Chapter 3: UML

[Note, in WS 20/21 we skip Chapter 3 “UML”]

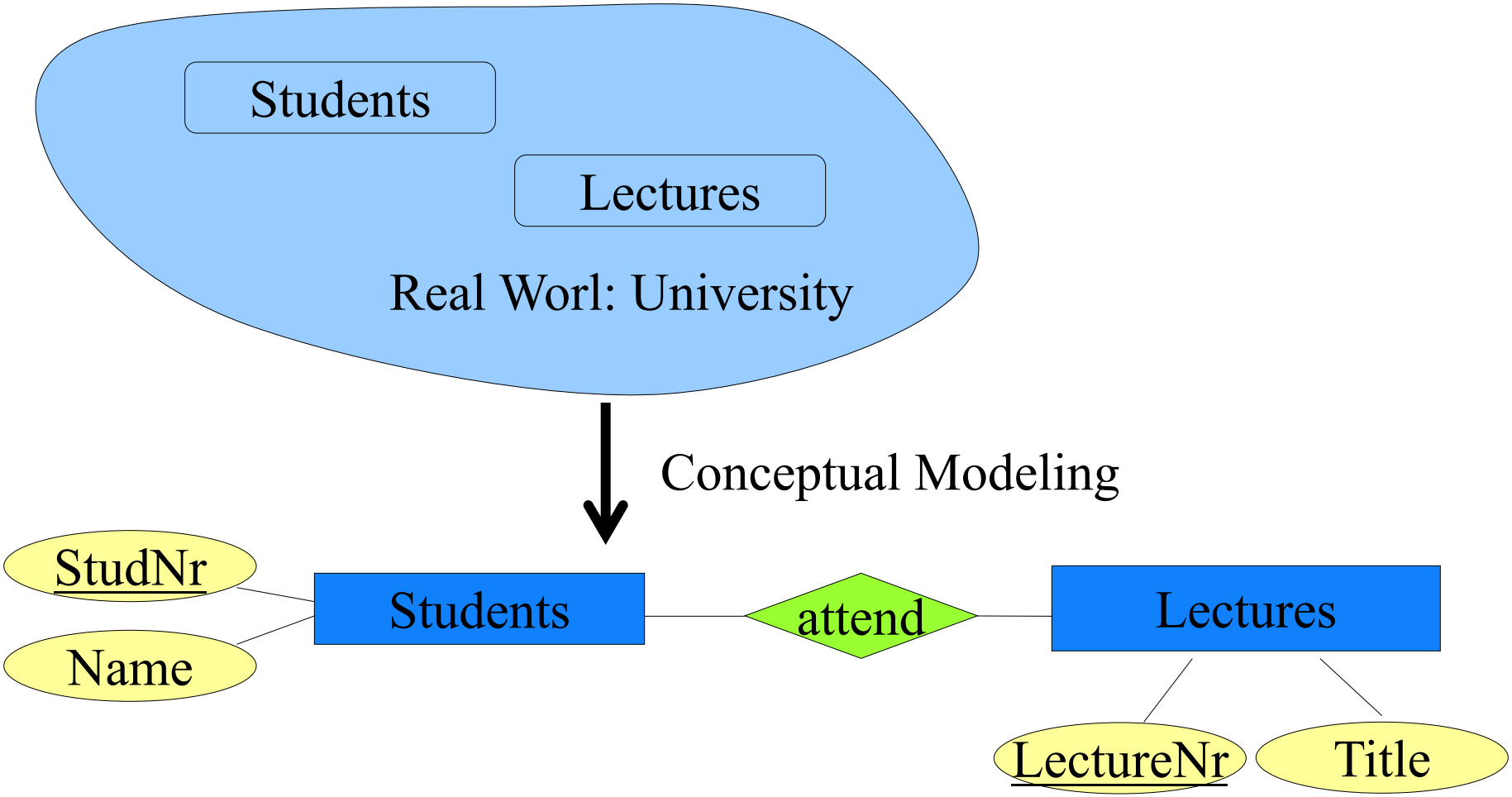
Content:

- Learn how to draw UML diagrams
- UML is an alternative way to model a database

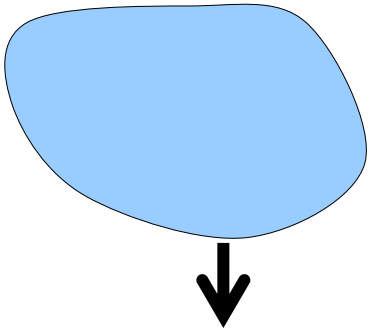
Next:

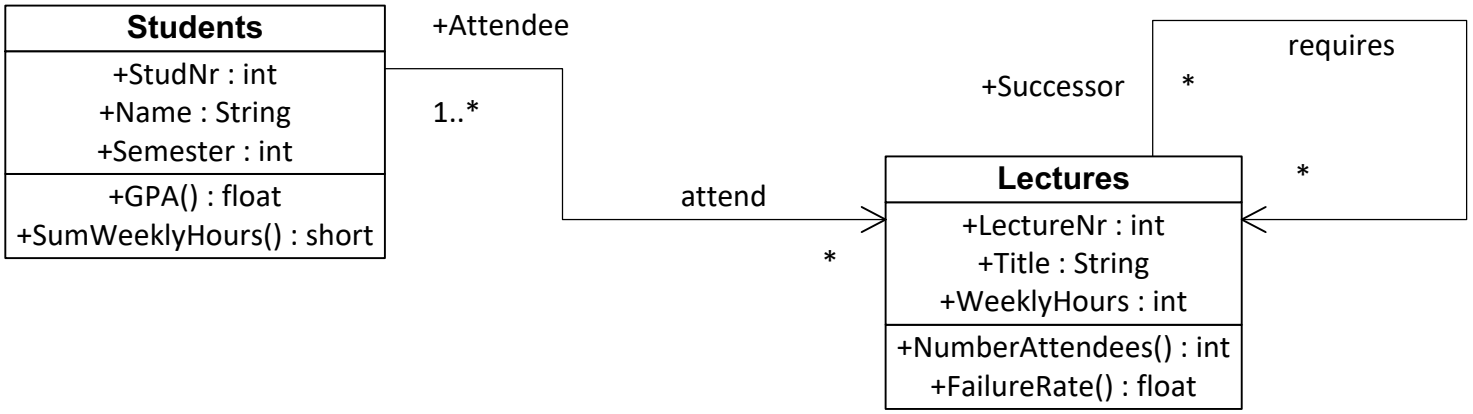
- Convert UML and ER diagrams into a database schema

Modeling a small example application: E/R



Modeling a small example application: UML





Data modelling with UML

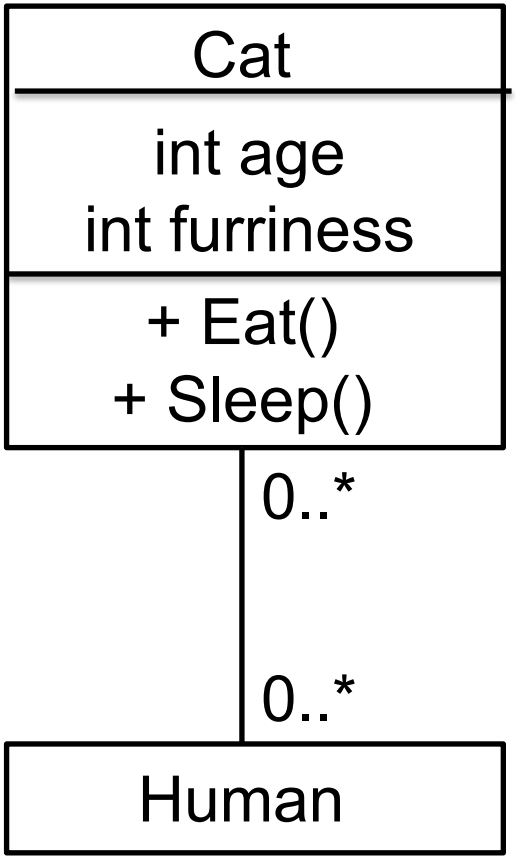
- UML = Unified Modelling Language
- De facto standard for object oriented software design
- Several diagrams, we focus on class diagrams

- Also other useful diagrams: state chart, activity, sequence ..

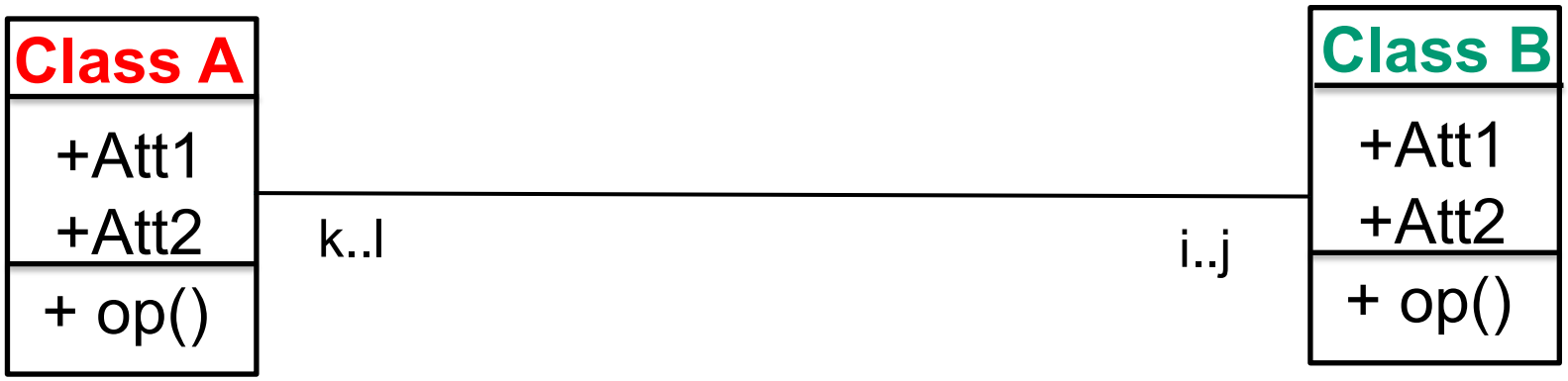
Data modelling with UML

Main concepts in UML class diagrams:

- **Classes:** models similar objects according to:
  - Structure (~Attributes)
  - Behavior (~Operations/Methods)
  - ≈ Entities in ER-Diagram
- **Associations:** between classes correspond to relationships
  - Generalization, Aggregation, …
  - ≈ Relationship in ER-Diagram
- **Multiplicities:** for associations
  - 0..* to 0..*, 1 to 1, …
  - ≈ Functionalities in ER-Diagram



Multiplicity



- Every element of **Class A** is associated with at least i elements of **Class B** and with at most j elements of **Class B**
- Analogously for the interval k..l
- Multiplicity is analogously to the functionalities in the ER-Model not to the (min, max)-Notation: Watch out!

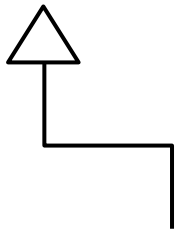
UML Association Types

Association:

- Generic relationship
- Any multiplicity possible

Generalization:

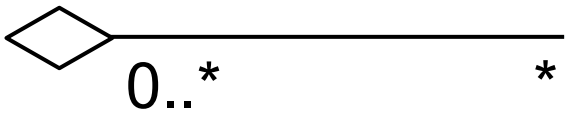
- “Is-a” relationship
- Inheritance in Java/C++



UML Association Types

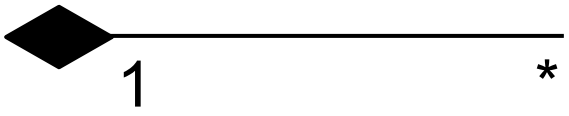
Aggregation:

- “belongs-to” or “has”
- Multiple owners

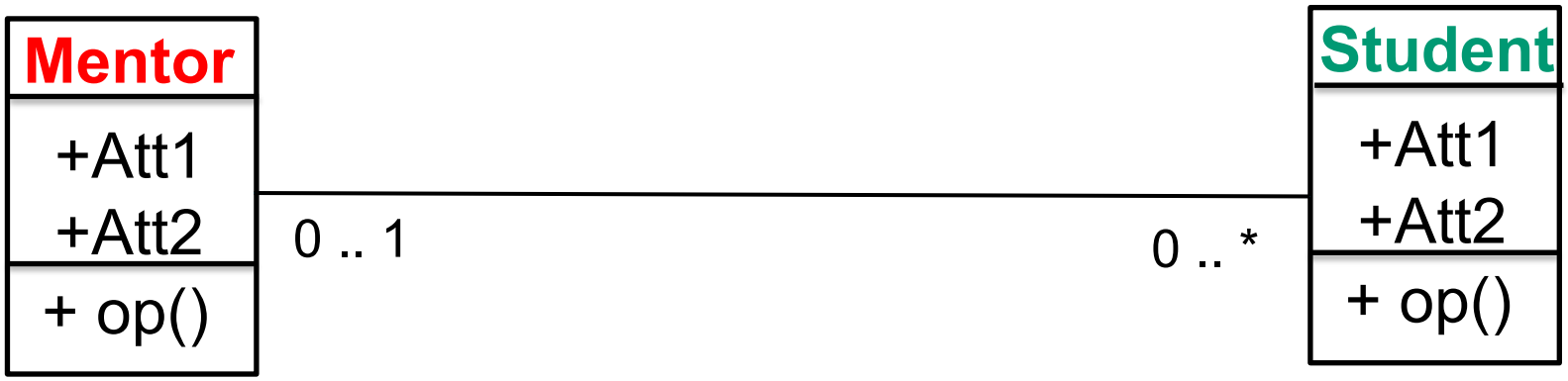


Composition:

- “part-of”
- Special case of Aggregation
- Existence dependent
- Exactly one owner



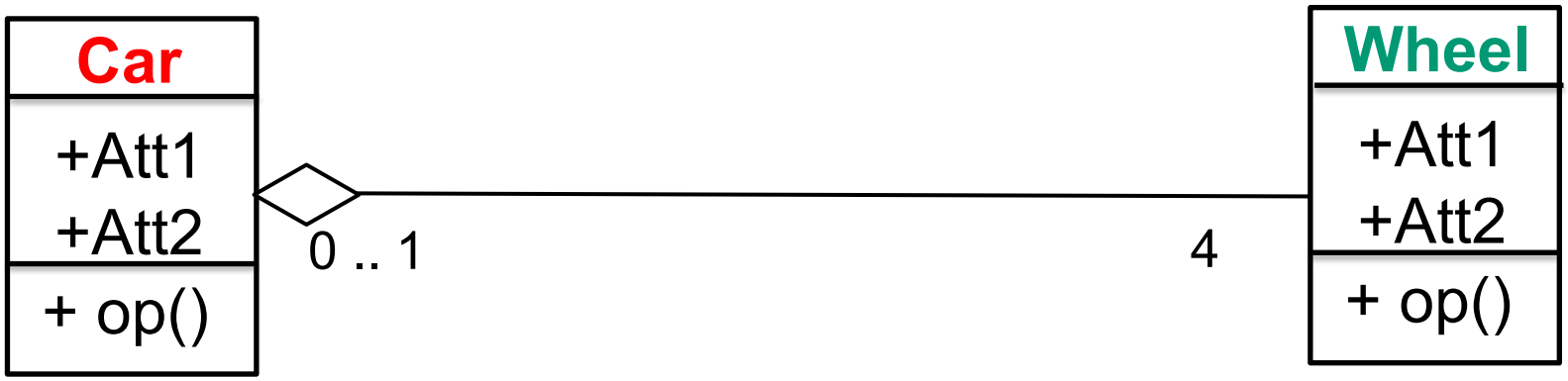
Multiplicity: Example 1



- A **Mentor** can have an arbitrary amount of **Student**
- A **Student** might have 0 or 1 **Mentor**

- Association type: Regular association (or aggregation)

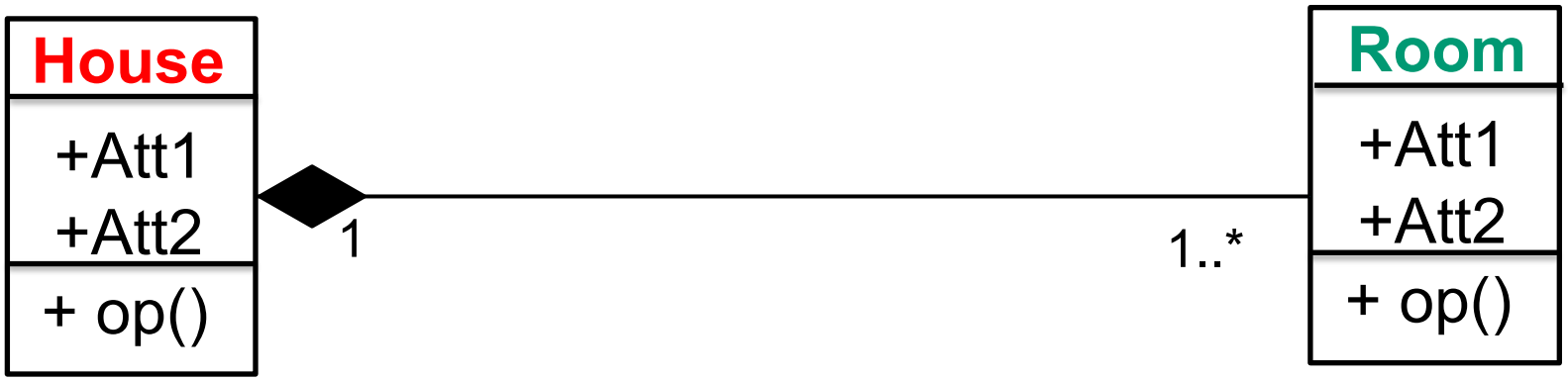
Multiplicity: Example 2



- A **Car** has 4 **Wheels**
- A **Wheel** belongs to one **Car**

- Association type: Aggregation (or composition)

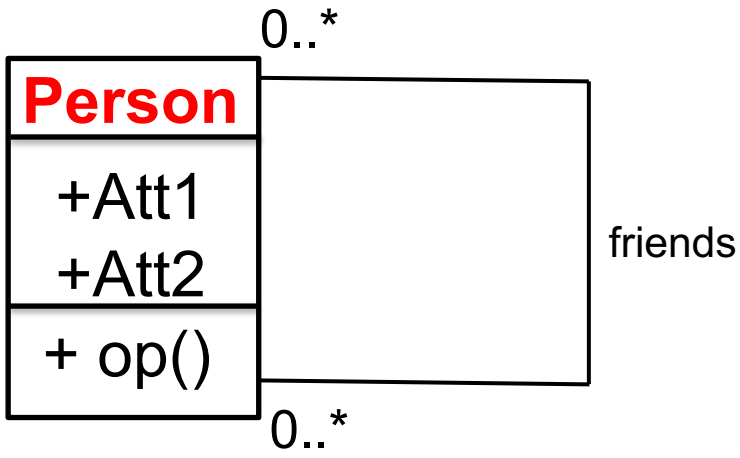
Multiplicity: Example 3



- A **Building** has at least 1 **Room**
- A **Room** belongs to exactly 1 **Building**

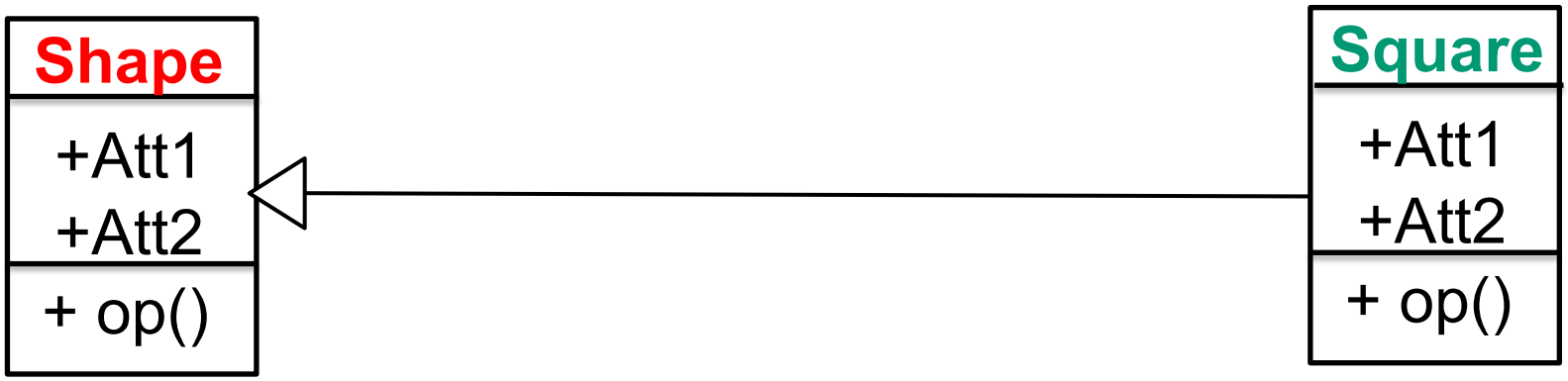
- Association type: Composition

Multiplicity: Example 4



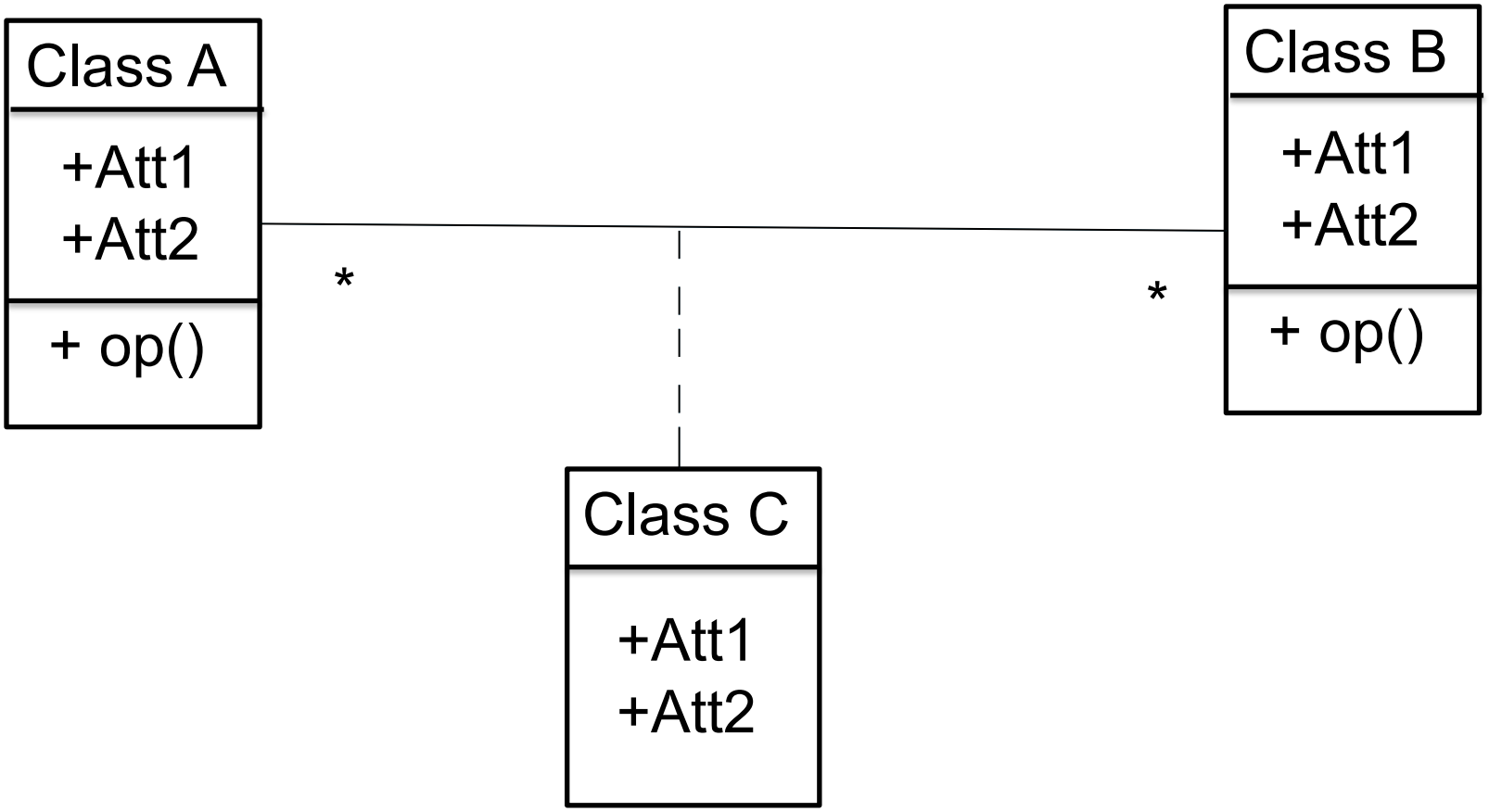
- A **Person** has any number of friends
- Association type: Regular association

Multiplicity: Example 5



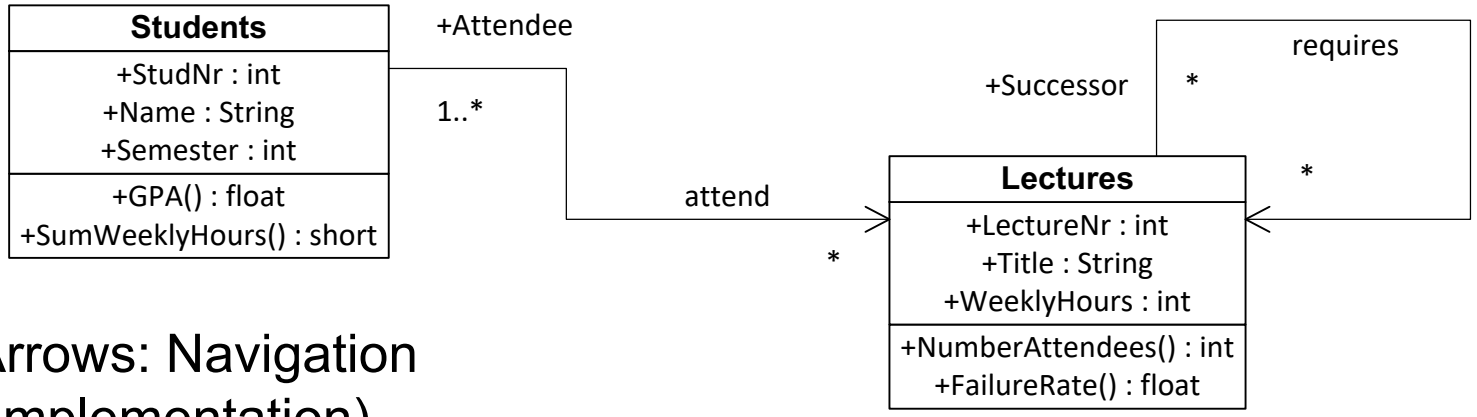
- A **Square** is a **Shape**
- Association type: Generalization

Association class



… for attributes of the association

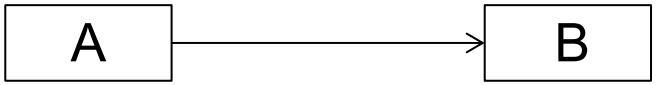
Navigation



Arrows: Navigation (Implementation)

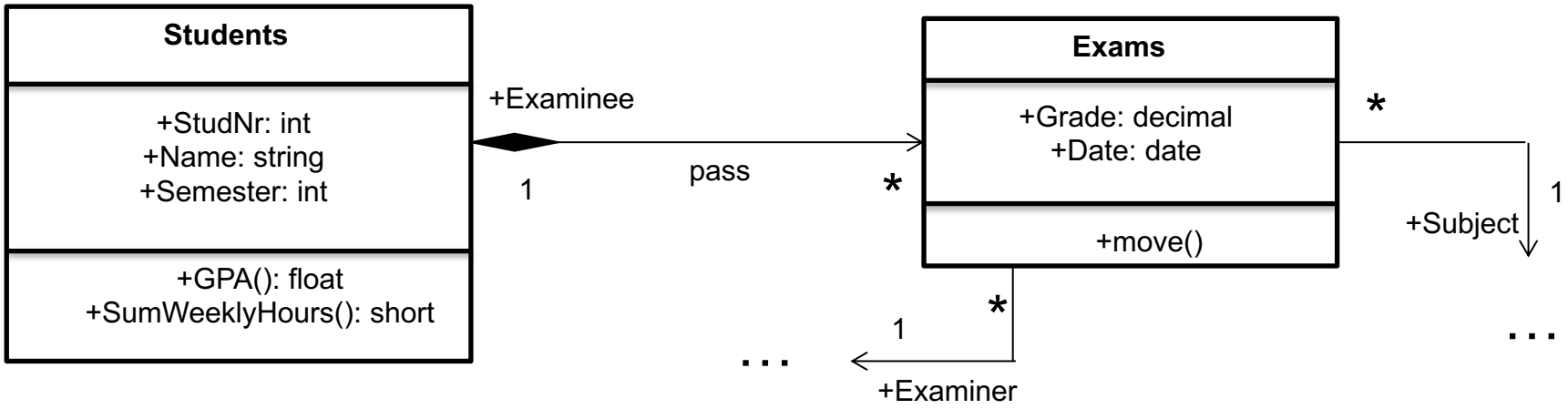
No statement on navigation

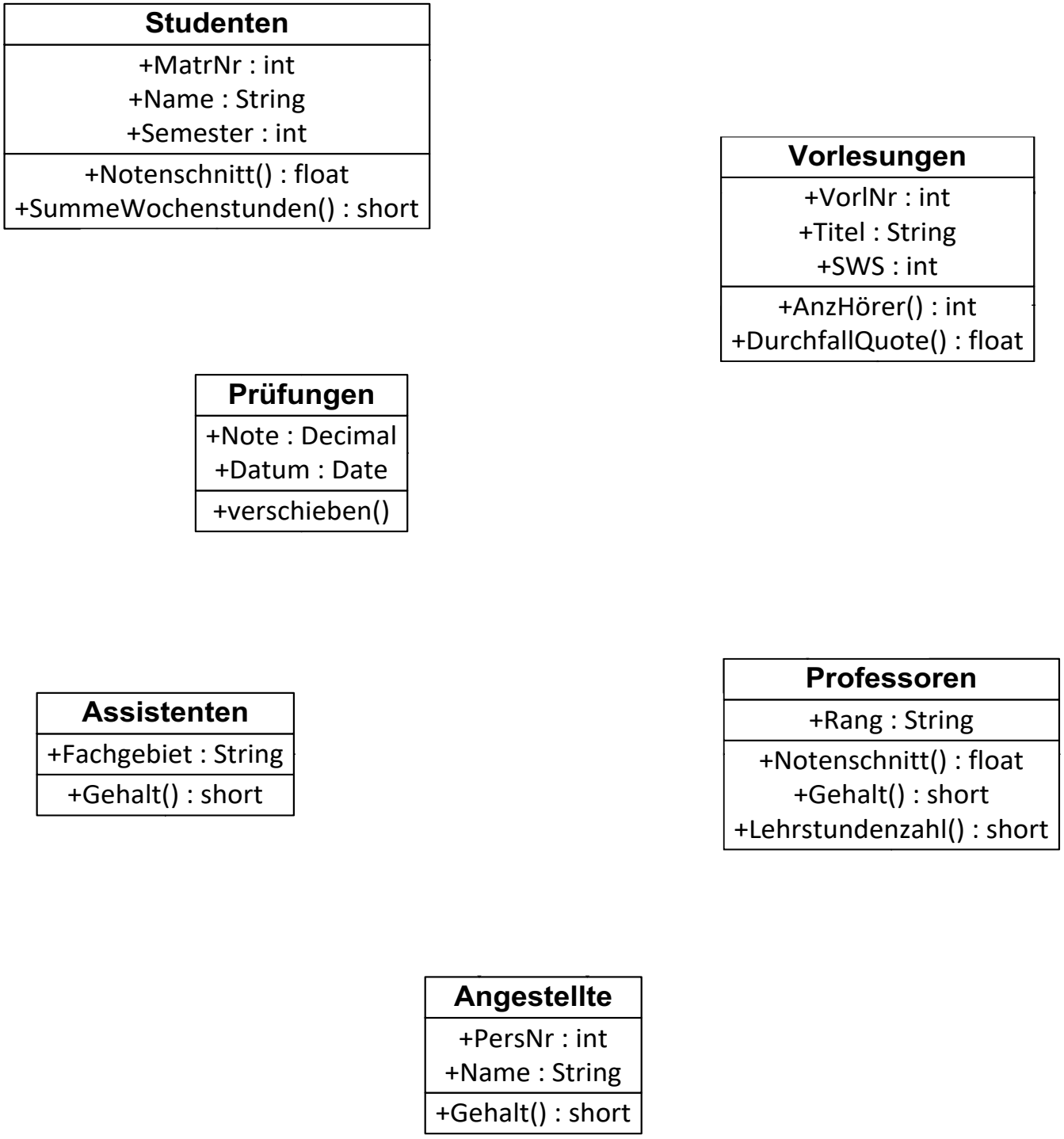
Navigation from A to B allowed

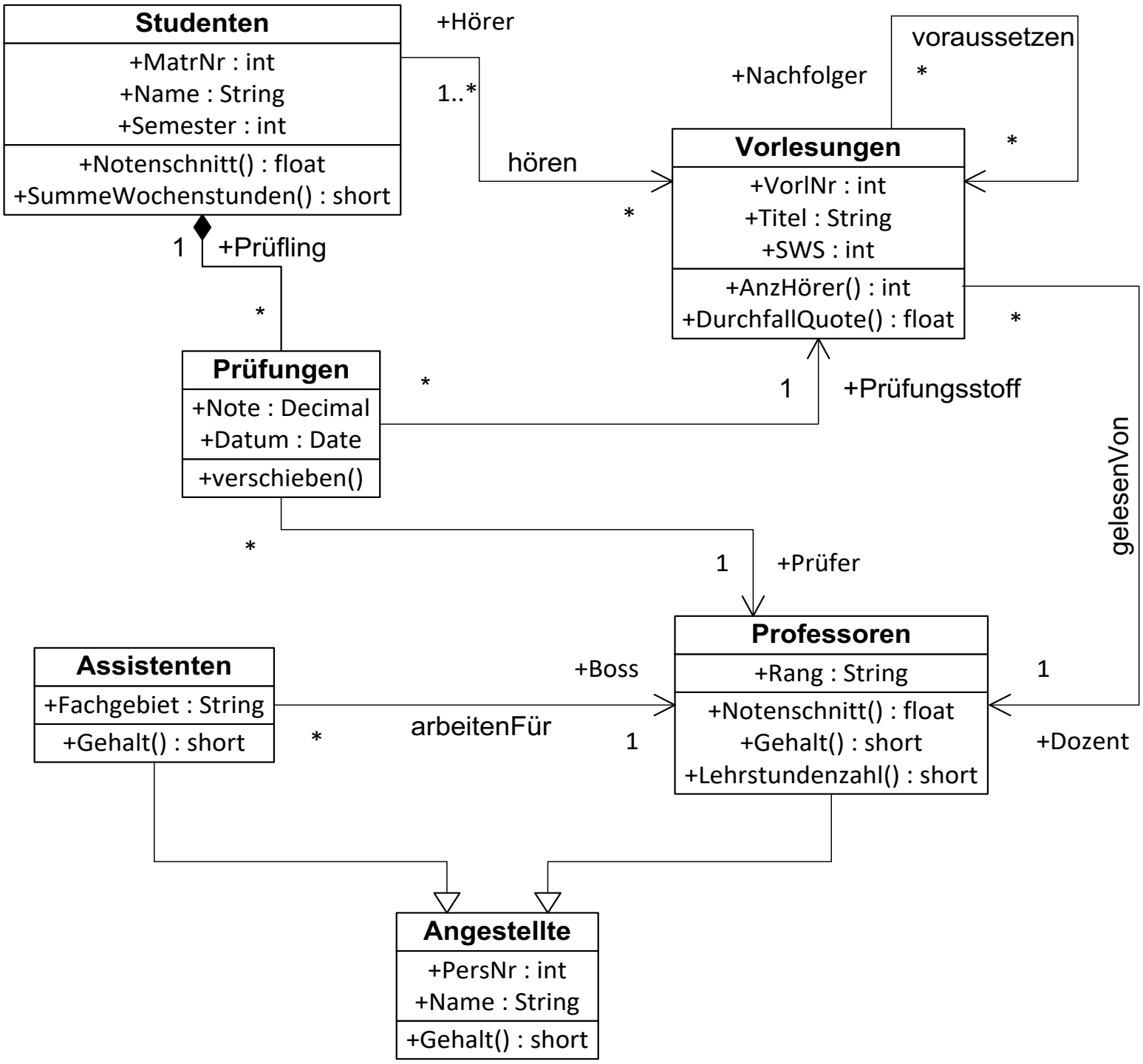


Navigation from A to B forbidden

Composition




Studenten
+MatrNr : int
+Name : String
+Semester : int
+Notenschnitt() : float
+SummeWochenstunden() : short
Vorlesungen
+VorlNr : int
+Titel : String
+SWS : int
+AnzHörer() : int
+DurchfallQuote() : float
Prüfungen
+Note : Decimal
+Datum : Date
+verschieben()
Assistenten
+Fachgebiet : String
+Gehalt() : short
Professoren
+Rang : String
+Notenschnitt() : float
+Gehalt() : short
+Lehrstundenzahl() : short
Angestellte
+PersNr : int
+Name : String
+Gehalt() : short


Studenten
+MatrNr : int
+Name : String
+Semester : int
+Notenschnitt() : float
+SummeWochenstunden() : short
+Hörer
1..*
hören
*
Vorlesungen
+VorlNr : int
+Titel : String
+SWS : int
+AnzHörer() : int
+DurchfallQuote() : float
voraussetzen
*
+Nachfolger
*
1
+Prüfling
*
Prüfungen
+Note : Decimal
+Datum : Date
+verschieben()
*
1
+Prüfungsstoff
*
gelesenVon
*
1
+Prüfer
Professoren
+Rang : String
+Notenschnitt() : float
+Gehalt() : short
+Lehrstundenzahl() : short
1
+Dozent
Assistenten
+Fachgebiet : String
+Gehalt() : short
*
arbeitenFür
+Boss
1
Angestellte
+PersNr : int
+Name : String
+Gehalt() : short

Quiz UML

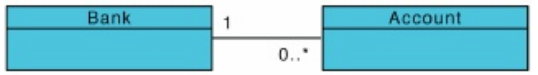
From the Stanford MOOC:

https://lagunita.stanford.edu/courses/DB/UML/SelfPaced/courseware/ch-unified_modeling_language/seq-quiz-uml/

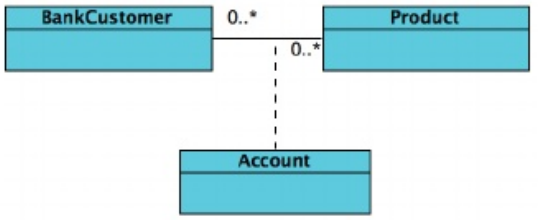
Quiz Q2 + Q5 – Q7

Cheat sheet class diagram

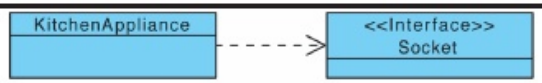
Previously on: http://www.code-meets-design.de/wp-content/uploads/2013/07/uml-classdiagram-cheat-sheet.pdf



The Account belongs to one Bank. The Bank contains 0 to infinite Accounts



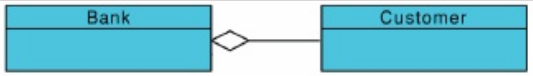
This type is often use in n to m relationships. The „Account“ chains the „Product“ with the



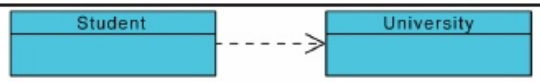
The class „KitchenApliance“ implements the interface

The account is part of the bank and can't exits without

The „Child“ extends the „Parent“ and contains every



The „Customer“ is part of the „Bank“, but the customer



The „Student“ dependents on the „University“