CSE 470 – Class Diagram in UML

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What is a Class?

- A general template that we use to create specific instances or objects in the application domain
- Represents a kind of person, place, or thing about which the system will need to capture and store information
- Abstractions that specify the attributes and behaviors of a set of objects

What is an Object?

- Entities that encapsulate state and behavior
- Each object has an identity
  - It can be referred individually
  - It is distinguishable from other objects

Types of Classes

- Ones found during analysis:
  - people, places, events, and things about which the system will capture information
  - ones found in application domain
- Ones found during design
  - specific objects like windows and forms that are used to build the system

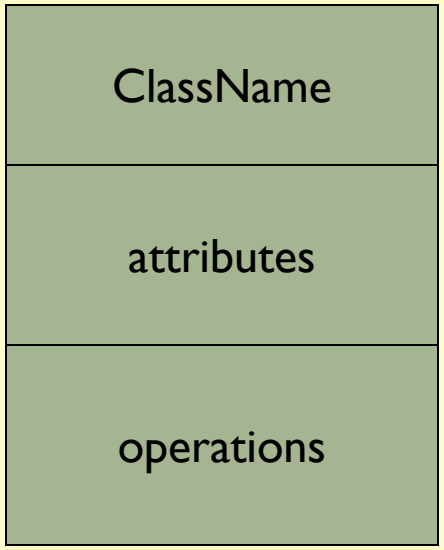
Potential Classes

- *External entities* (e.g., other systems, devices, people) that produce or consume information to be used by a computer-based system.
- *Things* (e.g., reports, displays, letters, signals) that are part of the information domain for the problem.
- *Occurrences or events* (e.g., a property transfer or the completion of a series of robot movements) that occur within the context of system operation.
- *Roles* (e.g., manager, engineer, salesperson) played by people who interact with the system.
- *Organizational units* (e.g., division, group, team) that are relevant to an application.
- *Places* (e.g., manufacturing floor or loading dock) that establish the context of the problem and the overall function of the system.
- *Structures* (e.g., sensors, four-wheeled vehicles, or computers) tha define a class of objects or related classes of objects.

2 Kinds of Classes during Analysis

- Concrete
  - Class from application domain
  - Example: Customer class and Employee class
- Abstract
  - Useful abstractions
  - Example: Person class

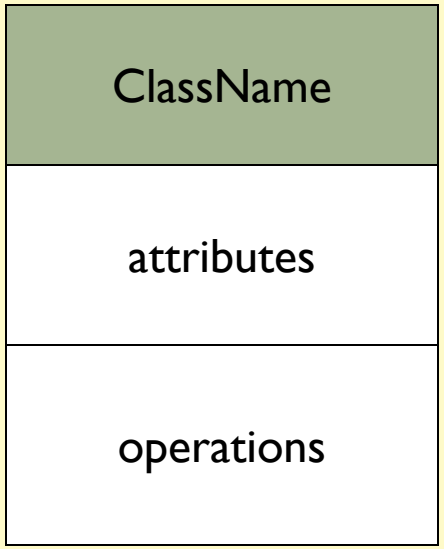
Classes



A *class* is a description of a set of objects that share the same attributes, operations, relationships, and semantics.

Graphically, a class is rendered as a rectangle, usually including its name, attributes, and operations in separate, designated compartments.

Class Names



The name of the class is the only required tag in the graphical representation of a class. It always appears in the top-most compartment.

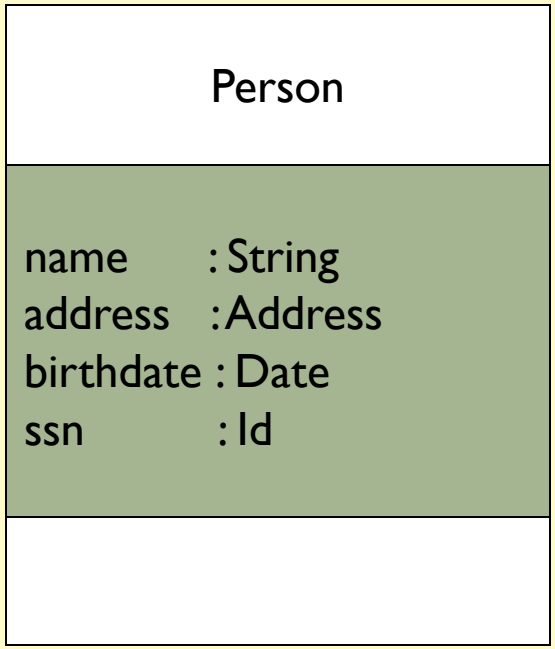
Attributes in a Class

- Properties of the class about which we want to capture information
- Represents a piece of information that is relevant to the description of the class within the application domain

Attributes in a Class

- Only add attributes that are primitive or atomic types
- Derived attribute
  - attributes that are calculated or derived from other attributes
  - denoted by placing slash (/) before name

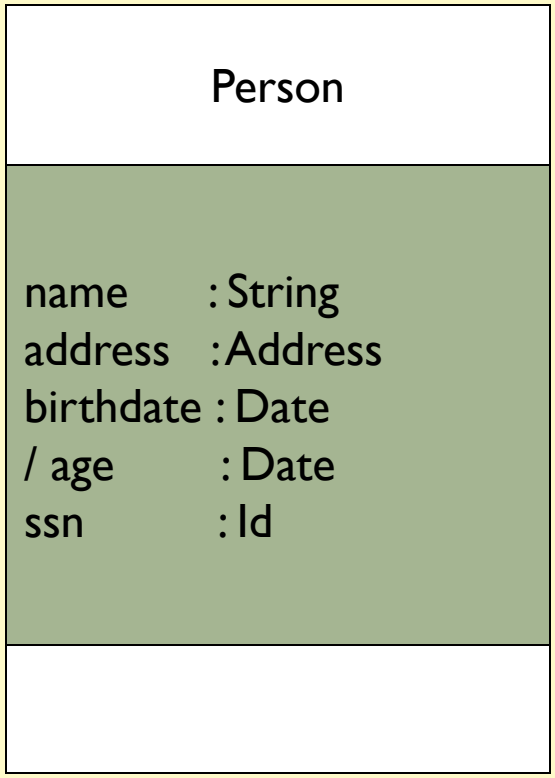
Class Attributes



An *attribute* is a named property of a class that describes the object being modeled.

In the class diagram, attributes appear in the second compartment just below the name-compartment.

Class Attributes (Cont'd)



Attributes are usually listed in the form:

attributeName : Type

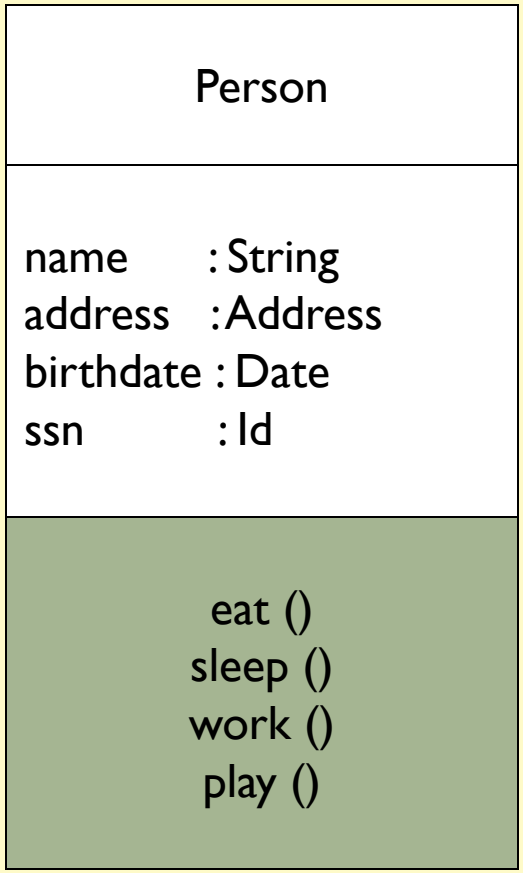
A *derived* attribute is one that can be computed from other attributes, but doesn't actually exist. For example, a Person's age can be computed from his birth date. A derived attribute is designated by a preceding '/' as in:

/ age : Date

Operations in a Class

- Represents the actions or functions that a class can perform
- Describes the actions to which the instances of the class will be capable of responding
- Can be classified as a constructor, query, or update operation

Class Operations



Operations describe the class behavior and appear in the third compartment.

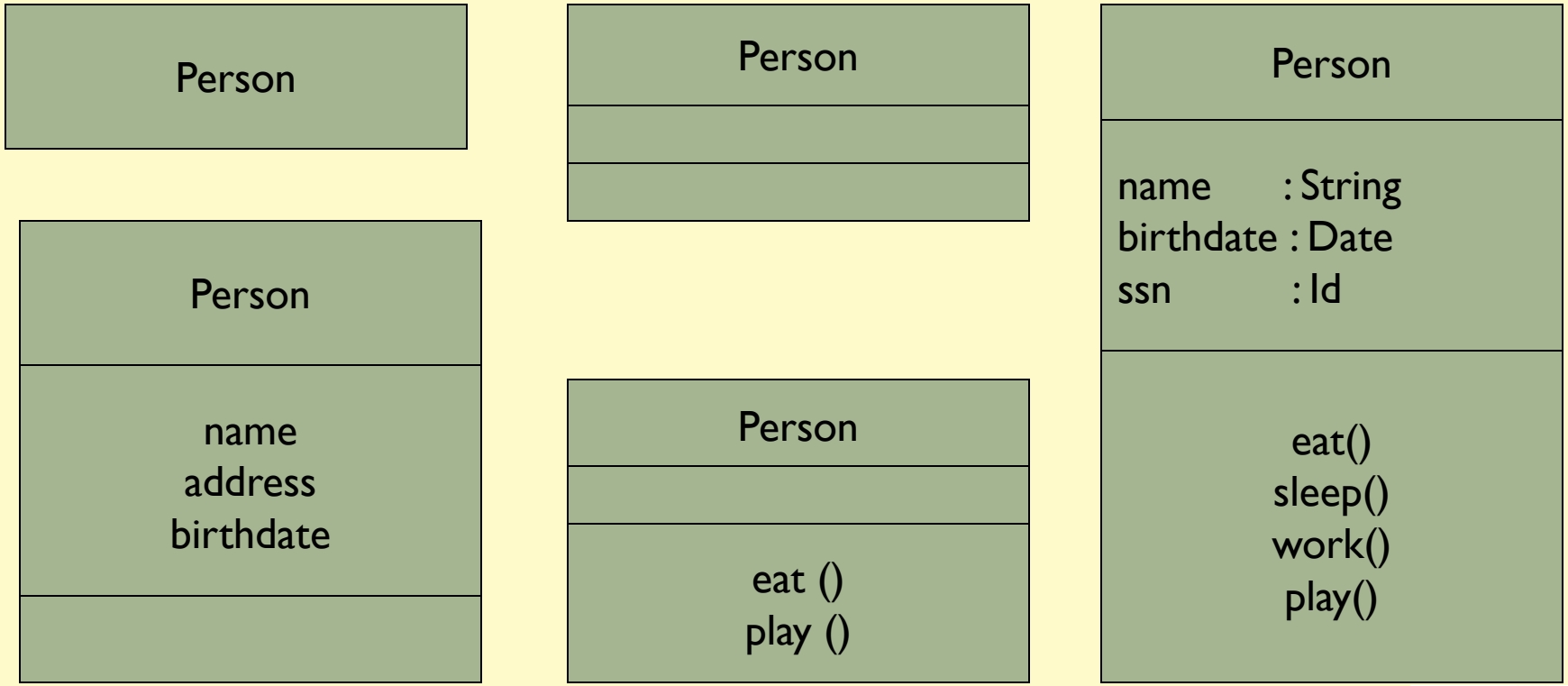
Class Operations (Cont'd)

PhoneBook
newEntry (n : Name, a : Address, p : PhoneNumber, d : Description) getPhone (n : Name, a : Address) : PhoneNumber

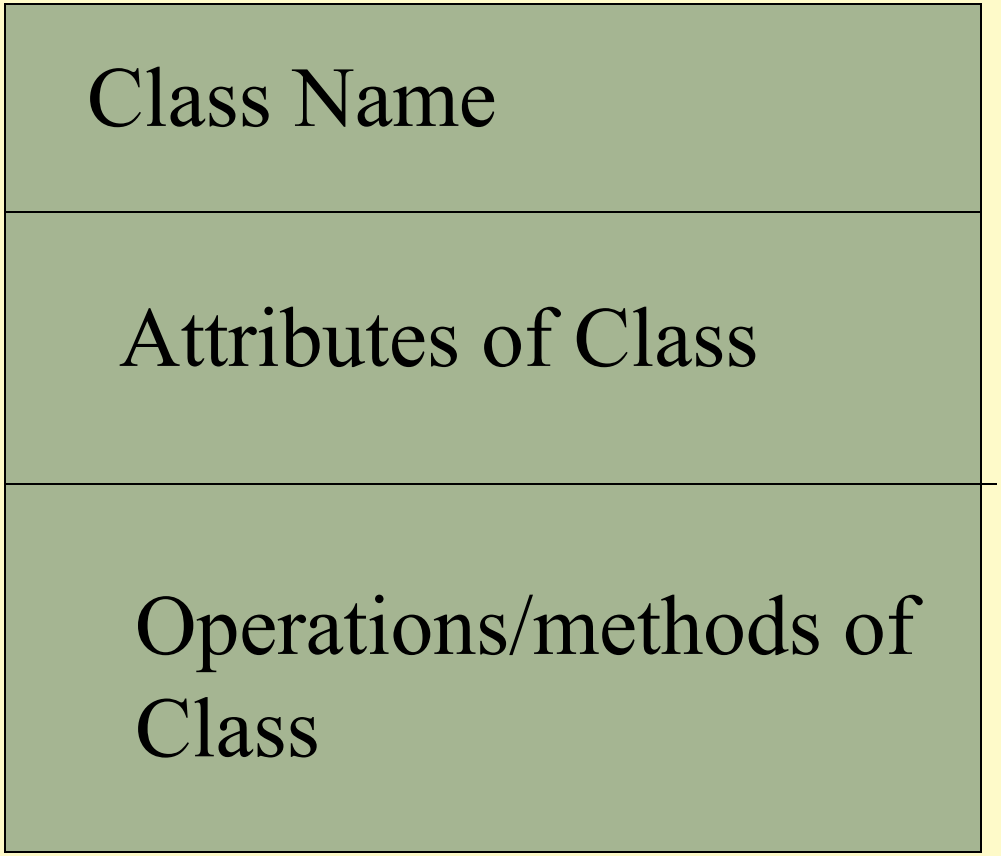
You can specify an operation by stating its signature: listing the name, type, and default value of all parameters, and, in the case of functions, a return type.

Depicting Classes

When drawing a class, you need not show attributes and operation in every diagram.



UML Representation of Class



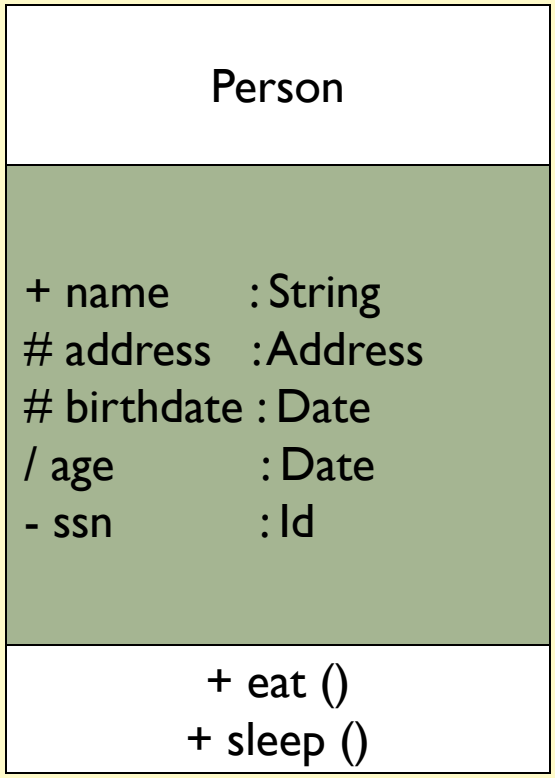
Visibility of Attributes and Operations

- Relates to the level of information hiding to be enforced

Visibility of Attributes and Operations

Visibility	Symbol	Accessible To
Public	+	All objects within your system.
Protected	#	Instances of the implementing class and its subclasses.
Private	-	Instances of the implementing class.

Visibility (Cont'd)



Attributes can be:

+ public
# protected
- private
/ derived

Relationships among Classes

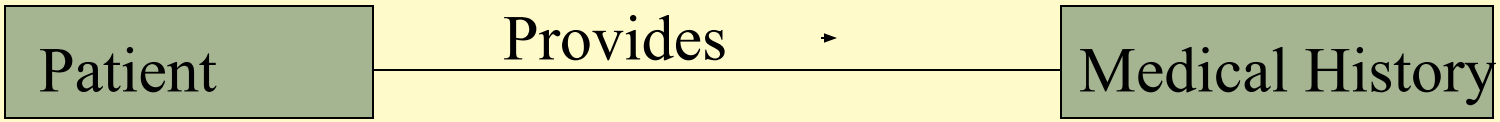
- Represents a connection between multiple classes or a class and itself
- 2 basic categories:
  - association relationships
    - Aggregation
    - Composition
  - generalization relationships

Association Relationship

- A bidirectional semantic connection between classes
- Type:
  - name of relationship
  - role that classes play in the relationship

Association Relationship

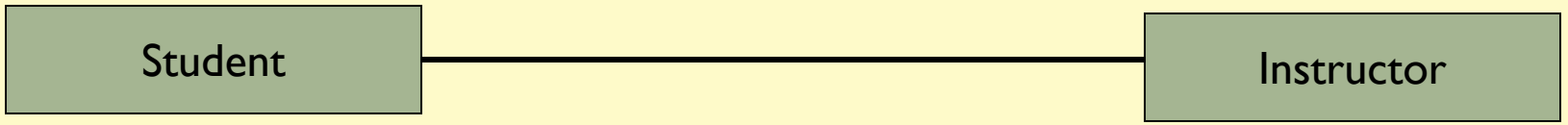
- Name of relationship type shown by:
  - drawing line between classes
  - labeling with the name of the relationship
  - indicating with a small solid triangle beside the name of the relationship the direction of the association



Association Relationships

If two classes in a model need to communicate with each other, there must be link between them.

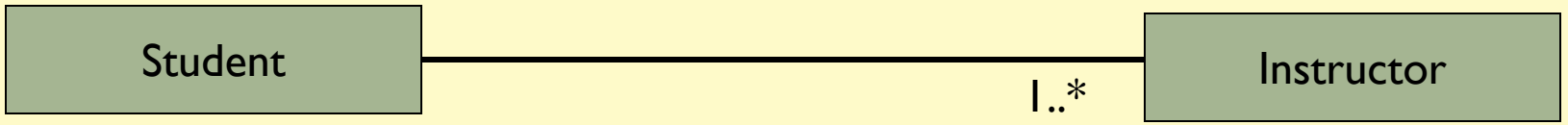
An *association* denotes that link.



Association Relationships (Cont'd)

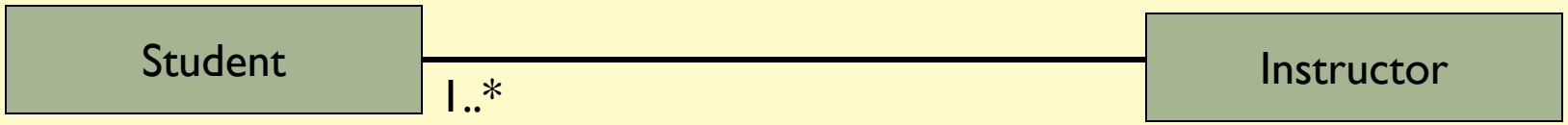
We can indicate the *multiplicity* of an association by adding *multiplicity adornments* to the line denoting the association.

The example indicates that a *Student* has one or more *Instructors*:



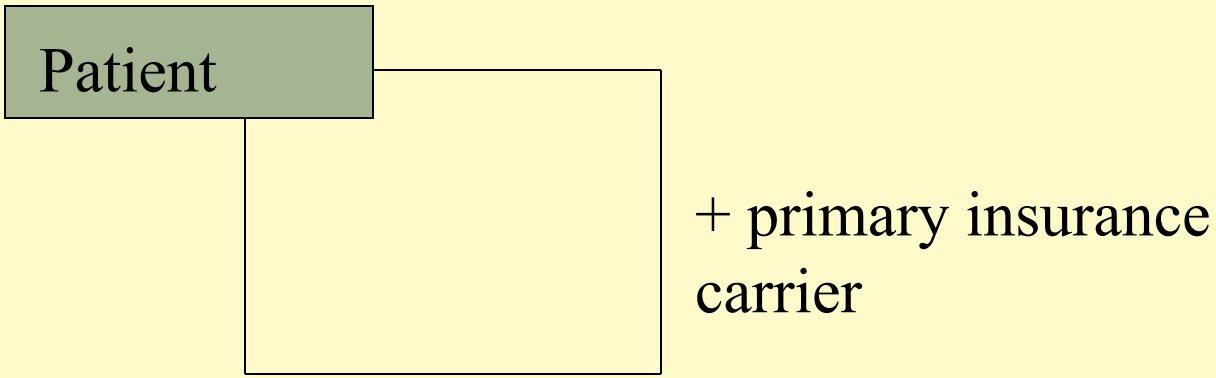
Association Relationships (Cont'd)

The example indicates that every *Instructor* has one or more *Students*:



Association Relationship

- Role type shown by:
  - drawing line between classes
  - indicating with a plus sign before the role name



Aggregation Relationship

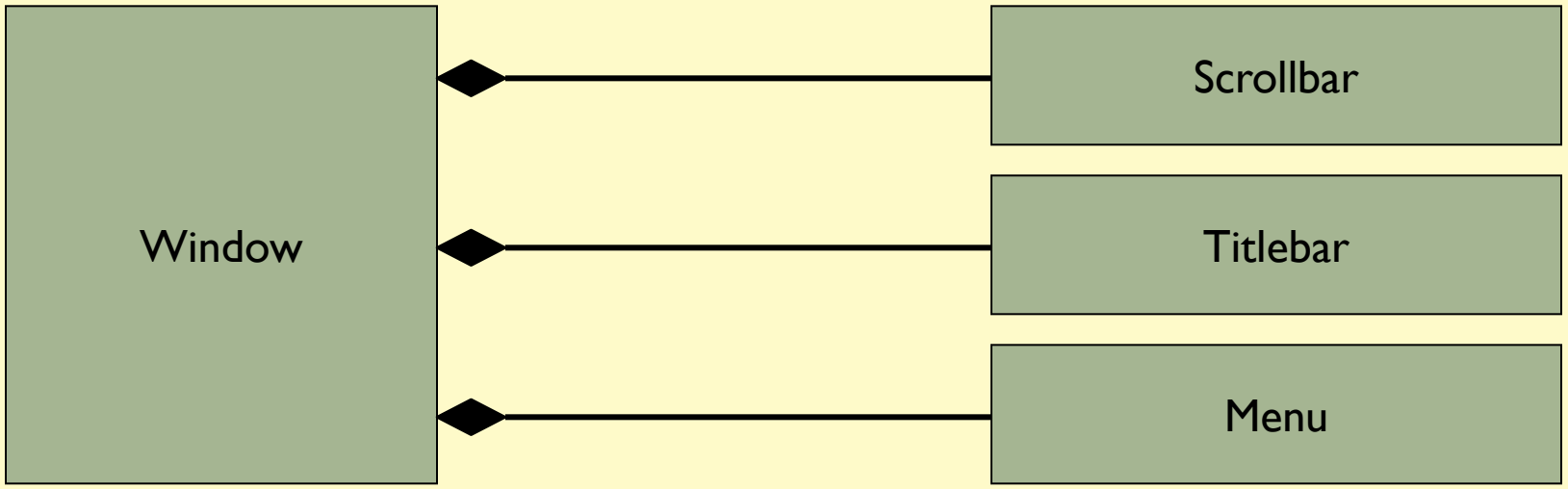
- Specialized form of association in which a whole is related to its part(s)
- Represented by *a-part-of* relationship
- Specifies a whole-part relationship between an aggregate (a whole) and a constituent part, where the part can exist independently from the aggregate.

Aggregation Relationship

- Aggregations are denoted by a hollow-diamond adornment on the association.

Composition Relationship

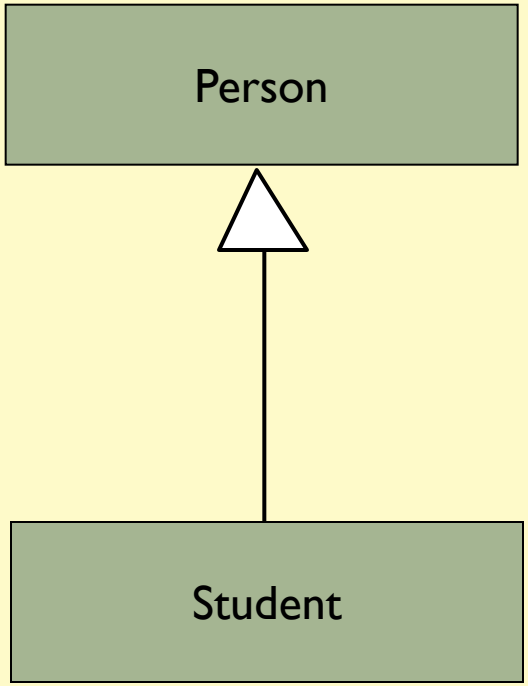
- A *composition* indicates a strong ownership and coincident lifetime of parts by the whole (*i.e.*, they live and die as a whole). Compositions are denoted by a filled-diamond adornment on the association



Generalization Relationship

- Enables the analyst to create classes that inherit attributes and operations of other classes
- Represented by *a-kind-of* relationship

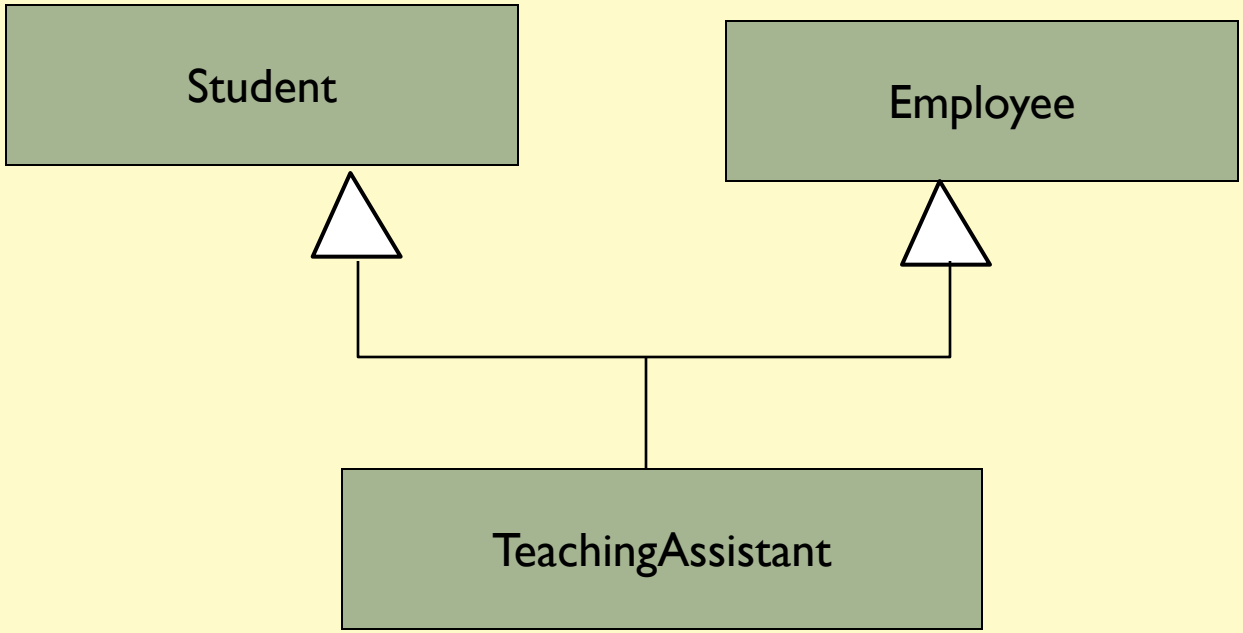
Generalization Relationships



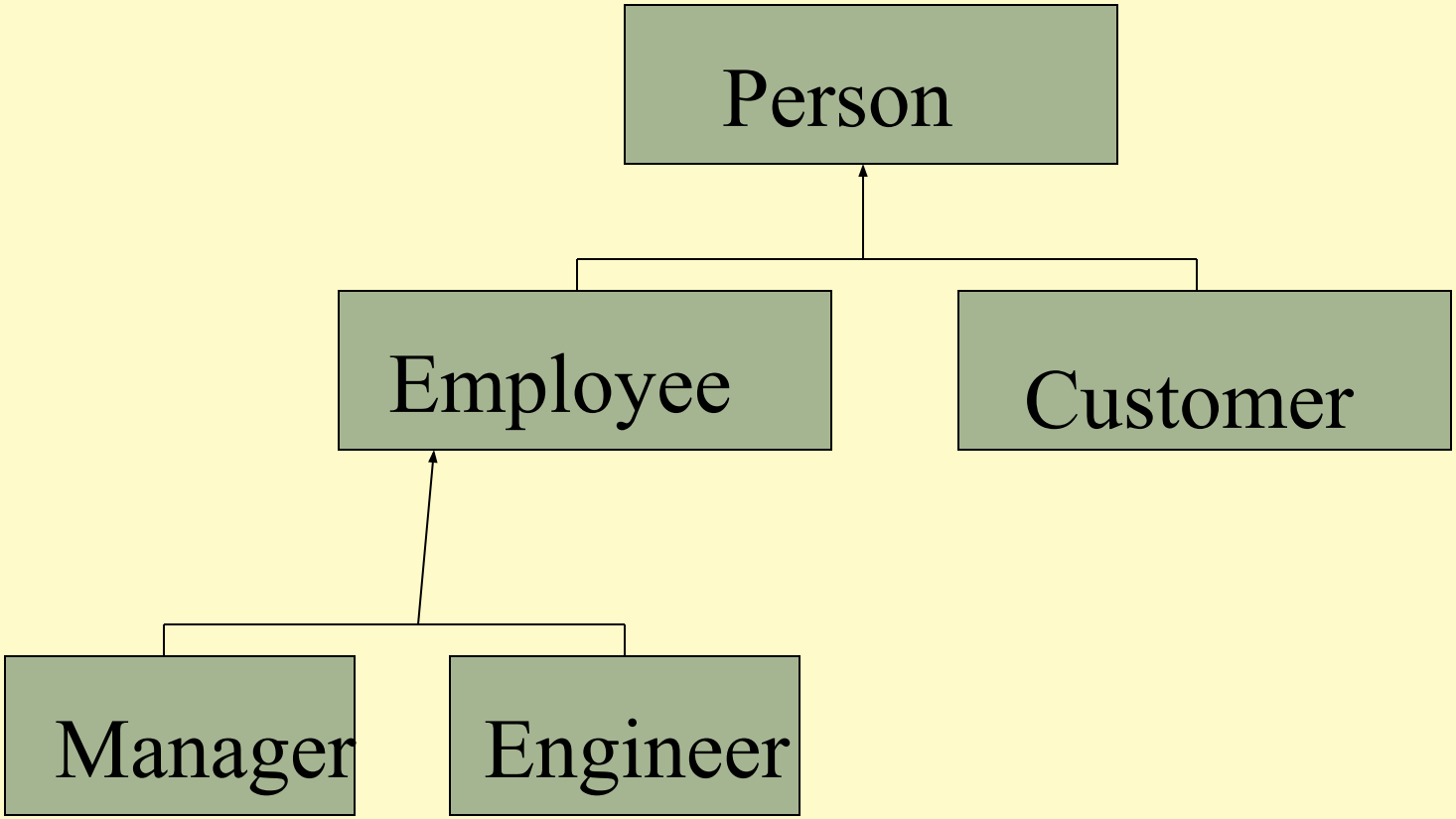
A *generalization* connects a subclass to its superclass. It denotes an inheritance of attributes and behavior from the superclass to the subclass and indicates a specialization in the subclass of the more general superclass.

Generalization Relationships (Cont'd)

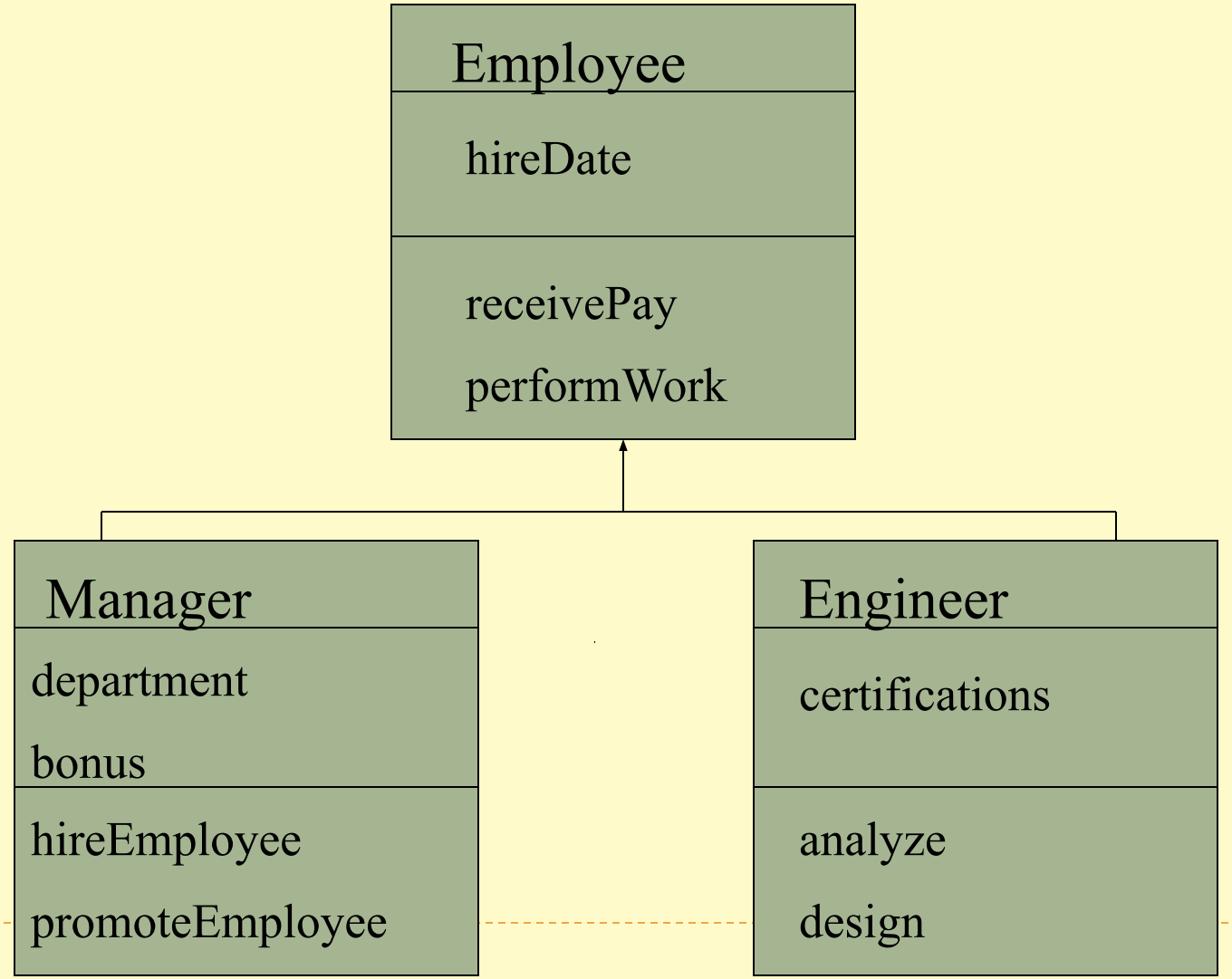
UML permits a class to inherit from multiple superclasses, although some programming languages (*e.g.*, Java) do not permit multiple inheritance.



Generalization Relationship

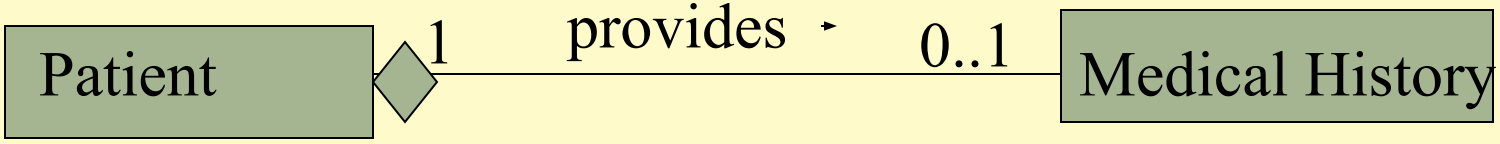


Generalization Relationship



Multiplicity

- Documents how many instances of a class can be associated with one instance of another class



Multiplicity

- Denotes the **minimum number.. maximum number** of instances

Exactly one	1	
Zero or more	0..*	or 0..m
One or more	1..*	or 1..m
Zero or one	0..1	
Specified range	2..4	
Multiple, disjoint ranges	1..3, 5