

Unified Modelling Language (UML)

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Literature

1. *Developing Software with UML*, Bernd Oestereich, Addison Wesley, 1999.
2. *Practical Object-Oriented Design with UML*, Mark Priestley, McGraw-Hill, Second Edition, 2003.
3. *Using UML, Software Engineering with Objects and Components*, Rob Pooley, Perdita Stevens, Addison Wesley, 1999.
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5. *UML in Practice*, Pascal Roques, Wiley, 2004.

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Object-Oriented Analysis and Design with Applications,
Second Edition, Addison Wesley, 1994.
- James Rumbaugh (General Electric)
Rumbaugh, J., Blaha, M., Premerlani, W., Eddy F., Lorenzen, W.,
Object-Oriented Modeling and Design, Prentice hall, 1991.
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Jacobson, I., Ericsson, M., Jacobson, A., The Object Advantage:
Business Process Reengineering with object Technology,
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Object Management Group an industry standards body requested
standard object modelling language (1996).

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Use Case Diagrams

Contents

1. Use Case
2. Actors
3. Use Case Diagrams

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Use case

Definition

Describes a task that a user can perform using the system.

Description

- describes requirements for the system
- task described by a use case is composed of *activities*
- use case can have different variations called *scenarios*
- should not be used for functional decomposition !

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Example. Automatic teller machine (ATM)

ATM offers the following services:

1. *Distribution of money to every holder of a smartcard via a card reader and a cash dispenser.*
2. *Report of account balance, cash and cheques deposit facilities for bank customers who hold a smartcard from their bank.*

In addition:

3. *All transactions are made sure.*
4. *The dispenser has to be refilled from time to time.*

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Withdraw money using a Visa card

Summary: *This use case allows a Visa card holder, who is not a customer of the bank to withdraw money if his/her daily limit allows it.*

- 1. The Visa CardHolder inserts his/her smart card in the ATM's card reader.*
- 2. The ATM verifies that the card that has been inserted is a smartcard.*
- 3. The ATM asks the Visa CardHolder to enter his/her pin number.*
- 4. The Visa CardHolder enters his/her pin number.*
- 5. The ATM compares the pin number with the one that is encoded on the chip of the smartcard.*
- 6. The ATM requests an authorisation from the Visa authorisation system*
- 7. The Visa authorisation system confirms its agreement and indicates the daily withdrawal limit.*
- 8. The ATM asks the Visa CardHolder to enter the desired withdrawal amount.*
- 9. The Visa CardHolder enters the desired withdrawal amount.*
- 10. The ATM checks the amount against the daily withdrawal limit.⁹*

- 11. The ATM asks the Visa CardHolder if he/she would like a receipt.*
- 12. The Visa CardHolder requests a receipt.*
- 13. The ATM returns the card to the Visa CardHolder.*
- 14. The Visa CardHolder takes his/her card.*
- 15. The ATM issues the banknotes and a receipt.*
- 16. The Visa CardHolder takes the banknotes and the receipt.*

Variations: Temporarily incorrect pin number

At step 5, the Visa CardHolder fails to enter a correct pin number

- 6. The ATM informs the CardHolder that the pin is incorrect for the first or second time.*
 - 7. The ATM records the failure on the smartcard.*
- The scenario goes back to step 3.*

Variations: The amount requested is greater than the daily withdrawal limit

...

Variations: *The Visa CardHolder does not want a receipt*

...

Error: *Invalid card*

...

Error: *Conclusively incorrect pin number*

...

Error: *Unauthorised withdrawal*

...

Error: *The card is not taken back by the holder*

...

Error: *The banknotes are not taken back by the holder*

...

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Notation

UcNo. **Name of use case:** *Withdraw money using a Visa card*

Actors: *Visa CardHolder, Visa AS*

Preconditions:

the ATM cash box is well stocked

there is no card in the reader

Postconditions

the amount of money in the ATM changes

Invariants

Non-functional requirements

response time: within a maximum time limit of 2 seconds

confidentiality: the procedure of comparing the pin number that has been entered on the keyboard of the

ATM with that of the smartcard must have a maximum failure rate of 10^{-6}

Process description

Exceptions, error situations

Variations

Rules

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(Notation continued)

Services

Contact partners, sessions

Notes/open questions

Documents, references, dialog samples

Diagrams: sequence and collaboration, class, activity and state

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Actors

Definition

Actor is an external entity which is involved in the interaction with the system described in a use case.

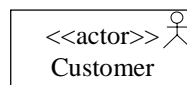
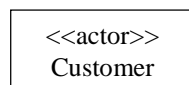
Description

- actors = roles
- actors can be also dialogs, and external systems

Notation



Customer

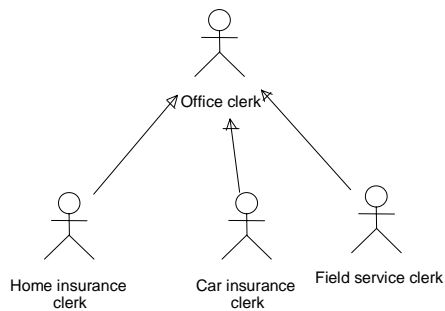


dialog

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- generalisation and specialisation of actors

Example



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Use Case Diagram

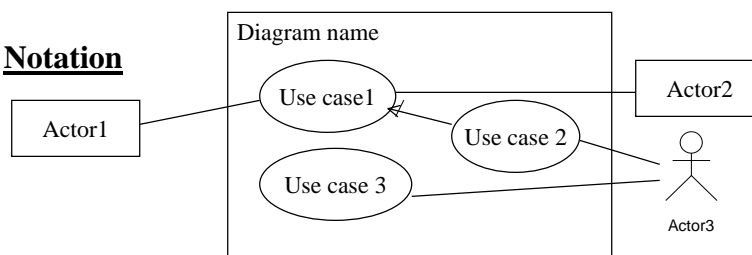
Definition

Shows the relationships between a set of use cases and the actors involved in these use cases.

Description

- tool for requirement determination
- use case describes those activities which are to be supported by the software under development

Notation



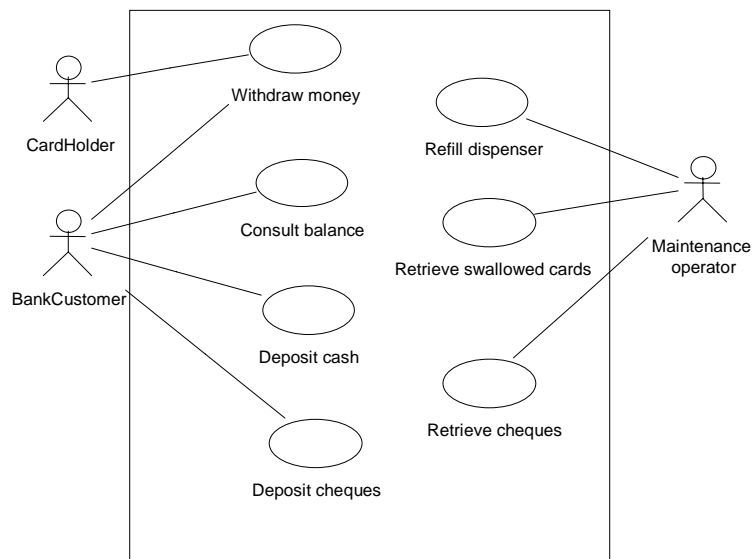
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ATM offers the following services:

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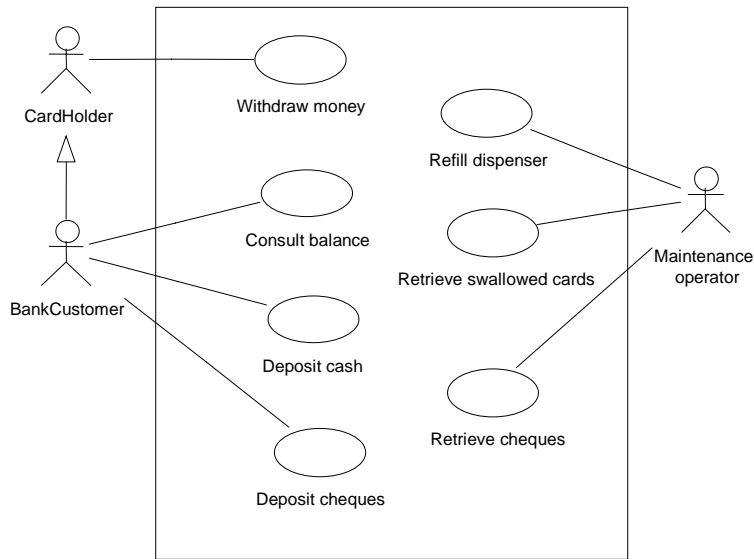
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Initial use case diagram for the ATM



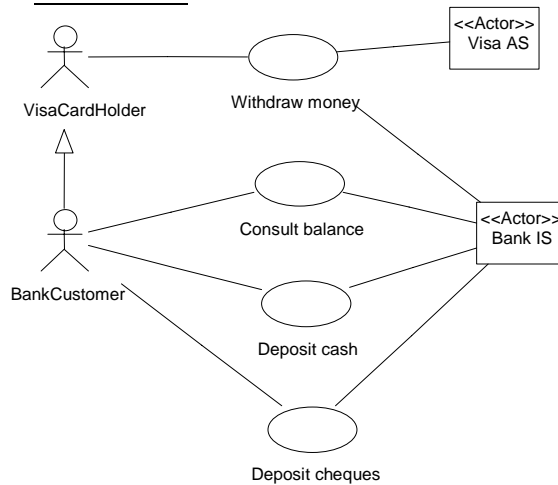
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Improved diagram



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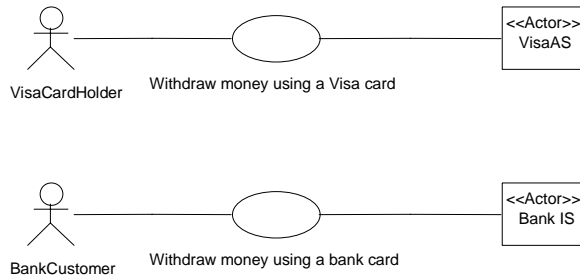
More actors



Problem: if the actor is Visa card holder the Visa AS must be called on, Whereas the Bank IS will be contacted for a bank customer!
Not presented on the diagram!

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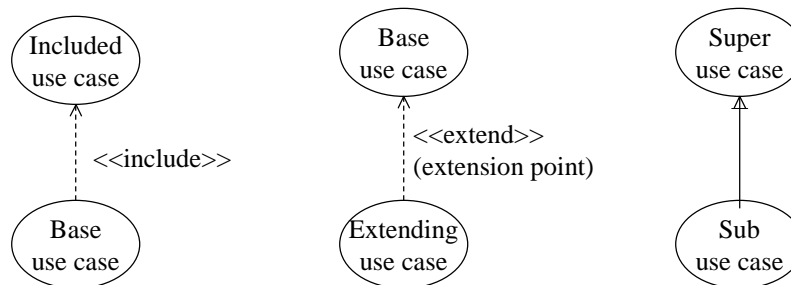
Another improvement



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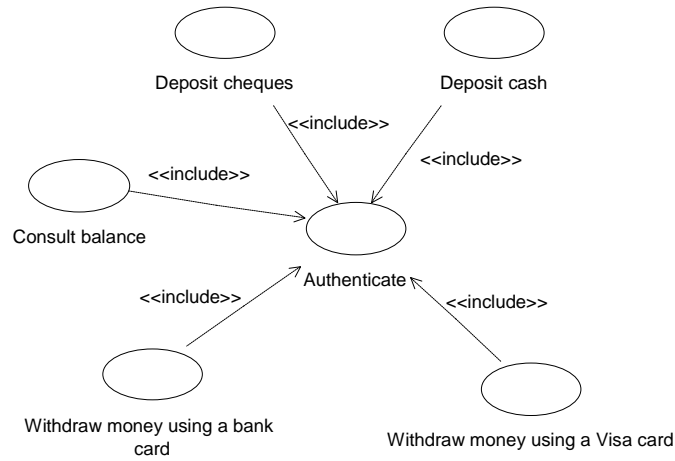
Relationships between use cases

- include: base use case includes the functionality of included use case
- extend: a use case is optionally extended by functionality of another use case
- generalisation: sub use case inherits behaviour and semantics from super use cases



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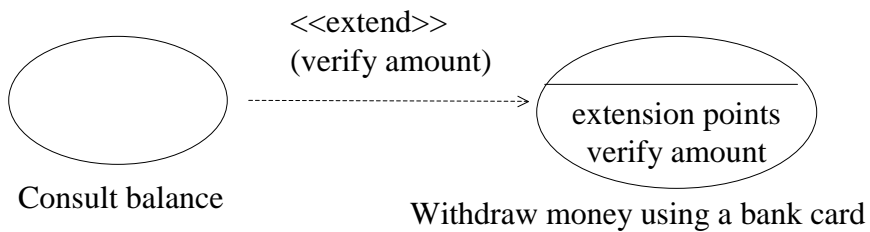
Example of an include relationship



Problem: users have to re-authenticate themselves for each kind of transaction.

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Example of an extend relationship



7. The BankIS confirms its agreement and indicates the daily withdrawal limit.

8. The ATM asks the BankCustomer to enter the desired withdrawal amount.

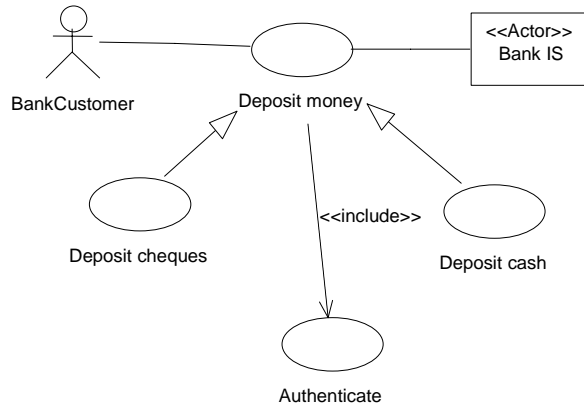
Extension point: Verify amount

9. The BankCustomer enters the desired withdrawal amount.

10. The ATM checks the amount against the daily withdrawal limit.

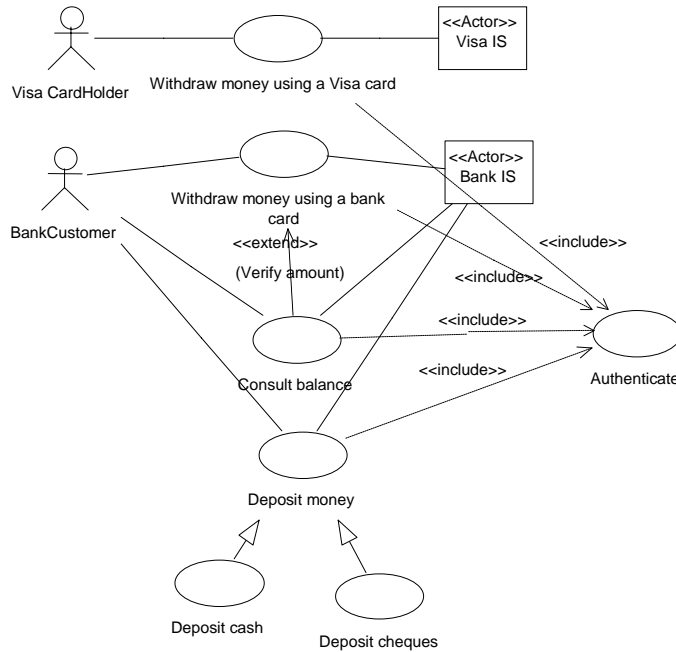
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Example of a generalisation relationship



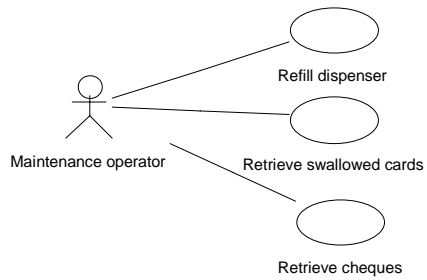
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Final use case diagram



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Final use case diagram (continued)



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How to identify use cases?

- Define the list of actors
then try to work out the use cases for each actor
- Identify external events to which system/user reacts.

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Summary

- Use-case modelling is a technique used to describe the functional requirements of a system.
- Use case diagrams consist of actors and use cases.

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