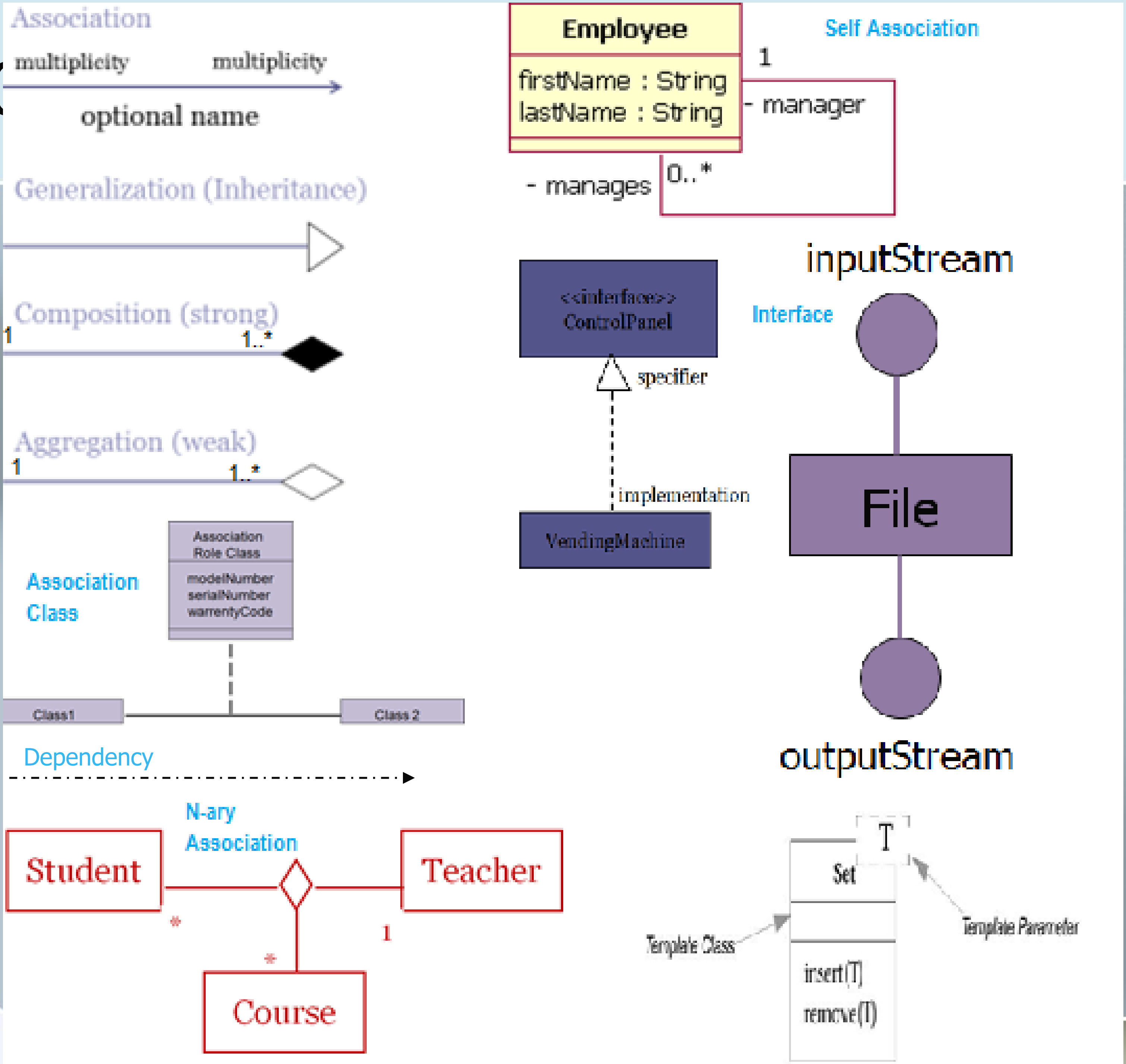
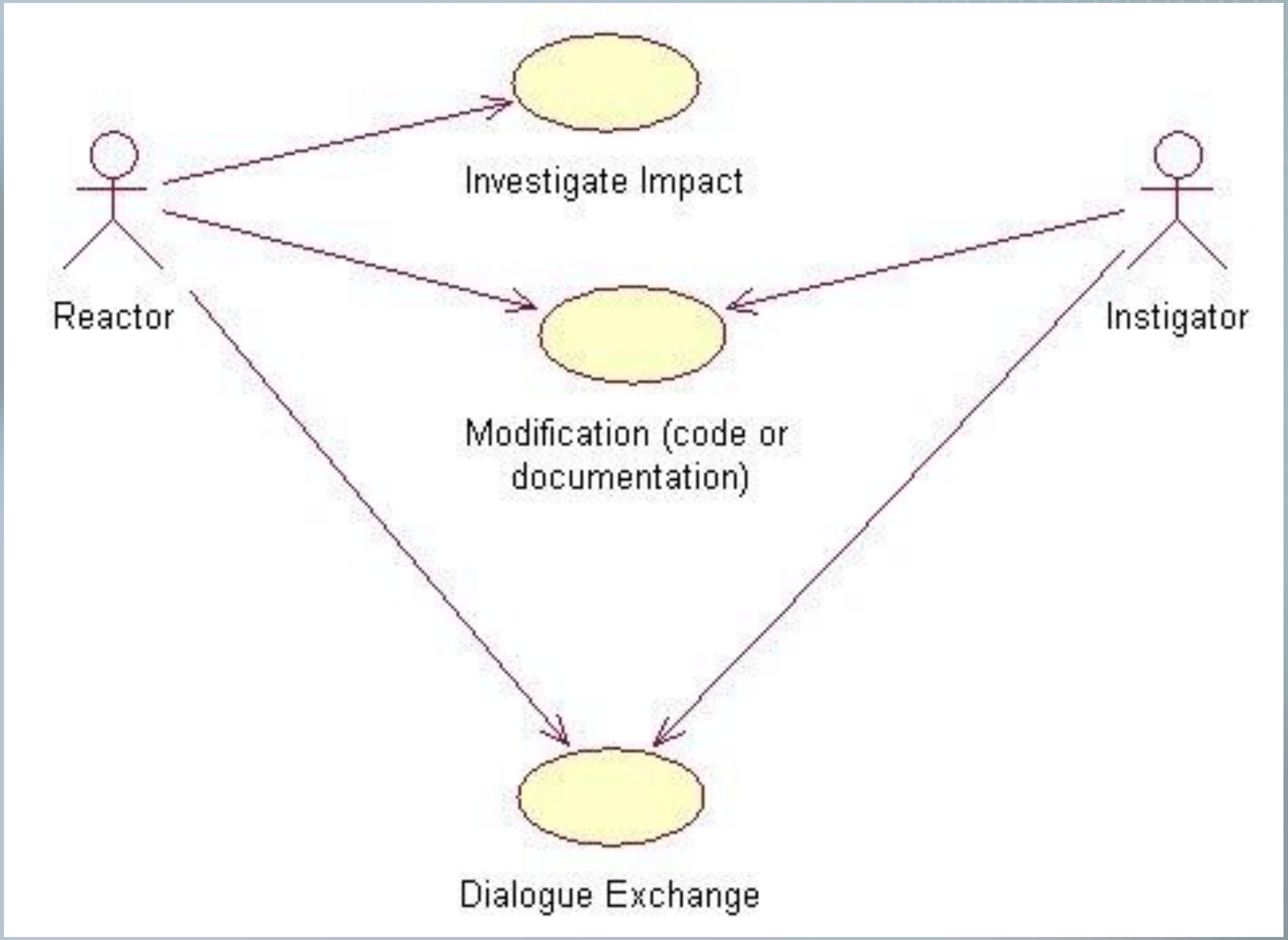

Association
multiplicity
multiplicity
optional name
Generalization (Inheritance)
Composition (strong)
1
1..*
Aggregation (weak)
1
1..*
Association Class
Association Role Class
modelNumber
serialNumber
warrentyCode
Class1
Class 2
Dependency
N-ary Association
Student
Teacher
Course
*
1
*
Employee
firstName : String
lastName : String
Self Association
1
- manager
- manages
0..*
<<interface>> ControlPanel
specifier
implementation
VendingMachine
Interface
inputStream
File
outputStream
T
Set
insert(T)
remove(T)
Template Class
Template Parameter

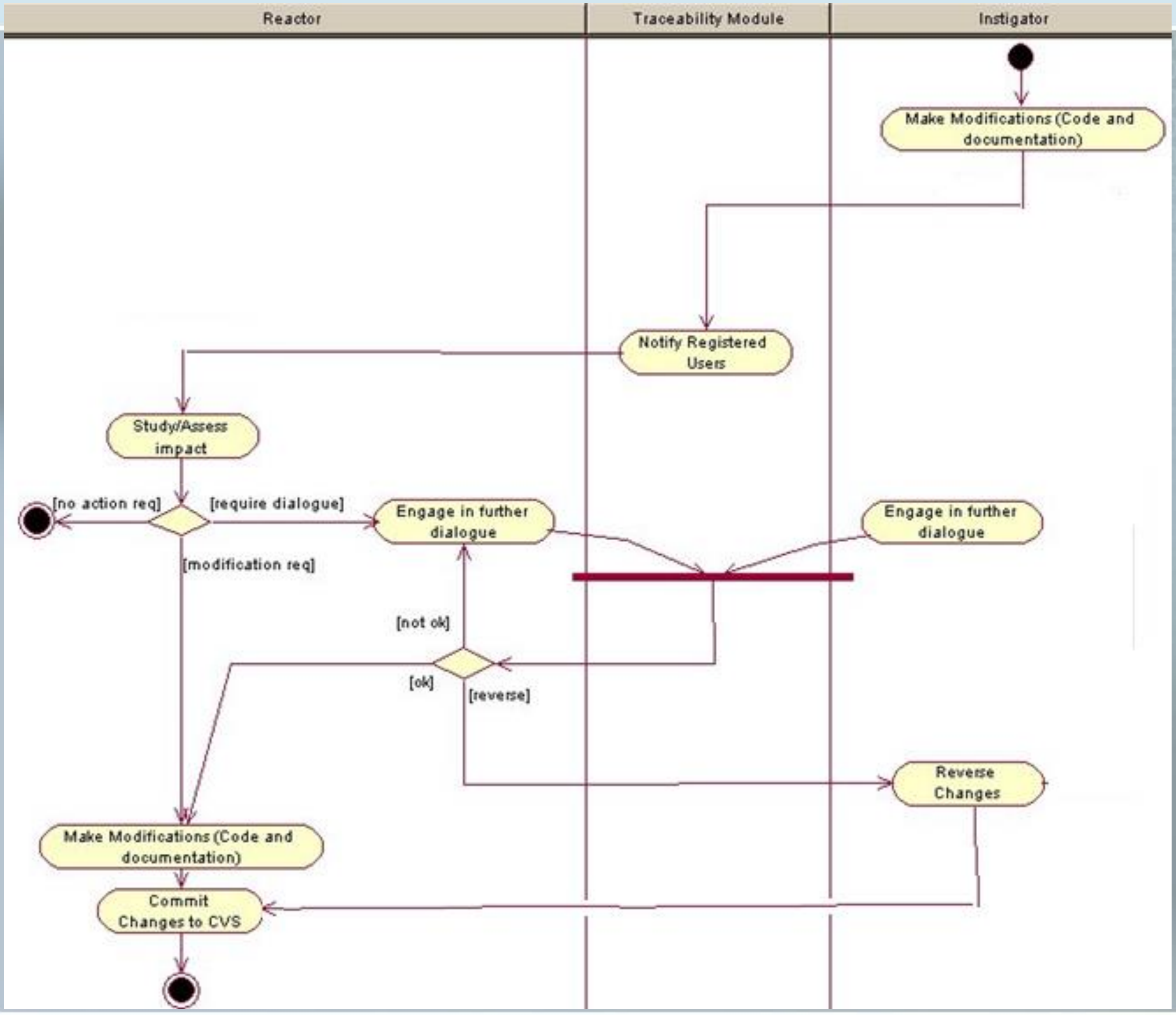
Lecture 09

ACTIVITY DIAGRAM

Scenario

1. **Instigator** makes a change to some code
2. **Instigator** then enters a dialogue with **Reactor** to notify of proposed change.
3. **Reactor** investigates impact of change
4. **Instigator** and **Reactor** may have further dialogue to clarify issues
5. If **Reactor** agrees to go ahead with change, the associated code and code documentation will be modified. This concerns modifying, testing and finally committing changes back into Code Versioning system (CVS).
6. **Reactor** has final task to update associated modelling documentation, including text and related UML diagrams (if appropriate)
7. If **Reactor** disagrees, then **Instigator** may be forced to undo the changes (if the developers cannot agree amongst themselves, then the problem may be escalated).


Investigate Impact
Reactor
Modification (code or documentation)
Instigator
Dialogue Exchange


Reactor
Traceability Module
Instigator
Make Modifications (Code and documentation)
Notify Registered Users
Study/Assess impact
[no action req]
[require dialogue]
[modification req]
Engage in further dialogue
Engage in further dialogue
[not ok]
[ok]
[reverse]
Reverse Changes
Make Modifications (Code and documentation)
Commit Changes to CVS

What is an Activity?

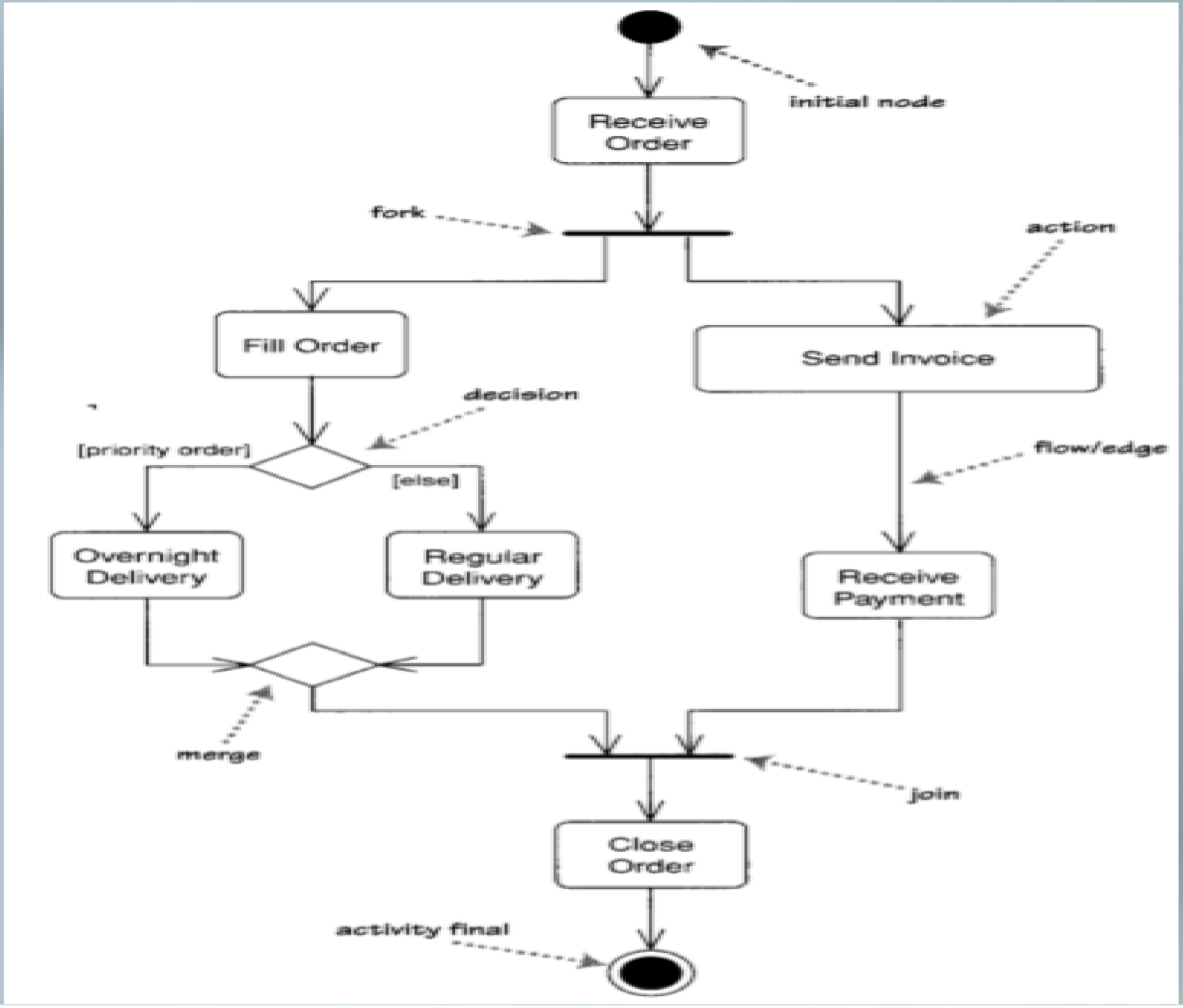
- In a conceptual diagram, an activity is some task that needs to be done, whether by a human or a computer
- In an implementation-perspective diagram, an activity is a method on a class
- Activity Diagrams are used to describe activities
    - Activity Diagrams are useful for describing complicated methods
    - Activity Diagrams are useful for describing use cases, since, after all, a use case is an interaction, which is a form of activity

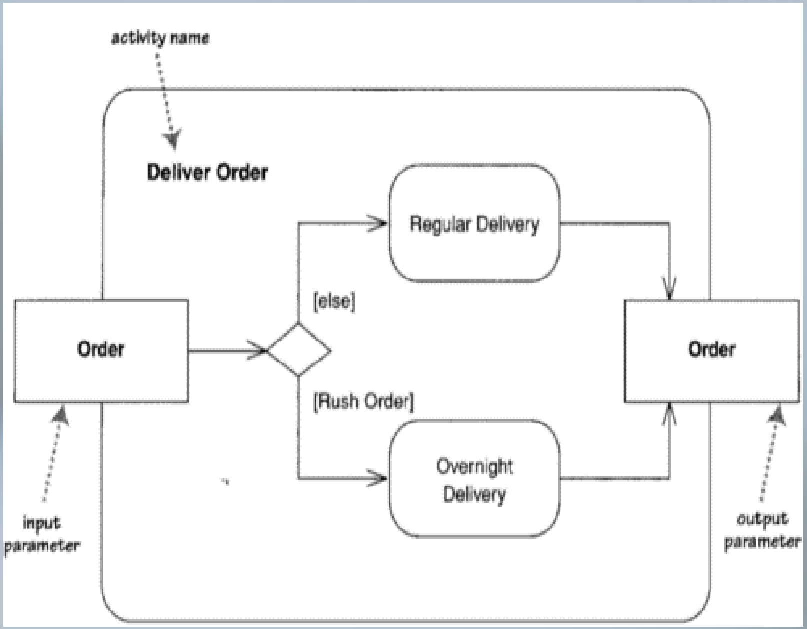
Activity arrangement

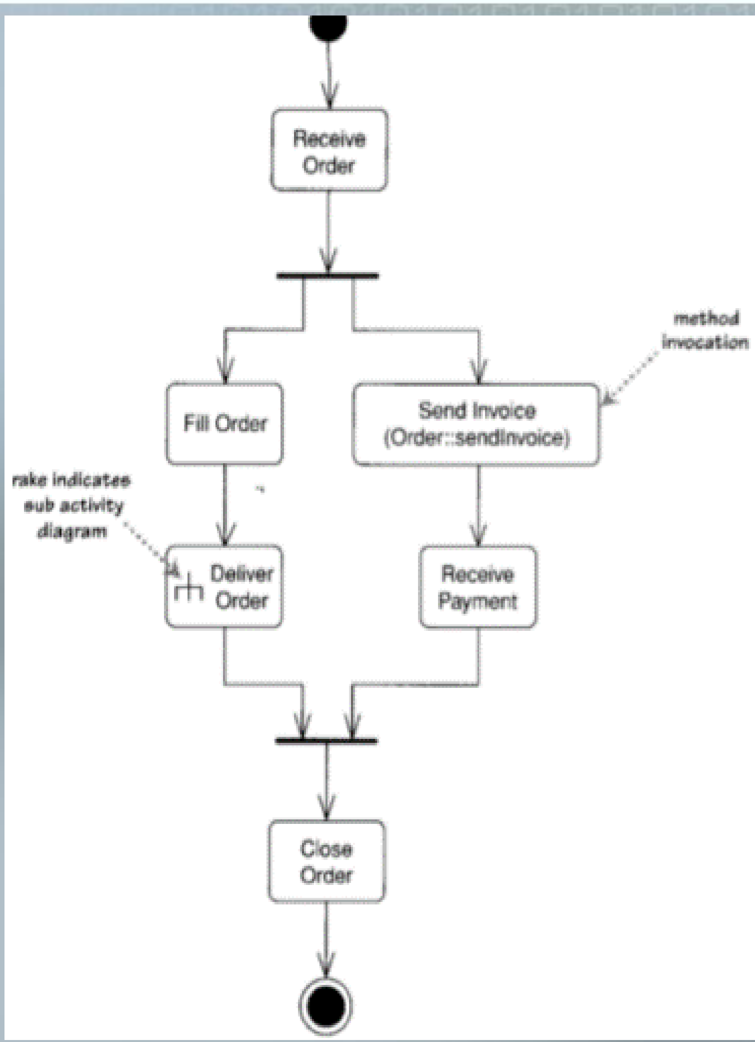
- Sequential – one activity is followed by another
- Parallel – two or more sets of activities are performed concurrently, and order is irrelevant

Processing an Order

- Once the order is received the activities split into two parallel sets of activities. One side fills and sends the order while the other handles the invoice and payments. On the Fill Order side, the method of delivery is decided conditionally. Depending on the condition either the Overnight Delivery activity or the Regular Delivery activity is performed. Finally the parallel activities combine to close the order


initial node
Receive Order
fork
action
Fill Order
Send Invoice
decision
[priority order]
[else]
flow/edge
Overnight Delivery
Regular Delivery
Receive Payment
merge
join
Close Order
activity final


activity name
Deliver Order
Regular Delivery
[else]
Order
[Rush Order]
Overnight Delivery
Order
input parameter
output parameter


Receive Order
method invocation
Fill Order
Send Invoice (Order::sendInvoice)
rake indicates sub activity diagram
Deliver Order
Receive Payment
Close Order

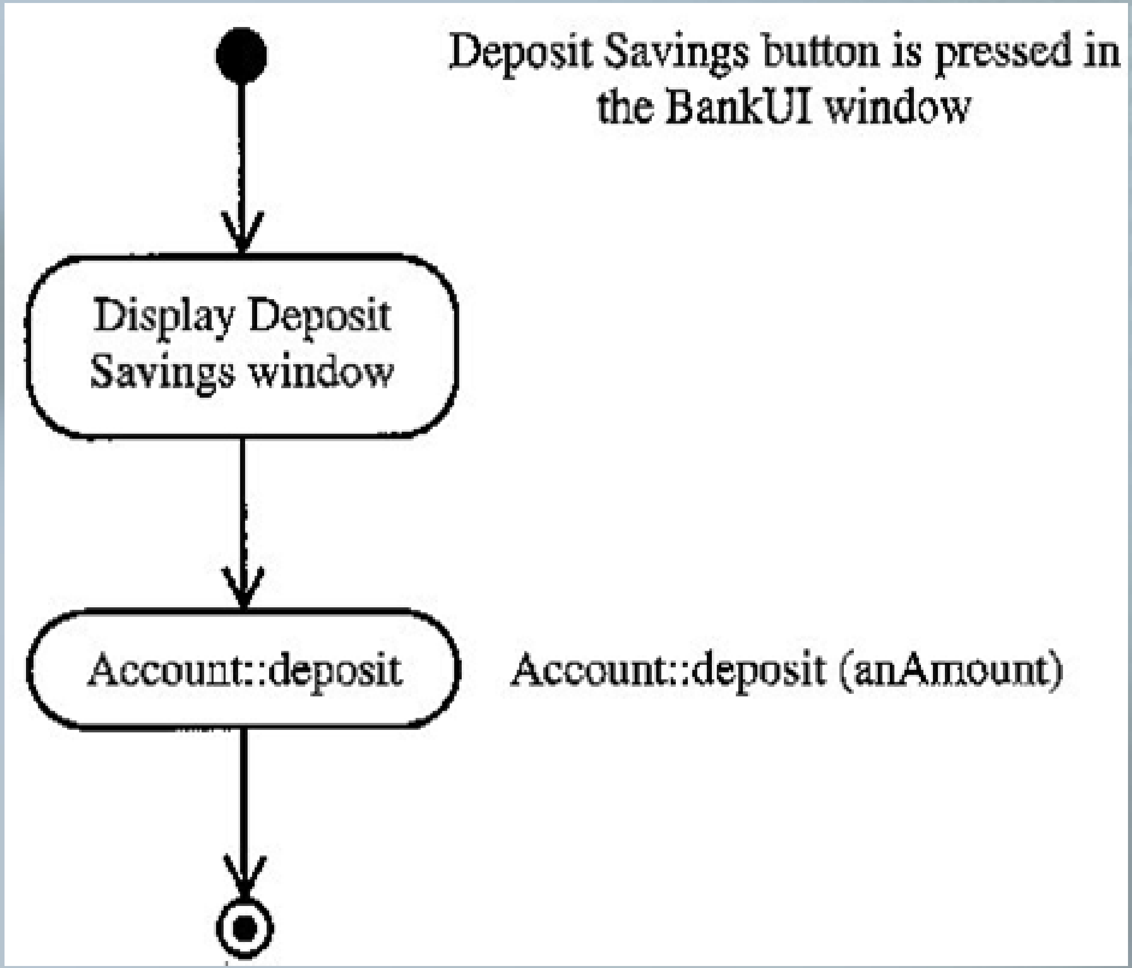
Transition

When the action or activity of a state completes, flow of control passes immediately to the next action or activity state

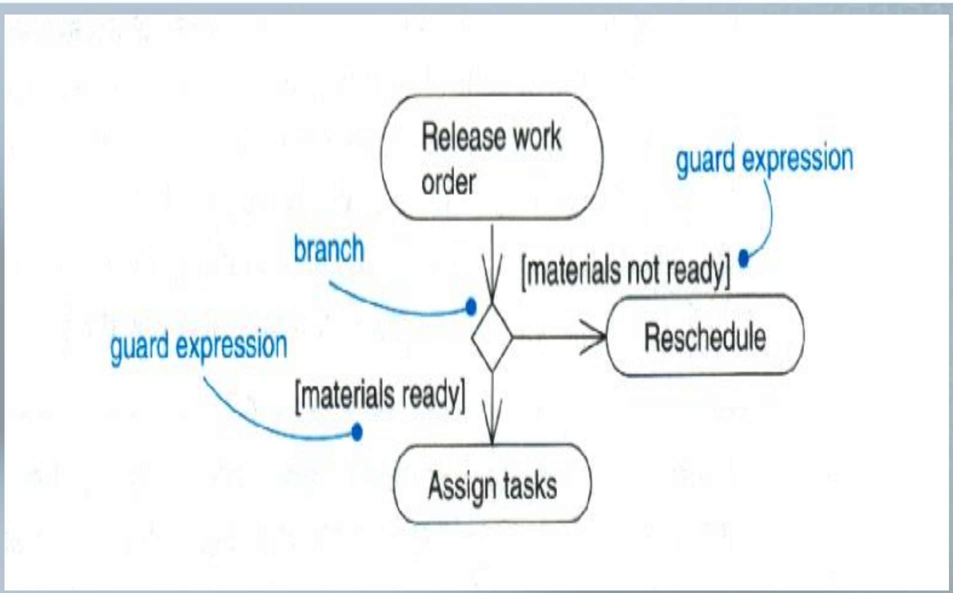
A flow of control has to start and end someplace

- initial state -- a solid ball
- stop state -- a solid ball inside a circle

Transition


Deposit Savings button is pressed in the BankUI window
Display Deposit Savings window
Account::deposit
Account::deposit (anAmount)

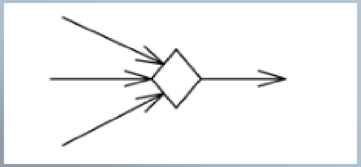
Branching

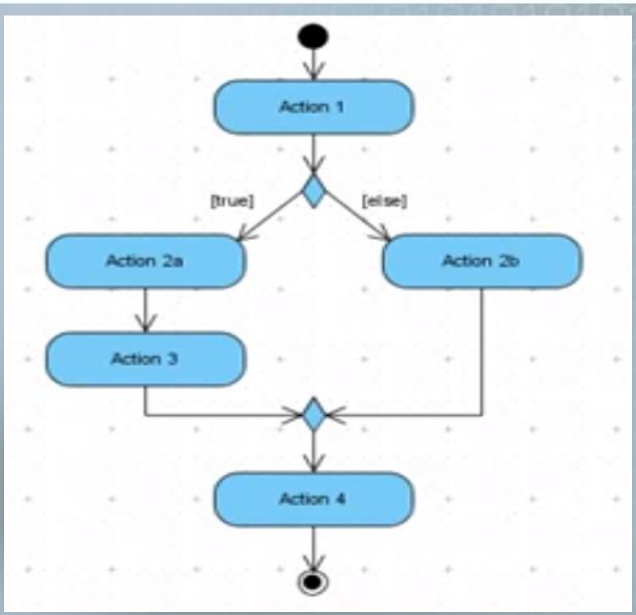


A branch specifies alternate paths taken based on some Boolean expression

A branch may have one incoming transition and two or more outgoing ones

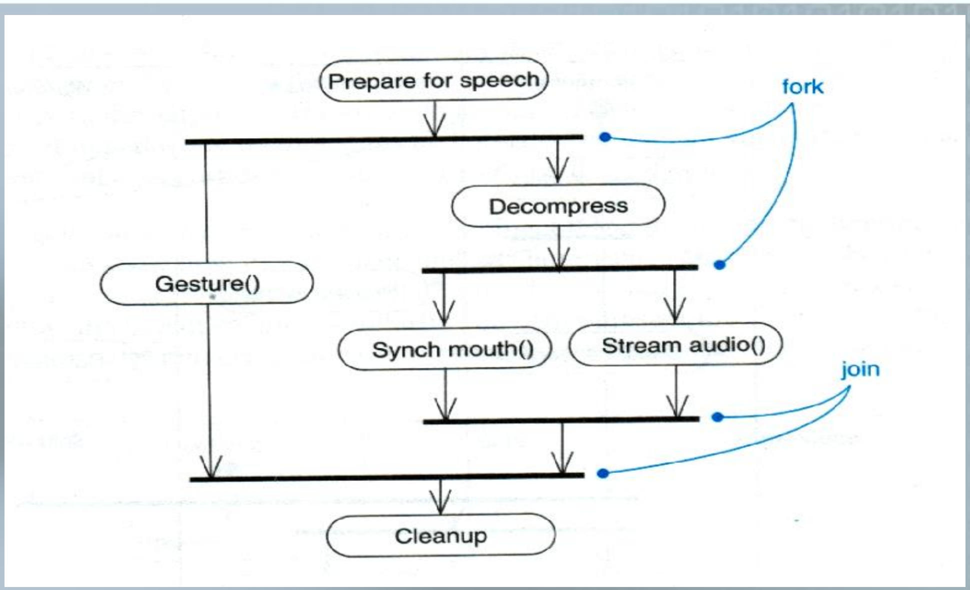
Merge Node





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.

Forking and Joining

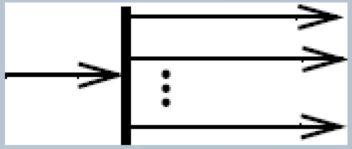


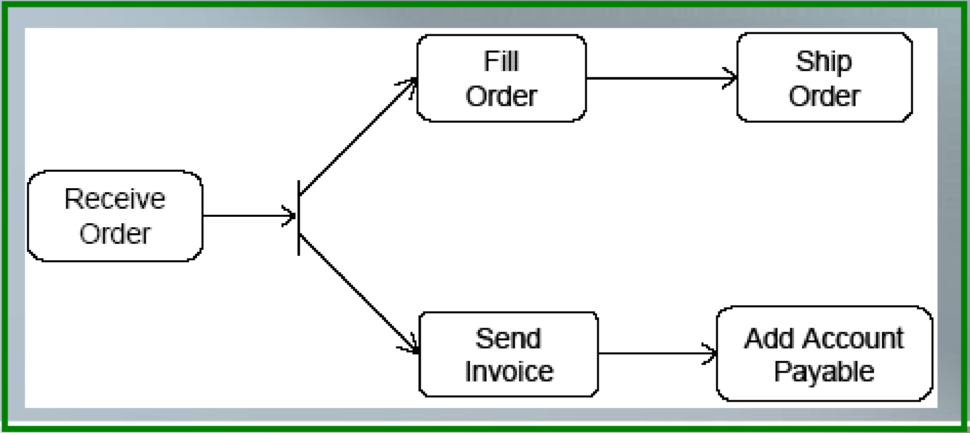
Use a synchronization bar to specify the forking and joining of parallel flows of control

A synchronization bar is rendered as a thick horizontal or vertical line

Fork

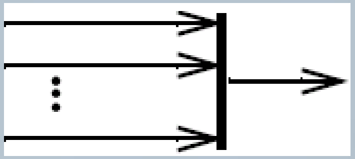
- A fork may have one incoming transitions and two or more outgoing transitions
    - each transition represents an independent flow of control
    - conceptually, the activities of each of outgoing transitions are concurrent
        - either truly concurrent (multiple nodes)
        - or sequential

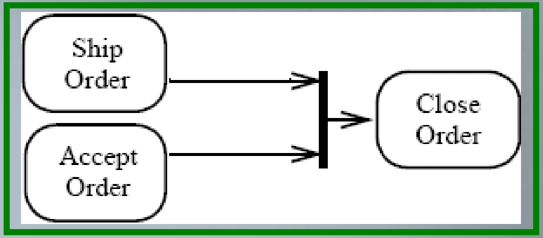




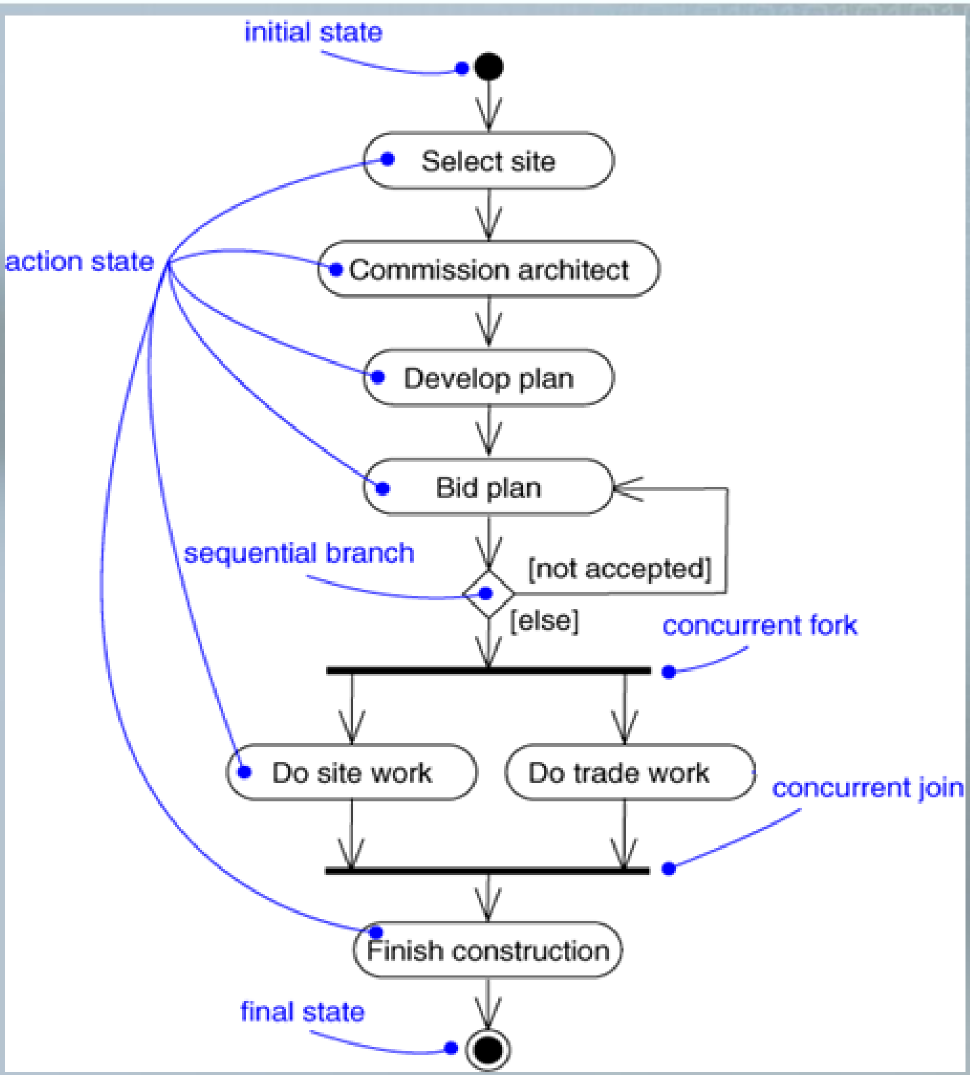
Join

- 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
    - each waits until all incoming flows have reached the join, at which point one flow of control continues on below the join





Bid for Site


initial state
Select site
action state
Commission architect
Develop plan
Bid plan
sequential branch
[not accepted]
[else]
concurrent fork
Do site work
Do trade work
concurrent join
Finish construction
final state

Swimlane

- A swimlane specifies a locus of activities
- To partition the action states on an activity diagram into groups
  - each group representing the business organization responsible for those activities
  - each group is called a swimlane
- Each swimlane is divided from its neighbor by a vertical solid line

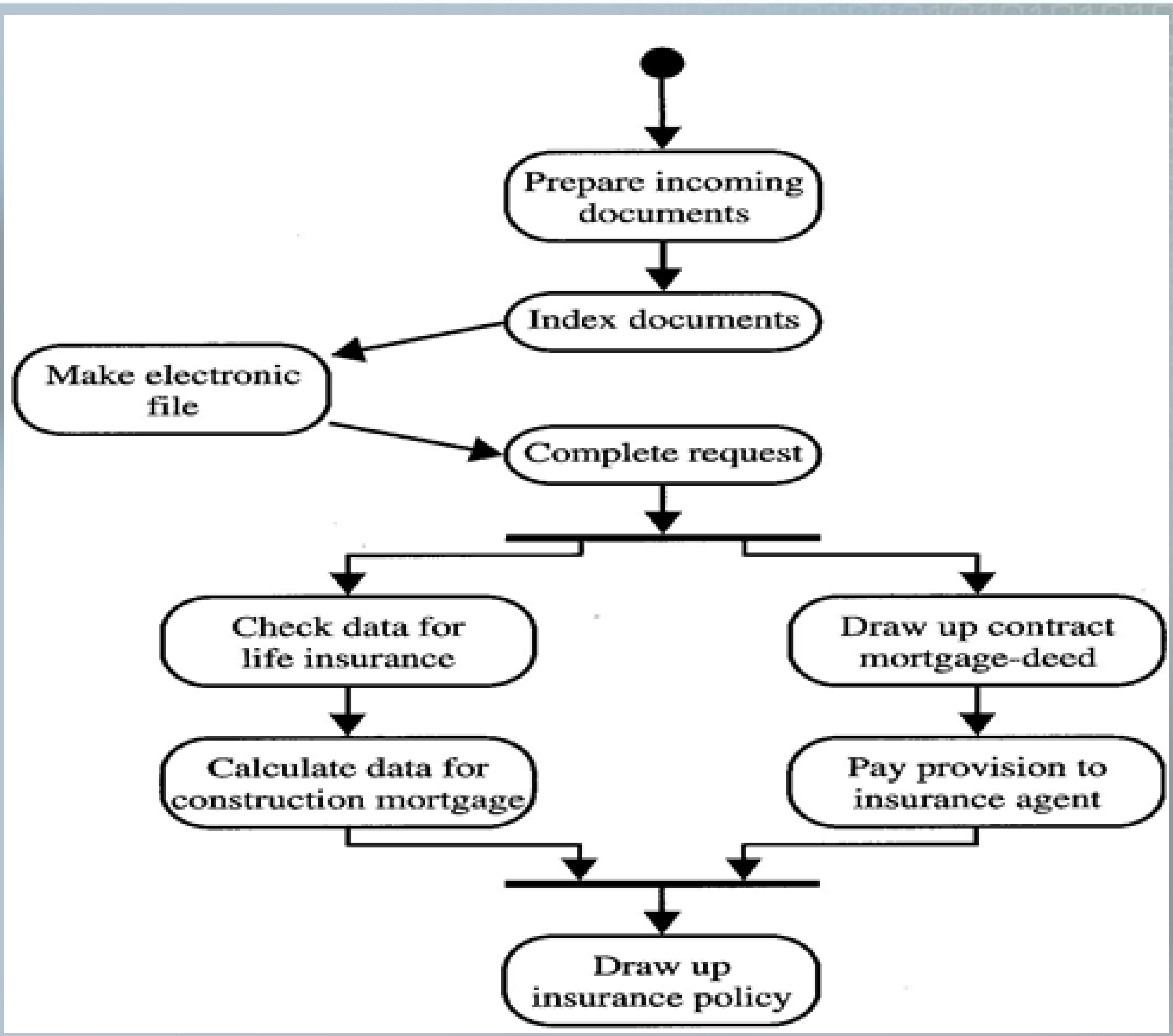
Swimlane

- 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

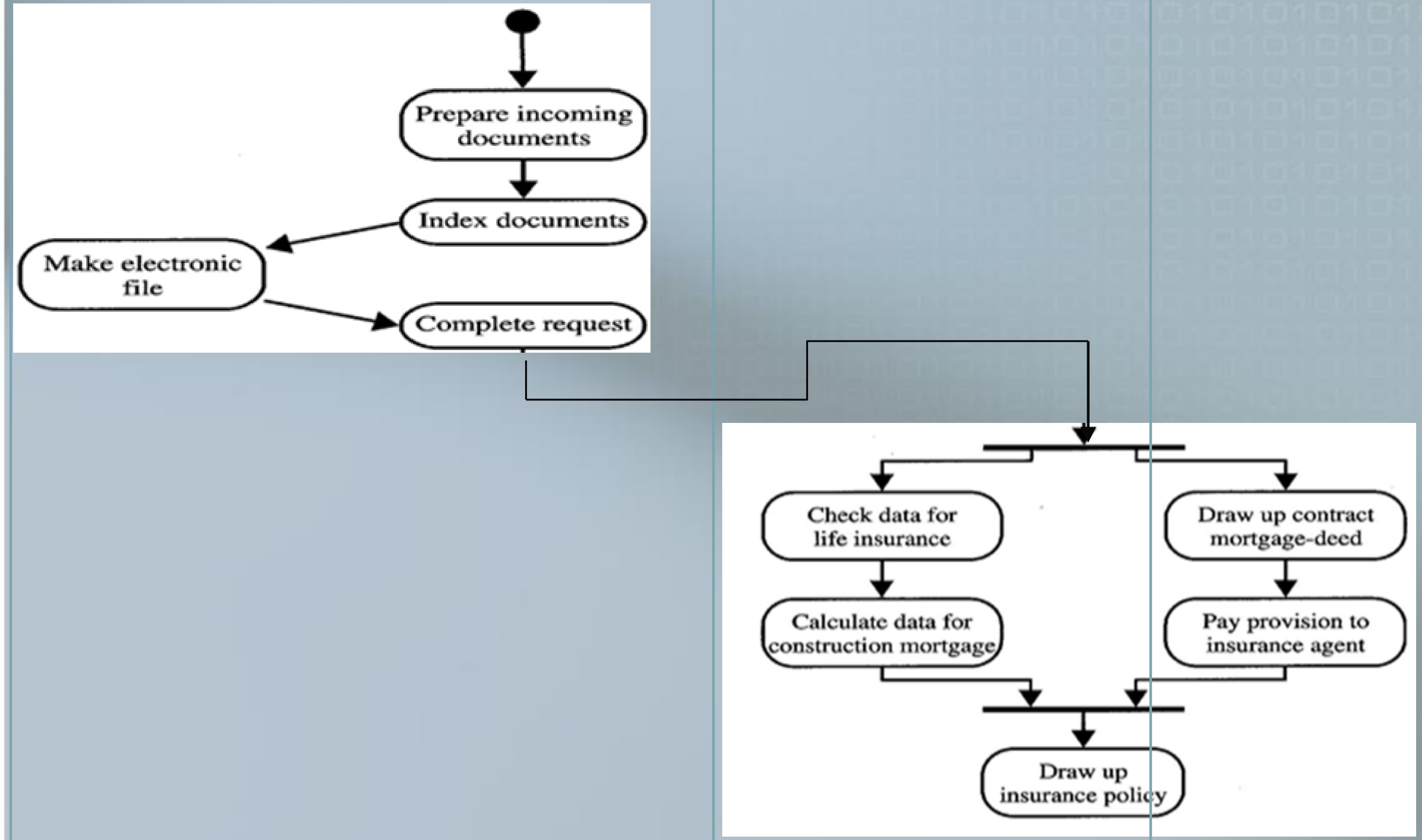
Insurance Policy

- *Office clerk prepare the documents for insurance policy by indexing the document, make a electronic file and complete the request. After the request is completed insurance agent check data for life insurance as well as loan officer make a contract of an advance loan deeds, insurance agent calculate data for advance loan deeds, loan officer pay provision to insurance agent. At the end the insurance agent draw up the policy plan.*

Insurance Policy


Prepare incoming documents
Index documents
Make electronic file
Complete request
Check data for life insurance
Draw up contract mortgage-deed
Calculate data for construction mortgage
Pay provision to insurance agent
Draw up insurance policy

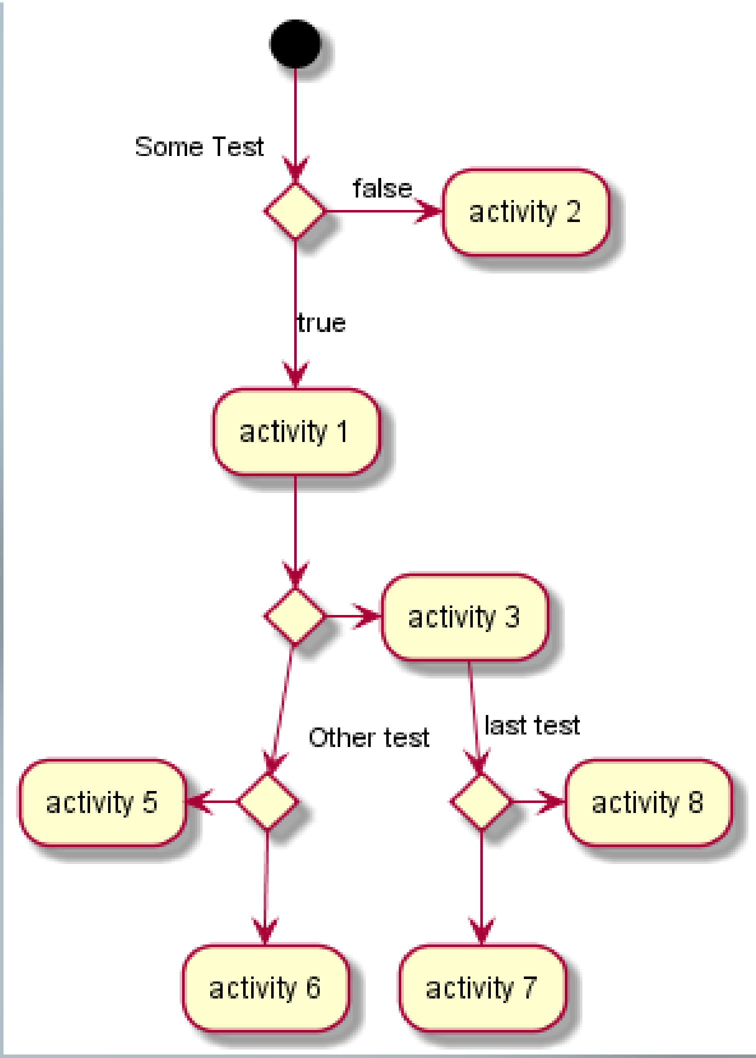
Offices Clerk	Insurance Agent	Loan Officer



Prepare incoming documents
Index documents
Make electronic file
Complete request
Check data for life insurance
Calculate data for construction mortgage
Draw up contract mortgage-deed
Pay provision to insurance agent
Draw up insurance policy

Implementation of nested branching

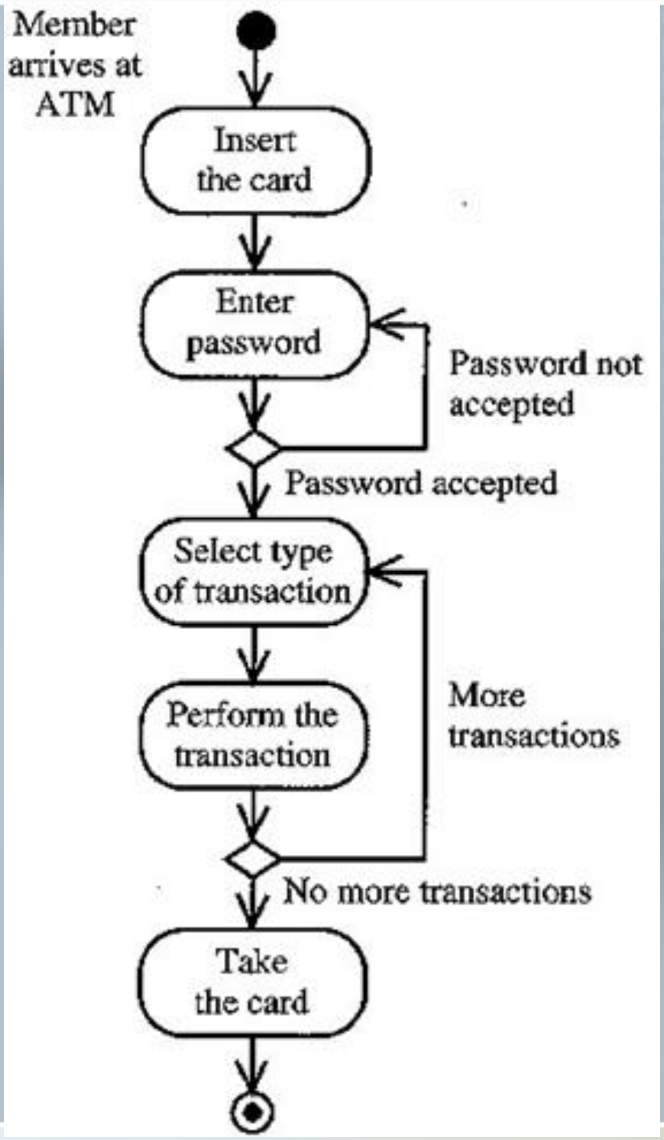
```
(*) --> if "Some Test" then
  -->[true] "activity 1"

  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
```



Withdraw the Money from ATM

- *Customer arrives at ATM, inserts the card, type the PIN number, enter the transaction type, perform the transaction, take out the card.*

Branching


Member arrives at ATM
Insert the card
Enter password
Password not accepted
Password accepted
Select type of transaction
Perform the transaction
More transactions
No more transactions
Take the card

Quotation of a software

- *Customer request for the quotation of the software from the salesperson. salesperson check notes for the requirement information, if the salesperson needs help in requirement, he ask technical expert to check the requirement and enter the data into the system, otherwise salesperson himself enter the data in to system. System then calculates the quote and the final quote is then reviewed by the customer, if its ok then customer will accept the quote else if any changes are required then again salesperson will develop a notes for requirements.*

Online Shopping

- Online customer can browse or search items. If the search item is not found, the customer again decides either he want to do searching or browsing. If the item is found after searching the customer can view the item details. The customer can also view the item detail after browsing the item. After the customer has viewed the item detail, he can either add the item to the shopping cart or continue with searching and browsing. After adding the items to the cart the customer can either view the shopping cart or add more items by searching or browsing decision or checkout with the items added.

Creating Document

- *Open the word processing package.*
- *Create a file.*
- *Save the file under a unique name within its directory.*
- *Type the document.*
- *If graphics are necessary, open the graphics package,*
- *If graphics are necessary, open the graphics package, create the graphics, and paste the graphics into the document.*
- *If a spreadsheet is necessary, open the spreadsheet package, create the spreadsheet, and paste the spreadsheet into the document.*
- *Save the file.*
- *Print a hard copy of the document.*
- *Exit the word processing package.*

Enrollment in University

- *An applicant wants to enroll in the university.*
- *The applicant hands a filled out copy of form U113 University Application Form to the registrar.*
- *The registrar inspects the forms.*
- *The registrar inspects the forms.*
- *The registrar determines that the forms have been filled out properly.*
- *The registrar informs student to attend in university overview presentation.*
- *The registrar helps the student to enroll in seminars*
- *The registrar asks the student to pay the initial.*

Business Process of Meeting a New Client for create a proposal.

- *A salesperson calls the client and sets up an appointment.*
- *If the appointment is onsite (in the consulting firm's office), corporate technicians prepare conference room for a presentation*
- *If the appointment is offsite(at the client's office), a consultant prepares a presentation on a laptop.*
- *The consultant and the salesperson meet with the client at the agreed-upon location and time.*
- *The salesperson follows up with a letter.*
- *If the meeting has resulted in a statement of a problem, the consultant create a proposal and sends it to the client.*

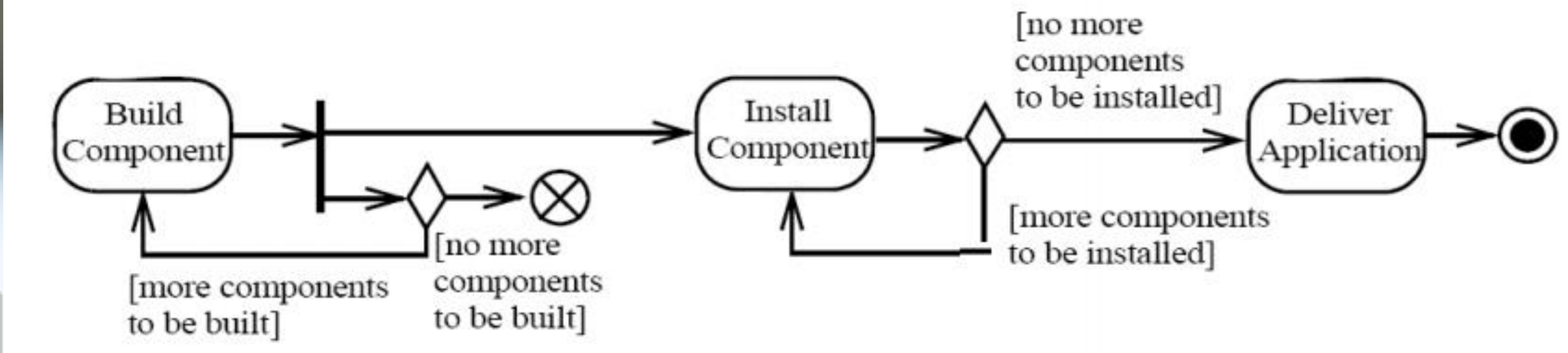
Advance Activity Diagram

Final nodes

- **Flow final**:
  - A final node that terminates a flow.
  - Destroys all tokens that arrive at it.
  - It has no effect on other flows in the activity.
  - Has no outgoing edges.

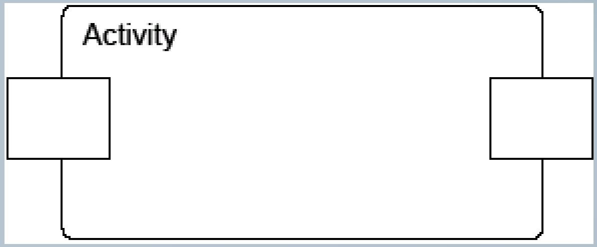
Component Building

- An activity starts with the company build the component. After the component is build the company install the component as well as checks for further requirement. If company needs more component to be build, it builds more component otherwise it stops building the component. The company checks either more component are needed to be install, it install more component otherwise it delivers the component.

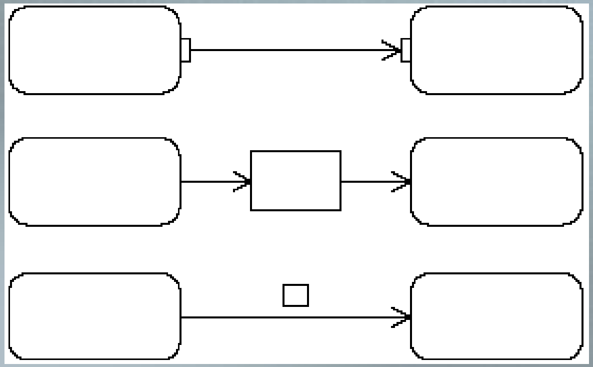

Build Component
[more components to be built]
[no more components to be built]
Install Component
[no more components to be installed]
[more components to be installed]
Deliver Application

Object nodes

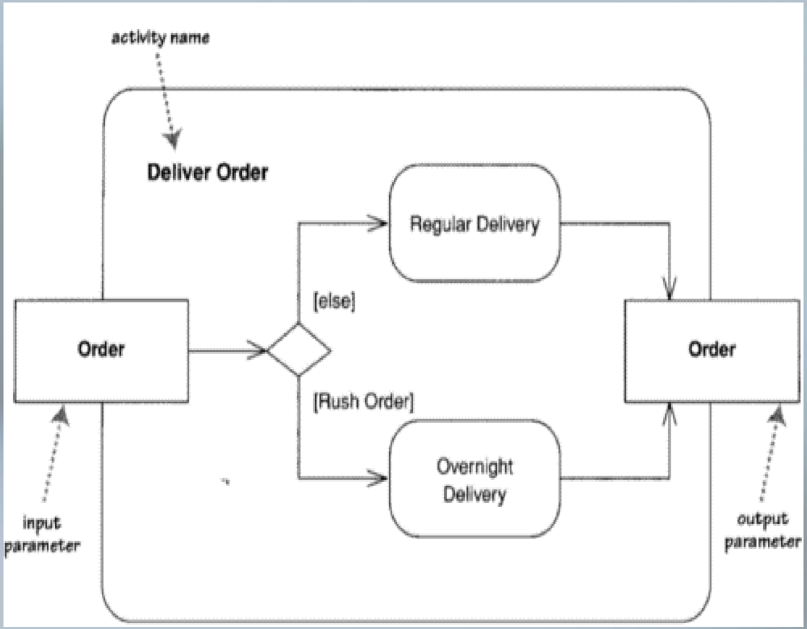
- Hold data temporarily while they wait to move through the graph
- Specify the type of values they can hold (if no type is specified, they can hold values of any type)

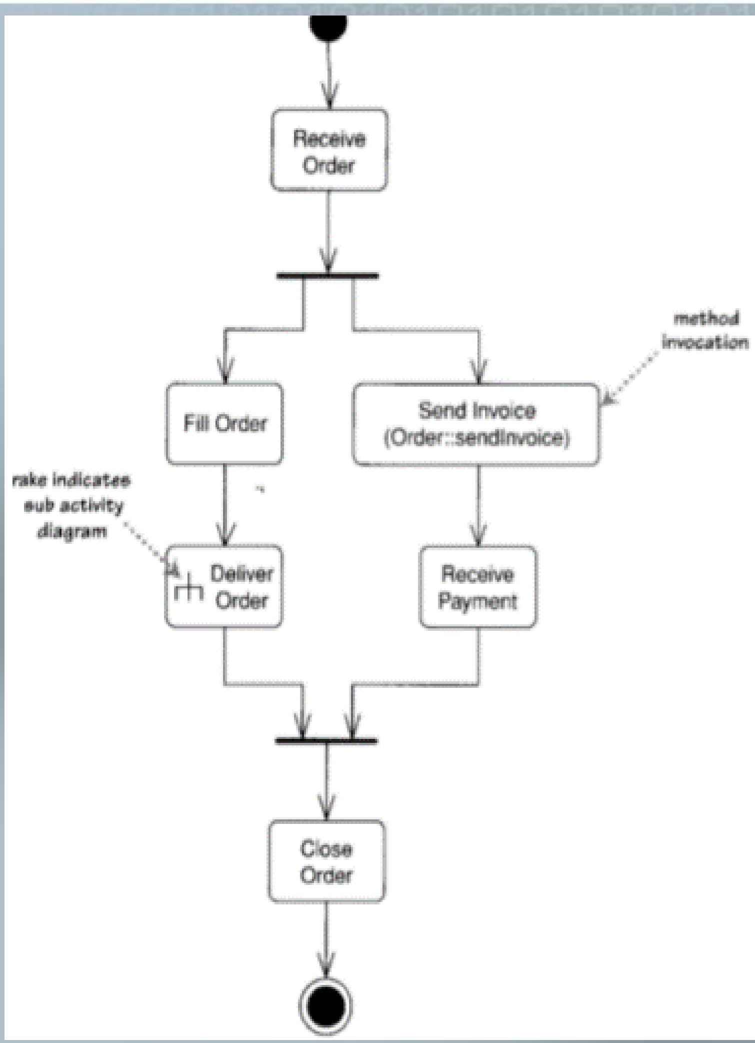


Activity Parameter Nodes



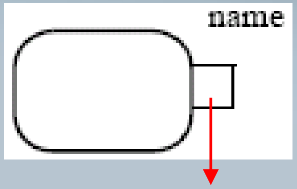
Pins
(three differents notations)


activity name
Deliver Order
Regular Delivery
[else]
Order
[Rush Order]
Overnight Delivery
Order
input parameter
output parameter

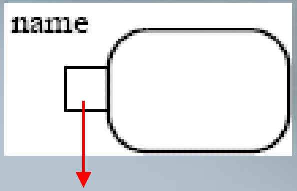

Receive Order
method invocation
Fill Order
Send Invoice (Order::sendInvoice)
rake indicates sub activity diagram
Deliver Order
Receive Payment
Close Order

Pins

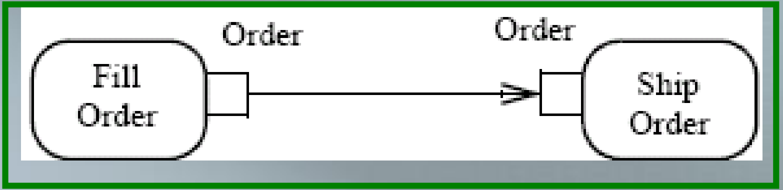
- Actions can have inputs and outputs, through the pins
- Hold inputs to actions until the action starts, and hold the outputs of actions before the values move downstream
- The name of a pin is not restricted: generally recalls the type of objects or data that flow through the pin

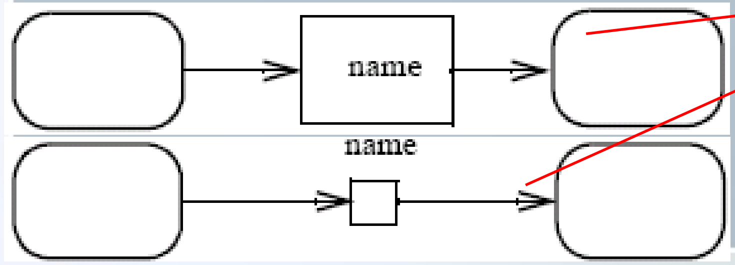


Output pins



Input pins

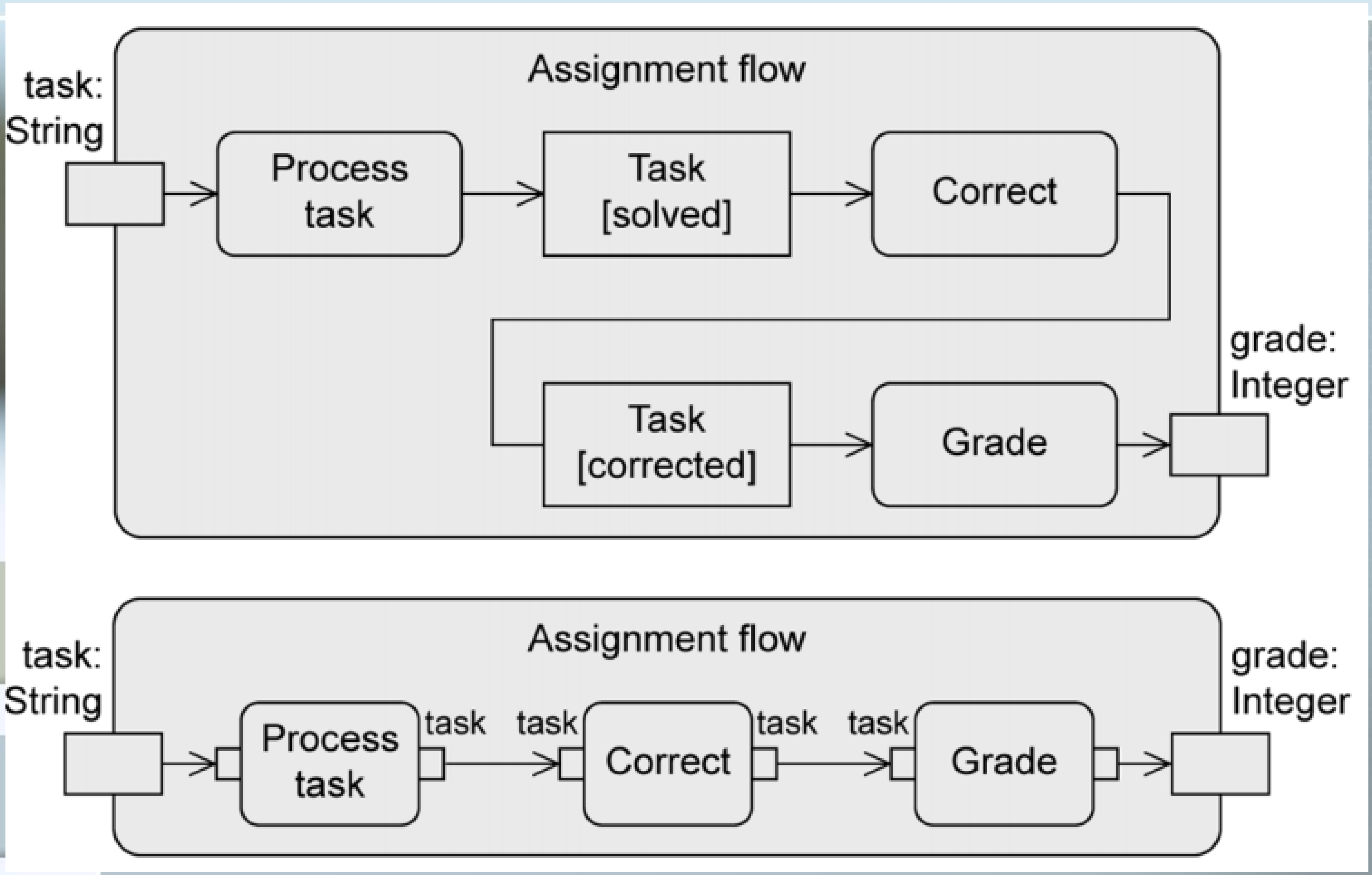




Standalone pin notations: the output pin and the input pin have the same name and same type

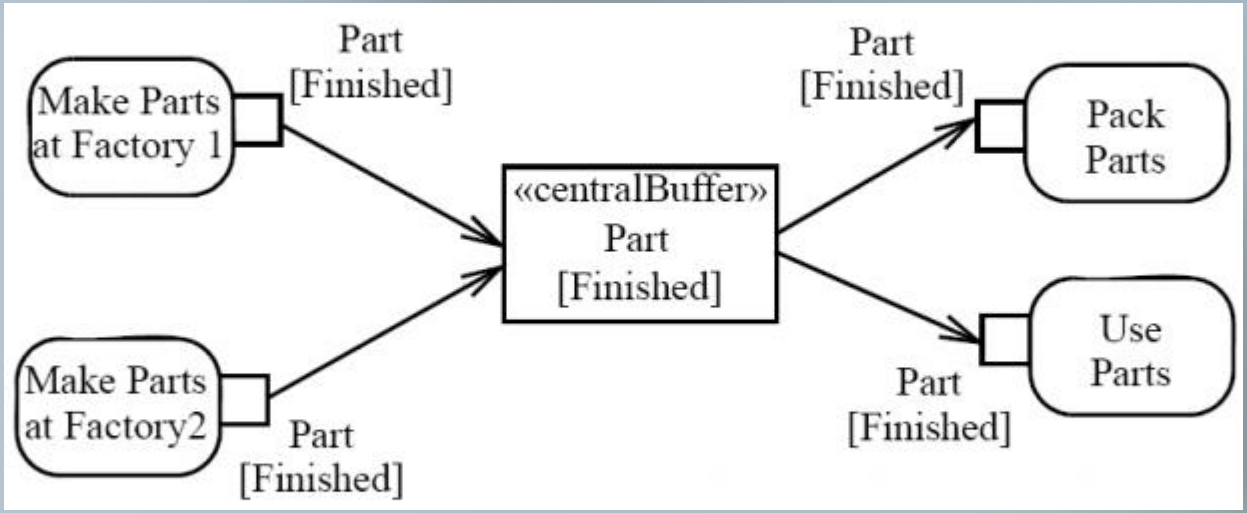
- An activity starts by taking a task as an input, where student process the task and the solved task is corrected by teacher. After the task is corrected, it is graded. The output of the activity is grade.

Example: Assignment Flow



Object node: Central Buffer

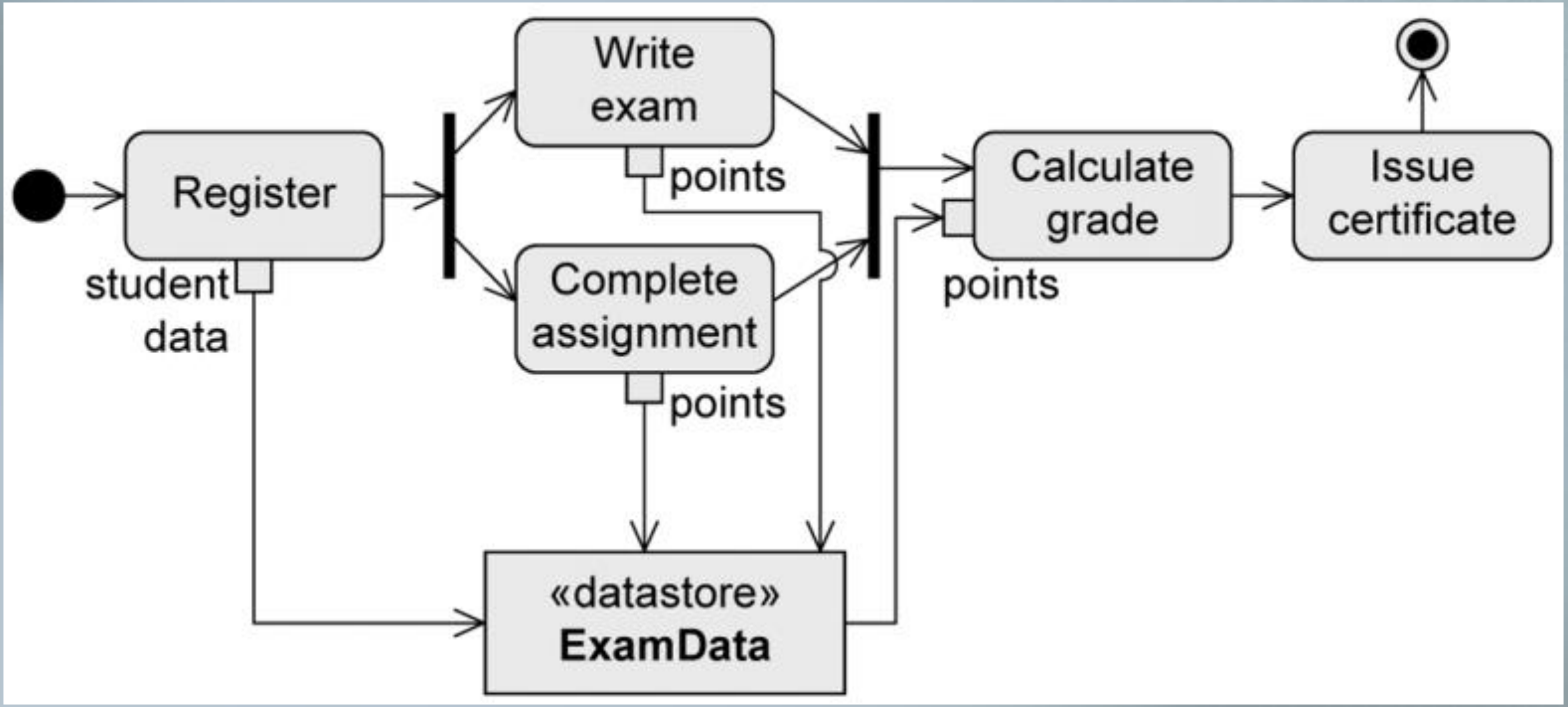
- For saving and passing on object tokens
- Transient memory
- Accepts incoming object tokens from object nodes and passes them on to other object nodes.
- When an object token is read from the central buffer, it is deleted from the central buffer and cannot be consumed again



Object nodes – Datastore

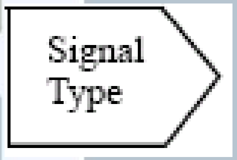
- For saving and passing on object tokens
- Permanent memory
- Saves object tokens permanently, passes copies to other nodes
- If arrives a token containing an object already present in the data store, this replaces the old one
- Tokens in a data store node cannot be removed (they are removed when the activity is terminated)

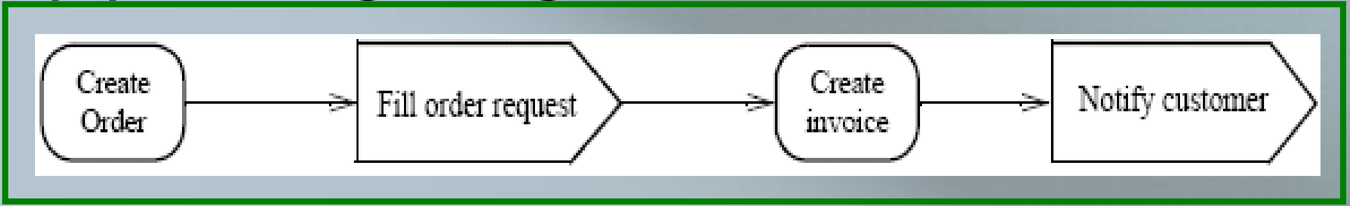
Example: Register and Withdraw



SendSignalAction

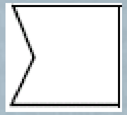
- Creates a signal instance from its inputs, and transmits it to the target object (local or remote)
- A signal is an asynchronous stimulus that triggers a reaction in the receiver in an asynchronous way and without a reply
- Any reply message is ignored

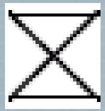


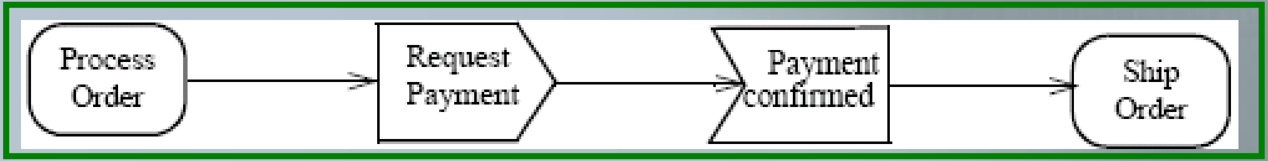


AcceptEventAction

- Waits for the occurrence of an event meeting specified conditions
- Two kinds of AcceptEventAction:
  - **Accept event action** – accepts signal events generated by a SendSignalAction
  - **Wait time action** – accepts time events





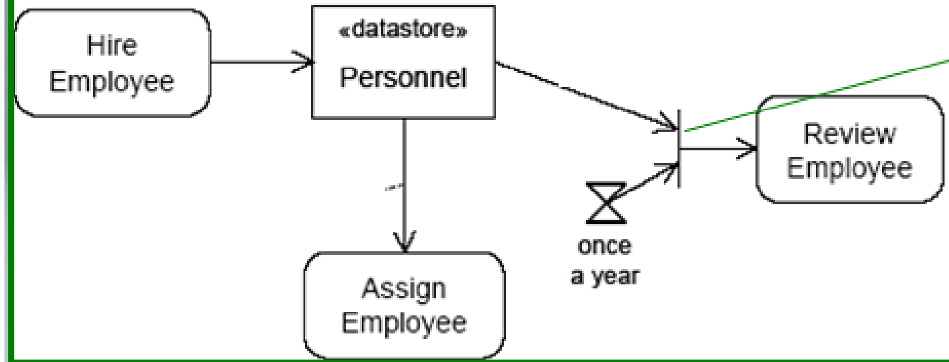


Time triggers and Time events

- A *Time trigger* is a trigger that specifies when a time event will be generated
- *Time events* occur at the instant when a specified point in time has transpired
- This time may be relative or absolute
  - ***Relative time trigger***: is specified with the keyword 'after' followed by an expression that evaluates to a time value
  - ***Absolute time trigger***: is specified as an expression that evaluates to a time value

$$\begin{tikzcd}\textbf{after (5 seconds)} \arrow[d] \\ \textbf{Relative time trigger}\end{tikzcd}$$

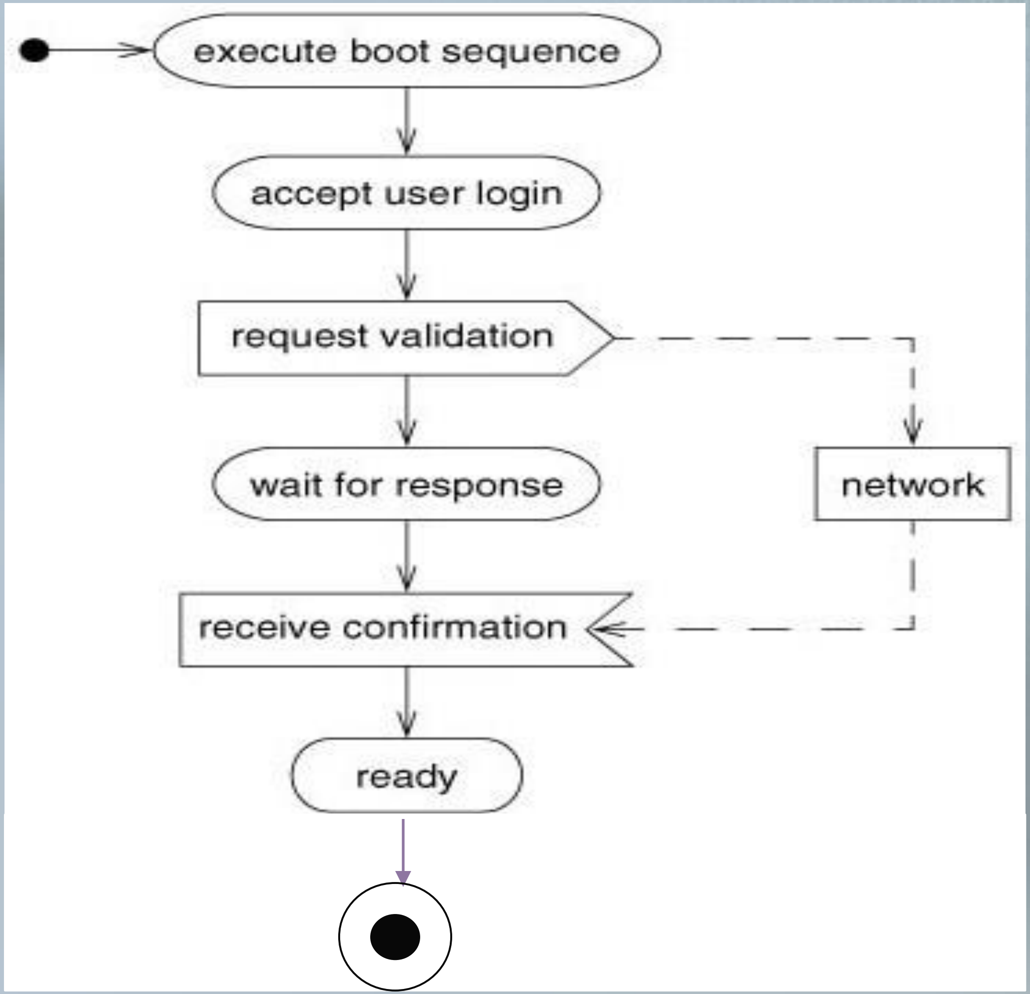
$$\begin{tikzcd}\textbf{Jan, 1, 2000, Noon} \arrow[d] \\ \textbf{Absolute time trigger}\end{tikzcd}$$



The objects stored in Personnel are only retrieved when the join succeeds (only once a year)

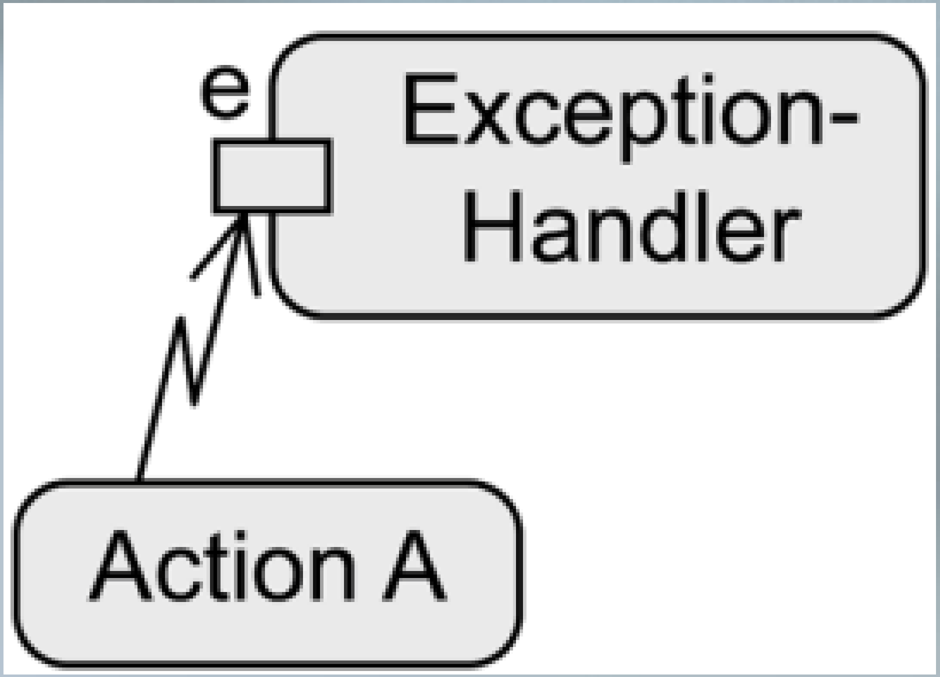
Example

- Consider a workstation that is turned on. It goes through a boot sequence and then requests that the user login. After entry of a name and password, the workstation queries the network to validate the user. Upon validation, the workstation then finishes its startup process.


execute boot sequence
accept user login
request validation
wait for response
network
receive confirmation
ready

Exception Handling- Exception Handler

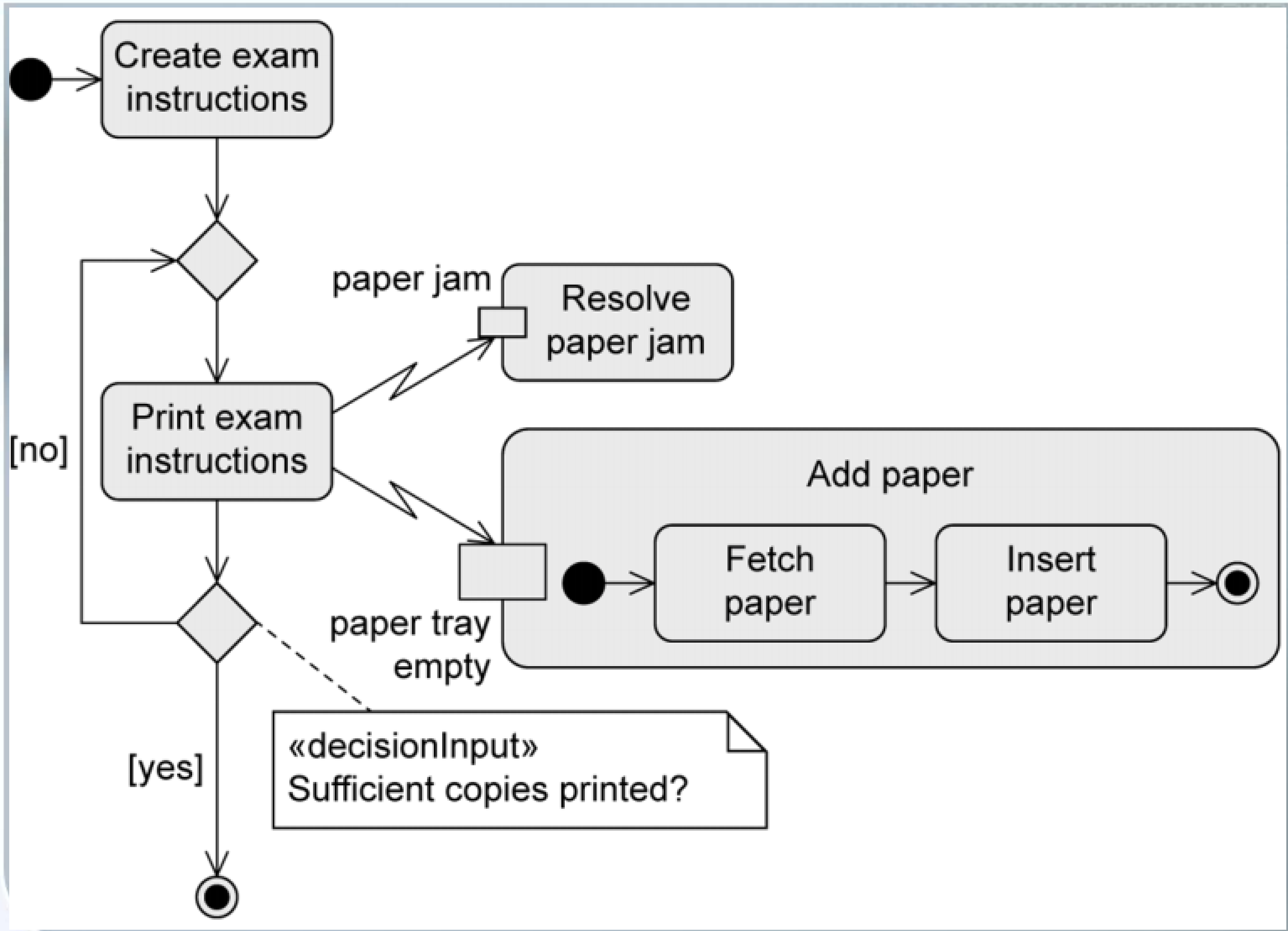
- Predefined exceptions.
- Defining how the system has to react in a specific error situation.
- The exception handler replaces the action where the error occurred



Exception Handling- Exception Handler

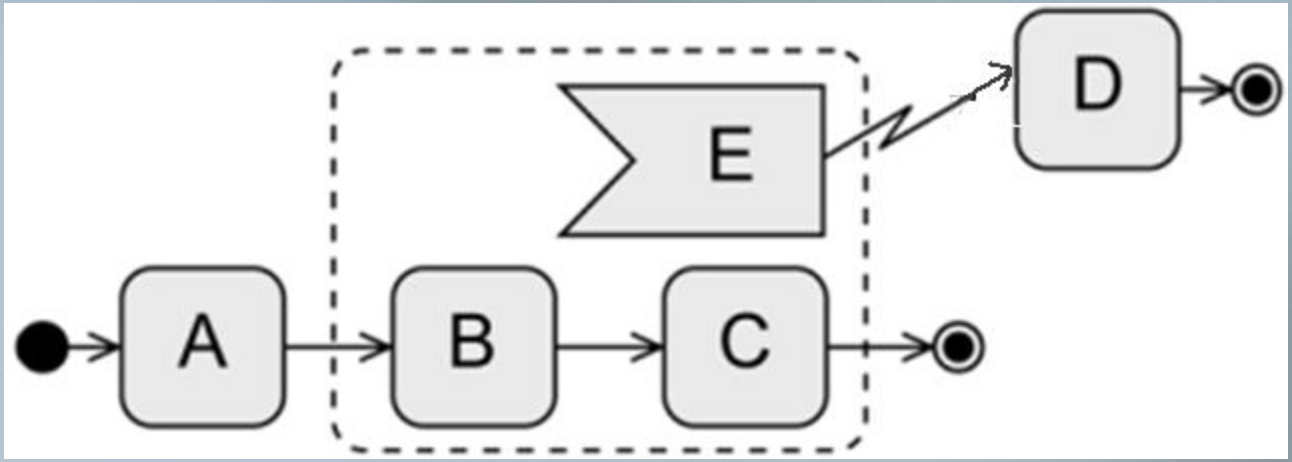
- If the error $_e$ occurs…
  - All tokens in Action A are deleted
  - The exception handler is activated
  - The exception handler is executed instead of Action A
  - Execution then continues regularly

Example: Printing Copies



Exception Handling– Interruptible Activity Region

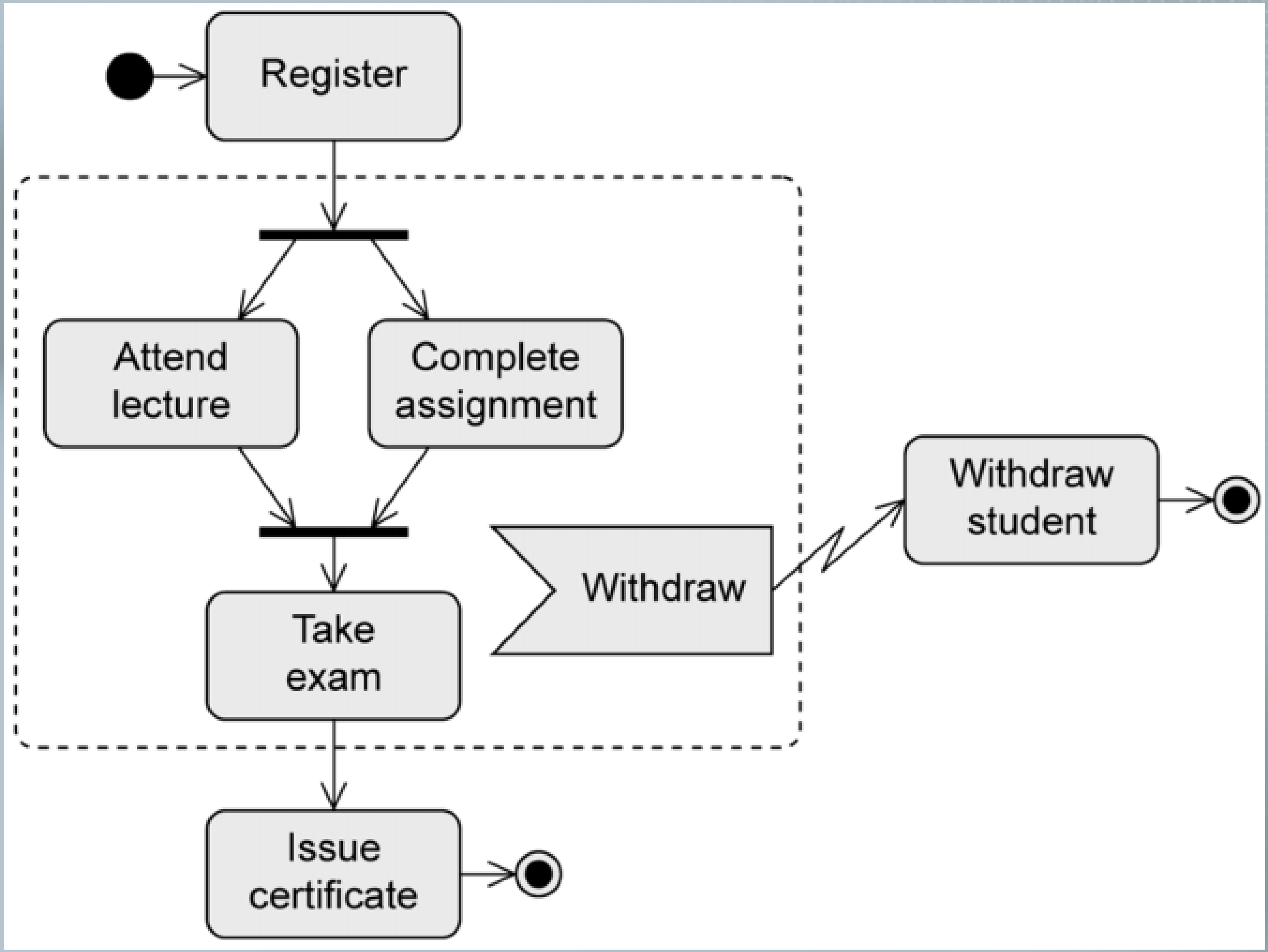
- Defining a group of actions whose execution is to be terminated immediately if a specific event occurs. In that case, some other behavior is executed.
- No "jumping back" to the regular execution!



Exception Handling– Interruptible Activity Region

- if $_E$ occurs while B or C are executed
  - Exception handling is activated
  - All control tokens within the dashed rectangle (= within B and C) are deleted
  - D is activated and executed

Example: Register and Withdraw

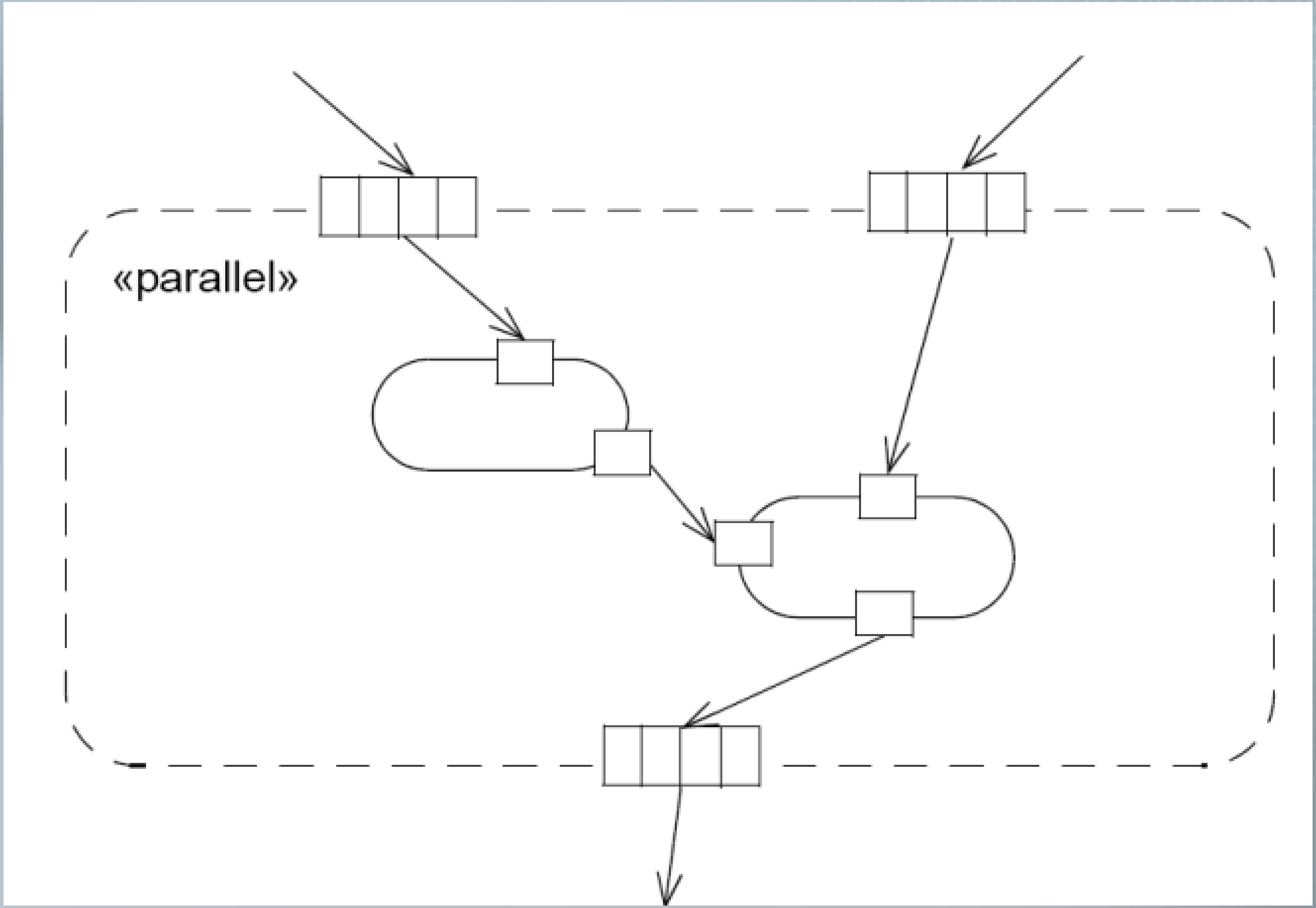


Expansion Regions

- An Expansion Region surrounds a process to be imposed multiple times on the incoming data, once for every element in the input collection.
- An expansion region is a structured activity region that executes multiple times for collection items.
- Input and output expansion nodes are drawn as a group of three / four boxes representing a multiple selection of items.

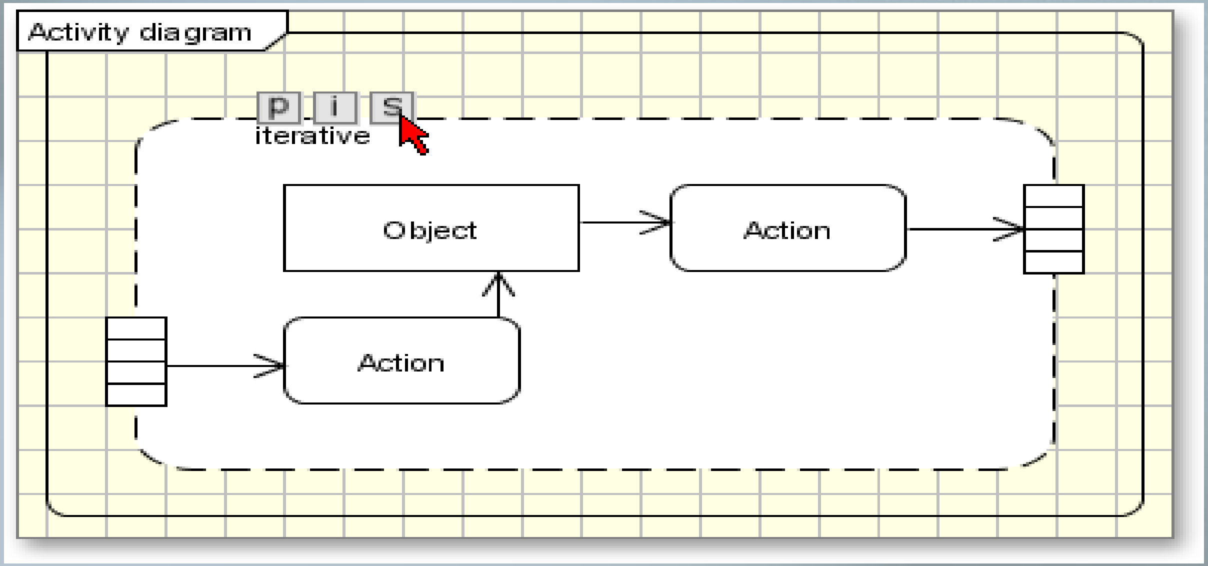
Concurrency of Multiple Executions

- The concurrency of the Expansion Region's multiple executions can be specified as type parallel, iterative, or stream.
- The keyword iterative, parallel or stream is shown in the top left corner of the region
- **Parallel** reflects that the elements in the incoming collections can be processed at the same time or overlapping.


«parallel»

Concurrency of Multiple Executions

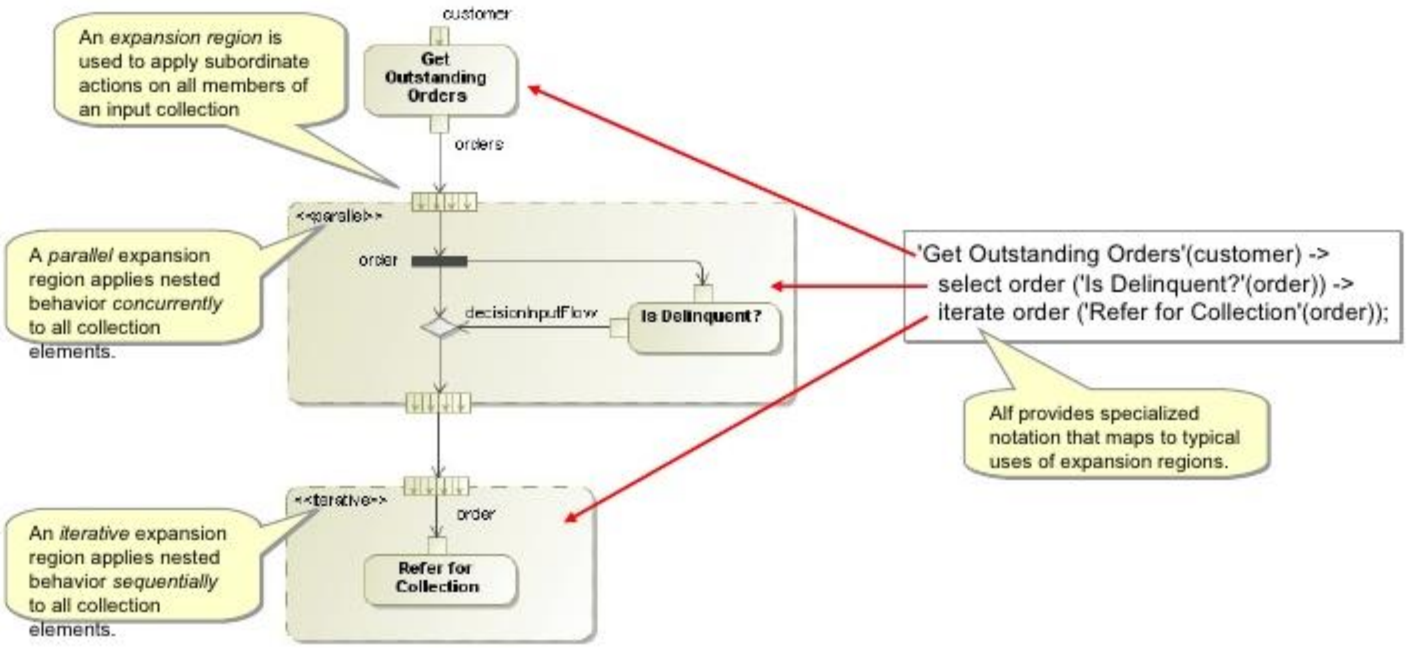
- An **iterative** concurrency type specifies that execution must occur sequentially.



Concurrency of Multiple Executions

- A **stream-type** Expansion Region indicates that the input and output come in and exit as streams, and that the Expansion Region's process must have some method to support streams.

Expansion Regions



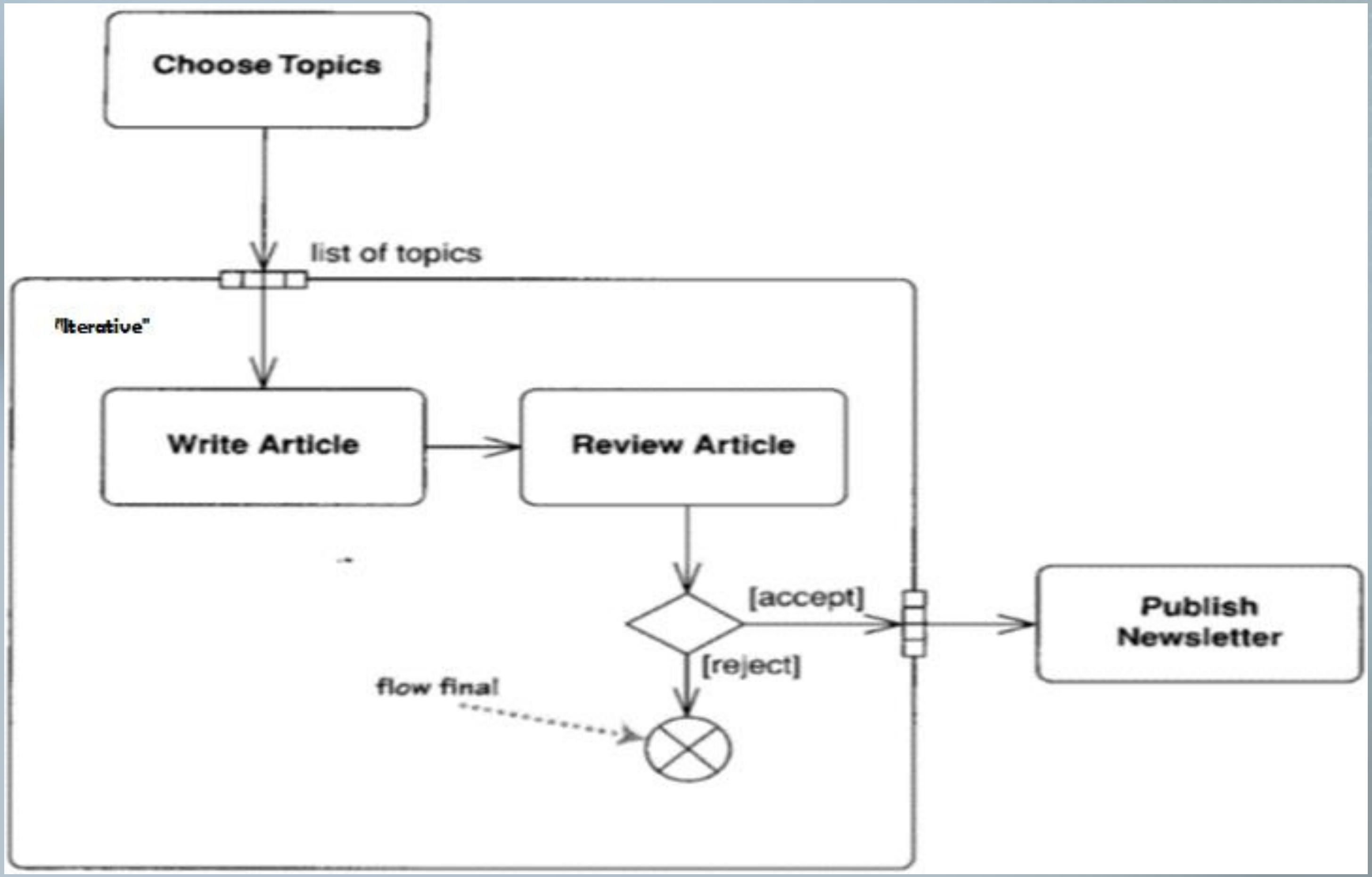
An *expansion region* is used to apply subordinate actions on all members of an input collection

A *parallel* expansion region applies nested behavior *concurrently* to all collection elements.

An *iterative* expansion region applies nested behavior *sequentially* to all collection elements.

```
'Get Outstanding Orders'(customer) ->
  select order ('Is Delinquent?'(order)) ->
  iterate order ('Refer for Collection'(order));
```

Alf provides specialized notation that maps to typical uses of expansion regions.

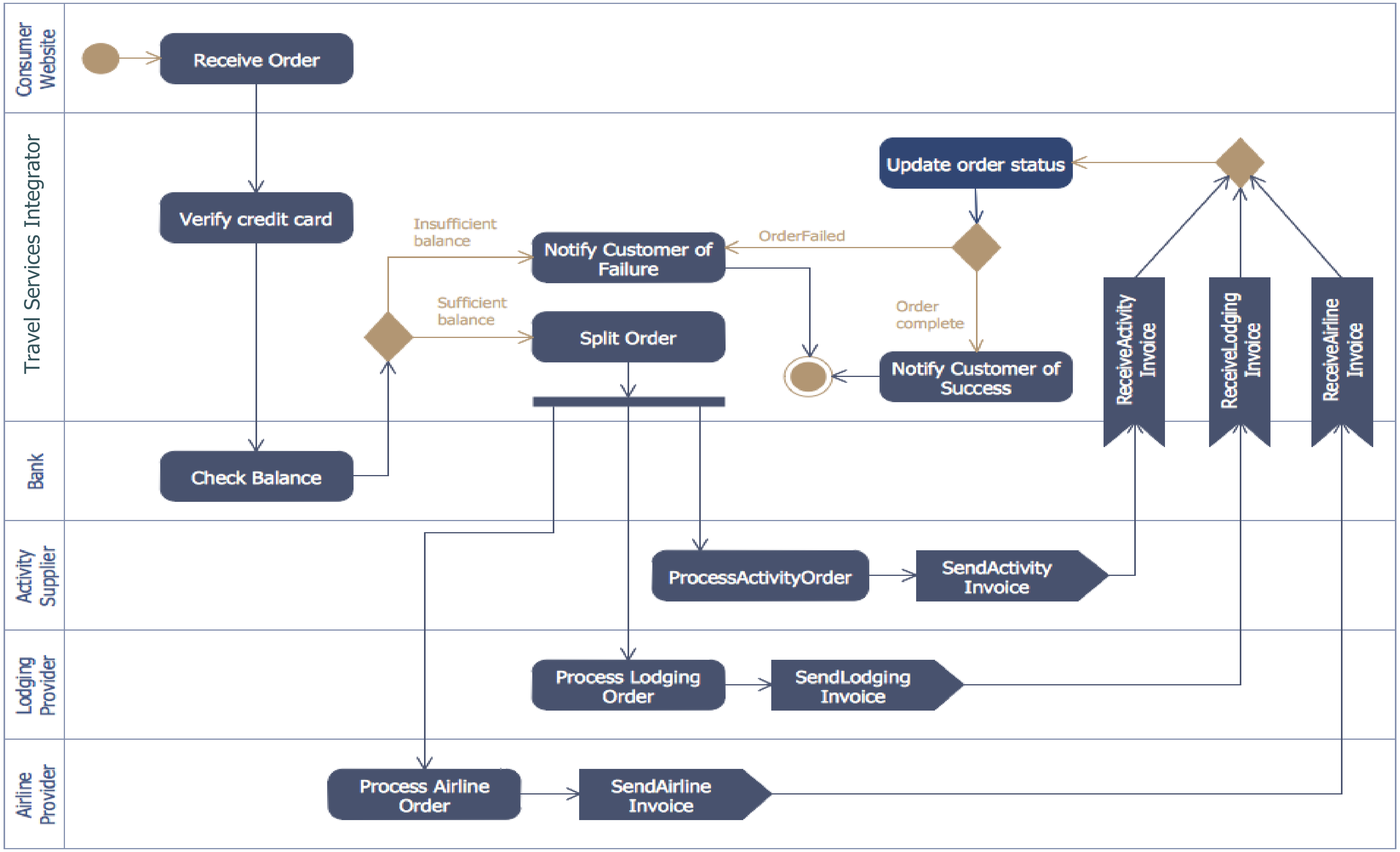

Choose Topics
list of topics
"Iterative"
Write Article
Review Article
[accept]
[reject]
flow final
Publish Newsletter

How to create Activity Diagram

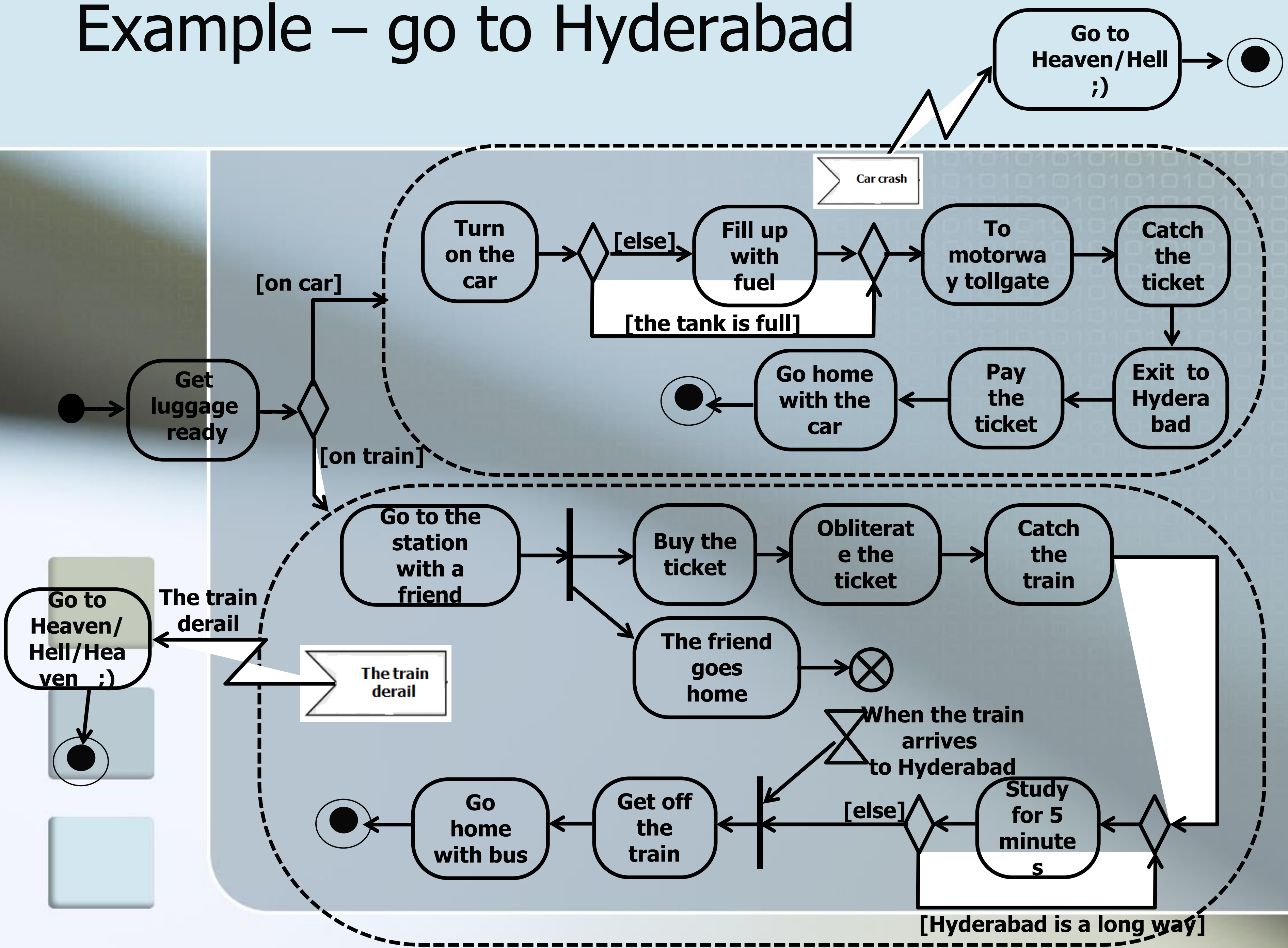
1. Identify activities (steps) of a process
2. Identify who/what performs activities (process steps)
3. Draw swimlanes
4. Identify decision points (if-then)
5. Determine if a step is in loop (*For each…,* *or* if-then loop)
6. Determine if step is parallel with some other
7. Identify order of activities, decision points

How to create Activity Diagram

8. Draw the start point of the process in the swimlane of the first activity (step)
9. Draw the oval of the first activity (step)
10. Draw an arrow to the location of the second step
11. Draw subsequent steps, while inserting decision points and synchronization/loop bars where appropriate
12. Draw the end point after the last step.


Consumer Website
Travel Services Integrator
Bank
Activity Supplier
Lodging Provider
Airline Provider
Receive Order
Verify credit card
Check Balance
Insufficient balance
Sufficient balance
Notify Customer of Failure
Split Order
OrderFailed
Update order status
Order complete
Notify Customer of Success
ReceiveActivity Invoice
ReceiveLodging Invoice
ReceiveAirline Invoice
ProcessActivityOrder
SendActivity Invoice
Process Lodging Order
SendLodging Invoice
Process Airline Order
SendAirline Invoice

Example – go to Hyderabad


Go to Heaven/Hell ;)
Car crash
Get luggage ready
[on car]
[on train]
Turn on the car
[else]
Fill up with fuel
[the tank is full]
To motorway tollgate
Catch the ticket
Exit to Hyderabad
Pay the ticket
Go home with the car
Go to the station with a friend
Buy the ticket
Obliterate the ticket
Catch the train
The friend goes home
When the train arrives to Hyderabad
Study for 5 minutes
[else]
[Hyderabad is a long way]
Get off the train
Go home with bus
The train derail
Go to Heaven/Hell/Heaven ;)