Collaboration Diagrams

Massimo Felici

Room 1402, JCMB, KB

0131 650 5899

mfelici@inf.ed.ac.uk

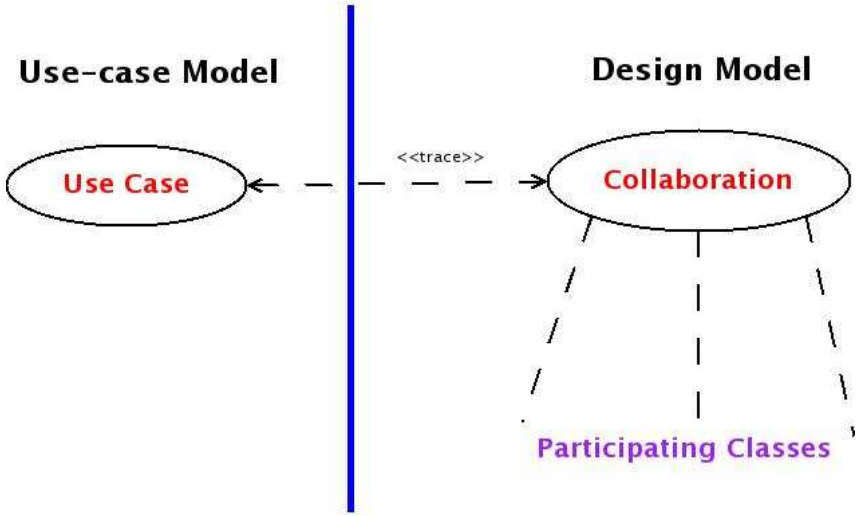
Interaction Diagrams

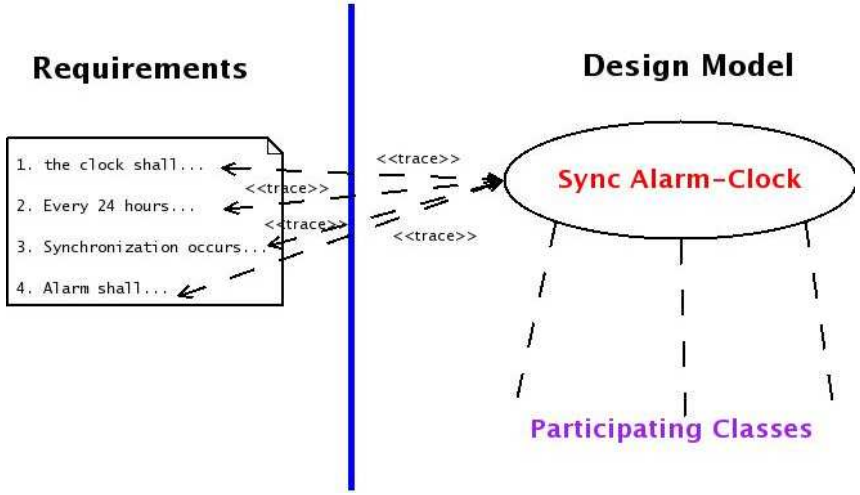
- UML **Interaction Diagrams** refine the kind of activity undertaken in checking with CRC cards
- There are two different kinds of interaction diagrams:
  - **Collaboration Diagrams**
  - **Sequence Diagrams**
- There is some redundancy between Collaboration and Sequence Diagrams
  - They differently show how elements interact over time
  - They document in detail how classes realize user cases
  - **Collaboration Diagrams** show relationship between objects
  - **Sequence Diagrams** focus on the time in which events occur

Collaboration Diagrams' Rationale

- Model collaborations between **objects** or **roles** that deliver the **functionalities** of use cases and operations
- Model mechanisms within the **architectural design** of the system
- Capture interactions that show the passed **messages** between objects and roles within the collaboration
- Model **alternative scenarios** within use cases or operations that involve the collaboration of different objects and interactions
- Support the **identification** of objects (hence classes) that participate in use cases

Realizing Use cases in the Design Model

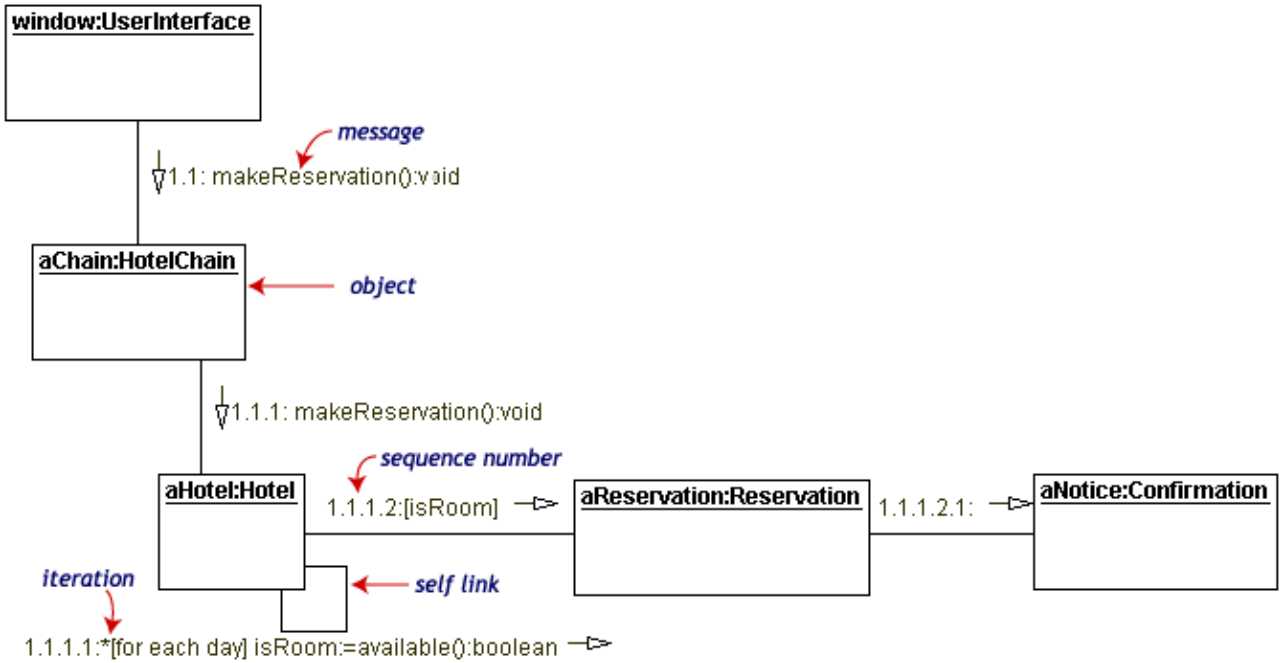




- **Use-case driven design** is a key theme in a variety of software processes based on the UML
- UML supports specific modeling constructs that realize use cases in the implementation
- **Collaborations** enhance the systematic and aggregate behavioral aspects of the system
- Collaborations support **traceability** from requirements expressed in use cases into the design

Collaboration Diagrams: An Example

- Each message in a collaboration diagram has a sequence number.
- The top-level message is numbered 1. Messages sent during the same call have the same decimal prefix but suffixes of 1, 2, etc. according to when they occur.



Collaboration Diagrams

- **Specification level** shows generic cases of collaborations
  - **Generic form** captures a collaboration among class roles and association roles and their interactions
- **Instance level** shows a specific instance of an interaction taking place and involving specific object instances
  - **Instance form** captures a scenario among objects conforming to class roles and links conforming to association roles

What is a Collaboration?

- A **Collaboration** is a collection of named **objects** and **actors** with **links** connecting them. They collaborate in performing some task.
- A **Collaboration** defines a set of participants and relationships that are meaningful for a given set of purposes
- A **Collaboration** between objects working together provides emergent desirable **functionalities** in Object-Oriented systems
  - Each object (responsibility) partially supports emergent functionalities
  - Objects are able to produce (usable) high-level functionalities by working together
- Objects collaborate by **communicating** (passing messages) with one another in order to work together

Collaborations

- **Actors**
  - Each Actor is named and has a role
  - One actor will be the **initiator** of the use case
- **Objects**
  - Each object in the collaboration is named and has its class specified
  - Not all classes need to appear
  - There may be more than one object of a class
- **Links**
  - Links connect objects and actors and are instances of associations
  - Each link corresponds to an association in the class diagram

Interactions

- Use cases and Class Diagrams constrain interactions
- **Associations** and **Links** in a **Collaboration Diagram** show the paths along which **messages** can be sent from one instance to another
- A **message** is the specification of a **stimulus**
- A **stimulus** represents a specific instance of sending the **message**, with particular arguments

Messages

- **Message Signature**
  - **return-value**, **message-name** and **argument-list**
- **Message Flows**
  - **Procedural** or **Synchronous**: A message is sent by one object to another and the first object waits until the resulting action has completed.
  - **Asynchronous**: A message is sent by one object to another,but the first object does not wait until the resulting action has completed.
  - **Flat**: Each arrow shows a progression from one step to the next in a sequence. Normally the message is asynchronous.
  - **Return**: the explicit return of control from the object to which the message was sent.
- Further information on Messages
  - Sequence-expression, Predecessor, Guard-condition

Where should messages go?

- The message is directed from **sender** to **receiver**
- The receiver must understand the message
- The association must be **navigable** in that direction

Law of Demeter

- Dealing with a message m an Object O can send messages to:
  - Itself
  - Objects sent as argument in the message m
  - Objects O creates in responding to m
  - Objects that are directly accessible from O, using attribute values

Activations: Flow of Control

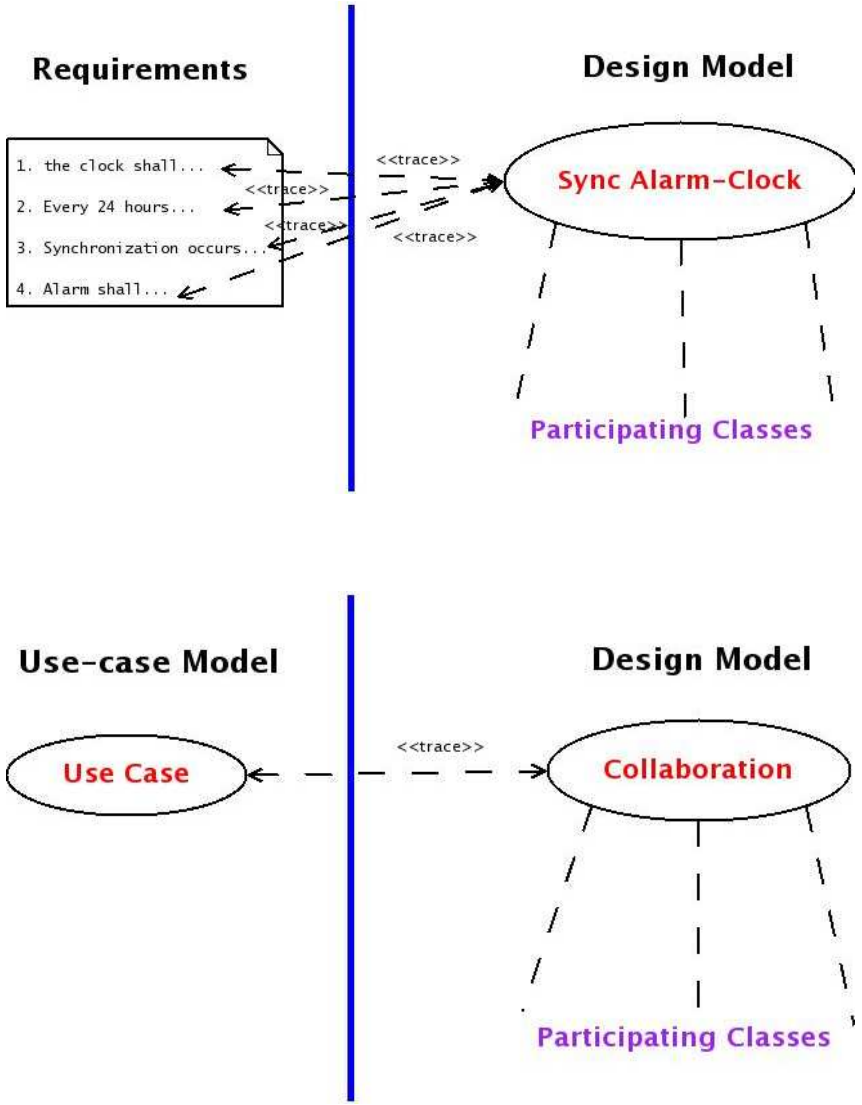
- **Procedural interactions**
  - At most one object is computing at any time
- **Activation**
  - An object has a live activation from when it receives a message until it responds to the message
- **Waiting for response**
  - Synchronous messages on sending a message to another object, an object will wait until it receives a response
- **Activation task**
  - Activations are stacked and the top activation has control. When the top action responds the next to top regains control and so on…

Constructing Collaboration Diagrams

1. Identify **behavior** whose realization and implementation is specified
2. Identify the **structural elements** (class roles, objects, subsystems) necessary to carry out the functionality of the collaboration
   - Decide on the context of interaction: system, subsystem, use case and operation
3. Model **structural relationships** between those elements to produce a diagram showing the context of the interaction
4. Consider the **alternative scenarios** that may be required
   - Draw instance level collaboration diagrams, if required.
   - Optionally draw a specification level collaboration diagram to summarize the alternative scenarios in the instance level sequence diagrams

Constructing Collaboration Diagrams

1. Identify **behavior**
2. Identify the **structural elements**
3. Model **structural relationships**
4. Consider the **alternative scenarios**



Reading/Activity

- Please Read
  - Chapter 8, Collaboration Diagrams, of the Schaum's Outlines UML book
  - Chapter 9, Interaction Sequence Diagrams, of the Schaum's Outlines UML book

Summary

- Interaction Diagrams
  - Collaboration Diagrams
  - Sequence Diagrams
- Collaboration Diagrams' Rationale
- Collaboration Diagrams
  - Collaborations
  - Interactions
  - Messages
- Constructing Collaboration Diagrams