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# Software Engineering

## Topic 3

## Requirement Modelling

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# Acknowledgement

These slides have been adapted from Pressman, R.S. (2015). *Software Engineering : A Practioner's Approach. 8th ed*. McGraw-Hill Companies.Inc, Americas, New York. ISBN : 978 1 259 253157. Chapter 9, 10, 11 and 12

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# Learning Objectives

LO 2 : Explain the software engineering practices and business environment

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# Contents

- Requirement Analysis
- Eliciting Requirements
- Developing Use Case
- Negotiating Requirements
- Validating Requirements

# REQUIREMENT ENGINEERING

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# Requirement Engineering

- Inception—ask a set of questions that establish …
  - basic understanding of the problem
  - the people who want a solution
  - the nature of the solution that is desired, and
  - the effectiveness of preliminary communication and collaboration between the customer and the developer
- Elicitation—elicit requirements from all stakeholders
- Elaboration—create an analysis model that identifies data, function and behavioral requirements
- Negotiation—agree on a deliverable system that is realistic for developers and customers

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# Requirement Engineering

- Specification—can be any one (or more) of the following:
  - A written document
  - A set of models
  - A formal mathematical
  - A collection of user scenarios (use-cases)
  - A prototype
- Validation—a review mechanism that looks for
  - errors in content or interpretation
  - areas where clarification may be required
  - missing information
  - inconsistencies (a major problem when large products or systems are engineered)
  - conflicting or unrealistic (unachievable) requirements.
- Requirements management

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# Requirement Engineering

## Inception

- Identify stakeholders
  - "who else do you think I should talk to?"
- Recognize multiple points of view
- Work toward collaboration
- The first questions
  - Who is behind the request for this work?
  - Who will use the solution?
  - What will be the economic benefit of a successful solution
  - Is there another source for the solution that you need?

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# Requirement Engineering

## Eliciting Requirements

- Meetings are conducted and attended by both software engineers and customers
- Rules for preparation and participation are established
- An agenda is suggested
- A "facilitator" (can be a customer, a developer, or an outsider) controls the meeting
- A "definition mechanism" (can be work sheets, flip charts, or wall stickers or an electronic bulletin board, chat room or virtual forum) is used
- The goal is
  - to identify the problem
  - propose elements of the solution
  - negotiate different approaches, and
  - specify a preliminary set of solution requirements

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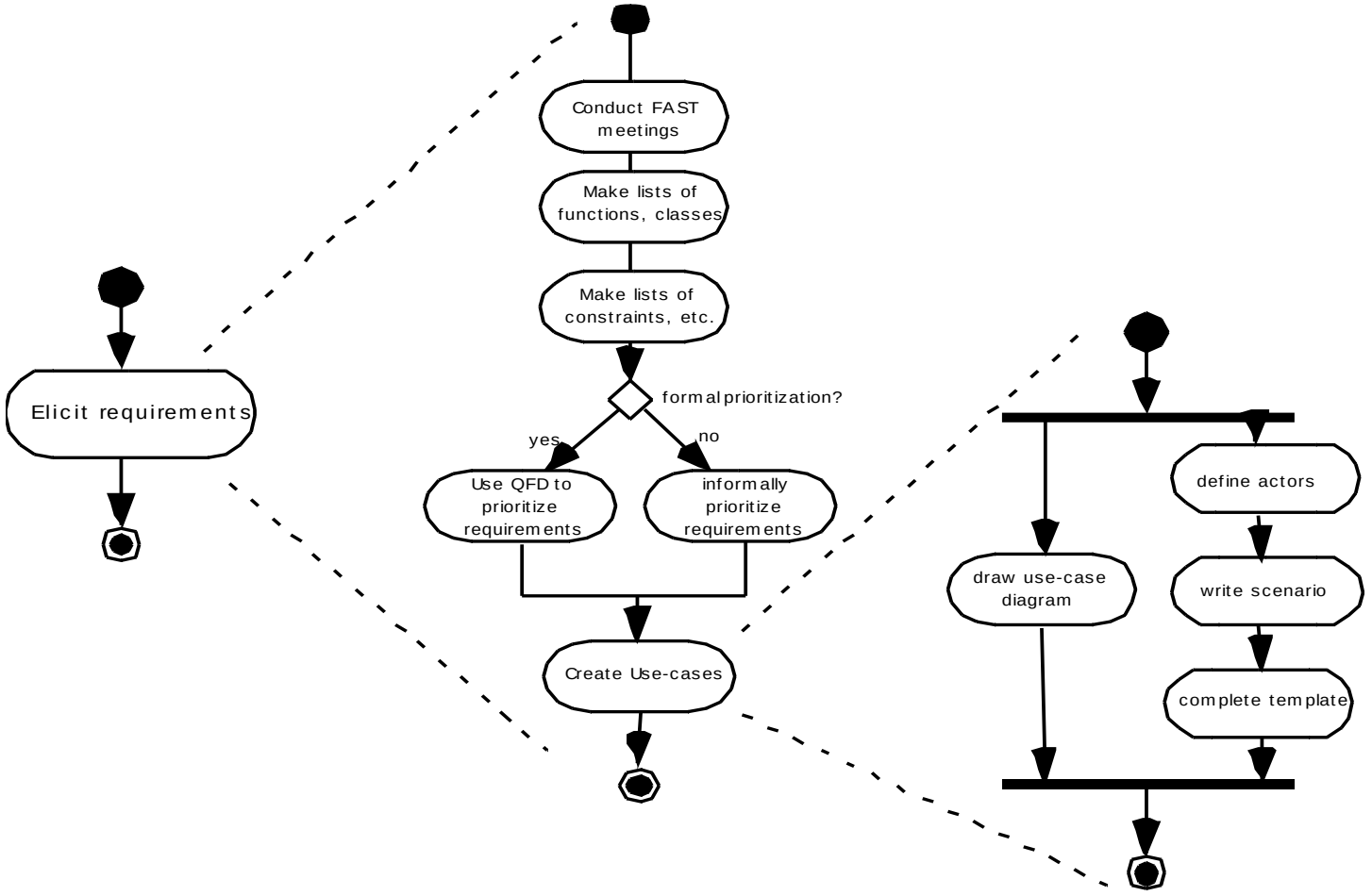
# Requirement Engineering

## Eliciting Requirements



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# Requirement Engineering

## Quality Function Deployment

- Function deployment determines the “value” (as perceived by the customer) of each function required of the system
- Information deployment identifies data objects and events
- Task deployment examines the behavior of the system
- Value analysis determines the relative priority of requirements

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# Requirement Engineering

## Elicitation Work Products

- a statement of need and feasibility.
- a bounded statement of scope for the system or product.
- a list of customers, users, and other stakeholders who participated in requirements elicitation
- a description of the system's technical environment.
- a list of requirements (preferably organized by function) and the domain constraints that apply to each.
- a set of usage scenarios that provide insight into the use of the system or product under different operating conditions.
- any prototypes developed to better define requirements.

# BUILDING THE ANALYSIS MODEL

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# Building the Analysis Model

## Elements of the analysis model :

- Scenario-based elements
  - Functional—processing narratives for software functions
  - Use-case—descriptions of the interaction between an “actor” and the system
- Class-based elements
  - Implied by scenarios
- Behavioral elements
  - State diagram
- Flow-oriented elements
  - Data flow diagram

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# Building the Analysis Model

## Use-Cases

- A collection of user scenarios that describe the thread of usage of a system
- Each scenario is described from the point-of-view of an “actor”—a person or device that interacts with the software in some way
- Each scenario answers the following questions:
  - Who is the primary actor, the secondary actor (s)?
  - What are the actor’s goals?
  - What preconditions should exist before the story begins?
  - What main tasks or functions are performed by the actor?
  - What extensions might be considered as the story is described?
  - What variations in the actor’s interaction are possible?
  - What system information will 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?

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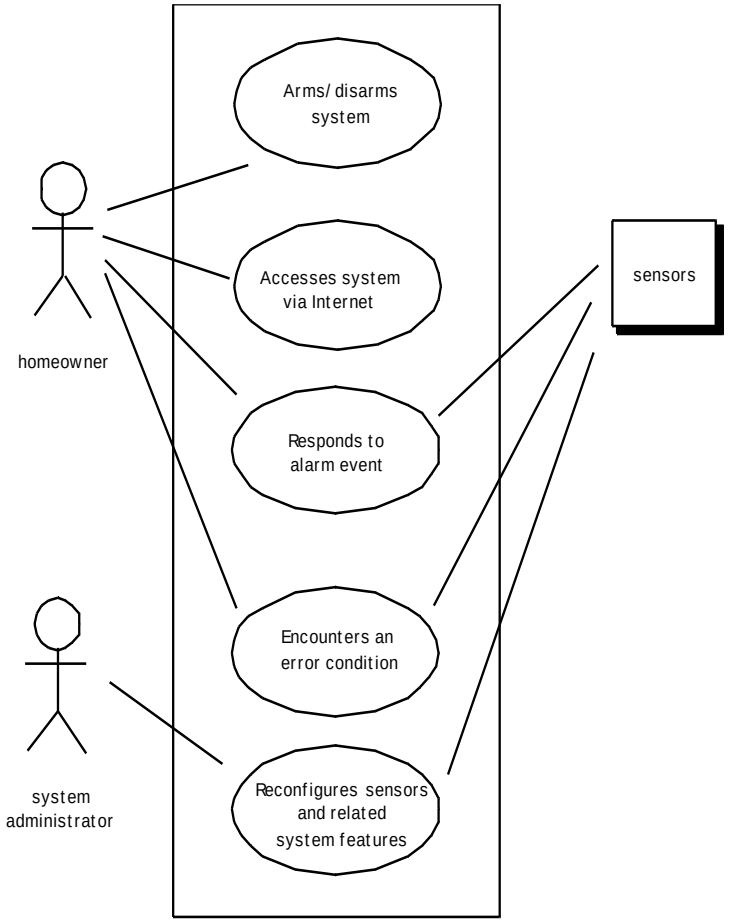
# Building the Analysis Model

## Use-Case Diagram



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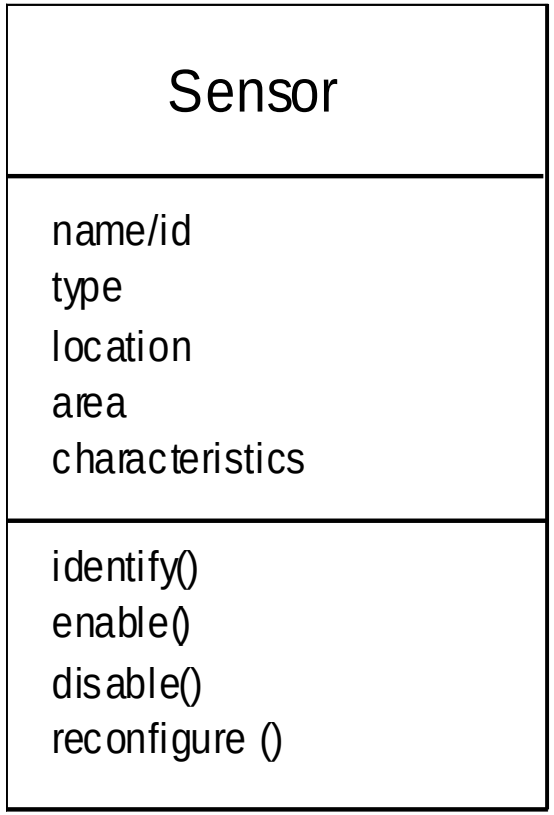
# Building the Analysis Model

## Class Diagram

**From the *SafeHome* system …**



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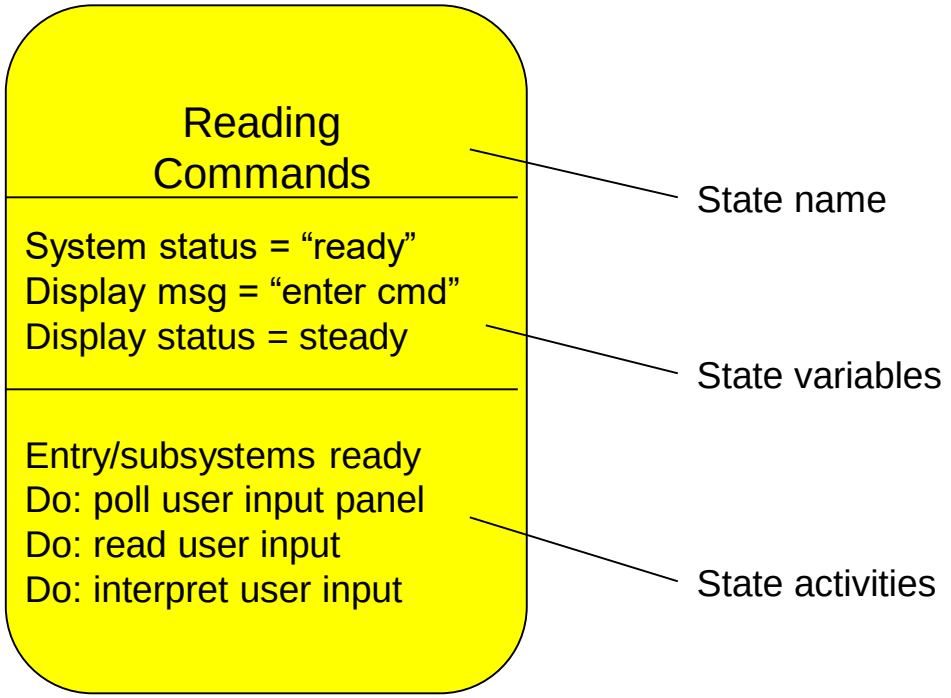
# Building the Analysis Model

## State Diagram



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# Analysis Patterns

**Pattern name:** A descriptor that captures the essence of the pattern.

**Intent:** Describes what the pattern accomplishes or represents

**Motivation:** A scenario that illustrates how the pattern can be used to address the problem.

**Forces and context:** A description of external issues (forces) that can affect how the pattern is used and also the external issues that will be resolved when the pattern is applied.

**Solution:** A description of how the pattern is applied to solve the problem with an emphasis on structural and behavioral issues.

**Consequences:** Addresses what happens when the pattern is applied and what trade-offs exist during its application.

**Design:** Discusses how the analysis pattern can be achieved through the use of known design patterns.

**Known uses:** Examples of uses within actual systems.

**Related patterns:** On e or more analysis patterns that are related to the named pattern because (1) it is commonly used with the named pattern; (2) it is structurally similar to the named pattern; (3) it is a variation of the named pattern.

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# Negotiating Requirements

- Identify the key stakeholders
  - These are the people who will be involved in the negotiation
- Determine each of the stakeholders "win conditions"
  - Win conditions are not always obvious
- Negotiate
  - Work toward a set of requirements that lead to "win-win"

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# Validating Requirements

- Is each requirement achievable in the technical environment that will house the system or product?
- Is each requirement testable, once implemented?
- Does the requirements model properly reflect the information, function and behavior of the system to be built.
- Has the requirements model been “partitioned” in a way that exposes progressively more detailed information about the system.
- Have requirements patterns been used to simplify the requirements model. Have all patterns been properly validated? Are all patterns consistent with customer requirements?

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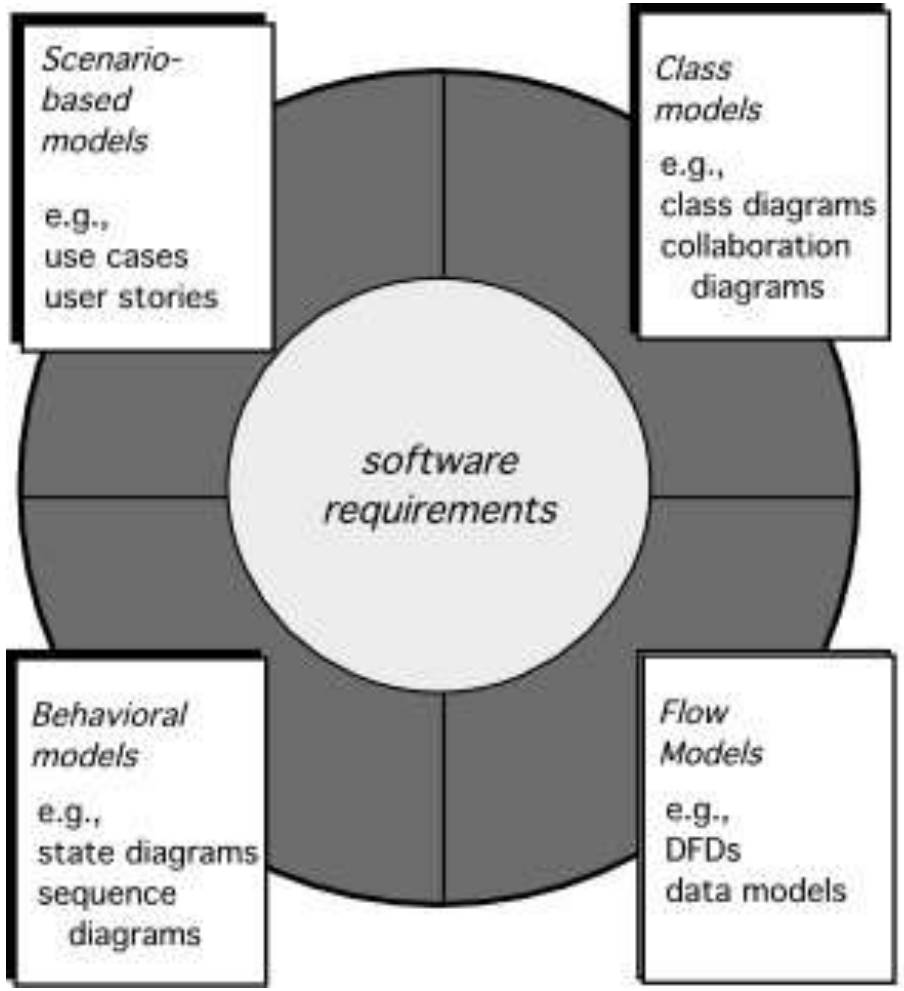
# Requirement Analysis



# REQUIREMENT MODELING

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# Scenario-Based Modeling

**"[Use-cases] are simply an aid to defining what exists outside the system (actors) and what should be performed by the system (use-cases)."**
**Ivar Jacobson**

**(1) What should we write about?**

**(2) How much should we write about it?**

**(3) How detailed should we make our description?**

**(4) How should we organize the description?**

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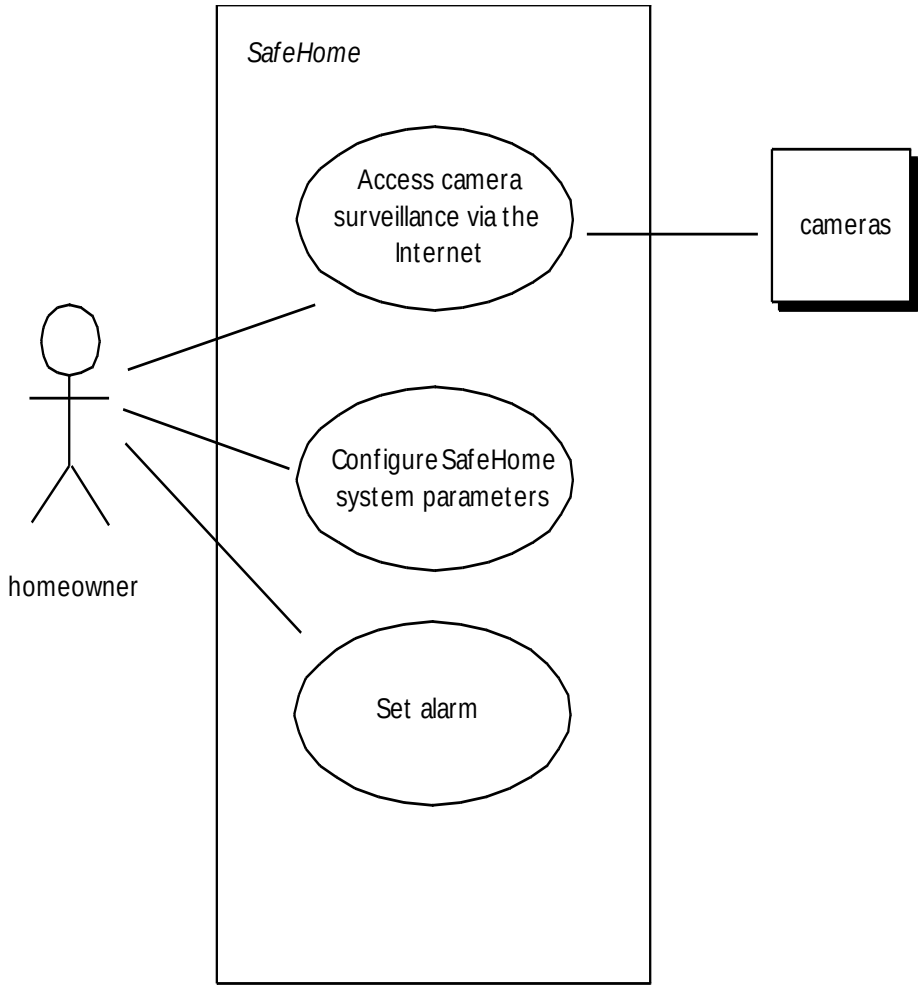
# Scenario-Based Modeling

## Use-Cases

- a scenario that describes a “thread of usage” for a system
- *actors* represent roles people or devices play as the system functions
- *users* can play a number of different roles for a given scenario



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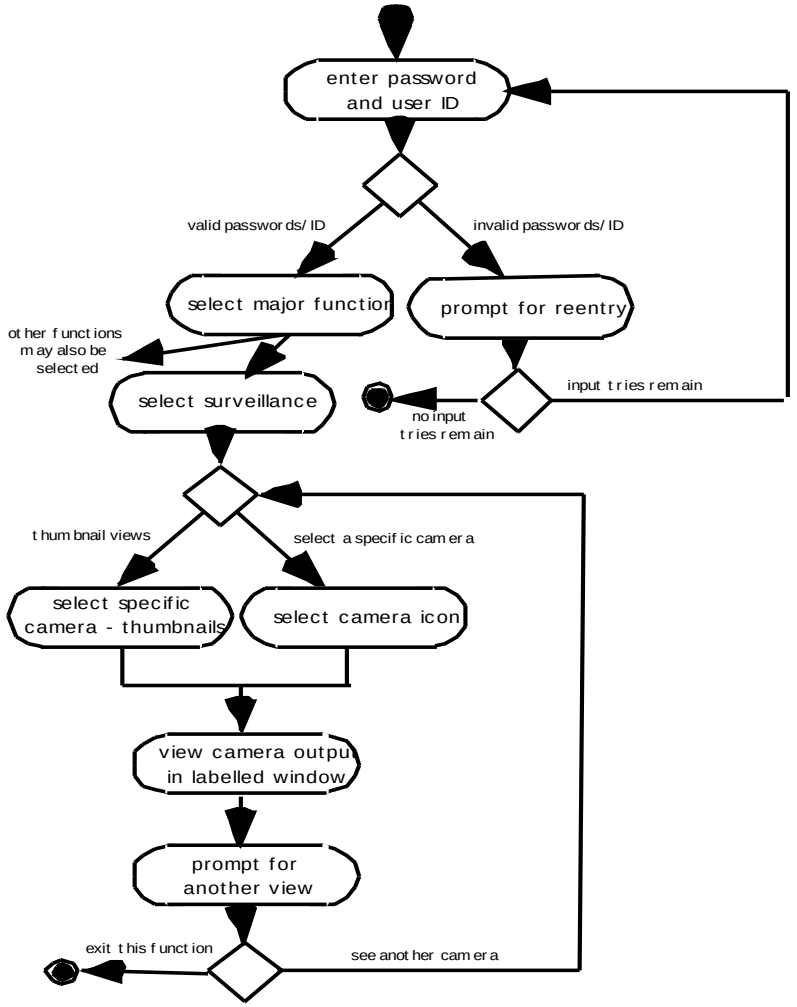
# Scenario-Based Modeling

## Activity Diagram

***Supplements the use case by providing a graphical representation of the flow of interaction within a specific scenario***



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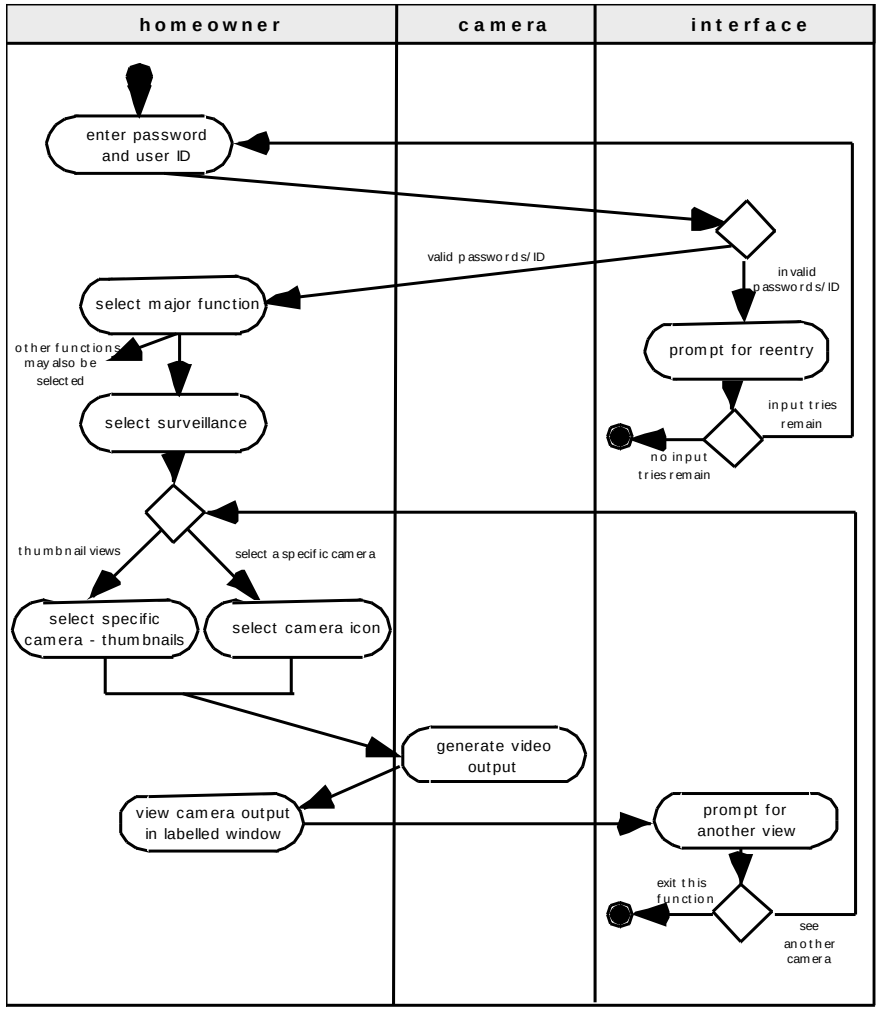
# Scenario-Based Modeling

## Swimlane Diagrams

***Allows the modeler to represent the flow of activities described by the use-case and at the same time indicate which actor (if there are multiple actors involved in a specific use-case) or analysis class has responsibility for the action described by an activity rectangle***



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# Class-Based Modeling

- Class-based modeling represents:
  - objects that the system will manipulate
  - operations (also called methods or services) that will be applied to the objects to effect the manipulation
  - relationships (some hierarchical) between the objects
  - collaborations that occur between the classes that are defined.
- The elements of a class-based model include classes and objects, attributes, operations, CRC models, collaboration diagrams and packages.

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# Class-Based Modeling

## Identifying Analysis Classes

- **Examining the usage scenarios developed as part of the requirements model and perform a "grammatical parse" [Abb83]**
  - **Classes are determined by underlining each noun or noun phrase and entering it into a simple table.**
  - **Synonyms should be noted.**
  - **If the class (noun) is required to implement a solution, then it is part of the solution space; otherwise, if a class is necessary only to describe a solution, it is part of the problem space.**

- ***But what should we look for once all of the nouns have been isolated?***

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# Class-Based Modeling

## Manifestations of Analysis Classes

***Analysis classes*** **manifest themselves in one of the following ways:**

- ***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., a property transfer or the completion of a series of robot movements) 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 or loading dock) that establish the context of the problem and the overall function**
- ***Structures: (*****e.g., sensors, four-wheeled vehicles, or computers) that define a class of objects or related classes of objects**

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# Class-Based Modeling

## Defining Attributes

- *Attributes* describe a class that has been selected for inclusion in the analysis model.
  - build two different classes for professional baseball players
    - **For Playing Statistics software:** name, position, batting average, fielding percentage, years played, and games played might be relevant
    - **For Pension Fund software:** average salary, credit toward full vesting, pension plan options chosen, mailing address, and the like.

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# Class-Based Modeling

## Defining Operations

- Do a grammatical parse of a processing narrative and look at the verbs
- Operations can be divided into four broad categories:
  - (1) operations that manipulate data in some way (e.g., adding, deleting, reformatting, selecting)
  - (2) operations that perform a computation
  - (3) operations that inquire about the state of an object, and
  - (4) operations that monitor an object for the occurrence of a controlling event.

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# Class-Based Modeling

## CRC Models

- *Class-responsibility-collaborator (CRC) modeling* [Wir90] provides a simple means for identifying and organizing the classes that are relevant to system or product requirements. Ambler [Amb95] describes CRC modeling in the following way:
  - A CRC model is really a collection of standard index cards that represent classes. The cards are divided into three sections. Along the top of the card you write the name of the class. In the body of the card you list the class responsibilities on the left and the collaborators on the right.

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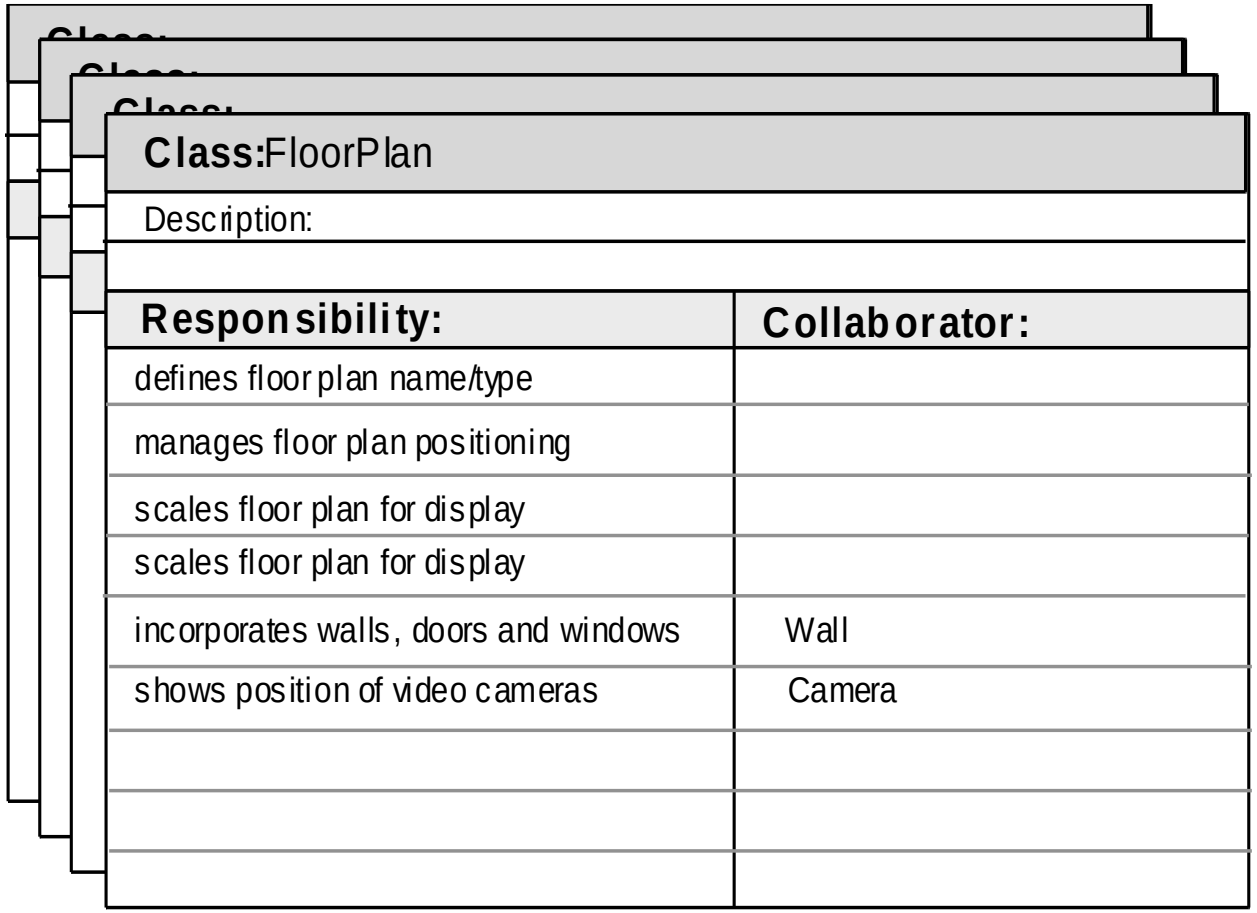
# Class-Based Modeling

## CRC Modeling



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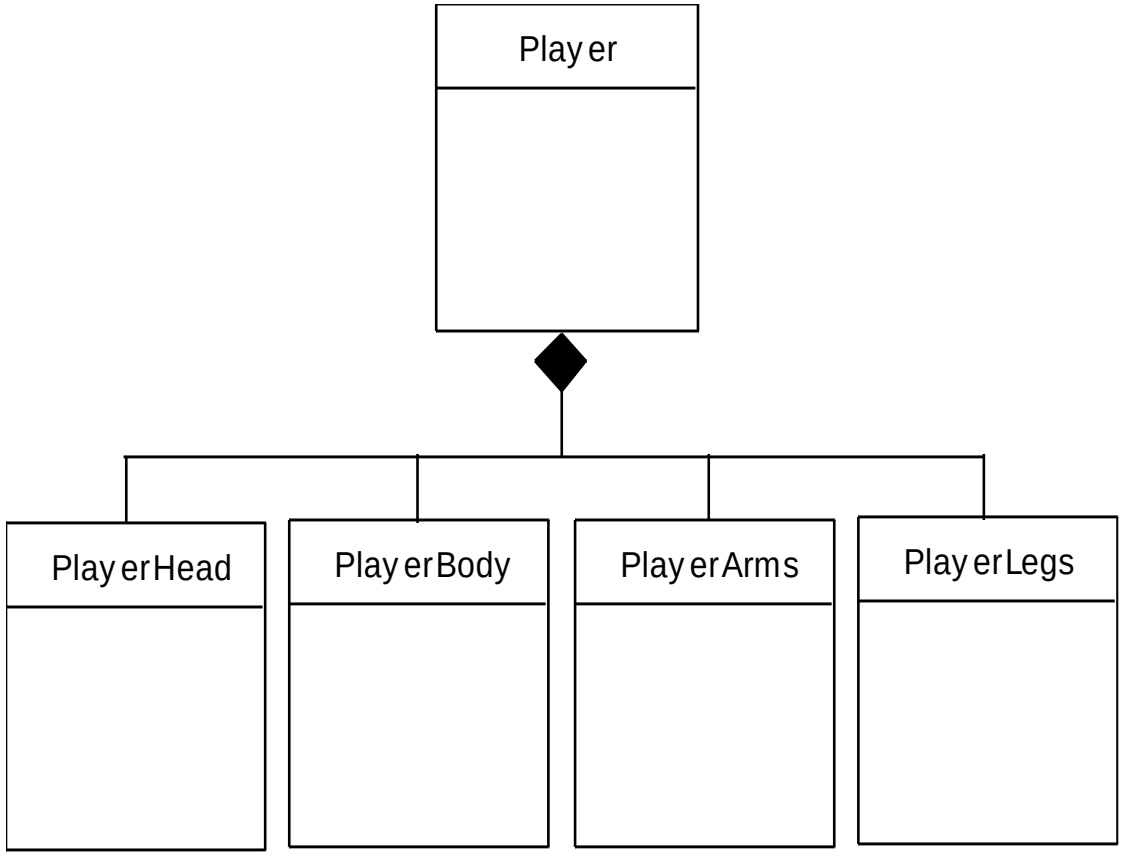
# Class-Based Modeling

## Composite Aggregate Class



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# Class-Based Modeling

## Associations and Dependencies

- Two analysis classes are often related to one another in some fashion
  - In UML these relationships are called *associations*
  - Associations can be refined by indicating *multiplicity* (the term *cardinality* is used in data modeling
- In many instances, a client-server relationship exists between two analysis classes.
  - In such cases, a client-class depends on the server-class in some way and a *dependency relationship* is established

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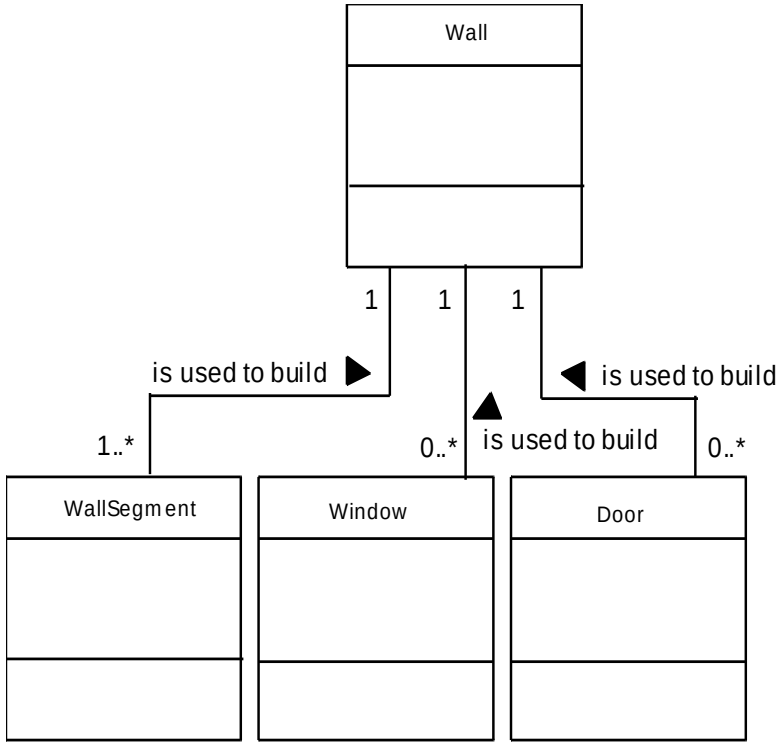
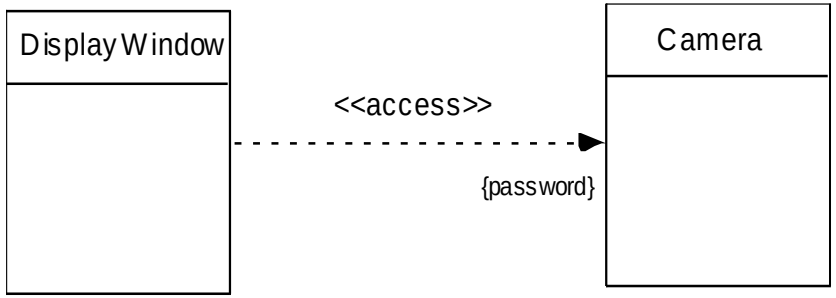
# Class-Based Modeling

## Multiplicity




## Dependencies



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# Class-Based Modeling

## Analysis Packages

- Various elements of the analysis model (e.g., use-cases, analysis classes) are categorized in a manner that packages them as a grouping
- The plus sign preceding the analysis class name in each package indicates that the classes have public visibility and are therefore accessible from other packages.
- Other symbols can precede an element within a package. A minus sign indicates that an element is hidden from all other packages and a # symbol indicates that an element is accessible only to packages contained within a given package.

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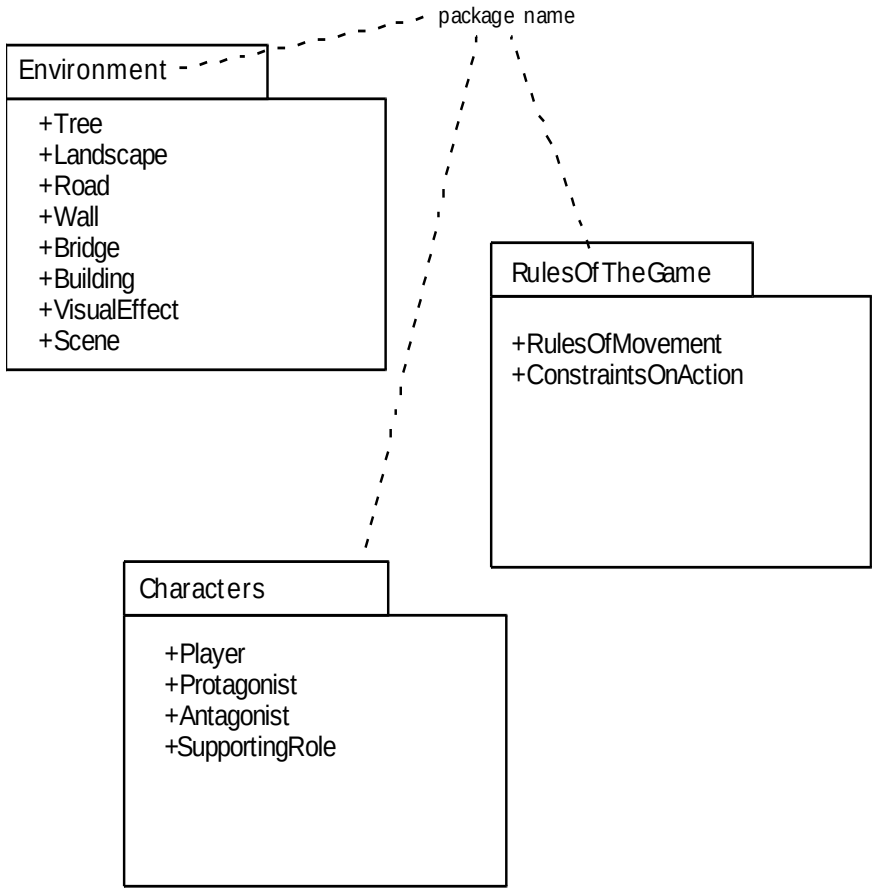
# Class-Based Modeling

## Analysis Packages



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# Creating A Behavioral Modeling

- The behavioral model indicates how software will respond to external events or stimuli. To create the model, the analyst must perform the following steps:
  - 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.

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# Creating A Behavioral Modeling

## State Representations

- 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 [CHA93].
  - 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.

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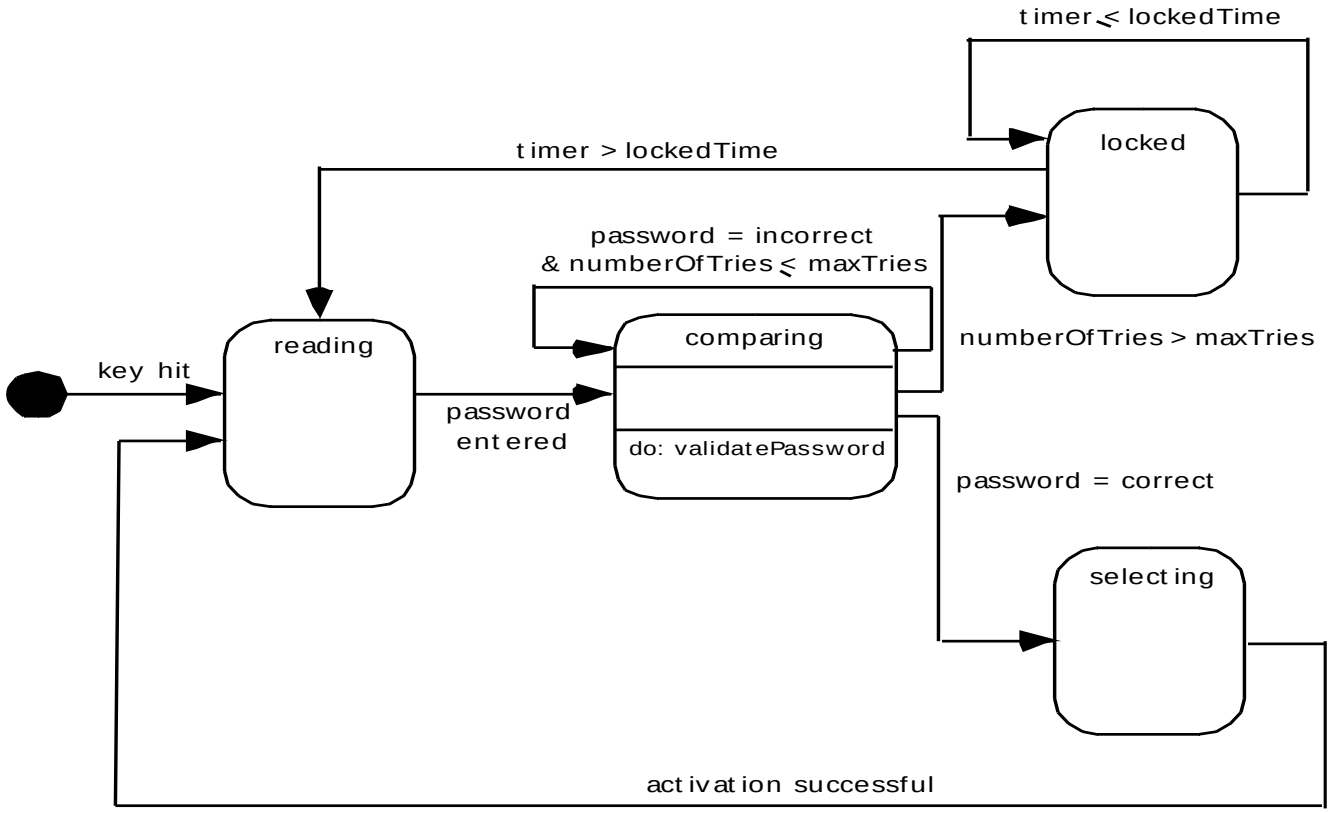
# Creating A Behavioral Modeling

## State Diagram for the ControlPanel Class



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# Creating A Behavioral Modeling

## 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

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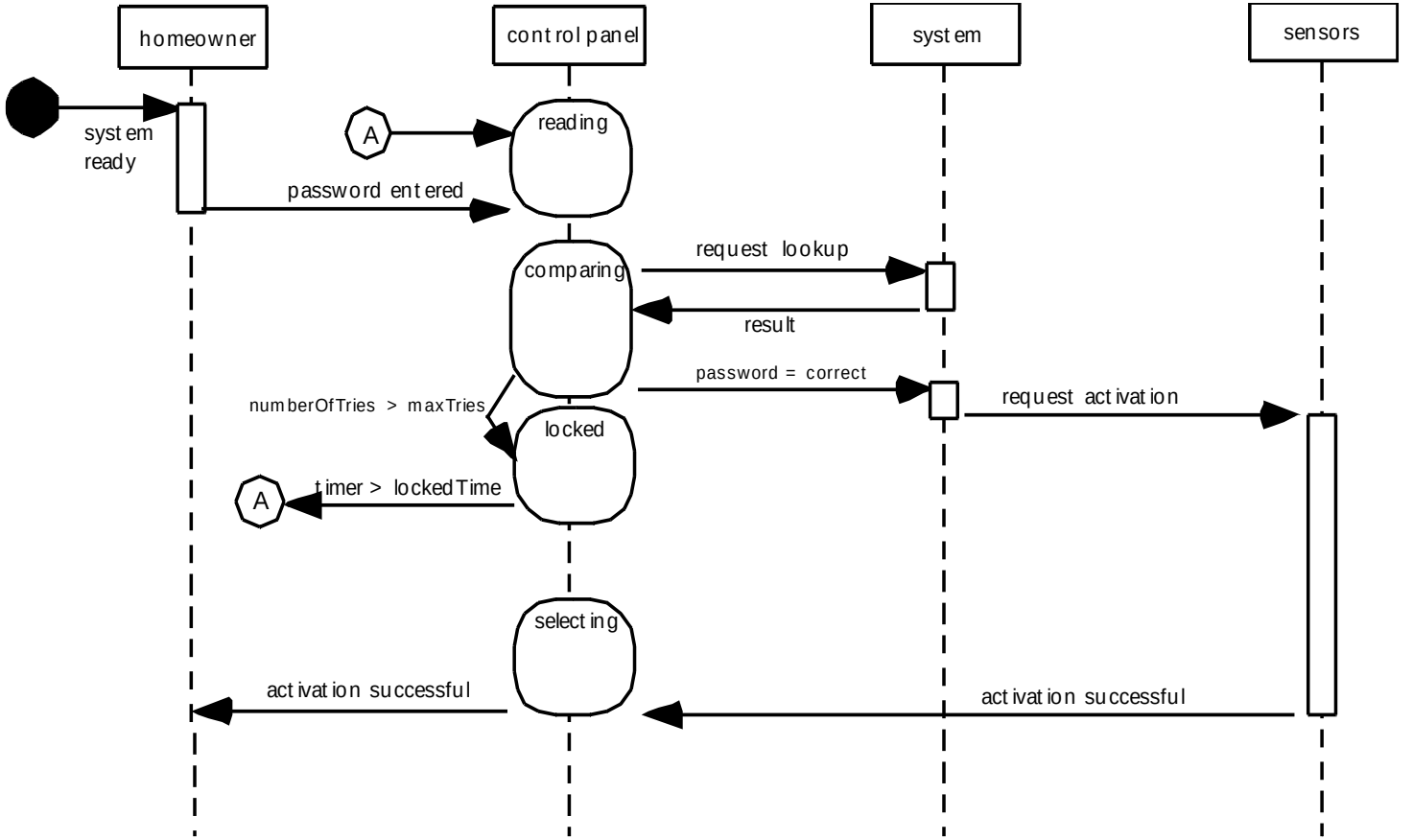
# Creating A Behavioral Modeling

## Sequence Diagram



# REQUIREMENT MODELING FOR WEB AND MOBILE APPS

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# Requirements Modeling for Web and Mobile Apps

## When Do We Perform Analysis?

- In some WebE situations, analysis and design merge. However, **an explicit analysis activity occurs when …**
  - the WebApp to be built is large and/or complex
  - the number of stakeholders is large
  - the number of Web engineers and other contributors is large
  - the goals and objectives (determined during formulation) for the WebApp will effect the business' bottom line
  - the success of the WebApp will have a strong bearing on the success of the business

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# Requirements Modeling for Web and Mobile Apps

## The Content Model

- Content objects are extracted from use-cases
  - examine the scenario description for direct and indirect references to content
- Attributes of each content object are identified
- The relationships among content objects and/or the hierarchy of content maintained by a WebApp
  - Relationships—entity-relationship diagram or UML
  - Hierarchy—data tree or UML

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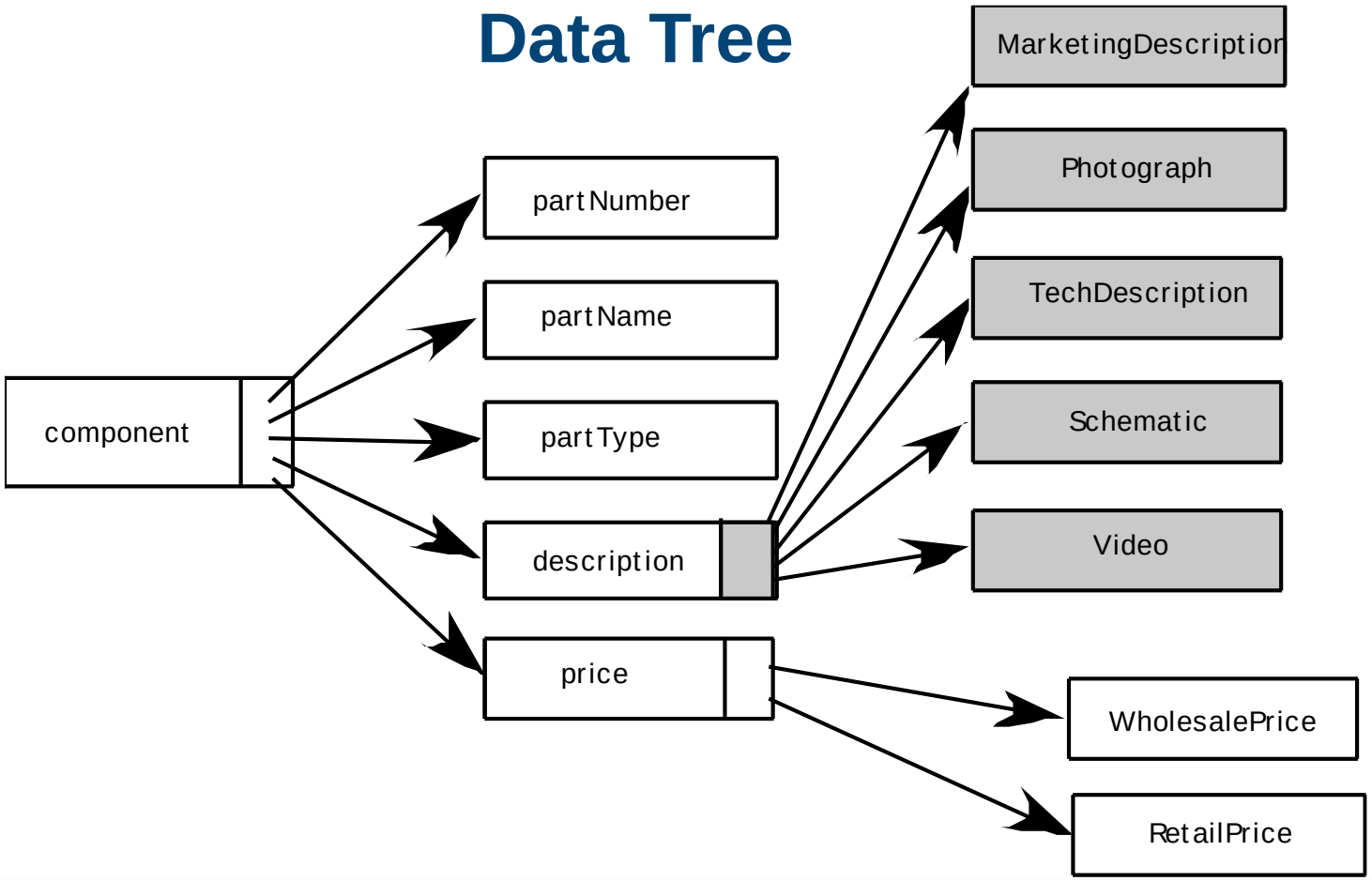
# Requirements Modeling for Web and Mobile Apps

## Data Tree



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# Requirements Modeling for Web and Mobile Apps

## The Interaction Model

- Composed of four elements:
  - use-cases
  - sequence diagrams
  - state diagrams
  - a user interface prototype

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# Requirements Modeling for Web and Mobile Apps

## The Functional Model

- The functional model addresses two processing elements of the WebApp
  - user observable functionality that is delivered by the WebApp to end-users
  - the operations contained within analysis classes that implement behaviors associated with the class.
- An activity diagram can be used to represent processing flow

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# Requirements Modeling for Web and Mobile Apps

## The Configuration Model

- Server-side
  - Server hardware and operating system environment must be specified
  - Interoperability considerations on the server-side must be considered
  - Appropriate interfaces, communication protocols and related collaborative information must be specified
- Client-side
  - Browser configuration issues must be identified
  - Testing requirements should be defined

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# References


- Pressman, R.S. (2015). ***Software Engineering : A Practioner's Approach. 8th ed***. McGraw-Hill Companies.Inc, Americas, New York. ISBN : 978 1 259 253157
- UML Specification, https://www.omg.org/spec/UML/About-UML/
- UML 2.0 Tutorial, **http://www.youtube.com/watch?v=OkC7HKtiZC0**
- Introduction to Model-View-View-Model (MVVM) Pattern, http://www.youtube.com/watch?v=pY60lLotZCg

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# Q & A

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# Thank You