02291: System Integration
Sequence Diagrams
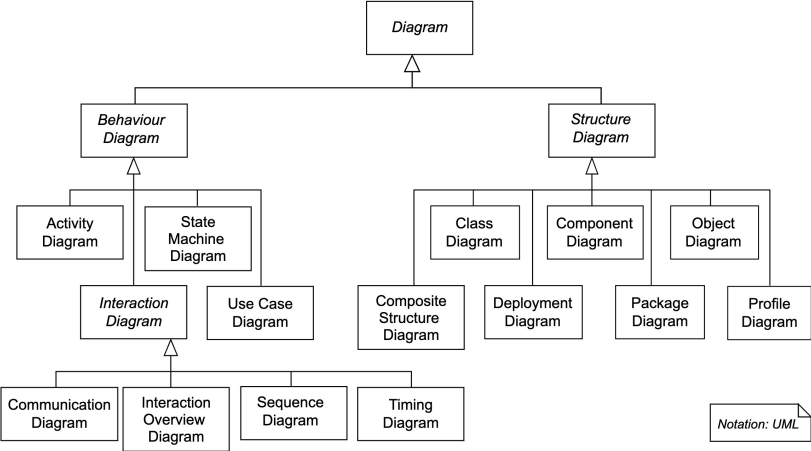
Hubert Baumeister
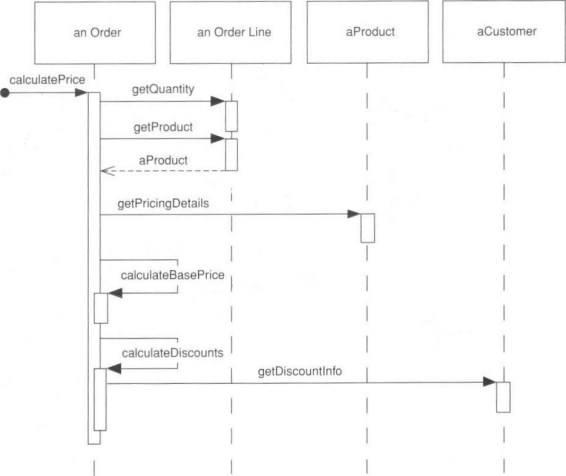`huba@dtu.dk`

DTU Compute
Technical University of Denmark

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UML diagrams

Diagram

Behaviour Diagram

Structure Diagram

Activity Diagram

State Machine Diagram

Interaction Diagram

Use Case Diagram

Class Diagram

Component Diagram

Object Diagram

Composite Structure Diagram

Deployment Diagram

Package Diagram

Profile Diagram

Communication Diagram

Interaction Overview Diagram
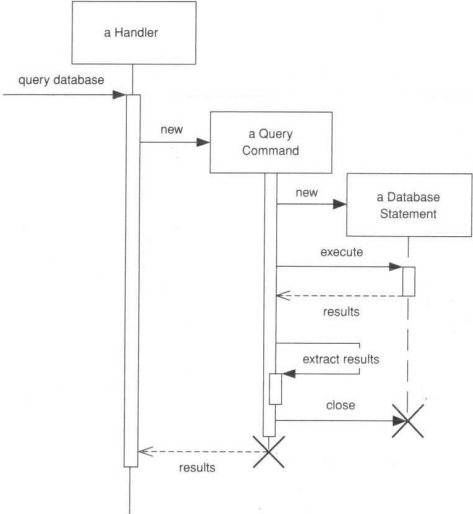
Sequence Diagram

Timing Diagram

Notation: UML

Wikipedia

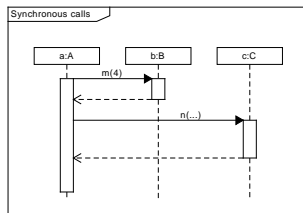# Example Sequence Diagram

Creation and deletion of participants
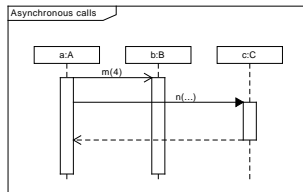
Synchronous vs Asynchronous calls

Synchronous: caller waits

```
b.m(4);
c.n(...) // Starts after m has returned
```
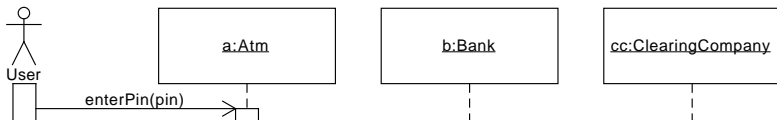

Asynchronous call: caller does not wait

```
new Thread(() -> {b.m(4);}).start();
c.n(...) // Starts immediately after m has been called
```
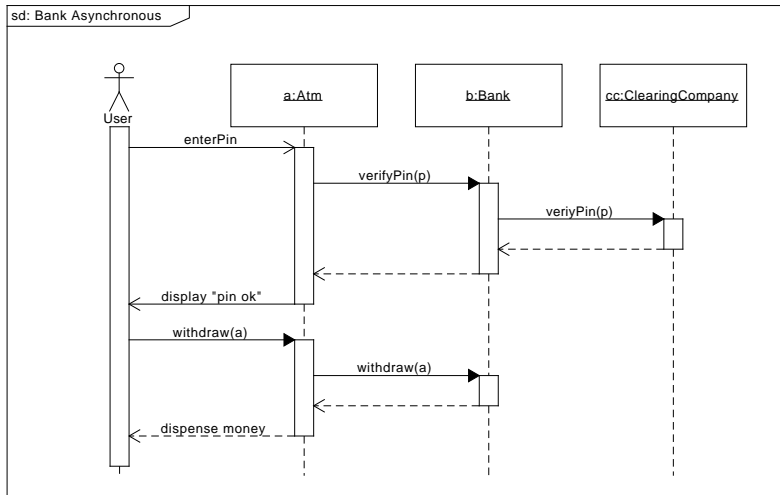
Exercise

- Stop the video
- Create a sequence diagram for the ATM, Bank, and Clearing Company example
    1. synchronous version
    2. asynchronous version
- Continue the video to see the solution

Start with:
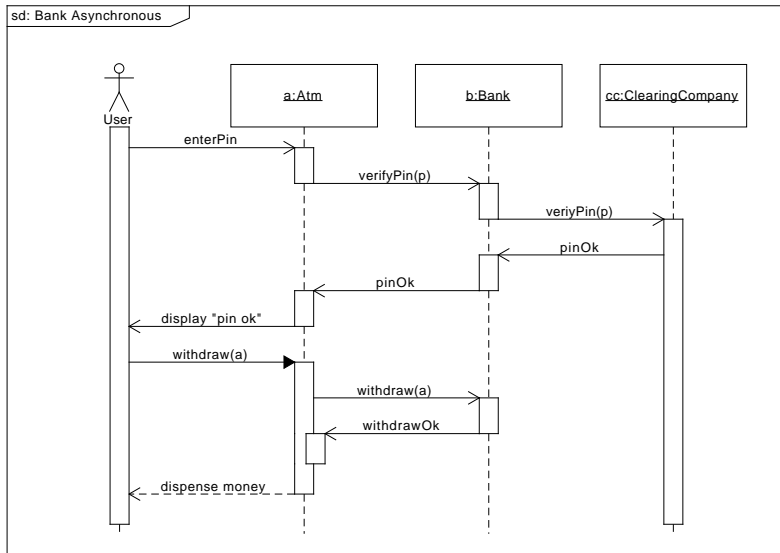
ATM to Bank: Synchronous Version

sd: Bank Asynchronous

User → a:Atm → b:Bank → cc:ClearingCompany

- enterPin
- verifyPin(p)
- veriyPin(p)
- display "pin ok"
- withdraw(a)
- withdraw(a)
- dispense money
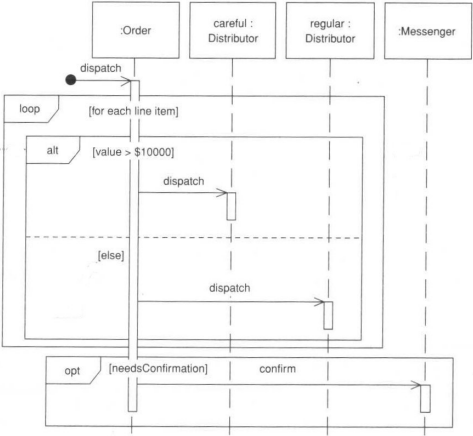
ATM to Bank: Asynchronous Version

Interaction Frames Example

Realising an algorithm using a sequence diagram

```java
public void dispatch() {
  for (LineItem lineItem : lineItems) {
    if (lineItem.getValue() > 10000) {
      careful.dispatch();
    } else {
      regular.dispatch();
    }
  }
  if (needsConfirmation()) {
    messenger.confirm();
  }
}
```

Realisation with Interaction Frames

Interaction Frame Operators

Operator	Meaning
alt	Alternative multiple fragments; only the one whose condition is true will execute (Figure 4.4).
opt	Optional; the fragment executes only if the supplied condition is true. Equivalent to an alt with only one trace (Figure 4.4).
par	Parallel; each fragment is run in parallel.
loop	Loop; the fragment may execute multiple times, and the guard indicates the basis of iteration (Figure 4.4).
~~region~~ critical	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 on another diagram. The frame is drawn to cover the lifelines involved in the interaction. You can define parameters and a return value.
sd	Sequence diagram; used to surround an entire sequence diagram, if you wish.

Nested sequence diagrams
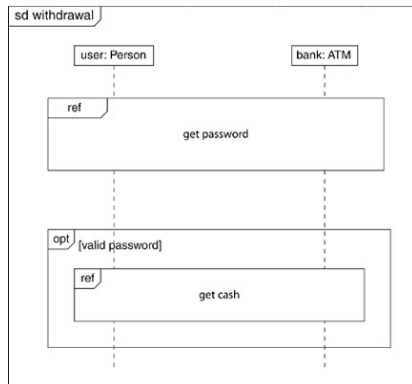
- Usages of sequence diagrams:
    - show the execution (i.e. exchange of messages) of a system
- Examples
    - Design (c.f. CRC cards)
    - Visualize program behaviour
    - Visualize model execution $\rightarrow$ use case realization