Use cases

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SoftEng http://softeng.polito.it

Requirements Document

1. Purpose and scope
2. Glossary
3. **The use cases**
4. The technology to be used
5. Other various requirements
6. Human backup, legal, political, organizational issues

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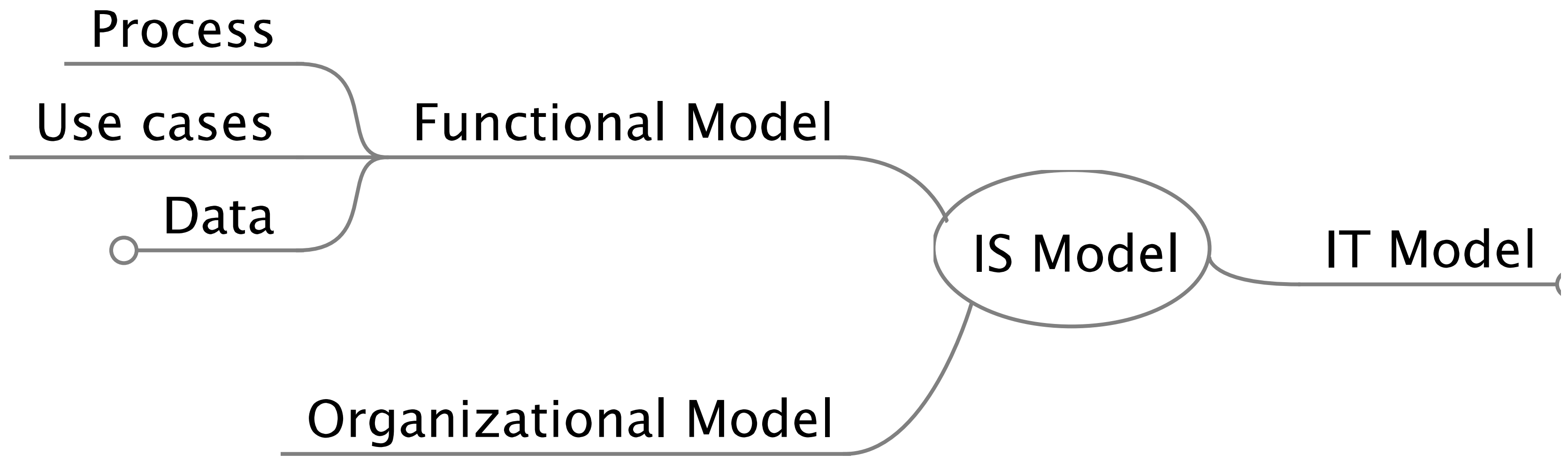
Functional model – Use cases



History

- Introduced by Ivar Jacobson in 1992
  - codified a visual modeling technique
- Widespread adoption in the 1990's
  - initially in the Object-Oriented community

Use case

- Captures a contract between the stakeholders of a system about its behavior.
- Describes the system's behavior under various conditions as it responds to a request
  - from a stakeholder, the *primary actor.*
- The primary actor initiates an interaction with the system to accomplish some goal.
- The system responds, protecting the interests of all the stakeholders.

Purpose of Use Cases

- Describes business’ work process,
- Focus discussion about upcoming software system requirements,
- Describe functional requirements for a system
- Document the design of the system

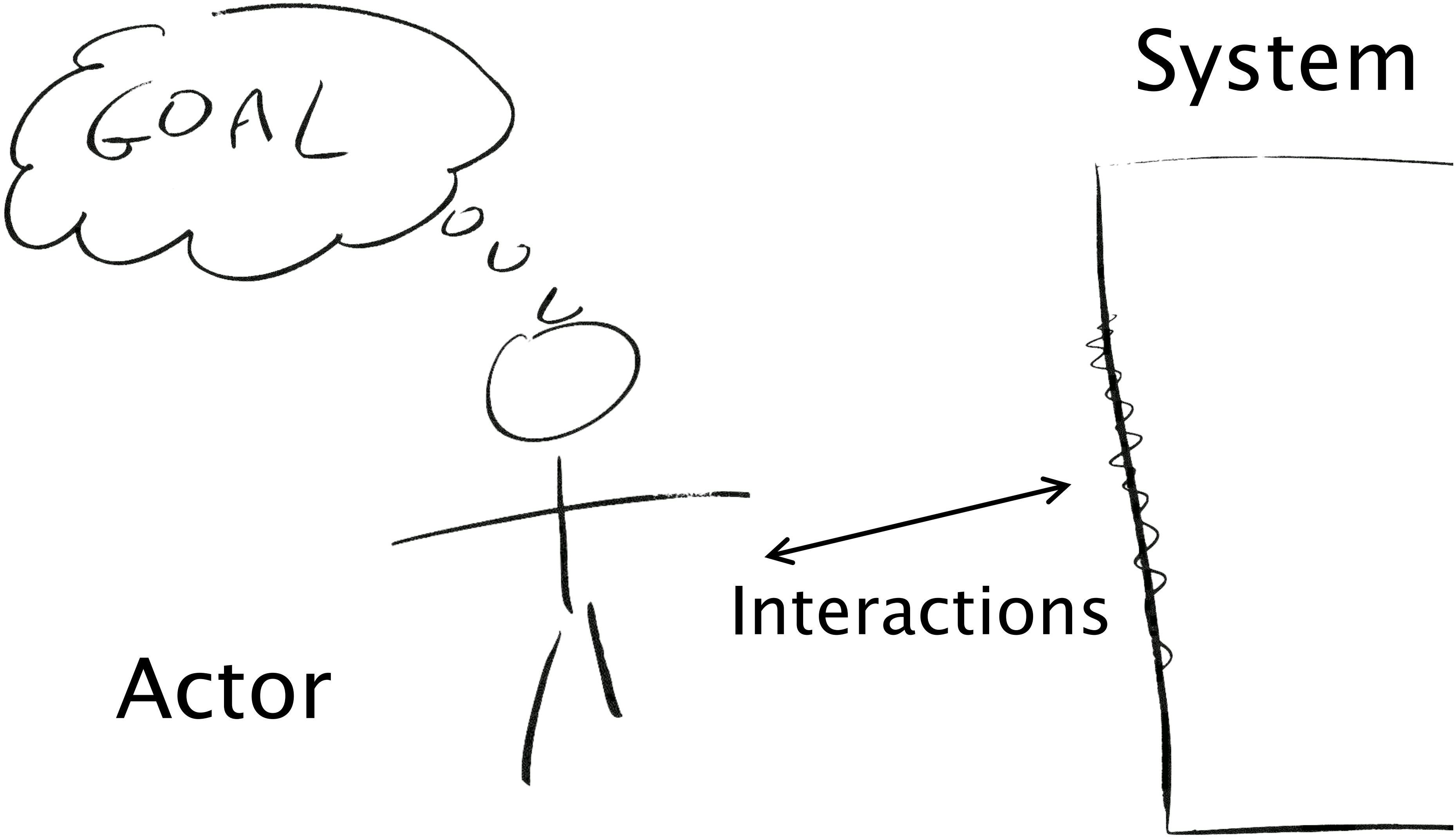
Requirements and Use Cases

- Use cases can represent the functional (behavioral) requirements
  - If properly written
- They miss
  - External interfaces
  - Data formats
  - Business rules

Definition

A use case describes a goal-oriented set of interactions between external actors and the system under consideration.

Key elements



Key elements

- The actor involved
  - type of user that interacts with the system
- The system being used
  - treated as a black-box
- The functional goal that the actor achieves using the system
  - the reason for using the system

Description

- Use cases describe the sequence of interactions between actors and the system
  - to deliver the service that satisfies the goal
- They also include possible variants of this sequence
  - either successful or failing

Actor

- Actors are parties outside the system that interact with the system.
- An actor may be a class of users, roles users can play, or other systems.
  - A primary actor is one having a goal requiring the assistance of the system.
  - A secondary actor is one from which the system needs assistance.

Actor

- External entities:
  - Which persons interact with the system (directly or indirectly)?
    - Don't forget maintenance staff!
  - Will the system need to interact with other systems or existing legacy systems?
  - Are there any other hardware or software devices that interact with the system?
  - Are there any reporting interfaces or system administrative interfaces?

Goals

- The use case describes only what is the relationship of the actor to the system
- The goal must be of value to the (primary) actor:
  - “Enter PIN code” is not
  - “Withdraw cash” is

Goal

As a *<actor type>*

I want *<to do something>*

So that *<some value is created>*

Goal

bank customer

As a ~~*<actor type>*~~

to perform a withdrawal

I want ~~*<to do something>*~~

I get some cash for me

So that ~~*<some value is created>*~~

Stakeholders and interests

- The system under design operates a contract between stakeholders
    - Use cases detail the behavioral part
- Use cases capture all and only the behaviors related to satisfy the stakeholders' interests

    - See Guarantees section

Stakeholders

- Someone having a vested interest in the behavior of the system (use case)
  - Actors (users) represent the main subset of stakeholders
  - Also offstage actors
    - E.g. owner, board of directors

Context abstraction

- Enterprise
  - Business use cases
- Software System
  - System use cases
- Software Component

Scope

- The extent of what we consider to be designed by us
  - Not already existing
  - Not someone else's design job
- Defined by
  - In-out list
  - Actor-Goal list
  - Use case briefs

In-out list

- What lies in or out of scope

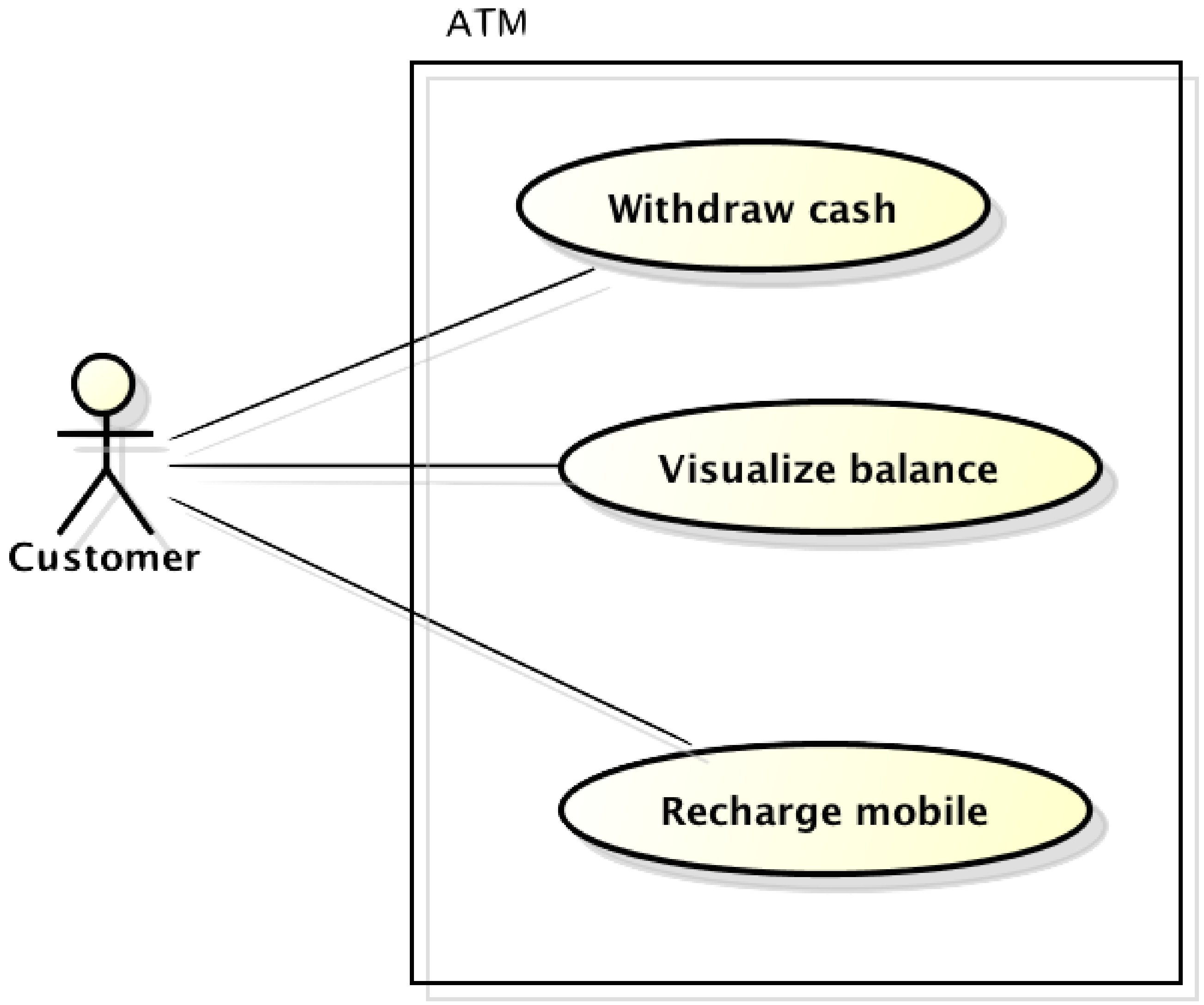
Topic	**In**	**Out**
Invoicing in any form		Out
Producing reports about requests, e.g. by vendor, by part, by person	In	
Merging requests to one PO	In	
Partial deliveries, late deliveries, wrong deliveries	In	
All new system services, software	In	
Any non-software parts of the system		Out
Identification of any pre-existing software that can be used	In	
Requisitions	In	

Actor–goal list

- Actors and corresponding goals + Priority
  - See UML Use Case Diagrams

Actor	Task-level Goal	Priority
Any	Check on requests	1
Authorizor	Change authorizations	2
Buyer	Change vendor contacts	3
Requestor	Initiate an request	1
"	Change a request	1
"	Cancel a request	4
"	Mark request delivered	4
"	Refuse delivered goods	4
Approver	Complete request for submission	2
Buyer	Complete request for ordering	1
"	Initiate PO with vendor	1
"	Alert of non-delivery	4
Authorizer	Validate Approver's signature	3
Receiver	Register delivery	1

Actor-goals as UC Diagram



Precision

- How much detail is provided
  - Brief
    - few sentences summarizing the use case
  - Casual
    - few paragraphs of text elaborating the use case in the form of a summary or story
  - Detailed
    - formal document based on a long template with fields for various sections

Use case briefs

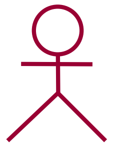
Actor	Goal	Brief
Production Staff	Modify the administrative area lattice	Production staff add admin area metadata (admin hierarchy, currency, language code, street types, etc.) to reference database and contact info for source data is catalogued.
Production Staff	Prepare digital cartographic source data	Production staff convert external digital data to a standard format, validate and correct it in preparation for merging with an operational database. The data is catalogued and stored in a digital source library
Production & Field Staff	Commit updated transactions of a shared checkout to an operational database	Staff apply accumulated update transactions to an operational db. Non-conflicting transactions committed to operational dn. Application context synchronized with op. db. Committed transactions cleared from application context. Leaves op. db consistent with conflicting transactions available for manual/interactive resolution.

USE CASE DIAGRAMS

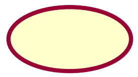
Use case diagrams

- Use cases can be (collectively) represented using UML use-case diagrams
- Often the “brief” level of detail can be useful in this context
- Note:
    - Use case diagrams report only the goal (in summary) they lack the detailed interactions (a.k.a. the narrative)

Elements of use case diagrams

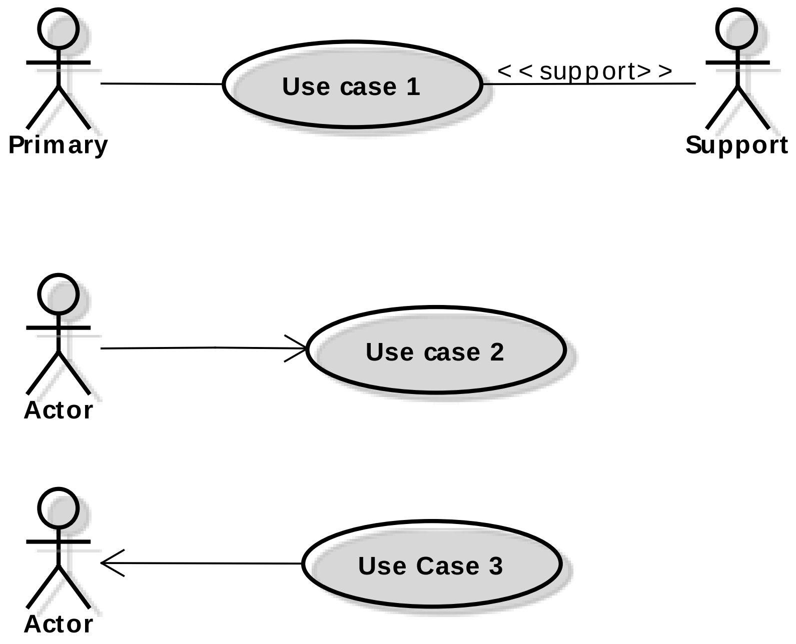


- Someone (user) or something (external system, hardware) that
  - Exchanges information with the system
  - Supplies input to the system, or receives output from the system



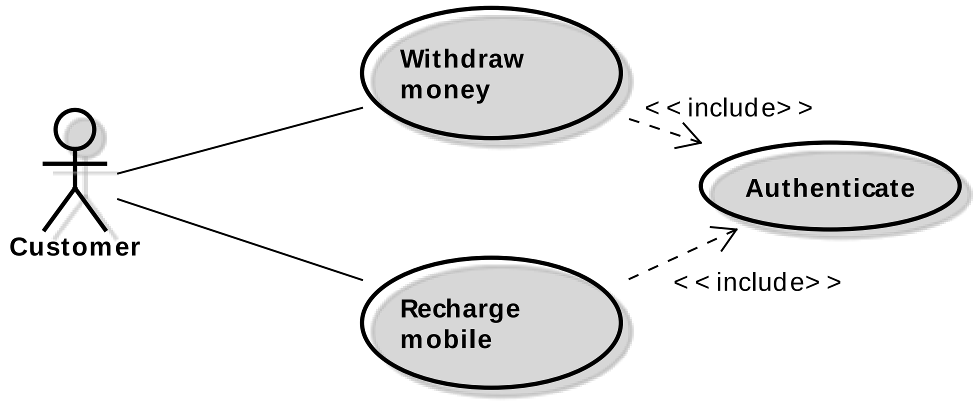
- A functional unit (functionality) part of the system

Relations – Participation



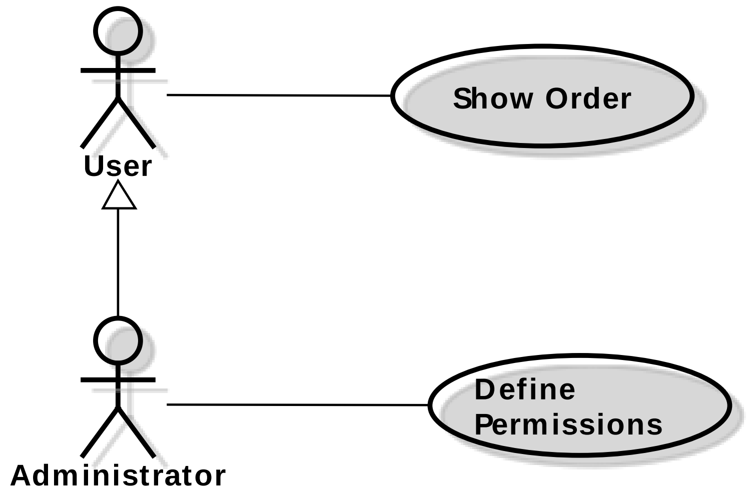
- Participation models:
  - Which actors participate in a use case
  - Whether an actor is just supporting
  - Where execution starts

Relations – Inclusion



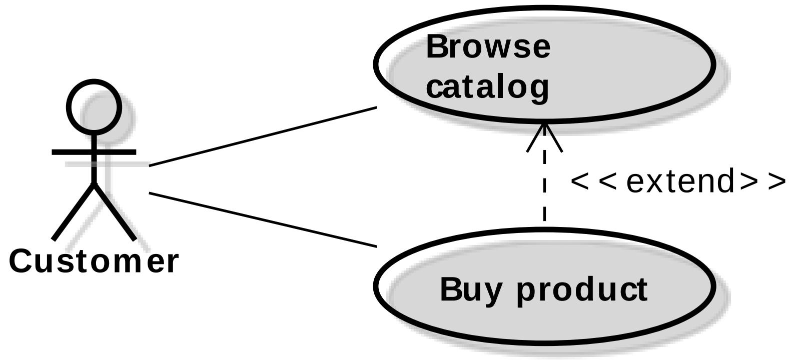
- Inclusion models
  - Models that functionality A is used in the context of functionality B (one is a phase of the other)
  - It is like a sub-function call

Relations – Generalization



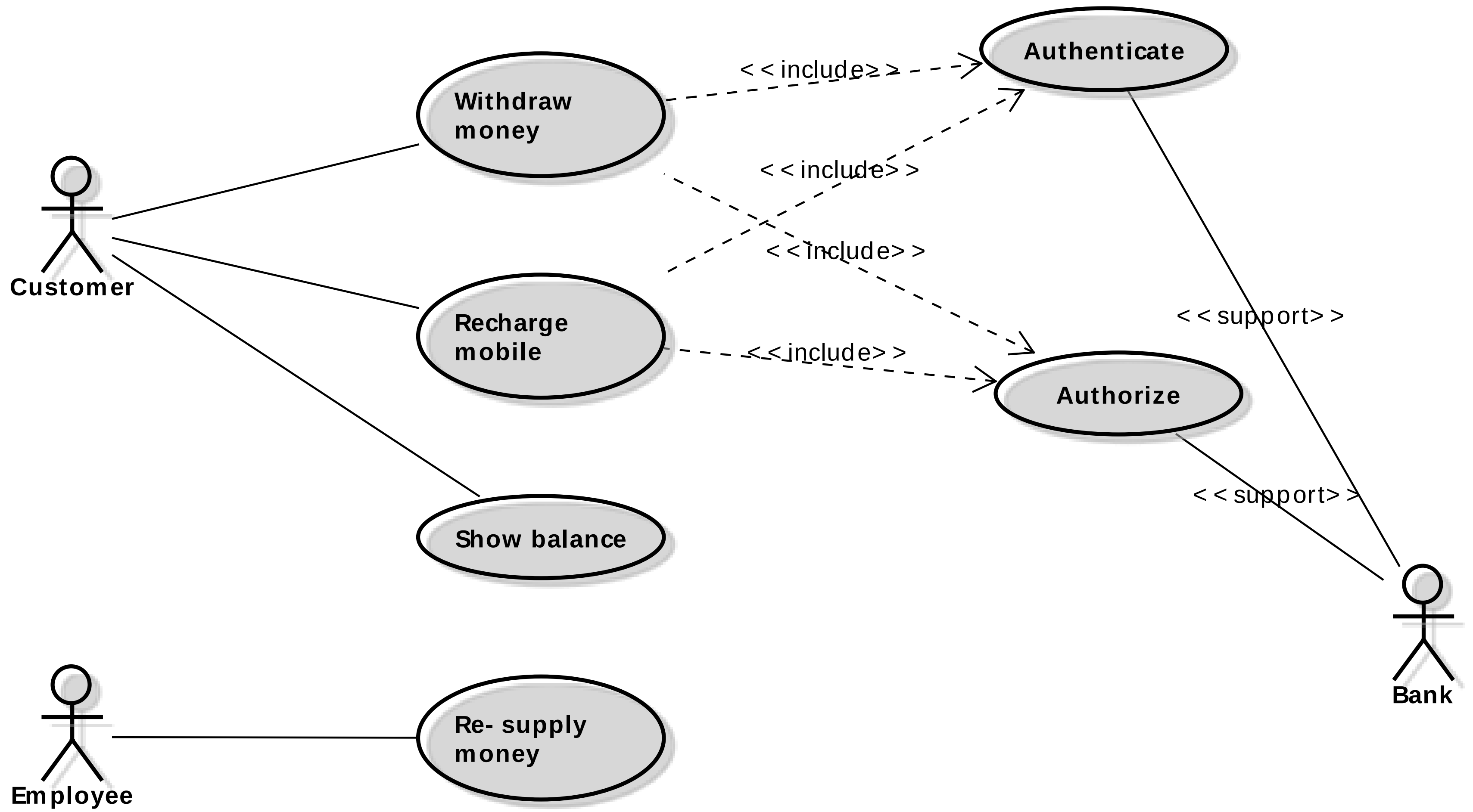
- A generalization from an actor B (Administrator) to an actor A (User) indicates that an instance of B can interact with the same use-case as an instance of A.
  - But not vice versa
- The more specific (Administrator) can interact with more use cases than the more general (User)

Relations – Extension



- A UC extend another UC when it represent the natural (though not mandatory) prosecution of the extended UC

Use case example



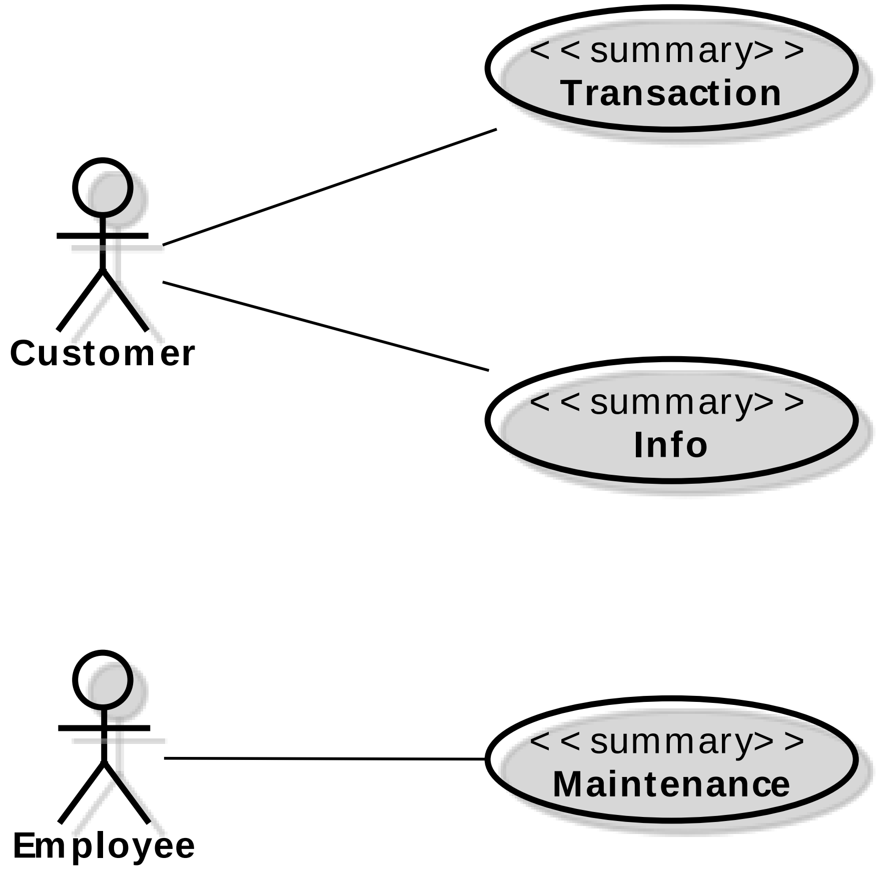
Granularity

- Summary level is the 50,000 feet perspective,
- User-goal level is the sea-level perspective,
- Subfunction is the underwater perspective.

Summary level

- Summary level use cases:
  - are large grain use cases that encompass multiple lower-level use cases; they provide the context (lifecycle) for those lower-level use cases.
  - they can act as a table of contents for user goal level use cases.

Summary level



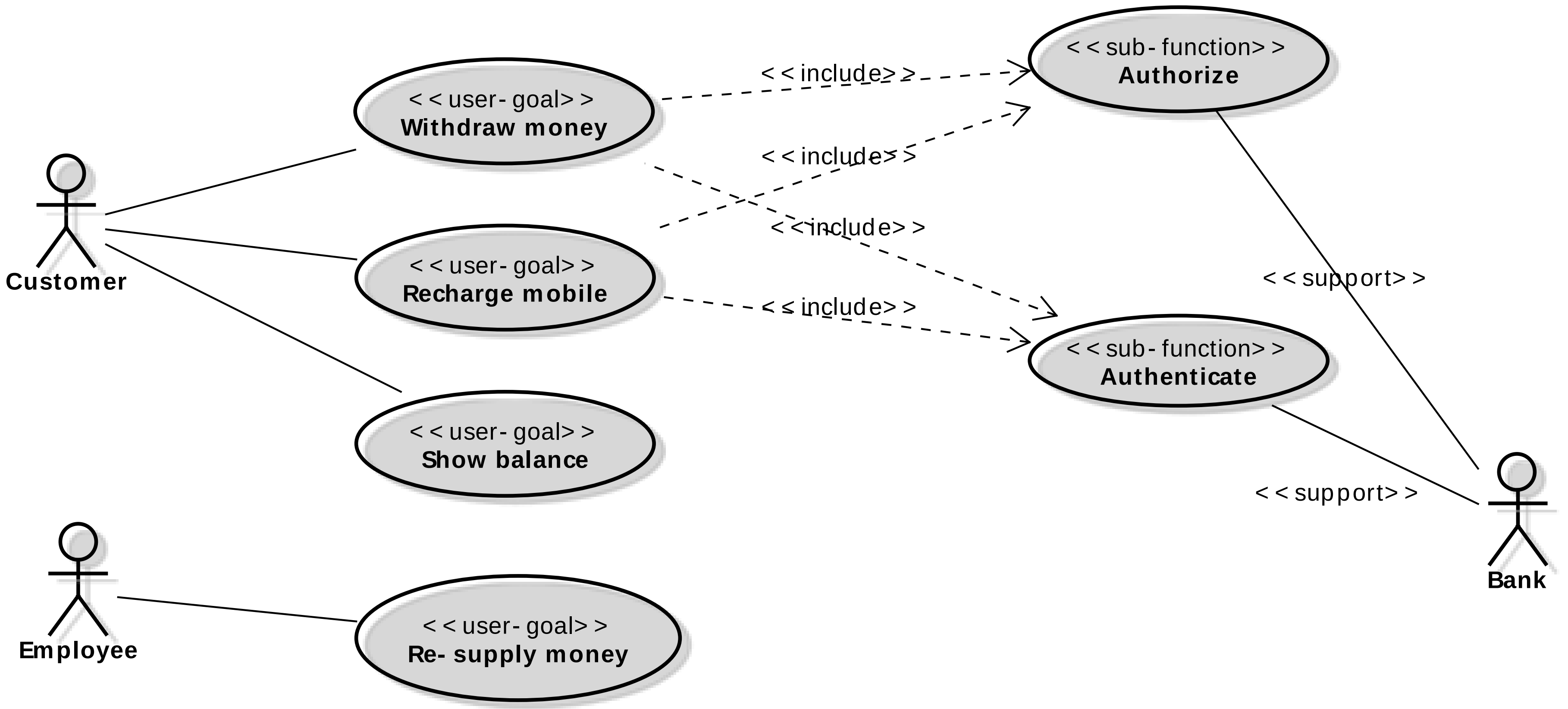
User Goal Level

- User-goal level use cases:
  - describe the goal that a primary actor or user has in trying to get work done or in using the system.
  - are *usually done by one person, in one place, at one time; the (primary) actor can normally go away happy as soon as this goal is completed.*

Subfunction level

- Subfunction level use cases
  - provide “execution support” for user-goal level use cases; they are low-level and need to be justified, either for reasons of reuse or necessary detail

User-goal and sub-function



Customer
Employee
Bank
<<user-goal>> Withdraw money
<<user-goal>> Recharge mobile
<<user-goal>> Show balance
<<user-goal>> Re-supply money
<<sub-function>> Authorize
<<sub-function>> Authenticate
<<include>>
<<include>>
<<include>>
<<include>>
<<support>>
<<support>>

Right level

- Too-much levels
  - Very summary, cloud level
  - Sub-sub-functions (black)
- Tendency to be too specific
  - What does the primary actor really want?
  - Why is this actor doing this?

Exercise

“Jenny is standing in front of her bank's ATM. It is dark. She has entered her PIN, and is looking for the 'Enter' button."

- Name a summary, a user and a sub-function goal for Jenny.

Answers

- Very Summary: Take some special one out for dinner.

- Summary: Use the ATM
- User goal: Get money from the ATM
- Sub-function: Enter PIN

- Sub-Sub-function: Find the Enter button.

USE CASE NARRATIVE

Use case briefs

- Summary of the use case
- Consisting of 2-6 sentences
- Clearly state
  - What is going on
  - Most significant activities

Template

- SWEED template
  - One column (no table)
  - Sequenced: Numbered steps (Dewey decimal numbering system) and extensions to main scenario use alphabetic letters to differentiate from main steps
    - Based on Cockburn “fully dressed” template

http://alistair.cockburn.us/get/2465

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.196.7782&rep=rep1&type=pdf

http://faculty.washington.edu/jtenenbg/courses/360/f01/project/usecasetemplate.html

Template

- Use Case:
  - Name of the use case. This is the goal stated by a short active verb phrase.
- Scope:
  - The scope of the "system" being considered (black-/white- box and enterprise/system/component).
- Level:
  - Summary, User-goal, or Sub-function
- Intention in Context:
  - A statement of the primary actors intention and the context within which it is performed.

Template

- Primary Actor:
  - The primary actor of the use case.
- *Support Actors:
  - The optional secondary actors.
- *Stakeholders' Interests:
  - The list of stakeholders and their key interests in the use case.
- *Precondition:
  - What we can assume about the current state of the system and environment.

Template

- *Minimum Guarantees:
  - How the interests of the stakeholders are protected in all circumstances.
- *Success Guarantees:
  - The state of the system and environment if the goal of the primary actor succeeds.
- *Trigger:
  - What event starts the use case.

Template

- Main Success Scenario:
  - <step_number> "." <action_description> The numbered steps of the scenario, from trigger to goal delivery, followed by any clean-up.
  - Conditions and alternatives are shown in the extension part.
- *Extensions:
  - <step_altered> <condition> ":" <action_description> or <sub-use_case>

Main Success Scenario: Steps

- An interaction between two entitites
  - Customer enters address
- A validation step to protect an interest of a stakeholder
  - System validate PIN code
- An internal change to satisfy a stakeholder
  - System deducts amount from balance

Actions steps

- Use a simple grammar
  - *<Subject> <verb> <direct object> <prepositional phrase>*
- Show clearly “who has the ball”
- Written from a bird’s eye pov
- Shows the process progressing
- Shows intent not movement
- Contains a reasonable set of actions
- Doesn’t “check whether”, “validates”

Action steps idioms

- Timing
  - “At any time…” or
  - “As soon as..”
- Trigger interaction with other system
  - “User has System A kick System B”
- Repeat
  - “Do steps x-y until condition”
- Parallel
  - “Steps x-y can happen in any order”

Exercise

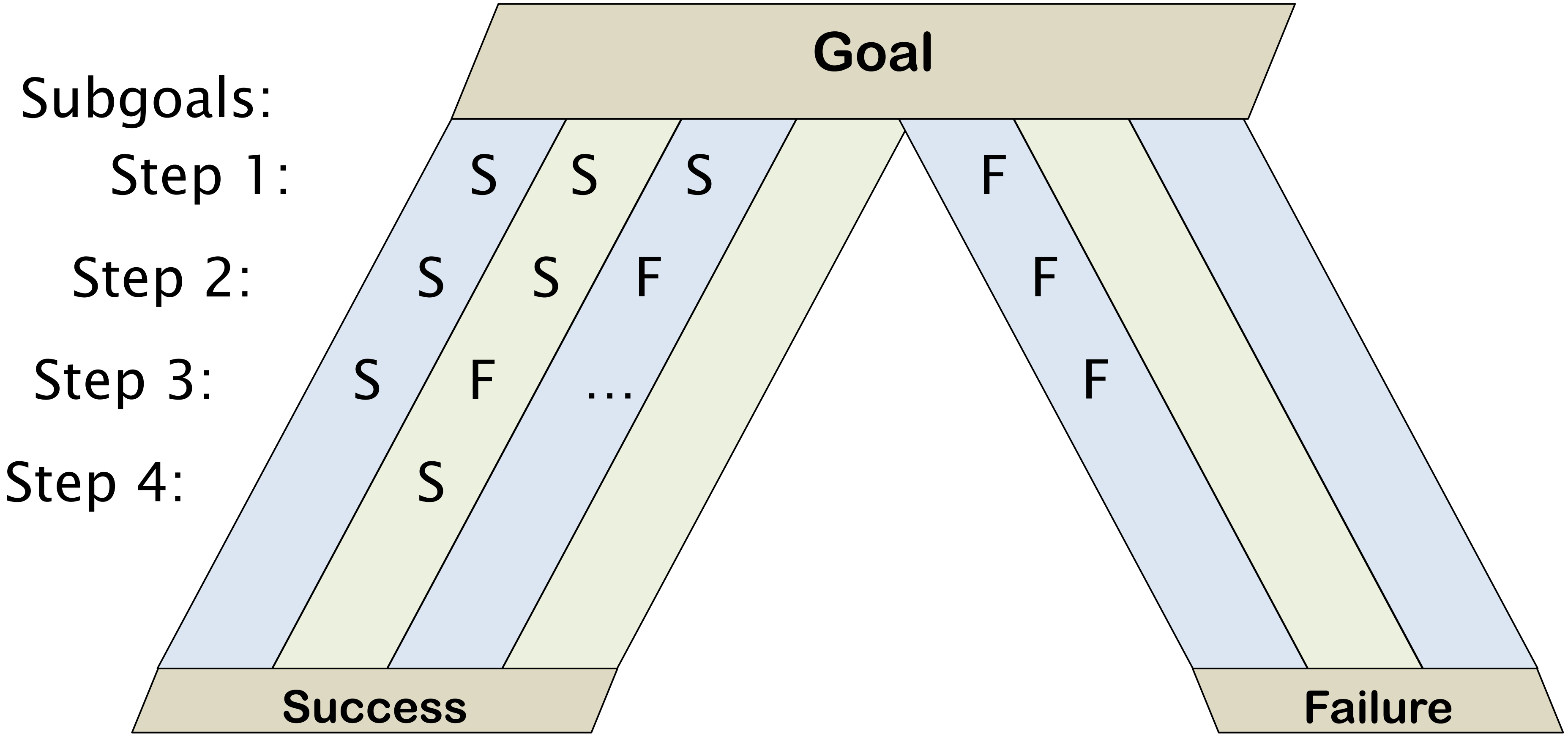
Mary, taking her two daughters to the day care on the way to work, drives up to the ATM, runs her card across the card reader, enters her PIN code, selects FAST CASH, and enters $35 as the amount. The ATM issues a $20 and three $5 bills, plus a receipt showing her account balance after the $35 is debited. The ATM resets its screens after each transaction with FAST CASH, so that Mary can drive away and not worry that the next driver will have access to her account.

- Write the main success scenario for the task-level use case "Withdraw money using FASTCASH option"

Answer

1. Customer runs ATM card through the card reader.
2. ATM reads the bank id and account number from the card, validates them with the main computer.
3. Customer enters PIN.
4. ATM validates PIN.
5. Customer selects FASTCASH and withdrawal amount, a multiple of $5.
6. ATM
   a. notifies main banking system of customer account, amount being withdrawn, and receives back acknowledgement plus the new balance.
   b. delivers the cash, card and a receipt showing the new balance.
   c. logs the transaction.

Alternatives



Extensions

- Brainstorm and include every possibility
  - Alternate success path
  - Primary actor behaves incorrectly
  - Inaction by the primary actor
  - Negative outcome of validation
  - Internal failure (expectable)
  - Unexpected or abnormal failure
  - Critical performance failure

Extensions

- The condition expresses what was detected
  - Not what happened
    - "PIN entry time-out" **OK**
    - "Customers forgets PIN" **Wrong**
- The system must be able to detect the condition
- Merge equivalent conditions

Template

- Steps can be nested. Dewey numbers are then used, e.g. 3a.1
- An extension always refers to a step of the Main Success Scenario.
- An extension step takes place in addition to the respective main step, notation: 2 ||,
- or as an alternative, notation: 2a.
- An extension might correspond to regular behavior, exceptional behavior that is recoverable, or unrecoverable erroneous behavior.

Exercise

- Brainstorm and list the things that could go wrong during the operation of an ATM.

Answer

- Card reader broken or card scratched
- Card for an ineligible bank
- Incorrect PIN
- Customer does not enter PIN in time
- ATM is down
- Host computer is down, or network is down
- Insufficient money in account
- Customer does not enter amount in time
- Not a multiple of $5
- Amount requested is too large
- Network or host goes down during transaction
- Insufficient cash in dispenser
- Cash gets jammed during dispensing
- Receipt paper runs out, or gets jammed
- Customer does not take the money from the dispenser

Precision stages

1. Actors and Goals
   - Prioritized list of actors and their goals
2. Main success scenario
   - Trigger and main success scenario
   - Check meeting stakeholders interests
3. Failure conditions
   - List of all possible failures
4. Failure handling
   - How to respond to each failure
   - Potentially revealing

Applying use cases

- Define the scope
  - What's in and what's out
- Identify your actors:
  - who will be using the system?
- Identify their goals:
  - what will they be using the system to do?
- Write a use case brief
  - 2-6 sentences
- Detail the steps in main success scenario
  - 3-9 steps
- Identify failure conditions
  - Which conditions the system can detect?
- Define failure handling

Warnings

- Use case alone are not the requirements
- Use cases should be based on some form of conceptual model or glossary
- Use cases should not include details about the user interface

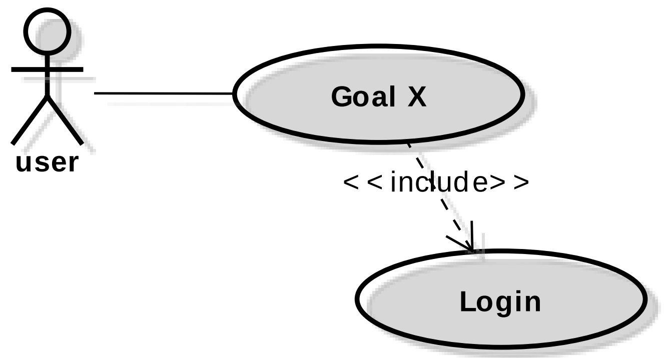
Typical errors

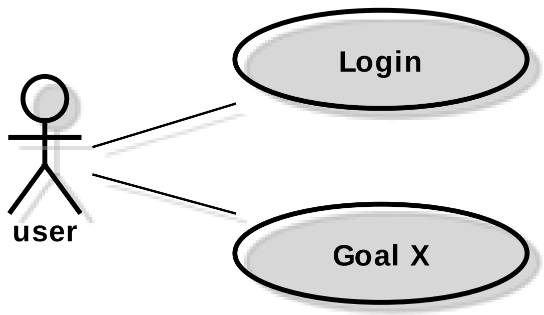
- Undefined or inconsistent system boundary
- Take System’s viewpoint instead of Actor’s
- Inconsistent Actor names
- Use cases refer to too many actors
  - Spider’s web

Typical errors

- Too long specifications
- Confused specifications
  - Use of conditional logic
  - Attempt to describe algorithms
- Actor non fully entitled
- Customer not understanding
- Never ending use cases
- Dialog descriptions
  - Long, over-constrained, brittle

Inclusion vs. Precondition



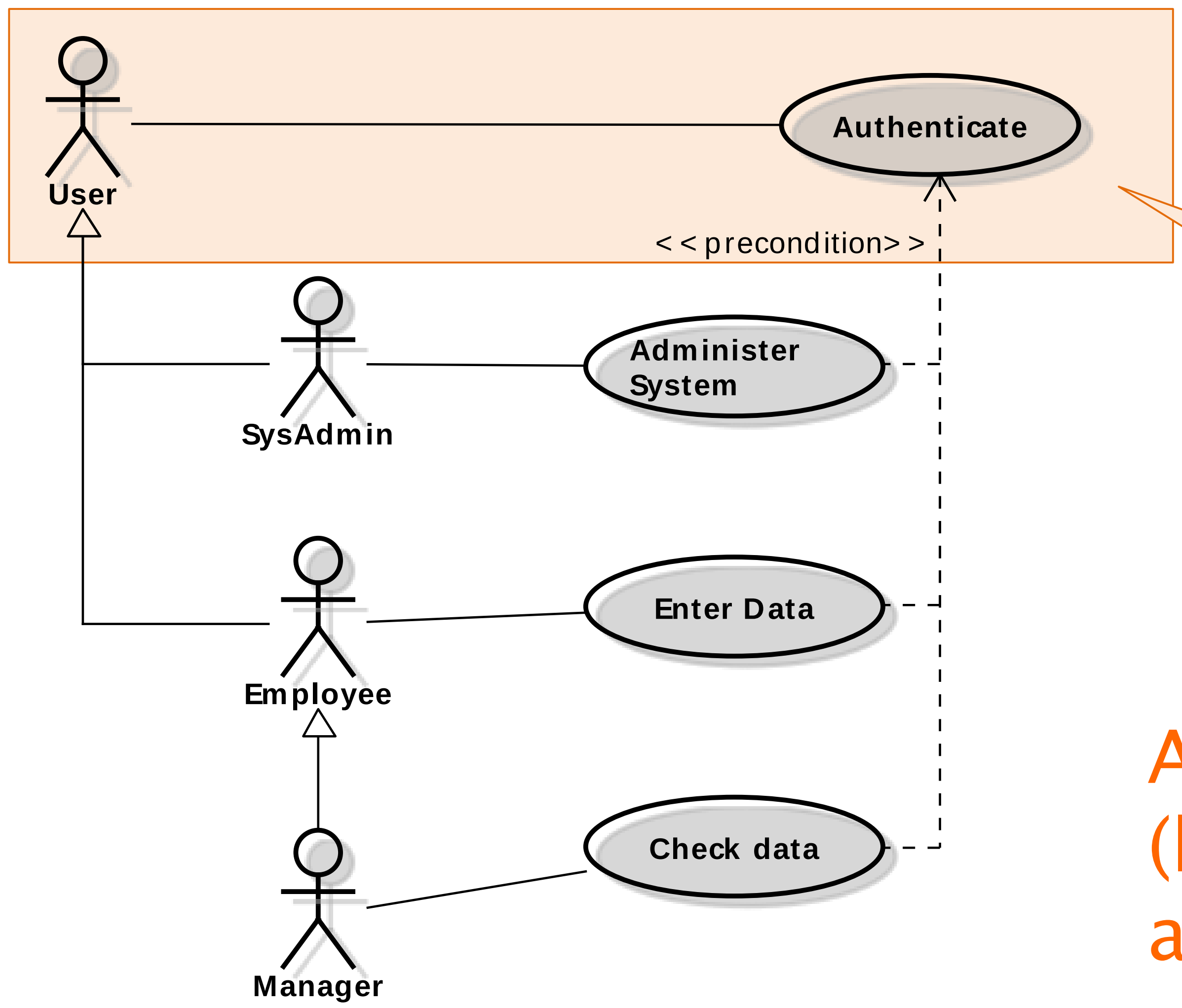


Use case: Goal X
…
Main success scenario:
…
1. User performs Login
…

Use case: Goal X
…
Precondition:
- User performed Login
…

Use case: Login
…

Authentication



This part should be repeated for every UCD

Authentication (login) will be always implicit

SUMMARY

Pros

- Use case modeling is generally regarded as an excellent technique for capturing the functional requirements of a system.
- Use cases discourage premature design
- Use cases are traceable.
- Use cases can serve as the basis for the estimating, scheduling, and validating effort.

Pros

- Use cases are reusable within a project.
  - The use case can evolve at each iteration from a method of capturing requirements, to development guidelines to programmers, to a test case and finally into user documentation.
- Use case alternative paths capture additional behaviour that can improve system robustness.

Pros

- Use cases are useful for scoping.
  - Use cases make it easy to take a staged delivery approach to projects; they can be relatively easily added and removed from a software project as priorities change.
- Use cases have proved to be easily understandable by business users, and so have proven an excellent bridge between software developers and end users.

Pros

- Use case specifications don't use a special language. They can be written in a variety of styles to suit the particular needs of the project.
- Use cases are concerned with the interactions between the user and the system.
  - UI designers can get involved in the development process either before or in parallel with software developers.

Pros

- Use cases put requirements in context, they are clearly described in relationship to business tasks.
- Use case diagrams help stakeholders to understand the nature and scope of the business area or the system under development.

Pros

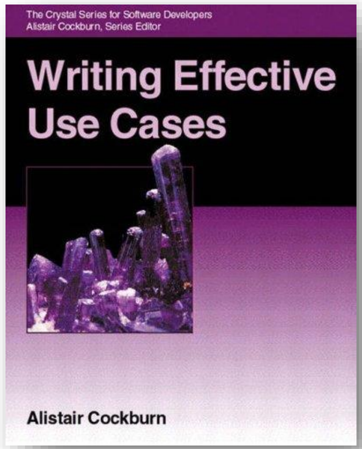
- Test Cases (System, User Acceptance and Functional) can be directly derived from the use cases
- Use cases are critical for the effective execution of Performance Engineering

Cons

- Use case flows are not well suited to easily capturing
  - non-interaction based requirements of a system (such as algorithm or mathematical requirements) or
  - non-functional requirements (such as platform, performance, timing, or safety-critical aspects)
- Use cases templates do not automatically ensure clarity. Clarity depends on the skill of the writer(s).

References

- A.Cockburn, "Writing Effective Use Cases". Addison-Wesley, 2000.
- M.Fowler, "UML Distilled" IV Edition. Addison-Wesley, 2010.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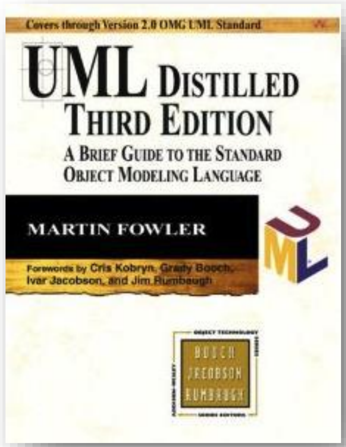
Alistair Cockburn

Covers through Version 2.0 OMG UML Standard
UML Distilled
Third Edition
A Brief Guide to the Standard Object Modeling Language
Martin Fowler
Forewords by Cris Kobryn, Grady Booch, Ivar Jacobson, and Jim Rumbaugh