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1 Software Architecture Reconstruction: Introduction

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github.com/mircealungu/reconstruction

1.1 Meta

This and following three lectures - Are material that you don't find in the SAiP textbook - Is going to be very practical - Will give you the chance to do a bit of coding for program analysis - The basis for your individual report - Have inspired several of your colleagues to choose thesis projects

Feedback & Questions - Anonymous form - Email: mlun@itu.dk - PR on the .md version of the slides on GH if you see bugs

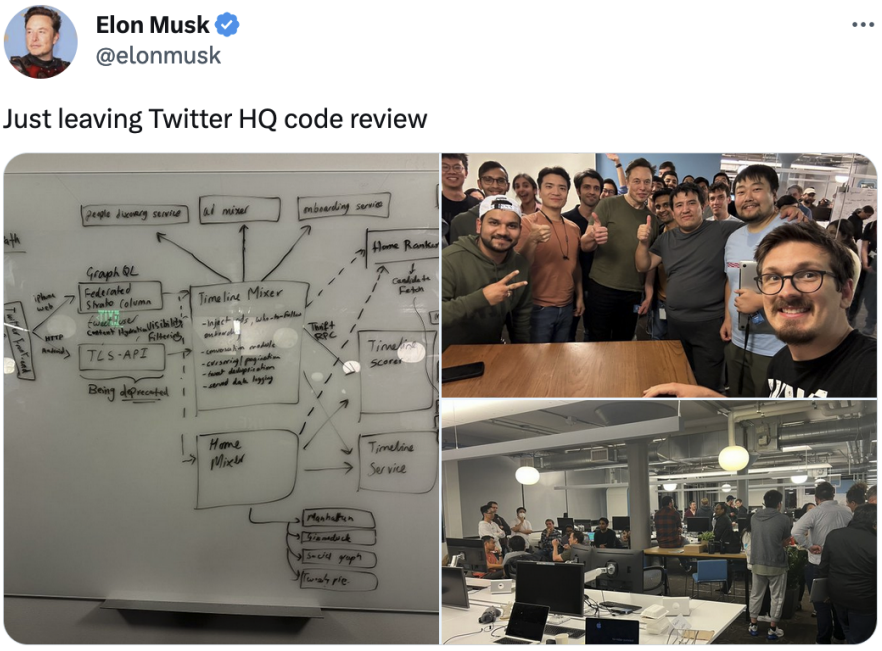
1.2 Imagine . . .

- Onboarding on a new system
- Buying a software company
- Having to do
  - a risk assessment for security
  - an architectural evaluation

Q: What would be nice to have in all these circumstances but we almost never have?

Hint: Even paying 50B for a company does not guarantee that you get this particular artefact. . . ?

1.3 An up-to-date architectural diagram



link to original tweet

1.4 Discussion

Have you seen architectural documentation for every system?

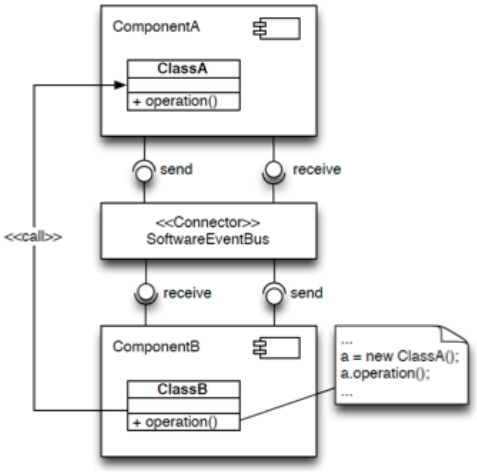
- No, *Why is it missing?*
- Yes?
  - Is it up to date?
  - *No? Why not?*

1.5 Why does architectural documentation not always exist and is not up to date?

- Hard to maintain
- Sometimes that's not a priority at all - you're a startup that needs to show that it's viable
- It requires a better and more general understanding of the system than just coding -> not everybody can even do it
- Maybe you're designing your own product and nobody to ask you to do it
- Link (traceability) between architecture and code is not easy to establish

- Often there is no perceived value for the customer (or more likely, no clear immediate value)
- Because developers make decisions and changes
  - that are not aligned with the original vision => **architectural drift**
  - that go against prescriptive architecture => **architectural erosion**

1.6 Architecture Erosion Example



What could be the cause of erosion here?

Why would it be a problem?

1.7 How to Keep Architectural Documentation up to Date?

1 / **Enforcing architectural constraints** - special DSLs and tools for architecture constraints definition (e.g. Dictō) (docker-compose? infrastructure?) - type system? - some are implemented as Unit Tests (e.g. ArchUnit)

How to integrate? - pre-commit hooks? - CI/CD - IDE

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2 / **Generating architectural diagrams from code** - as opposed to drawing them in Powerpoint - we'll see techniques for doing this - no sufficiently good tools for this

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3 / **Reconstructing the Architecture** - and ideally follow up with one of the previous two

2 Architecture Reconstruction (AR)

a.k.a: *architecture recovery* (the two are used interchangeably)

(def.) **A reverse engineering approach that aims at reconstructing viable architectural views of a software application** [1]

- reverse engineering?

[1] Ducasse & Pollet, Software Architecture Reconstruction: a Process-Oriented Taxonomy

2.1 Reverse Engineering

(def.) the process of analyzing a subject system to identify the system's components and their interrelationships and create representations of the system in another form or at a higher level of abstraction. (Demeyer et al., Object Oriented Reengineering Patterns, Chapter 1.2)

Focus on - components - relationships - higher level of abstraction

Relation with architecture recovery? They are overlapping activities and use overlapping methods.

2.2 Reverse Engineering vs. Reengineering?

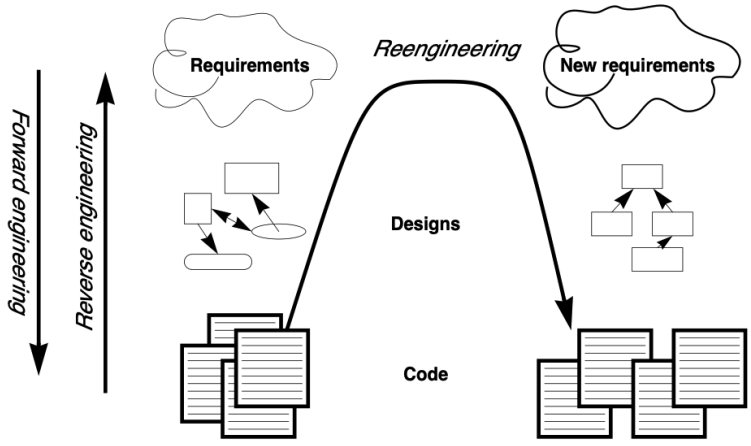
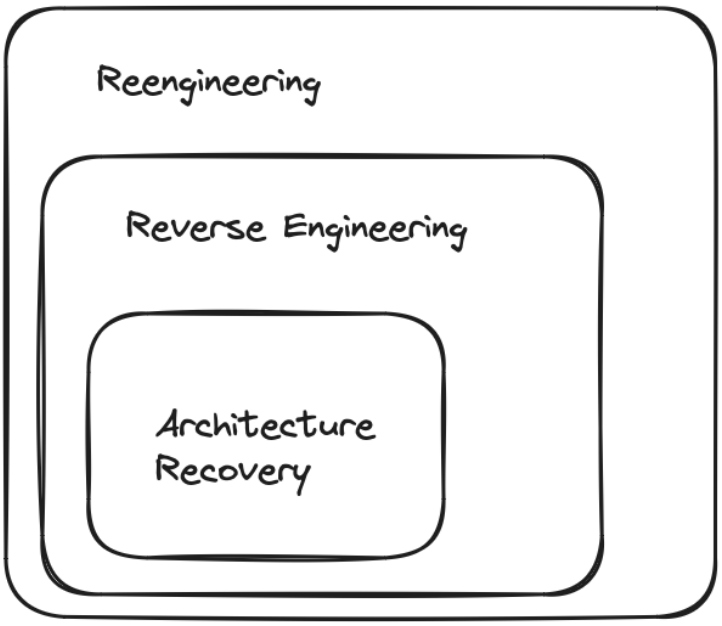


Figure 1.1: Forward, reverse and reengineering

"Reengineering is the **examination and alteration** of a subject system to reconstitute it in a new form" (Demeyer et al., Object Oriented Reengineering Patterns, Chapter 1.2)

? Relation with AR? AR could be a possible first step in reengineering

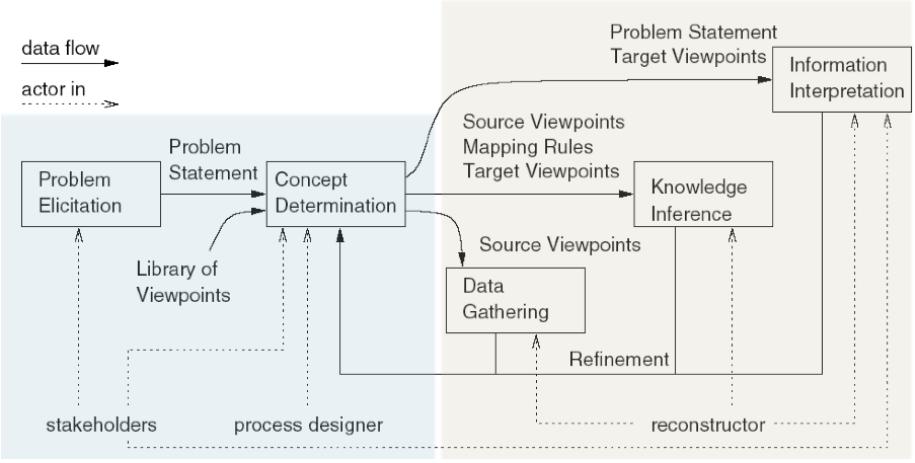


3 How To Do Architecture Reconstruction?

Symphony: View-Driven Software Architecture Reconstruction

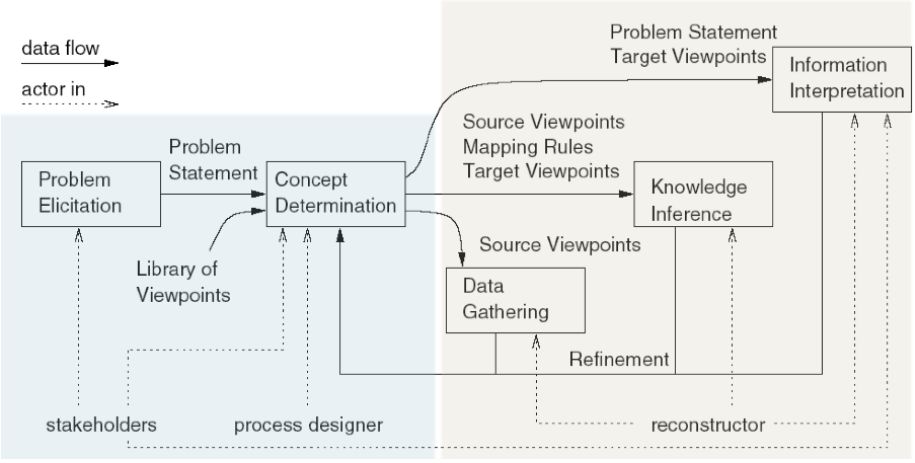
- Classical, principled way
- View-driven approach
- Distinguishes between three kinds of *views*
  1. **Source**
     - view extracted directly from artifacts of a system
     - not necessarily architectural (e.g. see later example)
  2. **Target**
     - describes architecture-as-implemented
     - any of the 3+1 views
  3. **Hypothetical**
     - architecture-as-designed
     - existing documentation
     - presentations

3.1 Symphony Stages: Design (blue) & Execution (yellow)



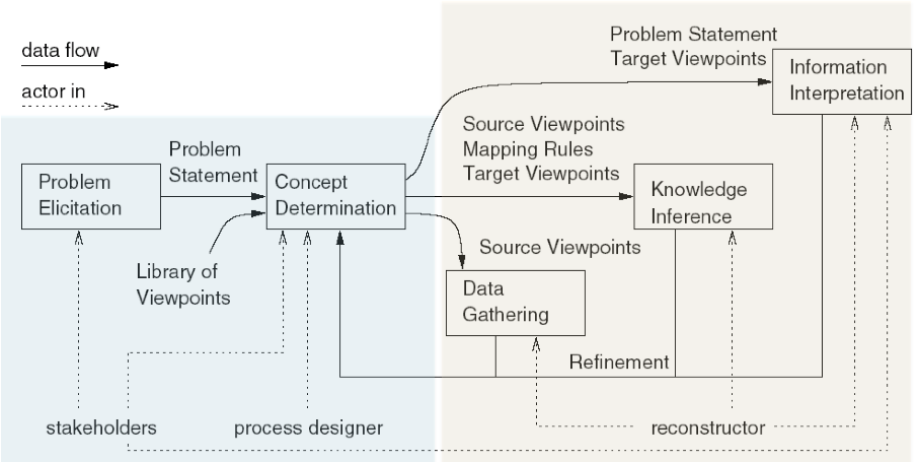
3.1.1 Desgin: Problem elicitation

- "Business case" for reconstruction
- What is the problem?



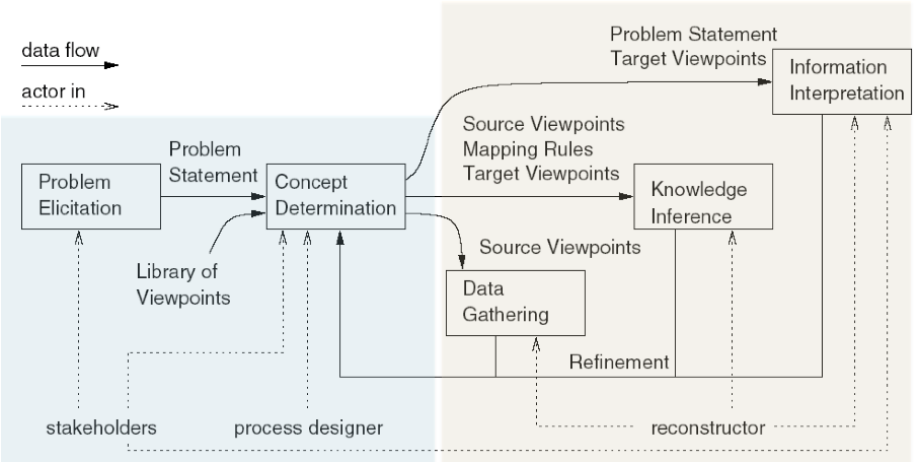
3.1.2 Design: Concept determination

- What architectural information is needed to solve the problem?
- **Which viewpoints are relevant?**



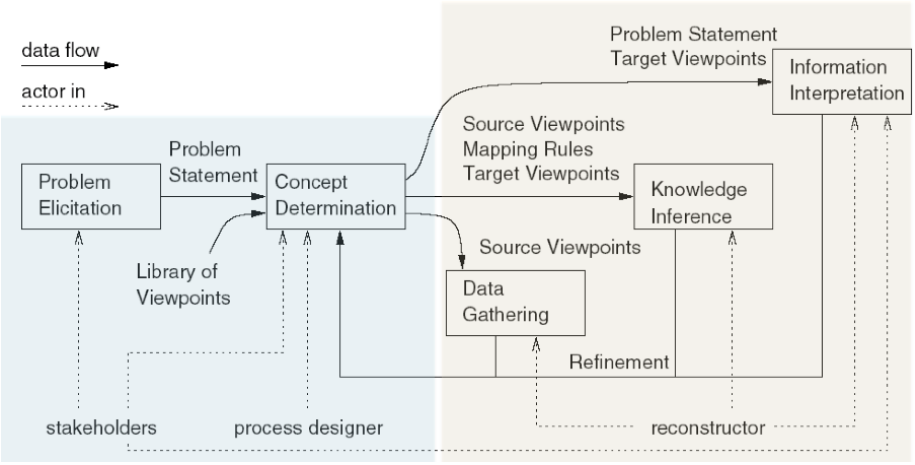
3.1.3 Execution: Data gathering

- Collecting and extracting low-level **source views**
- Can involve a multitude of sources



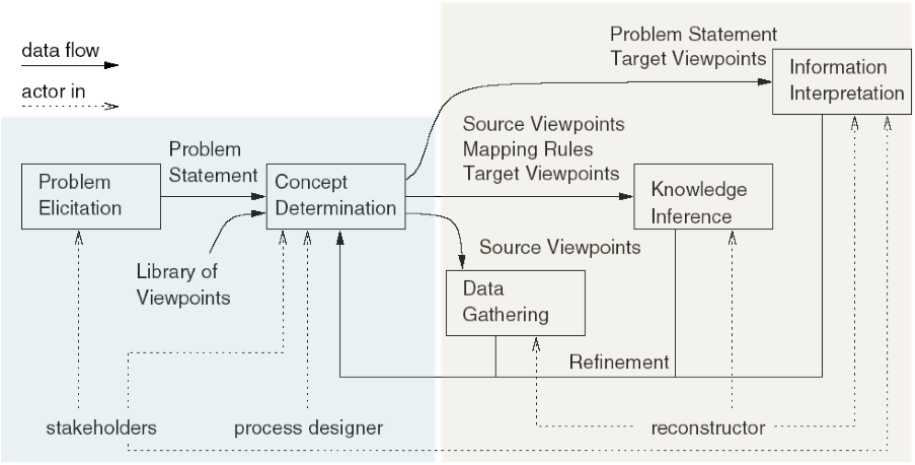
3.1.4 Execution: Knowledge inference

- Going from **source** to target **views**
- Abstracting low-level information



3.1.5 Execution: Information interpretation

- Visual representation
- Analysis, creating new documentation



3.2 Data Gathering: Interactive Case Study

Example: Google Collab with Basic Data Gathering

Or, *why source viewpoints are not necessarily architectural?*

4 Individual Assignment

4.1 Goal

- **Recover the architecture of an existing system**
- Document the outcome in an **individual report**
  - brief (not more than 3 – 5 pages)
  - do not explain to us what Symphony does in the report; you assume it's done
  - focus on your results
  - the target reader is a developer, who needs to take over that system and maintain it

4.2 Case-Study Systems

1. The Zeeguu Project
   - Online Deployment (invite code: zeeguu-usability)
   - Code:
     - Python Backend: Zeeguu-API
     - React Frontend: Zeeguu-Web
   - A paper about the system

or,

2. Another system that you know
   - if it has comparable complexity (>200 files)
   - you confirm with me about the appropriateness of the system

4.3 Viewpoints

1. Module Viewpoint (**default**)
   - we will write example code snippets in collab to support this
   - makes the most sense for the Zeeguu system
2. Other Viewpoints
   - you could look at the execution or deployment information
   - might make more sense for another system - the Zeeguu one is too simple (could be done together with the module)

4.4 Tools

- Are important for recovery
- **If you can program**, then this is your chance to be coding **analysis tools** over the upcoming lectures
  - you can still code as a team! you only have to write the analysis on your own

- **If you can't program**, then you'll have to find third party tools (the time the programming ones spend on programming, you'll be spending on finding third party tools)

5 For Next Week

5.1 Reading

- Symphony: View-Driven Software Architecture Reconstruction
- Demeyer et al., Object Oriented Reengineering Patterns (Chapter 1.2)

5.2 Individual Project

- Look at individual project description - you'll understand it better after the next week
- Start looking for a case study that you would like to analyze

5.3 Practice

- Google Collab with Basic Data Gathering
  - Understand the code
  - Apply it on your own case study if you already have one
  - Can you complete the implementation of the import extractor with the missing part?

5.4 Questions & Feedback

- Use the anonymous form
- Or the forum if it's of general interest