Activity Diagram

Lecture # 19, 20, 21
18, 20, 21 Oct

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Software Design and Analysis
CS-3004

Today's Outline

- Discuss and understand activity diagrams
- Understand the elements of activity diagrams
  - Activity
  - Transition
  - Synch. Bar
  - Decision Diamond
  - Start & Stop Markers

What is an Activity?

- Two definitions
  - An activity is some task that needs to be done, whether by a human or a computer
  - An activity is a method in a class
- Activity arrangement
  - Sequential – one activity is followed by another
  - Parallel – two or more sets of activities are performed concurrently, and order is irrelevant

Activity Diagram Definition

- Activity diagrams represent the dynamics of the system.
- They show the workflow of a system.
- They show
  - The flow of control from activity to activity in the system,
  - What activities can be done in parallel.
  - Alternate paths through the flow.
- Purpose
  - Model business workflows
  - Model operations

Activity Diagram

- Describes how activities are coordinated.
- Is particularly useful when you know that an operation has to achieve a number of different things, and you want to model what the essential dependencies between them are, before you decide in what order to do them.
- Records the dependencies between activities, such as which things can happen in parallel and what must be finished before something else can start.

Activity Diagram

- Activity Diagrams are like Flow Charts, but Flow Charts are usually limited to sequential activities while Activity Diagrams can show parallel activities as well

  - Activity Diagrams are useful for describing complicated methods
  - Activity Diagrams are useful for describing use cases, since, after all, a use case is an interaction, which is a form of activity

Activity Diagram Symbols and Notations

- An activity diagram has following individual elements

- Start Marker
  - A black circle is the standard notation for an initial state before an activity takes place. It can either stand alone or you can use a note to further elucidate the starting point.

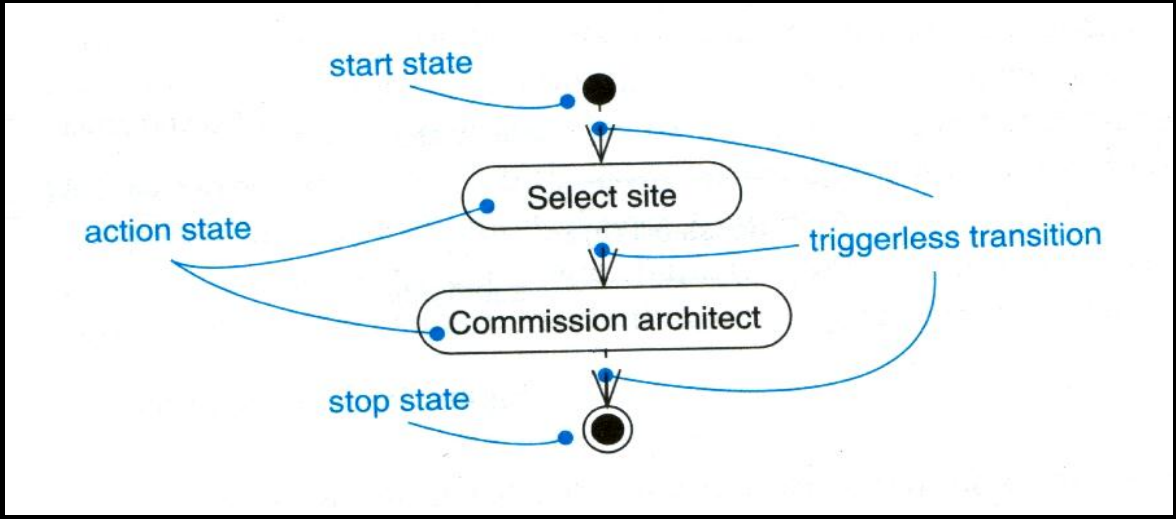
- Stop Marker
  - The black circle that looks like a selected radio button is the UML symbol for the end state of an activity. As shown in two examples above, notes can also be used to explain an end state.

Activity Diagram Symbols and Notations

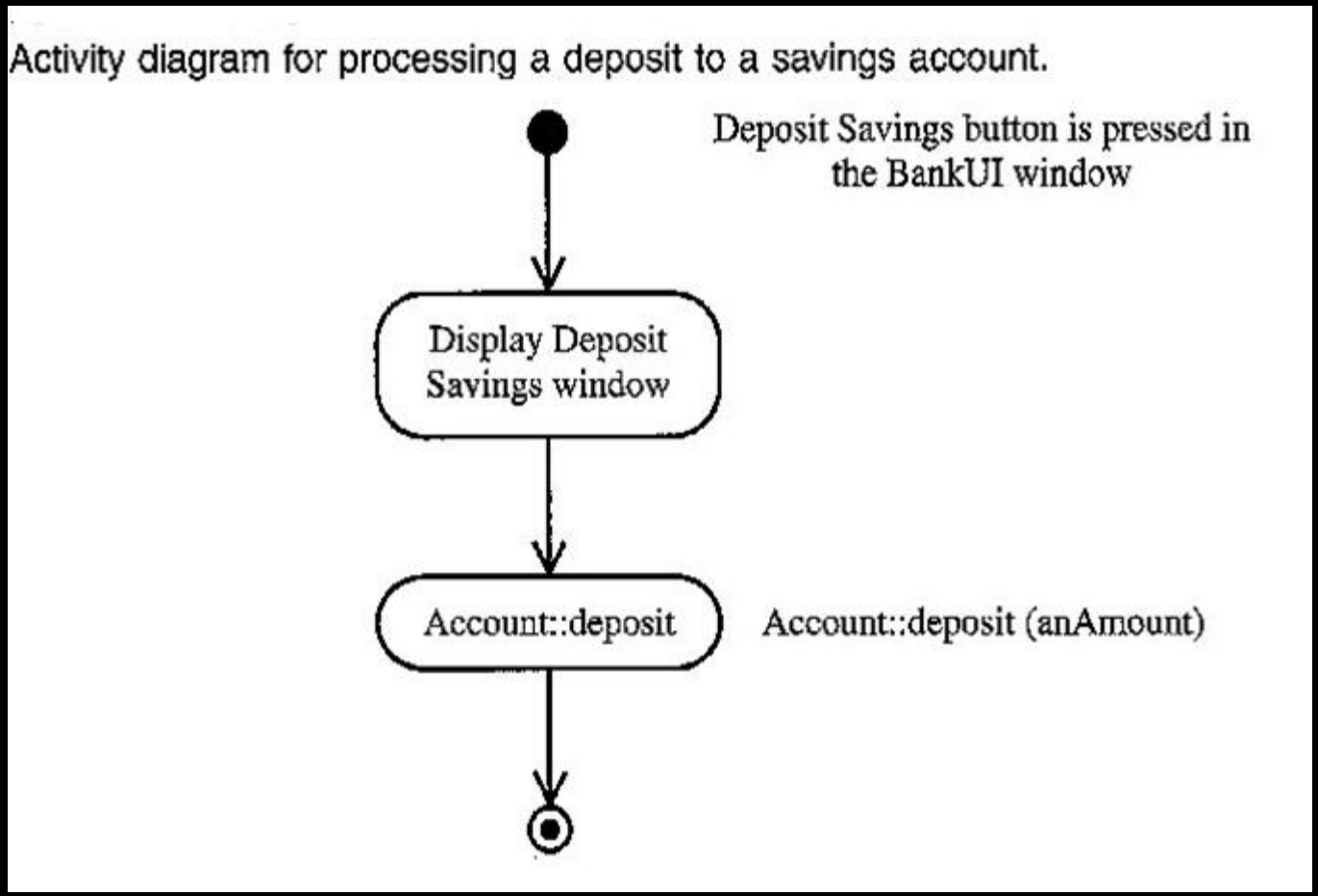
- Activity:
  - The activity symbols are the basic building blocks of an activity diagram and usually have a short description of the activity they represent.
  - Each activity can be followed by another activity (sequencing).

Activity Diagram Symbols and Notations

- Transition: ⟶
  - When the action or activity of a state completes, flow of control passes immediately to the next action or activity state
  - Arrows represent the direction flow. The arrow points in the direction of progressing activities.

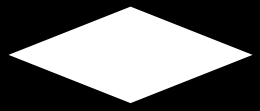


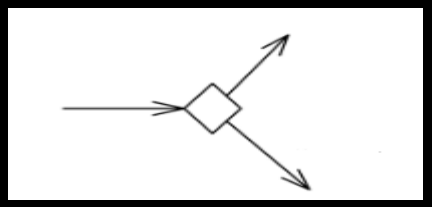
Activity Diagram: Example (activity and transition)

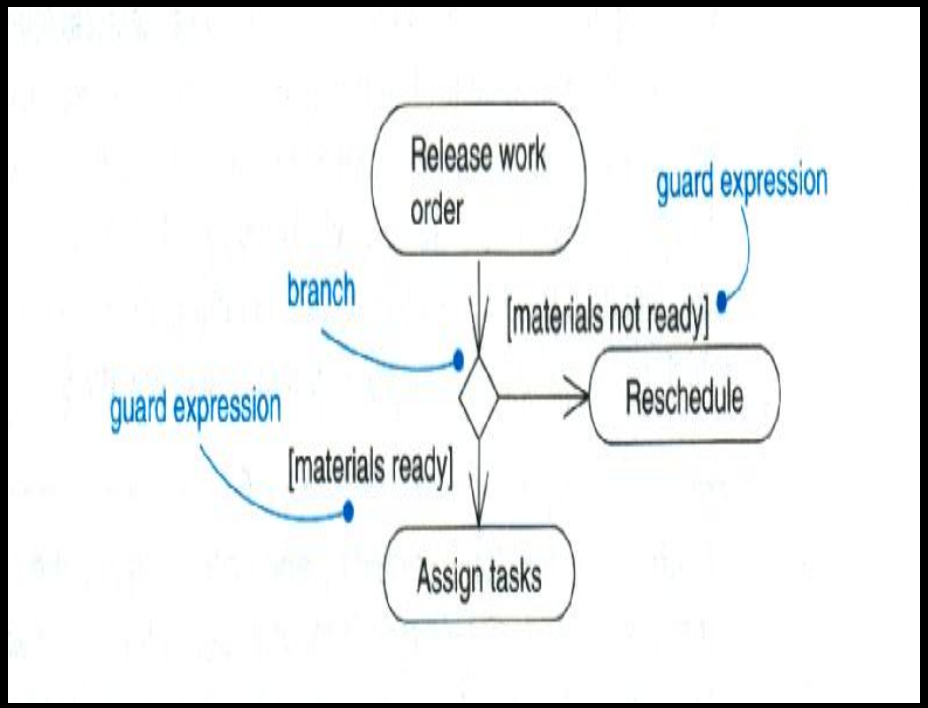


Activity Diagram Symbols and Notations

- Decision node / Branching
- Diamond.
  - Each trigger coming from it has a guard.
  - A branch specifies alternate paths taken based on some Boolean expression
  - A branch may have one incoming transition and two or more outgoing ones

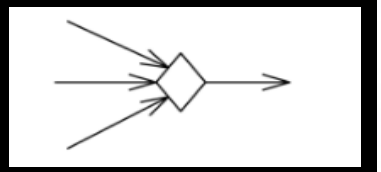




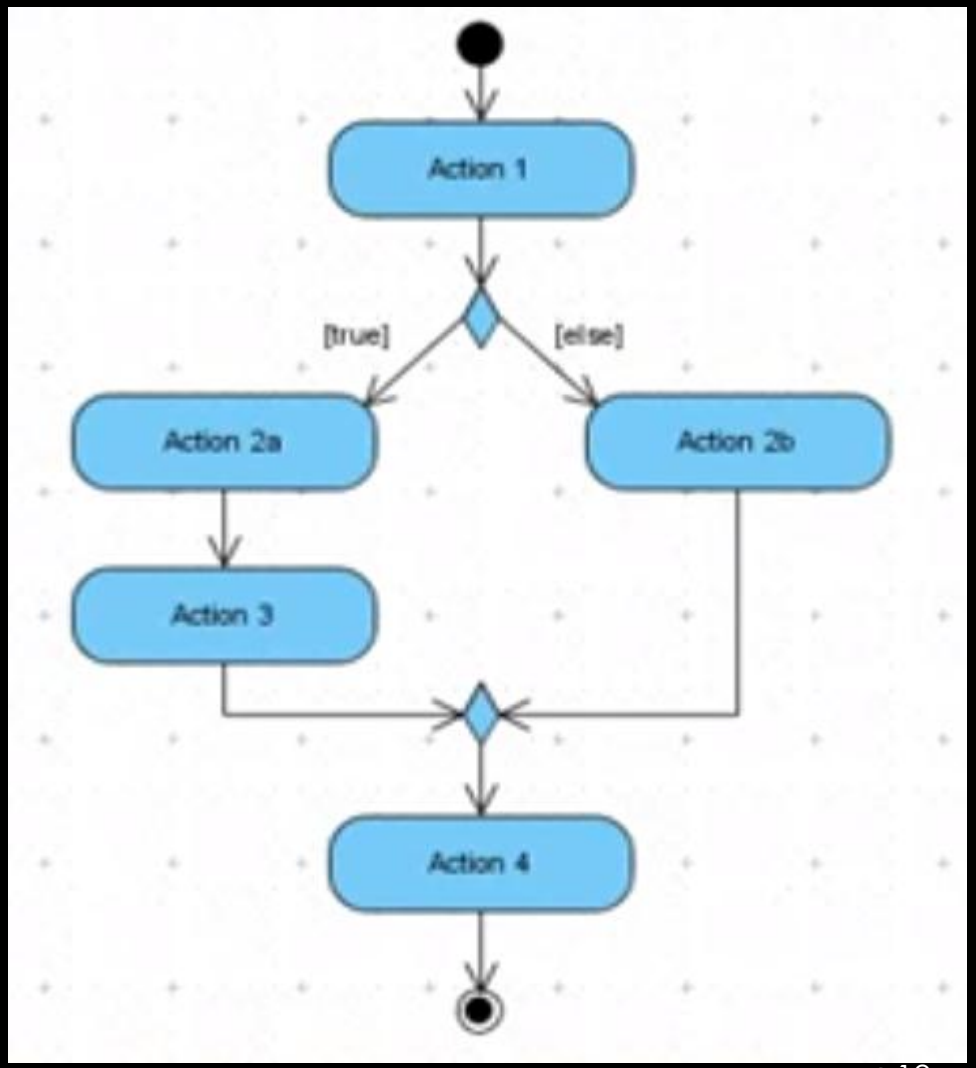


Activity Diagram Symbols and Notations

- Merge node :



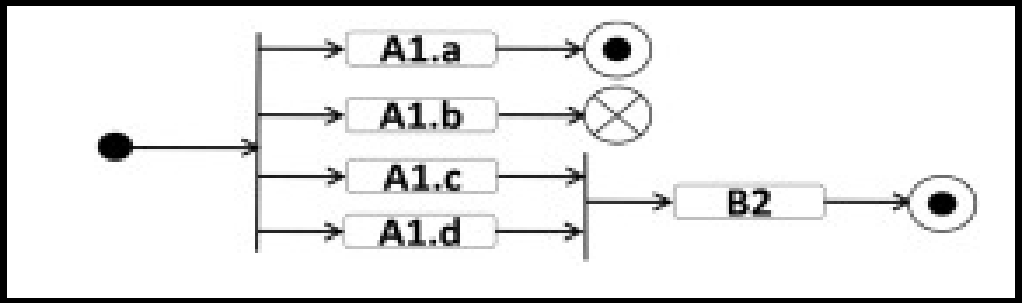
- Merge node is a control node that brings together multiple incoming alternate flows to accept single outgoing flow. There is no joining of tokens. Merge should not be used to synchronize concurrent flows.

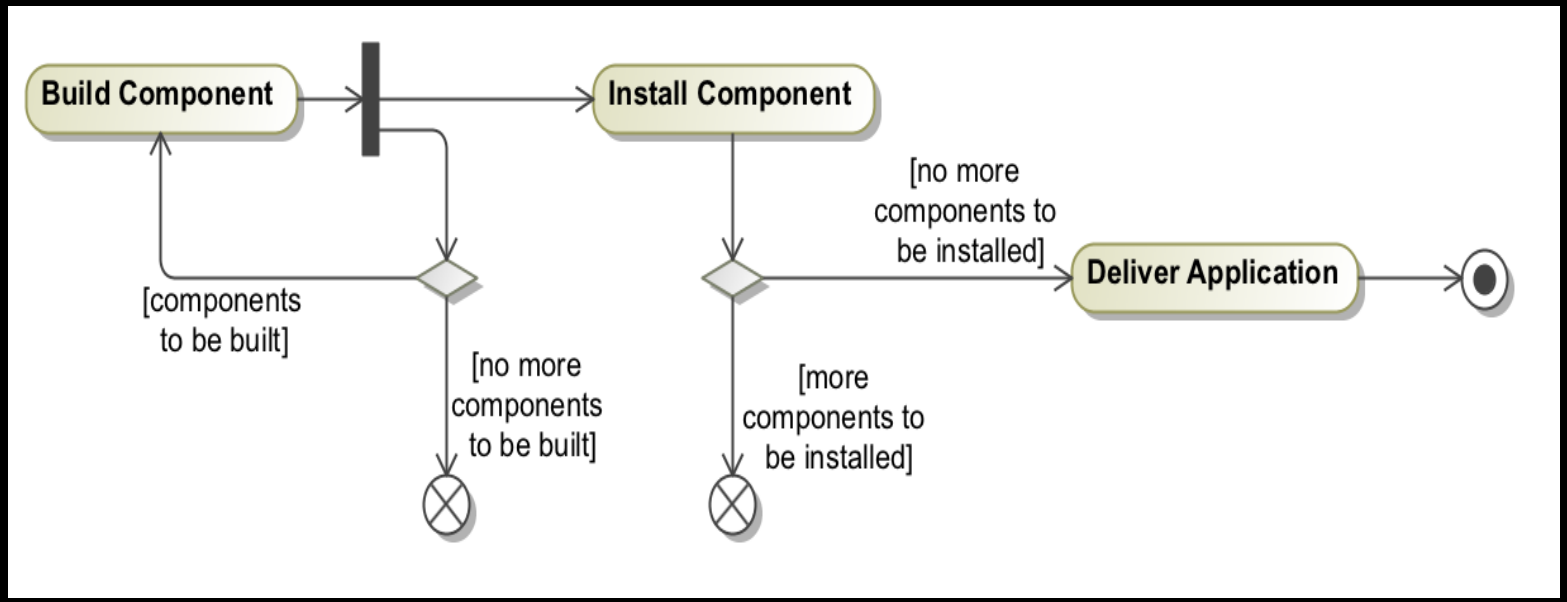


Activity Diagram Symbols and Notations

- [Condition]
  - Condition text is placed next to a decision marker to let you know under what condition an activity flow should split off in that direction.
- final flow
  - The final flow marker shows the ending point for a process in a flow. Flow final node is a control final node that terminates a flow. It destroys all tokens that arrive at it but has no effect on other flows in the activity. The difference between a final flow node and the end state node is that the latter represents the end of all flows in an activity.
- note
  - The shape used for notes.

Flow Final Node





Activity Diagram: Example (Branch and Merge)

- we have to develop an activity diagram for HR department to manage the employee records.

- If the employee is a new employee, his/ her record is created. And if the employee is an existing employee, his record can be updated. Record is deleted if the employee is terminated employee.

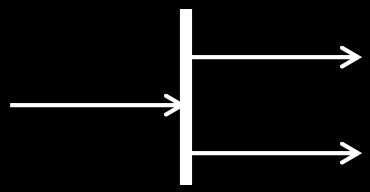
- Final record is updated after any modification.

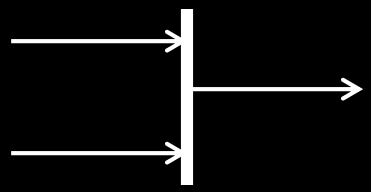
Activity Diagram Symbols and Notations

- Synchronisation bar:

- All triggers from this attach to activities that can occur in parallel, with no specific sequence, or concurrently.
- The next synchronisation bar closes the concurrency.
- Use a synchronization bar to specify the forking and joining of parallel flows of control
- A synchronization bar is rendered as a thick horizontal or vertical line

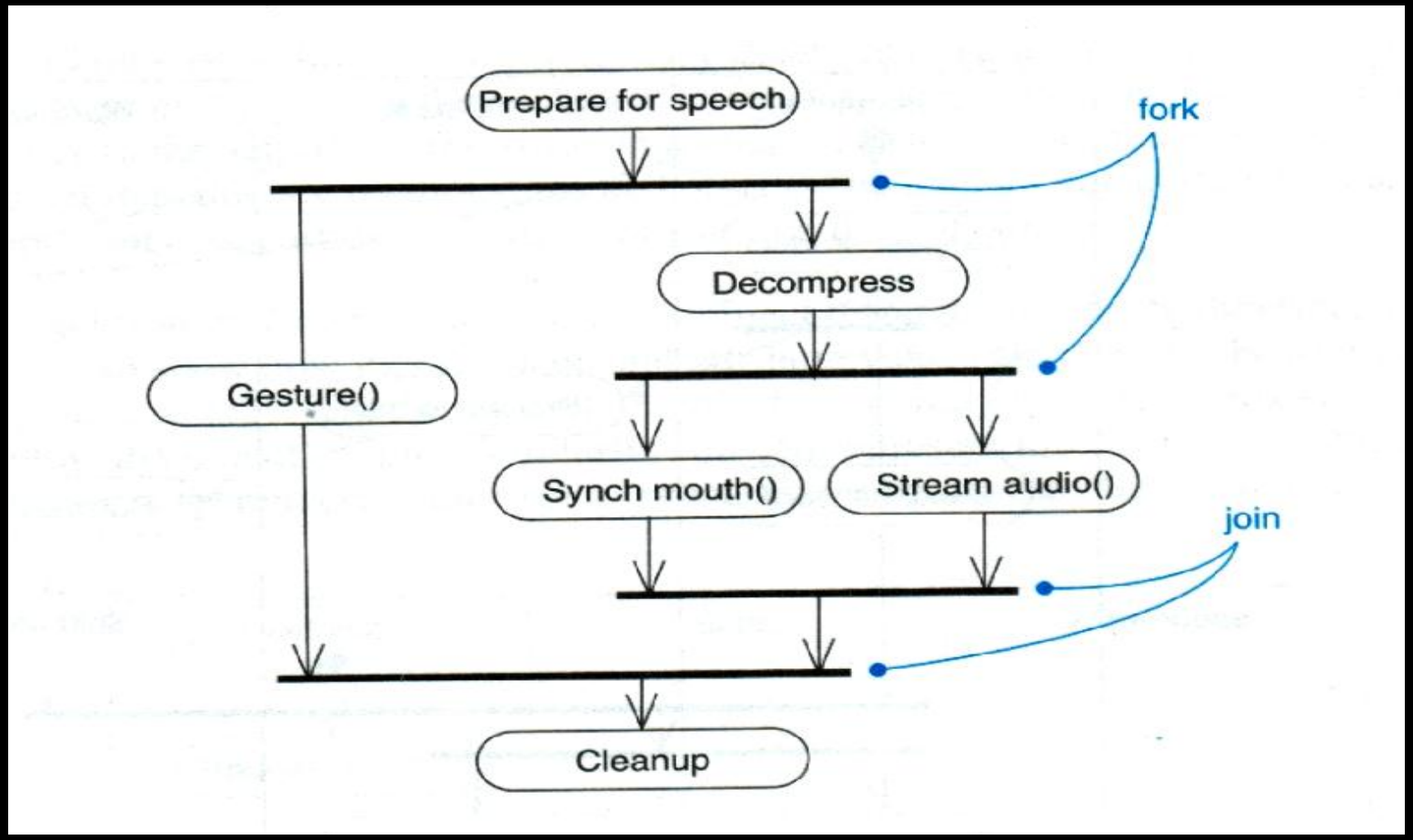
Fork and Join



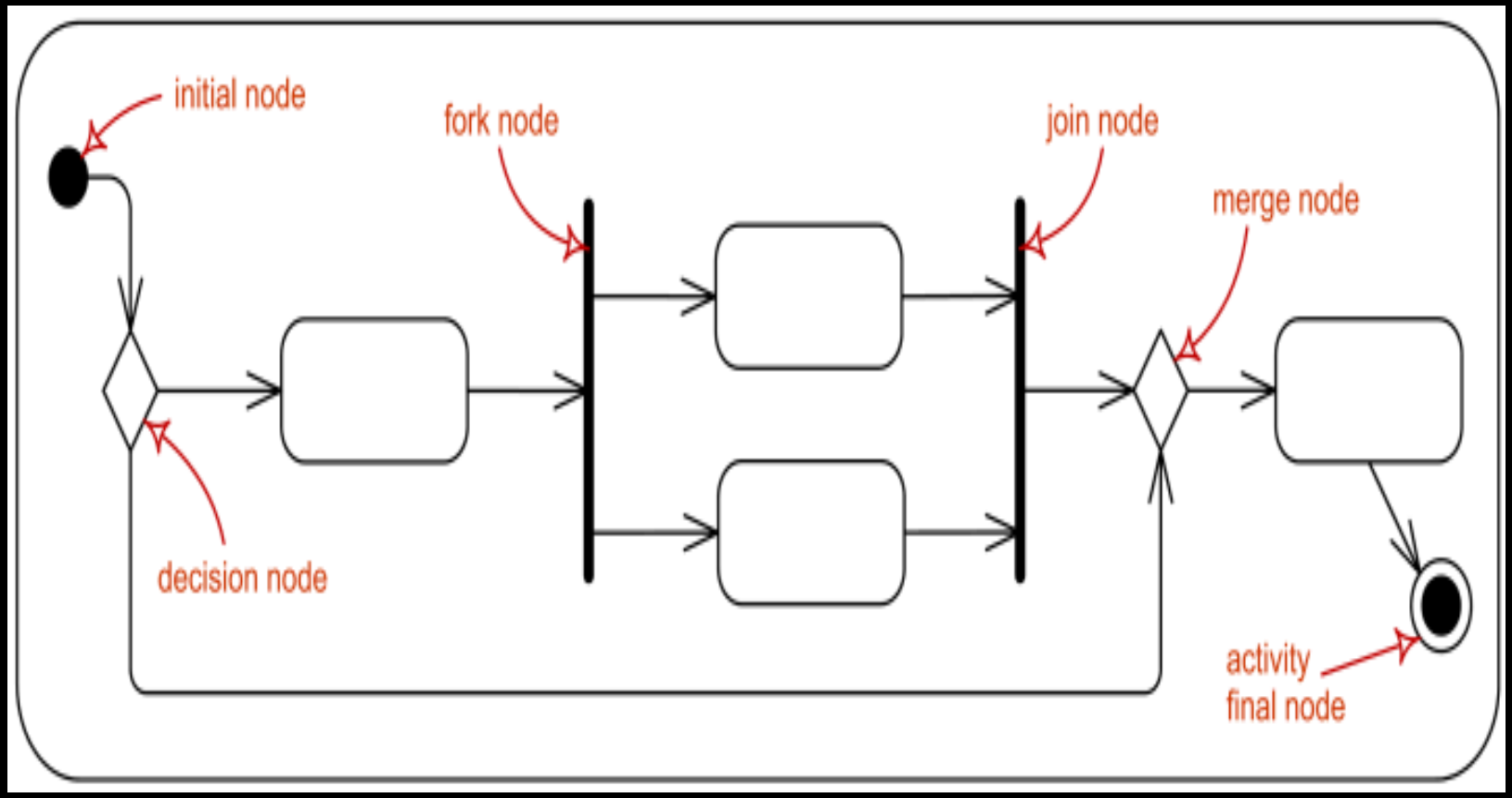


- A fork may have one incoming transitions and two or more outgoing transitions
  - each transition represents an independent flow of control
  - conceptually, the activities of each of outgoing transitions are concurrent
- A join may have two or more incoming transitions and one outgoing transition
  - above the join, the activities associated with each of these paths continues in parallel
  - at the join, the concurrent flows synchronize and flow of control continues on below the join

Activity Diagram: Example (Fork and Join)

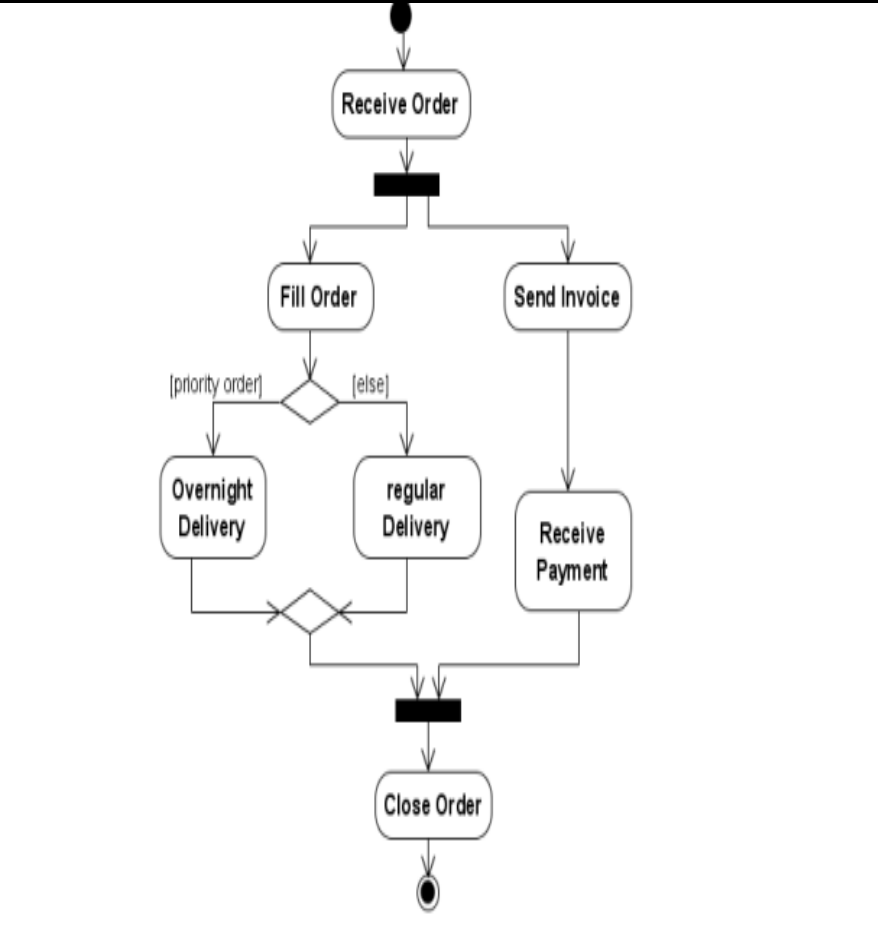


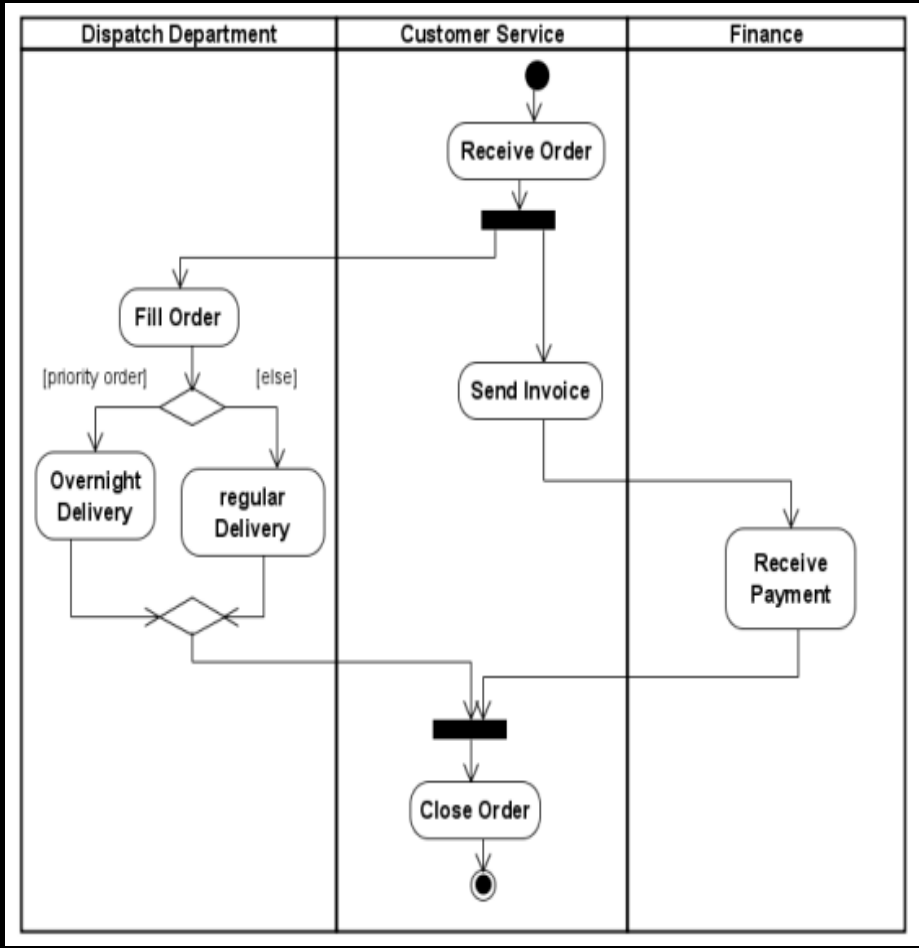
Branch &Merge, Fork & Join



Activity Diagram: Example (Fork and Join)

- We have to develop an activity diagram for order management system.
- When the order is received, order is filled and shipped after filling. *While we are doing this, invoice is sent for receiving the payment.*
- *After shipping the order and receiving the payment, order is closed.*


Receive Order
Fill Order
Send Invoice
[priority order]
[else]
Overnight Delivery
regular Delivery
Receive Payment
Close Order


Dispatch Department
Customer Service
Finance
Receive Order
Fill Order
[priority order]
[else]
Send Invoice
Overnight Delivery
regular Delivery
Receive Payment
Close Order

Swimlanes

- Arrange activity diagrams into vertical zones separated by dashed lines.
- Each zone represents the responsibilities of a particular class or department.
- A swimlane specifies a locus of activities
- To partition the activity states on an activity diagram into groups
  - each group representing the business organization responsible for those activities
  - each group is called a swimlane
- Swimlane visually distinguishes job sharing and responsibilities for sub-processes of a business process. Swim lanes may be arranged either horizontally or vertically.

Swimlanes (2)

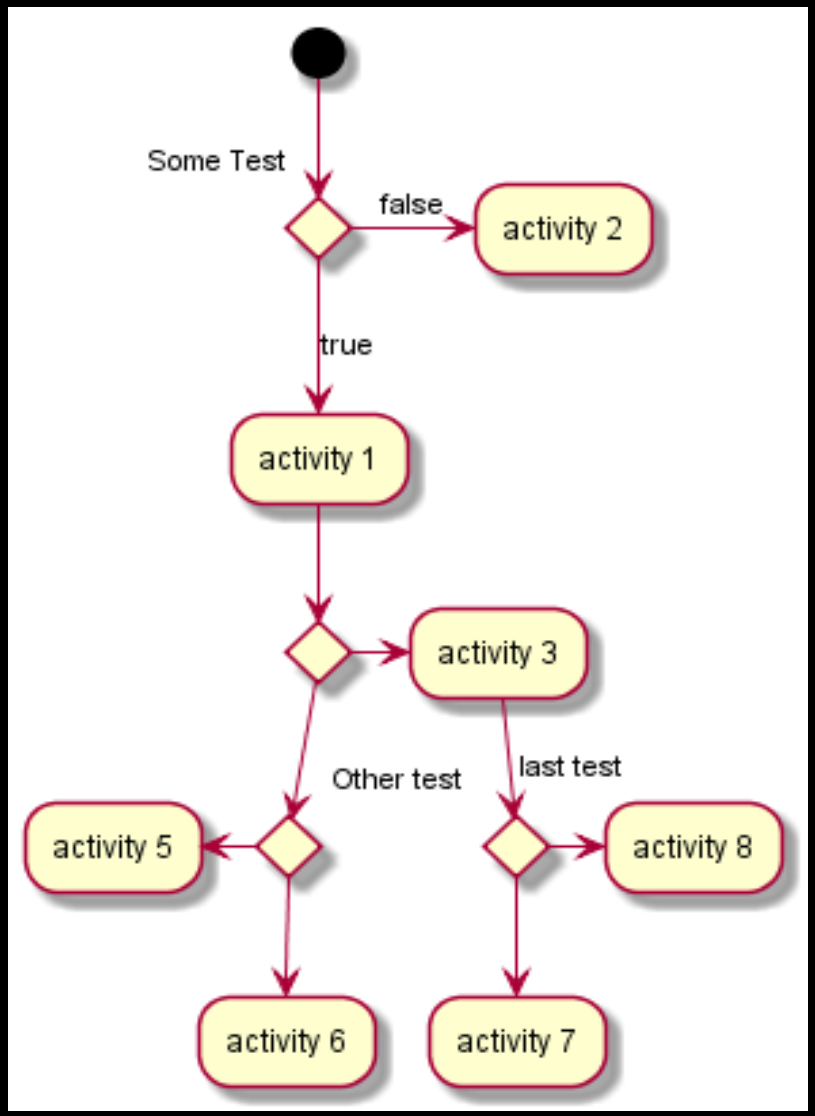
- Each swimlane has a name unique within its diagram
- Each swimlane may represent some real-world entity
- Each swimlane may be implemented by one or more classes
- Every activity belongs to exactly one swimlane, but transitions may cross lanes

Exercise

- A customer wants to draw money from his bank account. He enters his card into an ATM (automated teller machine). The ATM machine accept the card and prompts for PIN number. The customer enters his PIN. The ATM (internally) retrieves the bank account number from the card. The ATM encrypts the PIN and the account number and sends it over to the bank. The bank verifies the encrypted Account and PIN number. Card is returned incase of invalid pin number. If the PIN number is correct, the ATM displays "Enter amount", draws money from the bank account and prints the receipt.

Implementation of nested branching

```
(*) --> if "Some Test" then
  -->[true] "activity 1"

  if "" then
    -> "activity 3" as a3
  else
    if "Other test" then
      --> "activity 5"
    else
      --> "activity 6"
    endif
  endif

else

  ->[false] "activity 2"

endif

a3 --> if "last test" then
  --> "activity 7"
else
  -> "activity 8"
endif
```



Exercise

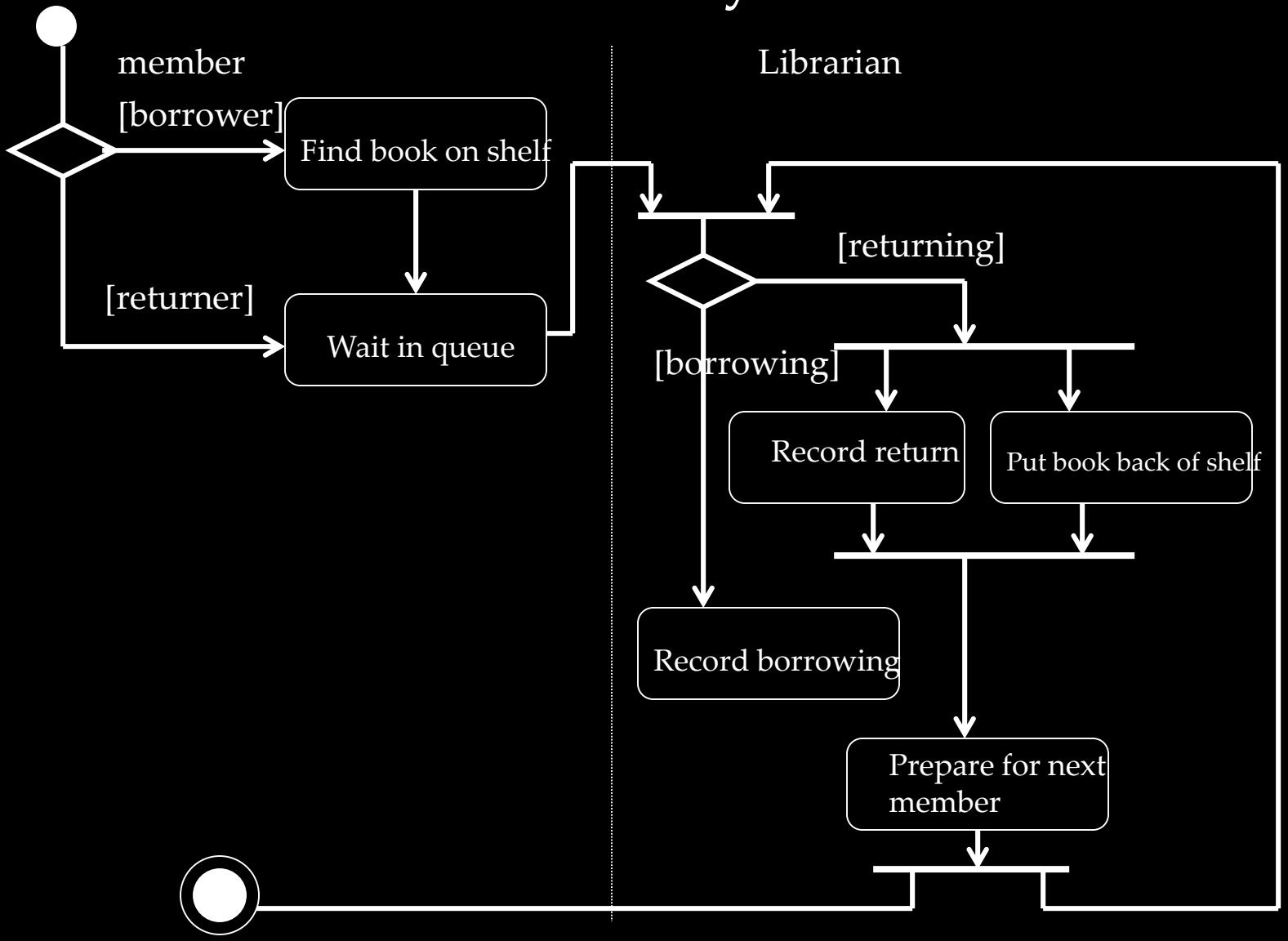
- A person visits a beverage shop where he/she can order soft drink or coffee. If he selects the coffee, then the coffee preparation process starts by putting the coffee beans in the filter, adding water to the reservoir and arranging cups. Filter after having the coffee beans in it is placed in the machine. Machine is turned on and coffee brews. When the machine's light turn off, coffee is poured into the cups and served for drinking.
- In case of soft drink selection, customer is asked for the soft drink brand. Customer is served with he drink if the desired drink is available in the shop.

Class Diagram Exercise

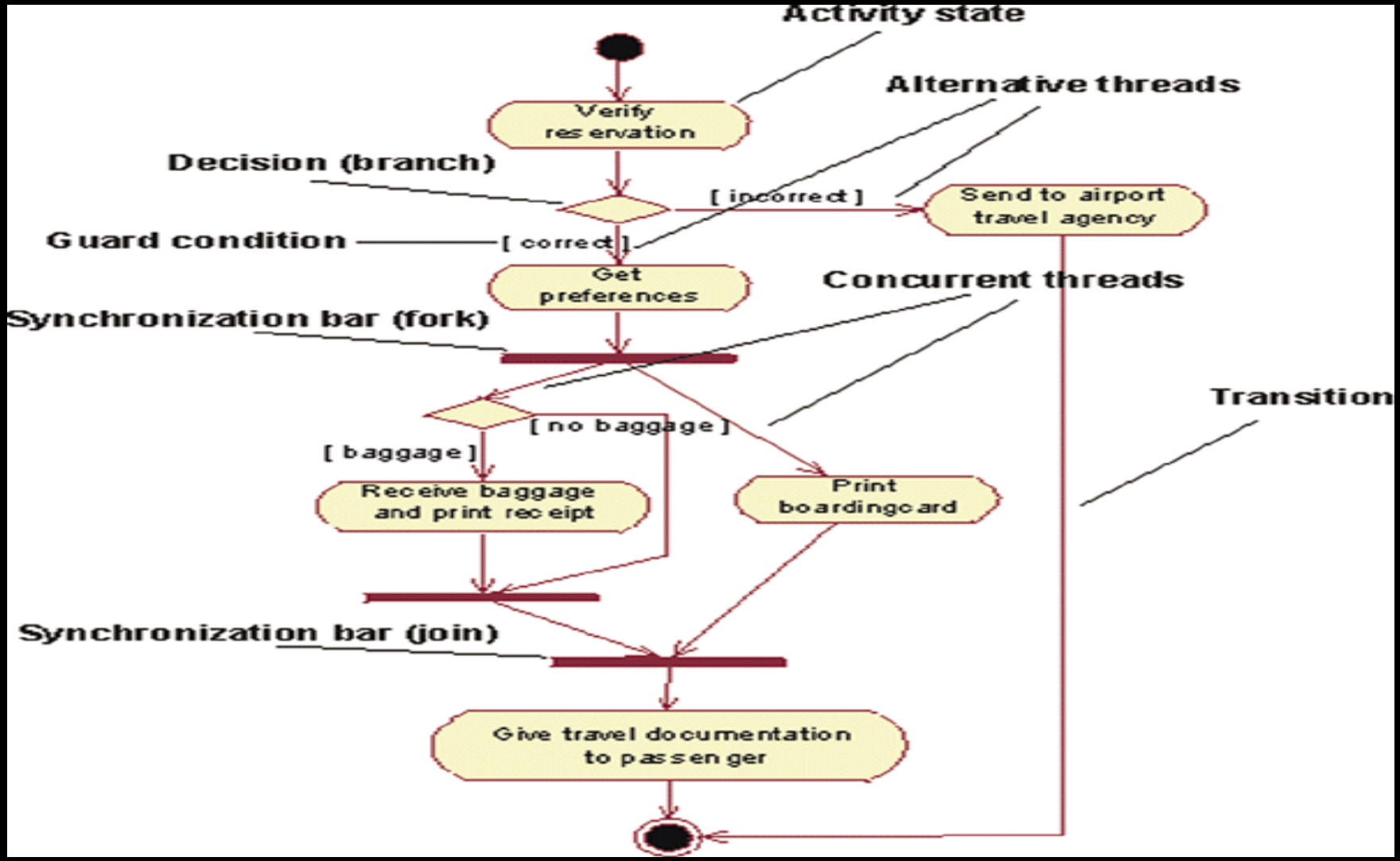
- We are after a system that controls a recycling machine for returnable bottles and cans. The machine will allow a customer to return bottles or cans on the same occasion. When the customer returns an item, the system will check what type has been returned. The system will register how many items each customer returns and, when the customer asks for a receipt, the system will print out what he deposited, the value of the returned items and the total return sum that will be paid to the customer. The system is also to be used by an operator. The operator wants to know how many items of each type have been returned during the day. At the end of the day, the operator asks for a printout of the total number of items that have been deposited in the machine on that particular day. The operator should also be able to change information in the system, such as the deposit values of the items. If something is amiss, for example, if a can gets stuck or if the receipt rolls are finished, the operator will be called by a special alarm signal. Draw the class diagram for this scenario and also generate class diagram code for this scenario.

Activity Diagrams – Some Examples

Example: Business Level Activity Diagram of the Library



Example: Business Level Activity Diagram of the Check-in Process



Activity Diagram: Example (3)

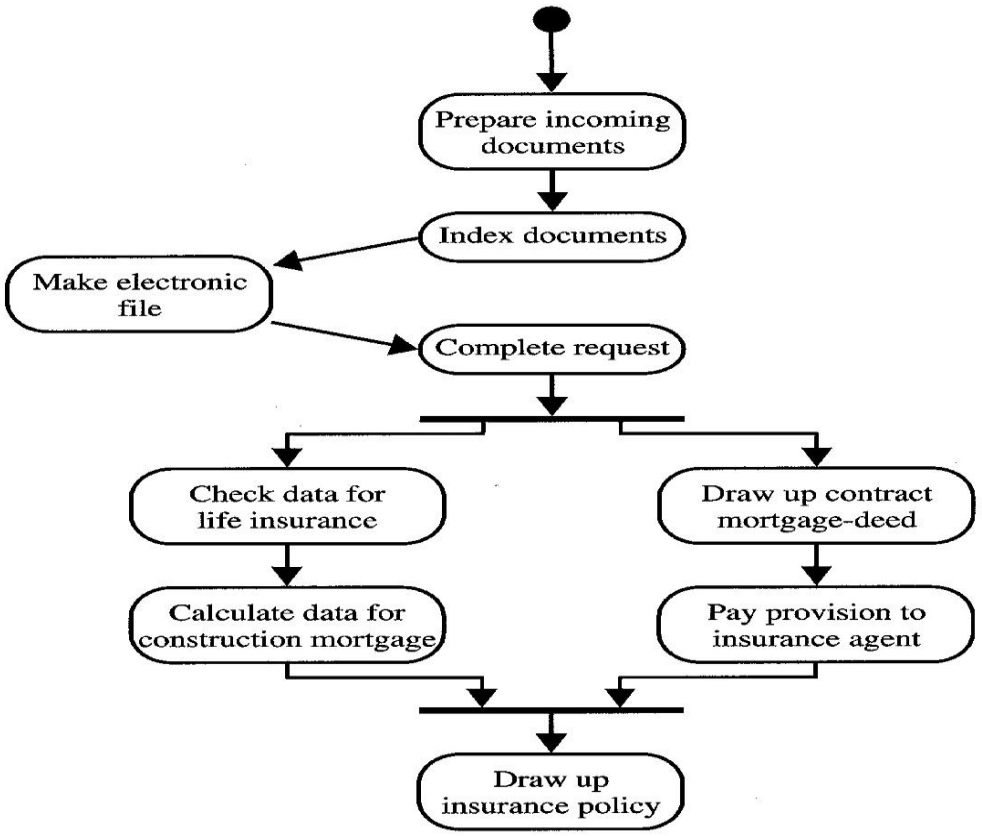
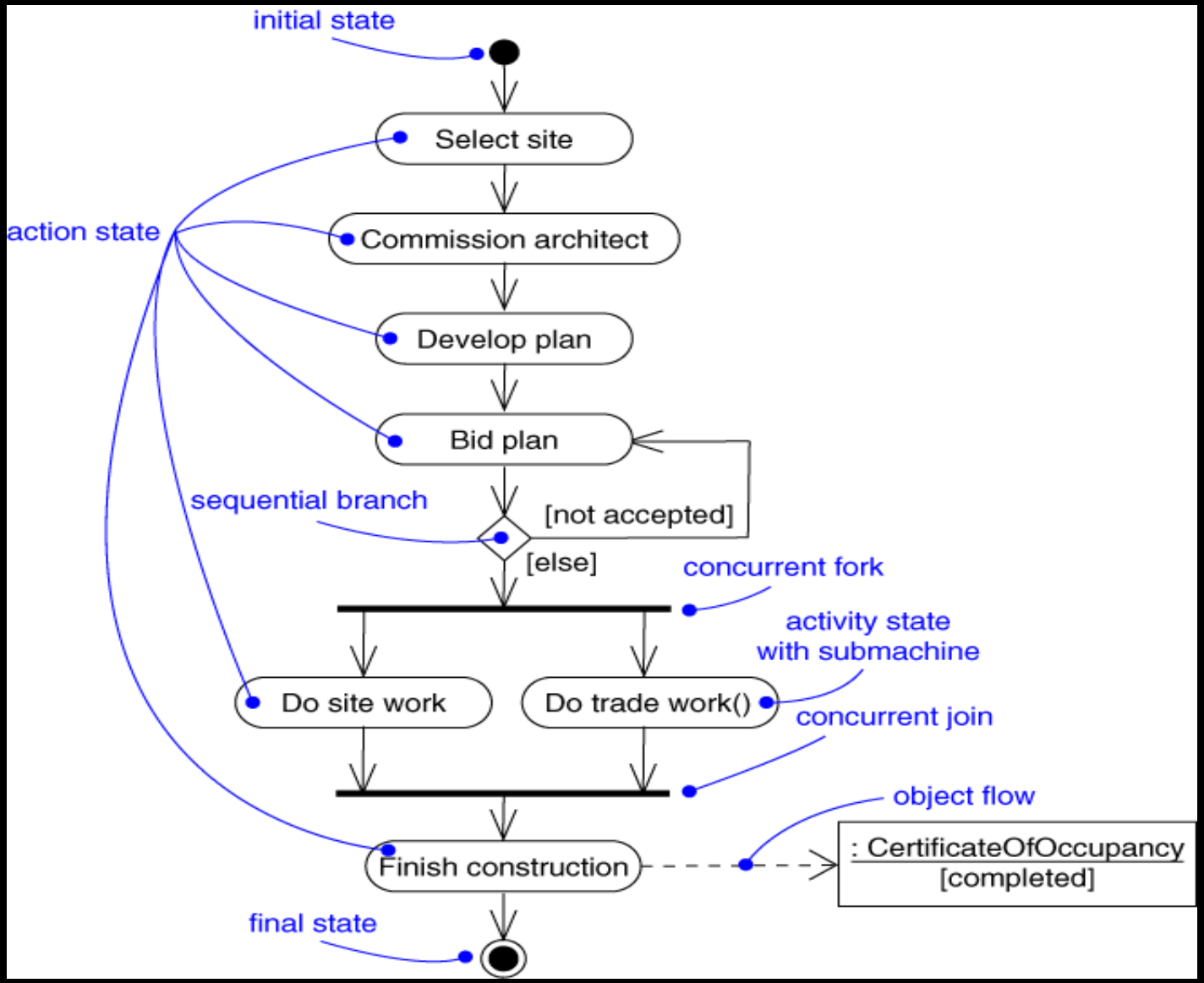


FIGURE 5–20
An activity diagram for processing mortgage requests (Loan: Processing Mortgage Request).

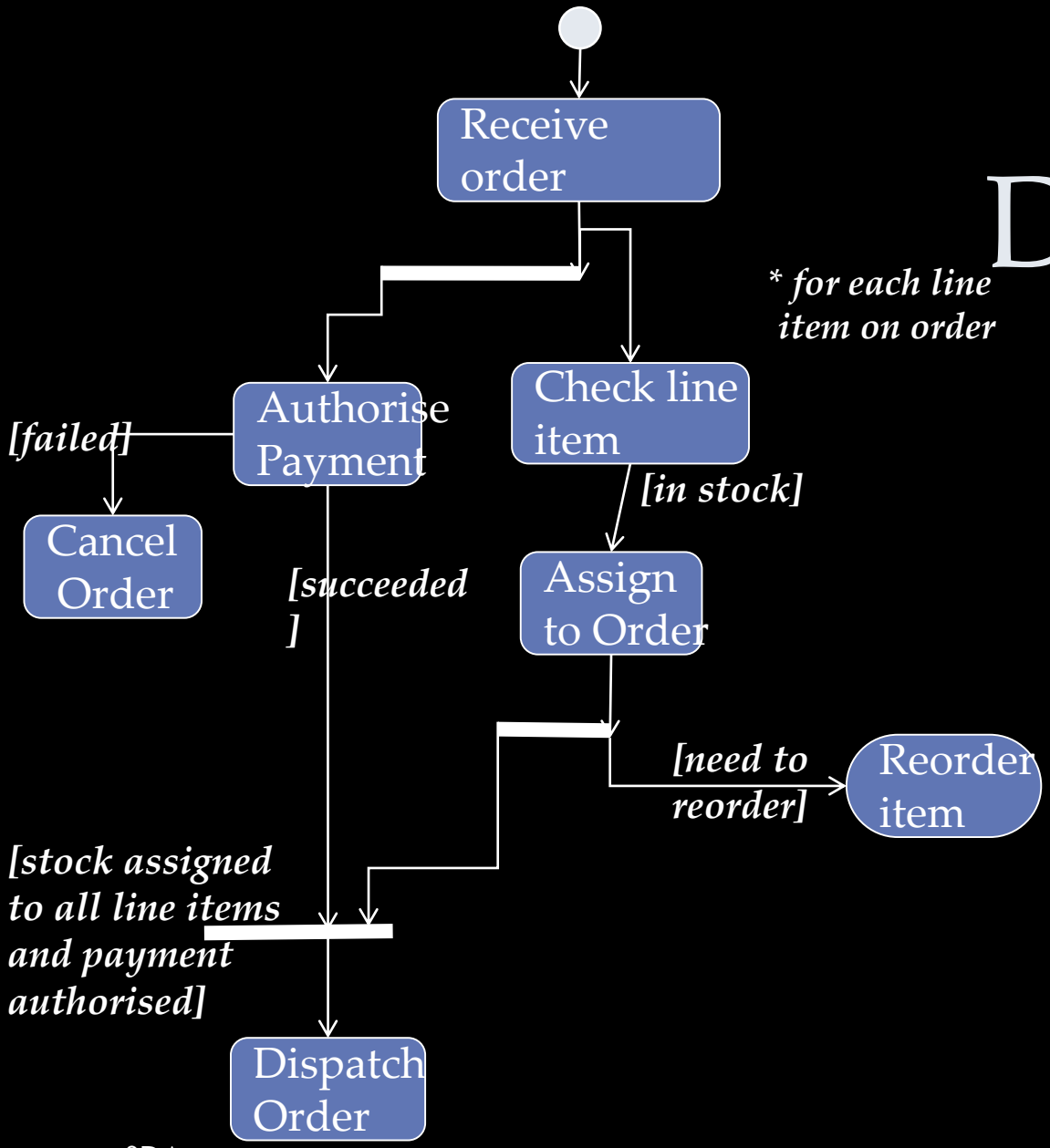
Activity Diagram: Example (4)



Use Case for Order Processing (Generic system)

- *"When we receive an order, we check each line item on the order to see if we have the goods in stock. If we do, we assign the goods to the order. If this assignment sends the quantity of those goods inn stock below the reorder level, we reorder the goods. While we are doing this, we check to see if the payment is OK. If the payment is OK and we have the goods in stock, we dispatch the order. If the payment is OK but we don't have the goods, we leave the order waiting. If the payment isn't OK, we cancel the order."*

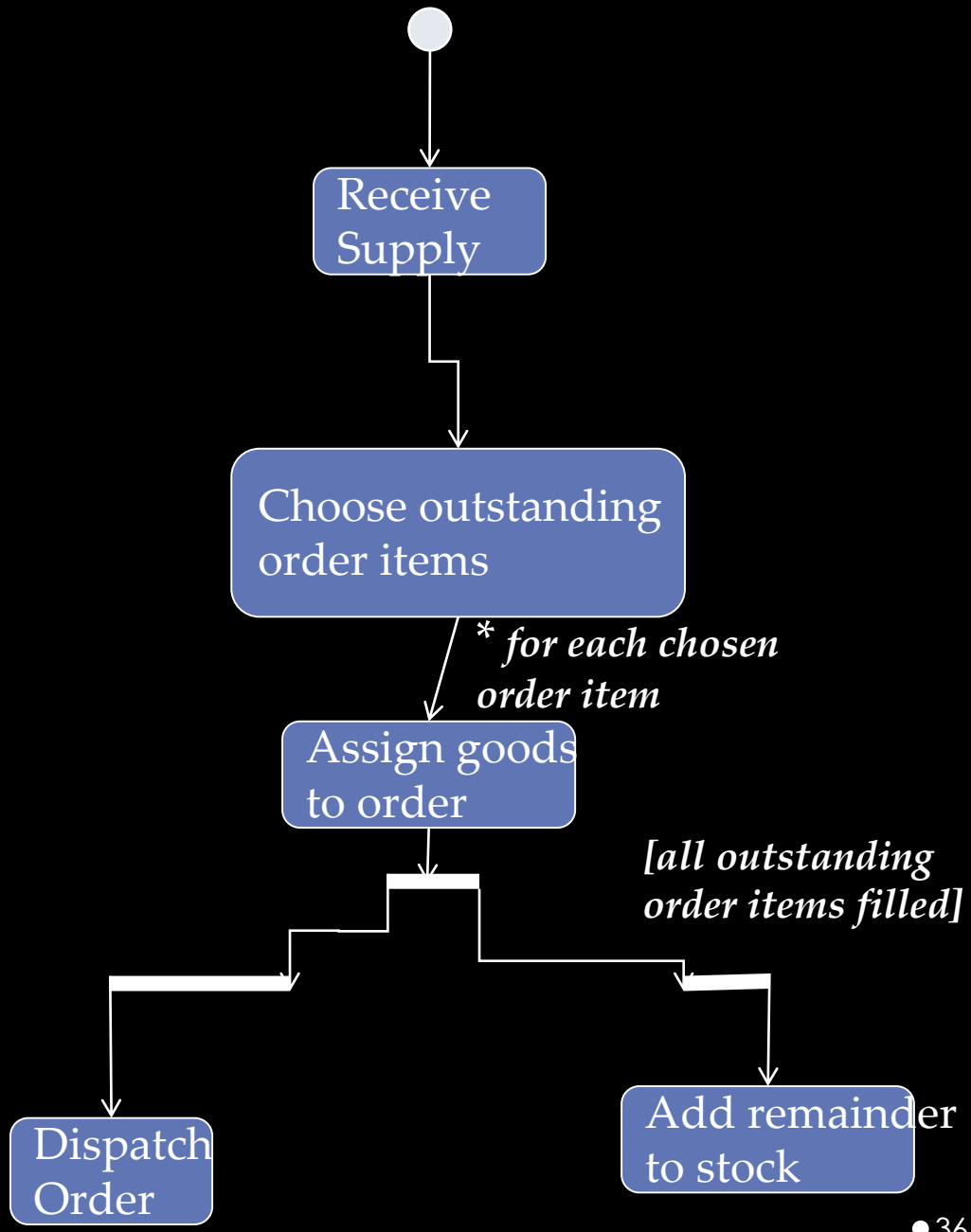
Activity Diagram for Receiving an Order



Receiving Supply

- *"When a supply delivery comes in, we look at the outstanding orders and decide which ones we can fill from this incoming supply. We then assign each of these to its appropriate orders. Doing this may release those orders for dispatching. We put the remaining goods into stock."*

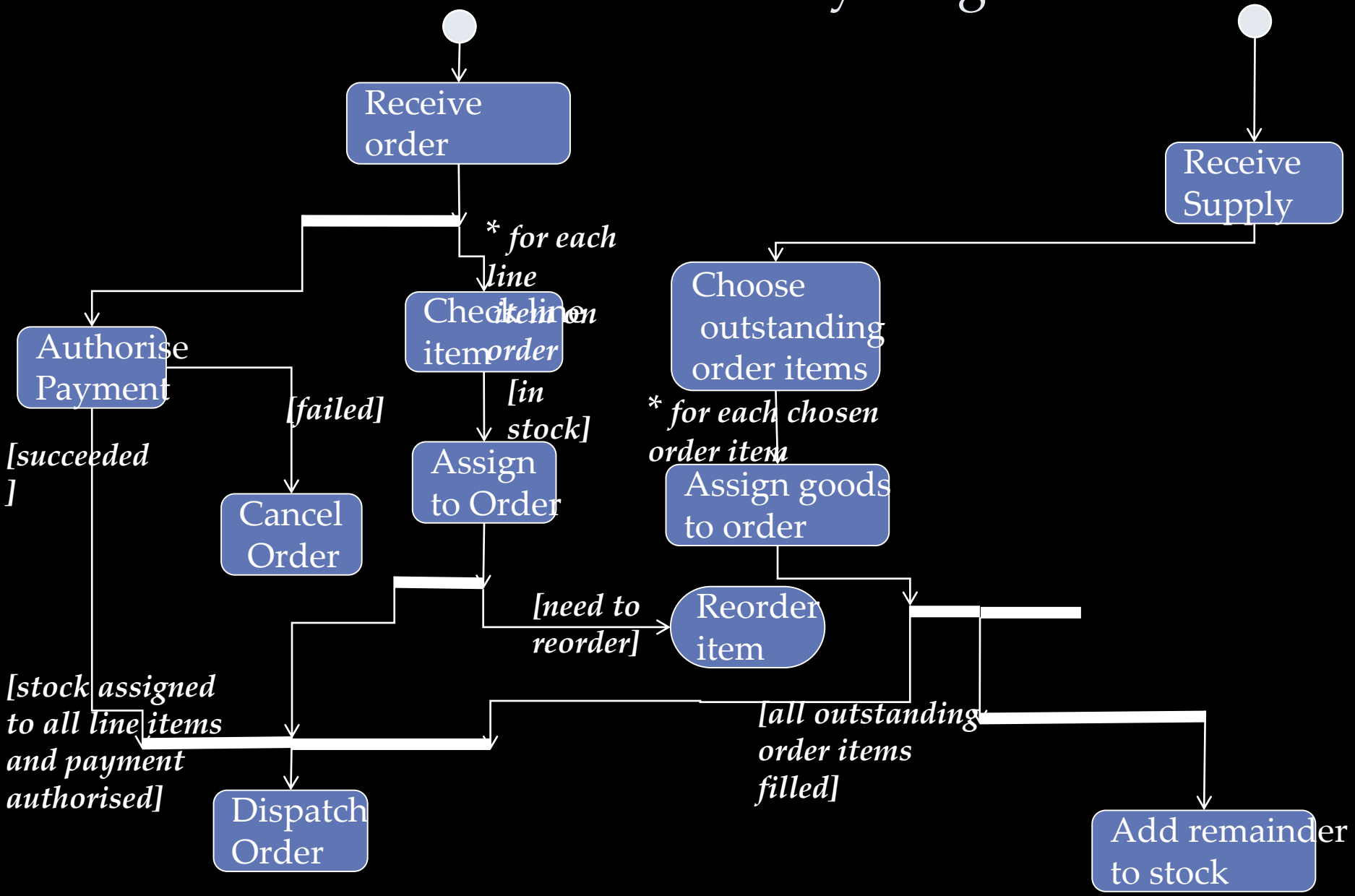
Activity Diagram for receiving Supply



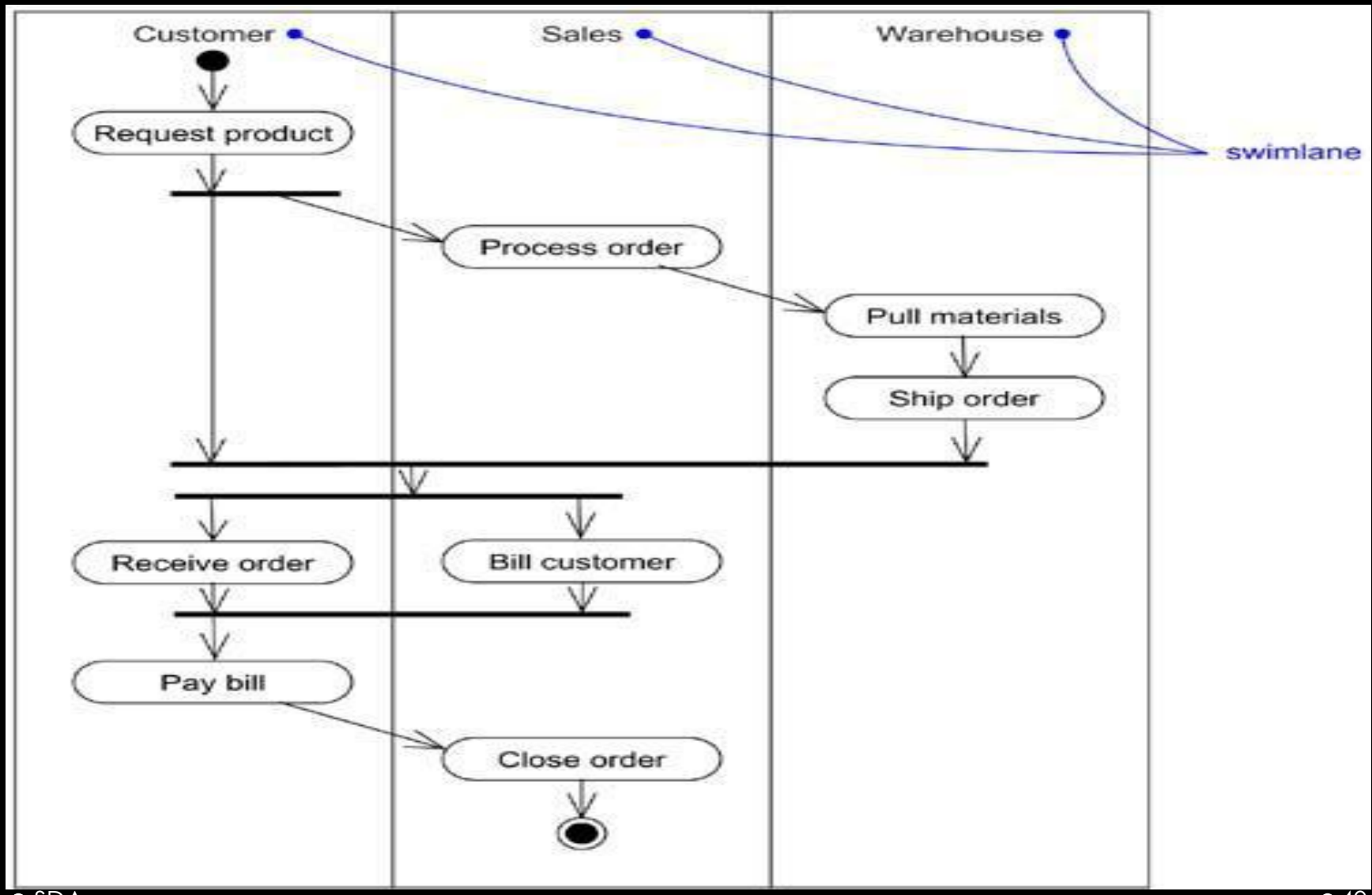
Combining Use Cases

- The end point of an activity diagram is the point at which all triggered activities have been run and there are no more left to do.
- Dead ends (e.g. Reorder item) can occur.
- Sometimes dead ends meet up with other use cases (e.g. Check line item).

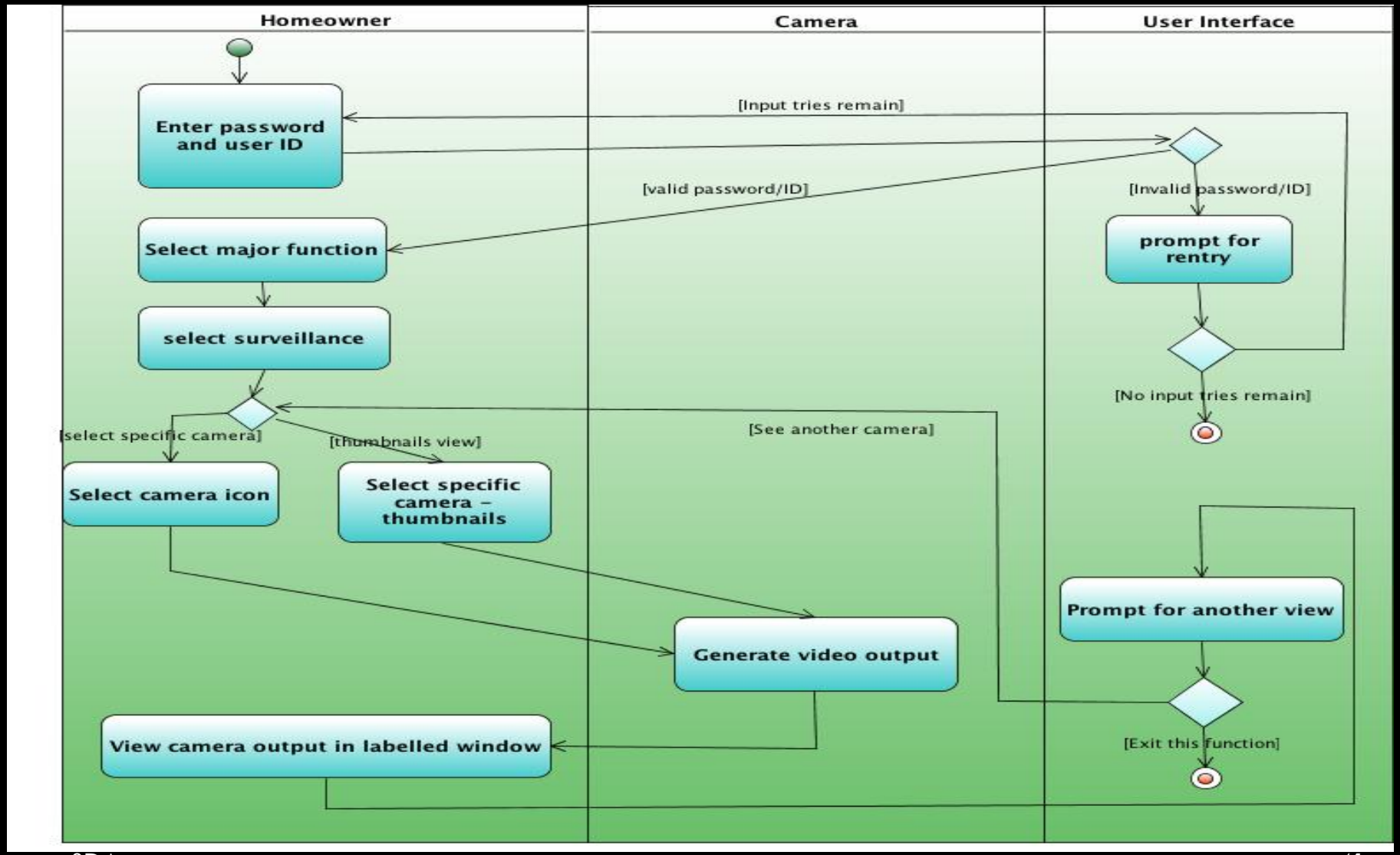
Combined Activity Diagram



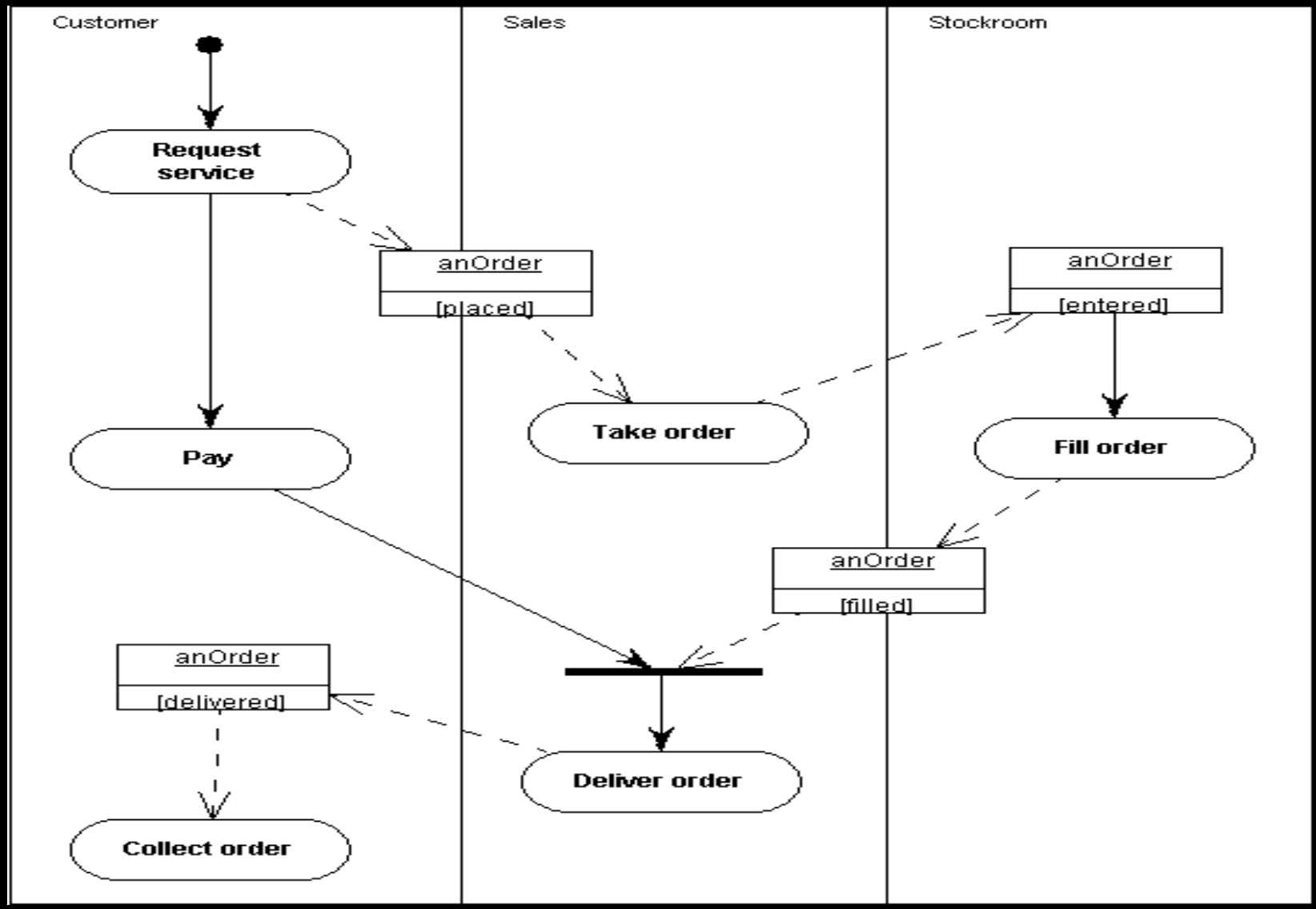
Swimlane Example

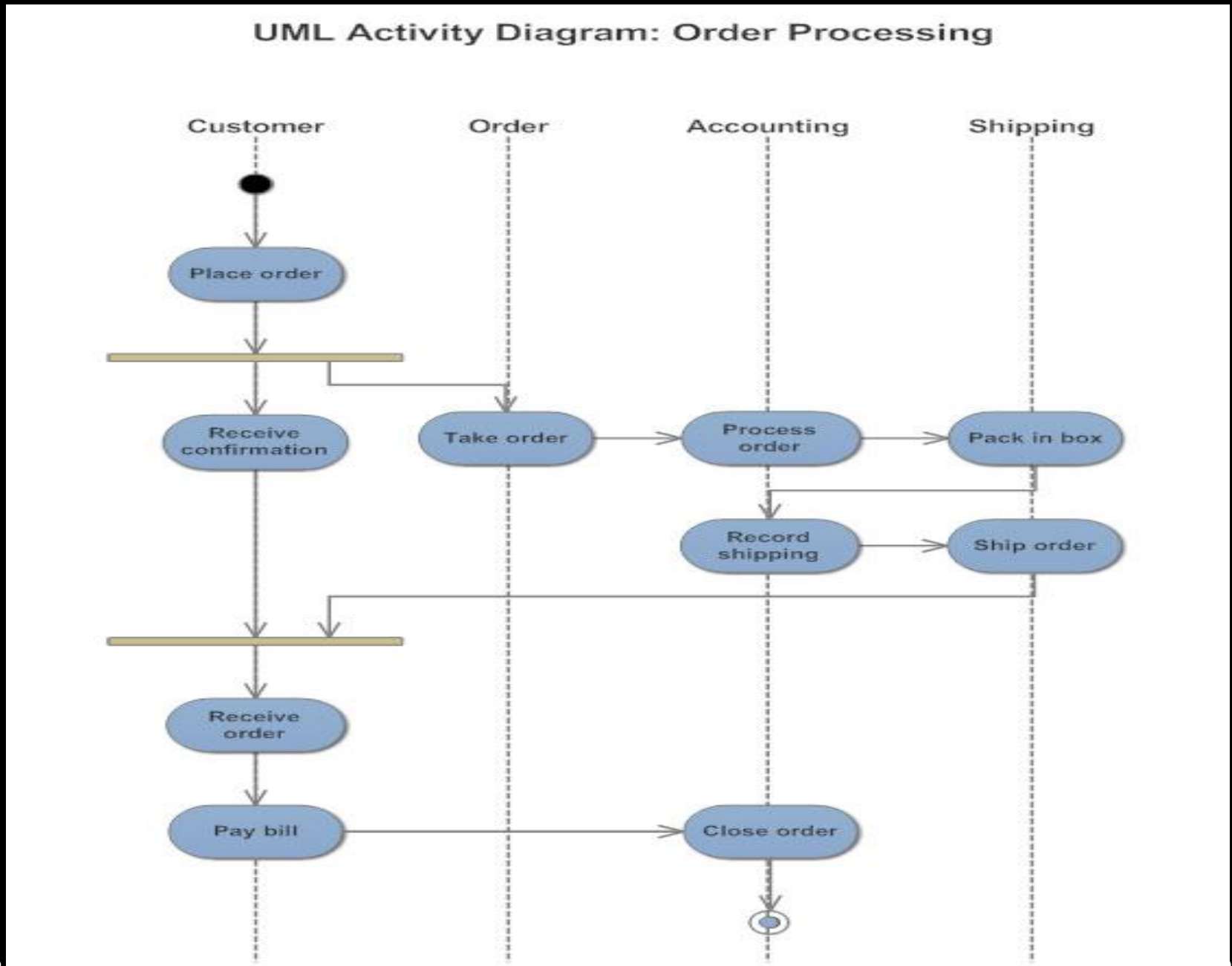


Swimlane Diagram



Activity Diagram: Example




UML Activity Diagram: Order Processing
Customer
Order
Accounting
Shipping
Place order
Receive confirmation
Take order
Process order
Pack in box
Record shipping
Ship order
Receive order
Pay bill
Close order

Homework Task

- Create a swimlane activity diagram for opening a Lemonade stand.
- Create a swimlane diagram to apply for and get a job when you graduate.
- Create a swimlane diagram for withdrawing money from an ATM.

That is all