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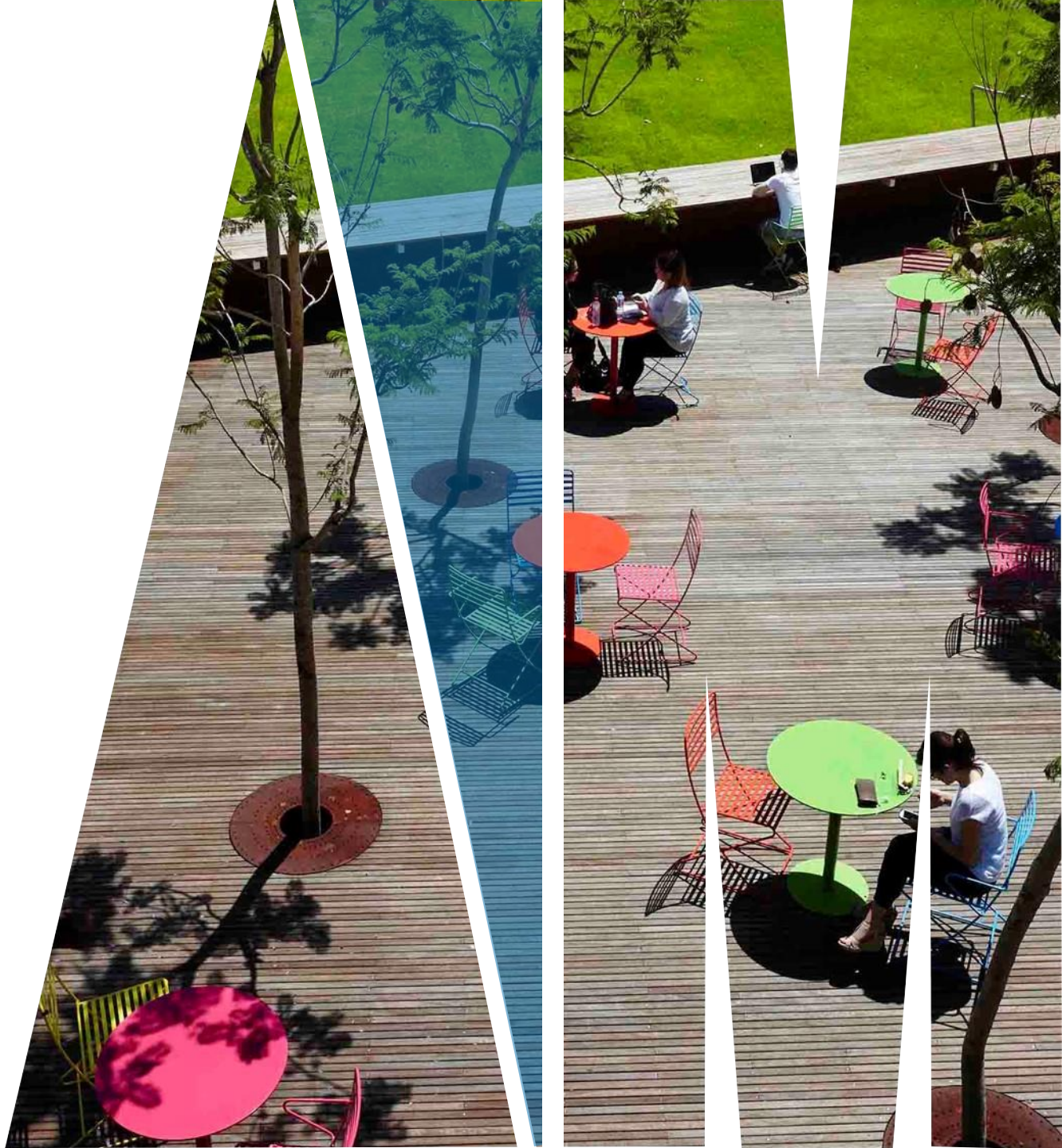
FIT2099 Object-Oriented Design and Implementation

Dynamic modelling



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Outline

Interaction diagrams

- Sequence diagrams
- Communication diagrams

DYNAMIC MODELLING

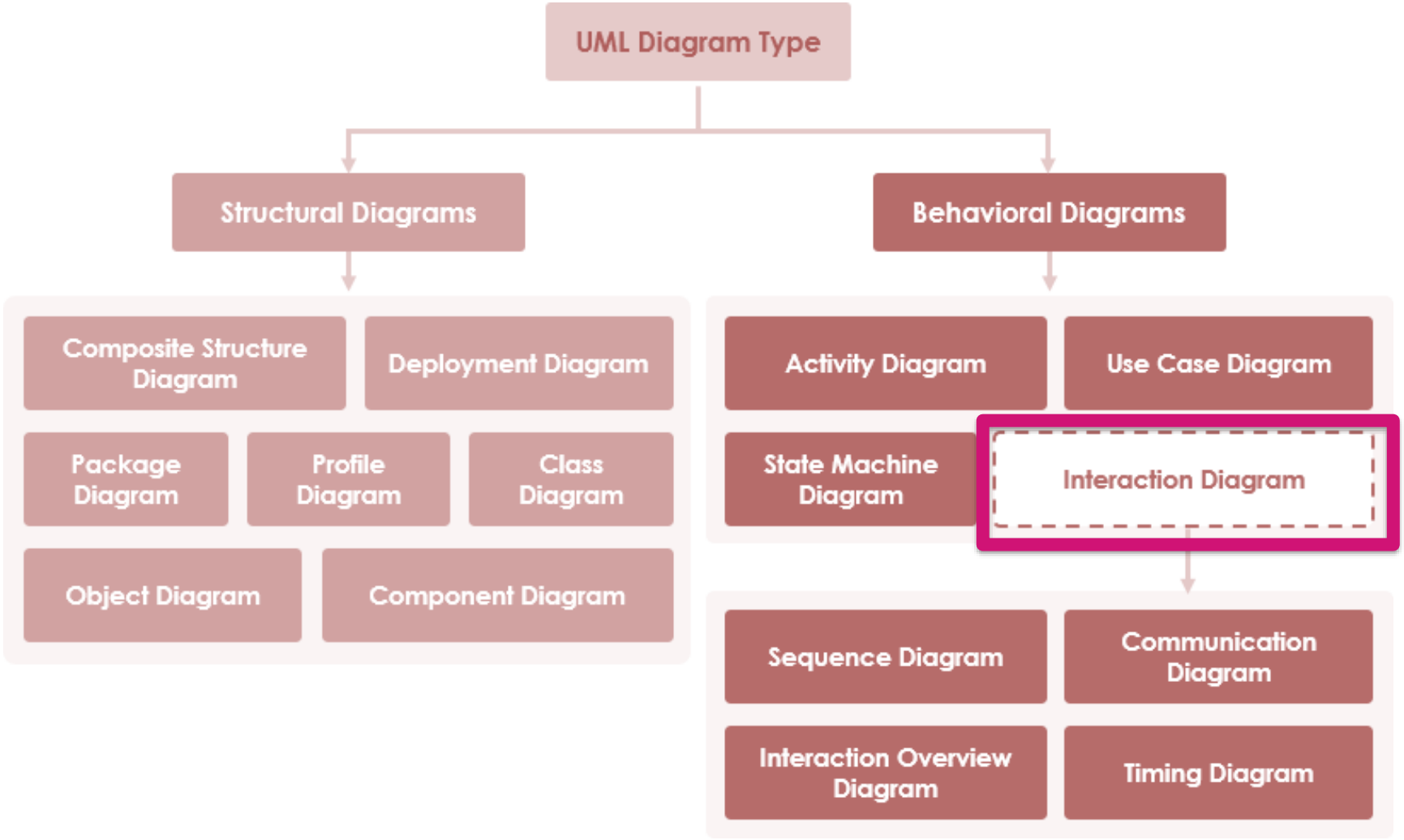
We have seen how you can design and document the **structure of a program**

- UML class diagrams
- UML package diagrams

But what about the way that classes **behave**?

- we need to understand **how classes interact**
- this is **how dependencies manifest** themselves when code is executed

DYNAMIC MODELLING



INTERACTION DIAGRAMS

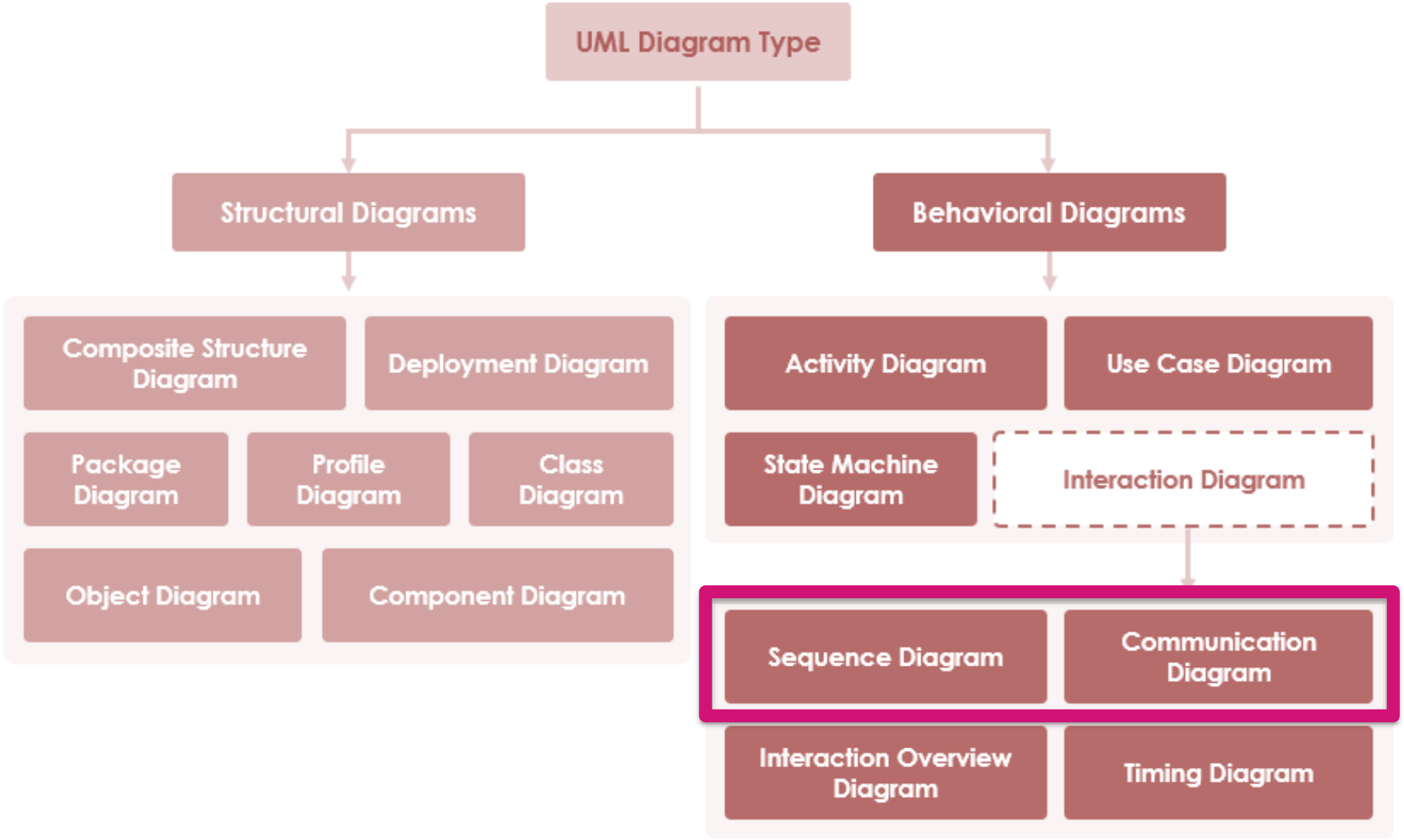
The UML supports several kinds of diagram that can be used to show the **dynamic behavior** of software

- **sequence** diagrams
- **communication** diagrams
- activity diagrams
- state diagrams

We will be looking at sequence diagrams and communication diagrams today

- collectively known as **interaction diagrams**

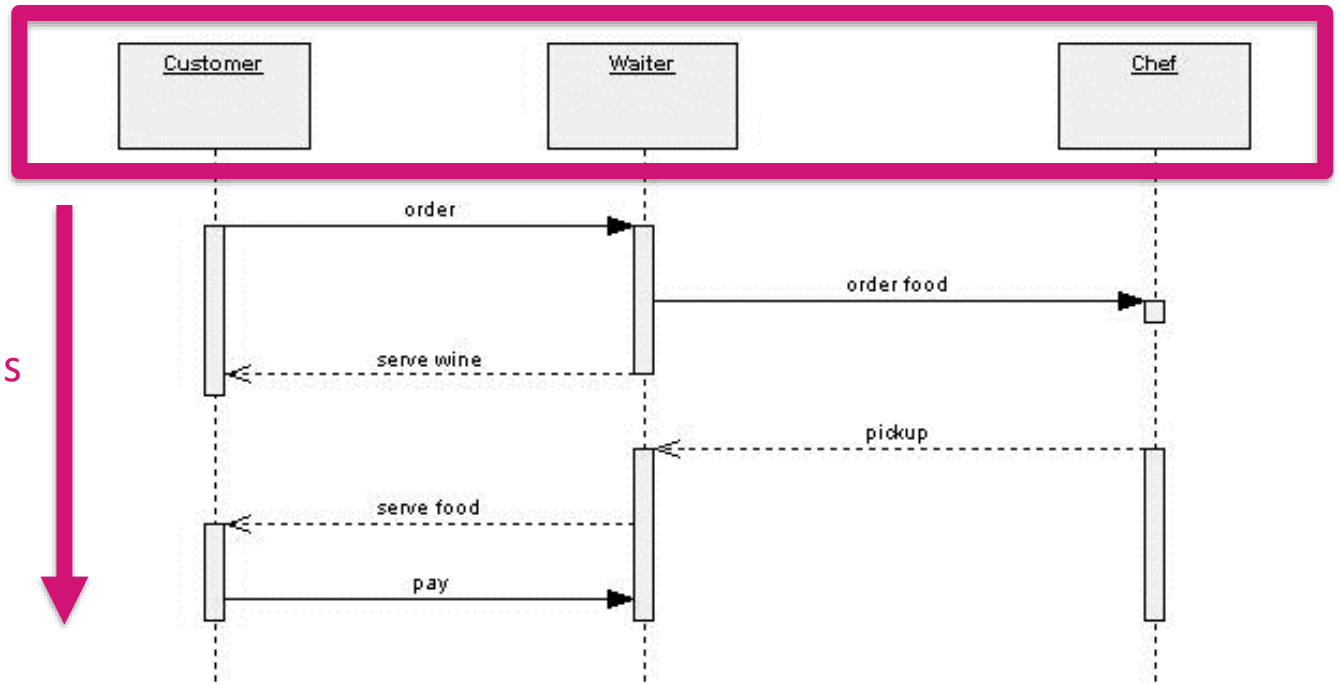
DYNAMIC MODELLING



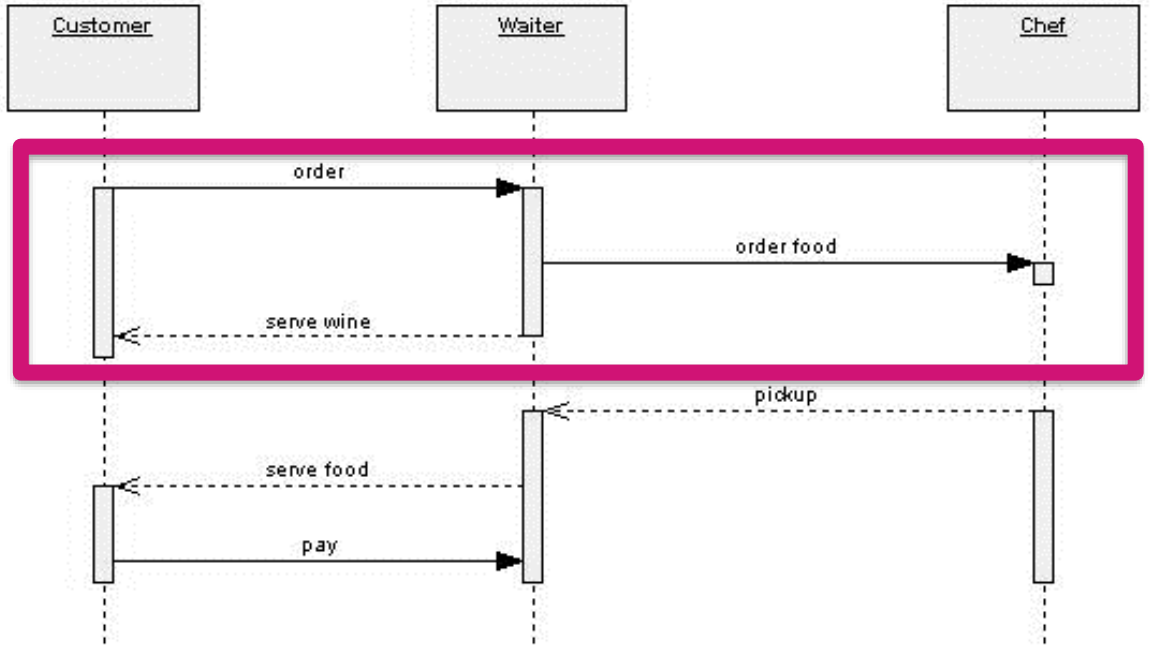
SEQUENCE DIAGRAMS

Classes

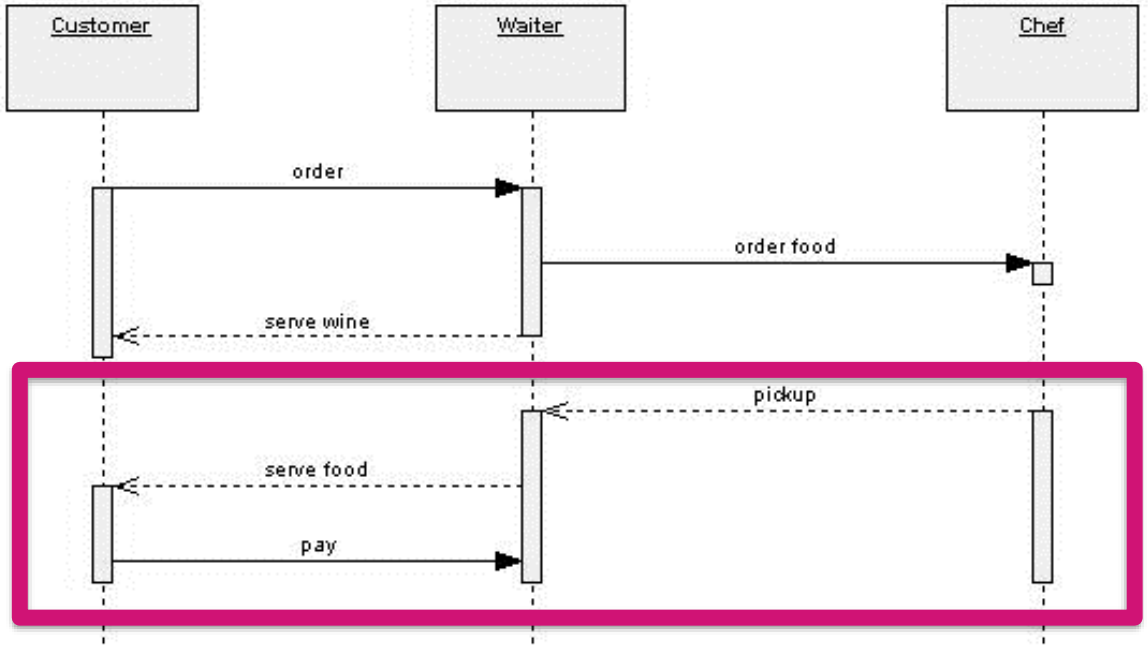
Method calls



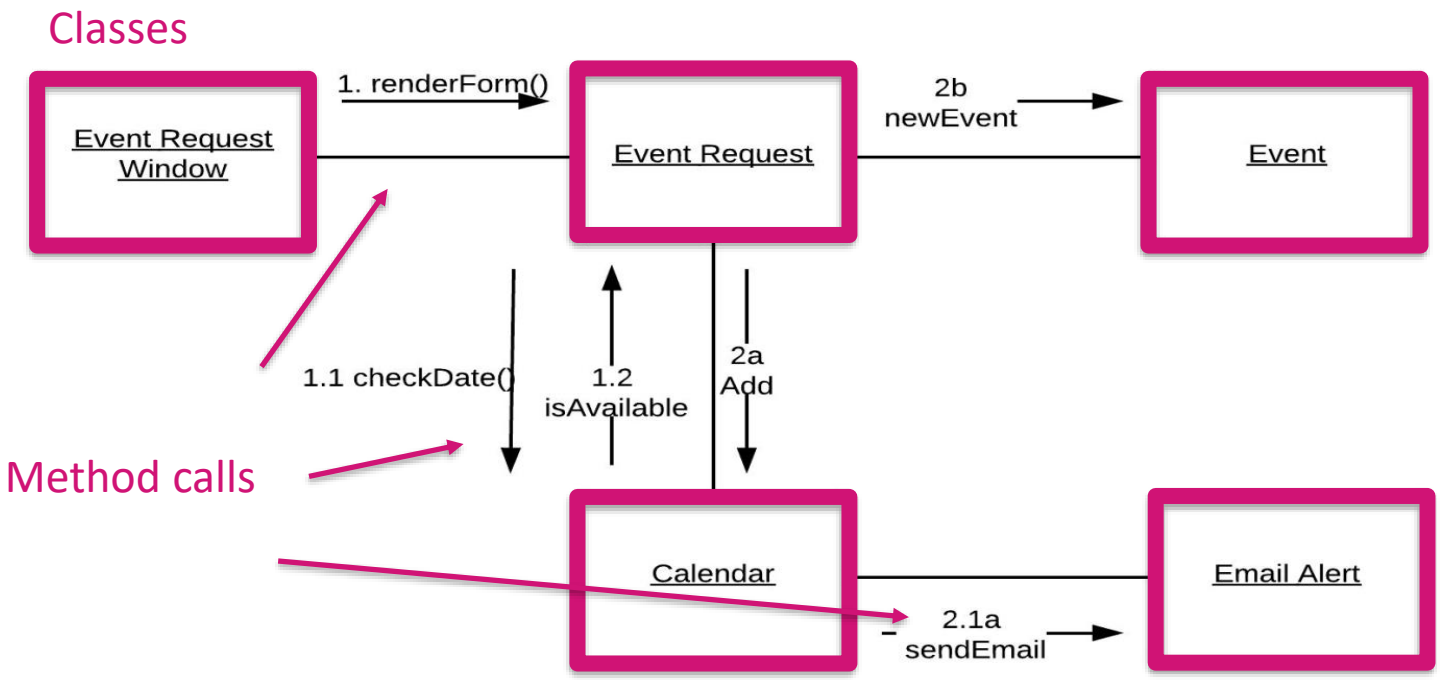
SEQUENCE DIAGRAMS



SEQUENCE DIAGRAMS



COMMUNICATION DIAGRAMS



SEQUENCE OR COMMUNICATION

Sequence diagrams are more commonly used than communication diagrams

- but they contain essentially **the same information**

Sequence diagrams are usually **easier to read**

Communication diagrams can be **easier to draw by hand**

- if you accidentally leave something out of a sequence diagram, it can be fiddly to fix
- if you're using a drawing tool, sequence diagrams usually have better support

You may use whichever you prefer

We will look at **sequence diagrams**

UML SYNTAX

CLASSES AND OBJECTS

Objects are represented by boxes

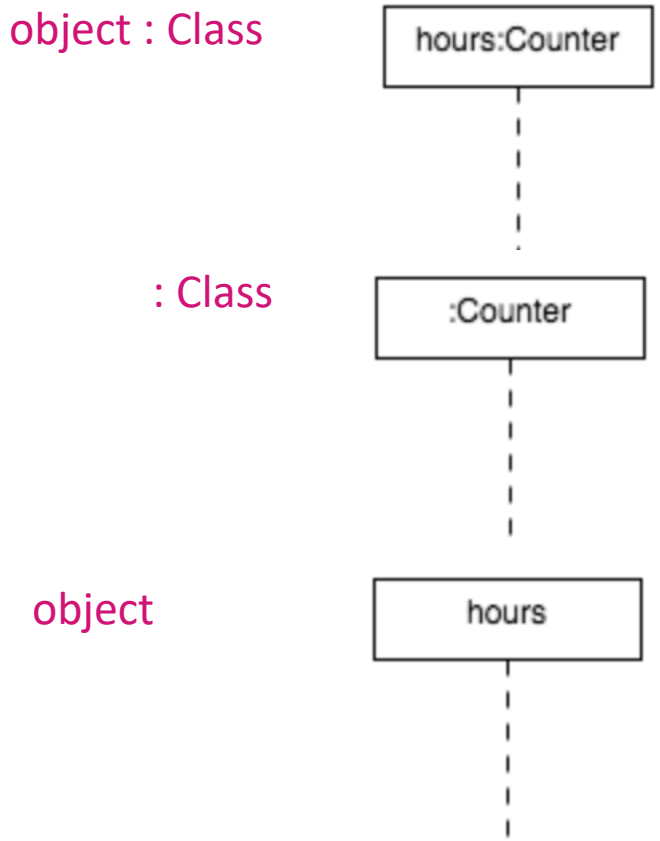
A label gives object name and/or class following the format:

objectName : ClassName

they are separated by a colon

can leave the colon out if the class isn't given

Class attributes should not be listed in this shape.

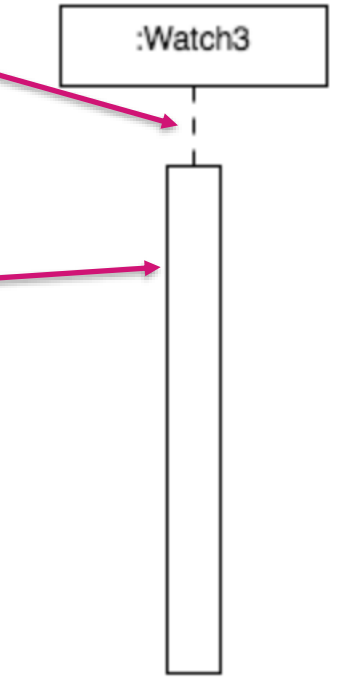


UML SYNTAX
LIFELINE AND ACTIVATION BARS

The dashed line dropping down from the classbox is called a ***lifeline***

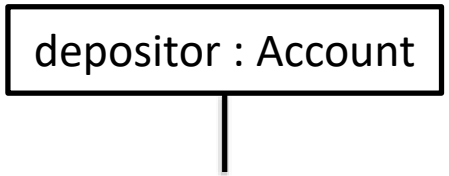
It represents the existence of the object

A thick line called an ***activation bar*** indicates that the object is active (i.e. a method is running in it). It also represents the time needed for an object to complete a task. The longer the task will take, the longer the activation box becomes.

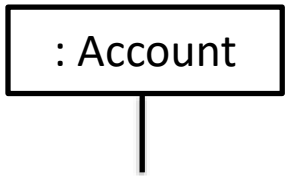


UML SYNTAX

CLASSES AND OBJECTS EXAMPLES

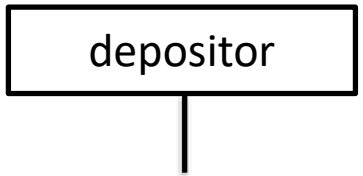


"An object of class Account, named 'depositor'"



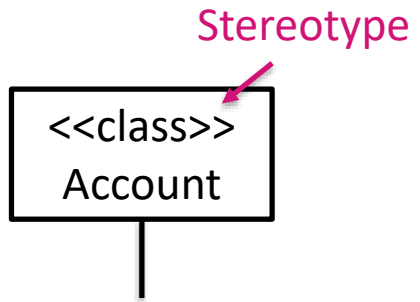
"A nameless object of class Account"

- can't refer to it elsewhere in the diagram
- common 'error' – leaving out the colon



"An object named 'depositor', its type doesn't matter"

- rarely used correctly

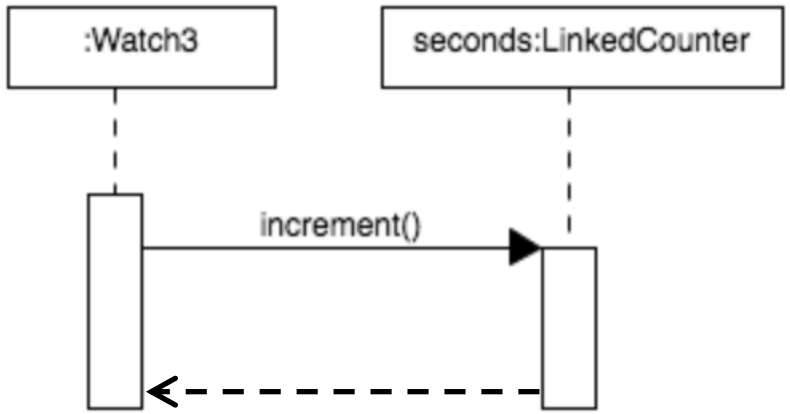


"The Account class"

- can only receive messages via static methods
- Stereotype lets you distinguish from typeless objects

UML SYNTAX

CLASSES AND OBJECTS EXAMPLES



Messages are indicated by arrows

- **solid arrow head** indicates that the caller will wait for a return before it will proceed
- **open arrow head** indicates that the caller won't wait for a return

The arrow is labelled with the **name of the method**

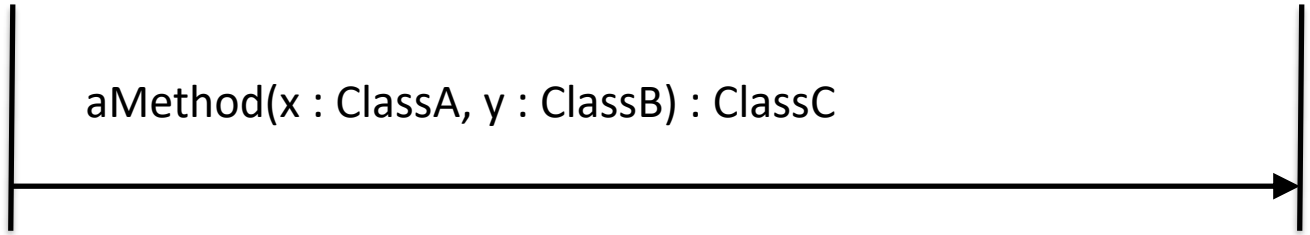
- **include parameters** if there are any

Returns are indicated by an **open headed arrow with a dashed line**

- **may** be labelled with the name of the object returned (if any)

UML SYNTAX

MESSAGE SYNTAX



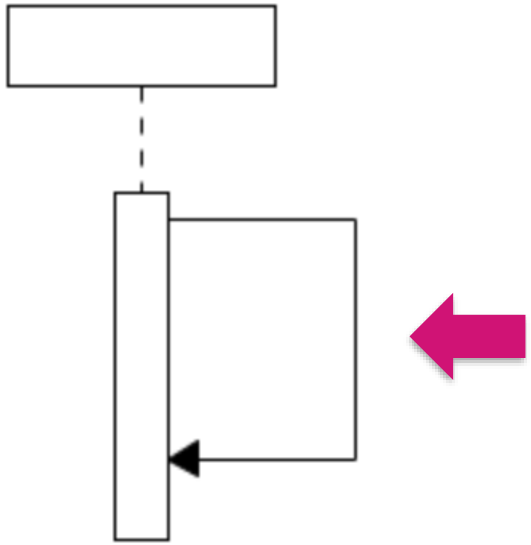
1. Client object (left) calls **aMethod** in supplier object (right) or class.
2. Parameters are a ClassA named **x** and a ClassB named **y**.
3. The method returns an **instance of ClassC**

Parameter *names* are **optional**. If present, they should match the names of the corresponding lifelines

Parameter *types* are **required**, and so is the return type

UML SYNTAX

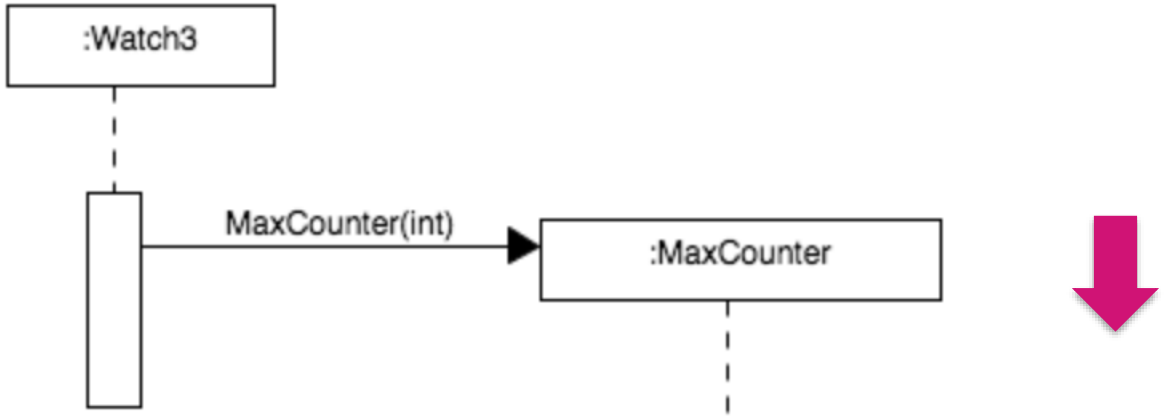
REFLEXIVE MESSAGES



Objects can call methods on (i.e. send messages to) **themselves**

Show this as an arrow pointing back to the same object's lifeline

UML SYNTAX
CREATING OBJECTS



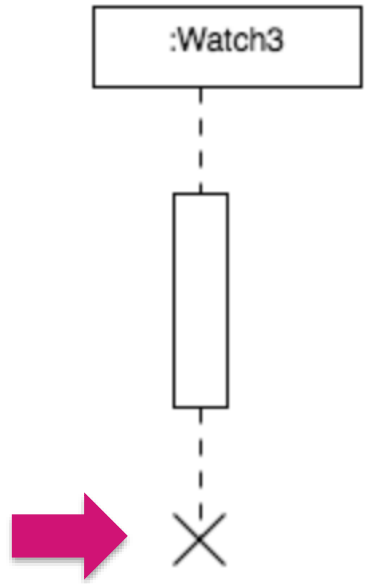
To show that a new object is created, you can drop the object symbol to show the **time of creation**

- This image shows an instance of a class called MaxCounter being created
- The message symbol is labelled with the **constructor signature**: MaxCounter(int)
- The message symbol can also be labelled with **<<create>>** instead of showing the constructor call

UML SYNTAX
DELETING OBJECTS

You can show the end of the life of an object by terminating its lifeline with an **X**

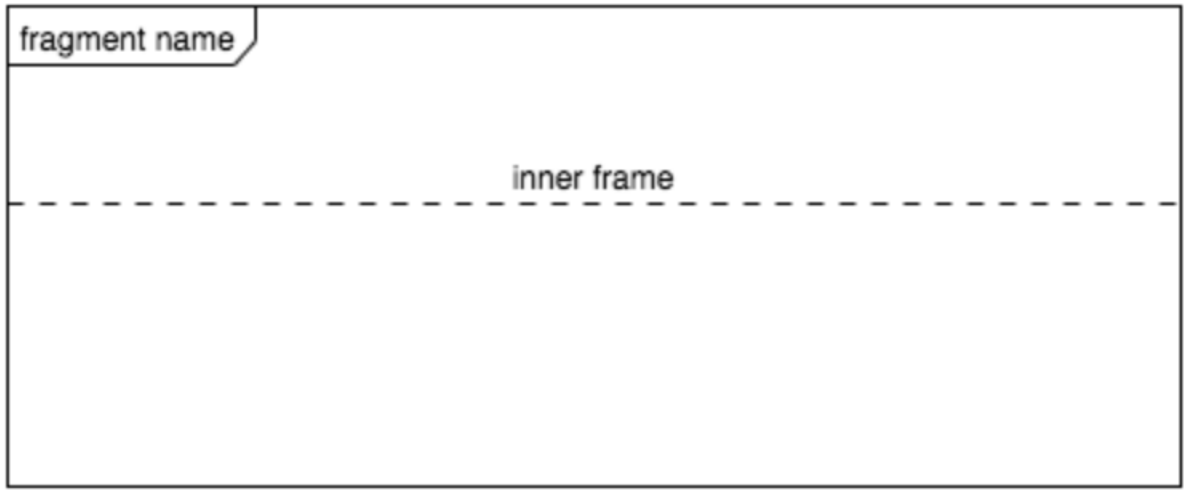
This image shows an instance of Watch3 class being terminated



UML SYNTAX
FRAGMENTS

You can use a **fragment** to group a collection of messages

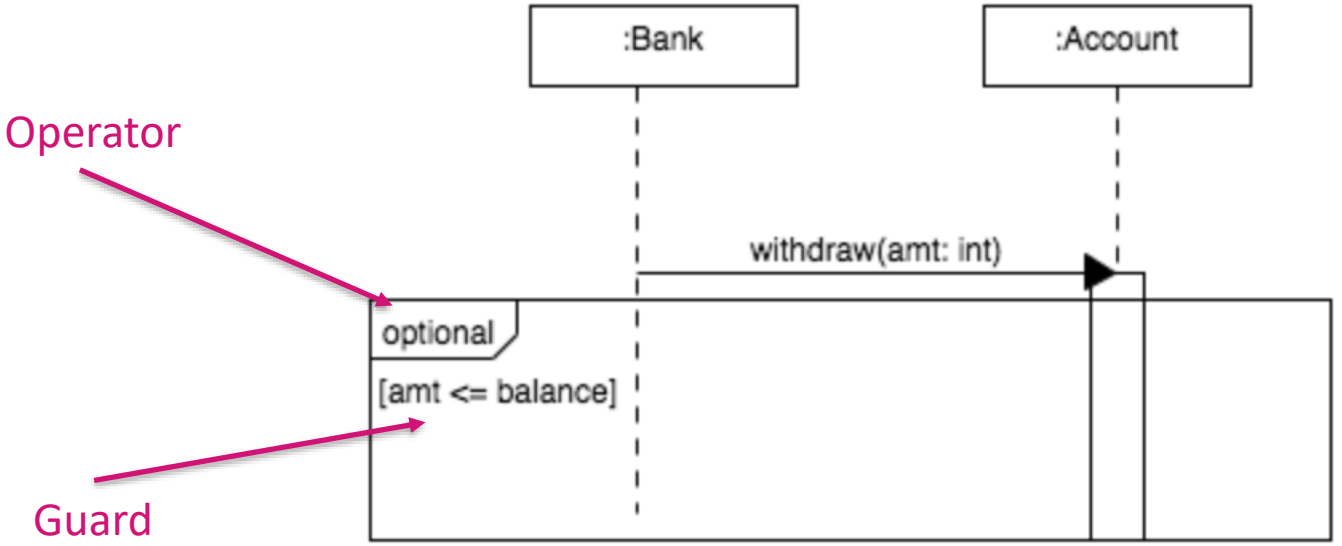
There are several kinds of fragments



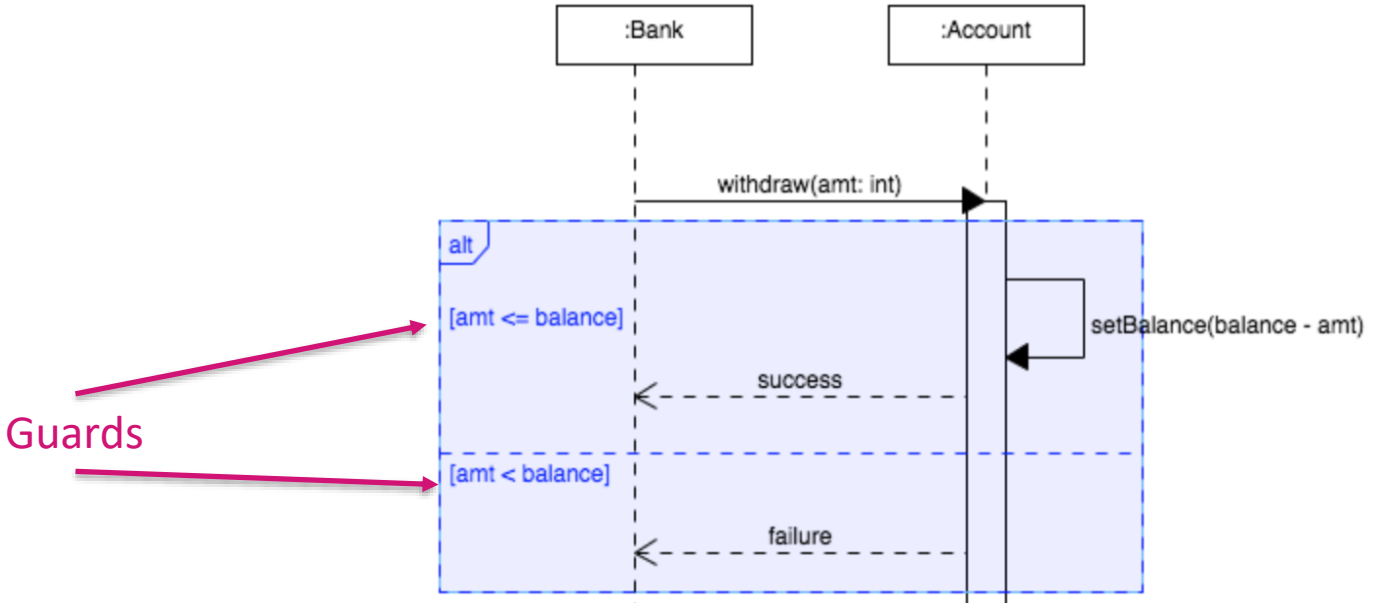
UML SYNTAX
OPTIONAL EXECUTION

The **opt** or **optional** fragment indicates that what is inside the freagment is executed only if the supplied condition is **TRUE**.

State the condition of execution in a **guard** on the left side, in square brackets



UML SYNTAX
CONDITIONAL EXECUTION

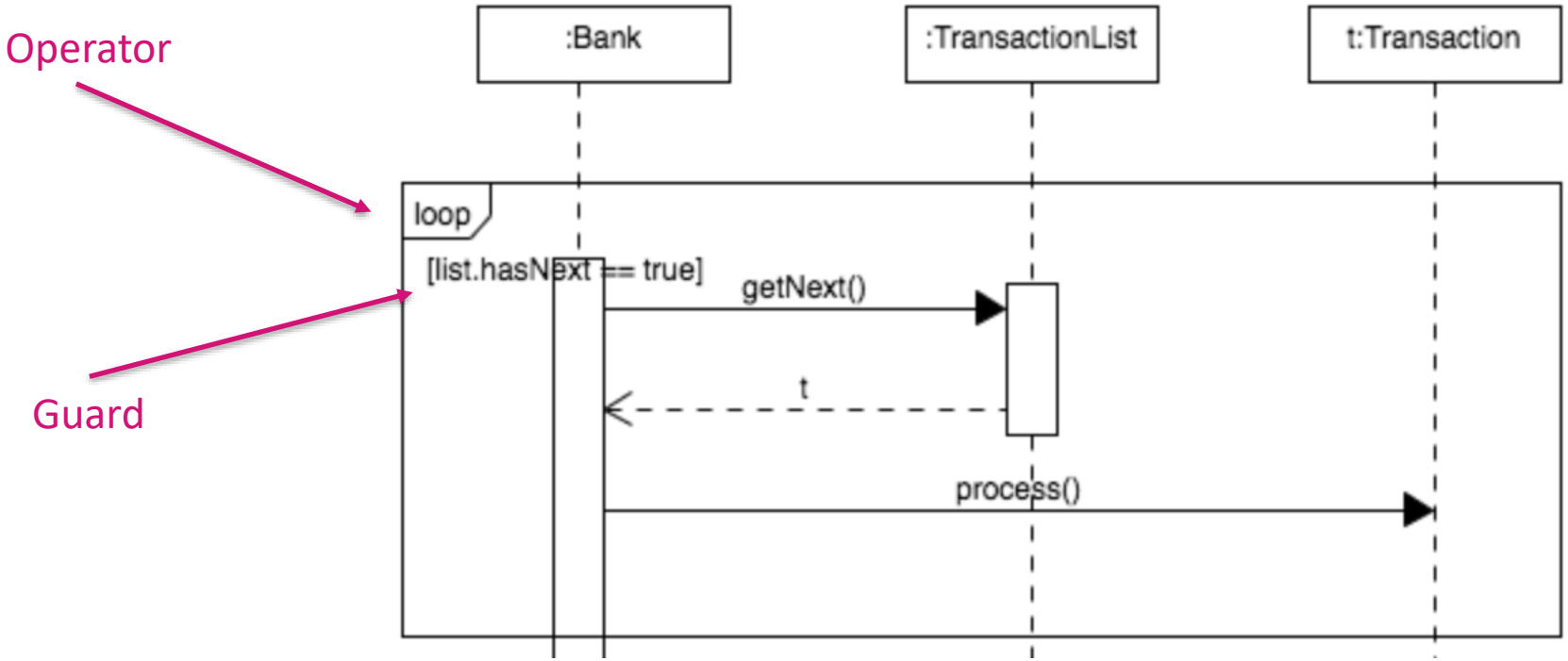


If there are **two or more alternatives** rather than a single optional component, use an **alt** or **alternative** fragment

- Syntax is **similar to the opt fragment**
- Separate alternatives with a **horizontal dashed line**

UML SYNTAX
ITERATION

Use a **loop** fragment for iteration



COMPLICATED

OPERATIONS

You can **nest fragments**

- so you can put an opt inside a loop inside an alt, etc.

But there are limits…

- it gets ***very* hard** to read this if you need to do a lot of nesting
- the syntax is **legal** UML but that doesn't mean it will be **legible**
- does not deal well with **complex** or **recursive** algorithms
- if algorithm is complicated, choose a different notation (e.g. **pseudocode**)

EVOLUTION OF INTERACTION DIAGRAMS

Can also use interaction diagrams for **analysis purposes**

- they can be used to document any sequence of interactions, not just in software

Typically, if used for analysis or **for early design**, notation is less formal

- can't use method names and signatures if these have not yet been decided upon, or if documenting a manual process
- under these circumstances it's okay to **describe messages in ordinary English** rather than as method calls

As design evolves and becomes clearer, the interaction diagram **should become more formalised**

- for your **Assignment 1,** you should try to get as close as possible to your final method names and signatures

Summary

Interaction diagrams

- **Sequence** diagrams
- Communication diagrams

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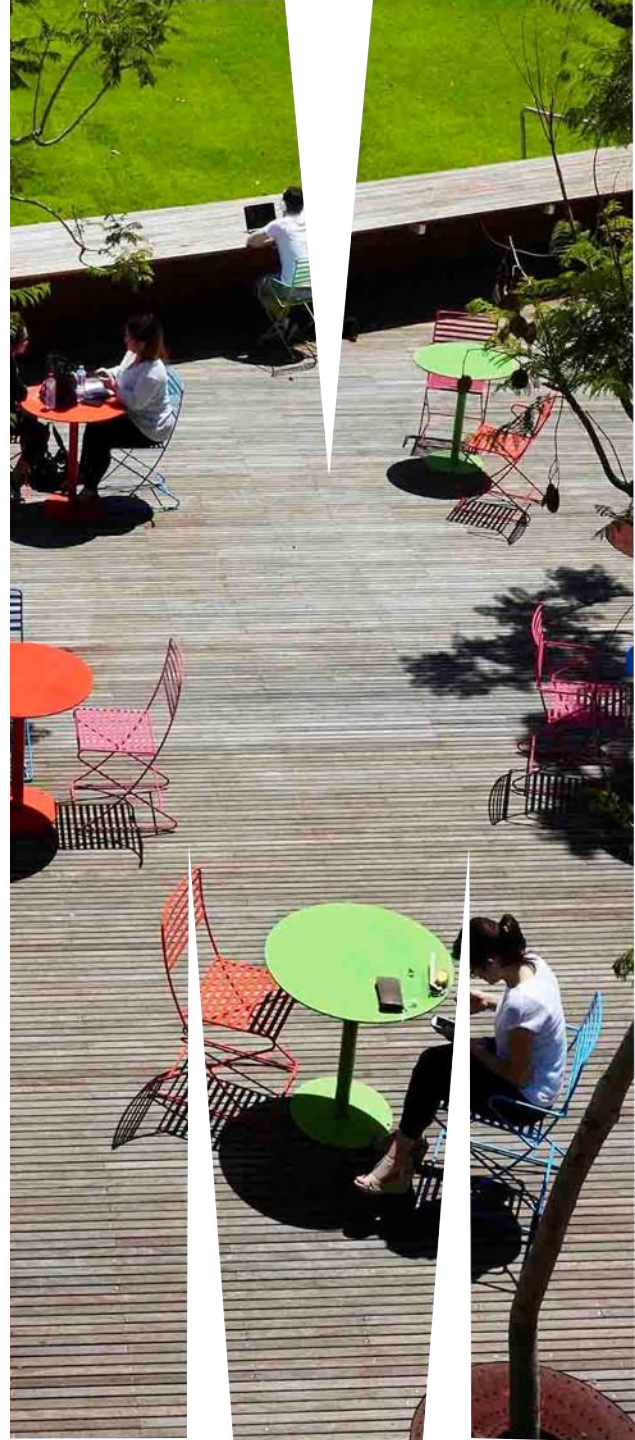
Thanks



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