Chapter 5
Extending the requirement models

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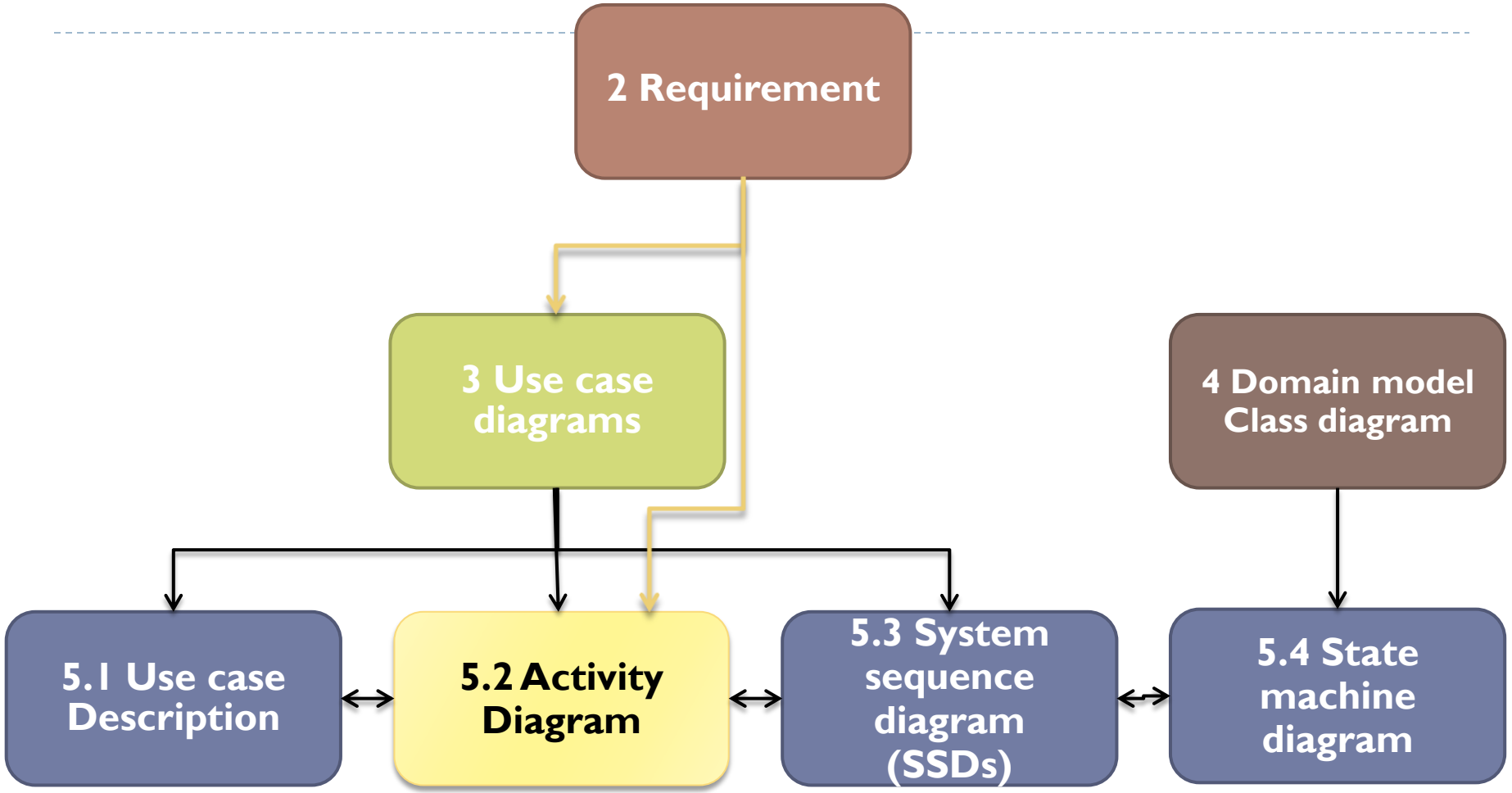
Topics

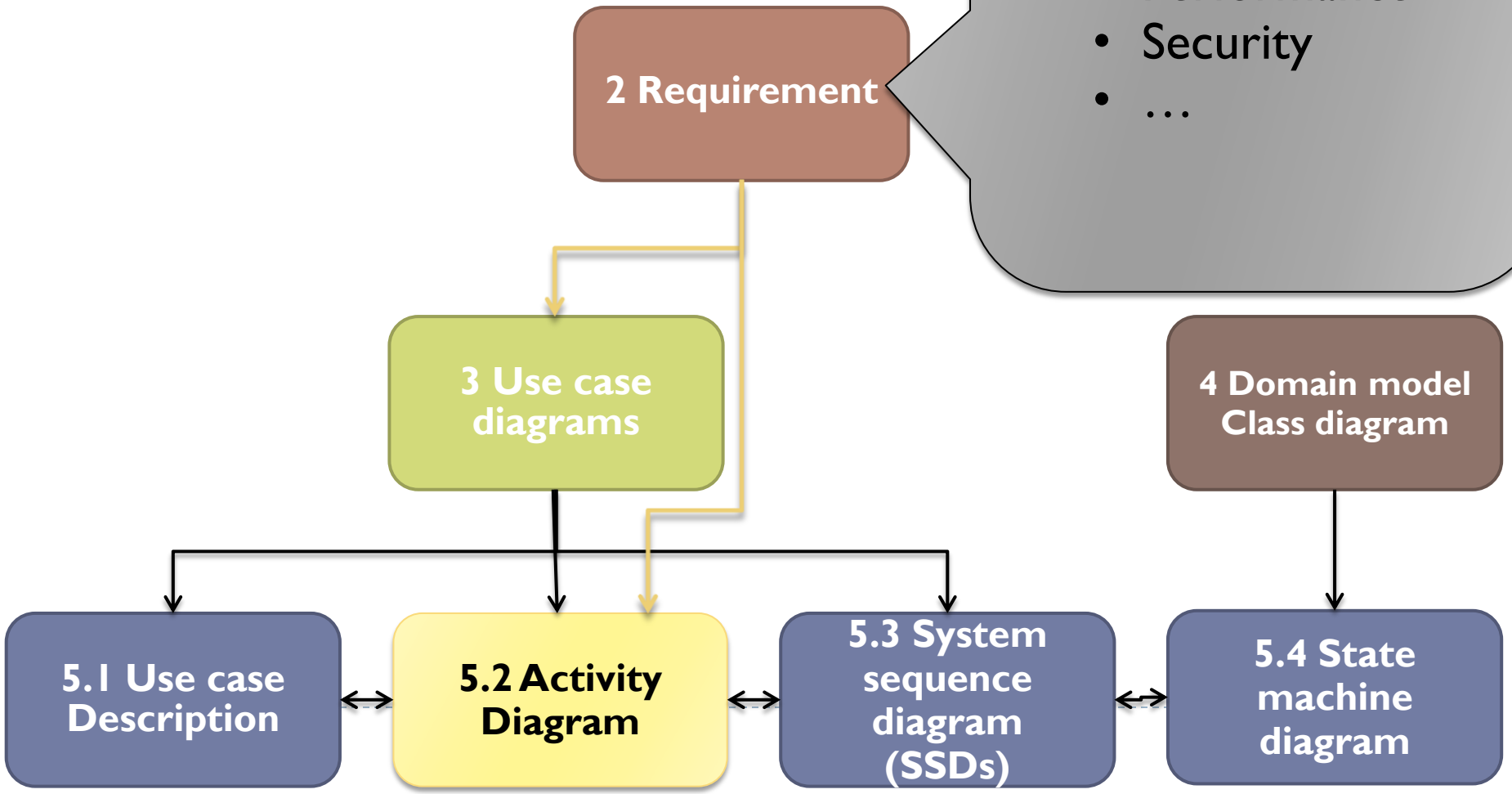
- Use case description
- Activity diagram for user cases
- The system sequence diagram
- The state machine diagram

Review2.0

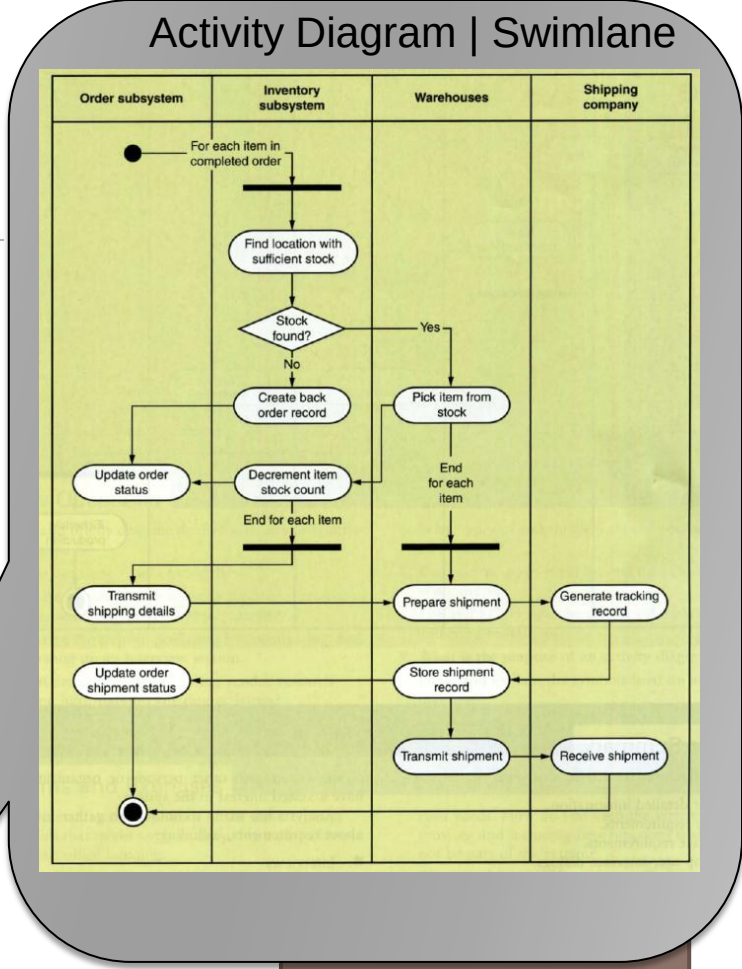

2 Requirement
3 Use case diagrams
4 Domain model Class diagram
5.1 Use case Description
5.2 Activity Diagram
5.3 System sequence diagram (SSDs)
5.4 State machine diagram

Review2.1

- Functional
- Nonfunctional
  - Usability
  - Reliability
  - Performance
  - Security
  - …



Review2.2



2 Requirement

3 Use case diagrams

Class diagram

5.1 Use case Description

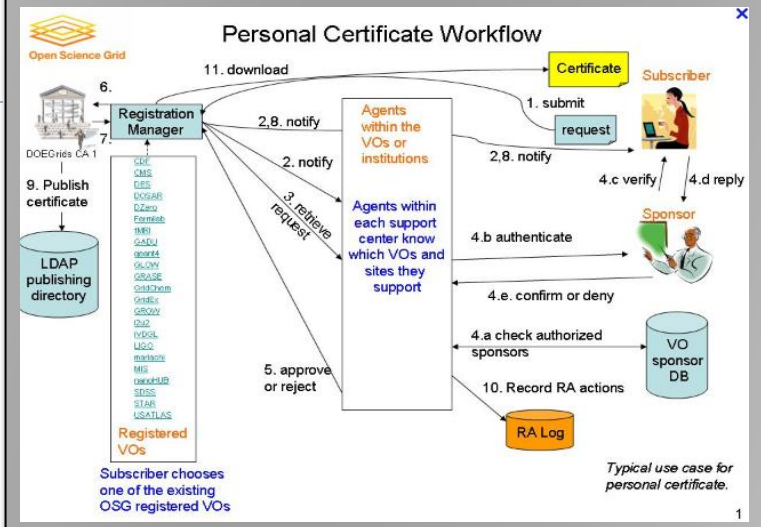
5.2 Activity Diagram

5.3 System sequence diagram (SSDs)

5.4 State machine diagram

Review2.3

Workflow



2 Requirement

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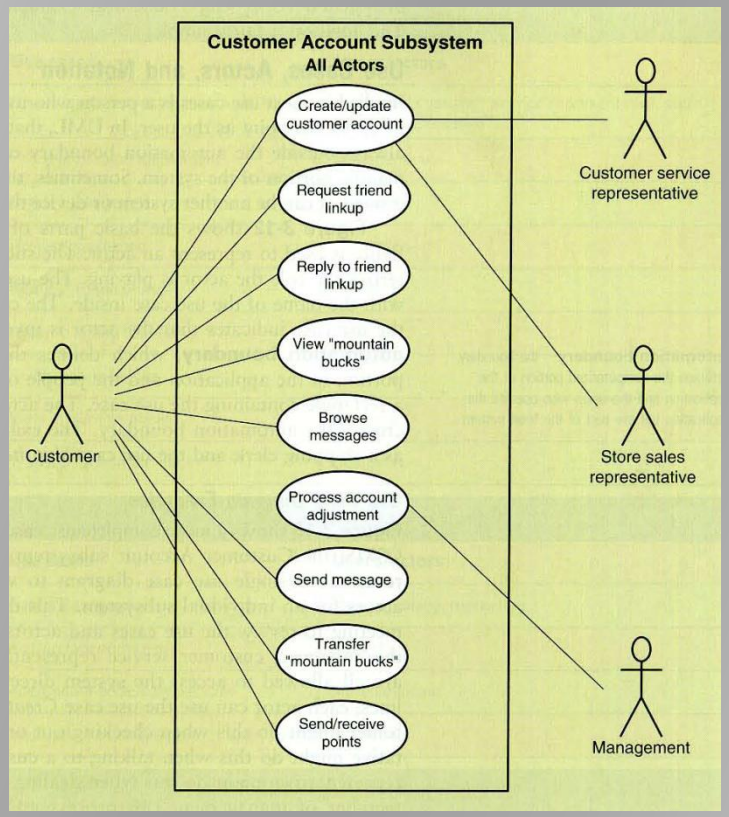
Review3.2



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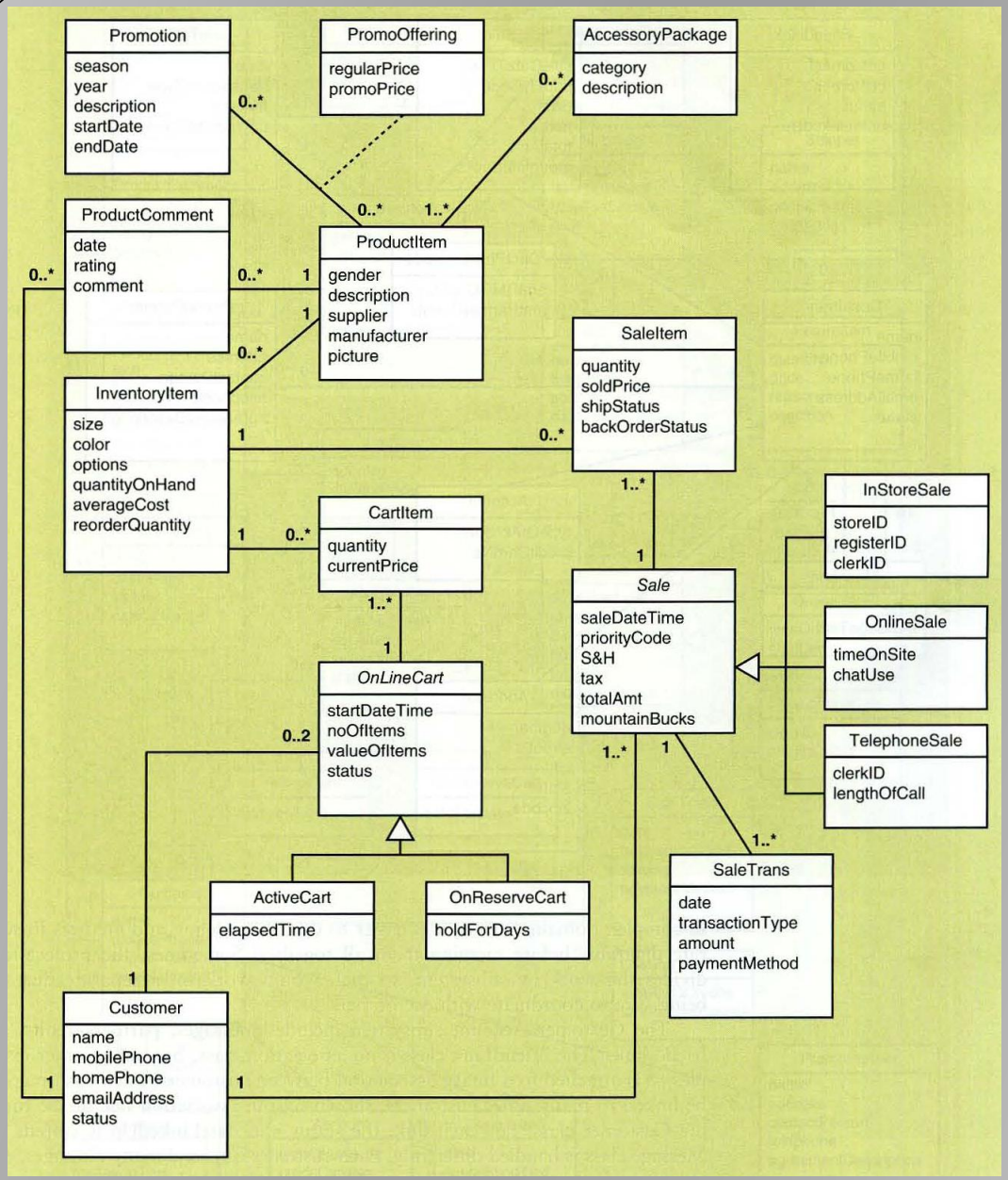

4 Domain model Class diagram

5.1 U… Descrip…

(SSDs)

5.4 State machine diagram

Review

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Scenario:	Create online customer account.	
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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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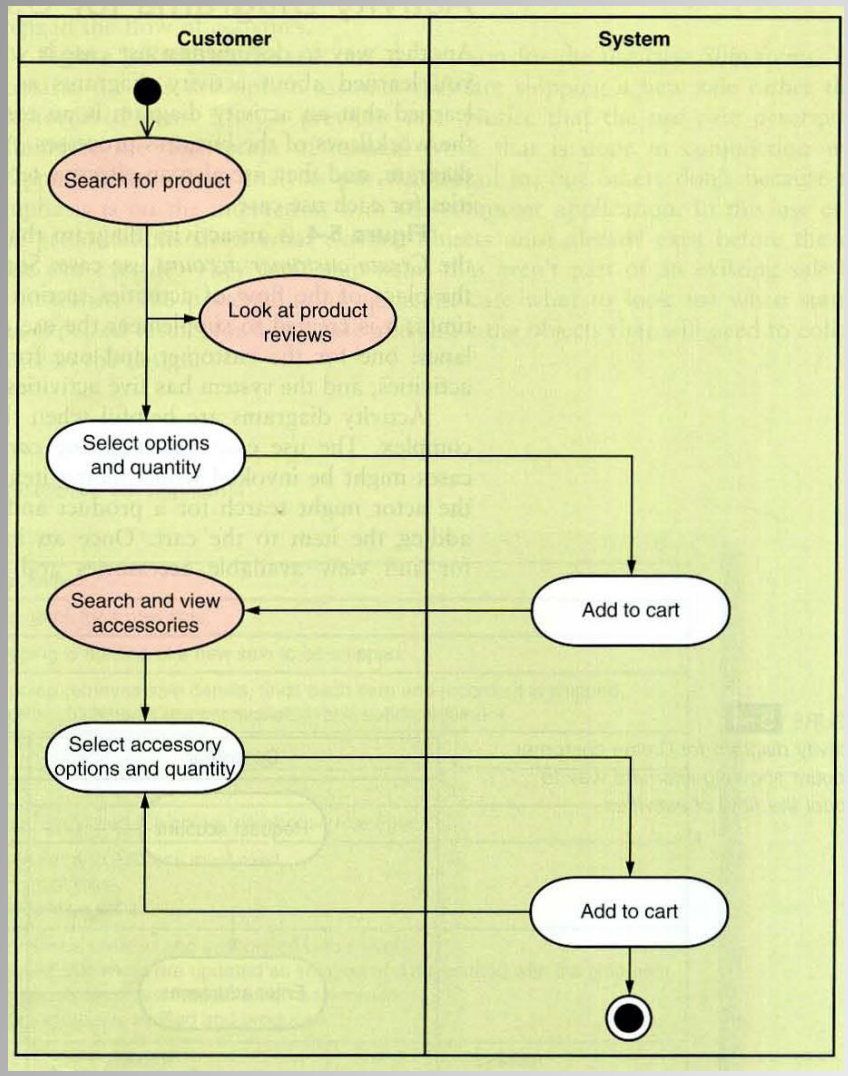
5.1 Use case Description ↔ **5.2 Activity Diagram** ↔ **5.3 System sequence diagram (SSDs)** ↔ **5.4 State machine diagram**

Review



Domain model
Class diagram

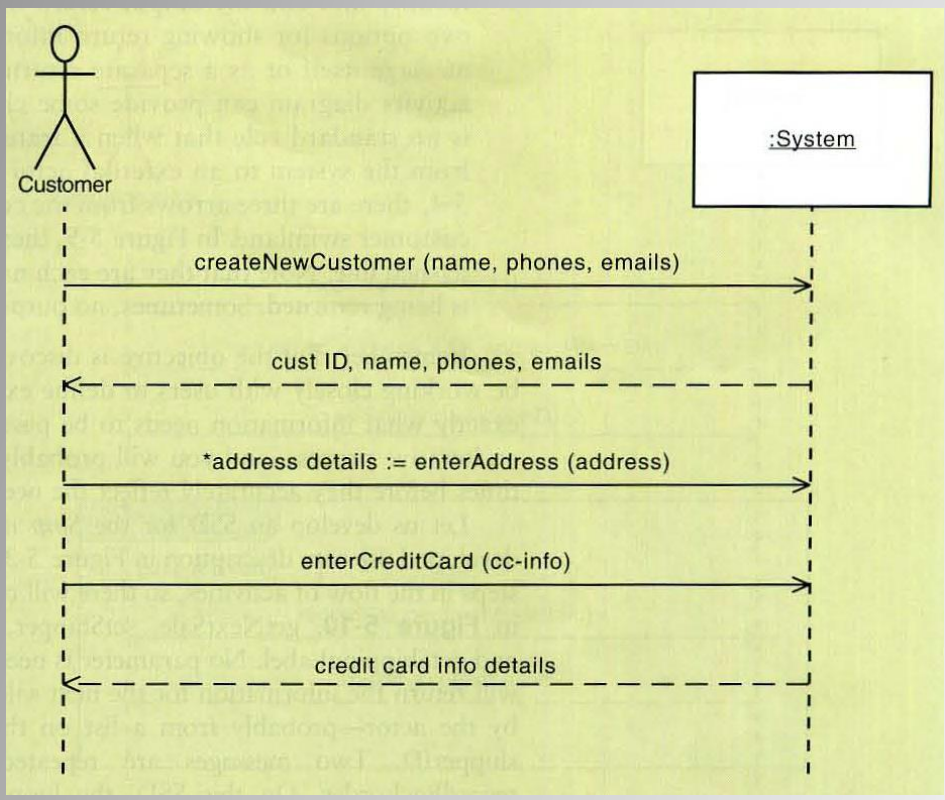
5.1 Use case Description

5.2 Activity Diagram

5.3 System sequence diagram (SSDs)

5.4 State machine diagram

Review



Domain model
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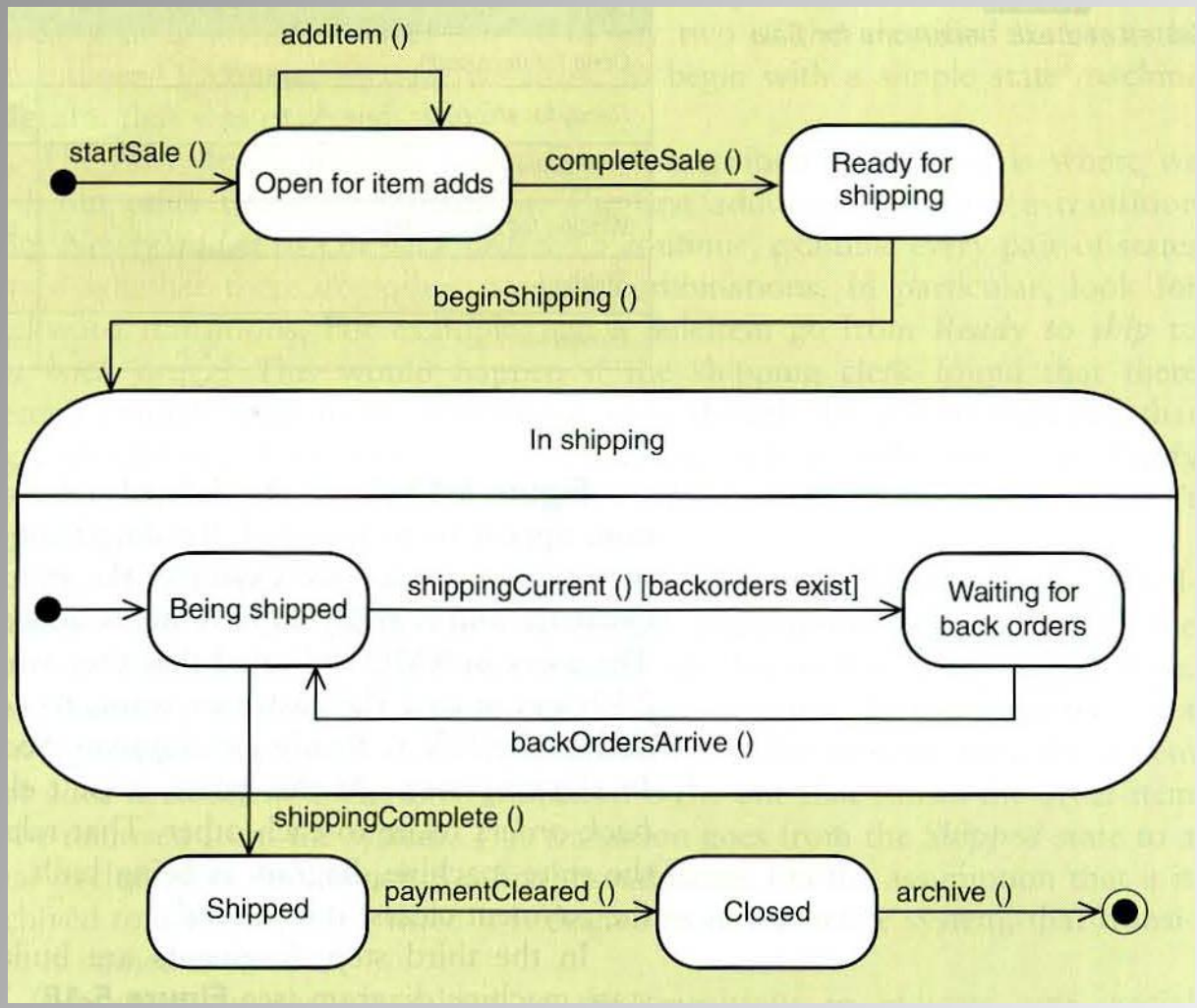
Review



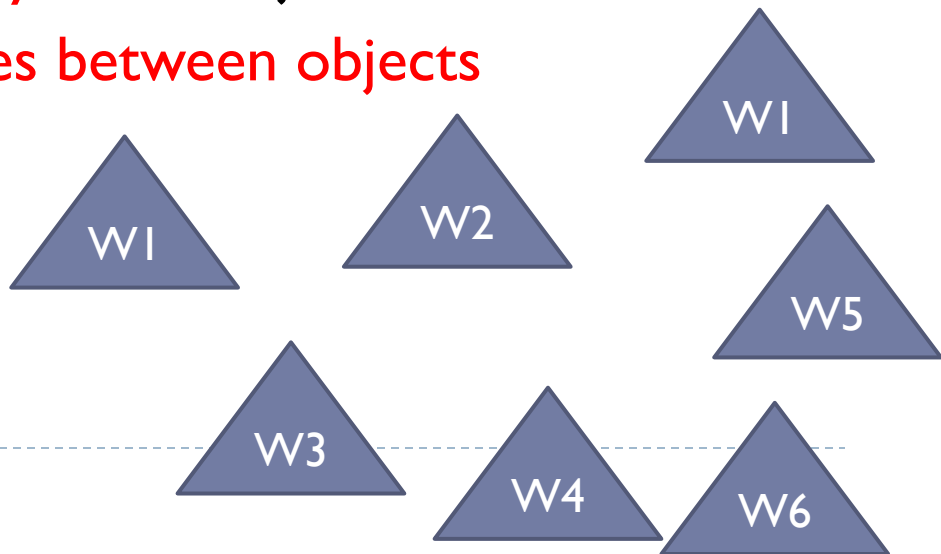
5.1 Use case Description ↔ **5.2 Activity Diagram** ↔ **5.3 System sequence diagram (SSDs)** ↔ **5.4 State machine diagram**

Objectives

- Write fully developed *use case description*
- Develop *activity diagram* to *model flow of activity*
- Develop *system sequence diagram*
- Develop *state machine diagram* to model object behavior
- Explain how use case description and UML diagram work together to define functional requirement

Company story: Electronics Unlimited Company

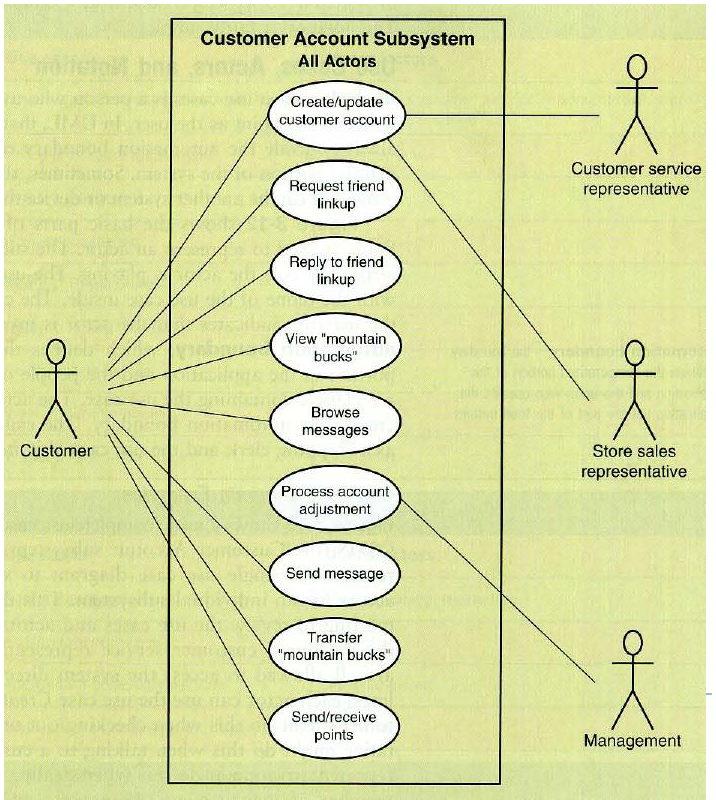
- Electronic Unlimited Company
  - Representative sells electronics equipment
  - Sell location United States and Canada
  - Warehouse locates on 6 cities
  - Develops an *integrated* supply chain system
    - *Object-oriented technique* links between *system-to-system*
    - A purchase order and employees as object
    - Activity (Sell) as the messages between objects



5.1 Use case descriptions

5.1 Use case description

- Use case description is lists and describes the processing details for a uses case.
- Brief use case description
  - An analyst takes note
  - Uses in small systems



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.

5.1. uses case description (2)

- Fully uses case description
  - Formal method for documenting a use case
  - Deep understanding of the user's need.
  - Increasing you understand the user's need.

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.	

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Use case name:	*Create customer account.*	
Scenario:	Create online customer account.	
Triggering event:	New custom… …account online.	
Brief description:	Onl… and…	
Actors:	Cus…	
Related use cases:	Mig…	
Stakeholders:	Acc…	
Preconditions:	Cus… Cre…	
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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1. The use case name

2. The scenario

Use case name:	*Create customer account.*	
Scenario:	Create online customer account.	
Triggering event:	New customer wants to set up account online.	
Brief description:	Cu…tomer creates customer account by entering basic information and then …ith one or more addresses and a credit or debit card.	
Actors:	C…	
Related use cases:	M…	
Stakeholders:	A…	
Preconditions:	C… C…	
Postconditions:	C… C… C… 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.
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3. The event identifies the triggers to the use case

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:	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.
	2. Customer enters one or more addresses.	2.1 System creates addresses. 2.2 System prompts for credit/debit card.
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4. The brief description is simple description of use case

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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:	Customer.	
Related use cases:	Might b	
Stakeholders:		
Preconditions:	Cust Credit/d	
Postconditions:	Custom One or Credit/d Accoun Address and Account must be associated with Customer.	
Flow of activities:	**Actor**	**System**
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5. Actors

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:	Accoun
Preconditions:	
Postconditions:	Custom One or Credit/ Accoun Addres
Flow of activities:	

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.
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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.

6. Related use cases, <<includes>>

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Actors:	Customer.
Related use cases:	Might be invoked by the *Check out shopping cart* use case.
Stakeholders:	Accounting, Marketing, Sales.
Preconditions:	Cust
Postconditions:	Cu One Cred Acco Addr
Flow of activities:	

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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7. Stakeholders

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Stakeholders:	Accounting, Marketing, Sales.
Preconditions:	Customer account subsystem must be available. Credit/debit authorization services must be available.
Postcondition	Cust One A Addr
Flow of activities:	1. Cu cre en 2. Customer enters one or more addresses. 3. Customer enters credit/debit card information.
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8. Precondition is condition or state that must be true before the use case begin.

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9. Post condition is conditions or states that must be true upon the successful completion of a use case.

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9. Flow of activity

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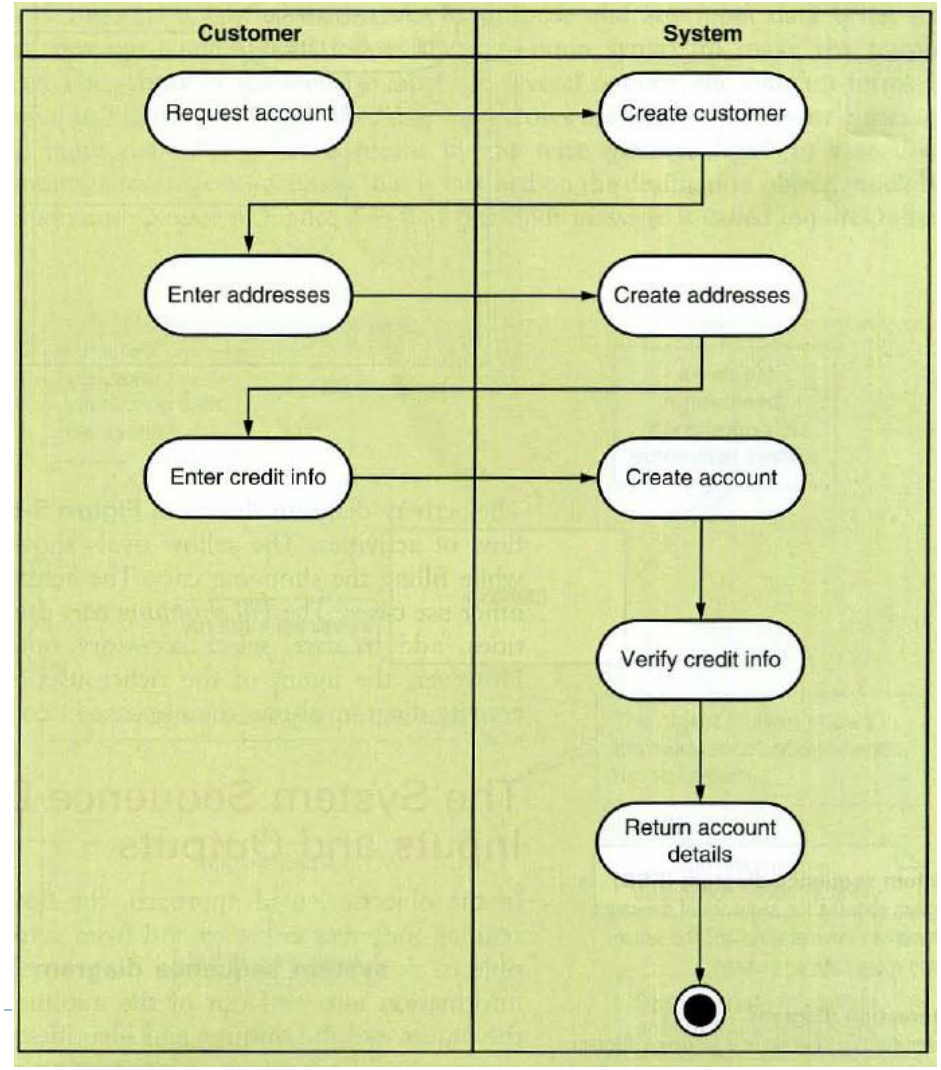
Actors:	Customer.
Related use cases:	Might
Stakeholders:	Accou
Preconditions:	Custo Credit
Postconditions:	Custo One o Credit Accou Address and Account
Flow of activities:	**Actor** / **System** 1. Customer indicat … create custome … enters basic … n. — 1.1 System creates a new customer. 1.2 System prompts for customer addresses. 2. Custome … ore address … — 2.1 System creates addresses. 2.2 System prompts for credit/debit card. 3. C … nters credit/debit card … on. — 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.

10. Exception condition

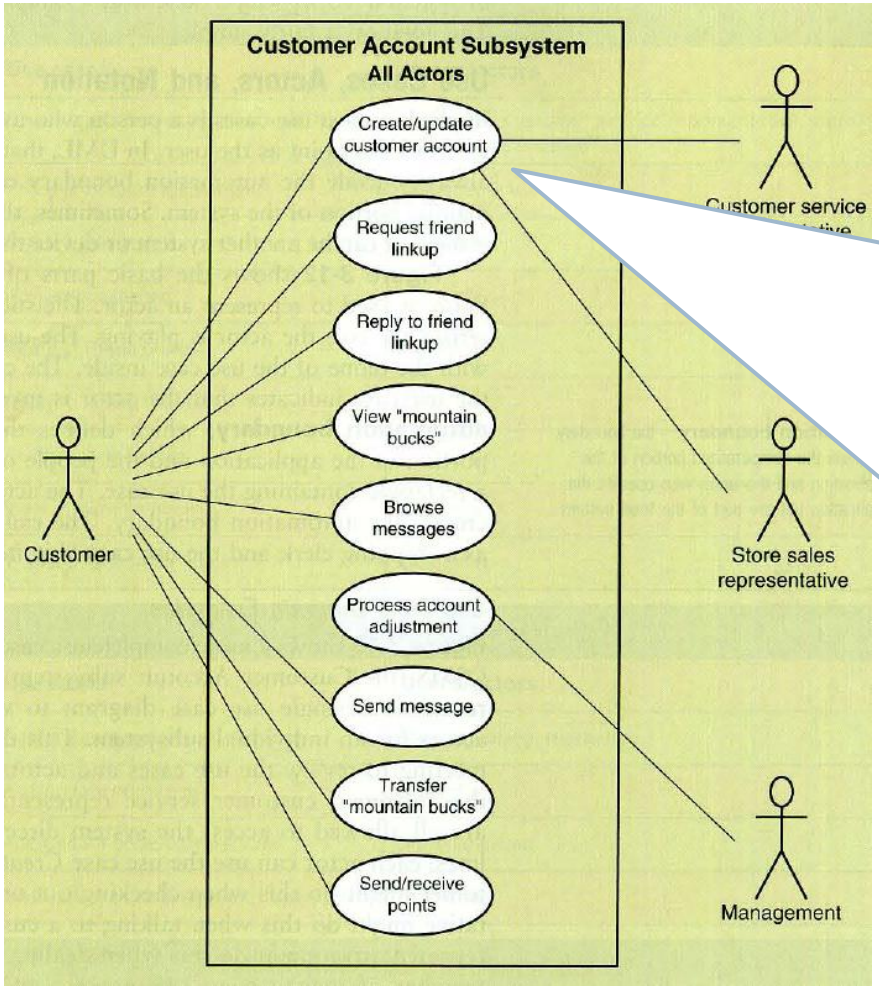
5.2 Activity diagram for use cases

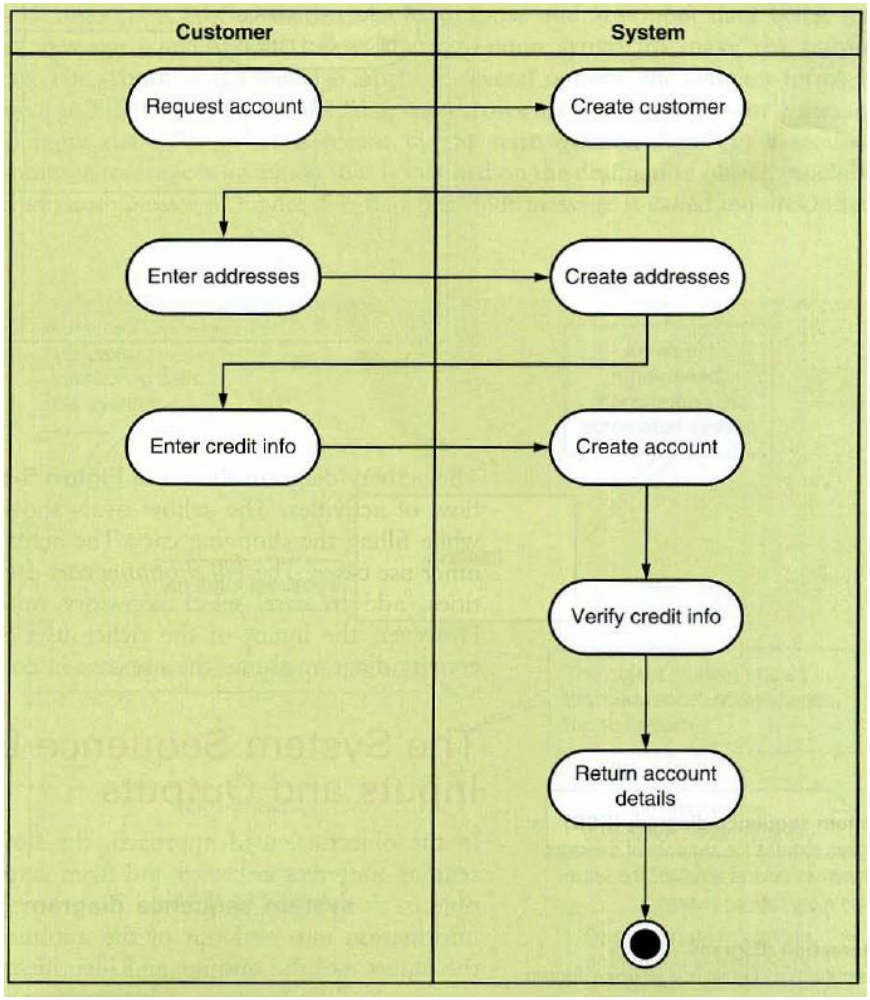
5.2 Activity diagram

- Activity diagram
  - The flow of business process similar as workflow.
  - a standard UML diagram
  - An effective technique describes the flow of activity in each use case.

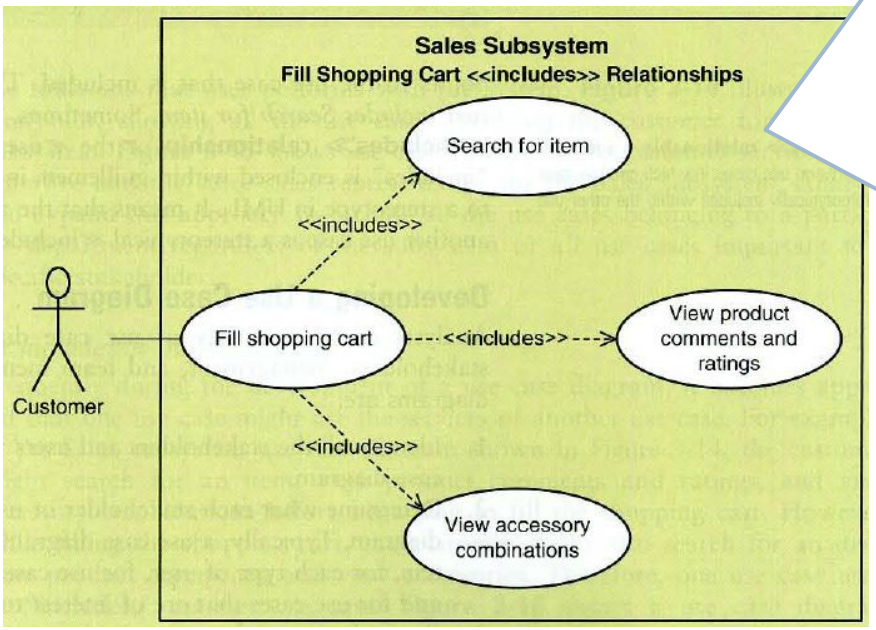


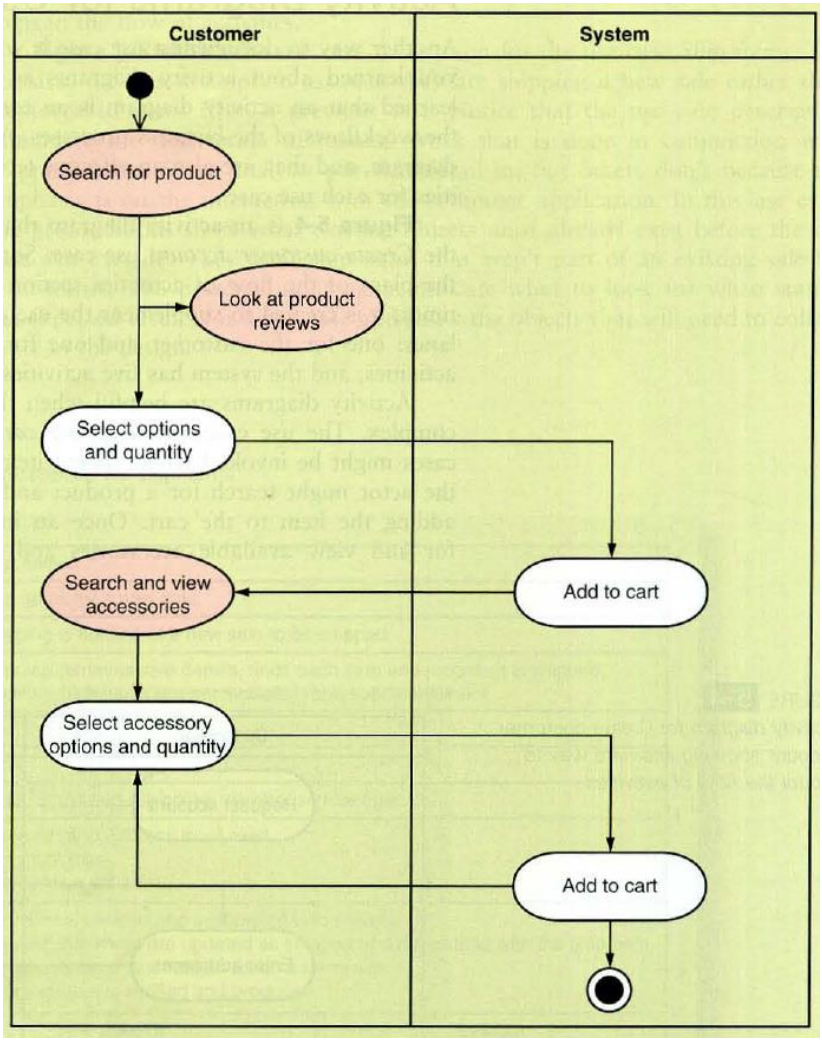
5.2 Activity diagram (2)





5.2 Activity diagram (3)

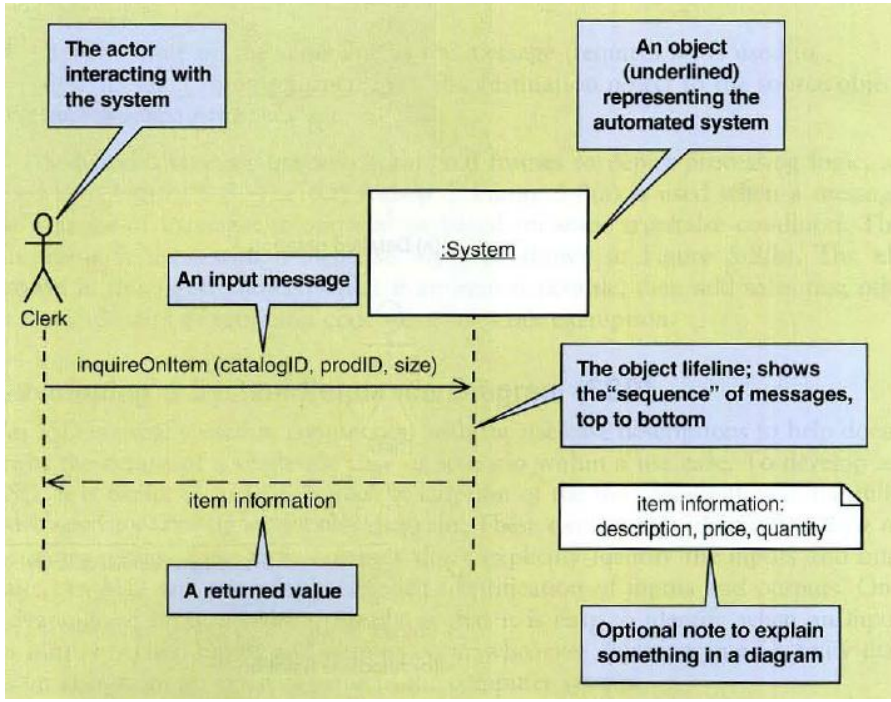




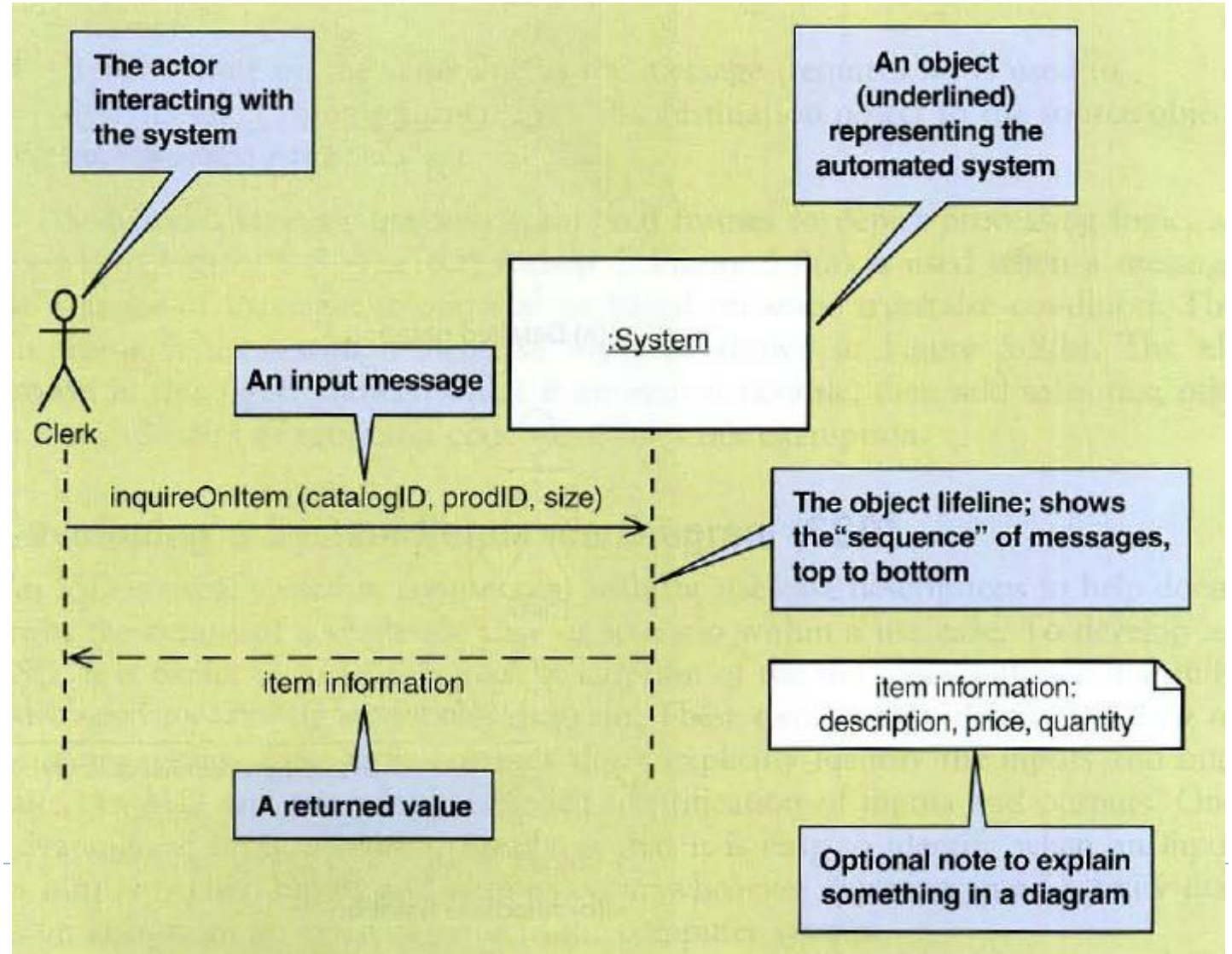
5.3 The system sequence diagram – Identifying inputs and outputs

5.3 SSD Indentifying I/O

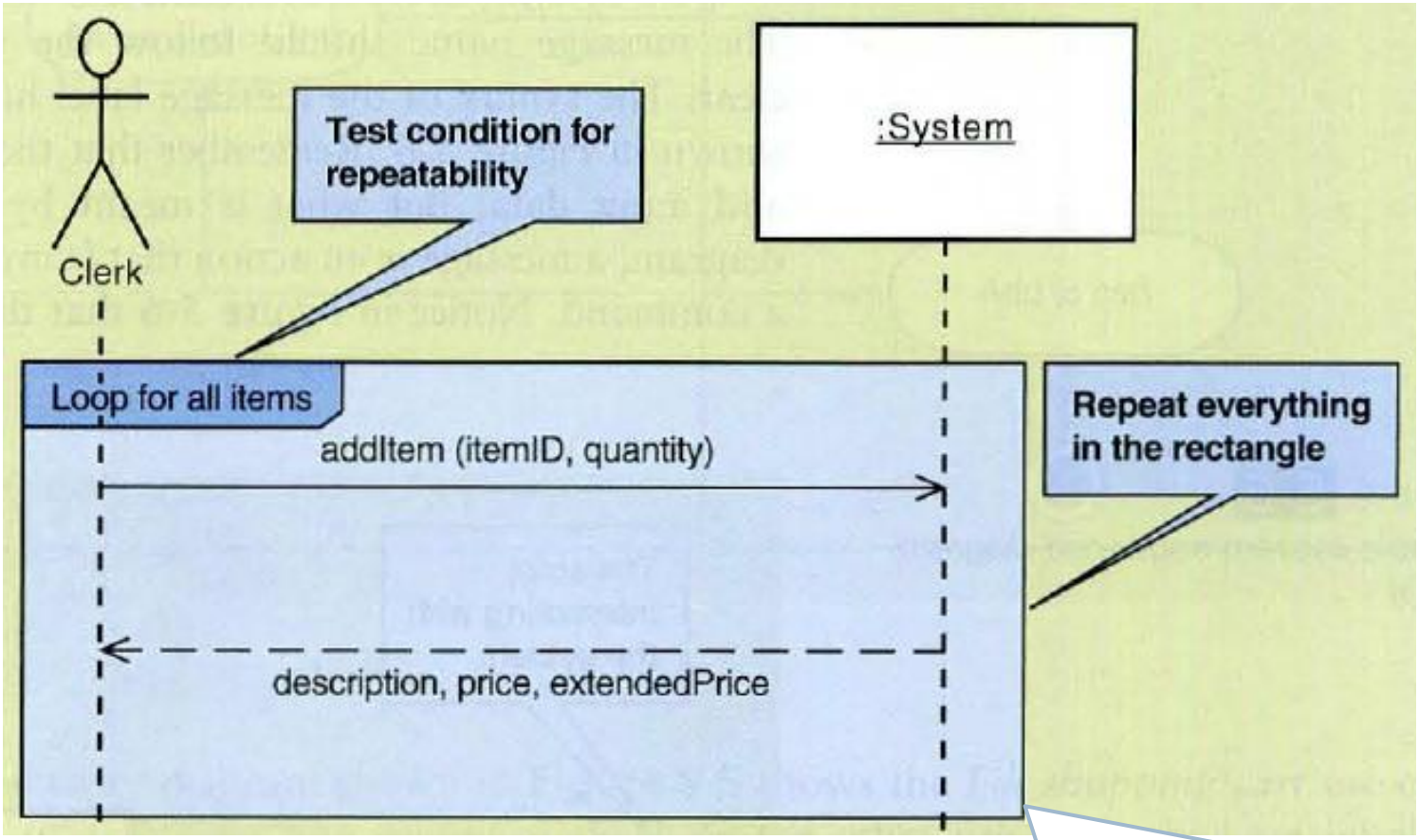
- System Sequence Diagram (SSD)
  - Uses to describe the flow of information into and out of the automatic system.
  - Show the sequence message inform diagram between an external actor and the system.
  - SSD is type of **Interaction diagram**



5.3 SSD Indentifying I/O (2)

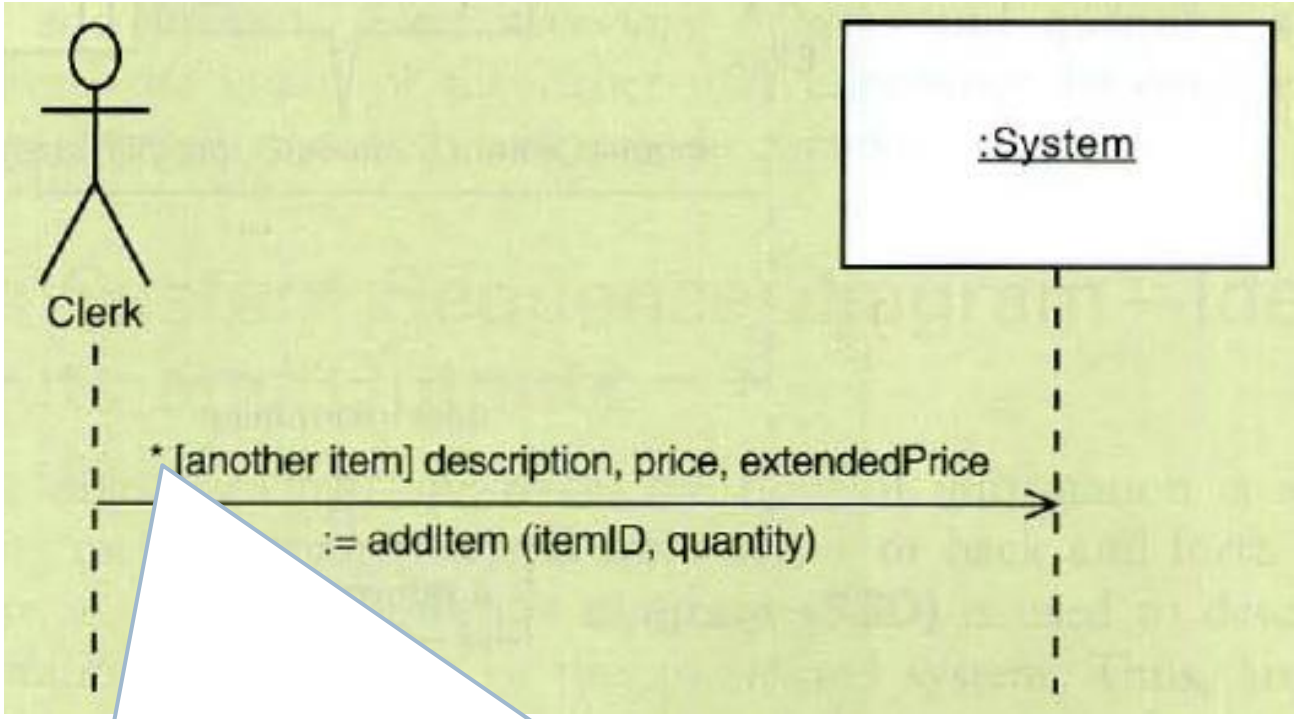


5.3 SSD Indentifying I/O (3): loop frame



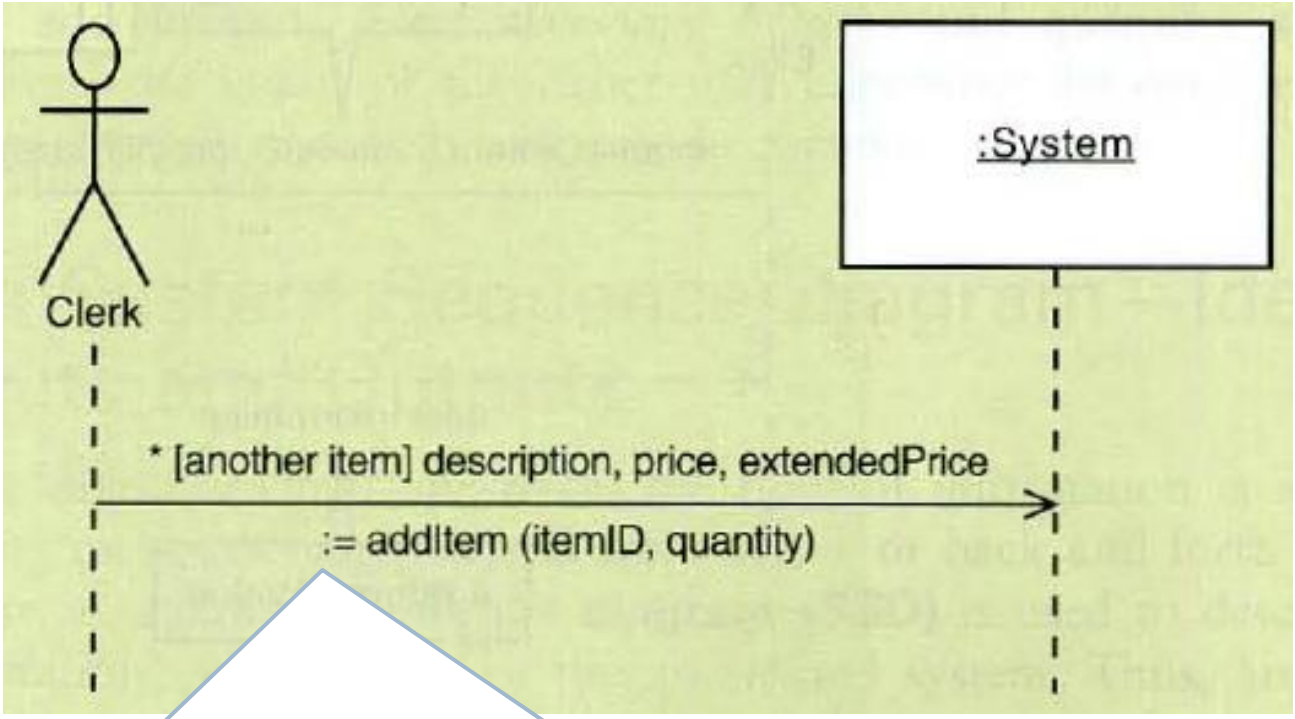
Loop frame is the repeating operation sending multiple time between actor and system

5.3 SSD Indentifying I/O (4): True/false condition



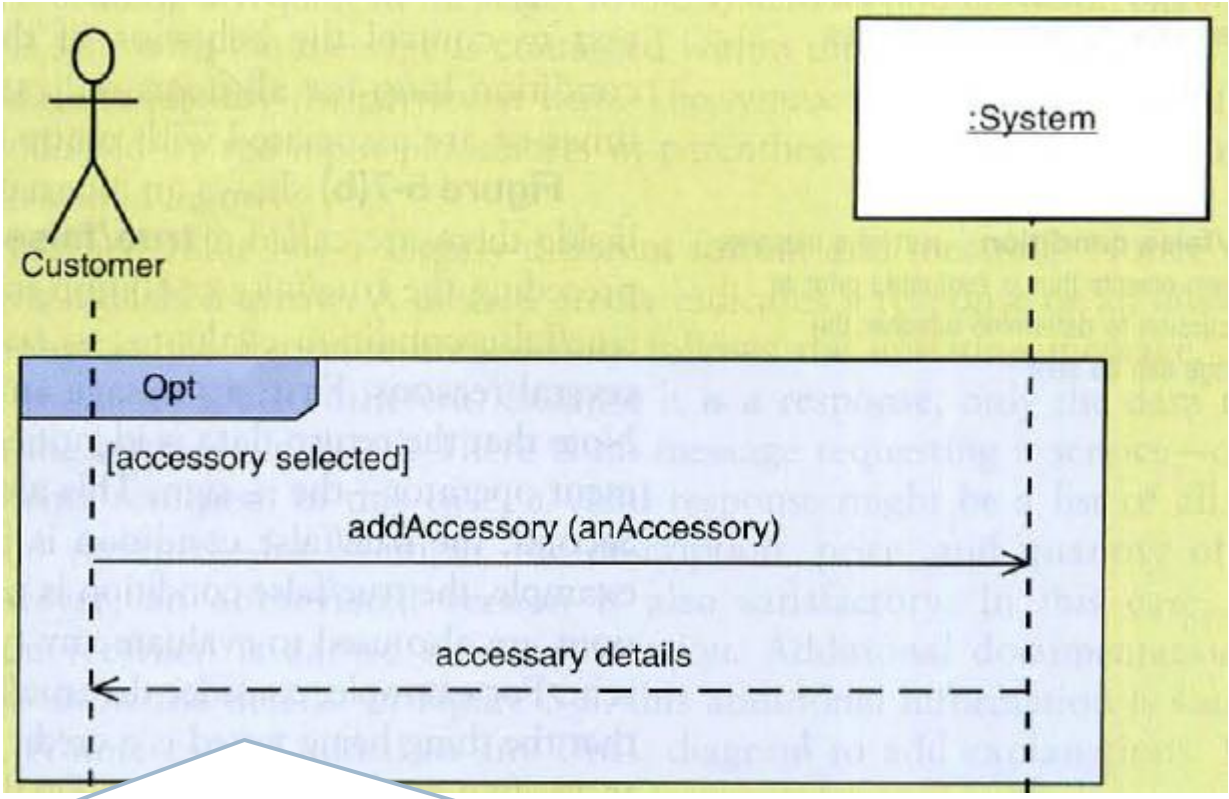
A true /false condition shown in "*" indicates that the message repeats as long as the condition change to true.

5.3 SSD Indentifying I/O (4): True/false condition



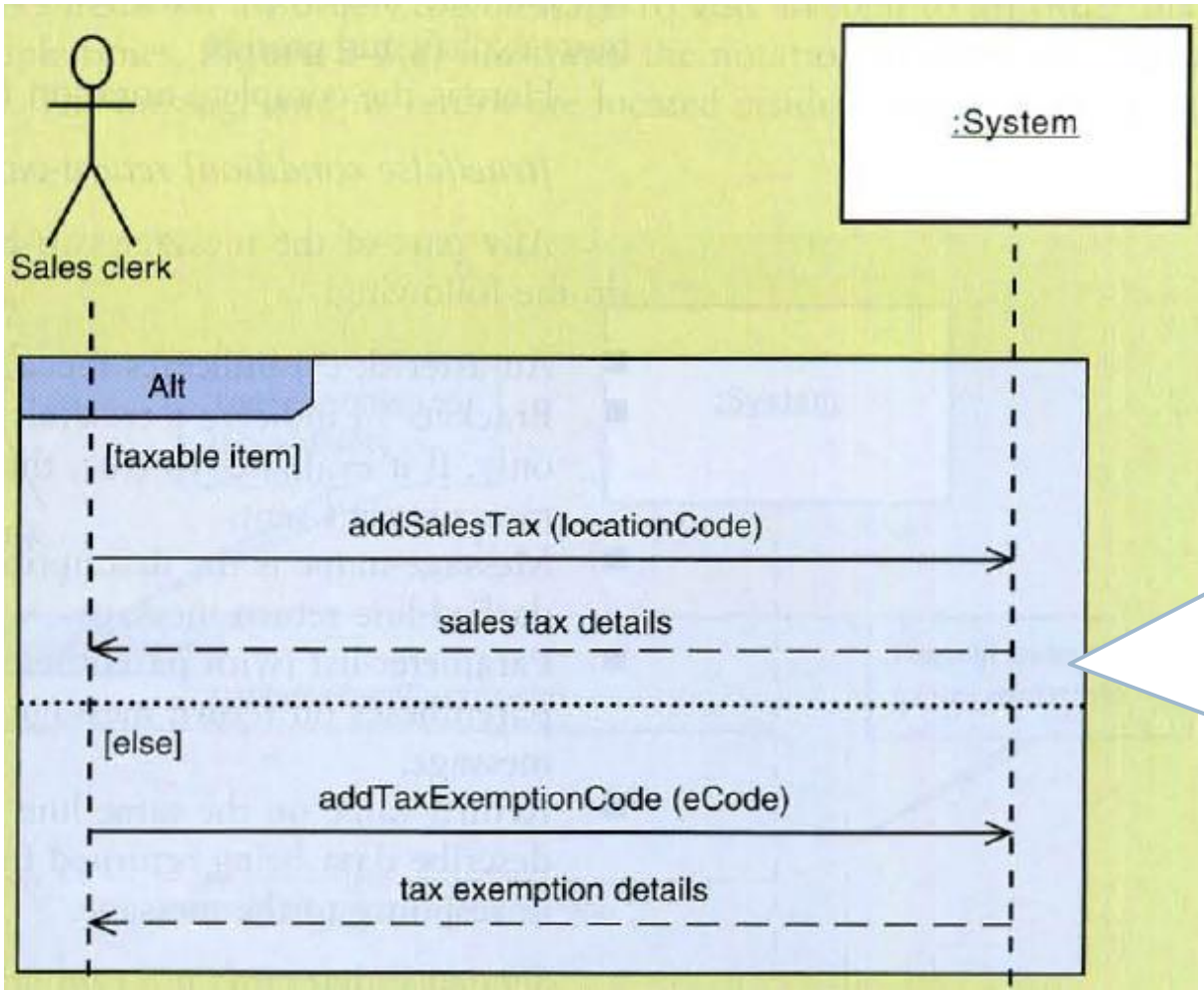
[true/false condition] return-value := *message-name(parameter-lists)*

5.3 SSD Indentifying I/O (5): Opt frame

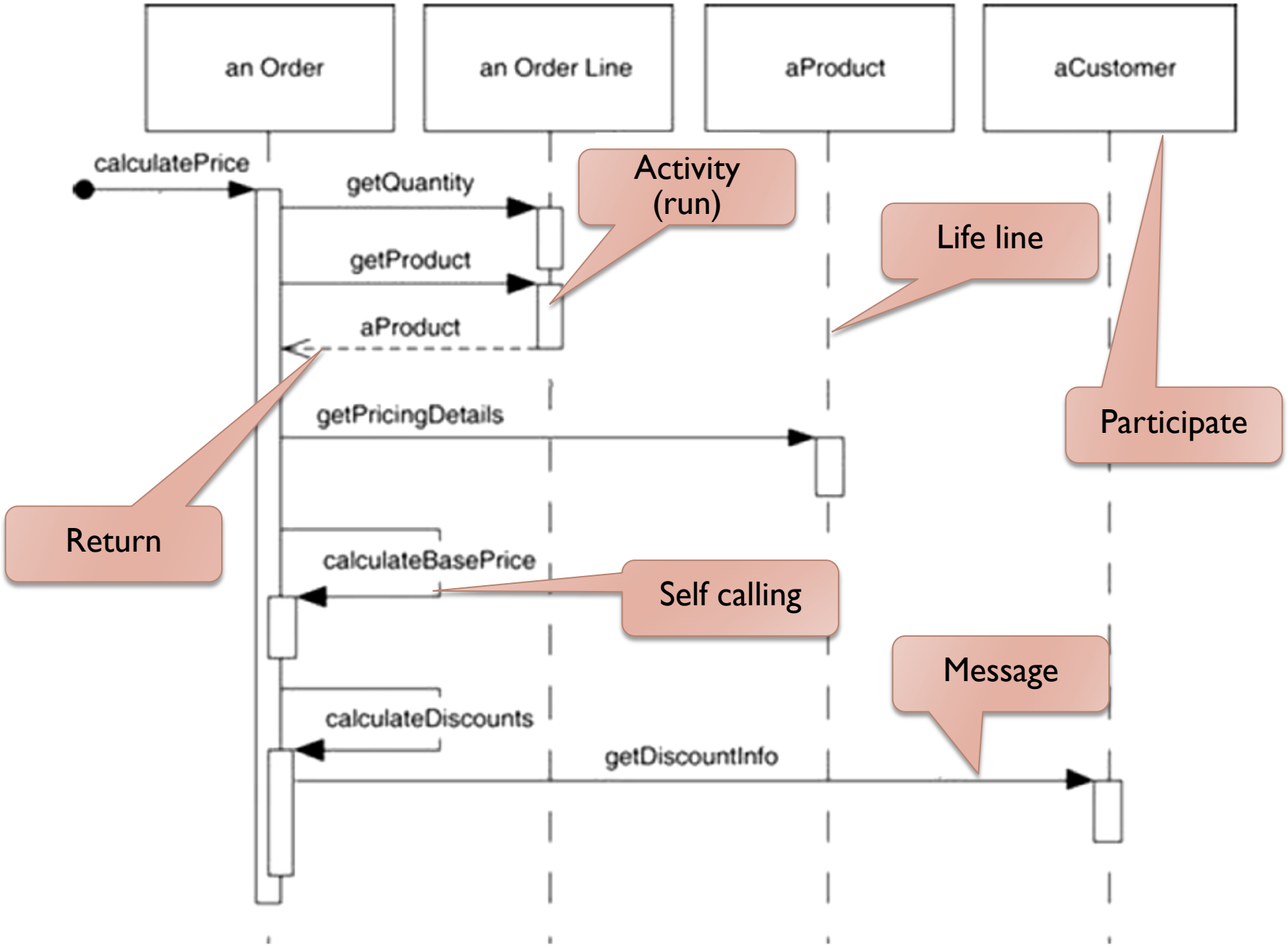


Opt frame is notation on a sequence diagram showing option message.

5.3 SSD Indentifying I/O (5): Alt frame

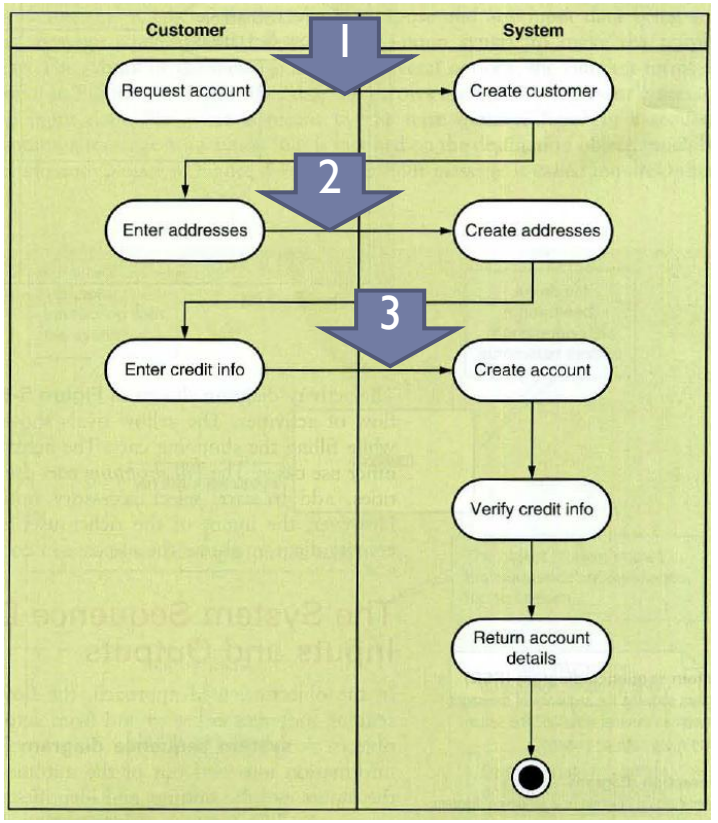


Alt frame is notation on a sequence diagram showing if-then-else logic


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

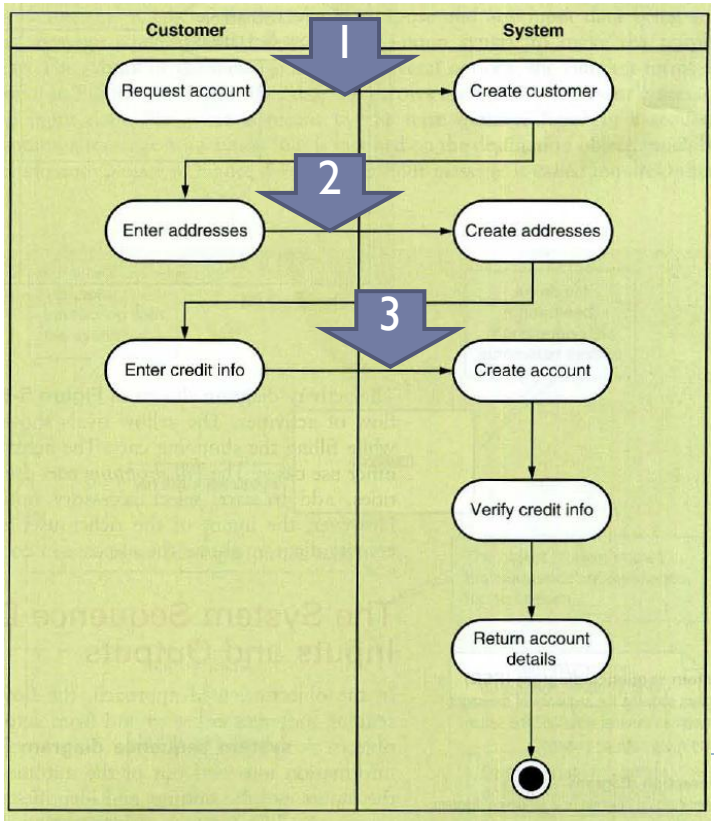
5.3 SSD Indentifying I/O (6): Develop a SSD

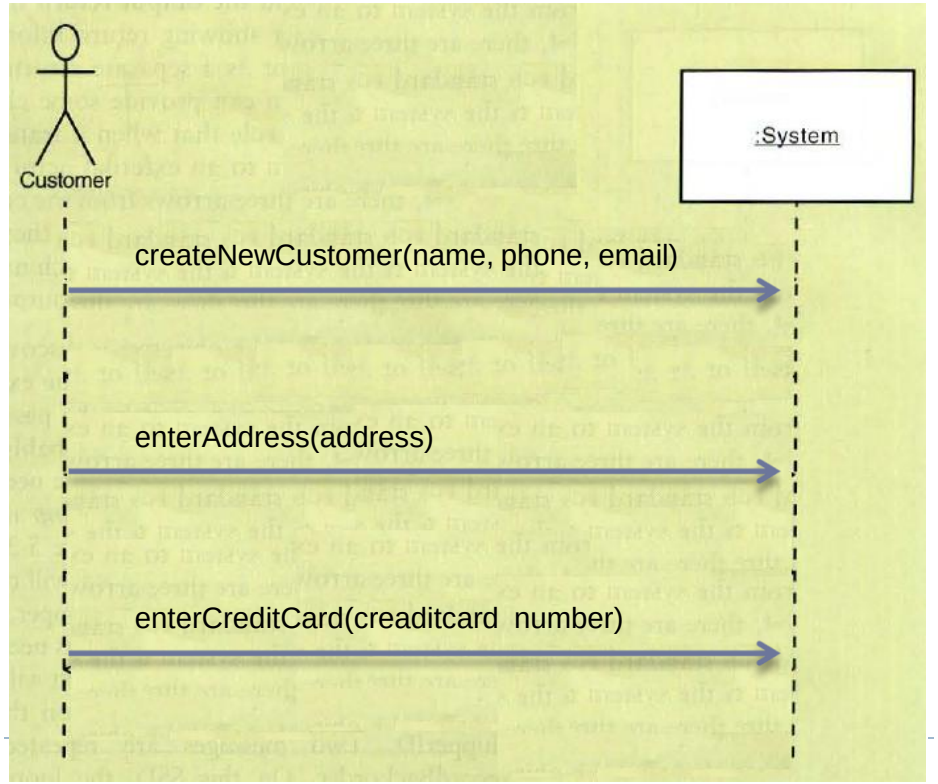
- Step of develop SSD based on an activity diagram
  1. Identify the input message, An example has three inputs.
  2. Describe the message from the external actor to the system by using the message notation describe earlier.



5.3 SSD Indentifying I/O (6): Develop a SSD

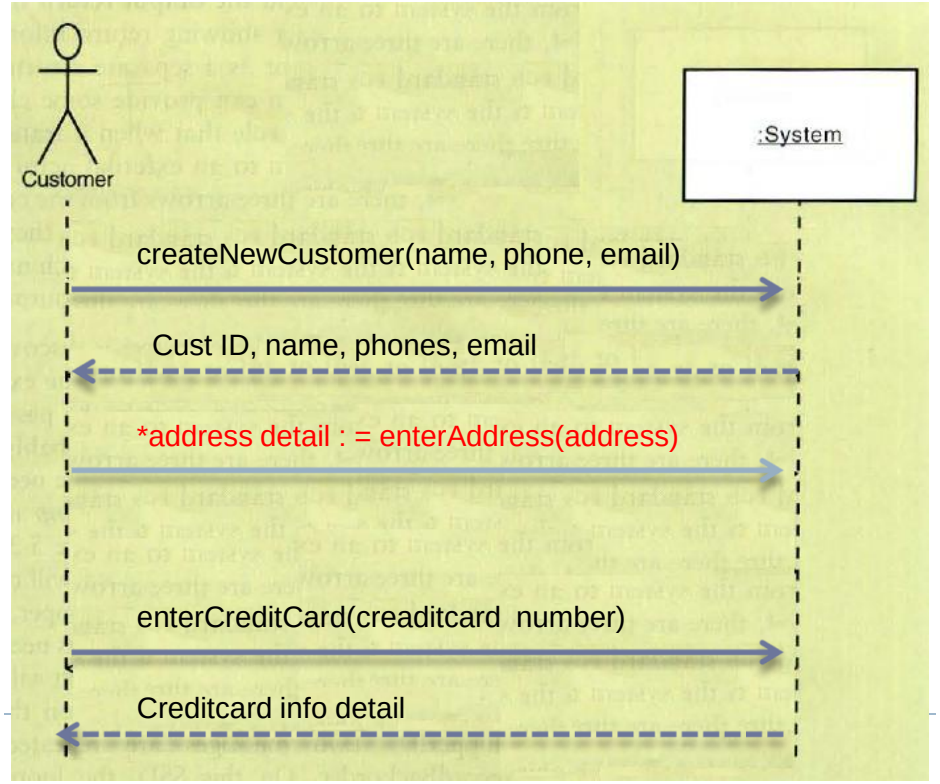
2. Describe the message from the external actor to the system by using the message notation describe earlier.



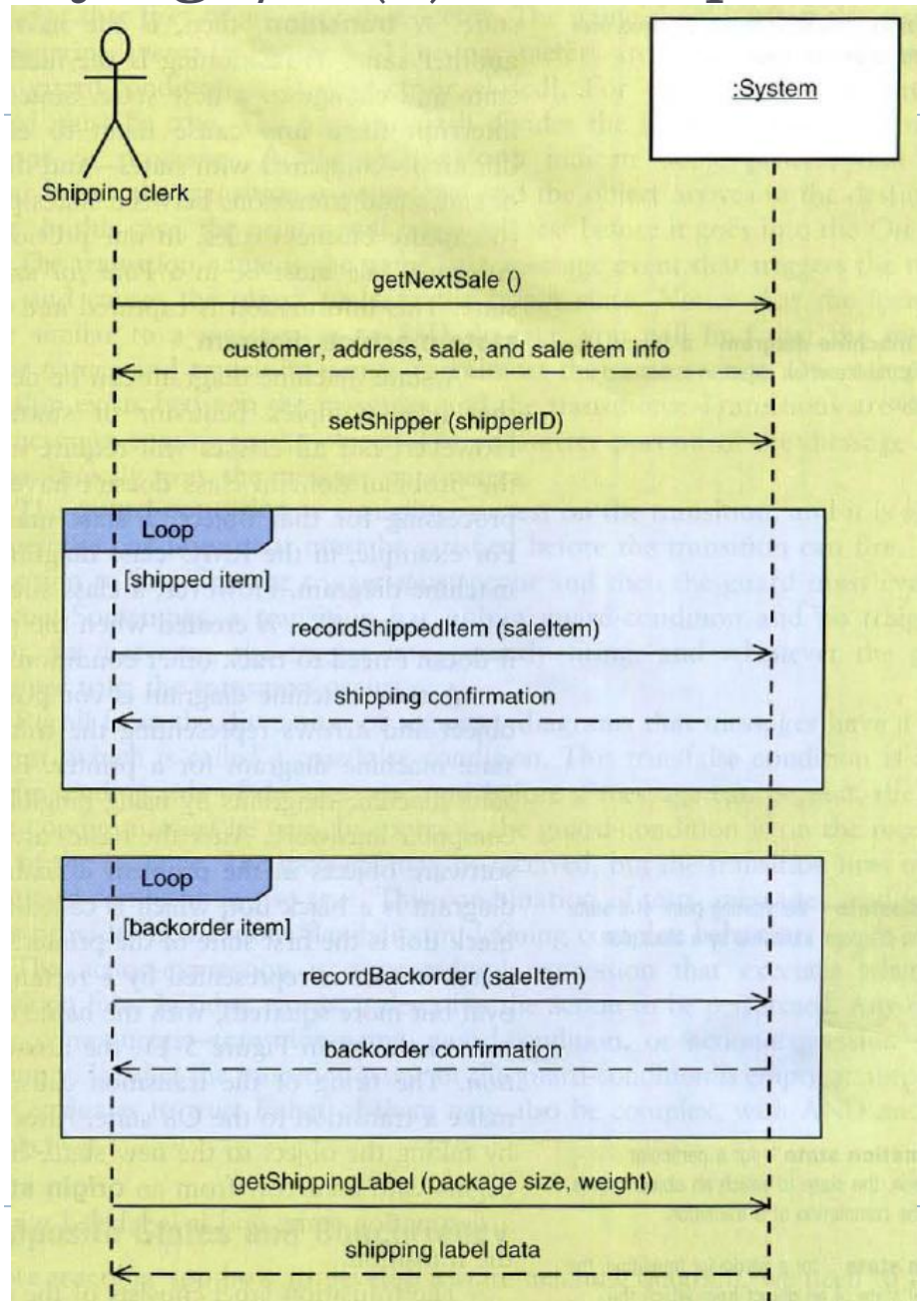


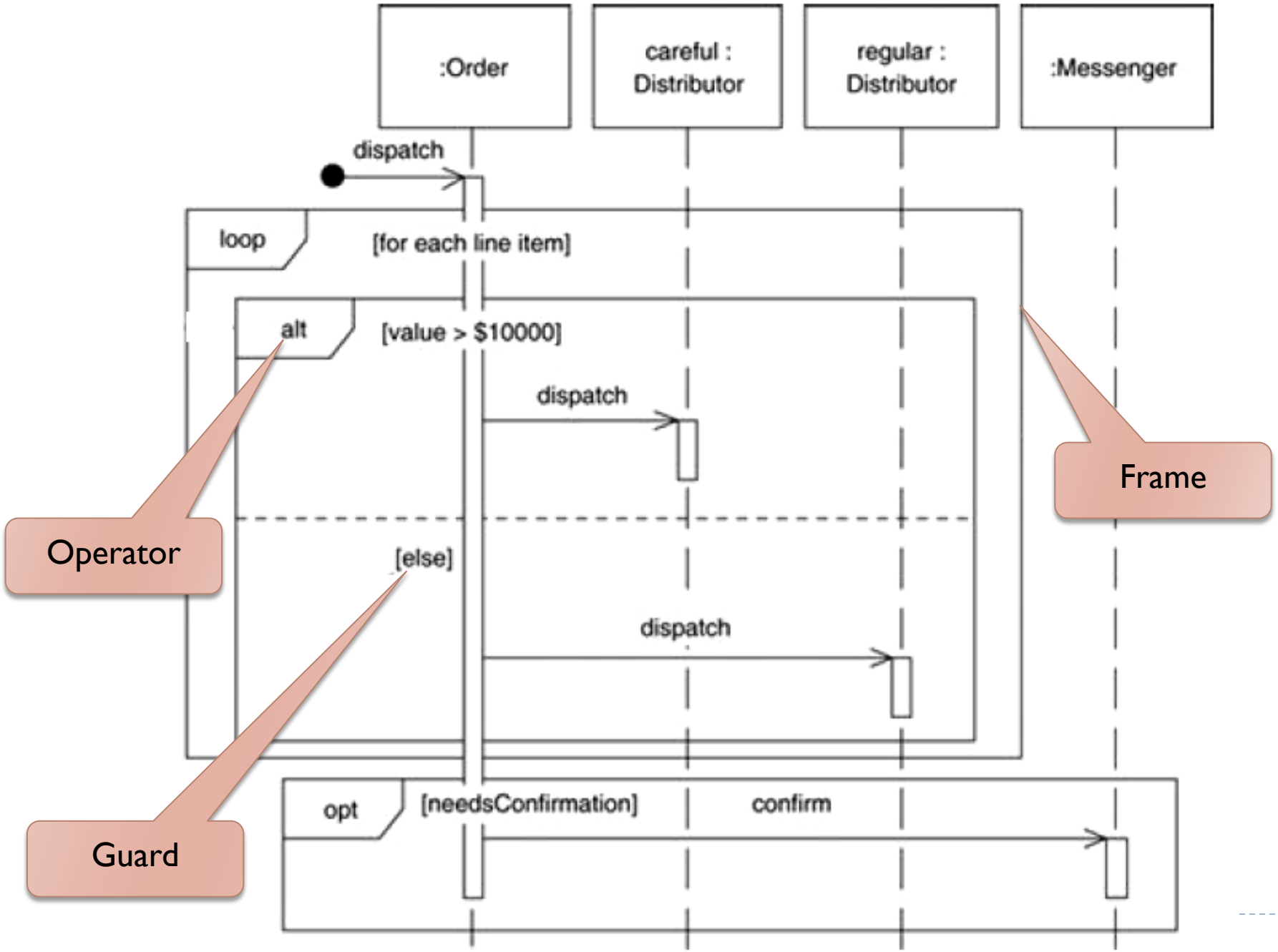
5.3 SSD Indentifying I/O (6): Develop a SSD

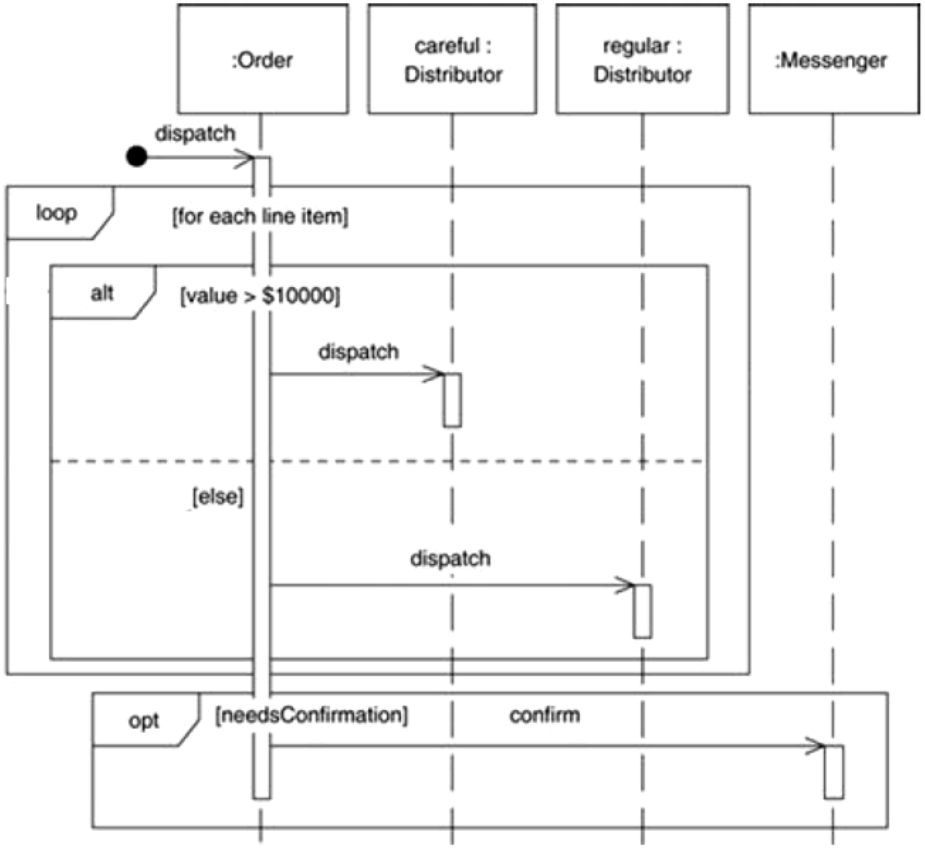
4. Identify and add the output return message.



5.3 SSD Indentifying I/O (6): Develop a SSD Example




: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
  - alternate multiple fragment; only the only one condition will be execute.
- Opt
  - The fragment executes only if the supplied condition is true.
- Par
  - Each fragment is run in parallel
- Loop
  - The fragment may execute multiple time, and use guard condition checking termination.
- Region
  - Critical region; only one thread executing
- Neg
  - The fragment shows an inverted interaction
- Ref
  - Reference interaction defined on another diagram.

5.4 The State Machine Diagram – Identifying Object Behavior

5.4 State Machine Diagram

- **State**, "state of the object" is a condition that occurs during its perform an action.

- **Transition** is the movement of an object from one state to another state.

- **State machine diagram** is diagram that describe the life of an object shown in state and transition.

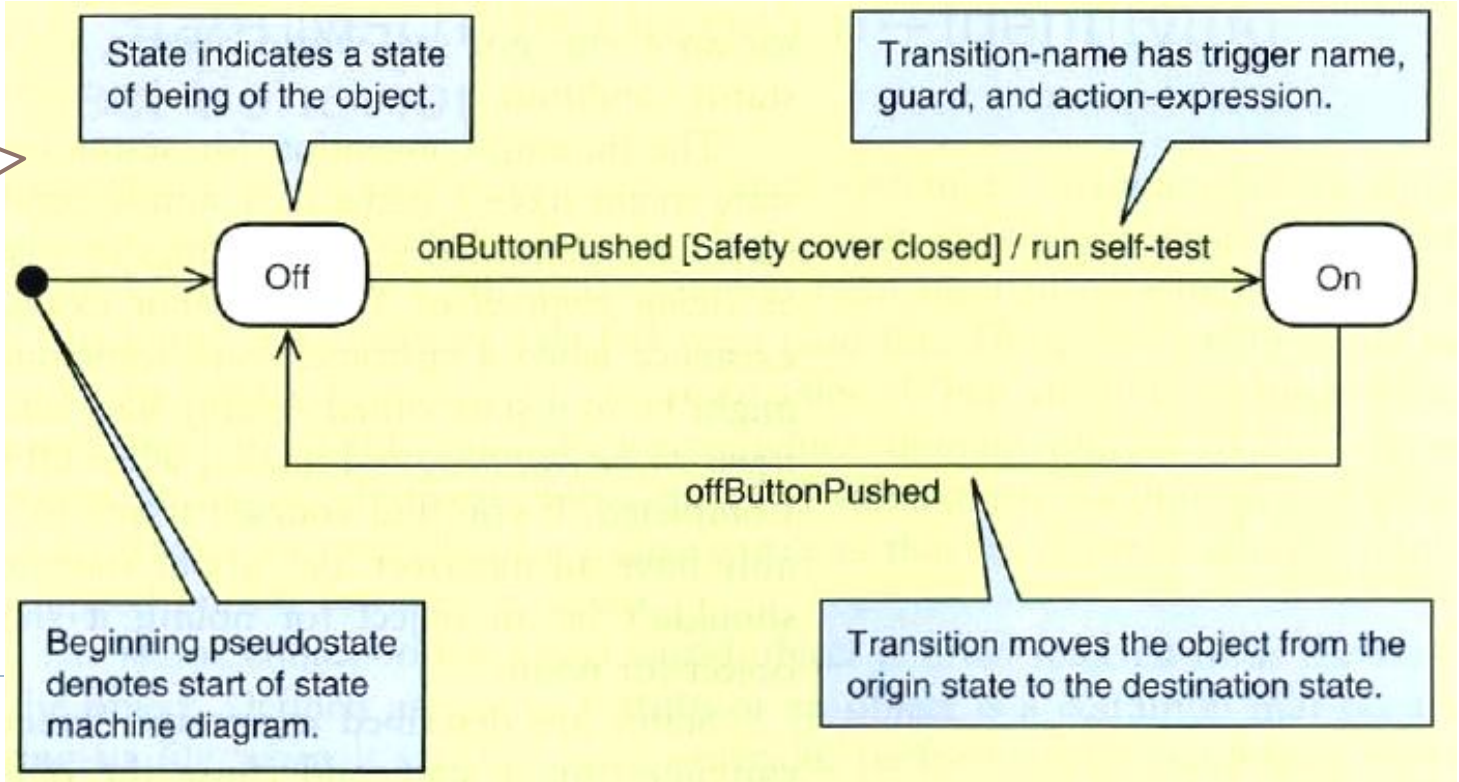
5.4 State Machine Diagram(2)

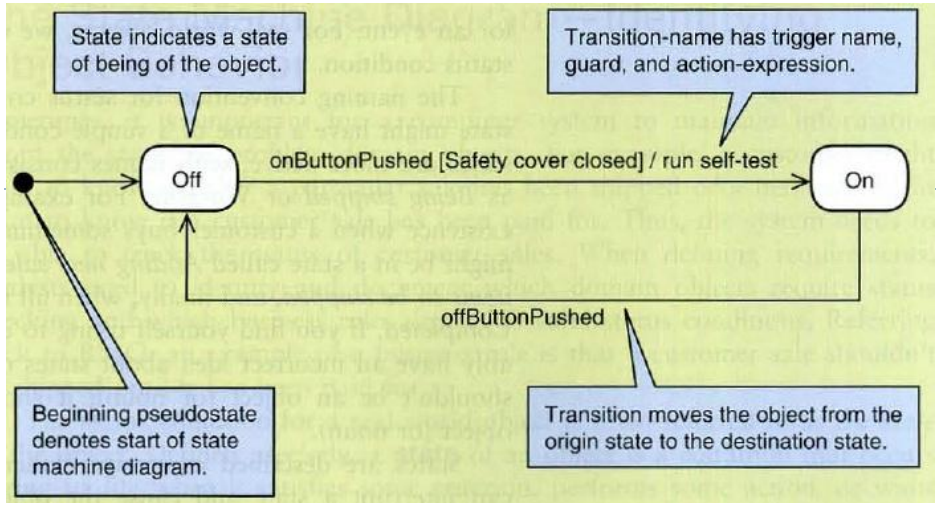
- **Pseudo state** is the starting point of a state machine diagram, show a black dot
- **Destination state** is a state that object move after completion of a transition.

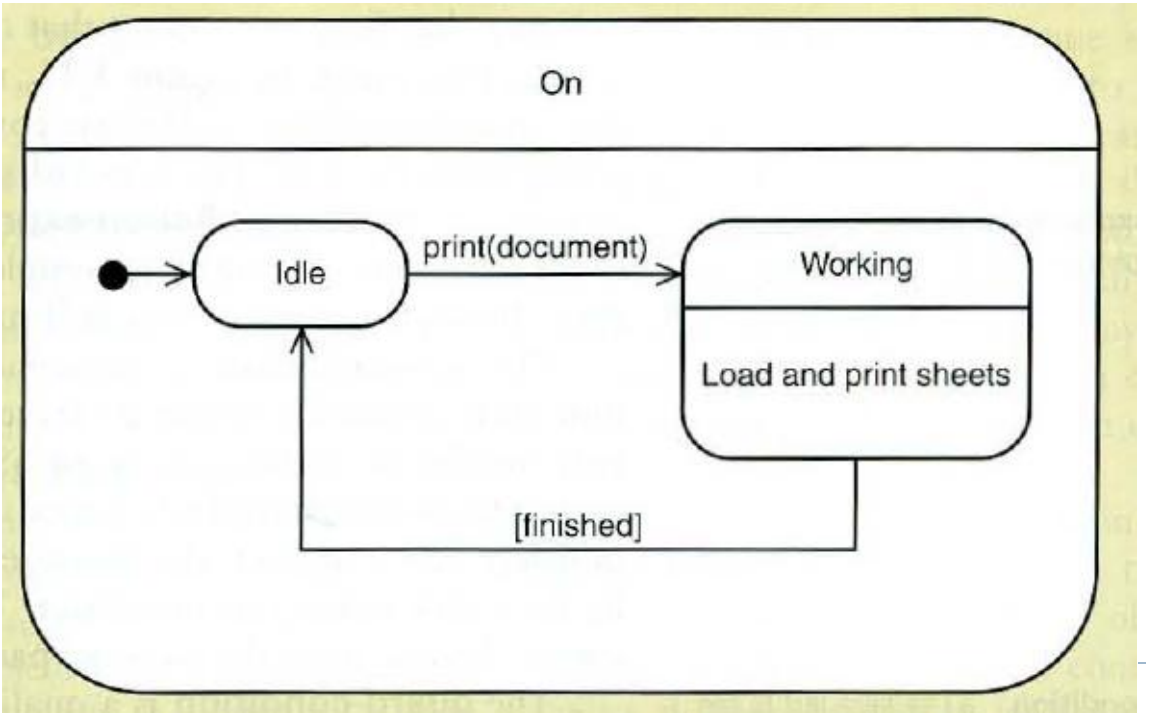
- **Origin state** is the state prior to the transition to destination.
- **Action-expression** is description that occur before transition completed.
- **Guard-condition** is true/false test on the transition.

A printer

On/Off button

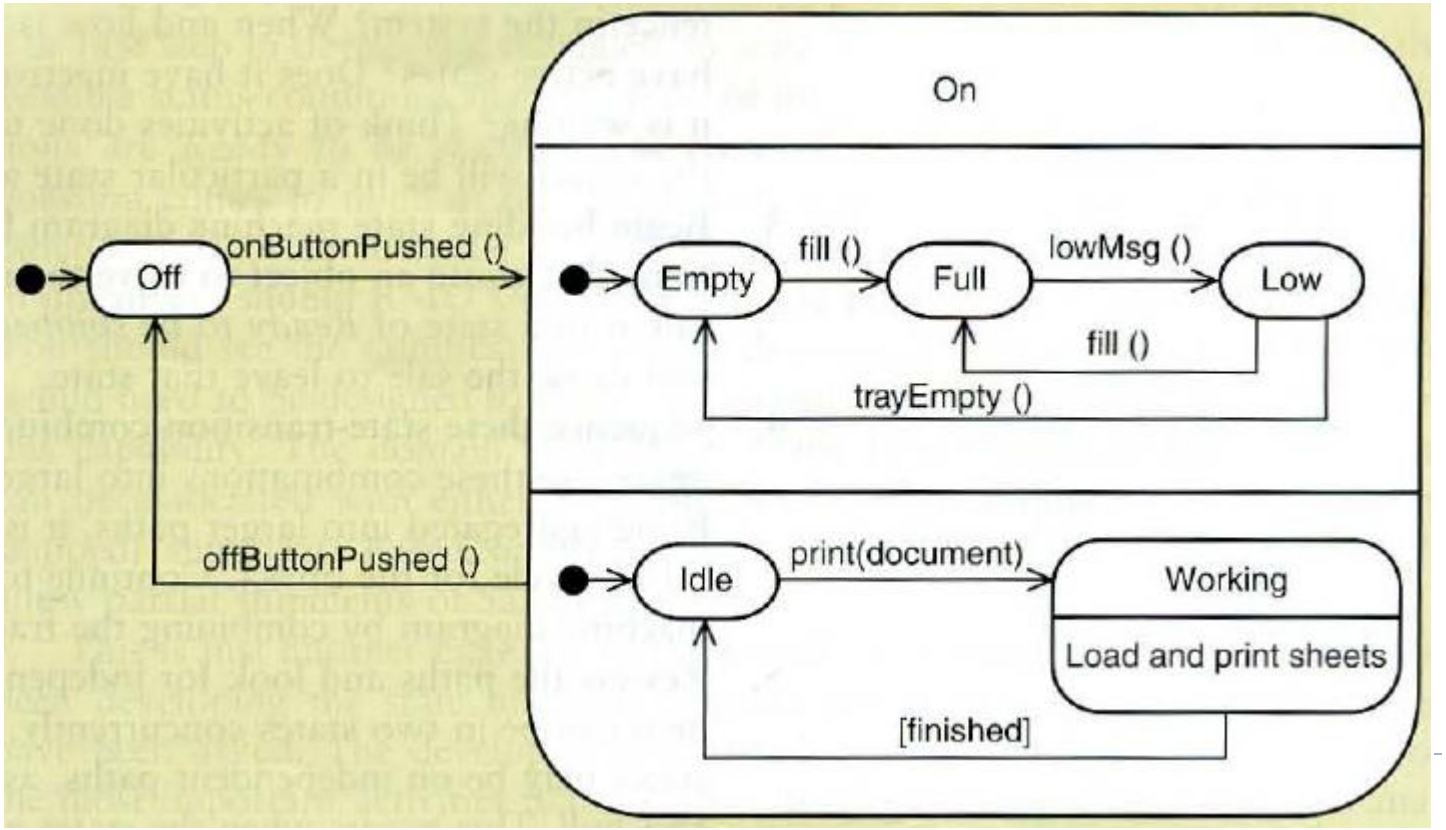



State indicates a state of being of the object.
Transition-name has trigger name, guard, and action-expression.
Off
onButtonPushed [Safety cover closed] / run self-test
On
offButtonPushed
Beginning pseudostate denotes start of state machine diagram.
Transition moves the object from the origin state to 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 the condition of being in more than one state at a time.
- **Composite state** is a state containing other states and transitions, likes nest state.



5.4 State Machine Diagram(4):

List of steps develops state machine diagram.

1. Review the class diagram and select the class that might require state machine diagram.

2. For each selected class in the group, make a list of all the status conditions you can identify.

3. Begin building state machine diagram fragments by identifying the transitions that cause an object to leave the identified state.

5.4 State Machine Diagram(4):

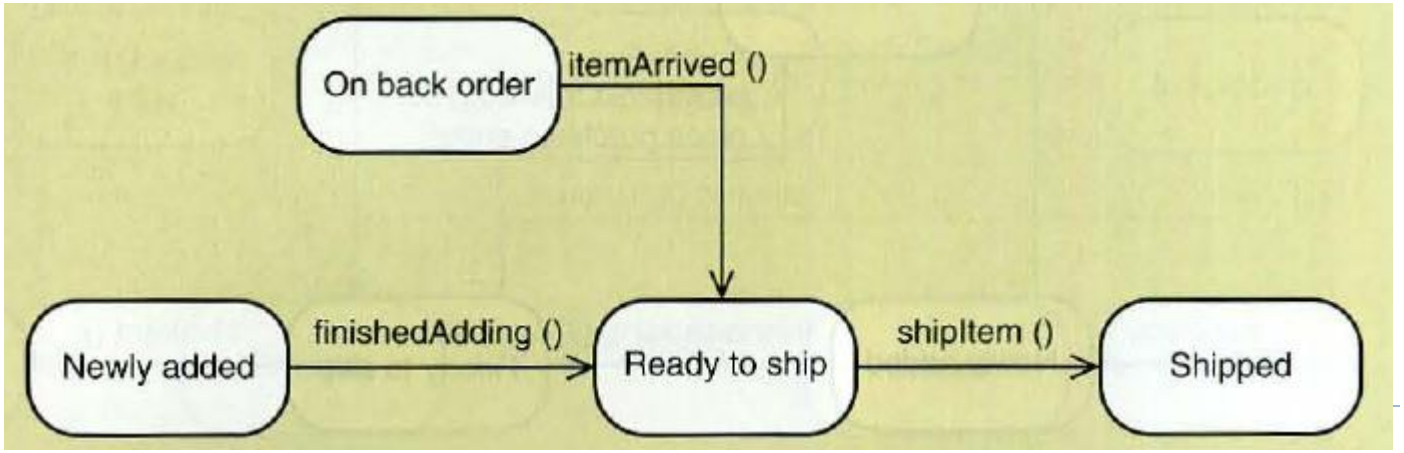
4. Sequence these state-transition combination in the correct order
5. Review the path and look for independent, concurrent paths
6. Look for additional transitions
7. Expand each transition with the appropriate message event, guard condition, and action expression
8. Review and test each state machine diagram

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

State and exit transition for Saleitem object

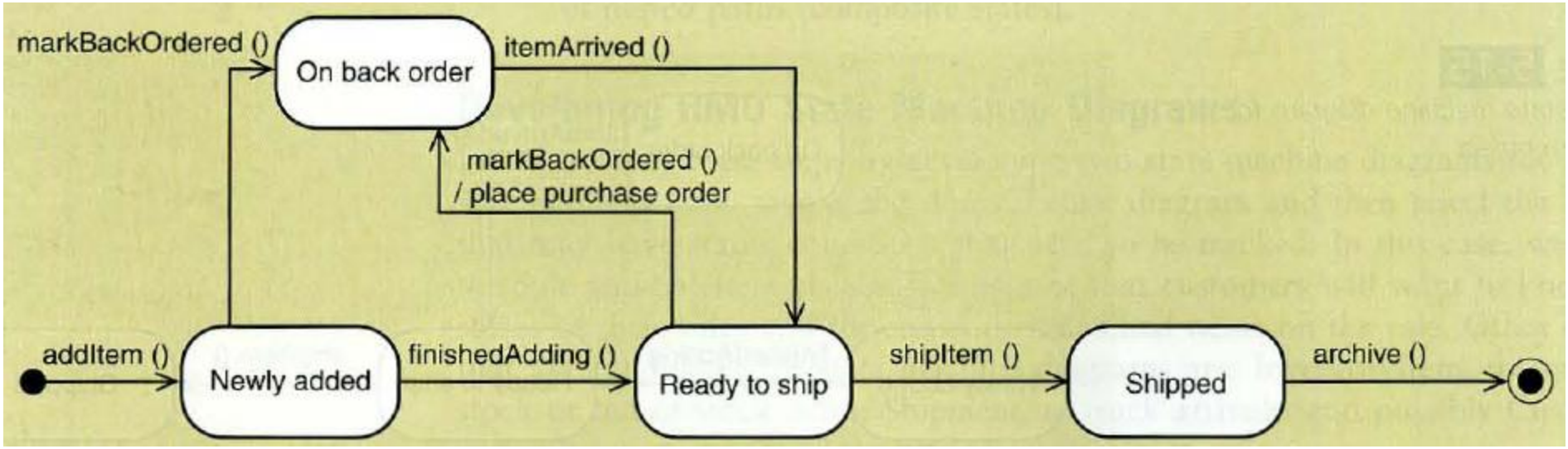
State	Transition causing exit from state
Newly added	finishedAdding
Ready to ship	shipItem
On back order	itemArrived
Shipped	No exit transition defined

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

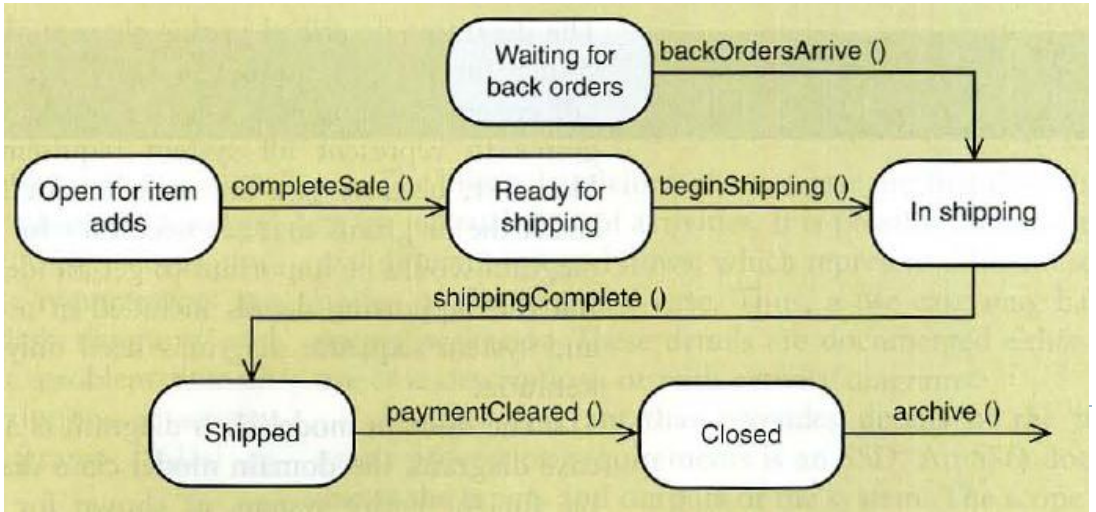


5.4 State Machine Diagram(5): Developing RMO state machine diagram

State and exit transition for Sale

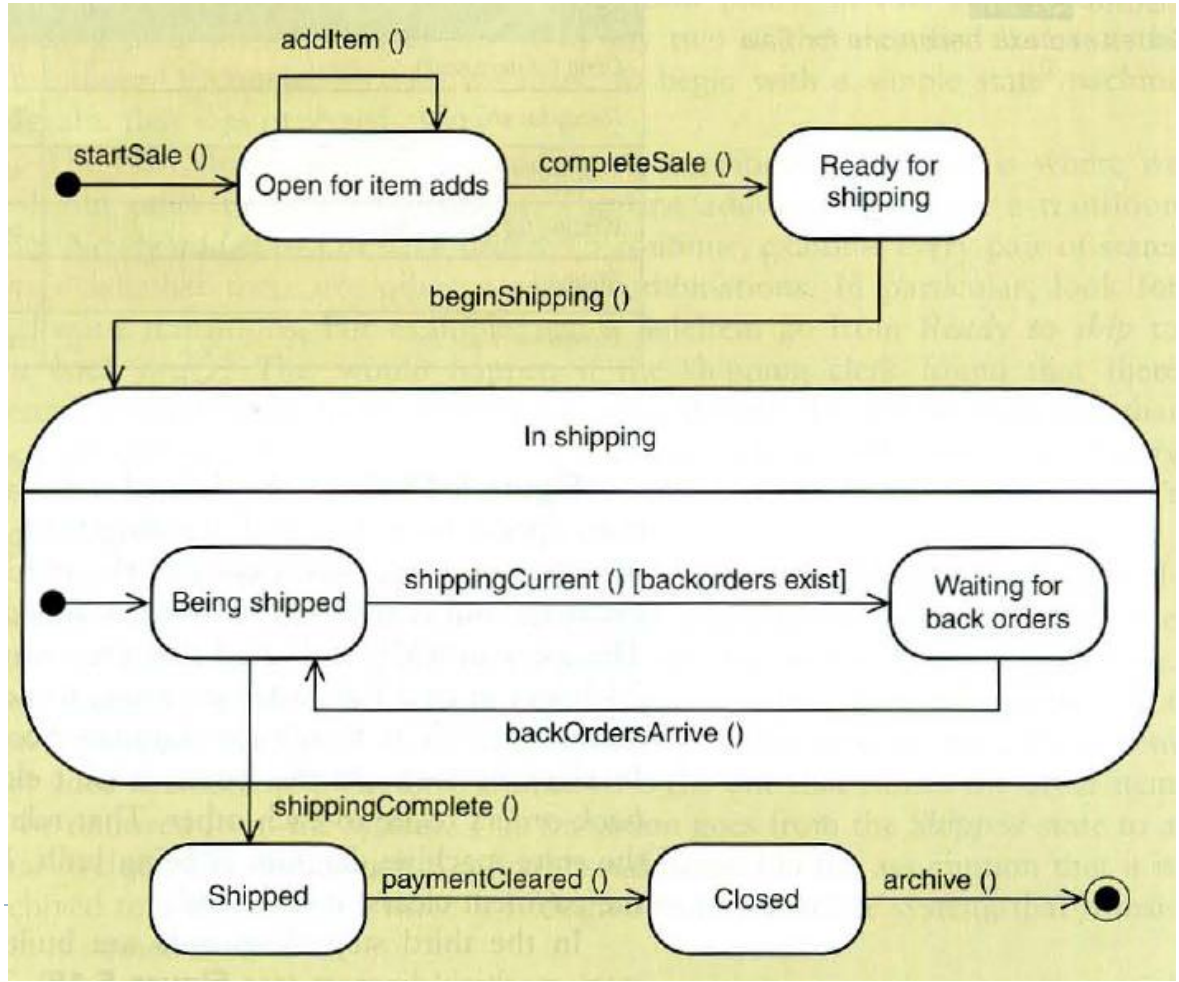
State	Exit transition
Open for item adds	completeSale
Ready for shipping	beginShipping
In shipping	shippingComplete
Waiting for back orders	backOrdersArrive
Shipped	paymentCleared
Closed	archive

First-cut state machine diagram for order

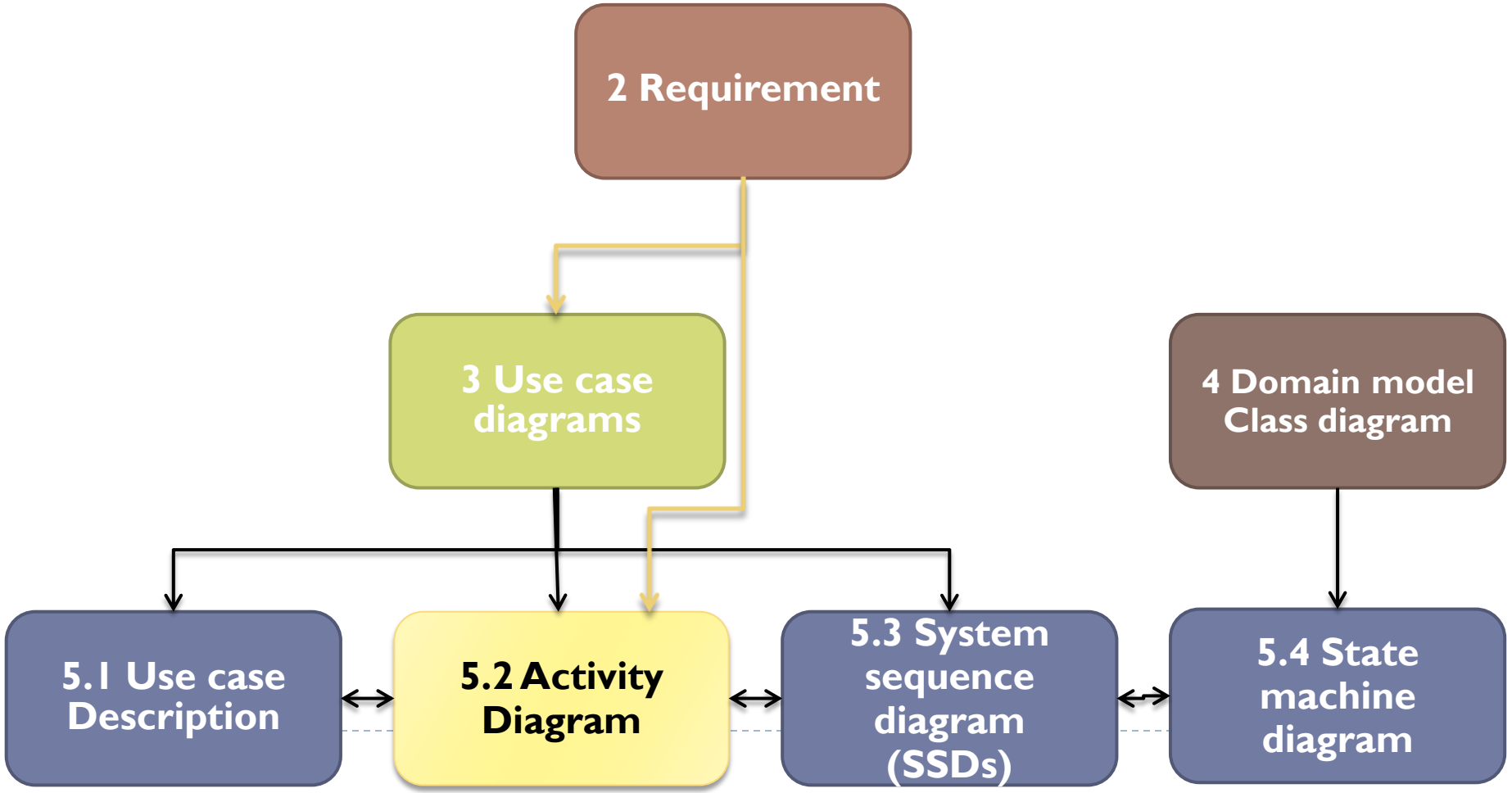


5.4 State Machine Diagram(5): Developing RMO state machine diagram

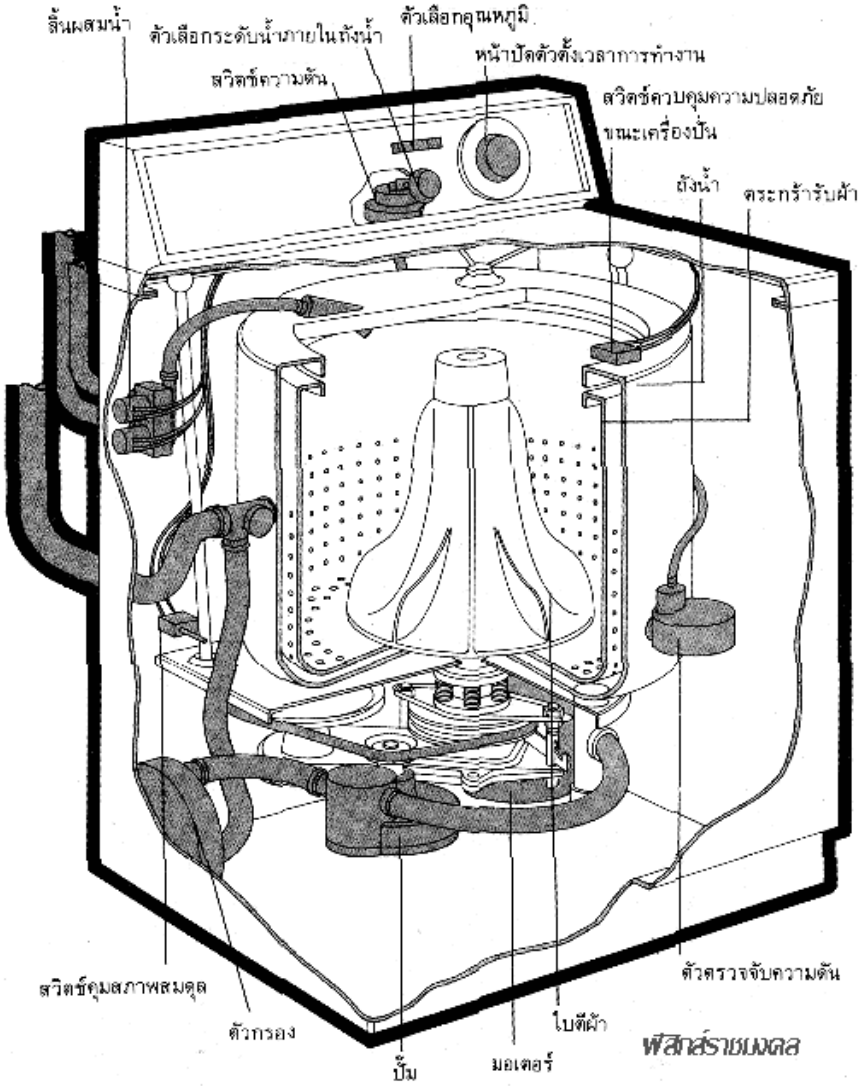
Second-cut state machine diagram for order



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