# Interaction Diagram

# 3.4 Interaction Diagrams

Subject/Topic/Focus:

- Dynamic aspects of objects

Summary:

- Sequence Diagrams
- Concurrent Processes
- Collaboration Diagrams

Literature:

- Fowler

# Interaction Diagrams

Interaction diagrams describe **exemplary** how groups of objects **collaborate** in some **behavior**.

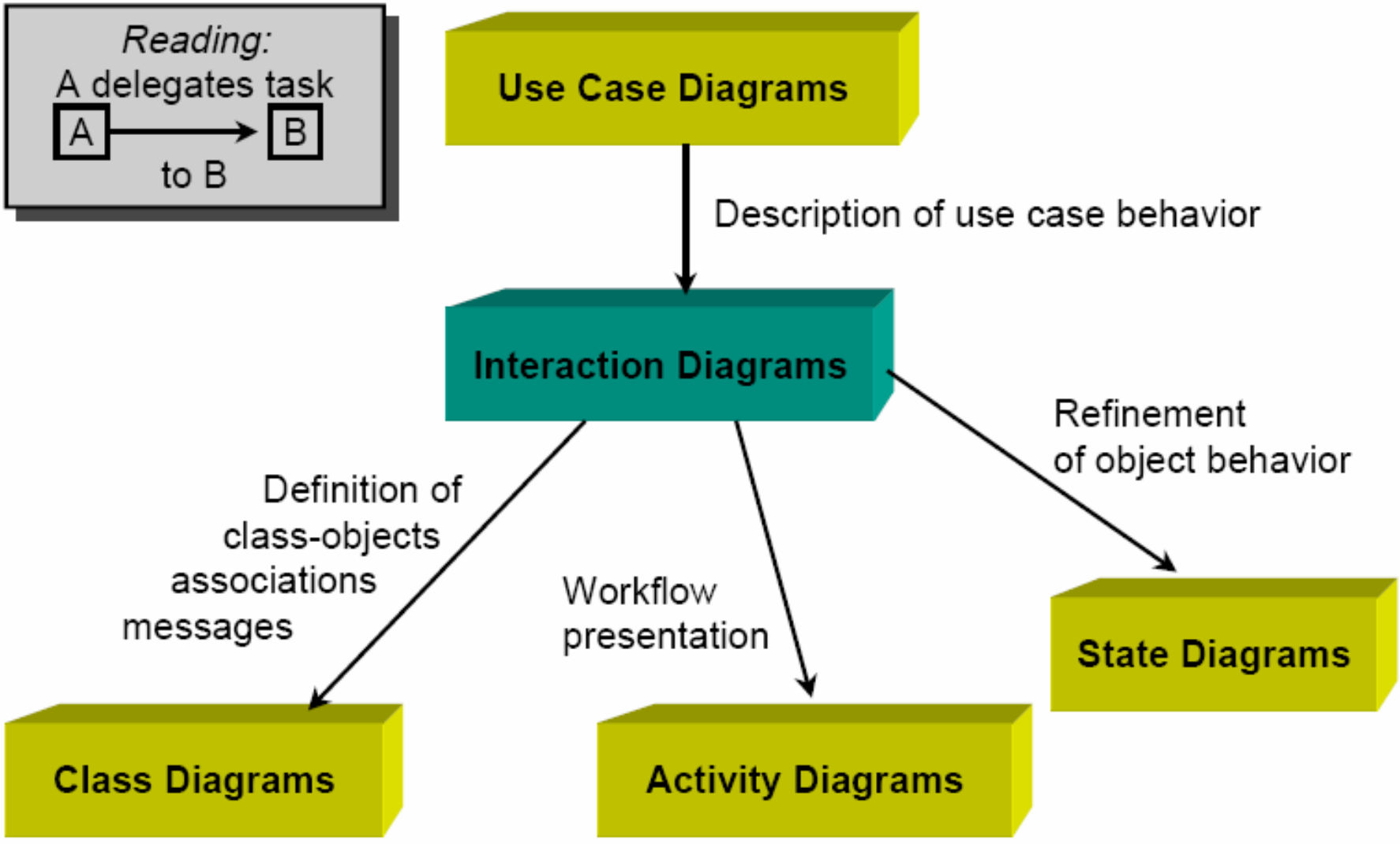
An interaction diagram typically captures the behavior of a **single use case**.

Interaction diagrams do **not** capture the **complete** behavior, **only** typical **scenarios**.

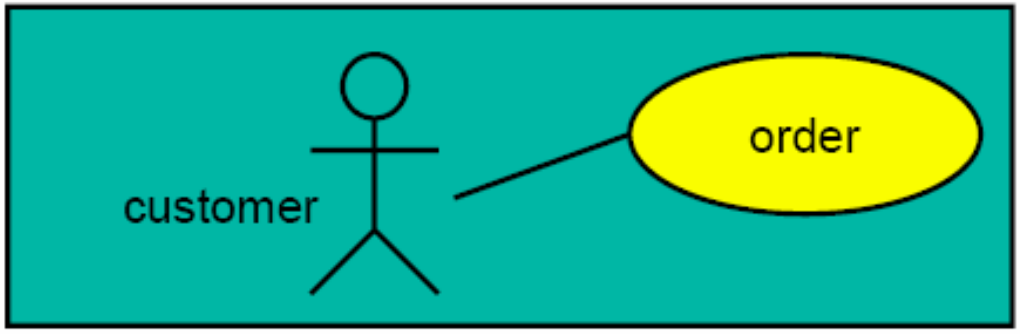
There are two types of **interaction** diagrams:

- **Sequence** diagrams emphasize the **order** or **concurrency** of the interactions.
- **Collaboration** diagrams emphasize the interacting **objects**.

# Role of Interaction Diagrams in UML



# Interaction Diagrams and Use Cases

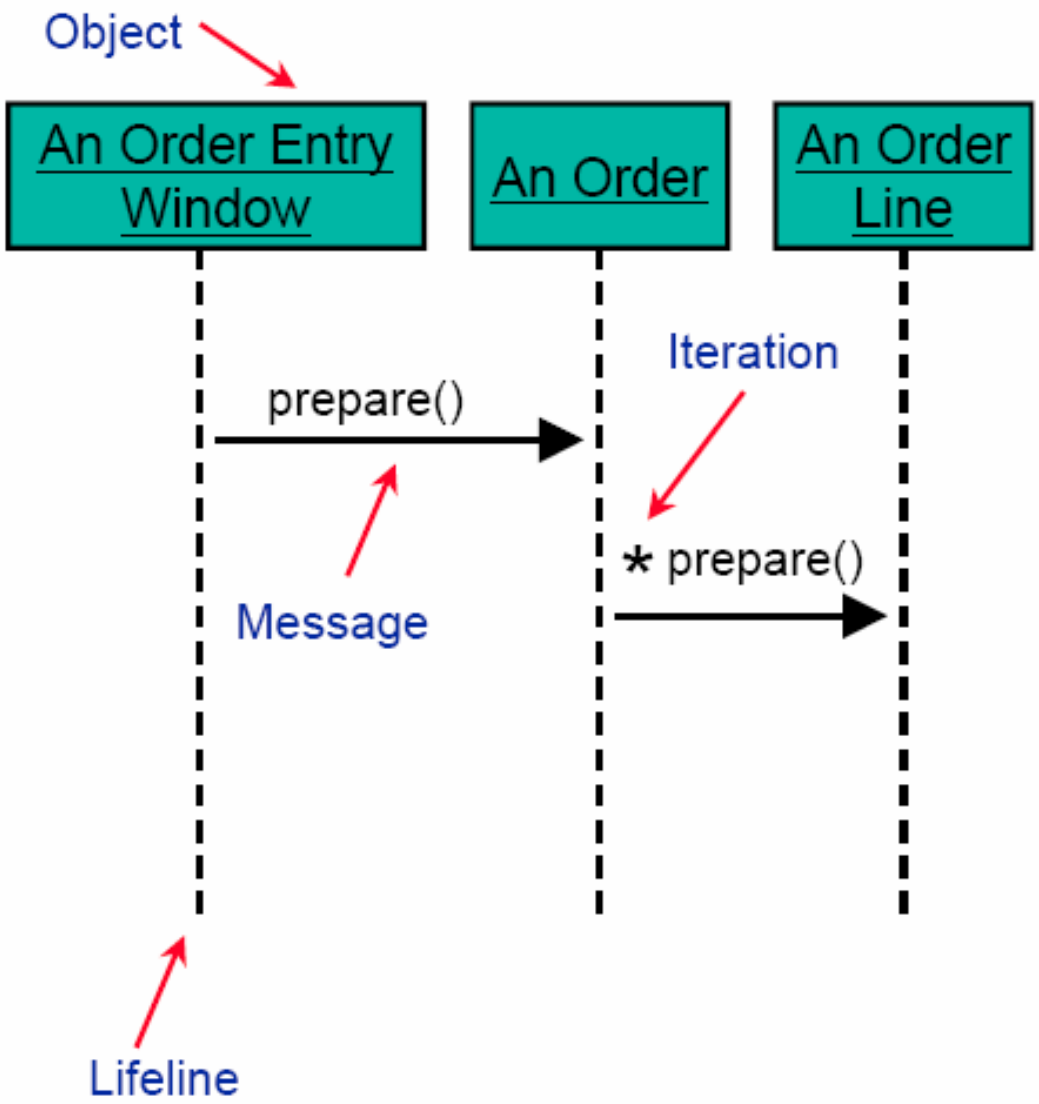



Behavior of the “order” use case:

- A customer orders several products.
- The (sub-)orders (“order lines”) for each product are prepared separately.
- For each product check the stock.
  - If the product is in stock, remove requested amount from stock.
  - If the product stock falls below a predefined level, reorder it.

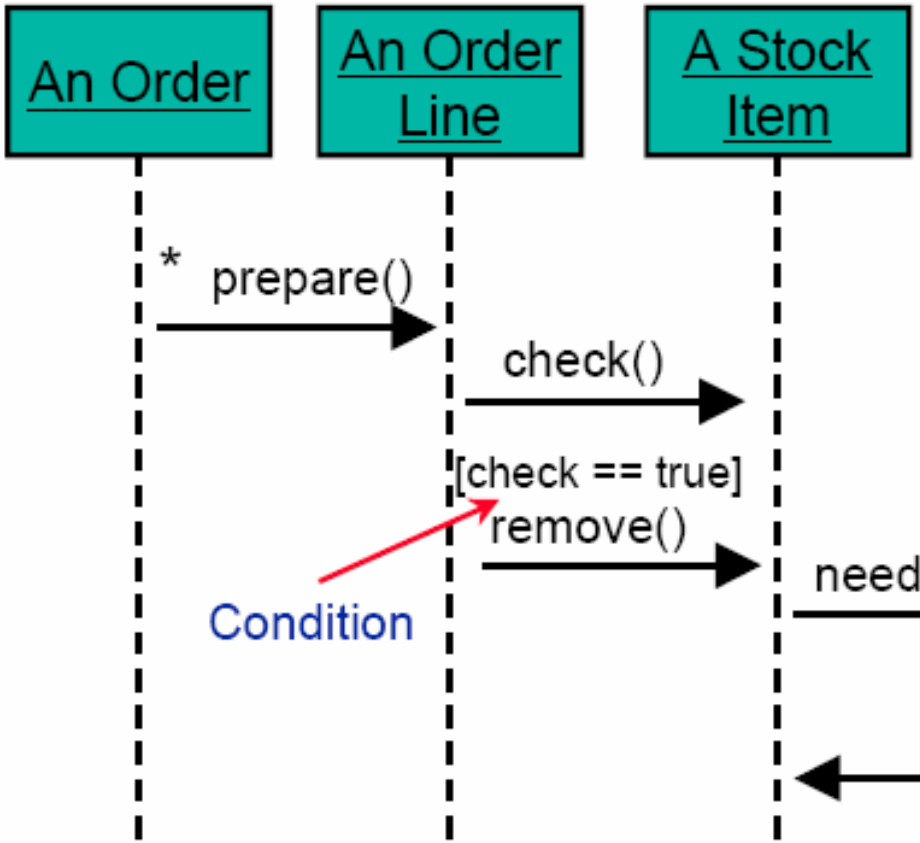
Note: The class diagram is prepared in parallel or before the interaction diagram!

# Sequence Diagrams (1)



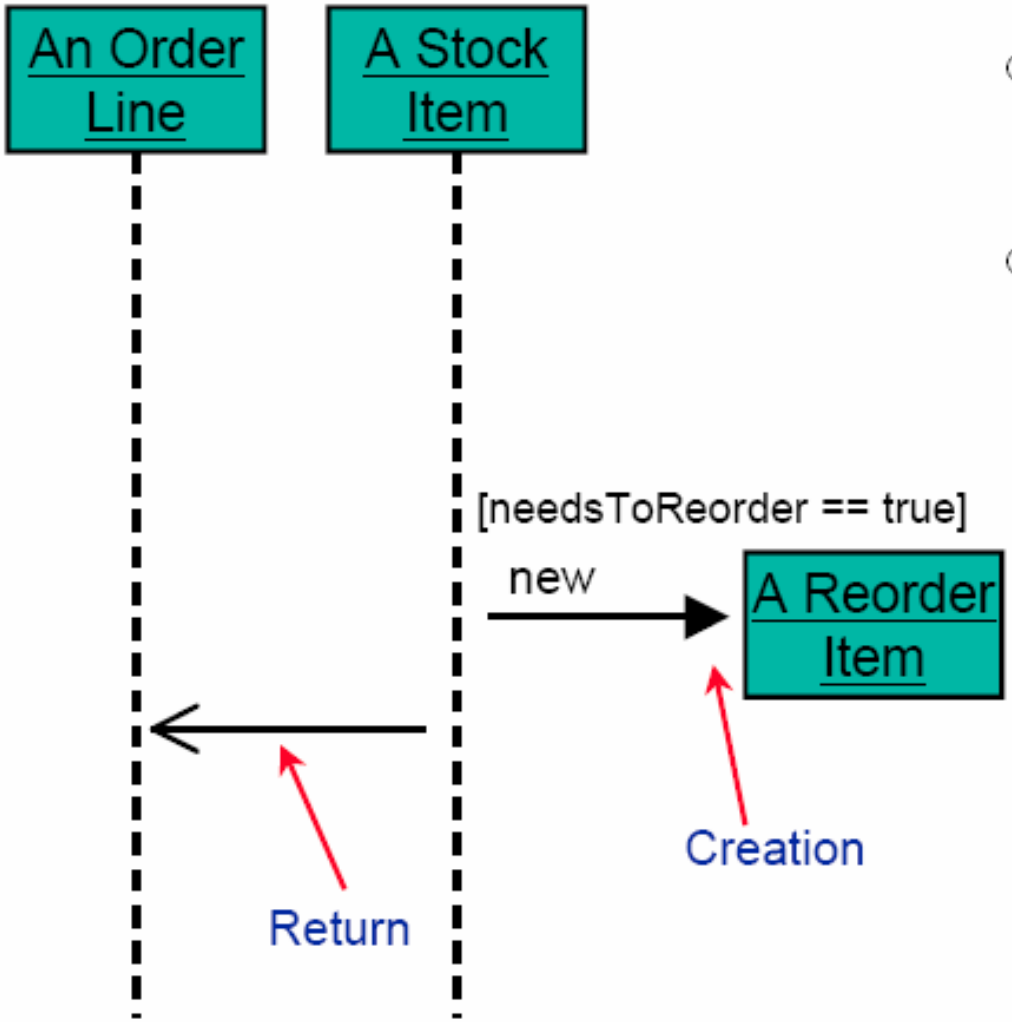

- The **objects** and **messages** are taken from the class diagram.
- The **lifeline** represents the object´s life during the interaction.
- **Messages** are represented by arrows between lifelines, labeled at minimum with the message name.
- To send a message between objects, there has to be an **association** between the classes in the class diagram.
- The **sequence** in which messages occur is shown top to bottom.
- The **iteration** marker indicates that a message is sent many times to multiple receivers.

# Sequence Diagrams (2)



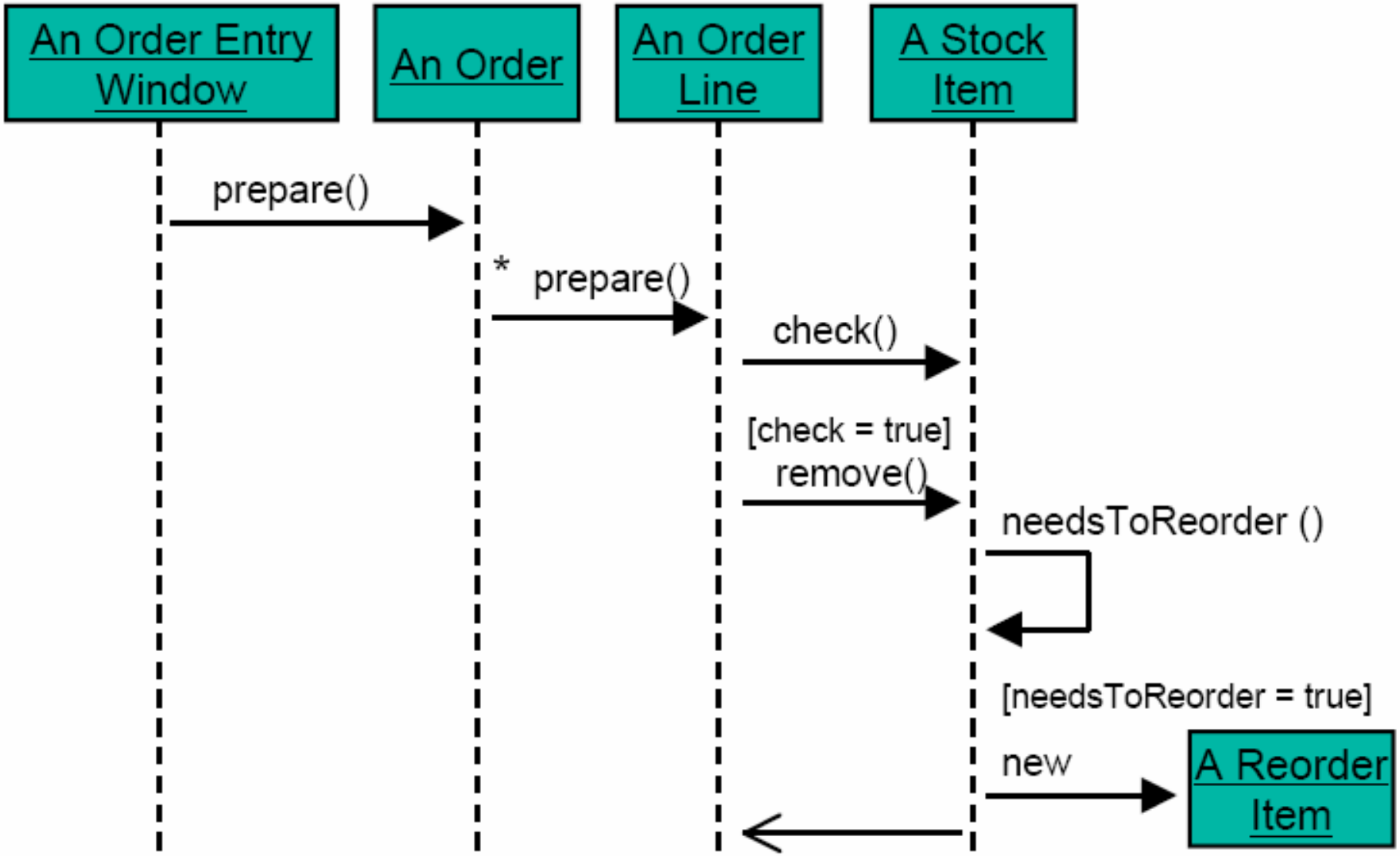

- **Conditions** report whether a message is sent or not.
- **Self-delegation** is used whenever an object sends a message to itself.

# Sequence Diagrams (3)

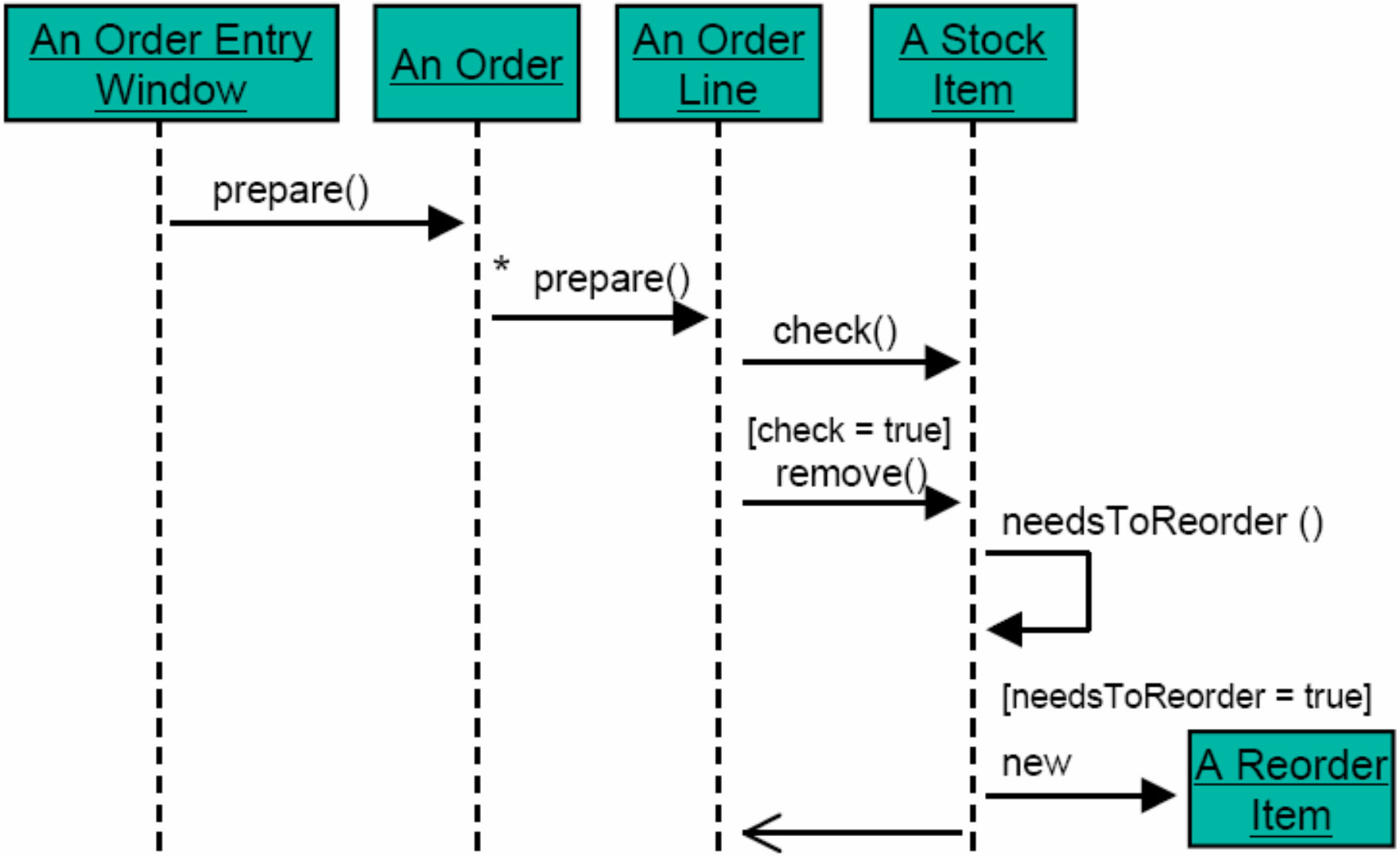



- **Creation** is whenever a new object appears below the starting level.
- **Returns** indicate the return of control after a message, **not** a new message.

# Sequence Diagrams (4)



# Sequence Diagrams (4)

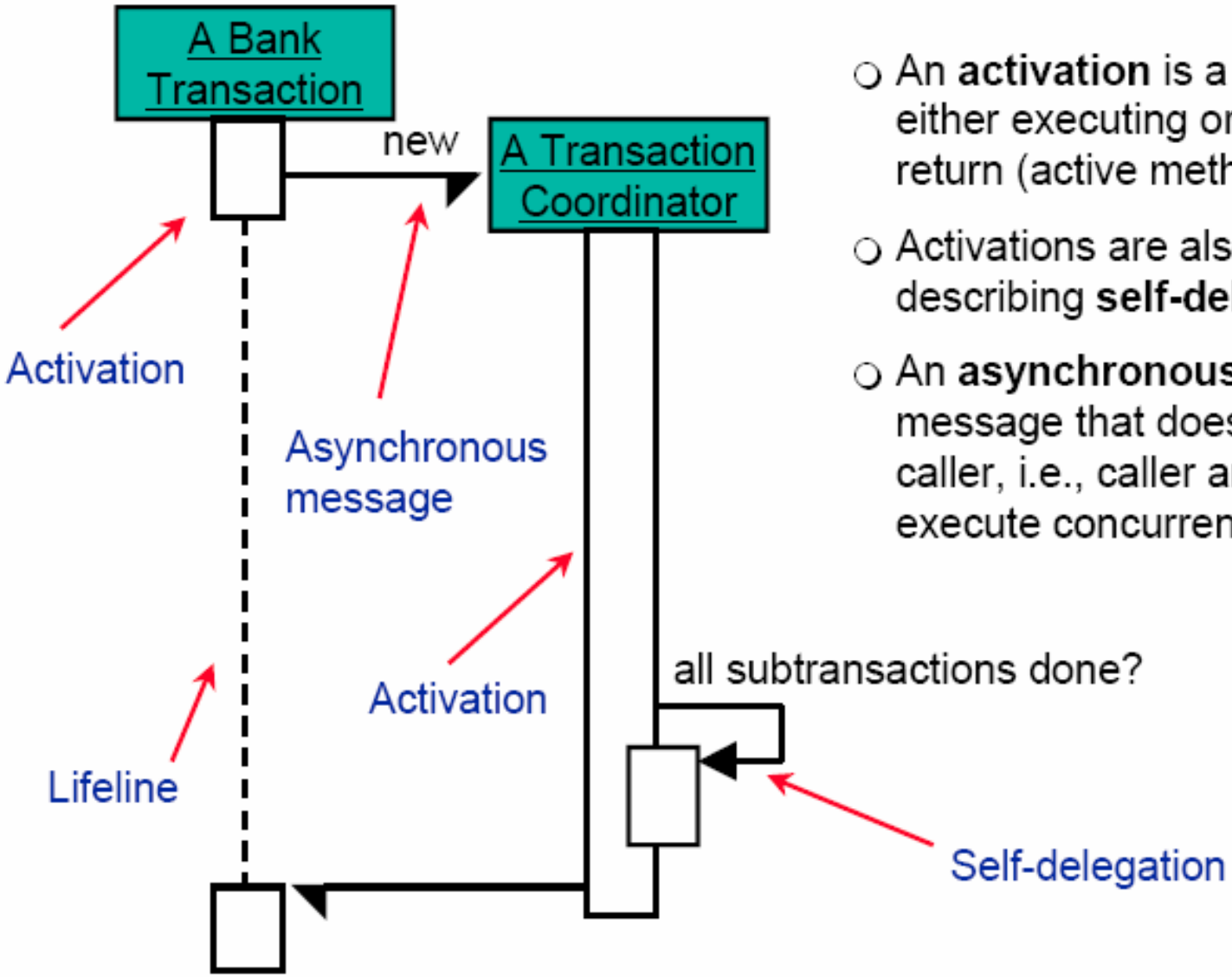


# Concurrency in Sequence Diagrams (1)

Example:

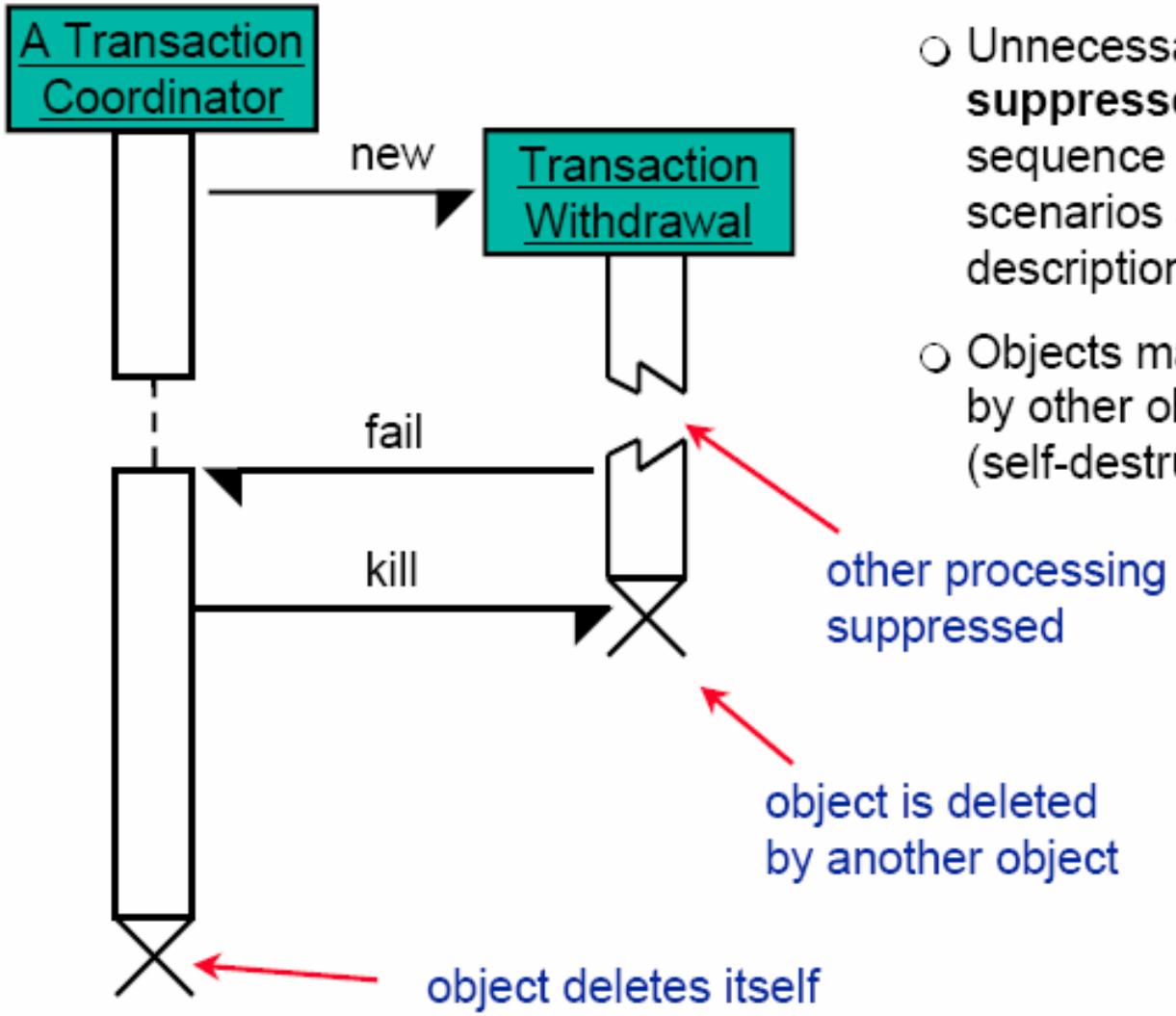
- A bank transaction transfers $100 from bank account #123 to #456.
  - Withdraw $100 from bank account #123.
  - Deposit $100 at bank account #456.
- Withdraw and deposit may be executed in parallel (concurrently).
- The transaction is only successful if both sub-transactions (withdraw and deposit) are successful.
- Therefore a transaction coordinator checks the successful completion of the concurrent sub-transactions.
  - Each time a sub-transaction completes successfully it checks if all other sub-transactions have been completed successfully. If this is the case, it reports success to its client.
  - If any sub-transaction fails, it cancels the other sub-transactions and reports failure to its client.

# Concurrency in Sequence Diagrams (2)



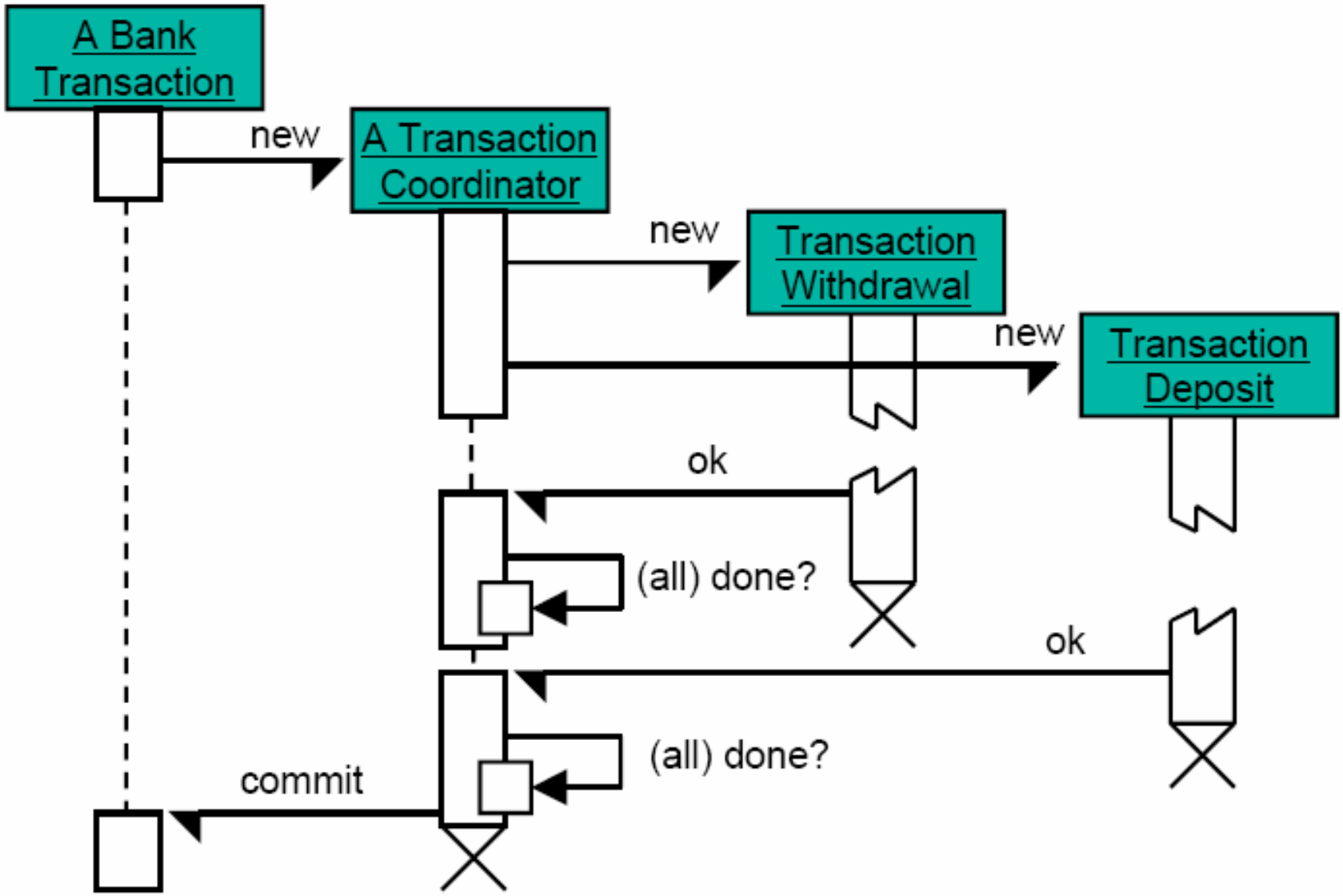

- An **activation** is a method that is either executing or waiting for a return (active method).
- Activations are also useful for describing **self-delegation**.
- An **asynchronous message** is a message that does not block the caller, i.e., caller and receiver execute concurrently.

# Concurrency in Sequence Diagrams (3)

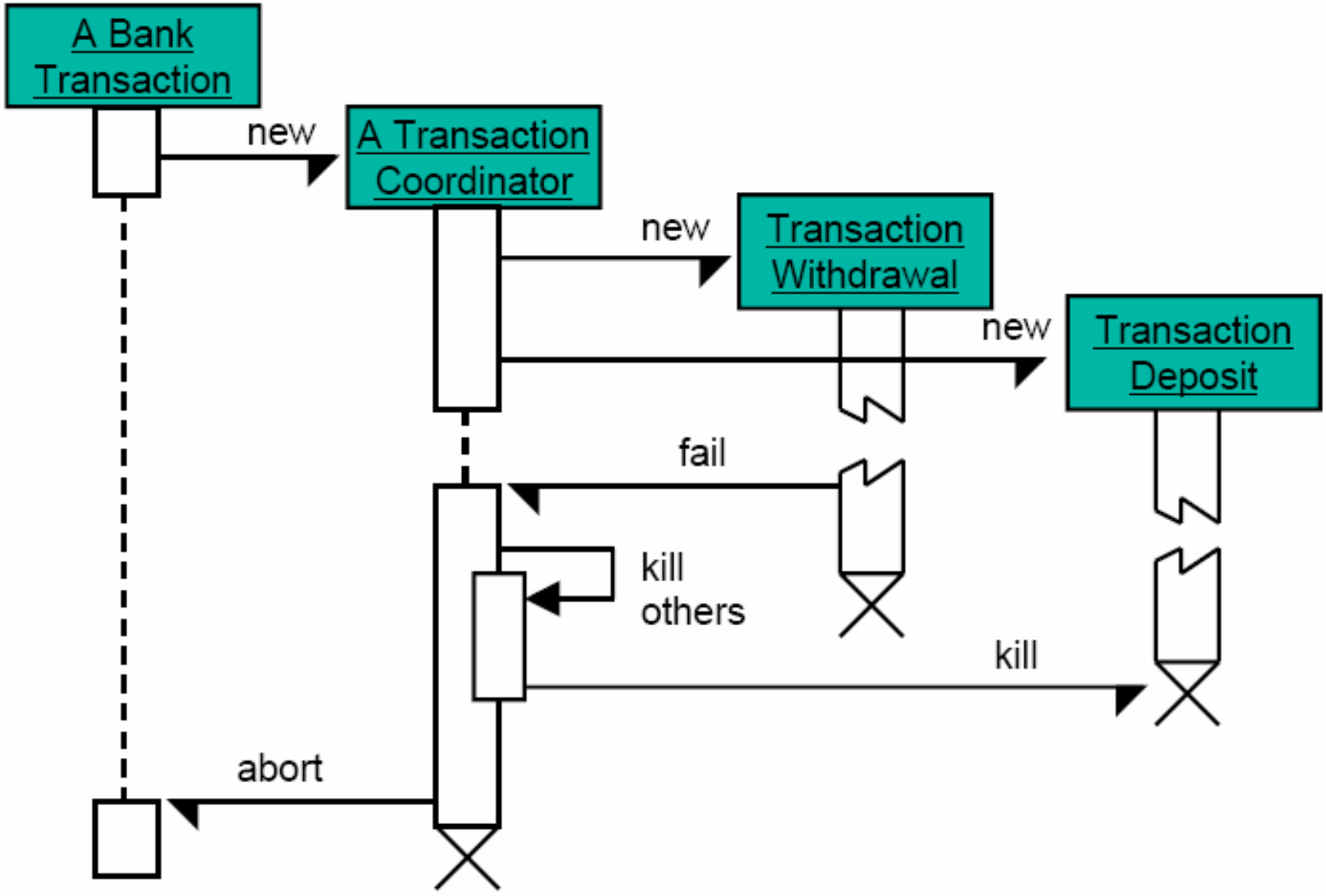



- Unnecessary **details** may be **suppressed**. Remember that sequence diagrams are only scenarios and not a complete description of the behavior.
- Objects may be **deleted explicitly** by other objects or by themselves (self-destruction).

# A Successful Bank Transaction



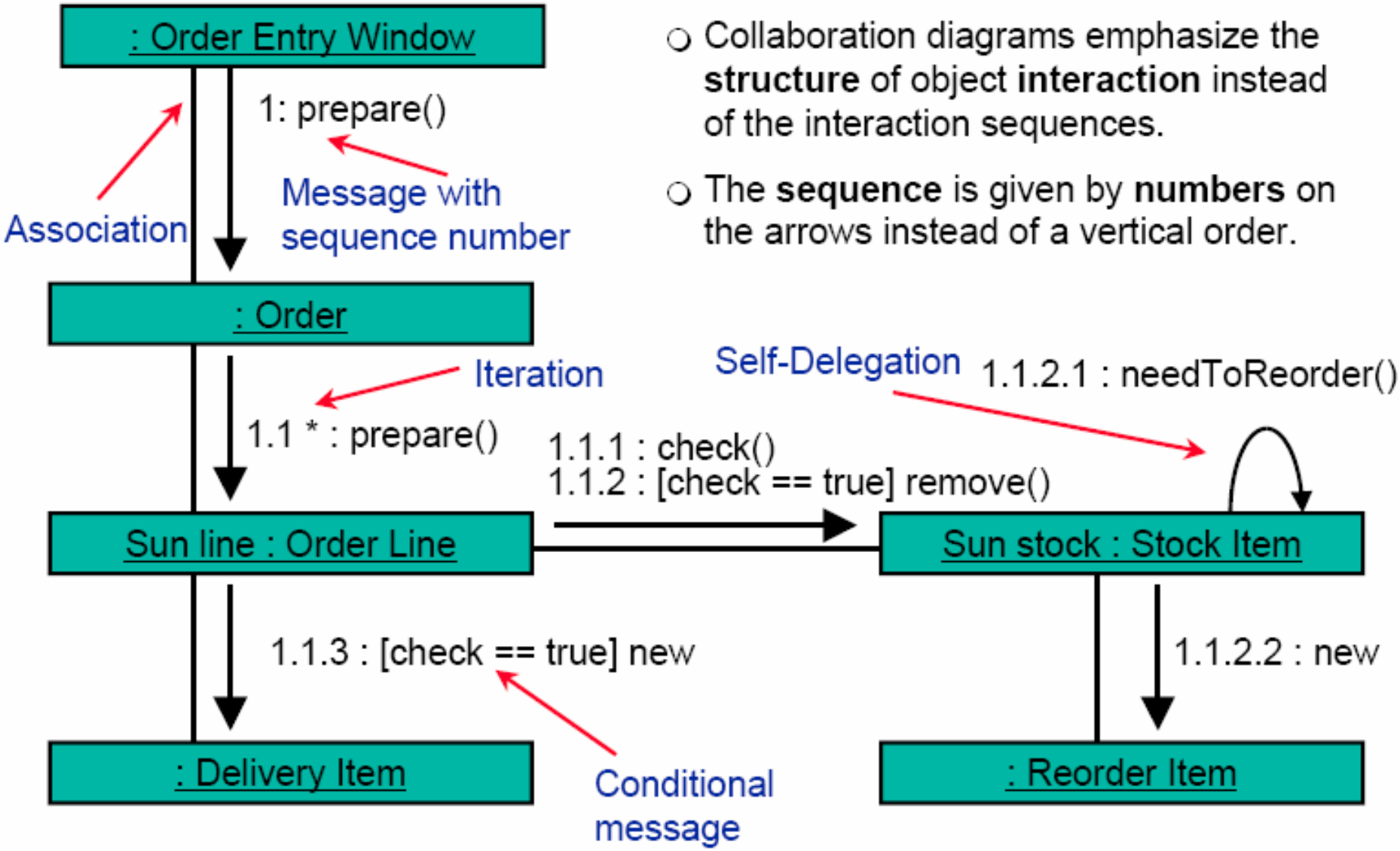
# A Failing Bank Transaction



# Collaboration Diagrams

- Dynamic behavior of objects can, in addition to sequence diagrams, also be represented by **collaboration** diagrams.
- The transformation from a sequence diagram into a collaboration diagram is a bidirectional function.
- The difference between sequence diagrams and collaboration diagrams is that collaboration diagrams emphasize more the structure than the sequence of interactions.
- Within sequence diagrams the order of interactions is established by vertical positioning whereas in collaboration diagrams the sequence is given by numbering the interactions.

# Collaboration Diagrams




- Collaboration diagrams emphasize the **structure** of object **interaction** instead of the interaction sequences.
- The **sequence** is given by **numbers** on the arrows instead of a vertical order.

# When to Use Interaction Diagrams

## Use Interaction Diagrams

- When catching user requirements:
  - Describe the behavior of several objects within a single use case.
  - Show collaborations among objects.
- After having described the object behavior completely with state and activity diagrams:
  - Test the state and activity diagrams against the scenarios.

## Do not Use Interaction Diagrams

- For precise definition of a single class behavior (use state diagrams).
- If you want to describe the behavior across many use cases or many threads (consider an activity diagram).

# Any Question?