

UNIFIED  
MODELING  
LANGUAGE



# Writing Classes

Unified Modeling Language (UML)  
Class Diagrams

# Lecture Contents

- UML Basics
- UML Class Diagrams
  - Attributes (Fields)
  - Operations (Methods)
  - Visibility
  - Scope
  - Relationships

# Unified Modeling Language

- By the *Object Management Group* (OMG)

- Version 1.0 in January 1997

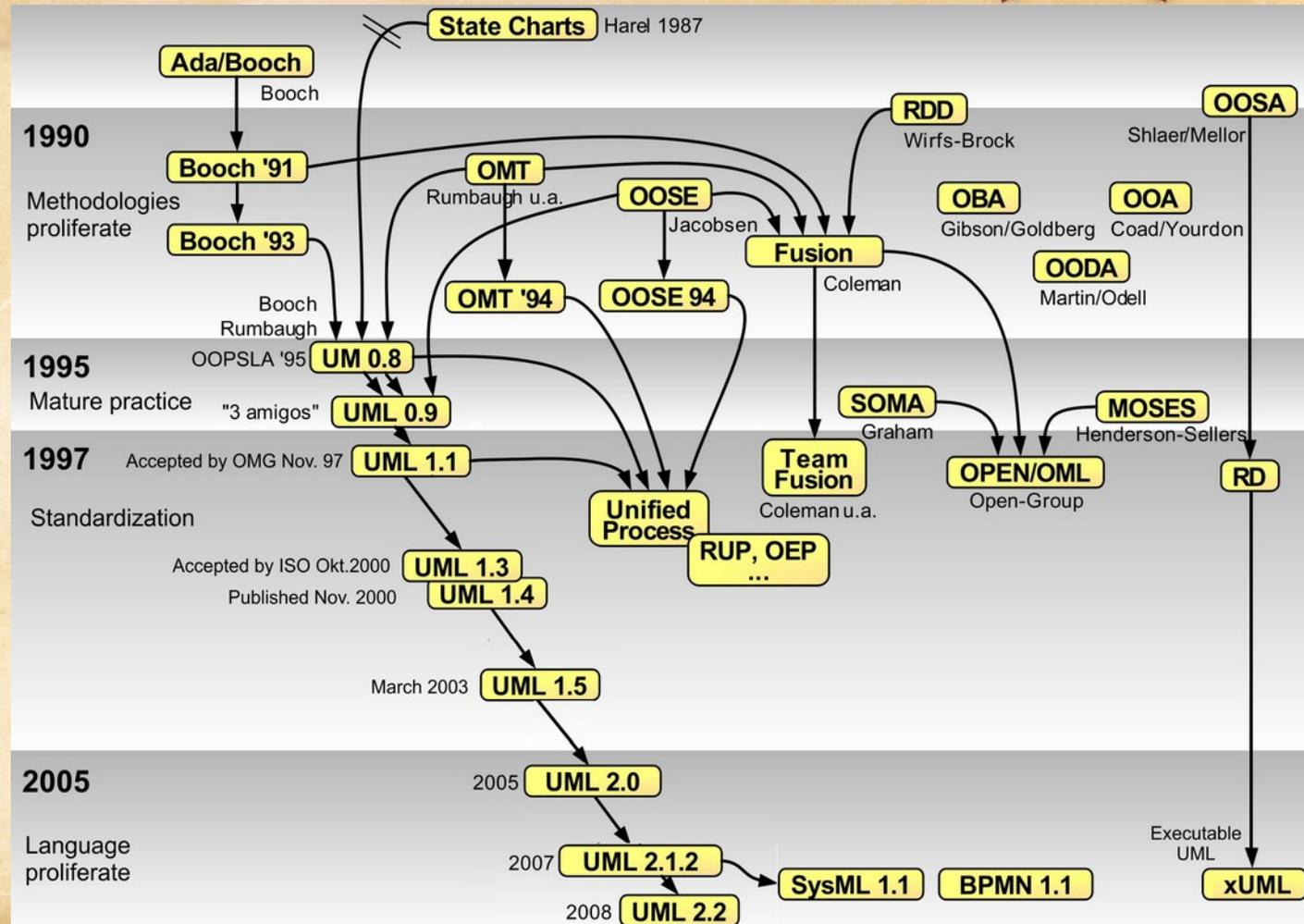


- A graphical way of describing software systems

- Easy to read and understand the system prior to coding
  - Independent of programming language
  - Facilitates communication between developers

# Unified Modeling Language

- Evolution

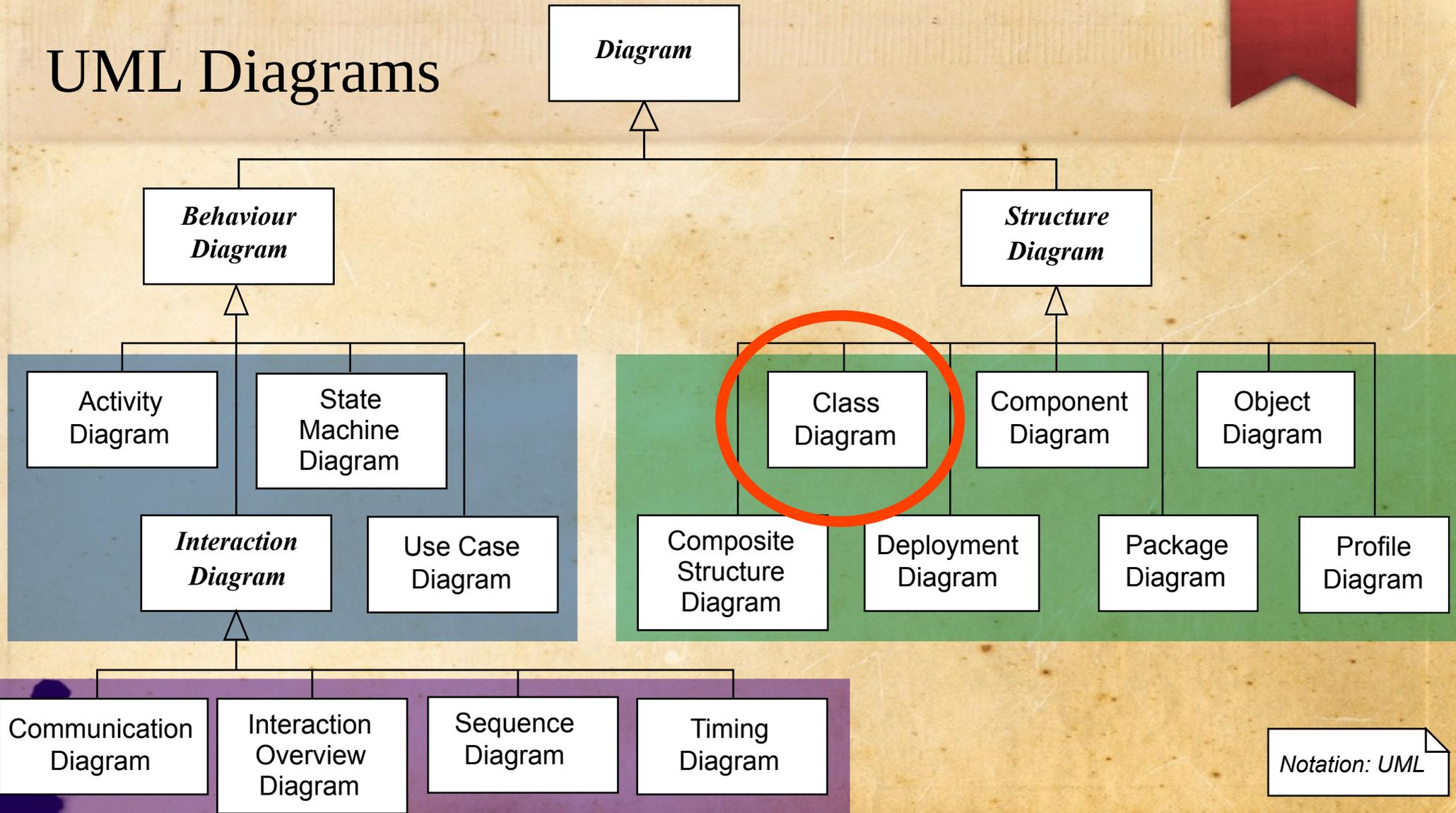


# References

- The most recent UML Specification from the *Object Management Group* (OMG)

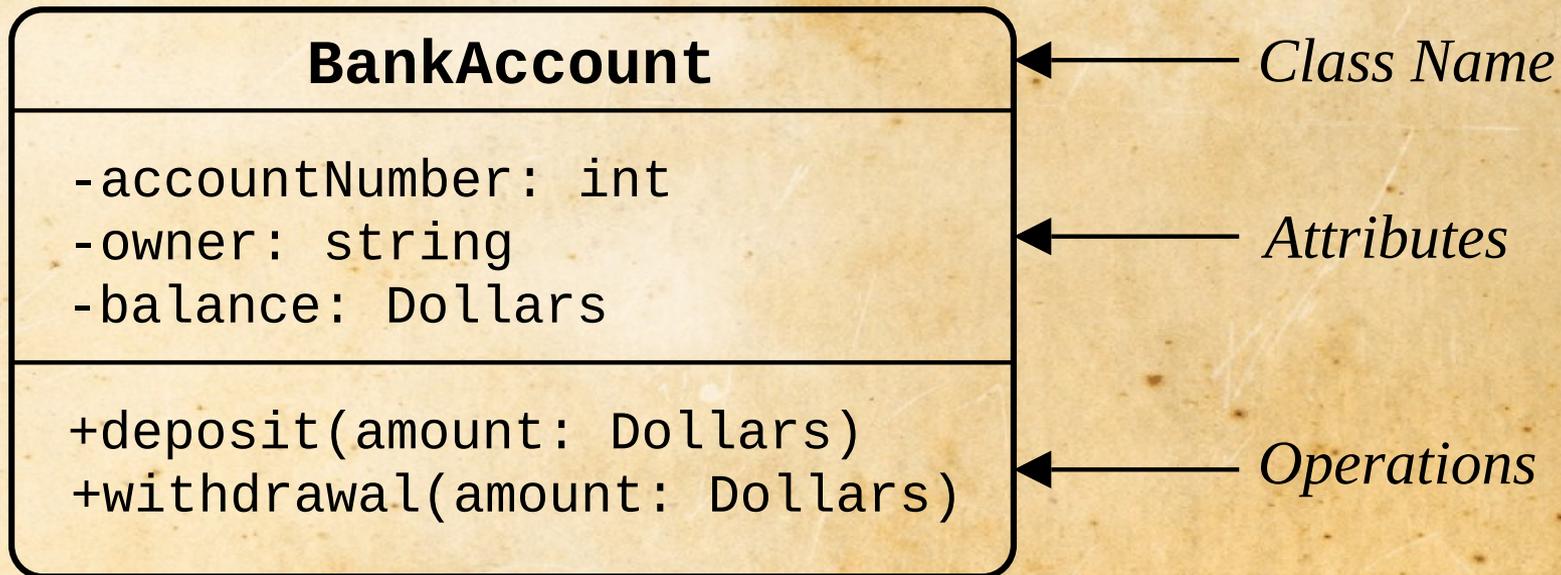
<https://www.omg.org/spec/UML/>

# UML Diagrams



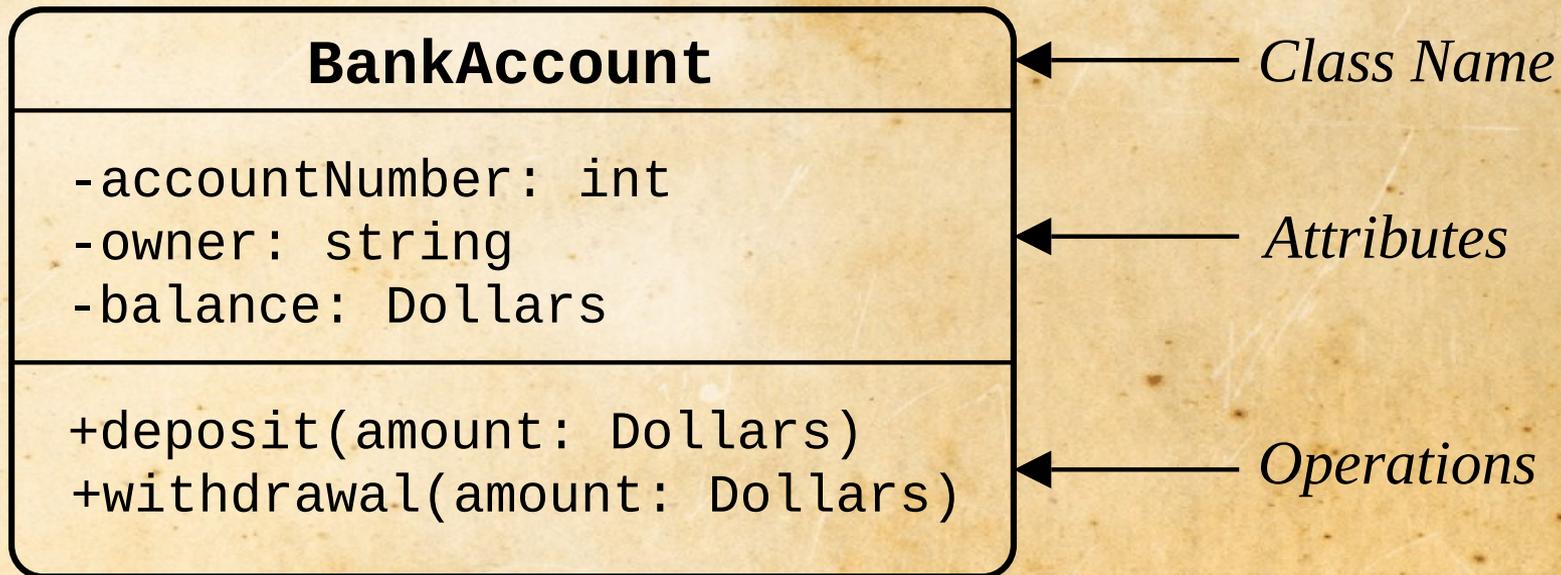
# UML Class Diagram

- A static structure diagram showing the systems **classes** and their **relationships**
- Classes are represented with boxes that have three compartments:



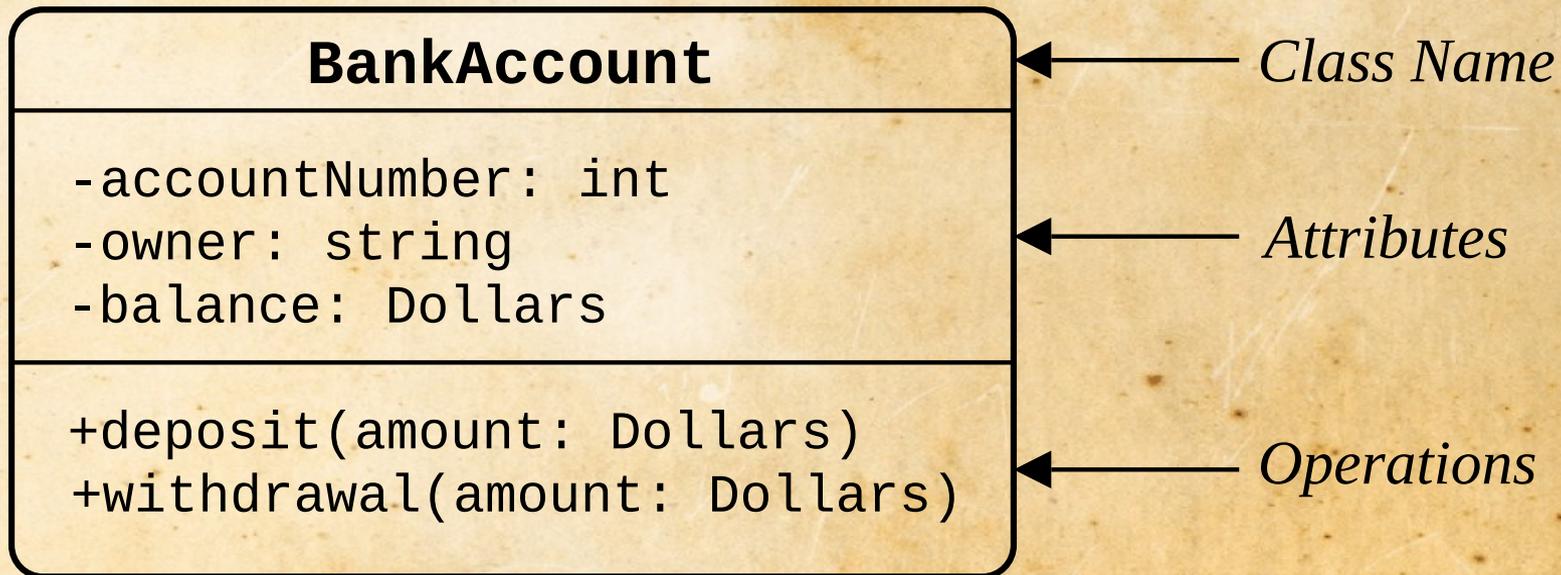
# UML Class Diagram

- The class name is bold and centered; the first letter is capitalized
- Attributes are left-aligned; the first case is lower case
- Operations are left-aligned; the first letter is lower case



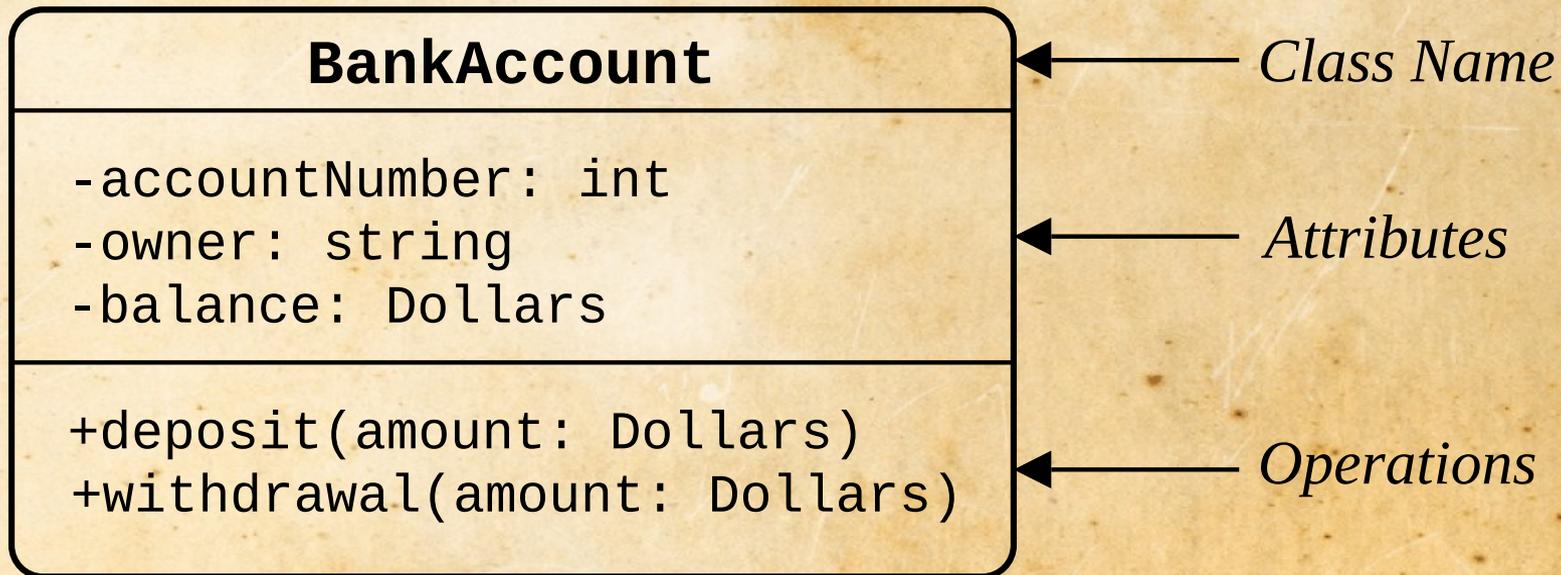
# UML Class Diagram

- Classes are represented with boxes that have three compartments
  - *Attributes* in object oriented programming are called **fields** (basically *variables*)
  - *Operations* in object oriented programming are called **methods**



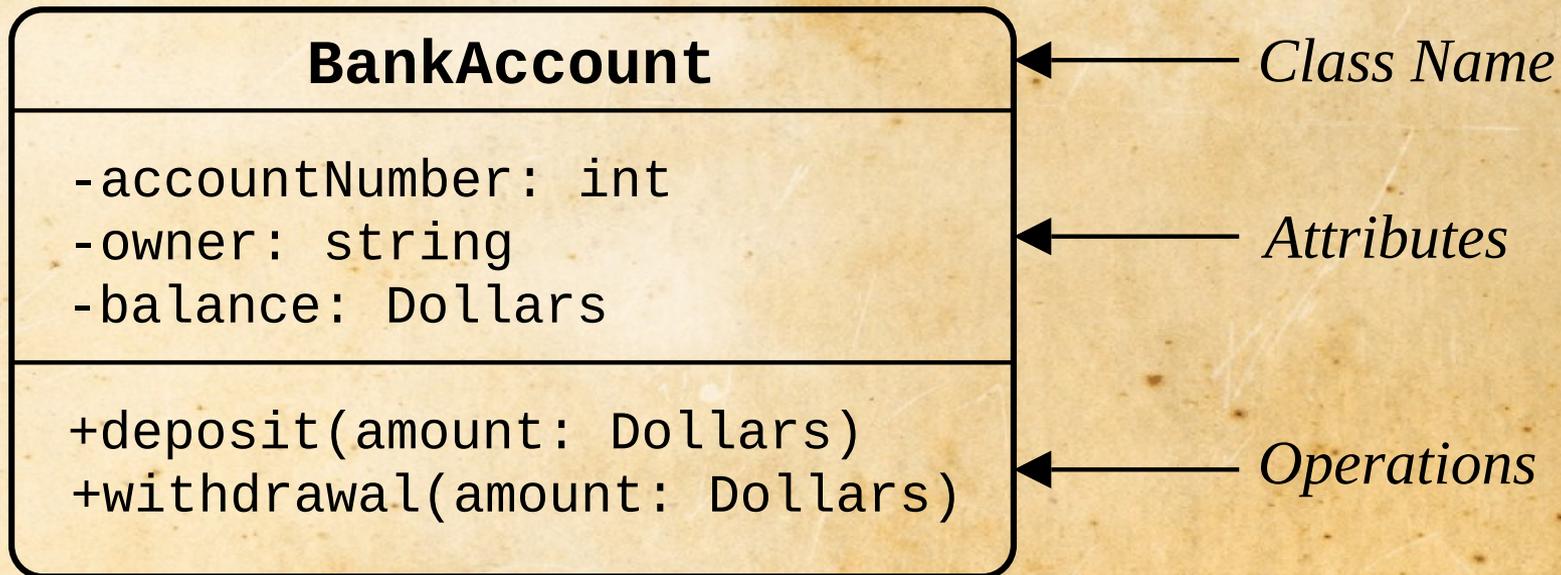
# Attributes (*Fields*)

- Significant piece of data containing values that describe each instance of that class.
- Also known as: *variables*, *states*, or *properties*



# Operations (Methods)

- Specify behavioral features of a class.
  - What an object can do, or what can be done to it
- Also known as: *behaviors* or *functions*



# Visibility

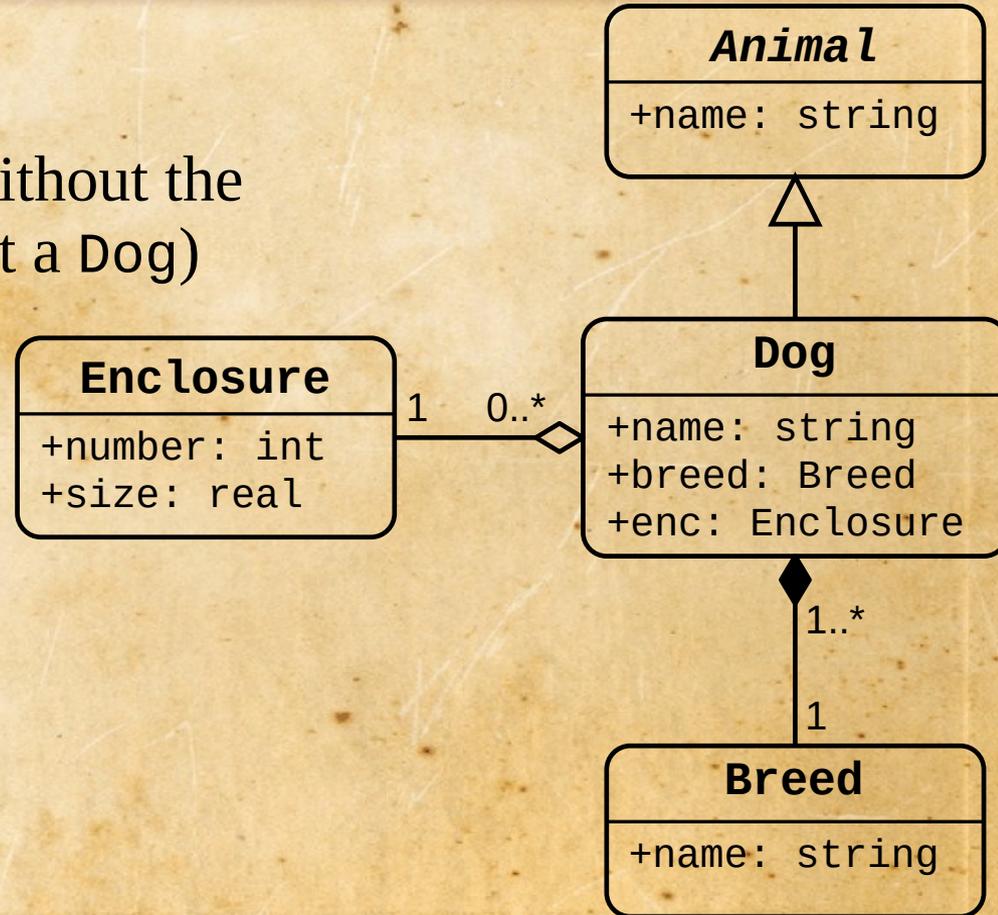
- Sets the accessibility for ***field*** or ***method***.
  - + ***public*** – accessible to all
  - ~ ***package (default)*** – accessible by classes within the same package
  - # ***protected*** – accessible by the class and subclasses
  - ***private*** – only accessible within the class
- ***Attributes (fields)*** generally should be ***private*** or ***protected***

# *Scope of Attributes and Operations*

- Two types of *scope* for members:
  - *Class members*, represented by underlined names
    - One *attribute* is shared by all instances
    - *Operations* cannot affect the state of instance *attributes*
  - *Instance members*, not underlined
    - *Attributes* may vary between instances
    - *Operations* may affect that instance's state (change the *attributes*)
- *Class members* are typically referred to as *static* in object-oriented programming languages.

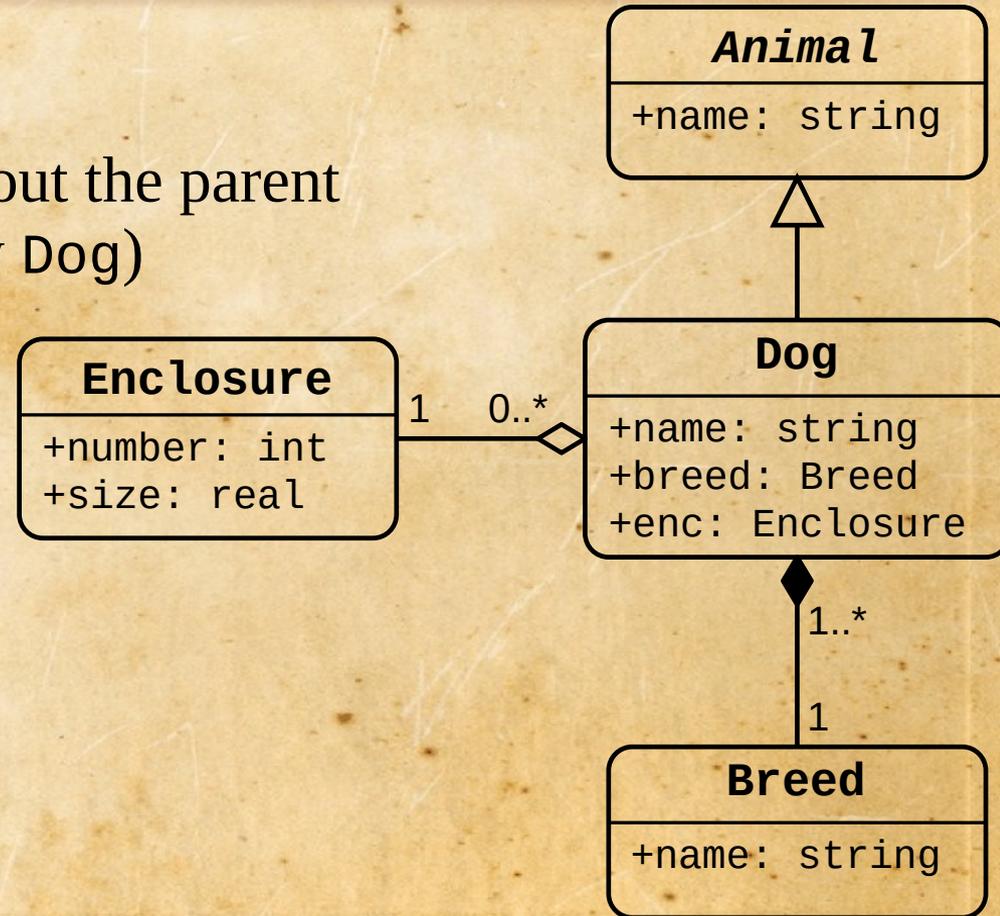
# Relationship: *Composition*

- When a class contains an object
- The contained class cannot exist without the parent (example: no Breed without a Dog)
- Shown with a connection with a closed diamond, ◆, on the containing class



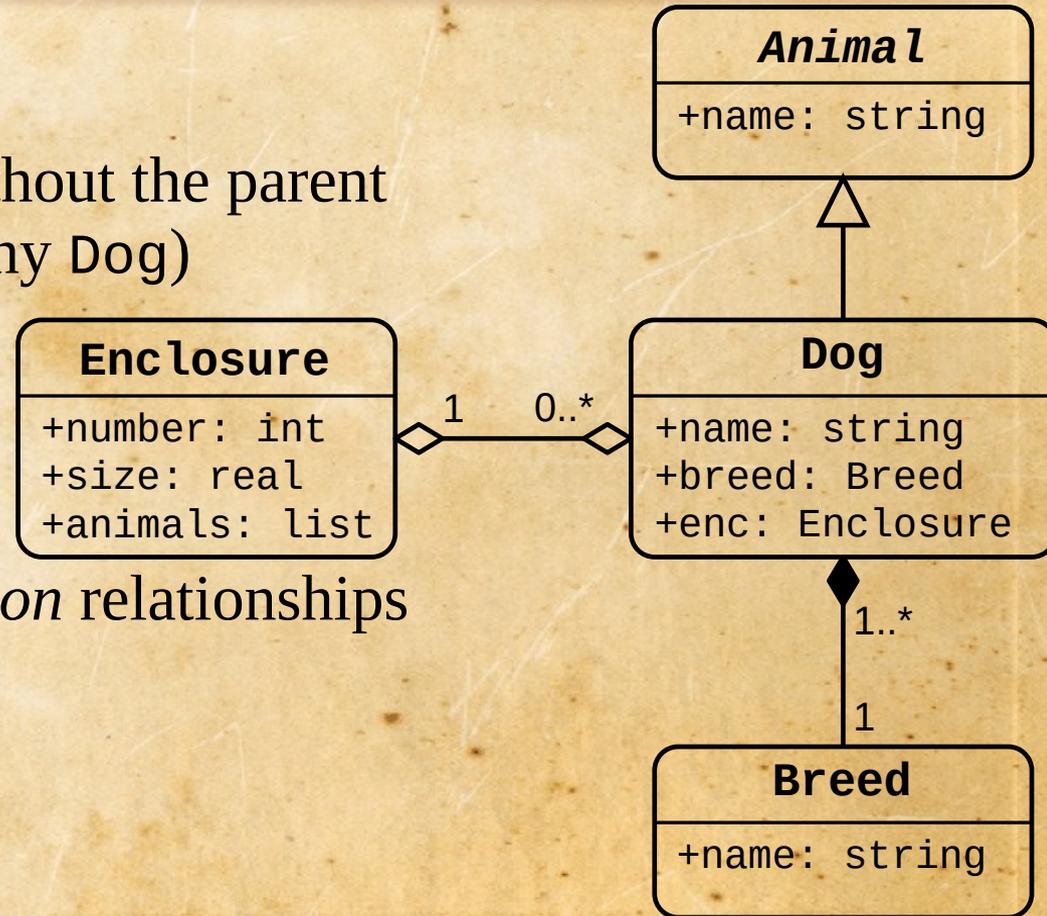
# Relationship: *Aggregation*

- When a class contains an object
- The contained class can exist without the parent (example: Enclosure without any Dog)
- Shown as a connection with an open diamond,  $\diamond$ , on the containing class



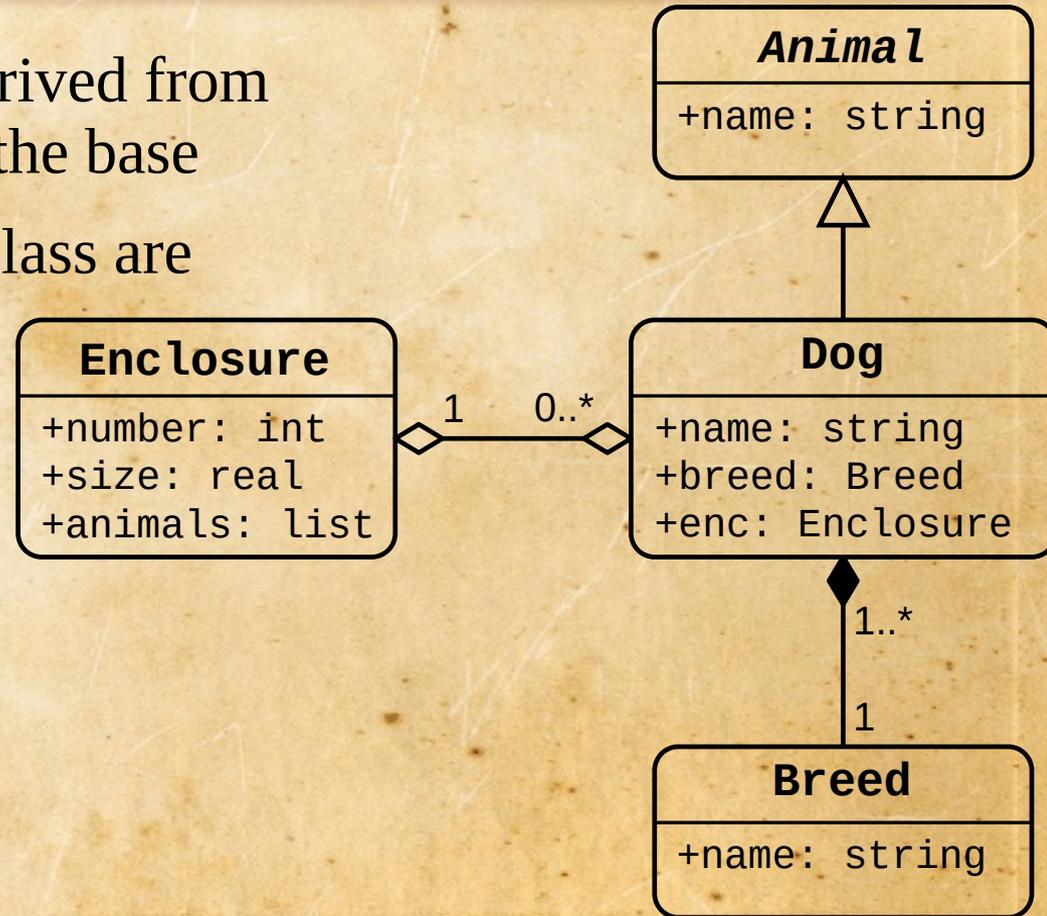
# Relationship: *Aggregation*

- When a class contains an object
- The contained class can exist without the parent (example: Enclosure without any Dog)
- Shown as a connection with an open diamond,  $\diamond$ , on the containing class
- Note: *composition* and *aggregation* relationships may be bidirectional



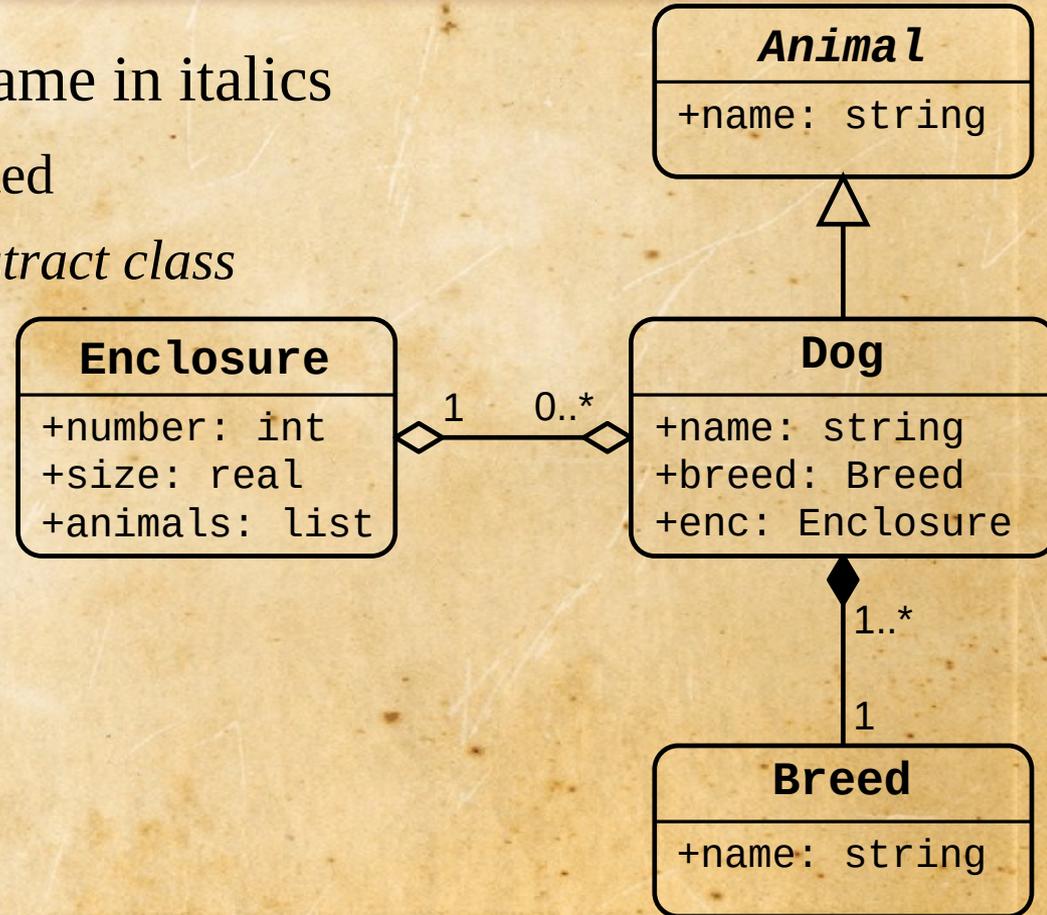
# Relationship: *Inheritance*

- When a class (the subclass) is derived from another class (the superclass) as the base
- Fields and methods of the superclass are inherited by the subclass, if *public*, *protected*, or *package/default*.
- Show as a connection with an arrow with an open arrow head  
→



# Abstract Classes

- An *abstract class* has the class name in italics
  - These classes cannot be instantiated
  - Here, the *Animal* class is an *abstract class*



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