# Software Engineering 2

## A practical course in software engineering

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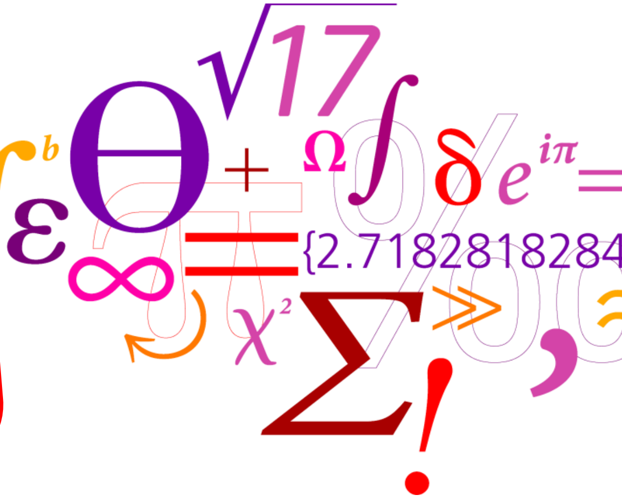
**Note**: These slides are a selection of the slides from lecture 3



# III. Specifying Software

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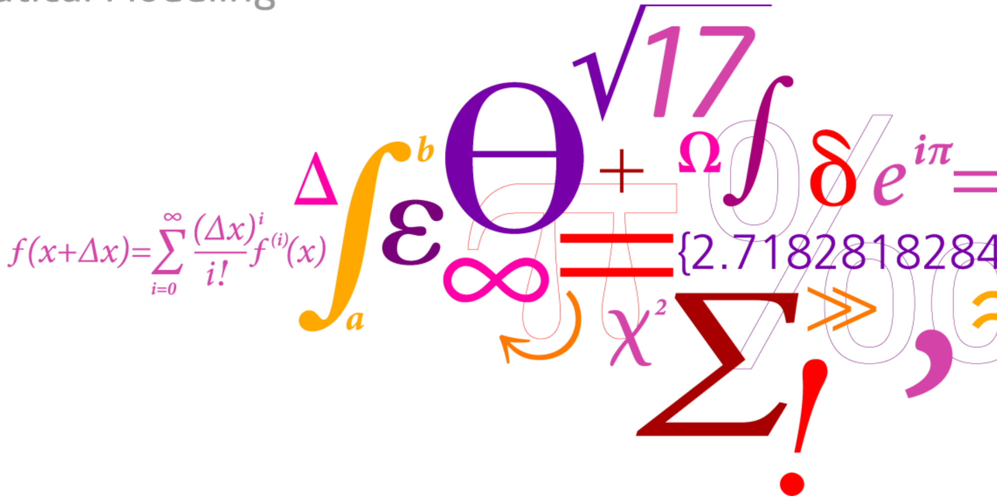
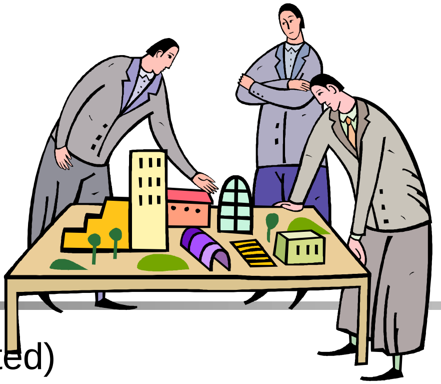
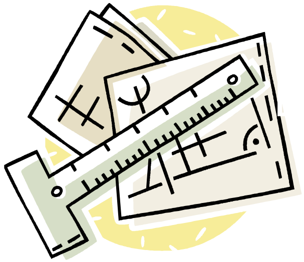

$f(x+\Delta x)=\sum_{i=0}^{\infty}\frac{(\Delta x)^i}{i!}f^{(i)}(x)$
$\Delta\int_a^b \varepsilon\, \Theta^{\sqrt{17}} + \Omega \int \delta e^{i\pi} =$
$\infty$
{2.7182818284
$\chi^2$
$\Sigma!$
≫

# III. Specifying Software

Goals:

- Defining what the software should do (before it is really there)
- **C**ustomer and **D**eveloper agree on what should be delivered
- Effort (resources and time) can be planned based on that (contract will be based on that).



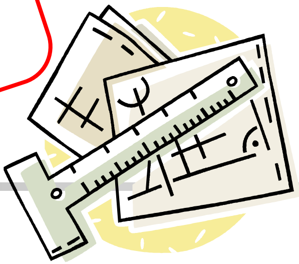


# Specifying Software

what

- Project Definition
- Requirements Specification
  - rough
  - detailed
- Systems specification
- Complete Models
- Implementation, Documentation Handbook

Actually, handbook is "what"; it could be part of the requirements specification.



how

# Specifying Software

- Project Definition
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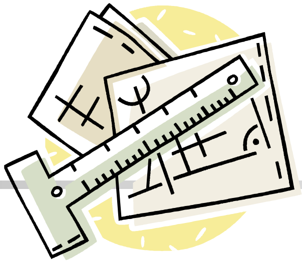
rough

detailed



# Specifying Software

- Project Definition
- Requirements Specification
  - rough
  - detailed
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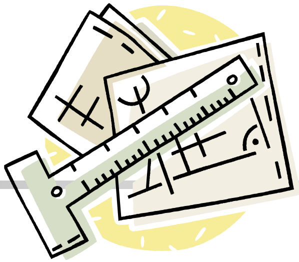
low cost

↓

high cost



# Specifying Software

Goals:

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On which kind of document will (can) the cost calculation and the contract be based?

Trade off:
earlier: lower cost / higher risk
later: higher cost / lower risk

# Project Definition: Contents

what

rough

Use examples, how things could look like in the final product.

- Partners
- Context
- Objective
- Scope
  (in particular, what is NOT to be done)
- **Functionality** (from the end-users point of view)
  - Users
  - Use cases (as text, not necessarily as diagrams)
  - Main data (in our case ”modelling concepts”, ”extra 3D info”)
- Platform (HW/SW)
- Glossary of main terms

→ inductive vs deductive writing!

# 2. Requirements Specification

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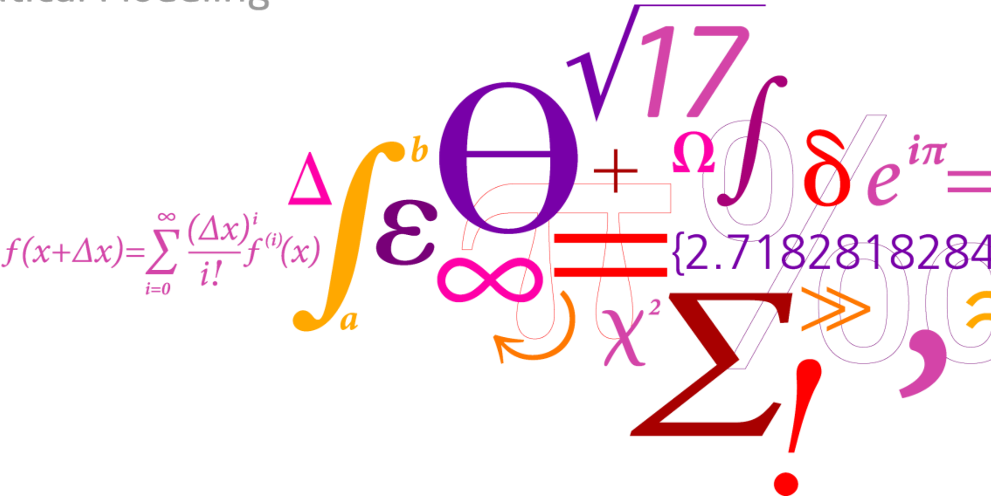
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# Specifying Software

- Project Definition
- Requirements Specification
  - rough
  - detailed
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# What do we need?

“Why”

- What should be achieved by the product?

- How is it used?
- Which functions does it have?
- Which data are there?
- What interfaces should be there?

“What”

- In which quality?

- On which platform or technology?

“how”

# Requirements Spec

Partners: Customer & Developer

1. Objectives
2. Product use
3. Product functions
4. Product characteristics (non-functional req.)
   - Platform
   - Performance
   - Security
   - …
5. Glossary
   (could be included somewhere else)

This can be done on different levels of detail: Project proposal, requirements specification, systems specification, final documentation.

# Differences

- Project definition / idea
- Text (possibly sketch of screen shots); not complete

- Requirements specification
  - Rough
  - Use cases (named), glossary, rough domain model
  - detailed
  - Use cases modelled and explained, complete domain model, GUI design (sketch), acceptance tests

The exact definition of different specification types varies: structure, level of detail, models, …

- Systems specification
- Architecture & design of Software, detailed models, software models

# 3. Software Specification

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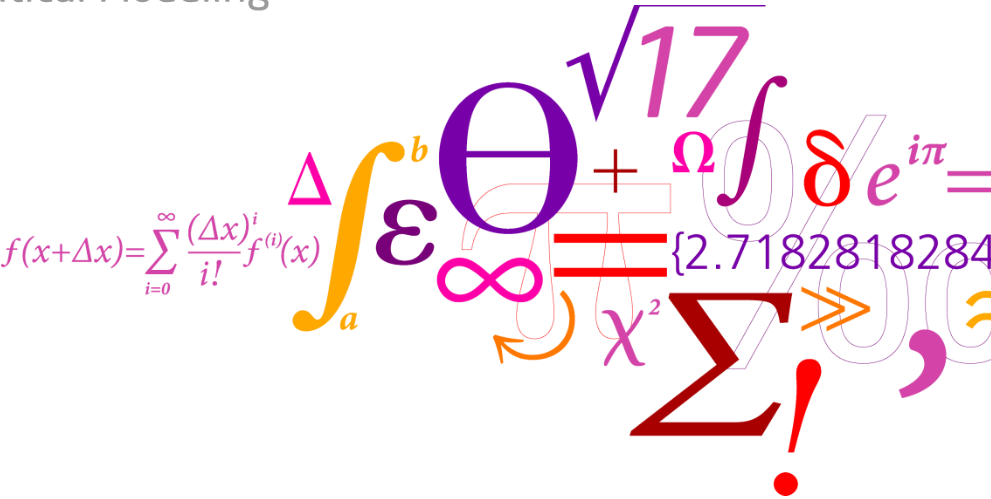
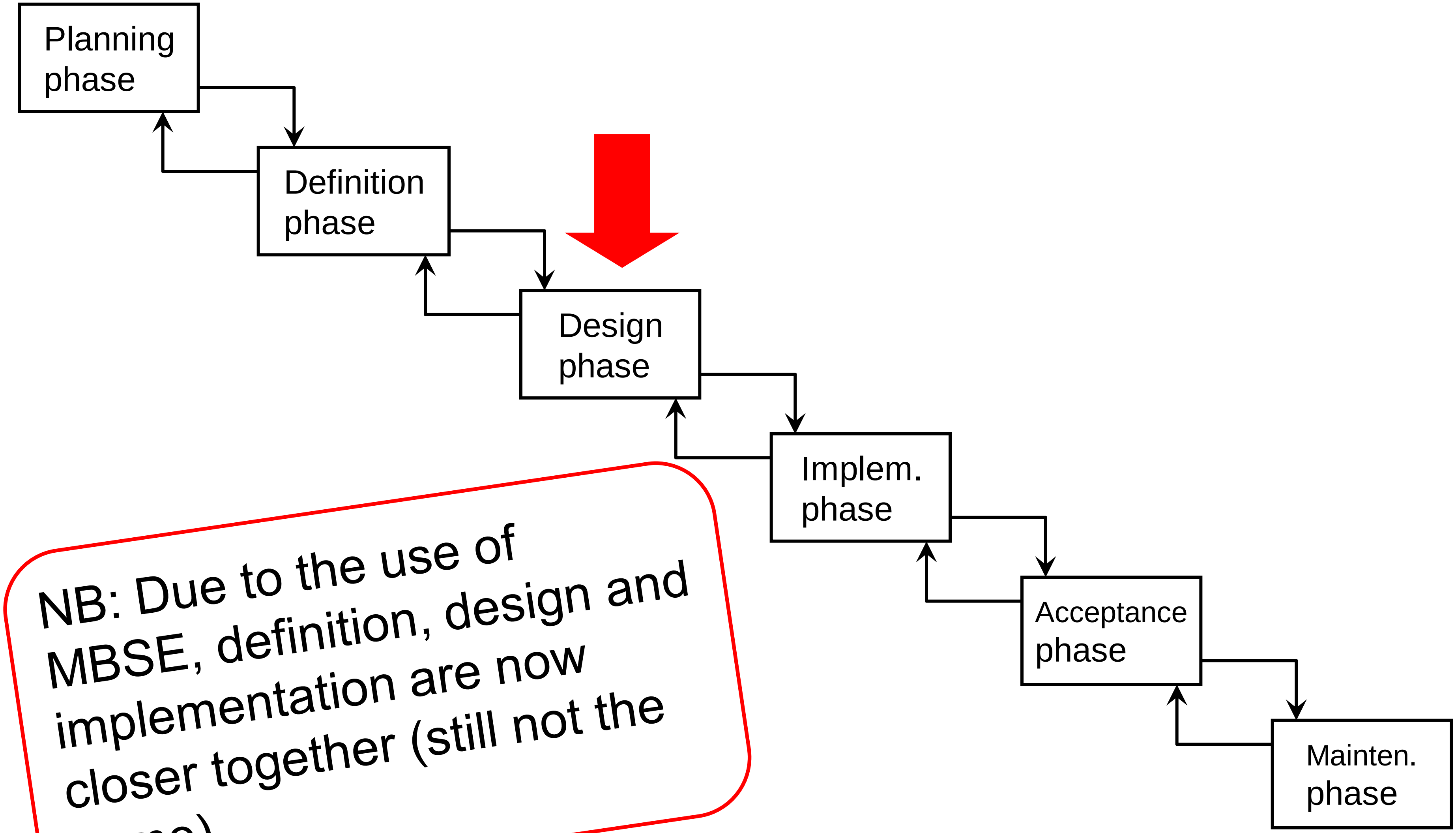


# Design Phase



NB: Due to the use of MBSE, definition, design and implementation are now closer together (still not the same).

# Specifying Software

Recapitulation
(→ p. 3)

Goals:

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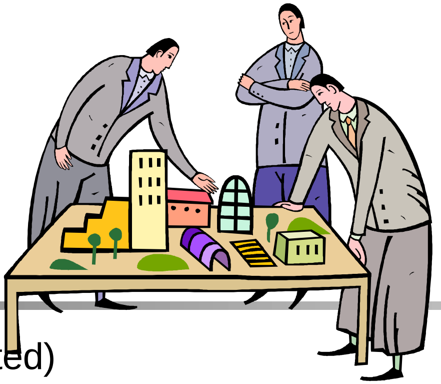
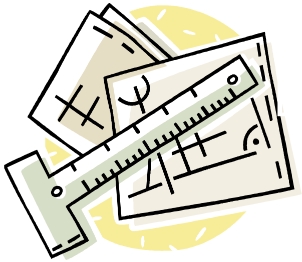




# Specifying Software

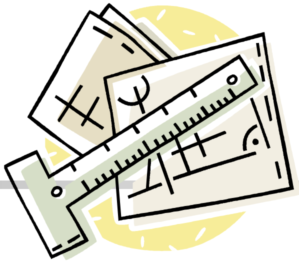
Recapitulation
(→ p. 4-6)

- Project Idea
- Requirements Specification
    - rough
    - detailed
- Systems specification
- Complete Models
- Implementation, Documentation Handbook

what

↓

how

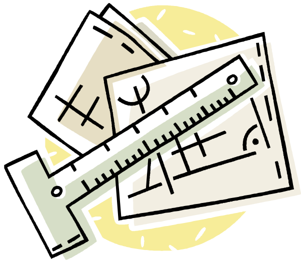


# Now: Software Specification

**Goals**:

- Defining **how** the software should be technically realized
- In such detail that the implementation is “details only”

C-requirements



**D-requirements**

# Main issues

"programming in the large"

- Software architecture / implementation architecture
- auxiliary systems and infrastructure persistent storage of data (→DB and DAL)
- GUI

With EMF, much of the auxiliary structure comes for free. As do a simple form of "persistence" (e.g. XMI serialisation) and some parts of the GUI.

- and the relation between them (and the domain model).

# Architecture

- Software architecture:
  - Main components and sub-components of the system
  - Interfaces (provided and required) of the components
- Implementation architecture:
  - Software architecture +
  - Platform, technology, and language specific details

# Architecture

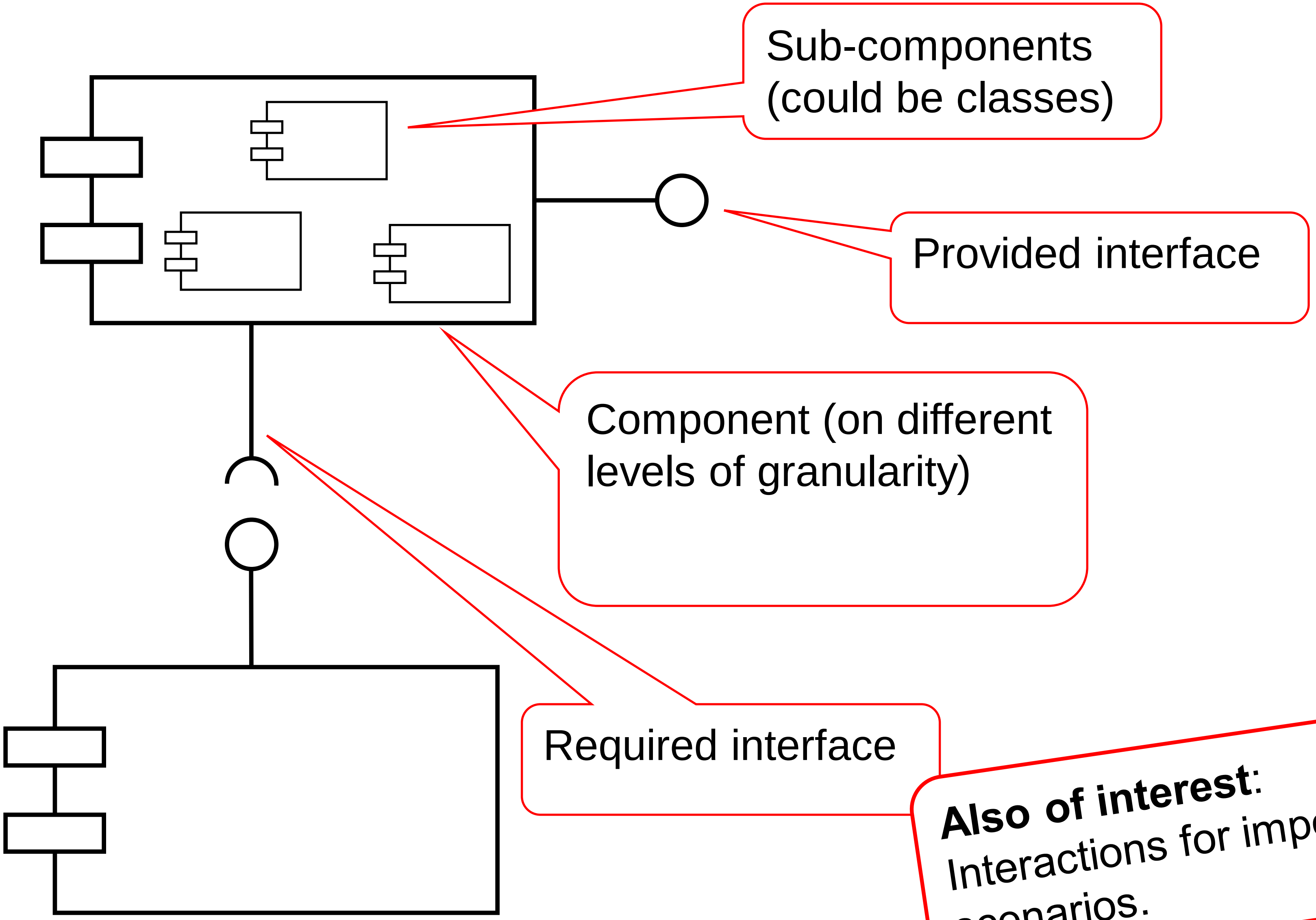
Use cases (refined) + activity diagrams should also be contained in the systems specification.

- Notations:
  - Component diagrams
  - Class diagrams (refined)
  - Design patterns & their terminology
  - Sequence diagrams + state machines

Behaviour at interfaces

Behaviour of important components or classes

# Reminder: Component Diagrams



Sub-components (could be classes)

Provided interface

Component (on different levels of granularity)

Required interface

**Also of interest**: Interactions for important scenarios.

# Design principles

- Clearly identified functionality
- Simplicity of interfaces
- Loose coupling between different components
- Performance / efficiency

# Model refinements

- Naming conventions
- Directions of associations
- Relaxed cardinalities
- Proper containments (→ serialization)
- Visibilities of attributes and references
- “Characteristics” (→ EMF generation)
- Auxiliary attributes, classes, and associations (in EMF often generated automatically)
- DB Schema

# Excursion / Discussion

(OO) Analysis vs. (OO) Design

# GUI

Screenshots (or mock-up screenshots) help writing a readable text on the functionality from a user point of view.

- Sketch GUI visually
- Associate GUI elements with model elements
- Discuss main use cases in terms of GUI (hand book)

# Req Spec vs. Swt Spec

1. Objectives
2. Product use
3. Product functions
4. Product characteristics (non-functional req.)
   - Platform
   - Performance
   - Security
   - …
5. …
6. Glossary

**Systems spec =**
**Requirements Spec +**

- Database Schema
- GUI
  (more detailed → Handbook)
- Architecture
- Refined models (from technical perspective)