REQUIREMENTS MODELING

Software Engineering

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REQUIREMENTS ANALYSIS

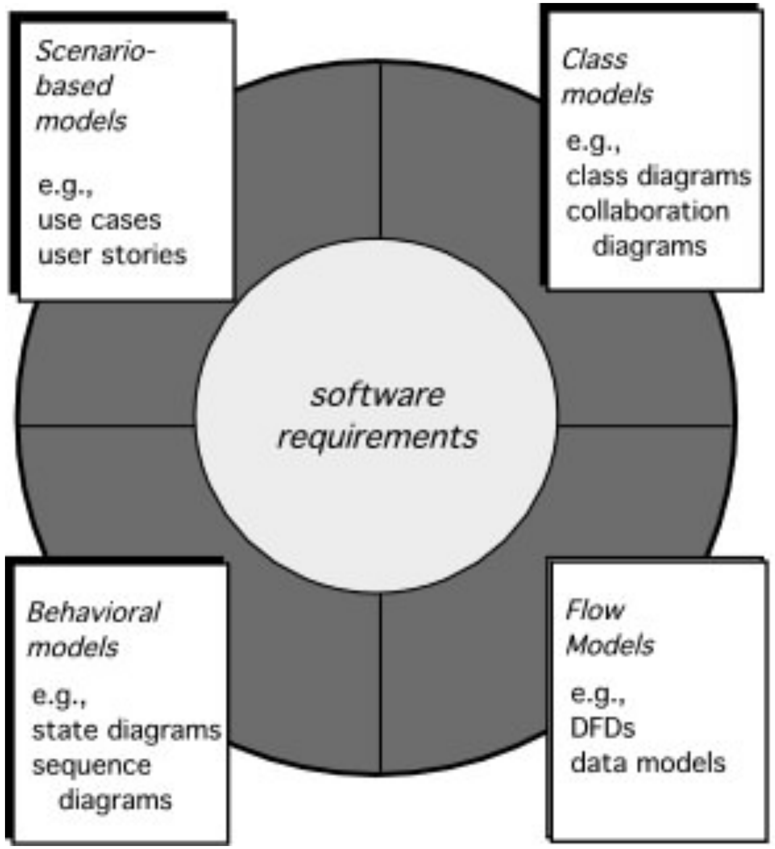
Requirements analysis

- specifies software’s operational characteristics
- indicates software's interface with other system elements
- establishes constraints that software must meet

Requirements analysis allows the software engineer to

- elaborate on basic requirements
- build models that depict user scenarios, functional activities, problem classes and their relationships, system and class behavior, and the flow of data as it is transformed

ELEMENTS OF REQUIREMENTS ANALYSIS



REQUIREMENTS MODELING

Scenario-based

system from the user's point of view

Data

shows how data are transformed inside the system

Class-oriented

defines objects, attributes, and relationships

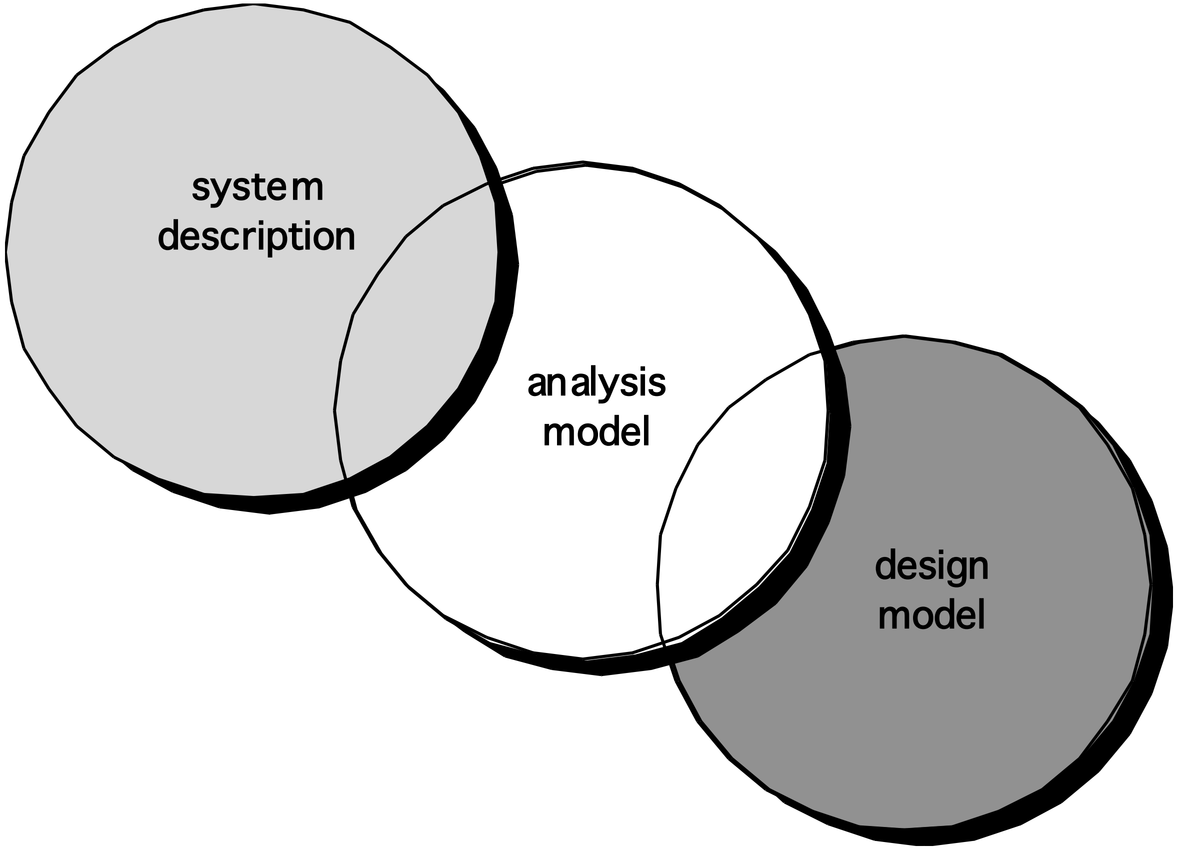
Flow-oriented

shows how data are transformed inside the system

Behavioral

show the impact of events on the system states

A BRIDGE



RULES OF THUMB

- The model should focus on requirements that are visible within the problem or business domain. The level of abstraction should be relatively high.
- Each element of the analysis model should add to an overall understanding of software requirements and provide insight into the information domain, function and behavior of the system.
- Delay consideration of infrastructure and other non-functional models until design.
- Minimize coupling throughout the system.
- Be certain that the analysis model provides value to all stakeholders.
- Keep the model as simple as it can be.

DOMAIN ANALYSIS

- Define the domain to be investigated.
- Collect a representative sample of applications in the domain.
- Analyze each application in the sample.
- Develop an analysis model for the objects.

SCENARIO-BASED METHODS

SCENARIO-BASED MODELING

Use case / scenario defines how a user uses a system to accomplish a particular goal.

A modeling technique that defines the features to be implemented and the resolution of any errors that may be encountered.

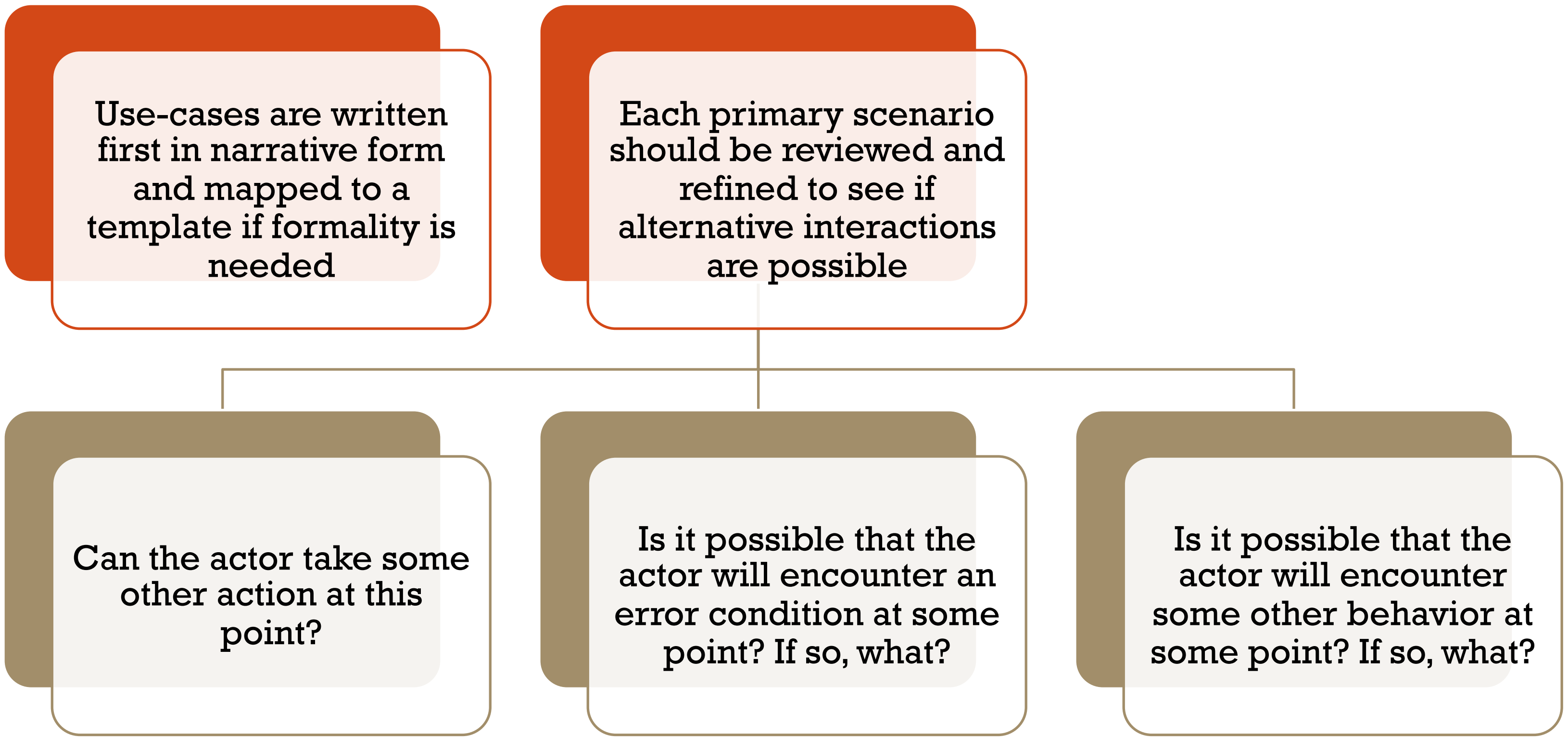
A methodology used in system analysis to identify, clarify, and organize system requirements.

A set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal.

DEVELOPING A USE-CASE

- What are the main tasks or functions that are performed by the actor?
- What system information will the the actor acquire, produce or change?
- Will the actor have to inform the system about changes in the external environment?
- What information does the actor desire from the system?
- Does the actor wish to be informed about unexpected changes?

REVIEWING A USE-CASE



Use-cases are written first in narrative form and mapped to a template if formality is needed

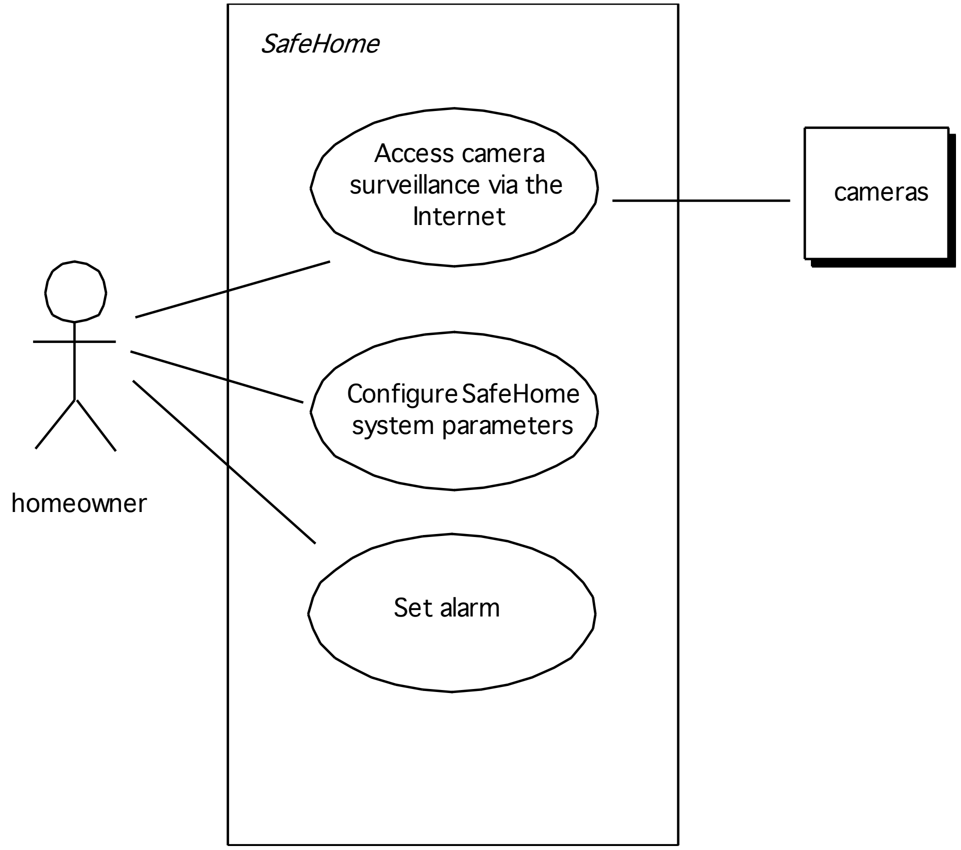
Each primary scenario should be reviewed and refined to see if alternative interactions are possible

Can the actor take some other action at this point?

Is it possible that the actor will encounter an error condition at some point? If so, what?

Is it possible that the actor will encounter some other behavior at some point? If so, what?

USE-CASE DIAGRAM EXAMPLE


SafeHome
Access camera surveillance via the Internet
Configure SafeHome system parameters
Set alarm
homeowner
cameras

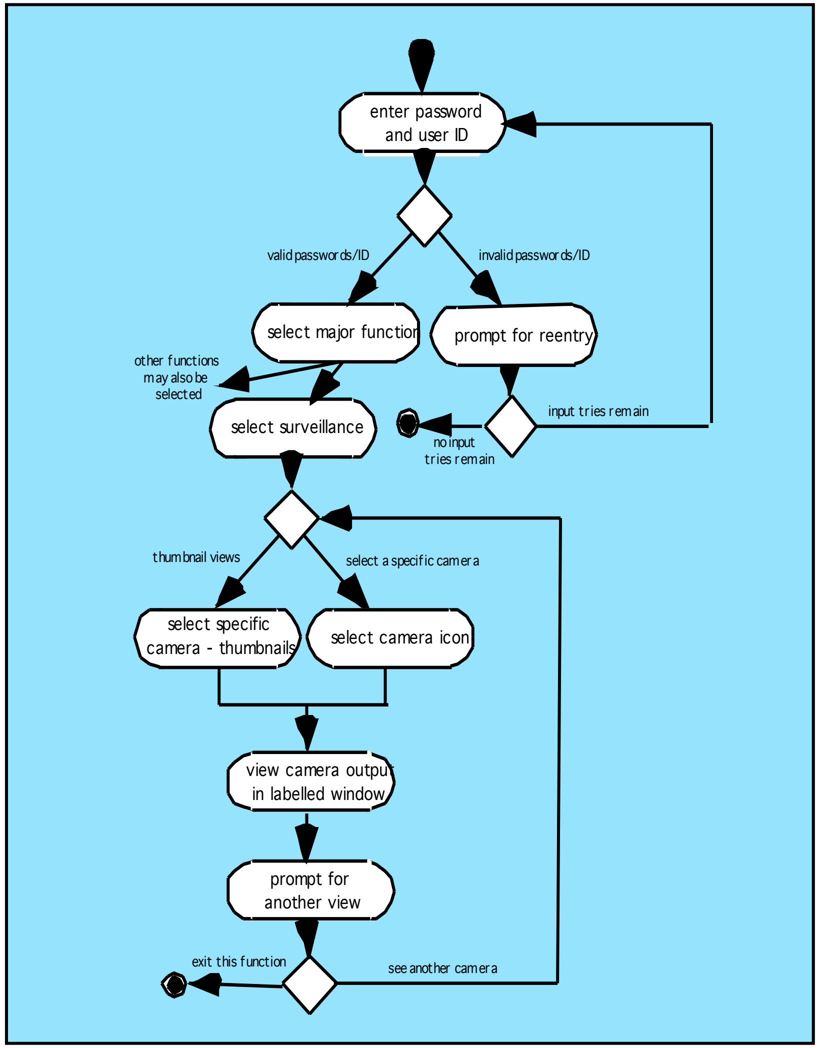
EXCEPTIONS

- Describe situations that may cause the system to exhibit unusual behavior
- Brainstorm to derive a reasonably complete set of exceptions for each use case
- Are there cases where a validation function occurs for the use case?
- Handling exceptions may require the creation of additional use cases

ACTIVITY DIAGRAM

Supplements the use case by providing a graphical representation

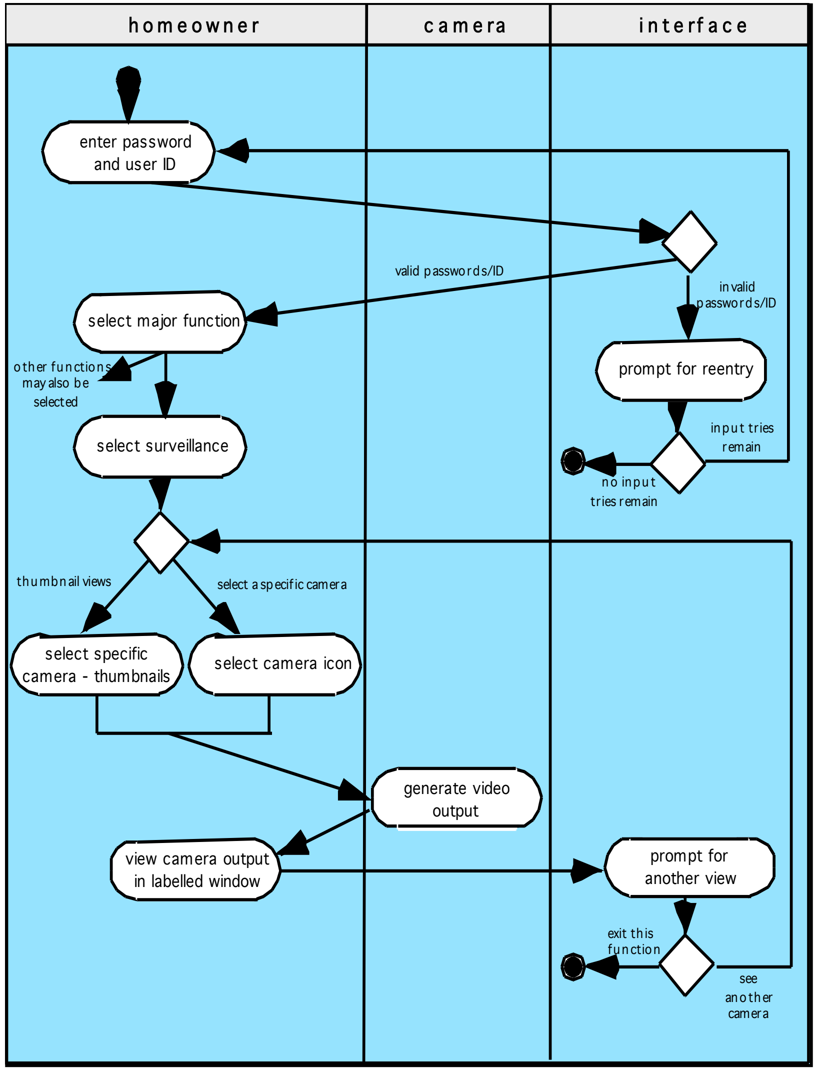
The flow of interaction between actor and the system within a specific scenario



SWIMLANE DIAGRAM

Allows the modeler to represent the flow of activities described by the use-case

Indicates which actor or analysis class has responsibility for the action described by an activity rectangle



CLASS-BASED METHODS

REQUIREMENTS MODELING STRATEGIES

One view of requirements modeling, called structured analysis, considers data and the processes that transform the data as separate entities.

Data objects are modeled in a way that defines their attributes and relationships.

Processes that manipulate data objects are modeled in a manner that shows how they transform data as data objects flow through the system.

A second approach to analysis modeled, called object-oriented analysis, focuses on

the definition of classes and

the manner in which they collaborate with one another to effect customer requirements.

CLASS-BASED MODELING

Class-based modeling represents

objects that the system will manipulate

operations (also called methods or services)

relationships between the objects

collaborations that occur between the classes

The elements of a class-based model include

classes and objects

attributes and operations

collaboration diagrams and packages

IDENTIFYING CLASSES

Classes are determined by underlining each noun or noun phrase and entering it into a simple table

If the class is required to implement a solution, then it is part of the solution space;

If a class is necessary only to describe a solution, it is part of the problem space.

MANIFESTATIONS OF CLASSES

External entities

- (e.g. other systems, devices, people) that produce or consume information

Things

- (e.g. reports, displays, letters, signals) that are part of the information domain for the problem

Occurrences or events

- (e.g. completion of actions) that occur within the context of system operation

Roles

- (e.g. manager, engineer, salesperson) played by people who interact with the system

Organizational units

- (e.g. division, group, team) that are relevant to an application

Places

- (e.g. manufacturing floor) that establish the context of the problem and the overall function

Structures

- (e.g. sensors, computers) that define a class of objects or related classes of objects

DEFINING ATTRIBUTES

Attributes describe a class that has been selected for inclusion in the analysis model.

Attributes describe the structure and value of an instance of a class.

DEFINING OPERATIONS

An operation is a method or function that can be performed by a class.

Operations define the behavior of a class, what a class can do.

Operations can perform computation, take an action, call another method, etc.

CLASS TYPES

Entity classes

also called model or business classes, are extracted directly from the statement of the problem

Boundary classes

are used to create the interface that the user sees and interacts with the software

Controller classes

manage a "unit of work" from start to finish

RESPONSIBILITIES

- System intelligence should be distributed across classes to best address the needs of the problem
- Each responsibility should be stated as generally as possible
- Information and the behavior related to it should reside within the same class
- Information about one thing should be localized with a single class, not distributed across multiple classes.
- Responsibilities should be shared among related classes, when appropriate.

COLLABORATIONS

Classes fulfill their responsibilities in one of two ways:

- a class can use its own operations to fulfill a particular responsibility
- a class can collaborate with other classes

Collaborations identify relationships between classes

Collaborations are identified by determining whether a class can fulfill each responsibility itself

ASSOCIATION, AGGREGATION AND COMPOSITION

Association is a (*a*) relationship between two classes, where one class use another

Aggregation, a special type of an association, is the (*the*) relationship between two classes.

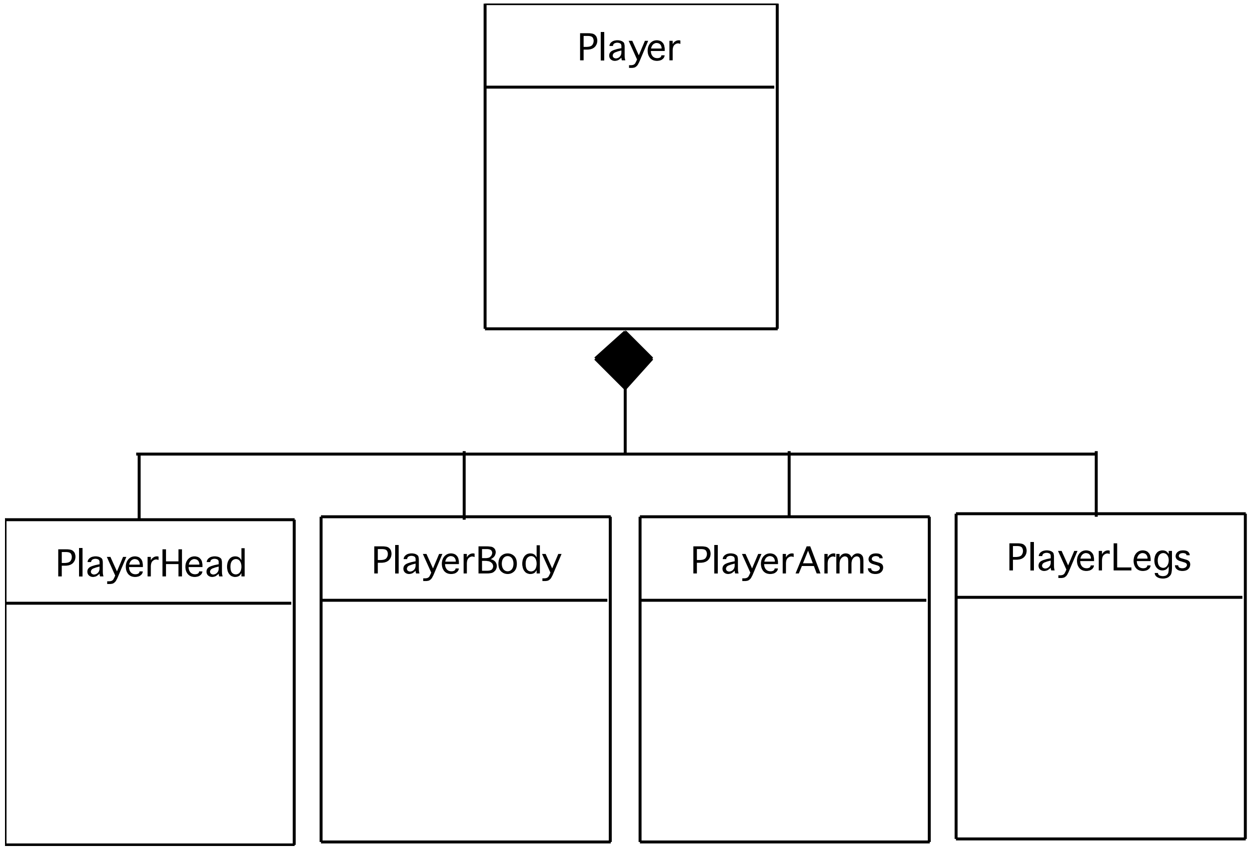
Association is non-directional, aggregation insists a direction.

Composition can be recognized as a special type of an aggregation.

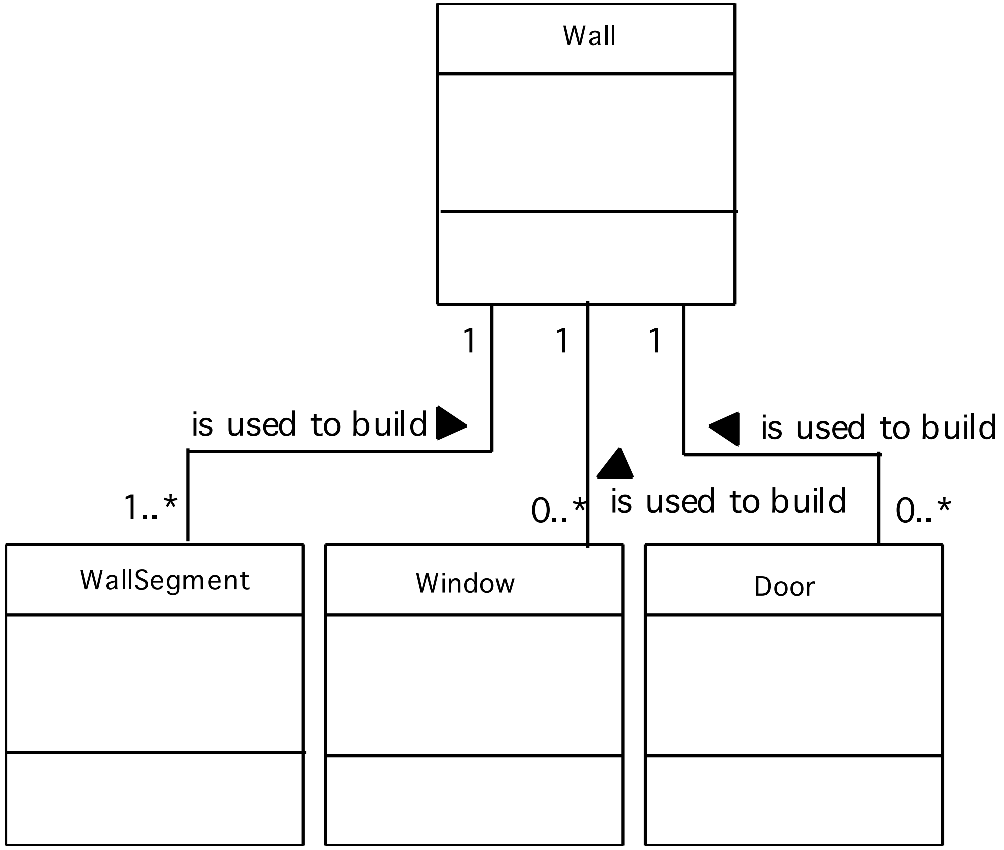
Aggregation is a special kind of an association and composition is a special kind of an aggregation.

Association →Aggregation →Composition

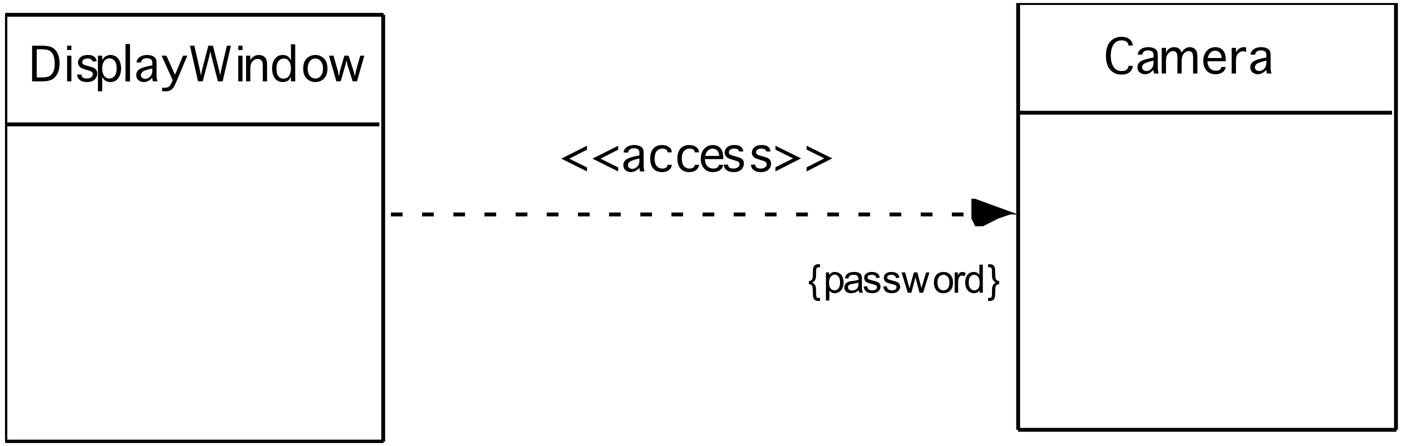
COMPOSITE AGGREGATE CLASS



MULTIPLICITY



DEPENDENCIES



BEHAVIORAL MODELING

BEHAVIORAL MODELING

- The behavioral model indicates how software will respond to external events.
- Evaluate all use-cases to fully understand the sequence of interaction within the system.
- Identify events that drive the interaction sequence and understand how these events relate to specific objects.
- Create a sequence for each use-case.
- Build a state diagram for the system.
- Review the behavioral model to verify accuracy and consistency.

STATE DIAGRAMS

In the context of behavioral modeling, two different characterizations of states must be considered:

- the state of each class as the system performs its function and
- the state of the system as observed from the outside as the system performs its function

The state of a class takes on both passive and active characteristics:

- A passive state is simply the current status of all of an object's attributes.
- The active state of an object indicates the current status of the object as it undergoes a continuing transformation or processing.

THE STATES OF A SYSTEM

State

a set of observable circum-stances that characterizes the behavior of a system at a given time

State transition

the movement from one state to another

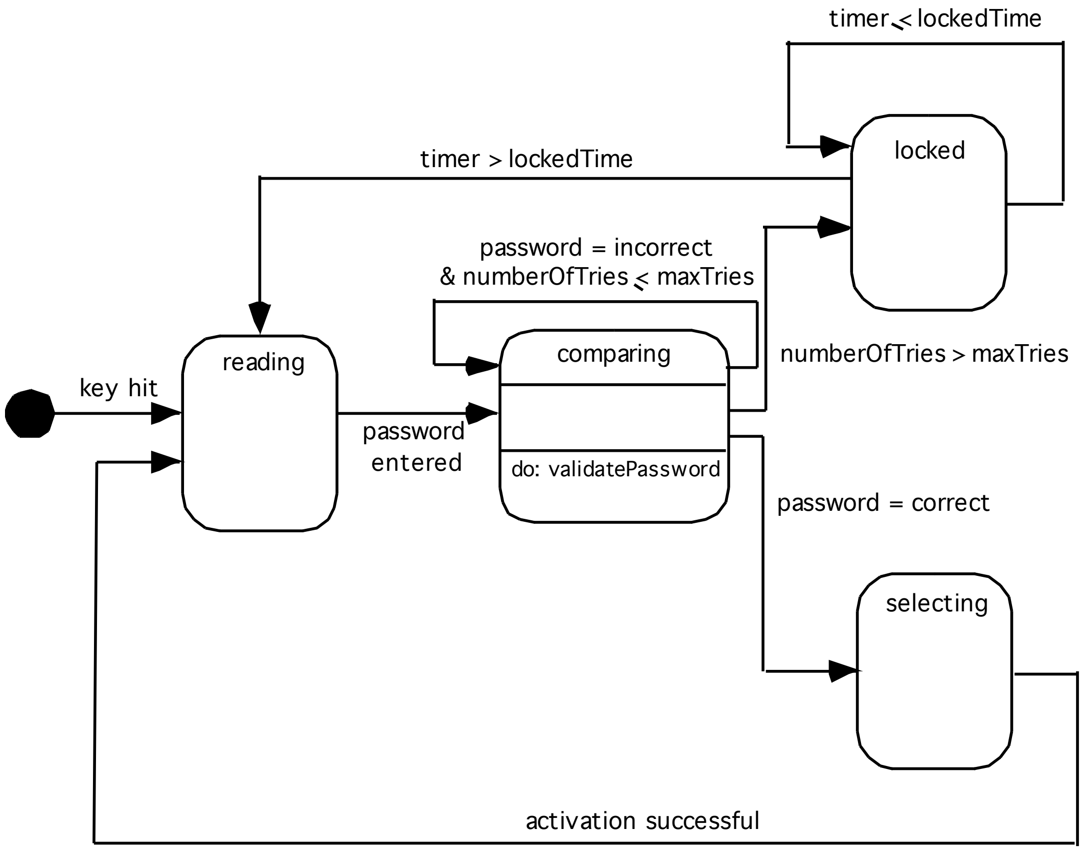
Event

an occurrence that causes the system to exhibit some predictable form of behavior

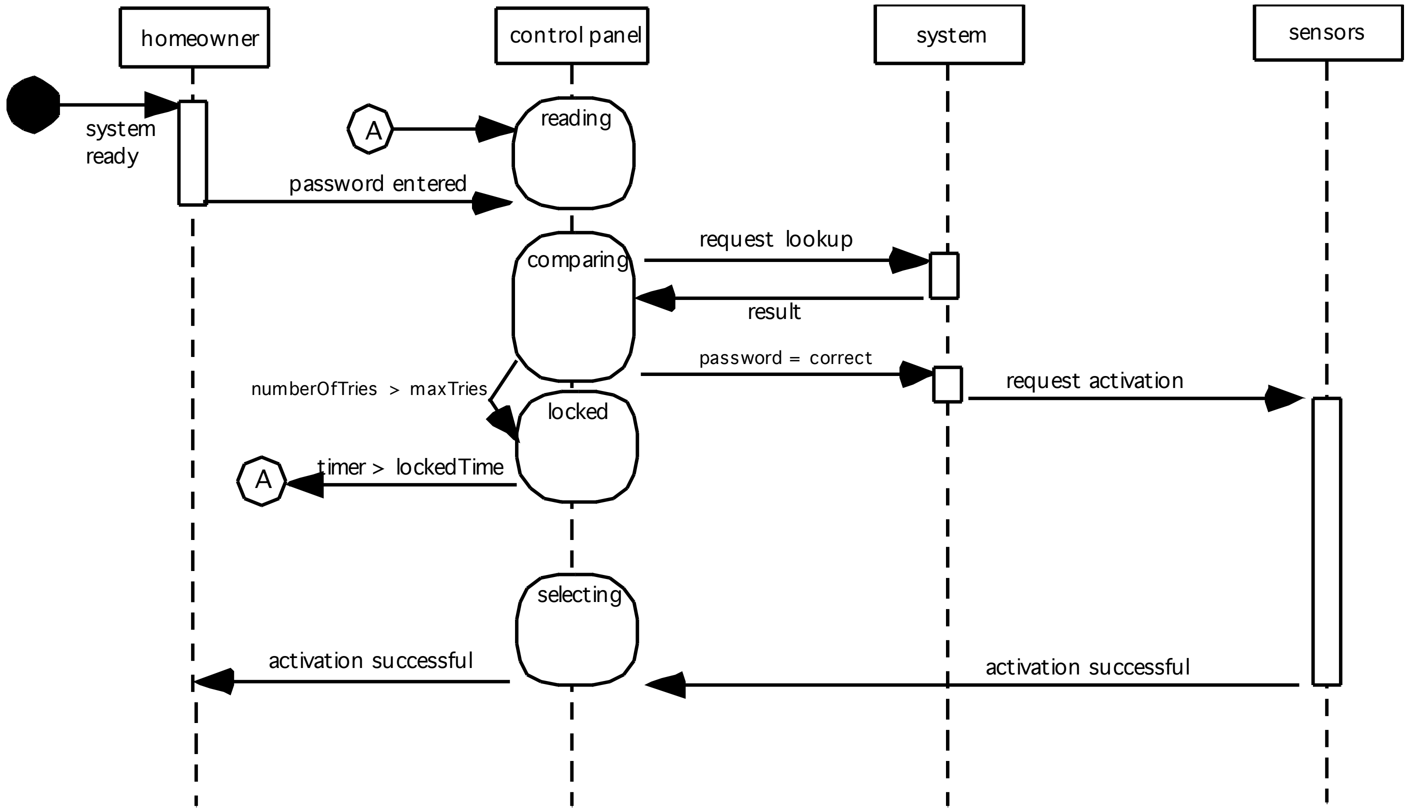
Action

process that occurs as a consequence of making a transition

STATE DIAGRAM EXAMPLE



SEQUENCE DIAGRAM

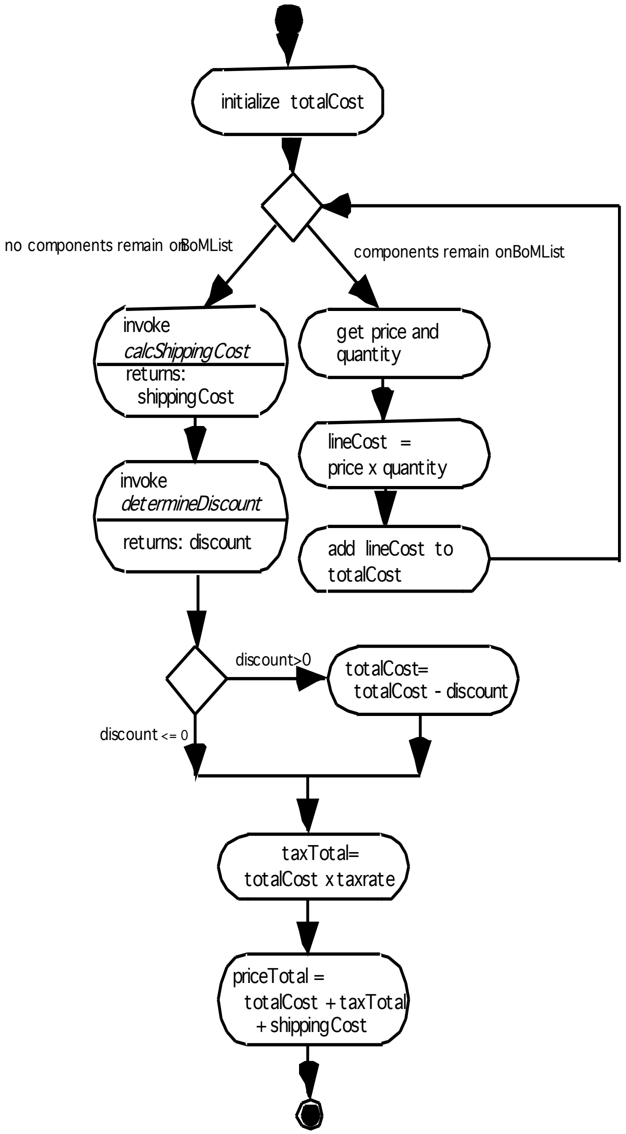


FLOW MODELS

ACTIVITY DIAGRAM

A flowchart to represent the flow from one activity to another activity.

The activity can be described as an operation of the system.

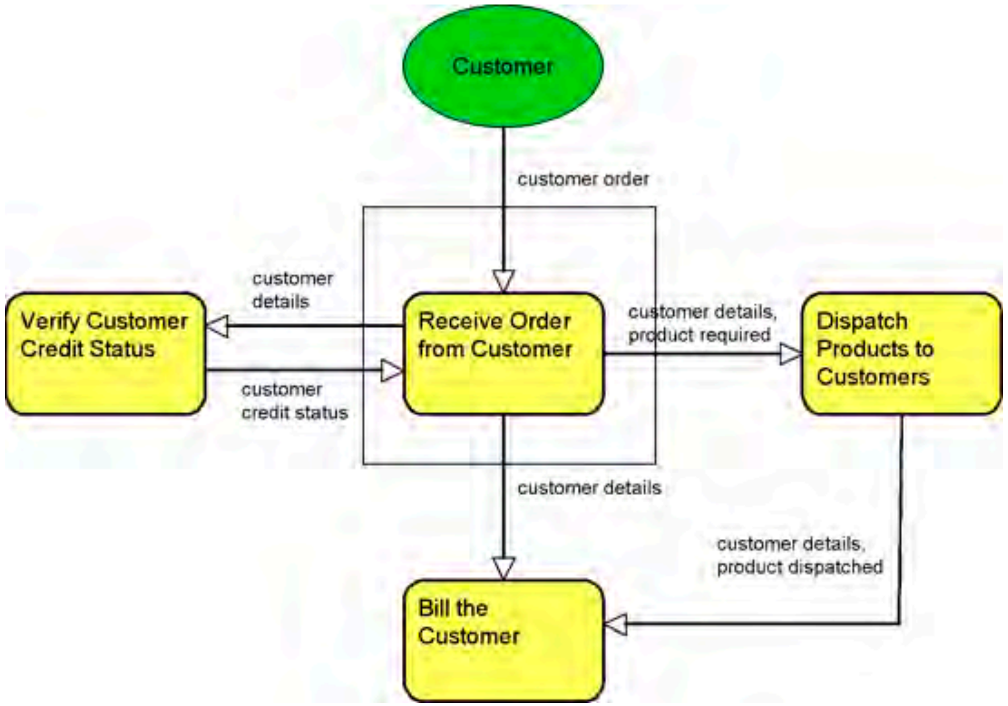

initialize totalCost
no components remain onBoMList
components remain onBoMList
invoke
calcShippingCost
returns:
shippingCost
get price and quantity
lineCost = price x quantity
invoke
determineDiscount
returns: discount
add lineCost to totalCost
discount>0
totalCost= totalCost - discount
discount <= 0
taxTotal= totalCost x taxrate
priceTotal = totalCost + taxTotal + shippingCost

DATA FLOW DIAGRAM

A data-flow diagram is a way of representing a flow of a data of a process or a system.

The DFD also provides information about the output and input of each entity and the process itself.

A data-flow diagram has no control flow, there are no decision rules and no loops.


Customer
customer order
customer details
Verify Customer Credit Status
Receive Order from Customer
customer details, product required
Dispatch Products to Customers
customer credit status
customer details
customer details, product dispatched
Bill the Customer

REFERENCE

- Roger Pressman, Software Engineering: A Practitioner's Approach, 8th edition, McGraw Hill, ISBN 0078022126