Activity Diagram

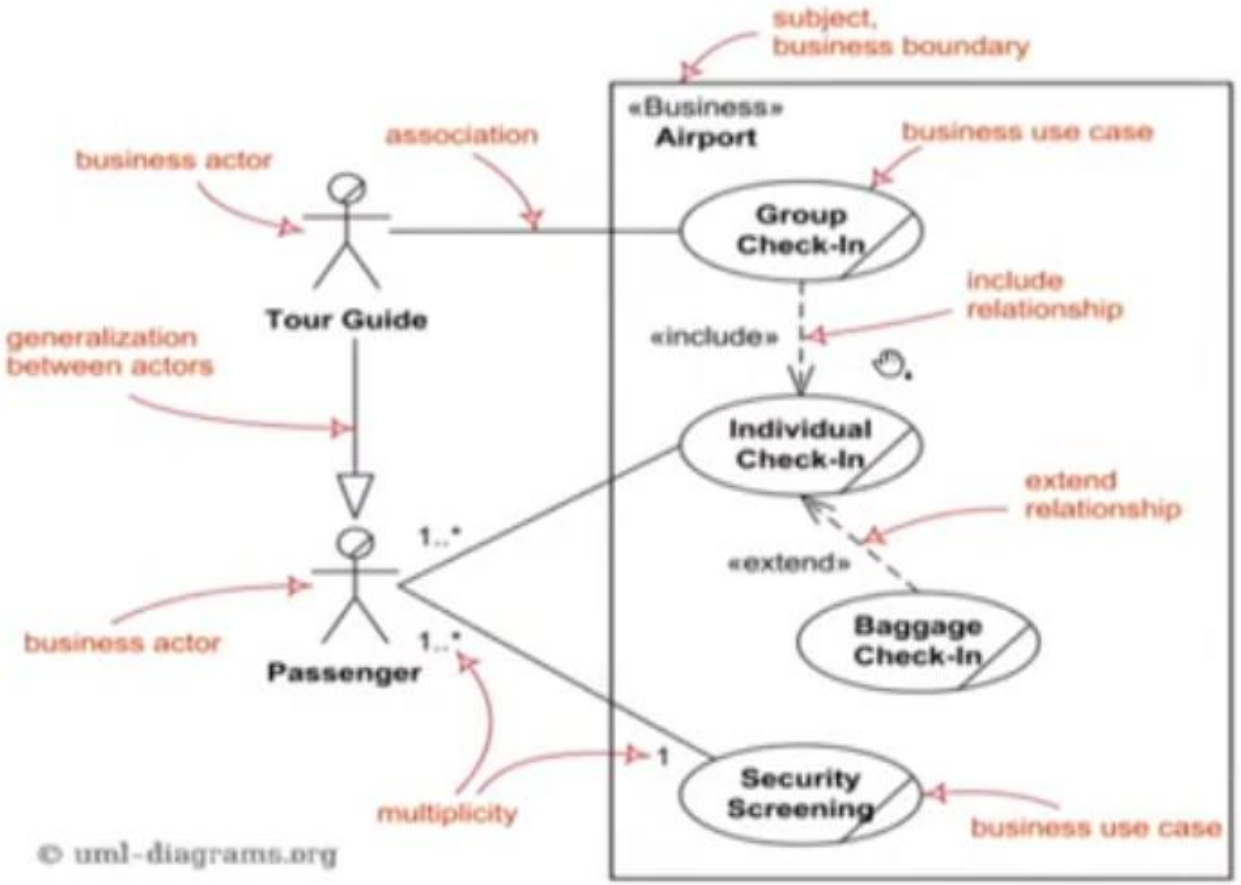
Overview

- What are Activity Diagrams?
  - Activity
  - Partition
  - Activity Edge
  - Control
  - Objects
  - Actions
- Activity Diagram for LMS

- No object exists in isolation
- Objects are acted on and themselves act on other objects
- Leads to the **Client-Server Model** of computing where
  - Behavior is
    - Services provided by an object
  - Services are requested by
    - Sending Messages, Invoking Operations
  - In Client-Server View
    - Clients request for Services
    - Servers provide Services
    - Contract between client and server ensures correctness

Activity Diagram

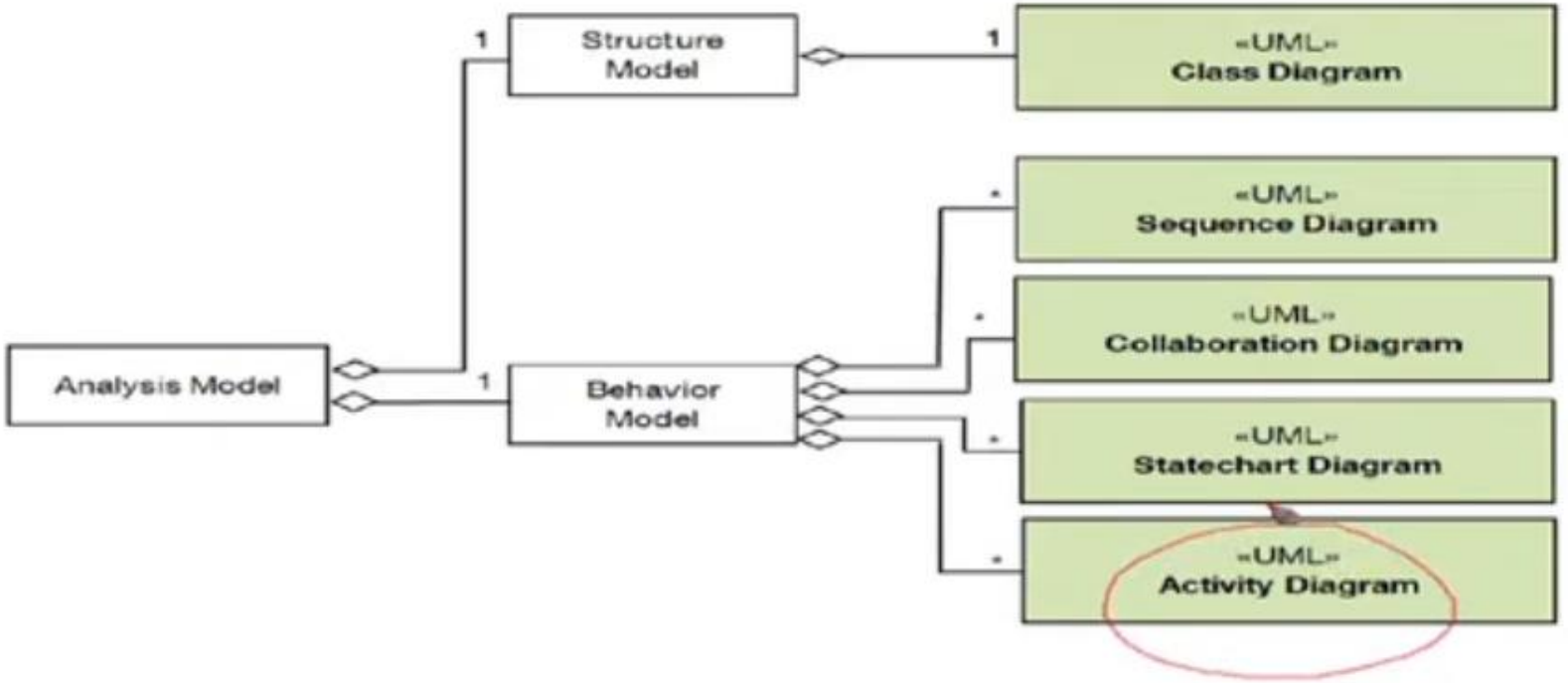
Uses Cases represent major Activities of the System



Group Check-in, Individual Check-in, Baggage Check-in and Security Screening are major activities of the Airport System

Activity Diagram

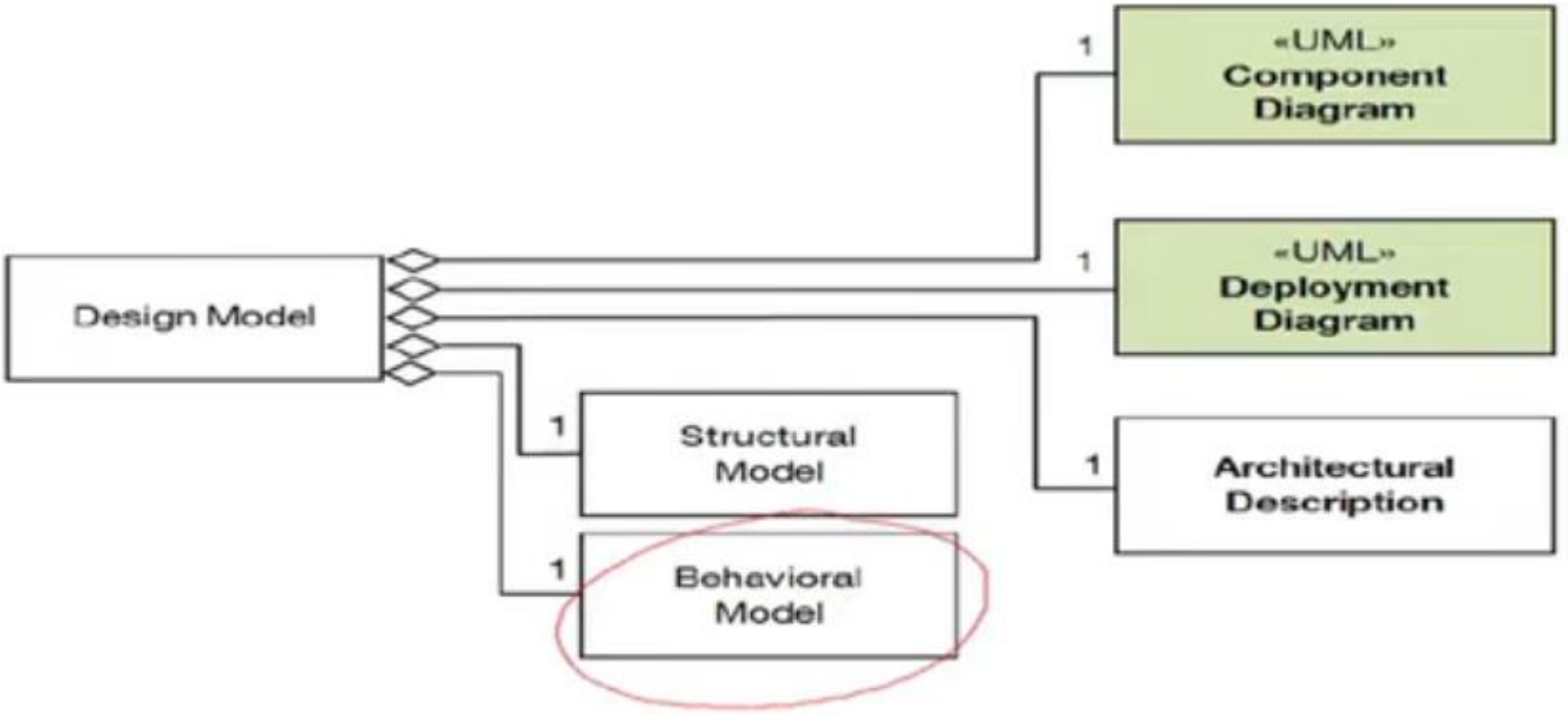
Activity Diagrams in the SDLC Phases



- In the Analysis Phase the problem domain is analyzed and refined from the Requirements Phase
- The behavior model of the system is hence understood in this phase
- Activity diagram is a result of the Analysis Phase

Activity Diagram

Activity Diagrams in the SDLC Phases



- Activity is included in the Behavioral Model
- It is further refined in the Design Phase

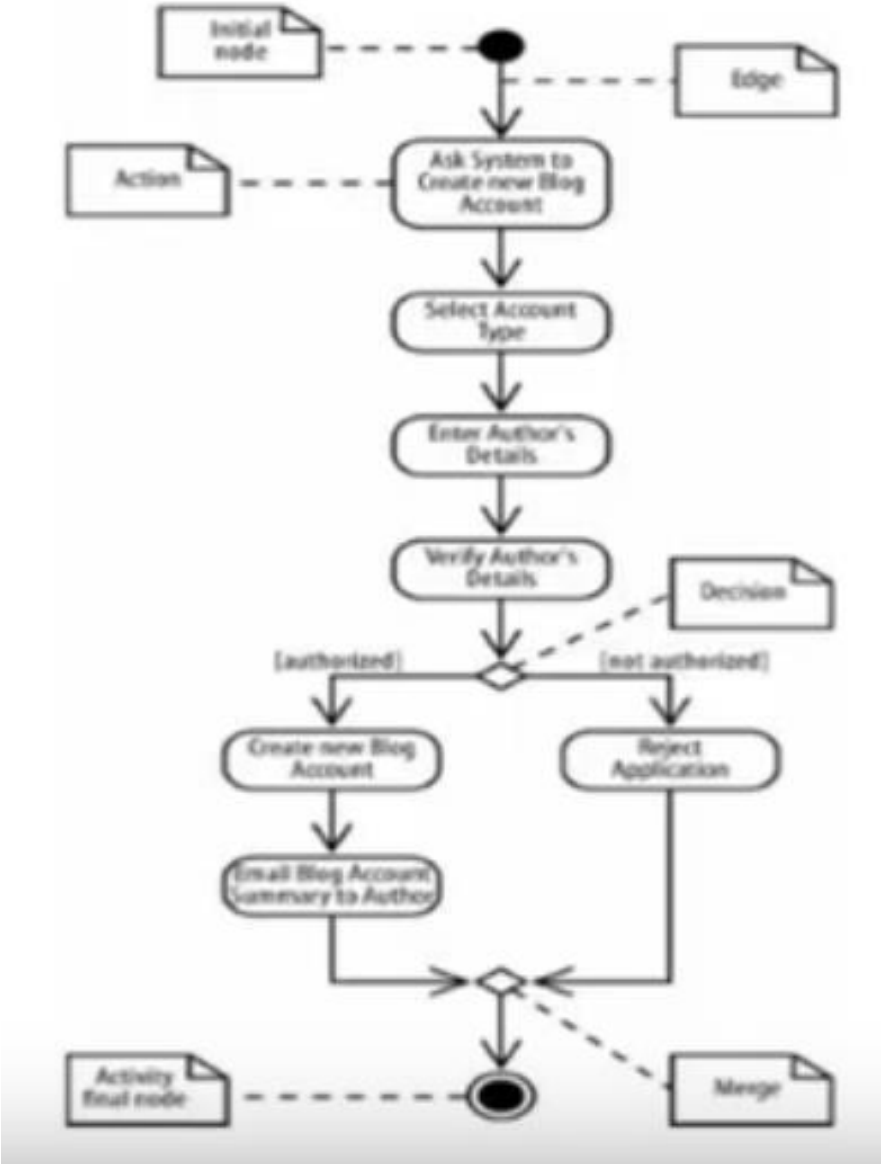
Activity Diagram

What are Activity Diagrams?

- Activity Diagram is a UML behavior diagram which shows **flow of control** or **object flow** with emphasis on the sequence and conditions of the flow
- Activity Diagrams resemble old-school flow-charts
- Typically used to model an algorithm (sequential as well as concurrent / parallel) or use-case realization
- The actions coordinated by activity models can be initiated because
  - other actions finish executing,
  - objects and data become available, or
  - some events external to the flow occur
- The major components of an Activity Diagram are:
  - Activity
  - Partition
  - Activity Edge
  - Control
  - Objects
  - Actions

Activity Diagram

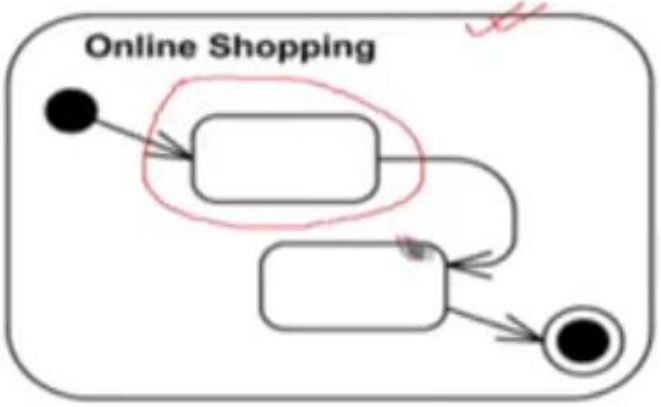
Blog Account Creation Process – Activity Diagram



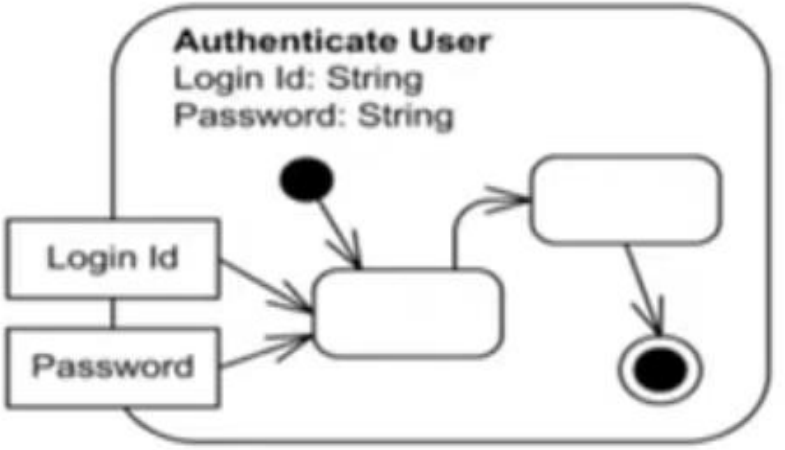
Activity Diagram

Activity

- **Activity** is a parameterized **behavior** represented as coordinated flow of **actions**
- It is denoted as round-cornered rectangle with activity name in the upper left corner containing the nodes and edges
- Activity parameters are displayed on the border as: **parameter-name: parameter-type**



Online Shopping activity



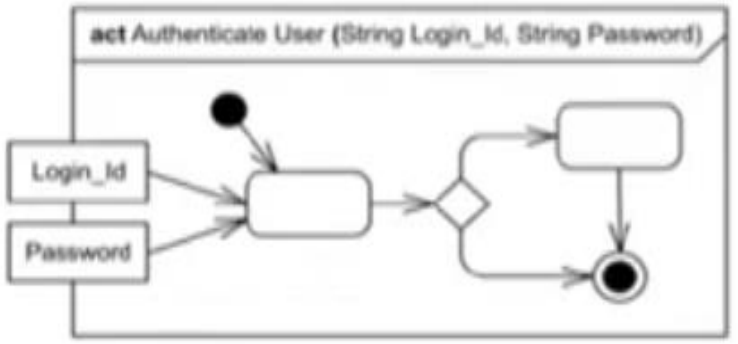
Authenticate User activity with two parameters - Login Id and Password

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

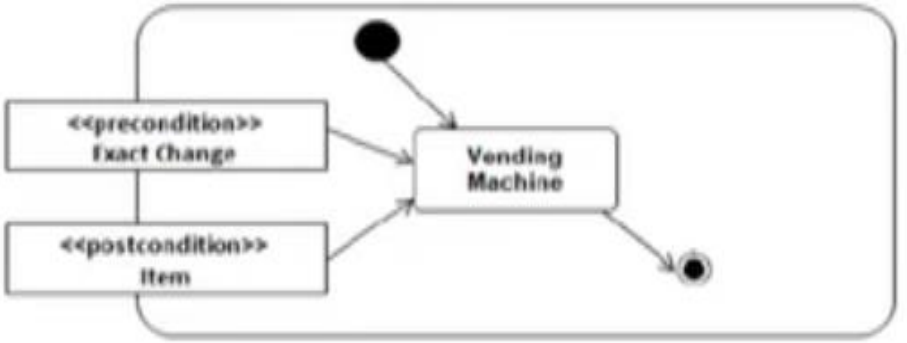
Activity Diagram

Activity

- As a **behavior** activity could have pre- and post-condition constraints, shown with the keywords ⟨⟨precondition⟩⟩ and ⟨⟨postcondition⟩⟩ respectively



Authenticate User activity frame with two parameters - Login Id and Password



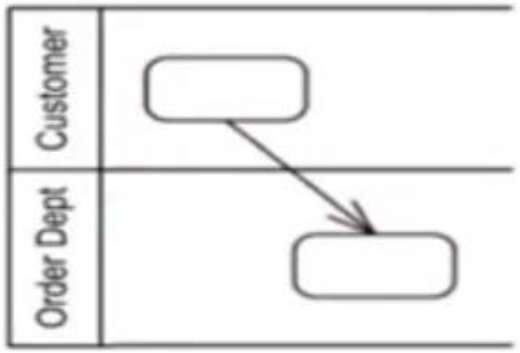
Vending machine activity with precondition and post condition

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

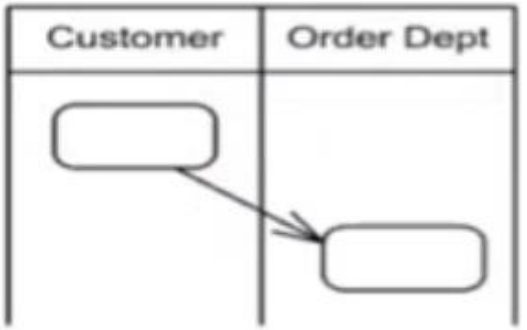
Activity Diagram

Activity Partition

- An **activity partition** is **activity group** for actions that have some common characteristic
- Partitions often correspond to **organizational units** or **business actors** in a **business model**
- **Activity partition** is shown with a **swimlane** notation - with two, usually parallel lines, either horizontal or vertical, with the partition name in a box at one end



Activity partitions Customer and Order Dept as horizontal swimlanes



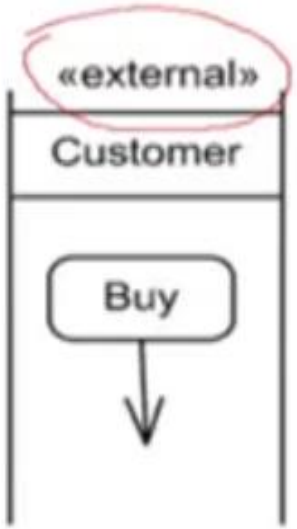
Activity partitions Customer and Order Dept as vertical swimlanes

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

Activity Partition

- Partition could represent an external entity to which the partitioning structure does not apply, labeled with keyword ⟨⟨external⟩⟩



Buy action occurs in external partition Customer - Swimlane notation

Buy action occurs in external partition Customer - Activity notation

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

Activity Edge

- Activity Edge is an abstract class for the directed connections along which tokens or data objects flow between activity nodes
- It includes
  - **control edges**
  - **object flow edges**

Activity edge connects Fill Order and Review Order

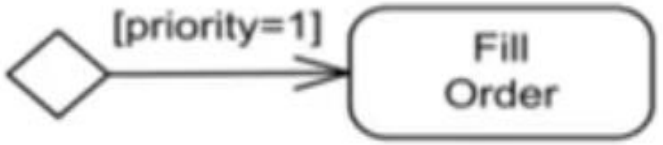
Activity edge "updated" connects two nodes

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

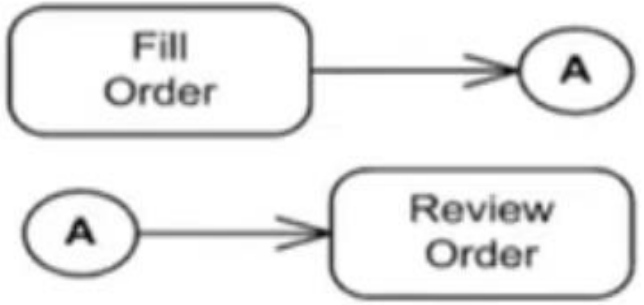
Activity Edge

- Activity edge can have a guard – specification evaluated at run-time to determine if the edge can be traversed
- **The guard of the activity edge is shown in square brackets that contain the guard**



Fill Order when priority is 1

- **An activity edge can be notated using a connector, which is a small circle with a name inside**



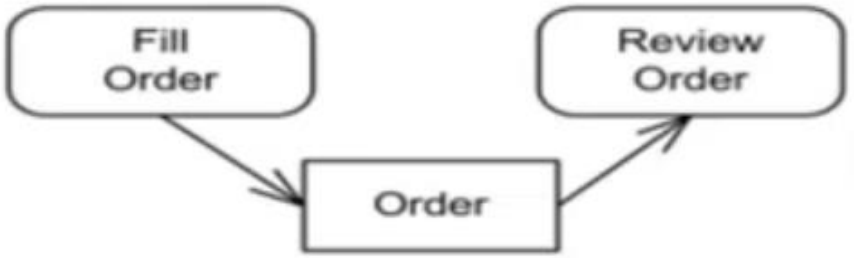
Connector A connects two edges between Fill Order and Review Order

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

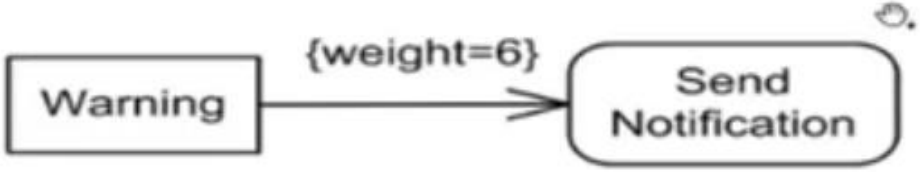
Activity Diagram

Object Flow Edge

- Object flow edges are activity edges used to show data flow of object and data tokens between action nodes
- The weight attribute dictates the minimum number of tokens that must traverse the edge at the same time



Object flow of Orders between Fill Order and Review Order actions



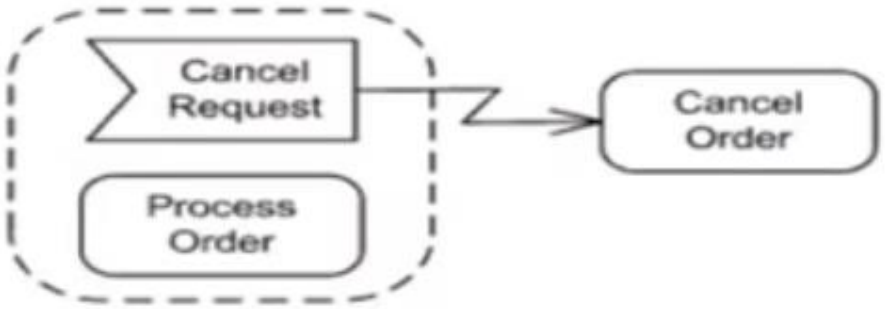
Send Notification when number of Warnings reaches 6

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

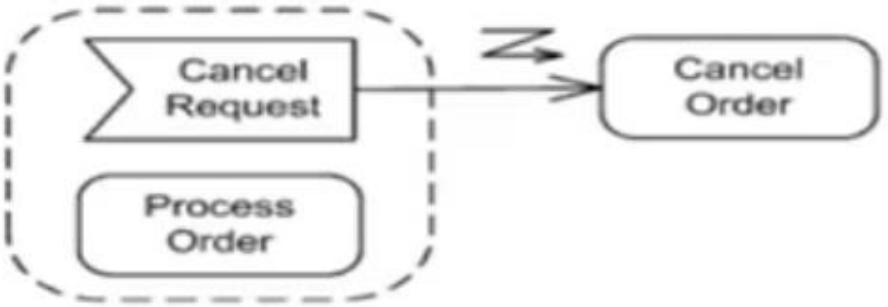
Activity Diagram

Interrupting Edge

- Interrupting edge is activity edge expressing interruption for regions having interruptions
- It is rendered as a lightning-bolt or zigzag adornment on a straight line



Cancel Request signal causes interruption resulting in Cancel Order

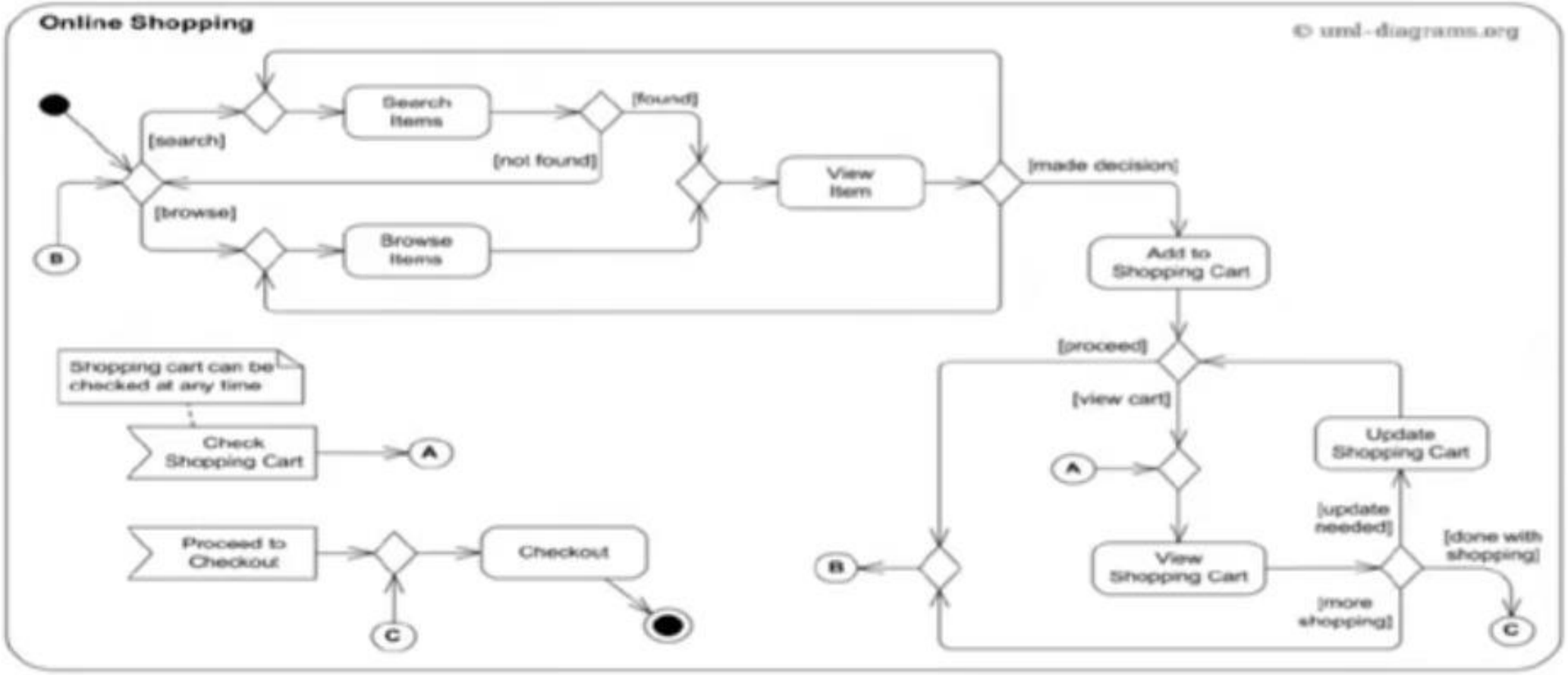


Cancel Request signal causes interruption resulting in Cancel Order

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

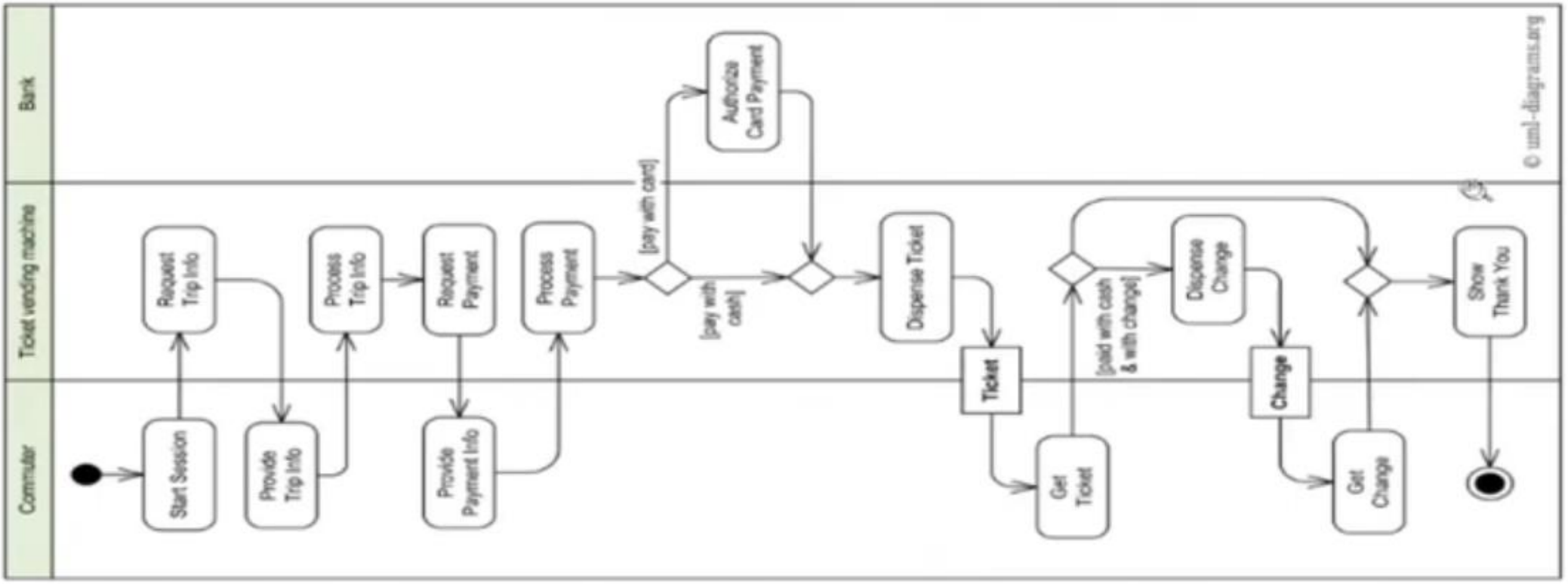
Activity Diagram

Online Shopping



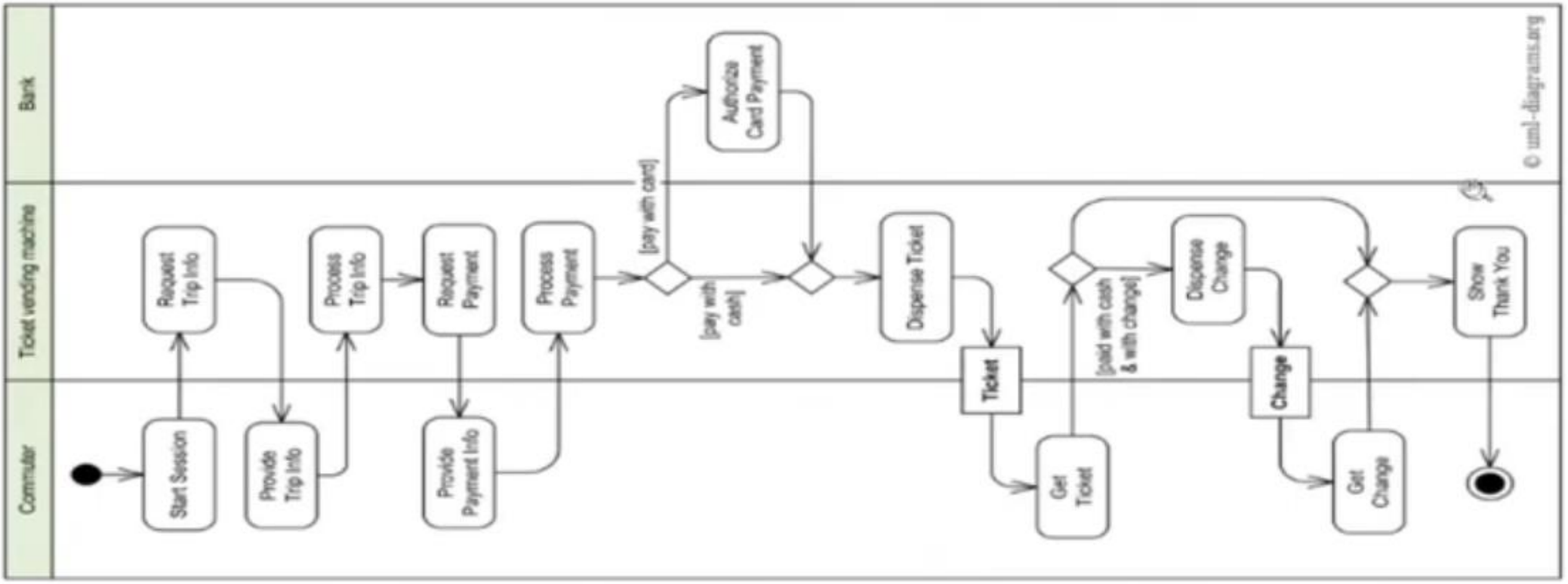
Activity Diagram

Ticket Vending Machine



Activity Diagram

Ticket Vending Machine



Activity Diagram Summary

- Activity Diagrams are introduced
- Various components of Activity Diagram like Activity, partition, and edge are discussed
- Examples are illustrated

Activity Diagram

- What are Activity Diagrams?
  - Activity
  - Partition
  - Activity Edge
  - Control
  - Objects
  - Actions
- Activity Diagram for LMS

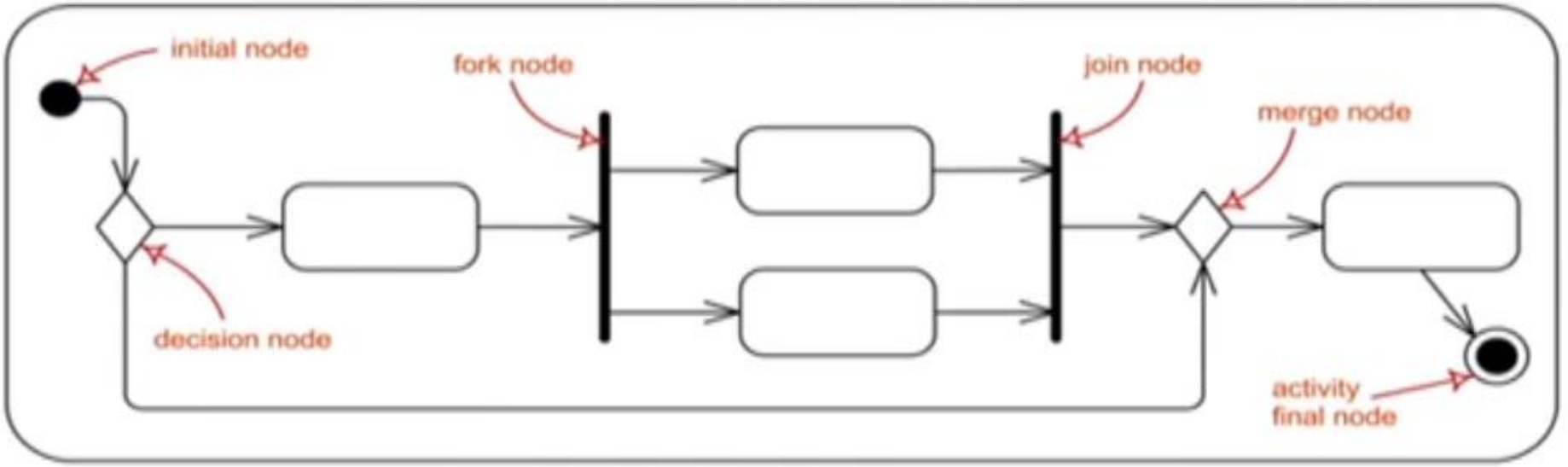
Activity Diagram

Control

- Control node is an activity node used to coordinate the flows between other nodes
- It includes:
  - Initial Node
  - Flow Final Node
  - Activity Final Node
  - Decision Node
  - Merge Node
  - Fork Node
  - Join Node

Activity Diagram

Activity Diagram – Control Node



Activity control nodes overview

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

Control Node- Initial, Flow Final and Activity Final Node

Initial node is a control node at which flow starts when the activity is invoked

Notation: Small solid circle

Activity initial node

Flow final node is a control final node that terminates a flow

Notation: Small circle with X inside

Flow final node

Activity final node is a control final node that stops all flows in an activity

Notation: Solid circle with a hollow circle inside

Activity final node

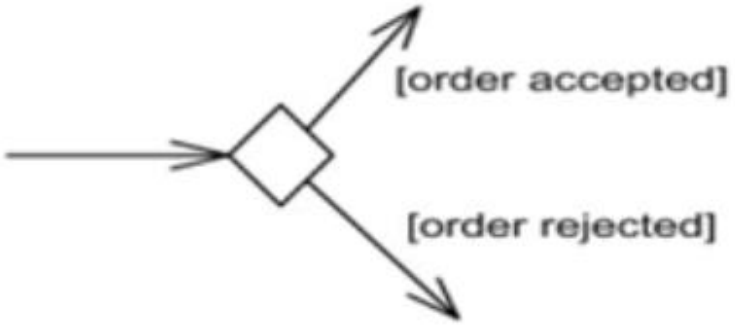
Activity Diagram

Control Node- Decision Node

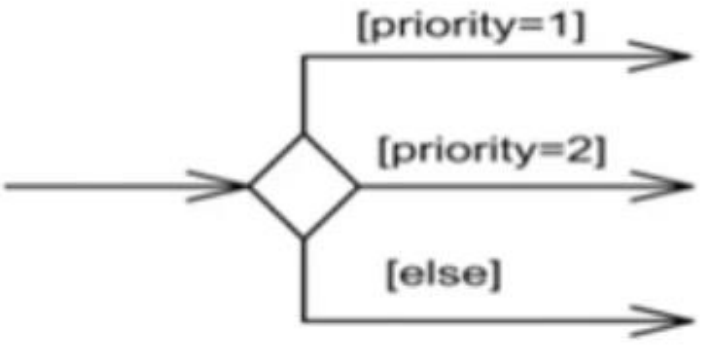
Decision node is a control node that accepts tokens on one or two incoming edges and selects one outgoing edge from one or more outgoing flows

Guards define which outgoing edge will be traversed

Notation: Diamond-shaped symbol



Decision node with two outgoing edges with guards



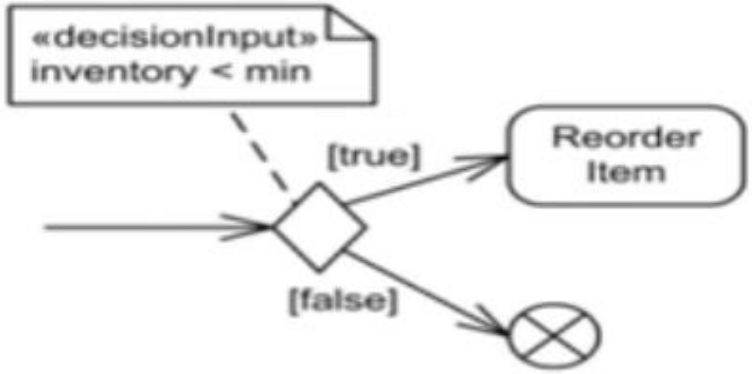
Decision node with three outgoing edges and [else] guard

Activity Diagram

Control Node- Decision Node

Tokens (Incoming activity) is passed to the **Decision input behavior** before guards are evaluated on the outgoing edges

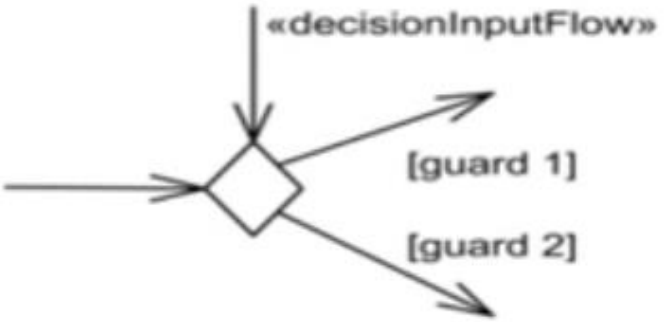
Notation: ⟨⟨decisionInput⟩⟩, note



Decision node with decision input behavior

Tokens (Incoming activity) of the **Decision input flow** are made available to the guards before evaluation

Notation: ⟨⟨decisionInputFlow⟩⟩

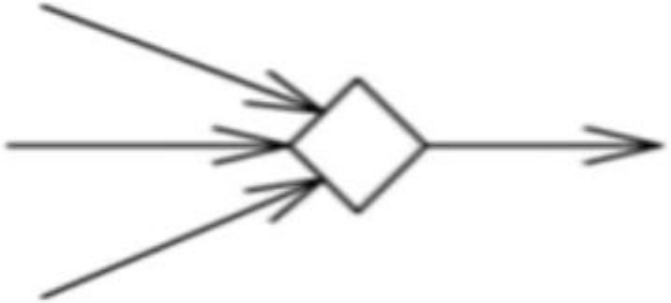


Decision node with decision input flow

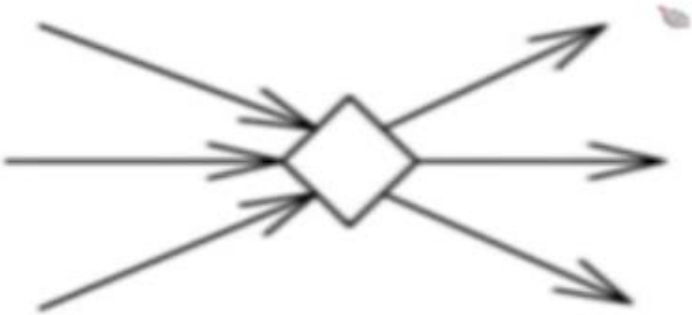
Activity Diagram

Control Node- Merge Node

- As a **Merge node** is a control node that brings together multiple incoming alternate flows to accept single outgoing flows (Control and Object Flows)
- Merge Node is non-blocking
- *Notation: Diamond-shaped symbol with two or more edges entering it and a single activity edge leaving it*



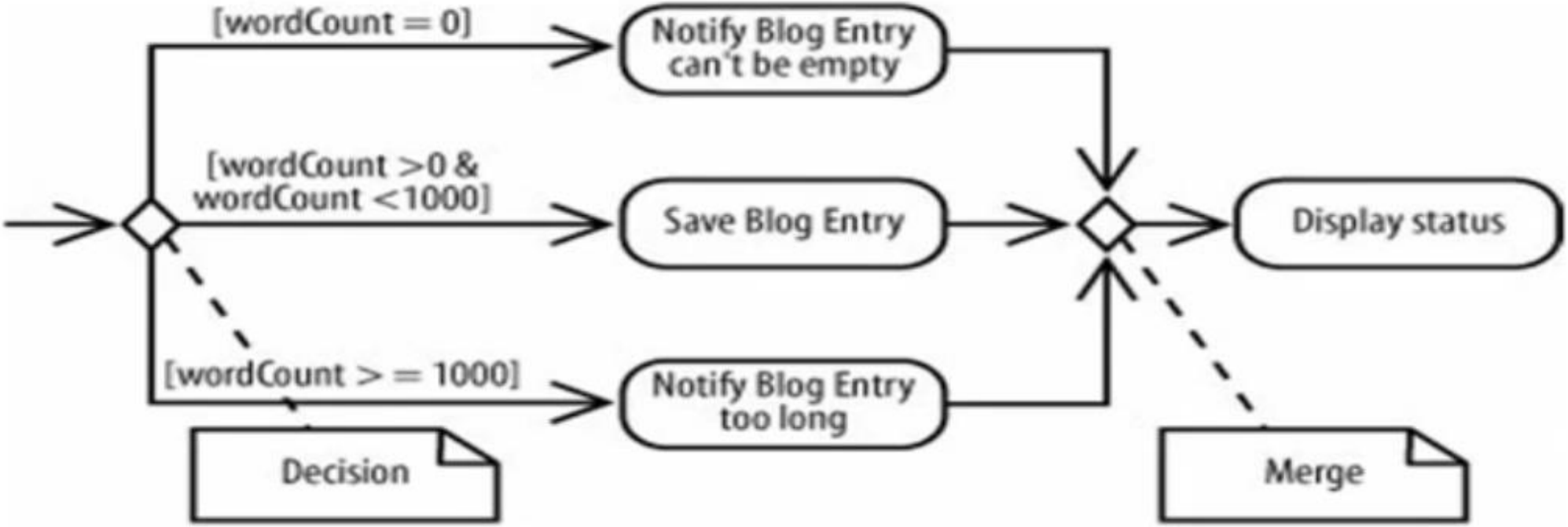
Merge node with three incoming edges and a single outgoing edge



Merge node and decision node combined using the same symbol

Activity Diagram

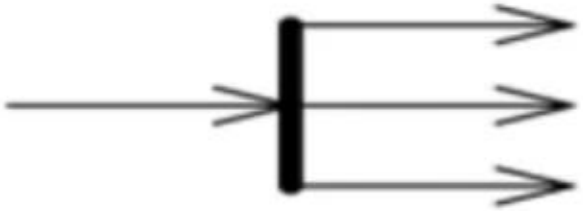
Control Node- Decision - Merger Node - Example



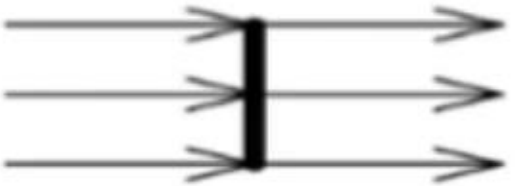
Activity Diagram

Control Node – Fork Node

- **Fork node** is a control node that has one incoming edge and multiple outgoing edges and is used to split incoming flow into multiple **concurrent** flows
- *Notation: Line segment with a single activity edge entering it, and two or more edges leaving it*



Fork node with a single activity edge entering it, and three edges leaving it

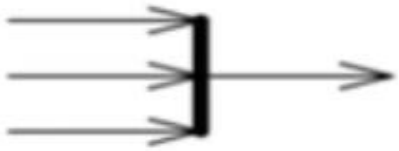


Combined join node and fork node

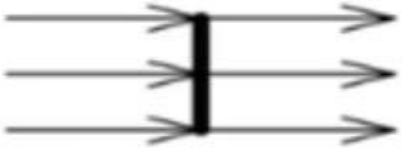
Activity Diagram

Control Node – Join Node

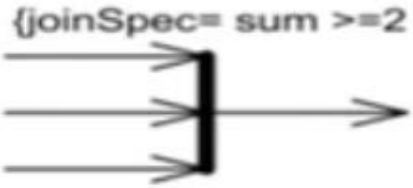
- **Join node** is a control node that has multiple incoming edges and one outgoing edge and is used to synchronize incoming **concurrent** flows
- Join Node is blocking
- *Notation: line segment with several activity edges entering it, and only one edge leaving it*



Join node with three activity edges entering it, and a single edge leaving it



Combined join node and fork node

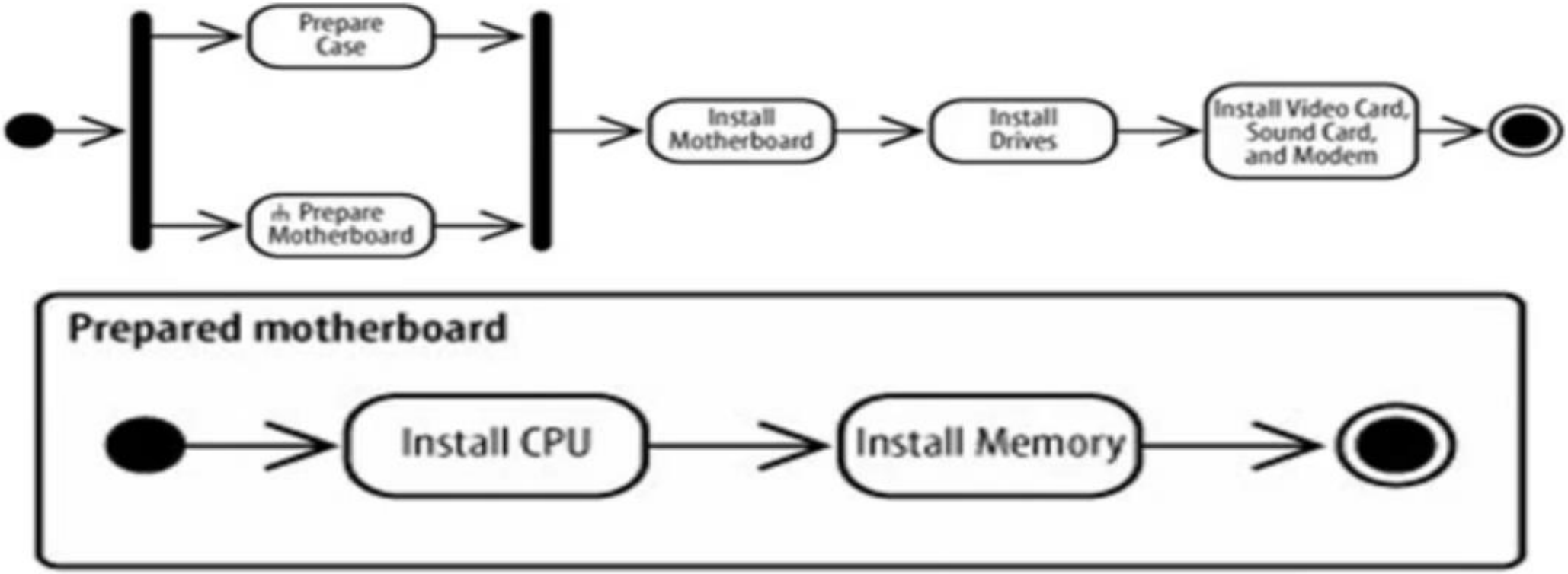


Join node with join specification shown in curly braces

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

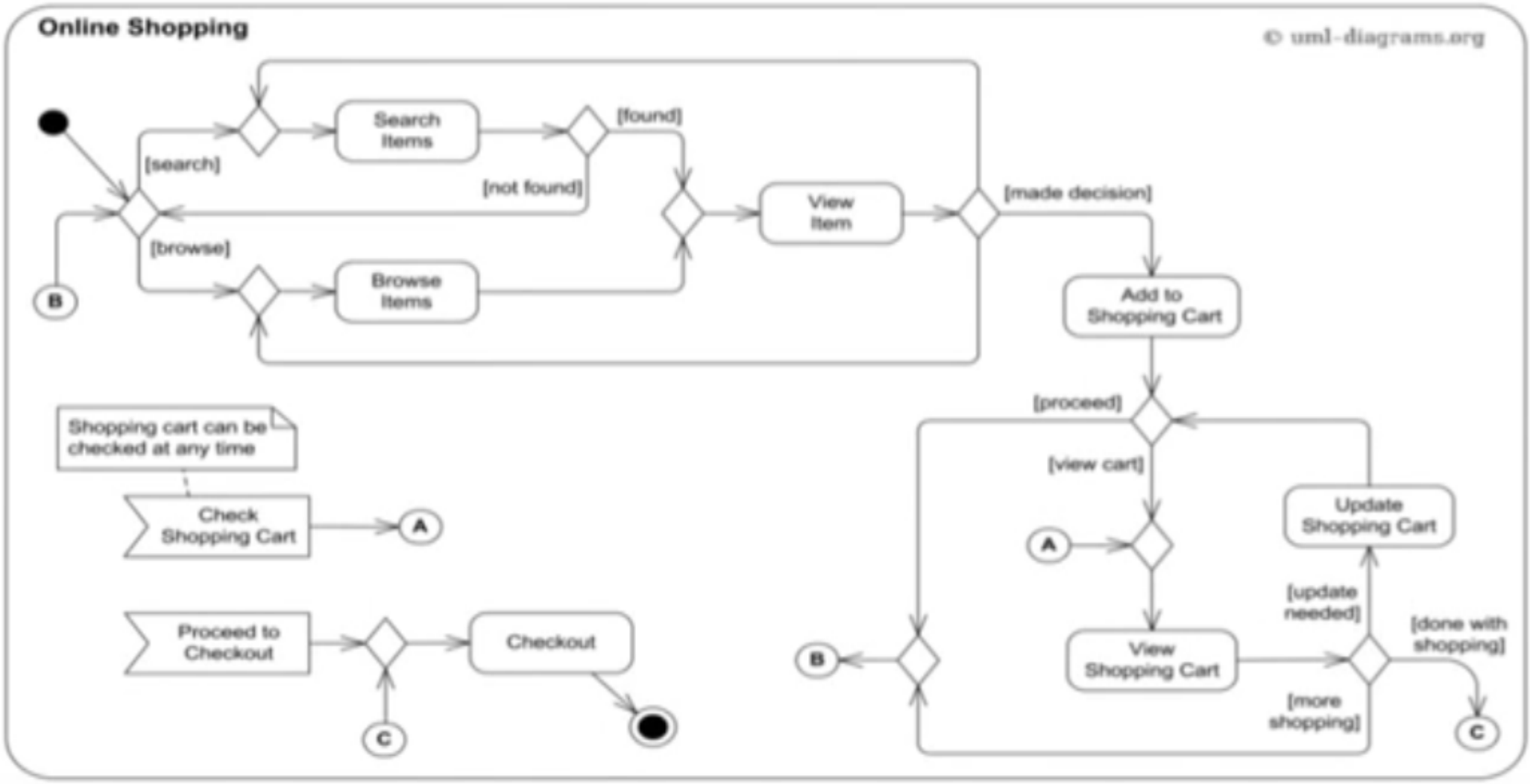
Activity Diagram

Control Node – Fork - Join Nodes Example



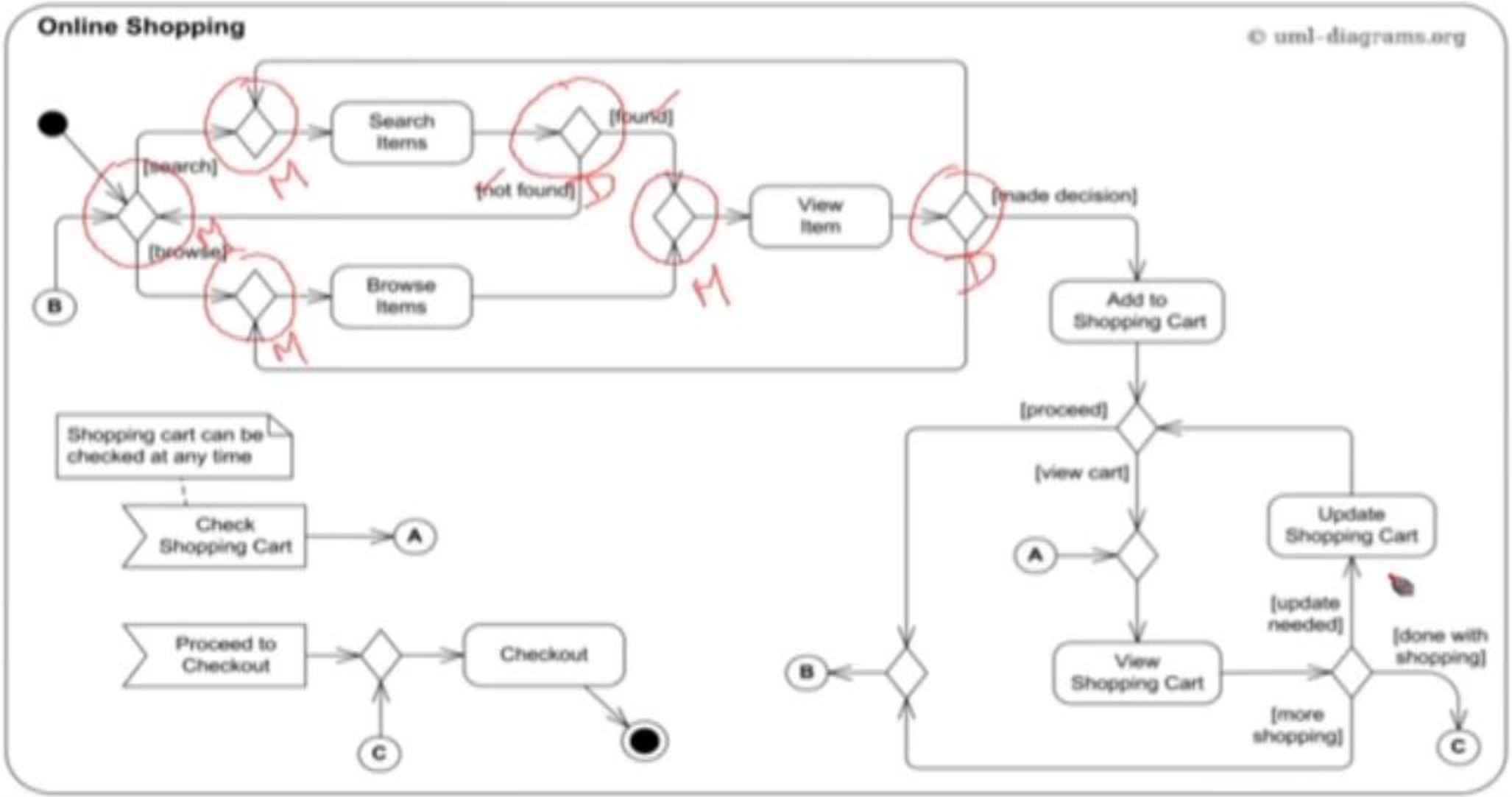
Activity Diagram

Activity Diagram - Online Shopping



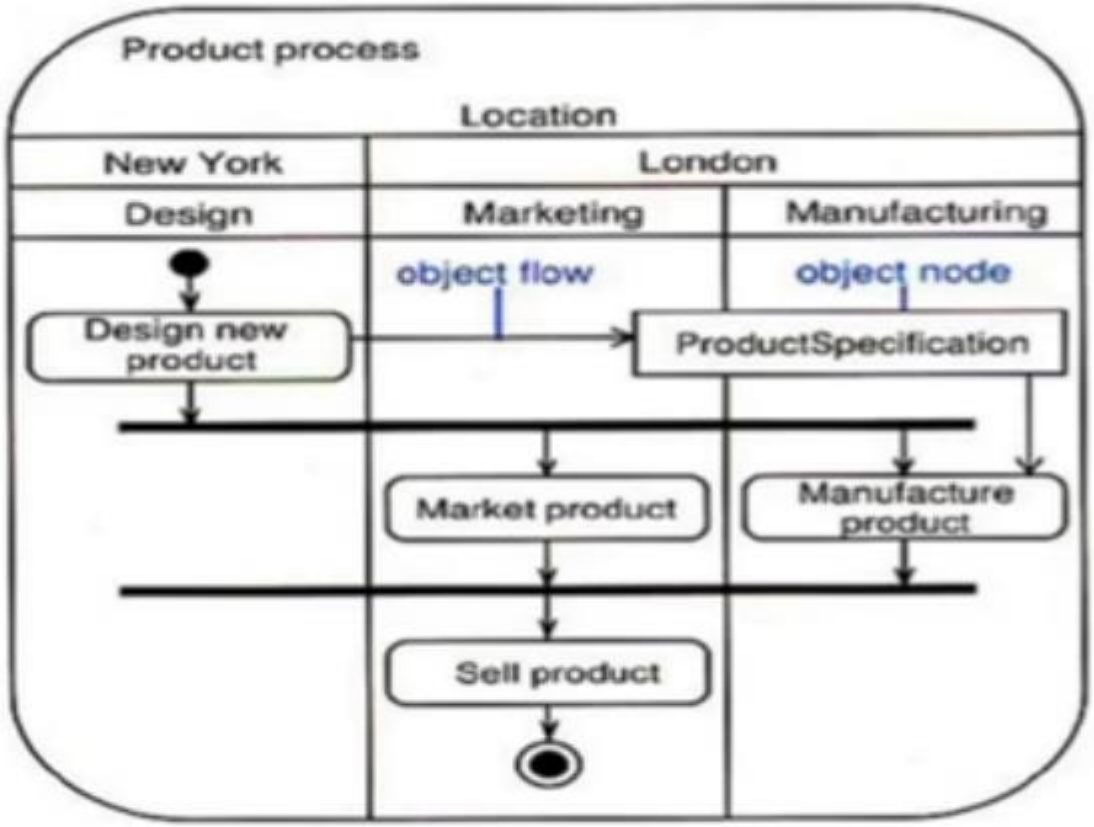
Activity Diagram

Activity Diagram - Online Shopping



Activity Diagram

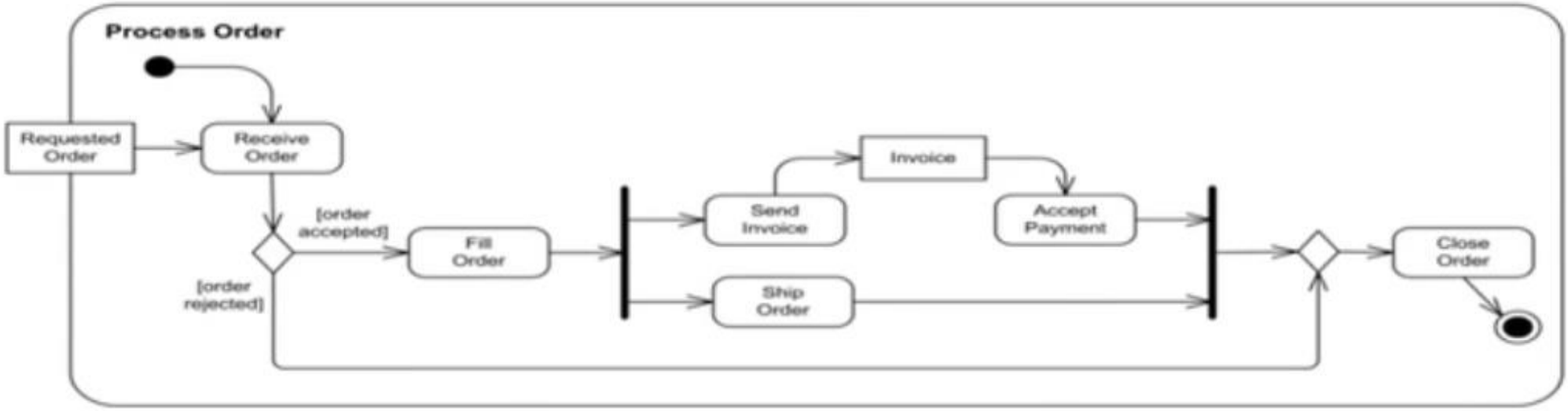
Activity Diagram – Product Process

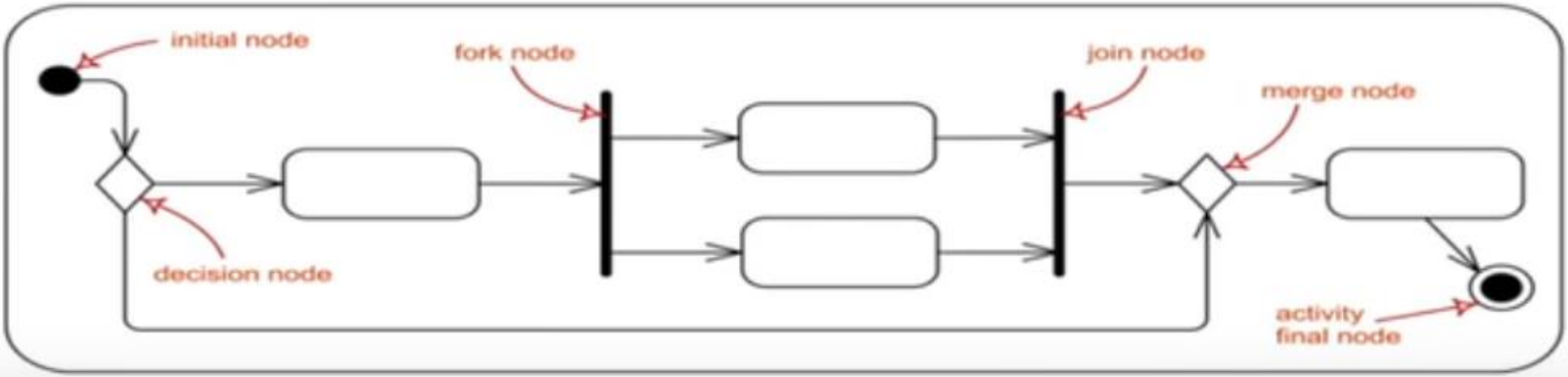


Source: *url: http://pja.mykhi.org/mgr/blokowe/INN/sorcersoft.org/io/uml/ActivityDiagrams.html*

Activity Diagram

Activity Diagram –Process the Order





Source: http://www.inf.ed.ac.uk/teaching/courses/seoc/2009_2010/notes/1_notes.pdf(20-Aug-16)

Activity Diagram

Summary

- Control Node of Activity Discussed
- Examples are illustrated

Next

- Understanding the various features of Activity Diagrams
- Deriving the Activity Diagram for LMS

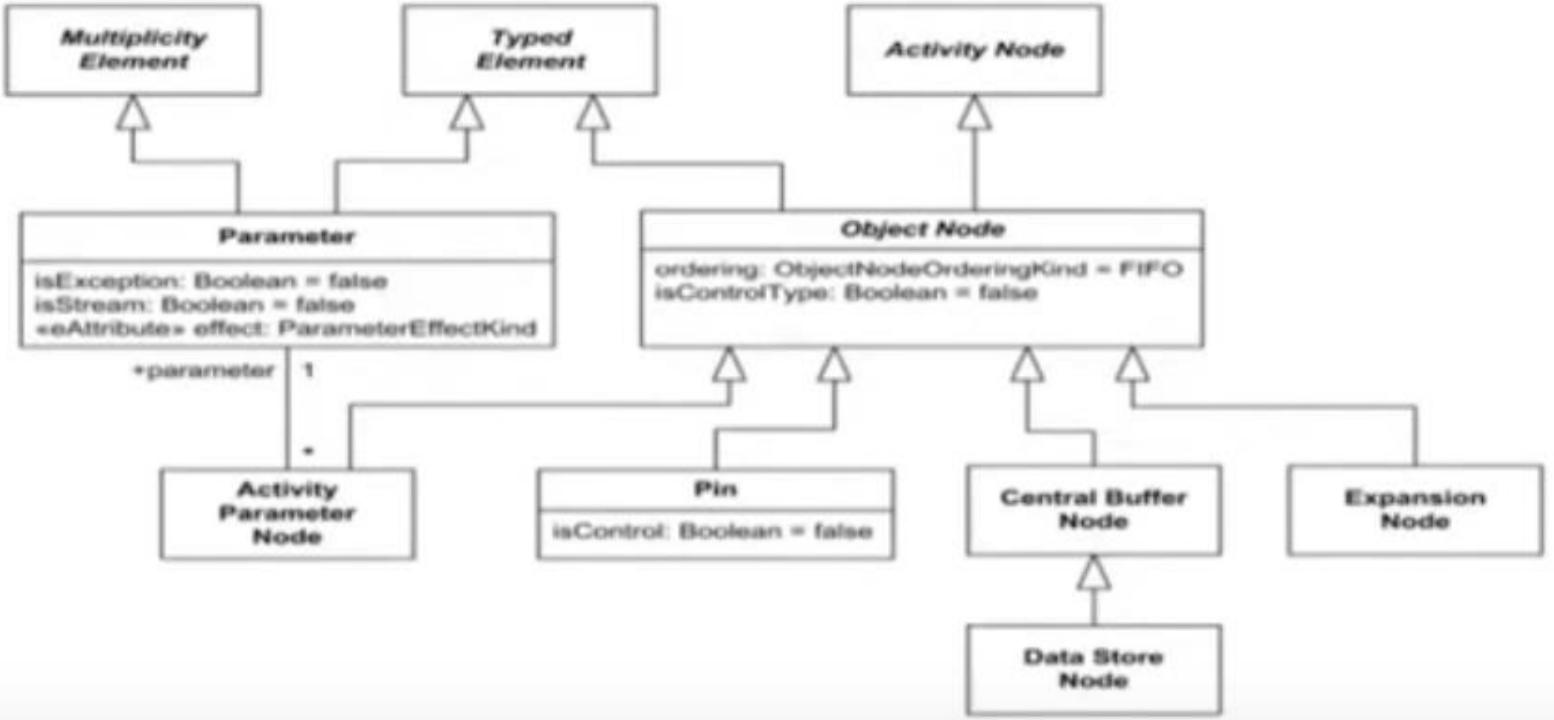
Activity Diagram

- What are Activity Diagrams?
  - Activity
  - Partition
  - Activity Edge
  - Control
  - Objects
  - Actions
- Activity Diagram for LMS

Activity Diagram

Objects

- An object is an abstract activity node that is used to define object flows in an activity
- Object nodes include **pin**, **central buffer**, **parameter**, and **expansion nodes**

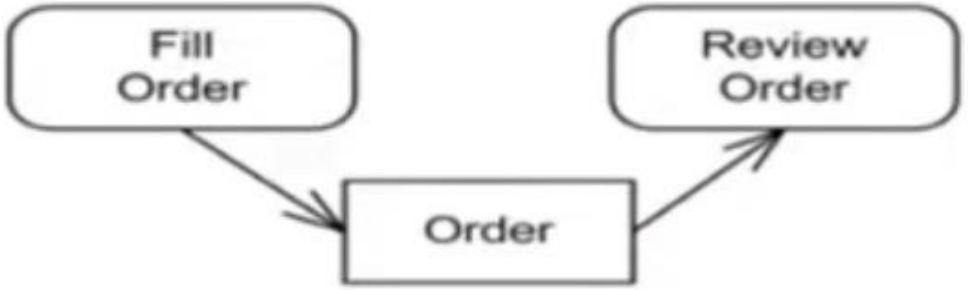


Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

Object Node

- An object node is an abstract activity node that is used to define object flow in an activity
- It represents a particular state of a class.
- Object nodes are notated as rectangles



Object flow of Orders between Fill Order and Review Order actions

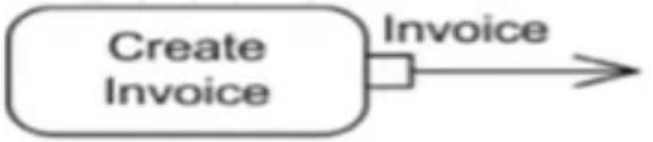
Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

Pin

- A pin is an object node for inputs and outputs to actions
- Pin is usually shown as a small rectangle attached to the action rectangle

Item is input pin to the Add to Shopping Cart action



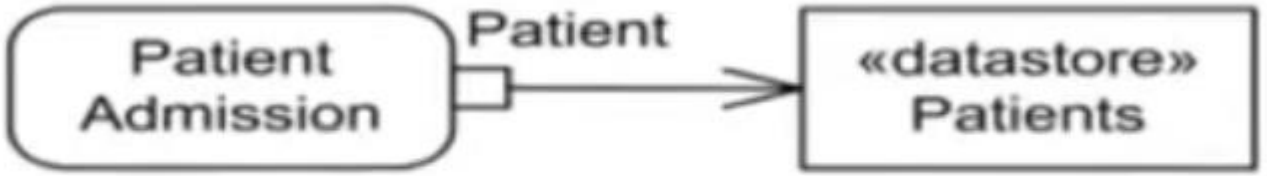
Invoice is output pin from the Create Invoice action

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

Central buffer

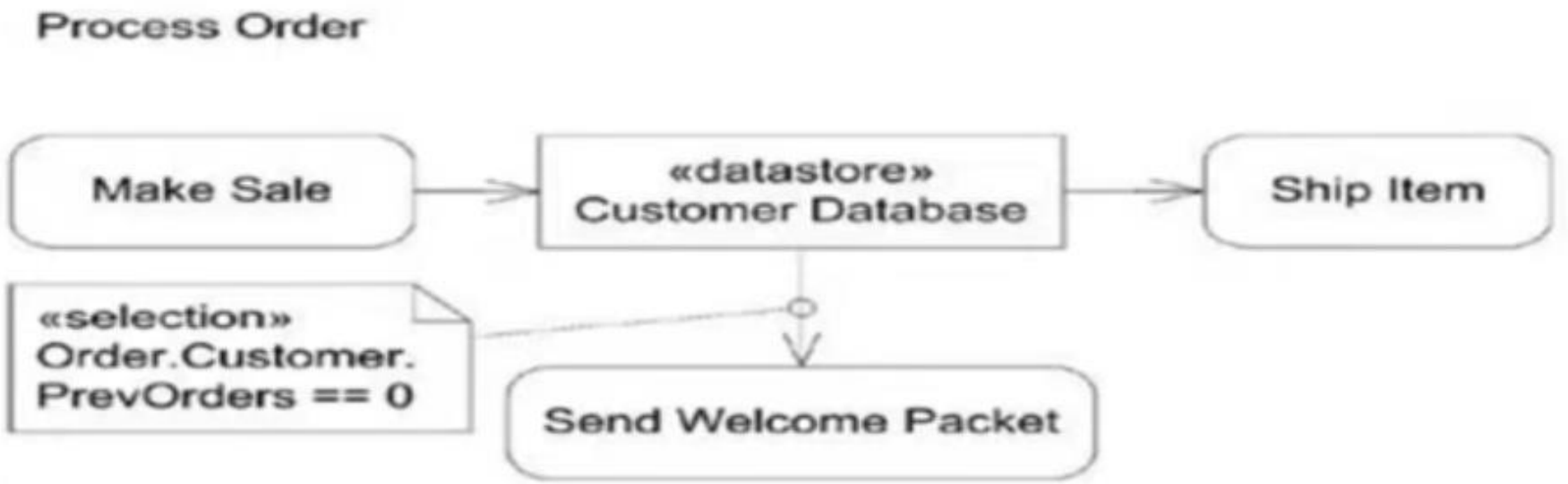
- A central buffer node is an object node for managing flows from multiple sources and destinations
- A data store is a central buffer node for non-transient information
- All incoming tokens are stored by the data store



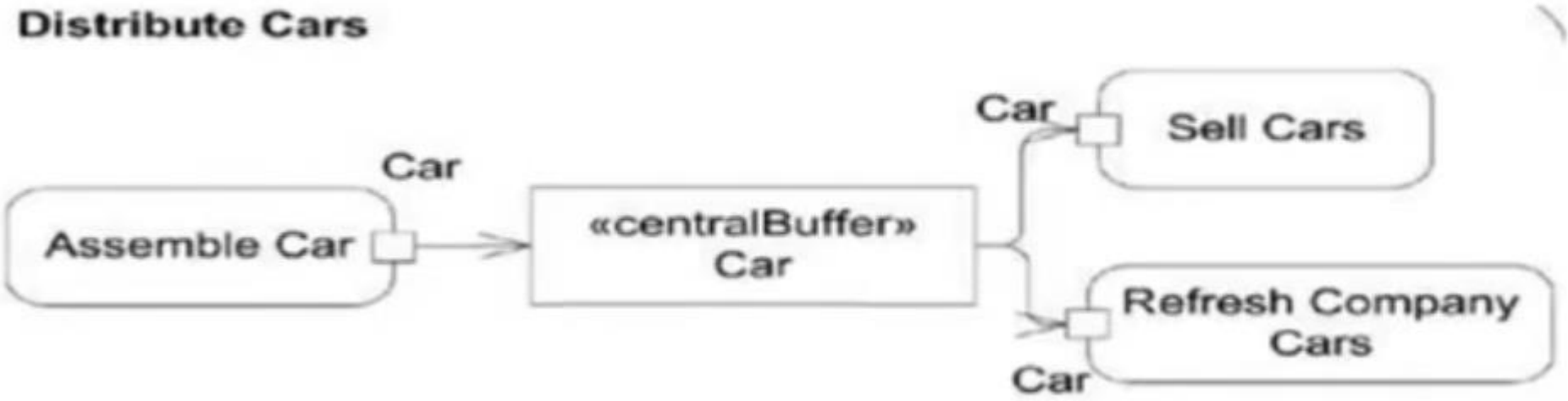
Incoming Patient token is stored by the Patients data store

Activity Diagram

Central buffer – Process the Order



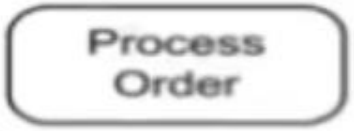
Central buffer – Distribute Cars



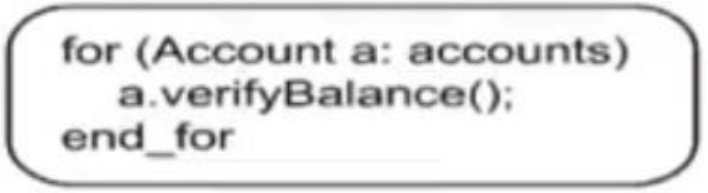
Activity Diagram

Action

- Action is a named element which represents a single atomic step within activity that is not further decomposed within the activity
- Action could also be expressed in some application-dependent action language



The Process Order action.



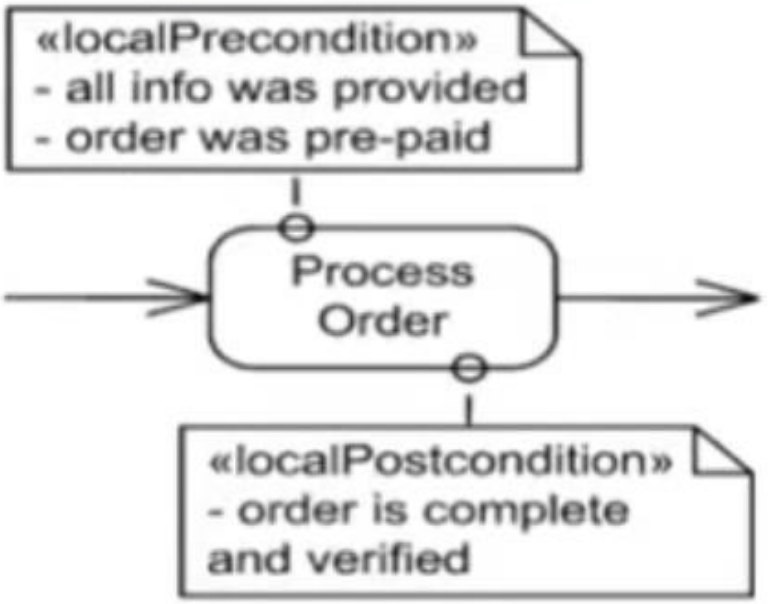
Example of action expressed with tool-dependent action language.

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

Action

- Action can have local pre and post conditions attached as note

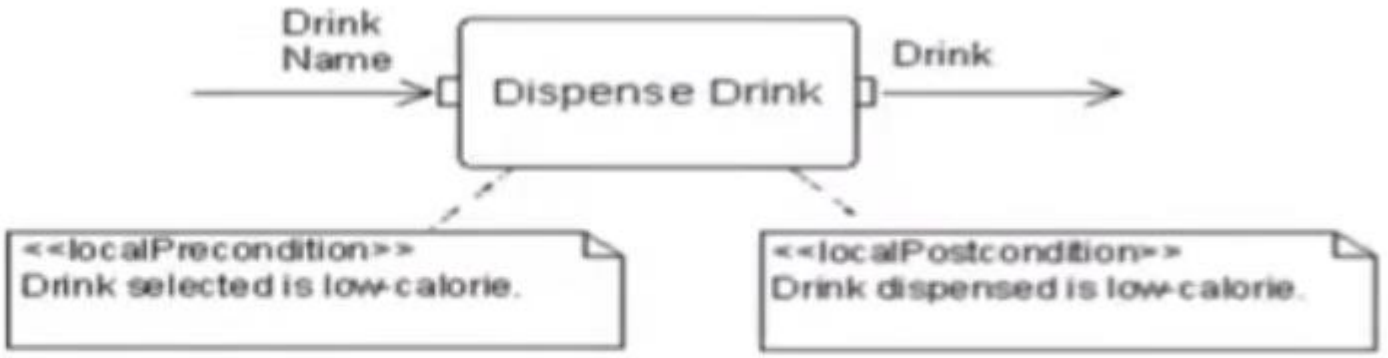


Local pre- and post-conditions shown as notes attached to Process Order action

Source: *UML 2.5 Diagrams Overview*: http://www.uml-diagrams.org/uml-25-diagrams.html (20-Aug-16)

Activity Diagram

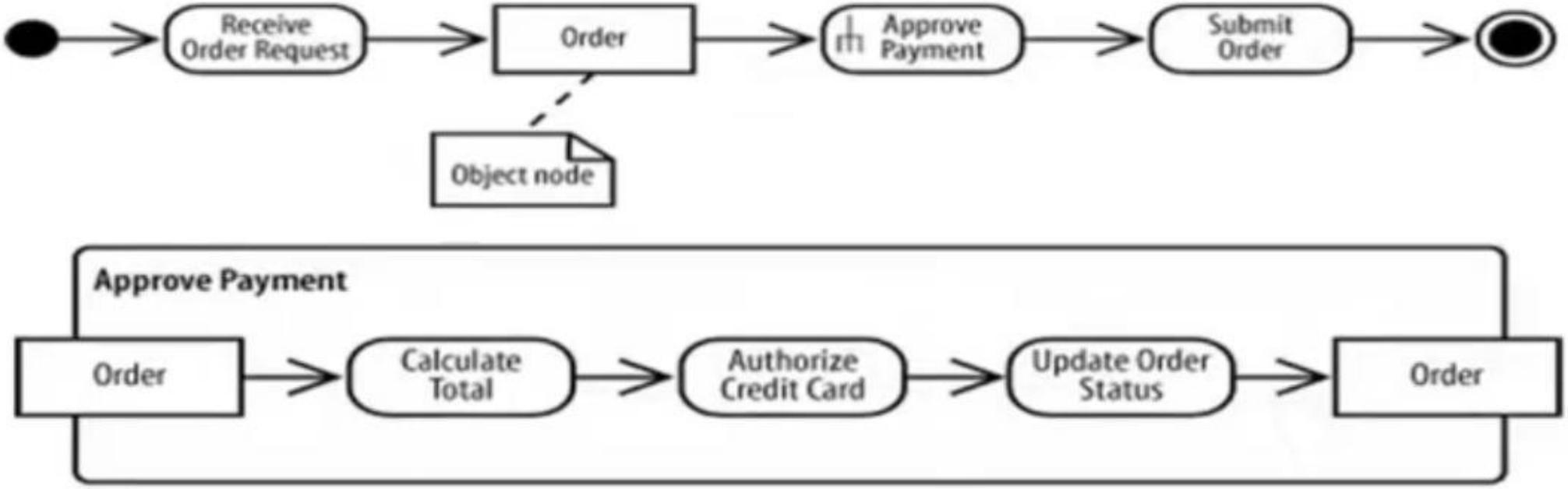
Actions: Dispense Drinks



Source: *url: http://www.jot.fm/issues/issue_2003_09/column4/* (22-Aug-16)

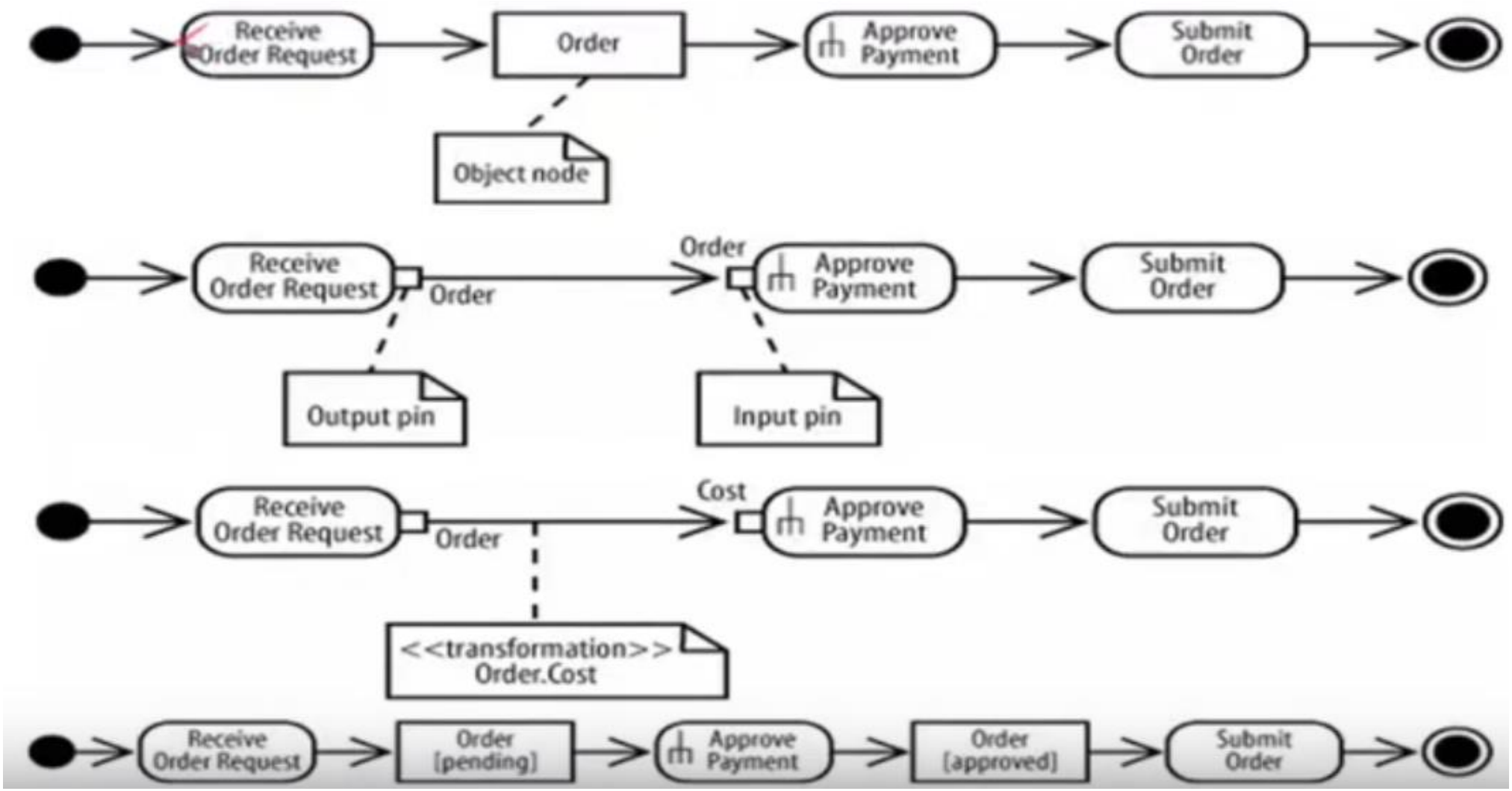
Activity Diagram

Objects & Actions



Activity Diagram

Objects & Actions



Summary

- Object and Action Feature of Activity Diagram discussed
- Examples are illustrated

Next

- Activity Diagram for LMS

Reference

Source: NPTEL - Object-Oriented Analysis and Design, IIT Kharagpur Prof. Partha Pratim Das Prof. Samiran Chattopadhyay Prof. Kausik Datta

https://nptel.ac.in/courses/106105153