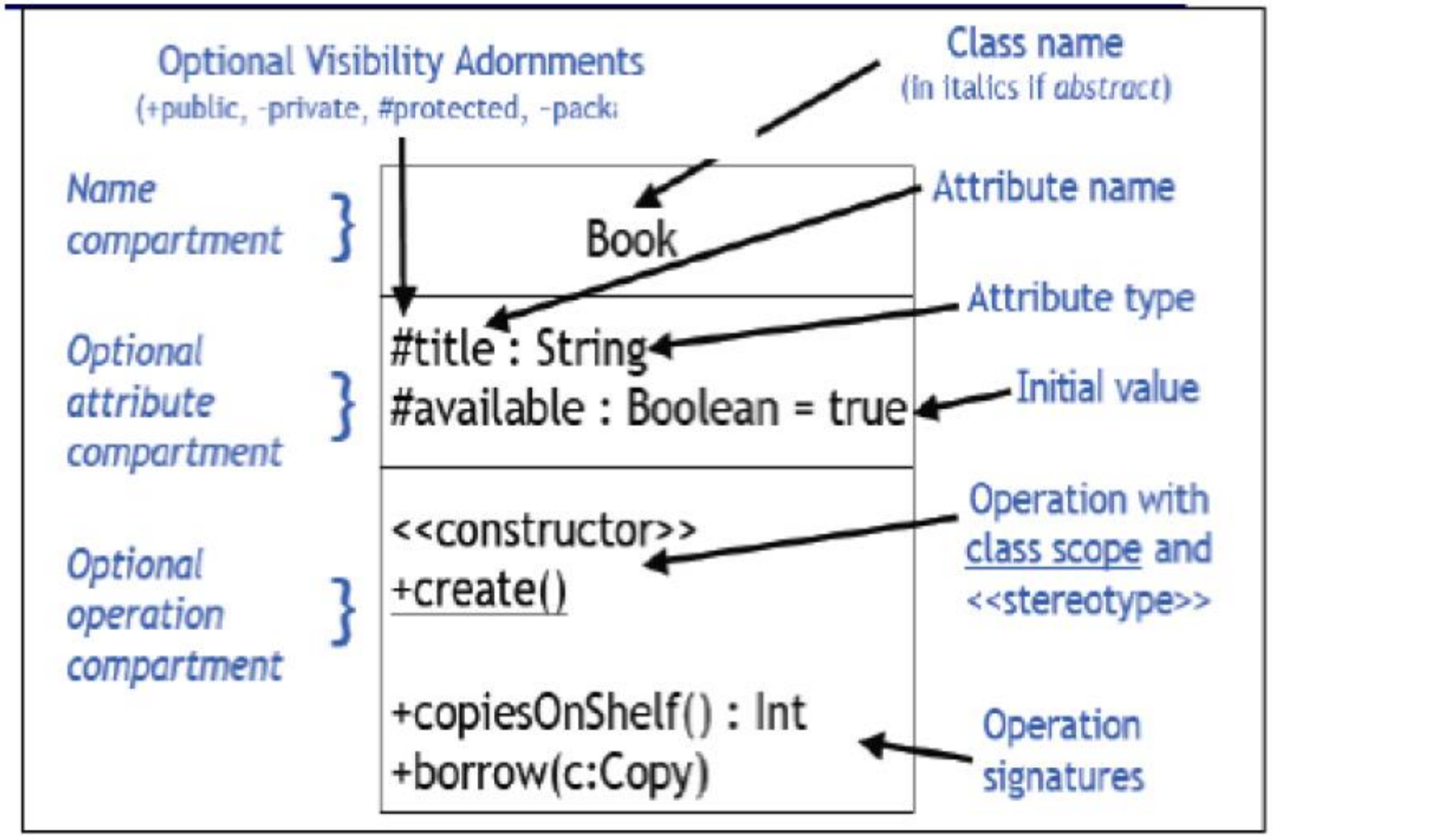
UML CLASS DIAGRAM

Birzeit University-CS Dept-Samer Zein(Ph.D)- Refs: Gomaa, H. "Software Modling and Design" 2011

CLASS DIAGRAM

- Class diagram is also known as static system modeling
- It addresses the structural view of a problem.
- It defines the:
  - classes (concepts) in the system,
  - their attributes,
  - operations,
  - and the relationships between these classes.



IDENTIFY CLASSES: DATA DRIVEN APPROACH

- Identify all the data in the system
- Divide into classes before considering responsibilities
- Common approach: noun identification
- Identify candidate classes by selecting all the nouns and
- nouns phrases in the requirements document
- Discard inappropriate candidates :
- Redundant or omnipotent entities
- Vague entities
- Events or operations
- Meta-language
- Entities outside system scope
- Attributes
- Verbs and verb phrases highlight candidate operations!

DATA DRIVEN APPROACH

- **Some heuristics/hints of what kind of things are classes [Shlaer and Mellor; Booch]:**
- Tangible or "real-world" things – e.g. book, copy,
- course;
- Roles- e.g. library member, student, director of studies,
- Events- e.g. arrival, leaving, request;
- Interactions- e.g. meeting, intersection

EXAMPLE DATA DRIVEN APPROACH NOUN/VERB ANALYSIS

Books and journals:
The library contains books and journals. It may have several copies of a given book. Some of the books are for short term loans only. All other books may be borrowed by any library member for three weeks. Members of the library can normally borrow up to six items at a time, but members of staff may borrow up to 12 items at one time. Only members of staff may borrow journals.

Borrowing:
The system must keep track of when books and journals are borrowed and returned, enforcing the rules described above.

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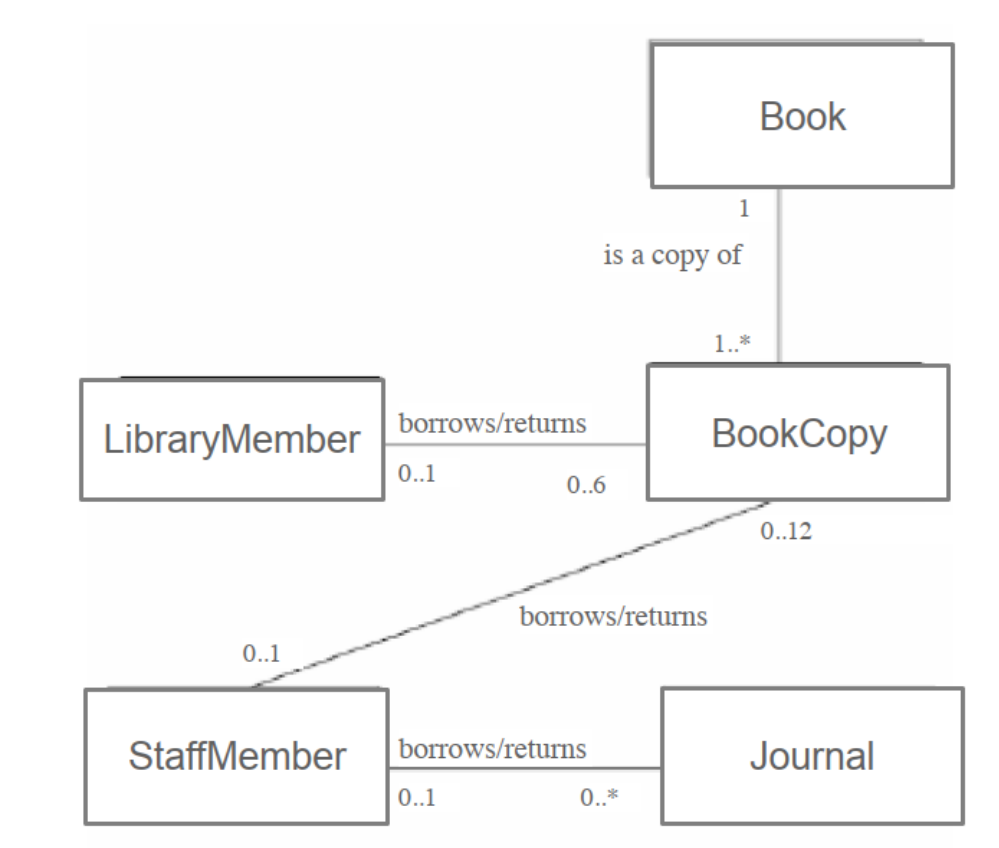
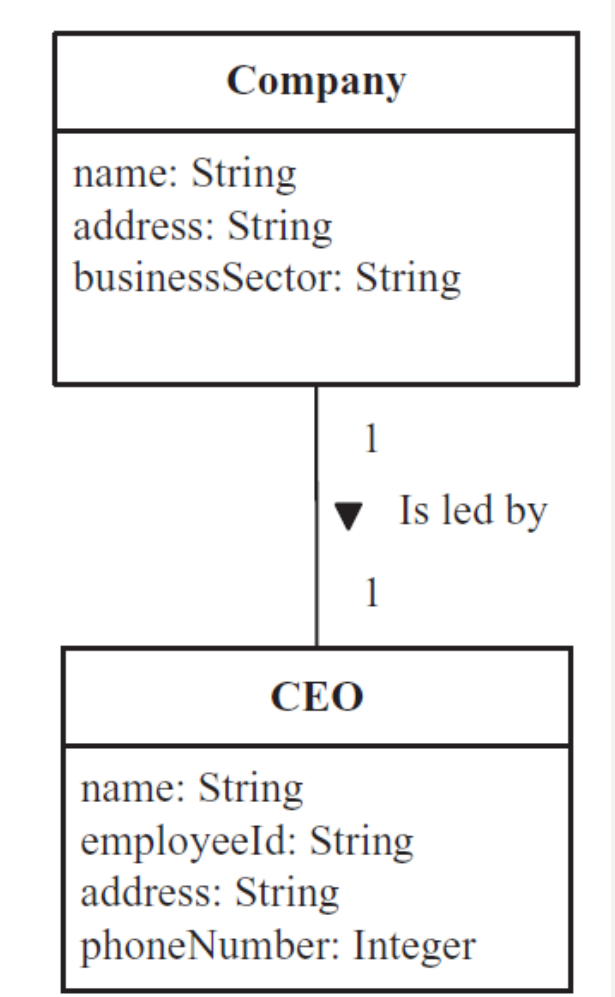


ASSOCIATIONS BETWEEN CLASSES

- An **association** defines a relationship between two or more classes, denoting a static, structural relationship between classes.
- For example, Employee *Works in* Department, where Employee and Department are classes and *Works in* is an association.
- Classes are named using nouns, while associations are named using verbs or verb phrases.
- A *link* is a connection between instances of the classes (objects) and represents an instance of an association between classes.
- For example, Jane *Works in* Manufacturing, where Jane is an instance of Employee and Manufacturing is an instance of Department.
- A link can exist between two objects if, and only if, there is an association between their corresponding classes.

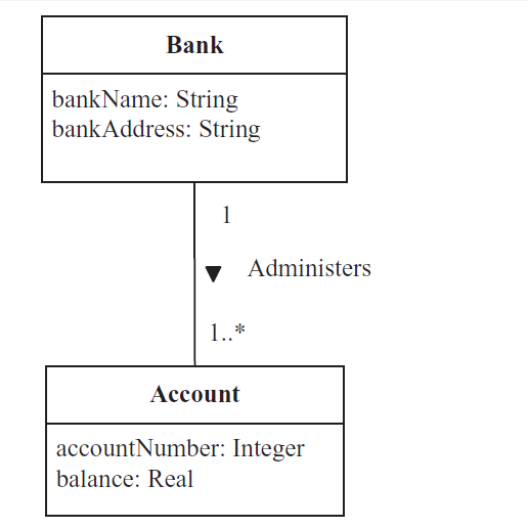
ASSOCIATIONS..2

- On class diagrams, an association is shown as an arc joining the two class boxes, with the name of the association next to the arc.
- In class diagrams, association names usually read from left to right and top to bottom.
- However, on a large class diagram with many classes, classes are usually in different positions relative to each other.
- To avoid ambiguity when reading UML class diagrams, COMET uses the UML arrowhead notation to point in the direction

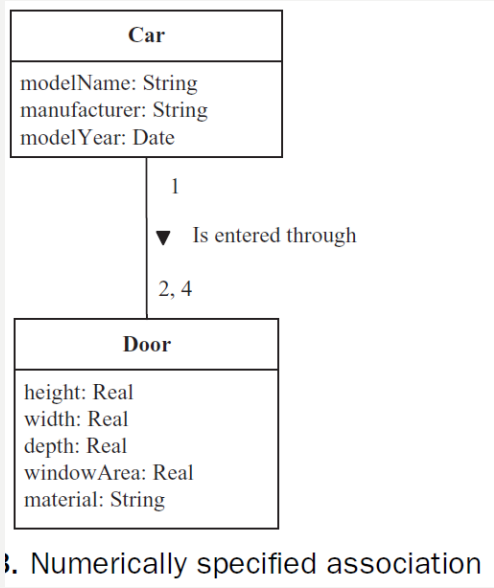


MULTIPLICITY OF ASSOCIATIONS

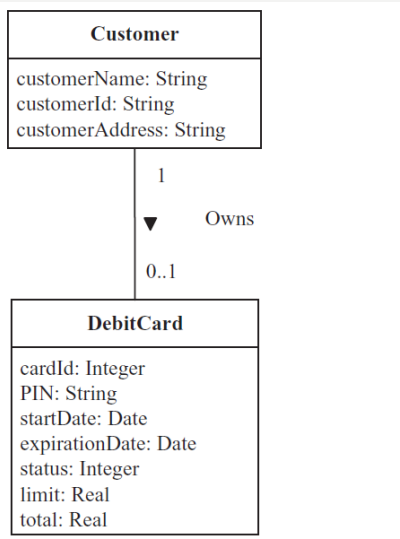
- The *multiplicity* of an association specifies how many instances of one class can
- relate to a single instance of another class.
- The multiplicity of an association can be as follows:
  - **One-to-one association.**
  - **One-to-many association**
  - **Numerically specified association**
  - **Optional association:** In an optional association, there might not always be a link from an object in one class to an object in the other class.
  - **Many to many associations**



Example of one-to-many association



3. Numerically specified association



Optional (zero or one) association

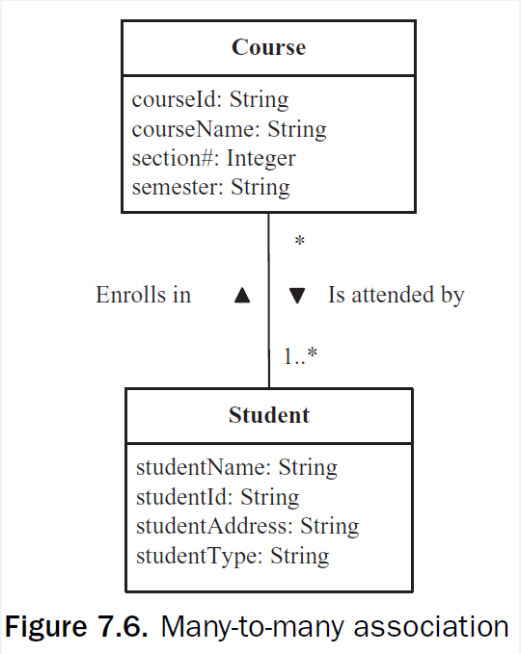
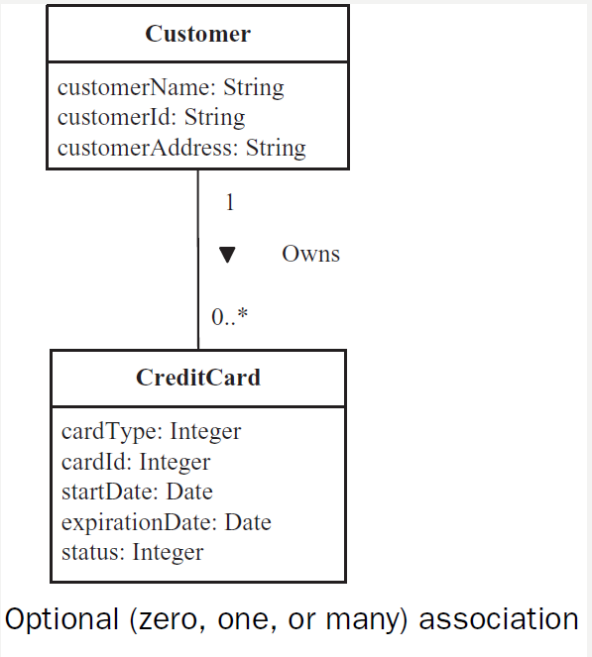


Figure 7.6. Many-to-many association



Optional (zero, one, or many) association

EXAMPLE CLASS DIAGRAM

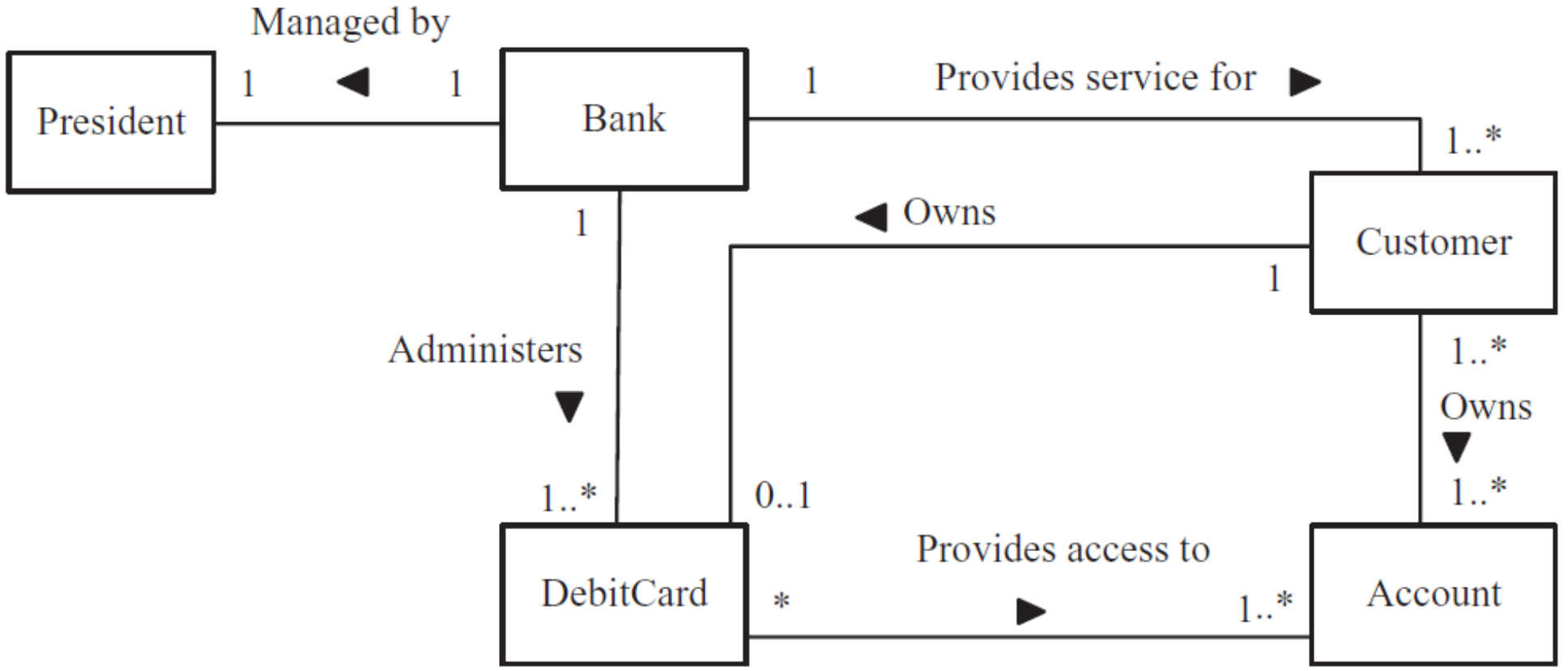


Figure 7.7. Example of associations on a class diagram

EXAMPLE ATTRIBUTES

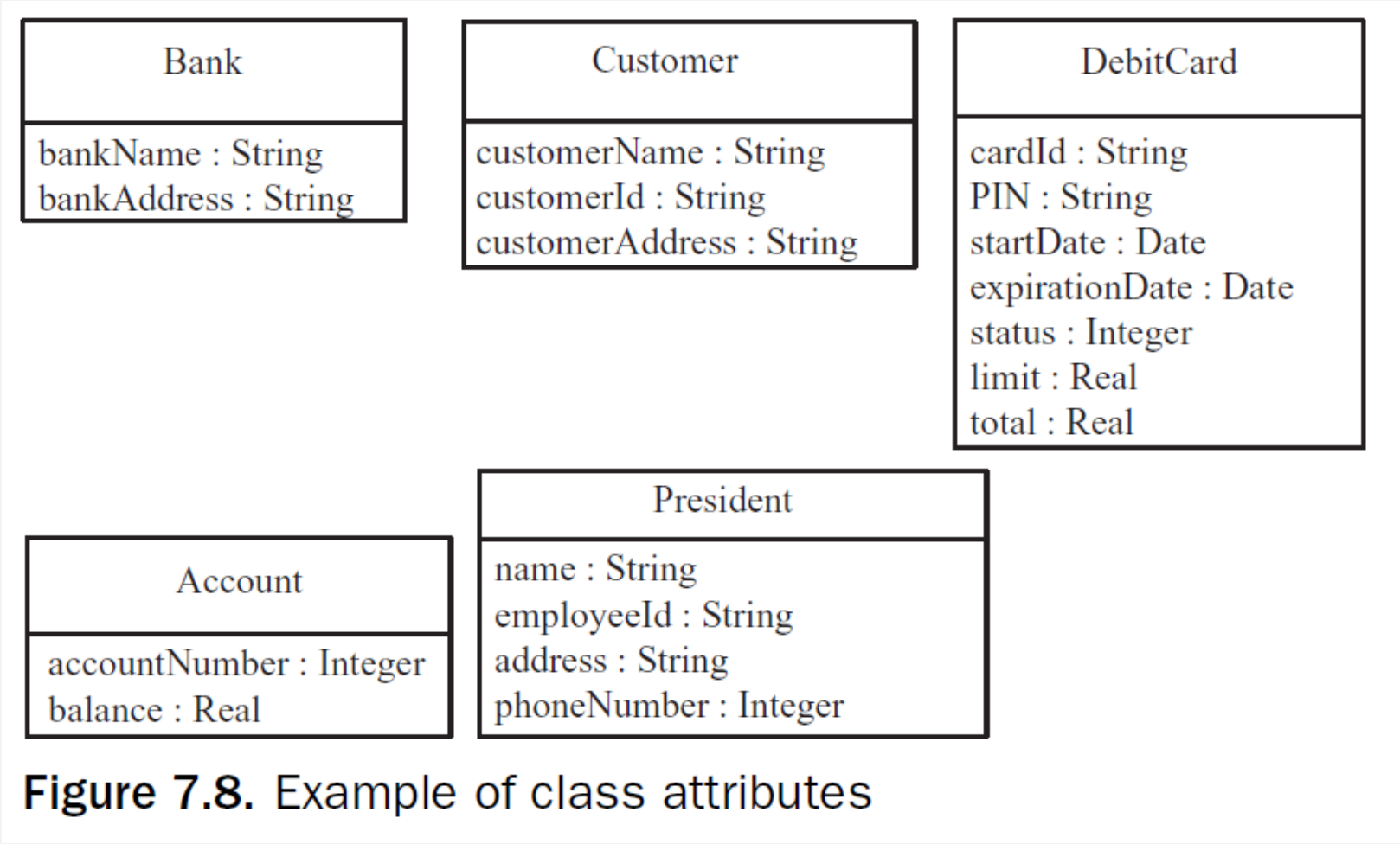


Figure 7.8. Example of class attributes

TRINARY ASSOCIATION

- A ternary association is a three-way association among classes.
- An example of a ternary association is among the classes Buyer, Seller, and Agent.
- The association is that the Buyer negotiates a price with the Seller through an Agent.

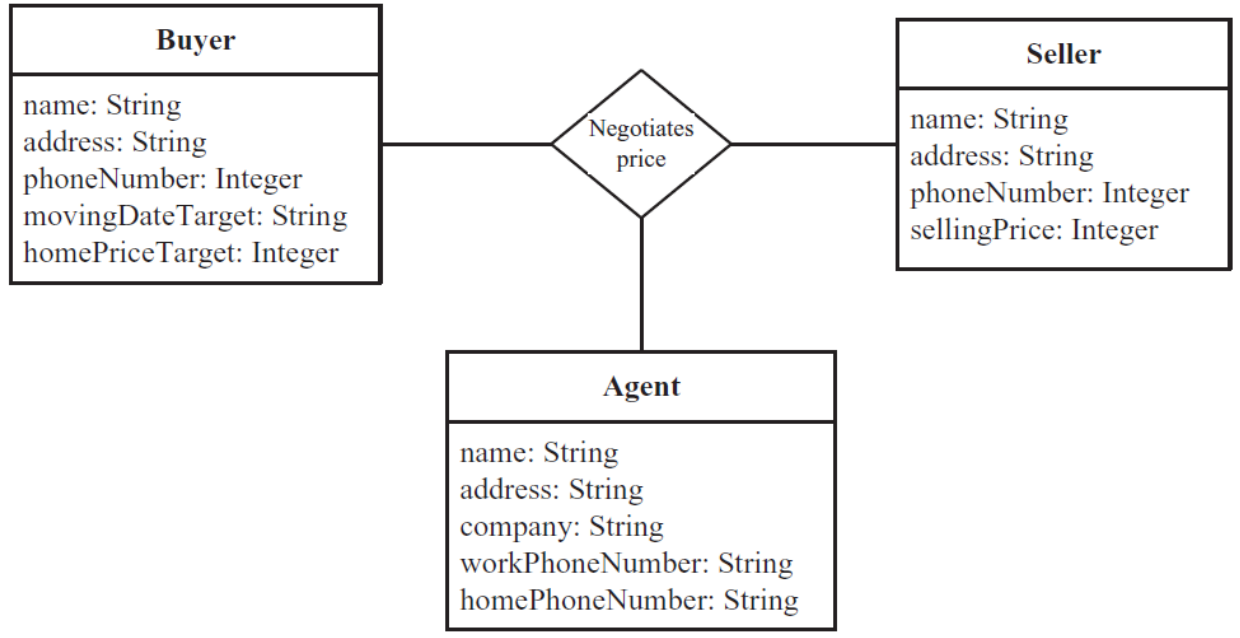


Figure 7.9. Example of ternary association

UNARY ASSOCIATIONS

- A unary association, also referred to as a self-association, is an association between an object of one class and another object in the same class

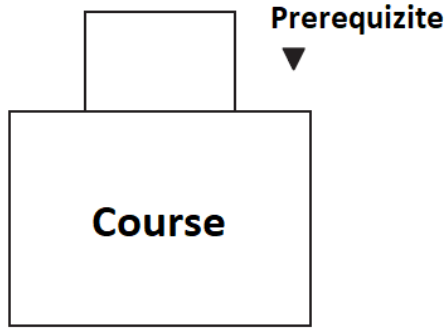


Figure 7.10. Example of unary association

ASSOCIATION CLASSES

- An *association class* is a class that models an association between two or more
- classes.
- The attributes of the association class are the attributes of the association.

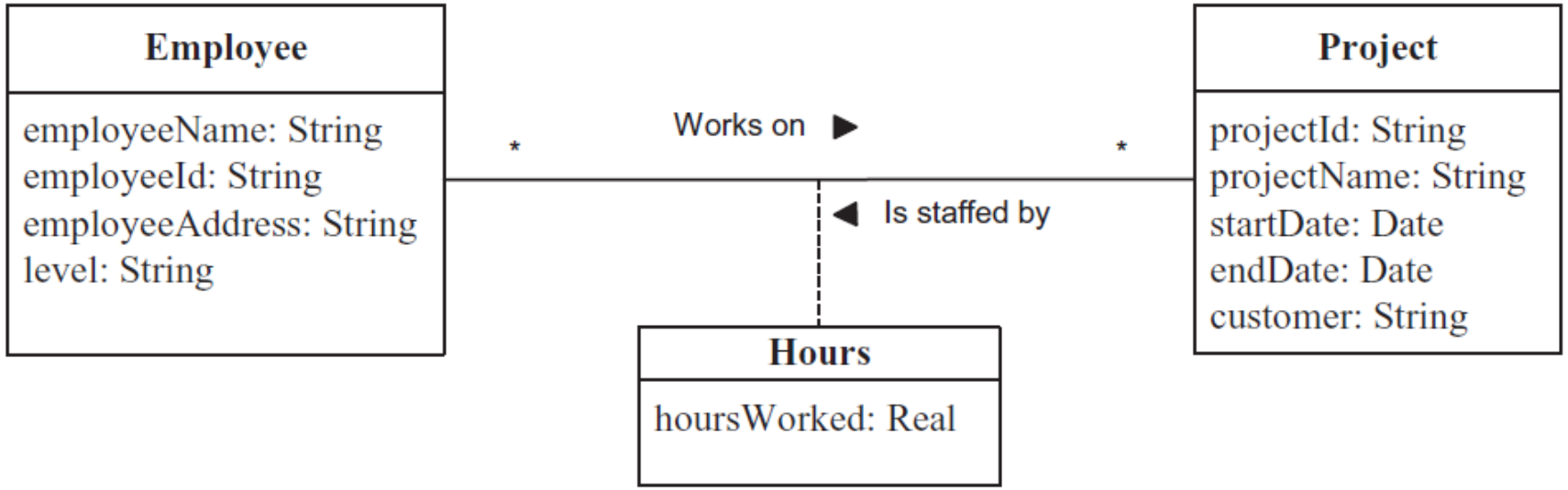


Figure 7.11. Example of association class

COMPOSITION AND AGGREGATION

- Both composition and aggregation hierarchies address a class that is made up of other classes.
- Composition and aggregations are special forms of a relationship in which classes are connected by the *whole/part* relationship.
- In both cases, the relationship between the parts and the whole is an *Is part of* relationship>
- A composition is a stronger relationship than an aggregation, and an aggregation is a stronger relationship than an association.
- Thus, the part objects are created, live, and die together with the whole.
- The part object can belong to only one whole.
- The aggregation hierarchy is a weaker form of whole/part relationship.
- In an aggregation, part instances can be added to and removed from the aggregate whole.
- In addition, a part could belong to more than one aggregation

COMPOSITION AND AGGREGATION

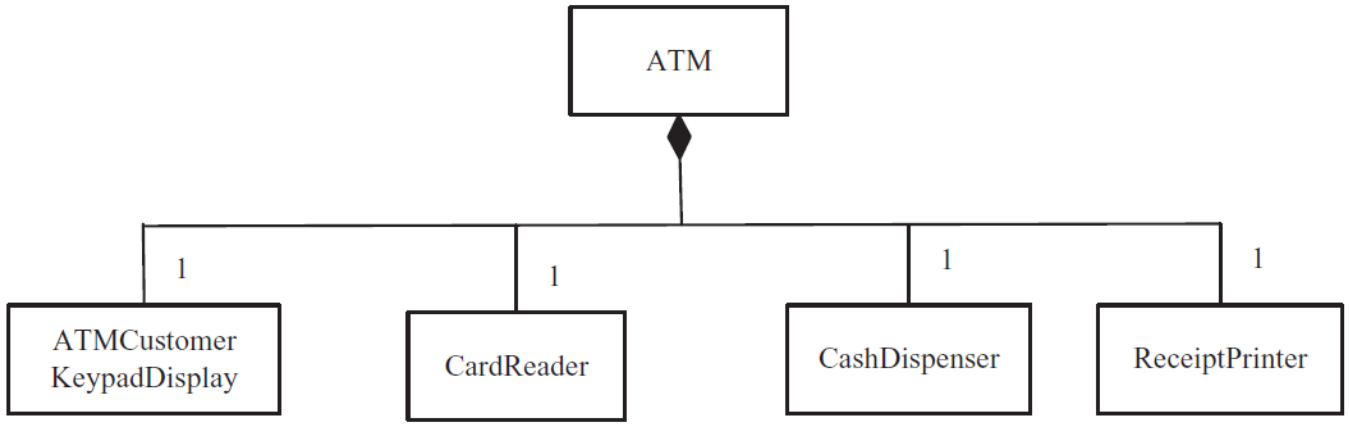


Figure 7.12. Example of composition hierarchy

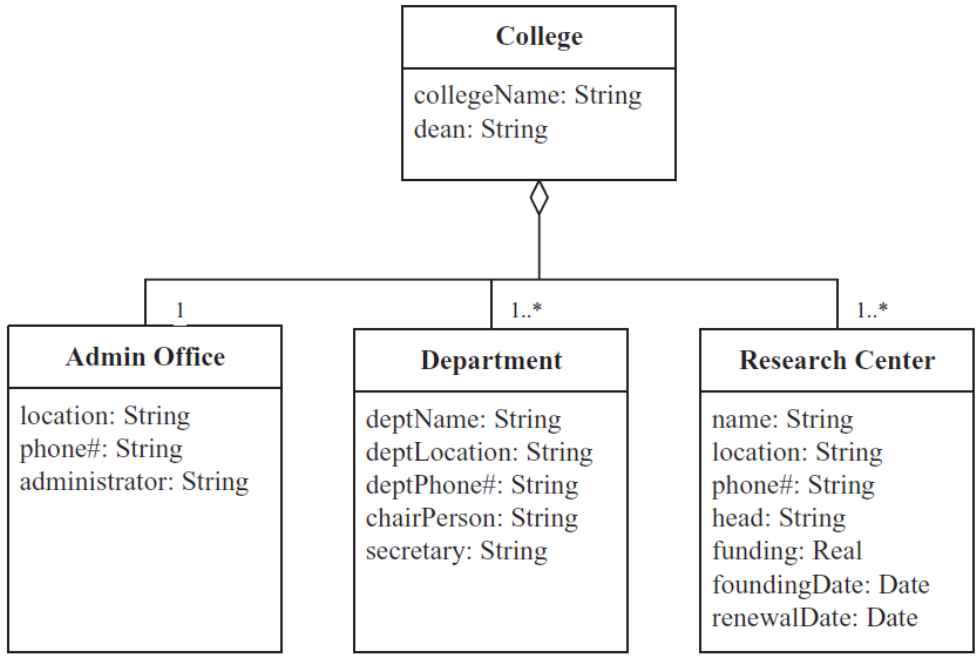


Figure 7.13. Example of aggregation hierarchy

GENERALIZATION/SPECIALIZATION HIERARCHY

- Some classes are similar but not identical.
- They have some attributes in common and others that are different.
- In a **generalization/specialization hierarchy**, common attributes are abstracted into a generalized class, which is referred to as a *superclass*.
- The different attributes are properties of the specialized class, which is referred to as a *subclass*.
- There is an *Is a* relationship between the subclass and the superclass.
- The superclass is also referred to as a parent class or ancestor class.
- The subclass is also referred to as a child class or descendent class

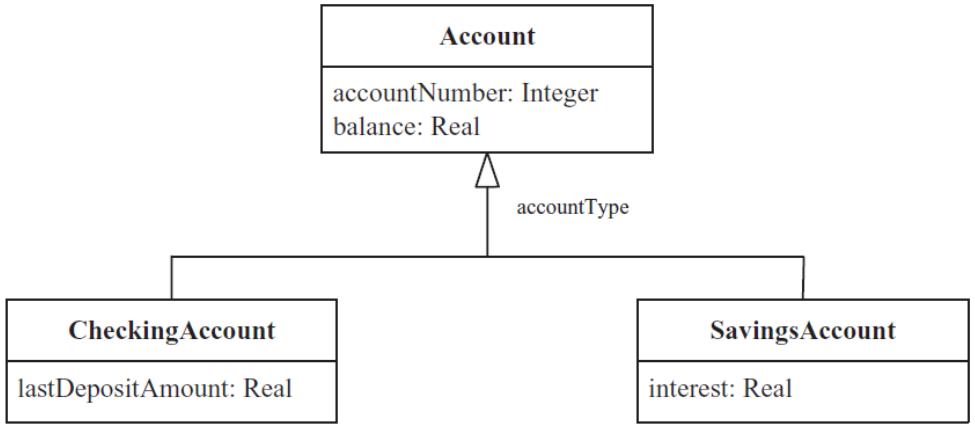


Figure 7.15. Discriminator in generalization/specialization