MACIASZEK, L.A. (2001): *Requirements Analysis and System Design. Developing Information Systems with UML*, Addison Wesley

Chapter 2 - Tutorial
Guided Tutorial in Analysis Modeling
OnLine Shopping

Version 1.0

Topics

- *Online Shopping – Tutorial Statement*
- *Use Case Modeling*
- *Activity Modeling*
- *Class Modeling*
- *Interaction Modeling*
- *Statechart Modeling*

OnLine Shopping – Order Processing

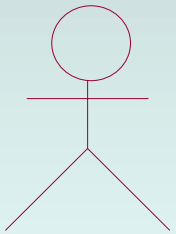
- *Buying computers via Internet*
- *The customer can select a standard configuration or can build a desired configuration online*
- *To place an order, the customer must fill out the shipment and payment information*
- *The customer can check online at any time the order status*
- *The ordered configuration is shipped to the customer together with the invoice*

Use case modeling

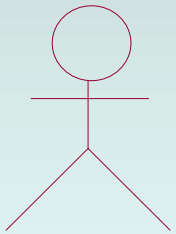
- ***Use case -*** *outwardly visible and testable system behavior*
- ***Actor*** *- whoever or whatever (person, machine, etc.) that interacts with a use case*
- *Actor receives a* ***useful result***
- *Use case represents a complete unit of functionality of value to an actor*
- *There may be some use cases that do not directly interact with actors*
- *In many instances, a function requirement maps directly to a use case*
- ***Use Case Diagram*** *is a visual representation of actors and use cases together with any additional definitions and specifications*
- ***UML diagram*** *is synonymous with* ***UML model***

Actors

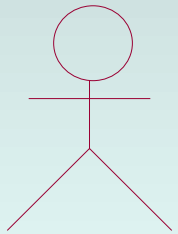
- *Consider the requirement:*
  *After **customer**'s order has been entered into the system, the **salesperson** sends an electronic request to the **warehouse** with details of the ordered configuration*



Customer



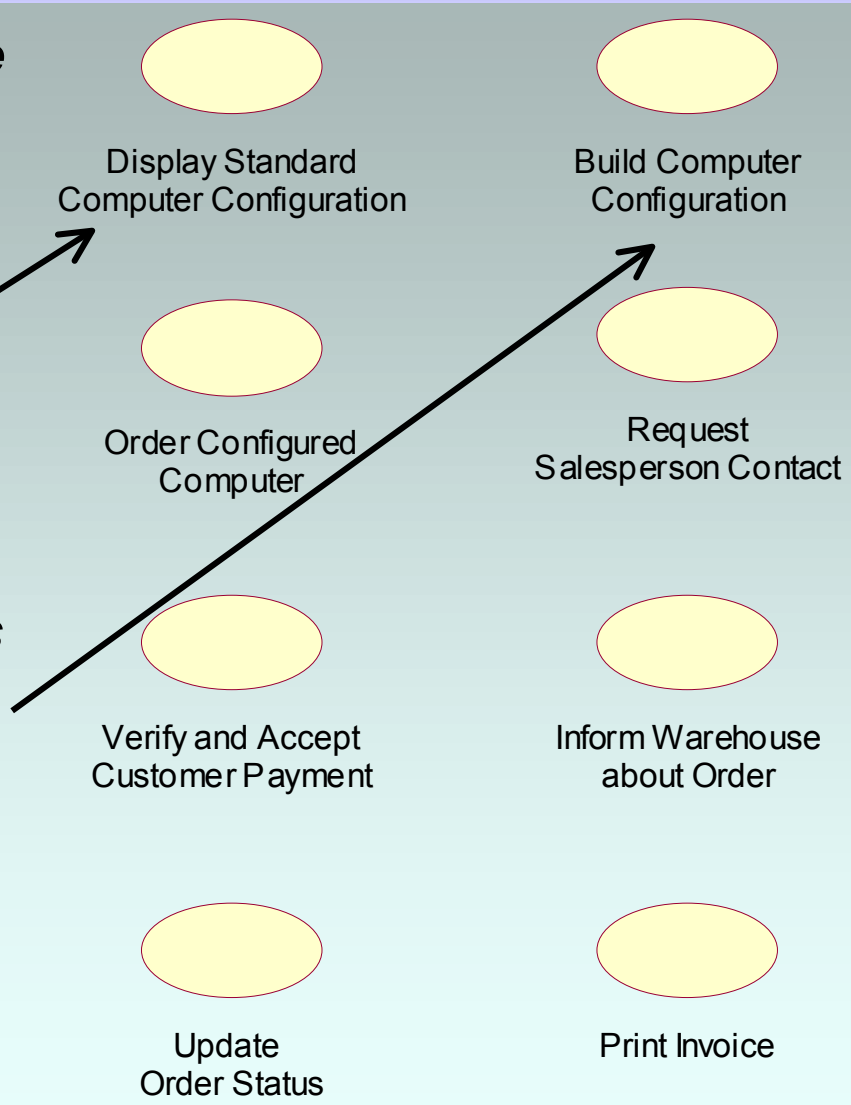
Salesperson



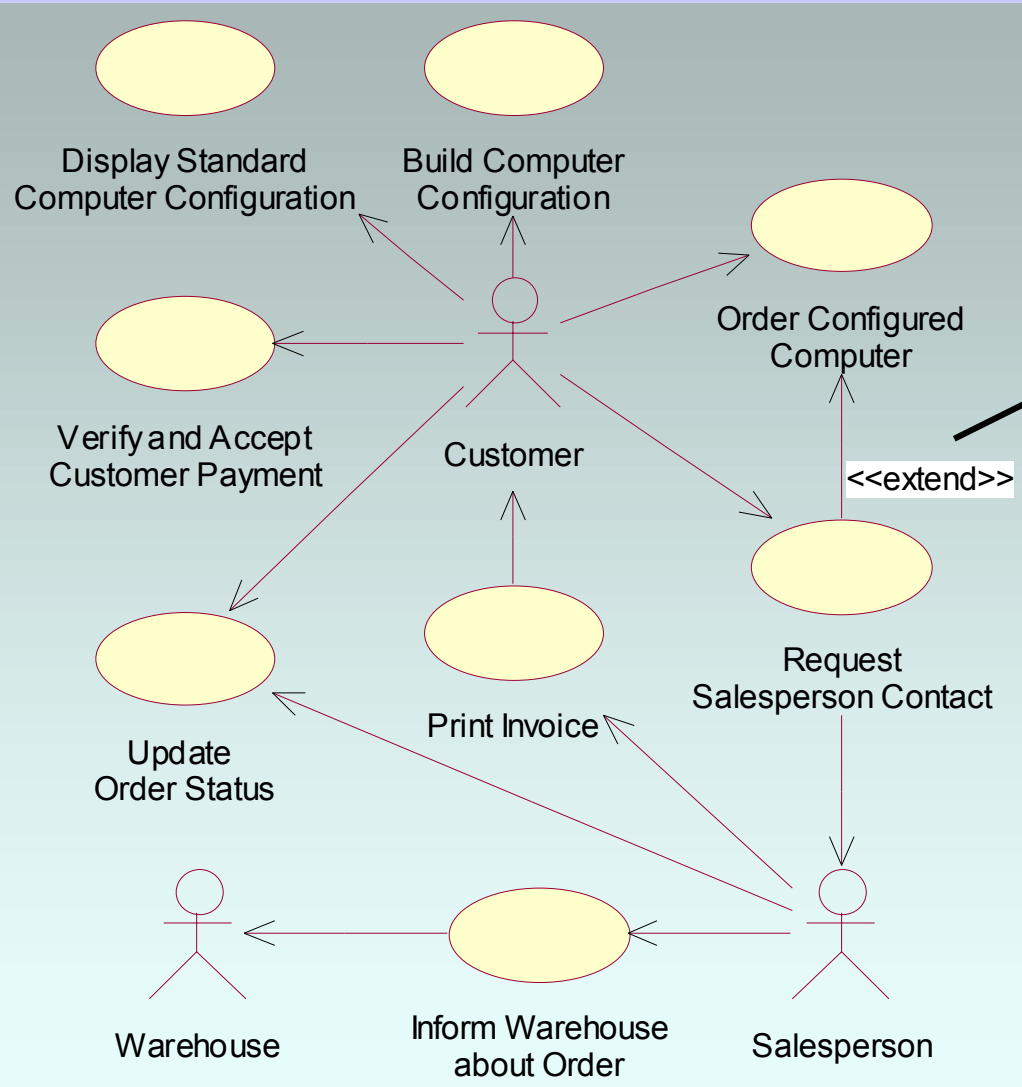
Warehouse

Use cases

- *The customer uses the manufacturer's online shopping Web page to view the standard configuration of the chosen server, desktop or portable computer*
- *The customer chooses to view the details of the configuration, perhaps with the intention to buy it as is or to build a more suitable configuration*



Use Case Diagram



The <<extend>> relationship - the use case `Order Configured Computer` can be extended by `Customer` with the use case `Request Salesperson Contact`

Documenting use cases

- ***Brief Description***
- ***Actors*** *involved*
- ***Preconditions*** *necessary for the use case to start*
- ***Detailed Description*** *of flow of events that includes:*
  - ***Main Flow*** *of events, that can be broken down to show:*
    - ***Subflows*** *of events (subflows can be further divided into smaller subflows to improve document readability)*
  - ***Alternative Flows*** *to define exceptional situations*
- ***Postconditions*** *that define the state of the system after the use case ends*

Narrative use case specification

Use Case	**Order Configured Computer**
Brief Description	*This use case allows a* `Customer` *to enter a purchase order. …*
Actors	`Customer`
Preconditions	*The page displays the details of a configured computer together with its price. …*
Main Flow	*The system assigns a unique order number and a customer account number to the purchase order and it stores the order information in the database. …*
Alternative Flows	*The* `Customer` *activates the* `Purchase` *function before providing all mandatory information. …*
Postconditions	*If the use case was successful, the purchase order is recorded in the system's database.*

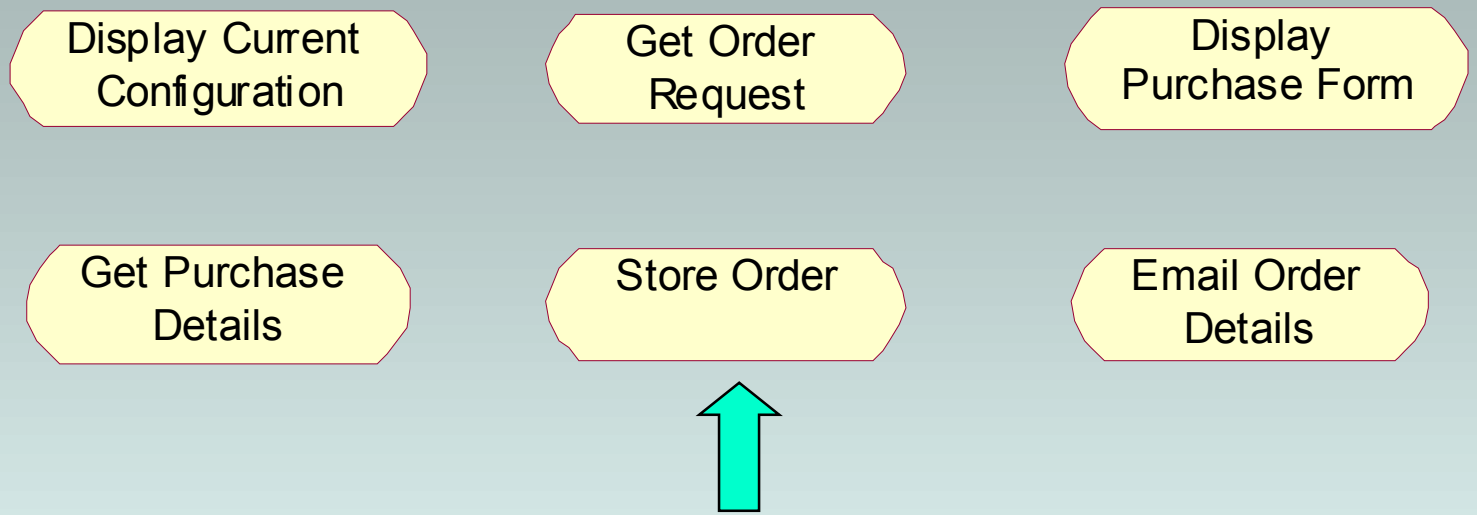
Activity Modeling

- ***Activity model***
  - *Can graphically represent the flow of events of a use case*
  - *Can be used to understand a business process at a high-level of abstraction before any use cases are produced*
- *Shows the steps of a computation*
  - *Each step is a **state** of doing something*
  - *Execution steps are called **activity states***
  - *Depicts which steps are executed in sequence and which can be executed concurrently*
  - ***Transition** – the flow of control from one activity state to the next*
- ***Use case descriptions** are (usually) written from an outside actor's perspective*
- ***Activity models** take an inside system's viewpoint*

Activities

- ***Activity states*** *can be established from the use case document*
- ***Activities*** *should be named from the system's perspective, not the actor's viewpoint*
- ***Activity*** *takes time to complete*
- ***Action*** *is so quick that – on our time scale – it is considered to take no time at all*
- *UML uses the same same graphical symbol for* ***activity state*** *and* ***action state*** *– rounded rectangle*

Activities

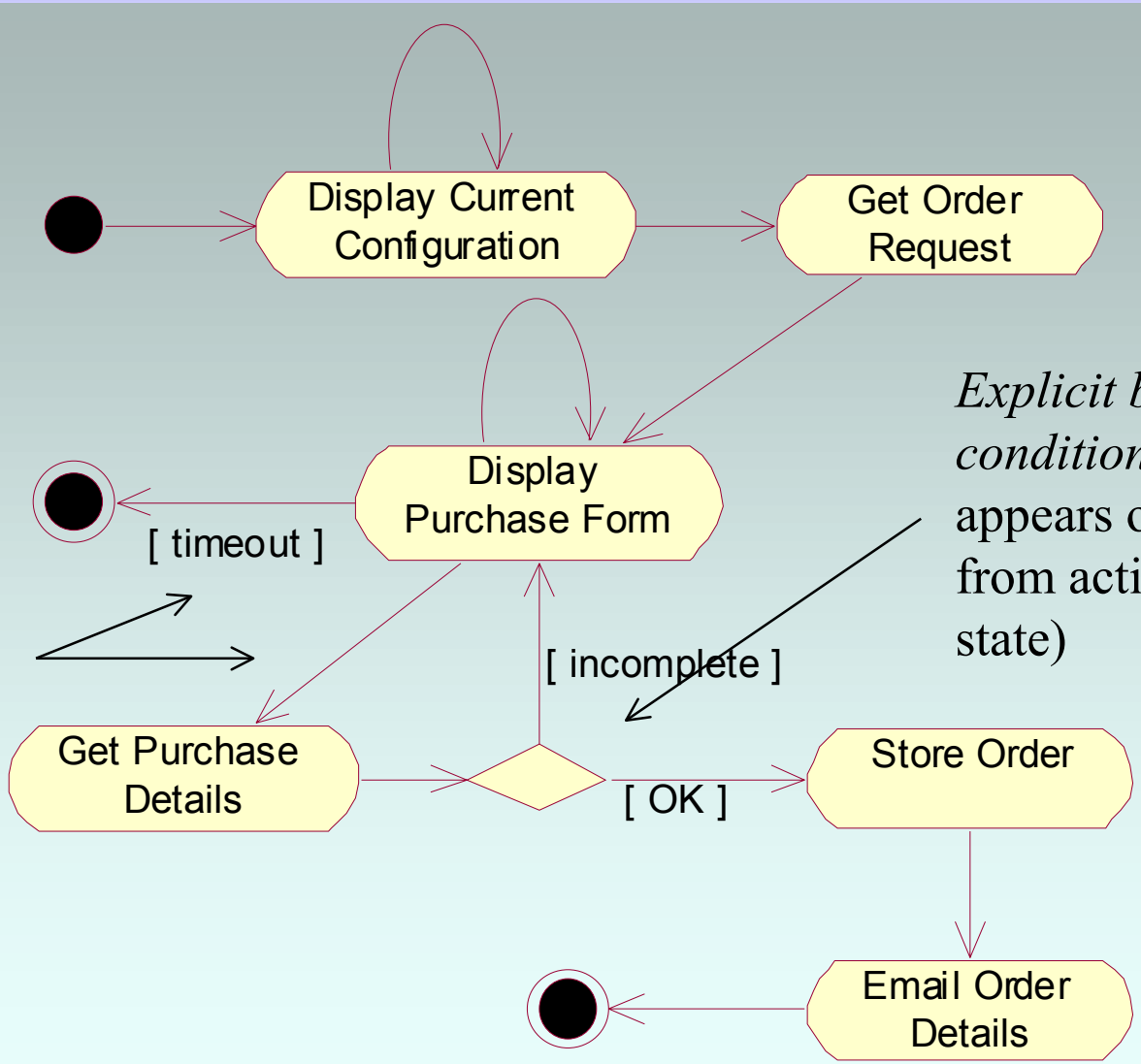


- *The system assigns a unique order number and a customer account number to the purchase order and it stores the order information in the database.*

Activity Diagram

- ***Activity Diagram*** *shows transitions between activities*
- *A solid filled circle represents the* ***initial state***
- *The* ***final state*** *is shown using so called bull's eye symbol*
- *Transitions can* ***branch*** *and* ***merge*** *(diamond) –* ***alternative*** *computation* ***threads***
- *Transitions can* ***fork*** *and re-****join*** *(bar line) –* ***concurrent*** *(parallel) computation* ***threads***
- *Activity diagram without concurrent processes resembles a conventional* ***flowchart***

Activity Diagram



Multiple exit transitions (branch condition that is internal to activity state)

Explicit branch condition (that appears on exit from activity state)

Class Modeling

- *Captures **system state** – the function of the system's information content at a point in time*
- *Class modeling elements*
  - *classes themselves*
  - *attributes and operations of classes*
  - *Relationships – associations, aggregation and composition, generalization*
- ***Class Diagram** – combined visual representation for class modeling elements*
- *Class modeling and use case modeling are typically conducted in parallel*

Classes

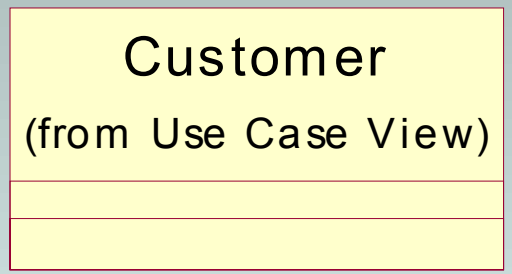
- *So far, we have used classes to define "business objects"*
  - *Called **entity classes** (model classes)*
  - *Represent persistent database objects*
- *Other classes*
  - *Classes that define GUI objects (such as screen forms) – **boundary classes** (view classes)*
  - *classes that control the program's logic – **control classes***
- *Boundary and control classes may or may not be addressed in requirements analysis – may be delayed until the system design phase*

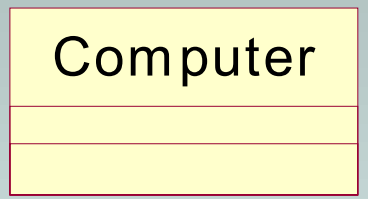
Classes

- *Is this a class?*
  - *Is the concept a container for data?*
  - *Does it have separate attributes that will take on different values?*
  - *Would it have many instance objects?*
  - *Is it in the scope of the application domain?*

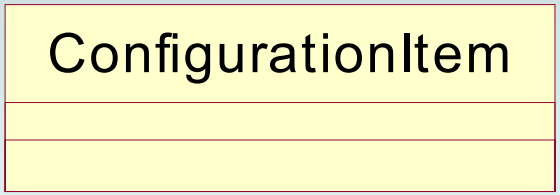
Classes

- *The warehouse obtains the **invoice** from the salesperson and ships the **computer** to the **customer***

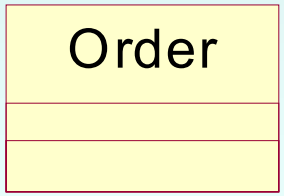


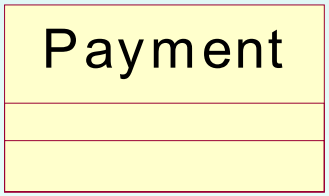


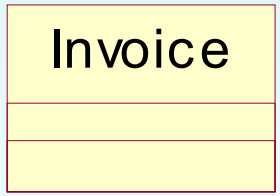
Do we need `Shipment` class? Is it in the scope?



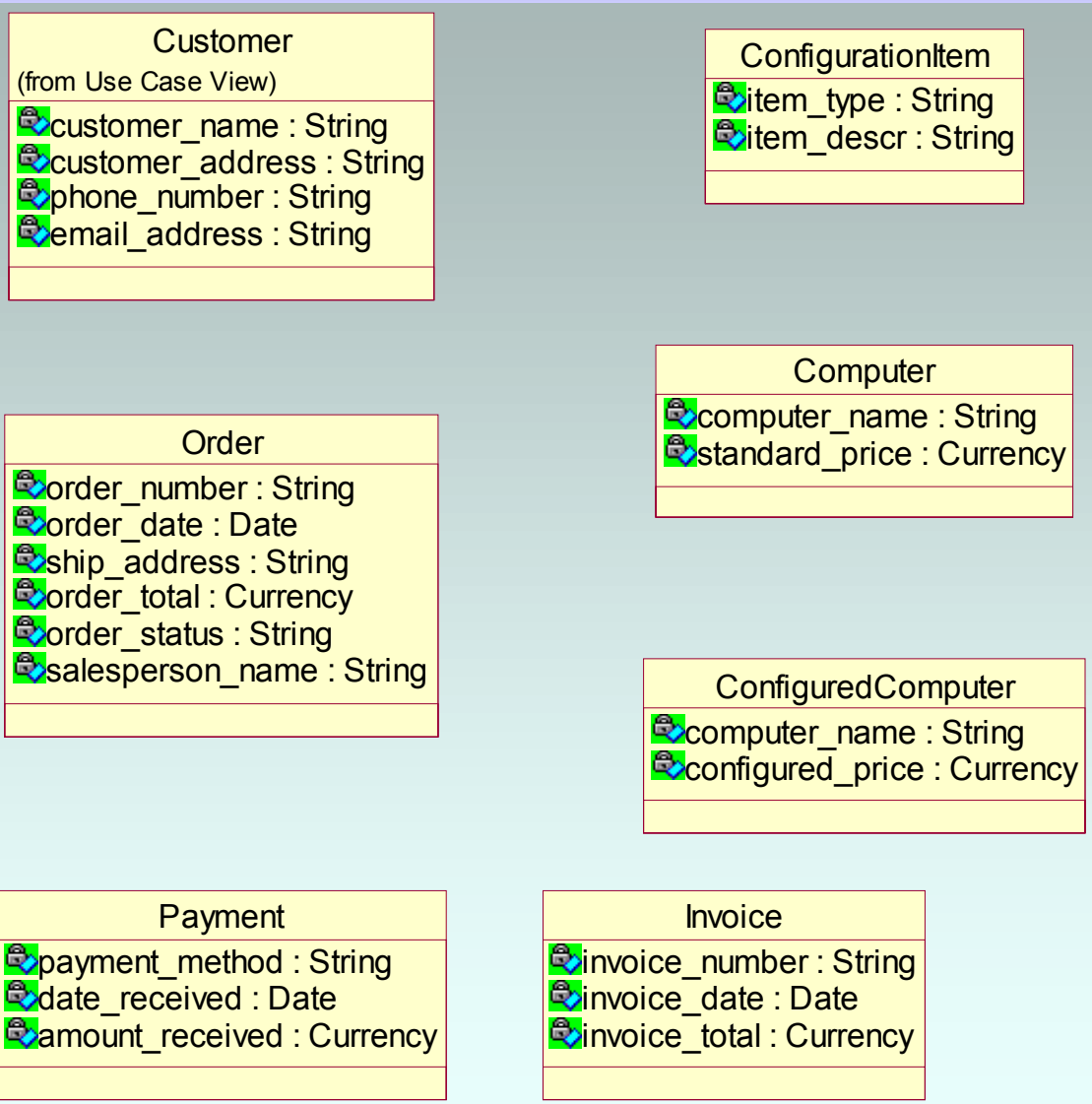
Is `Salesperson` a class or an attribute of `Order` and `Invoice`?



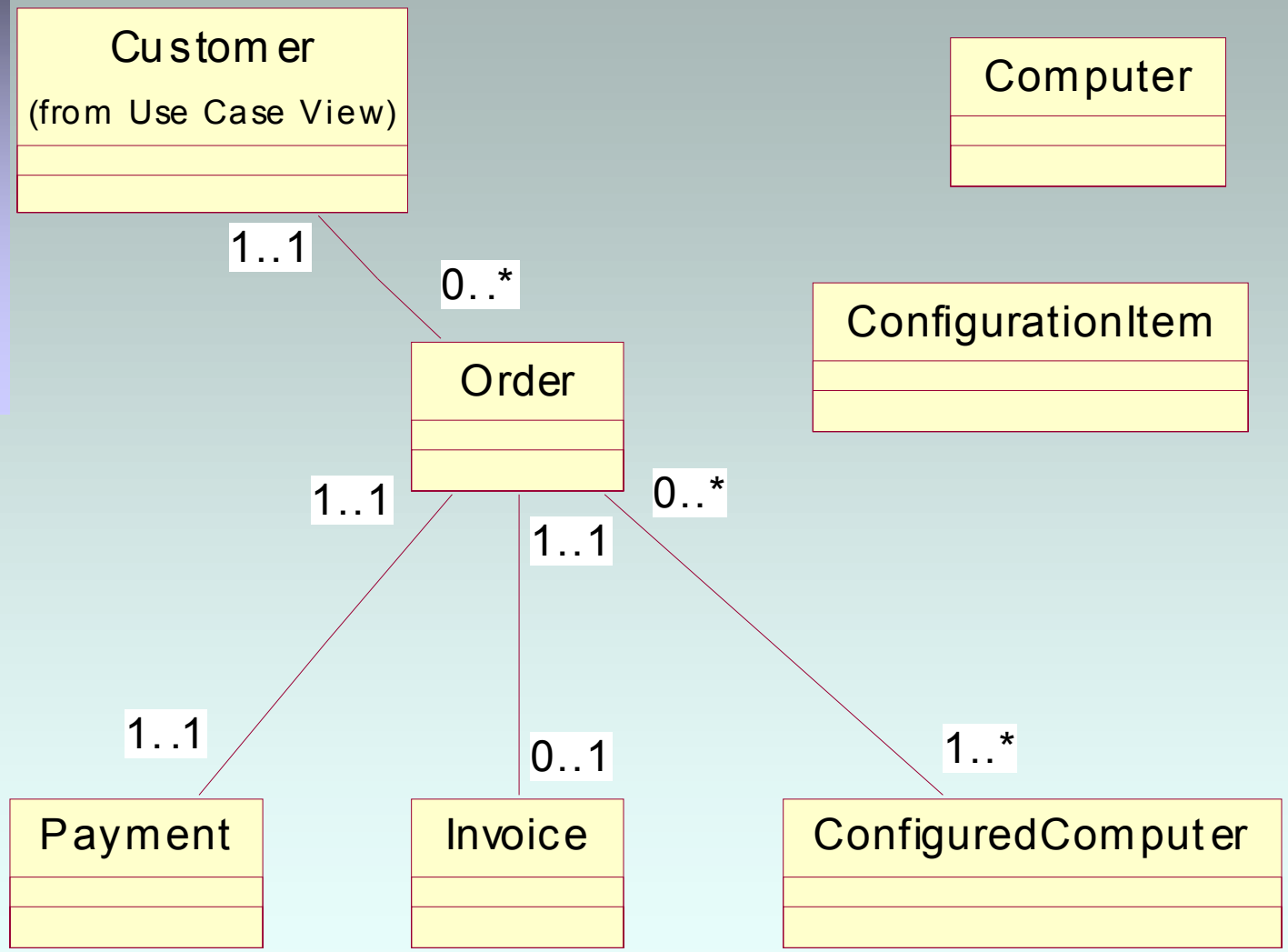




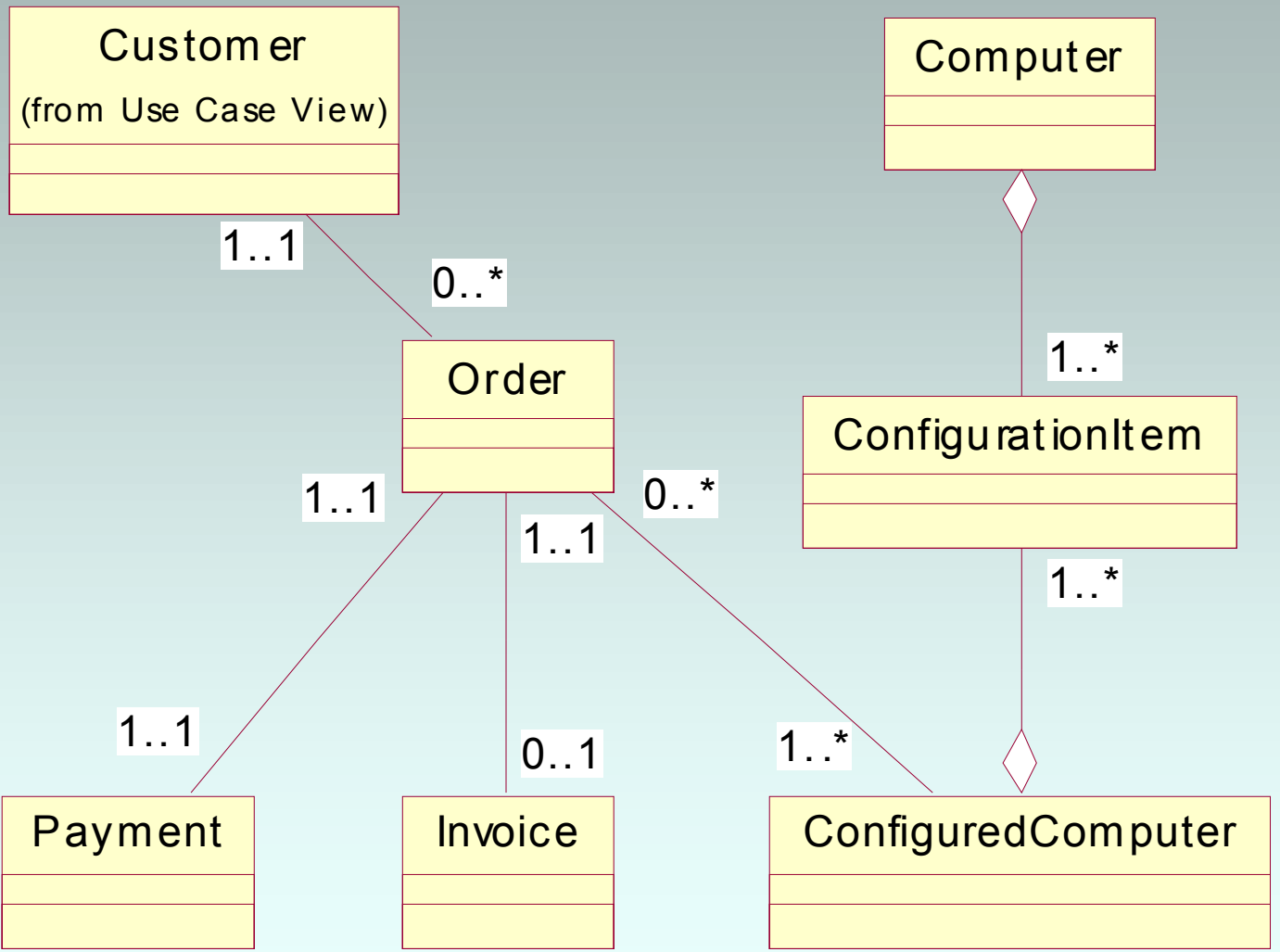
Attributes


Customer
(from Use Case View)
customer_name : String
customer_address : String
phone_number : String
email_address : String
ConfigurationItem
item_type : String
item_descr : String
Computer
computer_name : String
standard_price : Currency
Order
order_number : String
order_date : Date
ship_address : String
order_total : Currency
order_status : String
salesperson_name : String
ConfiguredComputer
computer_name : String
configured_price : Currency
Payment
payment_method : String
date_received : Date
amount_received : Currency
Invoice
invoice_number : String
invoice_date : Date
invoice_total : Currency

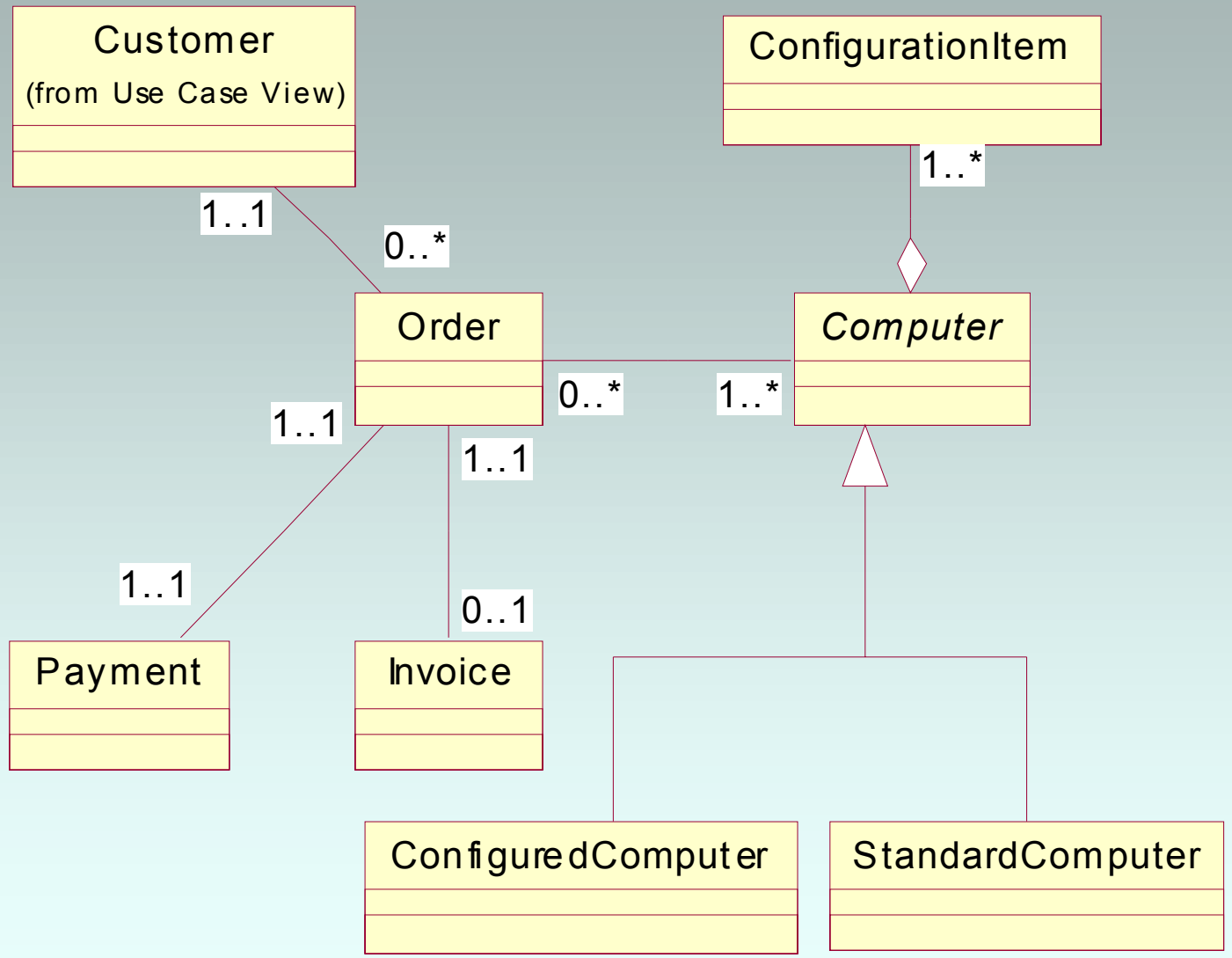
Associations



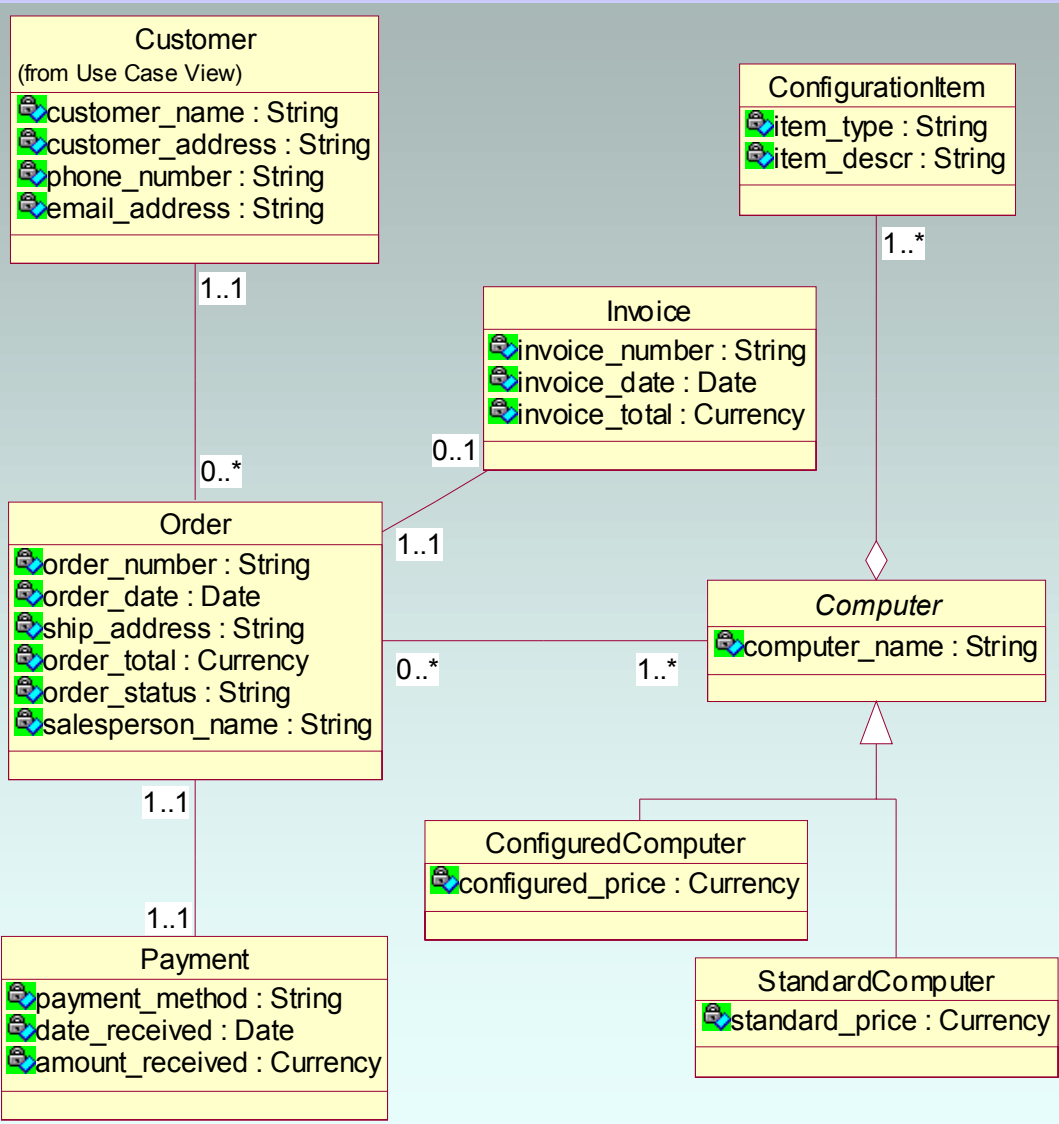
Aggregations



Generalizations



Class Diagram



Interaction modeling

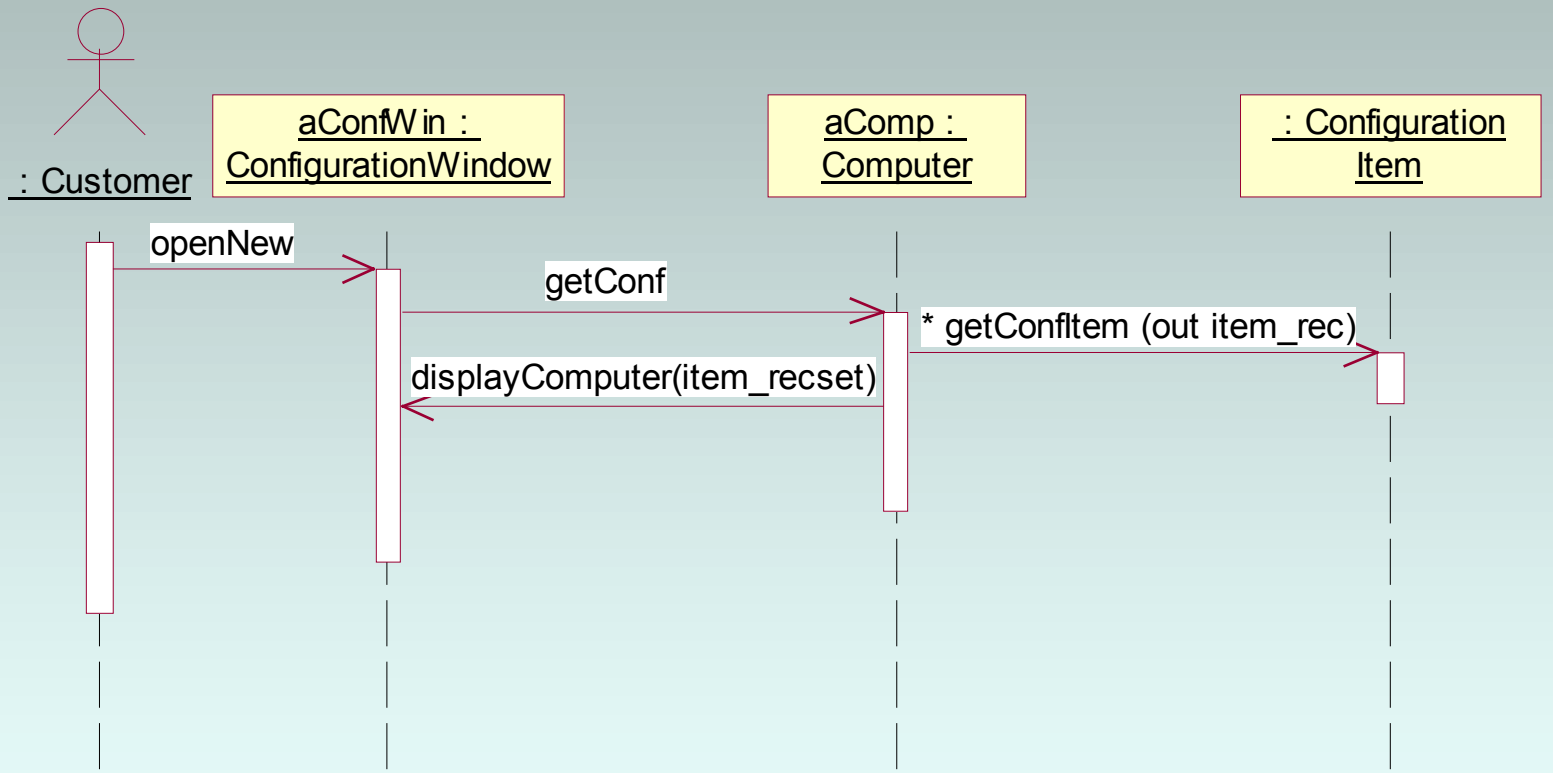
- *Captures interactions between objects needed to execute a use case*
- *Shows the sequencing of events (messages) between collaborating objects*
- *Used in more advanced stages of requirements analysis, when a basic class model is known, so that the references to objects are backed by the class model*
- *Two kinds of interaction diagrams*
  - ***Sequence Diagram** – concentrate on time sequences*
  - ***Collaboration Diagram** – emphasize object relationships*
- *Prevailing IS development practice – Sequence Diagrams in requirements analysis and Collaboration Diagrams in system design*

Interactions

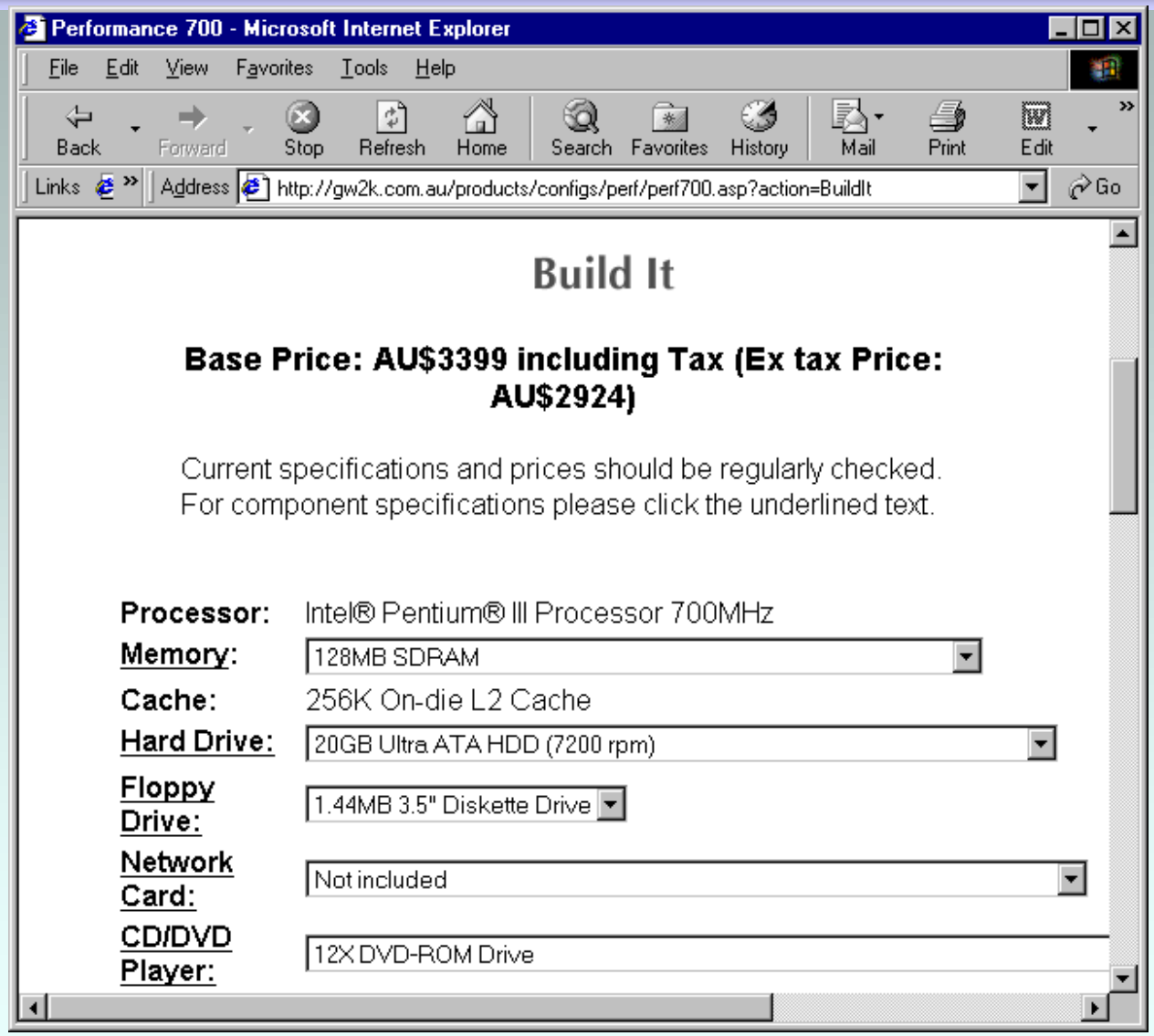
- ***Interaction*** *– set of messages in some behavior that are exchanged between objects across links*
- *Sequence Diagram*
  - *Objects - horizontal dimension*
  - *Message sequence - top to bottom on vertical dimension*
  - *Each vertical line - the object's* ***lifeline***
  - *Arrow -* ***message*** *from a calling object (sender) to an operation (method) in the called object (target)*
    - *Actual argument can be*
      - ***input argument*** *(from the sender to the target)*
      - ***output argument*** *(from the target back to the sender).*

    crs_ref.getCourseName(out crs_name)
  - *Showing the* ***return*** *of control from the target to the sender is not necessary*
  - ***Iteration marker*** *– an asterisk in front of the message label – indicates iterating over a collection*

Interactions



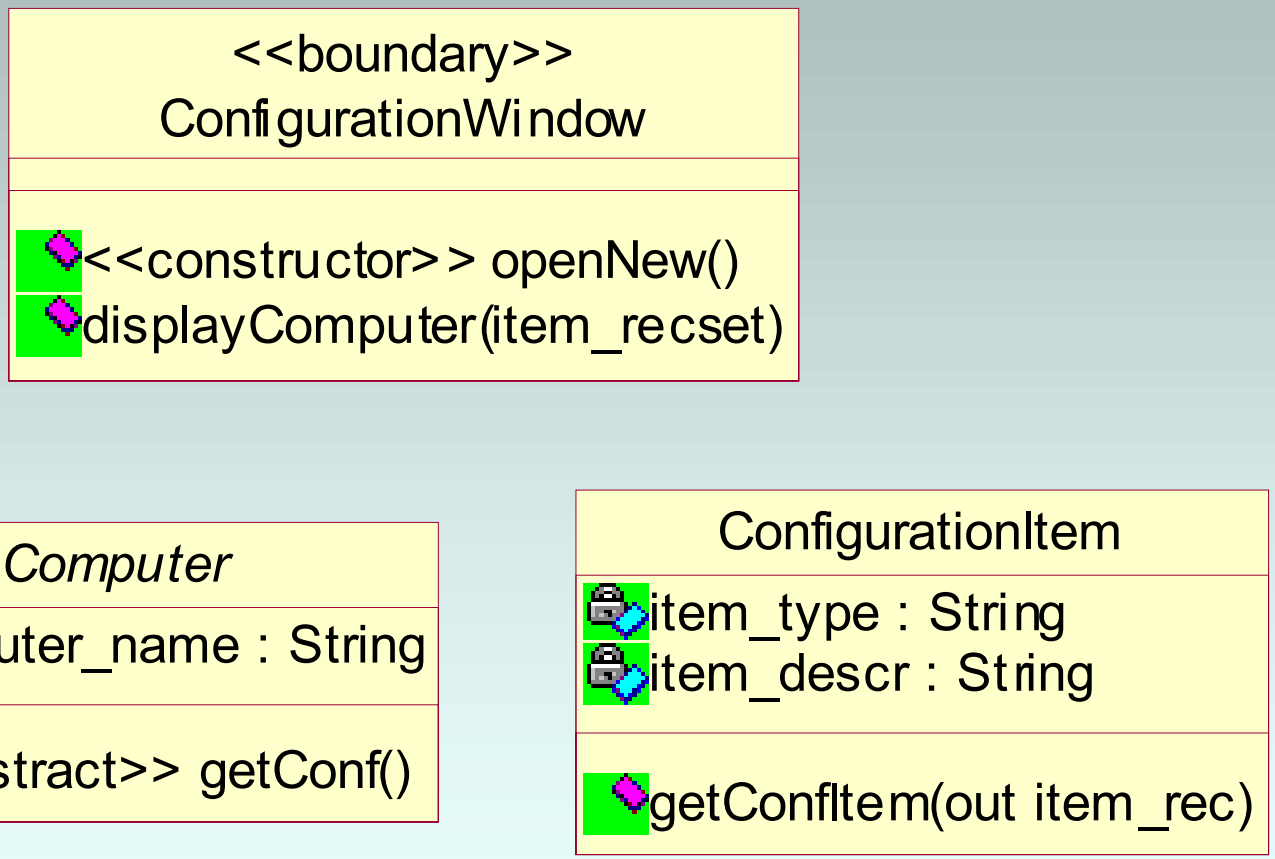
Interactions



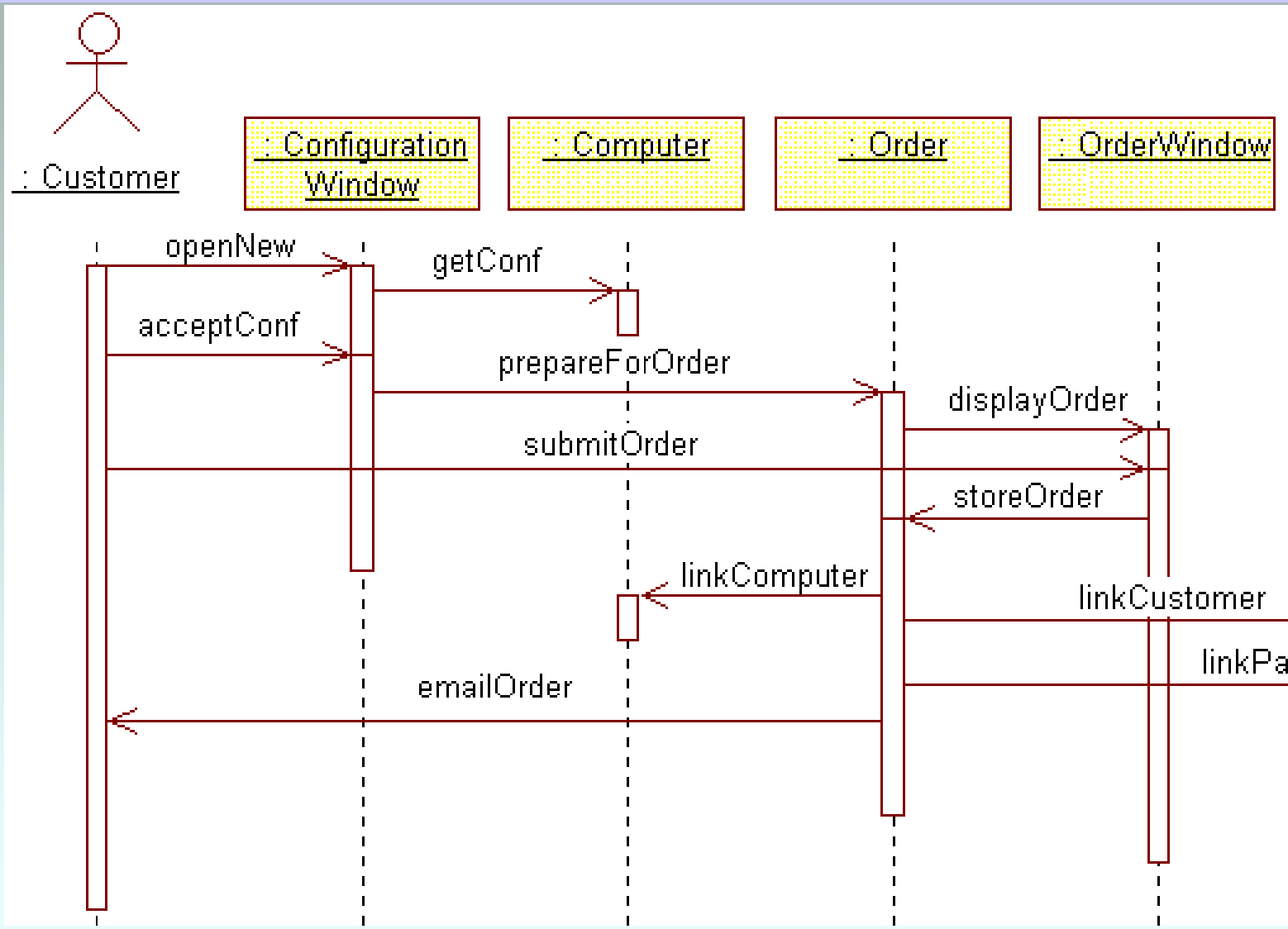
Operations

- *Examining the interactions can lead to the discovery of operations*
  - *Each **message** invokes an operation in the called object*
  - *The operation has the same name as the message*
- *Similarly, the presence of a message in a Sequence Diagram stipulates the need for an association in the Class Diagram*

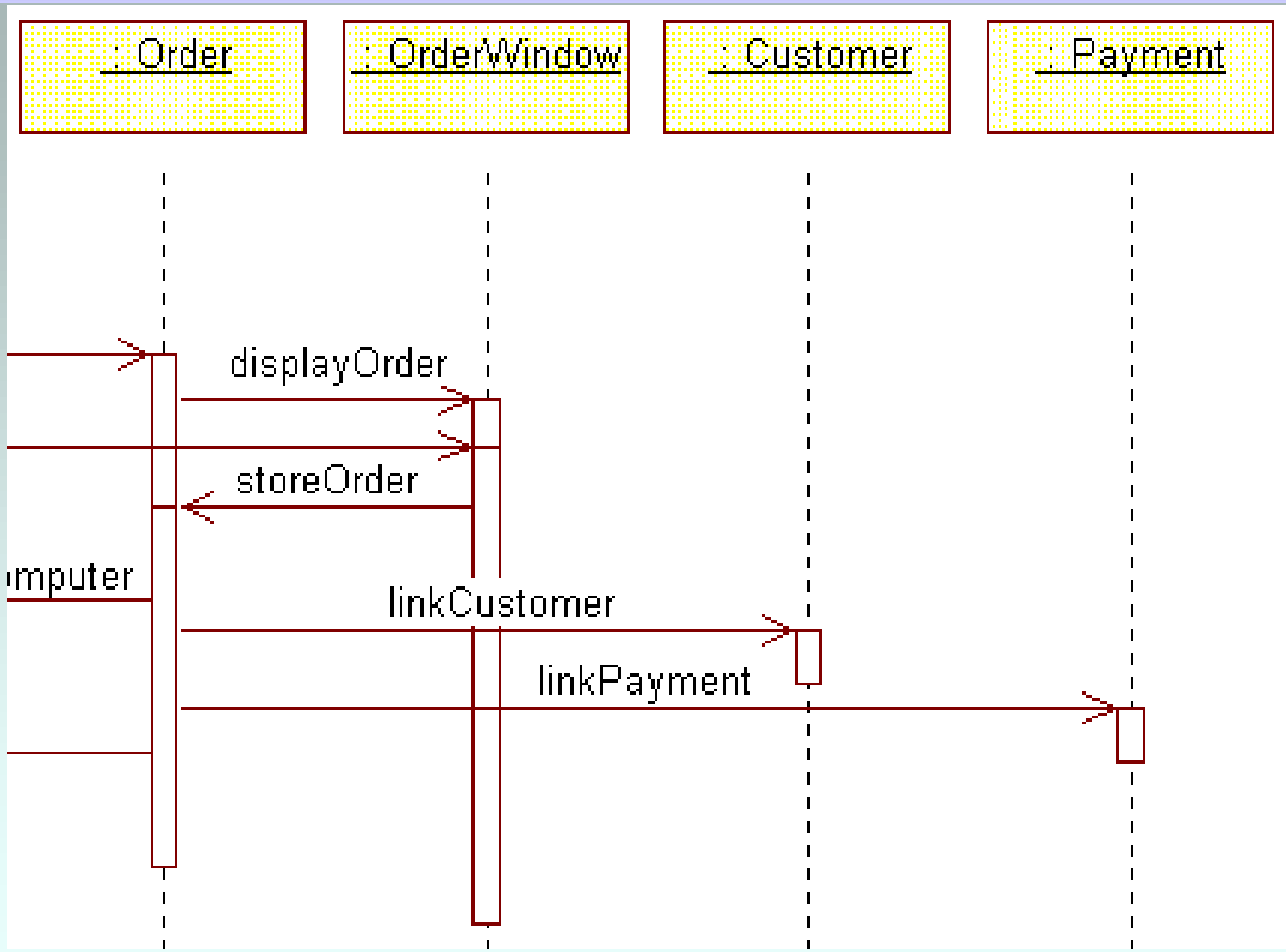
Operations


<<boundary>>
ConfigurationWindow
<<constructor>> openNew()
displayComputer(item_recset)
Computer
computer_name : String
<<abstract>> getConf()
ConfigurationItem
item_type : String
item_descr : String
getConfItem(out item_rec)

Sequence Diagram



Sequence Diagram



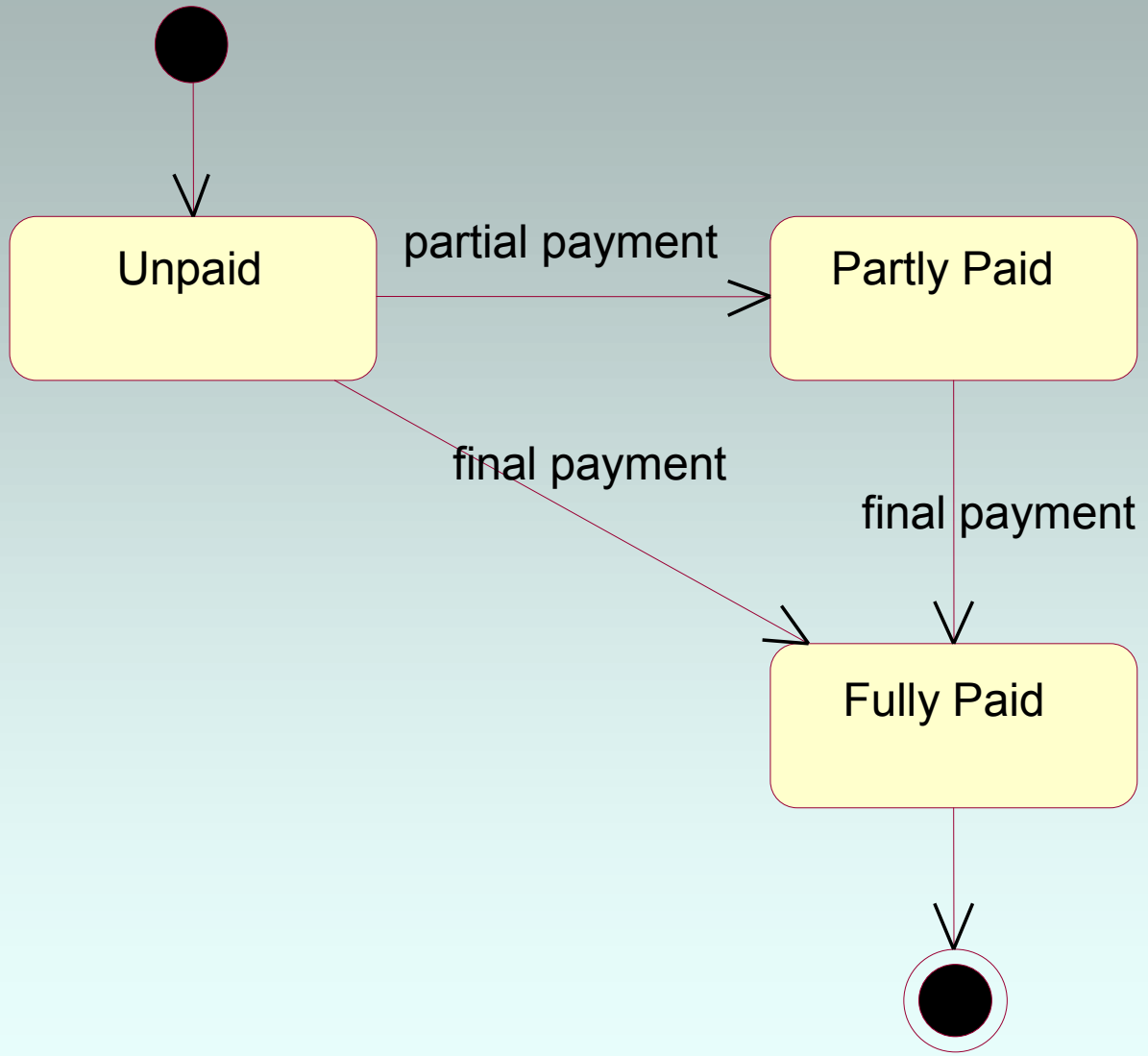
Statechart modeling

- *Captures dynamic changes of class states – the life history of the class*
- *These dynamic changes describe typically the behavior of an object across several use cases*
- ***State** of an object – designated by the current values of the object's attributes*
- ***Statechart Diagram** – a bipartite graph of*
  - ***states** (rounded rectangles) and*
  - ***transitions** (arrows) caused by **events***
- *The concepts of states and events are the same concepts that we know from Activity Diagrams – the difference is that "the states of the activity graph represent the states of executing the computation, not the states of an ordinary object"*

States and transitions

- *Objects change values of their attributes but not all such changes cause* ***state transitions***
- *We construct state models for classes that have interesting state changes, not any state changes*
- ***Statechart Diagram*** *is a model of business rules*
  - ***Business rules*** *are invariable over some periods of time*
  - *They are relatively independent of particular use cases*

States and transitions



Statechart Diagram

- *Normally attached to a class, but can be attached to other modeling concepts, e.g. a use case*
- *When attached to a class, the diagram determines how objects of that class react to events*
  - *Determines – for each object state – what **action** the object will perform when it receives an event*
  - *The same object may perform a different action for the same event depending on the object's state*
  - *The action's execution will typically cause a state change*

Statechart Diagram

- *The complete description of a **transition** consists of three parts*

```
event (parameters) [guard] / action
```

- ***Action** – short atomic computation that executes when the transition fires*
  - *can also be associated with a state*
- ***Activity** – longer computation associated with a state*

Statechart Diagram