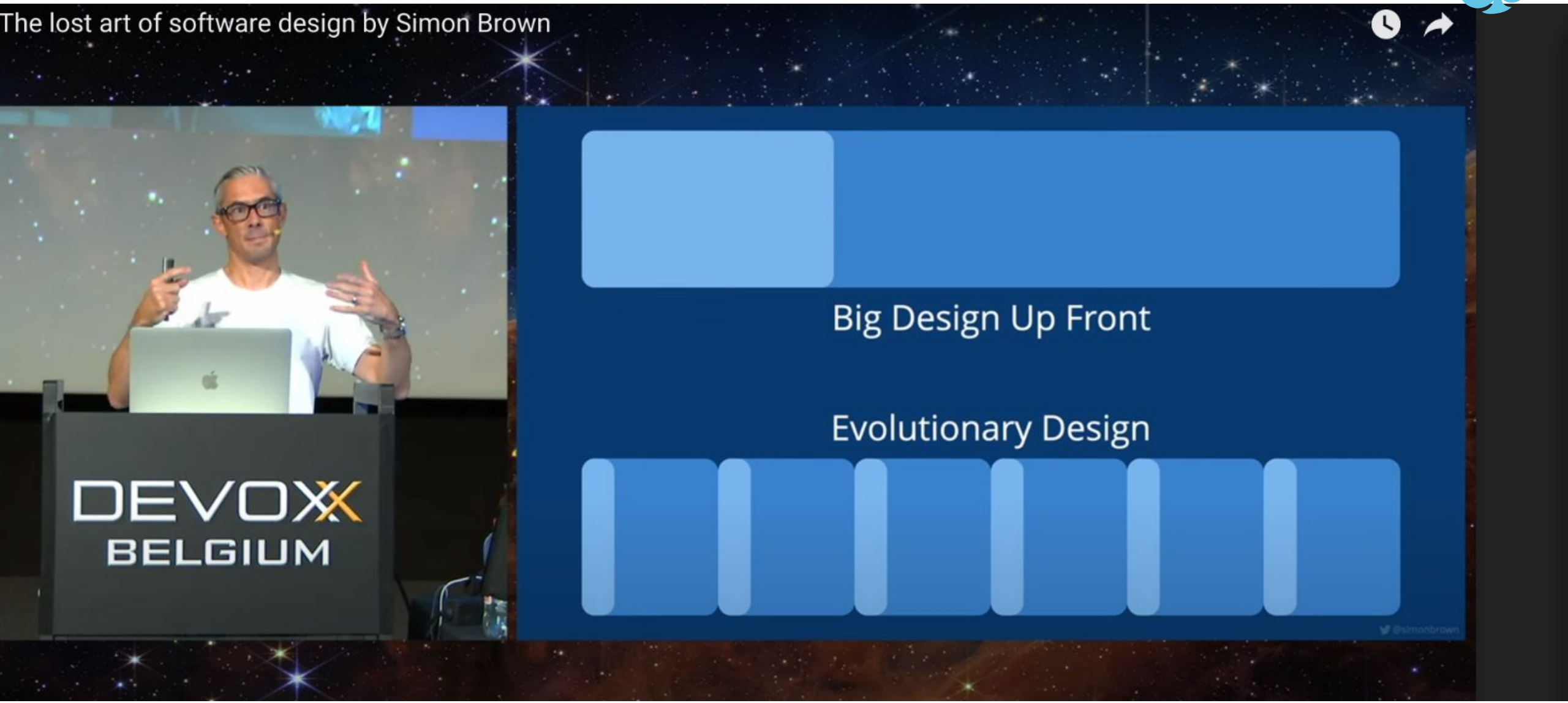
Steve Jobs



If you are in a hurry…..The lost art of software design by Simon Brown

https://youtu.be/36OTe7LNd6M

If you are in a hurry…..The lost art of software design by Simon Brown



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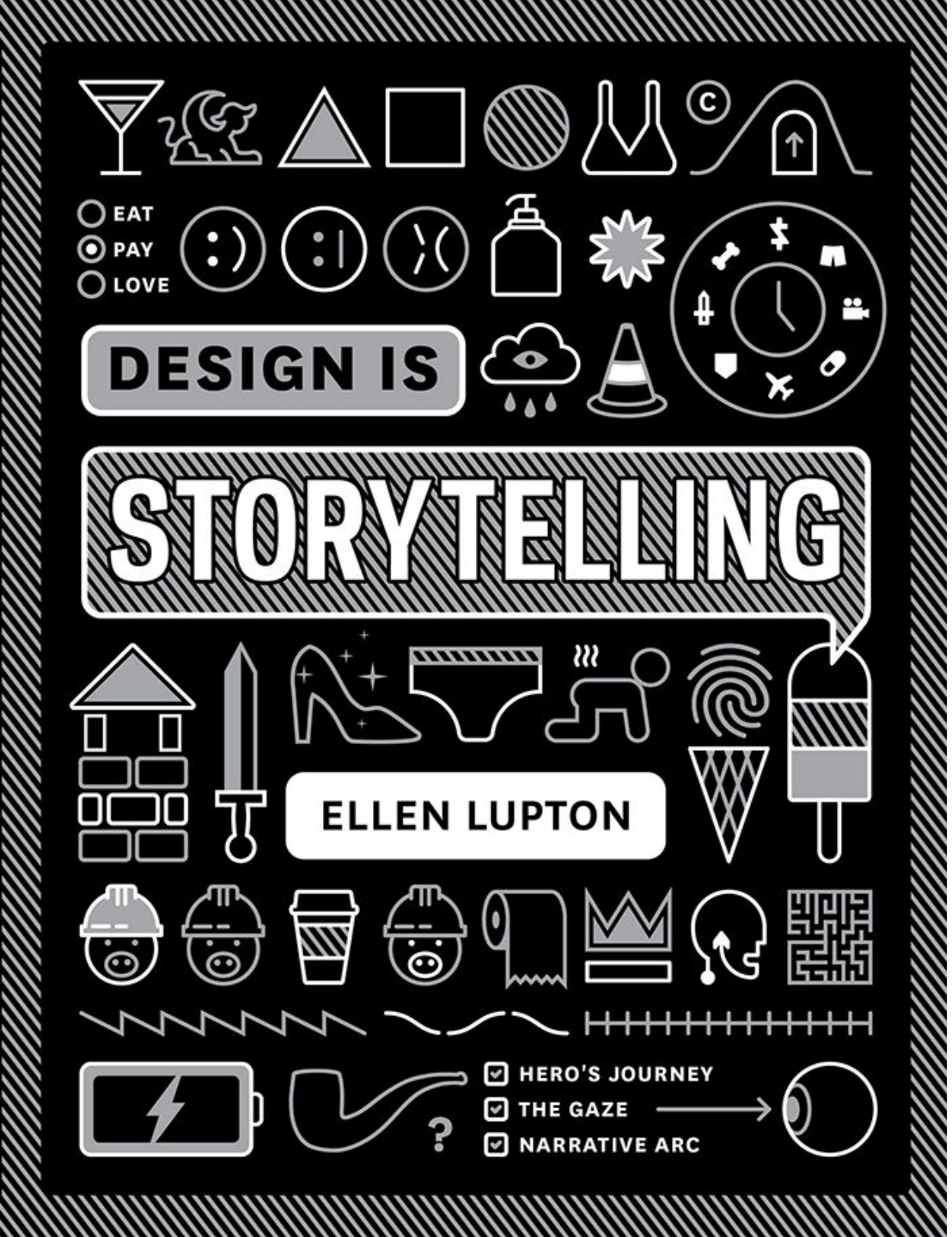
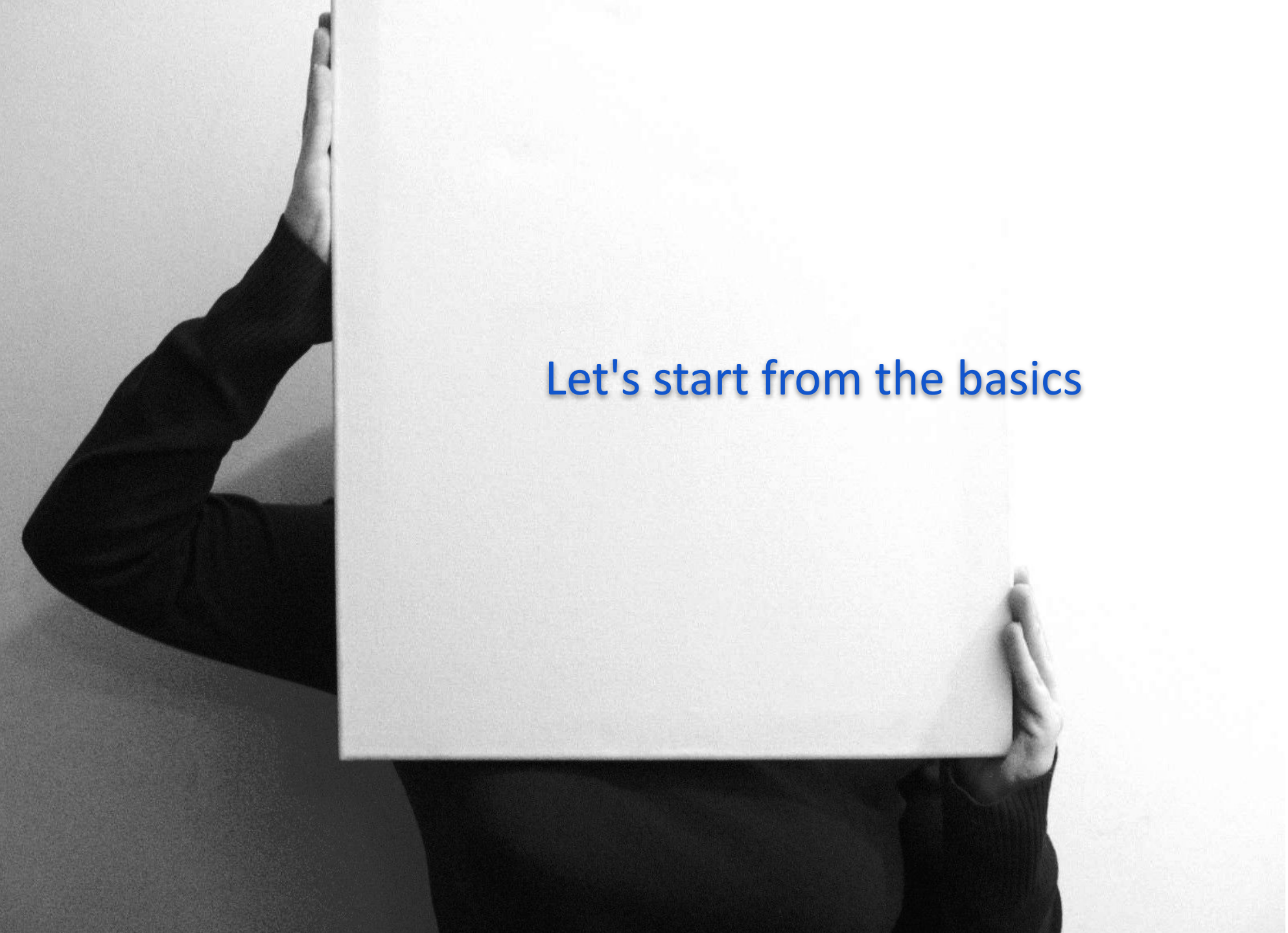


Design is describing
- telling a story -
about How “it” works

Lupton’s *Design is Storytelling* reminds software engineers that **humans connect with systems and interfaces through stories**—whether explicit or implicit.

For example: In software, user flows are like narratives. They take users on a journey with a beginning (onboarding), middle (tasks), and end (success or feedback).

By treating software experiences as narratives, engineers and designers can create products that are not only functional but also intuitive, memorable, and engaging.



Let's start from the basics


Architecture
and
Software Design

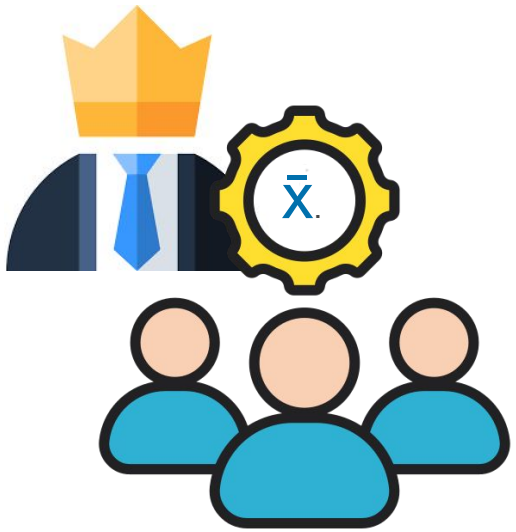
Defining the terms…

A Practical Guide to

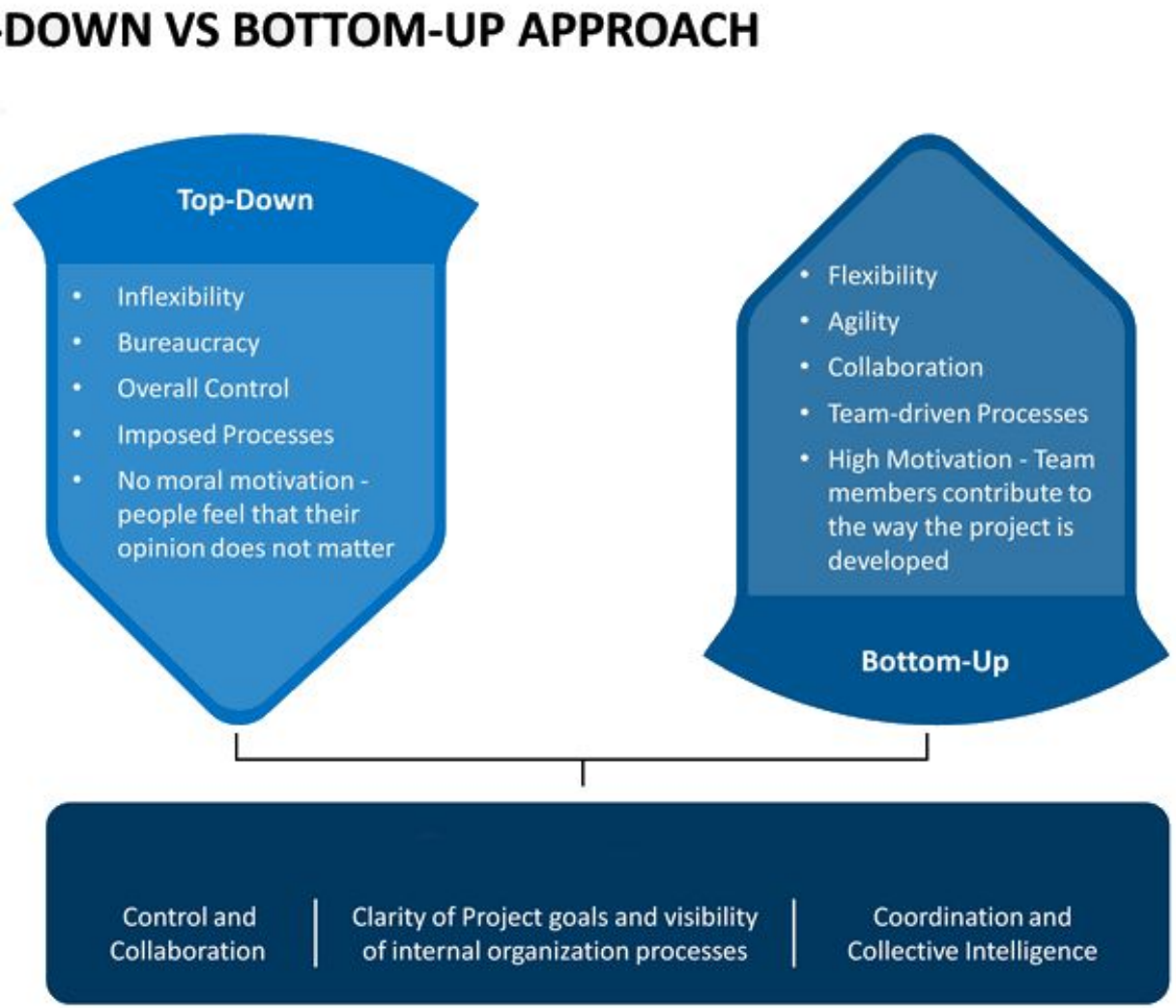
Collaborative

Software Design

Collaborative?



An strongly led, average, baseline team will suffice



Requires a strong, motivated team, capable and inclined to work peer to peer

The Team should (be able to) work as one

Defining the terms…

A Practical Guide to

Collaborative

Software Design

An important side note:

Software Design is not separate from User Experience Design

UX Design is PART OF Software Design, part of the process as well as the final artifacts. It is NOT a separate process in the same way that designing the Data Model is NOT a separate process.

What *is* Software Design?
Is it "Architecture"?
What *is* "Architecture"?

https://www.youtube.com/watch?v=DngAZyWMGR0

Ralph Johnson (on of the Design Patterns Gang of Four (GoF) – as paraphrased by Martin Fowler:

"….Expert developers' shared understanding of the system design

…

very much a social activity

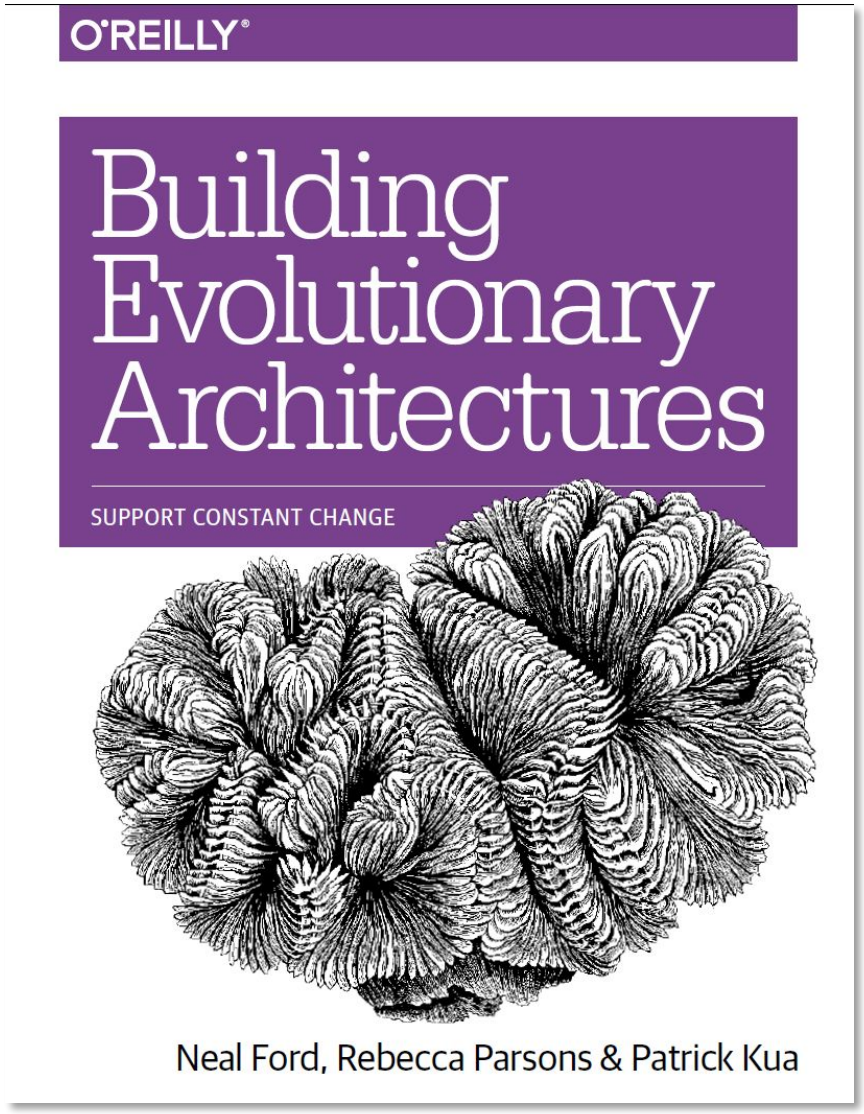
…

The set of design decisions that are hard to change

…

Which boils down to …."

Software Architecture is



"…….**the important stuff**

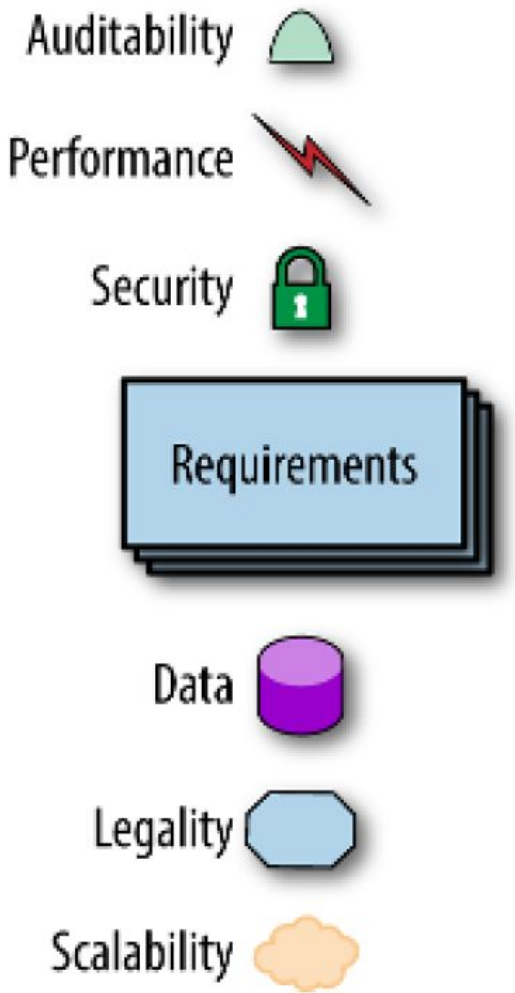
(whatever that is)….."

The architect's job is to understand and balance all of those important things (whatever they are)

…..

and to define and document in such a way that all involved understand it and do so in the same way

The important stuff



accessibility accountability accuracy adaptability administrability affordability agility auditability autonomy availability compatibility composability configurability correctness credibility customizability debugability degradability determinability demonstrability
dependability deployability discoverability distributability durability effectiveness efficiency usability extensibility failure transparency fault tolerance fidelity flexibility inspectability installability integrity interoperability learnability maintainability manageability mobility modifiability modularity operability orthogonality portability precision predictability process capabilities producibility provability recoverability relevance reliability repeatability reproducibility resilience responsiveness reusability robustness safety scalability seamlessness self-sustainability serviceability securability simplicity stability standards compliance survivability sustainability tailorability testability timeliness traceability

Architecture and Software Design

"....Architecture is the bigger picture: the choice of frameworks, languages, scope, goals, and high-level methodologies (Rational, waterfall, agile, etc.).

Design is the smaller picture: the plan for how code will be organized; how the contracts between different parts of the system will look; the ongoing implementation of the project's methodologies and goals. Specification are written during this stage…."

Architecture => Structure

Design => Structure and Meaning

The central question

How do we **define** and

communicate

this **structure** and

meaning

of the system (to be) build?

So what is (a) Software Design

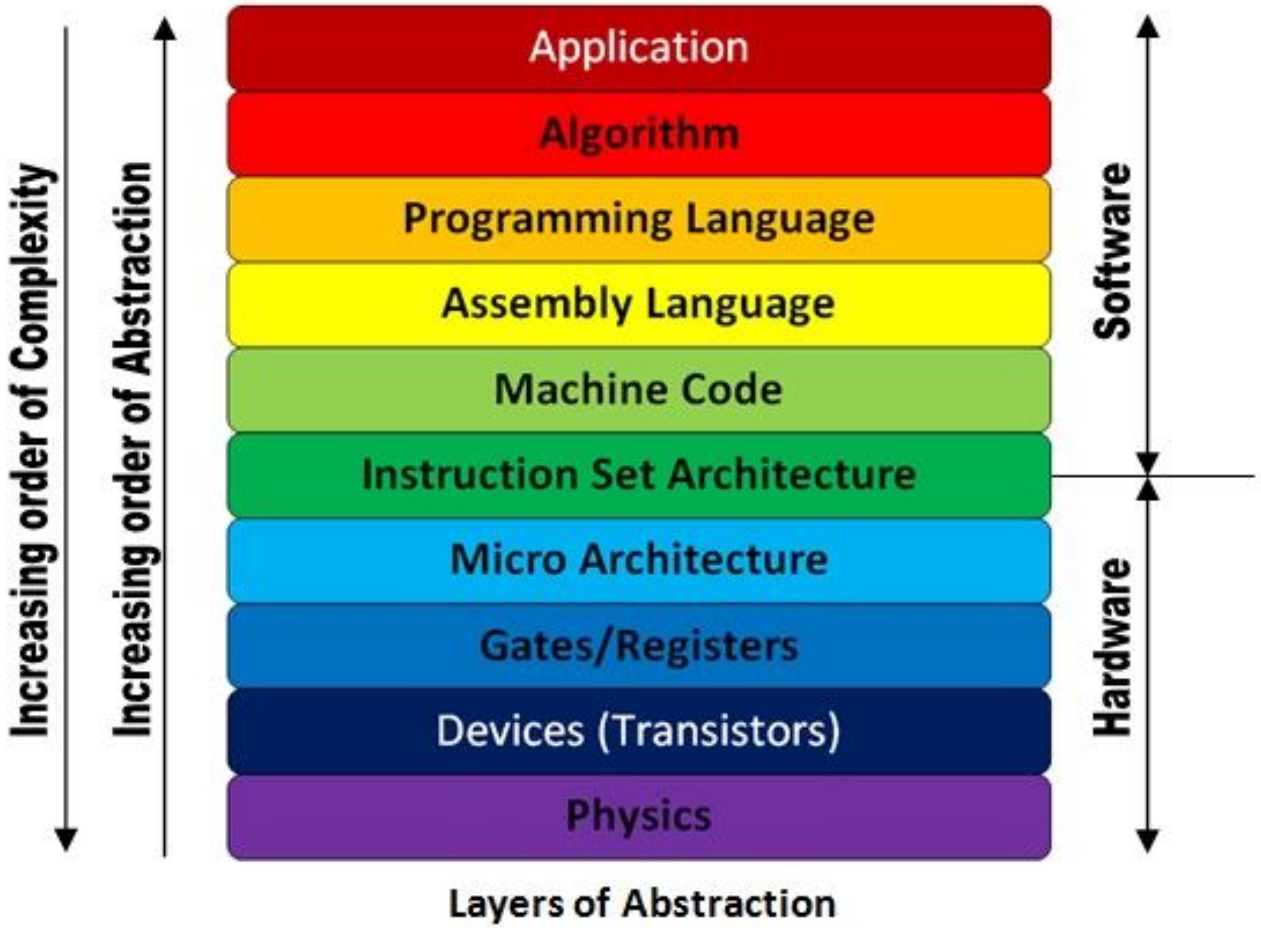
"...Software design is both a process and a model…"

- The design as a model is the "plan" of what to build
- It should define the structure of the code
- It should describe, make explicit, the functionality
- Using abstractions to arrange and reduce complexity

“...It's too abstract...”

- The imperative mind-set
- “...It's too vague…” or ”.. too abstract..”
- Mistake low-level imperative operations for exactness
- Every programming language, even assembler, is composed of high-level abstractions

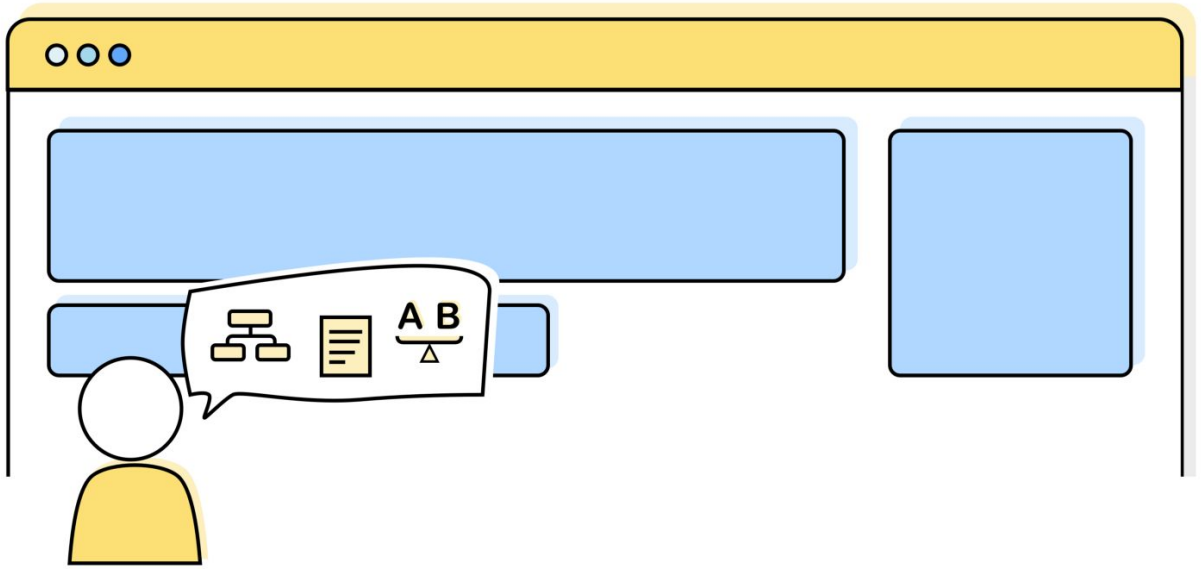
In computers, ALL is abstraction



The design

A software design is based on a composition of *abstractions*

(but what does that mean*?)*



Abstraction

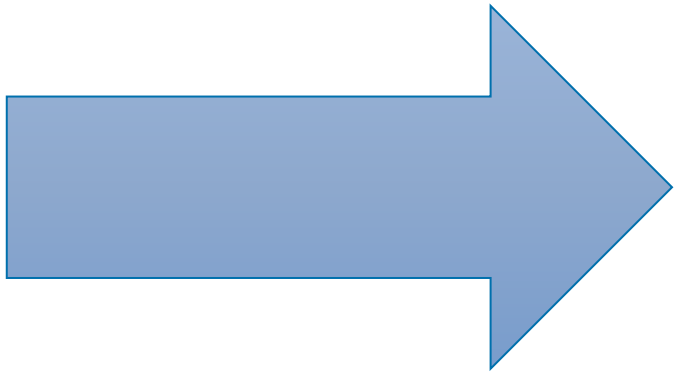
"...Being abstract is something profoundly different from being vague … The purpose of abstraction is not to be vague, but to create a new semantic level in which one can be absolutely precise…."

Edsger Dijkstra

How to express Abstractions

Depending the language

Types
Classes
Methods
Functions
Decorators
Attributes
Modules
Macros



Nouns, verbs and adjectives

(and ….Spells, Magical incantations, through macros and embedded languages or DSL. But that is for anot presentation)

Example abstractions

Structure

- Module
- Layer
- MessageBus
- Service
- WebPage
- File

Meaning (Functionality)

- Membership
- Account
- Sum
- Interest
- cashWithdrawal
- File
- Item
- increase
- demote

- ModelViewController
- Facade

Design Patterns

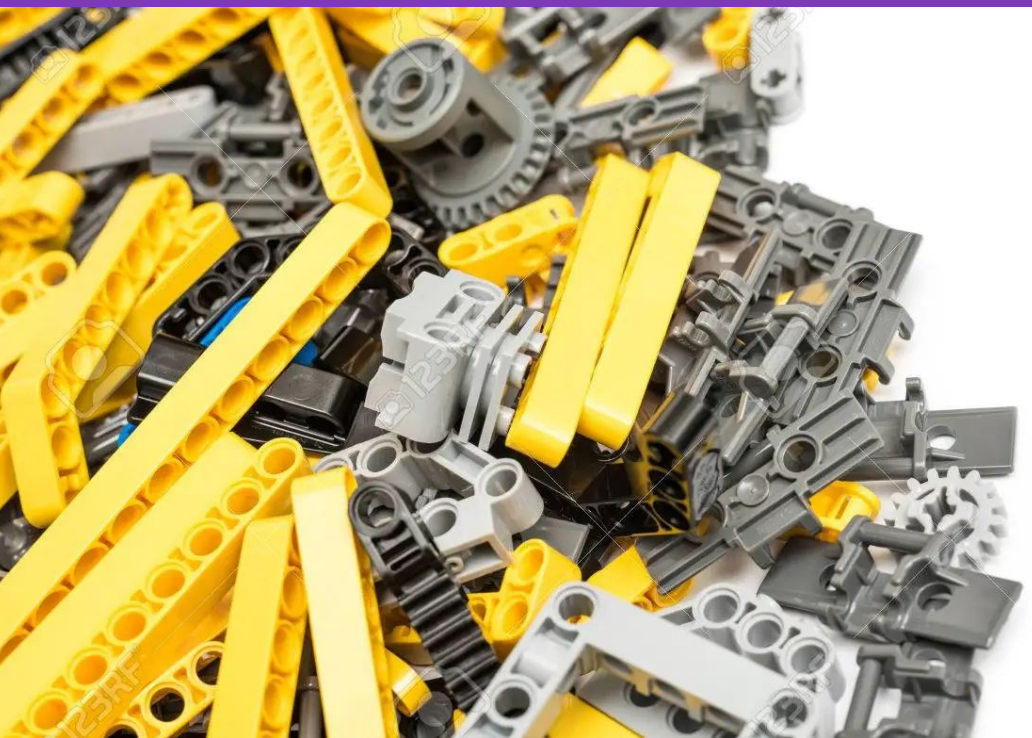
- Monoid
- Functor
- Monad

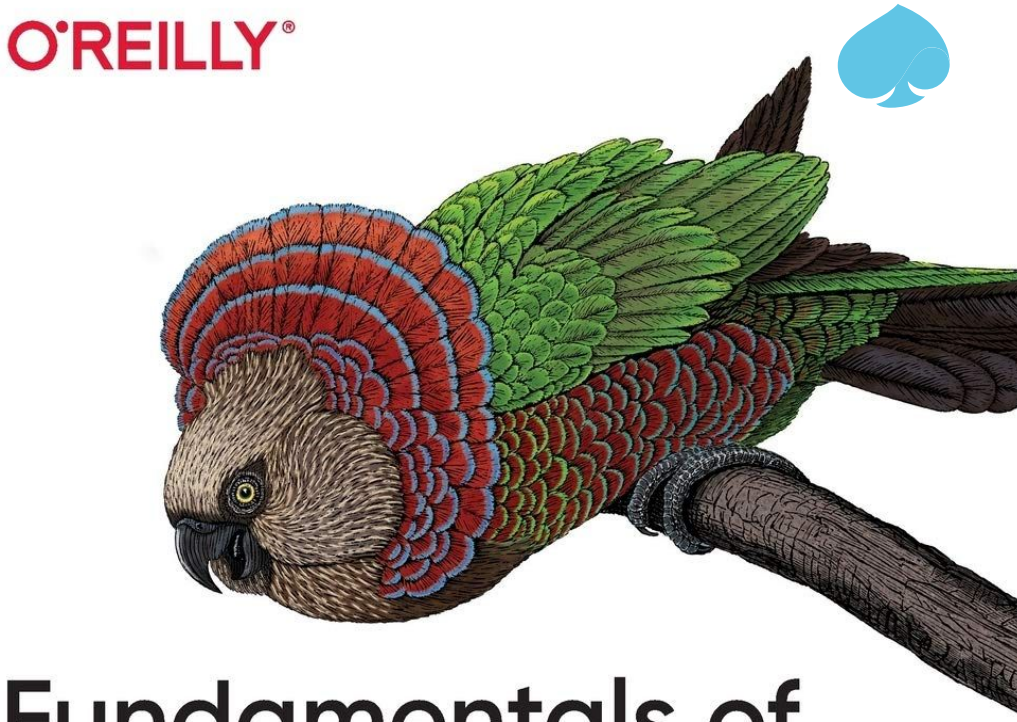
Category Theory

Don't overdo structure

It’s an engineering discipline…but…

You are not going to “build” physical objects. Focus on meaning and not on structure but do so using Engineering principles






Mindset
and
Practices

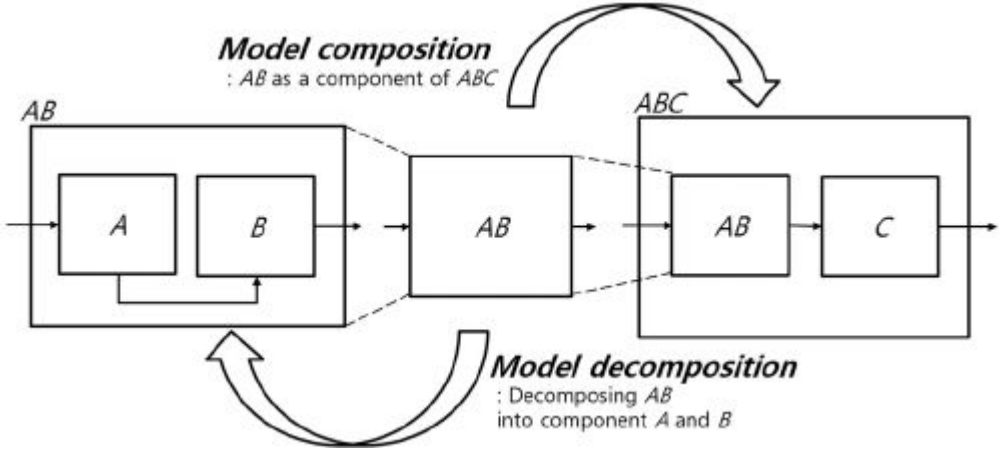
Software Design as Storytelling

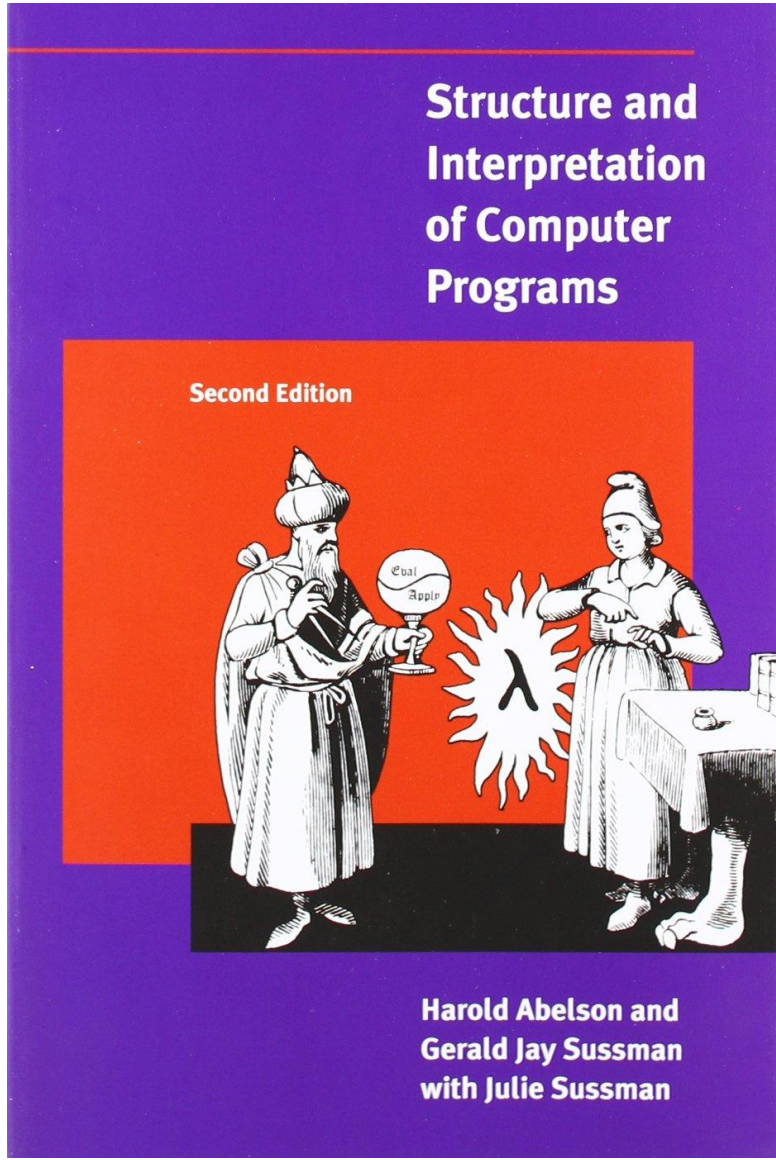
An abstraction can be created and combined with others to create a larger abstraction (**composition**). Once an abstraction needs to be detailed and specific it needs to be broken up in smaller components (**decomposition**).

This is the essence of programming….

This can be seen as a technical process. However, due to the intangible nature of software and modelling, it can actually be a linguistic process. Abstractions can consist of metaphors, similes, stories.

Software Design becomes a linguistic process. It becomes akin to telling a story.





So ……..

How do we **define** and **communicate** this **structure** and **meaning** of the system (to be) build?

By telling a story;
Software Design is
Storytelling with Abstractions

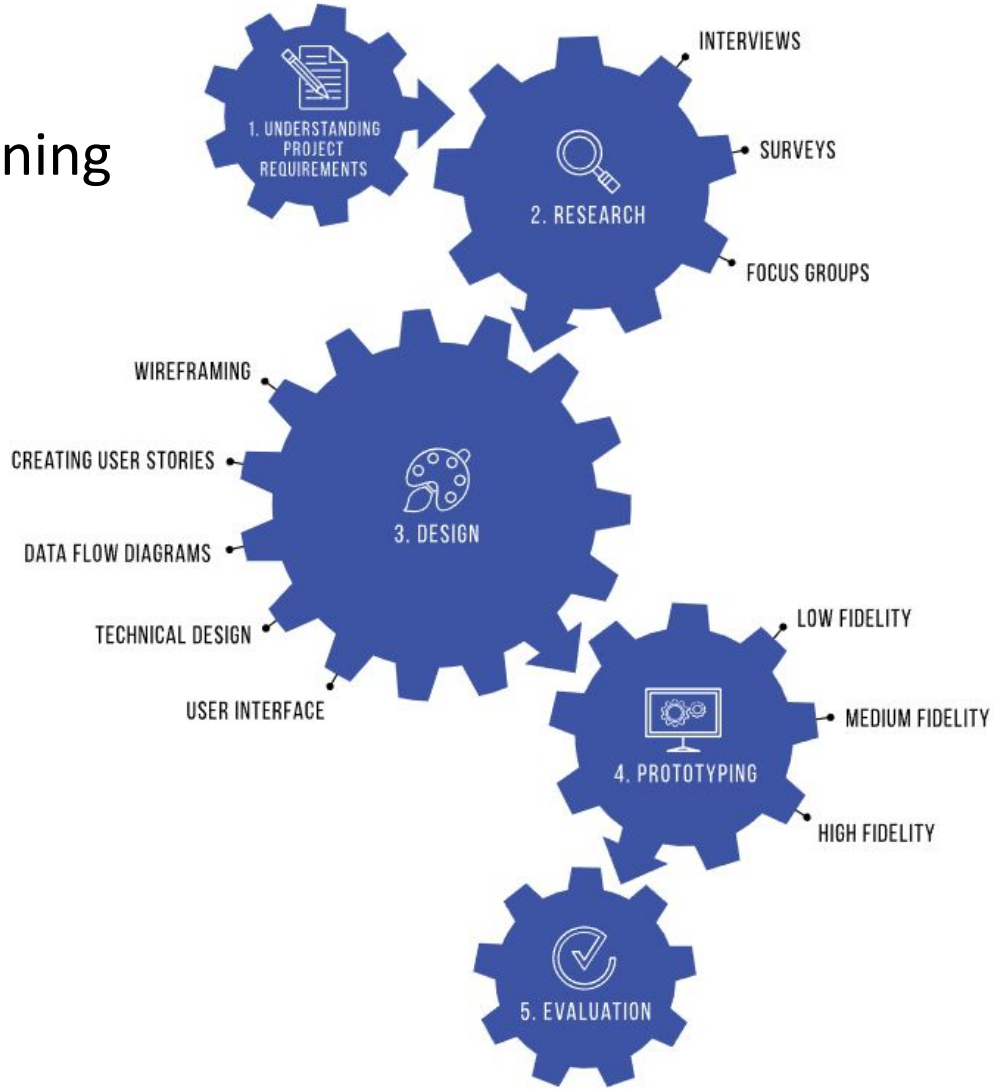
The design is relevant NOT the medium

Defining and communicate the structure and meaning of the system (to be) build

Telling WHAT to BUILD and HOW it WORKS

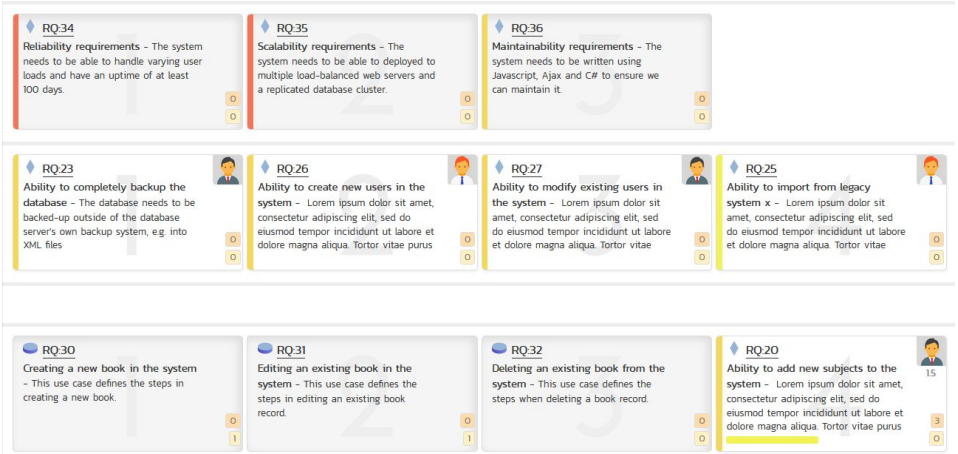
Create artifacts as diverse as:

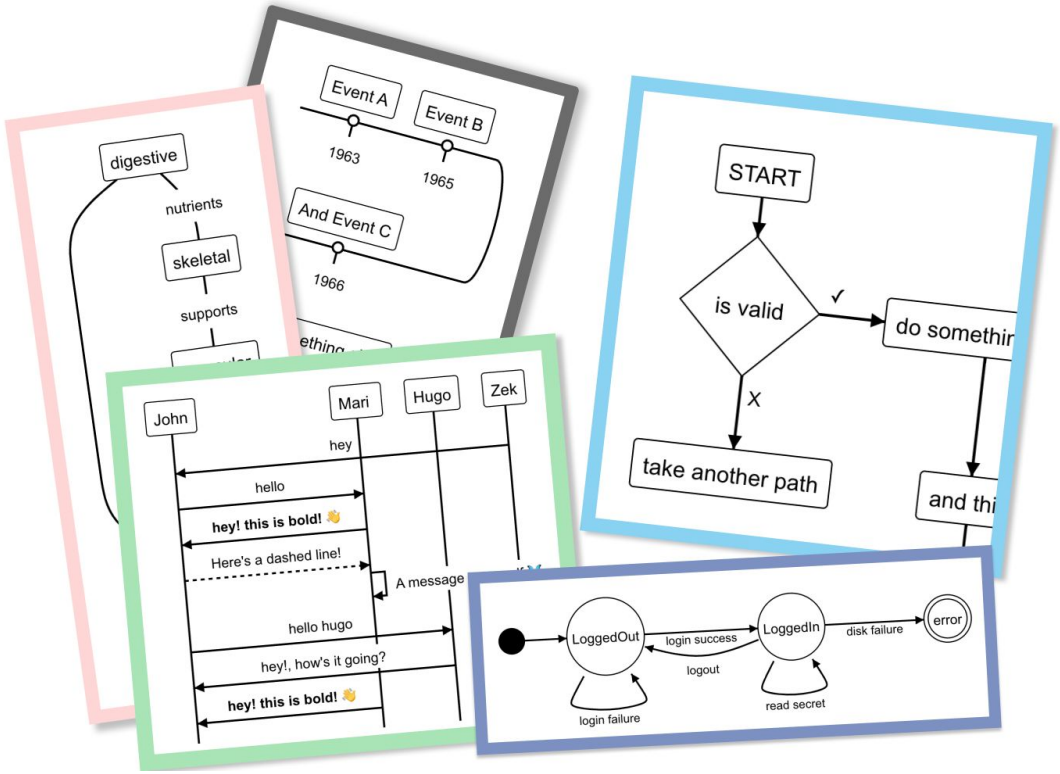
Wireframing
User Stories
Requirement Specs
Risk Logs
Prototypes (code, paper, etc)
Spikes (coding activity)
Type definitions (code)
Context Maps
Flow Charts
Sequence Diagrams
etc….



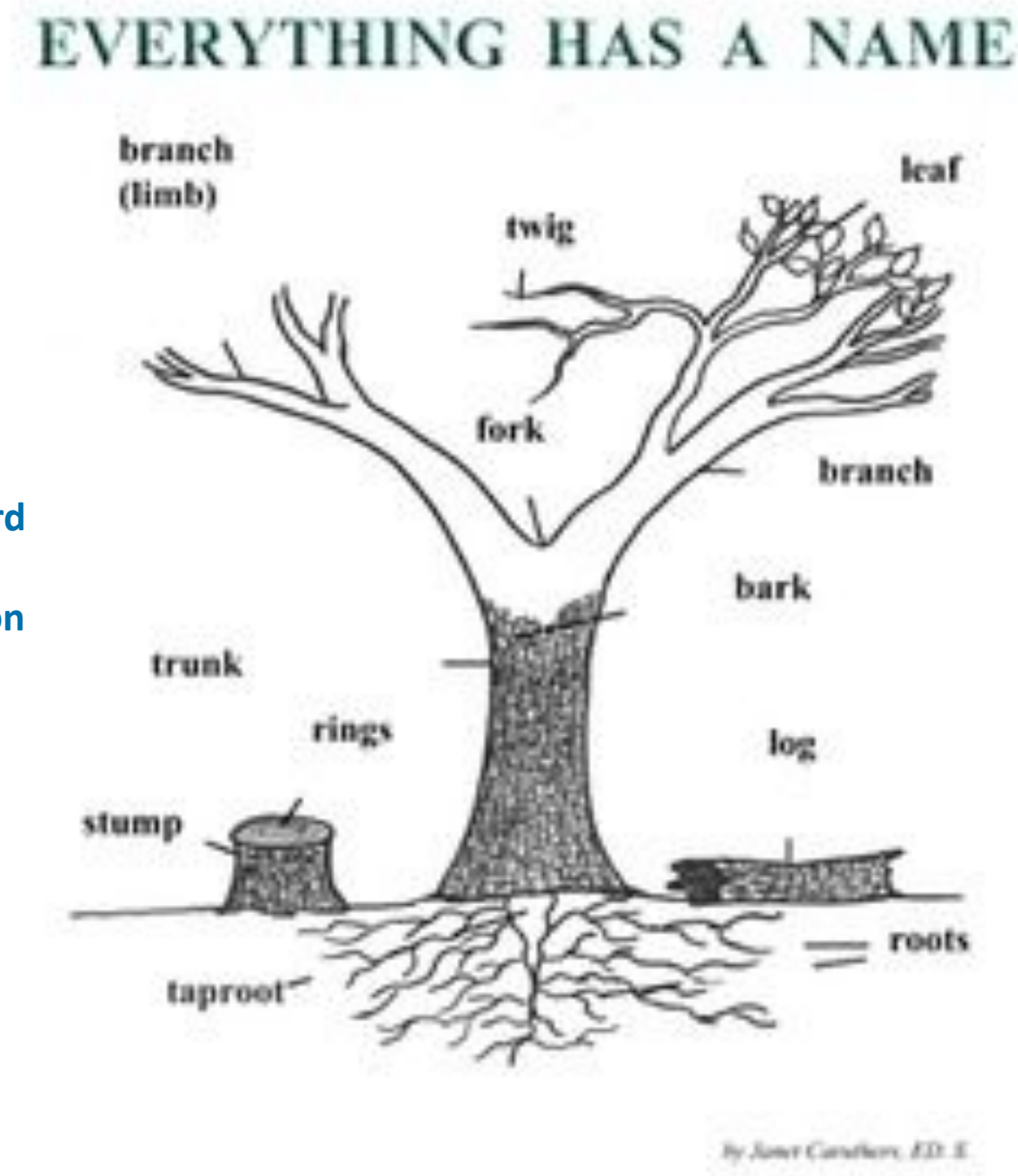
Telling a story with Text, Code & Diagrams

```python
from typing import List, Dict, Any

from agents import CoalitionAgent
from base import Coalition, Product
from communication import CoalitionAction


class MyCoalitionAgent(CoalitionAgent):
    PROD_TYPE_R1 = "r1"
    PROD_TYPE_R2 = "r2"

    def __init__(self, name: str, resources: float, products: List[Product]):
        super(MyCoalitionAgent, self).__init__(name, resources, products)

    def create_single_coalition(self):
        c = Coalition(self.products)
        c.set_agent(self, share={self.PROD_TYPE_R1:
                {
                    Coalition.PROD_CONTRIB: self.resources,
                    Coalition.PROD_VALUE: 0
                }
        })
        return c

    def state_announced(self, agents: List[CoalitionAgent], coalitions: List[Coalition]):
        super().state_announced(agents, coalitions)

    def do_actions(self, messages: List[CoalitionAction] = None):
        return []

```





Naming



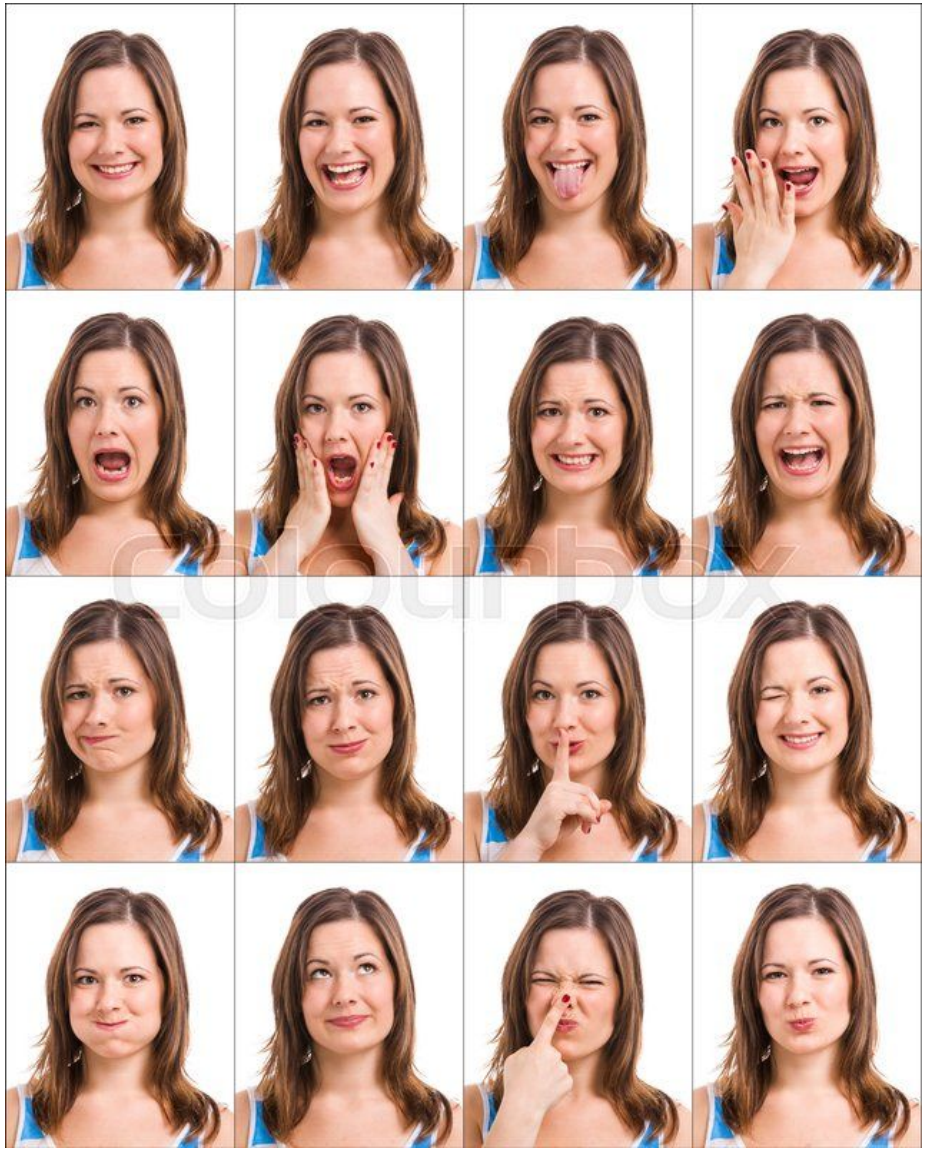
"...There are only two hard things in Computer Science: cache invalidation and naming things…"

Phil Karlton (Netscape)

"..If you consider programming to be a subset of writing, and I certainly do ……"

David Heinemeier Hansson (Ruby on Rails / Basecamp)

Simplifying for conciseness



Language and formulas

Gezelligheid (Dutch pronunciation: [ɣəˈzɛləxɛit] (listen)) is a Dutch word which, depending on context, can be translated as 'conviviality', 'coziness', 'fun'. In Spanish it can be translate by combining terms like ´acogedor´, ´convivencia´, or even ´calidez humana´, which can communicate its essence in specific contexts.

It is often used to describe a social and relaxed situation. It can also indicate belonging, time spent with loved ones, catching up with an old friend or just the general togetherness that gives people a warm feeling.

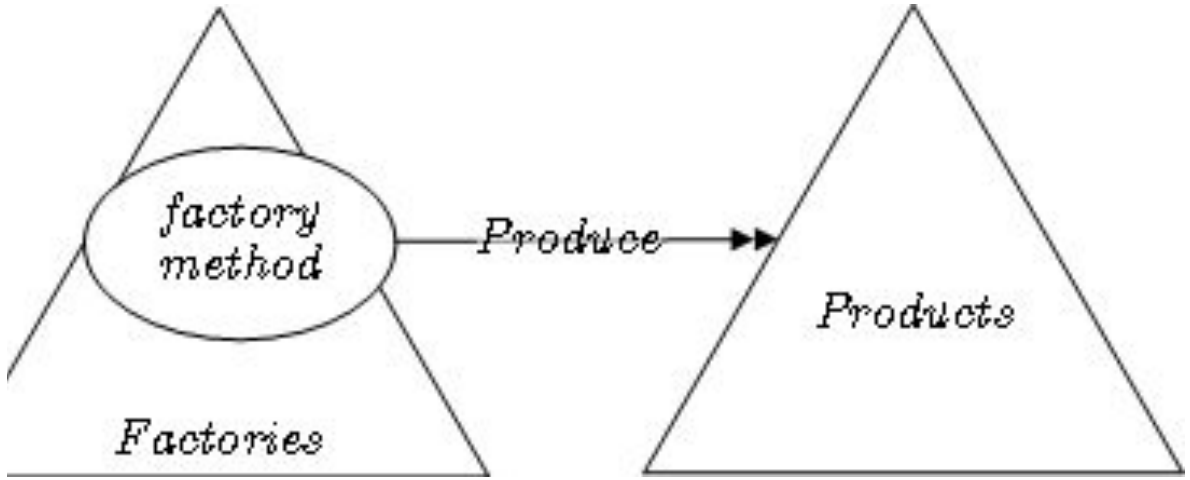
A common trait to all descriptions of *gezelligheid* is a general and abstract sensation of individual well-being that one typically shares with others. All descriptions involve a positive atmosphere, *flow* or vibe that colours the individual personal experience in a favorable way and in one way or another corresponds to social contexts.

Being a vague, abstract notion, the word is considered by some to be an example of untranslatability, and one of their hardest words to translate to English or Spanish. Some consider the word to encompass the heart of Dutch culture.[1]

$$F_g = G\frac{m_1 m_2}{r^2}$$

Metaphor


Factory
Abstract Factory
Strategy
Observer
Facade
Singleton
Adapter


factory method
Produce
Products
Factories

Abstraction: representing *and* hiding
State, Structure and Flow

state
structure
& flow

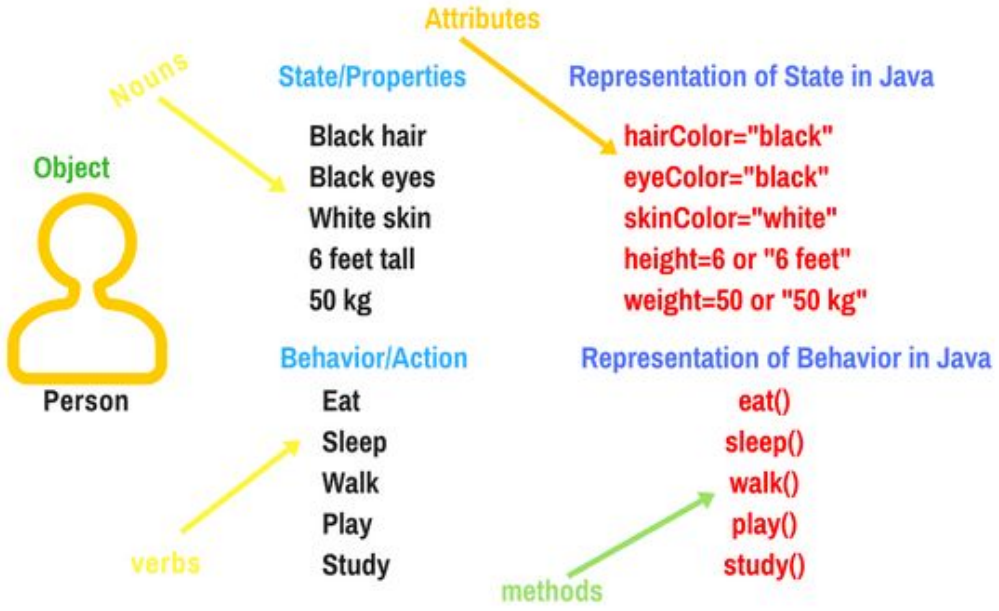
The *structure* of the code and in-memory representation.

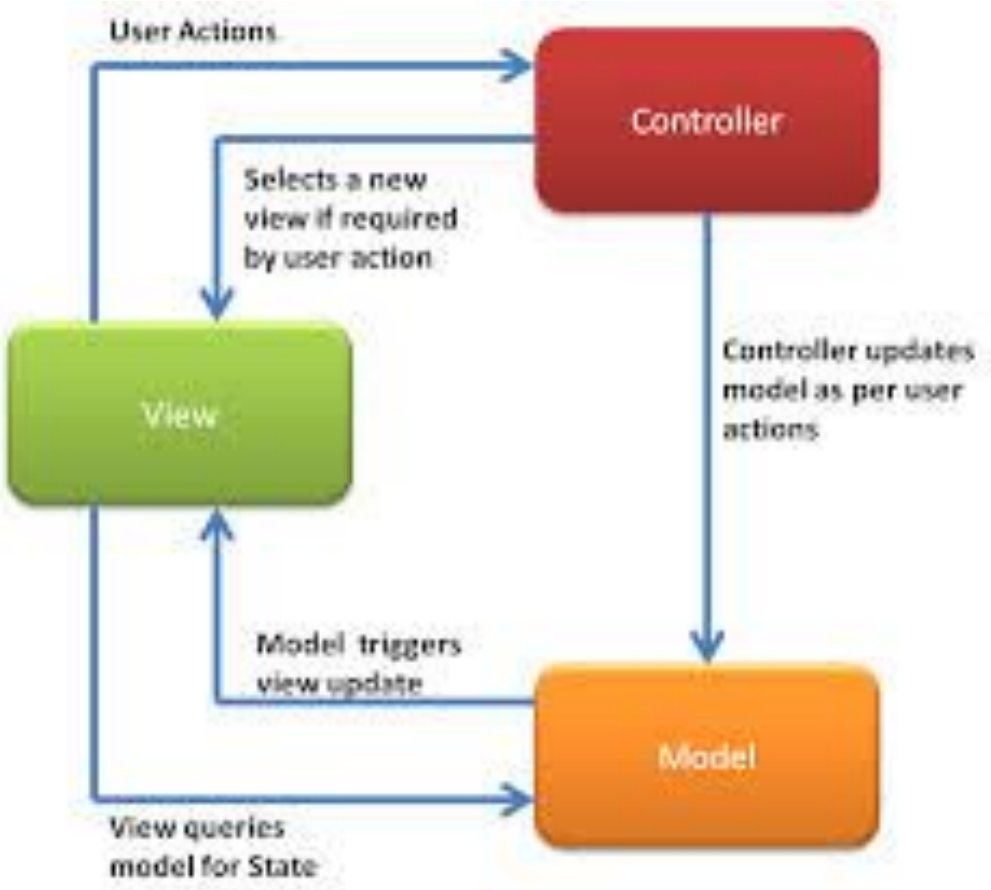
The *state* or particular condition that a program is in at a specific time. The total of all data in all variables in a particular system.

The flow or transition or transformation of one particular state to another.

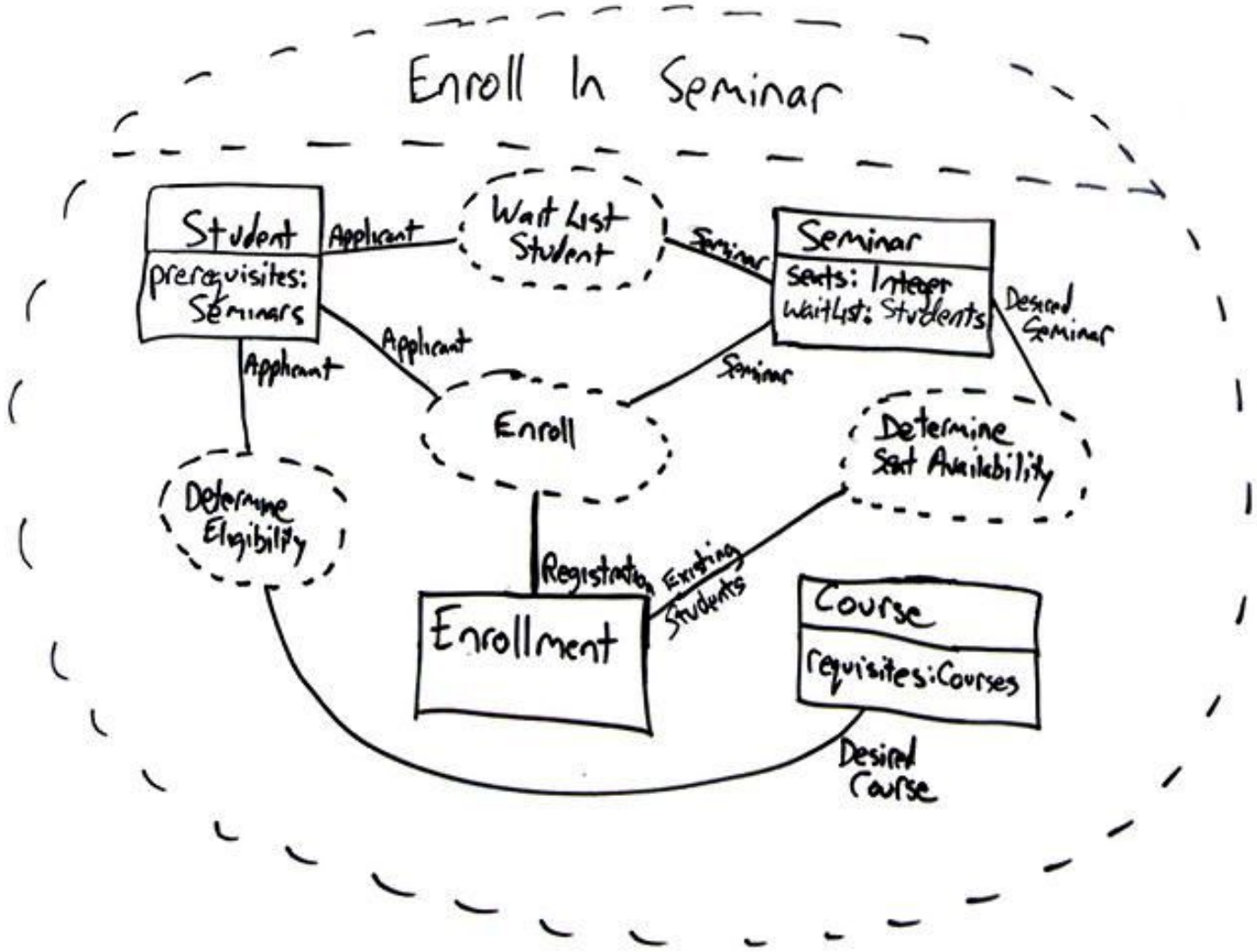
Examples: Queue, Stream, Workflow

Representing concepts, things, structure, behaviour





Software design: combining abstractions into larger units or components



Naming, composition:
try to read and write *stories*

```
let year = 2020
let bonus_ceiling = 5.5

try {
    let employees = db.exec("FROM EMPLOYEES SELECT * WHERE ACTIVE=1").toArray()
    for(let n=0; n < employees.count; n++){

        let employee = employees[n]
        let bonus = service.EmployeeAppraisal(employee.ID, year)
        if(bonus <= bonus_ceiling) {
            db.exec("UPDATE EMPLOYEES " +
                    "SET bonus = %d" +
                    "WHERE ID = %i", bonus, employee.ID)
        }
    }
} catch(error){

    throw error
}


// or
service.updateActiveEmployeesWith(bonus({year: 2020, ceiling: 5.5}));

//
service.updateActiveEmployeesWith(changeGlobalAddress);
```

Separation of Concerns

Separation of concerns is a principle for breaking up your program into sections so each of them does a single thing.

Each of your components (modules, classes, etc) should be a grouping of functions (methods, etc) that are related to a single task. Each of the functions in that component should do one thing and do it well. For example, in a User component, have a function to add a user, another to delete, etc. By separating things logically you make them more dependable, portable, and flexible. You reduce dependencies across your components that otherwise would make debugging a nightmare.

Do one thing and do it well.

Compose existing abstractions rather than inventing your own

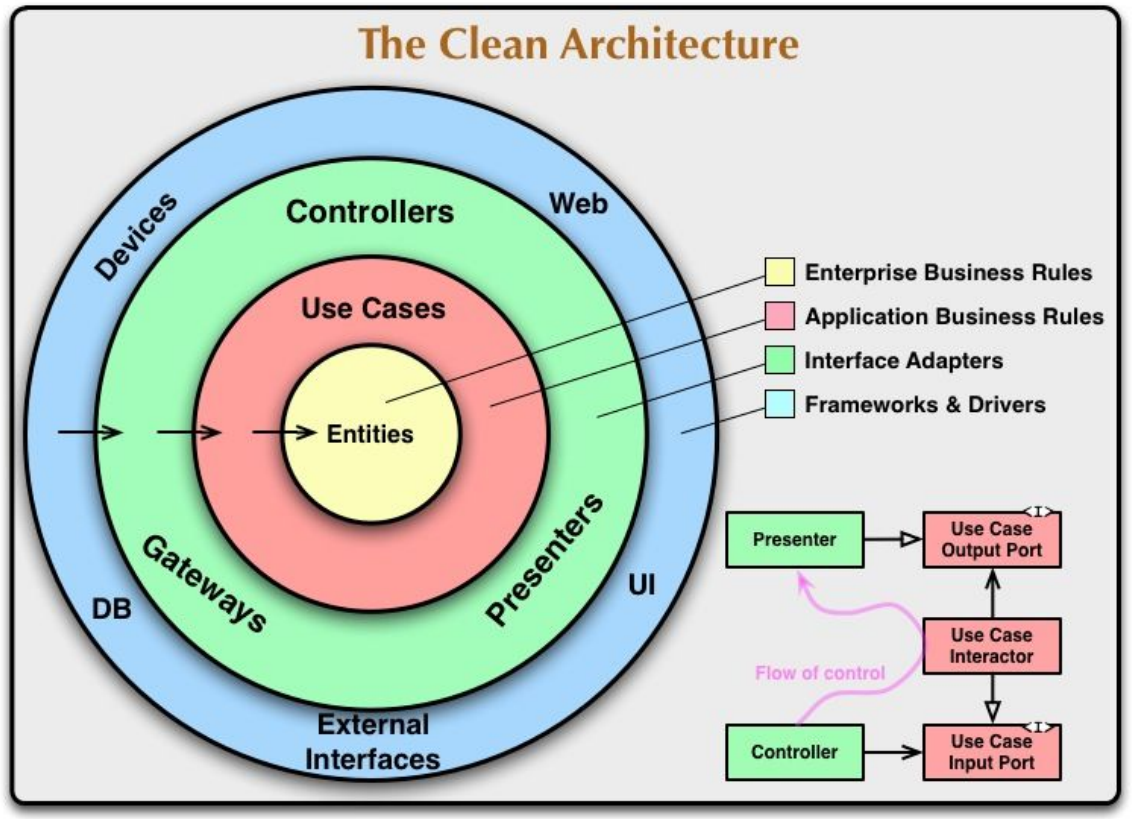
Pick and choose existing abstractions, libraries, frameworks

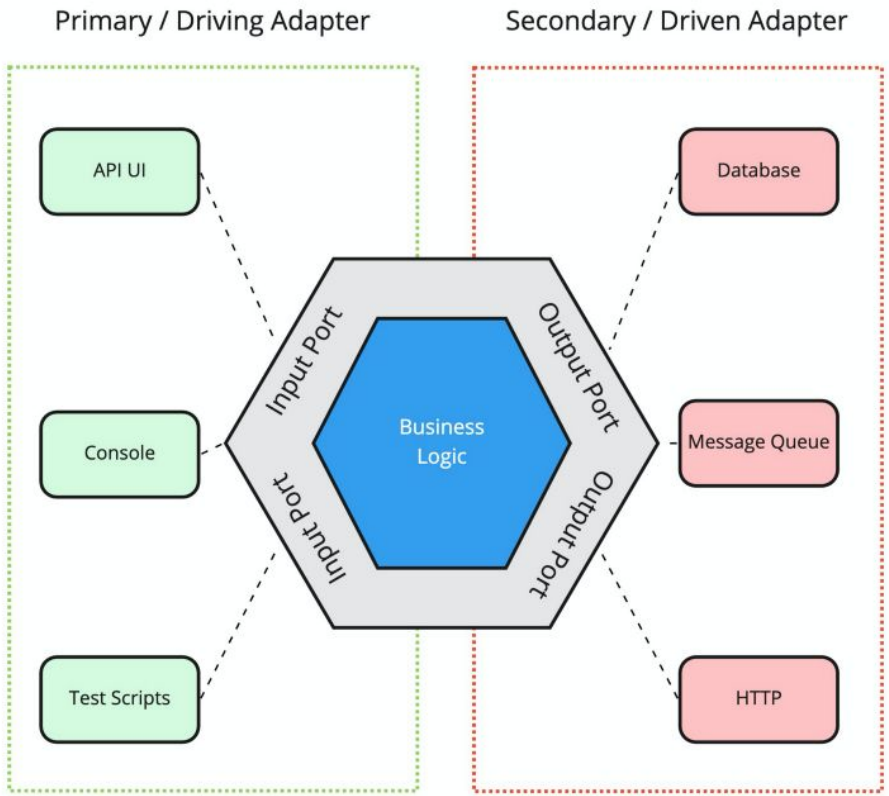
Design your code when a design is lacking but don't try to be an “Architect”.

“Architecture” is a big upfront expense and difficult to get right.

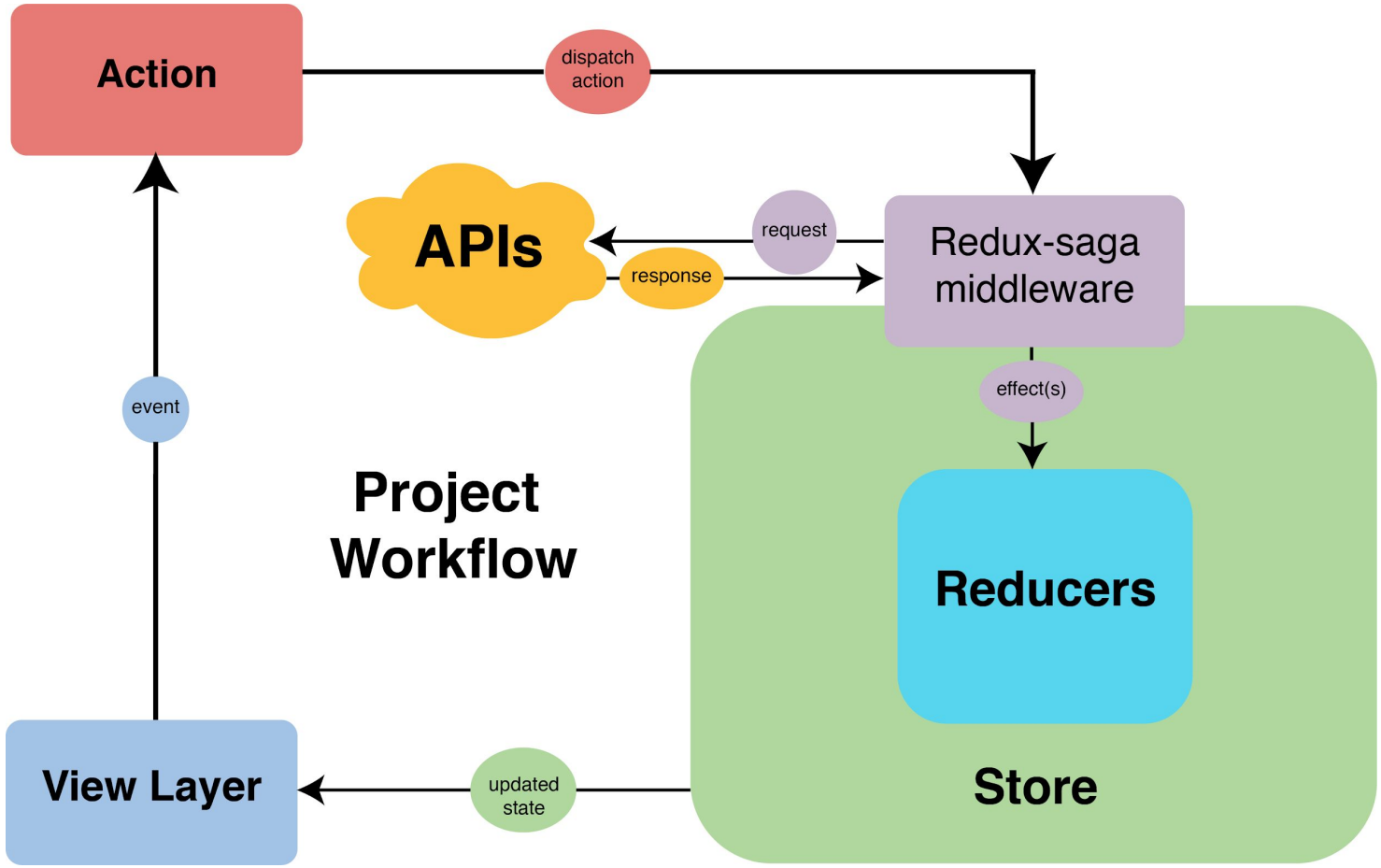
So use an existing architecture or framework which defines how should be structured.

Use existing Architecture design models (for example Clean or Ports and Adapters)





Use existing component architectures (for example React / Redux)



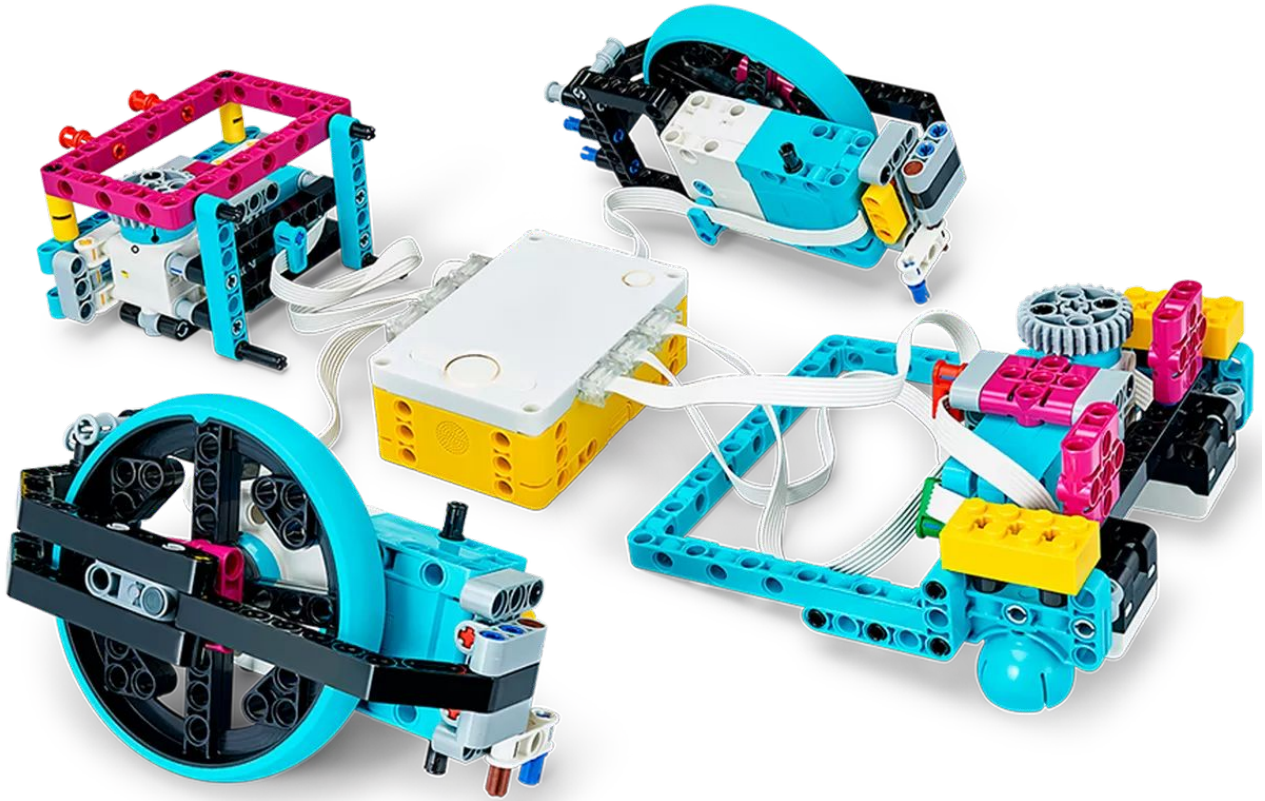
Don't “Program”. Or at least postpone it as long as possible But do use ¨Code¨

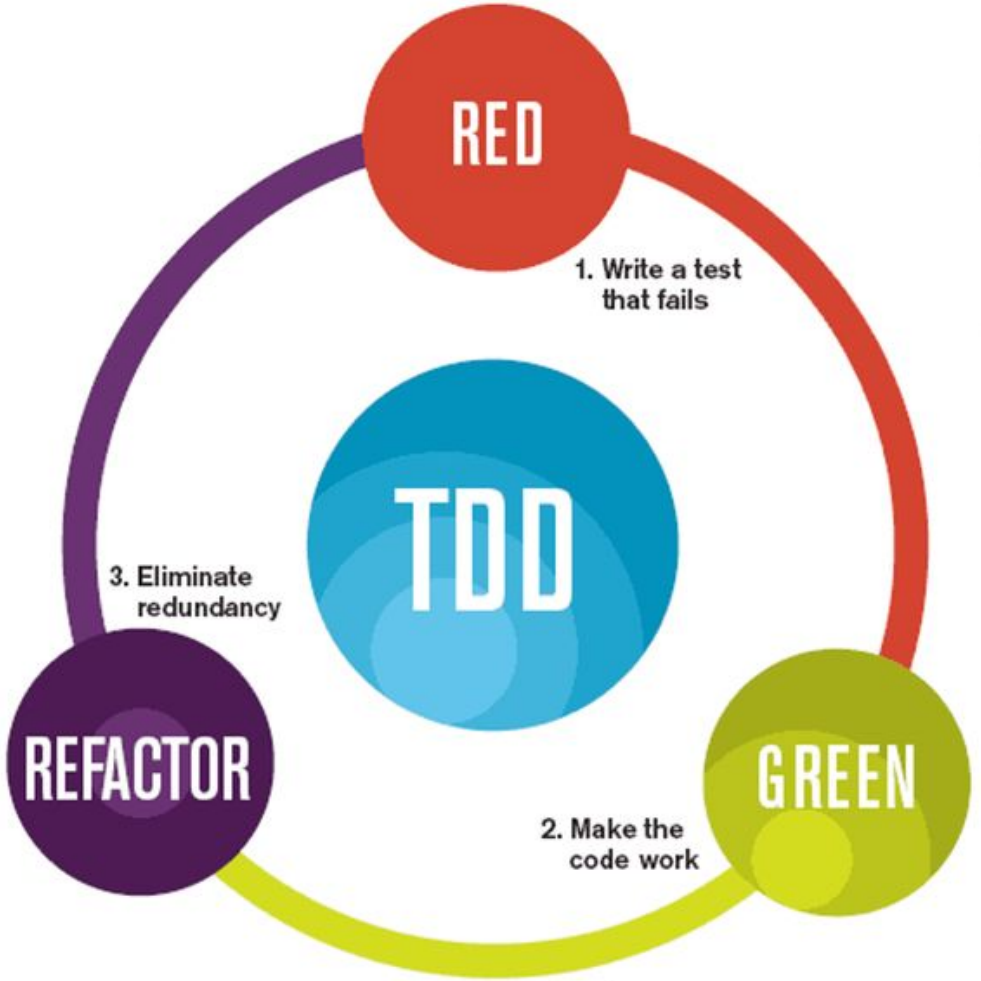
- Use “off the shelf” products
- Configure
- Design
- Implement Stories
- Use libraries

“programming” is expensive (time, effort) and error prone

Code to test, to investigate, to play around, to design

Code to experiment, test, prototype to gain knowledge and take away uncertainty





The mantra of Test-Driven Development (TDD) is "red, green, refactor."

Code prototyping / Type Driven Development example

Flash sales, left-over sales, launch day sales, holiday sales and limited inventory sales are all high volume, high velocity events. Here we call them ¨Markets". The following User Stories help to define the general scope:

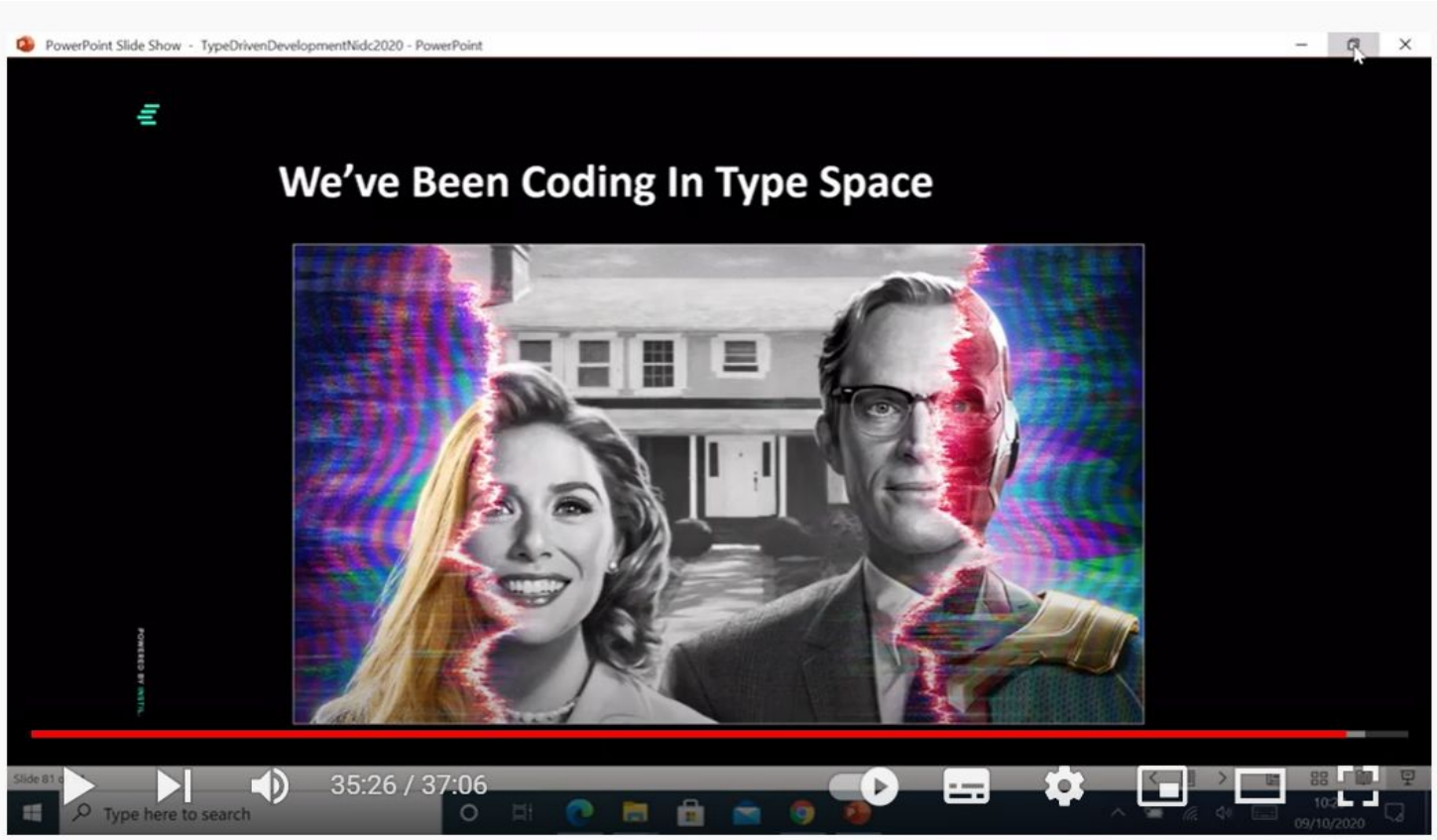
As a client of a market I want to receive a notification so I can bid for items temporarily available on that market

As a client I want to receive a notification whether a bid for an Item has been overbid so I can make a counter bid if so required

As a Client I want to receive the final status of a bid so that I can arrange for the post-sale process (etc)

```
type AvailableItemsHandler = fn(_:[&Item]);
type ProcessedBidHandler = fn(_:&Bid, _:BidStatus);

enum BidStatus {
    OverBid = 0,
    Canceled,
    Succeeded
}

trait Market {
    fn register_bid(_:Item, _:Bid);
    fn notify_available_items(_:AvailableItemsHandler);
    fn notify_bid_action(_:ProcessedBidHandler);
}

struct FleaMarket {

    bids: Vec<Item>
    //... more data
}

impl Market for FleaMarket {

    fn register_bid(item: Item, bid: Bid) {  /* code here */ }
    fn notify_available_items(handler: AvailableItemsHandler){  /* code here */ }
    fn notify_bid_action(handler: ProcessedBidHandler){/* code here */ }
}
```

Use code to define, ¨Type¨, to design data models, interfaces, functions etc

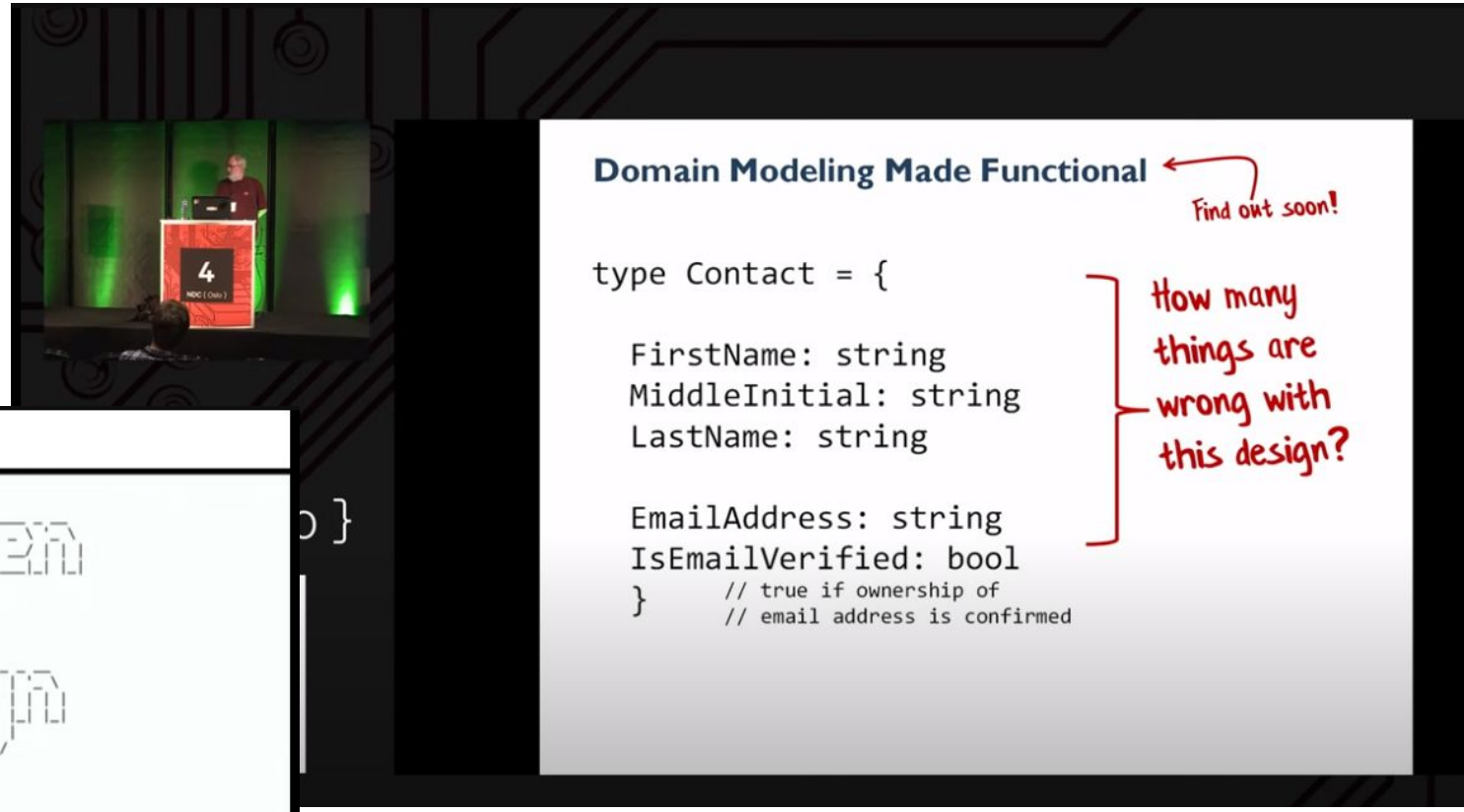


Not Your Mother's TDD: Type Driven Development in TypeScript - G Gilmour & R Gibson - NIDC2020

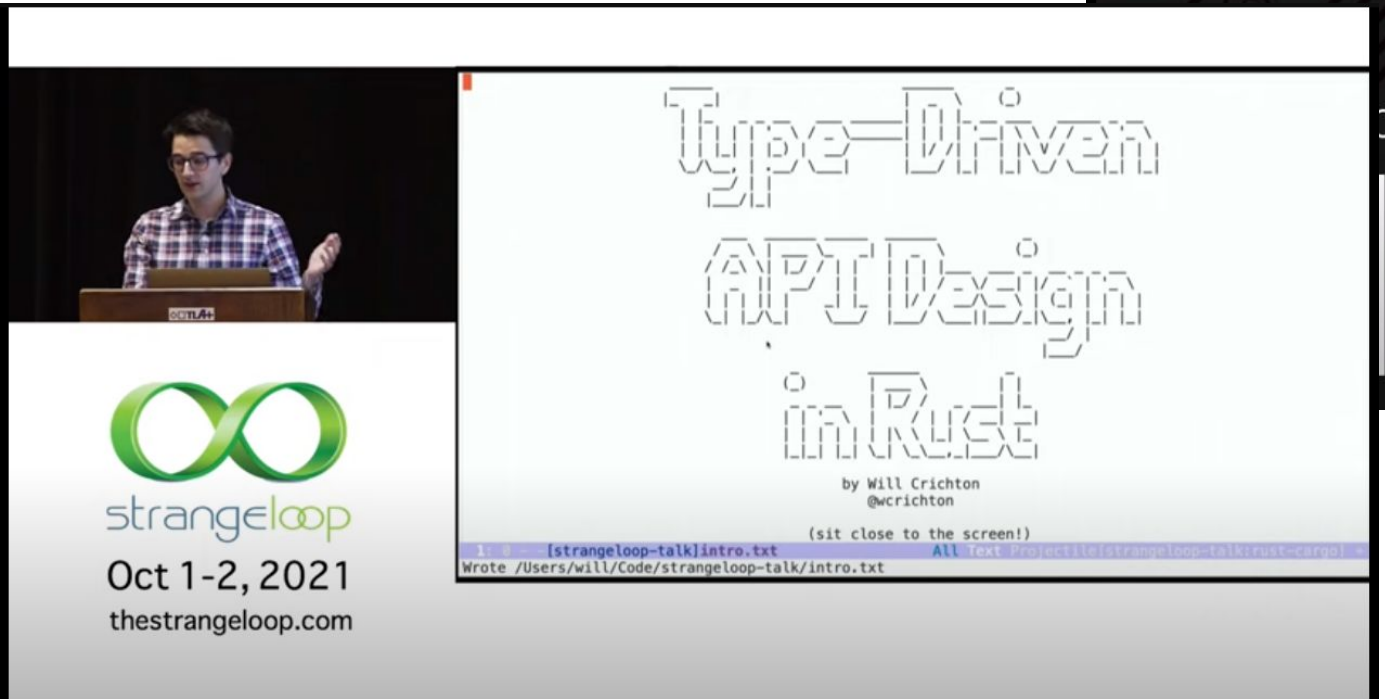
https://youtu.be/YidUm-CO9kk

https://www.slideshare.net/ggilmour/type-driven-development-with-typescript

Type Driven Design



"Type-Driven API Design in Rust" by Will Crichton
https://youtu.be/bnnacleqg6k



Domain Modeling Made Functional - Scott Wlaschin
https://youtu.be/Up7LcbGZFuo

Get, grasp, grok, understand the problem and the solution

It is critical that you fully understand the underlying architecture, concepts, patterns in order to be able to use them competently. **At the level of the abstractions, not the "internals".** In order to be able to drive a car you need to know the mechanics of driving and the traffic rules, not the internals of the car engine….

And when you Code, it should tell the story, reflect the Design

But….

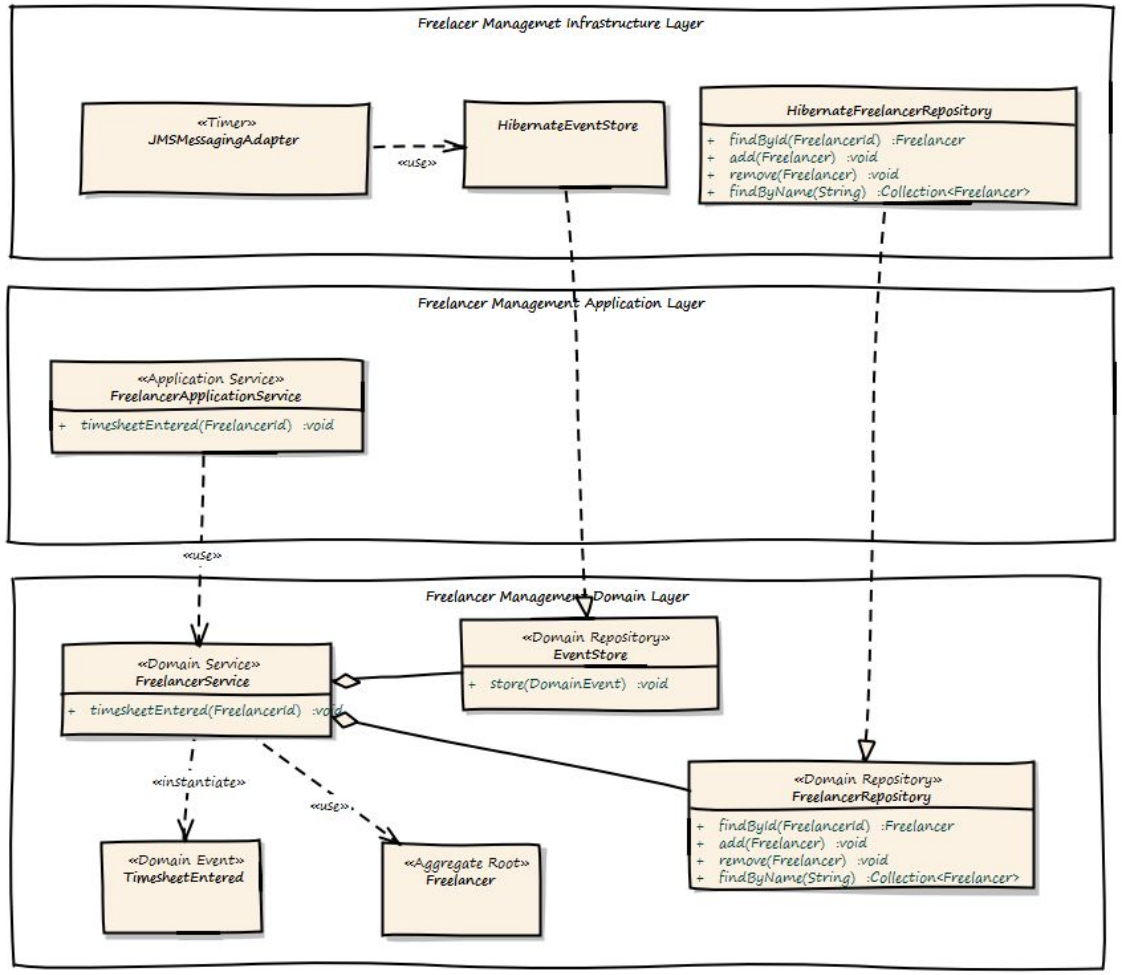
- Not all people find textual representation readable for all aspects of the design (especially relationships)
- Most programming languages cannot adequately express the whole software design satisfactorily - their syntax is not sufficiently expressive, flexible or extensible enough to viably communicate the wider architecture concerns
- We therefore reach for models and diagrams, representing the code

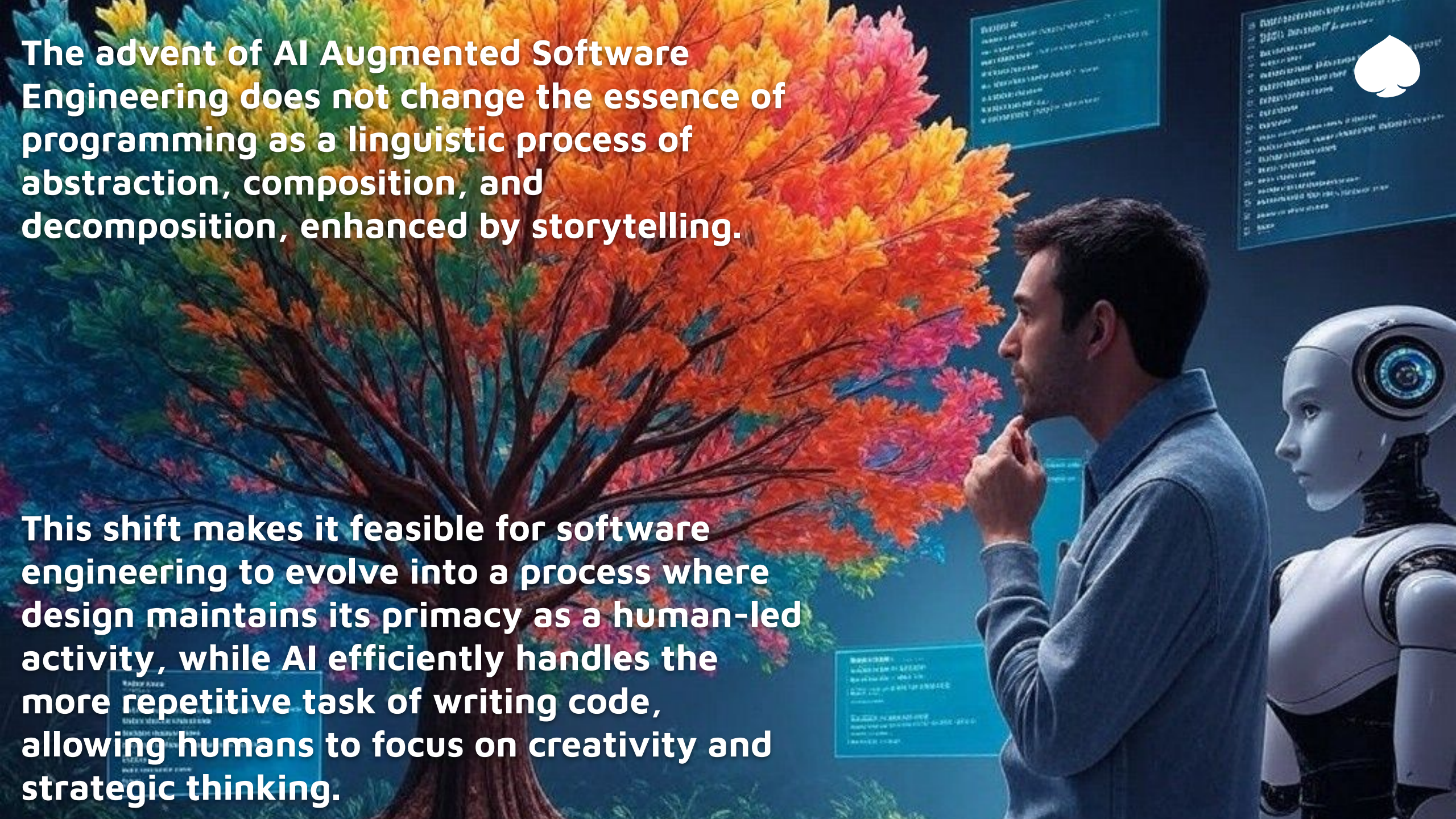
Draw it; model it.
But trace it back to the code

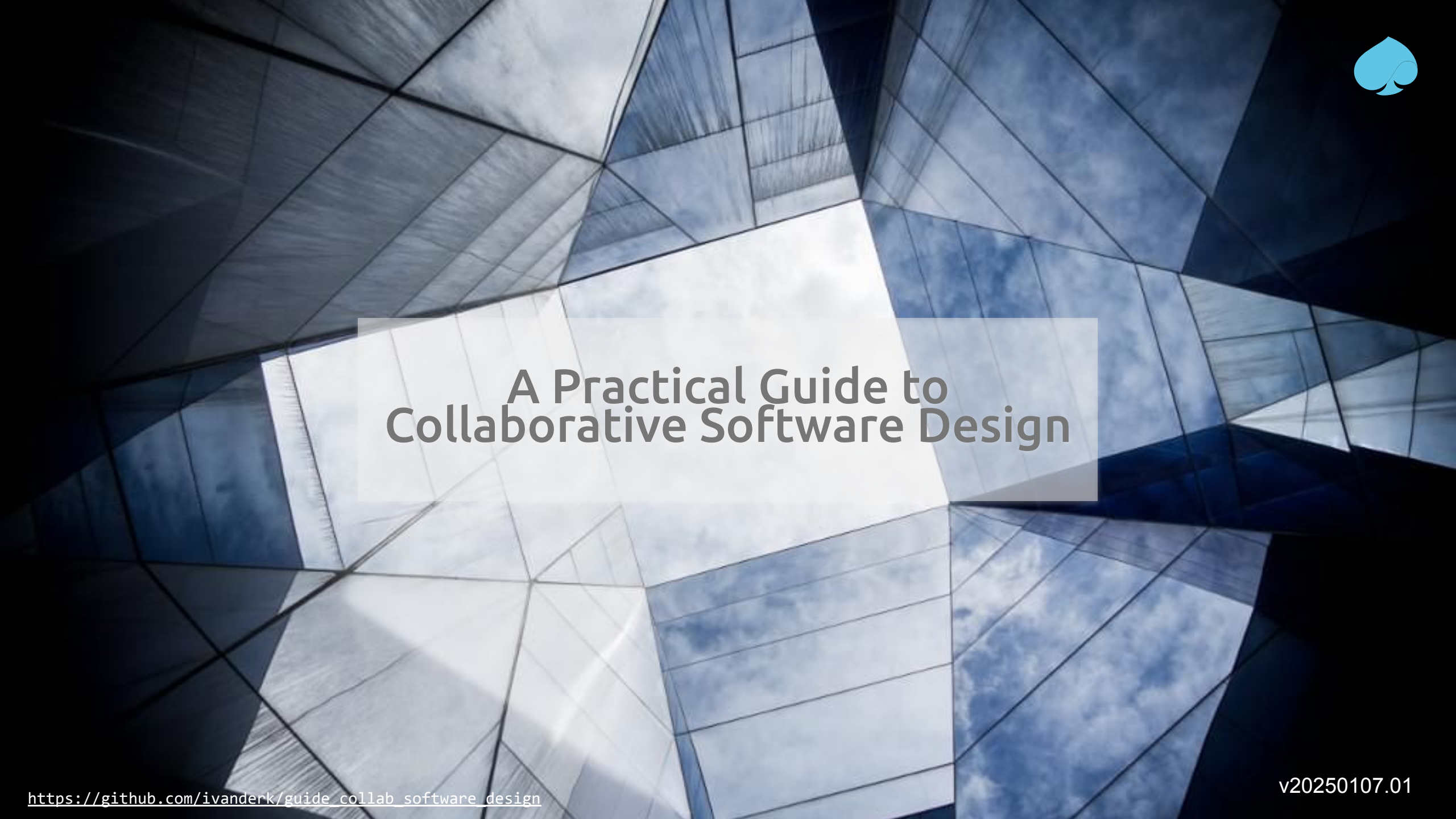
If you cannot draw a system or component you probably have not been able to proper model it; or did not think enough about it.

You can use any modeling methodology but the more important thing is conveying meaning in a concise and clear way.

The structure of the architecture and your code should be directly mapped to the model and vice versa.




The advent of AI Augmented Software Engineering does not change the essence of programming as a linguistic process of abstraction, composition, and decomposition, enhanced by storytelling.
This shift makes it feasible for software engineering to evolve into a process where design maintains its primacy as a human-led activity, while AI efficiently handles the more repetitive task of writing code, allowing humans to focus on creativity and strategic thinking.



A Practical Guide to Collaborative Software Design

https://github.com/ivanderk/guide_collab_software_design

v20250107.01

Summary session 1

Overview
Session 1 introduces software design as a collaborative, narrative-driven process rooted in abstraction and storytelling. It emphasizes that software engineering should be treated as both a craft and a culture, focusing on human-centric design principles. Key elements include:

Philosophy:

- Software design is a process of creating and communicating a system's structure and meaning.
- It integrates user experience (UX) as an inseparable part of the design process.
- Design is defined as both a process and a model, balancing abstract and concrete elements.

Key Concepts:

- Architecture vs. Design: Architecture addresses high-level decisions (frameworks, methodologies) while design focuses on organizing code and defining relationships.
- Abstraction: Abstract representations reduce complexity, forming the backbone of programming and design.
- Storytelling: Software design parallels storytelling, where abstractions convey meaning and guide implementation.

Practices:

- Prioritize existing architectures and frameworks to minimize complexity.
- Use abstraction effectively, ensuring precision rather than vagueness.
- Represent concepts visually through diagrams, ensuring traceability to code.

Recommendations:

- Treat programming as a linguistic process, combining abstraction and composition.
- Postpone programming specifics by focusing on high-level design and prototypes.
- Adopt modular and testable structures with clear separation of concerns.

1 Architecture and Software Design

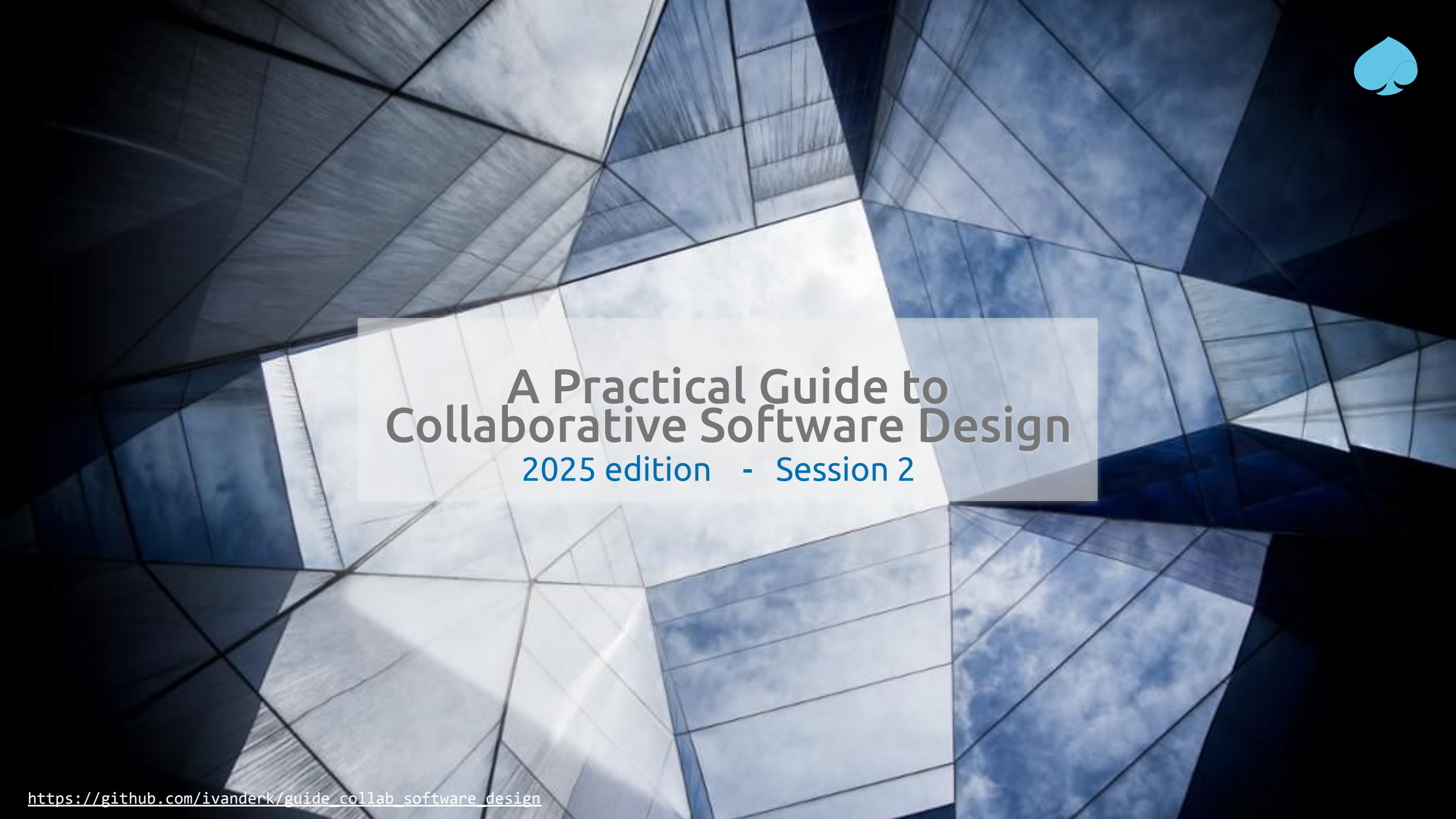
2 Mindset and practices

3 Models

4 How to Design

5 Next Steps &
Further reading and viewing…

Next Session



A Practical Guide to Collaborative Software Design

2025 edition - Session 2

https://github.com/ivanderk/guide_collab_software_design

1 Architecture and Software Design

2 Mindset and practices

3 Models

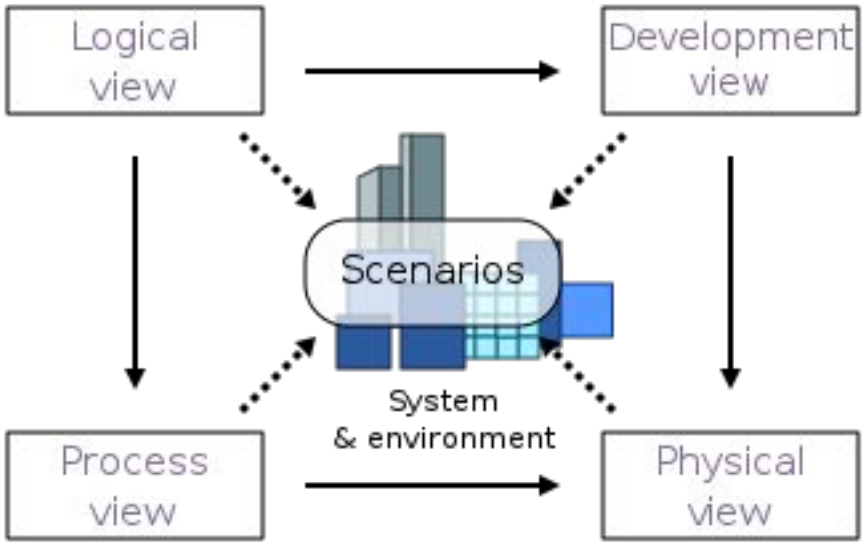
4 How to Design

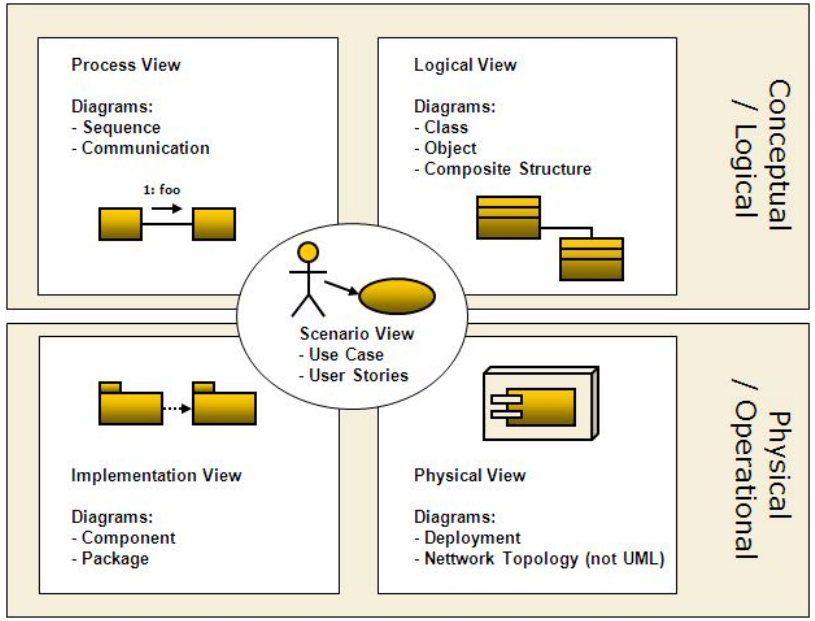
5 Next Steps &
Further reading and viewing…

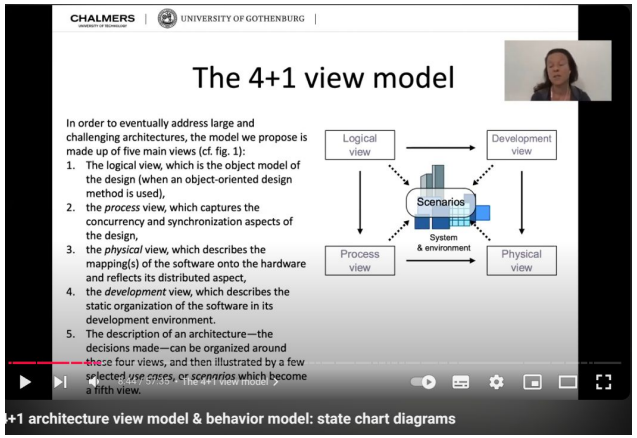
Today


Models

We can create models using existing paradigms like the 4+1 architectural view model



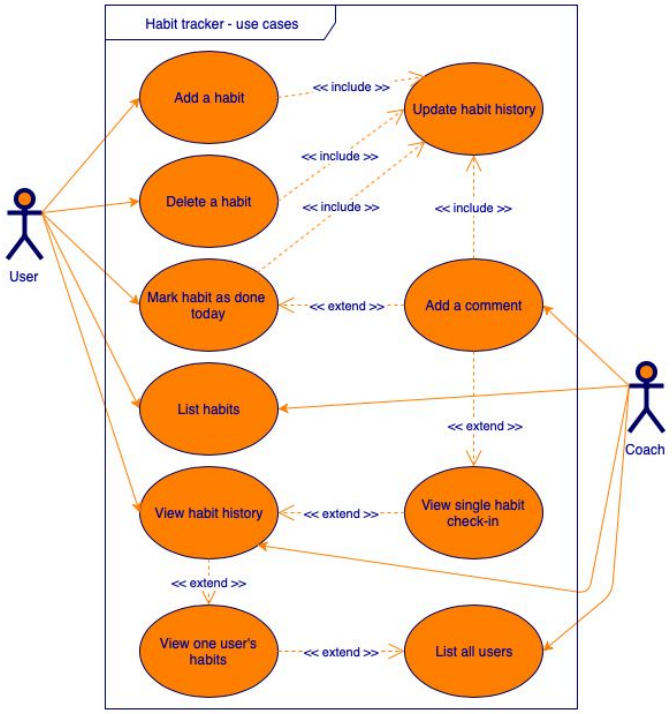




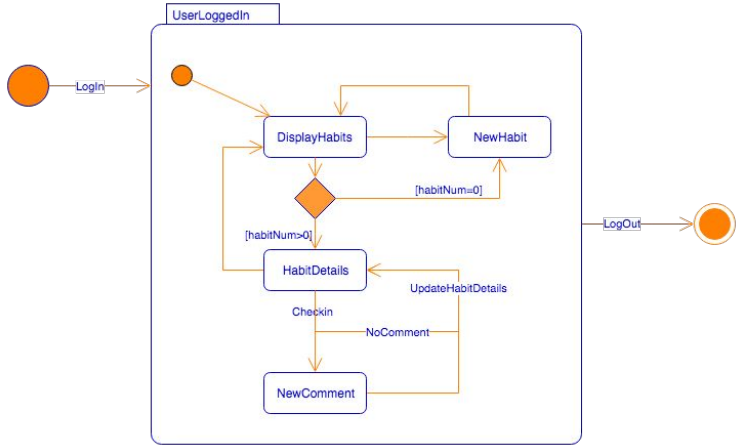
https://arxiv.org/abs/2006.04975

https://youtu.be/r8ucofiI8vY

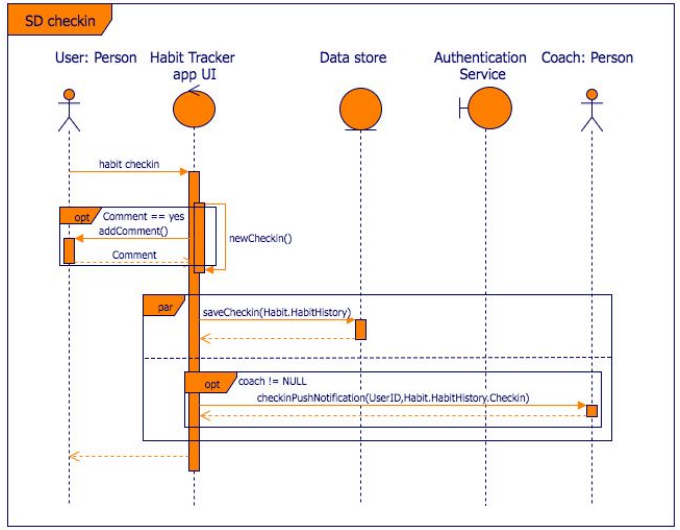
Unified Modeling Language (UML)



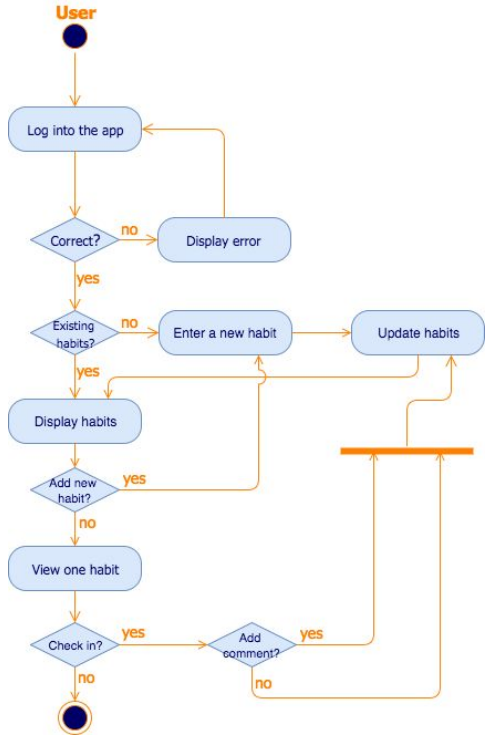
Use case diagram



State diagram



Sequence diagram

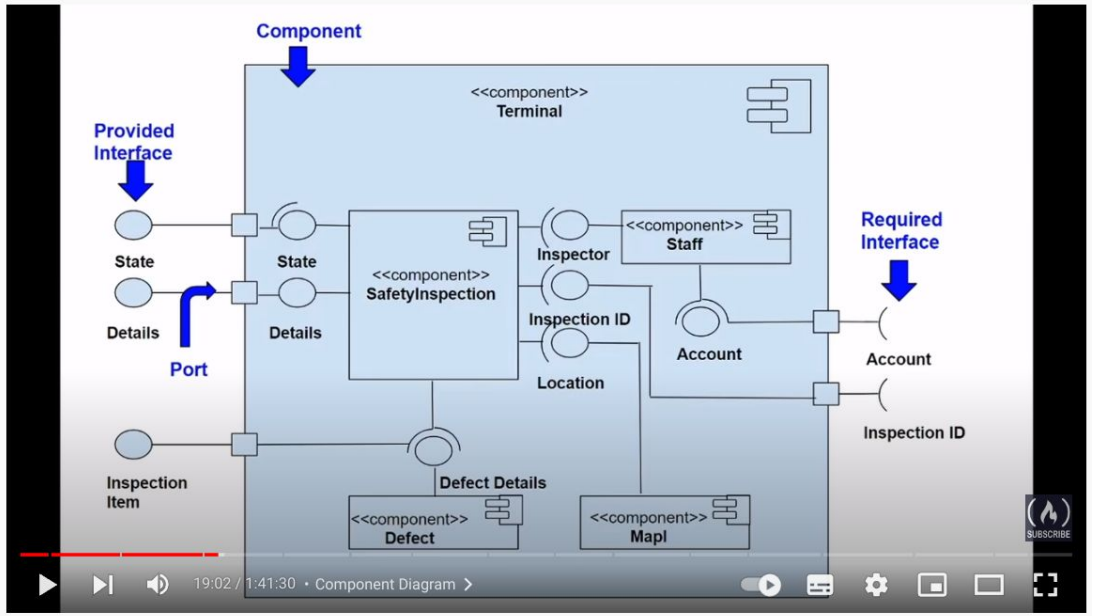


Activity diagram

https://drawio-app.com/uml-diagrams/

Unified Modeling Language (UML)

- Standard notation
- Good variety in diagrams
- Great tool support (see PlantUML for usage in VSCode)



UML Diagrams Full Course (Unified Modeling Language)

https://youtu.be/WnMQ8HlmeXc

But…

- Low level
- Limited expressiveness (needs OCL)
- Too complex
- Not very suitable for programming paradigms which are not “OOP”
- “Nobody uses UML”
  - Associated with “Big Design up-front”, “Waterfall”
  - Not being taught at University anymore

As many diagram types as there are designs

Google software architecture diagram

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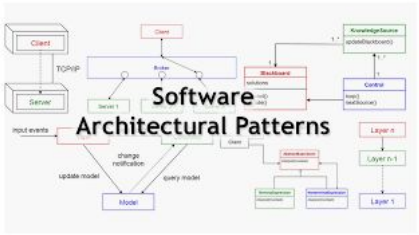
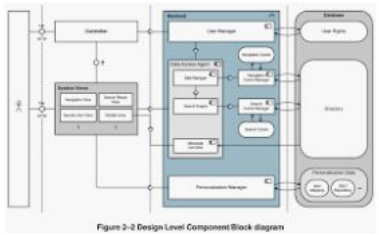
software architecture | design | example | deployment | uml | azure | visio | draw | application | level | visualising | powerpoint | rational software | component | templates | static | architecture design



Software Architectural Patterns ...
towardsdatascience.com



Software Architecture Modelling ...
softwareengineering.stackexchange.com

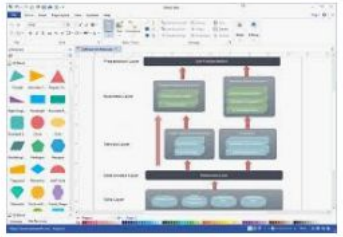
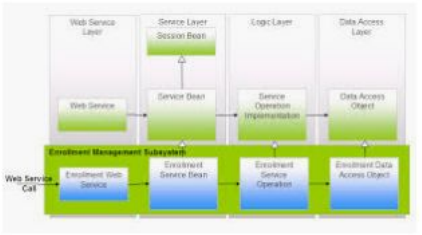
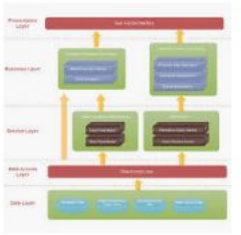


diagram software architecture ...
quora.com

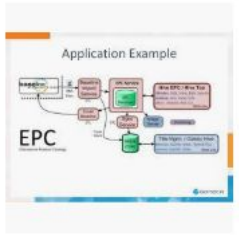
A Software Architect's View On Diagr...
slideshare.net



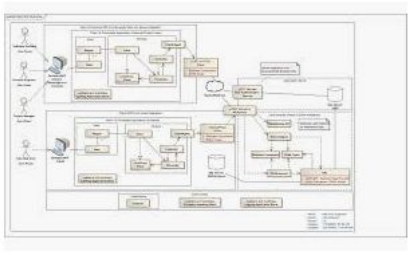
Examples of well designed software ...
graphicdesign.stackexchange.com



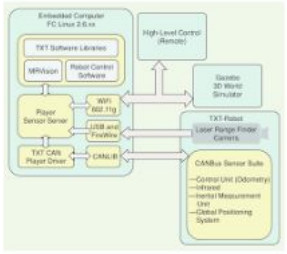
Software Architecture Exa...
edrawsoft.com



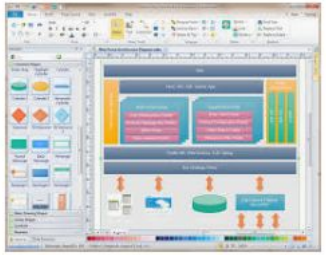
A Software Architect's Vie...
slideshare.net



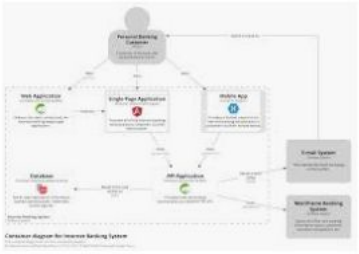
What is Software Architecure
predic8.com



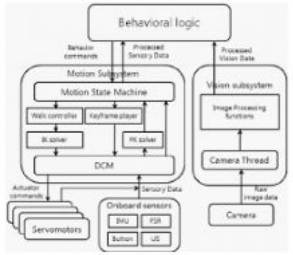
block diagram shows how ...
researchgate.net



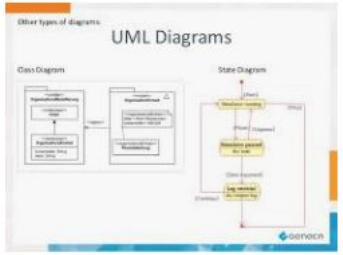
Easy Architecture Diagram Software
edrawsoft.com



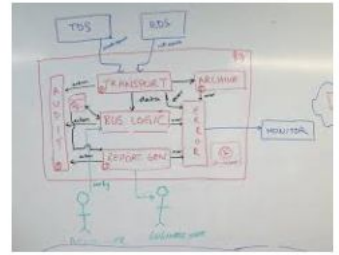
Structurizr
structurizr.com



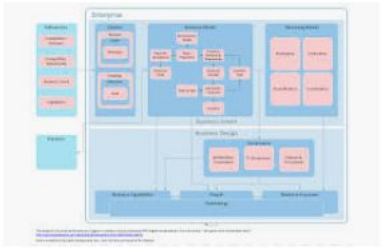
Block Diagram of the Software ...
researchgate.net



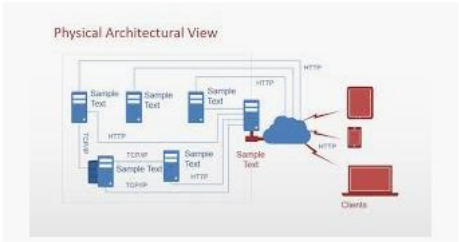
A Software Architect's View On Diagram...
slideshare.net



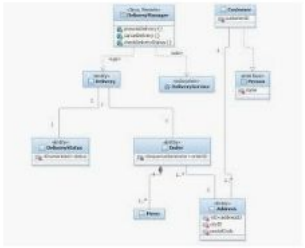
model for visualising software architect...
c4model.com



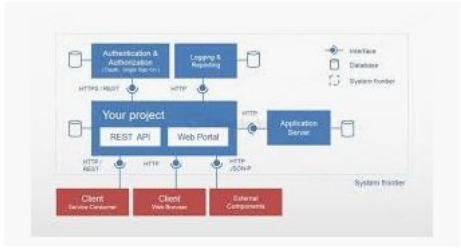
Computer Software Microsoft Visio ...
kisspng.com



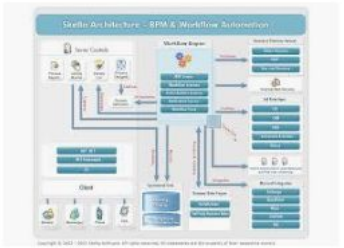
Software Diagrams for PowerPoint ...
slidemodel.com



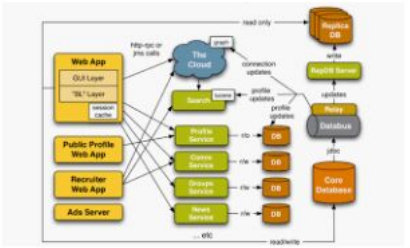
Rational Software Architect ...
ibm.com



Web Portal Static Software Architecture ...
slidemodel.com



Software architecture diagram - software
ricksnursery.com

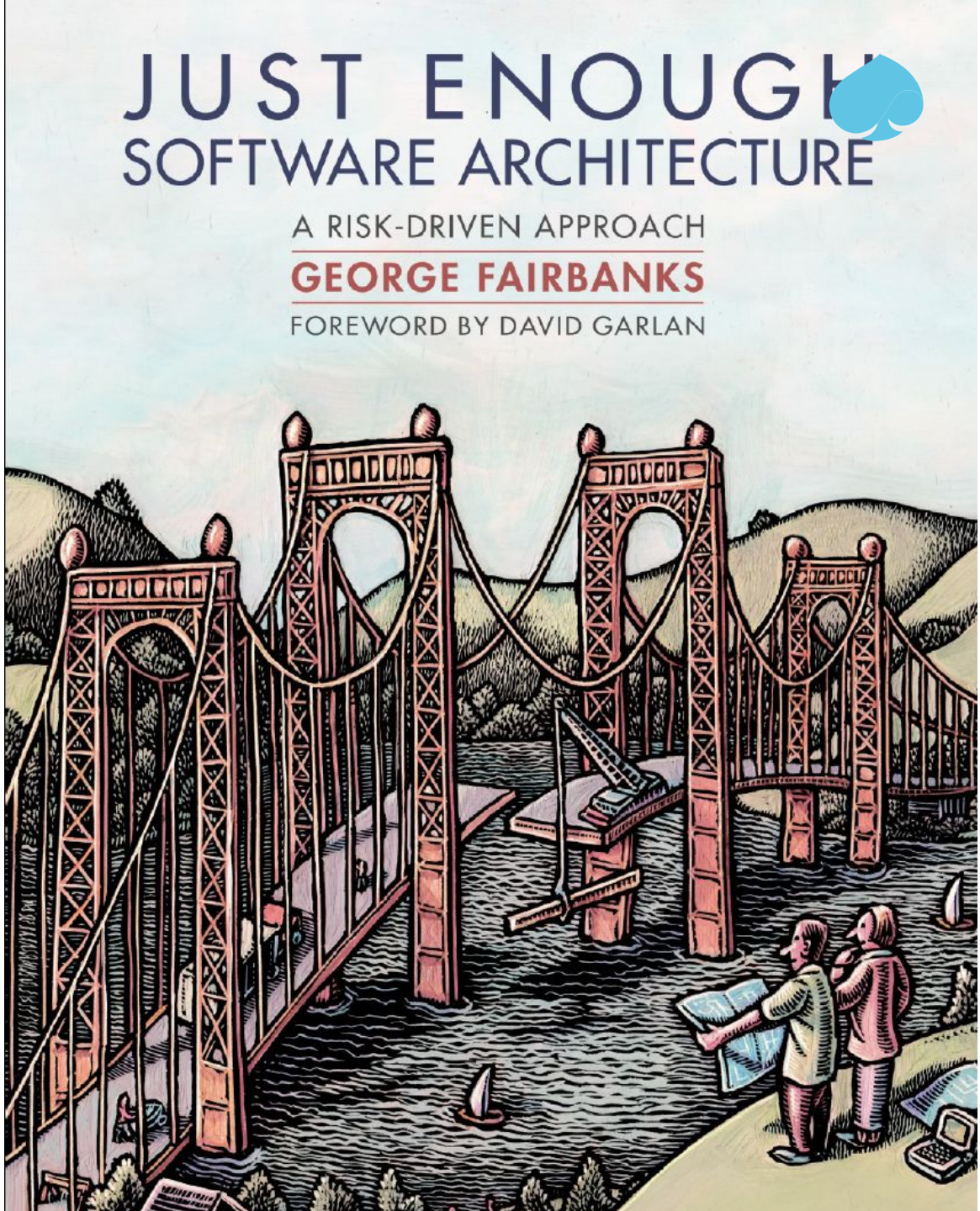


technical architecture diagram ...
softwareengineering.stackexchange.com

Model-code gap

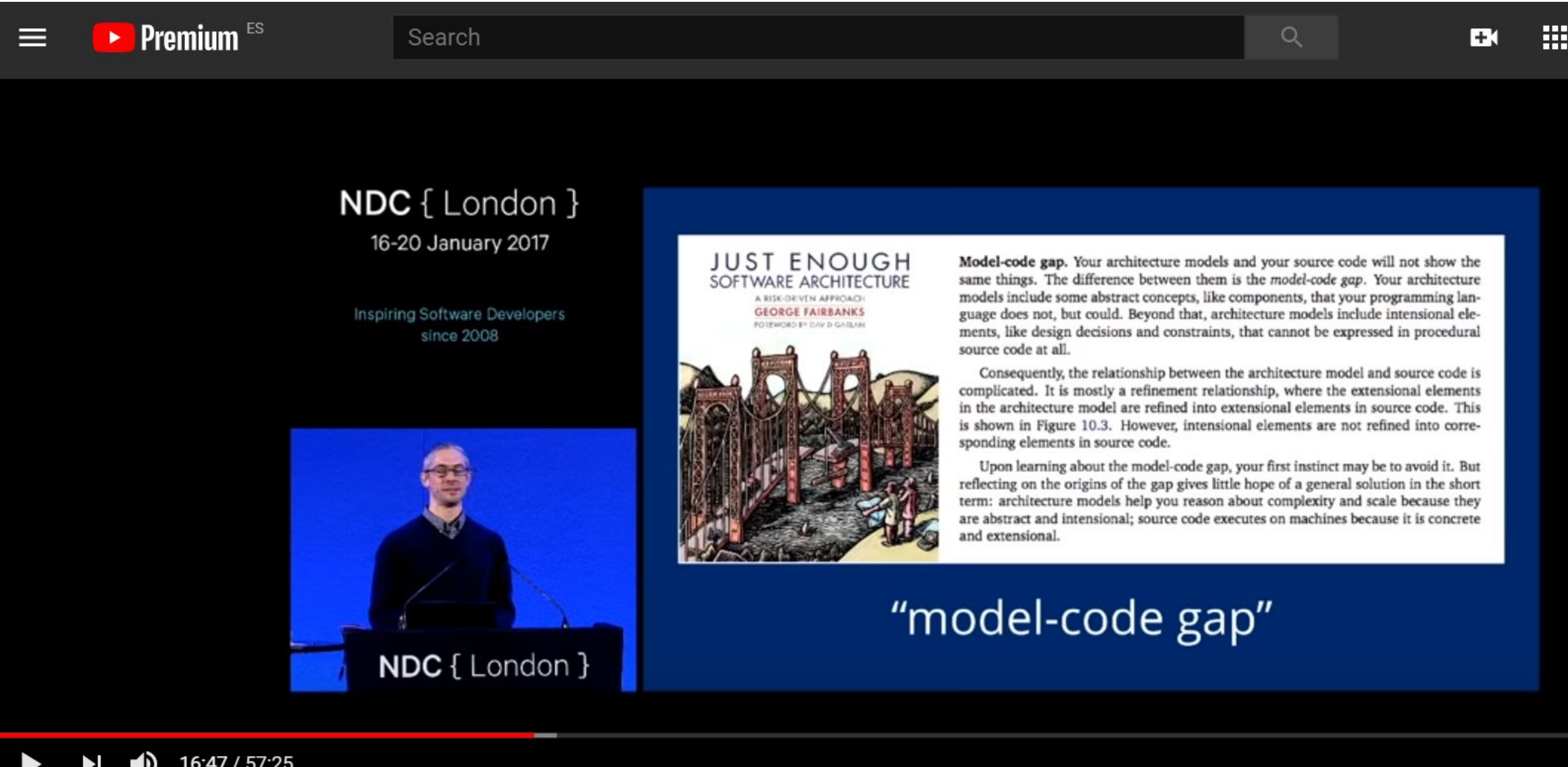
"…**Your architecture models and your source code will not show the same things.** The difference between them is the ***model-code gap***. Your architecture models include some abstract concepts, like components, that your programming language does not, but could. Beyond that, architecture models include intentional elements, like design decisions and constraints, that cannot be expressed in procedural source code at all.

Consequently, the relationship between the architecture model and source code is complicated



https://www.youtube.com/watch?v=Ym9nhVZs89o

Visualise, document and explore your software architecture - Simon Brown



https://c4model.com/

The C4 model for visualising software architecture

Context, Containers, Components and Code

In a hurry? Read the 5 minute introduction to the C4 model at InfoQ:

The C4 model for software architecture

O modelo C4 de documentação para Arquitetura de Software

用于软件架构的C4模型

ソフトウェアアーキテクチャのためのC4モデル

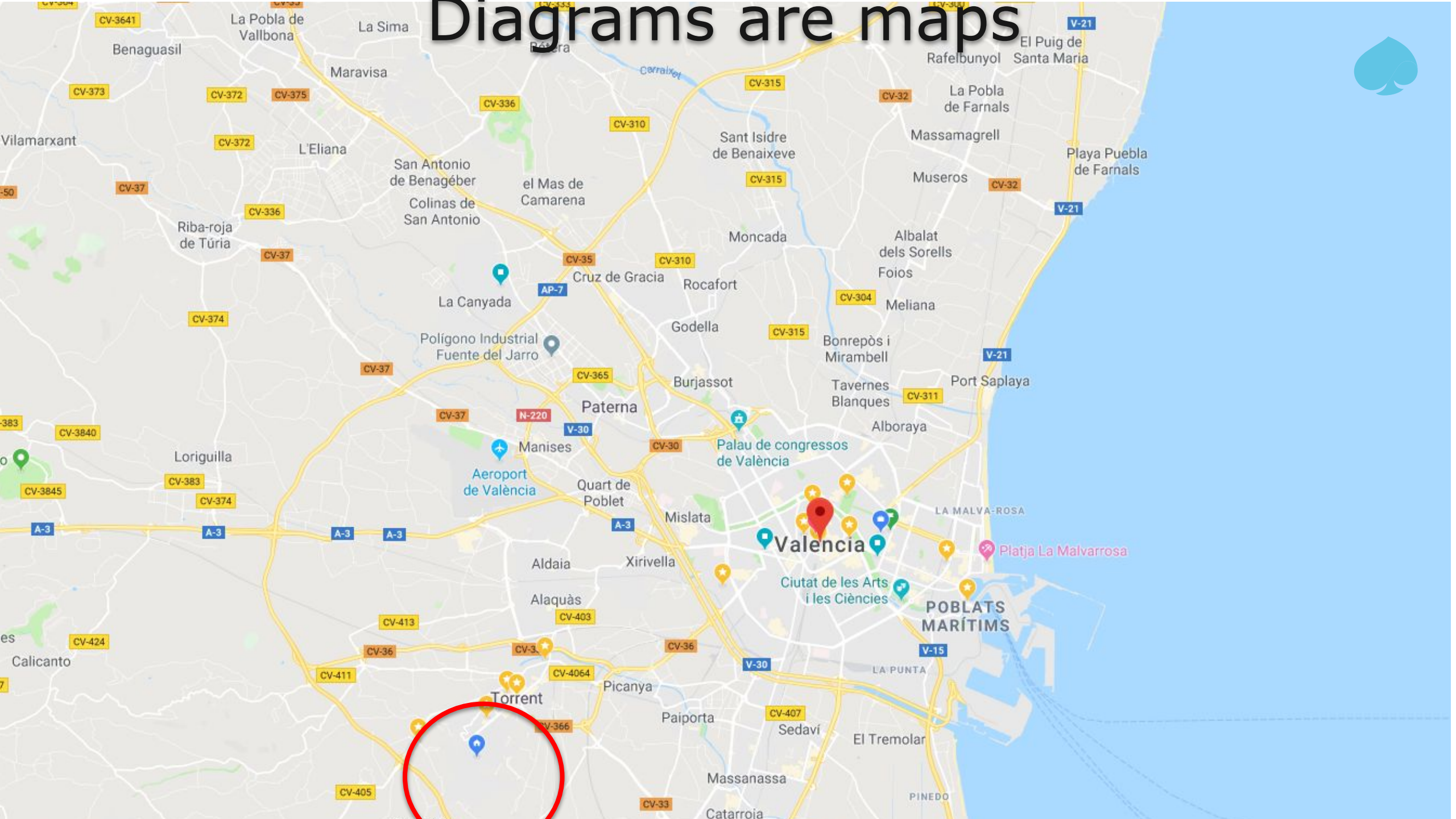
Introduction

Ask somebody in the building industry to visually communicate the architecture of a building and you'll be presented with site plans, floor plans, elevation views, cross-section views and detail drawings. In contrast, ask a software developer to communicate the software architecture of a software system using diagrams and you'll likely get a confused mess of boxes and lines ... inconsistent notation (colour coding, shapes, line styles, etc), ambiguous naming, unlabelled relationships, generic terminology, missing technology choices, mixed abstractions, etc.

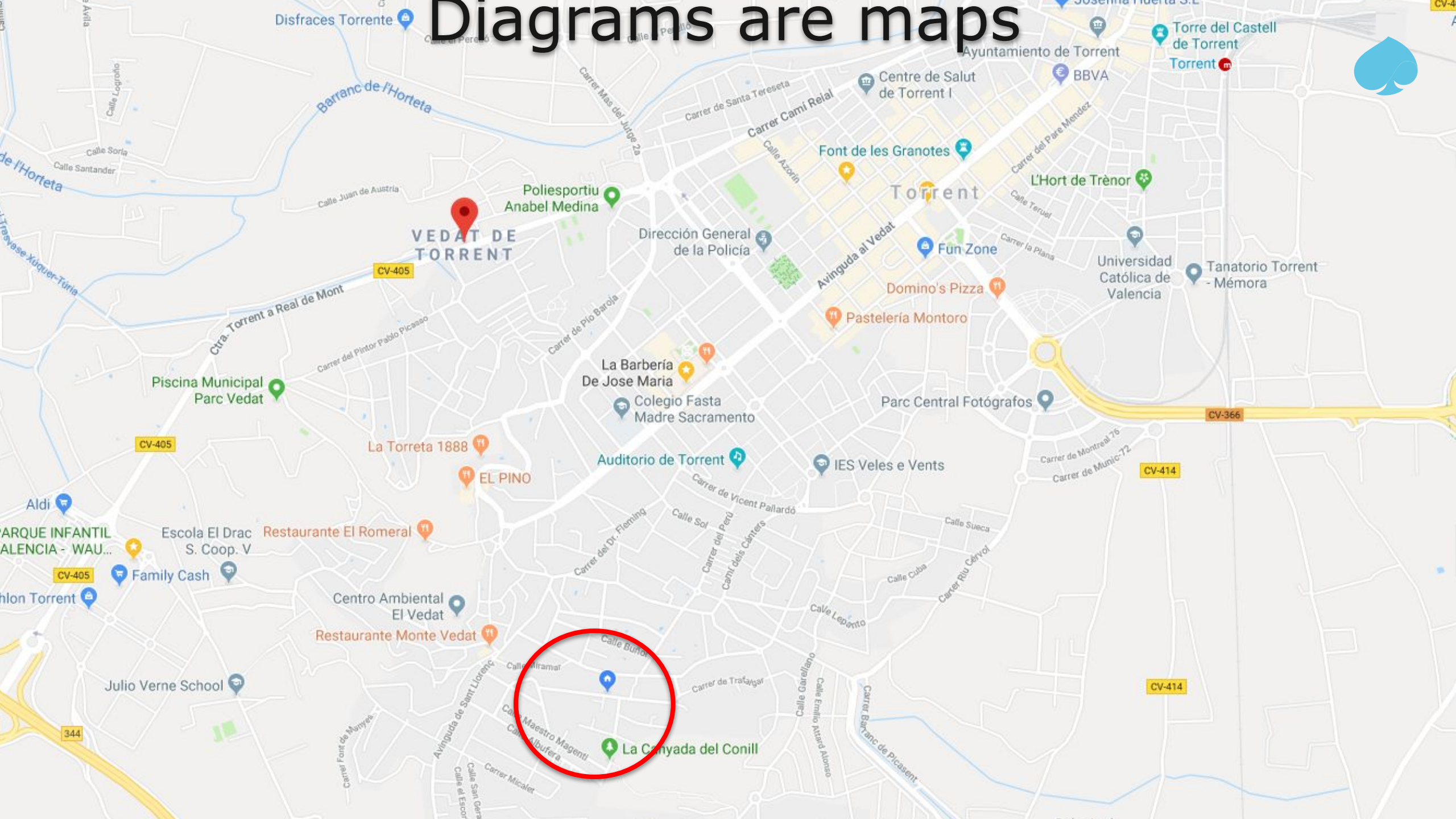


Diagrams are maps

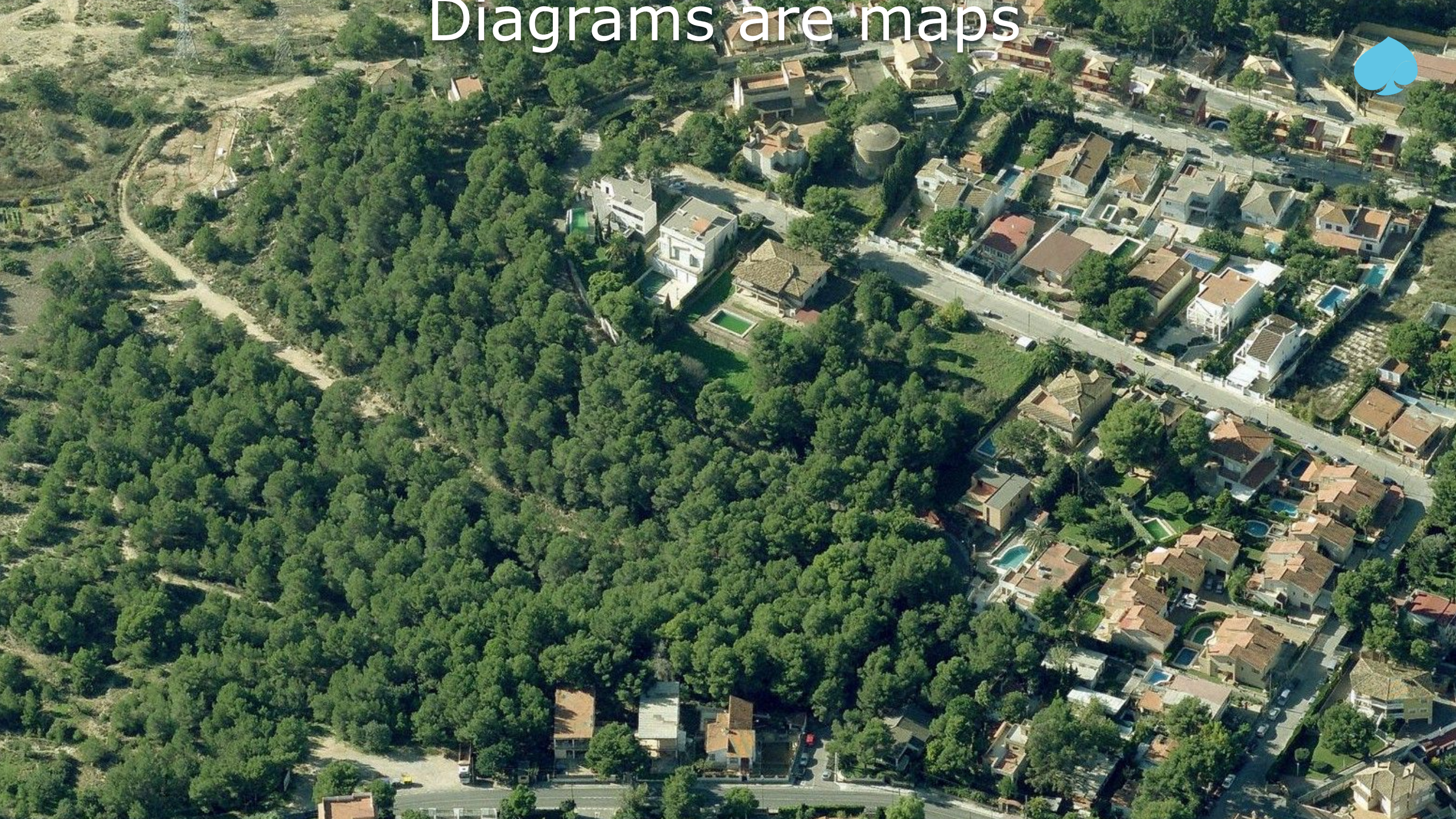
Diagrams are maps

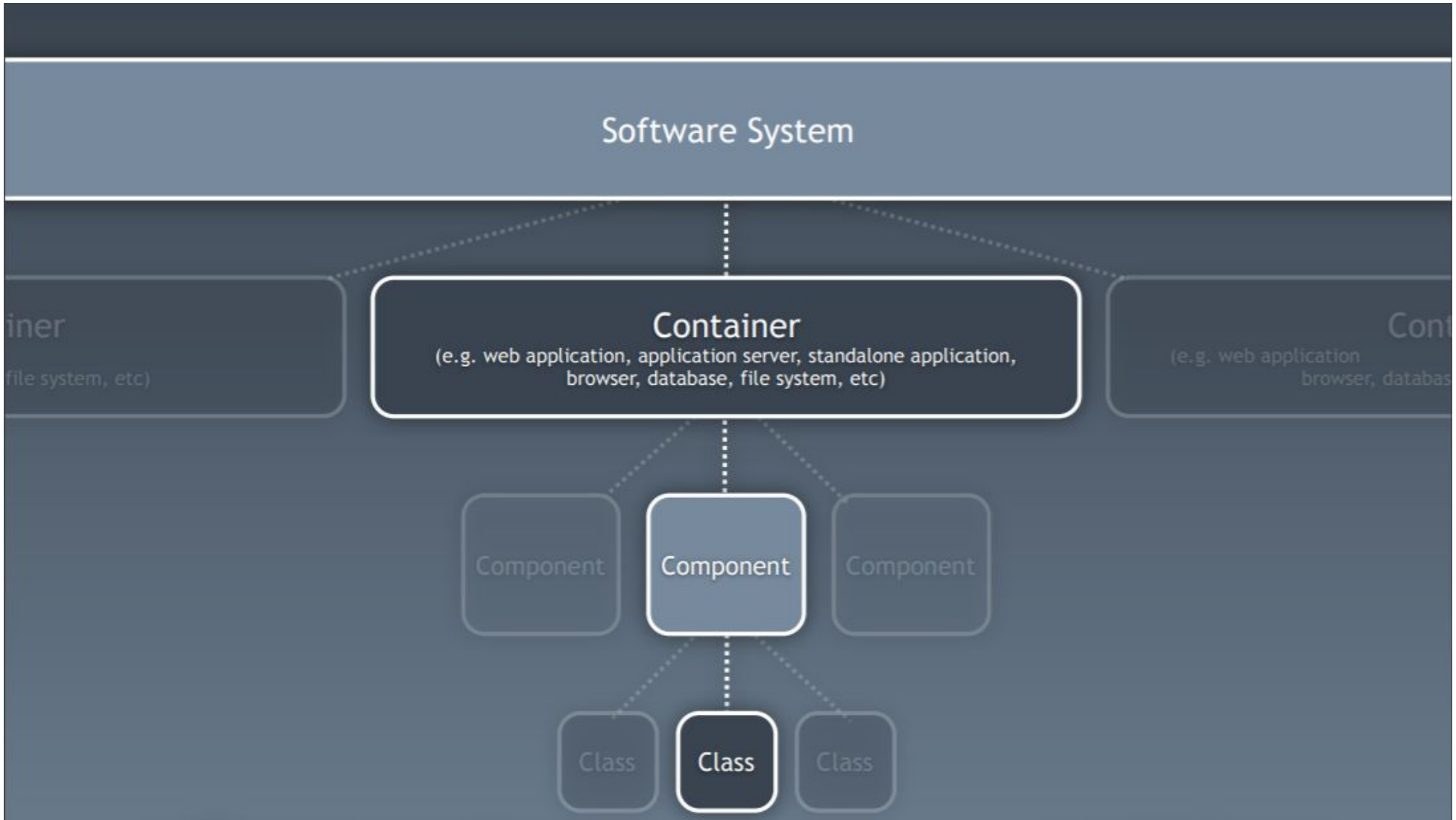


Diagrams are maps

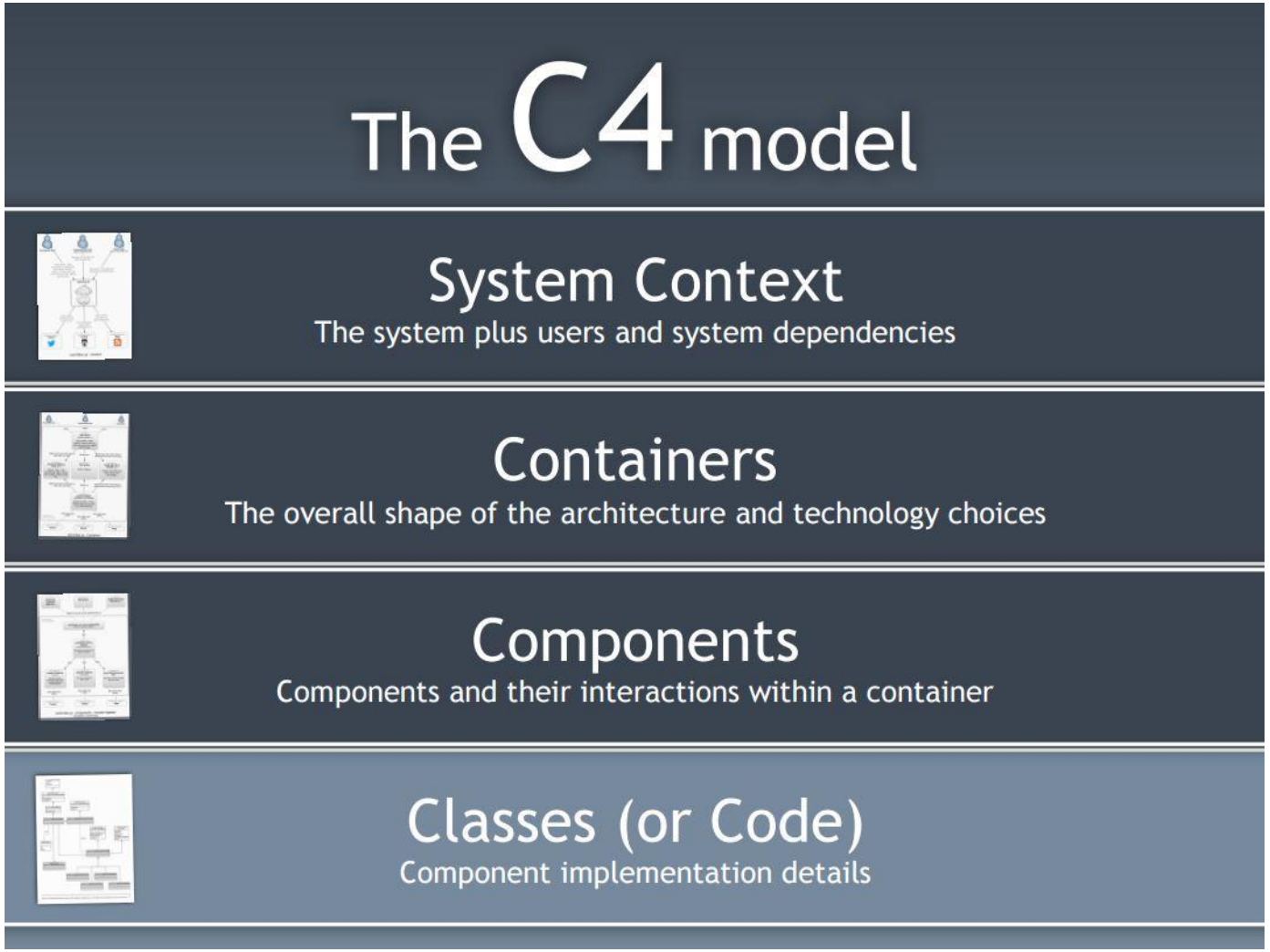


Diagrams are maps





A **software system** is made up of one or more **containers**, each of which contains one or more **components**, which in turn are implemented by one or more **classes**.



Compose

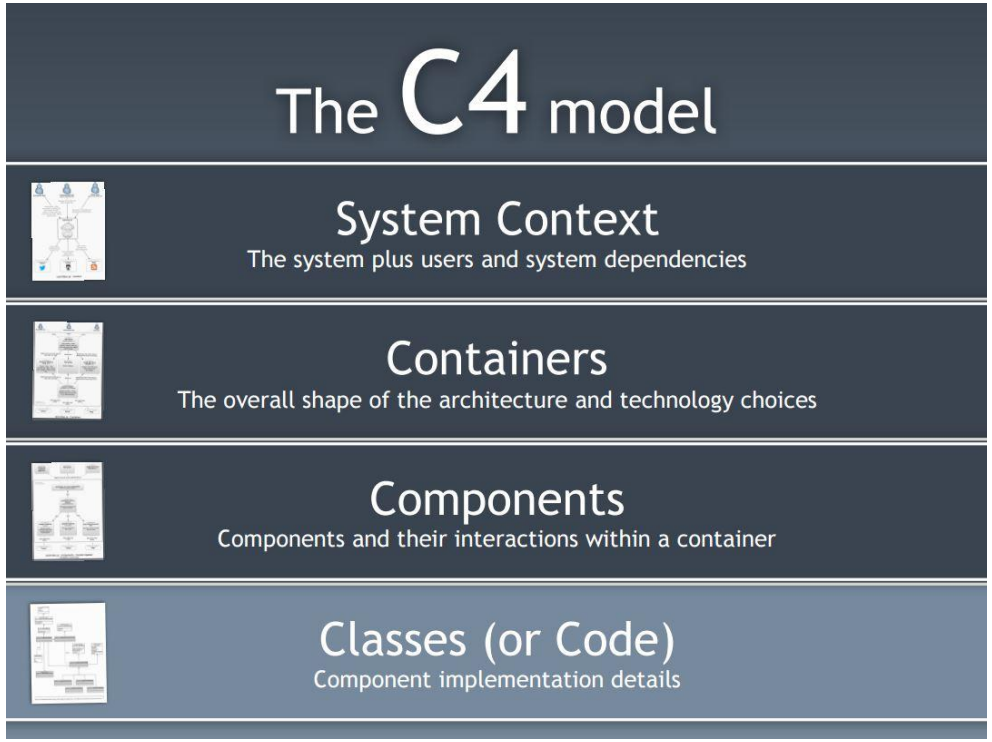
Tell the story

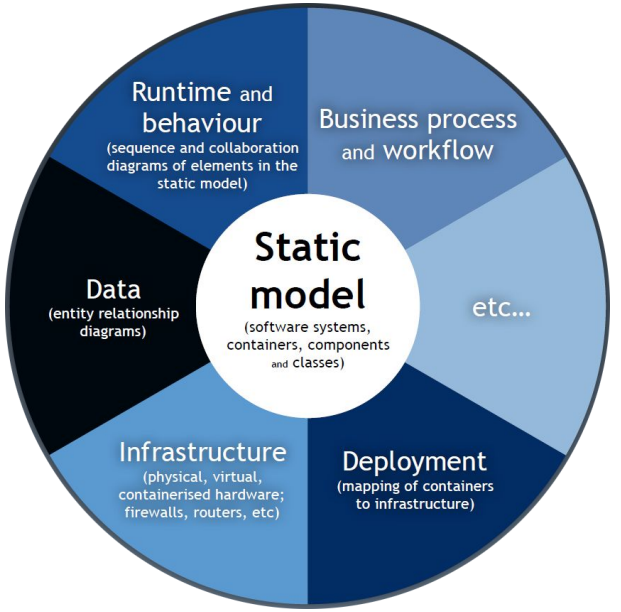
Decompose

A Hierarchy of Models

- UX/UI prototype
- UML (Sequence, State, Class etc)
- Flow diagrams
- Sketches and drawings
- Interfaces
- Code fragments
- etc…

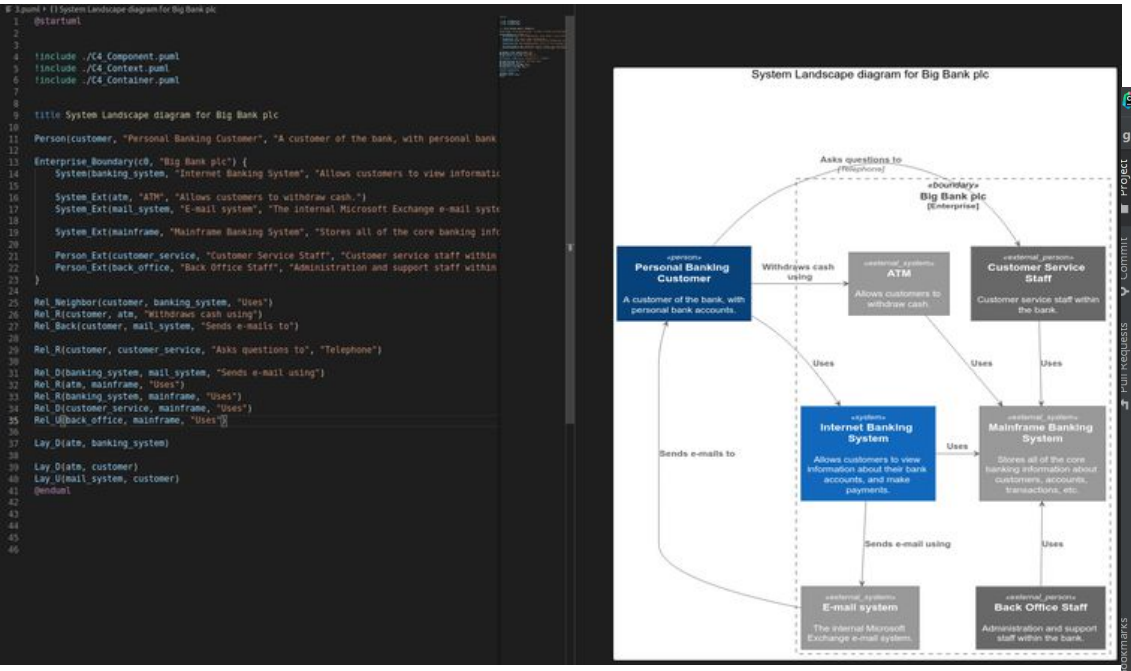
The C4 diagrams

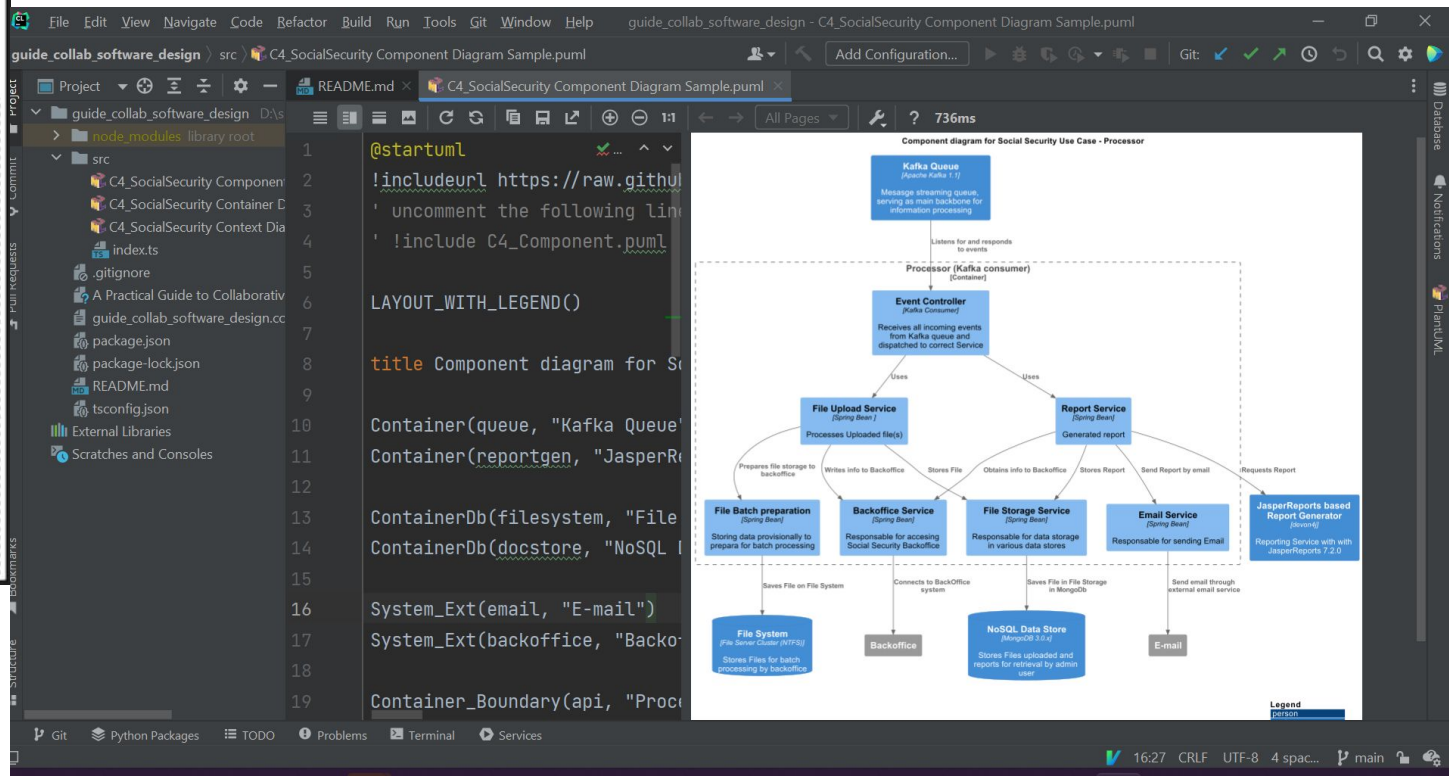





How to Design

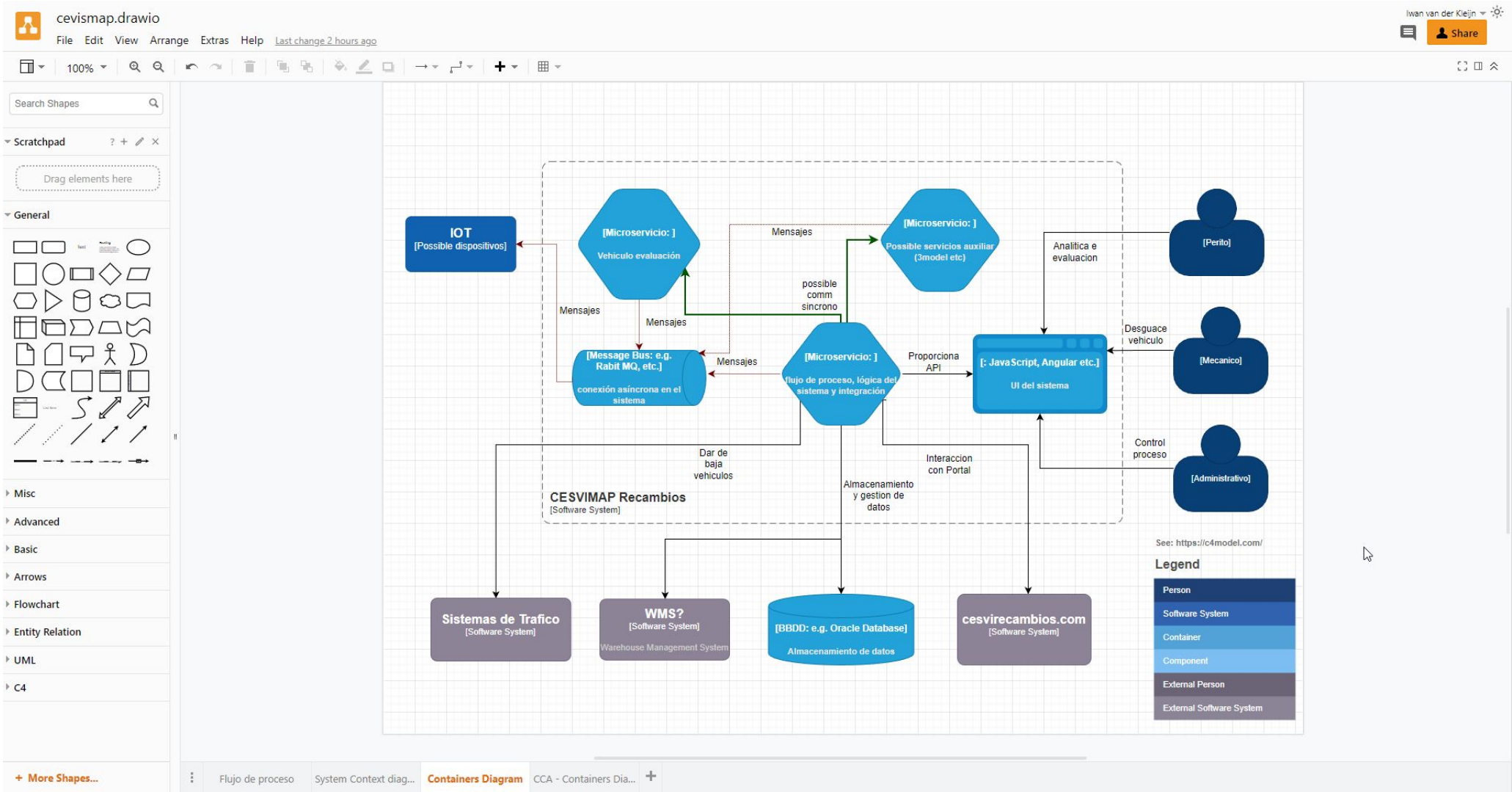
C4 and UML in Visual Studio Code, Jetbrains editors etc using PlantUML



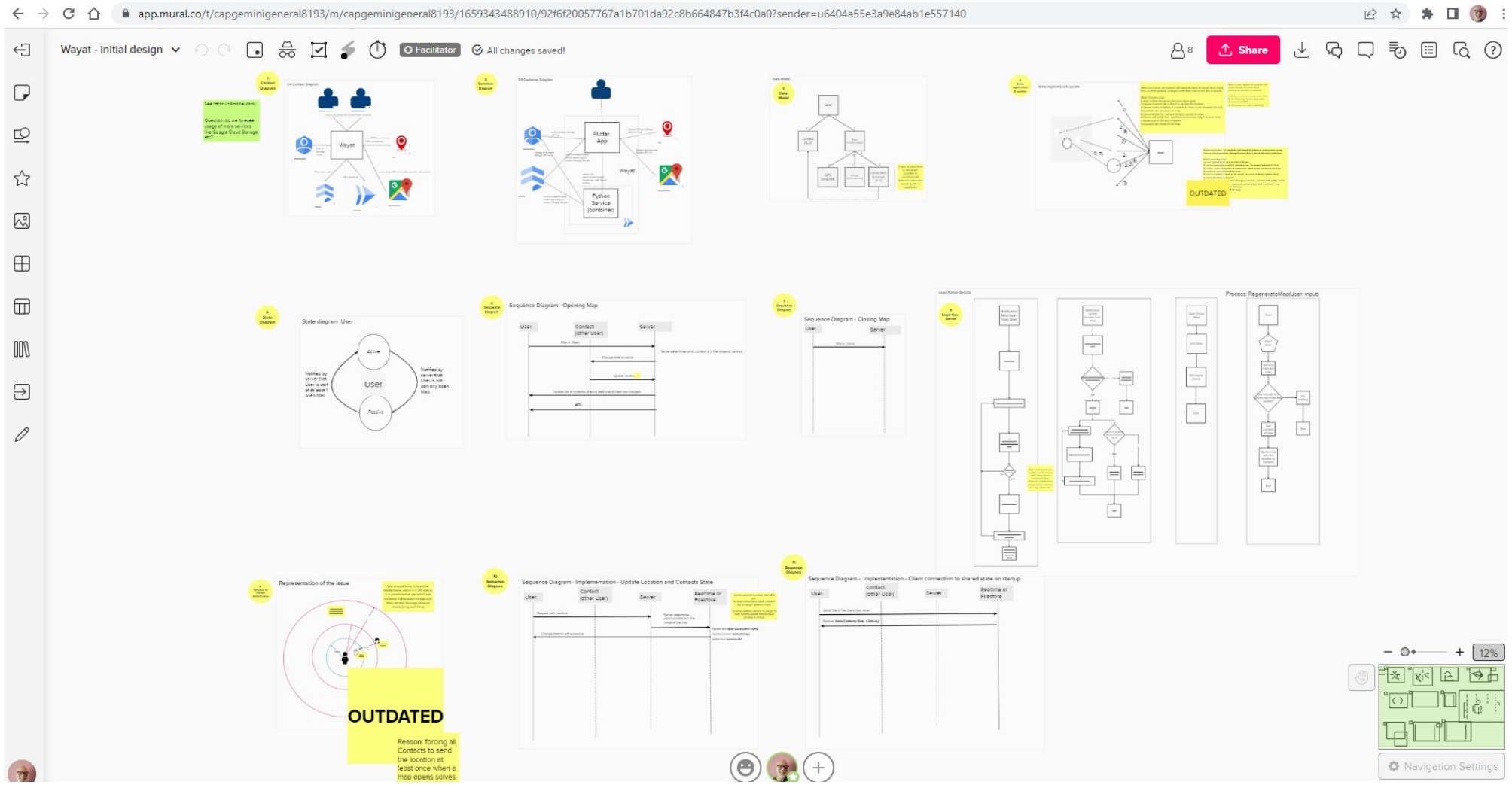


https://github.com/plantuml-stdlib/C4-PlantUML

C4 and UML in Diagrams.net (draw.io)
Single use and collaborative



Collaborative Design (using Mural or equivalent)



Social Security Example

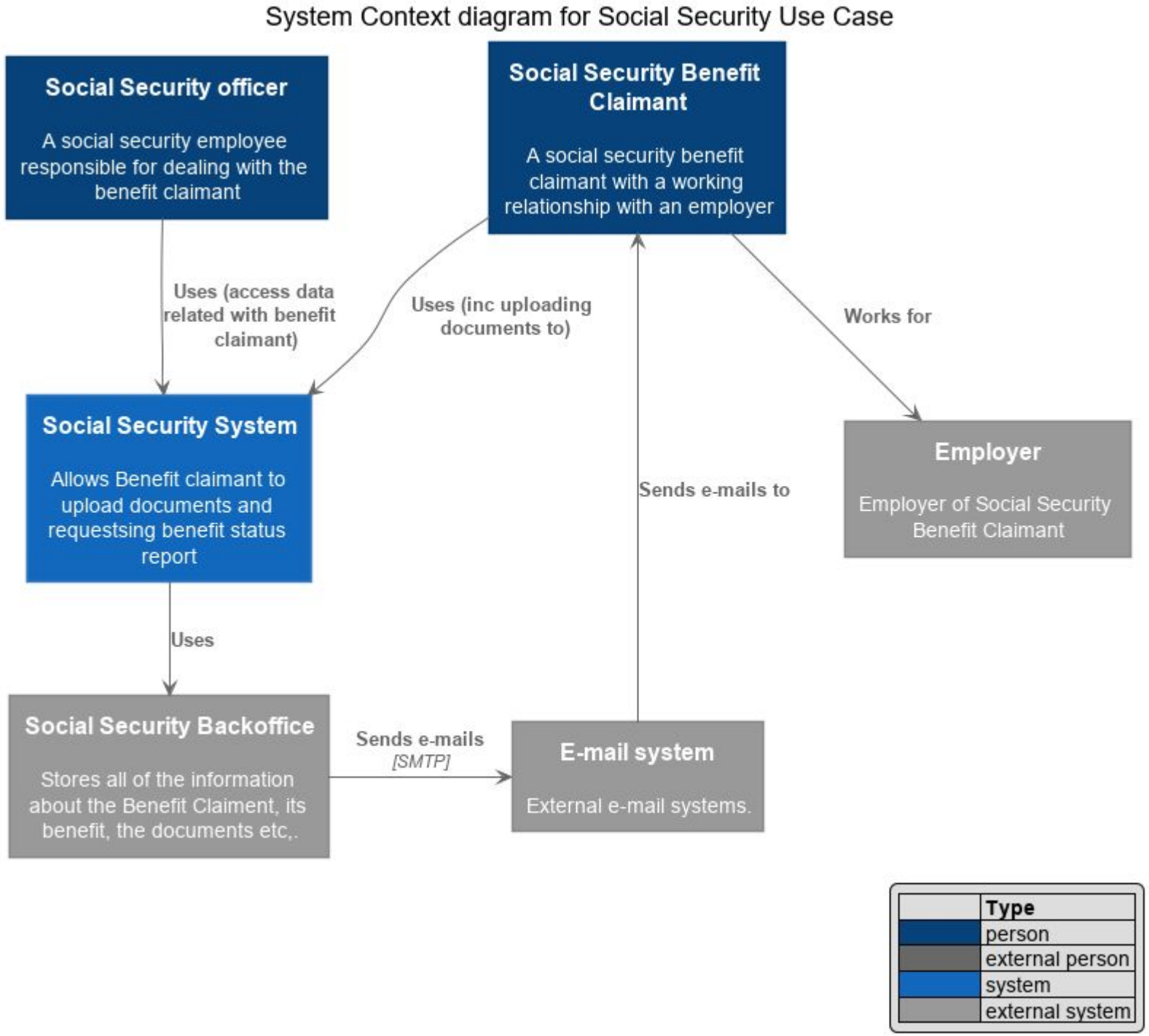
The application is used to give benefit recipients the option of uploading 'supporting documents' (documents such as pay slips) that prove a working relationship.

If a benefit claimant has a working relationship with an employer, this has an impact on the benefit. These supporting documents are checked and it is checked whether the data is in accordance with the data made available to the Social Security from the employers.

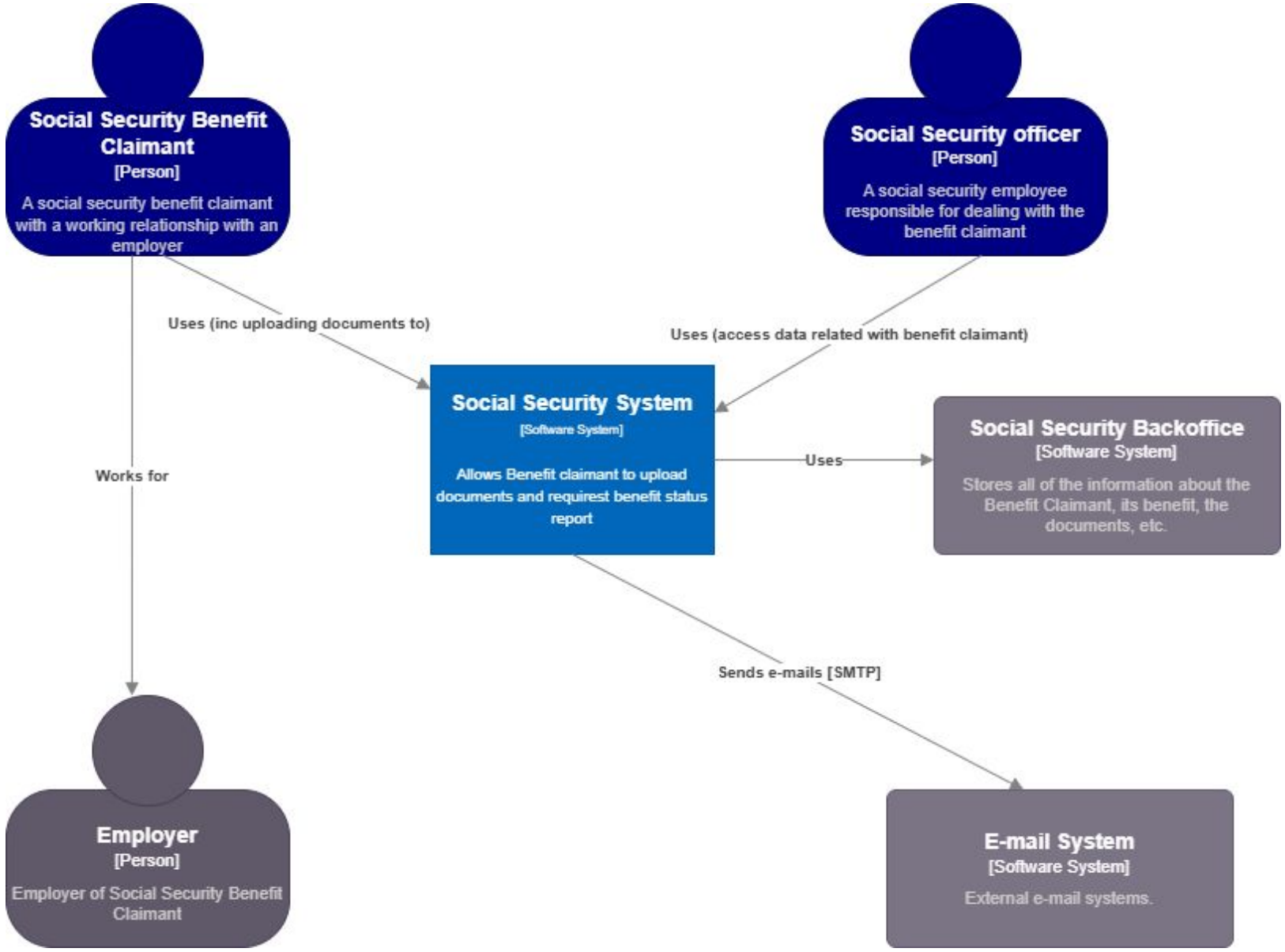
The application can also be used to obtain an official, signed, report about any change of the benefit requested by or granted to the benefit claimant.

The Social Security Officer responsible for the case of the claimant should be able to access the information through an internal application.

System Context

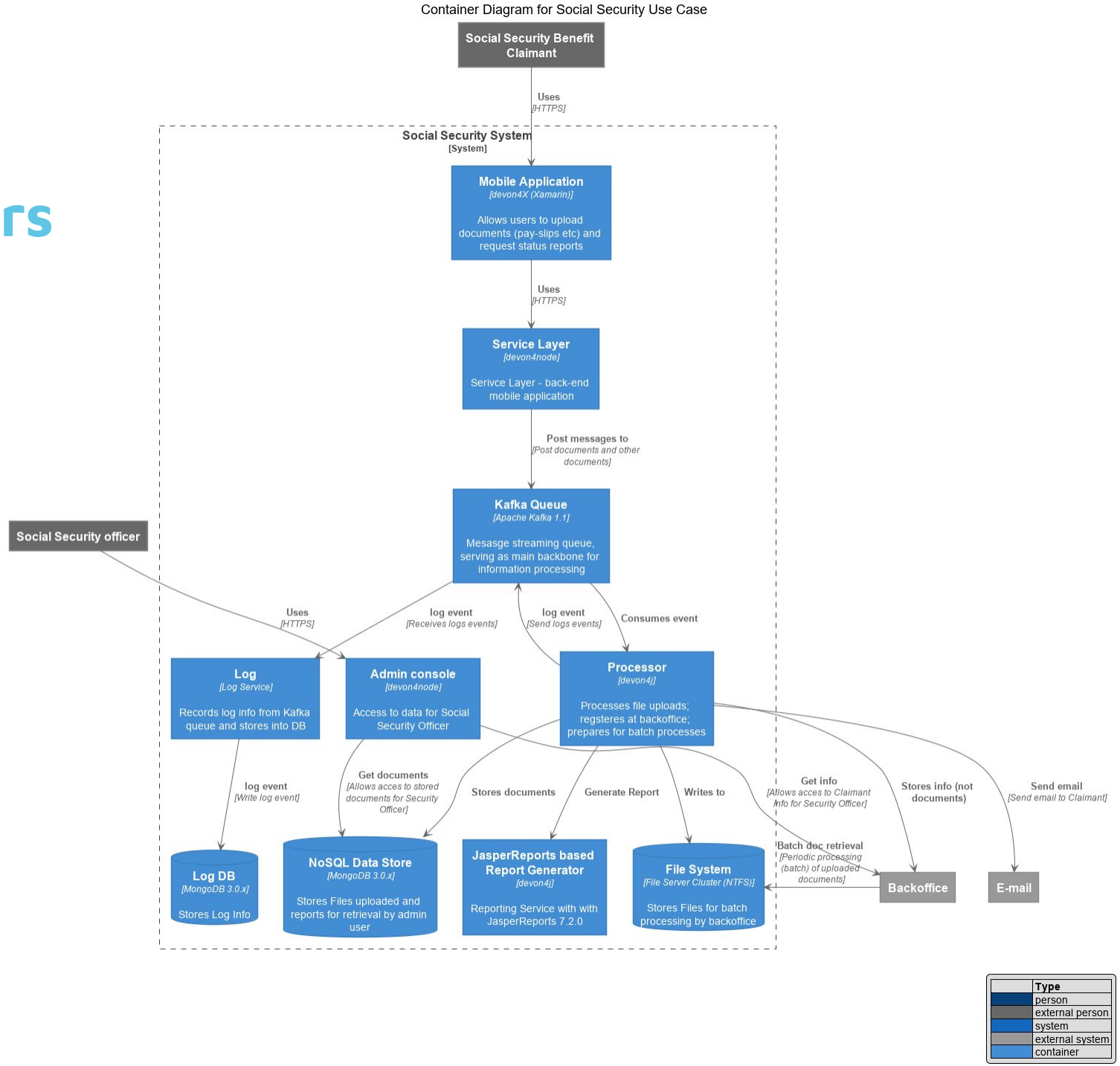


System Context

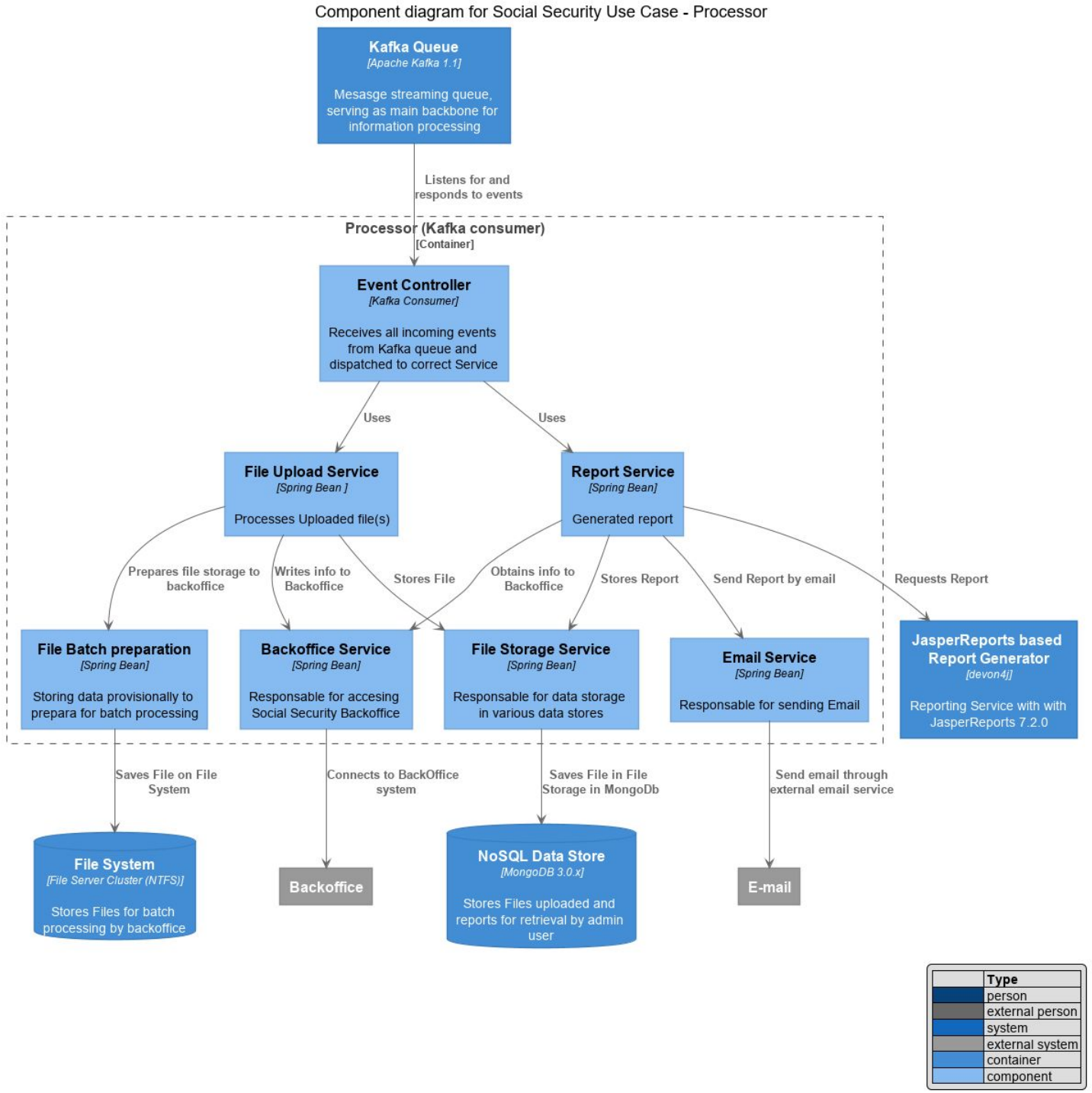


draw.io

Containers


Container Diagram for Social Security Use Case
Social Security Benefit Claimant
Uses
[HTTPS]
Social Security System
[System]
Mobile Application
[devon4X (Xamarin)]
Allows users to upload documents (pay-slips etc) and request status reports
Uses
[HTTPS]
Service Layer
[devon4node]
Serivce Layer - back-end mobile application
Post messages to
[Post documents and other documents]
Kafka Queue
[Apache Kafka 1.1]
Mesasge streaming queue, serving as main backbone for information processing
Social Security officer
Uses
[HTTPS]
log event
[Receives logs events]
log event
[Send logs events]
Consumes event
Log
[Log Service]
Records log info from Kafka queue and stores into DB
Admin console
[devon4node]
Access to data for Social Security Officer
Processor
[devon4j]
Processes file uploads; regsteres at backoffice; prepares for batch processes
log event
[Write log event]
Get documents
[Allows acces to stored documents for Security Officer]
Stores documents
Generate Report
Writes to
Get info
[Allows acces to Claimant info for Security Officer]
Stores info (not documents)
Send email
[Send email to Claimant]
Batch doc retrieval
[Periodic processing (batch) of uploaded documents]
Log DB
[MongoDB 3.0.x]
Stores Log Info
NoSQL Data Store
[MongoDB 3.0.x]
Stores Files uploaded and reports for retrieval by admin user
JasperReports based Report Generator
[devon4j]
Reporting Service with with JasperReports 7.2.0
File System
[File Server Cluster (NTFS)]
Stores Files for batch processing by backoffice
Backoffice
E-mail
Type
person
external person
system
external system
container

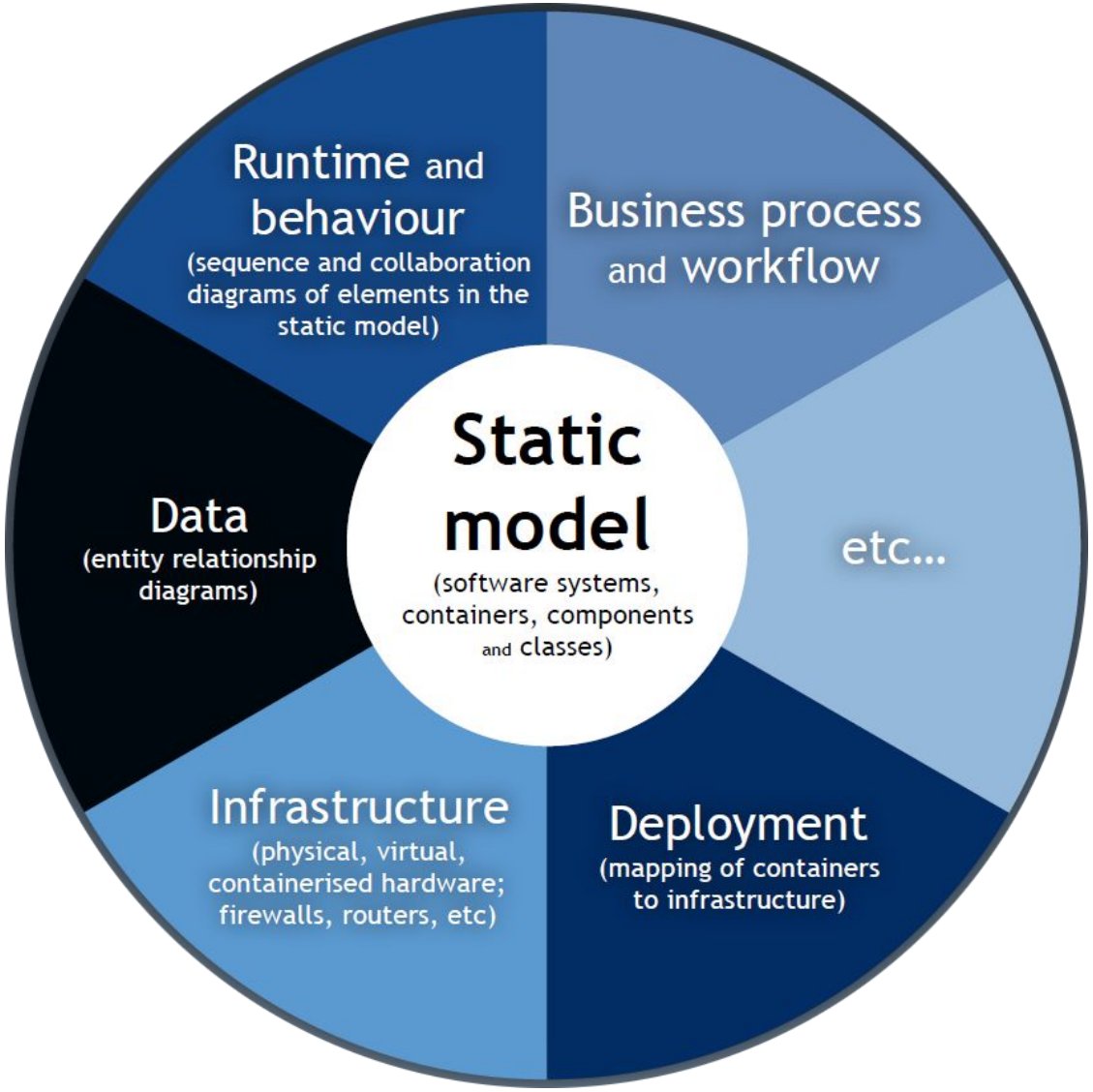
Components


Component diagram for Social Security Use Case - Processor
Kafka Queue
[Apache Kafka 1.1]
Mesasge streaming queue, serving as main backbone for information processing
Listens for and responds to events
Processor (Kafka consumer)
[Container]
Event Controller
[Kafka Consumer]
Receives all incoming events from Kafka queue and dispatched to correct Service
Uses
Uses
File Upload Service
[Spring Bean]
Processes Uploaded file(s)
Report Service
[Spring Bean]
Generated report
Prepares file storage to backoffice
Writes info to Backoffice
Stores File
Obtains info to Backoffice
Stores Report
Send Report by email
Requests Report
File Batch preparation
[Spring Bean]
Storing data provisionally to prepara for batch processing
Backoffice Service
[Spring Bean]
Responsable for accesing Social Security Backoffice
File Storage Service
[Spring Bean]
Responsable for data storage in various data stores
Email Service
[Spring Bean]
Responsable for sending Email
JasperReports based Report Generator
[devon4j]
Reporting Service with with JasperReports 7.2.0
Saves File on File System
Connects to BackOffice system
Saves File in File Storage in MongoDb
Send email through external email service
File System
[File Server Cluster (NTFS)]
Stores Files for batch processing by backoffice
Backoffice
NoSQL Data Store
[MongoDB 3.0.x]
Stores Files uploaded and reports for retrieval by admin user
E-mail
Type
person
external person
system
external system
container
component

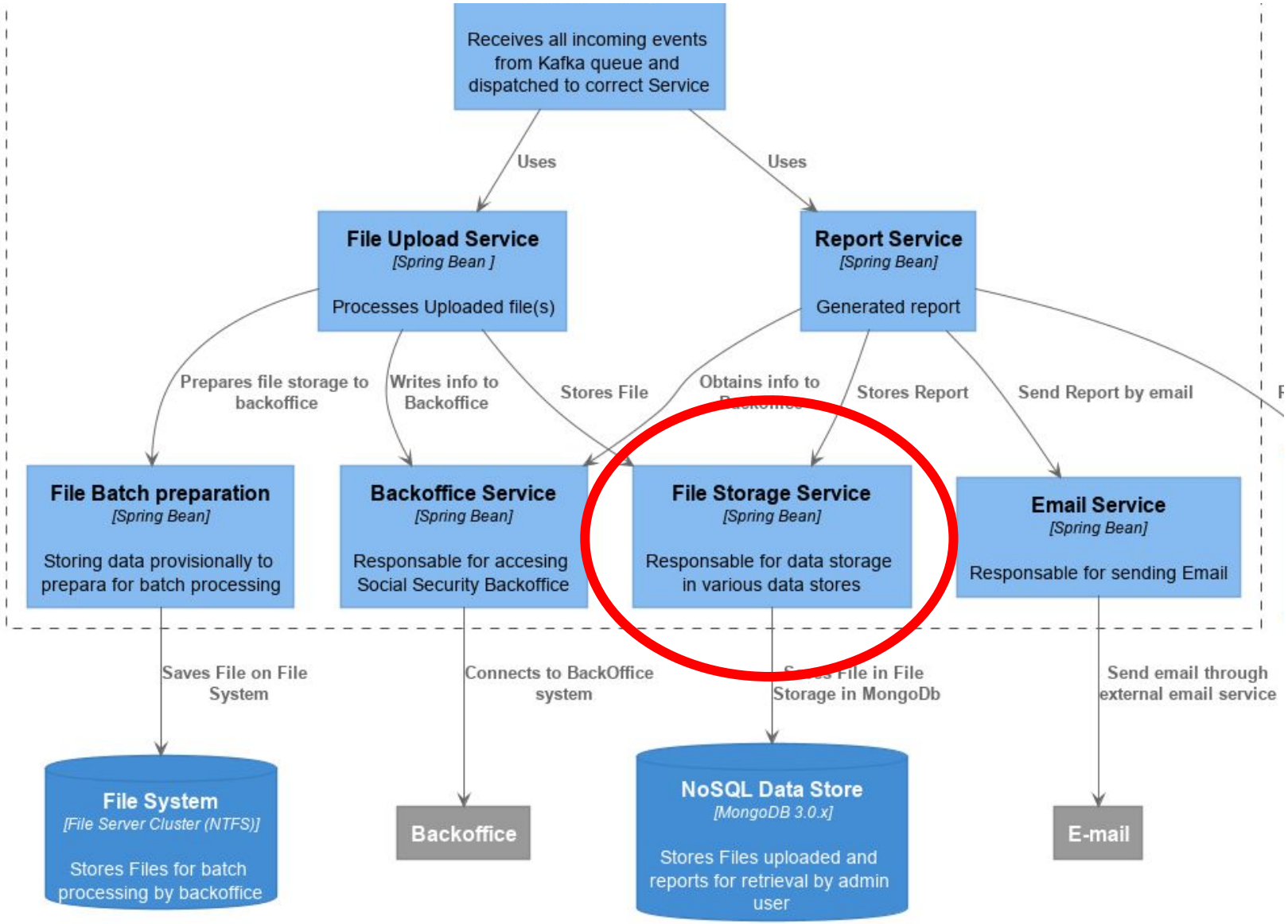
Extend the model

Based on the static model, the Design can be enriched with other diagram types.

UML and other (in)formal standards (ERD) can play a very useful role

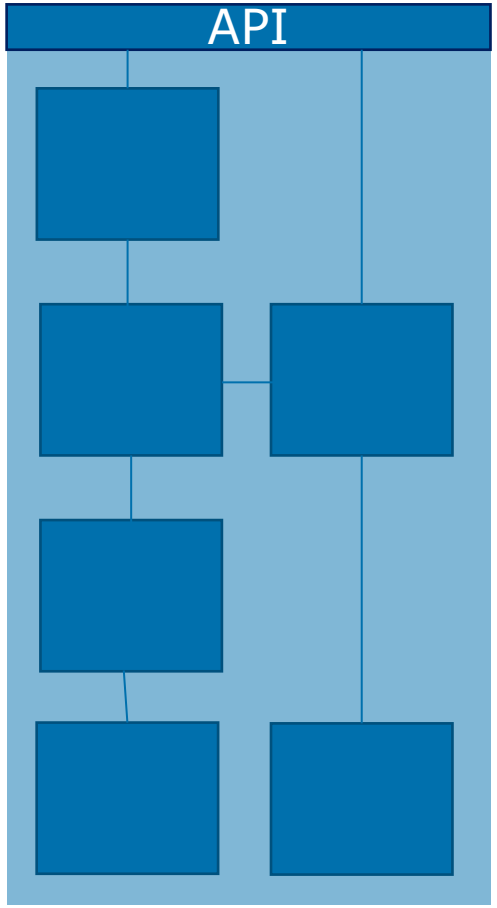


How to design a Component



Component

- Definition of a component in the C4 model
- Should be the smallest building block of the “Architecture”
- Is should contain a clearly defined API / **Interface**
- Will typically consist of multiple classes and functions
- A component should restrict access to its subcomponents (i.e.. Java packages, .NET Assemblies, ECMAScript/TypeScript modules etc)
- “Visible as” Angular Service, Spring Bean, Node module
- It should typically be a global singleton and not Support instantiation (multiple instances)
- Should have a Functional or Service Oriented Interface rather than OOP (no maintaining of state between invocations!)



Create abstractions to define meaning (functionality)

Apart from the structure of the system, the design also needs to describe the functionality of the system.

The basis for this form the Functional Requirements for the applications as contained in the Specifications like Use Cases or User Stories.

As with the “Structure” of the Architecture, there needs to be a clear link to defined functionality and Code.

And telling the story works here as well….

System Design as a story

As a user generating a **document**,

I need to be able to **store** the document,

so that it can be **retrieved** at any later moment by myself or other parties

Use abstractions!
Postpone the “definitions” of these concepts

“I can have a **storage unit** when I can **store documents.**

I or other parties can **retrieve** documents from the store

For this the stored document needs to be represented by a **unique ID**”

System Design as a story

As a user generating a **document**,

I need to be able to **store** the document,

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Use abstractions!
Postpone the “definitions” of these concepts

“I can have a **storage unit** when I can **store documents.**

I or other parties can **retrieve** documents from the store

For this the stored document needs to be represented by a **unique ID**”

```python
@runtime_checkable
class Storage1(Protocol):
    def save(self, arg0: Store, arg1: Document) -> ID:
        pass

    def get(self, arg0: Store, arg1: ID) -> Document:
        pass
```

Elaborating the Story

"I can have **storage unit** when I can **store and retrieve documents of an undeterminable length and/or varying size. Basically I should consider them to be a stream of data. "**

"This stream of data can be either a **stream of bytes** or a stream of **utf-8 encoded text.** As the stream does not represent a "Document" I can accompany it with a corresponding set of **Document attributes"**

```
type Data = Text | Binary
interface Storage {

    save(arg0: Store, arg1: Stream<Data>, arg2: DocumentAttrs) : ID;
    get(arg0: Store, arg1: ID): Stream<Data>;
    getAttr(arg0: Store, arg1: ID): DocumentAttrs;
}
```

Elaborating the Story

“I can have **storage unit** when I can **store and retrieve documents of an undeterminable length and/or varying size. Basically I should consider them to be a stream of data. “**

“This stream of data can be either a **stream of bytes** or a stream of **utf-8 encoded text.** As the stream does not represent a “Document” I can accompany it with a corresponding set of **Document attributes”**

```python
Data = Union[Text, Binary]
Stream = TypeVar('Stream')


@runtime_checkable
class Storage2(Protocol):
    def save(self, arg0: Store, arg1: Stream[Data], arg2: DocumentAttrs) -> ID:
        pass

    def get(self, arg0: Store, arg1: ID) -> Stream[Data]:
        pass

    def getAttr(self, arg0: Store, arg1: ID) -> DocumentAttrs:
        pass
```

Refining the Story

“I can have **storage unit** when I can **store and retrieve documents of an undeterminable length and/or varying size without having to wait** for the completion of the operation”

“I need to be able to **initiate an asynchronous operation**. In case of both an asynchronous as well as a synchronous operation, I need to be **advised of the success** of the operation.”

“Finally, I should be able to **remove the stored document.”**

```
interface Storage {

    save(arg0: Store, arg1: Stream<Data>, arg2: DocumentAttrs) : Promise<ID>;
    get(arg0: Store, arg1: ID): Promise<Stream<Data>>;
    getAttr(arg0: Store, arg1: ID): Result<DocumentAttrs>;

    remove(arg0: ID): Result<void>
}
```

Refining the Story

"I can have **storage unit** when I can **store and retrieve documents of an undeterminable length and/or varying size without having to wait** for the completion of the operation"

"I need to be able to **initiate an asynchronous operation**. In case of both an asynchronous as well as a synchronous operation, I need to be **advised of the success** of the operation."

"Finally, I should be able to **remove the stored document.**"

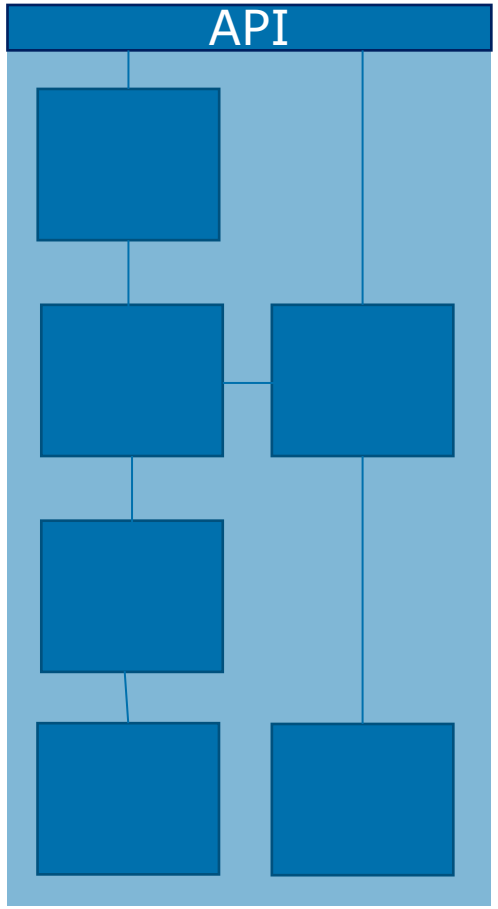
```python
@runtime_checkable
class Storage(Protocol):
    def save(self, arg0: Store, arg1: Stream[Data], arg2: DocumentAttrs) -> Awaitable[ID]:
        pass

    def get(self, arg0: Store, arg1: ID) -> Awaitable[Stream[Data]]:
        pass

    def getAttr(self, arg0: Store, arg1: ID) -> Result[DocumentAttrs]:
        pass

    def remove(self, arg0: ID) -> Result[None]:
        pass
```

The Storage Interface




```
interface Storage {

    save(arg0: Store, arg1: Stream<Data>, arg2: DocumentAttrs) : Promise<ID>;
    get(arg0: Store, arg1: ID): Promise<Stream<Data>>;
    getAttr(arg0: Store, arg1: ID): Result<DocumentAttrs>;

    remove(arg0: ID): Result<void>
}
```

By having begun as an abstraction, the component is assured to be fully decoupled of – i.e. have no dependencies on – any underlying storage mechanism. In that way:

- It is generic enough to be used by different storage mechanism (File system, Sharepoint, Mongo, etc etc)
- It is testable
- And “pluggable”

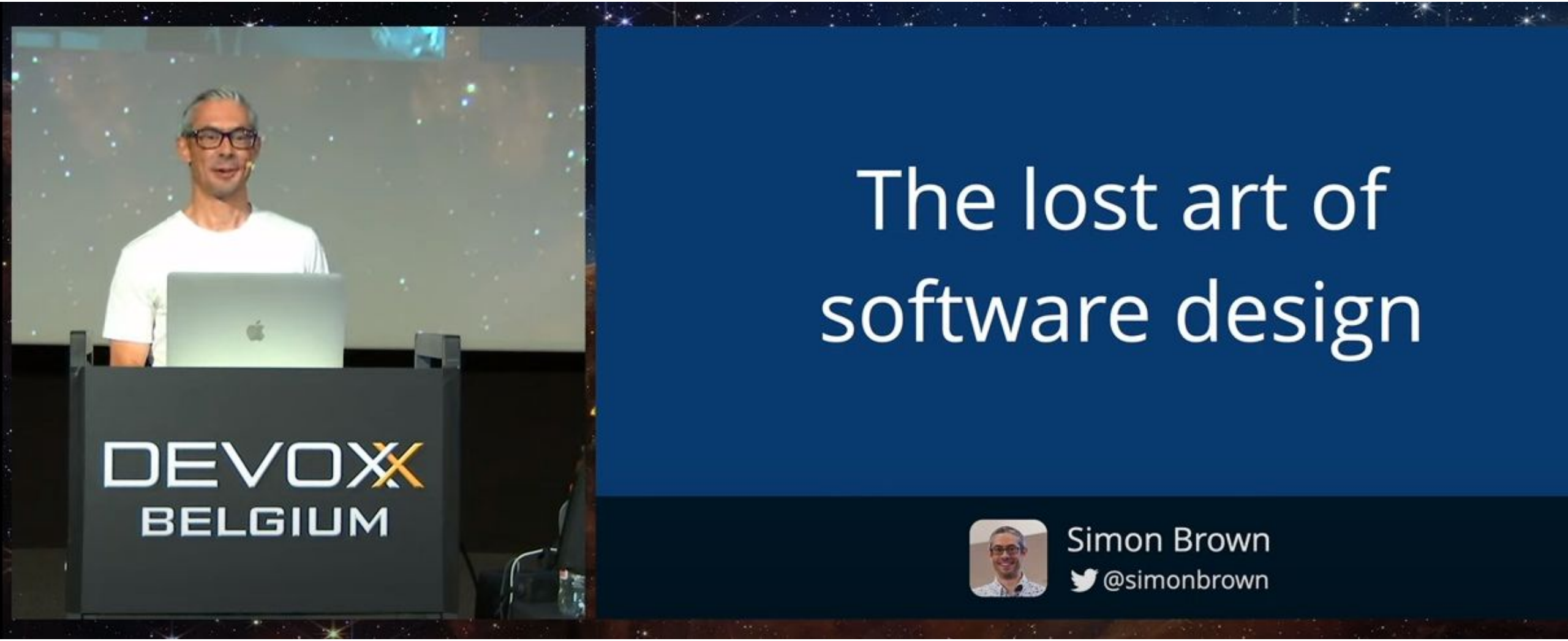
Further reading

and

Viewing...

https://github.com/ivanderk/guide_collab_software_design

The lost art of software design by Simon Brown

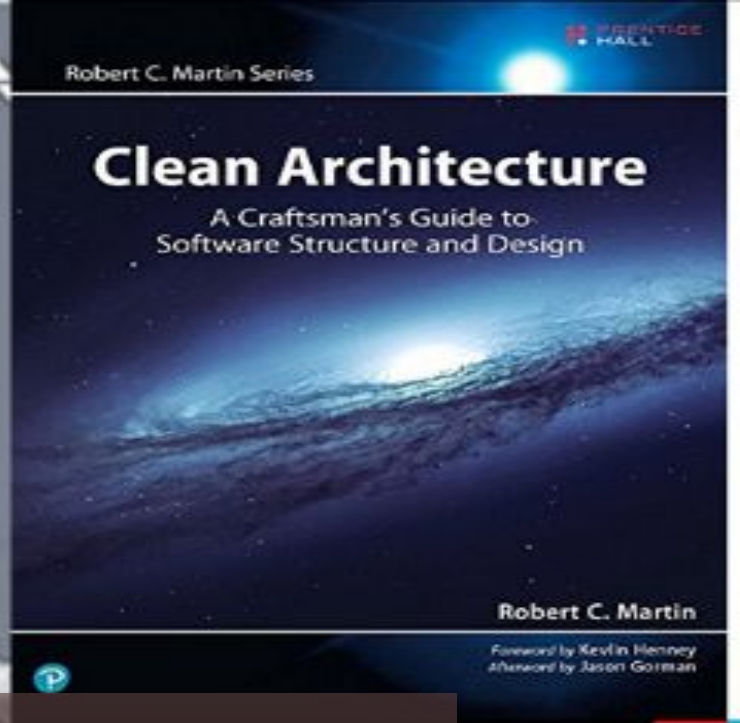


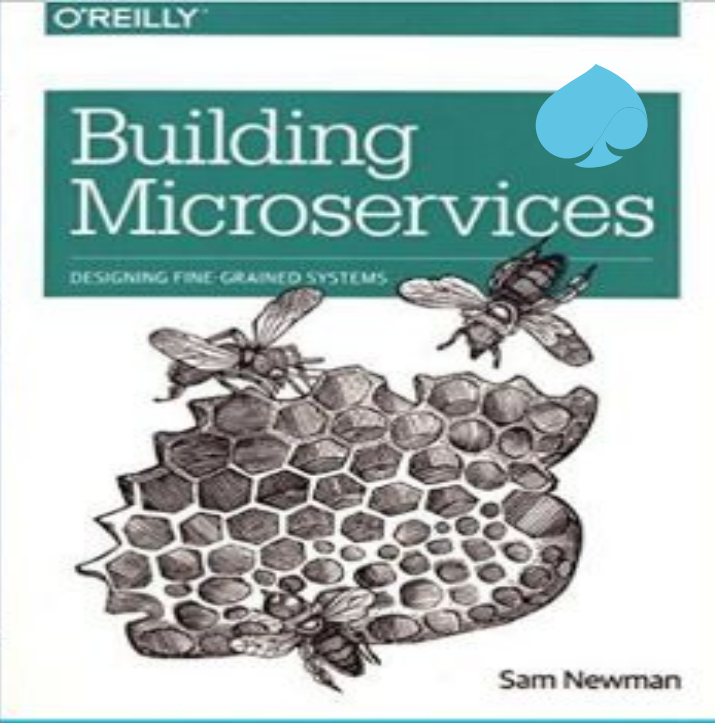
https://youtu.be/36OTe7LNd6M

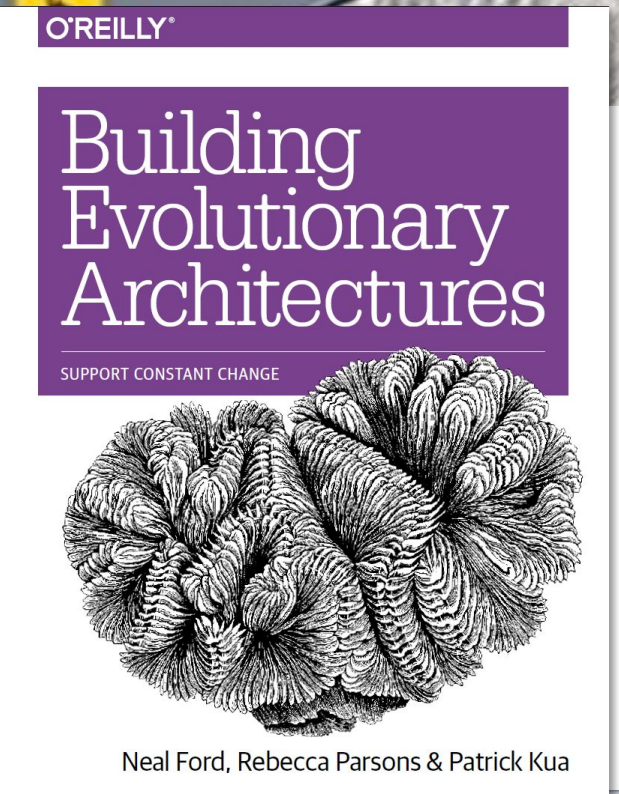
Large-Scale Architecture: The Unreasonable Effectiveness of Simplicity by Randy Shoup

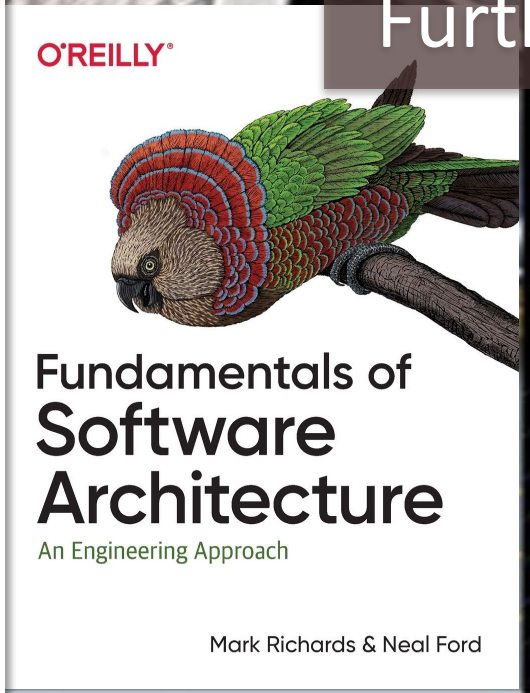
https://youtu.be/oejXFgvAwTA

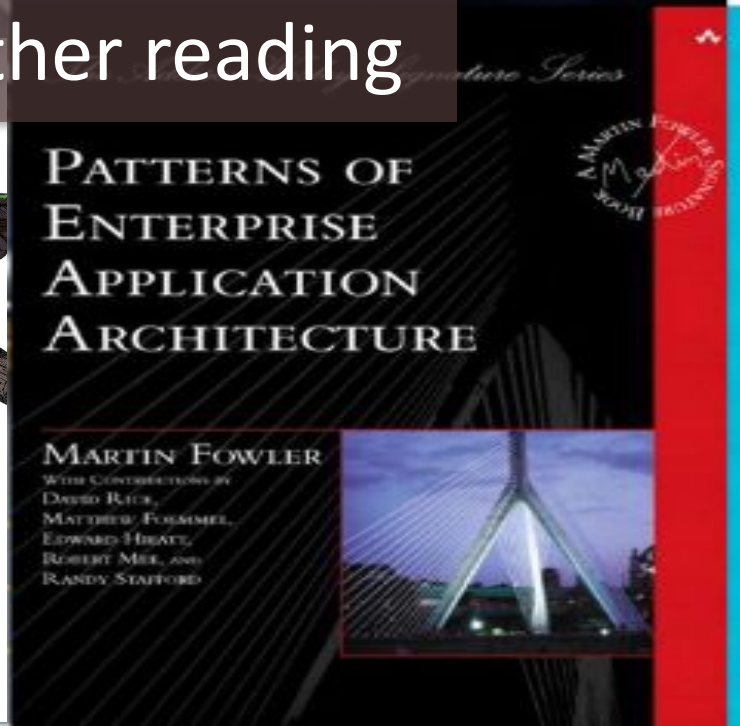
Further reading

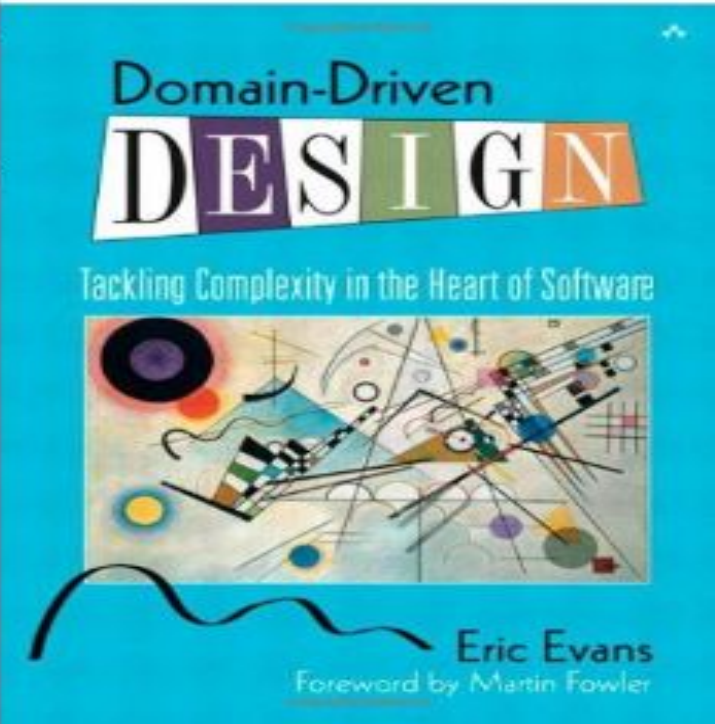










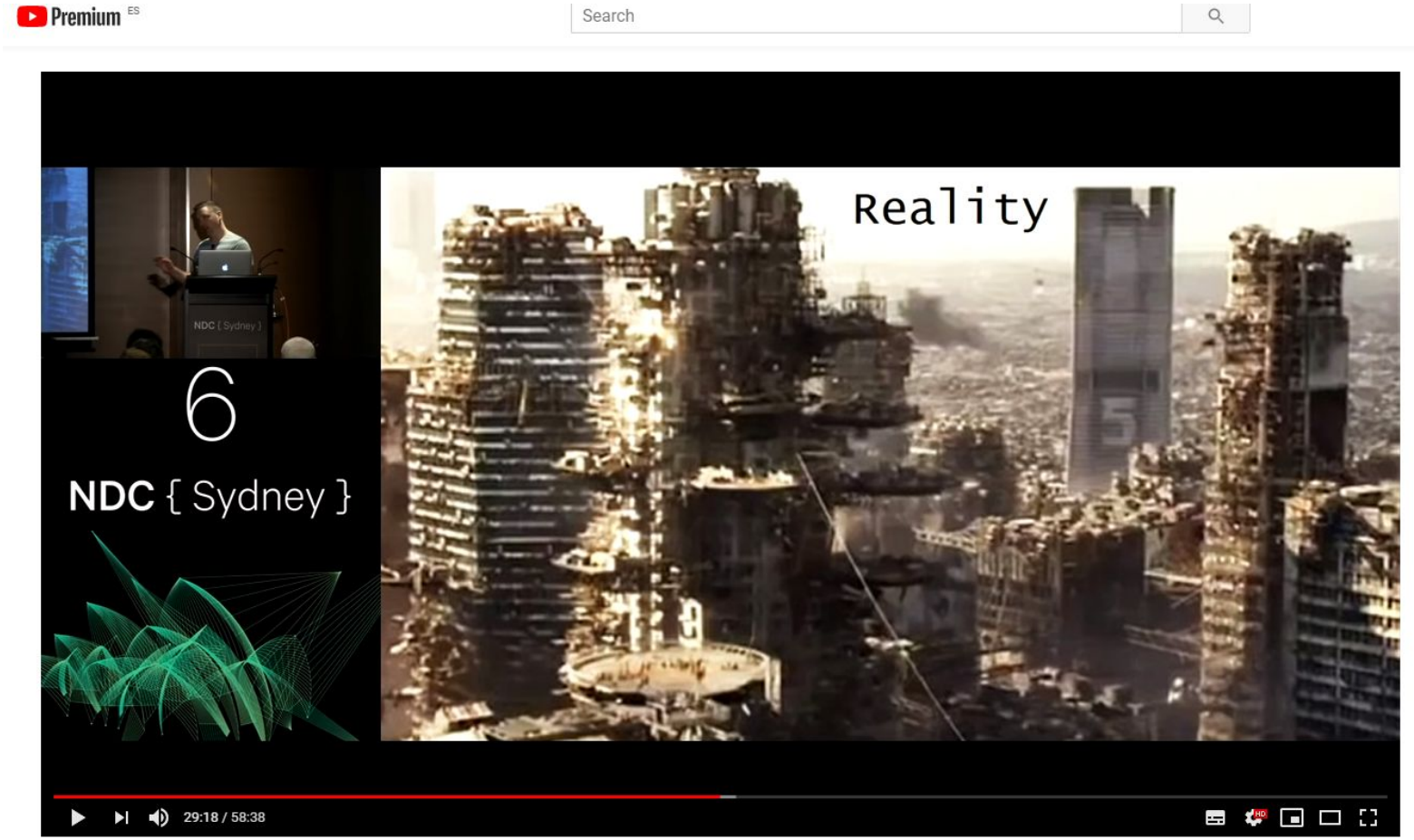


Domain Driven Design

A established, relatively formal, methodology for such language driven design is **Domain Driven Design** as introduced by Eric Evans in the 2000´s

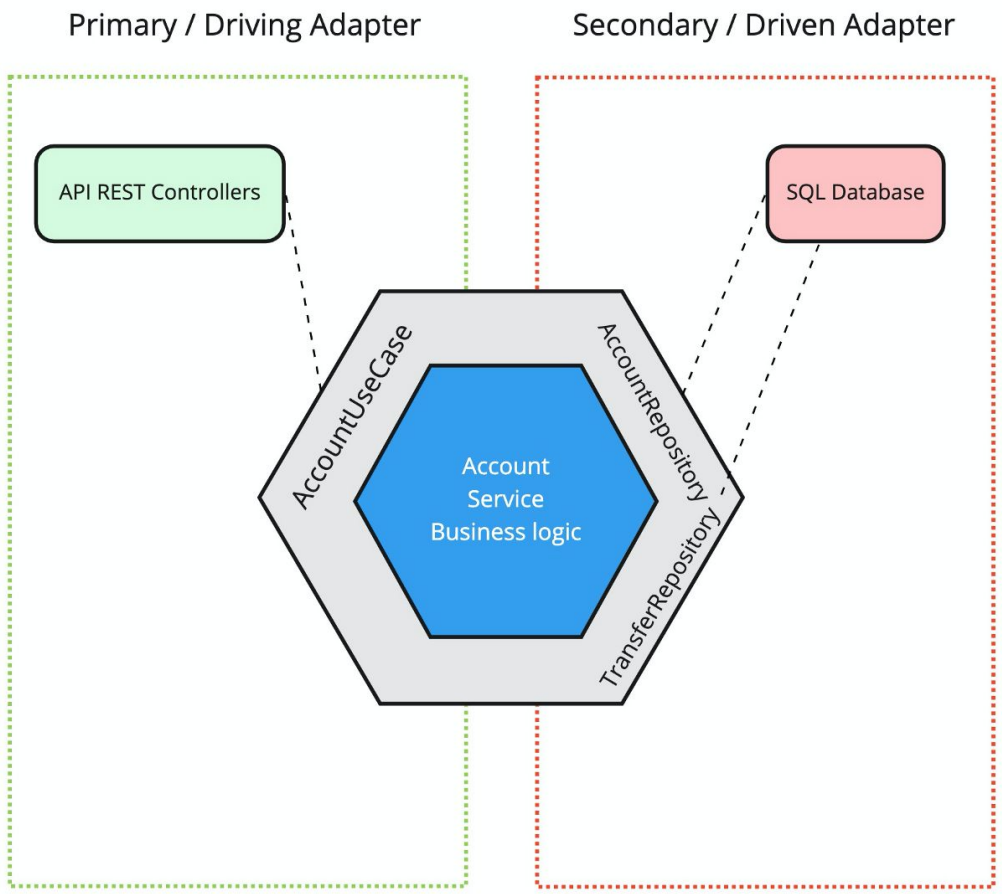
See: Domain Driven Design by Jimmy Bogard

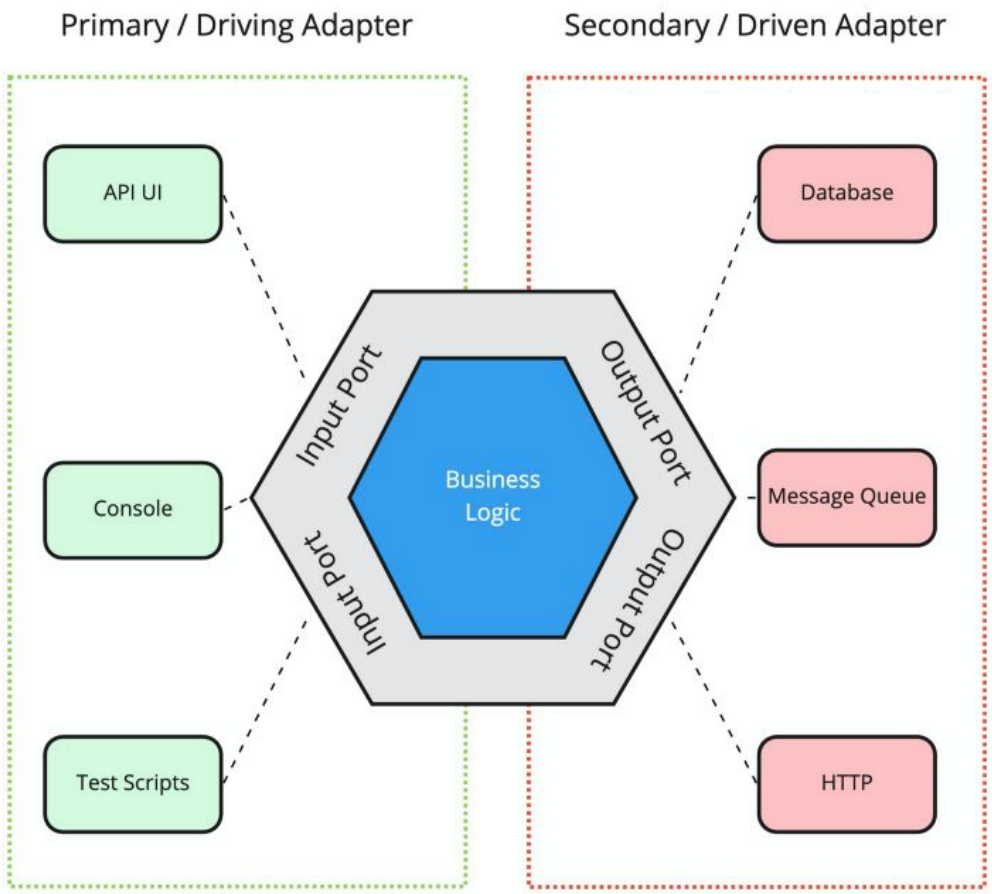
https://www.youtube.com/watch?v=U6CeaA-Phqo



Domain Driven Design: The Good Parts - Jimmy Bogard

Ports and Adapters





https://medium.com/idealo-tech-blog/hexagonal-ports-adapters-architecture-e3617bcf00a0

Next Steps for those in a hurry

https://www.infoq.com/articles/architecture-as-language-a-story/

Summary – Next Steps

Watch the videos

Read up on the **C4 Model**

Install and play around with **PlantUML and/or Draw.IO**

Try to model **an "*imaginary real/real imaginary*" system** with the **C4 Model**

Try to define the interfaces for the internal components

Rinse – Repeat

Read up on **UML** and try to play with it

Read up on **DDD** and try to play with it

Read about **Ports and Adapters**

Try to do the exercise (Appendix)

Deeper…

The Language of the System – Rich Hickey https://www.youtube.com/watch?v=ROor6_NGIWU

Summary session 2

Overview:
Session 2 shifts focus to modeling and visualization techniques, emphasizing their role in bridging the gap between design concepts and implementation. It provides practical guidance on tools and methodologies for collaborative and iterative software design.

Modeling Approaches:

- Utilize models like the 4+1 architectural view model to capture different perspectives of a system.
- Employ tools such as Unified Modeling Language (UML) for standard notations (e.g., use case, sequence, and state diagrams) while acknowledging its limitations for non-OOP paradigms.
- Highlight the importance of visualizing software architecture through C4 models and other diagramming approaches.

Challenges and Solutions:

- Model-Code Gap: Addressing differences between architecture models and source code by ensuring abstraction and traceability.
- Promote iterative refinement of abstractions, starting with high-level stories and decomposing into concrete implementations.

Component Design:

- Define components as the smallest architectural building blocks, with clearly defined APIs and functionality.
- Prioritize generic, pluggable, and testable designs, focusing on functional interfaces rather than maintaining state.

Best Practices:

- Use diagrams to visualize and document systems, ensuring alignment between models and code.
- Leverage domain-driven design and type-driven development for clarity in functionality and data modeling.

Next Steps:

- Experiment with modeling tools like PlantUML and other diagramming platforms.
- Study methodologies like Domain-Driven Design and Ports and Adapters for deeper insights.
- Practice defining interfaces and creating prototypes to enhance design understanding.

Appendix
An exercise…

https://github.com/ivanderk/guide_collab_software_design

Cognitive Canvas
Collaborative Design and Documentation Platform

Overview

Cognitive Canvas is a collaborative tool designed for software architects and developers, extending the capabilities of Excalidraw (an open-source whiteboard) with added functionality for project management, real-time collaboration, AI-assisted design, and Markdown-based documentation. It aims to streamline workflows by integrating drawing, chat, documents, and AI-generated content into a single, cohesive interface.

Key Features

- **Project Management**: Organize drawings, documents, and team chats under unified projects.
- **Collaborative Drawing**: Real-time editing powered by Excalidraw.
- **AI-Enhanced Design**: Analyze and modify drawings, assist documentation, and summarize project details using AI.
- **Integrated Documentation**: Combine drawings, documents, and AI content into cohesive reports using a Markdown editor (CodeMirror).
- **Extensible Backend**: Modular services for projects, chats, documents, and AI, designed to scale easily.
- **Code Generation**: Graphical elements and metadata are interpreted as software structures, enabling AI to generate starter code.

System Design Principles

- **Developer-Oriented**: Prioritizes modularity and extensibility for seamless integration with existing systems.
- **Scalability**: Built to grow with organizational needs, leveraging modern cloud-native solutions.
- **Open-Source Friendly**: Integrates existing components like Excalidraw, CodeMirror, and real-time libraries (e.g., Socket.IO).

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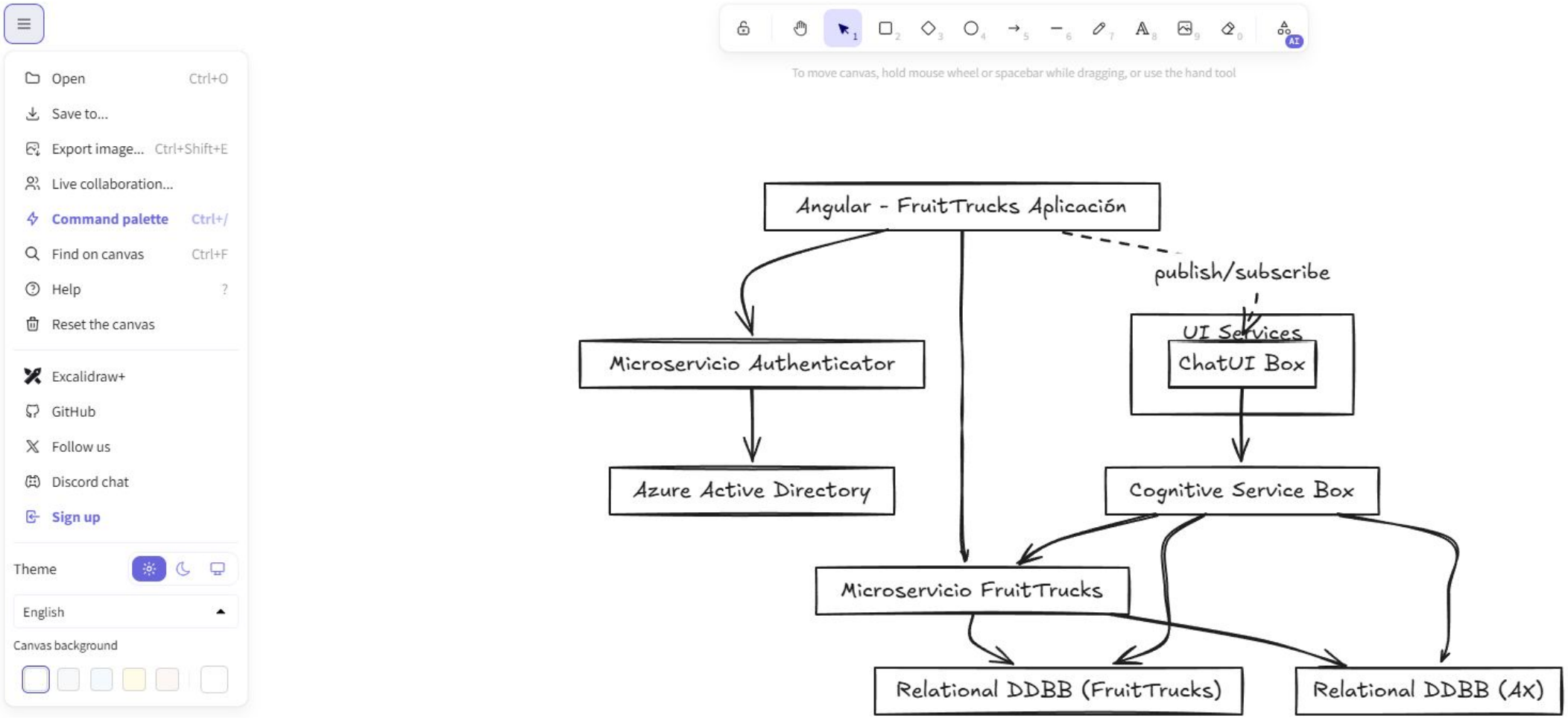

Screenshot Excalidraw

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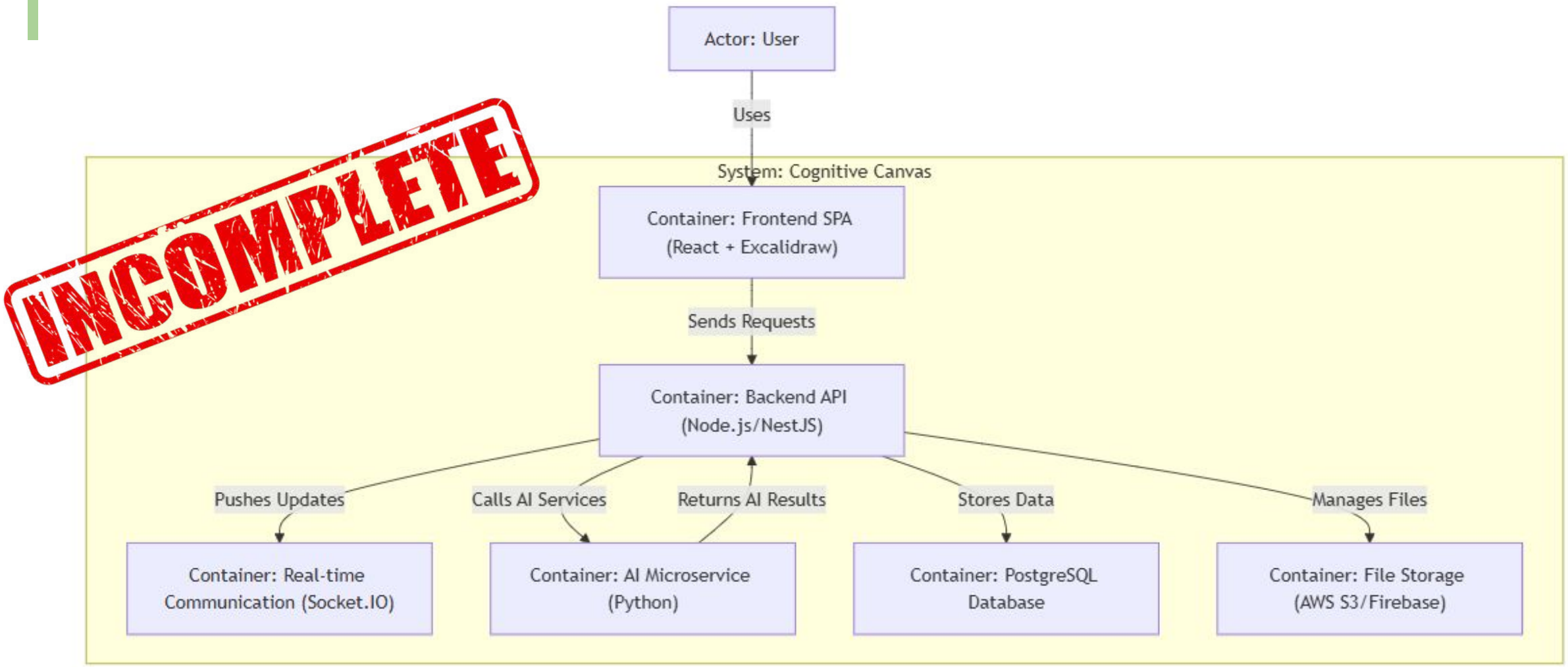

Draft solutionion sketch (incomplete)

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