Overview

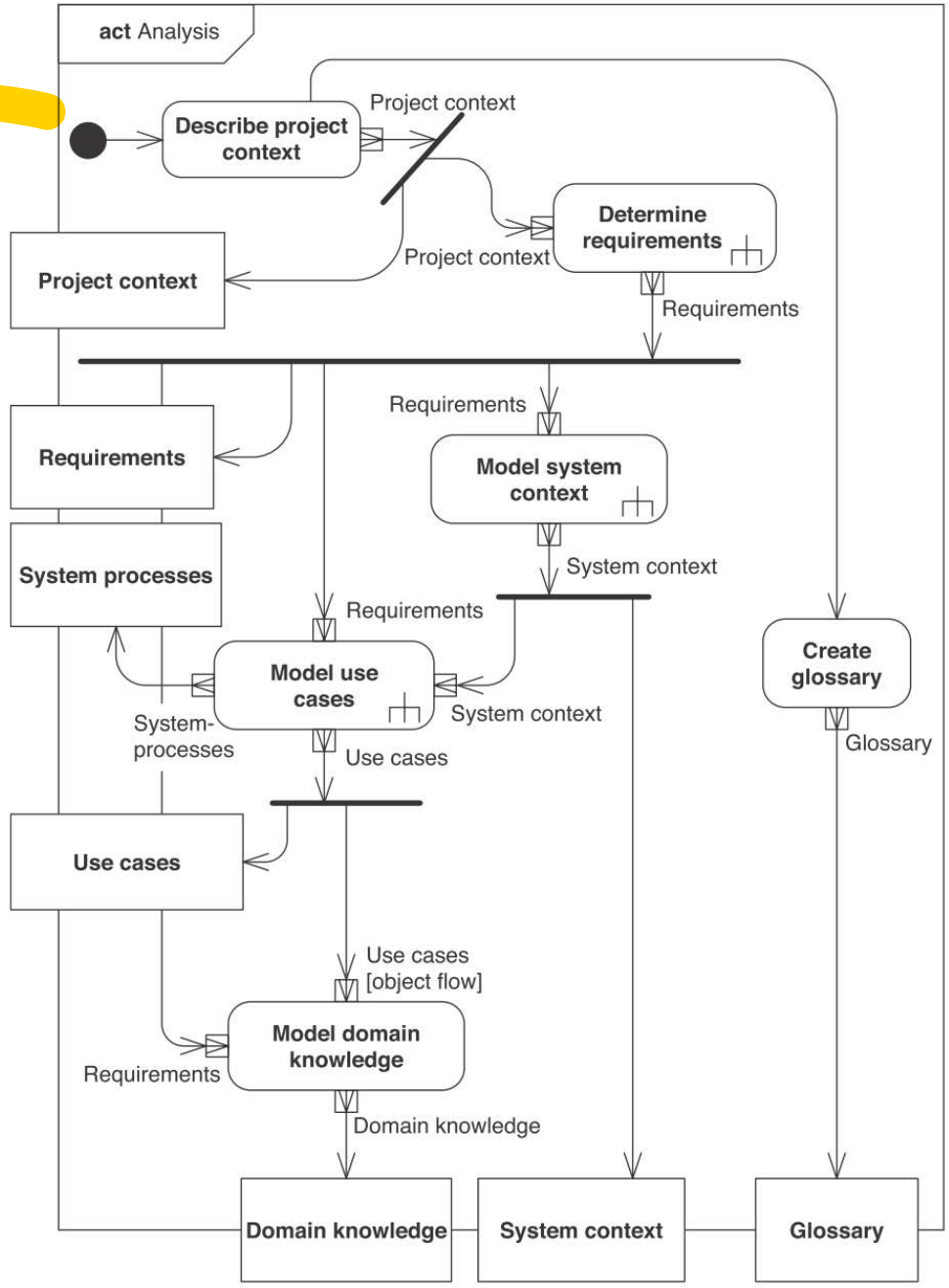
- Context
- SysML Overview
- **SysML details + the SYSMOD Systems Engineering Methodology**

Language vs. Methodology

- Modeling Language
  - Defines elements and their relationship
  - Defines syntax and semantics
  - *What type of elements can be used during modeling?*
  - E.g. SysML
- Development Methodology
  - Defines the steps of analyzing and designing the system
  - Defines the usage of the model elements and diagrams
  - *How shall the model be built?*
  - E.g. SYSMOD (SYStem MODeling) by Tim Weilkiens

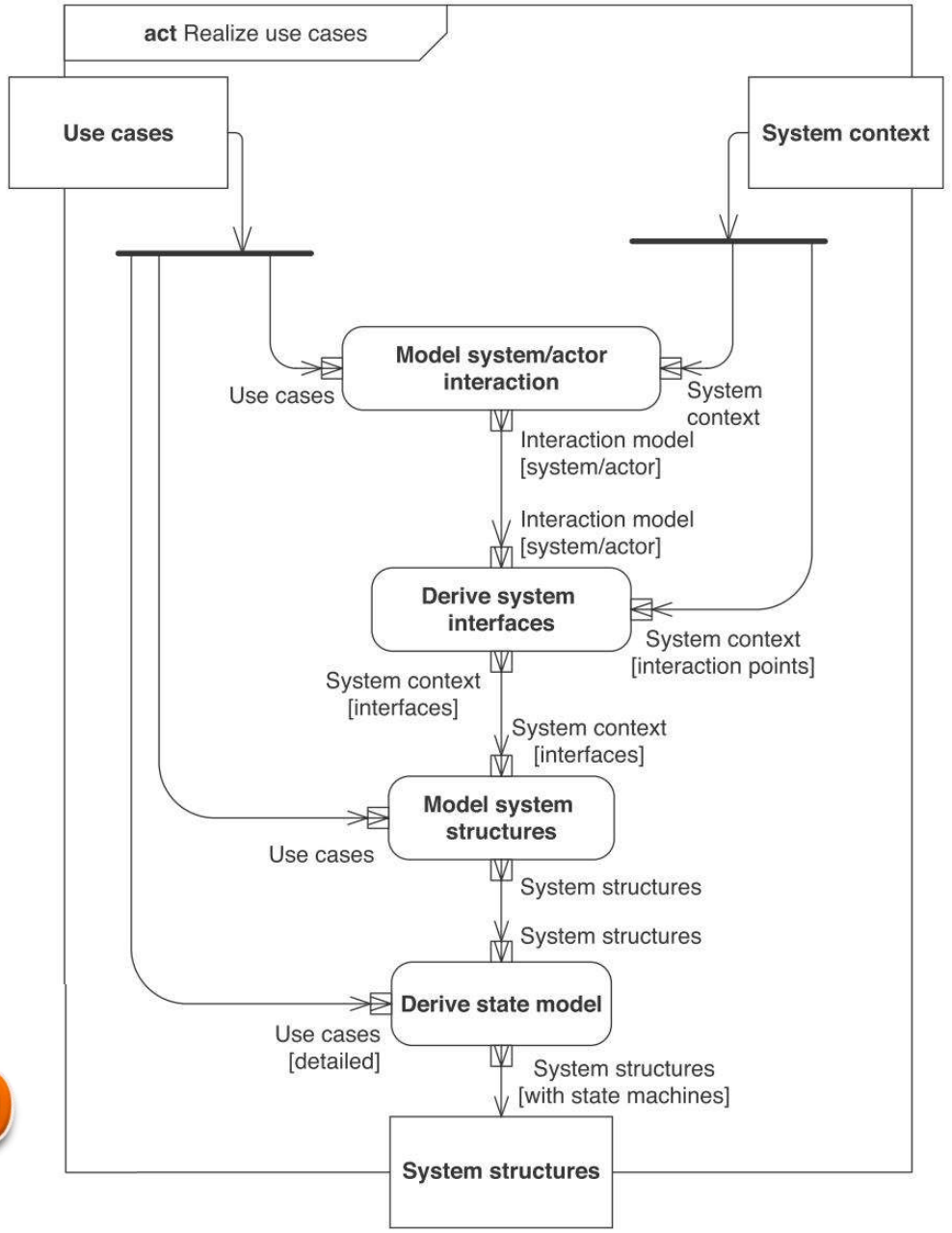
The SYSMOD approach

- Analyzing Requirements



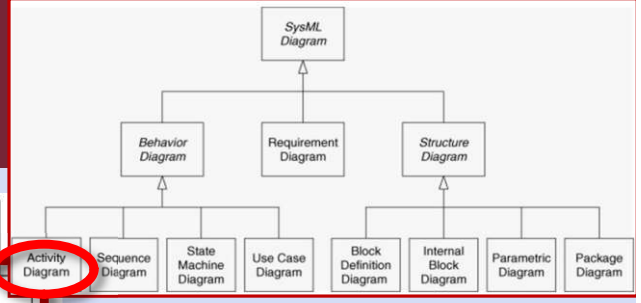
SYSMOD

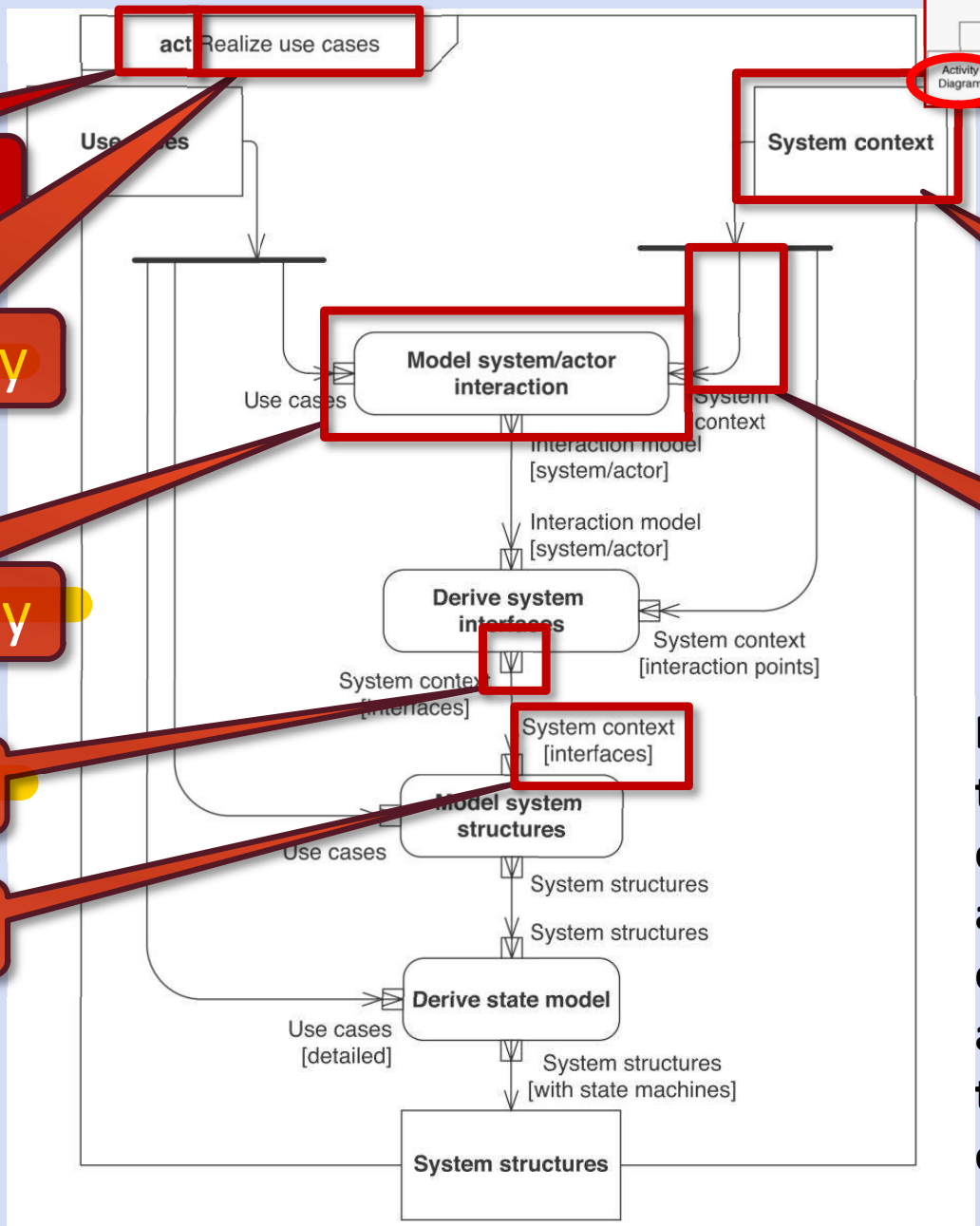
The SYSMOD approach for design



SYSMOD

SysML





Activity diagram

Name of activity

Action in activity

Pin

Object

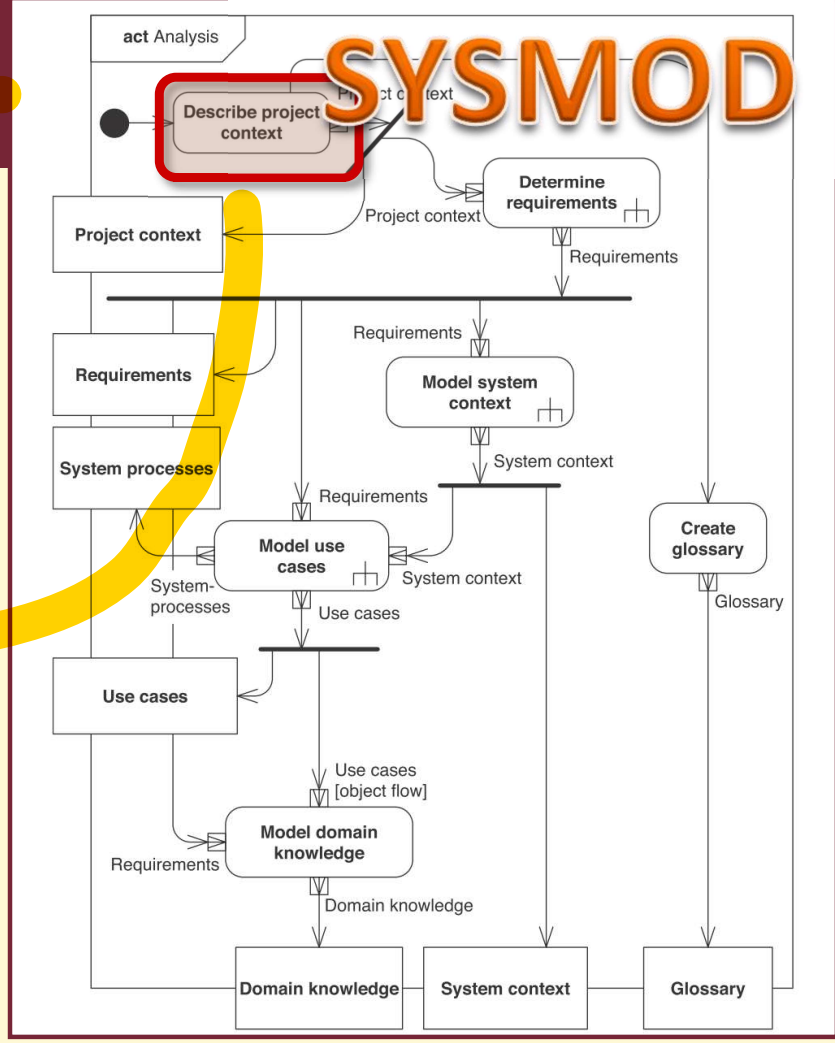
Parameter of activity

Object flow

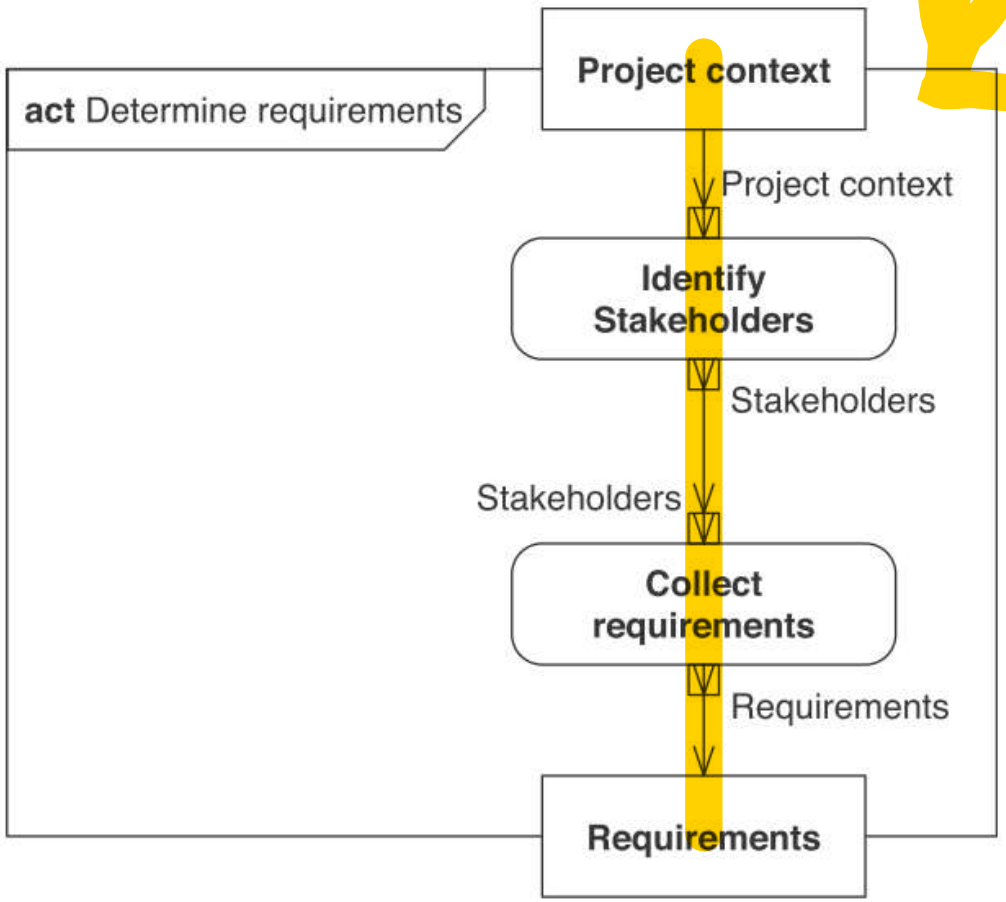
Represents behavior in terms of the ordering of actions based on the availability of inputs, outputs, and control, and how the actions transform the inputs to outputs

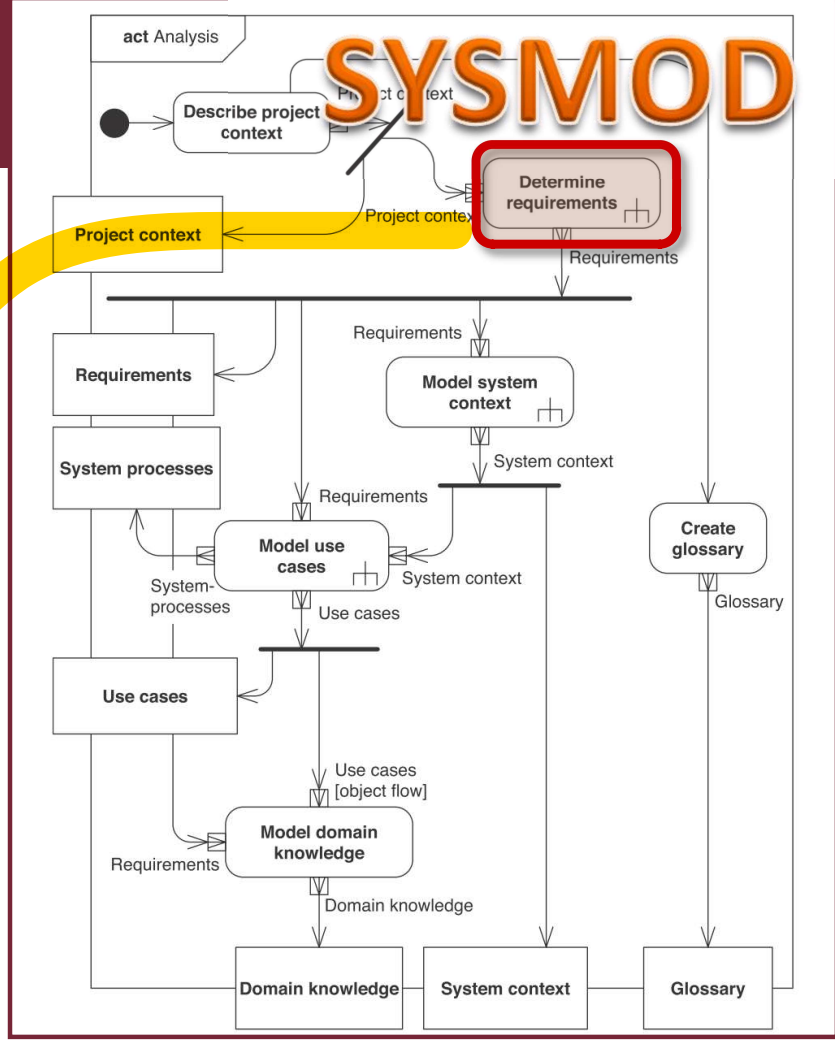
Describe Project Context

- Car rental system
  - Works without staff
    - Customer identification needed
  - Central computer in radio compartment
    - Communicates with central reservation system
    - Collects usage data
    - Comfort features
      - Navigation
      - Radio
      - Phone
      - ...



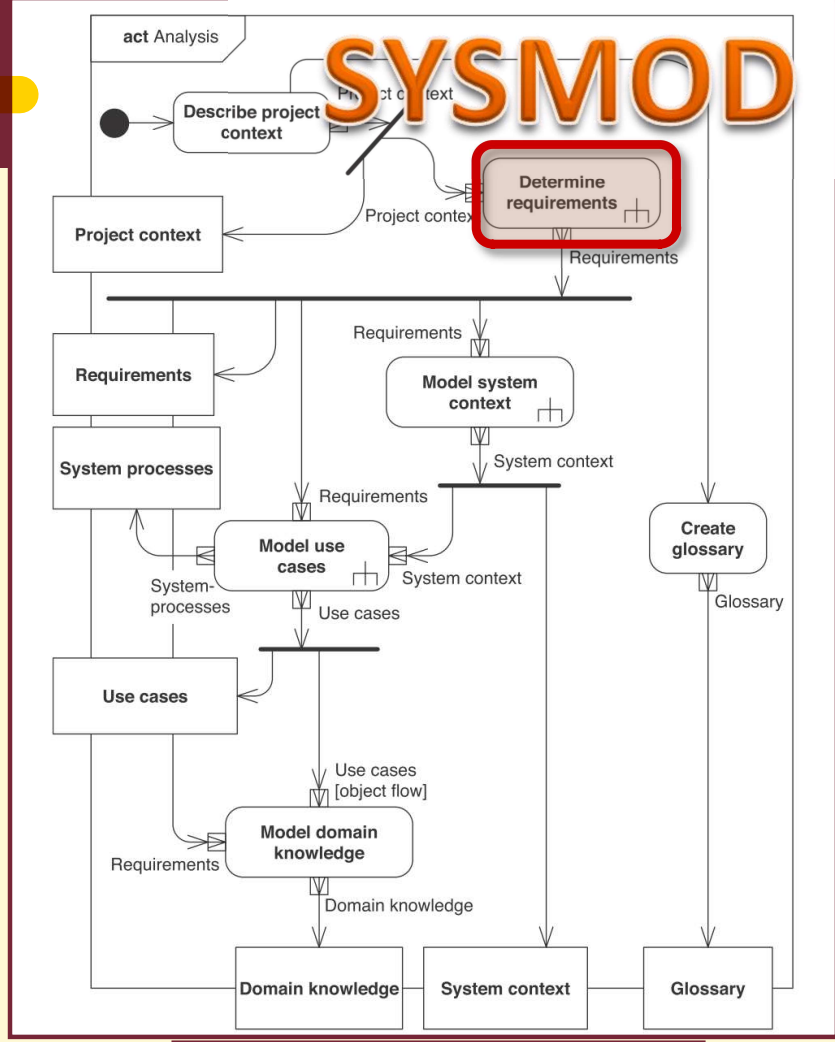
Determine requirements

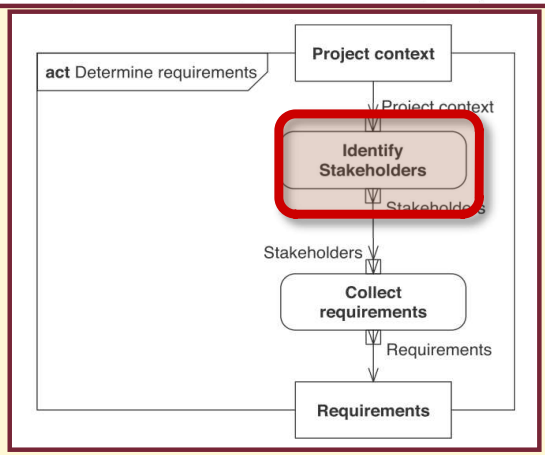




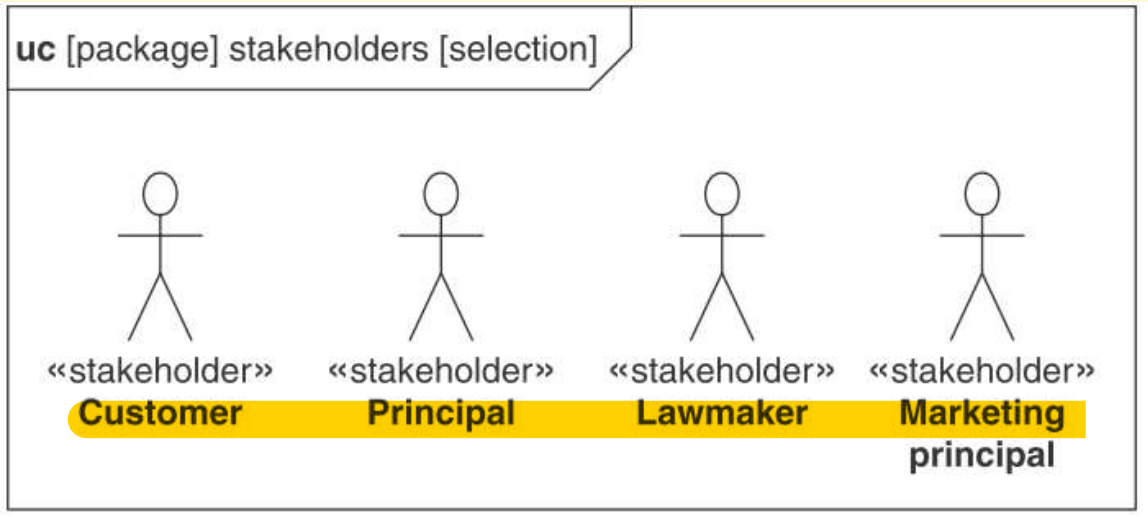
Identify stakeholders

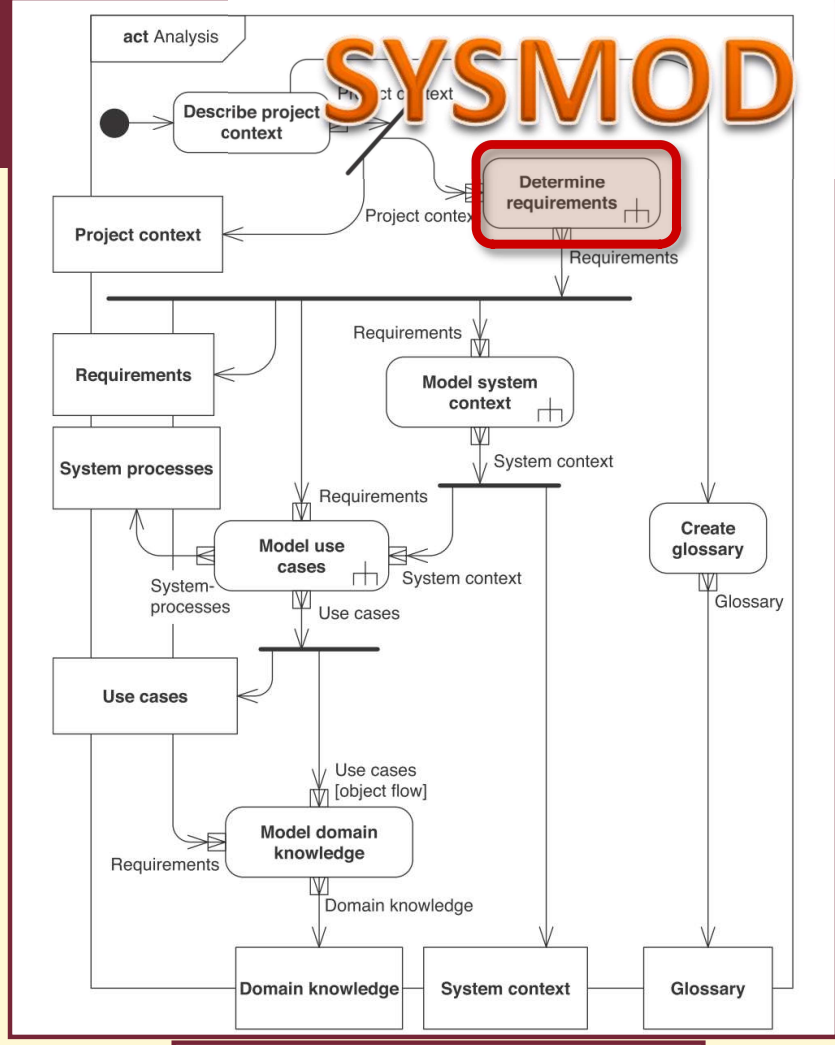
Stakeholder	Priority (1–4)	Comments/Interests
Customer	1	Wants easy and comfortable access to a car and low prices.
Reservation system	2	Requires interface to the on-board computer.
Car manufacturer	1	The on-board computer must control the central locking system and the drive-away protection, and collect mileage information.
Cellular communication vendor	1	The on-board computer and the reservation system will presumably communicate via SMS. Both speed and availability must be ensured.
Insurance company	1	Is break-in protection coverage for the on-board computer sufficient?
Car service	2	Installation, maintenance, and configuration of the on-board computer.
SpeedyCar call center	2	Handles customer enquiries with regard to the on-board computer's operation.
Navigation system manufacturer	4	SpeedyCar wants the on-board computer to have navigation system functionality.
Car radio manufacturer	2	The on-board computer should integrate car radio functionality since it will replace the regular radio.
Card reader manufacturer	1	The access device will be purchased from third party.
Legacy systems takeback law	3	What does the law say about the disposal of old devices? Who is responsible?
Lawmaker	1	What size/weight is permitted for the on-board computer? Other legal provisions have to be checked yet.

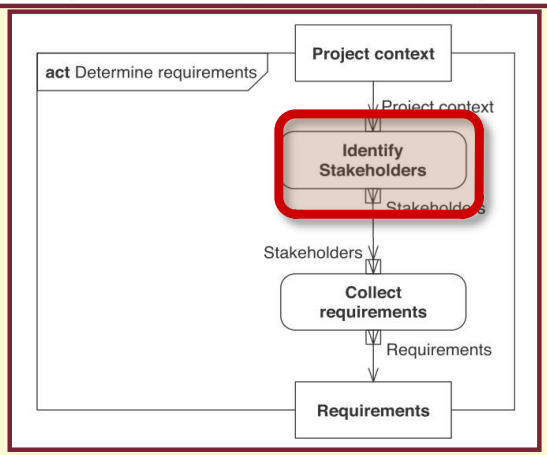




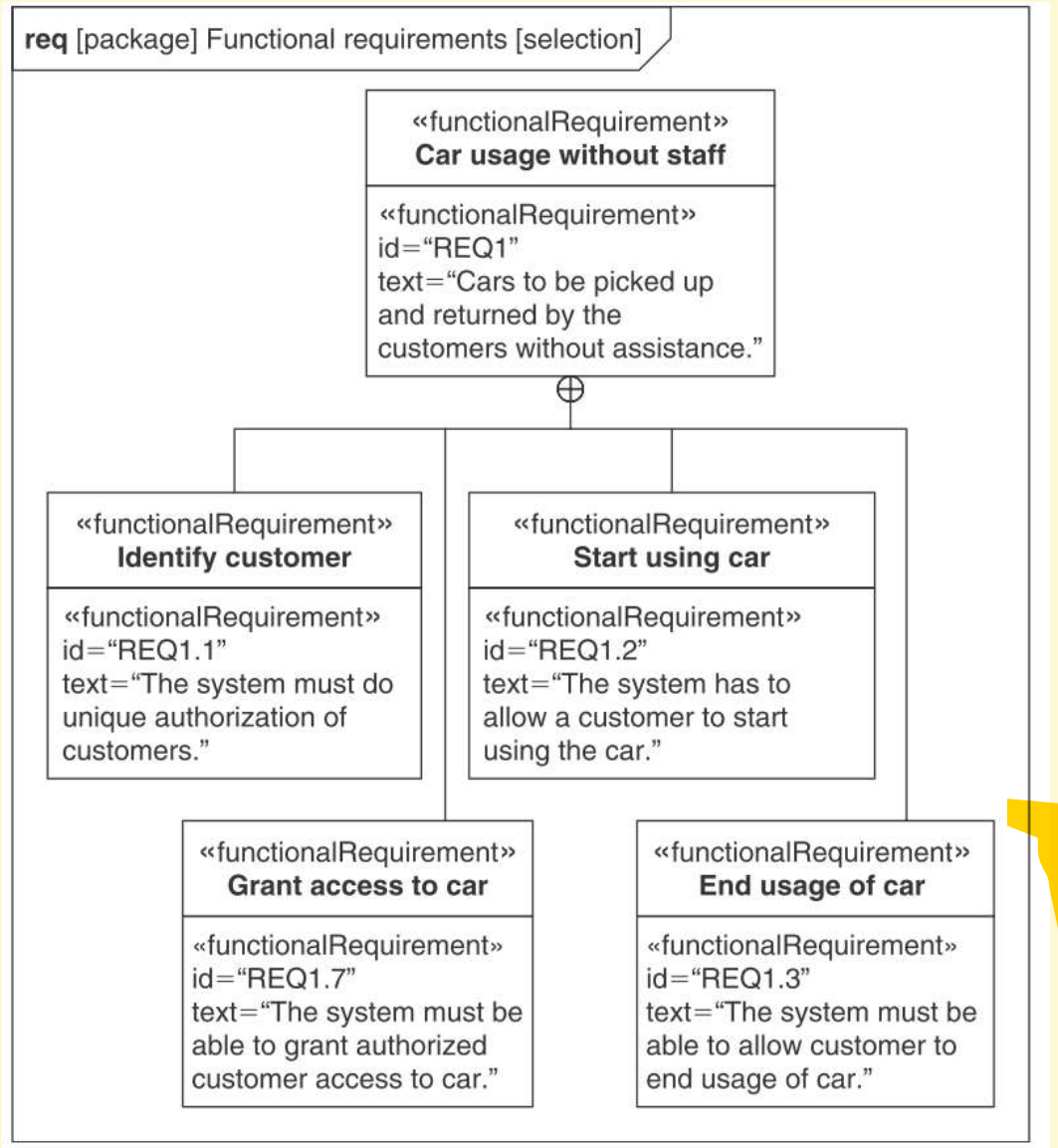
Identify stakeholders

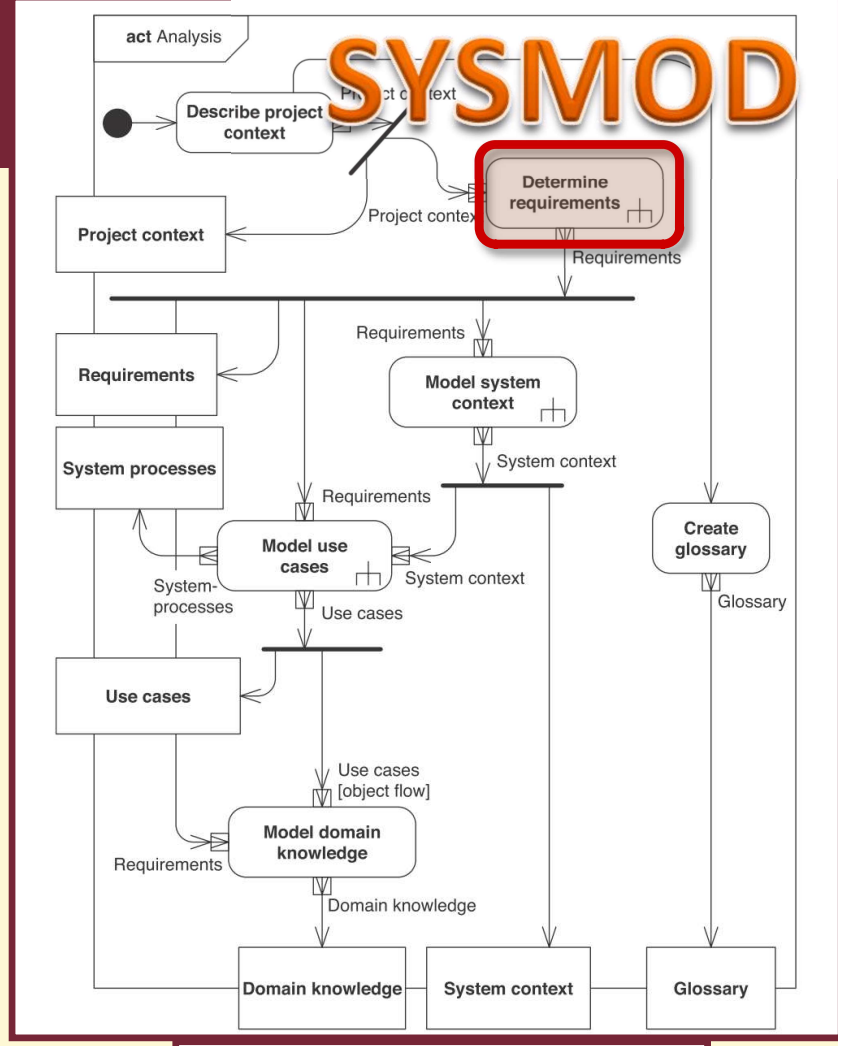


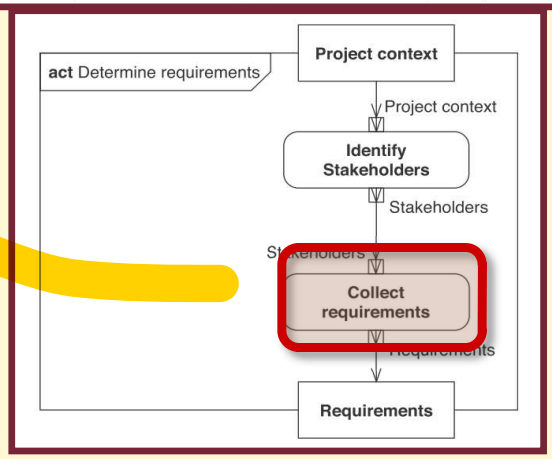




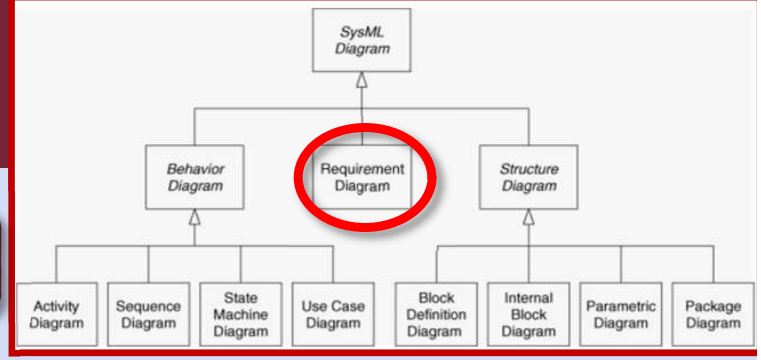
Collect requirements







SysML



Requirements diagram

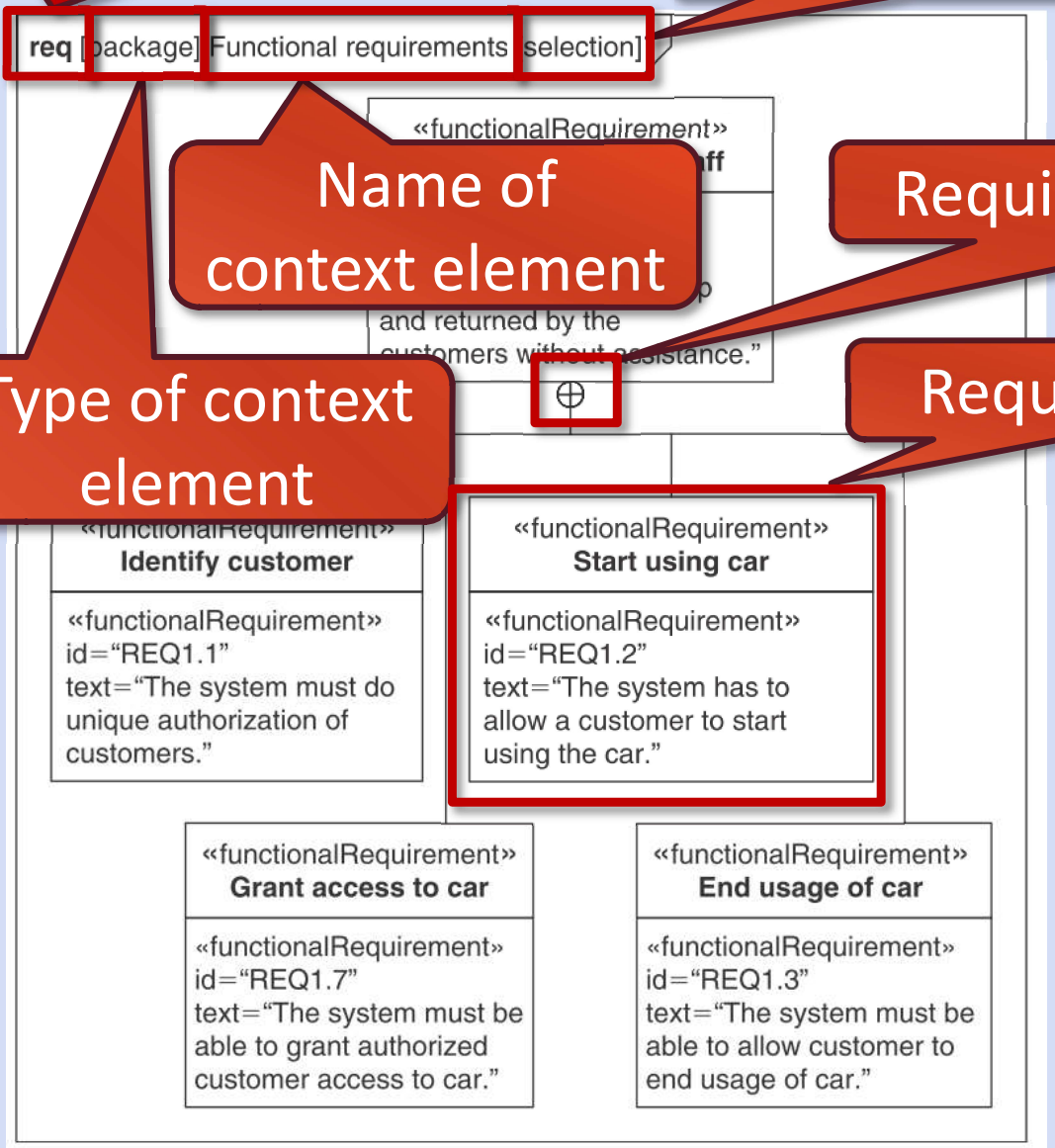
Name of diagram

Name of context element

Requirement composition

Type of context element

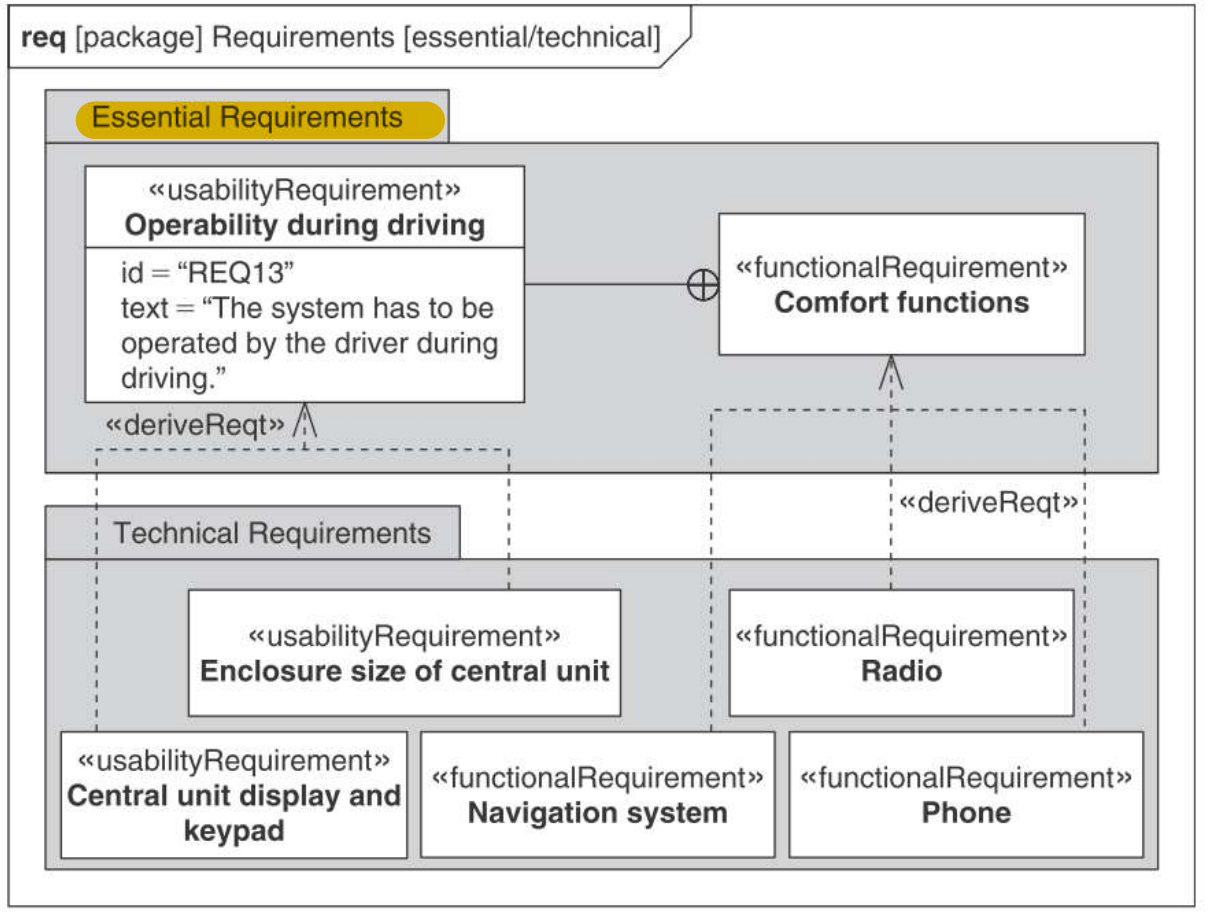
Requirement

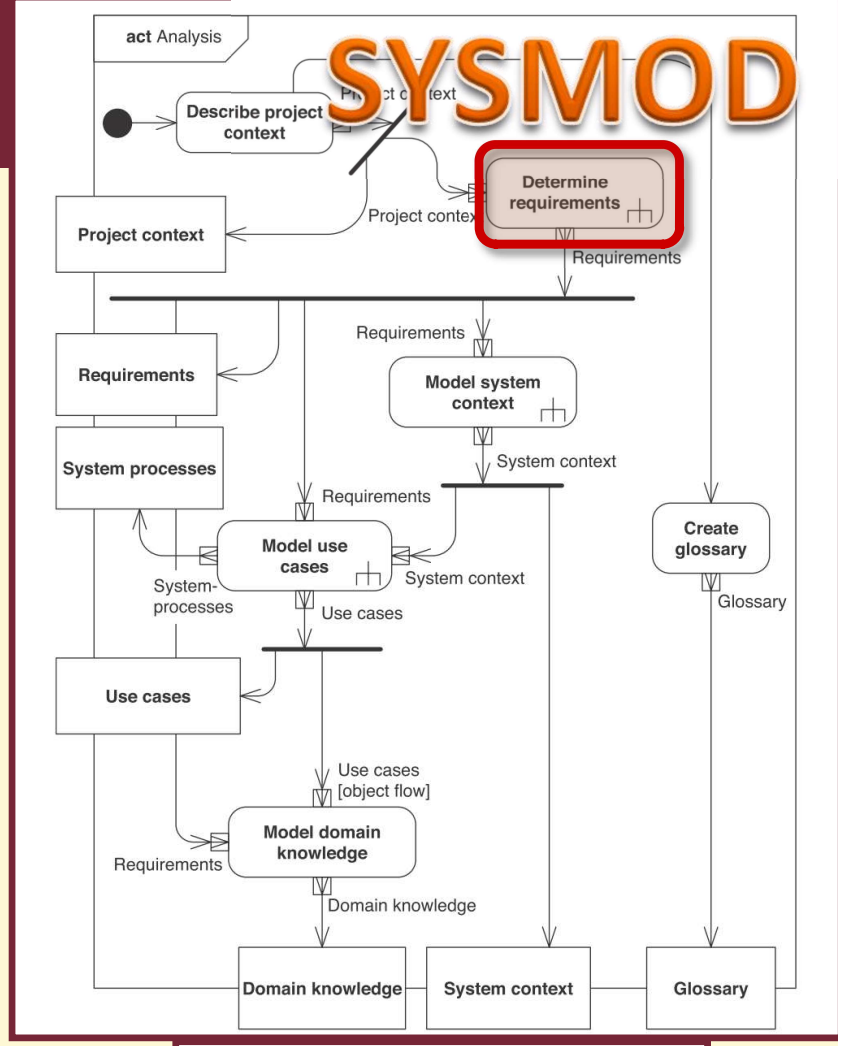


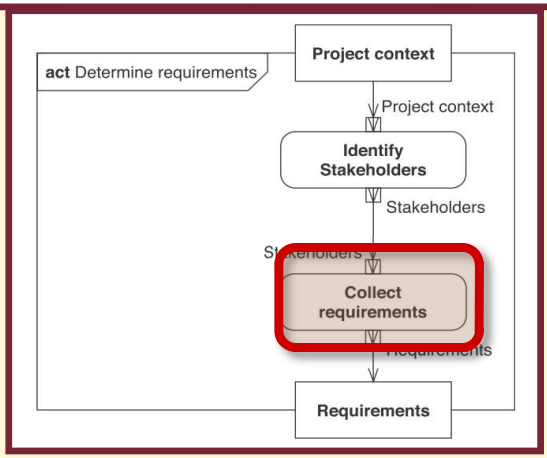
Requirements diagram

Represents text-based requirements and their relationship with other requirements, design elements, and test cases to support requirements traceability

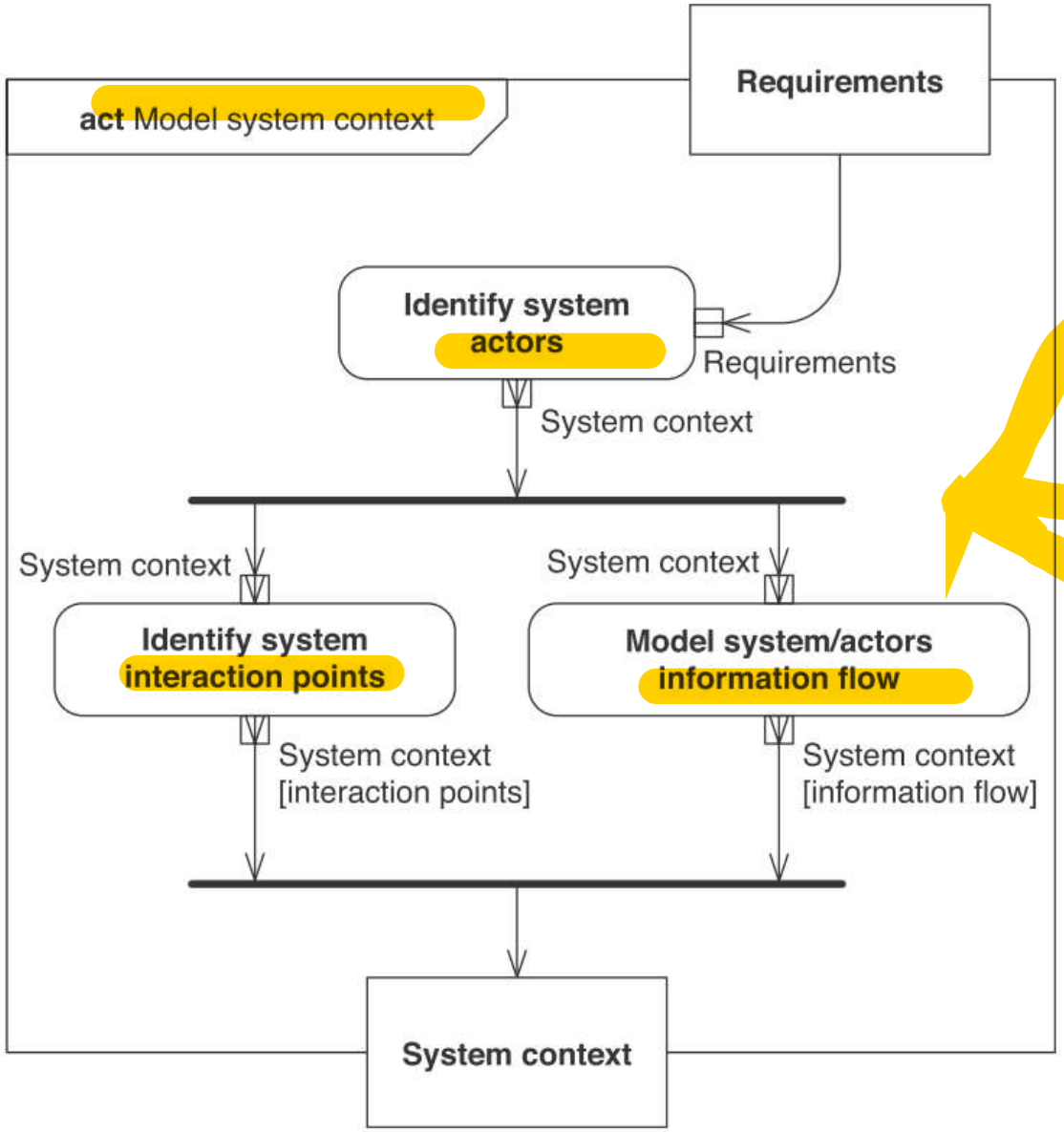
Collect requirements

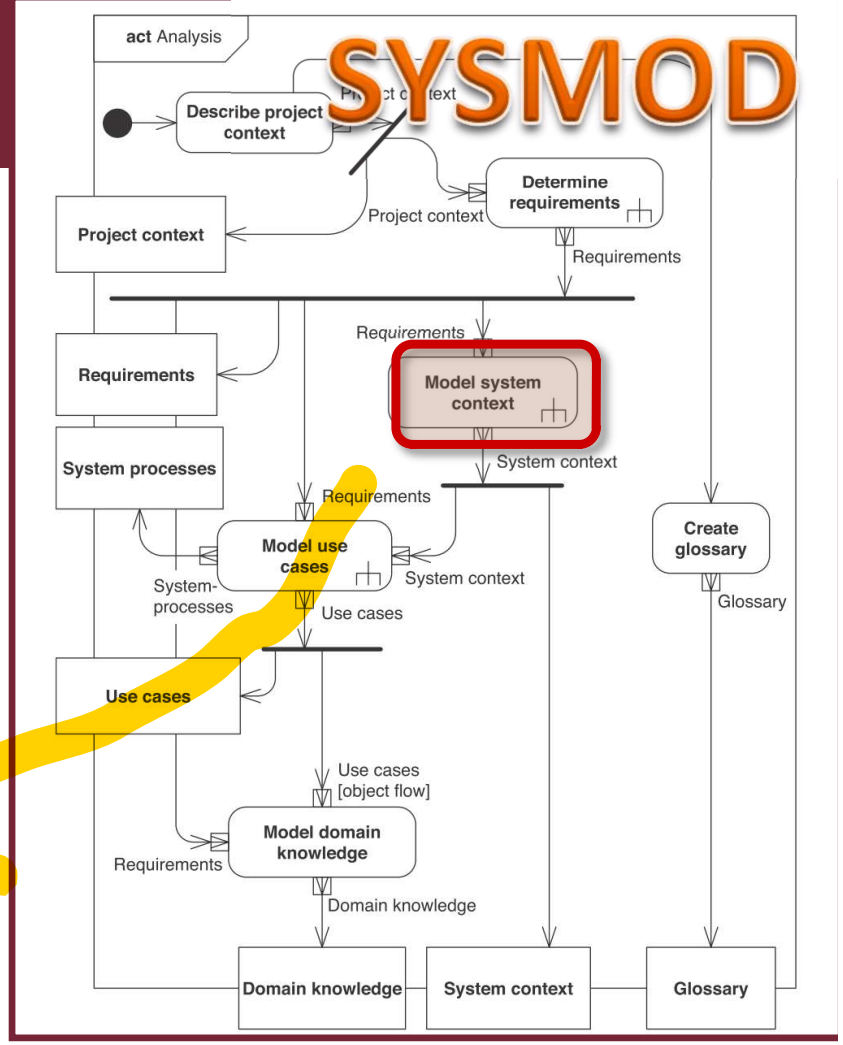




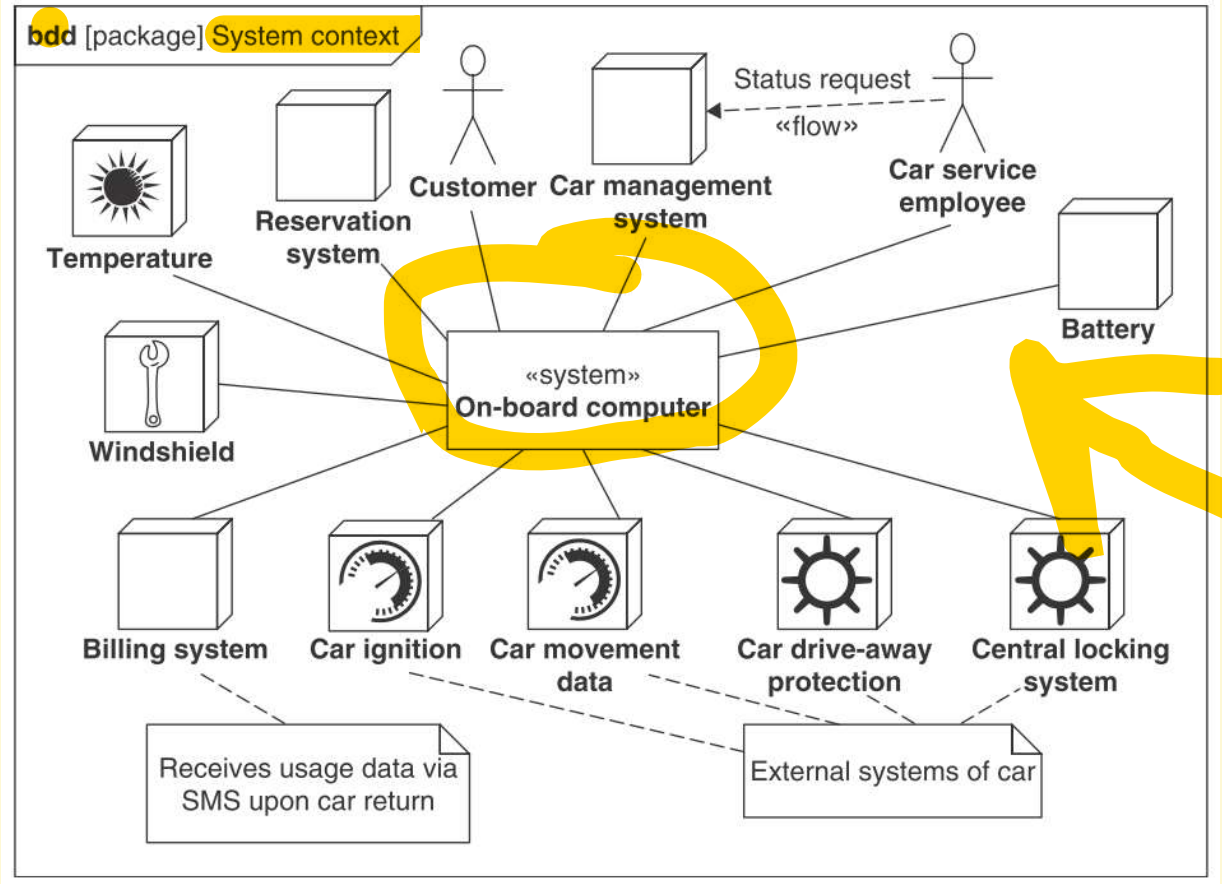


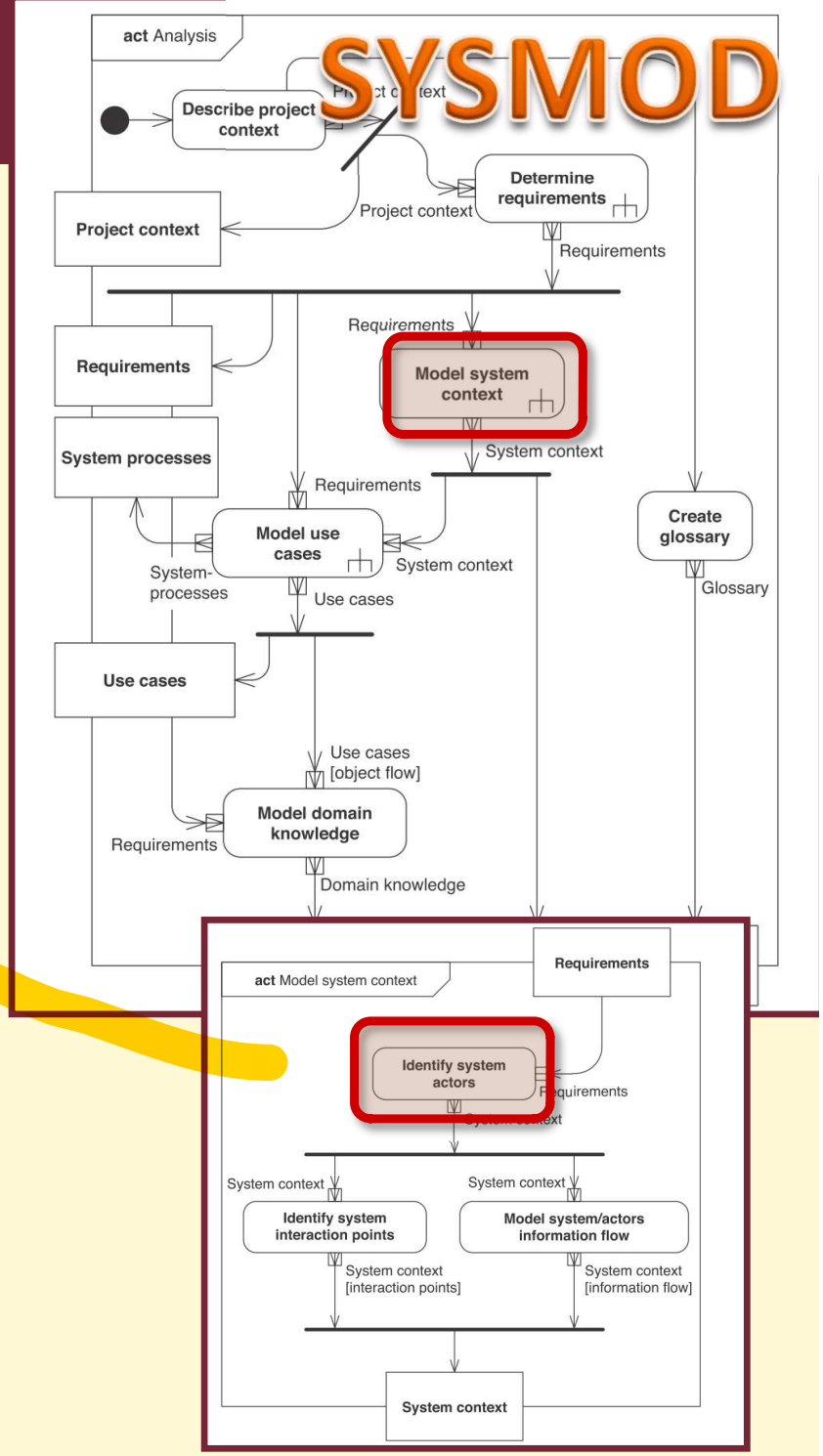
Model System Context





Identify System Actors





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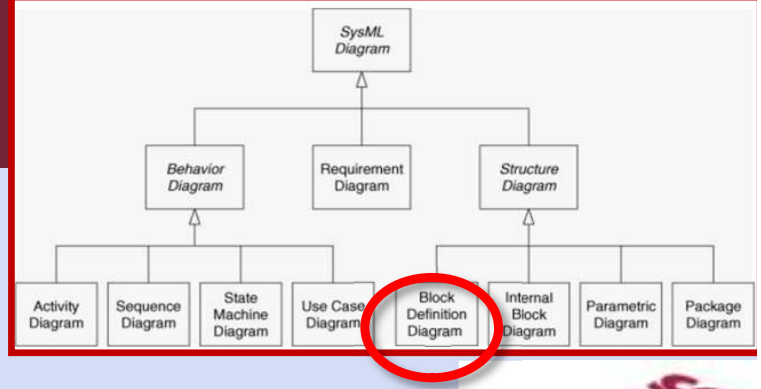
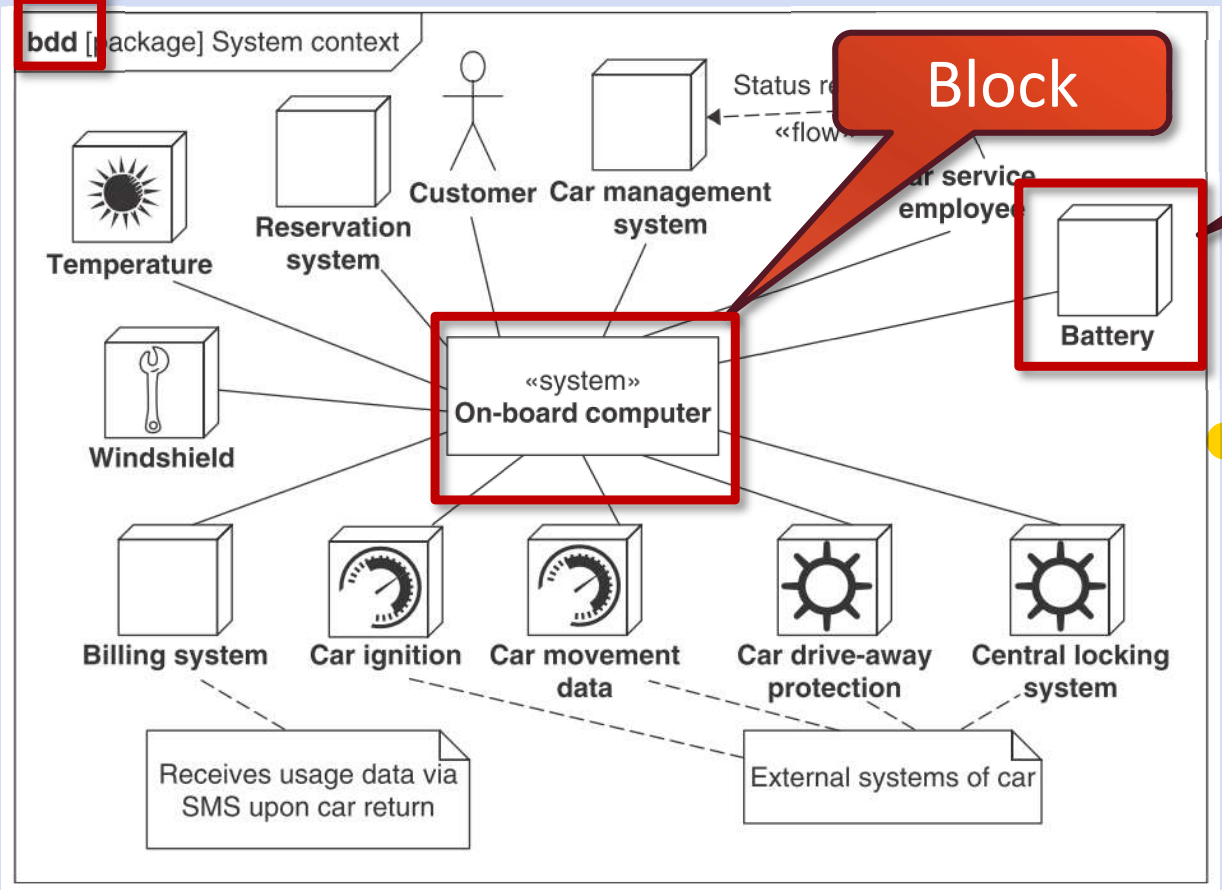


Block definition diagram



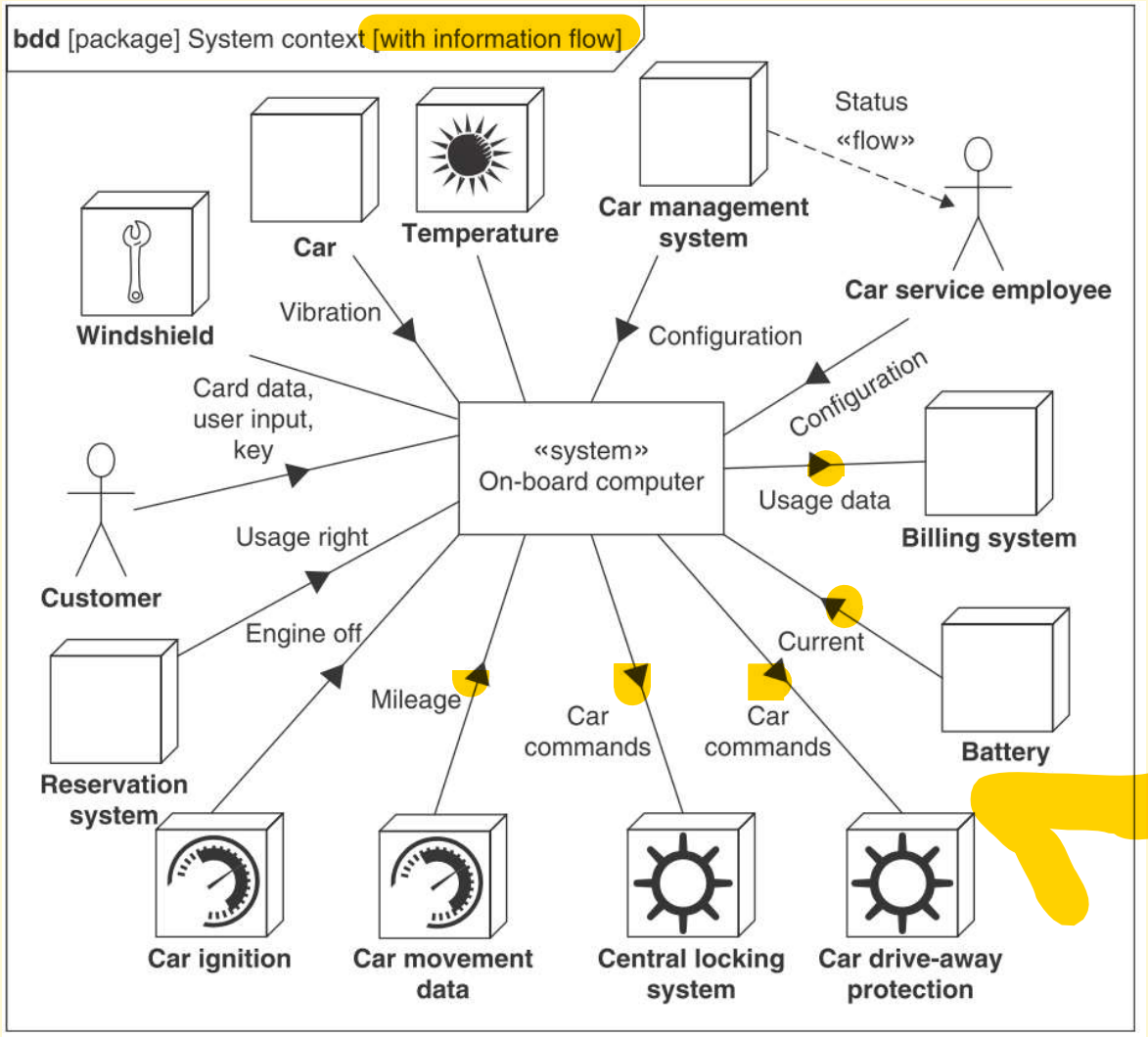
Block

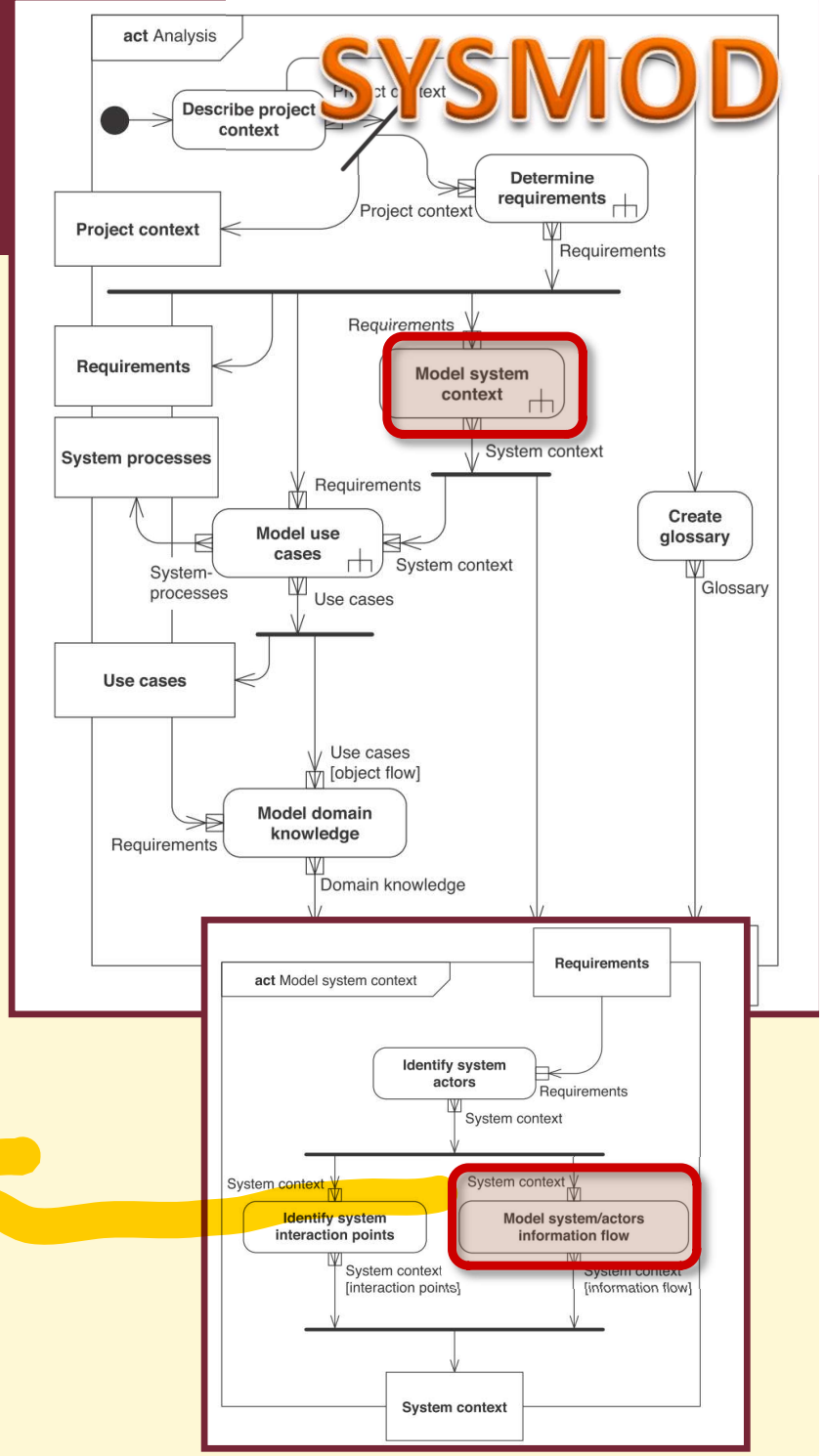
Actor

Block Definition Diagram

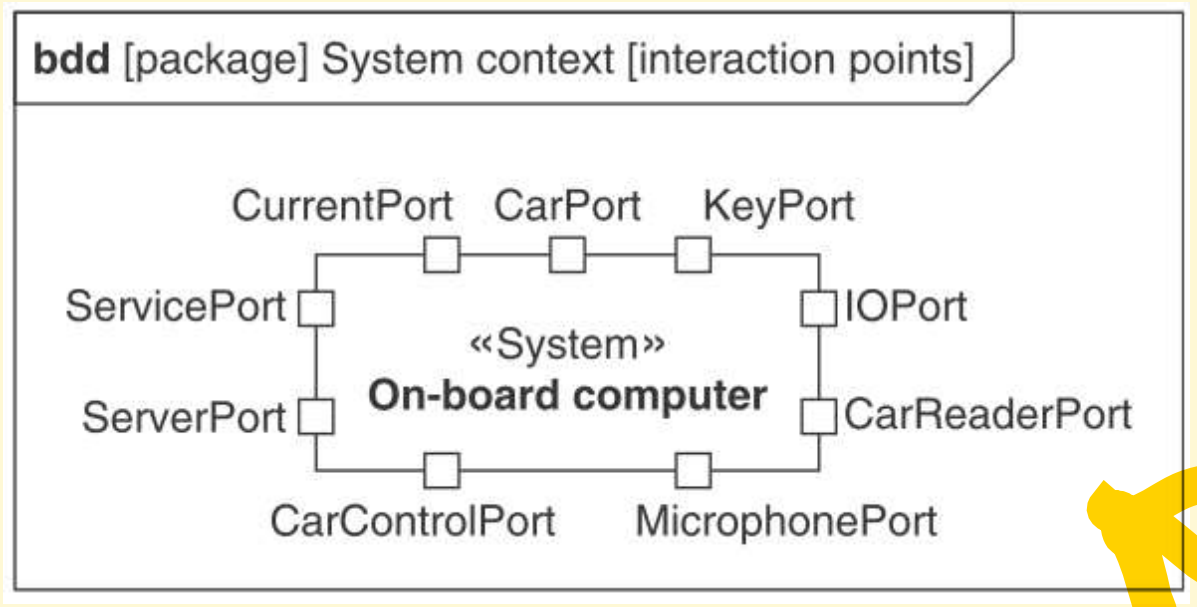
Represents structural elements called blocks, and their composition and classification

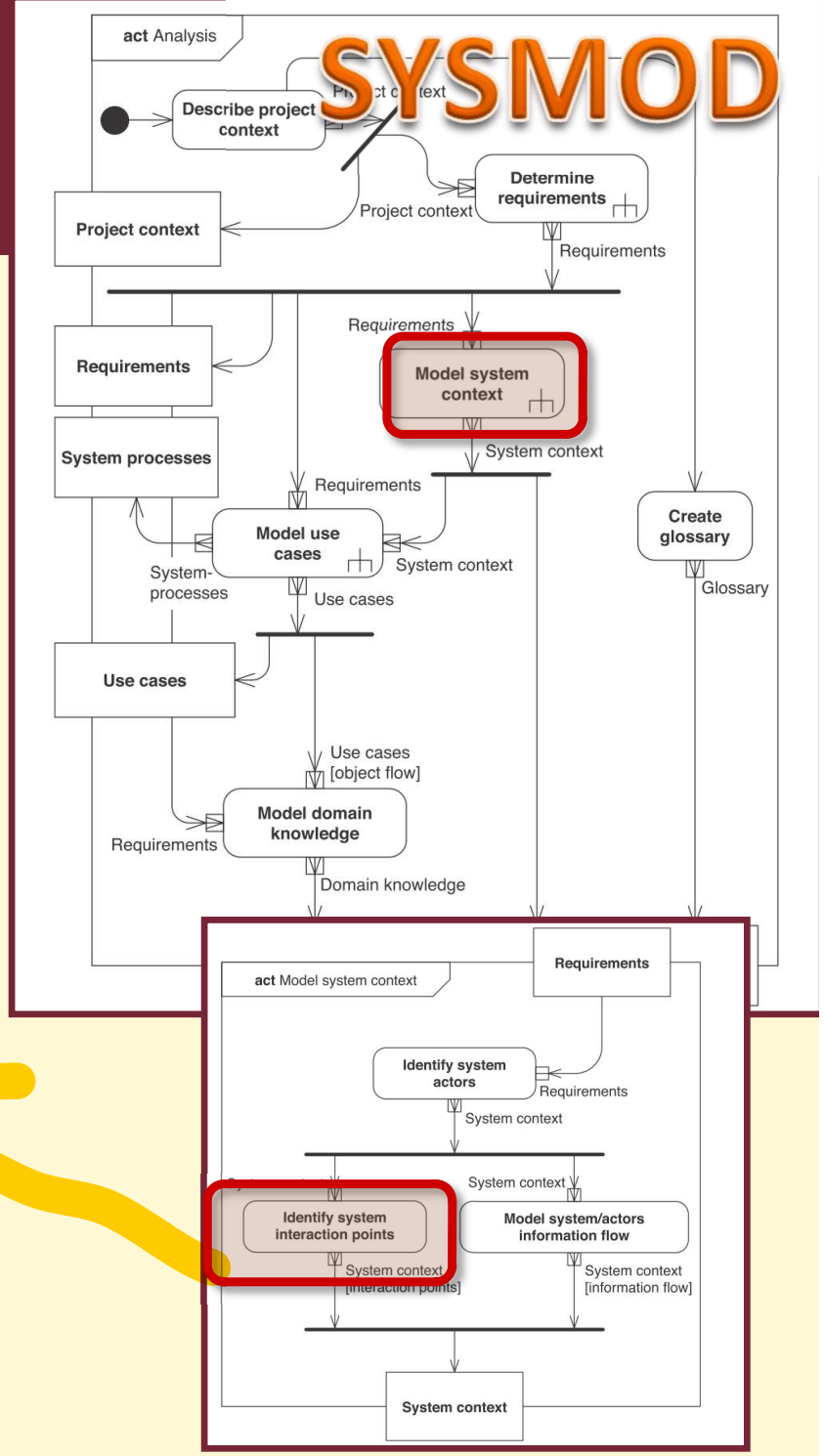
Model System-Actor Information Flow



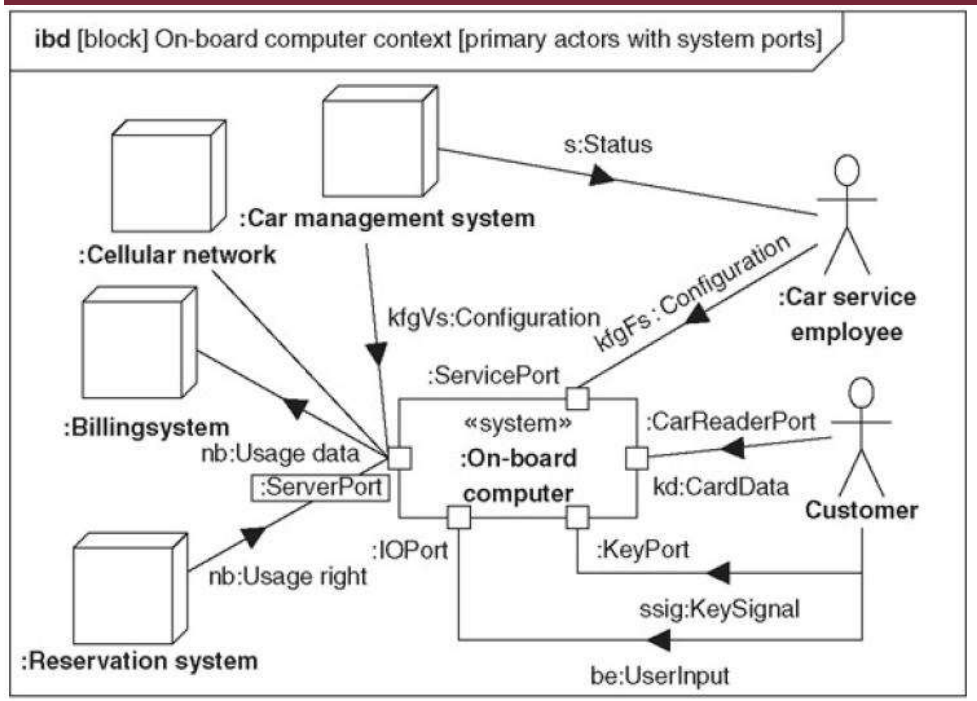


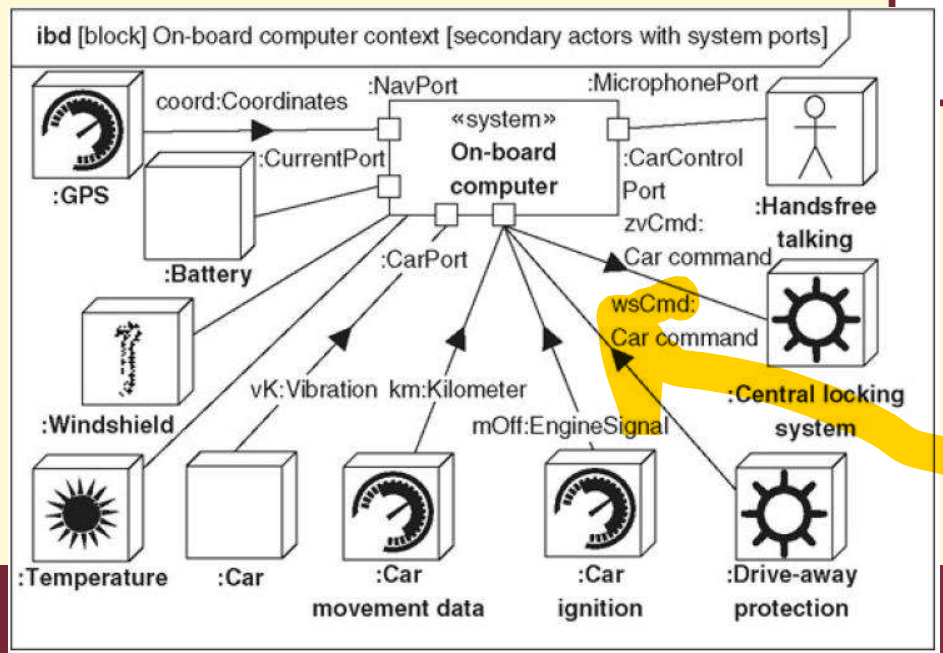
Identify System Interaction Points

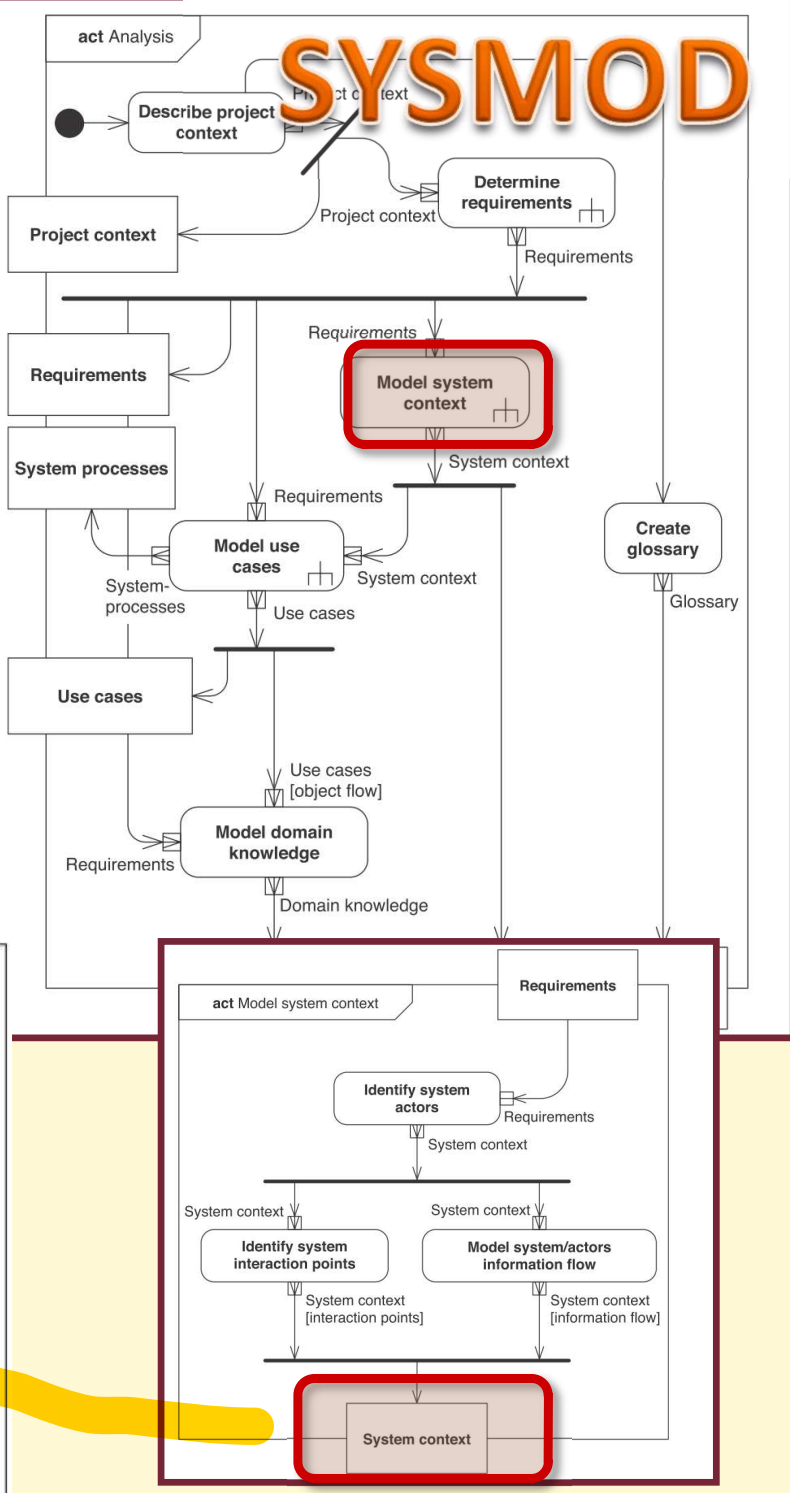




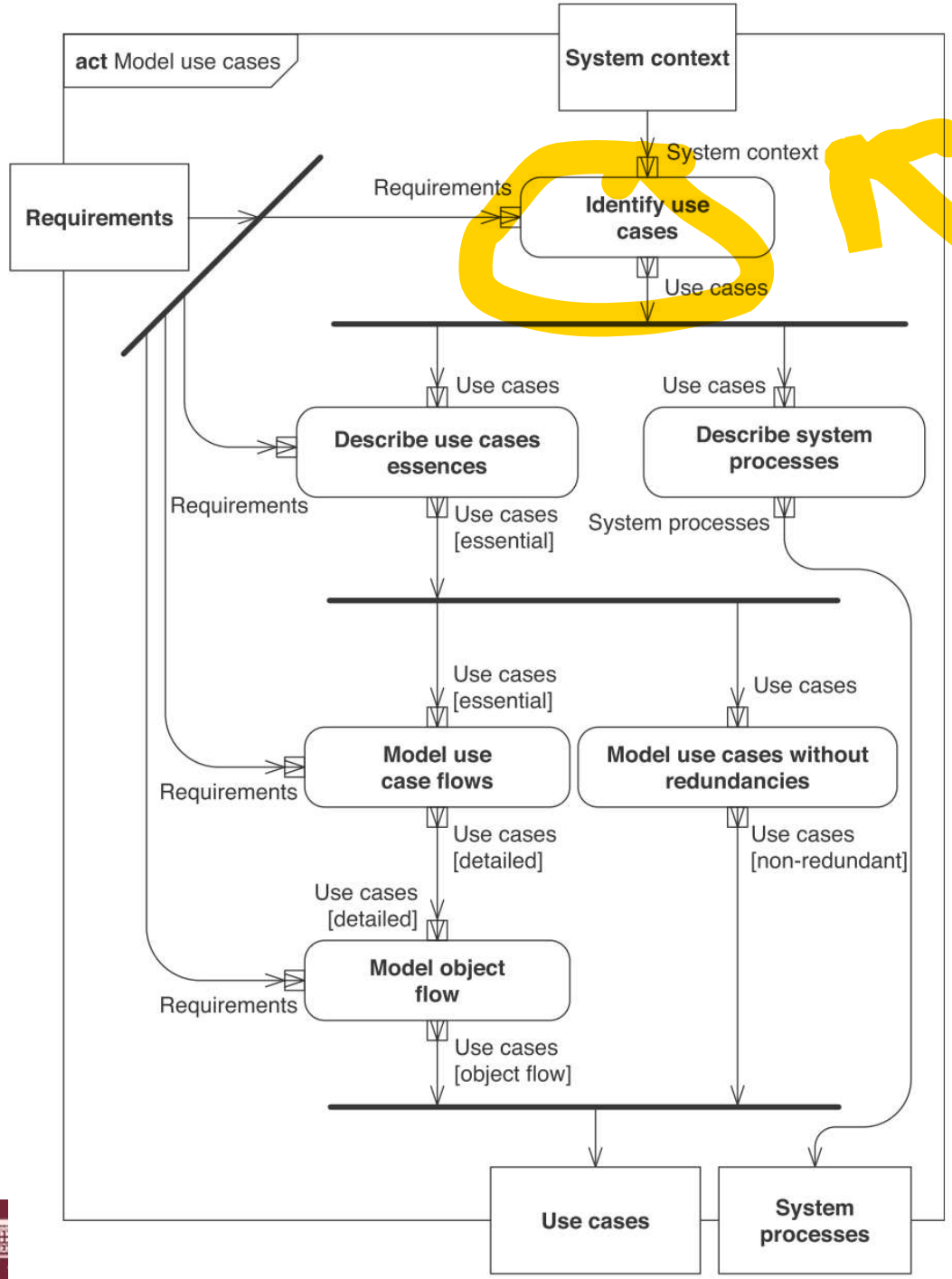
System Context

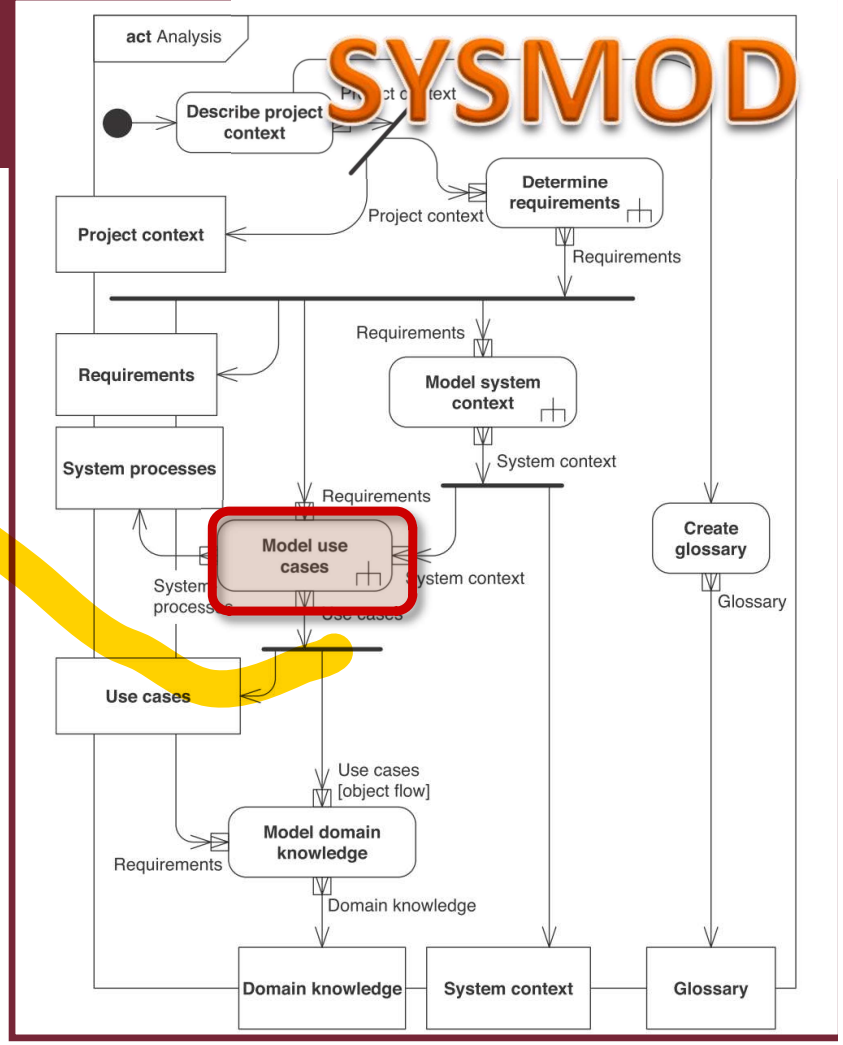




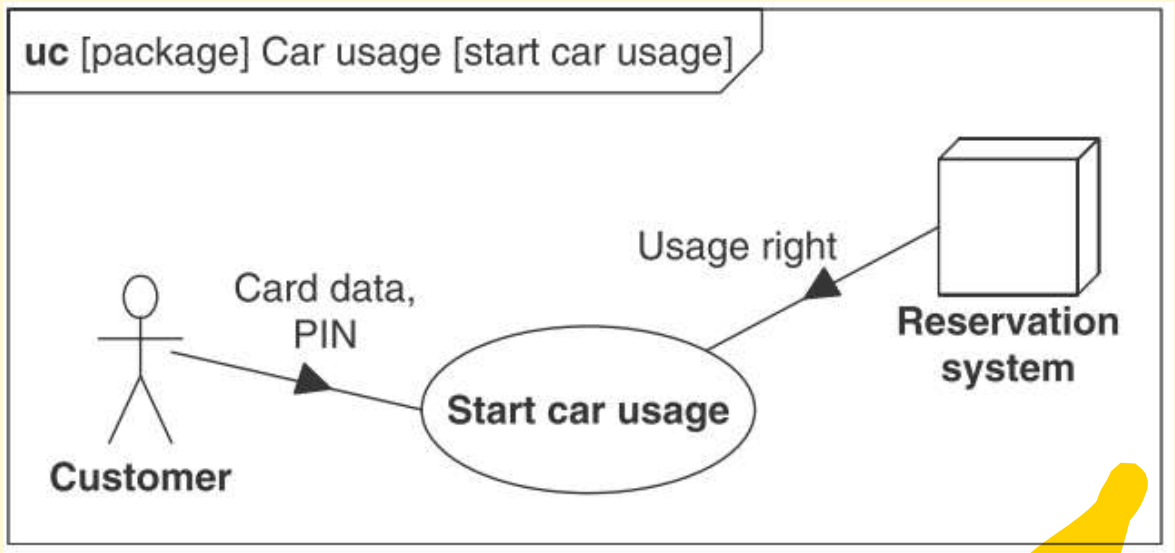


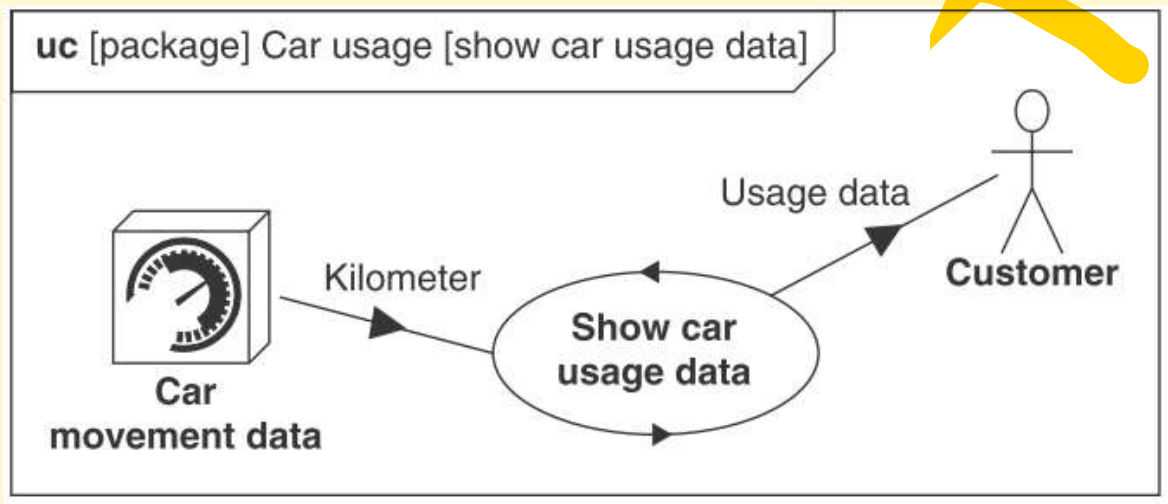
Model Use Cases

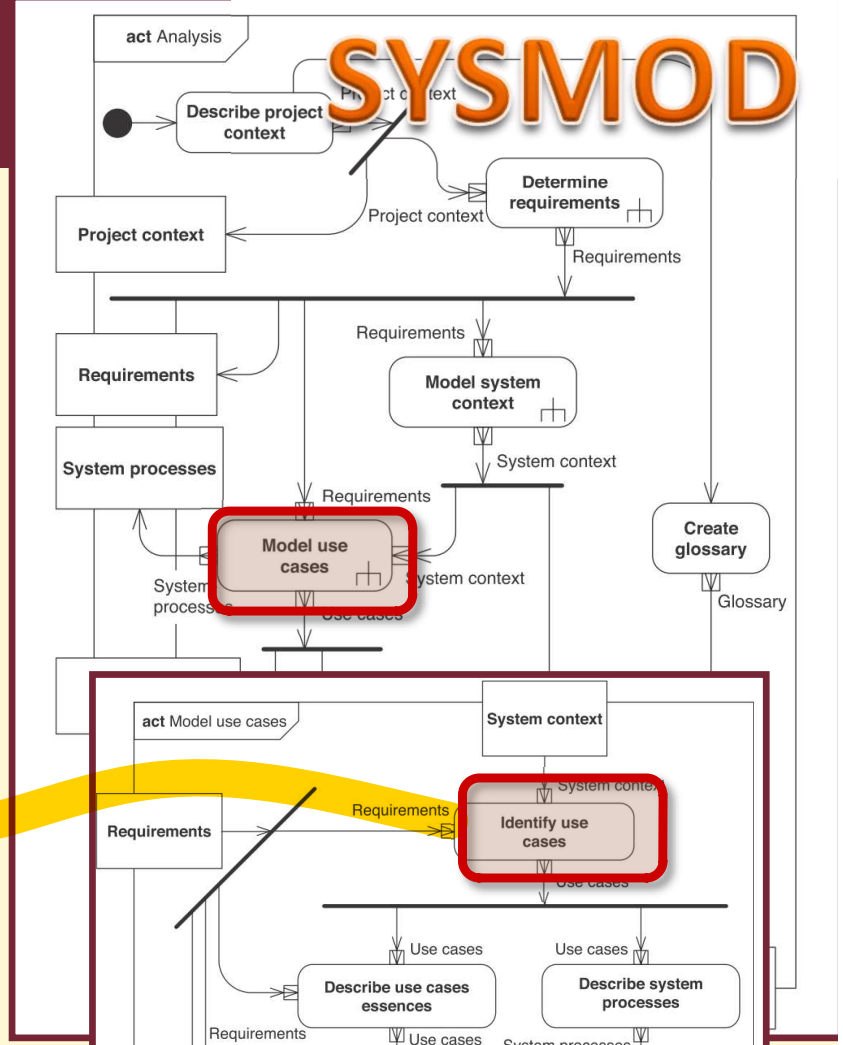




Model Use Cases







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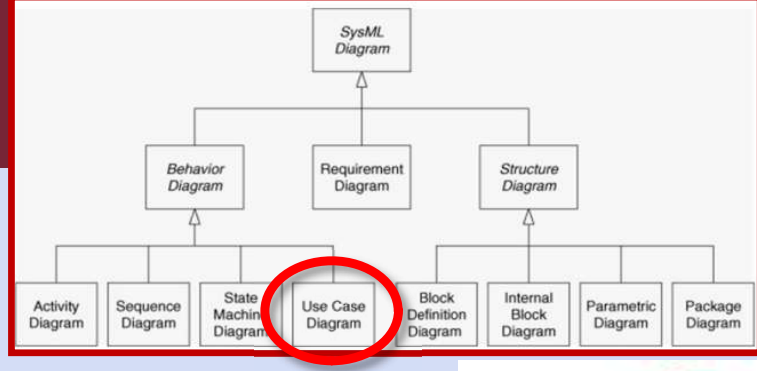
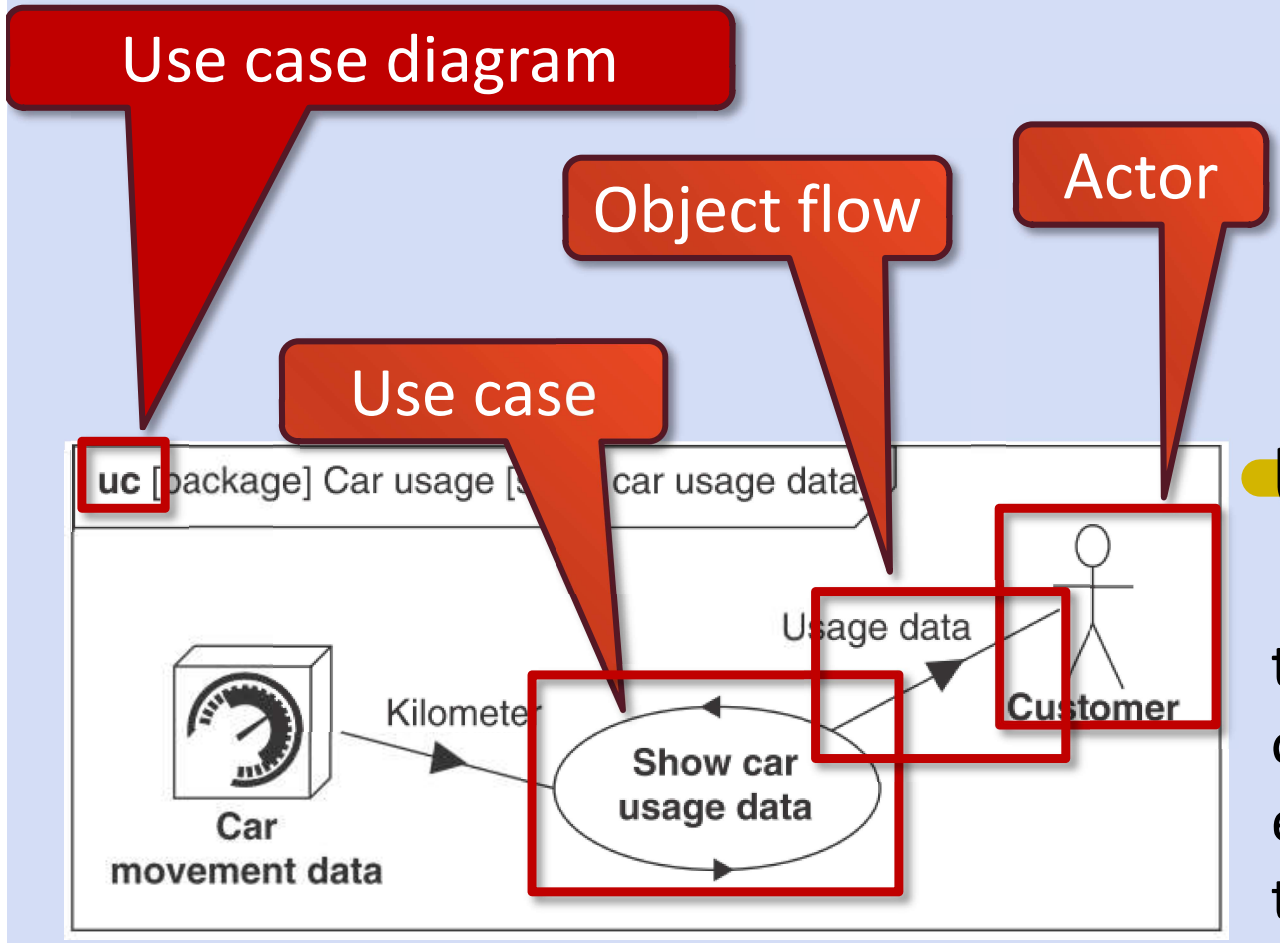


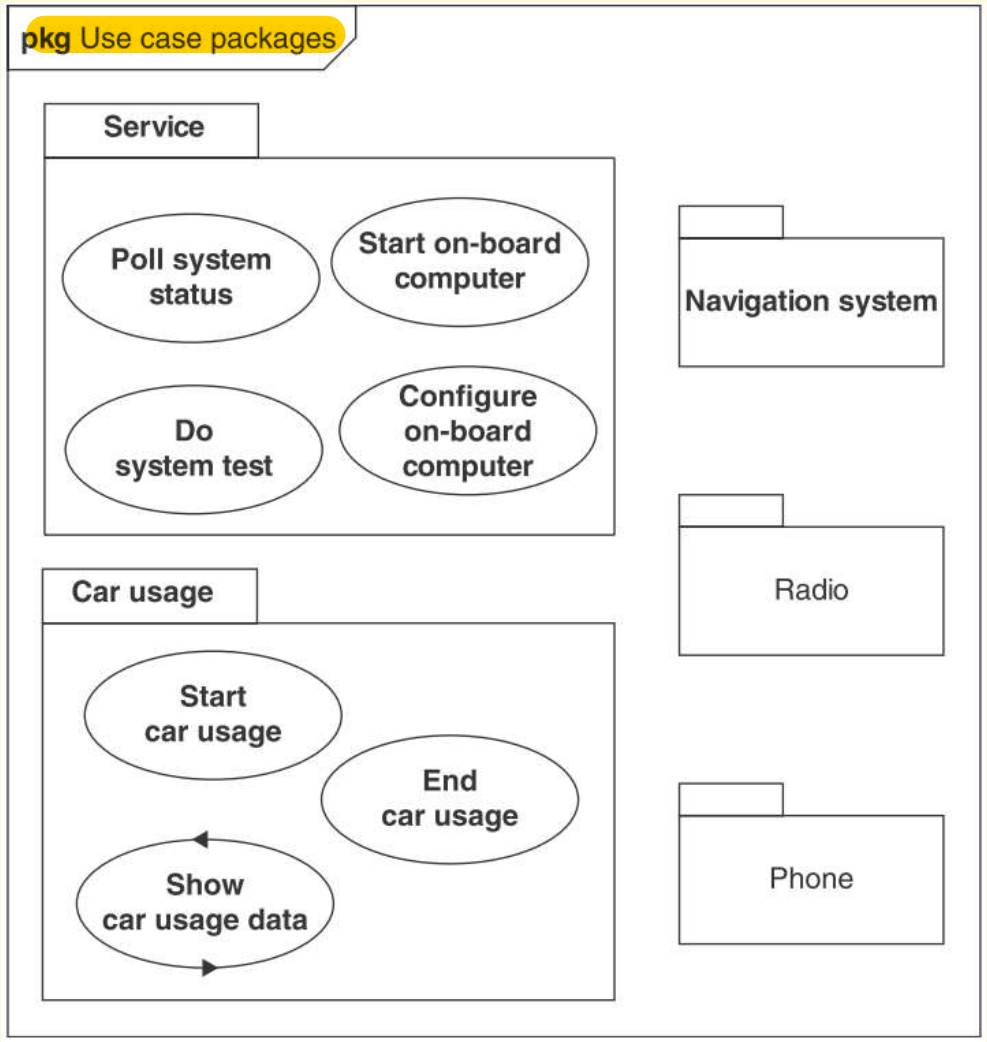


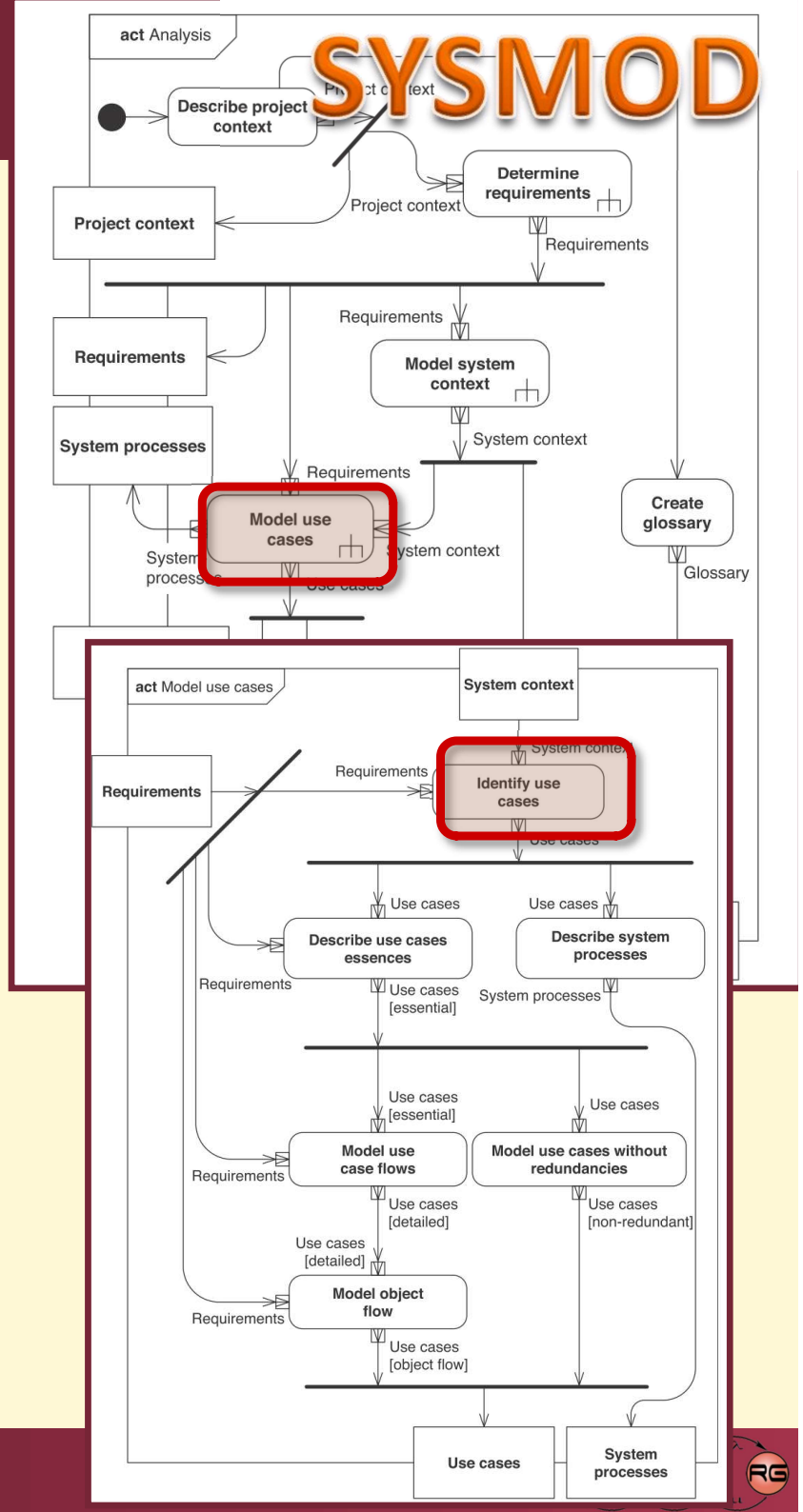
Use Case Diagram

Represents functionality in terms of how a system or other entity is used by external entities (i.e., actors) to accomplish a set of goals

Model Use Cases

Organizing use cases into packages





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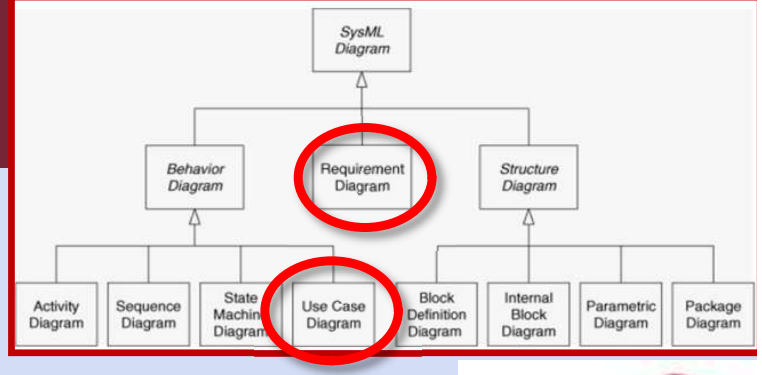
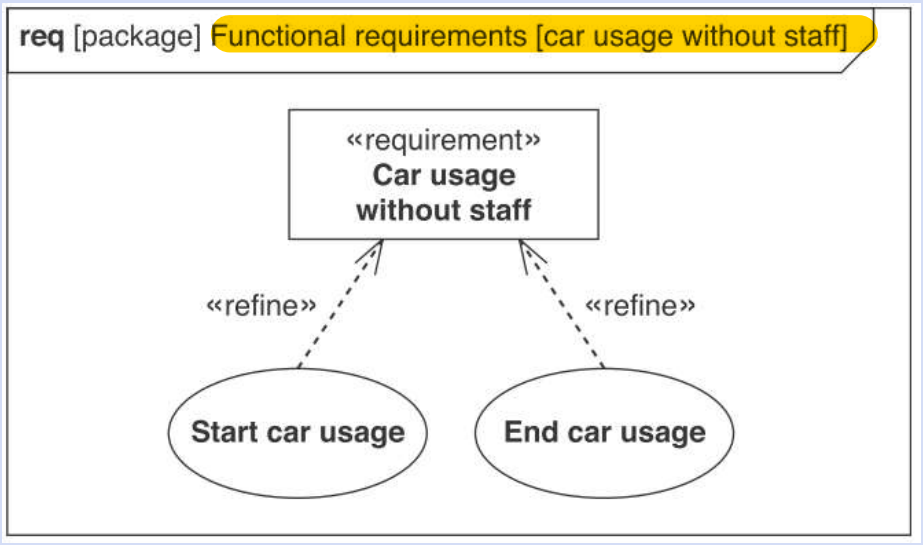
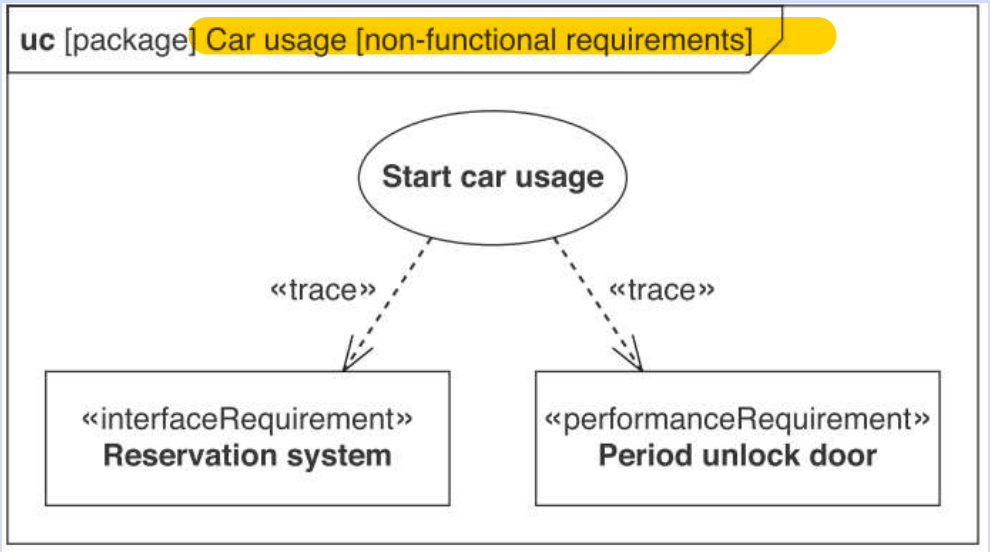


Requirements traceability

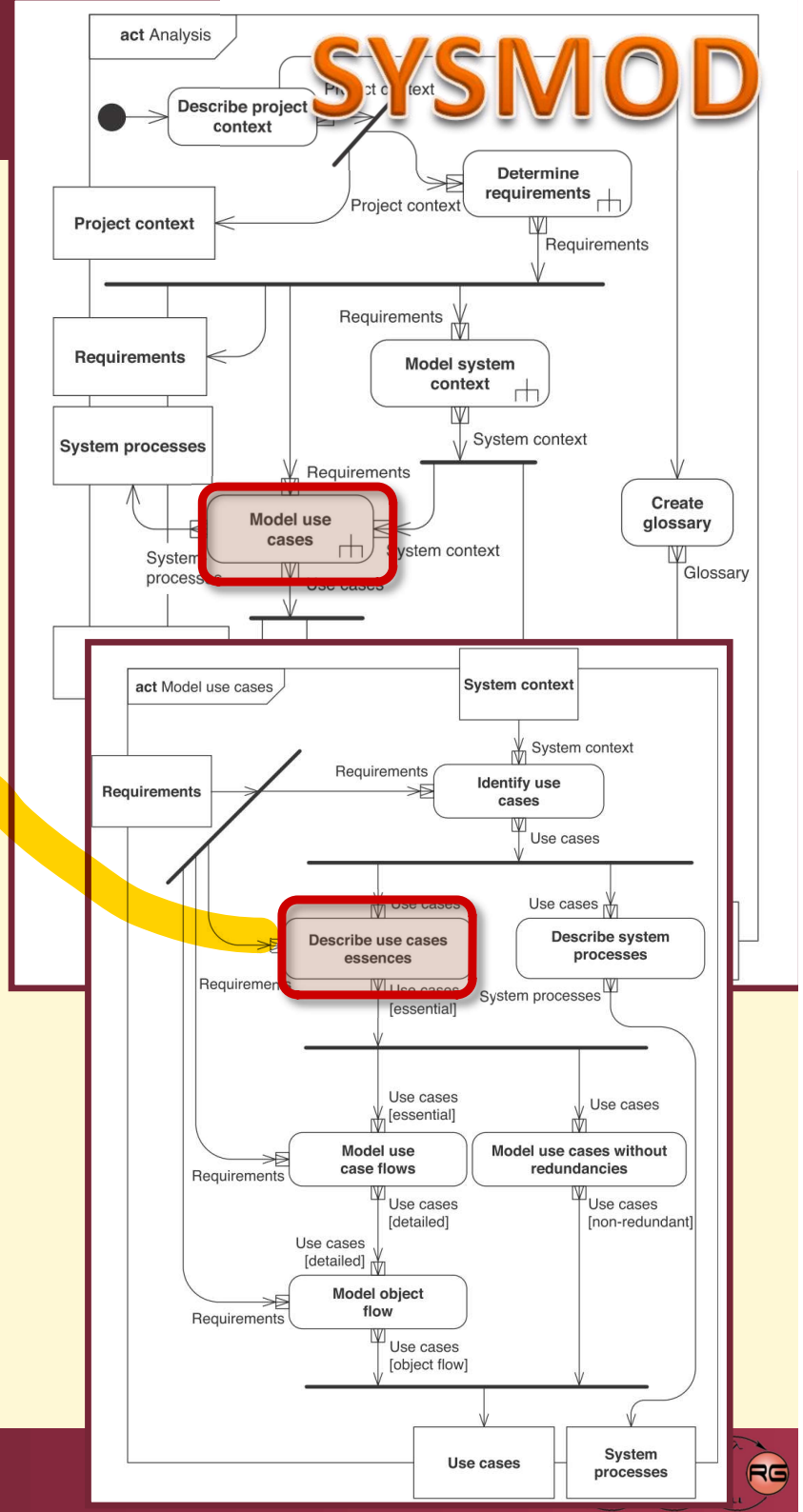




Describe Use Cases Essences

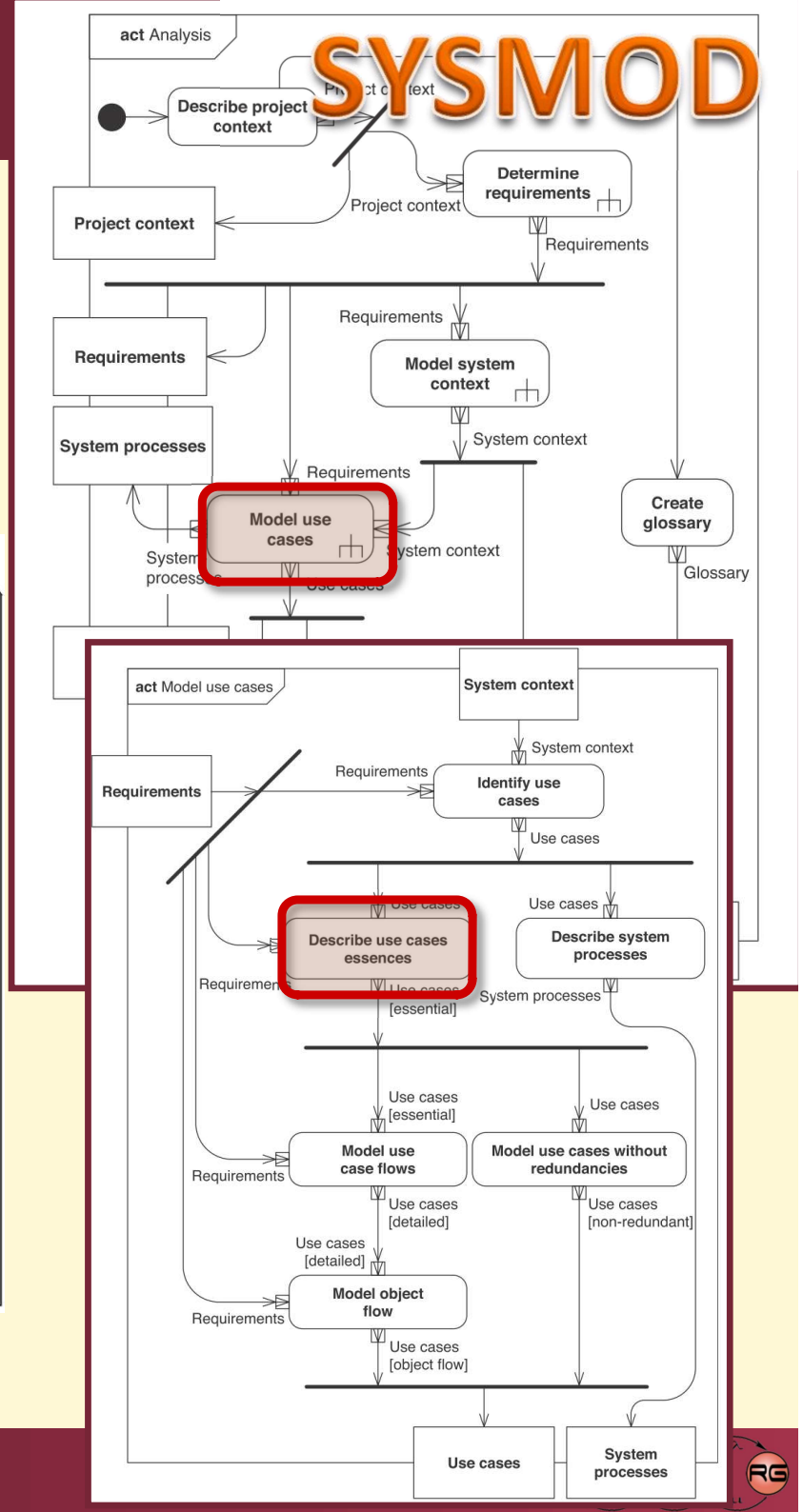
Pragmatic description

Apply customer card
Read card
Send SMS to reservation center
Receive SMS reply
Check usage right
Unlock car doors via central locking system
Poll PIN
Enter PIN
Verify PIN
Deactivate electronic drive-away protection
Remove key
Display customer welcome message

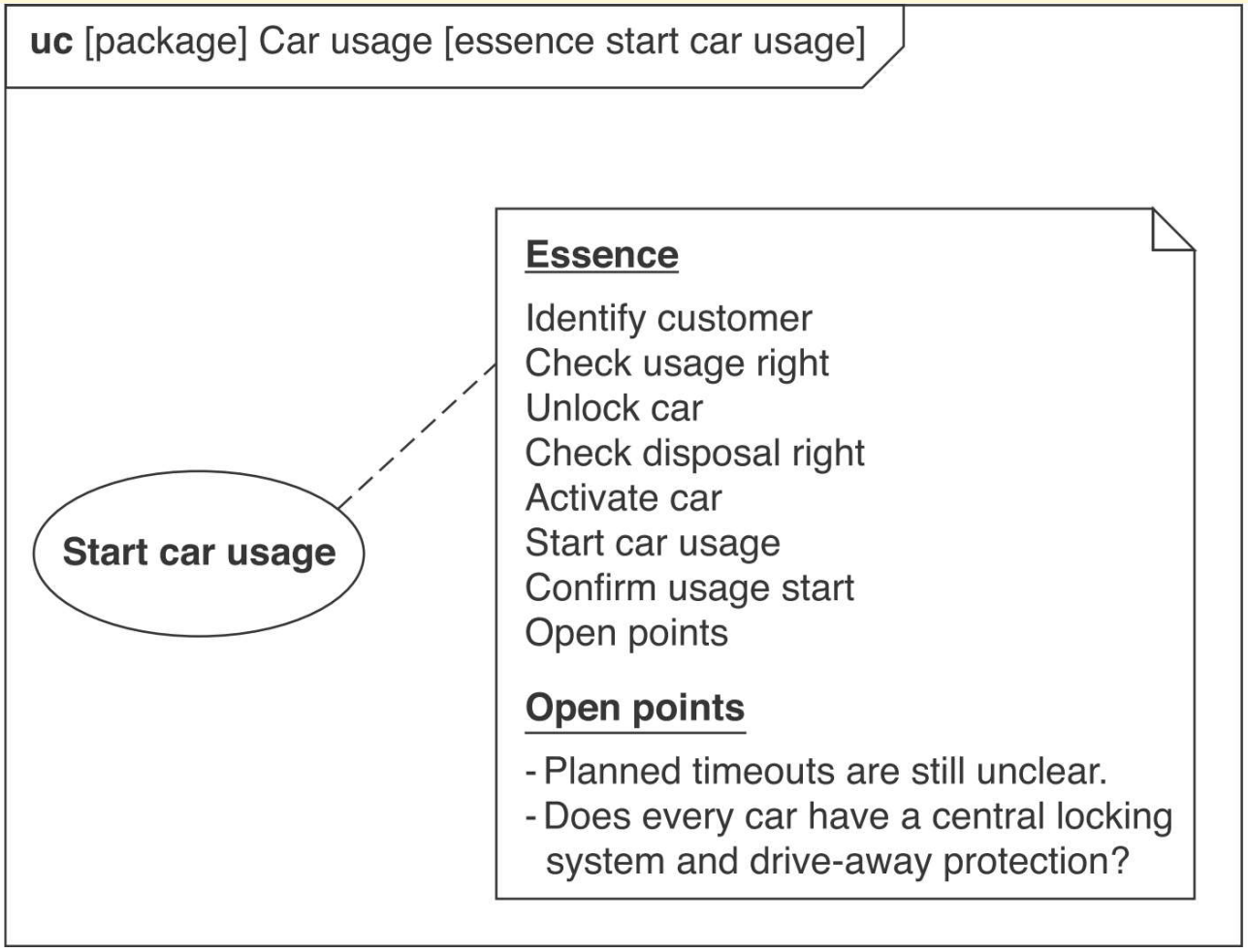


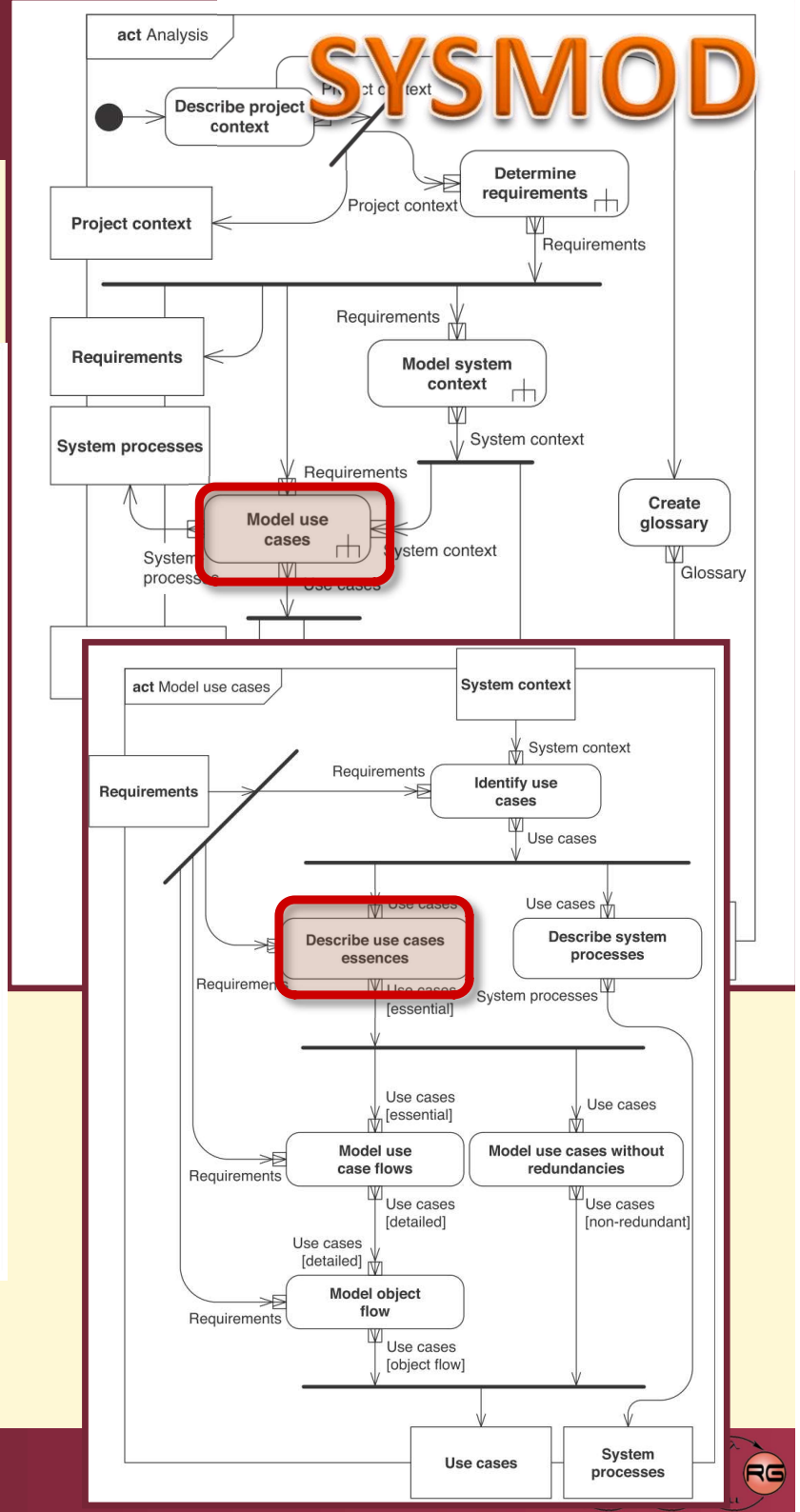
Describe Use Cases Essences

Pragmatic description	Essential description
Apply customer card Read card	Identify customer
Send SMS to reservation center Receive SMS reply Check usage right	Check usage right
Unlock car doors via central locking system	Unlock car
Poll PIN Enter PIN Verify PIN Deactivate electronic drive-away protection	Check disposal right
Remove key Display customer welcome message	Start car usage Confirm usage start

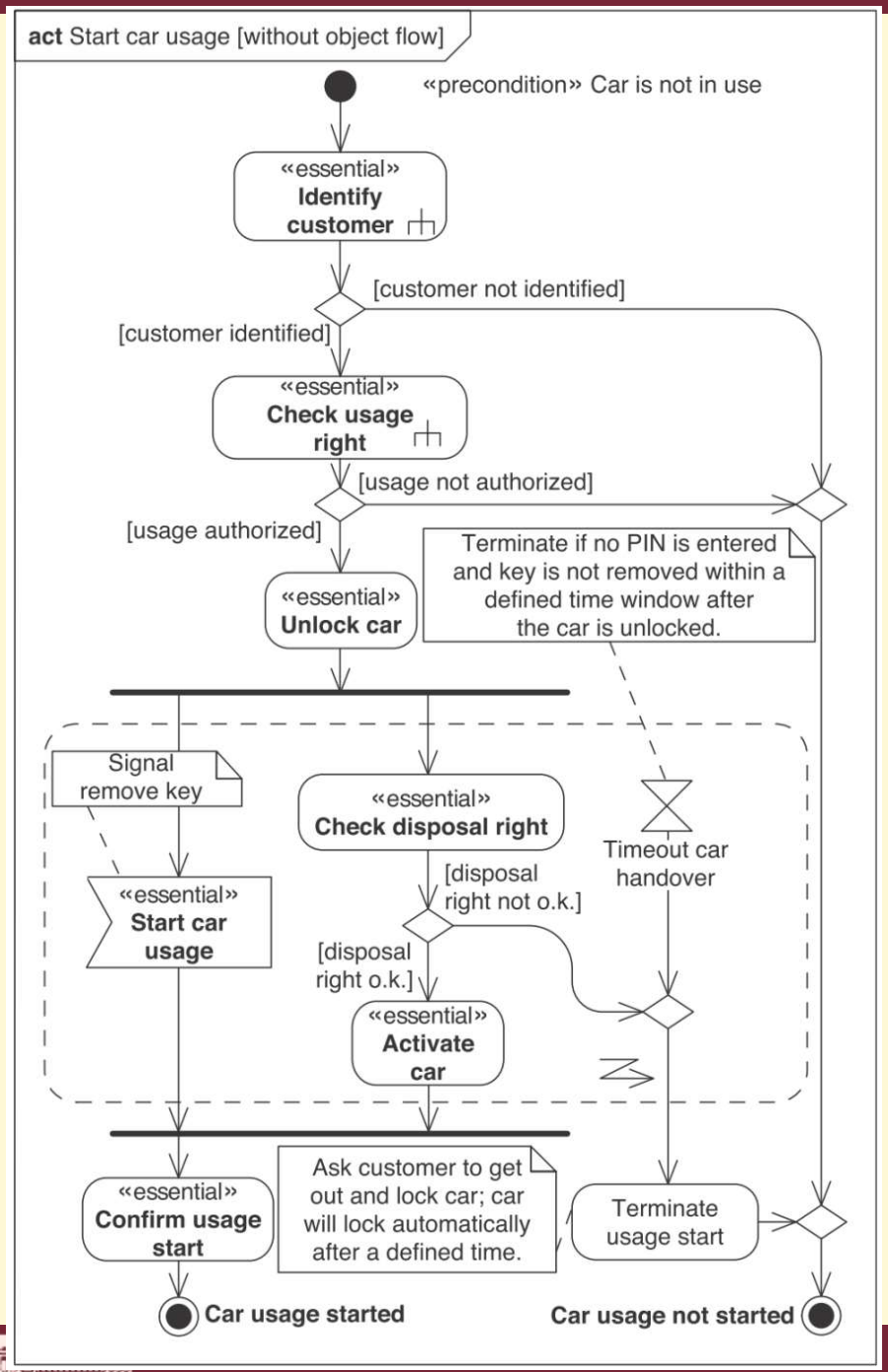


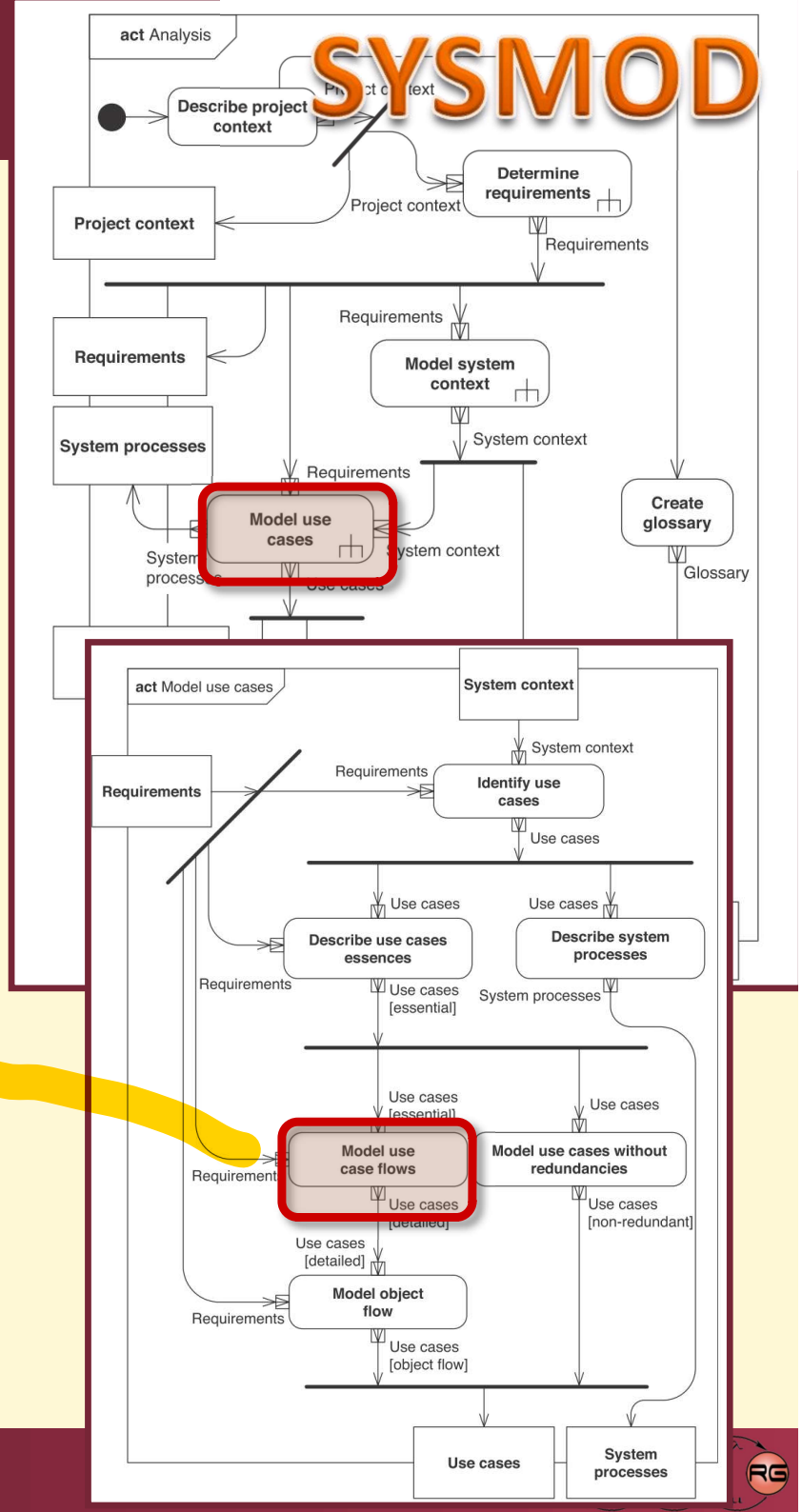
Describe Use Cases Essences



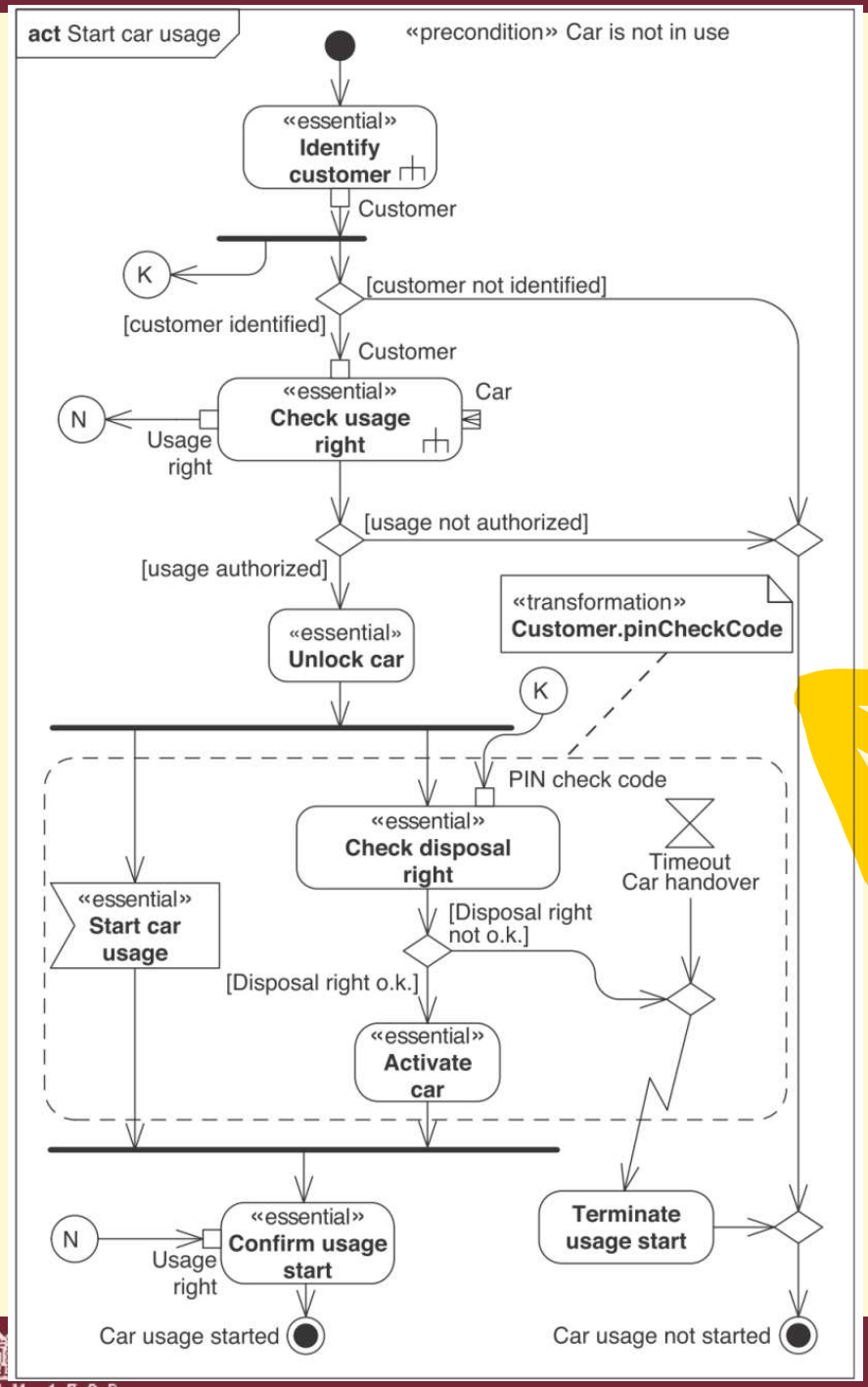


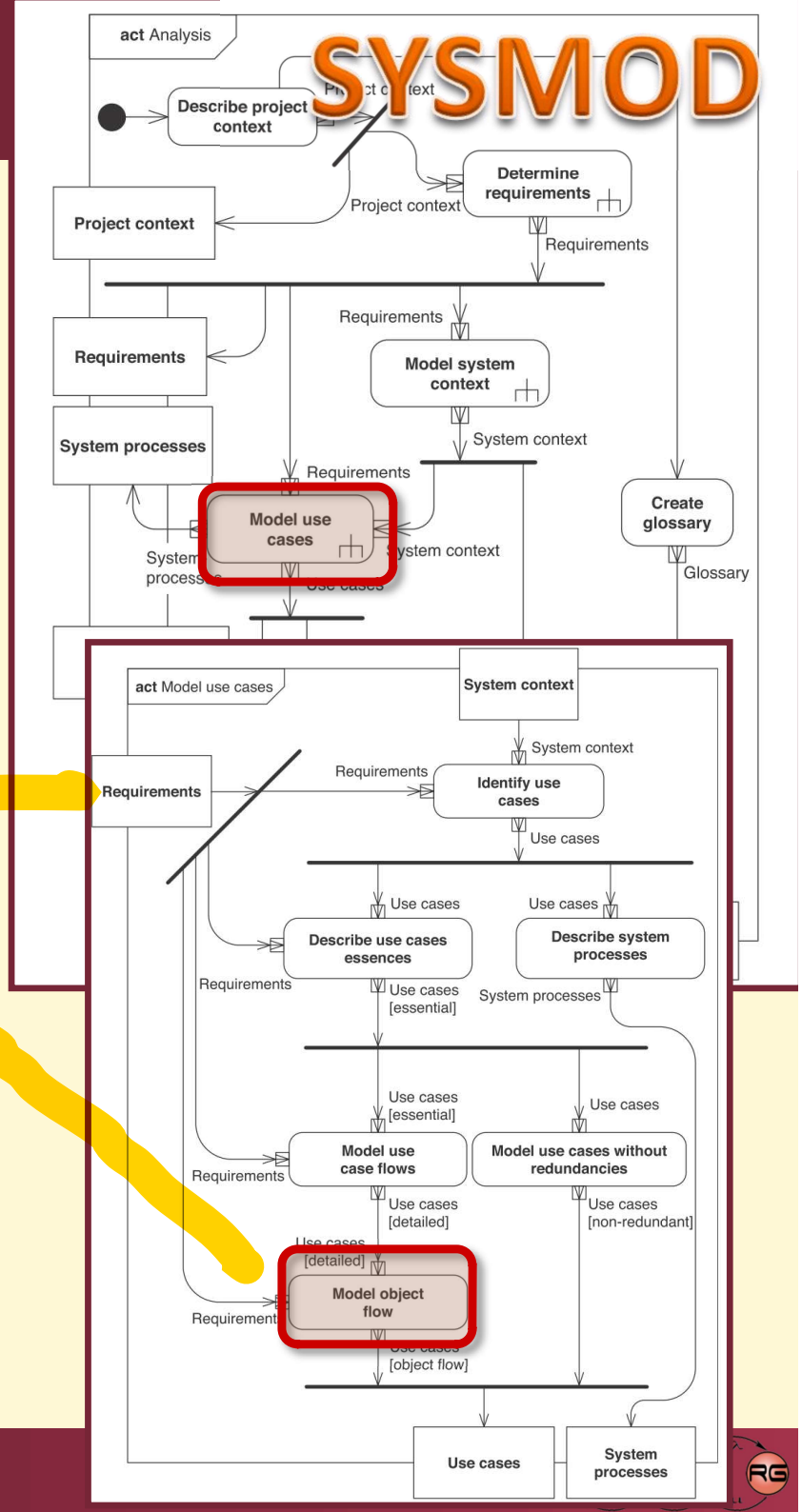
Model Use Case Flows



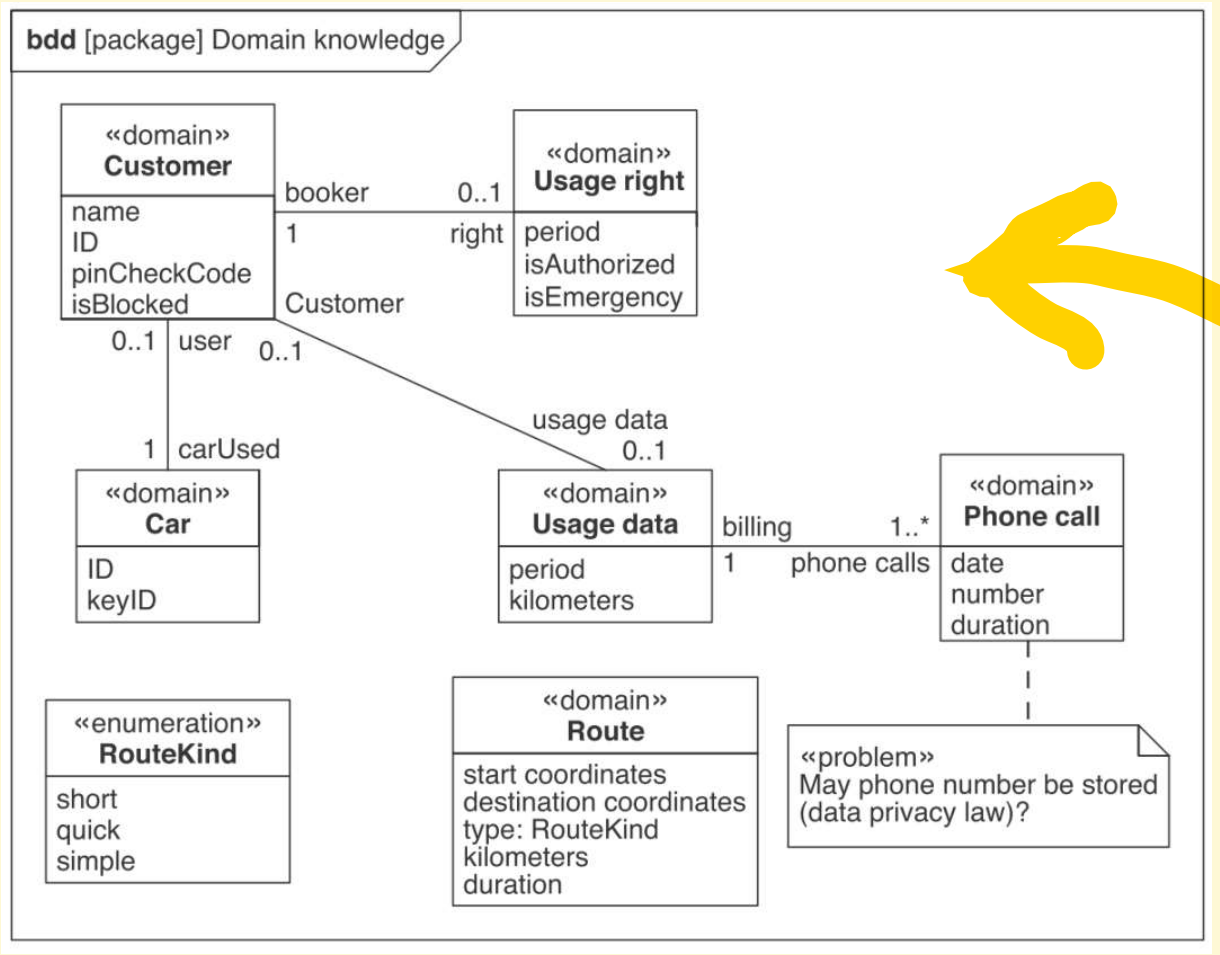


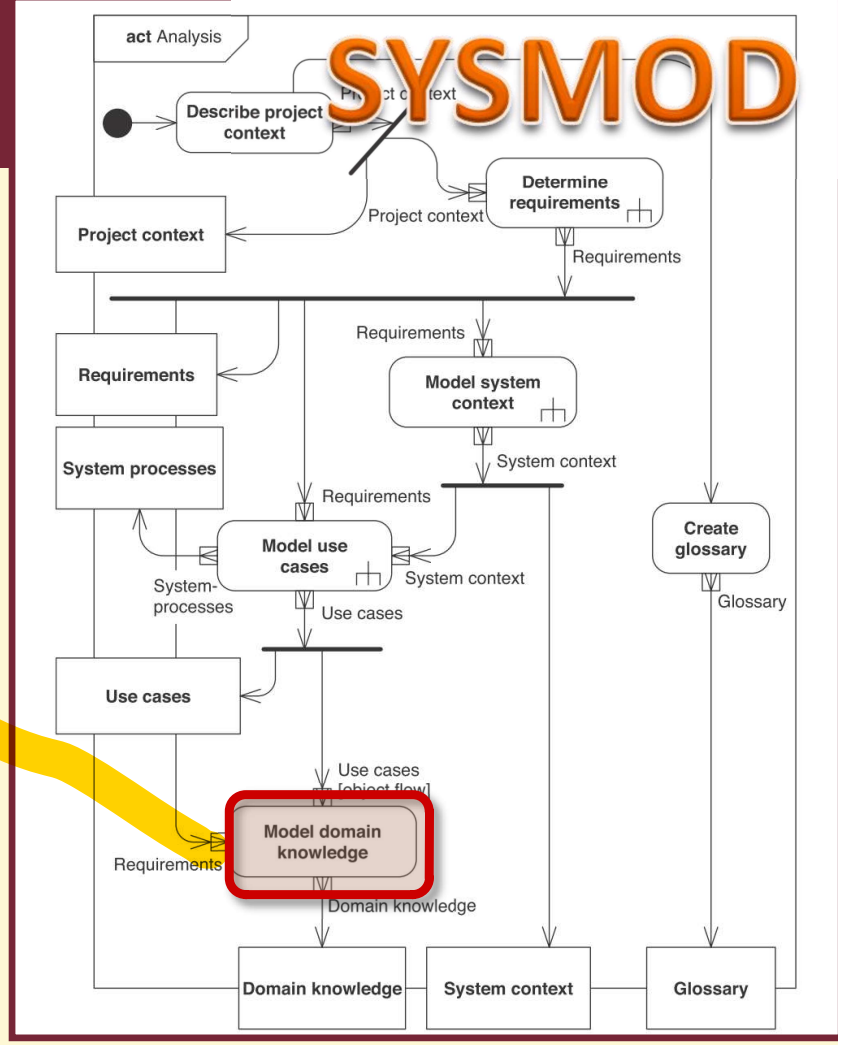
Model Object Flows





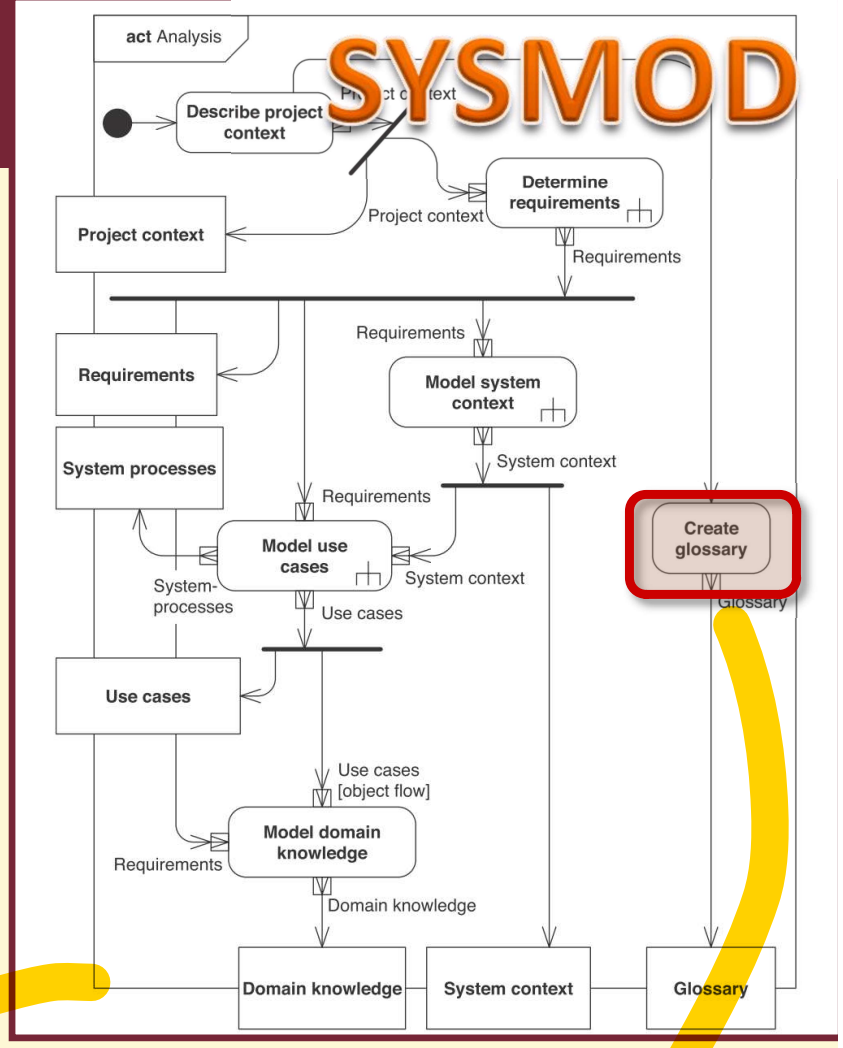
Model Domain Knowledge





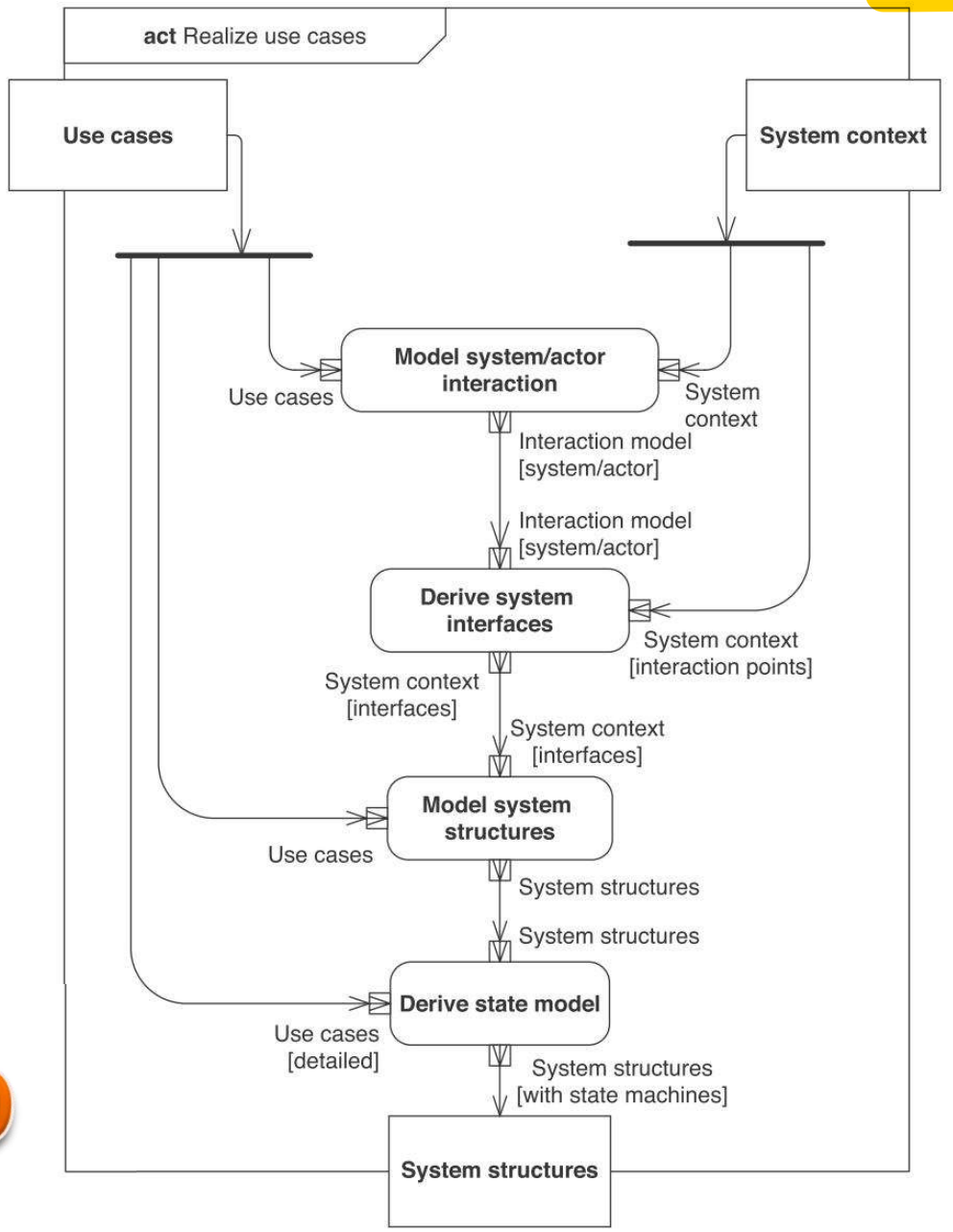
Create Glossary

Table 2.17 Glossary entries.	
Usage right	
Description:	A usage right describes whether or not a customer is entitled to use a car. It includes information about the customer, the booking period, and whether it is an emergency driving case.
Domain block:	Yes
Author, last change:	Tim Weilkiens, April 30, 2004
Disposal right	
Description:	The on-board computer grants a customer disposal right, if this customer has entered a correct customer PIN upon start of usage.
Domain block:	No
Author, last change:	Tim Weilkiens, April 30, 2004



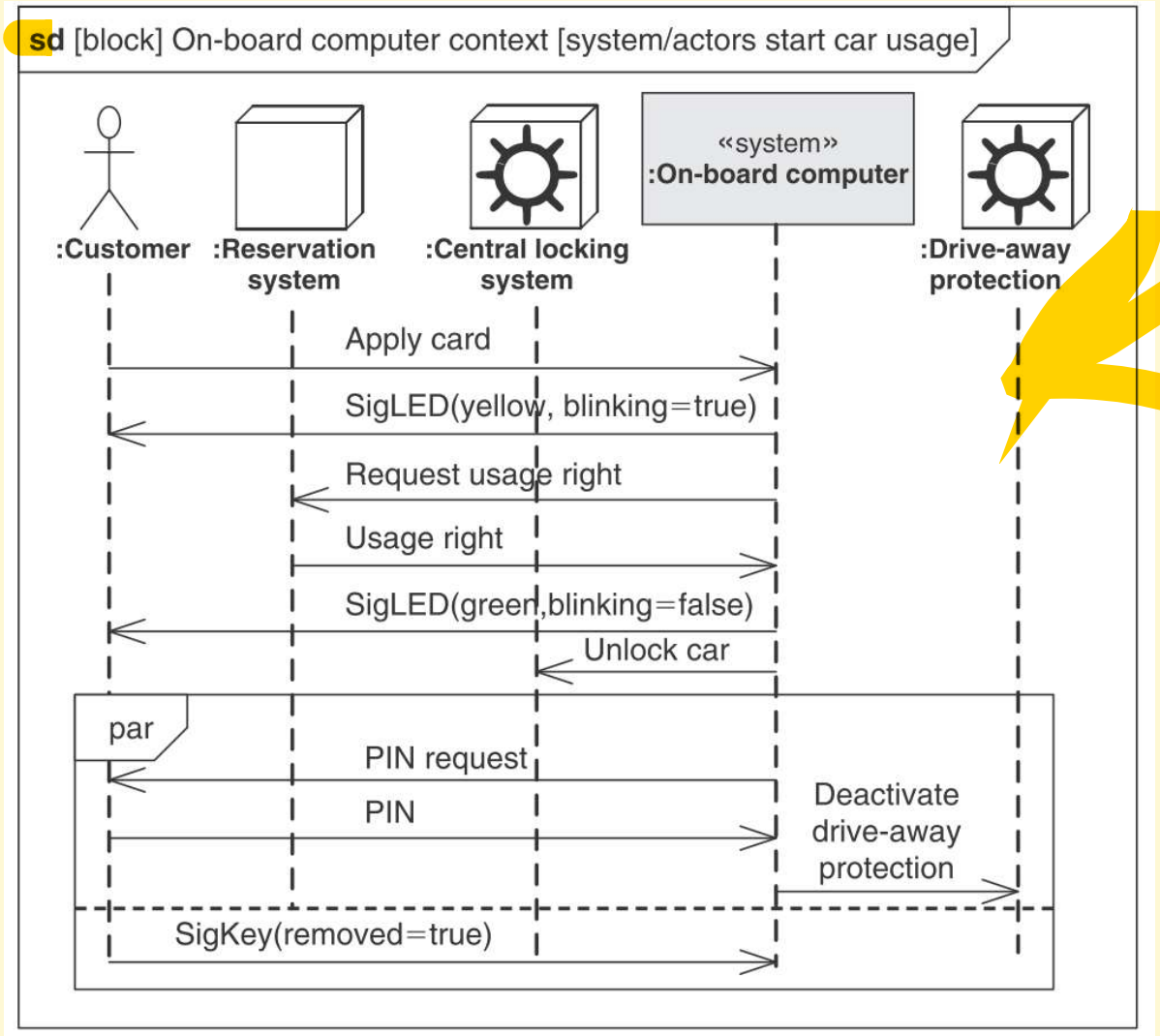
Supports better understanding

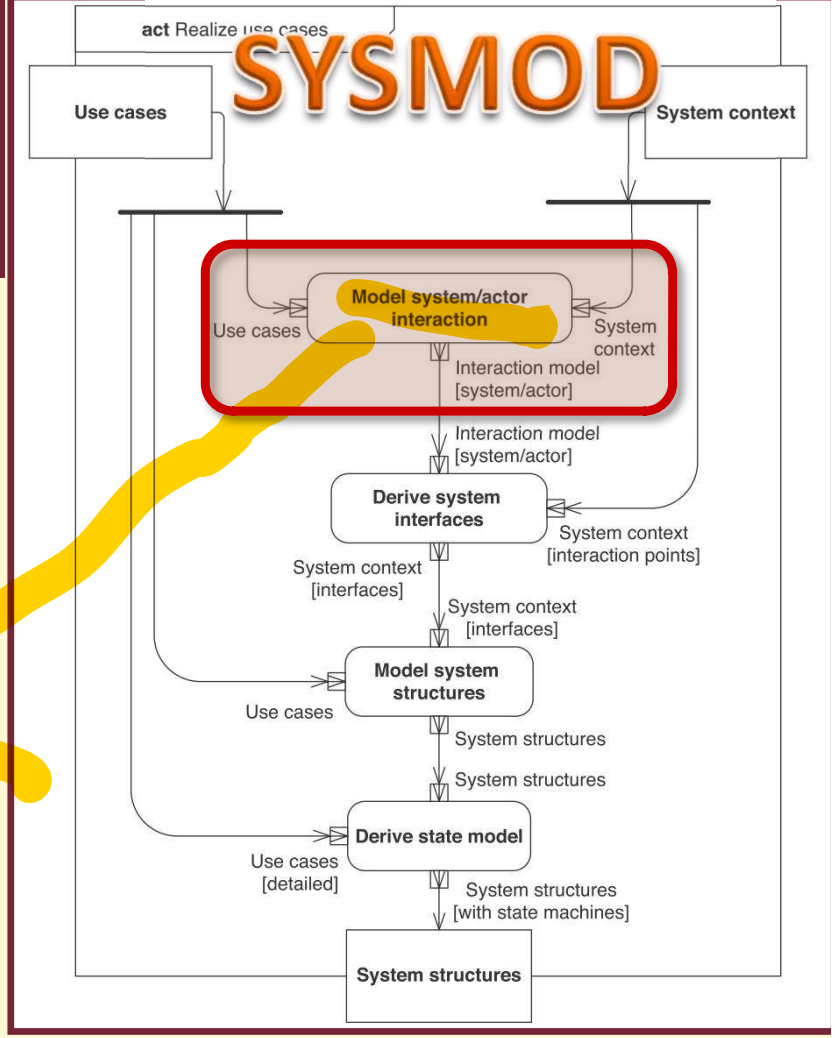
The SYSMOD approach for design



SYSMOD

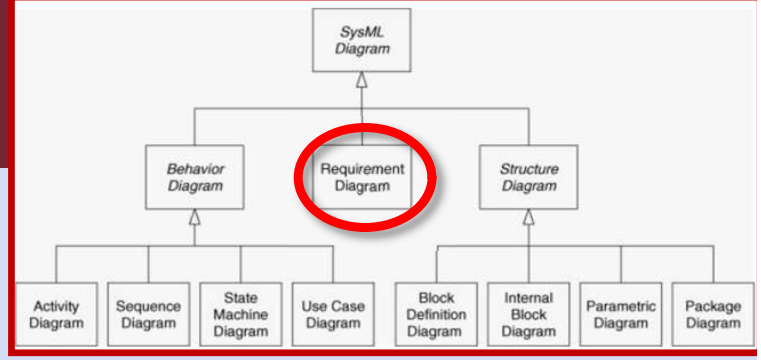
Model System/Actor Interaction

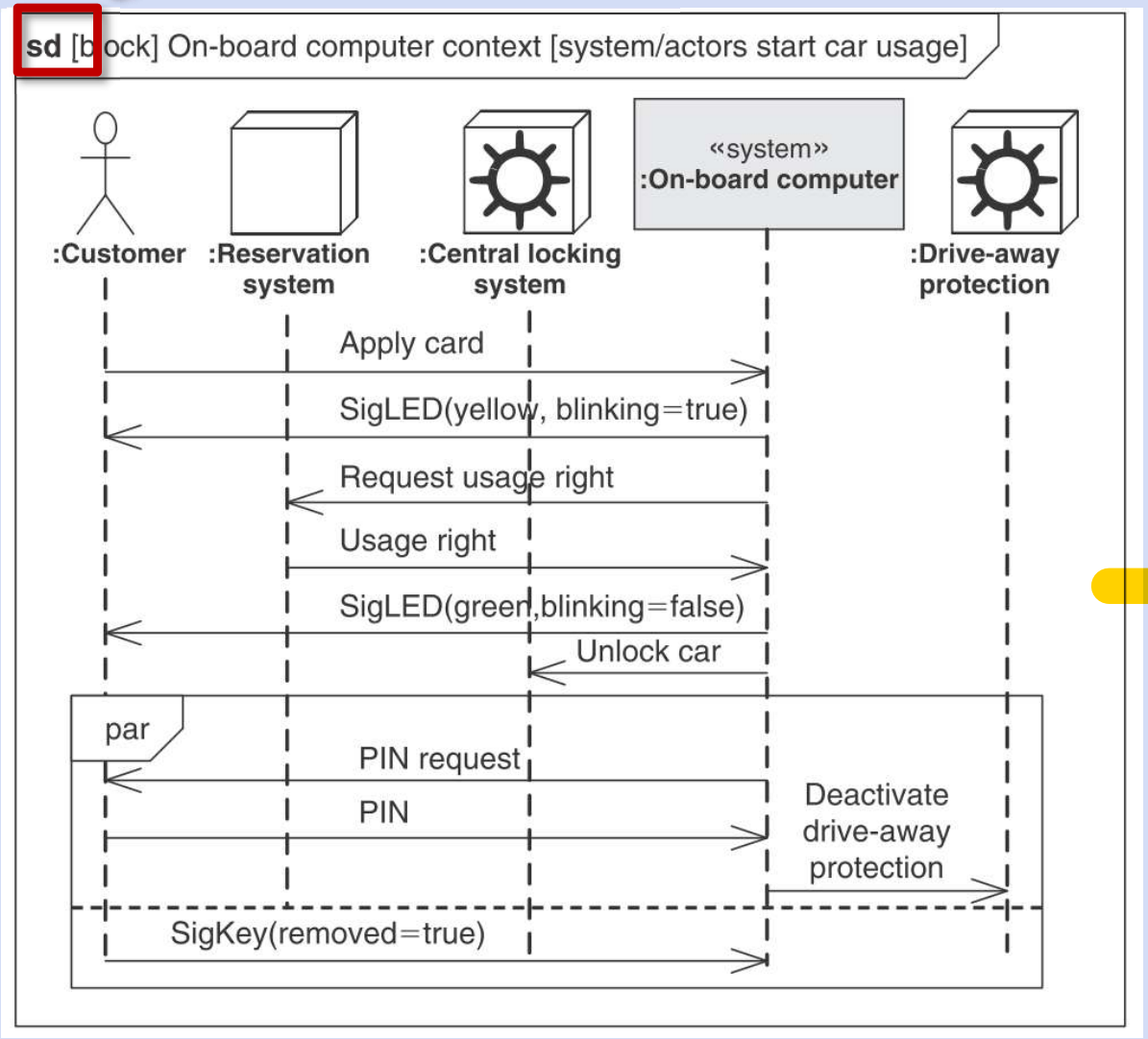




SysML

Sequence diagram

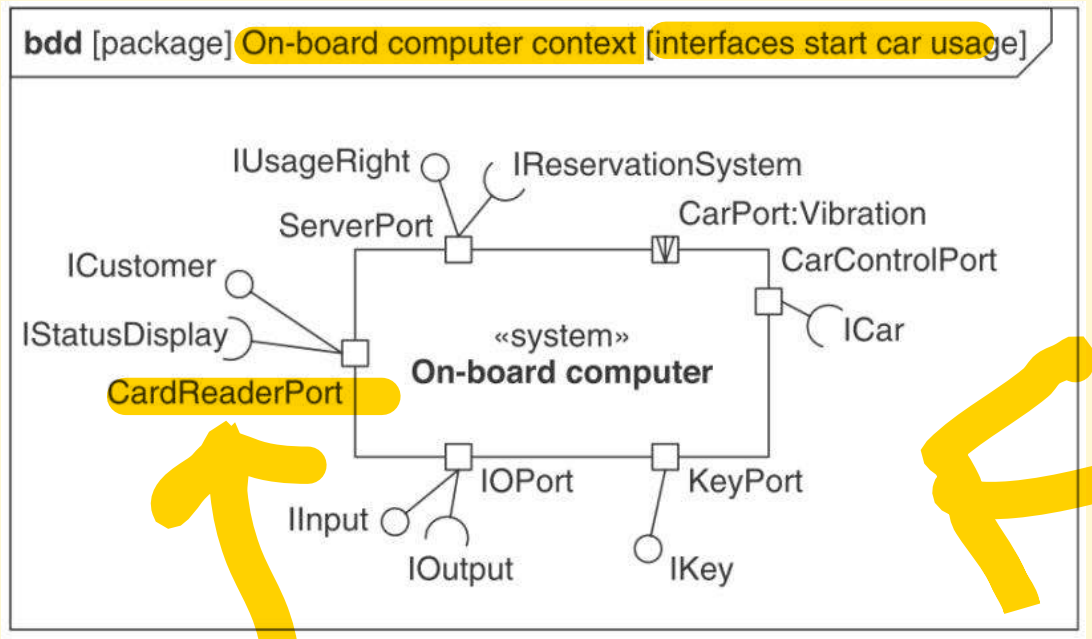


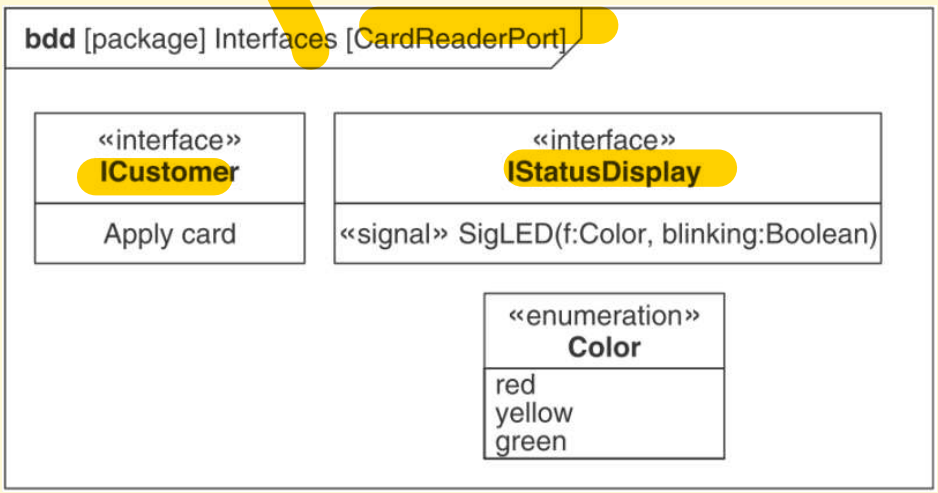


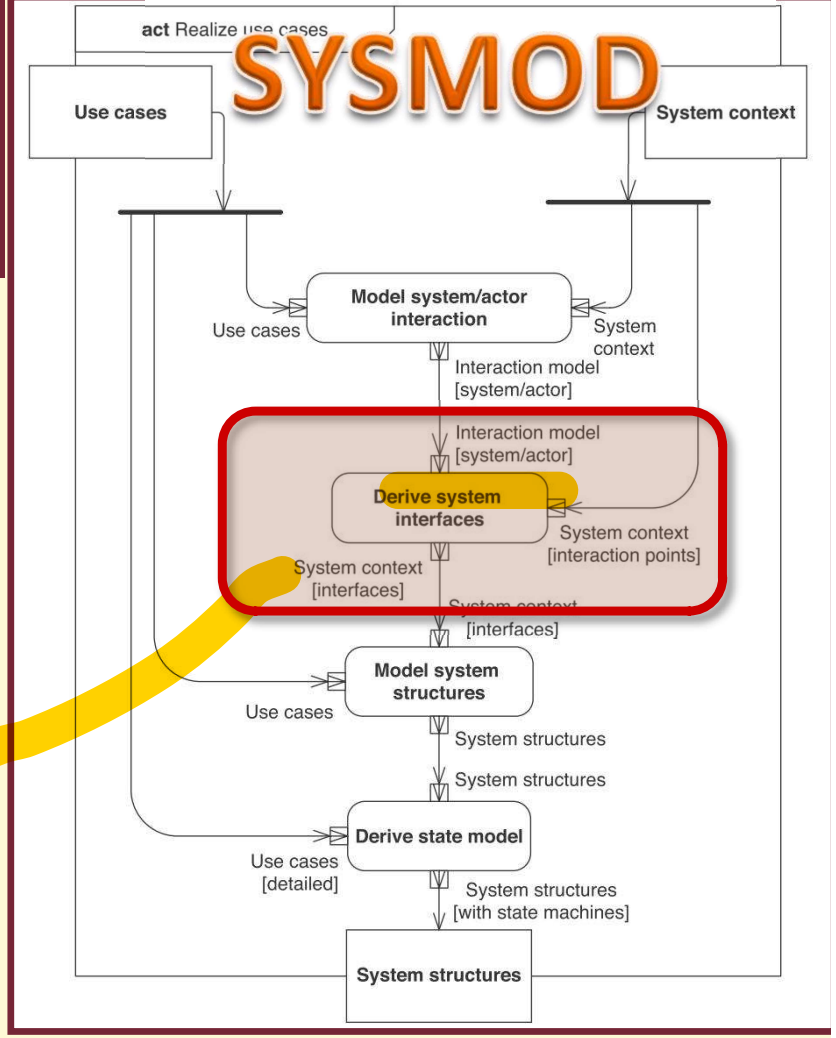
Sequence Diagram

Represents behavior in terms of a sequence of messages exchanged between parts

Derive System Interfaces

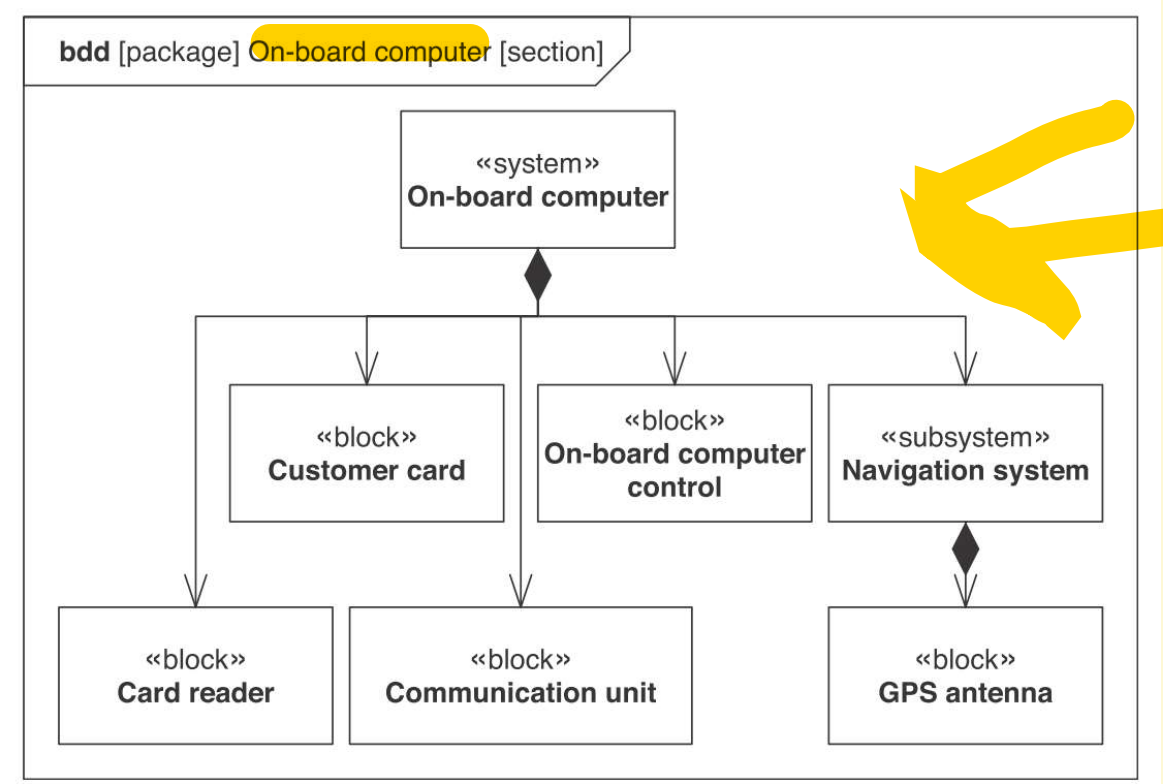


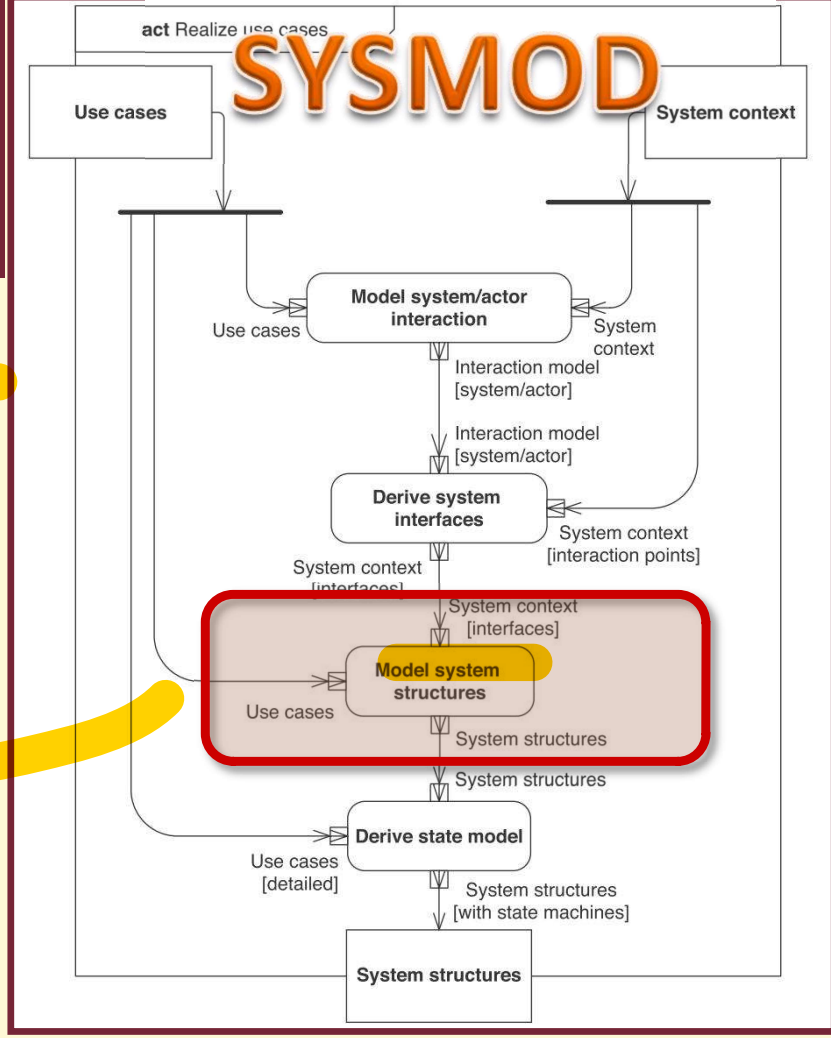




Model System Structures

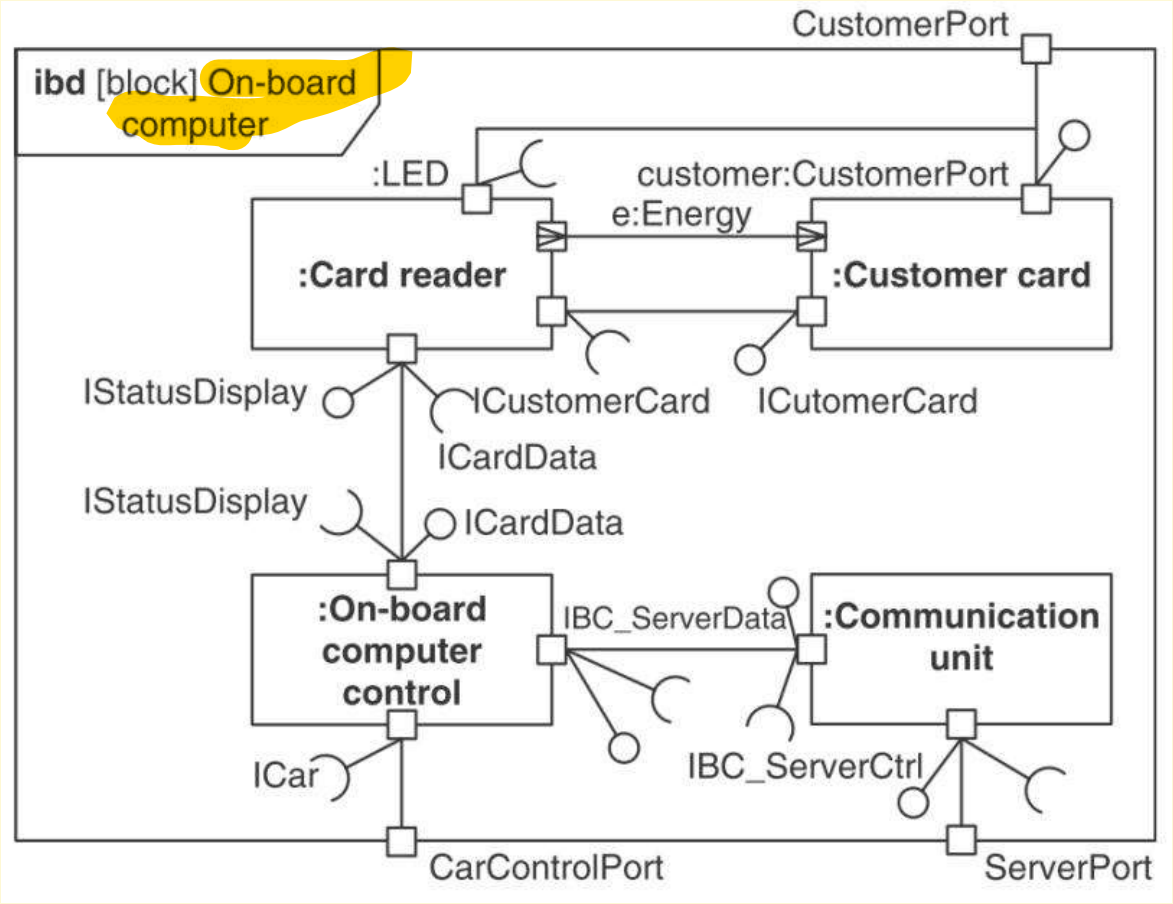
Identify system components

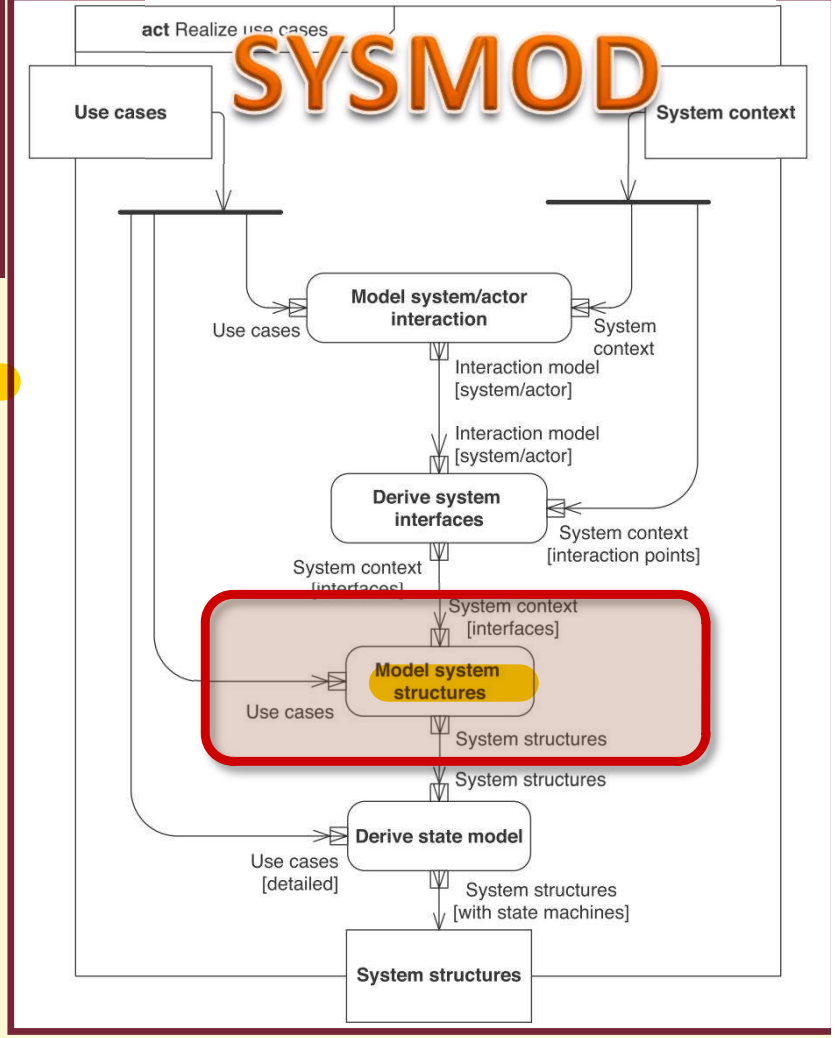




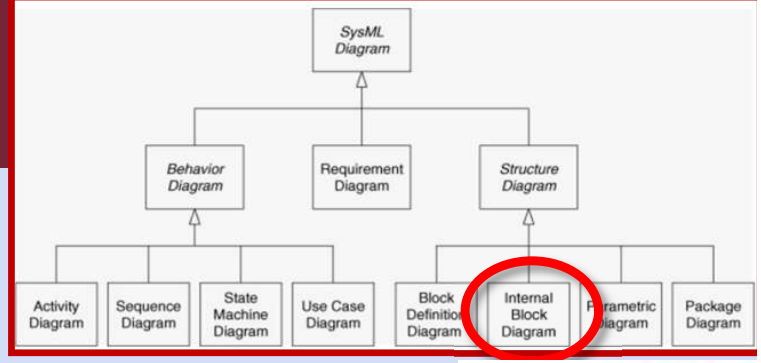
Model System Structures

Identify relation of components





SysML



Internal block diagram

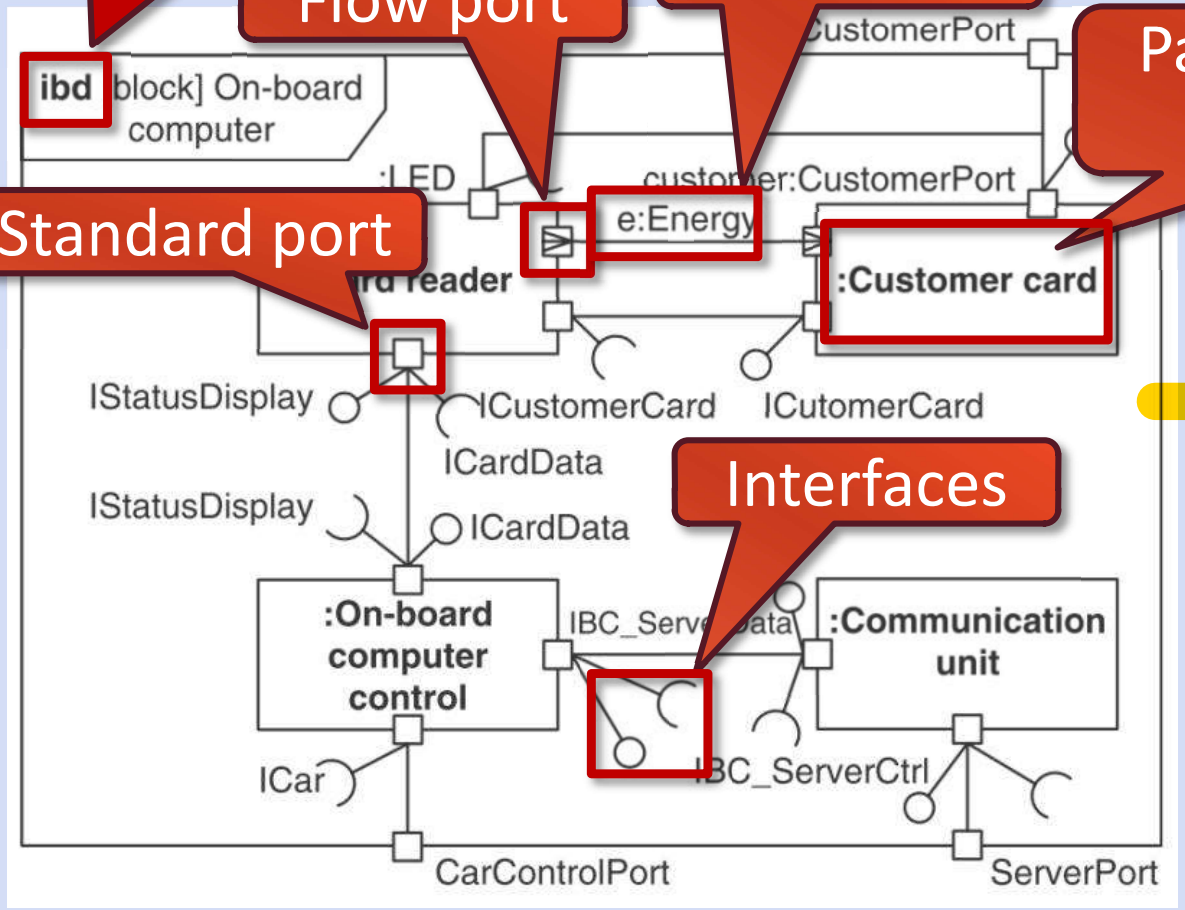
Flow port

Item flow

Part: usage of block type

Standard port

Interfaces

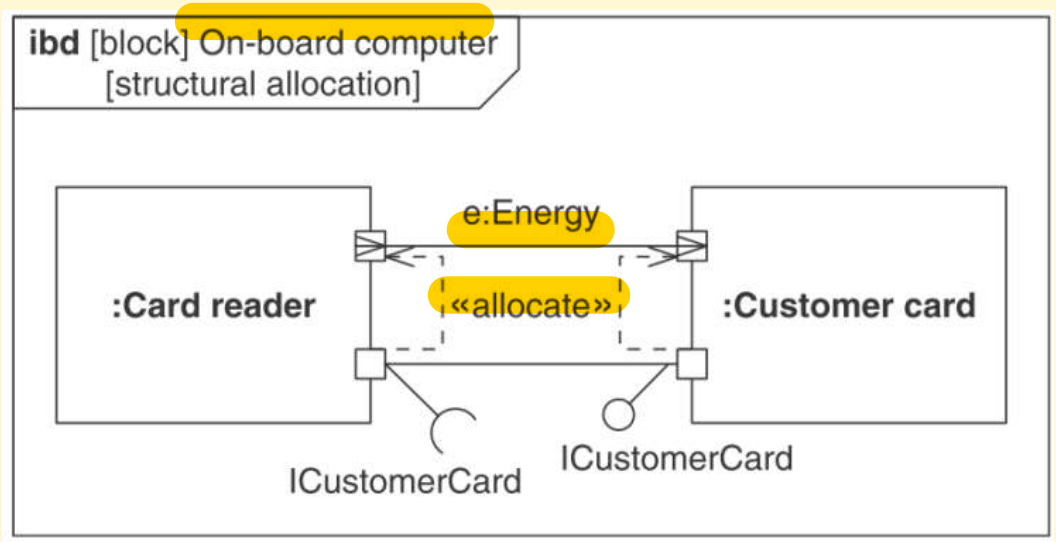


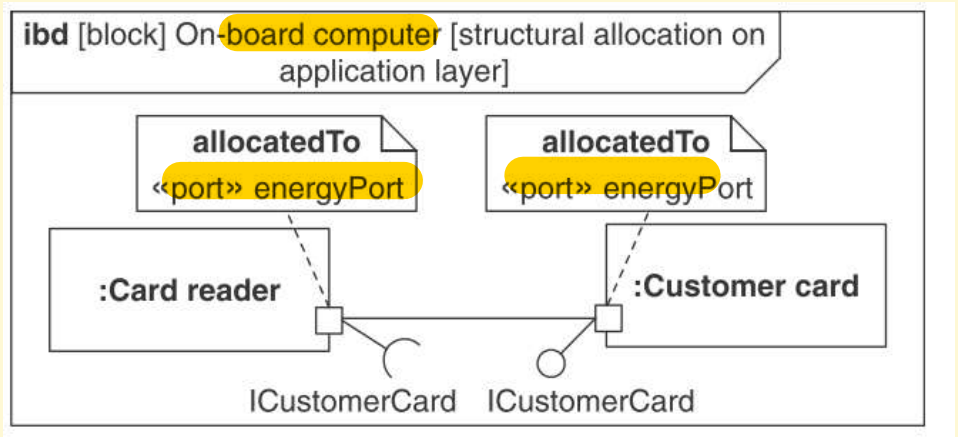
Internal Block Diagram

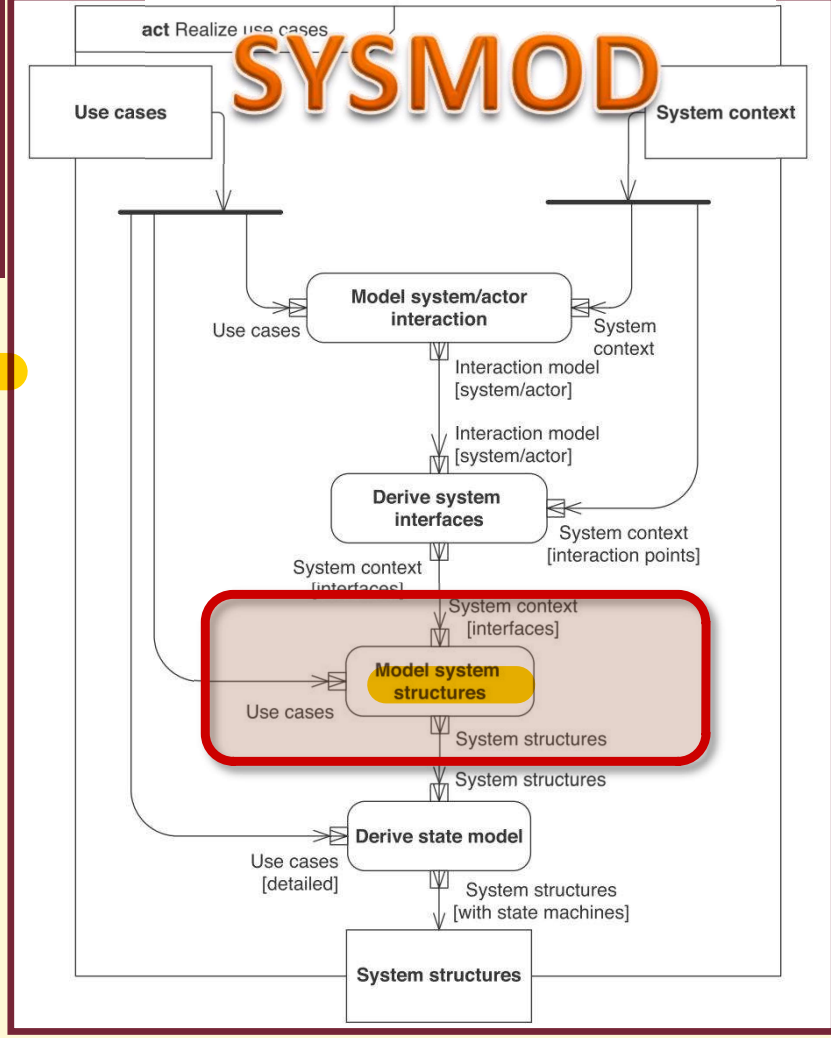
Represents interconnection and interfaces between the parts of a block

Model System Structures

Structural allocation



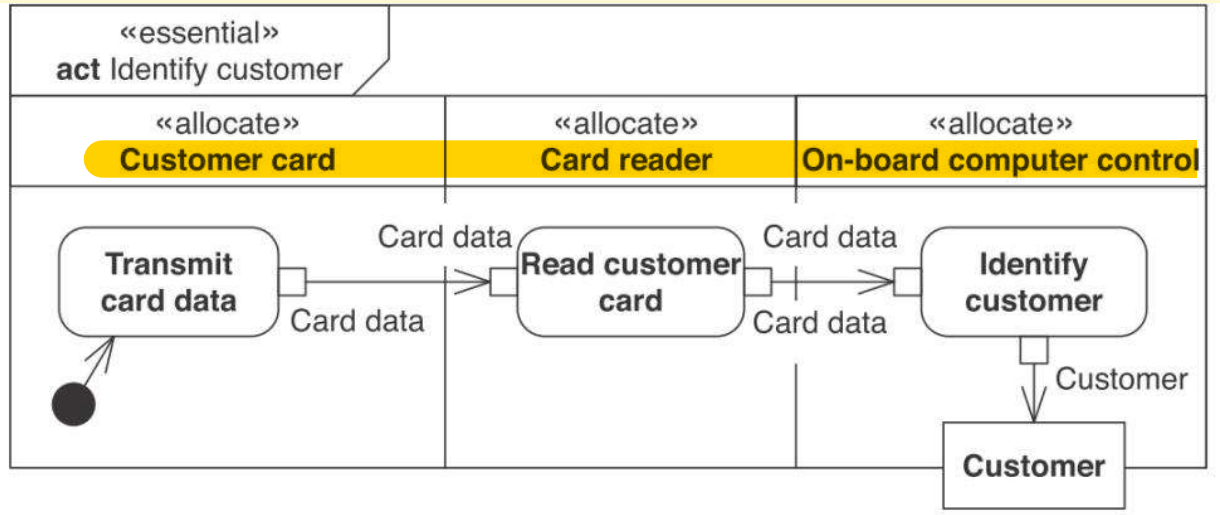


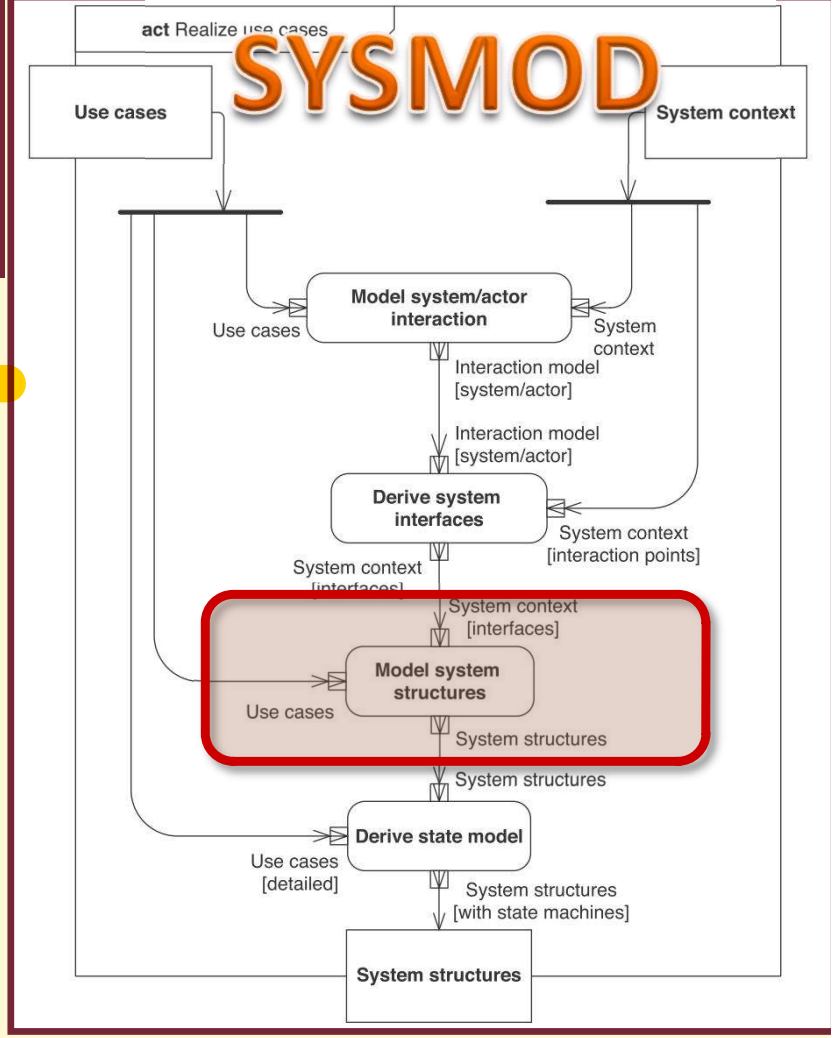


Model System Structures

Functional allocation:

Actions to System components

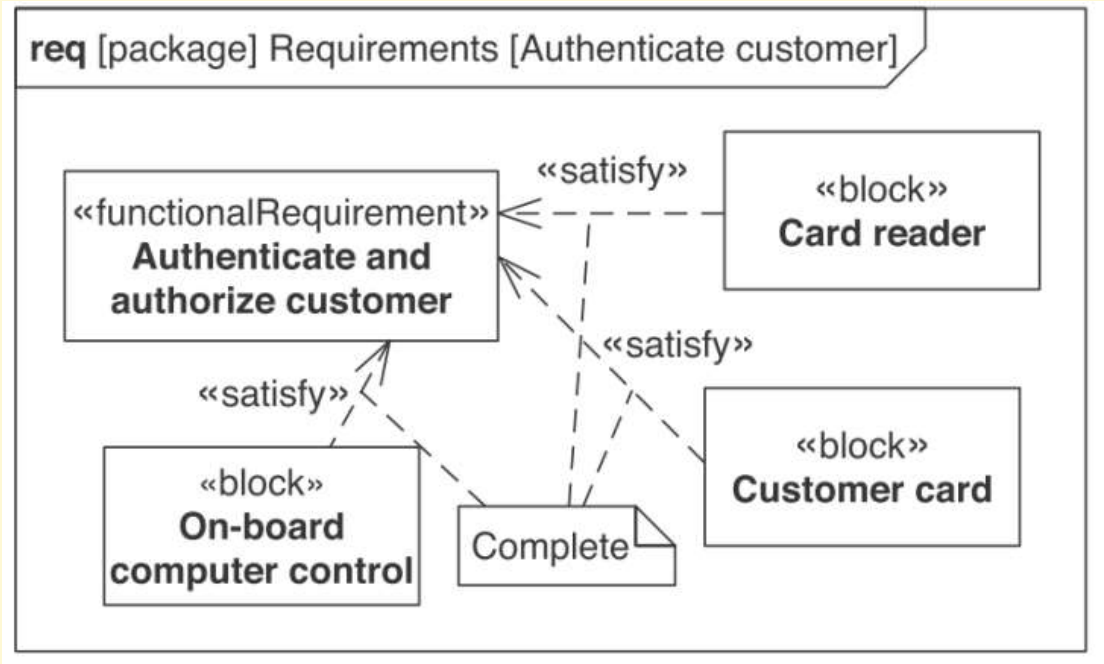


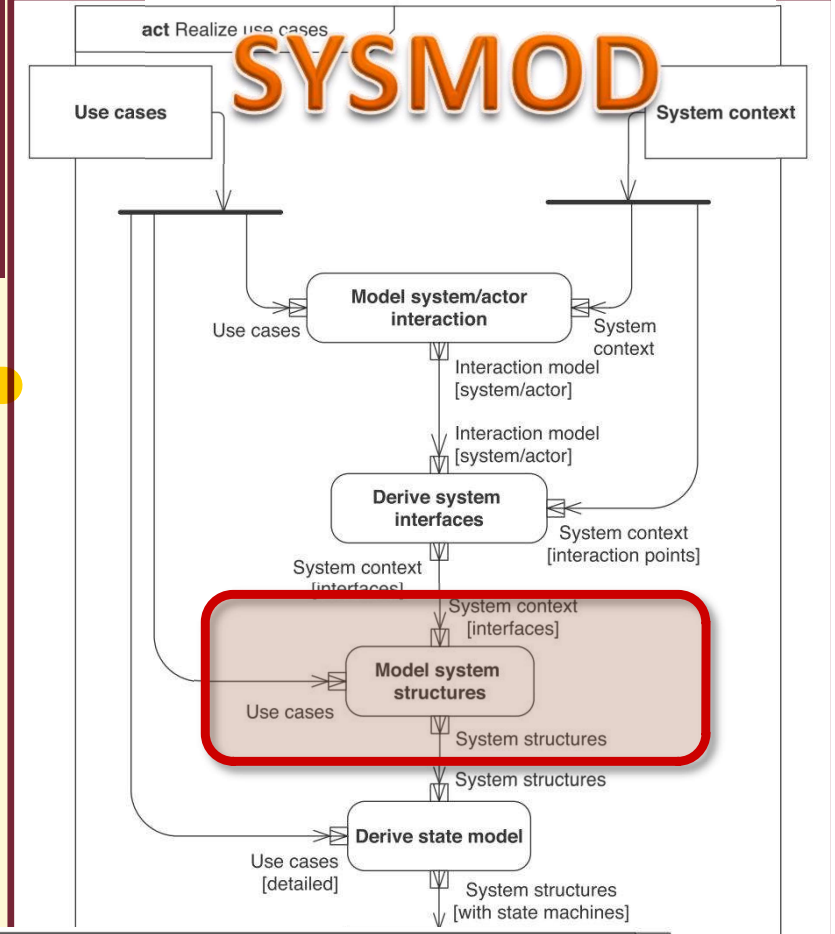


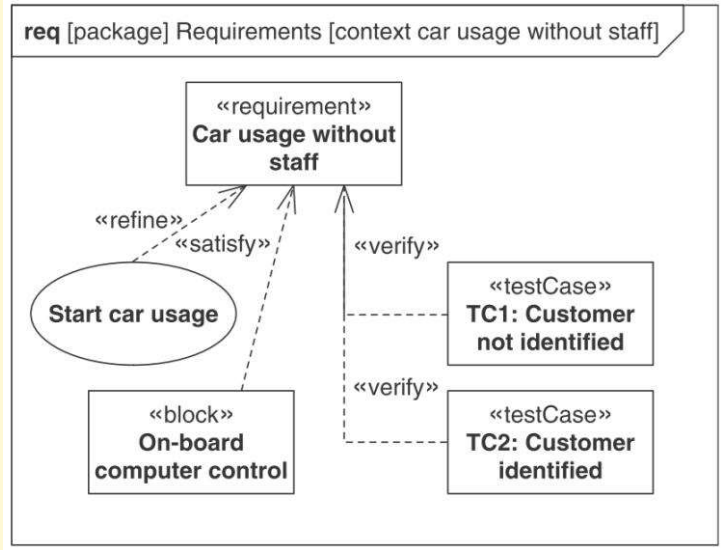
Model System Structures

Traceability to requirements:

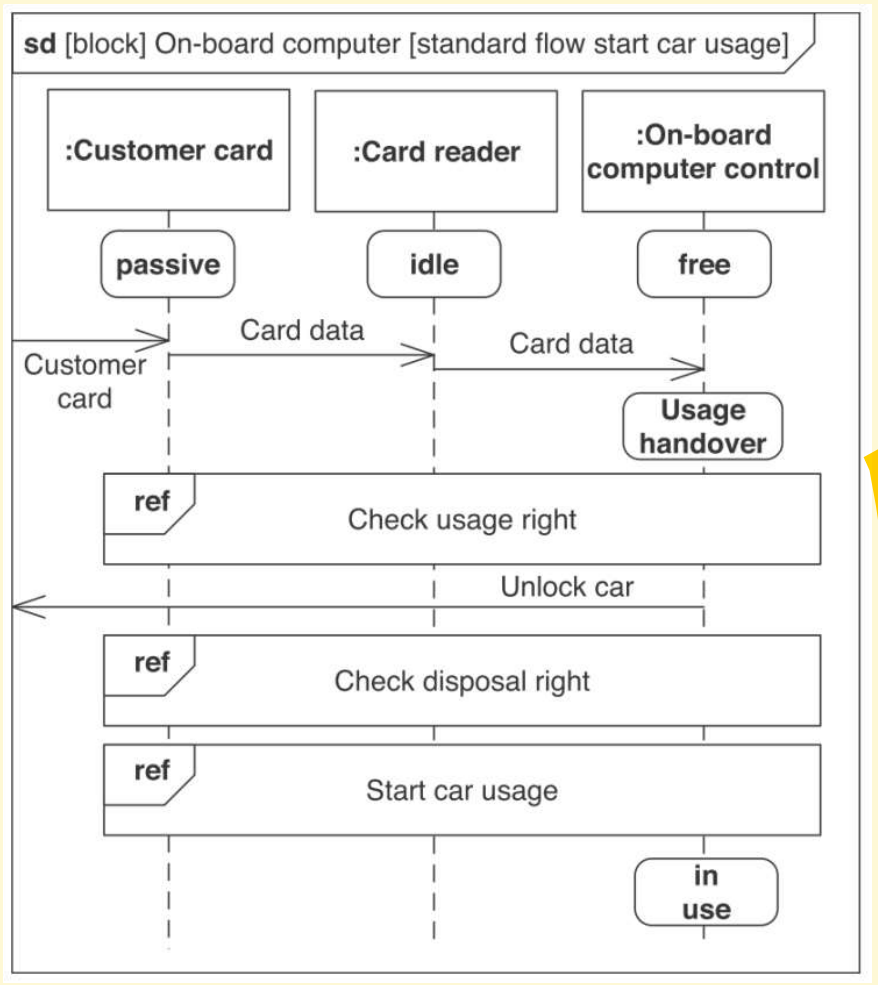
Blocks satisfying a req.

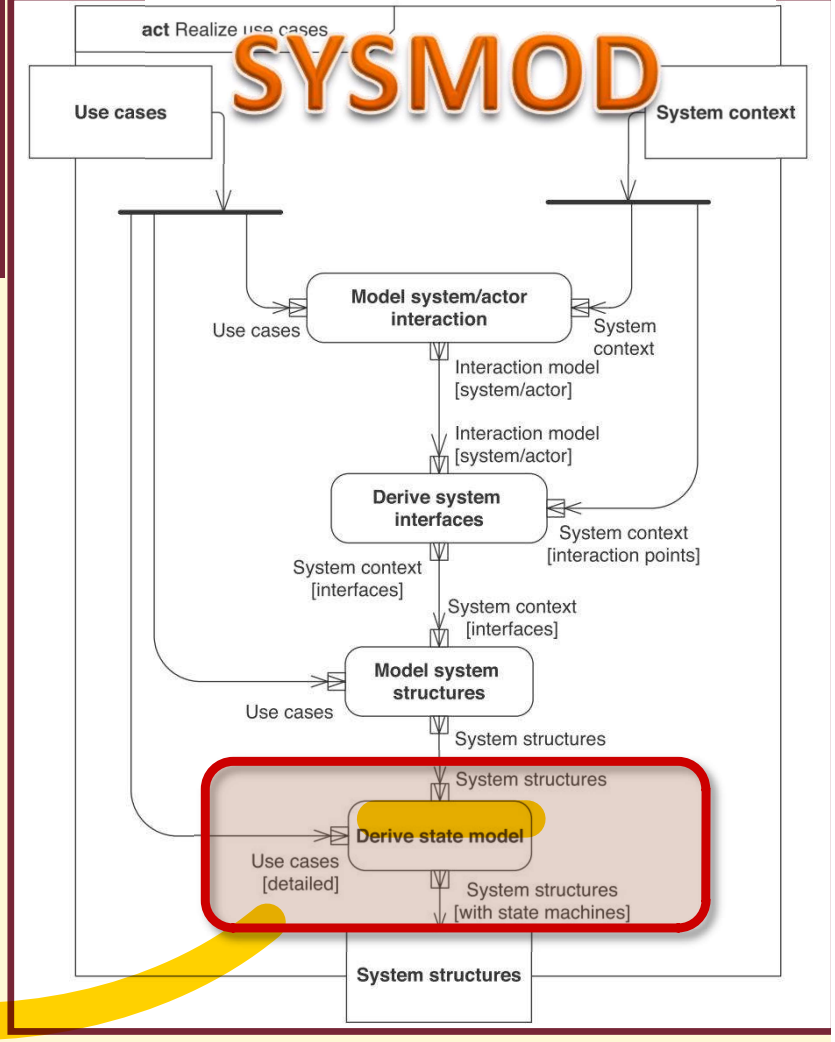




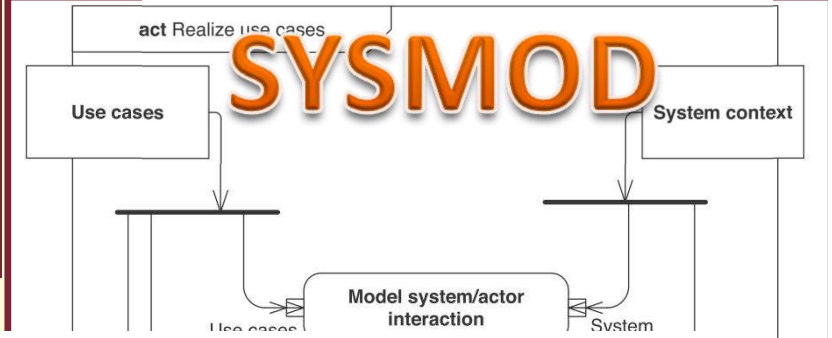


Derive State Model

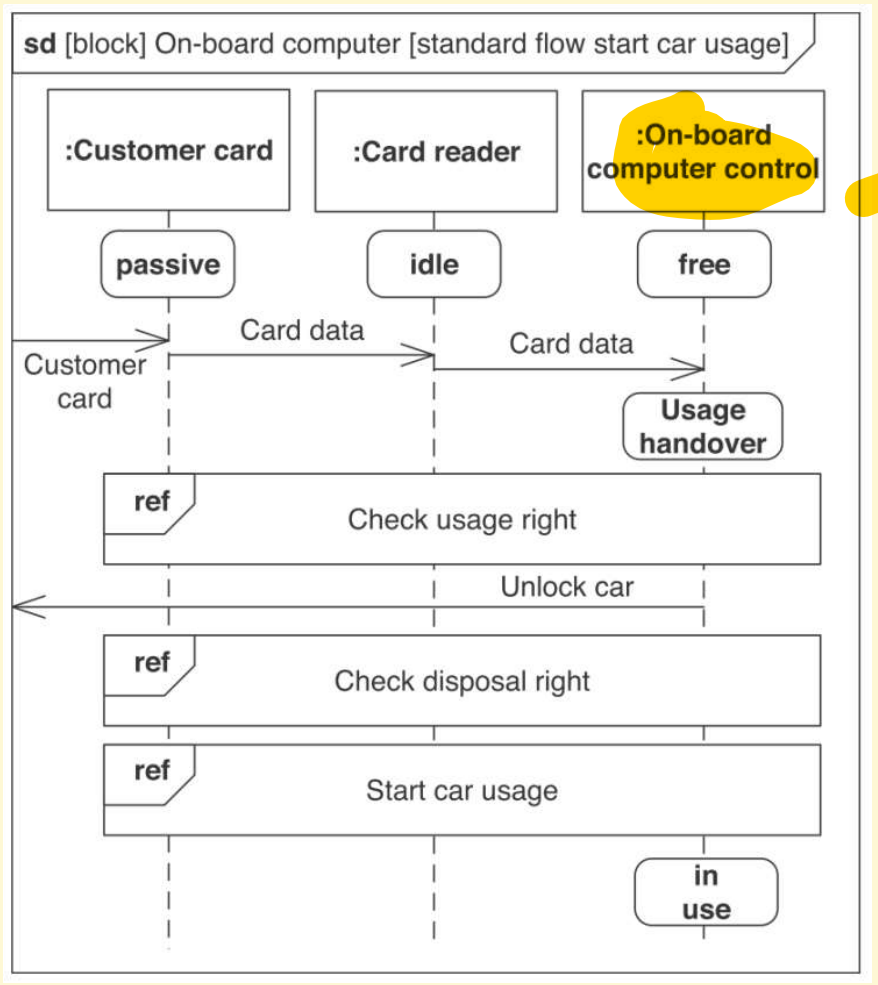


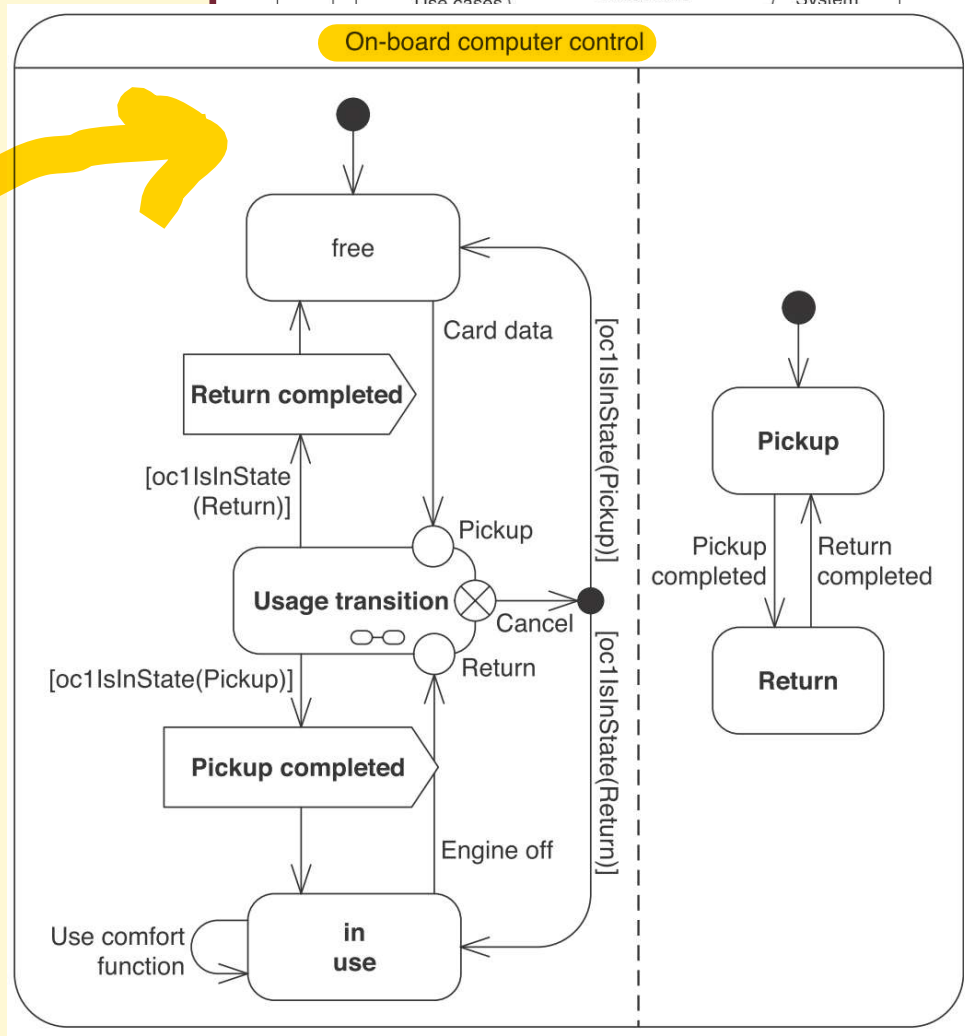


Derive State Model

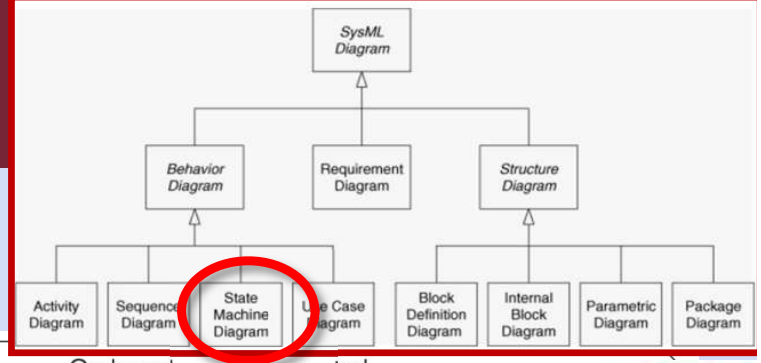


SYSMOD



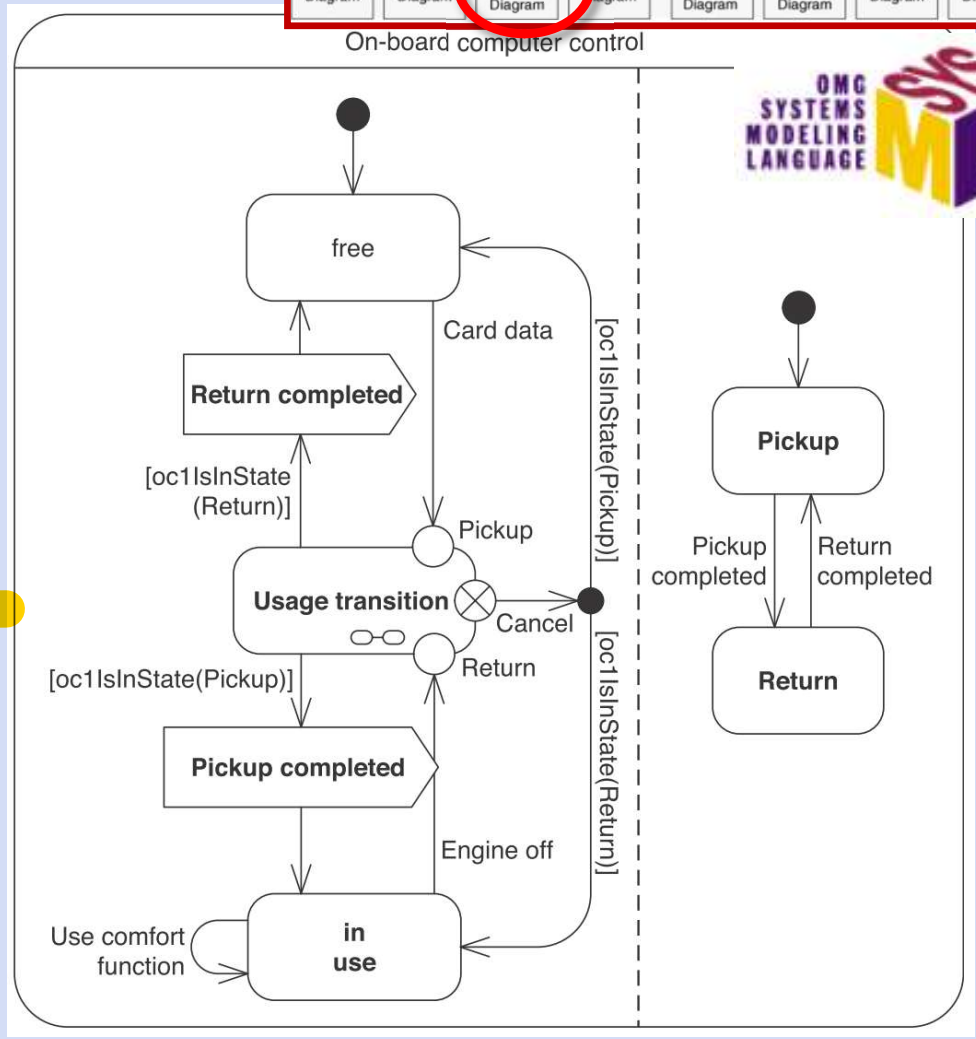


SysML



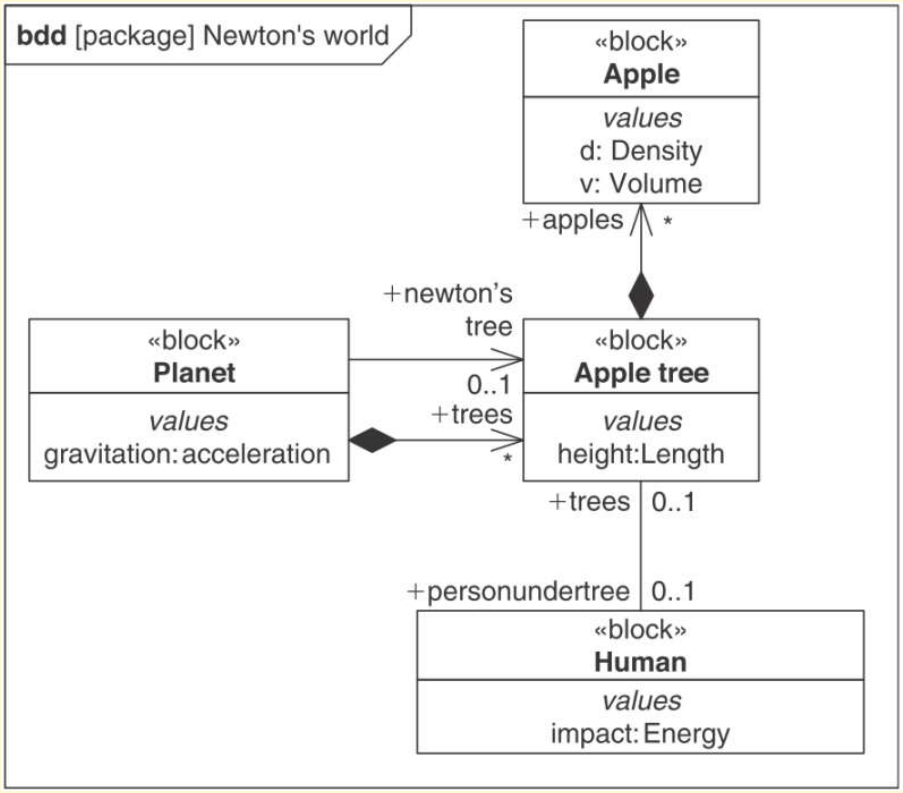
State Machine Diagram

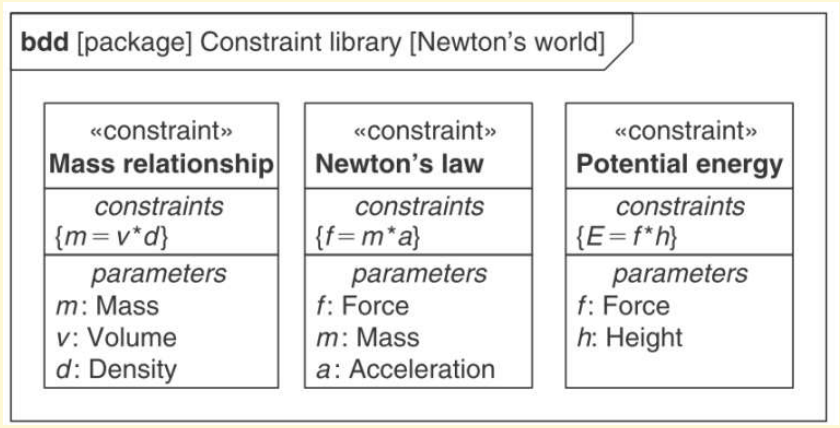
Represents behavior of an entity in terms of its transitions between states triggered by events

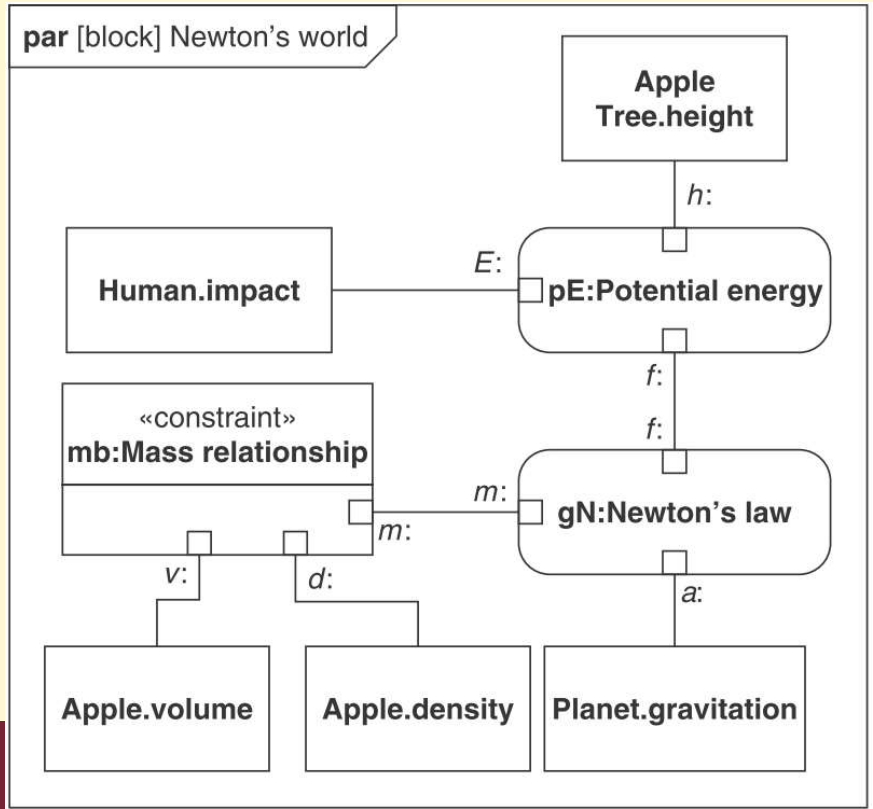


Parametrics

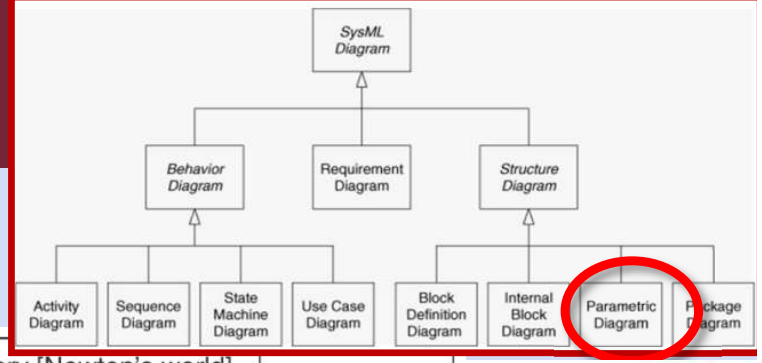
- Constraints on block properties







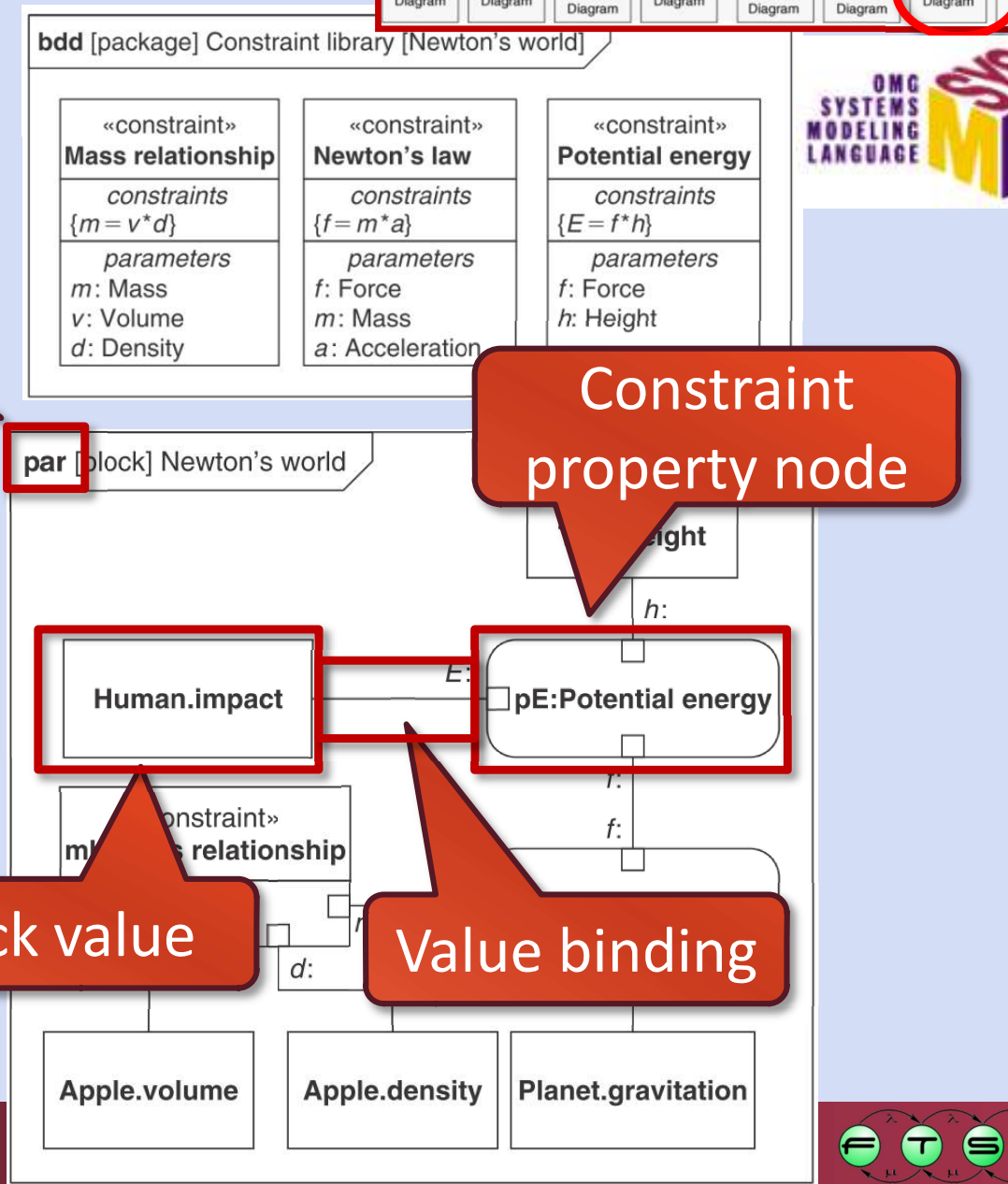
SysML



Parametric diagram

Parametric Diagram

Represents constraints on property values used to support engineering analysis



Summary

- SysML
  - OMG's most widely accepted standard
  - Heavily used by embedded system engineerings
  - Reuses the „better" part of UML
- SYSMOD
  - Provides a framework for MDE of embedded systems
  - (MDA) → more focused and fits to developer needs