Specification, Part 2

Use Cases

System Engineering

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Agenda

- What is a Use Case
- Why use Use Cases
- Use Case diagrams
- Actors
- Scenarios : Format and styles
- Guidelines: Finding and describing actors and UC's
- Good and Bad Use Cases

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What is a Use Case (1/3)

A use case is a specific way of using the system by performing some part of the functionality. Each use case constitutes a complete course of events initiated by an actor, and it specifies the interaction that takes place between an actor and the system

- A textual description of events between a user and a system
- In order to discover and describe requirements
- Are described from a users view or the environment (not from the systems view)

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What is a Use Case (2/3)

"If you design a new house and you are reasoning about how you and your family will use it, this is use case-based analysis. You consider the various ways in which you'll use the house, and these use cases drive the design."

– Booch

What is a Use Case (3/3)

- Defined by Ivar Jacobson, Ericsson
- Originally named: Usage cases
  - Swedish: användningsfall
  - Danish: brugssituation / brugstilfælde
    - Normally ”Use case” is used
- Key people
  - Ivar Jacobson, Craig Larman, Alistair Cockburn

What are they used for

- Used to specify the functional requirements
  - In FURPS+, they give emphasis to the F
- Outside-in approach, where the functionality is described from the users viewpoint
  - Not from the developers

Specification and Use Cases

- A use case describes behavior
- Requirements describes a law that directs behavior

Use Case Example

Buy Product

1. *Customer* browses through catalog and selects items to buy
2. *Customer* goes to check out
3. *Customer* fills in shipping information
4. *Customer* fills in credit card information
5. *System* authorizes purchase

5a [Authorization fails]
Customer may go to 4. or Cancel

Martin Fowler, UML Distilled (2nd Edition)

Use Case terminology

Buy Product

Actor

Scenario

1. *Customer* browses through catalog and selects items to buy

Reference

2. *Customer* goes to check out
3. *Customer* fills in shipping information
4. *Customer* fills in credit card information
5. *System* authorizes purchase

Extensions/ Alternate Flows

5a [Authorization fails]
Customer may go to 4. or Cancel

Martin Fowler, UML Distilled (2nd Edition)

Use Case terminology

- A use case either reach it's goal or fails;
- If only a main success scenario is given, then success is assumed
- Use Case naming rule:
  Described in terms of obtaining a goal for a given actor

  Examples:
  Withdraw Money
  Check Balance

Why use Use Cases

- Capturing requirements of a system
- Validating systems (all use cases are realized)
- Can drive implementation and tests
- Use Case Modeling is
  - A simple concept
  - User-friendly (allow customers to contribute)
  - Effective
- Discovery and definition are the goals of Use Cases

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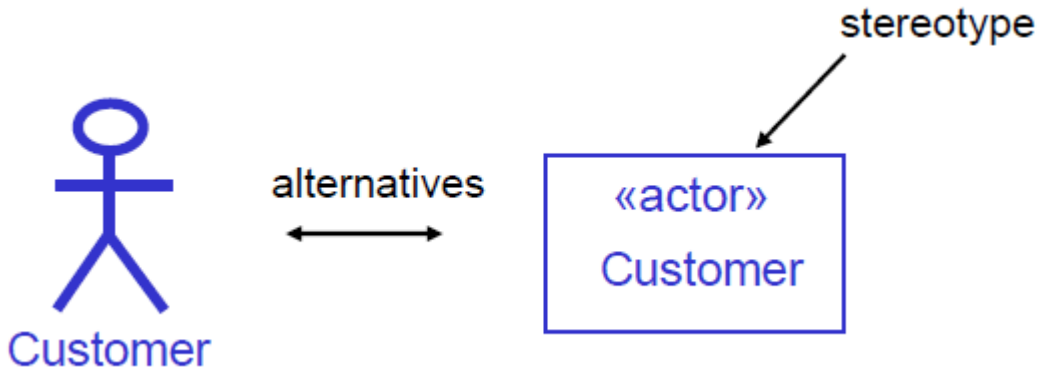
Actors

- Role – more precise translation from swedish
- An actor describes an object, external to the system, who interacts with the system
- Actors represents:
  - Persons
  - Other systems
  - HW devices
- UML notation:



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Actors

- Person actors:
  Describes the role played by a person who interacts with the system
  The same person can play different roles over time
- Other systems:
  Describes the external systems who communicates with the system under development
- HW devices:
  A concrete HW unit can also be subdivided in different logical roles played by the HW unit or device

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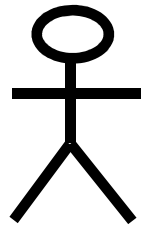
Actor type



- Primary Actor
  Has goals to be fulfilled by system

- Supporting Actor (alternatively Secondary Actor)
  - Provides service to the system

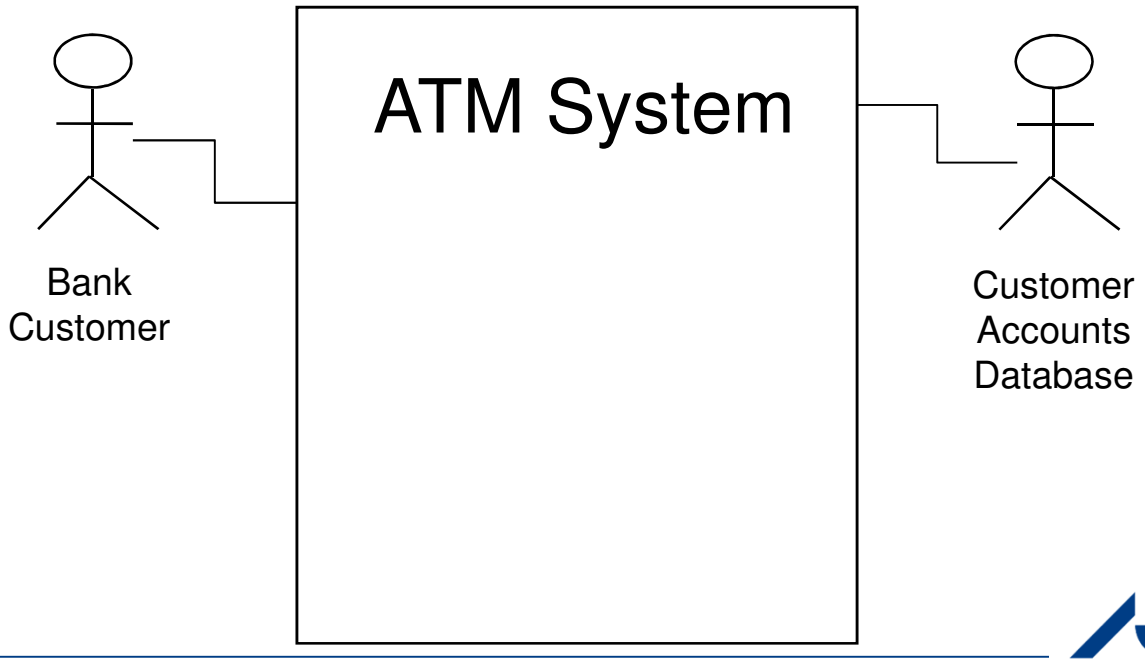
- Offstage Actor
  - Interested in the behavior, but no contribution

Actor description

Name of actor:	Shopper
Alternate references	Customer
Type:	Primary
Description:	The Shopper is the sole end user of the system … Wants to ...

Actor-Context diagram

- Supplies overview of the actors in relation to the system boundary
- Essentially a diagram with actors, the system boundary and no use cases.



System Boundary

- Boundary between the inside and the outside of the system
- Determining the level of abstraction
- There may be systems within systems
  - One system may be made up of several subsystems, which interact with each other
- Identify interactions between the system and its environment (stimuli and responses)

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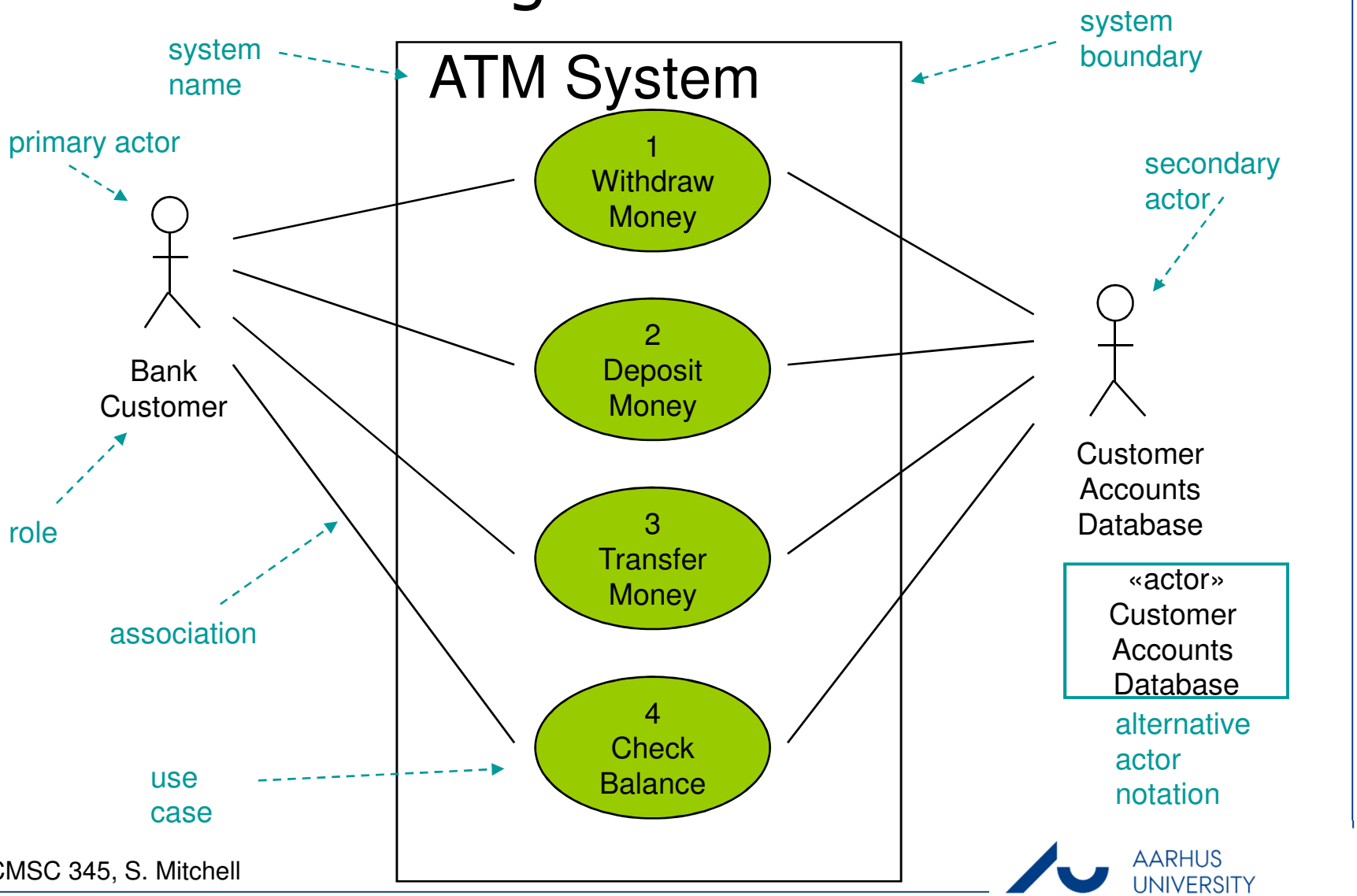
Exercise 1. in class

- Start Car Engine
  - Find Boundary
  - Actors
- Withdraw Money
  - Find Boundary
  - Actors

Why money is not an actor

- No interest in the scenario
- A means to fulfil the scenario

Use Case diagrams



Stereotypes

- actor, extends and include is shown as stereotypes.
  In UML stereotype names are included in «stereotypes»
- Not << >>
- « »

Use Case diagrams

- A way of visualizing the relationships
  - between actors and use cases
  - among use cases

- A graphical table of contents for the use case set

Use Case diagrams heuristics

- Minimize association-line crossing
- In general don’t show associations among actors, only among actors and Use Cases
- Actors may be devices rather than humans, if the system interfaces to devices outside its scope

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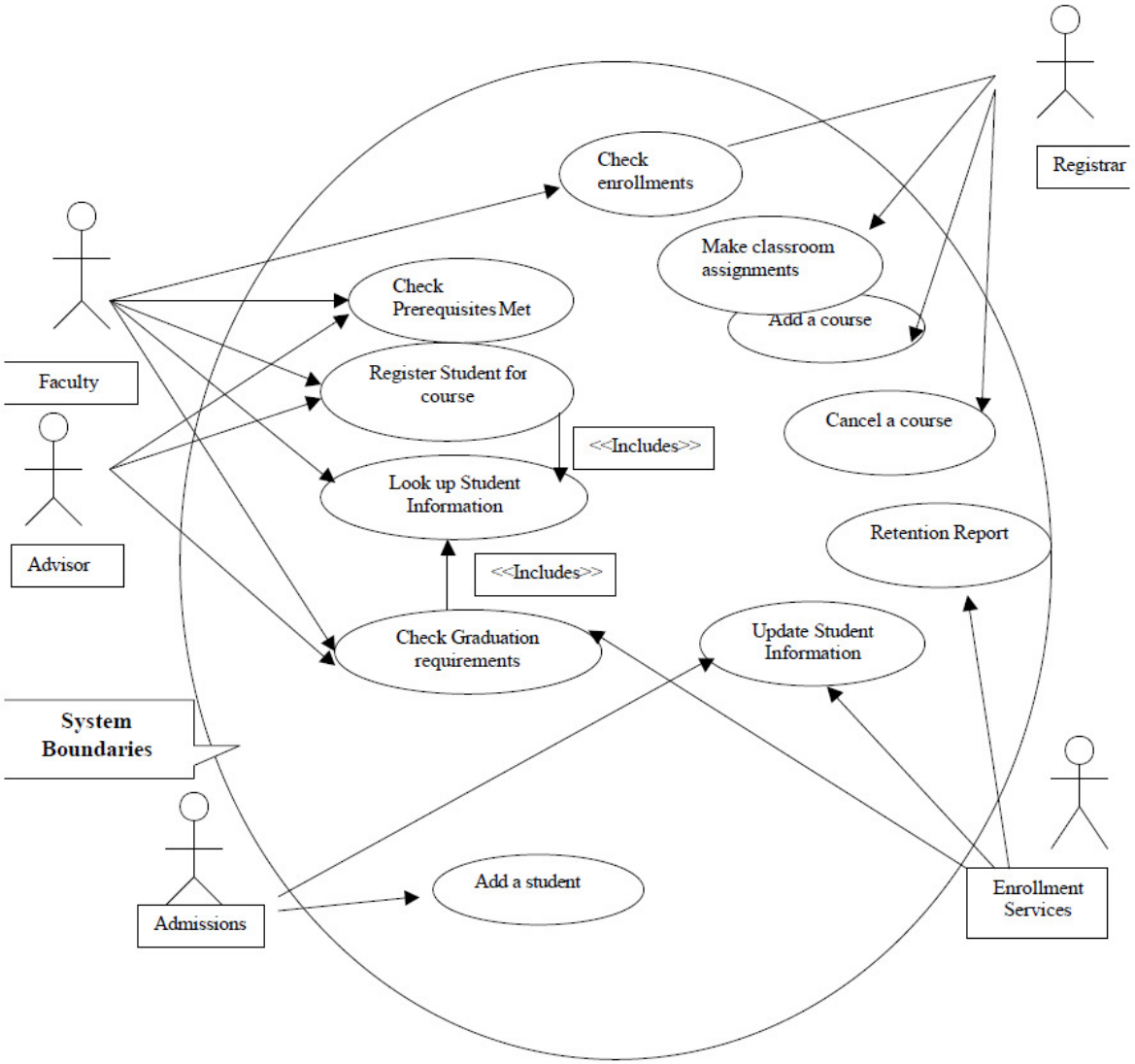
Use Case diagrams



Use Case diagrams – Muddy Example

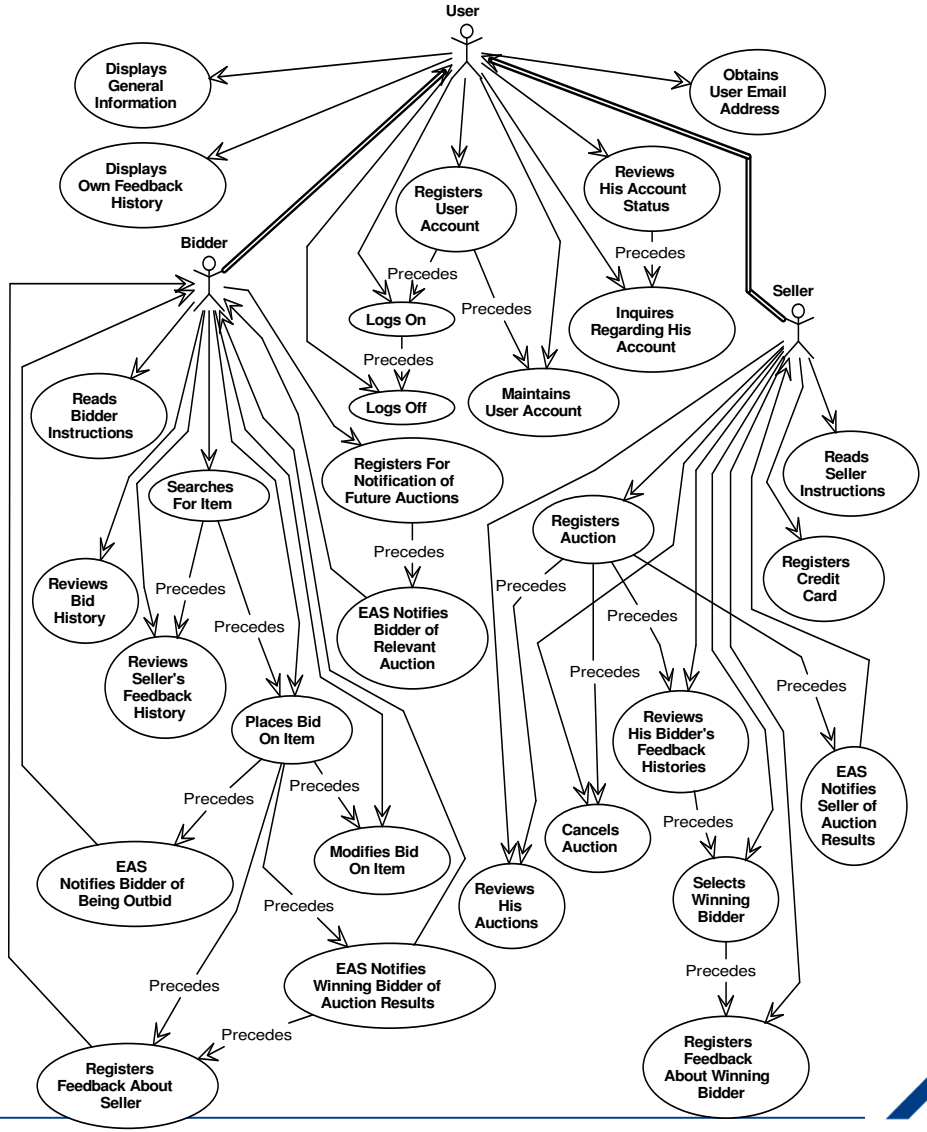
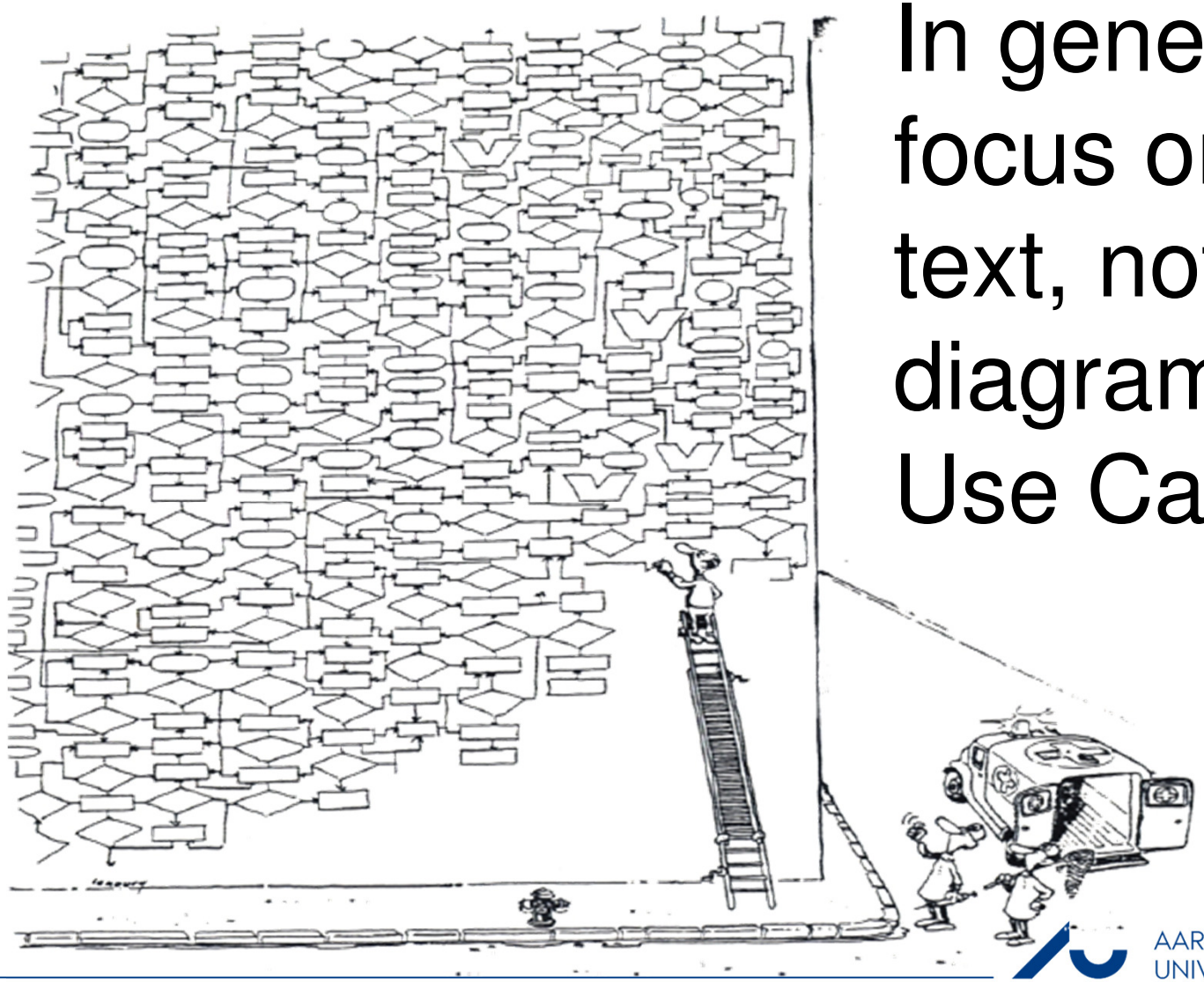


Diagram Complexity



In general focus on text, not on diagrams in Use Cases

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Diagram Purpose

- A Use Case diagram is an overview of Use case scenarios
- Diagrams shall only contain Use Cases that actually exists
- Do not join several Use Cases into one in a diagram

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Exercise 2. in class

- Medical Consultation System
- Draw a Use Case diagram of the following:

	Patient	Doctor	EPR/EPJ	National Board of Health
Make Appointment	Primary	Secondary	-	-
Cancel Appointment	Primary	Secondary	-	-
Access Patient Record	Secondary	Primary	Secondary	Offstage

Scenarios

- The Main Success Scenario is the scenario where the actor obtains its goal
  - - is also called
    - Sunshine scenario
    - Happy scenario
- Extensions / Alternative Flows
  - The alternative flows can be more comprehensive than the main scenario

Styles

- Essential:
  - Focus is on intent
  - Free of technology and mechanisms
  - Avoid making user interface decisions
- Concrete:
  - UI decisions are embedded in the use case text
    - e.g. “Admin enters ID and password in the dialog box, (see picture X)”

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Scenarios : Formats

- Different ways of structuring use cases:
  - Brief
  - Casual
  - Fully Dressed

Scenarios : Formats : Brief

- 1-6 sentence description of behavior
- Mention only most significant behavior and failures
- Short enough to put many on a page
- Used to
  - Estimate complexity
  - To get a sense of subject and scope

Scenarios : Formats : Brief : Example

Process Sale:

A customer arrives at a checkout with items to purchase.
The cashier uses the POS system to record each purchased item.
The system presents a running total and line-item details.
The customer enters payment information, which the system validates and records.
The system updates inventory.
The customer receives a receipt from the system and then leaves with the items.

Applying UML and Patterns, C. Larman 2005

Scenarios : Formats : Casual

- Multiple paragraphs written as a text
- Not placed in a numbered form
- Includes alternate flows
- Used to
  - Estimate complexity
  - To get a sense of subject and scope
  - Can be given to developers

Scenarios : Formats : Casual :Example

Handle Returns:

Main Success Scenario: A customer arrives at a checkout with items to return. The cashier uses the POS system to record each returned item.

Alternate Scenarios:

If the customer paid by credit, and the reimbursement transaction to their credit account is rejected, inform the customer and pay them with cash.

If the item identifier is not found in the system, notify the Cashier and suggest manual entry of the identifier code […]

Applying UML and Patterns, C. Larman 2005

Scenarios : Formats : Fully dressed

- Paragraphs written in a numbered form
- Includes all step and alternate flows in detail
- Normally follows a defined template of supporting sections

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Fully-dressed Template

Goal	What is acheived by the UC
Initiation	Actor, System initiation
Actors and Stakeholders	List of actors Actor role (type)
References	Other use cases referenced
Number of concurrent occurrences	2, 10, none
Precondition	What must be true on start
Postcondition	What is true on completion
Main Scenario	Happy path scenario
Extension	Alternate flows
Data Variations List	e.g. Data Formats

Fully-dressed elements

- Actors and Stakeholders
  - list of stakeholders and their key interests in the use case
- Pre/Post conditions
  - assumptions before and success guarantees
- Data Variations List
  - technical variations in how data is defined

Use Case Example (1/3)

Buy stocks

- Goal: Purchaser seeks to buy stocks and get them added to the Personal Advisors / Finance system (PAF) automatically
- Initiation: Purchaser
- Number of concurrent occurences: 1
- Stakeholders and Interests:
  - Purchaser (primary) wants to buy stocks, get them added to the PAF portfolio automatically.
  - Stock agency (secondary) - wants full purchase information.

- Precondition: User already has PAF open.
- Postcondition: remote web site has acknowledged the purchase, and the user's PAF is updated.

Use Case Example (2/3)

Main success scenario:

1. User selects to buy stocks over the web.
2. PAF gets name of web site to use from user.
3. PAF opens web connection to the site, retaining control.
4. User browses and buys stock from the web site.
5. PAF intercepts responses from the web site, and updates the user's portfolio.
6. PAF shows the user the new portfolio standing.

4-6 is repeated until User is finished buying.

Extensions:

2a. User wants a web site PAF does not support:
2a1. System gets new suggestion from user, with option to cancel use case.

Use Case Example (3/3)

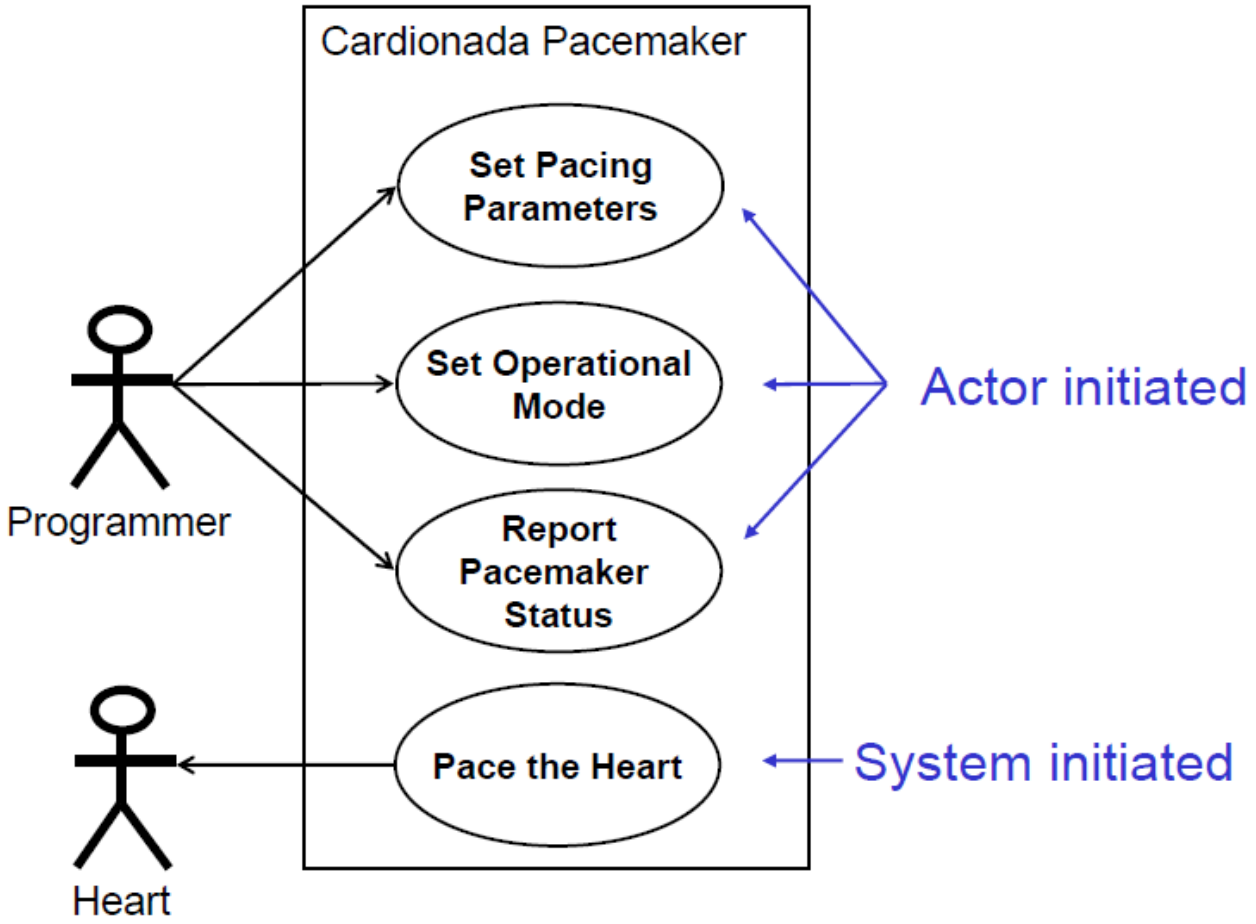
Extensions:

3a. Web failure of any sort during setup:
3a1. System reports failure to user with advice, backs up to previous step.
3a2. User either backs out of this use case, or tries again.
4a. Computer crashes or gets switched off during purchase transaction:
4a1. (what do we do here?)
4b. Web site does not acknowledge purchase, but puts it on delay:
4b1. PAF logs the delay, sets a timer to ask the user about the outcome.
4b2. (see use case Update questioned purchase)
5a. Web site does not return the needed information from the purchase:
5a1. PAF logs the lack of information, has the user Update questioned purchase.

Use Case activation

- Actor initiated:
  - Actor takes initiative to activate a Use Case
- System initiated:
  - Use Cases activated by the system, is very common in technical systems
    - Periodic activated Use Cases
    - Aperiodic activated Use Cases, where a Use Case is started, when a given condition is true

Use Case activation



Guidelines: Building a System in UC's

1. Name the system scope
2. Brainstorm and list the primary actors
3. Brainstorm and exhaustively list user goals for the system.
4. Select one use case to expand
5. Write the main success scenario
6. Brainstorm and exhaustively list the extension conditions
7. Write the extension-handling steps

Writing Effective Use Cases, A. Cockburn, 2000

Finding and describing actors

- Identify
  - Ask the End-Users
  - Documentation
- Issues
  - Roles Vs. Job Titles
  - Time

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Finding and describing use cases

- Scenario Driven
  - Find measurable value
  - Business events
  - Services actor needs / supplies
  - Information needed
- Actor/Responsibility
- Mission decomposition

Testing use cases : Boss test

- The Boss Test
  - the boss ask questions about the Use case scenarios to ensure they fulfills the needs.
  - Your Boss asks, “What have u been doing all the day?” You reply: “Logging in”..
  - Is your boss happy?

Exercise 3.

- Service station
  CampusNet -> Øvelser
  L3_UseCaseOvelse.pdf

Testing use cases : EBP Test

- Elementary Business Process:
  - a task performed by one person in one place at one time, in response to a business event, which adds measurable business value and leaves the data in a consistent state
- An EBP level use case is known as a user goal level use case. i.e. user wants to do something that adds business value
- E.g. Approve Credit

Testing use cases : Size Test

- The size test
  - observe the size of main scenario,
    how many steps.
  - A common mistake is modeling some UC with only a single step
  - e.g. “Enter Item ID”

Developing a Use Case

Start out by answering these questions:

- Who are the primary and secondary actors?
- What are each (primary) actor's goals?
- What preconditions must exist before the story begins?
- What main tasks or functions are performed by each actor?
- What exceptions will need to be considered as the story develops?
- What variations in the actors' interactions are possible?
- What system information will each actor acquire, produce, or change?
- What information does each actor need from the system?

Developing a Use Case

- Use case names should start with a verb.
  - **DO:** Rent Items
  - **DON'T:** Item Rental
- Actor names should be capitalized.
- Use cases should be written in the active voice, using actors.

  DO: Customer arrives with videos to rent.
  DON'T: Videos are brought to the cash register by a Customer.
- Be as terse as possible while still being clear.

  DO: Clerk enters..., System outputs....
  DON'T: The Clerk enters..., The System outputs...

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Good Use Cases

- Keep it simple
- Use present tense
- Subject should be primary actor, system under design and secondary actors
- Must provide a meaningful result to primary actor
- Verb should be what actor does to successfully move the use case forward
- Avoid GUI: write in terms of goals, not details of the GUI

Applying UML and Patterns, C. Larman 2005
Writing Effective Use Cases, A. Cockburn, 2000

Bad Use Cases

- A common use case mistake is defining use cases at too low level or sub function level
- We might mistake design for requirements, e.g. specifying a sequence of interactions which in fact is only one of many sequence *candidates* to achieve the goal.

Relationships between Use Cases

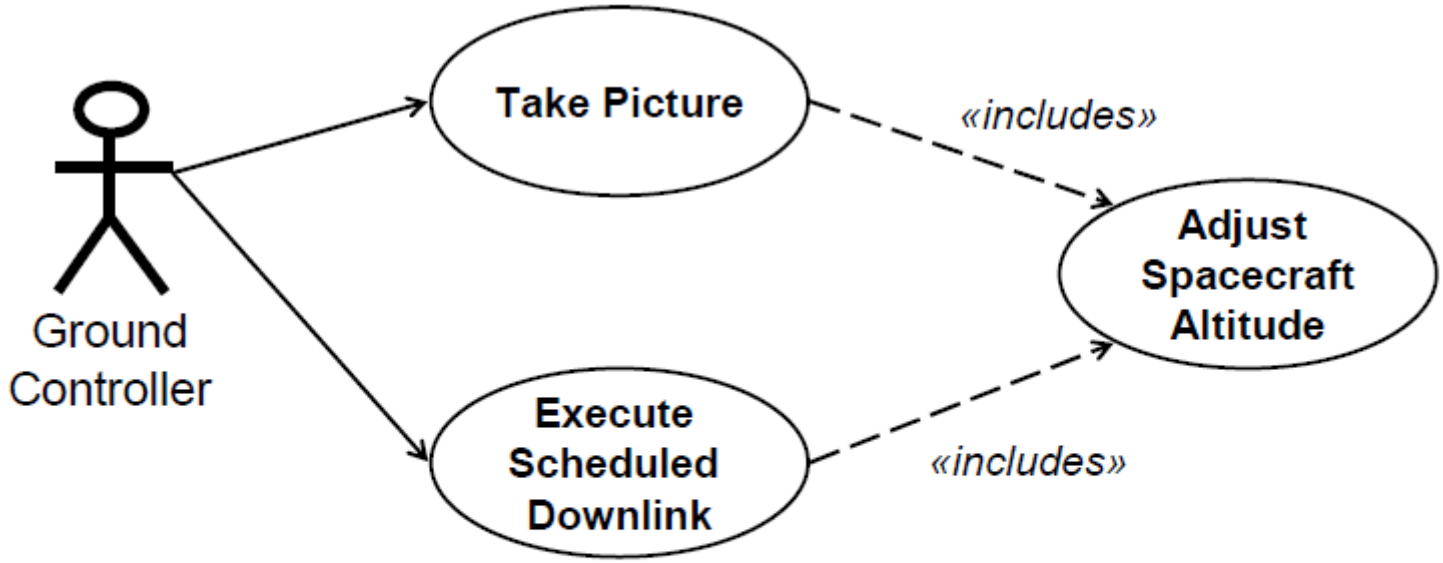
- You have three types of relationships:
  - Include
  - Extends
  - Generalization

- Use of these features will typically make a use case diagram more complex to read.
- So they should be used with caution.

Includes

- An *include* relation is a structuring mechanism
- Used primarily to avoid redundancy in the specification
  - An include use case can be used and reused in many situations

Includes

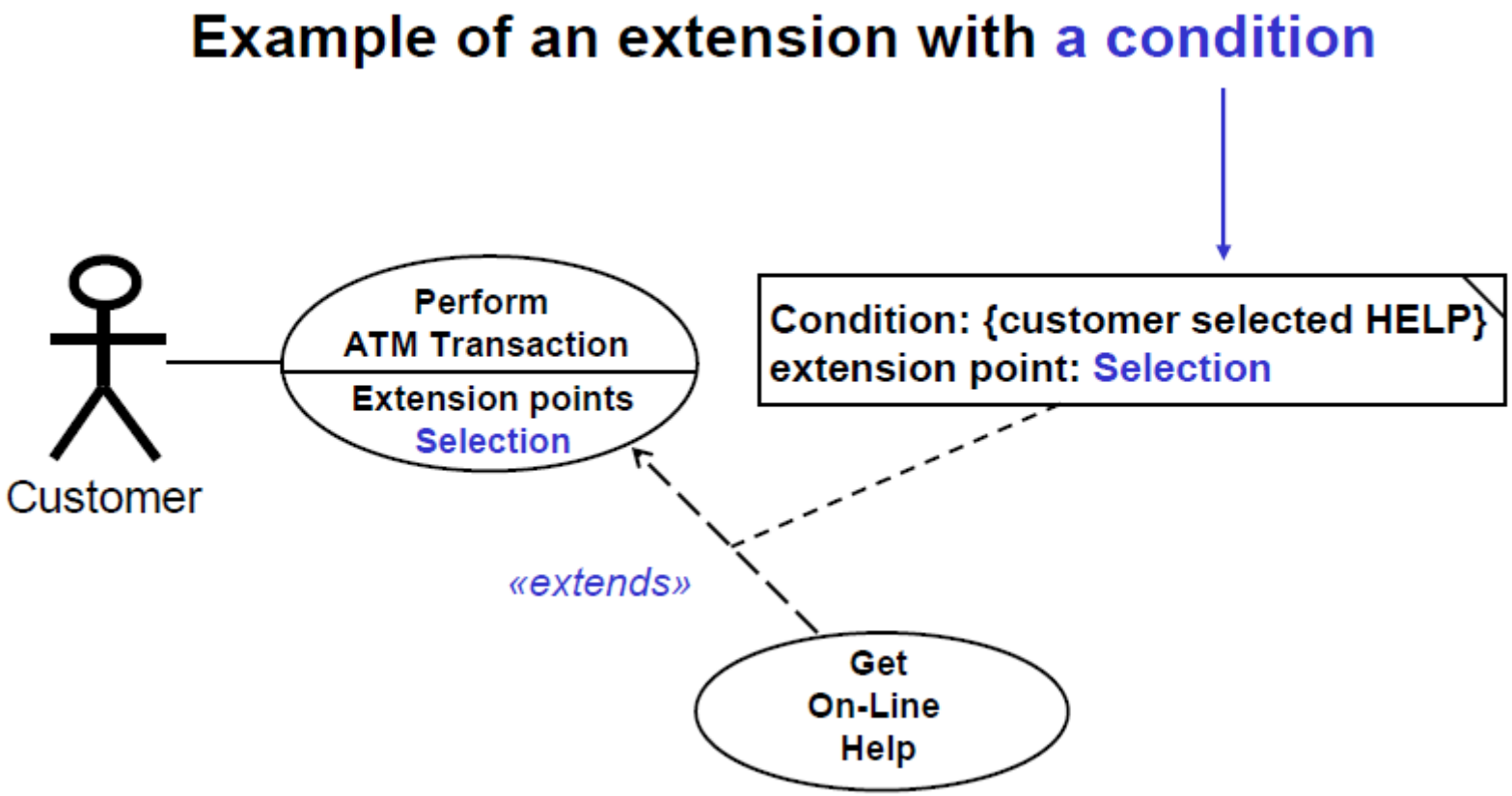


Common functionality is here moved out and described by its own Use Case

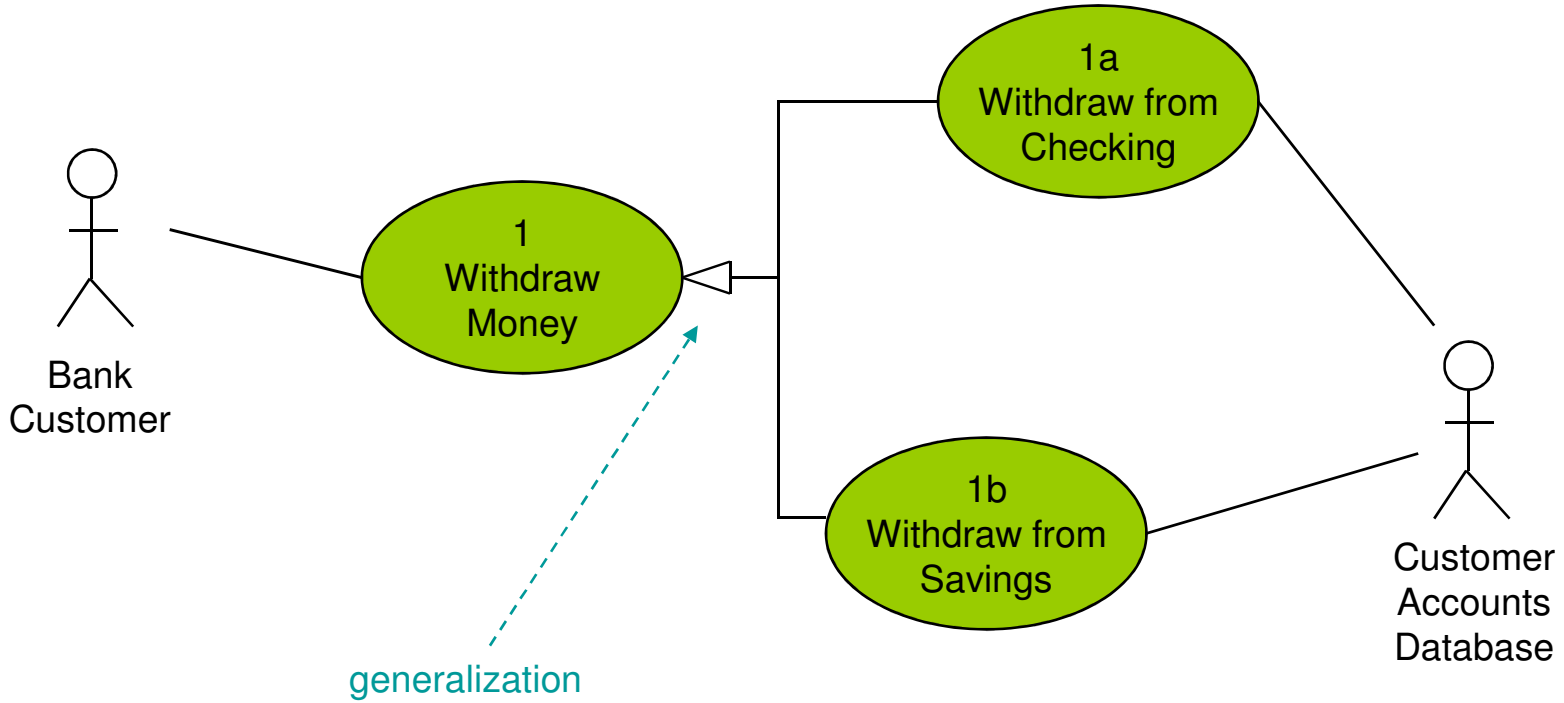
Extends

- An extends relation is a structuring mechanism:
  - Used to describe optional extensions
  - Used to describe special situations for example errors or other exceptional scenarios
- Can be used late in the development cycle – as a way to add functionality in a structured way, without disturbing the other use cases

Extends

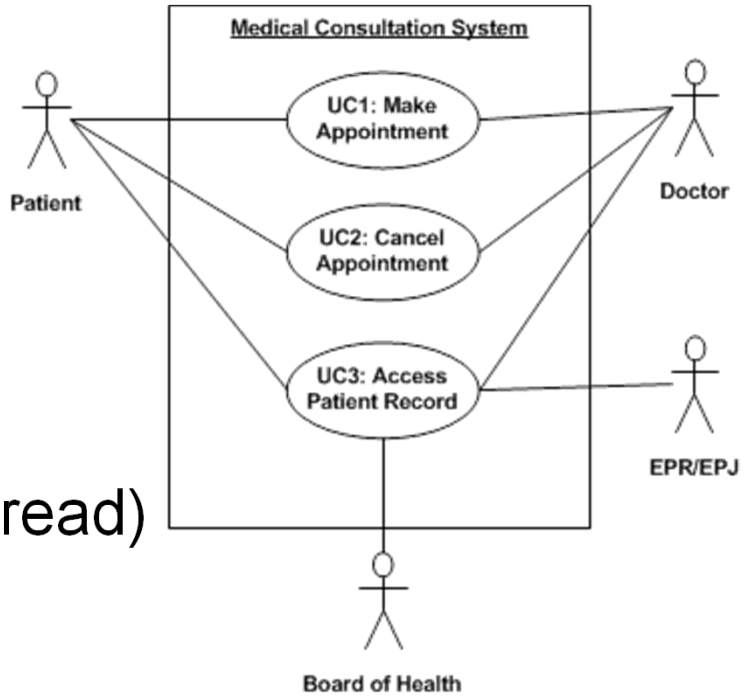

Example of an extension with a condition
Perform
ATM Transaction
Extension points
Selection
Condition: {customer selected HELP}
extension point: Selection
Customer
«extends»
Get
On-Line
Help

Generalization



Exercise in class

- Medical Consultation System
- Write the use case
  - Access Patient Record: Doctor seeking to access(read) patient data, through an electronic patient journal, which data is regulated by the National Board of Health.
  - Use the template on slide: Fully-dressed Template



Mandatory Exercise A

- Bottle Recycling / Reverse Vending Machine
- Use Cases and Test
- Exercise is on CampusNet
- In groups of 3-4 persons!

Questions?

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