System Analysis & Design

Topic 4: System Analysis: Requirements Modelling

4b: Use Case Diagrams & Descriptions

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What is a use case?

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A requirements analysis concept

- A **case** of a **use** of the system/product
- Describes the system's actions from the **point of view of a user**

Tells a story

- A sequence of events involving Interactions of a user with the system
- Specifies one aspect of the behavior of a system, without specifying the structure of the system
- Is oriented toward satisfying a user's goal

Closing point : A use case is a **process** or **procedure**, describing a ***user's interaction*** with the system (e.g. library) for a ***specified, identifiable purpose.*** (e.g. borrowing a book).

How do we describe use cases?

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- Textual or tabular descriptions
- User stories
- Diagrams

Use Case Descriptions

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- **actors** - something with a behavior or role, e.g., a person, another system, organization.
- **scenario** - a specific sequence of actions and interactions between actors and the system, a.k.a. a use case instance
- **use case -** a collection of related success and failure scenarios, describing actors using the system to support a goal

What is an Actor?

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- Include all **user roles** that **interact with the system**

- Include **system components only if** they are **responsible for initiating/triggering a use case**.
  For example, a timer that triggers sending of an e-mail reminder

- **primary** - a user whose goals are fulfilled by the system
  importance: define user goals

- **supporting -** provides a service (e.g., info) to the system
  importance: clarify external interfaces and protocols

- **offstage -** has an interest in the behavior but is not primary or supporting
  e.g., government
  importance: ensure all interests (even subtle) are identified and satisfied

Finding Actors

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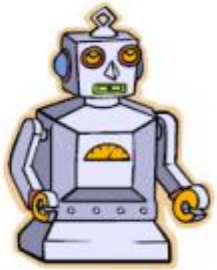
- External objects that produce/consume data:
- **Must** serve as sources and destinations for data
- **Must** be **external** to the **system**

Humans



Machines

External systems

Organizational Units

Sensors

Finding Actors

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Ask the following questions:

- Who are the system's primary users?
- Who requires system support for daily tasks?
- Who are the system's secondary users?
- What hardware does the system handle?
- Which other (if any) systems interact with the system in question?
- Do any entities interacting with the system perform multiple roles as actors?
- Which other entities (human or otherwise) might have an interest in the system's output?

What is a user story?

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An abbreviated description of a use case
Used in agile development

Answers 3 questions:

1.Who? As a <type of user>,
2.Does what? I want <some behavior from the system>
3.And why? so that <some value is achieved>

Use Case Diagrams

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- A picture
- describes how actors relate to use cases and use cases relate to one another
- Built in early stages of development

Purpose :

- Specify the context of a system
- Capture the requirements of a system
- Validate a systems architecture
- Drive implementation and generate test cases
- Developed by analysts and domain experts

Example Use Case Diagram

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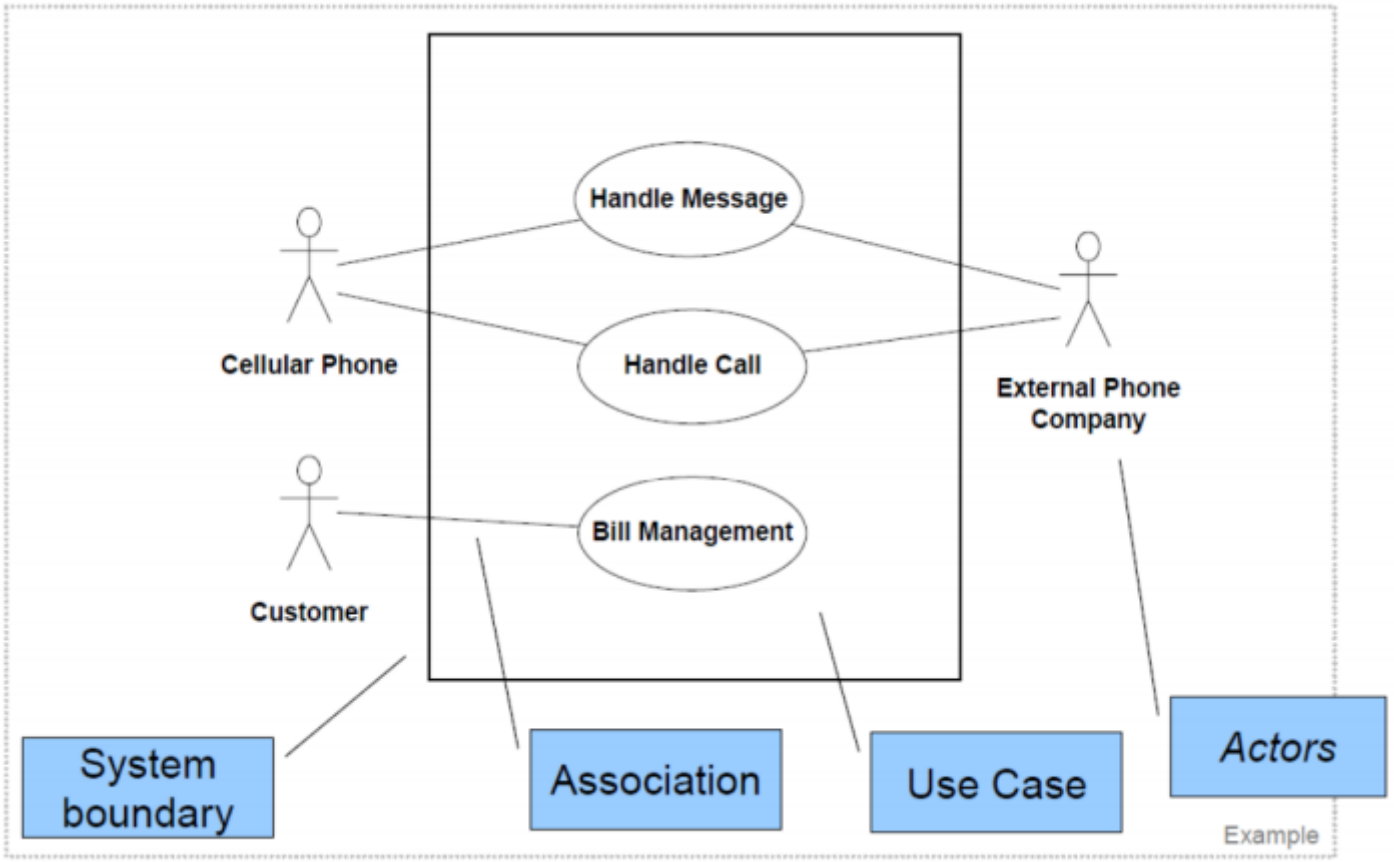
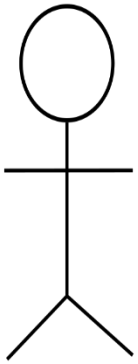


Elements of use case diagram: ACTOR



Name

Actor

- Actor is someone interacting with use case (system function).
- **Named by noun.**
- Similar to the concept of user, but a user can play different roles; (example: a prof. can be instructor and researcher – plays 2 roles with two systems).
- Actor triggers use case.
- Actor has **responsibility toward the system (inputs),** and Actor have **expectations from the system (outputs).**

Elements of use case diagram: USE CASE

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Use Case

- System function (process – automated or manual).
- **Named by verb.** Do something
- **Each Actor must be linked to a use case**, while some use cases may not be linked to actors.

USER/ACTOR	USER GOAL = Use Case
Order clerk	Look up item availability Create new order Update order
Shipping clerk	Record order fulfillment Record back order
Merchandising manager	Create special promotion Produce catalog activity report

Elements of use case diagram: Other Details

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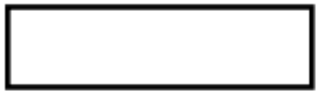
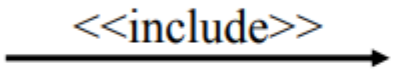
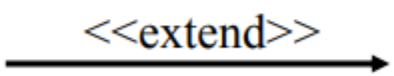
Connection between Actor and Use Case



Boundary of system



Include relationship between Use Cases (one UC must call another; e.g., Login UC includes User Authentication UC)



Extend relationship between Use Cases (one UC calls Another under certain condition; think of if-then decision points)

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In your Teams Draw a Use Case for the following Scenario

Inventory System

In order to generate an invoice a clerk must log in. If a clerk is a first time user, one must have themselves registered.
There should be an option for a user to register oneself within the login page.
Any user can use the system to view products online.

The option of login is also provided when a user views products online.

Linking Use Cases

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- **Generalization relationships :** One element (child) "is based on" another element (parent)
- **Include relationships :**One use case (base) includes the functionality of another (inclusion case) , Supports re-use of functionality
- **Extend relationships :**One use case (extension) extends the behavior of another (base)

Use Case Levels

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Base Use Case: Used directly by the user

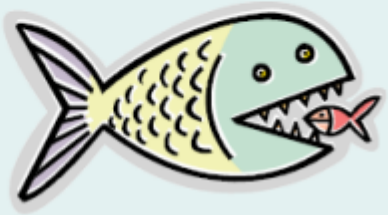
Perform Sale

User goals

Sub-functionality

Choose Products

Fill-in billing info



Alistair Cockburn "Writing Effective Use Cases"

Generalization

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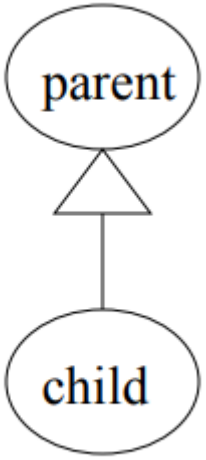
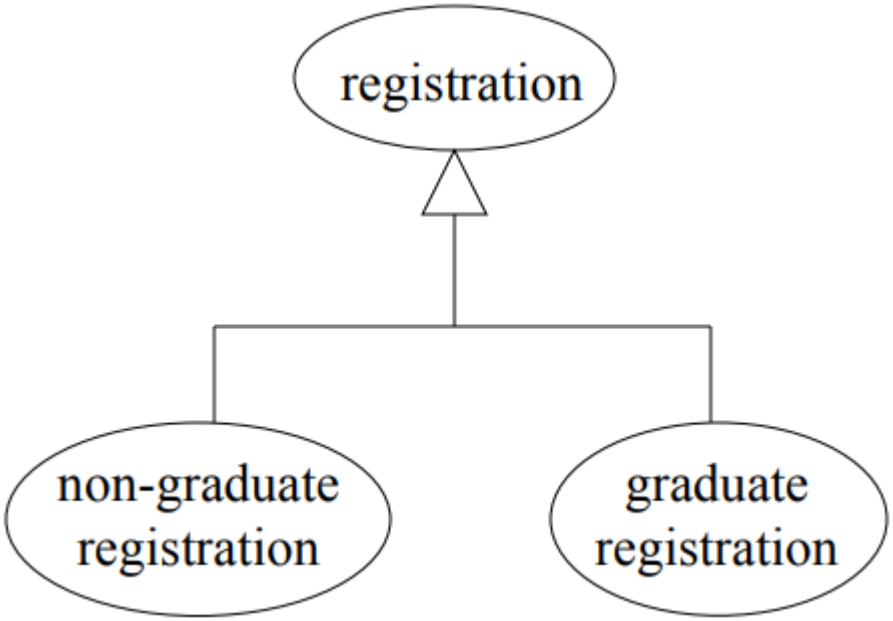
- The child use case inherits the behavior and meaning of the parent use case.
- The child may add to or override the behavior of its parent.





Generalization Example

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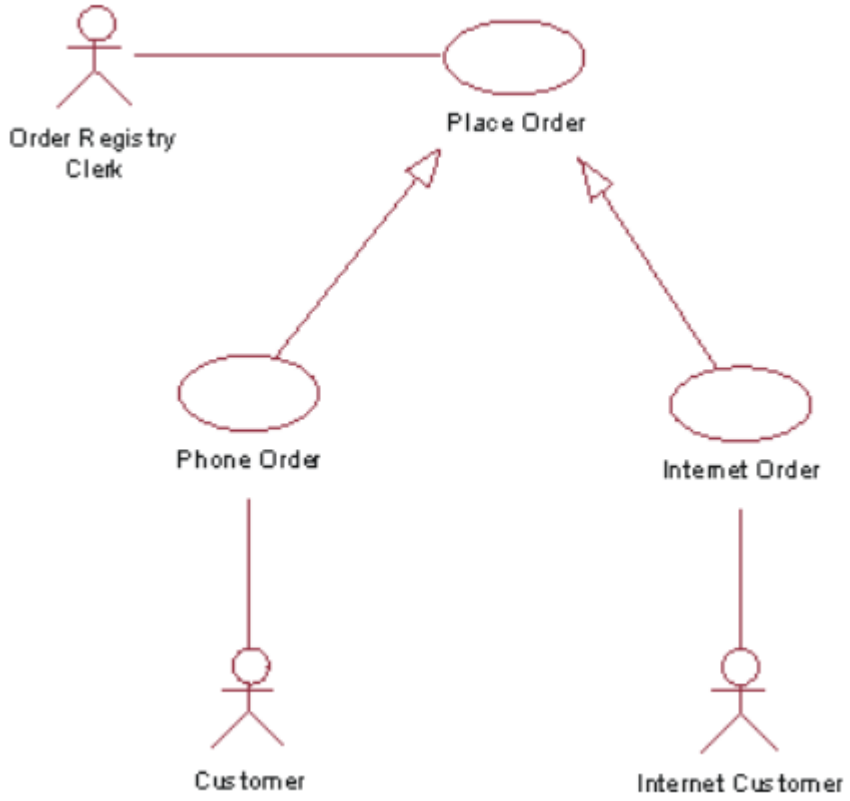
The actor Order Registry Clerk can instantiate the general use case Place Order.

Place Order can also be specialized by the use cases Phone Order or Internet Order.



Generalization Example

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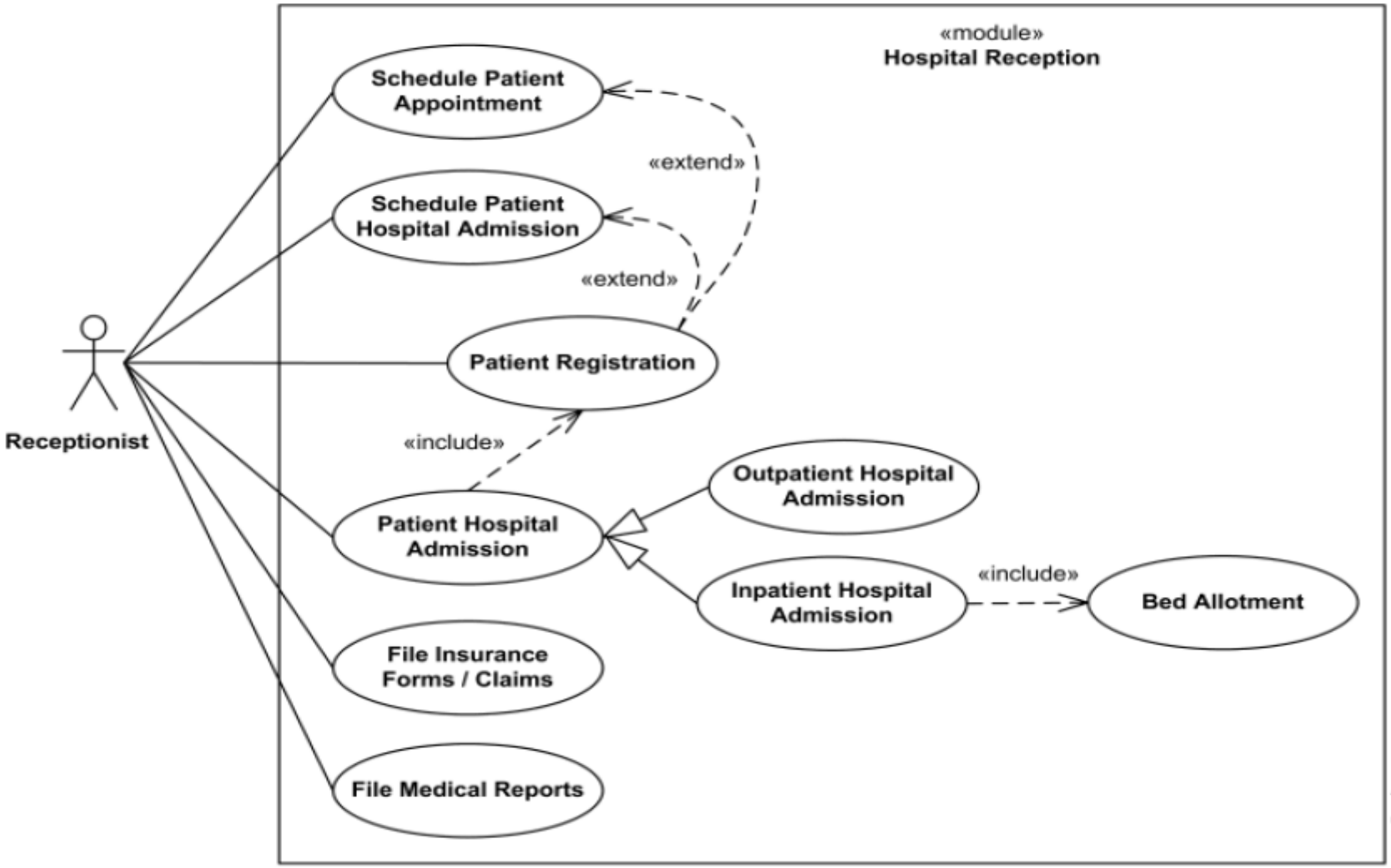
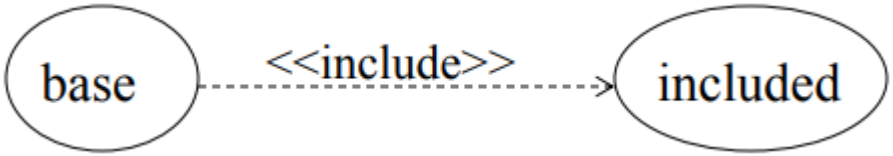
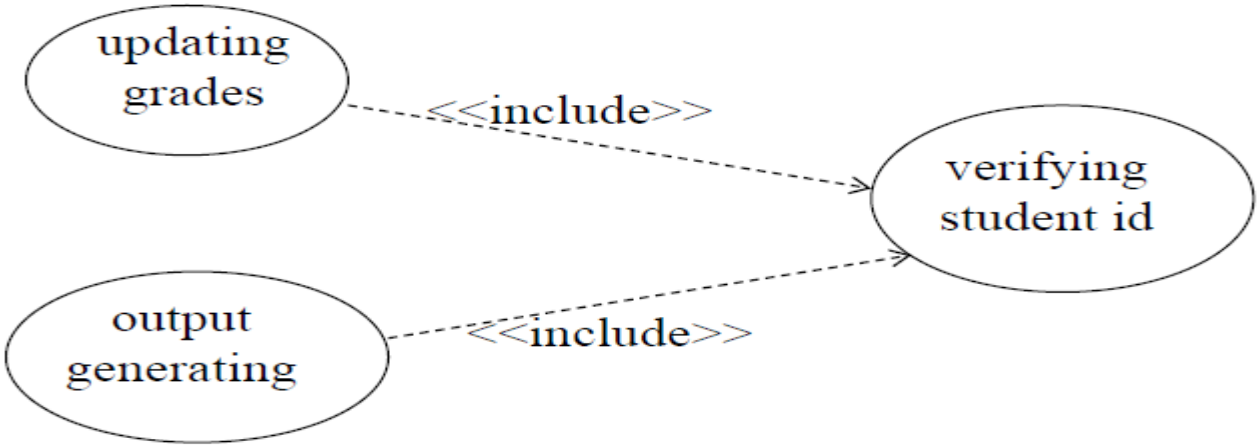


Include



- The base use case explicitly incorporates the behavior of another use case at a location specified in the base.
- The **included use case never stands alone**. It only occurs as a part of some larger base that includes it.
- Enables us to avoid describing the same flow of events several times by putting the common behavior in a use case of its own.



Include Example

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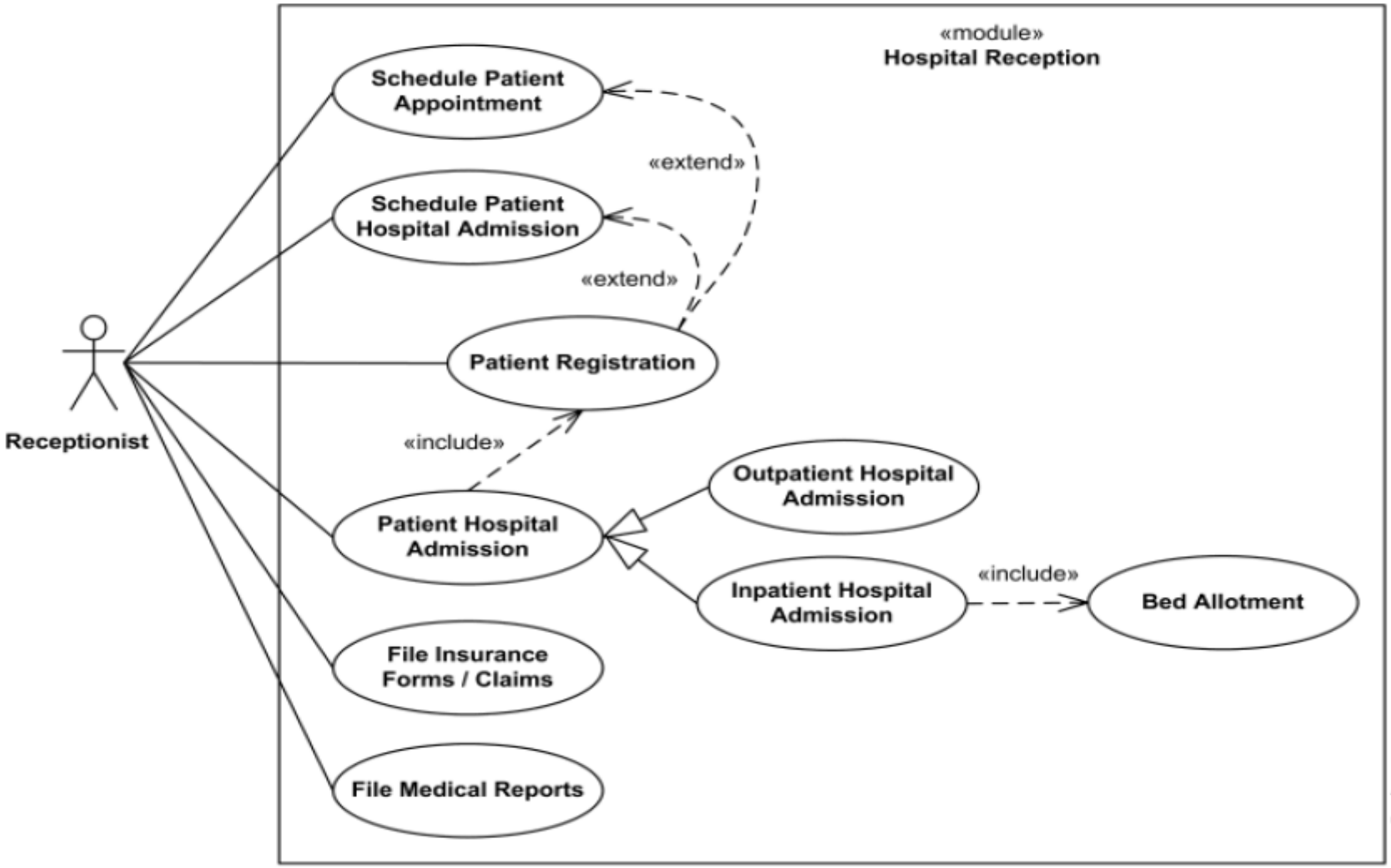
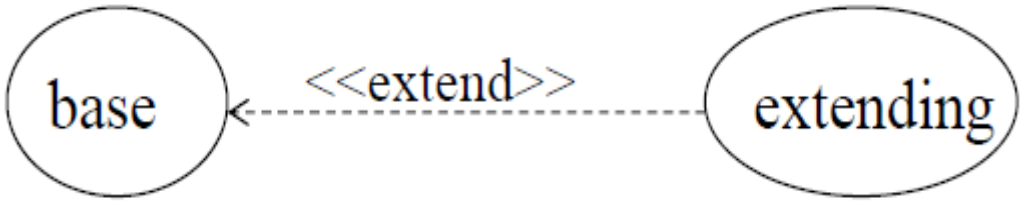
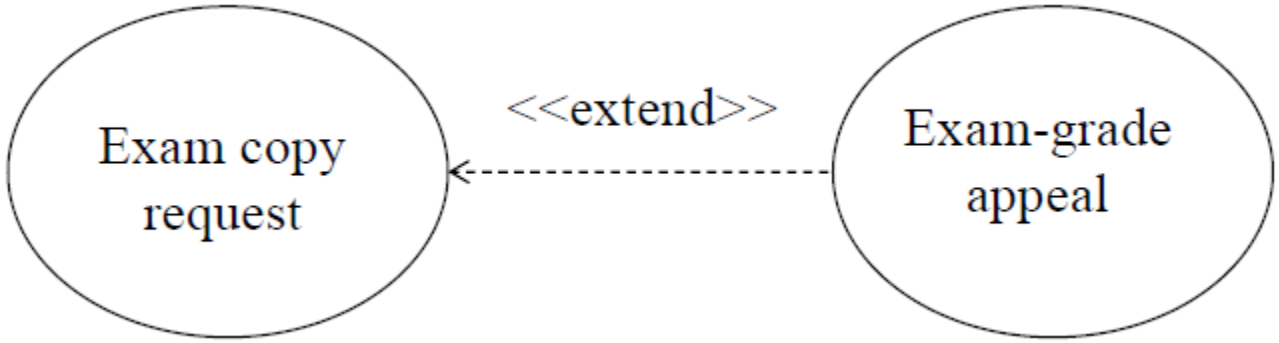


Extend



- The base use case implicitly incorporates the behavior of another use case at certain points called extension points.
- **The base use case may stand alone**, but under certain conditions its behavior may be extended by the behavior of another use case.
- Enables to model optional behavior or branching under conditions



Extend Example

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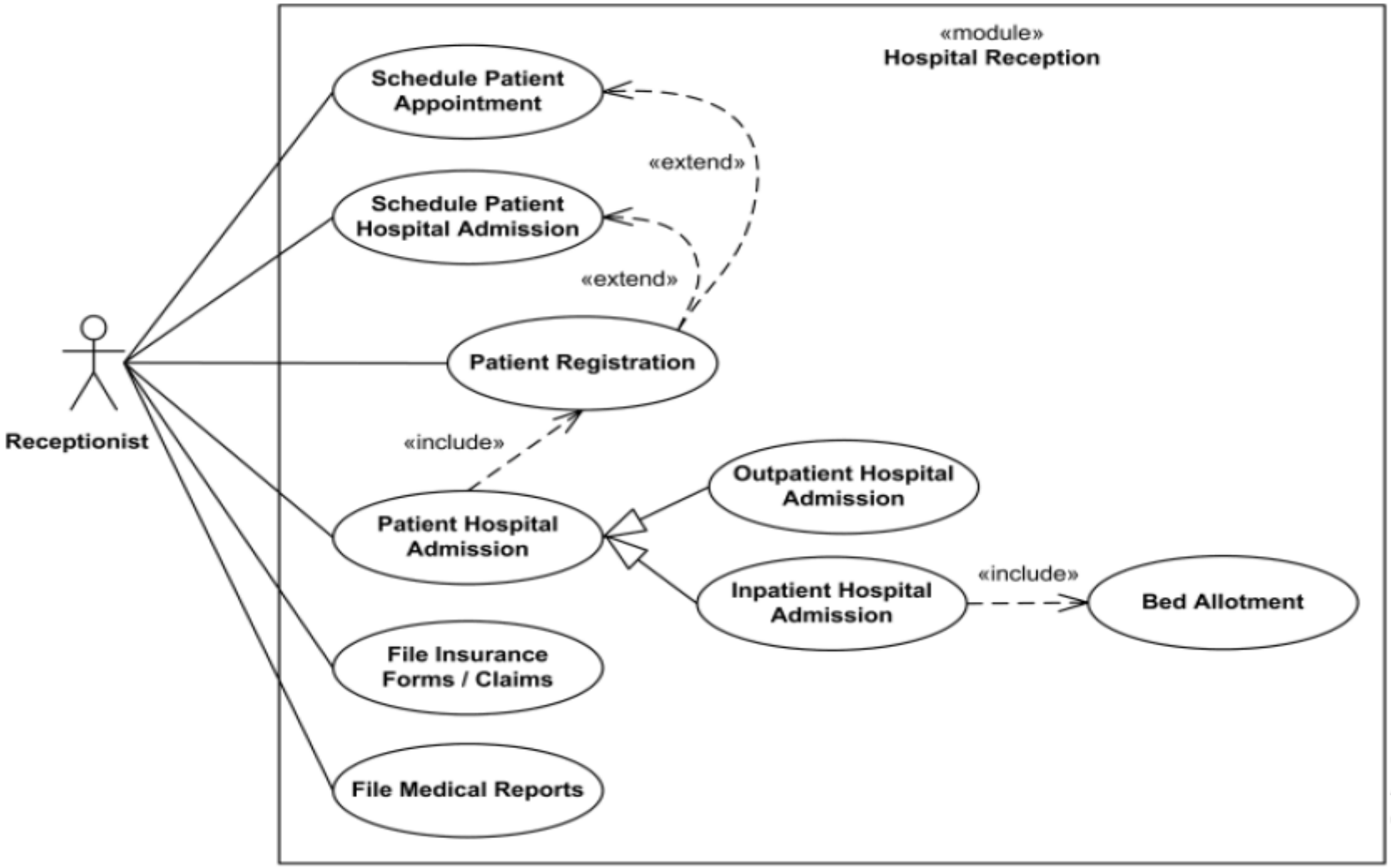

Extend Example 2

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Product Page

Shopping Cart

Review Writing

Extend Example 2 continued…

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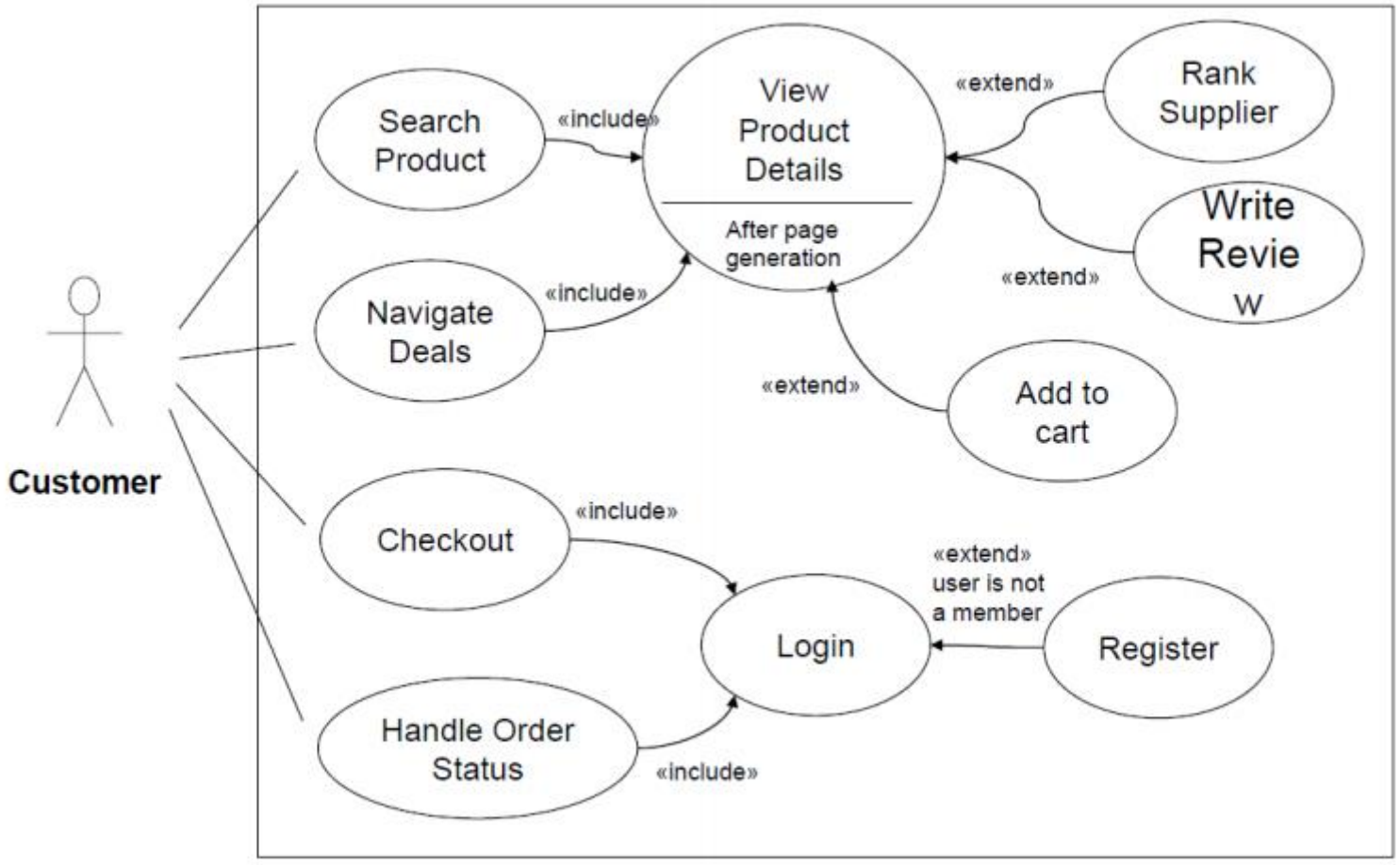

How to create use case diagram

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1. List main system functions (use cases) in a column:
–think of business events demanding system's response
–users' goals/needs to be accomplished via the system
–Create, Read, Update, Delete (CRUD) data tasks
–Naming use cases – user's needs usually can be translated in data tasks

2. Draw ovals around the function labels

3. Draw system boundary

4. Draw actors and connect them with use cases (if more intuitive, this can be done as step 2)

5. Specify include and extend relationships between use cases (yes, at the end - not before, as this may pull you into process thinking, which does not apply in UC diagramming).

Use Case Diagram Guideline and Caution

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- Use cases should ideally begin with a verb – i.e generate report.
- Use cases should NOT be open ended – i.e Register (instead should be named as Register New User)
- **Avoid** showing communication between actors.
- Actors should be named as singular. i.e student and NOT students. NO names should be used – i.e John, Sam, etc.
- Do NOT show behaviour in a use case diagram; instead only **depict only system functionality.**
- Use case diagram does not show sequence – unlike DFDs

USE CASE DESCRIPTIONS

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Draw a use case diagram for a food ordering and Delivery system e.g Uber Eats

Actors: Customer, Restaurant Order Clerk, Restaurant Merchandiser, Delivery Rider, Restaurant Owner, Uber Eats Admin

Use Case Diagram of the Customer Support System

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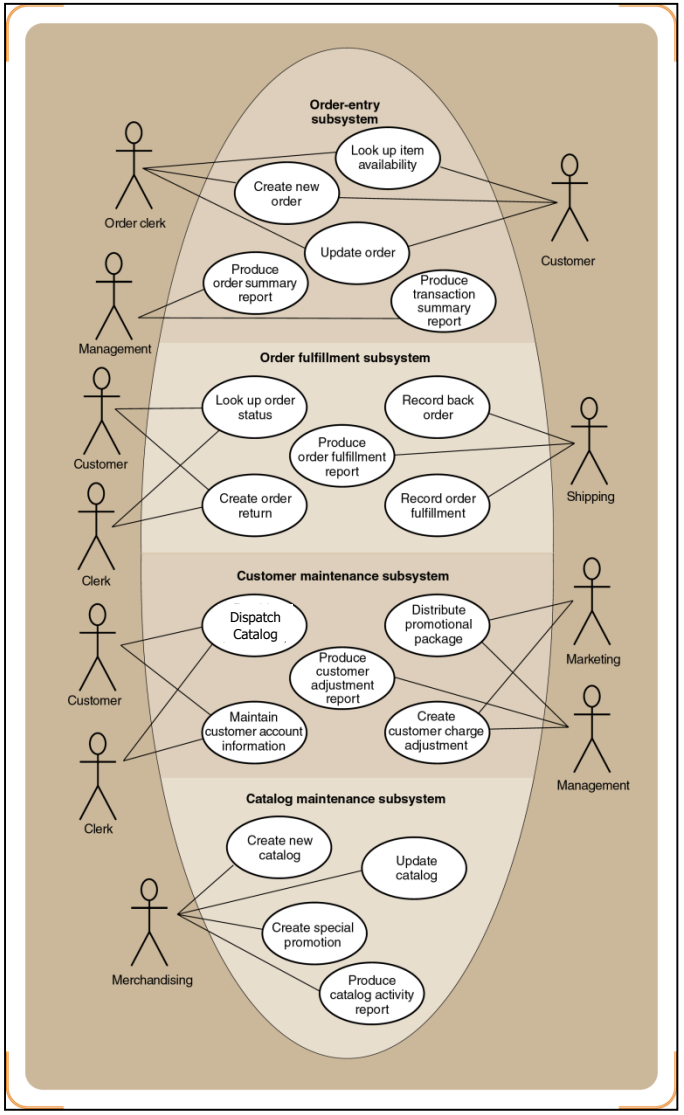
Use Cases grouped into system modules

Customer interacts with different modules of Customer Relations Management System



Use Case Description

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- **Complements** Use Case Diagram

- A breakdown of a single use case (e.g., sequence of steps included in the function "Look up item availability"); process logic included

- In contrast to Use Case Diagram, Use Case Description captures variations of a Use Case
  - Example: "Create new order" can be done via a. customer's phoning + clerk's help or b. customer's Internet ordering with no clerk = 2 *scenarios*

Levels of Use Case Description

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Three levels of detail:

a) UC Brief description

Summary of what system does in response to actor's actions

b) UC Intermediate description

Shows steps in use case, if-then

c) UC Full description

Includes Brief description, expands intermediate description, shows scenarios

a) Brief Description of Use Case

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USE CASE: **Create New Order**

***Create new order* description**

When the customer calls to order, the order clerk and system verify customer's record, create a new order, add items to the order, verify payment, create the order transaction, and finalize the order.

- Same description that is usually captured in initial Use Case Diagrams ("bird's view" of system)*

b) Intermediate Use Case Description

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Telephone Order Scenario for Create New Order Use Case

Flow of activities for scenario of *Order Clerk creates telephone order*
Main Flow: 1. Customer calls RMO and gets order clerk. 2. Order clerk verifies customer information. If a new customer, invoke *Maintain customer account information* use case to add a new customer. 3. Clerk initiates the creation of a new order. 4. Customer requests an item be added to the order. 5. Clerk verifies the item and adds it to the order. 6. Repeat steps 4 and 5 until all items are added to the order. 7. Customer indicates end of order; clerk enters end of order; system computes totals. 8. Customer submits payment; clerk enters amount; system verifies payment. 9. System finalizes order.
Exception Conditions: 1. If an item is not in stock, then customer can a. choose not to purchase item, or b. request item be added as a back-ordered item. 2. If customer payment is rejected due to bad-credit verification, then a. order is canceled, or b. order is put on hold until check is received.

Full Use Case Description

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Superset of **intermediate and brief descriptions** (contains these)

Consists of 11 compartments (we will use some)

Shows steps (“Flow of Events”) broken down to the actor and the system side – useful!

Full Use Case Description

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Telephone Order Scenario for Create New Order Use Case

Use Case Name:	Create new order	
Scenario:	Create new telephone order	
Triggering Event:	Customer telephones RMO to purchase items from the catalog.	
Brief Description:	When customer calls to order, the order clerk and system verify customer information, create a new order, add items to the order, verify payment, create the order transaction, and finalize the order.	
Actors:	Telephone sales clerk	
Related Use Cases:	Includes: *Check item availability*	
Stakeholders:	Sales department: to provide primary definition Shipping department: to verify that information content is adequate for fulfillment Marketing department: to collect customer statistics for studies of buying patterns	
Preconditions:	Customer must exist. Catalog, Products, and Inventory items must exist for requested items.	
Postconditions:	Order and order line items must be created. Order transaction must be created for the order payment. Inventory items must have the quantity on hand updated. The order must be related (associated) to a customer.	
Flow of Events:	**Actor**	**System**
	1. Sales clerk answers telephone and connects to a customer.	
	2. Clerk verifies customer information.	
	3. Clerk initiates the creation of a new order.	3.1 Create a new order.
	4. Customer requests an item be added to the order.	
	5. Clerk verifies the item (*Check item availability* use case).	5.1 Display item information.
	6. Clerk adds item to the order.	6.1 Add an order item.
	7. Repeat steps 4, 5, and 6 until all items are added to the order.	
	8. Customer indicates end of order; clerk enters end of order.	8.1 Complete order. 8.2 Compute totals.
	9. Customer submits payment; clerk enters amount.	9.1 Verify payment. 9.2 Create order transaction. 9.3 Finalize order.
Exception Conditions:	2.1 If customer does not exist, then the clerk pauses this use case and invokes *Maintain customer information* use case. 2.2 If customer has a credit hold, then clerk transfers the customer to a customer service representative. 4.1 If an item is not in stock, then customer can a. choose not to purchase item, or b. request item be added as a back-ordered item. 9.1 If customer payment is rejected due to bad-credit verification, then a. order is canceled, or b. order is put on hold until check is received.	

Order Entry System (steps encoded in software)

Writing Use Case Descriptions

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1. Select a use case

2. Write abbreviated *full description* (Use case name, Scenario (if any), Business Event, Actors, Flow of steps, Exception conditions)

3. For figuring Flow of steps,
   - Keep in mind general system model: Input-Processing-Output
   - Steps should be at nearly the same level of abstraction (each makes nearly same progress toward use case completion)

4. For figuring exception conditions, focus on if-then logic.

In-Class Assignment-Individual

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Qn : Model Use Case Diagram and Use Case Descriptions for the AIR-BNB Case Study (30 Marks)

Use Case Diagram (clearly show include and extend relationships) -10 marks

Use Case Descriptions-20 marks

Exercise: Project- Team

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1.Prepare Use Case Diagrams and Use Case Descriptions for your team project

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