UML 2.0

Interaction Diagrams

UML 2.0

- Class diagrams (+ OCL constraints)
- Package diagrams
- Component diagrams
- Deployment diagrams
- Use case diagrams
- State diagrams
- Activity diagrams
- Interaction diagrams

UML 2.0

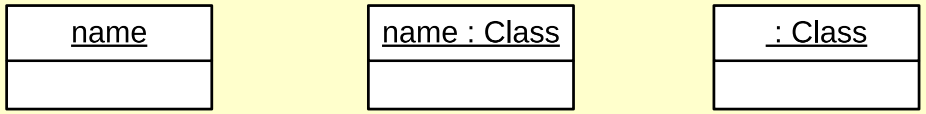
- ✓ Class diagrams (+ OCL constraints)
- Package diagrams
- Component diagrams
- Deployment diagrams
- ✓ Use case diagrams
- State diagrams
- Activity diagrams
- ✓ Interaction diagrams: today!

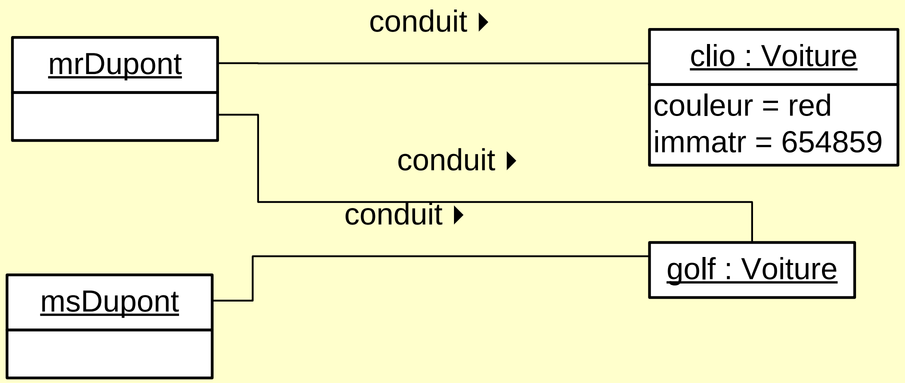
Recall: Class Diagrams

- Each UML diagram models a different point of view over the same system
- Example: Class Diagrams
  - Goal: to describe the static structure of the system, i.e. the system from a *spatial* point of view
  - Specifications: definition of classes, attributes, operations and relationships among classes
  - Class: definition domain for a set of objects which share the same characteristics
  - Relationships: aggregation, composition, generalization…

Recall: Object Diagrams

- Represent particular instances of class diagrams
- Snapshot of the system at a given point in time
- Graphical elements:





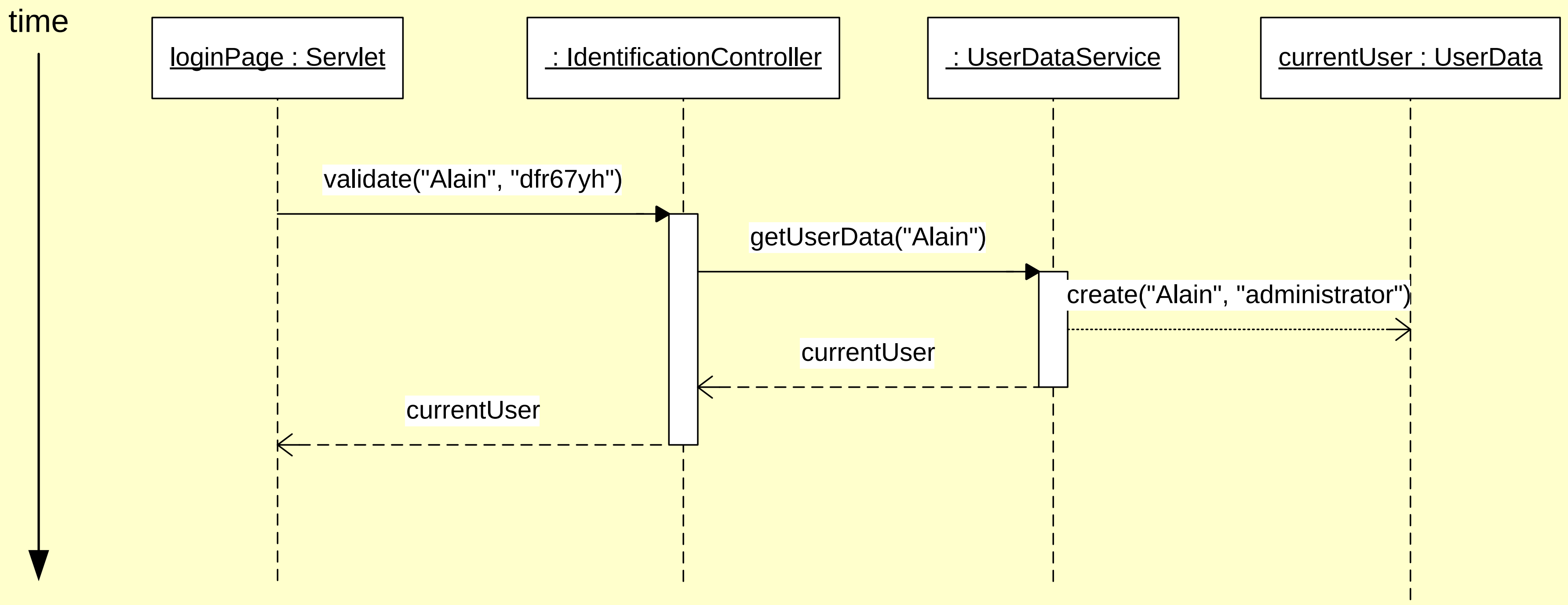
Recall: Use Case Diagrams

- Use Case Diagrams
  - Goal: describe the system from the users’ point of view, i.e. identify the needs
  - Specifications: identifying actors, use cases, and the relationships among them
  - Use case: a feature of the system from the point of view of an external user
  - Relationships: generalize, include, extend

Interaction Diagrams

- Describe the dynamic structure of a system
- Represent sequences of events involving the objects of a system
- Model communication protocols between objects
  - Show interactions among the objects in a given situation
  - Sequence diagrams: interactions from “temporal” point of view (time matters)
  - Collaboration diagrams: interactions from “spacial” point of view (space matters)

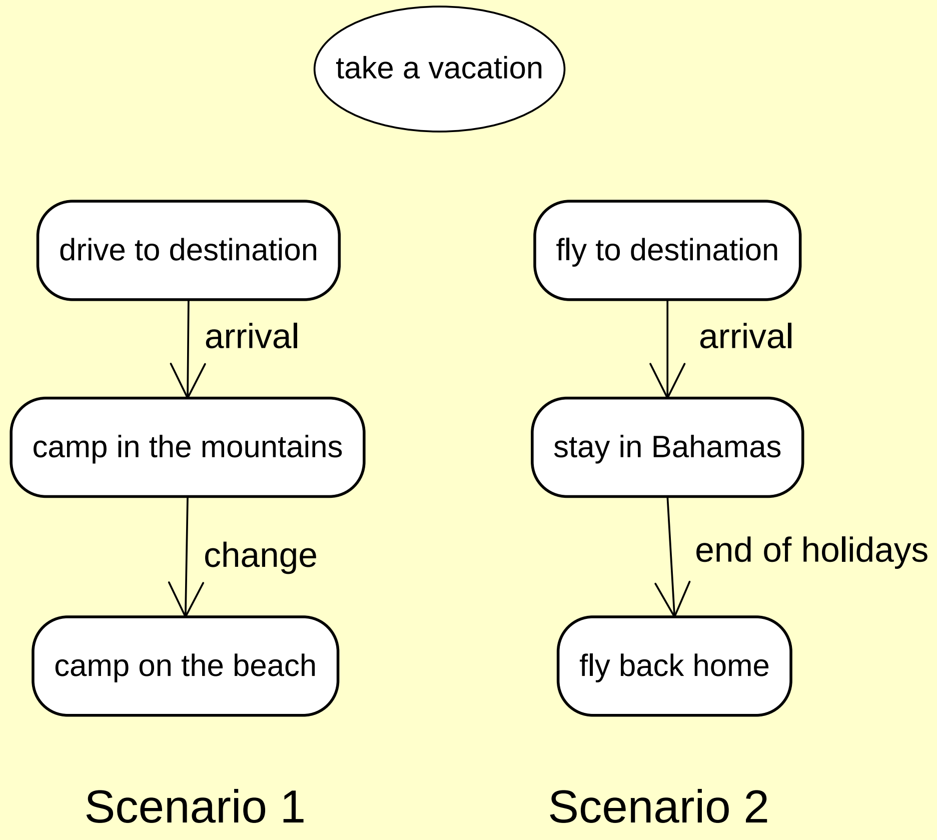
Sequence Diagram: an example



From Use Cases to Interaction Diagrams

- Use cases and Scenarios
  - A scenario is an instance of a use case
- Scenarios and Interaction Diagrams
  - Describe the interactions between the objects involved in the scenario

From Use Cases to Scenarios

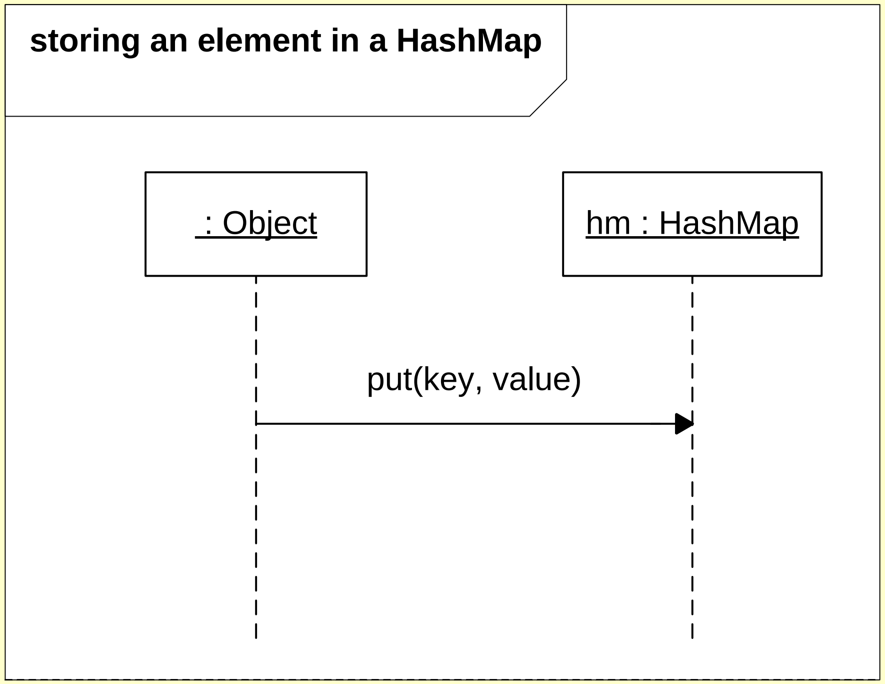


From Scenarios to Interaction Diagrams

- The interaction diagram shows how the objects involved in the scenario interact with each other
- An interaction describe the dynamic behavior of objects
- Two points of view are possible
  - Time (sequence diagram)
  - Space (collaboration diagram)
- The only possible way for an object A to interact with object B is to send a message.
  - Class A { B.sendMessage()}

Actors of an Interaction

- The actors of an interaction are instances of objects
- They are represented by objects lifelines
- The class of the objects can be specified or not

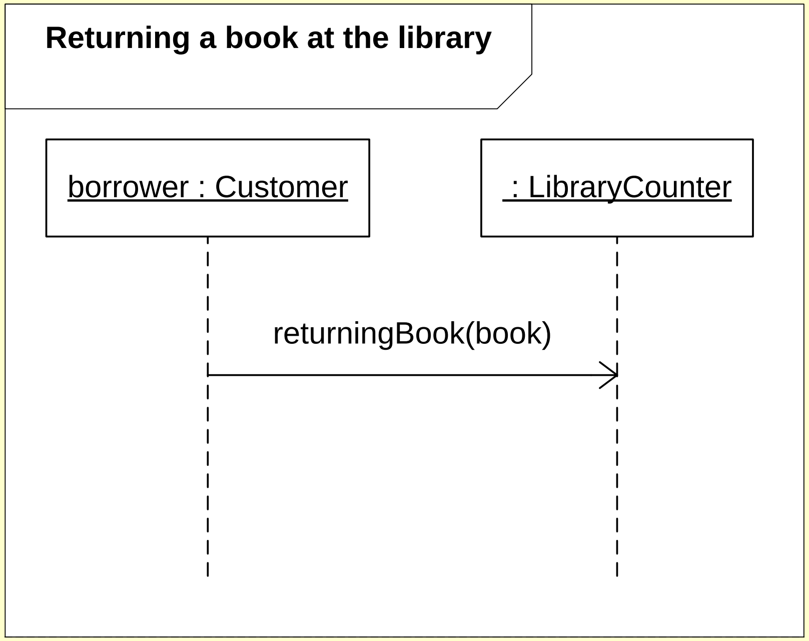


Messages

- Messages from an object to another are represented as arrows from the sender to the receiver
- Different shapes correspond to different types of messages:
  - Asynchronous: thick line with open arrow head
  - Synchronous (i.e. operation calls): filled arrow head
  - Reply message: dashed line
  - Object creation: dashed line with open arrow
  - Lost: a small circle at the arrow end of the line
  - Found: a small circle at the origin of the line

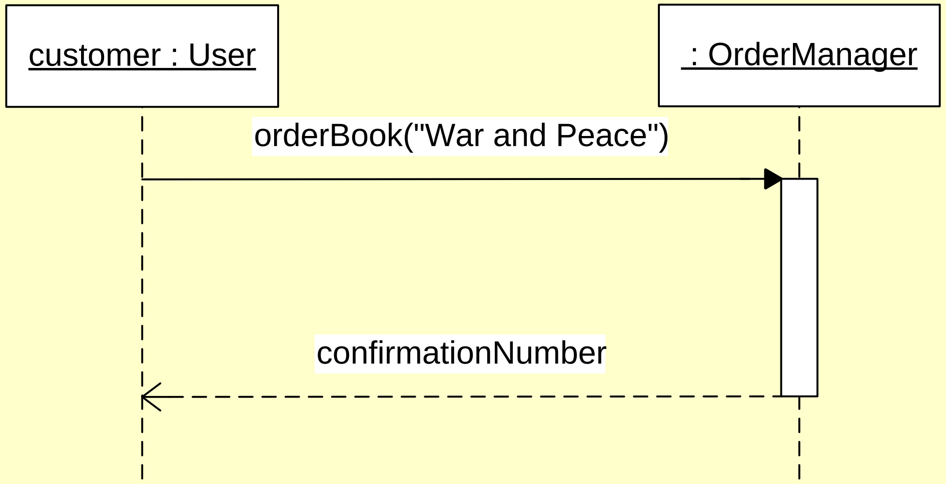
Asynchronous Messages

- The sender does not stop and wait for the receiver to process the message and respond



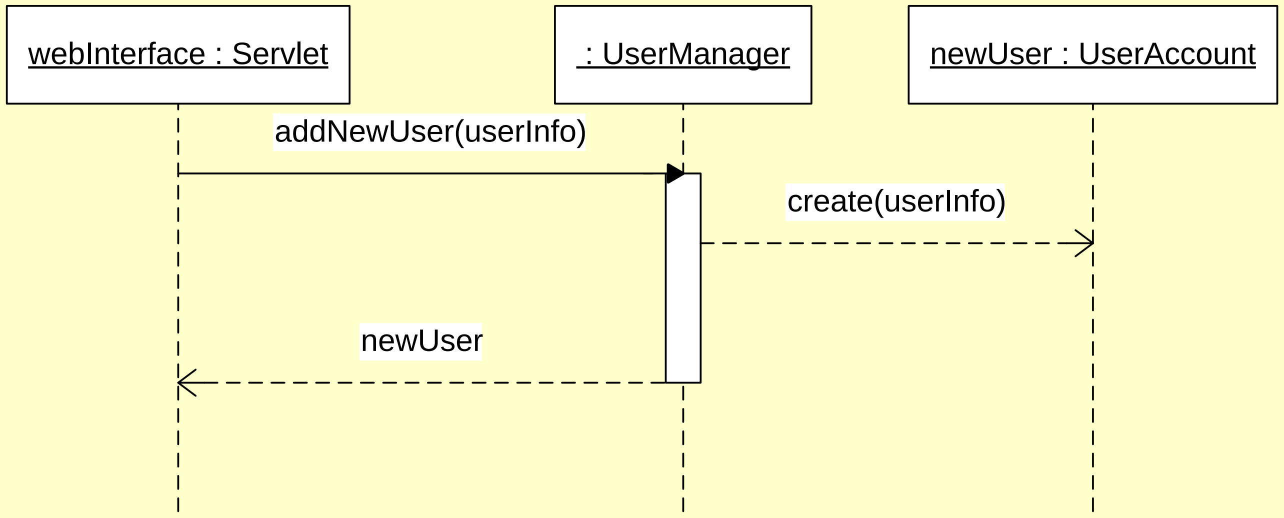
Synchronous Messages

- The sender stops and waits for the receiver to process the message and respond
- Method calls are (usually) synchronous messages
- The value returned is represented either by a dashed arrow, or specified as the return type of the message



Creation messages

- Special messages involving the instantiation of a class



Frames (1)

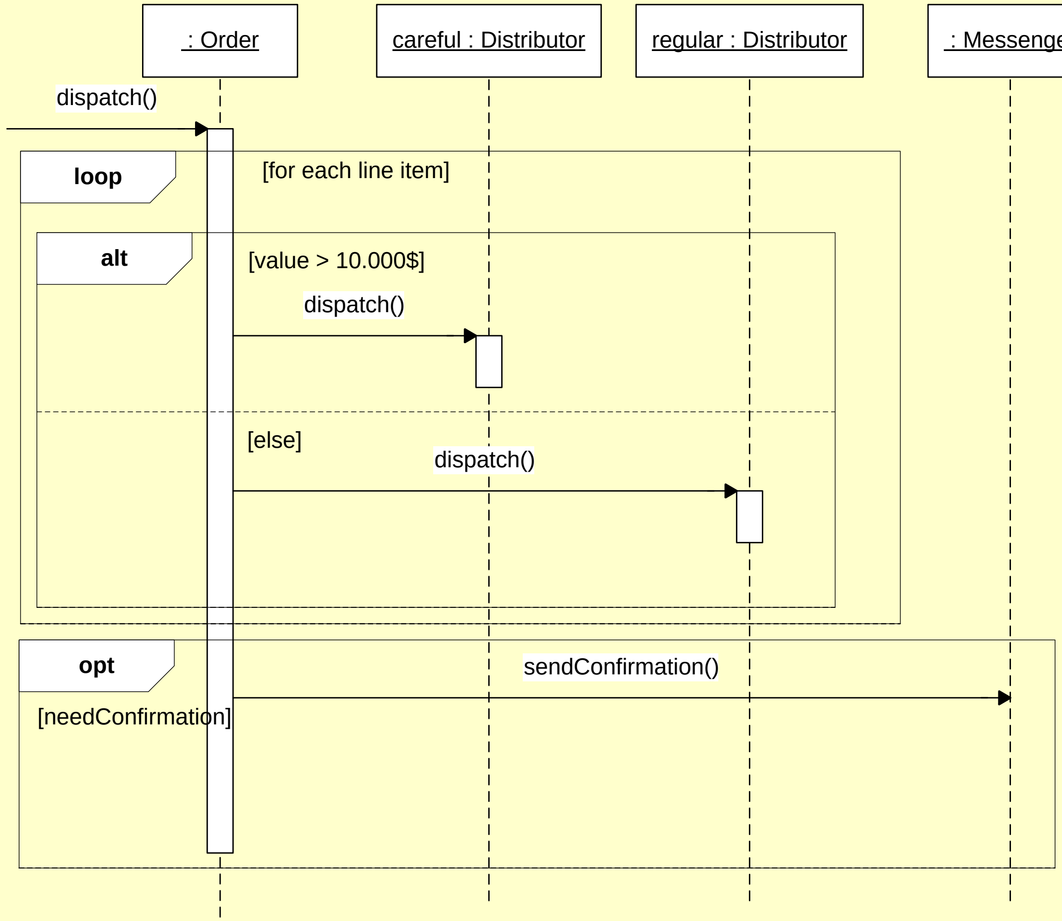
- Frames are named interaction fragments
- Special operators exist in order to specify special conditions for its execution (exclusive, alternative, conditional, parallell)

Frames (2)

- **Alt**: alternative multiple fragments, only the fram whose condition is true will execute
- **Opt**: optional, if the condition is true the fragment will execute (equivalent to an Alt with only one trace)
- **Par**: parallel, each fragment will run in parallel
- **Loop**: the fragment may execute multiple times, controlled by a guard
- **Region**: critical region, the fragment can have only one thread executing it at once
- **Neg**: negative, the fragment shows an invalid interaction
- **Ref**: reference, refers to an interaction defined in another diagram
- **Sd**: sequence diagram, used to surround an entire sequence diagram

Frames: example

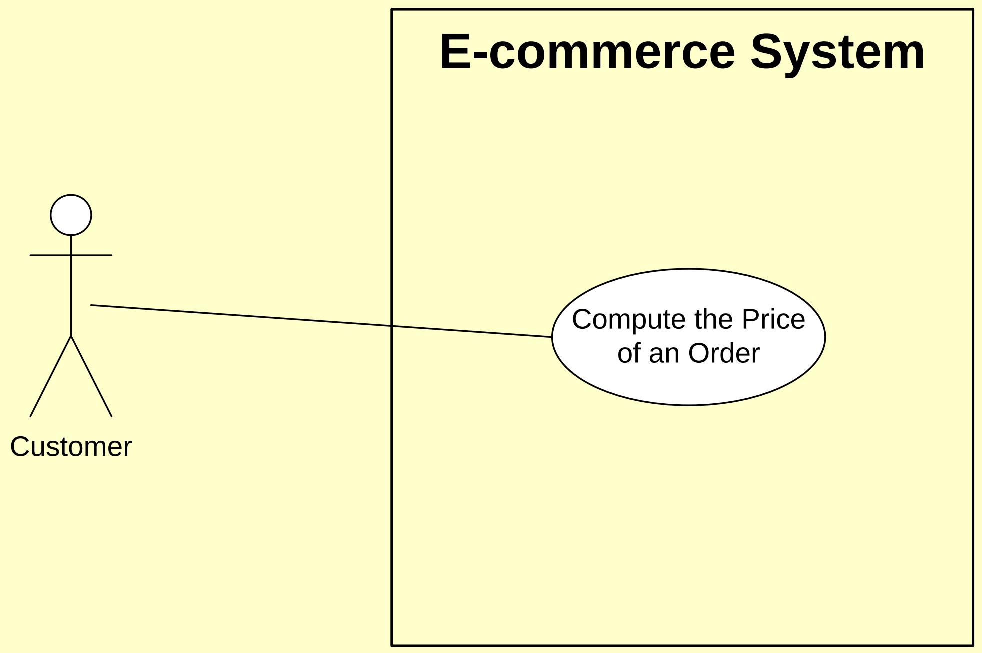
```
procedure dispatch
   foreach (lineitem)
       if (product.value>10k)
             careful.dispatch()
       else
             regular.dispatch()
       end if
    end for
    if (needsConfirmation)
             messanger.sendConfirm()
end procedure
```



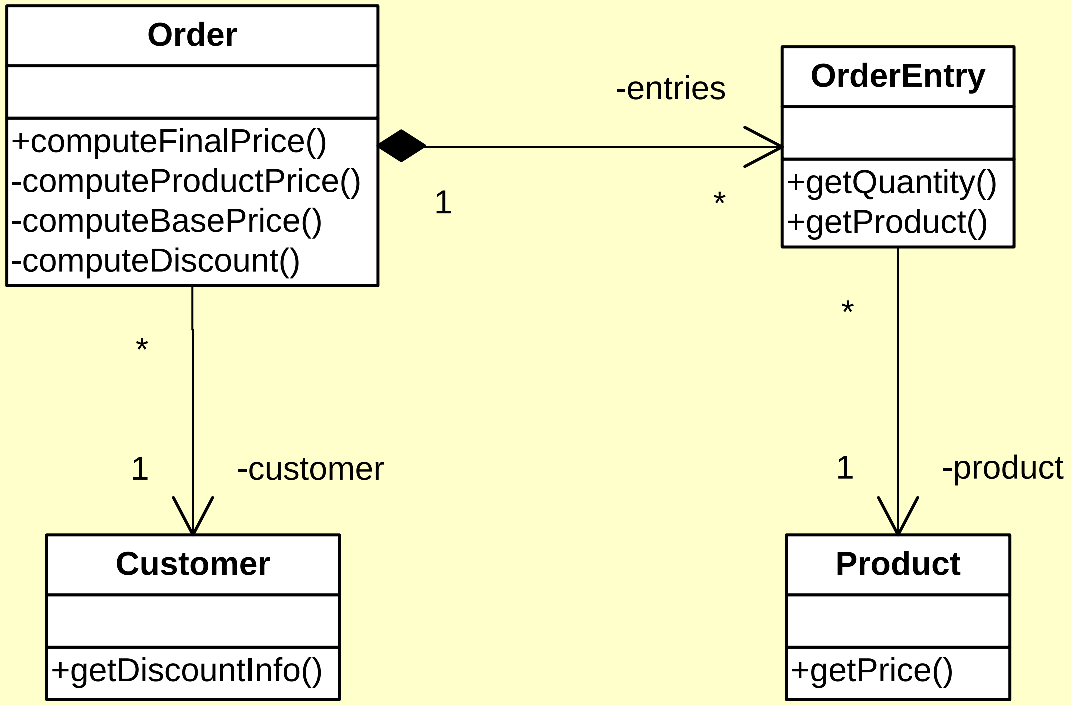
Example: Price of an Order

- A software application gives a customer the possibility to compute the final price of an order
- An order is made of a set of entries and is associated to only one customer
- An order entry is defined by
  - the product
  - the quantity of the product which is ordered
- A product stores some information about its price
- A customer can have special discounts

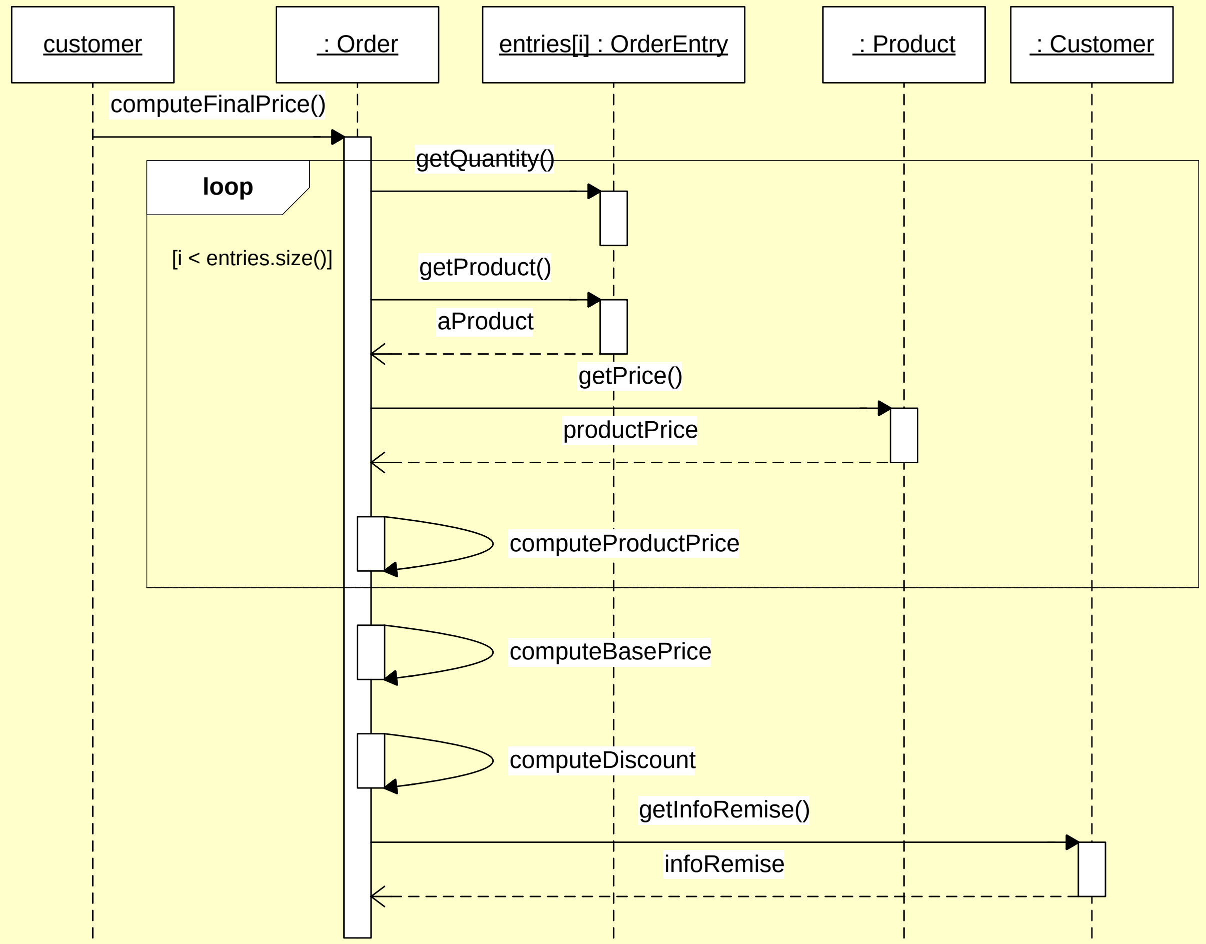
Compute the Price of an Order: Use Case



Compute the Price of an Order: Class Diagram



Compute the Price of an Order: Sequence Diagram


customer
: Order
entries[i] : OrderEntry
: Product
: Customer
computeFinalPrice()
getQuantity()
loop
[i < entries.size()]
getProduct()
aProduct
getPrice()
productPrice
computeProductPrice
computeBasePrice
computeDiscount
getInfoRemise()
infoRemise