Chapter 5
Extending the requirement models

Asst.Prof.Dr. Supakit Nootyaskool
Faculty of Information Technology
King Mongkut's Institute of Technology Ladkrabang

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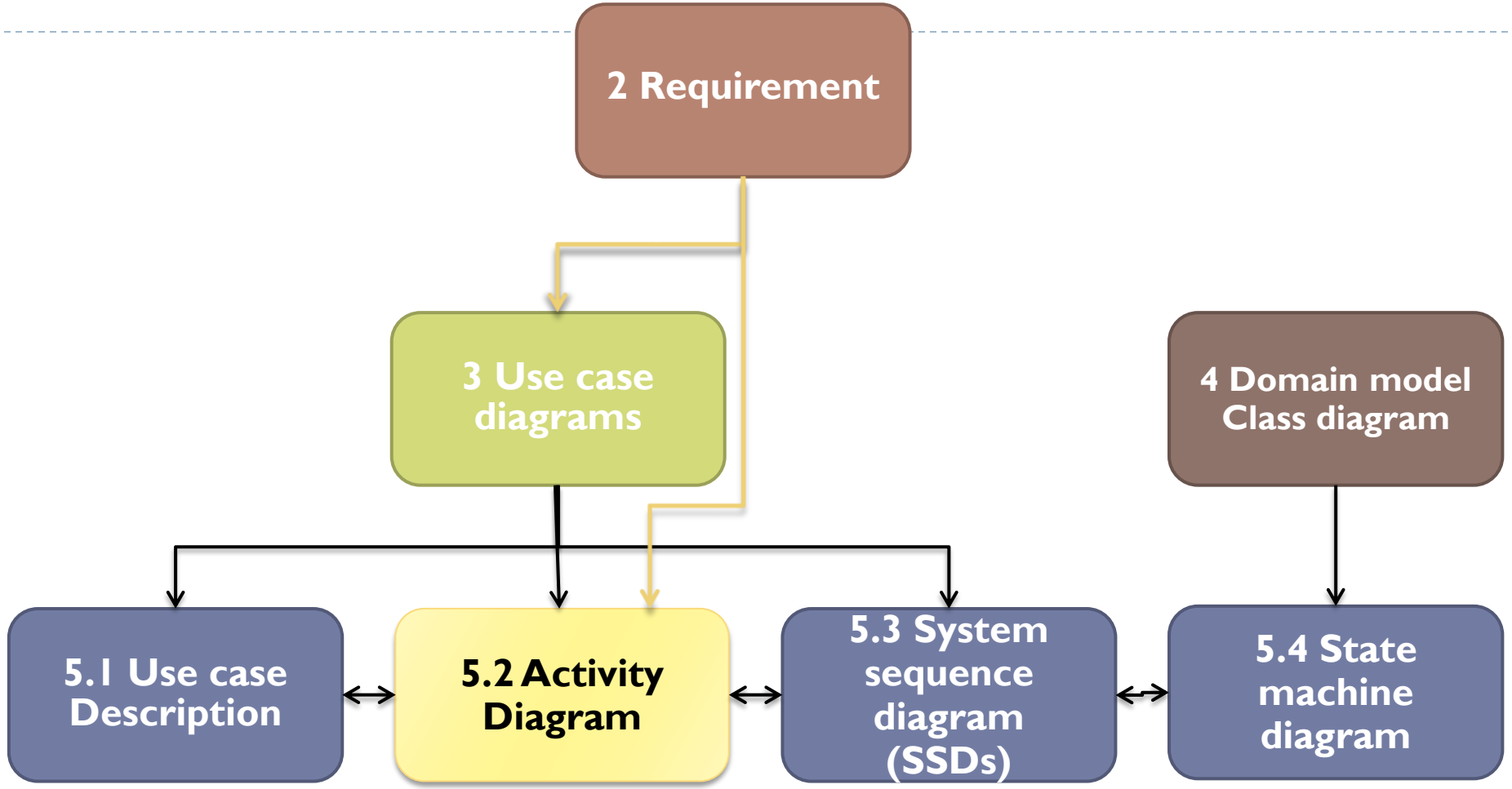
Learning Outcome

- You can draw the use case and write the use case description.
- You can apply the activity diagram to describe each of the use case.
- You can draw the system sequence diagram

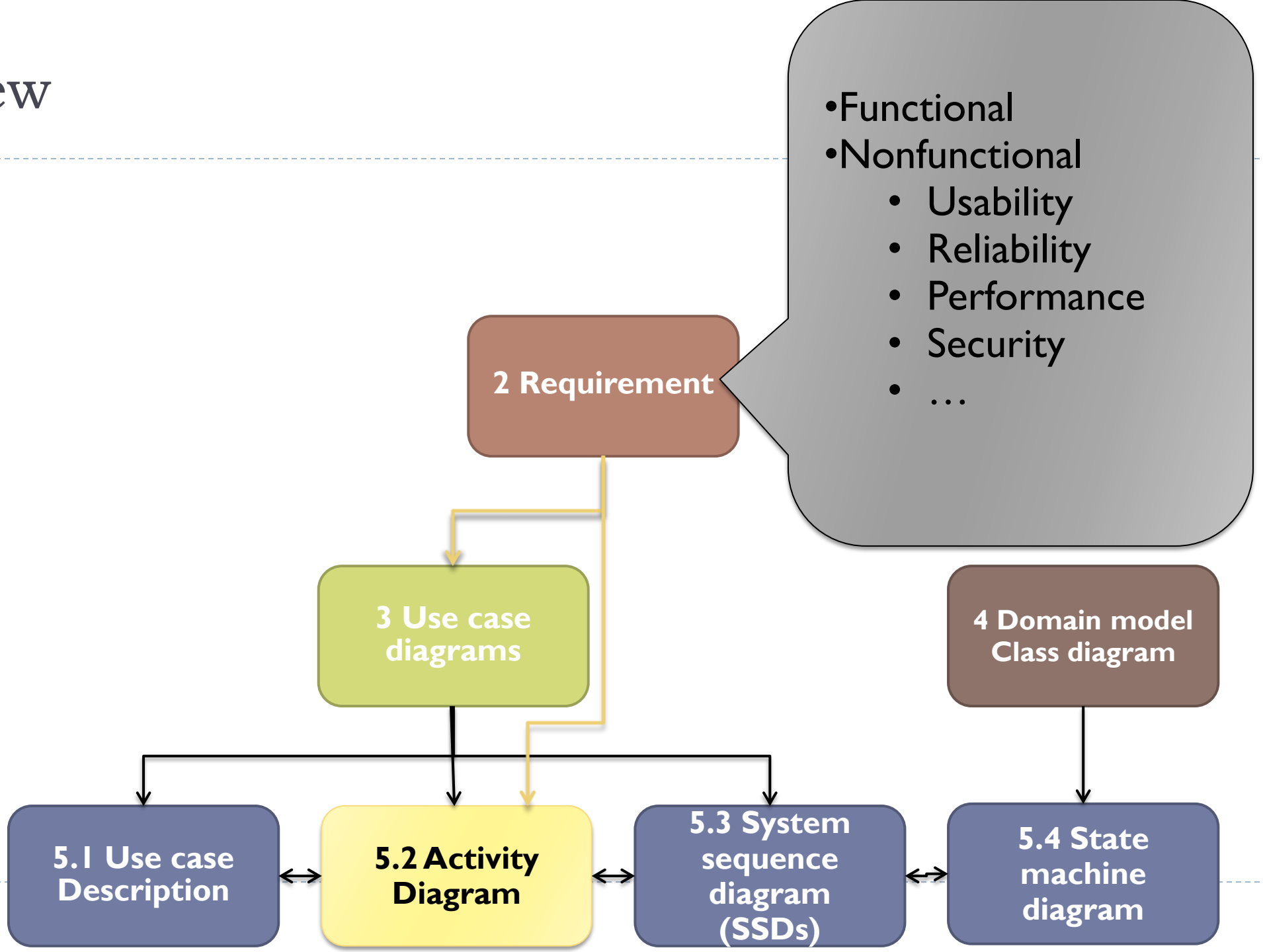
Topics

- Use case description
- Activity diagram for user cases
- The system sequence diagram
- The state machine diagram

Review


2 Requirement
3 Use case diagrams
4 Domain model Class diagram
5.1 Use case Description
5.2 Activity Diagram
5.3 System sequence diagram (SSDs)
5.4 State machine diagram

Review


•Functional
•Nonfunctional
• Usability
• Reliability
• Performance
• Security
• …
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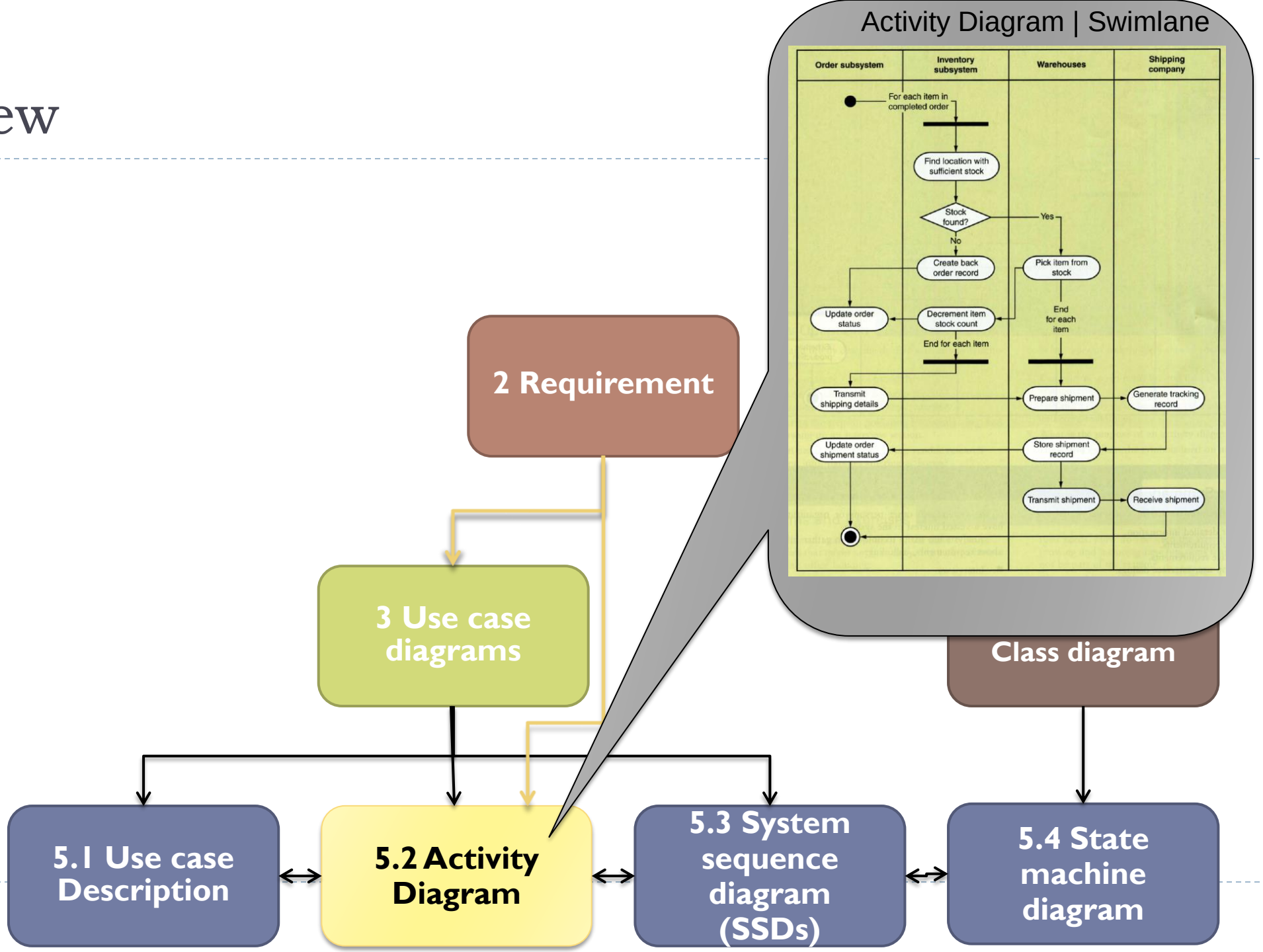
Activity Diagram | Swimlane
Order subsystem
Inventory subsystem
Warehouses
Shipping company
For each item in completed order
Find location with sufficient stock
Stock found?
Yes
No
Create back order record
Pick item from stock
Update order status
Decrement item stock count
End for each item
End for each item
Transmit shipping details
Prepare shipment
Generate tracking record
Update order shipment status
Store shipment record
Transmit shipment
Receive shipment
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Class diagram
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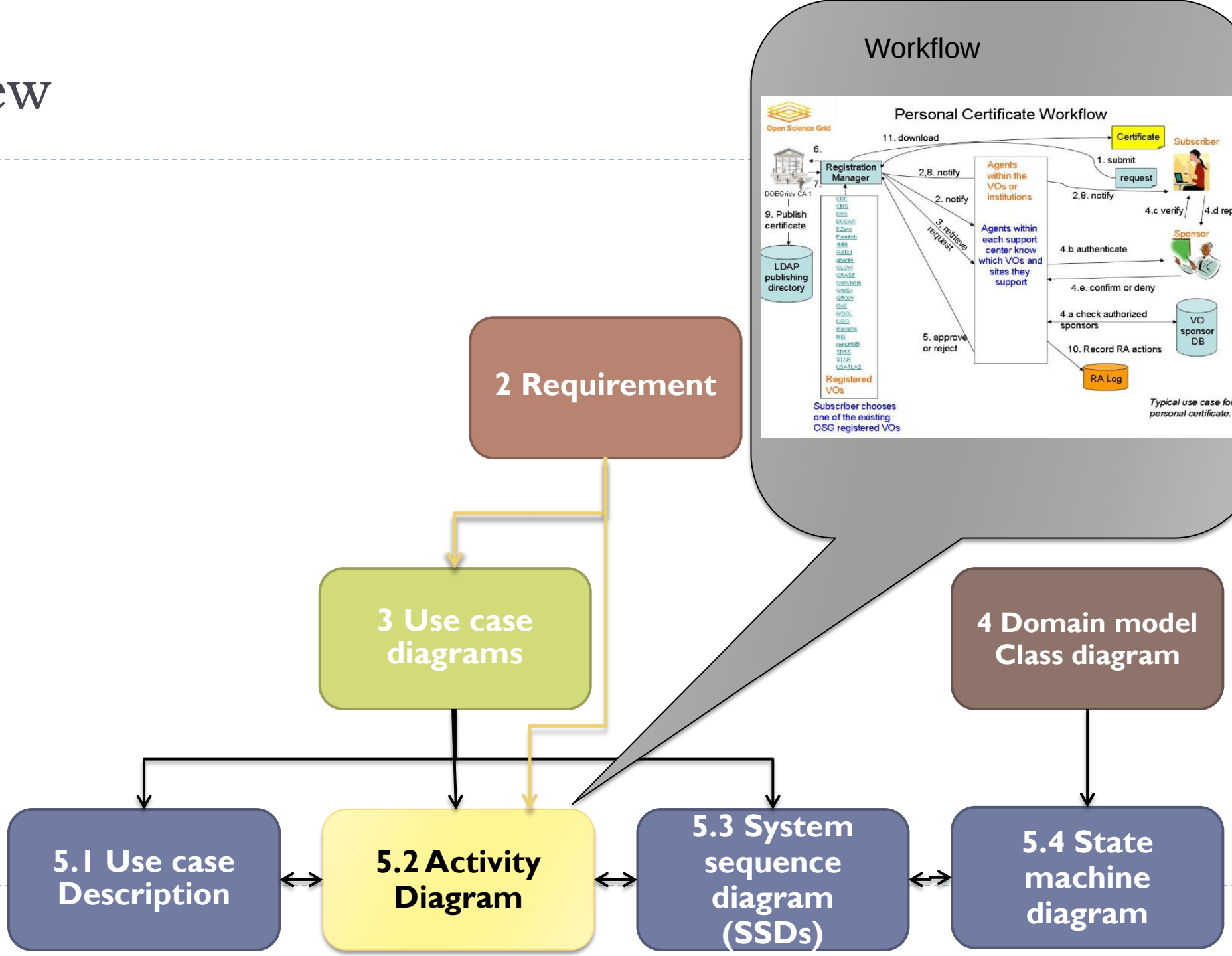
Workflow
Personal Certificate Workflow
Open Science Grid
11. download
Certificate
Subscriber
1. submit
request
6.
Registration Manager
7.
DOEGrids CA 1
2,8. notify
2. notify
3. retrieve request
Agents within the VOs or institutions
Agents within each support center know which VOs and sites they support
2,8. notify
4.c verify
4.d reply
Sponsor
9. Publish certificate
LDAP publishing directory
4.b authenticate
4.e. confirm or deny
4.a check authorized sponsors
VO sponsor DB
5. approve or reject
10. Record RA actions
RA Log
Registered VOs
Subscriber chooses one of the existing OSG registered VOs
Typical use case for personal certificate.
1
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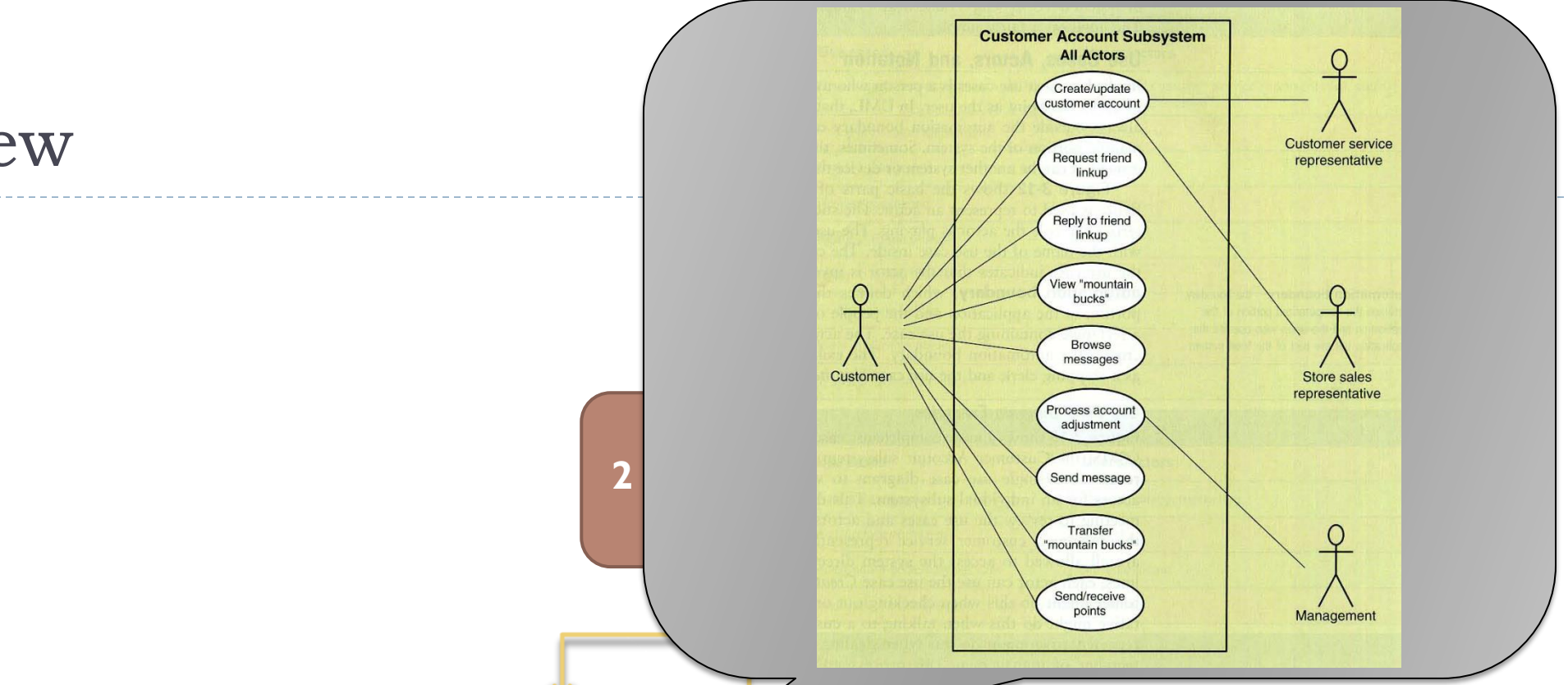

2

3 Use case diagrams

4 Domain model Class diagram

5.1 Use case Description

5.2 Activity Diagram

5.3 System sequence diagram (SSDs)

5.4 State machine diagram

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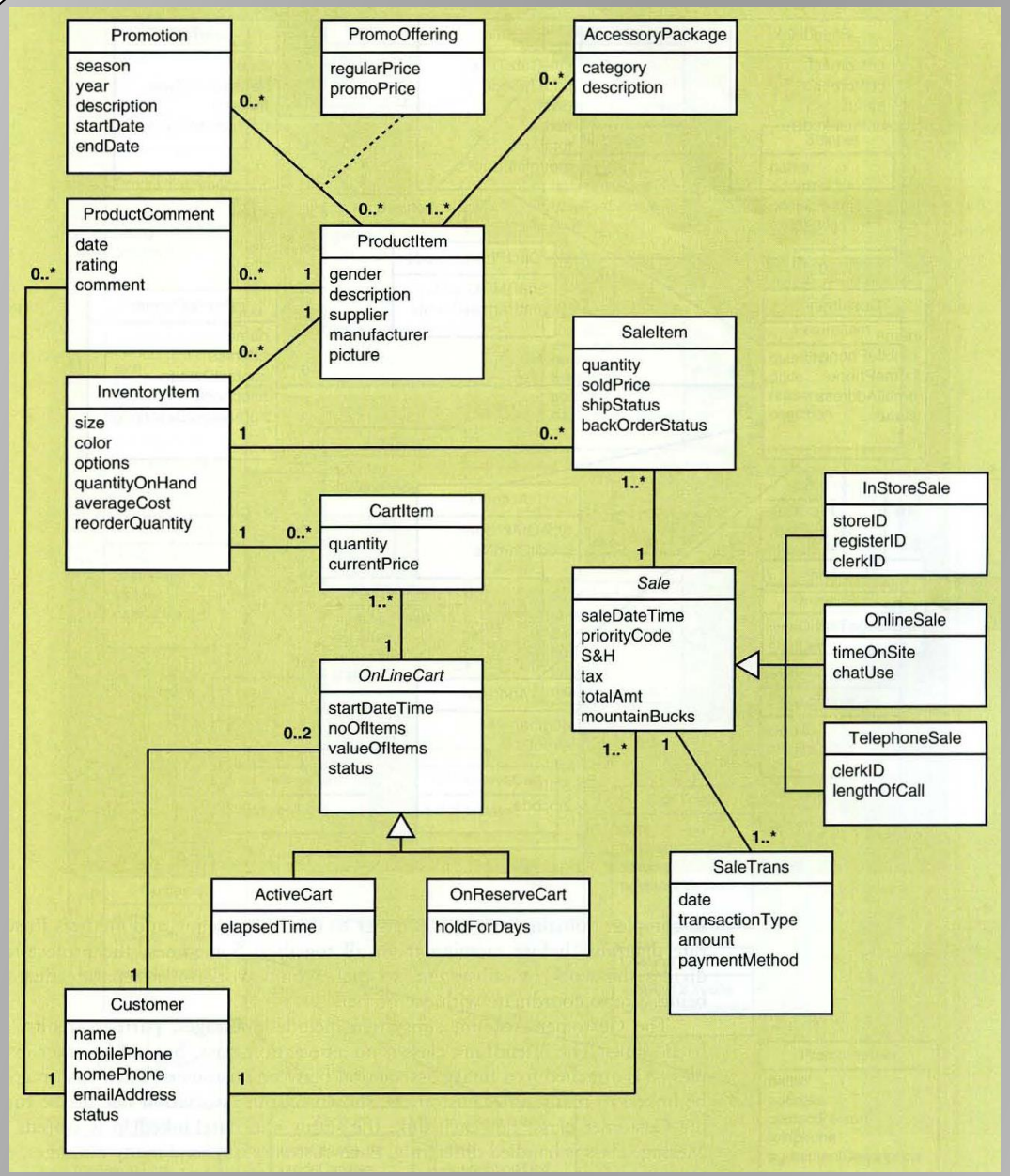

4 Domain model Class diagram

5.1 U… Descrip…

(SSDs)

5.4 State machine diagram

Review

Use case name:	*Create customer account.*
Scenario:	Create online customer account.
Triggering event:	New customer wants to set up account online.
Brief description:	Online customer creates customer account by entering basic information and then following up with one or more addresses and a credit or debit card.
Actors:	Customer.
Related use cases:	Might be invoked by the *Check out shopping cart* use case.
Stakeholders:	Accounting, Marketing, Sales.
Preconditions:	Customer account subsystem must be available. Credit/debit authorization services must be available.
Postconditions:	Customer must be created and saved. One or more Addresses must be created and saved. Credit/debit card information must be validated. Account must be created and saved. Address and Account must be associated with Customer.
Flow of activities:	**Actor** / **System**
	1. Customer indicates desire to create customer account and enters basic customer information. / 1.1 System creates a new customer. 1.2 System prompts for customer addresses.
	2. Customer enters one or more addresses. / 2.1 System creates addresses. 2.2 System prompts for credit/debit card.
	3. Customer enters credit/debit card information. / 3.1 System creates account. 3.2 System verifies authorization for credit/debit card. 3.3 System associates customer, address, and account. 3.4 System returns valid customer account details.
Exception conditions:	1.1 Basic customer data are incomplete. 2.1 The address isn't valid. 3.2 Credit/debit information isn't valid.

5.1 Use case Description ↔ **5.2 Activity Diagram** ↔ **5.3 System sequence diagram (SSDs)** ↔ **5.4 State machine diagram**

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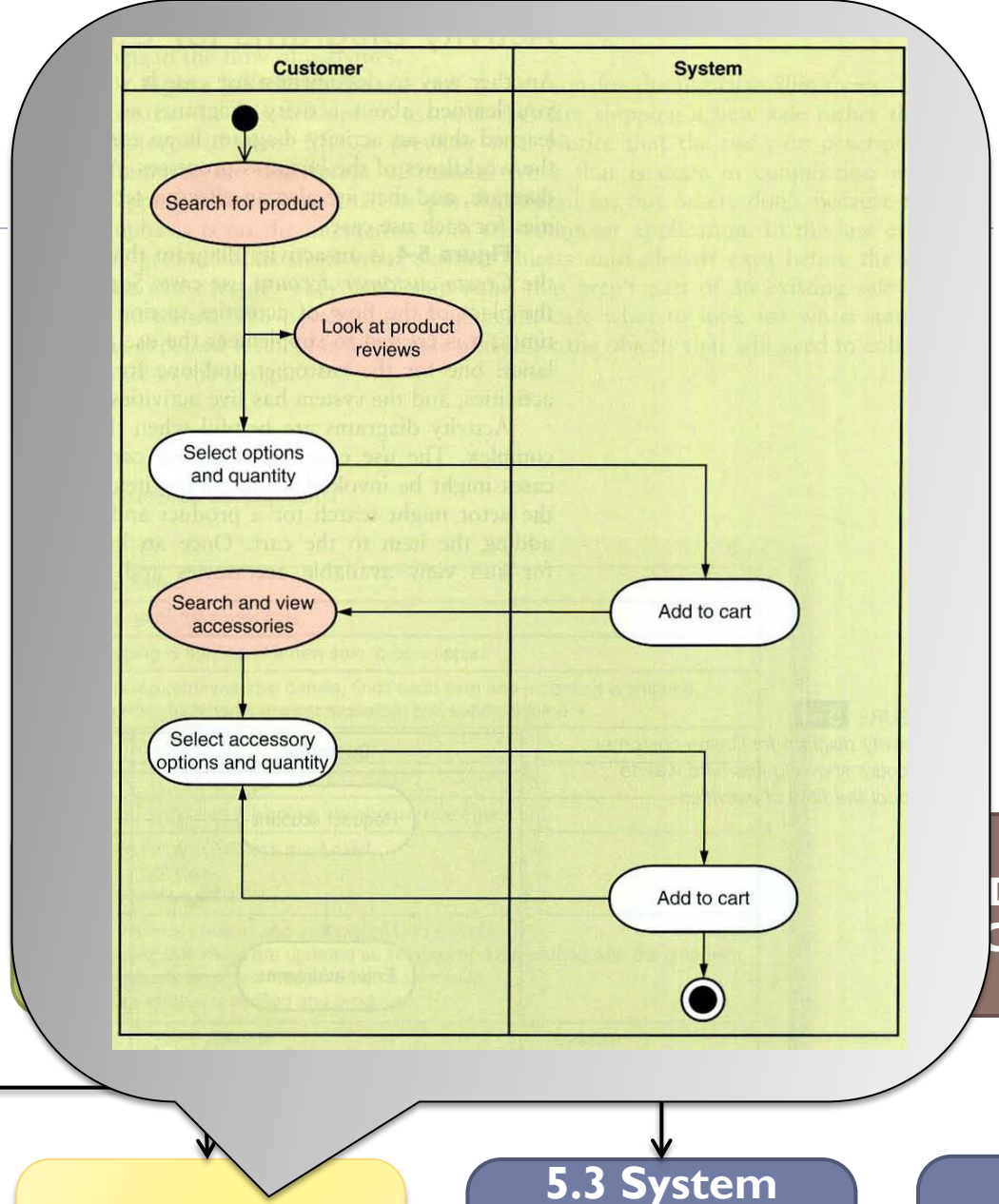

Domain model
Class diagram

5.1 Use case Description

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5.3 System sequence diagram (SSDs)

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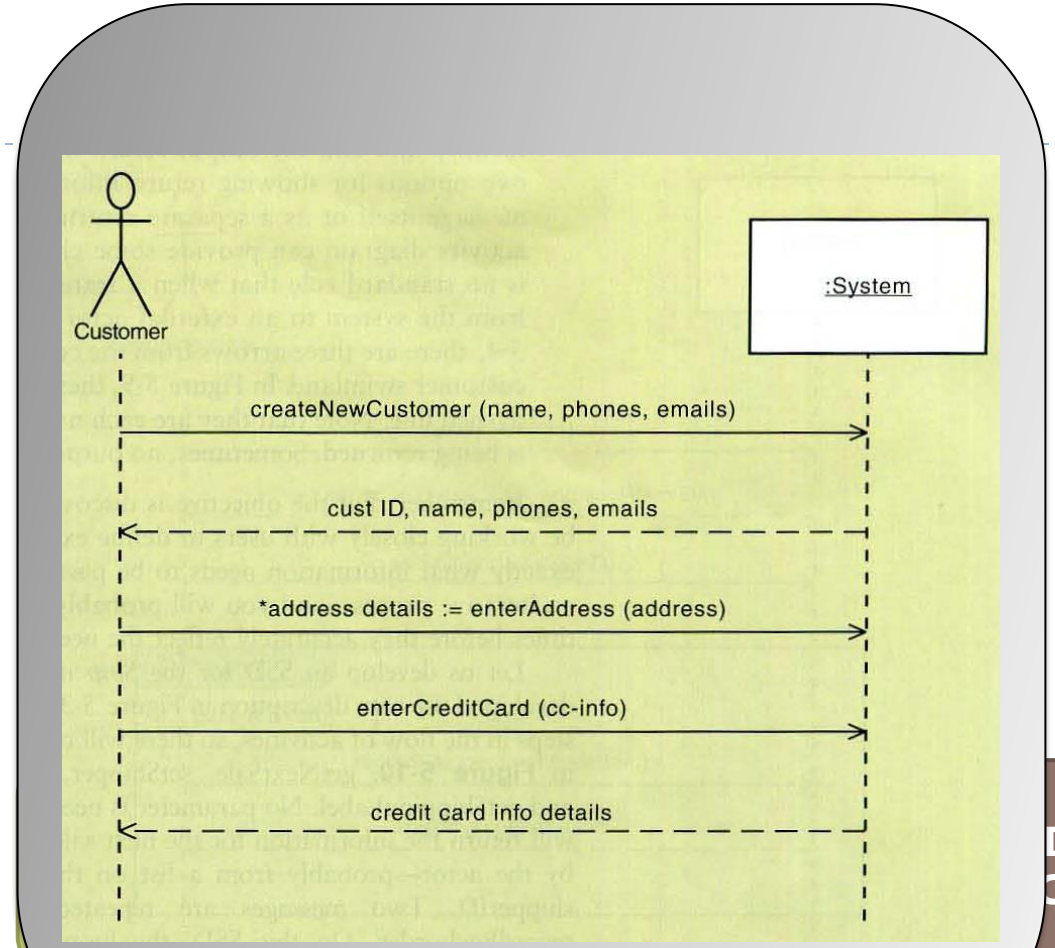
Review



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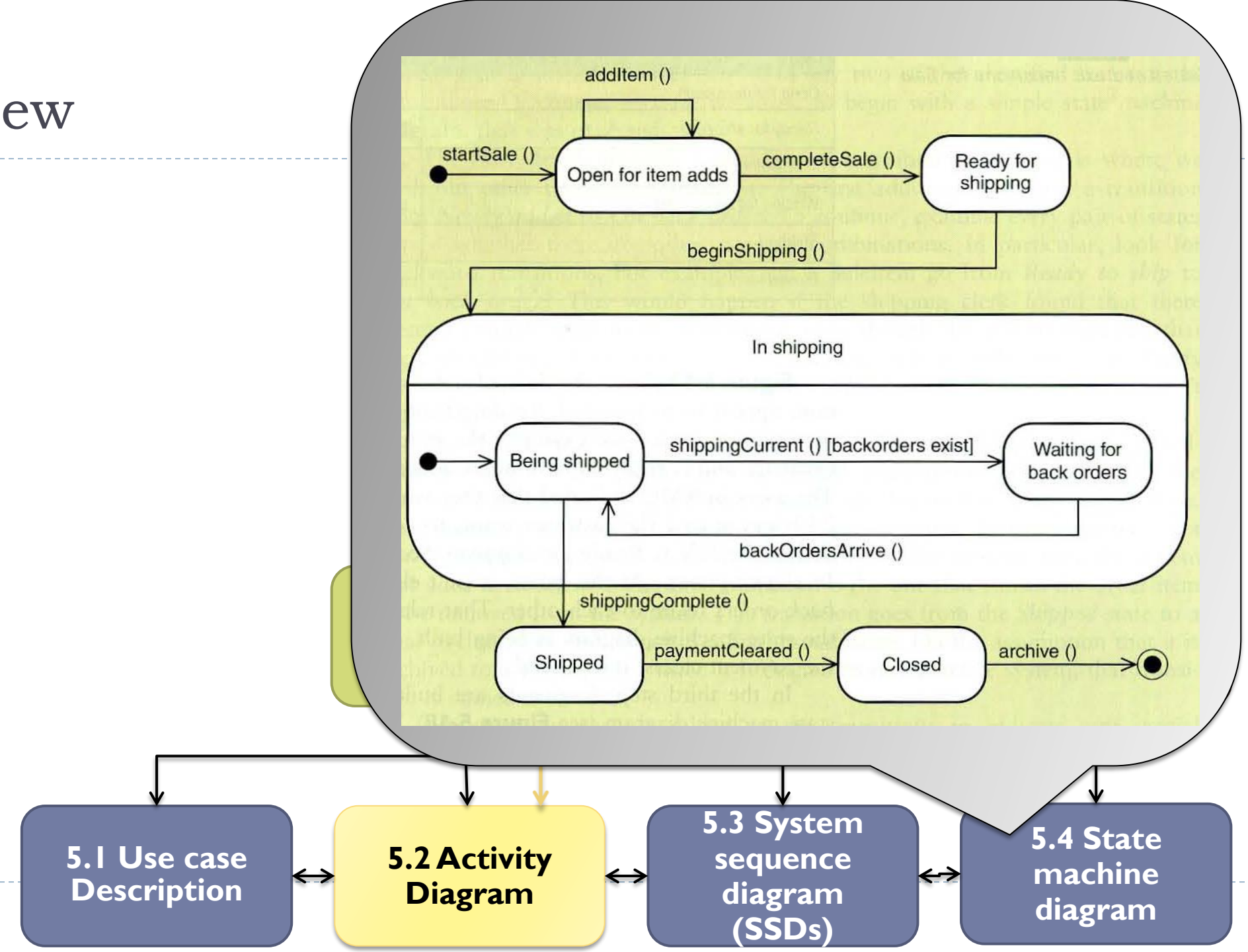
addItem ()
startSale ()
Open for item adds
completeSale ()
Ready for shipping
beginShipping ()
In shipping
Being shipped
shippingCurrent () [backorders exist]
Waiting for back orders
backOrdersArrive ()
shippingComplete ()
Shipped
paymentCleared ()
Closed
archive ()
5.1 Use case Description
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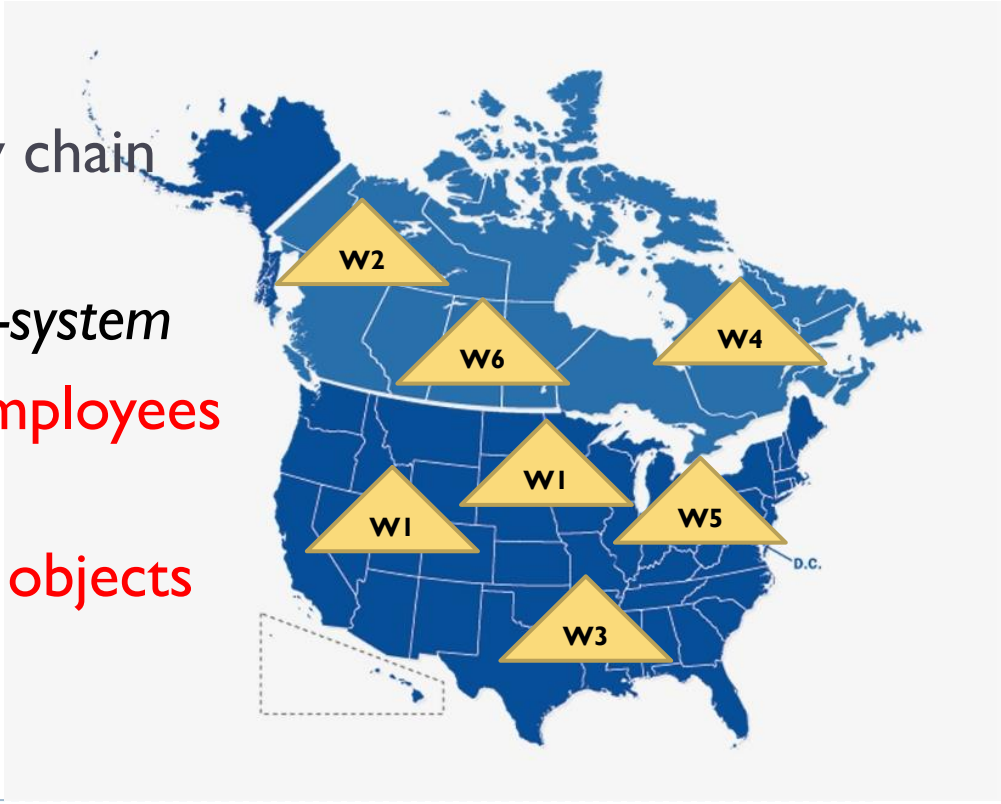
Objectives

- To understand *use case description* and applied to the work.
- To recognize *activity diagram and flow of the activity*
- To know symbols and detail in the *system sequence diagram*
- To know *state machine diagram* to model object behavior
- To explain the usage of use case description and UML diagram working together that defined from the functional requirement

What is object-oriented programming? Company story:

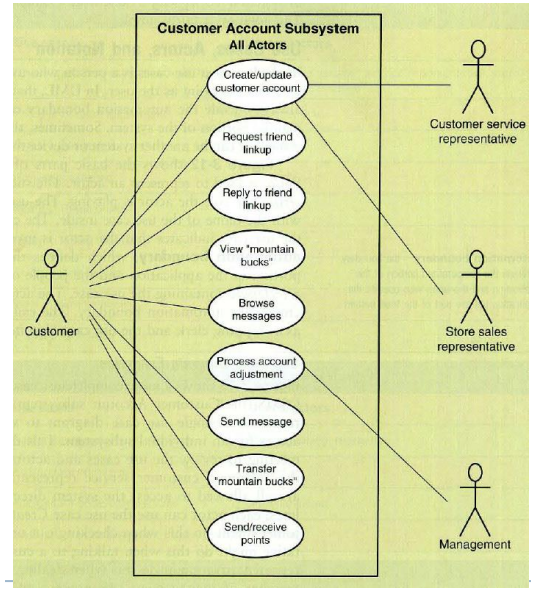
- Electronic Unlimited Company
  - Representative sale in the electronics equipment
  - Sale location in the United States and Canada
  - Warehouse locates in 6 cities
  - The company want to develop an *integrated* supply chain system that has three main features.
    - *Object-oriented technique* links between *system-to-system*
    - The variable definition of purchase order and employees are objects.
    - Sale activity uses the messages passing between objects



5.1 Use case descriptions

5.1 Use case description

- Use case description is an explanation table of the process in each of the use case diagram.
- Two types
  - Brief use case description (Take note or short brief)
  - Fully use case description (Formal)



Use case	Brief use case description
Create customer account	1. User enter new customer account data 2. The system assign account number 3. Create a customer record 4. Create an account record
Look up customer	1. User enter customer account number 2. The system retrieves and display account data
Process account adjustment	1. User enter order number. 2. The system retrieves customer and order data. 3. The actor adjustment amount data. 4. The system create the transaction record for the adjustment.

Use case name:	*Create customer account.*	
Scenario:	Create online customer account.	
Triggering event:	New customer wants to set up account online.	
Brief description:	Online customer creates customer account by entering basic information and then following up with one or more addresses and a credit or debit card.	
Actors:	Customer.	
Related use cases:	Might be invoked by the *Check out shopping cart* use case.	
Stakeholders:	Accounting, Marketing, Sales.	
Preconditions:	Customer account subsystem must be available. Credit/debit authorization services must be available.	
Postconditions:	Customer must be created and saved. One or more Addresses must be created and saved. Credit/debit card information must be validated. Account must be created and saved. Address and Account must be associated with Customer.	
Flow of activities:	**Actor**	**System**
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Exception conditions:	1.1 Basic customer data are incomplete. 2.1 The address isn't valid. 3.2 Credit/debit information isn't valid.	

5.1. uses case description (2)

- Fully uses case description
  - Formal document

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1. Use case name is the name of a functional requirement that wrote in **Verb + Noun**
   Example:
   Search customer data,
   Show summary report

2. Scenario is the outline or a postulate sequence.

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Actors:	C
Related use cases:	Migh *Check out shopping cart* use case.
Stakeholders:	Accoun
Preconditions:	Customer available.
Postconditions:	
Flow of activities:	create customer account and enters basic customer information. → 1.2 System prompts for customer addresses. 2. Customer enters one or more addresses. → 2.1 System creates addresses. 2.2 System prompts for credit/debit card. 3. Customer enters credit/debit card information. → 3.1 System creates account. 3.2 System verifies authorization for credit/debit card. 3.3 System associates customer, address, and account. 3.4 System returns valid customer account details.
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3. Triggering events are conditions running the use case.
   - By timer
   - By user
   - By machines (sensor, alarm, connection, …)

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Brief description:	Online customer creates customer account by entering basic information and then following up with one or more addresses and a credit or debit card.
Actors:	Custom
Related use cases:	Might
Stakeholders:	Accou
Preconditions:	Custo Credit
Postconditions:	Custo One o Credit Accou Address and Account must be associated with Customer.

Flow of activities:	**Actor**	**System**
	1. Customer indicates desire to create customer account and enters basic customer information.	1.1 System creates a new customer. 1.2 System prompts for customer addresses.
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4. The brief description is simple description.

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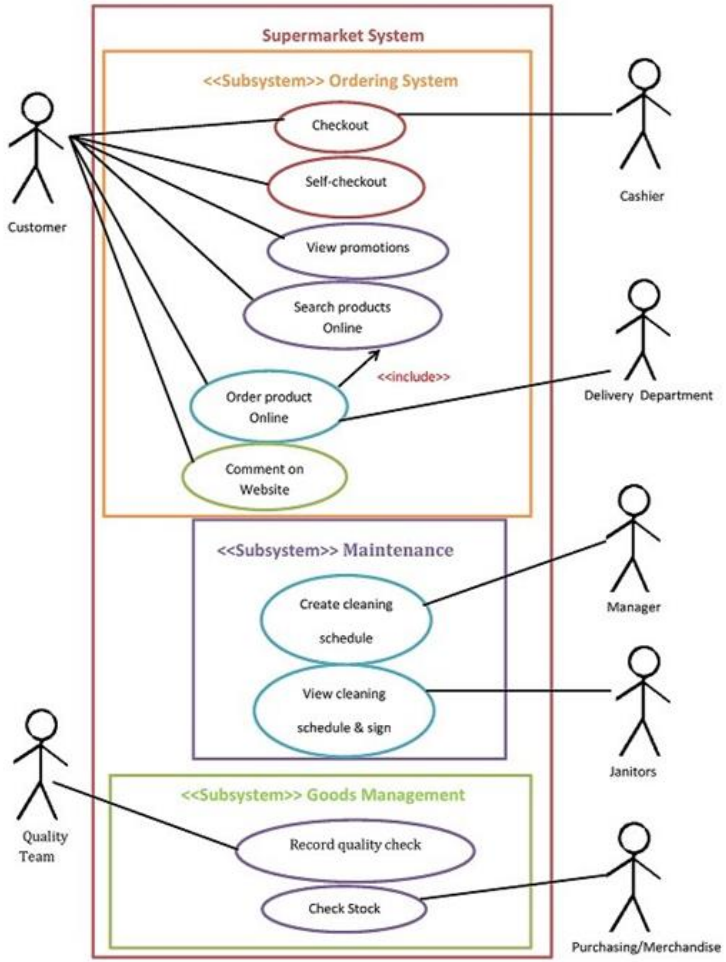
5. Actor is peoples or external systems relating to the use case.



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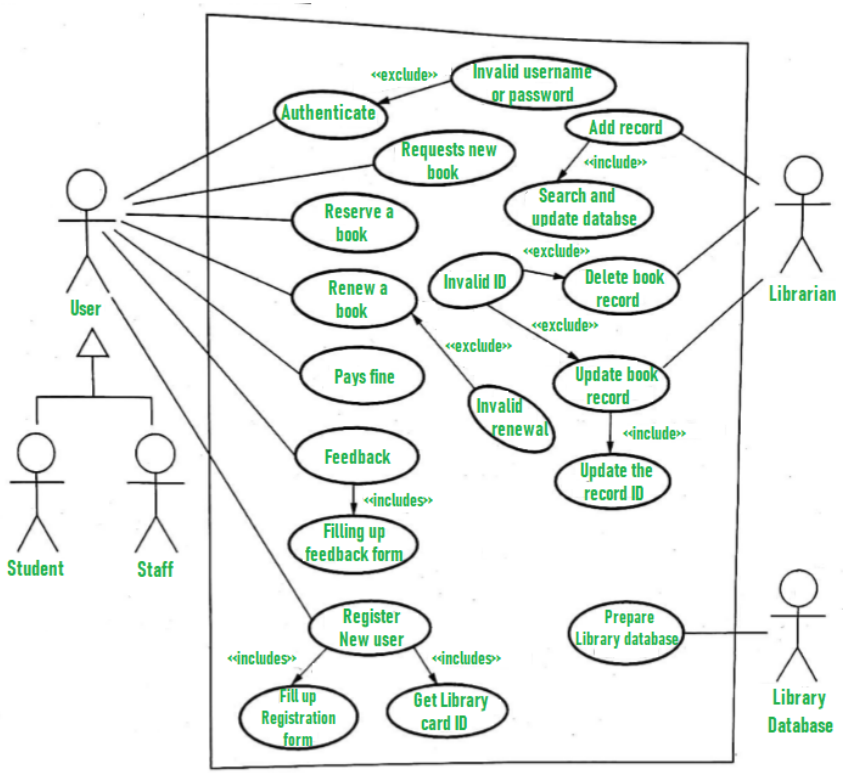
6. Related use cases, <<includes>> or <<extend>>



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Preconditions:	Cust
Postconditions:	Cu One Cred Acco Addr
Flow of activities:	

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7. Stakeholders

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8. Preconditions are list of condition that must be check **before** running the use case.

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Flow of activities:	enter 2. Cust addr 3. Customer enters credit/debit card information.
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9. Flow of activities are a sequence process for running the use case.

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10. Exception conditions are the stopping conditions before risking the error.

Addition

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Better Use Case Diagrams by Using Work System Snapshots

Narasimha Bolloju, LNM Institute of Information Technology, Jaipur, India
Steven Alter, University of San Francisco, San Francisco, CA, USA

ABSTRACT

Research to date shows significant variability in the success of applying the common technique of use case diagramming for identifying information system scope in terms of use cases performed by actors interacting with an information system or performed automatically by the information system. The current research tests a) the benefits of using a work system snapshot, a basic analytical tool from the work system method, before producing use case diagrams, and b) the additional benefits of enhancing use case diagramming constructs to distinguish between automated activities, activities supported by the information system, and relevant manual activities. Teams of student subjects in an experiment produced substantially better use case diagrams - containing far more use cases and qualitatively better use cases than did the teams in control group - when provided with a work system snapshot that summarized a test scenario in terms of work system concepts.

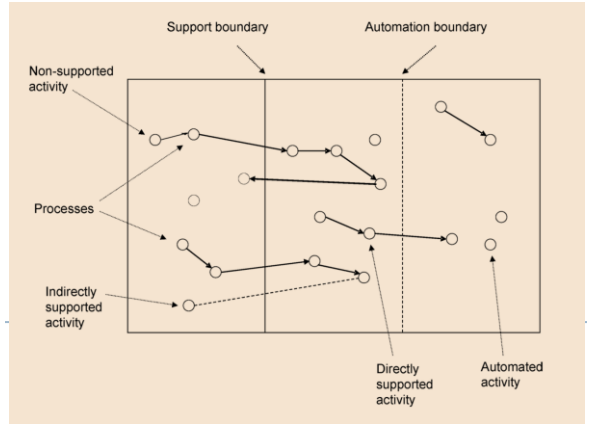
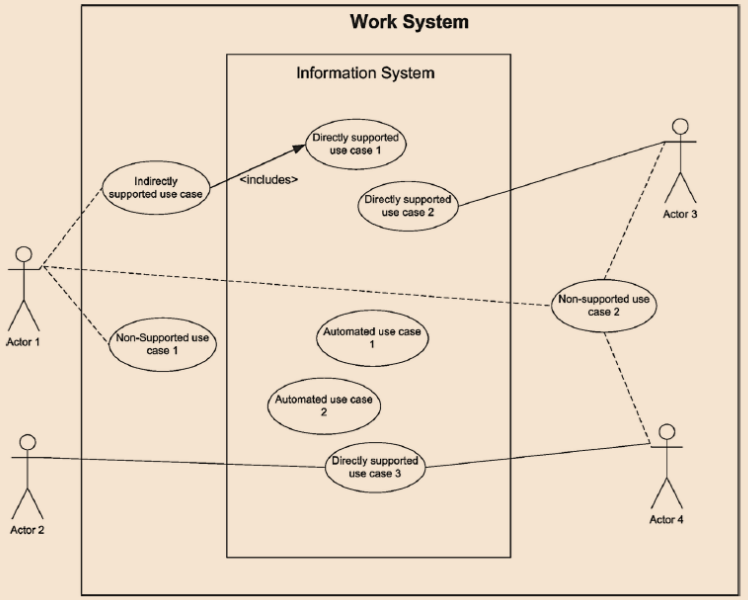
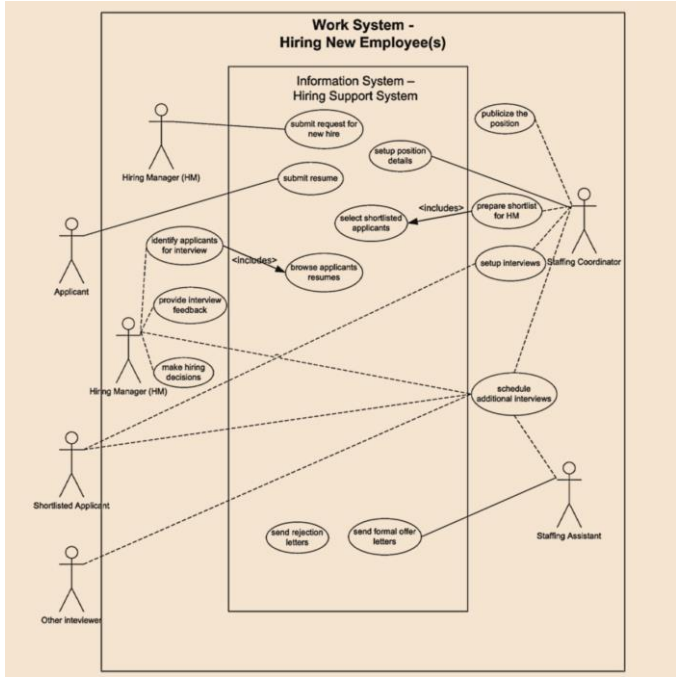


Figure 2. Enhanced use case diagram showing information system and work system boundaries

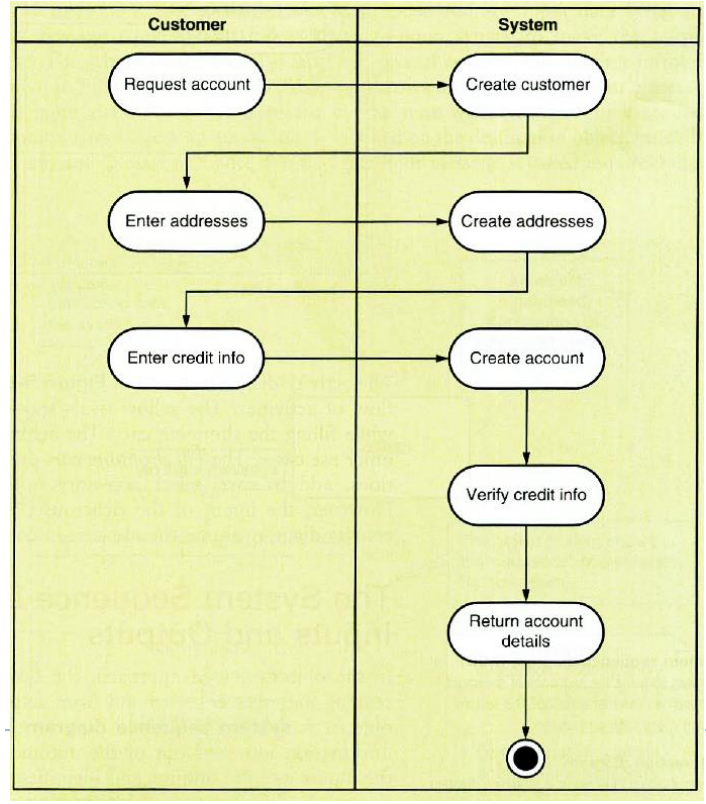


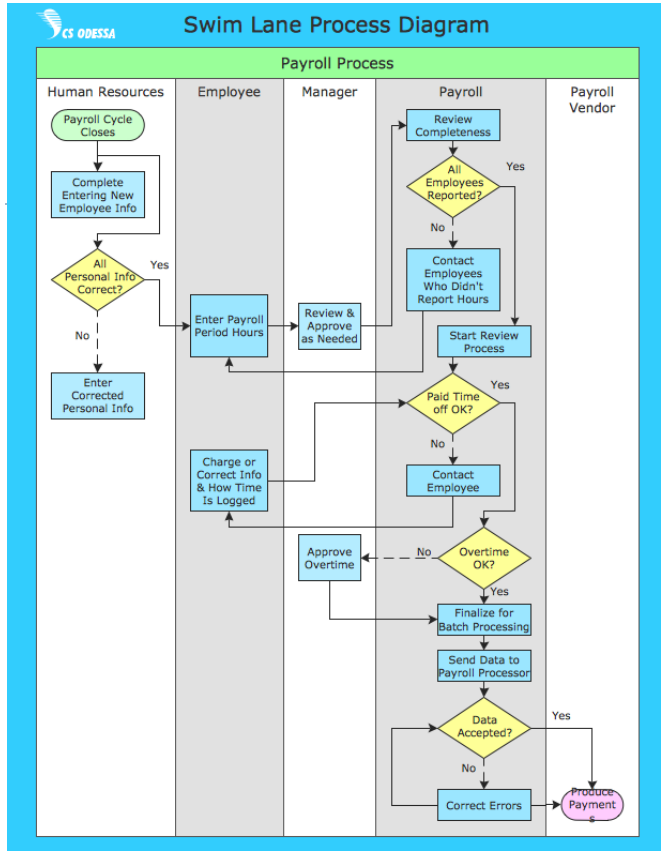


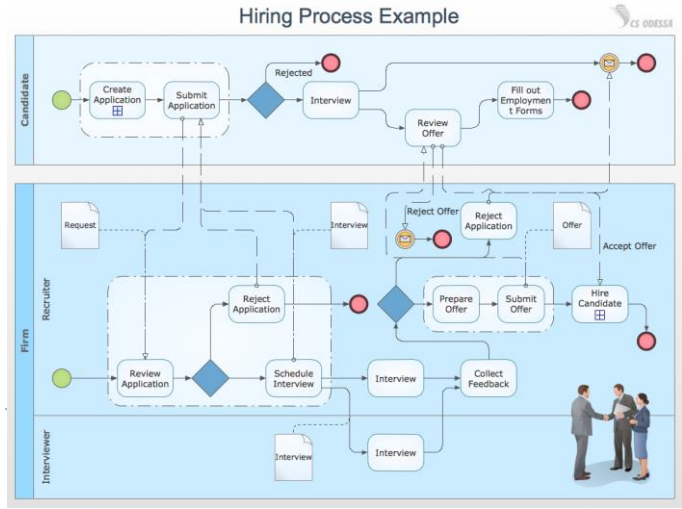
5.2 Activity diagram for use cases

5.2 Activity diagram

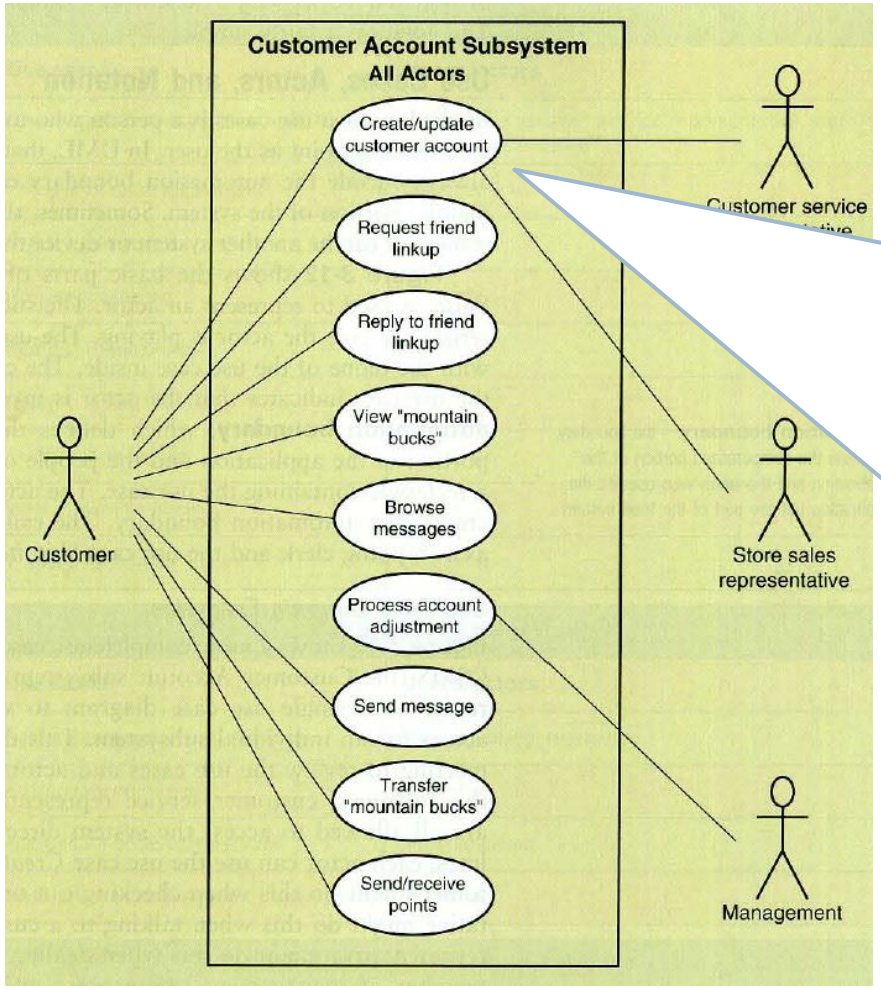
- Activity diagram
  - Business flow is similar to the workflow, but the process shows the actor who is responsible in each step.
  - Workflow is drawn as to the flowchart.

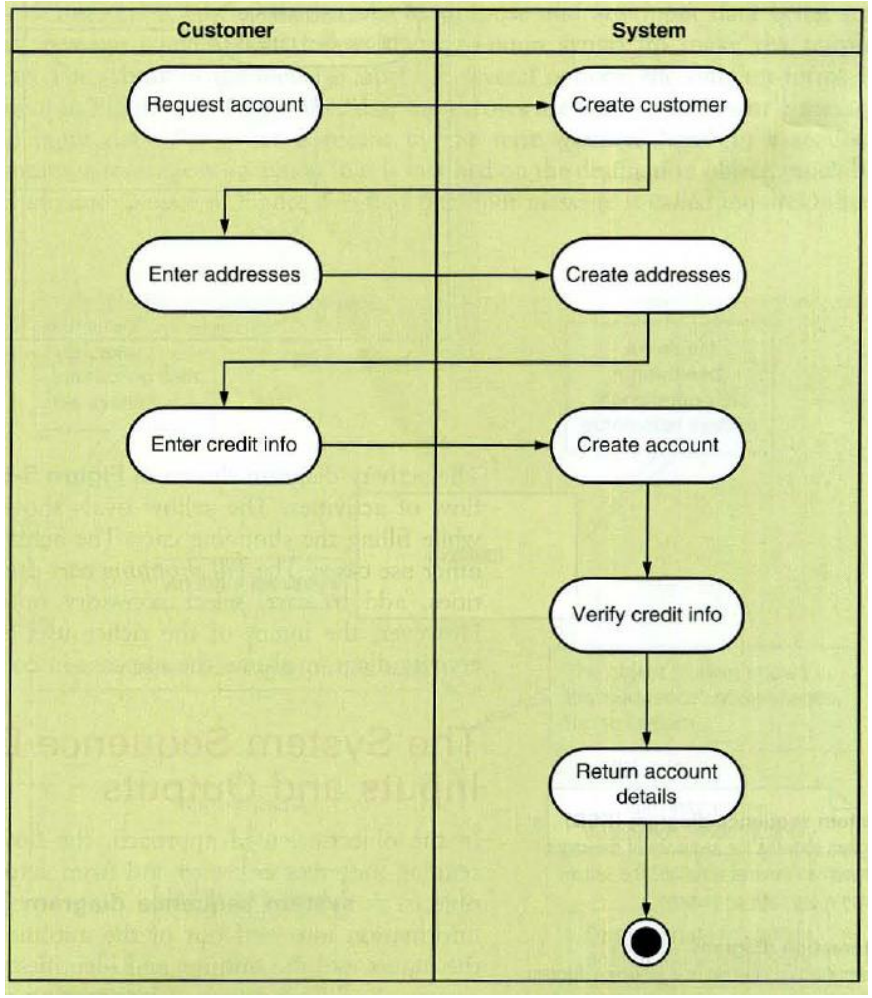




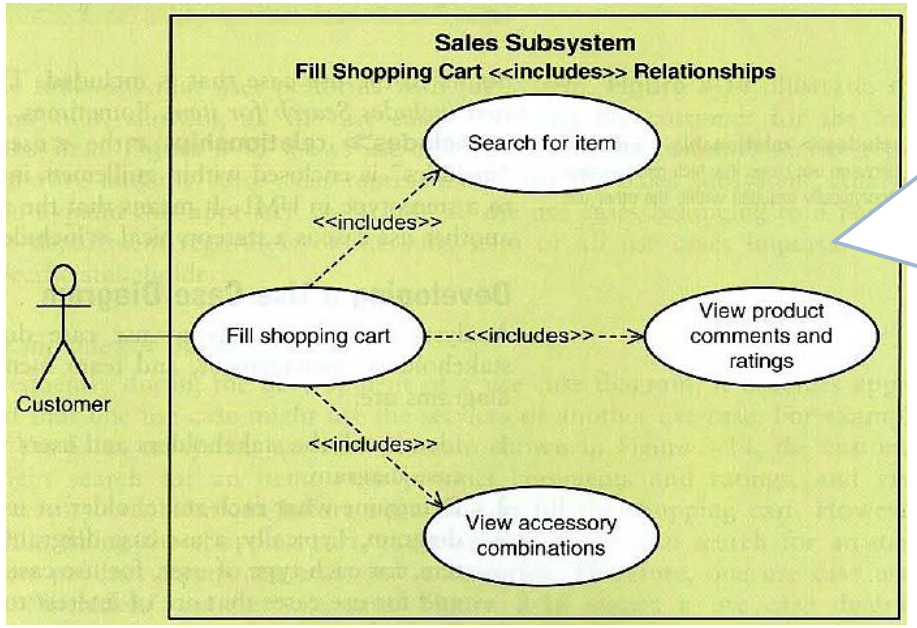


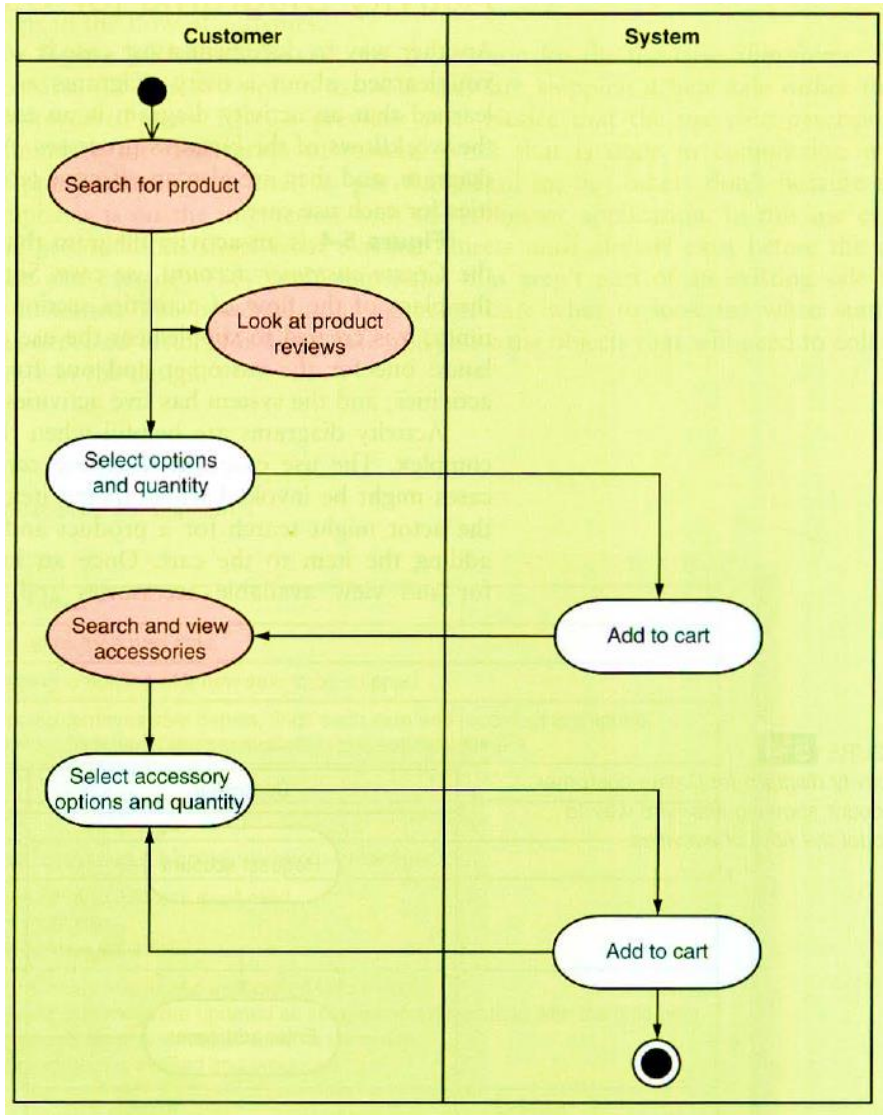
5.2 Activity diagram (2)





5.2 Activity diagram (3)

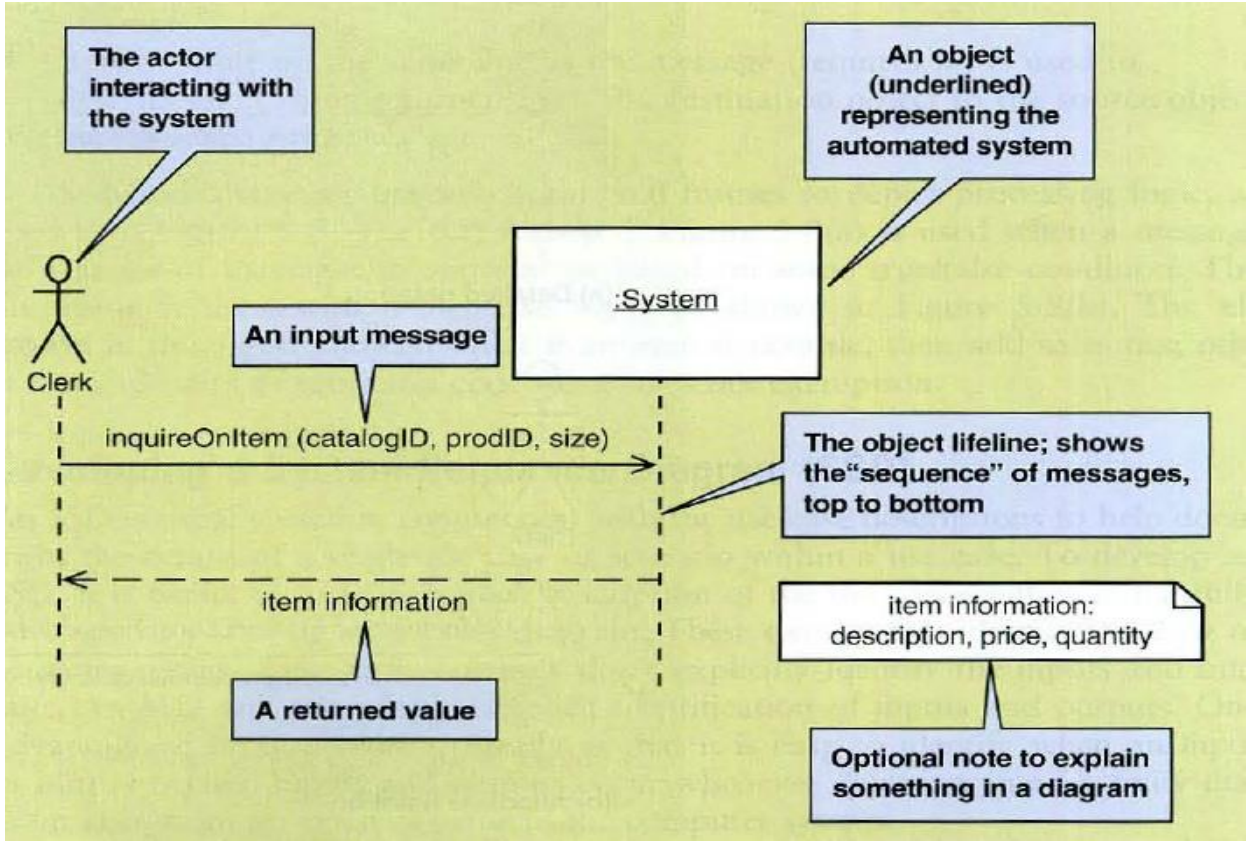




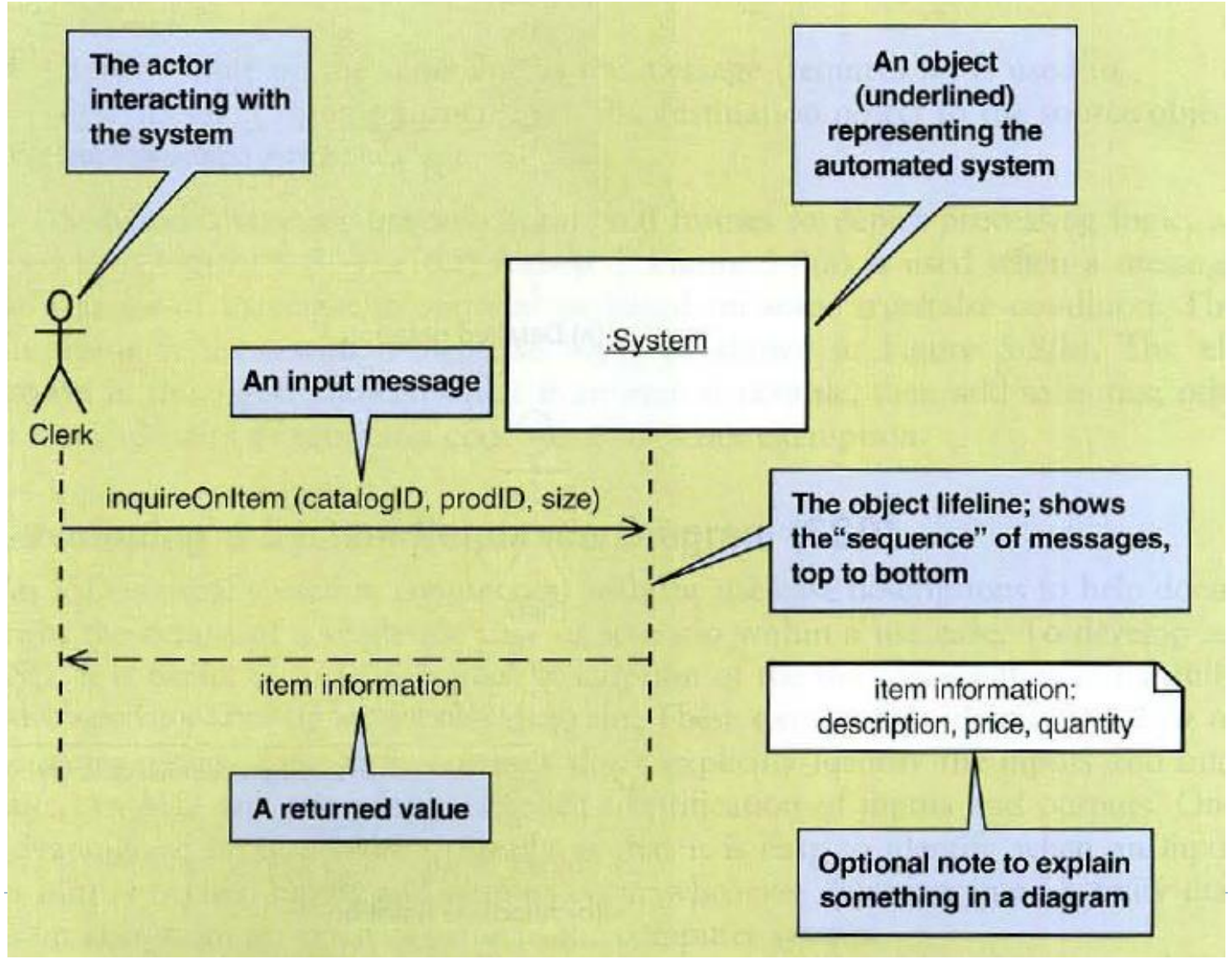
5.3 The system sequence diagram (SSD)

5.3 System Sequence Diagram: Identifying I/O

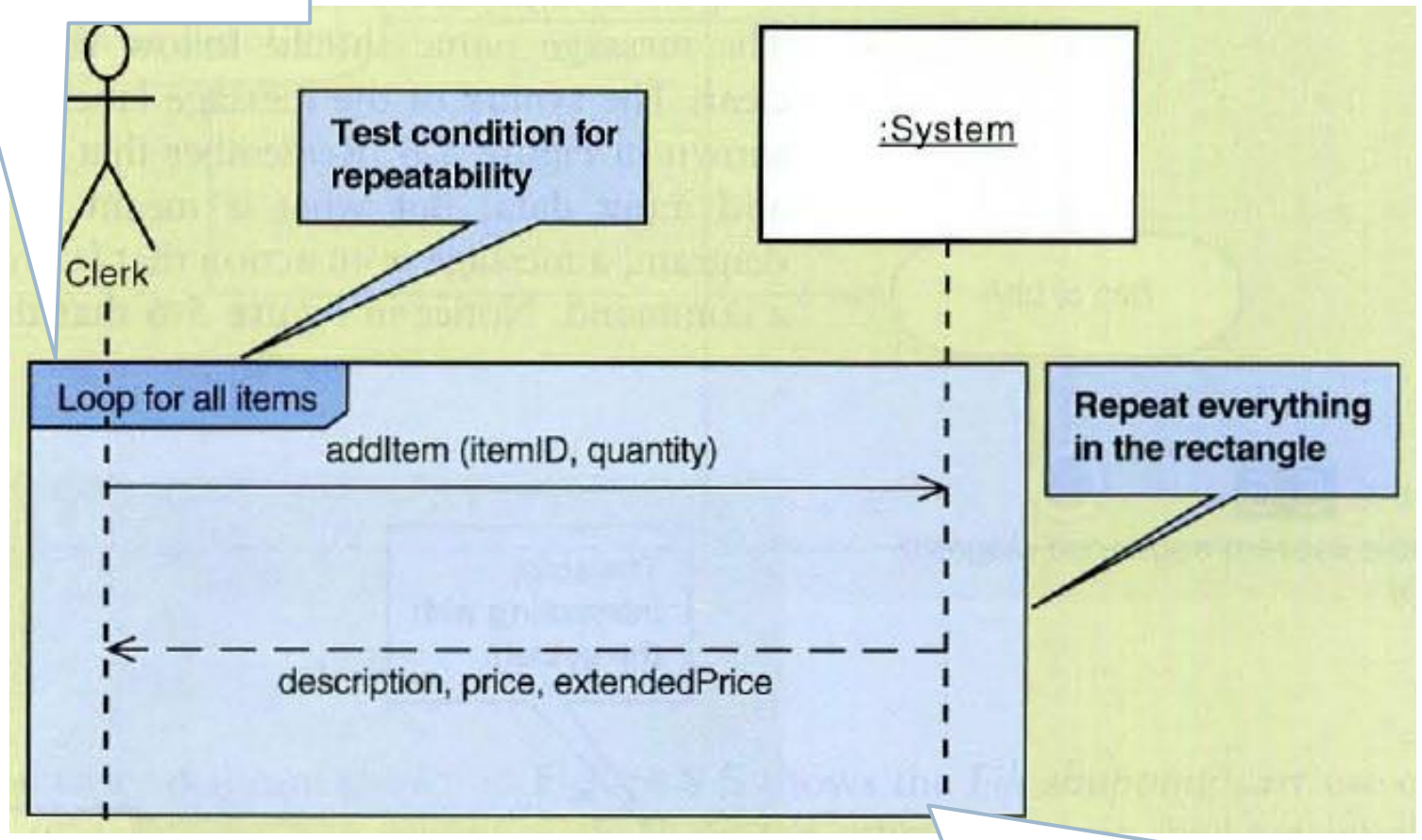
- System Sequence Diagram (SSD)
  - SSD uses to describe the information or data in/out from the system.
  - SSD does not describe information flow inside the system.
  - SSD is called **Interaction diagram**



System Sequence Diagram: Identifying I/O(2)

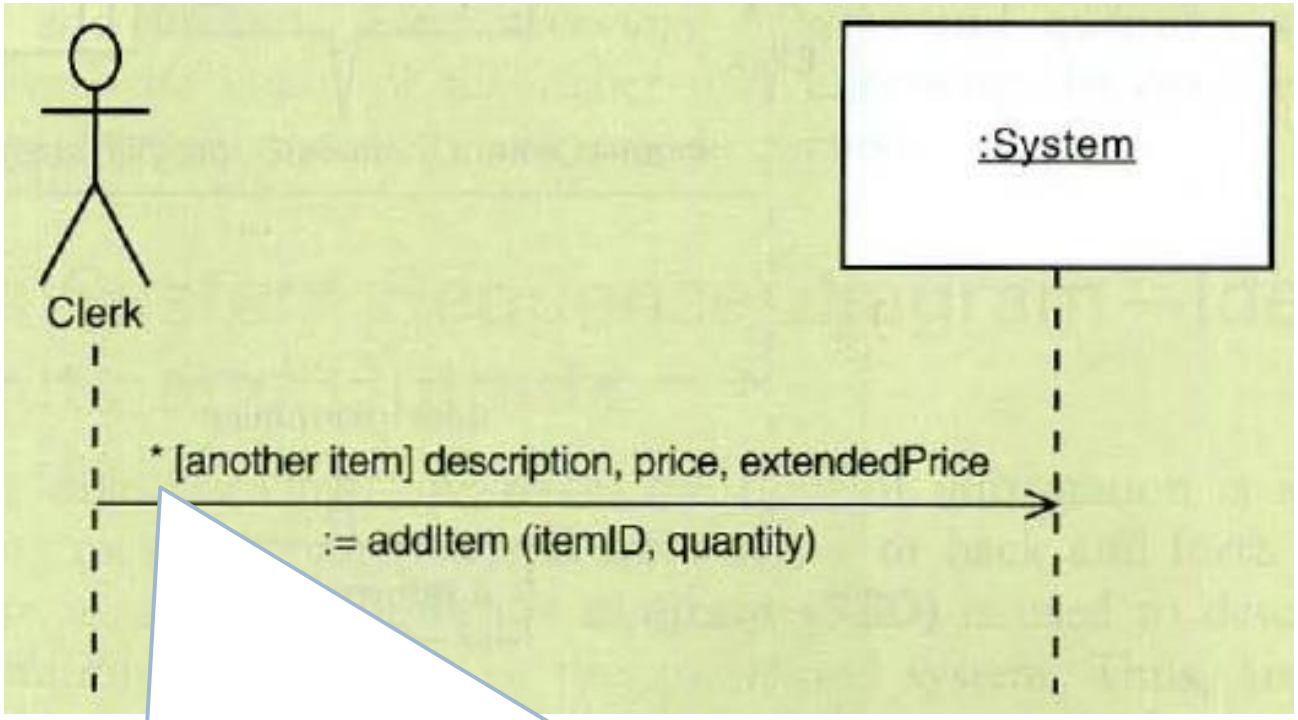


System Sequence Diagram: Identifying I/O (3): loop frame



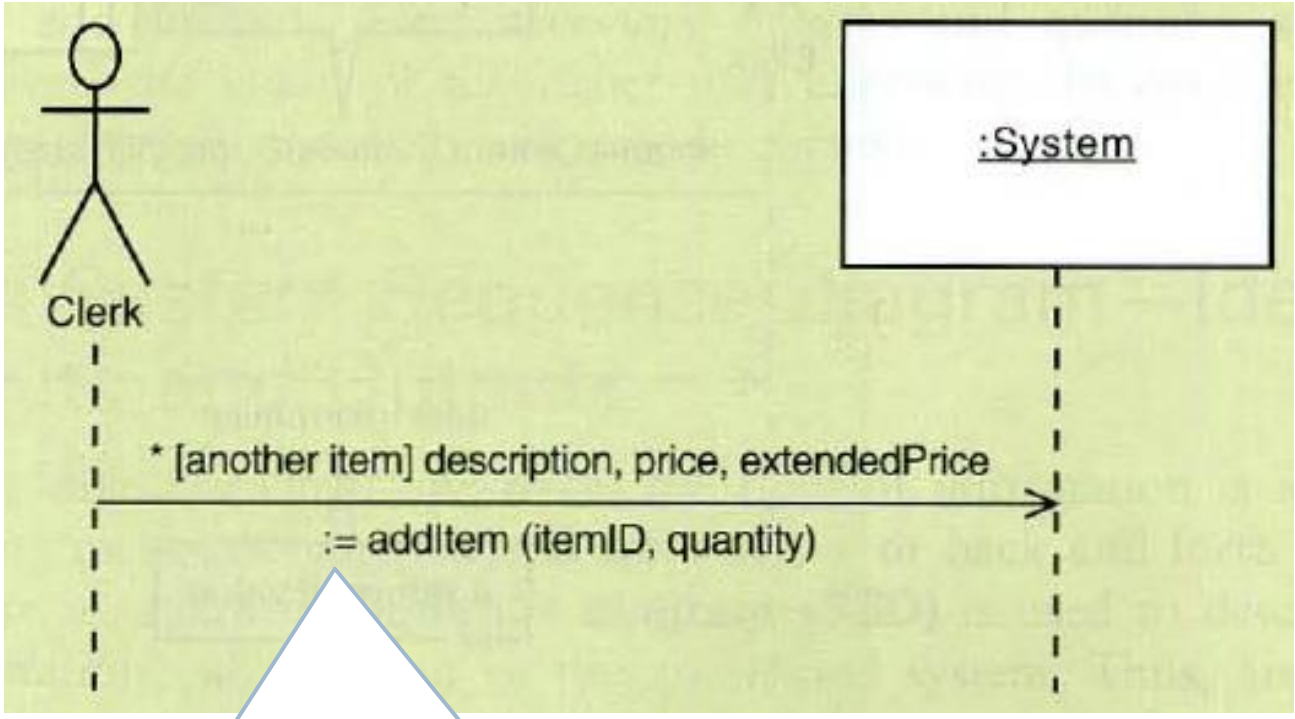
Loop frame is the multiple-time operation doing between the actor and the system.

5.3 SSD Identifying I/O (4): True/False Condition



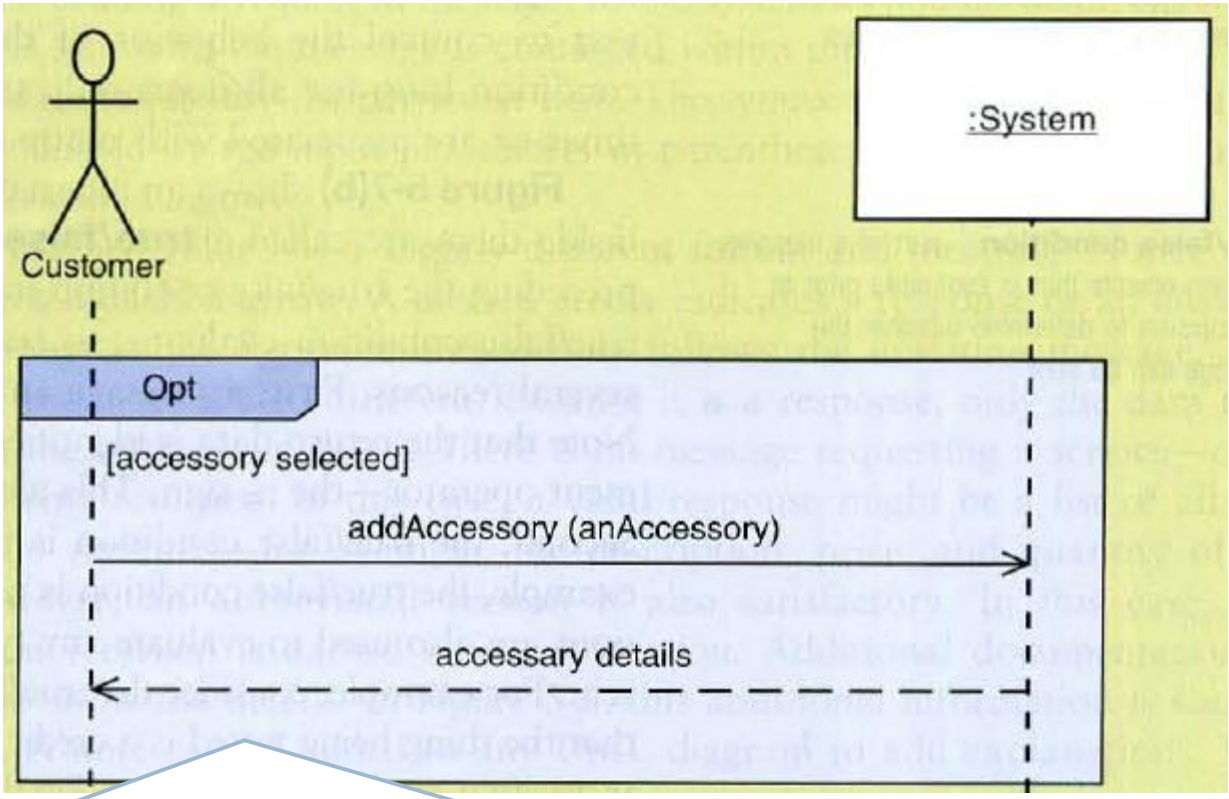
- Write in a sort form of the loop frame
- "*" indicates the repeating operation until the process completed or the condition is true..

5.3 SSD Identifying I/O (4): True/False Condition



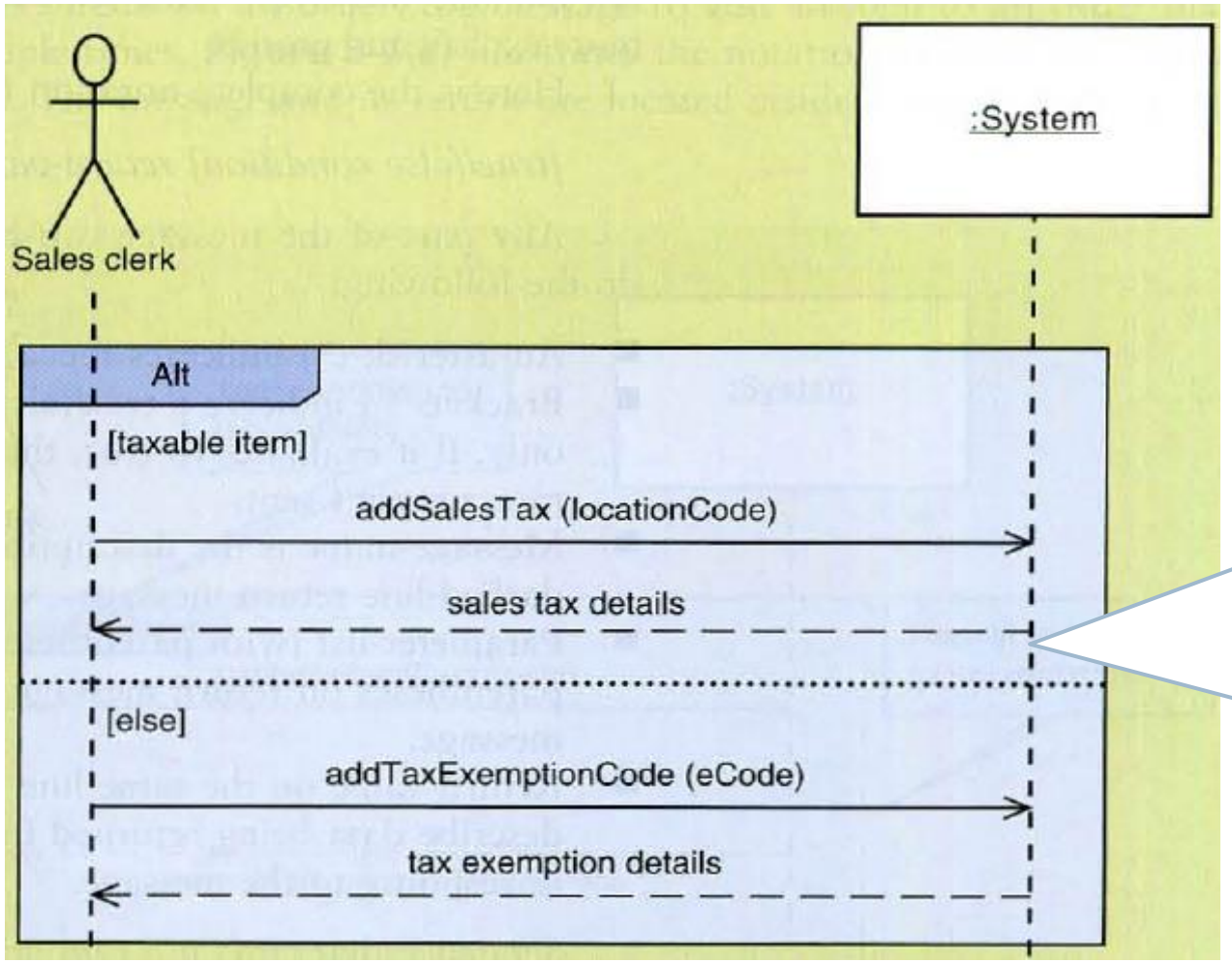
[true/false condition] return-value := *message-name(parameter-lists)*

5.3 SSD Identifying I/O (5): Options

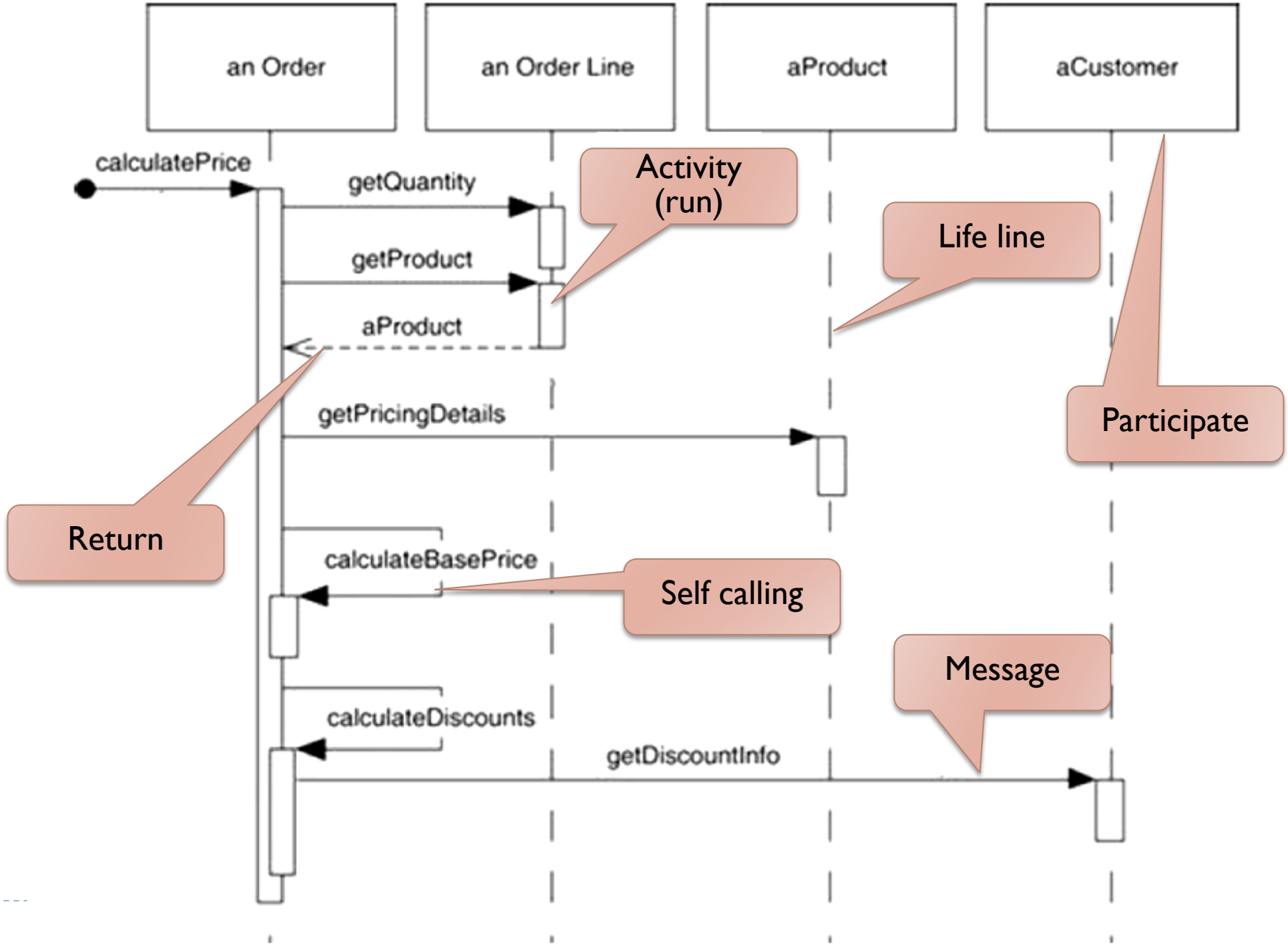


Opt frame is multi-selection.

5.3 SSD Identifying I/O (5): Alternate/Condition



Alternate is the conditional control of data sequence like if-then-else logic

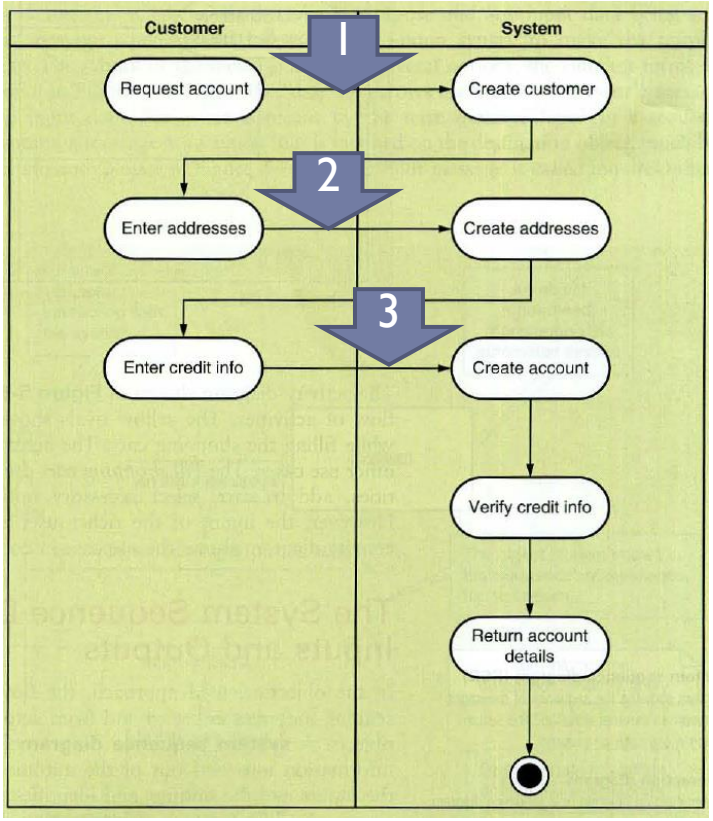

an Order
an Order Line
aProduct
aCustomer
calculatePrice
getQuantity
getProduct
aProduct
getPricingDetails
calculateBasePrice
calculateDiscounts
getDiscountInfo
Activity (run)
Life line
Participate
Return
Self calling
Message

5.3 SSD Identifying I/O (6): How to create SSD

- Develop step of system sequence diagram from an activity diagram

Step 1: Identify the input message to the system, in the example shown three inputs.

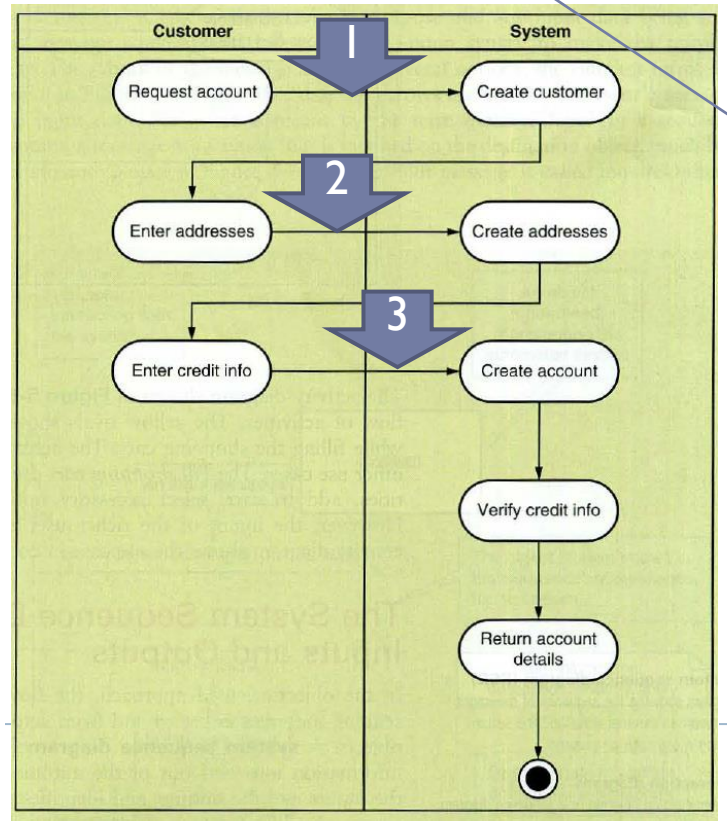
Step 2: Set variable or data in each message and placement variable and data name in the SSD.

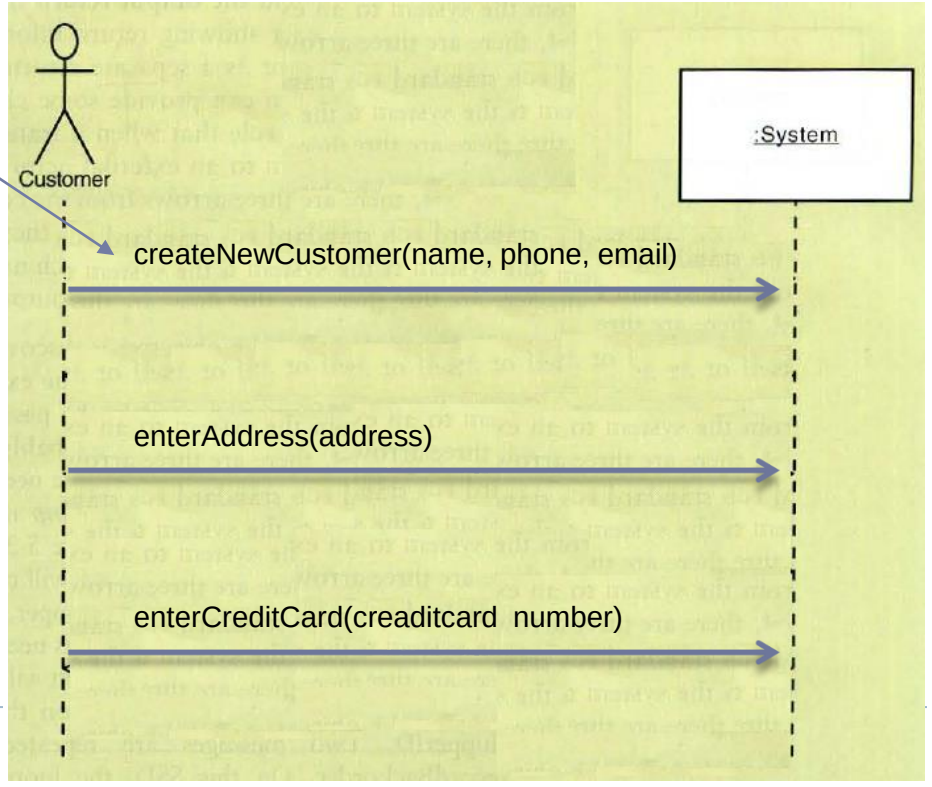


5.3 SSD Identifying I/O (6): How to create SSD

Step 3: Write down to SSD, example below

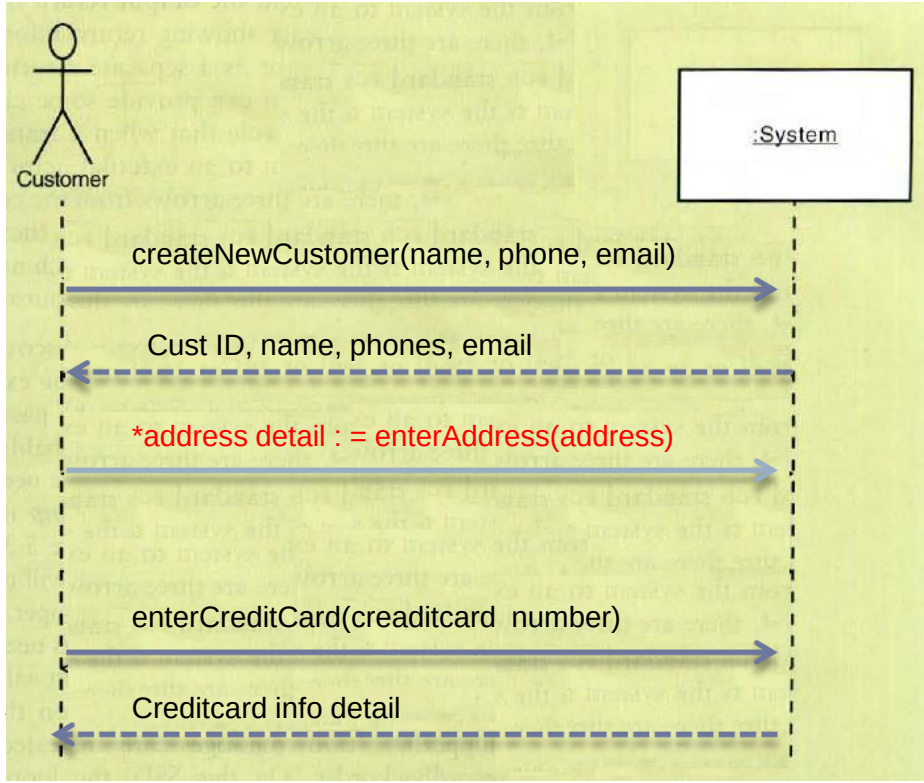
1) customer sends name, phone, and email to the system by controlling with createNewCustomer method.



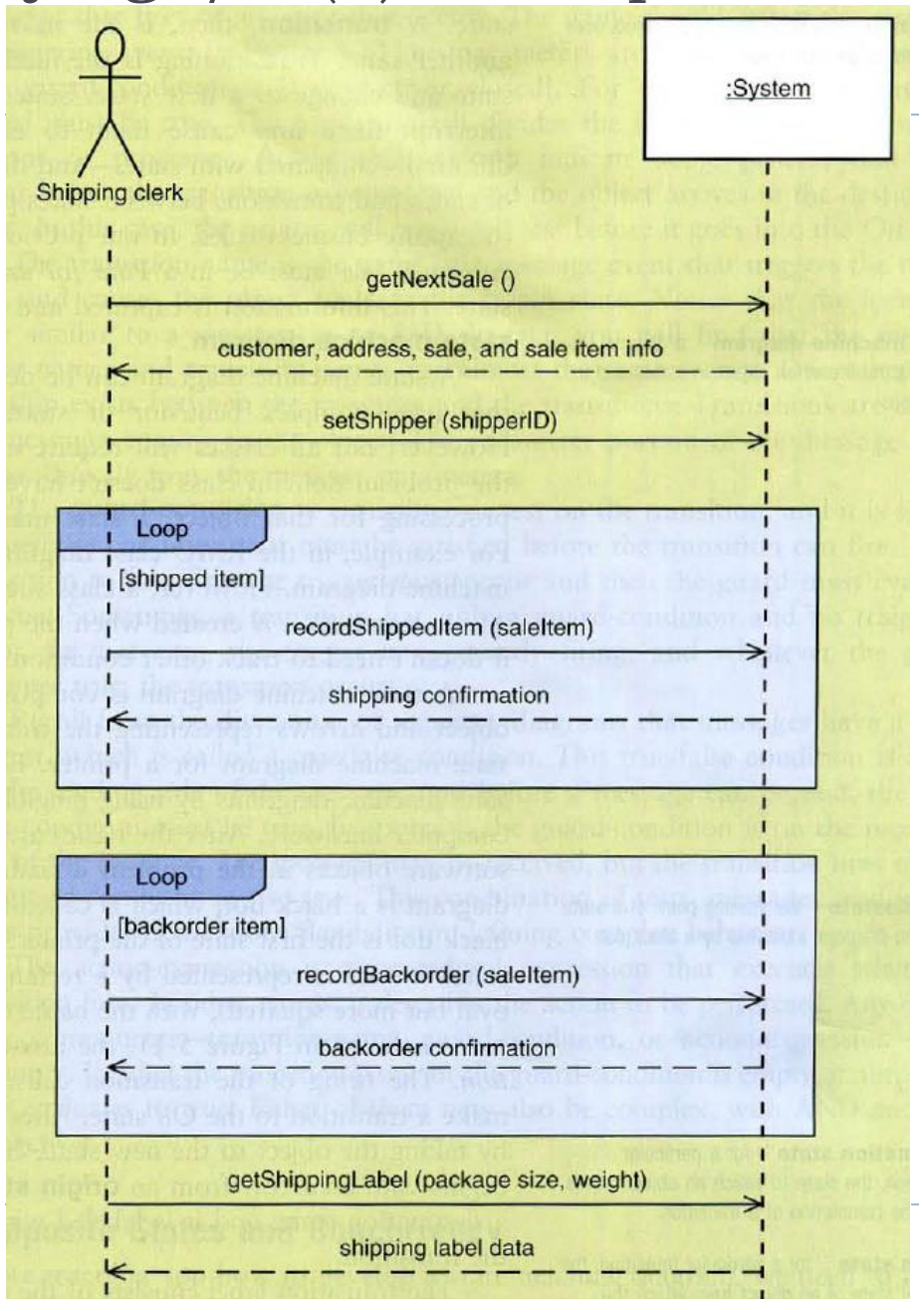


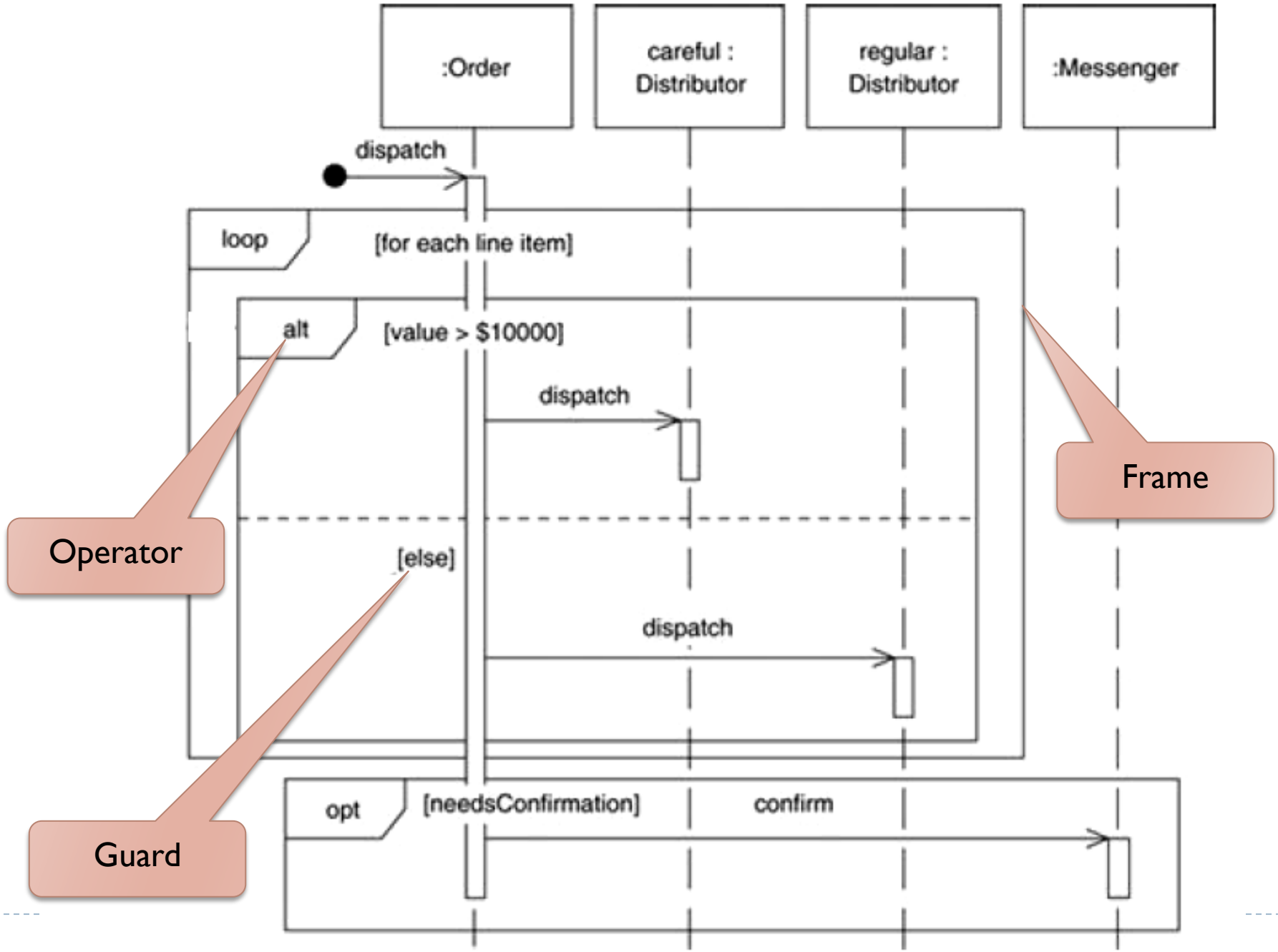
5.3 SSD Identifying I/O (6): How to create SSD

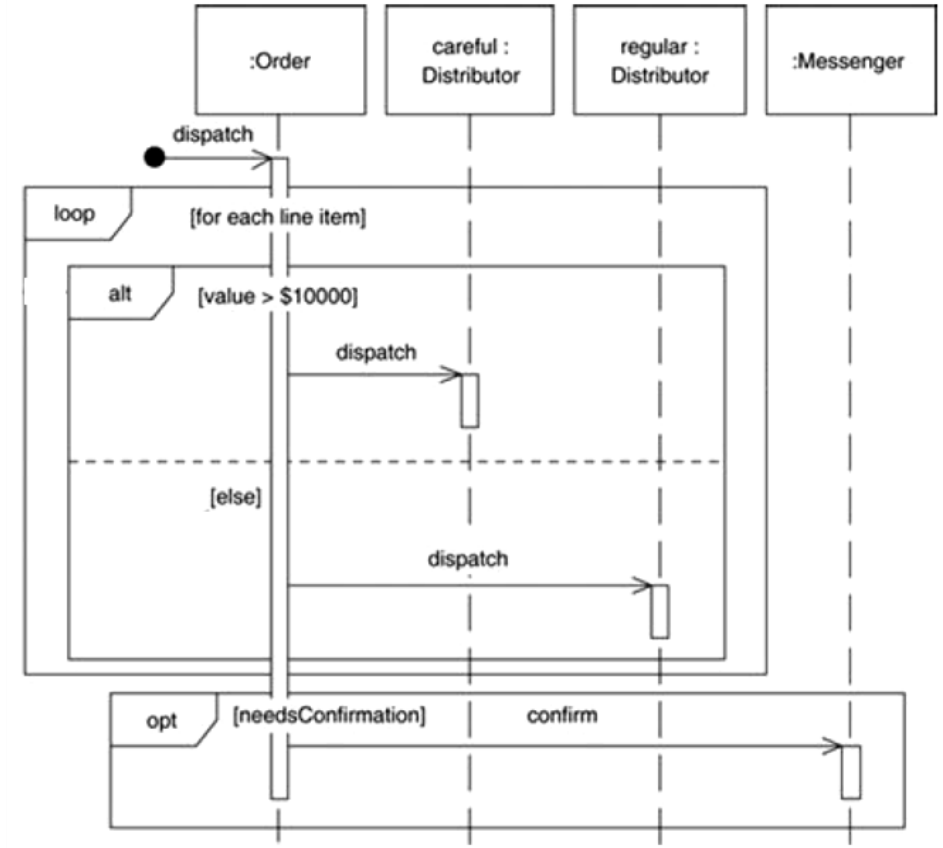
4. Define variables or information returns from the system to the actor. The example, the system return CustID, Name, Phones, and Email after the data recorded in the system.



5.3 SSD Identifying I/O (6): Example Develop SSD




:Order
careful : Distributor
regular : Distributor
:Messenger
dispatch
loop
[for each line item]
alt
[value > $10000]
dispatch
[else]
dispatch
opt
[needsConfirmation]
confirm
Operator
Guard
Frame




```
procedure dispatch
  foreach (lineitem)
    if (product.value > $10K)
      careful.dispatch
    else
      regular.dispatch
    end if
  end for
  if (needsConfirmation) messenger.confirm
end procedure
```

Common Operator in Interaction Frame

- Alt
  - Multiple condition but it has only one executed condition.
- Opt
  - Multiple condition but only selected conditions will be executed.
- Par
  - Split and run the process in parallel
- Loop
  - The multiple time execution, and termination until the condition is true.
- Region
  - Critical region; only one thread is executed
- Neg
  - The inverted interaction, not run by sequential process.
- Ref
  - Reference to another diagram.

5.4 The State Machine Diagram – Identifying Object Behavior

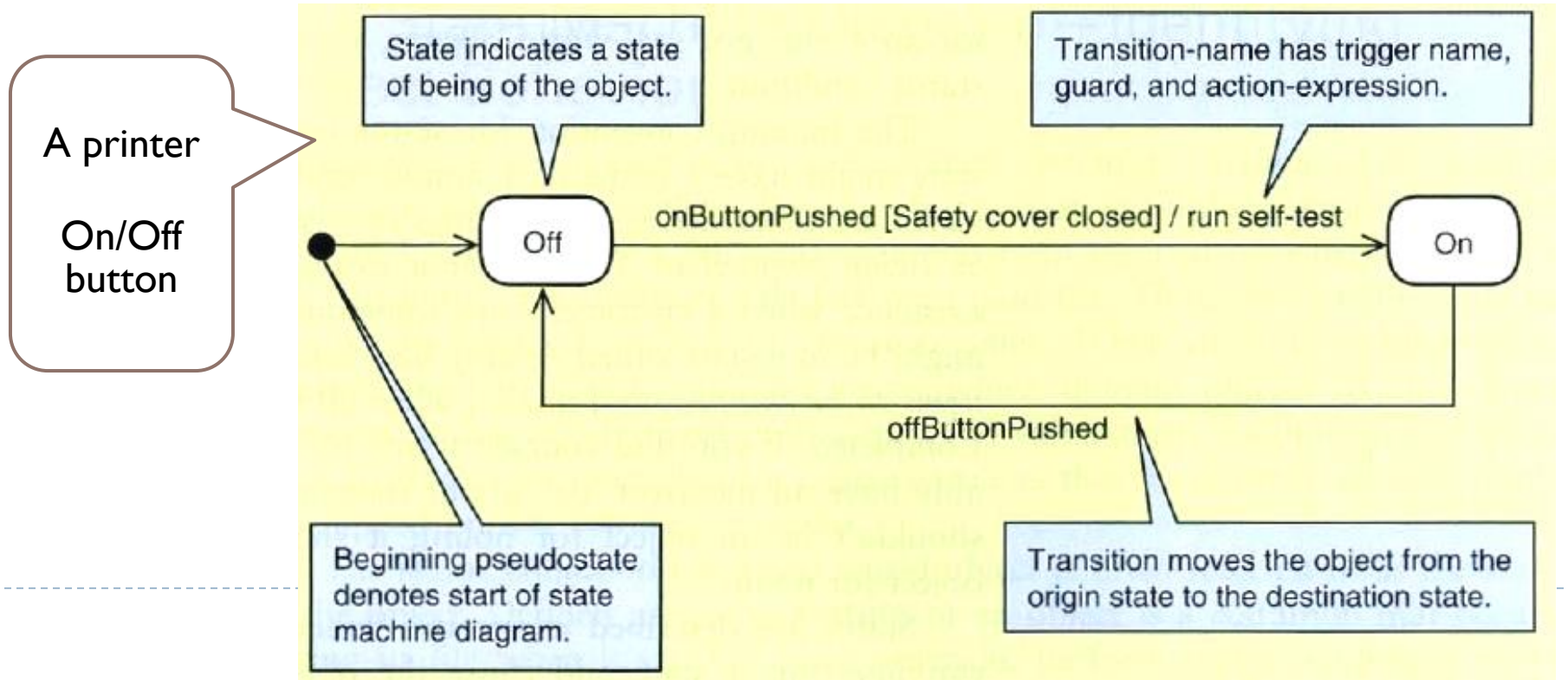
5.4 State Machine Diagram

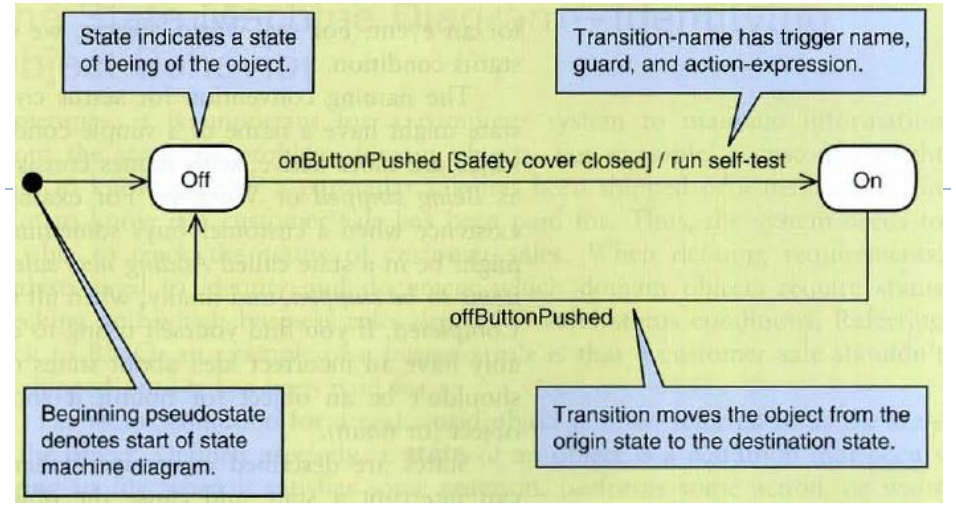
- **State** is state of the work or process that occur from the operation.
- **Transition** is the process or operation after doing the state will change to the next state.
- **State machine diagram** describes the life cycle of the process (called state) in the work.

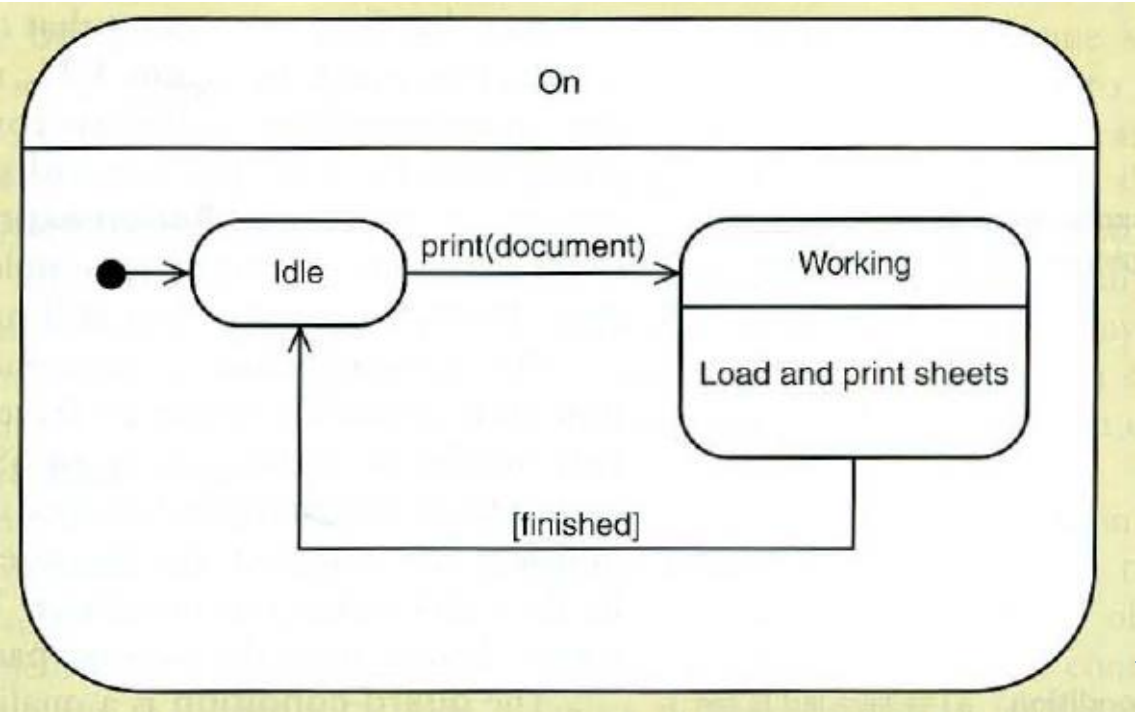
5.4 State Machine Diagram(2)

- **Pseudo state** is the starting point.
- **Destination state** is a state that object move after completion of a transition.

- **Origin state** is the state prior to the transition to destination.
- **Action-expression** is description that occur before transition completed.
- **Guard-condition** is true/false test on the transition.

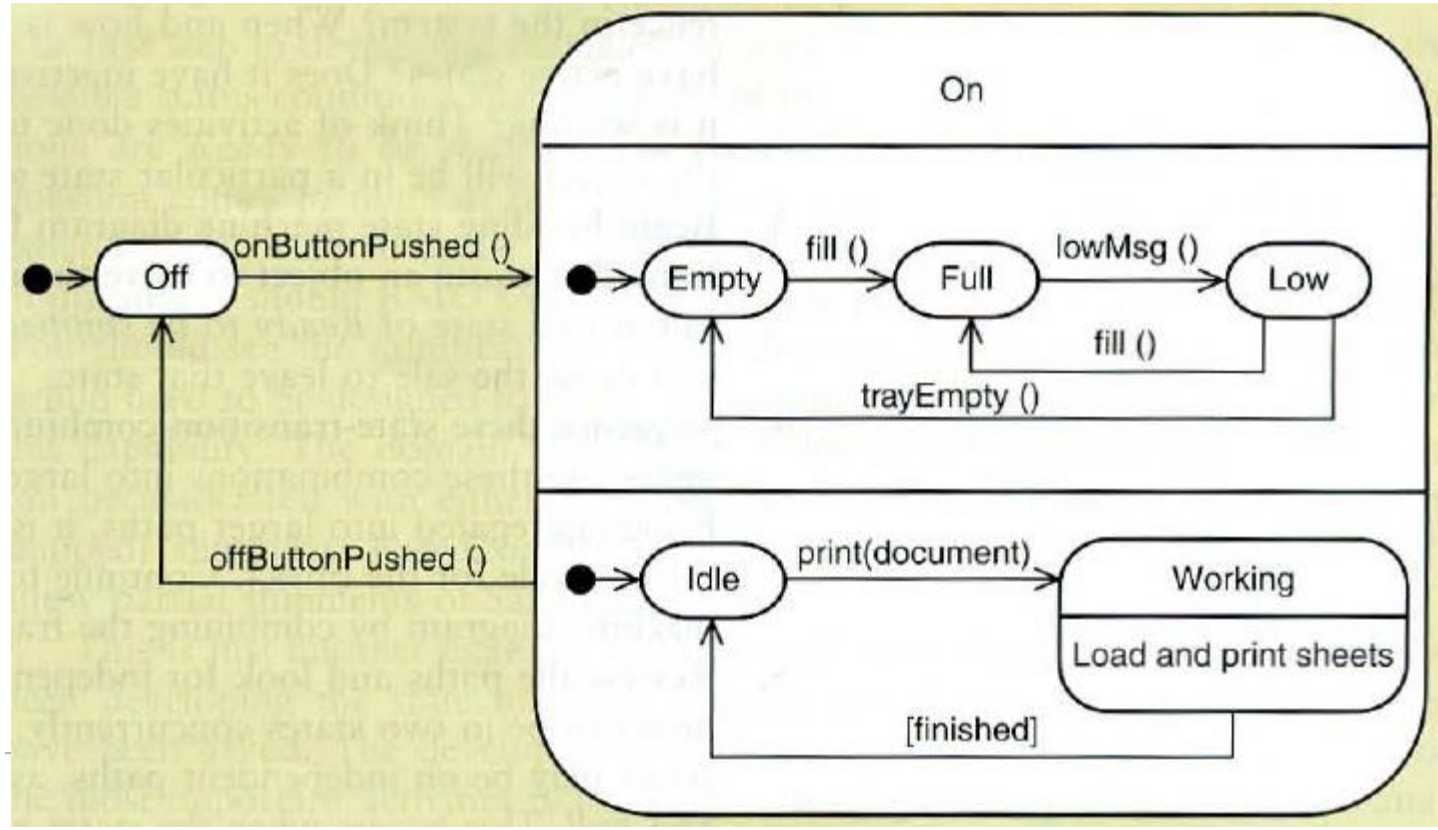



State indicates a state of being of the object.
Transition-name has trigger name, guard, and action-expression.
Off
onButtonPushed [Safety cover closed] / run self-test
On
offButtonPushed
Beginning pseudostate denotes start of state machine diagram.
Transition moves the object from the origin state to the destination state.


On
Idle
print(document)
Working
Load and print sheets
[finished]

5.4 State Machine Diagram(3): Composite states and concurrency

- **Concurrency or concurrent state** is more states running at the same time.
- **Composite state** is a container having states running inside, sometime called nest state.



5.4 State Machine Diagram(4):

Step of drawing the state machine diagram.

1. Review the class diagram and focus at a class or process that it describes by the state machine diagram.

2. At the selected class, you write a list of status (State).

3. Begin building state machine diagram fragments and you identifies the transition state by considering the condition of changing states.

5.4 State Machine Diagram(4):

4. Check sequence all state-transition in all path.

5. Review the path and look at independent and concurrent paths

4. Expand each transition with the appropriate message event, guard condition, and action expression

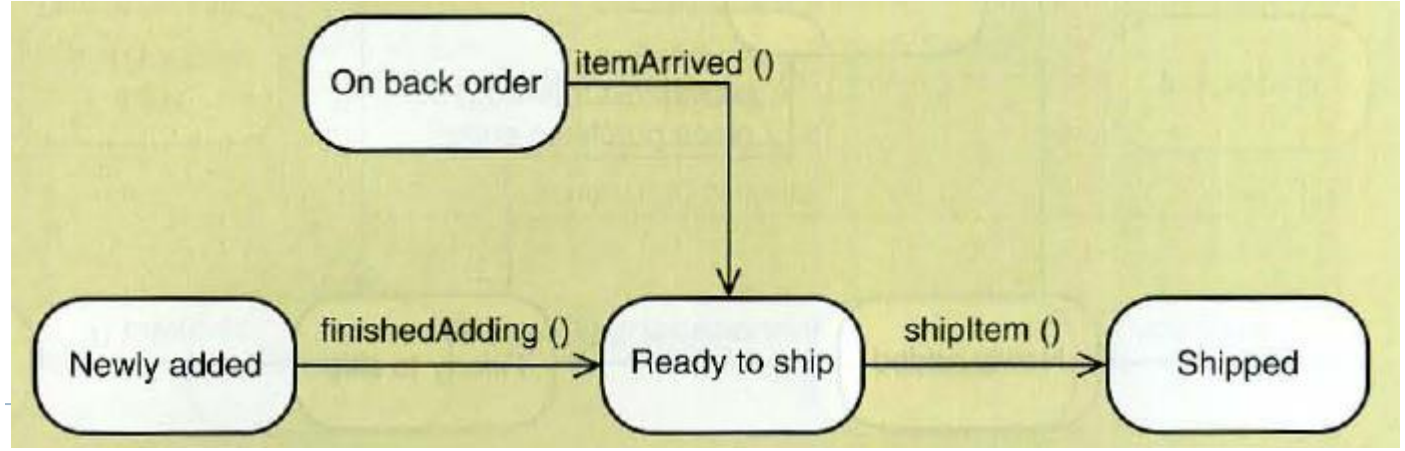
5. Review and test each state machine diagram again

5.4 State Machine Diagram(5): Developing RMO state machine diagram

State and exit transition for Saleitem object

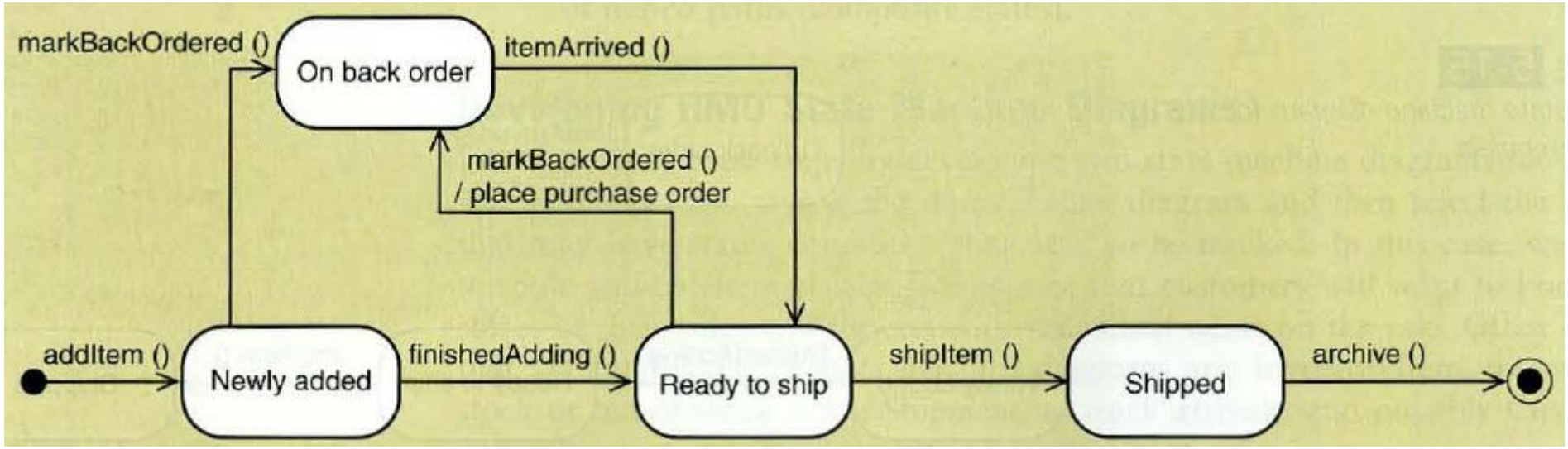
State	Transition causing exit from state
Newly added	finishedAdding
Ready to ship	shipItem
On back order	itemArrived
Shipped	No exit transition defined

Partial state machine diagram for Saleitem object



5.4 State Machine Diagram(5): Developing RMO state machine diagram

Final state machine diagram for Saleitem object

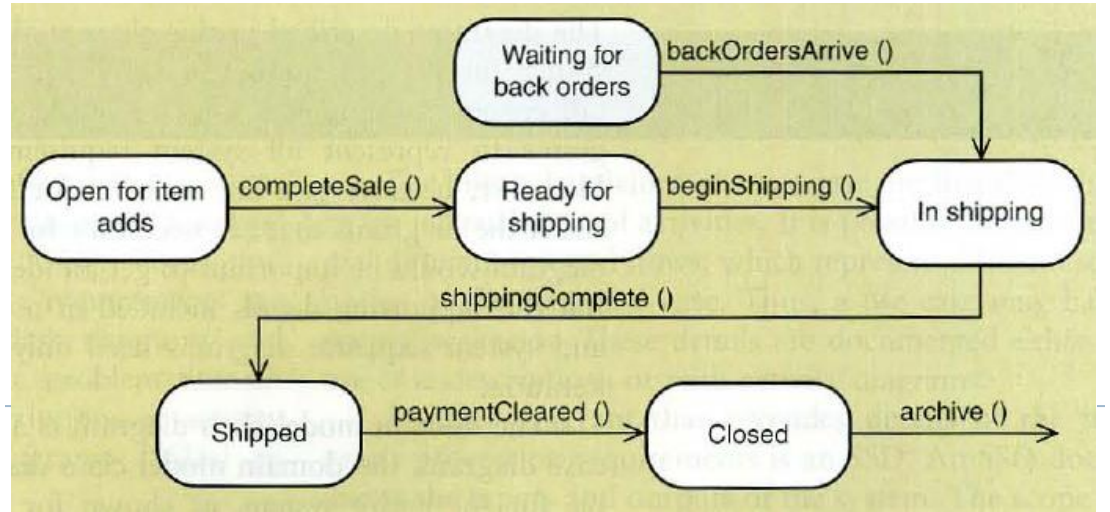


5.4 State Machine Diagram(5): Developing RMO state machine diagram

State and exit transition for Sale

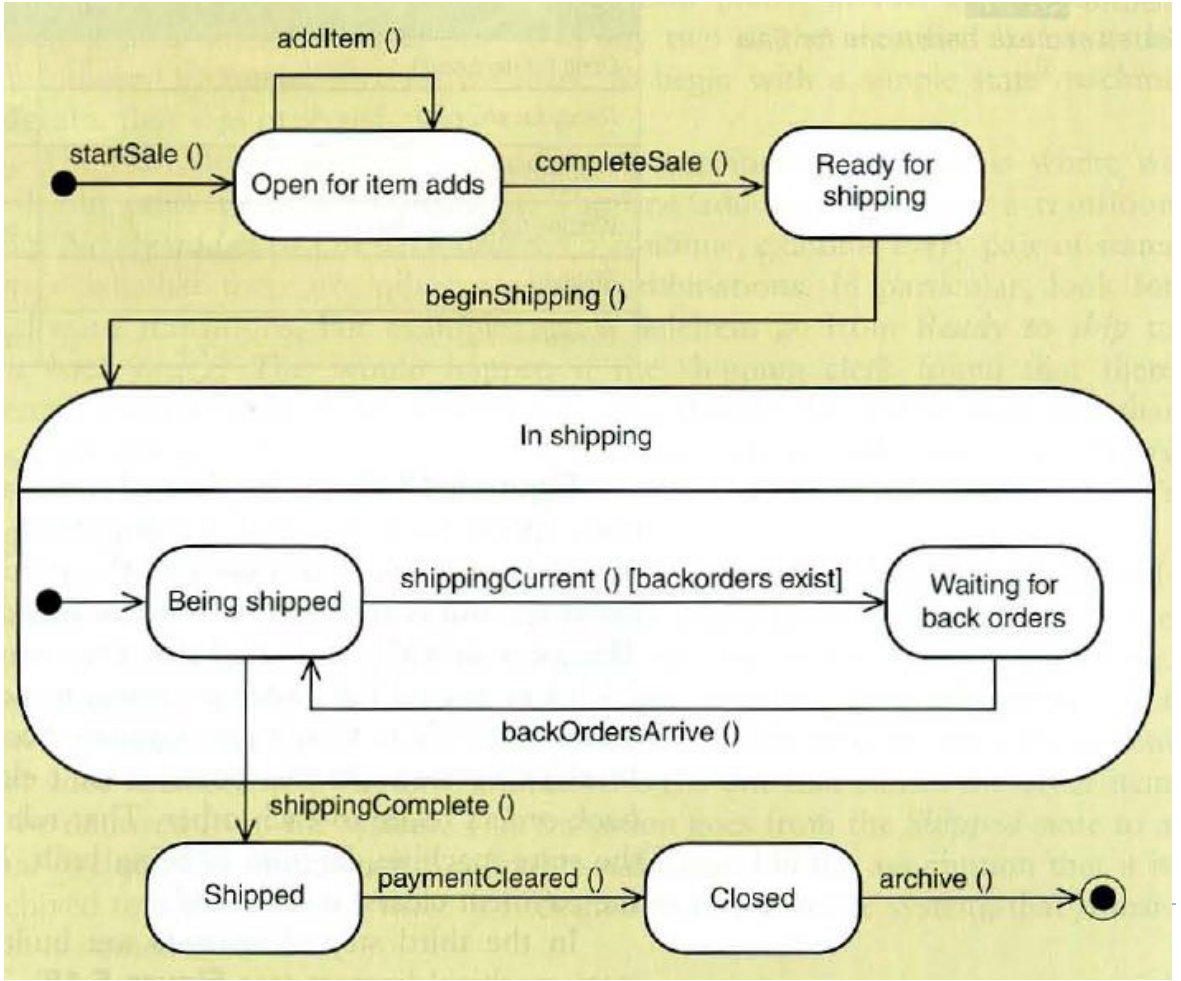
State	Exit transition
Open for item adds	completeSale
Ready for shipping	beginShipping
In shipping	shippingComplete
Waiting for back orders	backOrdersArrive
Shipped	paymentCleared
Closed	archive

First-cut state machine diagram for order

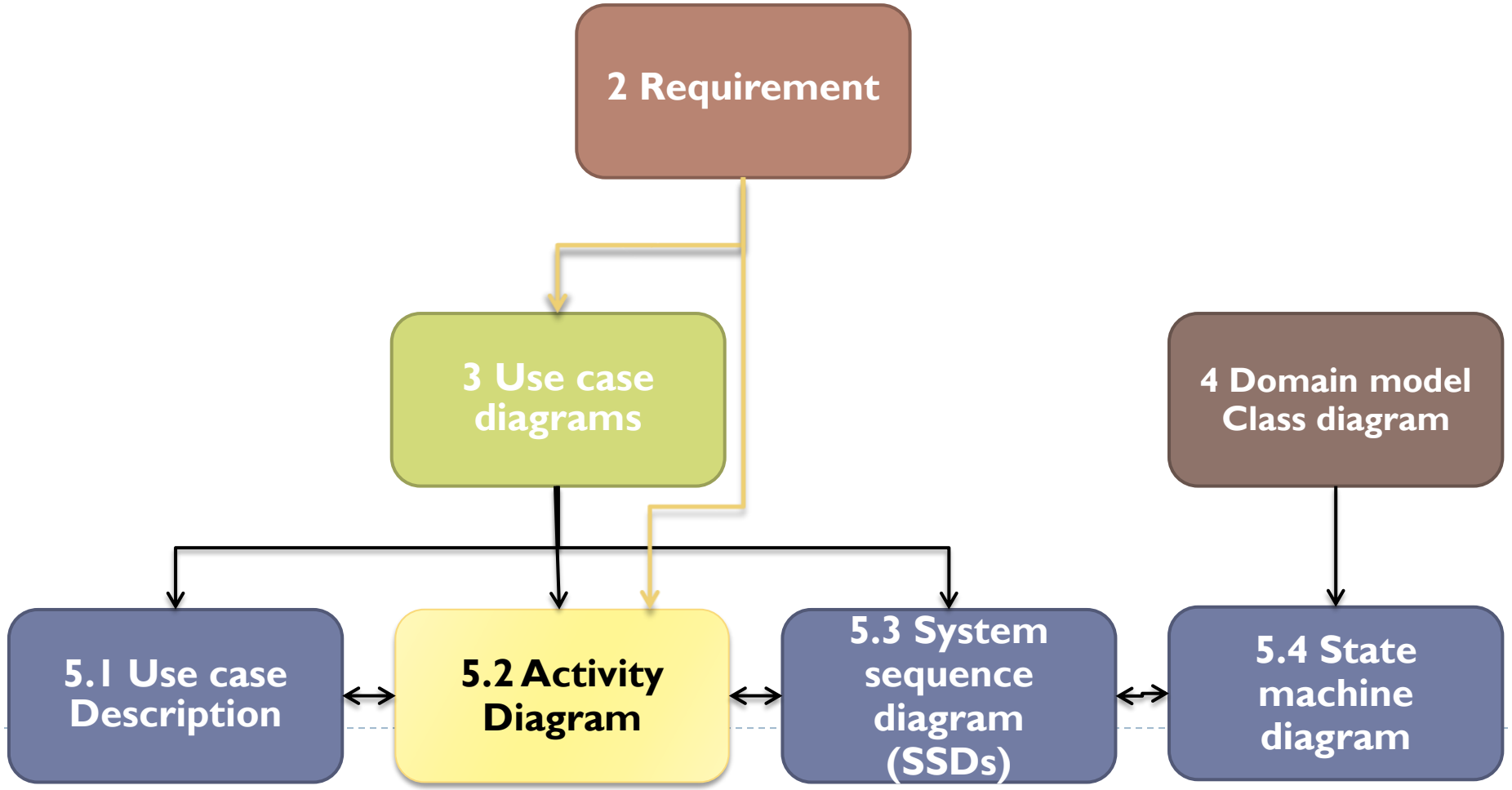


5.4 State Machine Diagram(5): Developing RMO state machine diagram

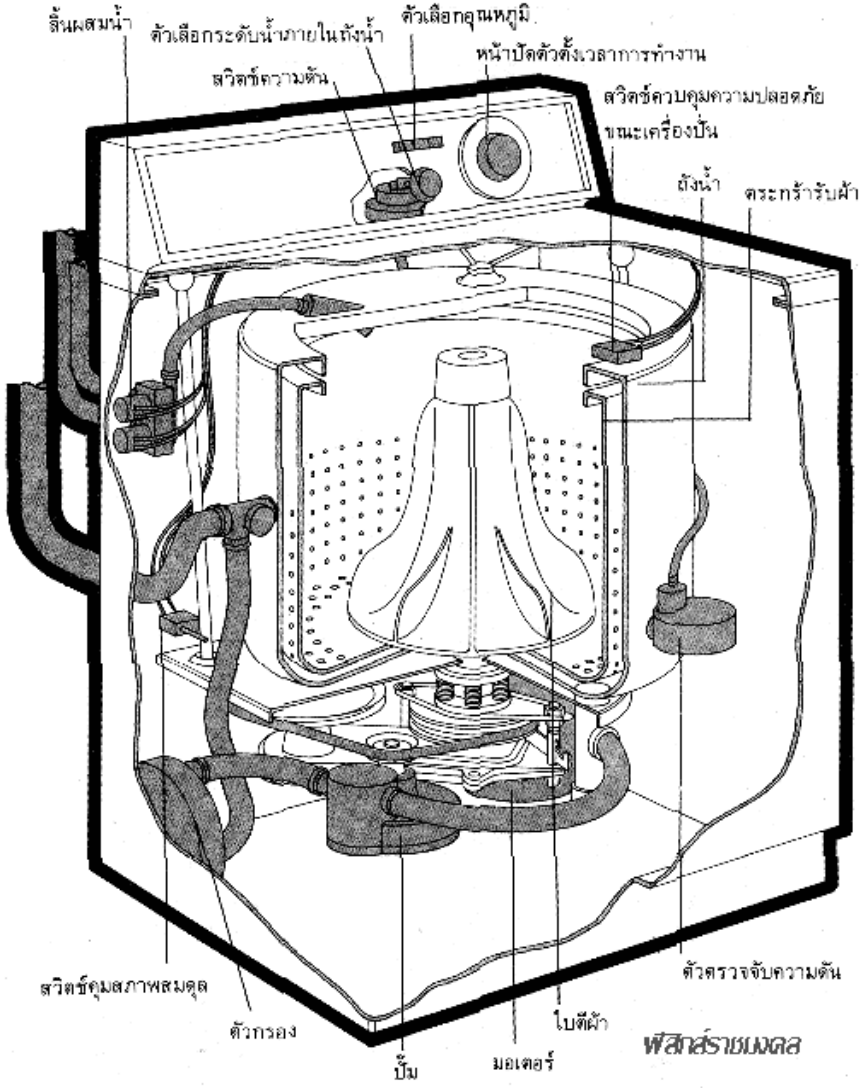
Second-cut state machine diagram for order



5.5 Integrating Requirement Models



Question:
Drawing state machine of washing machine:



รูปที่ 1 ลักษณะทั่วไปและส่วนประกอบภายในเครื่องซักผ้า

- The washing machine is designed having a start button. It is fully automatic, which user do not set the washing program.
- 10 Minutes for design and present

UML 2.0 Diagram Summary

- Behavioral diagram
  - Activity
  - Sequence
  - Use-case
  - State machine

- Structure diagram
  - Class
  - Object
  - Component
  - Composite structure

Summary

- Use case description
- Activity diagrams
- The System Sequence Diagram
- The State machine diagram