(Object-)Interaction Diagrams

Specifying (constraints on) Dynamics

- Class diagrams describe (constraints on)

  the structure of instances.
- (Object-)Interaction diagrams describe (constraints on)

  the behaviour of an application.
  - Not structure (static), but behaviour (dynamic)
  - Composed run-time entities : objects (no classes at run-time)
- Two kinds of object-interaction diagrams
  - Communication Diagrams (formerly known as Collaboration)
  - Sequence Diagrams

Behaviour

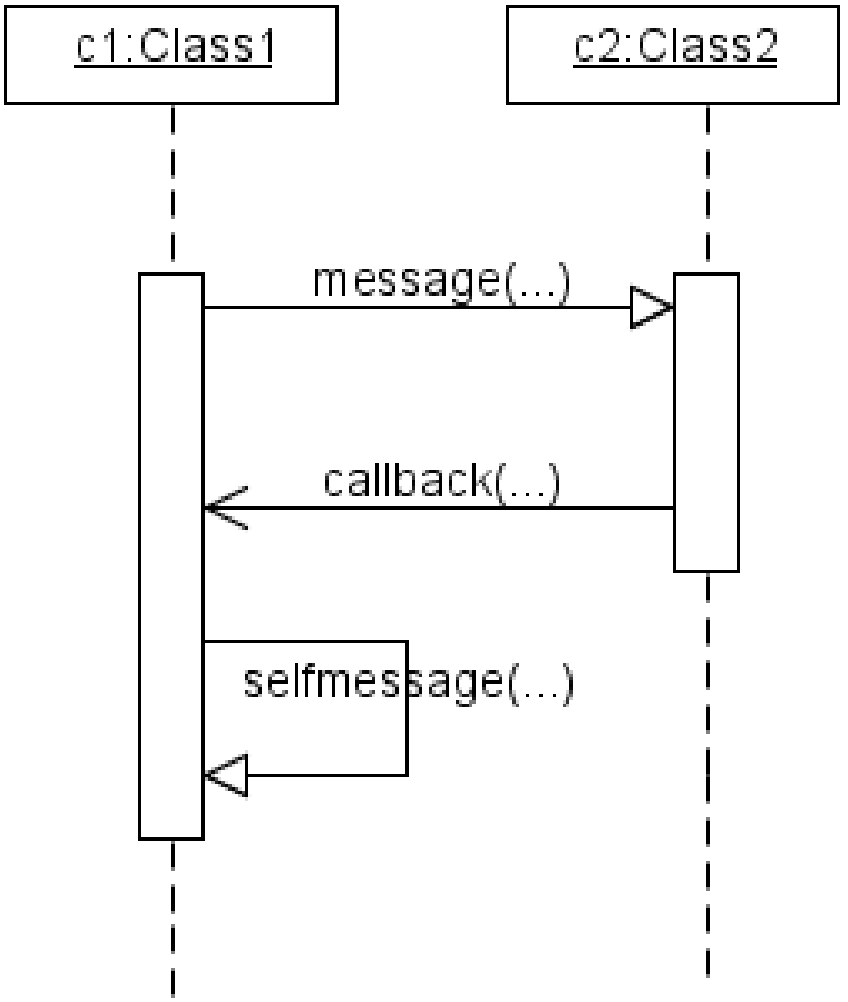
- Object-Interaction diagrams depict dynamic, run-time behaviour (between objects, not internal view!)
  - communication between objects via messages
  - sequence of transactions in a dialog between a user and a system, or between objects in a system
  - one trace of behaviour ideally corresponds to one use case
- With the object-interaction diagram, we introduce the notion of time (may be abstraction: progress).

Communication Diagrams

- Communication diagrams represent objects in a system and their links.
- They are composed of three elements:
  - Objects
  - Links (“instance” of Association)
  - Messages

Sequence Diagrams

- Sequence diagrams illustrate the sequence of actions that occur in a system.
- They are composed of 2 elements
  - Object
  - Messages



Sequence vs. Communication

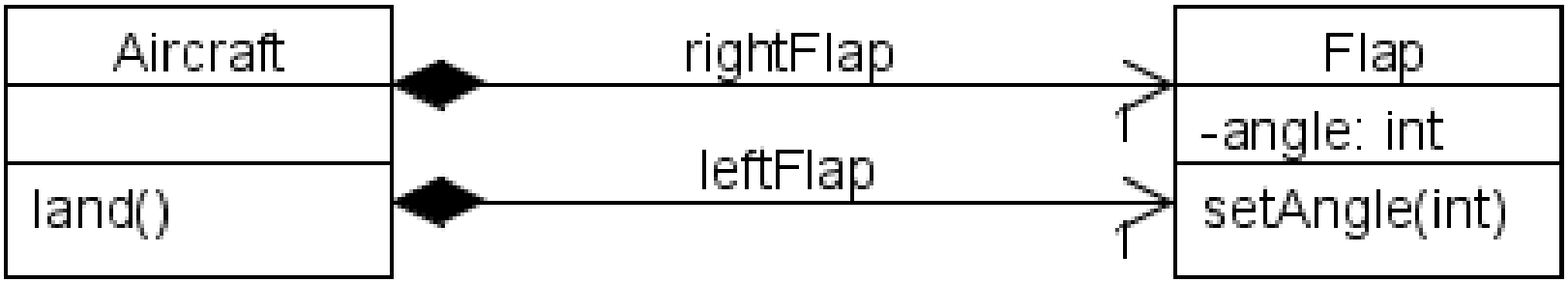
- Both diagrams specify/constrain object interaction.
  - Sequence is used to illustrate temporal interactions.
  - Collaboration is better suited to display the association between the objects.
- In principle, a sequence diagram can be converted into a collaboration diagrams (and vice-versa). Need to contain equal amount of information.

Trace of Behaviour

- Use Case: using an ATM
  - System : waiting for card
  - User: insert card
  - System : ask for pin
  - User: enter pin
  - System : verify pin
  - ...
- Once you have traversed a use case, you can figure out how many objects are created and what messages are passed between them

Setting up an example

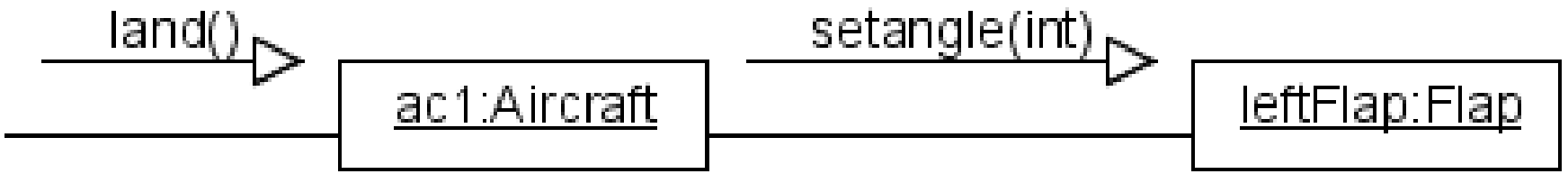
- Consider the following class diagram.



- Suppose some external call to land(), a public method of an instance of class Aircraft.
- In turn, land() calls setangle() of some instance of Flap.

Communication Diagram

- Remember, we are depicting the interaction between instances, not classes.
- ac1 has a reference to a Flap named leftFlap.
- In the code of the method land(), there is a call leftFlap.setangle(int)
- Add sequence numbers !



A few things to note

- To depict a message, we draw a small arrow from the sender object to the target object. This shows the direction of communication
- With the arrow is the operation name we desire to execute, along with all arguments
- The arrow is parallel to a line, which depicts there is a link between the objects (usually an instance of an association, but not necessarily)

No association?

- If objects aren't linked by association, then how could they be linked?
- Suppose o1 sent o2 a reference to itself. So, o2 may refer to o1 (via the reference) even though there is no association between the classes of o1 and o2.
- This is known as a dynamic reference.
- This reference allows a target object to “callback” a sender object.

Callback

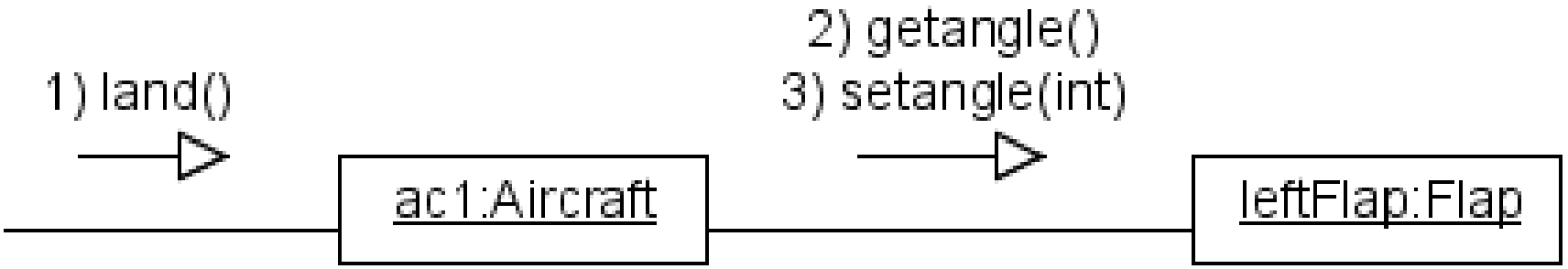
- The more formal description of callback is executable code that is passed as an argument to other code.
- However, the term callback is also used when a reference is passed to achieve the same thing.
- Callbacks are often used in asynchronous messaging.
- A piece of code or a reference is assigned to do something when a specific event occurs.
  - i.e. Swing and an ActionListener

Execution Trace

- The following diagram is exactly the same as the previous diagram, except that it shows which objectName.ClassName.methodName(args) starts this particular behaviour trace.

Order

- Suppose we wanted to verify the angle first, then set it, how do we depict the order in which the calls should be made.
- We simply need to add sequence numbers to the messages to show the sequence of the messages.



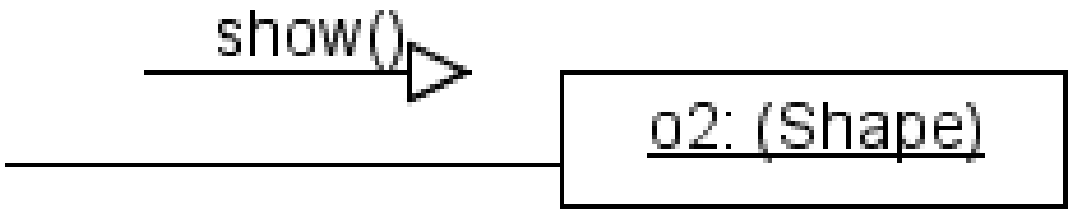
Polymorphism

- Triangle, Rectangle and Square are subclasses of Shape.
- Suppose we want to send the message show() to a Shape object.
  - At run-time, this object could be an instance of Triangle, Rectangle or Square.
- We know source and destination of the message:

  o1 sends a message to o2

Polymorphism (cont.)

- Make the target object's class the lowest class in the inheritance hierarchy that is a superclass of all the classes to which the target object may belong to.
- Put the superclass name in parenthesis to show that it will be evaluated at run-time.
- This is a form of substitutability.



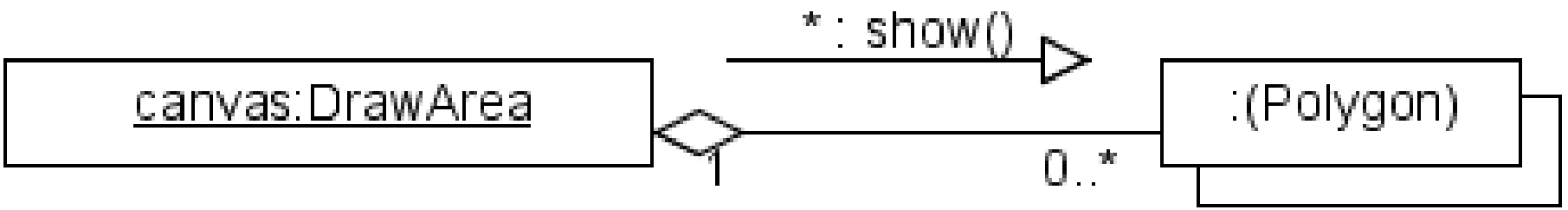
Iterated Messages

- Suppose we have an object canvas:DrawArea which contains an array of Polygons (Triangles, Rectangles and Squares).
- We want to send the message show() to all the contained objects (Polygons) of the aggregate object canvas.
- The Iterator Pattern (a design pattern) can be used as a traversal method.

Iterated Messages (cont.)

- Notice the aggregate connector

  (in Class Diagram, really).
- show() message is called many times (the *)
- DrawArea may have 0 or more Polygons in its collection named shapes.
- The target object is unnamed and double boxed to show multiplicity.



Referring to Self

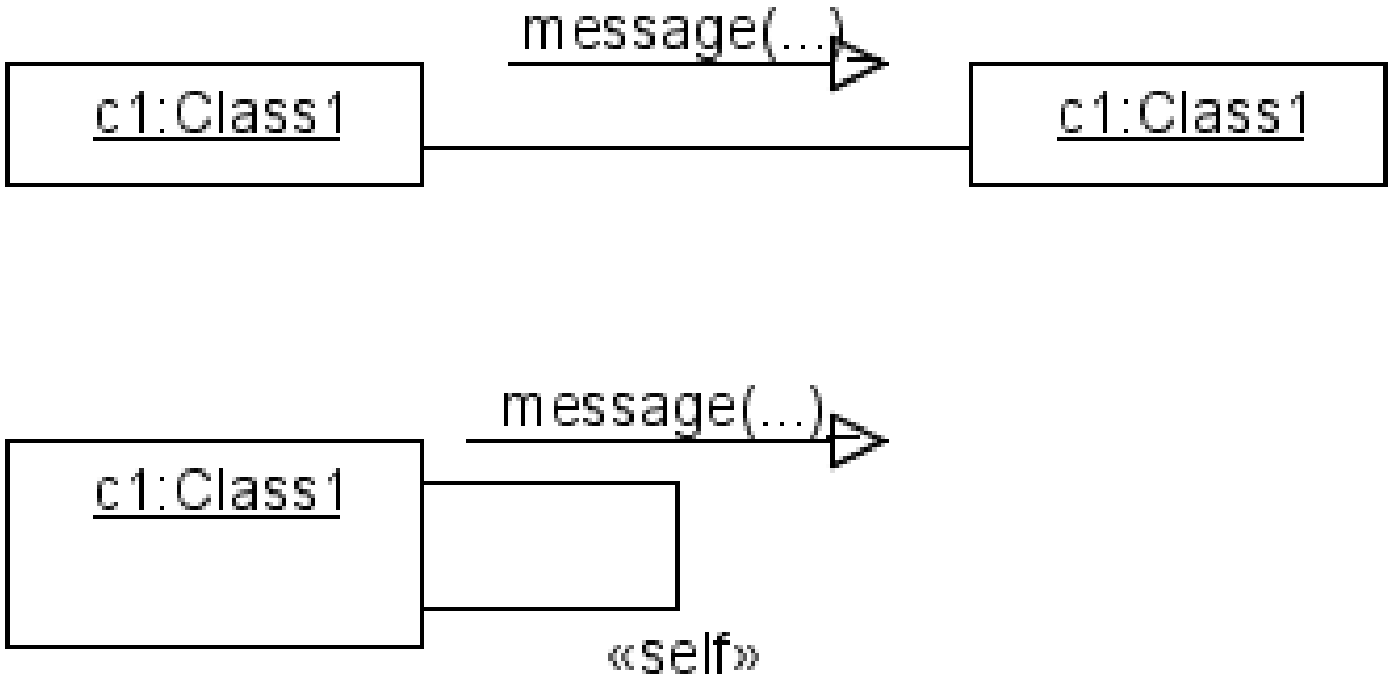
- When an object refers to self, it is referring to its own object handle.
  - In Python, we also use the keyword *self*
  - In Java, C++ and PHP, we use the keyword *this*
  - In Visual Basic, we use the keyword *me*
- This is useful to
  - Pass the target object a reference to the sender object (for callbacks)
  - Send a message to itself

Passing a reference to self

- In message, just add self as an argument.

Sending a message to self

- There are two ways to depict this (note: aliases in UML)



Why send a message to self?

- Implementation / information hiding.
  - We don't want to show how a variable is stored or manipulated.
    - → get/set (accessor/mutator) methods
- We might want to hide implementation details from methods within the same class (especially if those methods are public).