# CH5.Functional Modeling (Use Case Diagram)

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# Objectives

- Understand the rules and style guidelines for use case
- Be able to create activity diagram, use case, and use case diagram
- Become familiar with the use of use case

# Use Cases

- **Simple description of a system's functions from bird's-eye view of the users**
- **Illustrate the activities that are performed by users of a system**
- **Logical models**
  - They describe the activities of a system without specifying how the activities are implemented
- **Describe basic functions of the system**
  - What the user can do
  - How the system responds
- **Building blocks for continued design activities**

# How Are Use Cases Created?

- **Primary drivers for all of the UML diagramming techniques**
- **Capture the typical interaction of the system with the system's users**
- **Two steps:**
  - Write text-based case descriptions
  - Translate the descriptions into diagrams
- **Based on the identified requirements and the activity diagram description of a business process**
- **Describes one and only one function, but may have multiple paths.**
  - Scenario : an instance of Use Case
- **Developed working with users for contents.**

# Types of Use Cases

## ❖ Overview vs. Detail Use Case

- On high-level overview of the requirements
- Use case represents an important business process.
- Created early in the process of understanding the system requirements
- Included information
  - use case name, ID number, primary actor, type, brief description
- Converted to **Detail Use Case**

## ❖ Essential vs. Real Use Case

- Describes the minimum essential issues necessary to understand the required functionality
- Implementation-independent
- Extended to **Real Use Case**
  - detailed descriptions of how to use the system once it is implemented

# Elements of a Use Case Descriptions

❖ **Use Case Template :** Campus housing maintain available rental unit information overview use-case description

| | | | |
|---|---|---|---|
| Use Case Name: | Maintain Available Rental Unit Information | ID: 1 | Importance Level: High |
| Primary Actor: | Apartment Owner | Use Case Type: | Detail, Essential |

**Stakeholders and Interests:** 이해 당사자, 관계자
Apartment Owner—wants to advertise available apartment
Campus Housing Service—provides a service that enables the apartment owners to rent their available apartments

**Brief Description:** This use case describes how the campus housing service can maintain an up-to-date listing of available apartments.

**Trigger:** Apartment Owner wants to add or delete an available apartment

**Type:** External

**Relationships:**
Association: Apartment Owner
Include:
Extend:
Generalization:

+ Normal Flow of Events
+ Sub Flows
+Alternate/Exceptional Flows

(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. *Systems analysis and design*. John wiley & sons.)

# Guidelines for Use Case Descriptions

1. Write each step in "SVDPI" form
2. Make sure it is clear who the initiator of the step
3. Write the steps from the perspective of the independent observer
4. Write each step at about the same level of abstraction
5. Ensure the use case has a sensible set of steps
6. Apply KISS principle liberally
7. Write repeating instructions after the set of steps to be repeated.

# Use Case Description: Example

- **Medical Appointment System - "Make Old Patient App." Use Case (1/3)**

| | | | |
|---|---|---|---|
| Use Case Name: | Make Old Patient Appt | ID: 2 | Importance Level: Low |
| Primary Actor: | Old Patient | Use Case Type: | Detail, Essential |

Stakeholders and Interests:
Old Patient – wants to make, change, or cancel an appointment
Doctor – wants to ensure patient's needs are met in a timely manner

Brief Description: This use case describes how we make an appointment as well as changing or canceling an appointment for a previously seen patient.

Trigger: Patient calls and asks for a new appointment or asks to cancel or change an existing appointment

Type: External

Relationships:

| | |
|---|---|
| Association: | Old Patient |
| Include: | |
| Extend: | Update Patient Information |
| Generalization: | Manage Appointments |

(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. *Systems analysis and design*. John wiley & sons.)

# Use Case Description: Example

- **Medical Appointment System - "Make Old Patient App." Use Case (2/3)**

Normal Flow of Events:

1. The Patient contacts the office regarding an appointment.
2. The Patient provides the Receptionist with his or her name and address.
3. If the Patient's information has changed
   Execute the Update Patient Information use case.
4. If the Patient's payment arrangements has changed
   Execute the Make Payments Arrangements use case.
5. The Receptionist asks Patient if he or she would like to make a new appointment, cancel an existing appointment, or change an existing appointment.
   If the patient wants to make a new appointment,
   the S-1: new appointment subflow is performed.
   If the patient wants to cancel an existing appointment,
   the S-2: cancel appointment subflow is performed.
   If the patient wants to change an existing appointment,
   the S-3: change appointment subflow is performed.
6. The Receptionist provides the results of the transaction to the Patient.

(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. *Systems analysis and design*. John wiley & sons.)

# Use Case Description: Example

- **Medical Appointment System - "Make Old Patient App." Use Case (3/3)**

SubFlows:

S-1: New Appointment

1. The Receptionist asks the Patient for possible appointment times.
2. The Receptionist matches the Patient's desired appointment times with available dates and times and schedules the new appointment.

S-2: Cancel Appointment

1. The Receptionist asks the Patient for the old appointment time.
2. The Receptionist finds the current appointment in the appointment file and cancels it.

S-3: Change Appointment

1. The Receptionist performs the S-2: cancel appointment subflow.
2. The Receptionist performs the S-1: new appointment subflow.

Alternate/Exceptional Flows:

S-1, 2a1: The Receptionist proposes some alternative appointment times based on what is available in the appointment schedule.

S-1, 2a2: The Patient chooses one of the proposed times or decides not to make an appointment.

(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. *Systems analysis and design*. John wiley & sons.)

# Your Turn - Activity

- How would you make requirements gathering (interviews, observation, and concept map) more effective by knowing that eventually you will be creating use-case descriptions and diagrams?

# Your Turn

- A student wants to borrow a software from PC Lab.
- Write a Use Case/Scenario using Use Case Template.

| | | |
|---|---|---|
| Use Case Name: | ID: | Importance Level: |
| Primary Actor: | | Use Case Type: |
| Stakeholders and Interests: | | |
| Brief Description: | | |
| Trigger: | | |
| Relationships: | | |

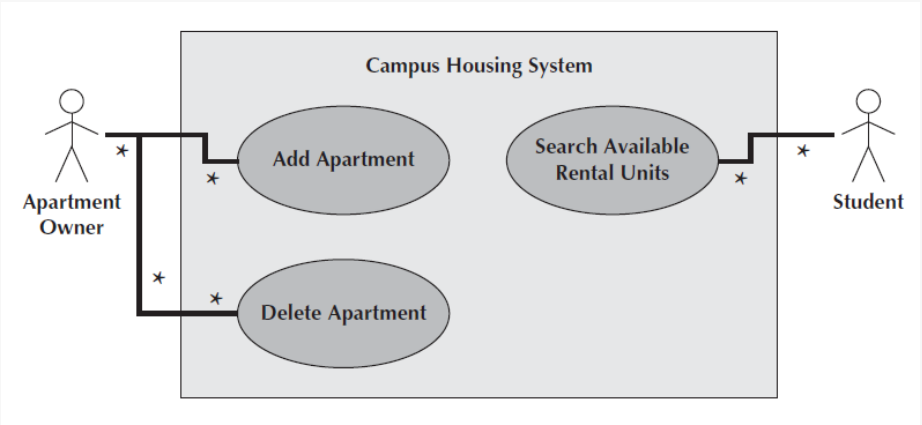
Continue to next page

# Your Turn (Cont'd)

| |
|---|
| **Normal Flow of Events:** |
| **Subflows:** |
| **Alternate/Exceptional Flows:** |

# Use Case Diagram

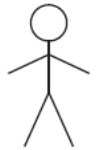
- Summarizes all of the use cases for the part of the system being modeled together in one picture
- Understand the functionality of the system at a very high level
- Drawn early on the SDLC when gathering and defining requirements for the system
- Illustrates the main function of the system and the different kinds of users that will interact with it
- Components of Use Case Diagram
  - Actor
  - Use Case
  - Subject Boundary (System Boundary)
  - Relationship




(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. *Systems analysis and design*. John wiley & sons.)

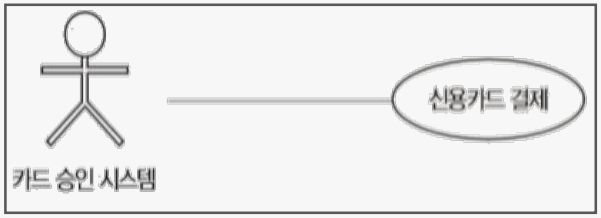
# Syntax for Use-Case Diagram (1/3)

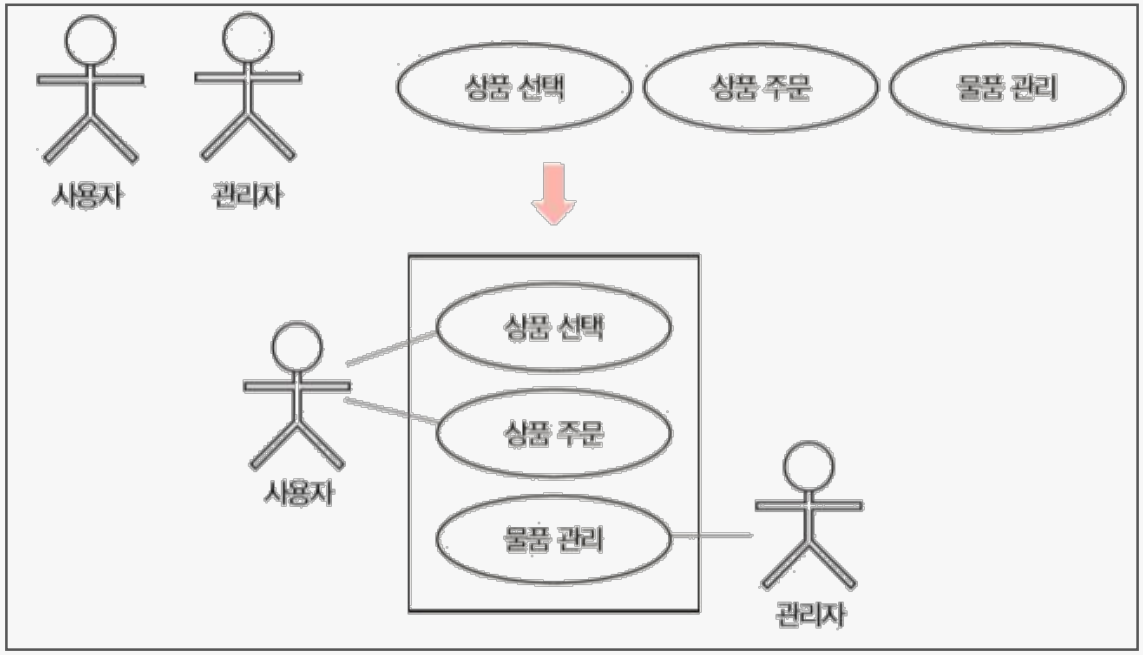
❖ **Name, Meanings and its Symbol**

| | |
|---|---|
| **An actor:** 사람 or 시스템<br>■ Is a person or system that derives benefit from and is external to the subject.<br>■ Is depicted as either a stick figure (default) or, if a nonhuman actor is involved, a rectangle with <<actor>> in it (alternative).<br>■ Is labeled with its role.<br>■ Can be associated with other actors using a specialization/superclass association, denoted by an arrow with a hollow arrowhead.<br>■ Is placed outside the subject boundary. |  <br>Actor/Role<br><<actor>><br>Actor/Role |
| **A use case:**<br>■ Represents a major piece of system functionality.<br>■ Can extend another use case.<br>■ Can include another use case.<br>■ Is placed inside the system boundary.<br>■ Is labeled with a descriptive verb–noun phrase. | Use Case |

# Syntax for Use-Case Diagram (Example)

❖ **Example of use-case**

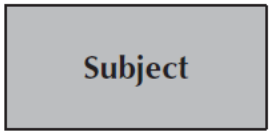
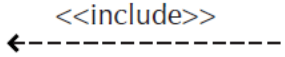



(source: 한빛미디어 UML기초와 응용)

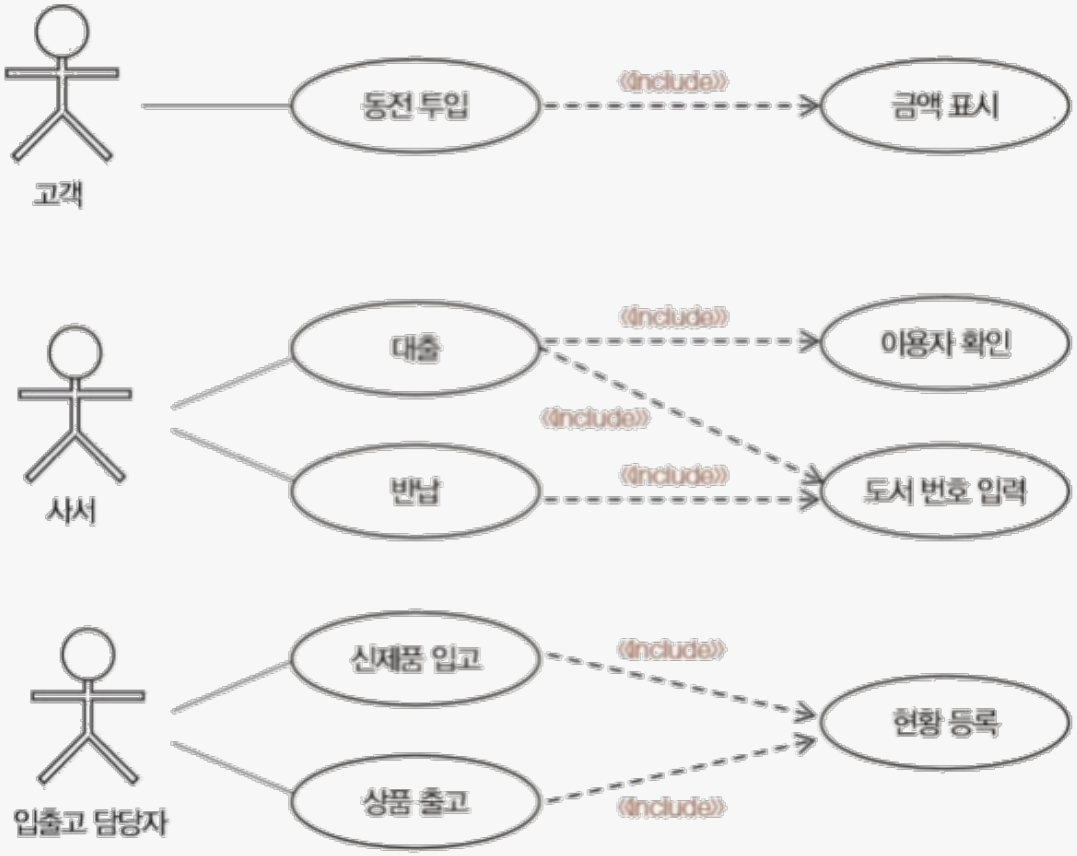
# Syntax for Use-Case Diagram (2/3)

- **Name, Meanings and its Symbol**

| | |
|---|---|
| **A subject boundary:**<br>■ Includes the name of the subject inside or on top.<br>■ Represents the scope of the subject, e.g., a system or an individual business process. |  |
| **An association relationship:**<br>■ Links an actor with the use case(s) with which it interacts. |  |
| **An include relationship:**<br>■ Represents the inclusion of the functionality of one use case within another.<br>■ Has an arrow drawn from the base use case to the used use case. |  |

# Syntax for Use-Case Diagram (Example)

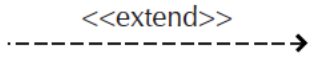
❖ **Example of use-case diagram**




(source: 한빛미디어 UML기초와 응용)

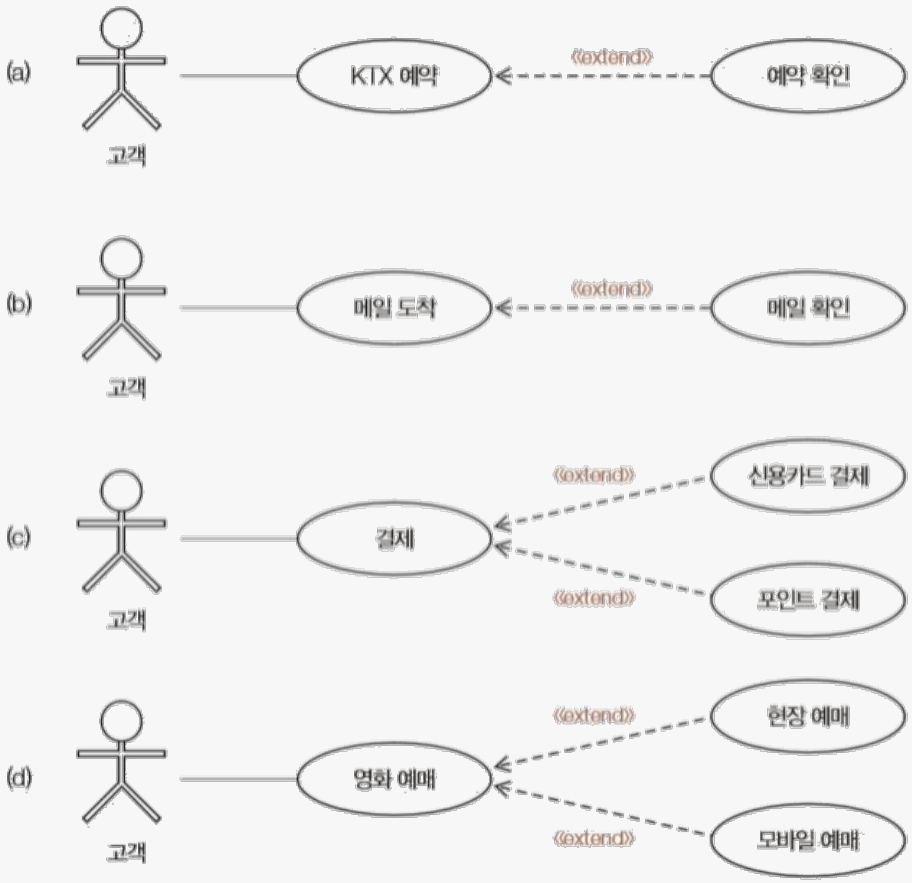
# Syntax for Use-Case Diagram (3/3)

- **Name, Meanings and its Symbol**

| | |
|---|---|
| **An extend relationship:**<br>■ Represents the extension of the use case to include optional behavior.<br>■ Has an arrow drawn from the extension use case to the base use case. |  |
| **A generalization relationship:**<br>■ Represents a specialized use case to a more generalized one.<br>■ Has an arrow drawn from the specialized use case to the base use case. |  |

# Syntax for Use-Case Diagram (Example)

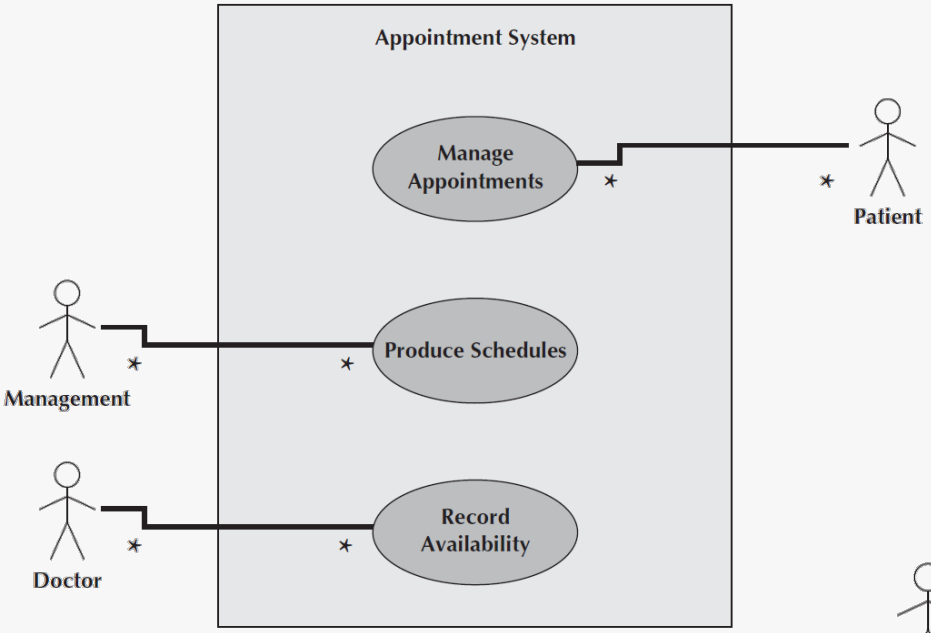
❖ **Example of use-case diagram**



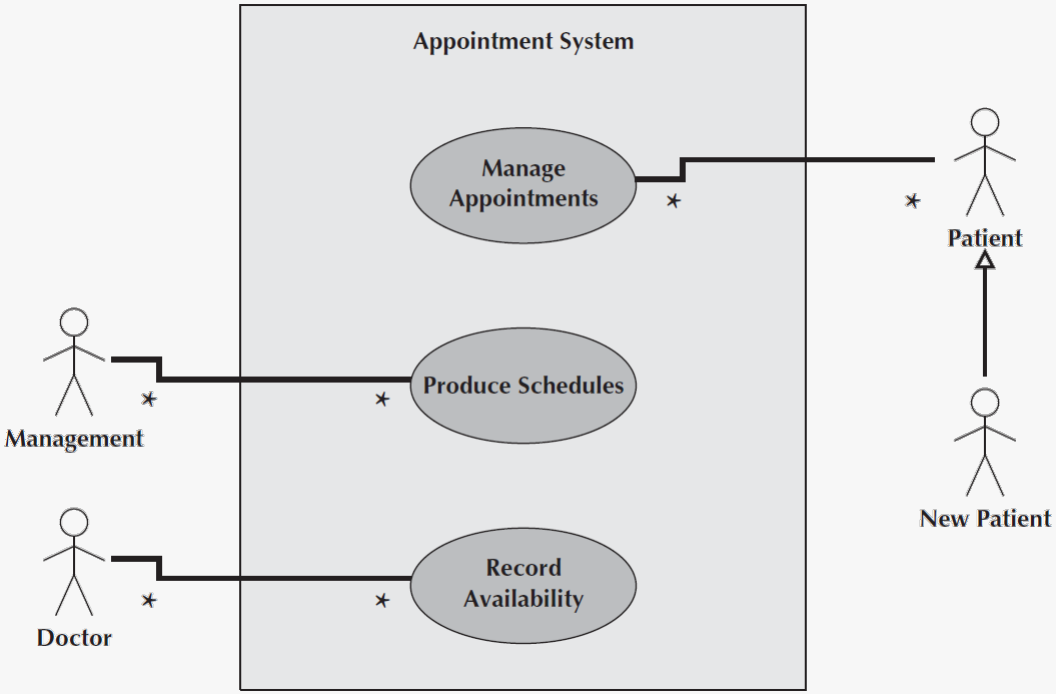

(source: 한빛미디어 UML기초와 응용)

# Use Case Diagrams : Example

<Appointment System>



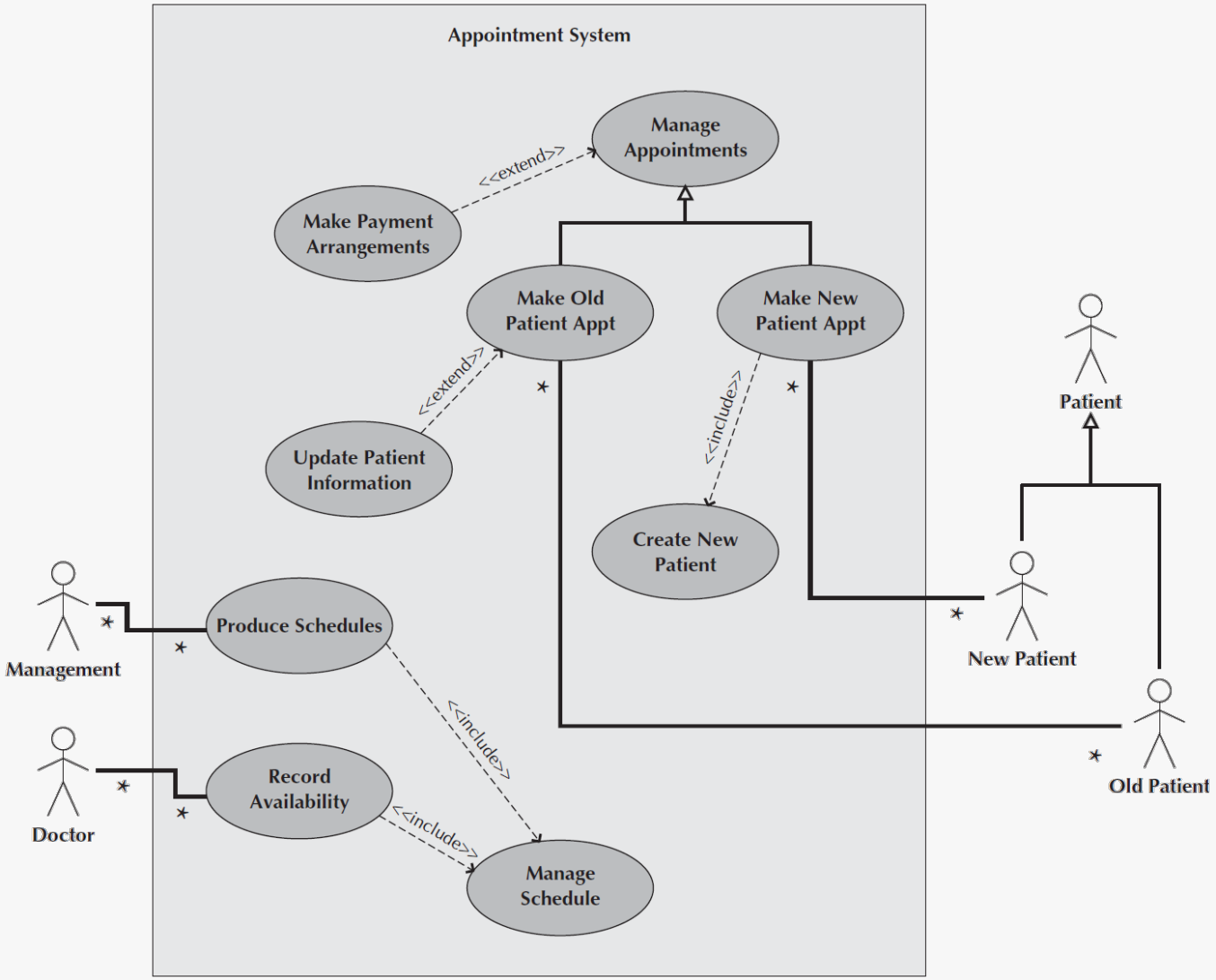

<Appointment System with a Specialized Actor>




(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. Systems analysis and design. John wiley & sons.)

# Use-Case Diagram : Extend and Include Relationships

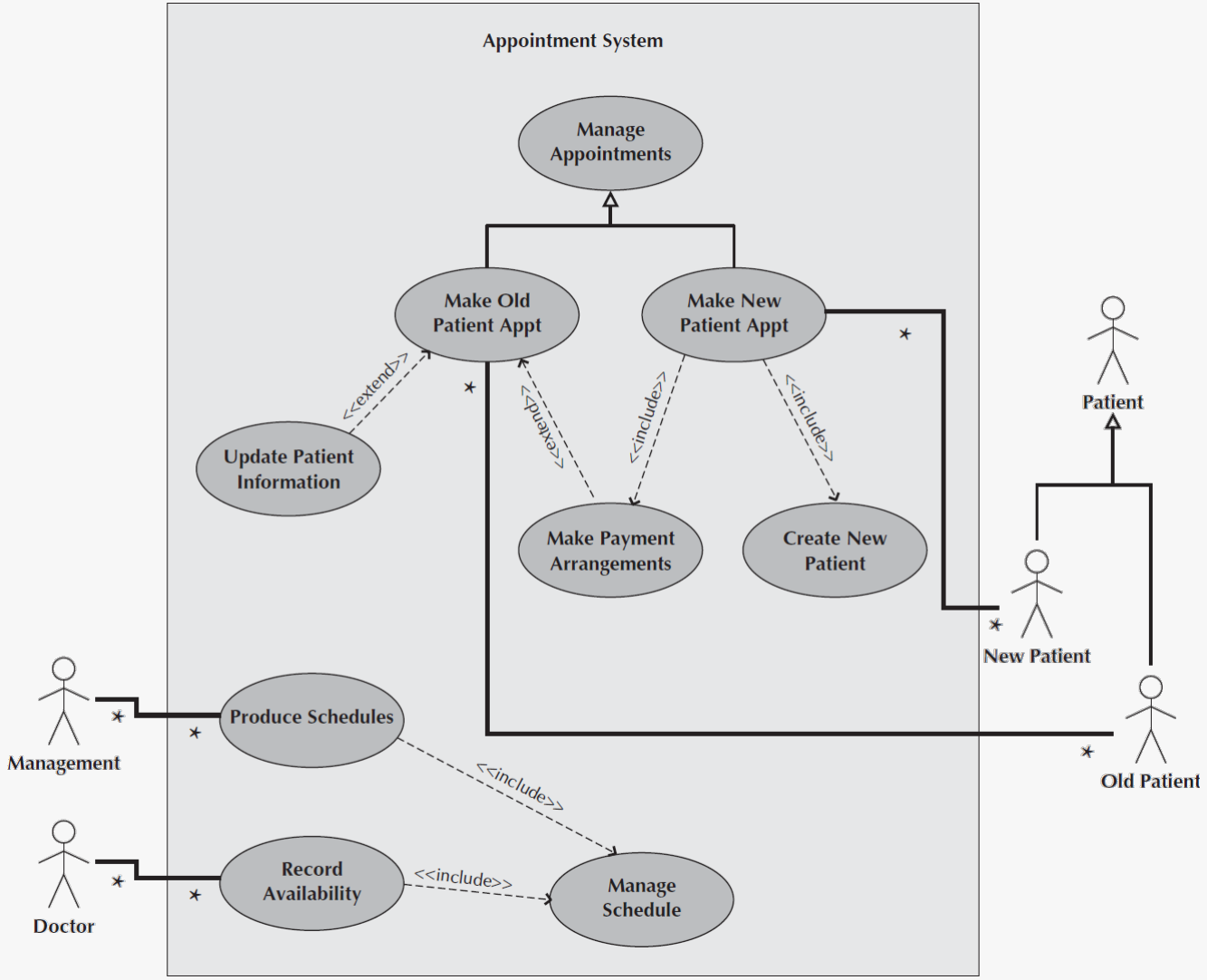
<Medical Appointment System- Case A>




(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. Systems analysis and design. John wiley & sons.)

# Use-Case Diagram : Extend and Include Relationships

<Modified Medical Appointment System - Case B>




(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. Systems analysis and design. John wiley & sons.)

# Writing Use Cases

- **Use Case**
  - describes the functionality of the system
  - model of the dialog between actors and the system
  - model both the contexts of the system and the detailed requirements for the system
- **Purpose of Use Case**
  - document the functional requirements of the system
  - basis for testing the evolving system
- **Major steps in writing Use Case**
  - Identify the major use cases
  - Expand the major use cases
  - Confirm the major use cases
  - Create the use-case diagram

# Steps in Writing Use Case (1)

❖ **Identify the Major Use Cases**

1. Review the activity diagram.
2. Find the subject's boundaries.
3. Identify the primary actors and their goals.
4. Identify and write the overviews of the major use cases for the above.
5. Carefully review the current use cases. Revise as needed.

❖ **Expand the Major Use Cases**

6. Choose one of the use cases to expand.
7. Start filling in the details of the chosen use case.
8. Write the Normal Flow of Events of the use case.
9. If the Normal Flow of Events is too complex or long, decompose into sub-flows.
10. List the possible alternate or exceptional flows.
11. For each alternate or exceptional flow, list how the actor and/or system should react.

# Steps in Writing Use Case (2)

❖ **Confirm the Major Use Cases**

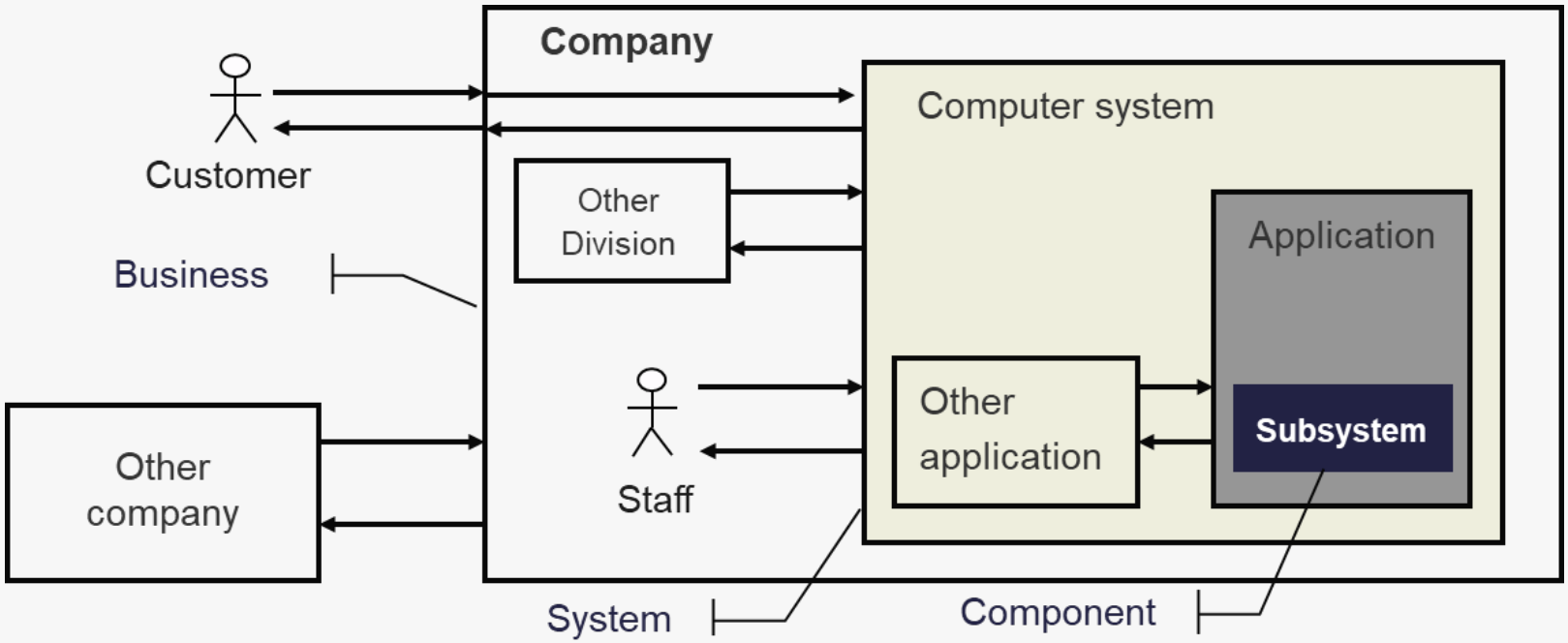
12. Carefully review the current set of use cases. Revise as needed.
13. Start at the top again.

❖ **Create the Use Case Diagram**

1. Draw the subject boundary.
2. Place the use cases on the diagram.
3. Place the actors on the diagram.
4. Draw the associations.

# Identifying the Major Use Cases

1. **Review the activity diagram**
   - understanding a complete overview of the underlying business process being modeled
2. **Identify the system's boundaries (or subject boundaries)**
   - identify the scope of the system



# Identifying the Major Use Cases

3. **List the primary actors and their goals**
   - actor is not an individual user, but a role

**What is actor ?**

- External entities that interacting with the system
  - human, Organization, Device, System, Database, Network

human

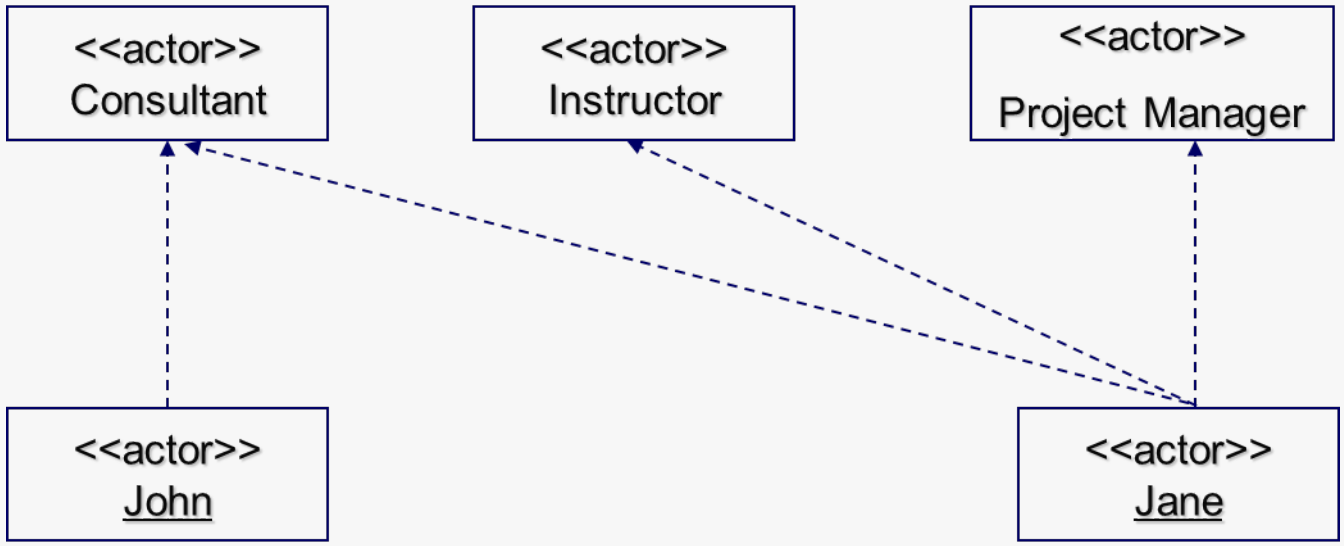
Software


hardware

clock

# Identifying the Major Use Cases

3. **List the primary actors and their goals (cont.)**
   - **Human Actor**
   - **Not means a specific person (human) or a specific device**
     - Physically, many person can be represented as an actor
       - Multi persons have a same role
     - Physically, a person can be represented as multiple actors
       - Multiple roles can be assigned to one person

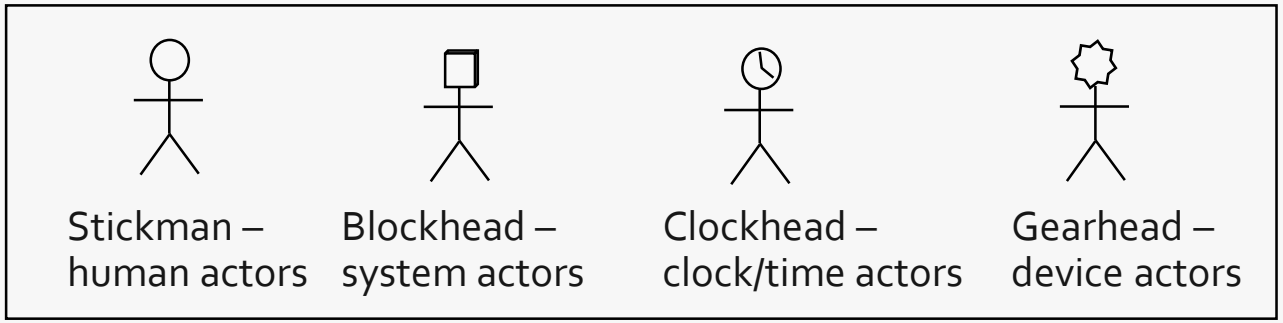


# Identifying the Major Use Cases

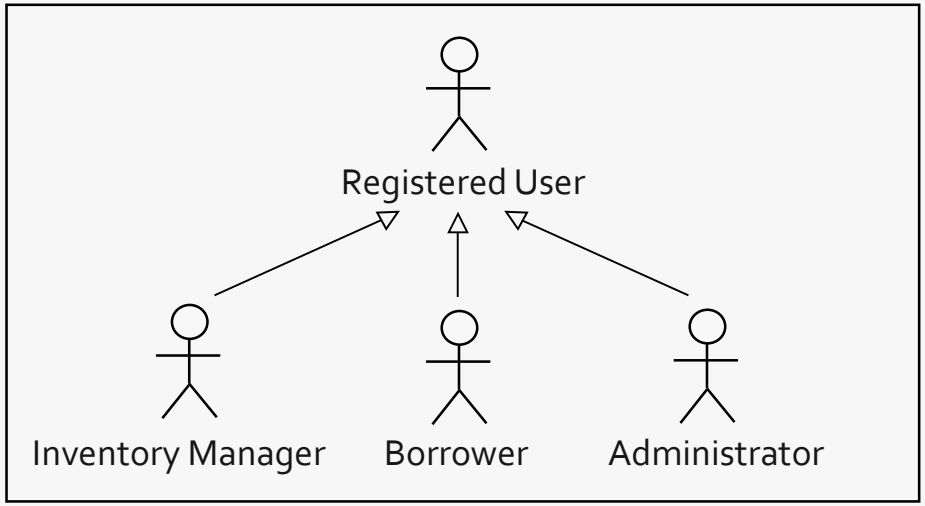
3. **List the primary actors and their goals (cont.)**
   - **Questions to identify the actor :**
     - Who will use the main functionality of the system ?
     - What is the other system which interacts with developing system ?
     - Who will need support from the system to do their daily tasks ?
     - Who/What does generate the event toward the system ?
     - Who/What does respond to output event of the system ?
     - Who is the provider/acquirer the information to/from the system ?
     - Is it necessary any interface to report information ?
     - Is there any predefined-actors in the system ?
     - Who is the operator installing maintaining, retiring the system ?

# Identifying the Major Use Cases

3. **List the primary actors and their goals (cont.)**
   - **Figuring the Actor**
     - **Some alternative presentation options to the stickman**




     - **Generalization relationship between actors**



# Identifying the Major Use Cases

4. **Identify and write the overview of the major use cases**
   - **focus on major use cases because of users' cognition and business processes**
   - **includes**
     - Use case name, ID, Importance level, Primary actor, Use case type,
     - Stakeholder, Brief description

**Use Case SHOULD BE …**

- Identified by the level of Elementary Business Process
  - Elementary Business Process : a person, a place, and same time
- Separated when some of its behaviors occur at different time
- Always initiated by an actor
  - always be connected to at least one actor
- Complete description

# Identifying the Major Use Cases

**Questions to find Use Case :**

- Which functions does the actor require from the system ?
- What does the actor need to do ?
- Does the actor need to read, create, destroy, modify, or store some kind of information in the system ?
- What do the events represent in terms of functionality ?

5. **Carefully review use cases**
   - **split or merge some of use cases**
   - **three to nine use cases in each system, in general, overview use case diagram**

**Three to Nine? Why ?**

# Expand the Major Use Cases (1/2)

6. **Choose one major use case to expand**
   - using the importance level of the use case (refer slide # 21)
7. **Fill in details on the chosen use case**
   - filling in the details on the use case template (refer slide #21)
8. **Write the normal flow of events of the use case**
   - focus on what the biz process does to complete the use case
   - steps in the order in which they are performed, written in **SVDPI** form
9. **If the normal flow of events is too complex, decompose into sub-flows**
   - should  not too complex or too long
   - not more than seven to twelve steps, in general

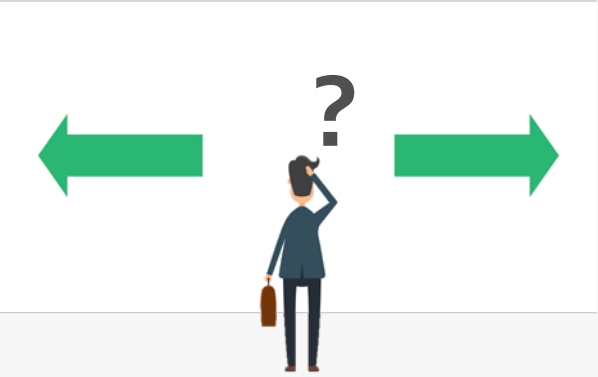
# Expand the Major Use Cases (2/2)

**10. List the possible alternate or exceptional flows**

- represent optional or exceptional behavior

**11. For each alternate, list how the actor and/or system should react**

- the description of the alternate or exceptional flow



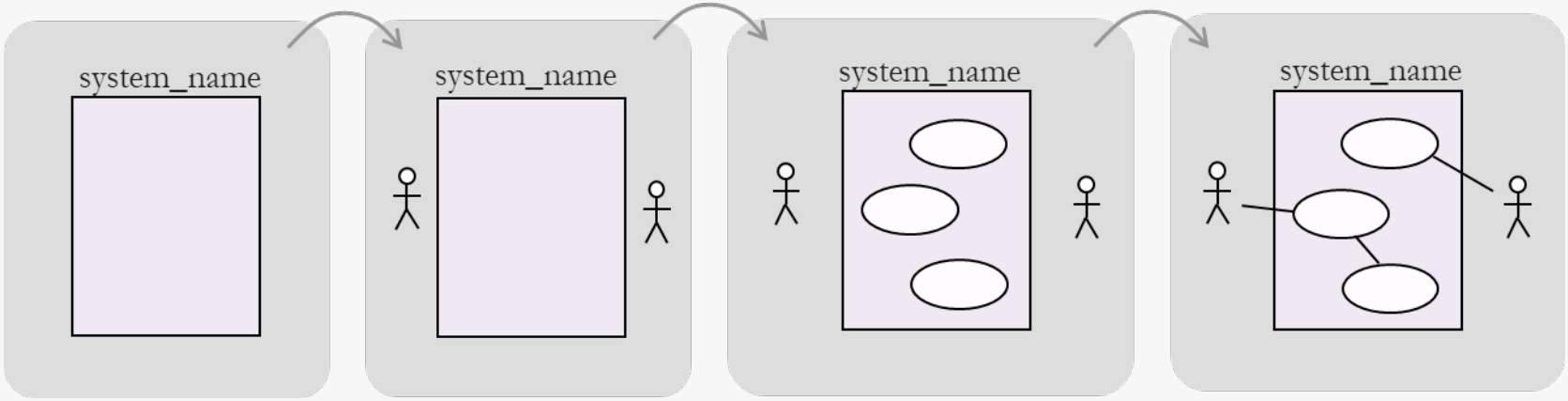
# Confirm the Major Use Cases

12. **Review the current set of use cases**
    - review the use cases with users to make sure each step is correct
    - consider include, extend, or generalization relationship bwn use cases
13. **Iterate the entire set of steps until all use cases are defined**
    - sufficient number of use cases have been documented to begin identifying candidate classes for the structural model

# Create the Use Case Diagram

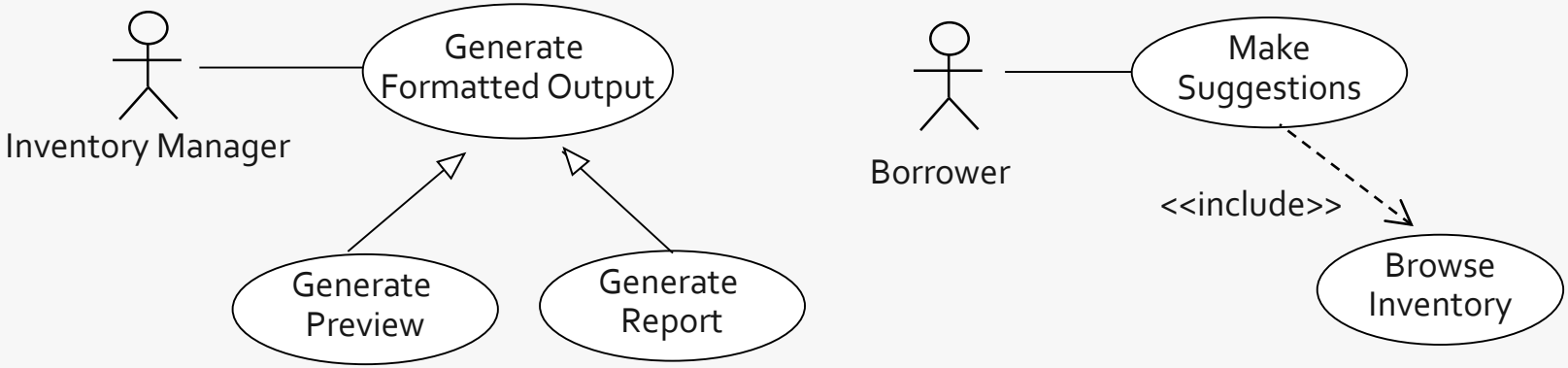
- **Use case diagram provides the user with an overview of the detailed use cases**

- **4 steps to drawing the UCD**
  1. Draw the system boundary
  2. Place the actors on the diagram
  3. Place the Use Cases on the boundary
  4. Draw the associations



# Relationship between Use Case

- **Three types of relationships**
  - **Generalization : a relationship from a child use case to a parent use case**
  - **Extend**
    - for sets of optional behavior
    - to deploy functional use case, though not complete
  - **Include**
    - contains the behavior defined in another use case
    - can be inserted into the behavior of the base use case



# Case Study : CD Selection Company

## ❖ Requirements

**Nonfunctional Requirements**

1. Operational Requirements

1.1 The Internet sales system will draw information from the main CD information database, which contains basic information about CDs (e.g., title, artist, ID number, price, quantity in inventory). The Internet sales system will not write information to the main CD information database.

1.2 The Internet sales system will store orders for new CDs in the special order system and will rely on the special order system to complete the special orders generated.

1.3 A new module for the in-store system will be written to manage the "holds" generated by the Internet sales system. The requirements for this new module will be documented as part of the Internet sales system because they are necessary for the Internet sales system to function.

2. Performance Requirements

No special performance requirements are anticipated.

3. Security Requirements

No special security requirements are anticipated.

4. Cultural and Political Requirements.

No special cultural and political requirements are anticipated.

**Functional Requirements**

1. Maintain CD Information

1.1 The Internet sales system will need a database of basic information about the CDs that it can sell over the Internet, similar to the CD database at each of the retail stores (e.g., title, artist, ID number, price, quantity in inventory).

1.2 Every day, the Internet sales system will receive an update from the distribution system that will be used to update this CD database. Some new CDs will be added, some will be deleted, and others will be revised (e.g., a new price).

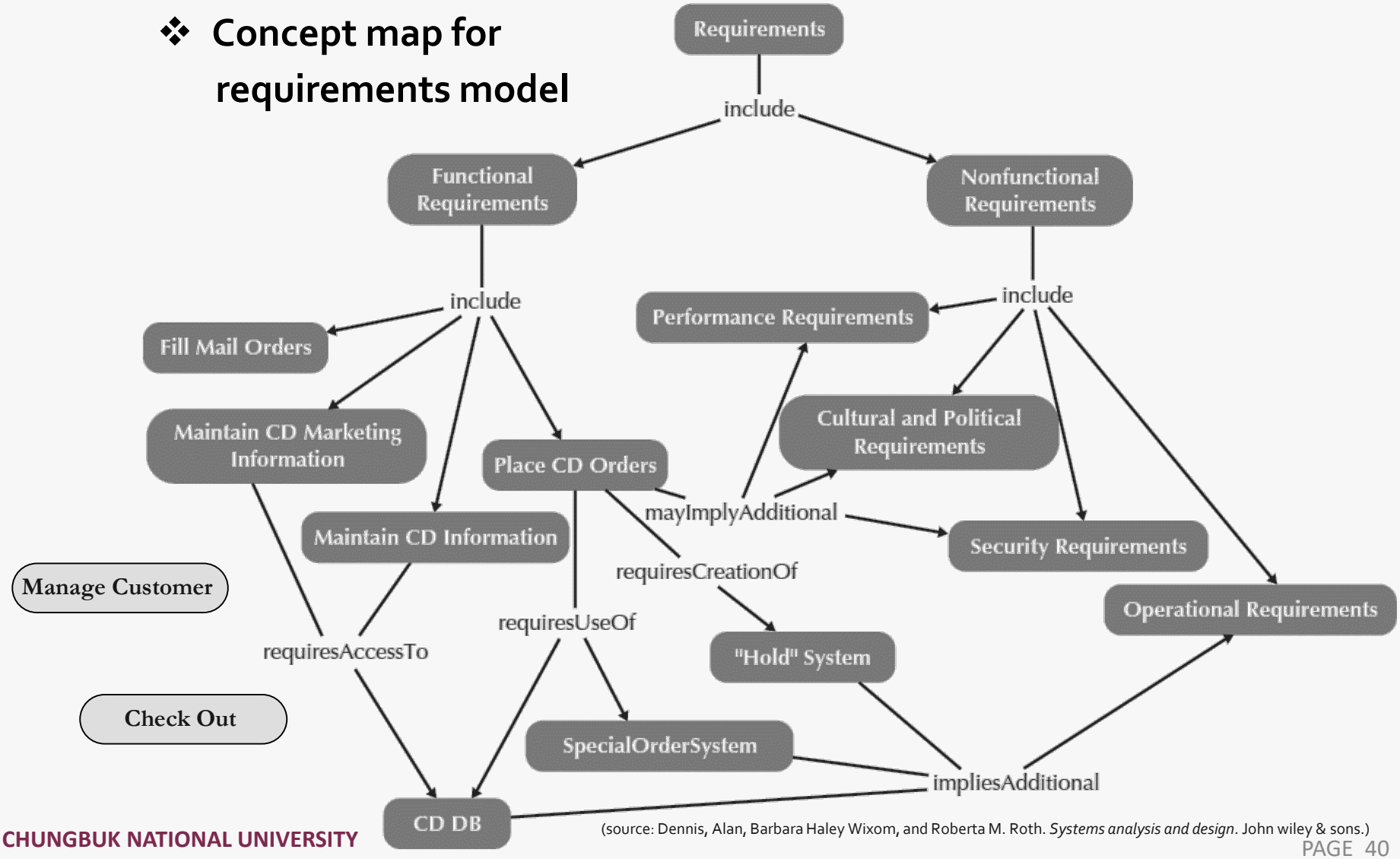
1.3 The electronic marketing (EM) manager (a position that will need to be created) will also have the ability to update information (e.g., prices for sales).

2. Maintain CD Marketing Information

2.1 The Internet sales system provides an additional opportunity to market CDs to current and new customers. The system will

# Case Study : CD Selection Company

- Concept map for requirements model




(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. *Systems analysis and design*. John wiley & sons.)

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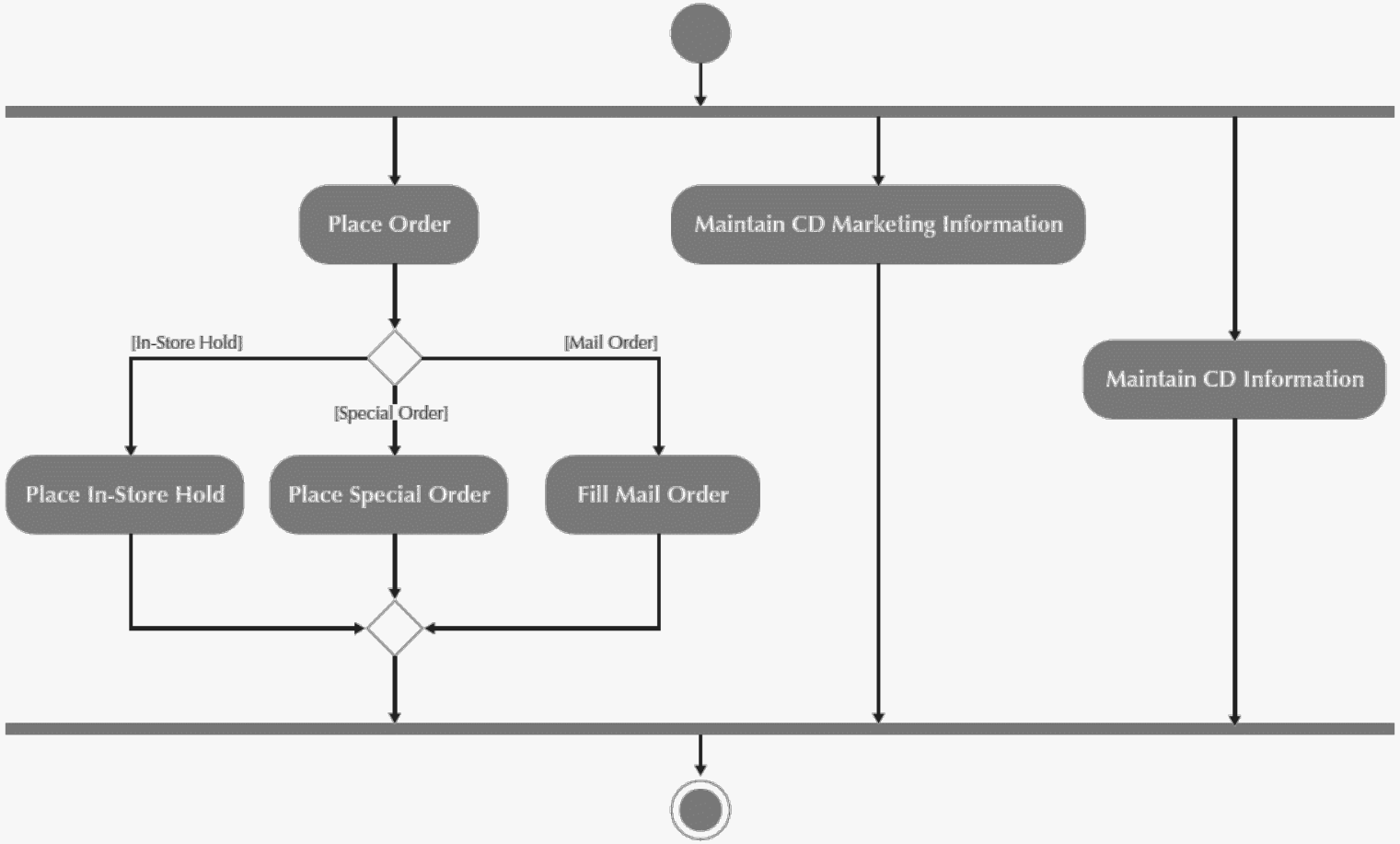
- Activity Diagram in brief

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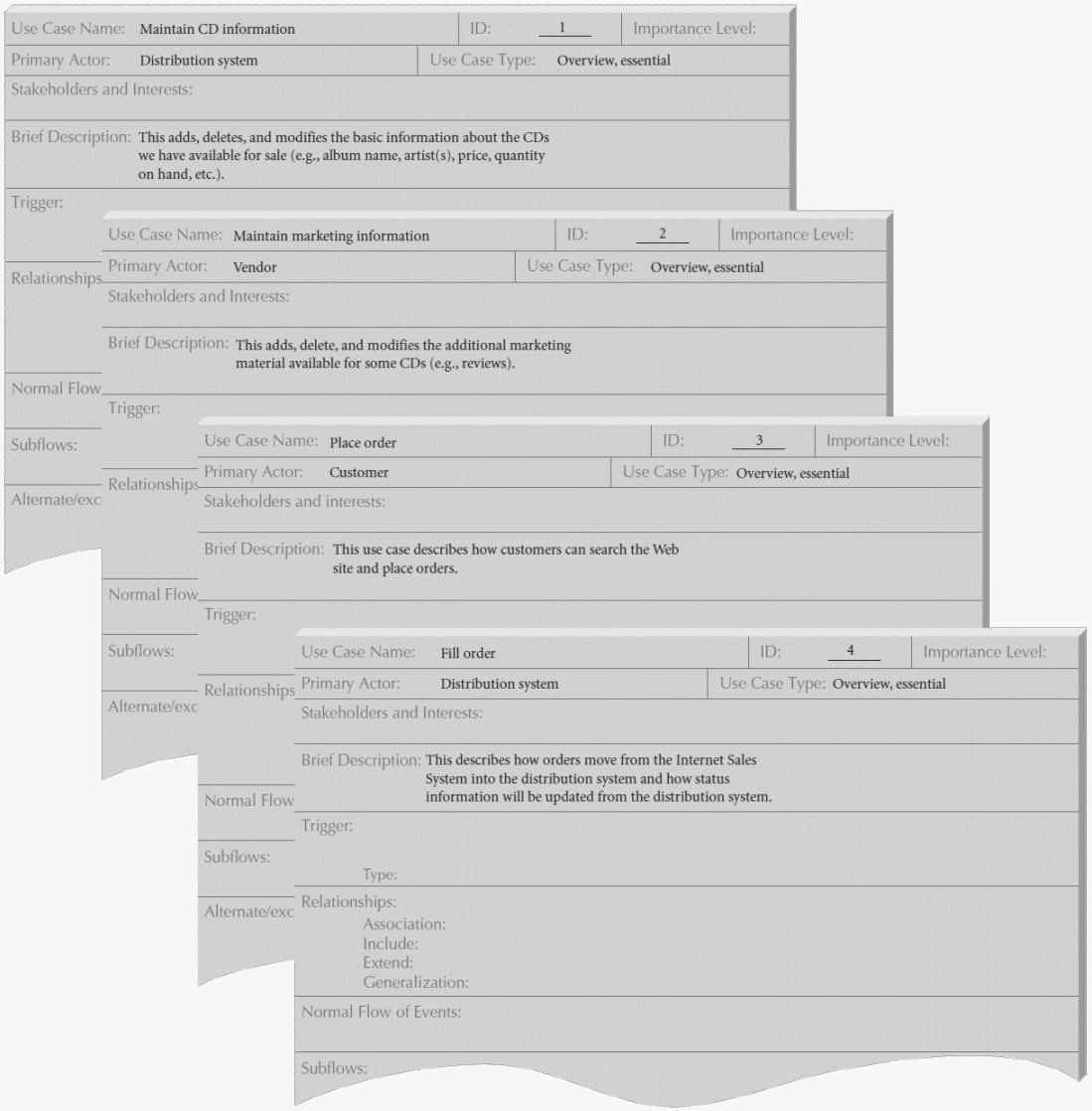
- **Overview major Use Cases**

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# Case Study : CD Selection Company

- **Use Case : Place Order**

| | | | | | |
|---|---|---|---|---|---|
| Use Case Name: | Place Order | | ID: | 3 | importance level: High |
| Primary Actor: | Customer | | Use case type: | Detail, Essential | |
| Stakeholders and Interests: | Customer - wants to search Web site to purchase CD<br>EM manager - wants to maximize customer satisfaction | | | | |
| Brief Description: | This use case describes how customers can search the Web site and place orders. | | | | |
| Trigger: | Customer visits Web site and places order | | | | |
| Type: | External | | | | |
| Relationships: | | | | | |
| Association: | Customer | | | | |
| Include: | Maintain order | | | | |
| Extend: | | | | | |
| Generalization: | | | | | |
| Normal Flow of Events: | | | | | |
| 1. The Customer submits a search request to the system. | | | | | |
| 2. The System provides the Customer a list of recommended CDs. | | | | | |
| 3. The Customer chooses one of the CDs to find out additional information. | | | | | |
| 4. The System provides the Customer with basic information and reviews on the CD. | | | | | |
| 5. The Customer adds the CD to his or her shopping cart. | | | | | |
| 6. The Customer decides how to "fill" the order. | | | | | |
| 7. The Customer iterates over 3 through 5 until done shopping. | | | | | |
| 8. The Customer executes the Maintain Order use case. | | | | | |
| 9. The Customer logs in to check out. | | | | | |
| 10. The System validates the Customer's credit card information. | | | | | |
| 11. The System sends an order confirmation to the Customer. | | | | | |
| 12. The Customer leaves the Web site. | | | | | |
| Subflows: | | | | | |
| Alternate/exceptional Flows: | | | | | |

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| Type: | External | | | | |
| Relationships: | | | | | |
| Association: | Customer | | | | |
| Include: | Checkout, Maintain Order | | | | |
| Extend: | | | | | |
| Generalization: | | | | | |
| Normal Flow of Events: | | | | | |
| 1. Customer submits a search request to the system. | | | | | |
| 2. The System provides the Customer a list of recommended CDs. | | | | | |
| 3. The Customer chooses one of the CDs to find out additional information. | | | | | |
| 4. The System provides the Customer with basic information and reviews on the CD. | | | | | |
| 5. The Customer calls the Maintain Order use case. | | | | | |
| 6. The Customer iterates over 3 through 5 until done shopping. | | | | | |
| 7. The Customer executes the Checkout use case. | | | | | |
| 8. The Customer leaves the Web site. | | | | | |
| Subflows: | | | | | |
| Alternate/exceptional Flows: | | | | | |
| 3a-1. The Customer submits a new search request to the system. | | | | | |
| 3a-2. The Customer iterates over steps 2 through 3 until satisfied with search results or gives up. | | | | | |
| 7a. The Customer aborts the order. | | | | | |

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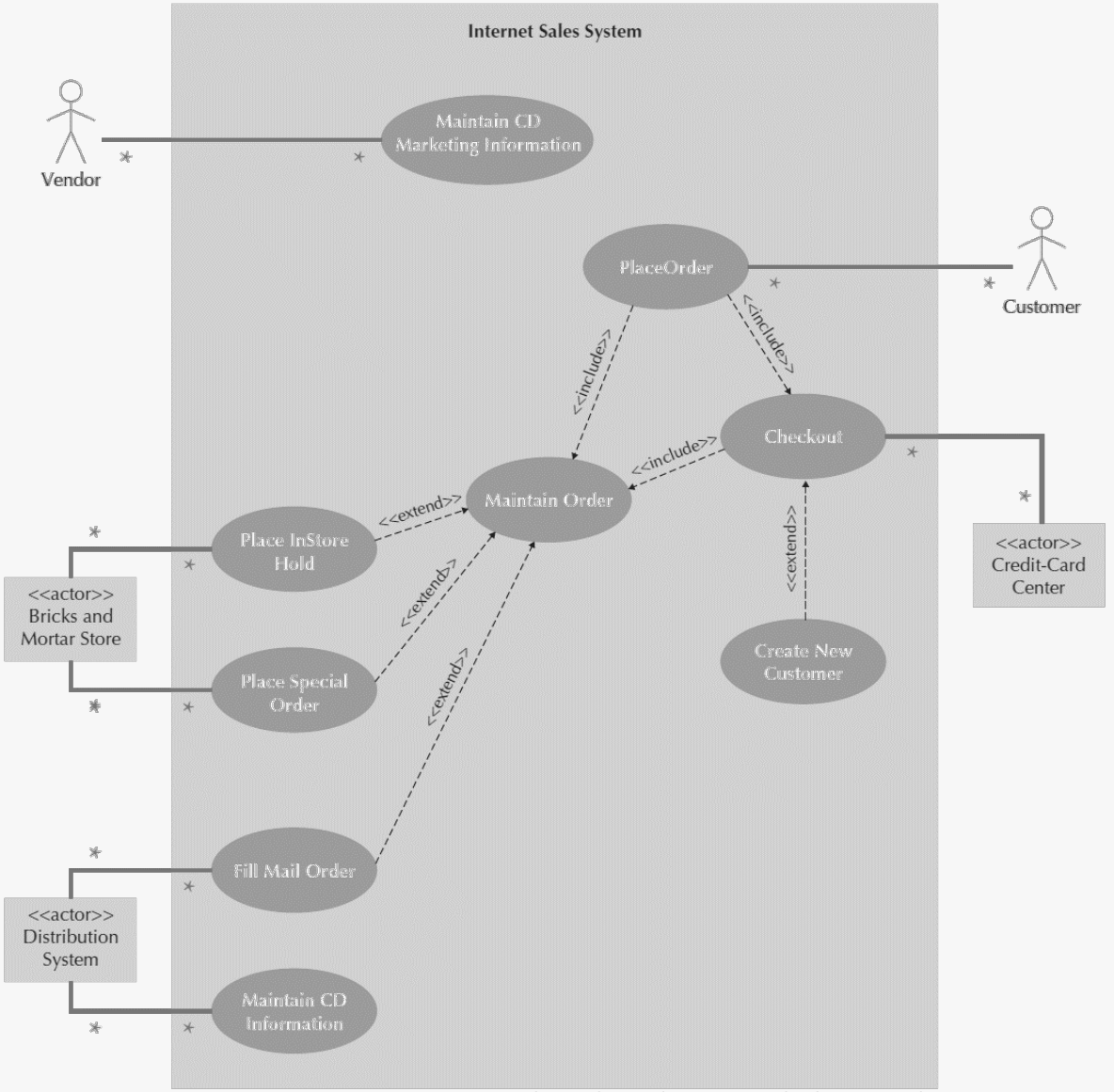
- Use Case Diagram




(source: Dennis, Alan, Barbara Haley Wixom, and Roberta M. Roth. Systems analysis and design. John wiley & sons.)

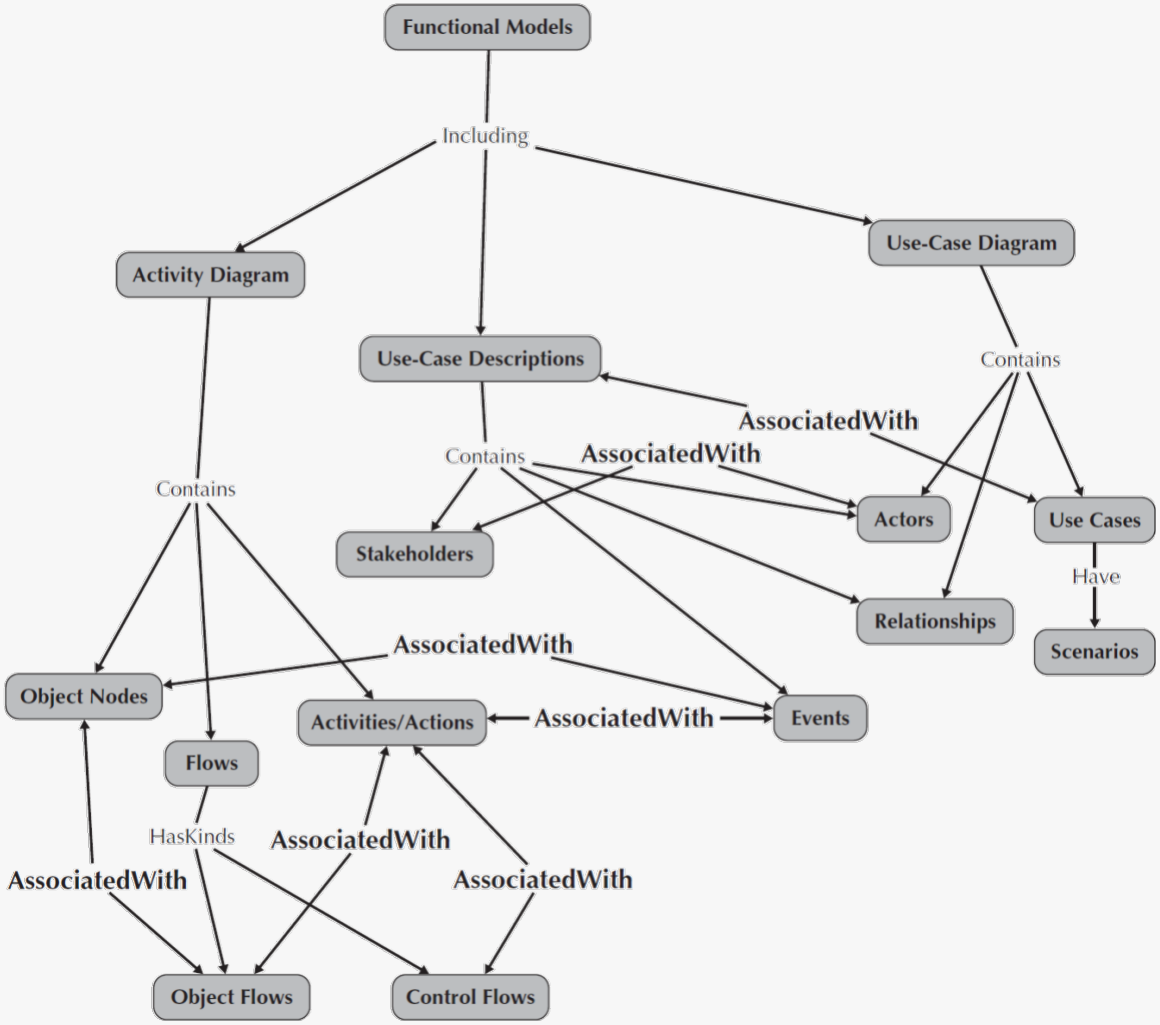
# Your Turn - Activity

- Create an activity diagram and a set of detail use case descriptions for the process of buying glasses from the viewpoint of the patient, but do not bother to identify the flow of events within each use cases.

The first step is to see an eye doctor who will give a prescription.
Once you have a prescription, you go to a glasses store, where select your frames and place the order for your glasses.
Once the glasses have been made, you return to the store for a fitting and pay for the glasses.

# Summary and Discussion

- **Interrelationships among Functional Models**

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# Summary and Discussion

- Use case descriptions are the basis for further analysis and design. They are created based on 7 guidelines and 13 steps.
- Use case diagrams present a graphical overview of the main functionality of a system.

- What is the purpose of an activity diagram ?
- Why do we take use case diagram to represent the business functionality (instead of flowchart, activity diagram, etc) ?