

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

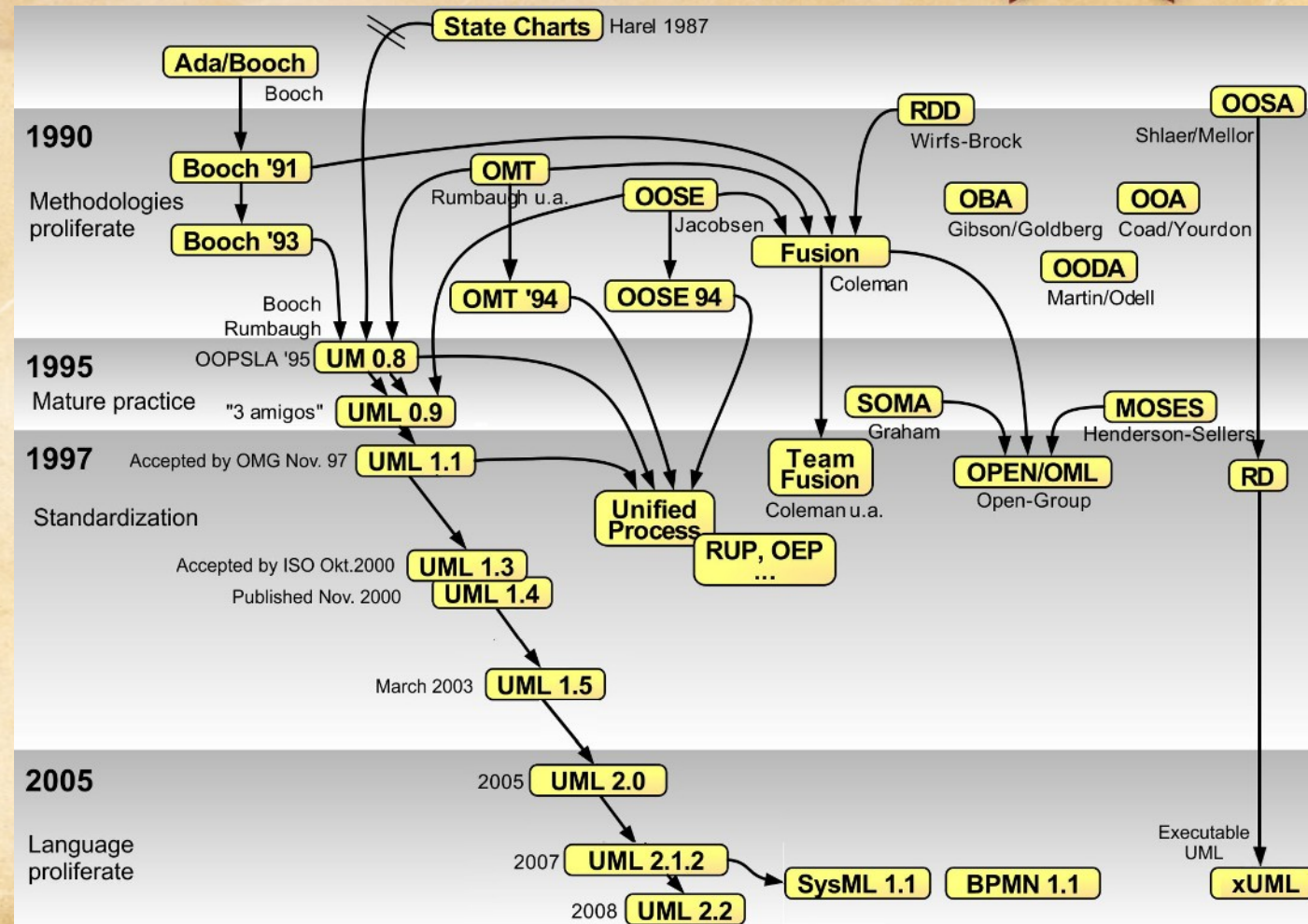
Unified Modeling Language

- 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

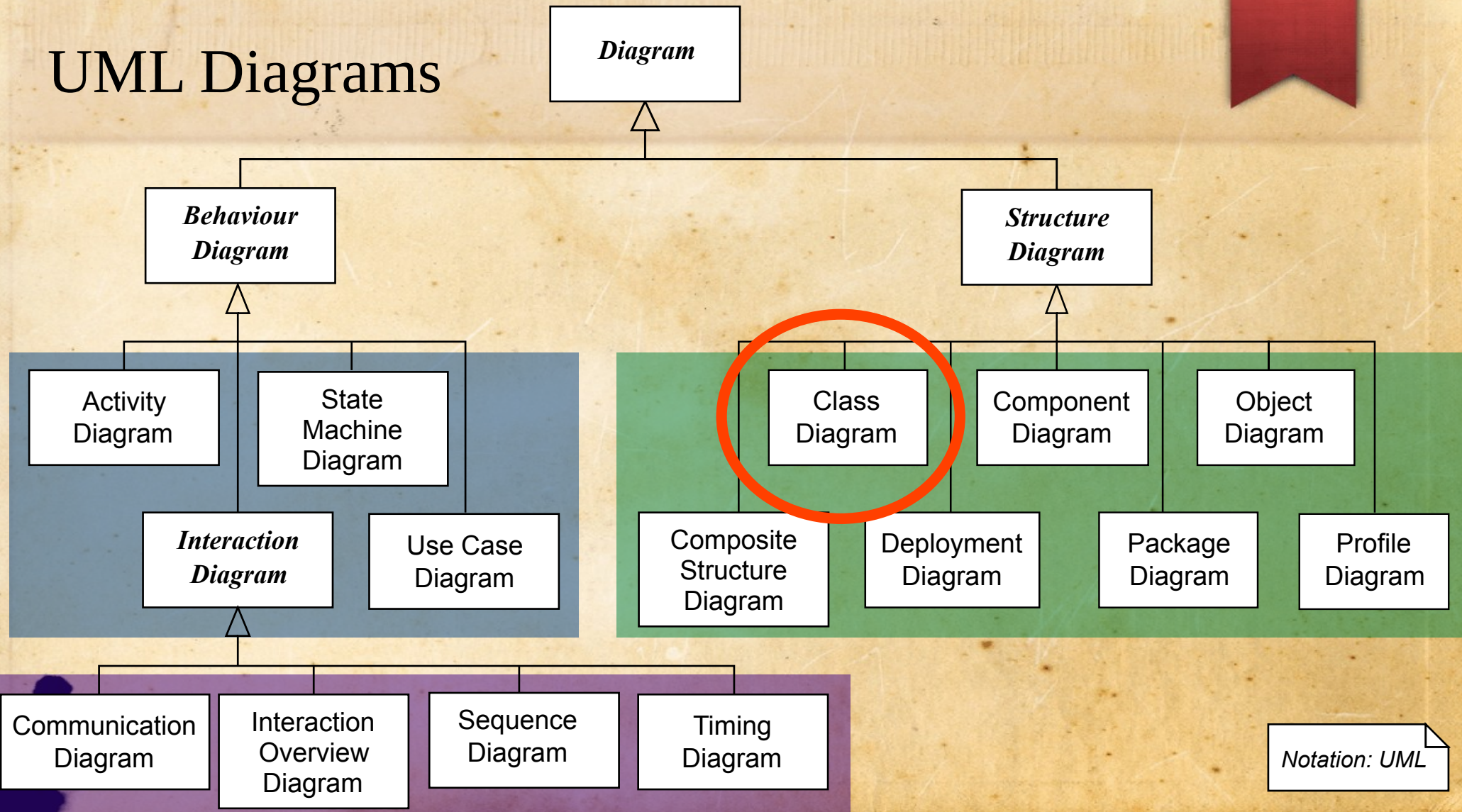


References

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

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

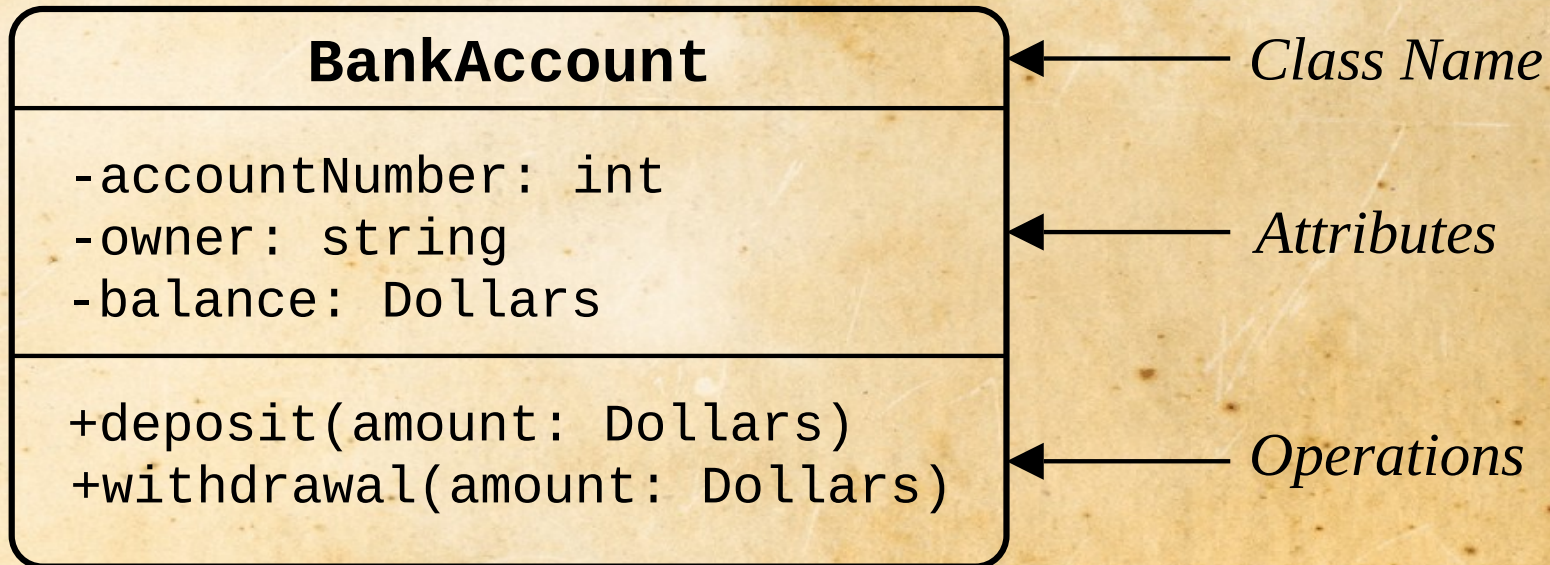
UML Diagrams



Notation: UML

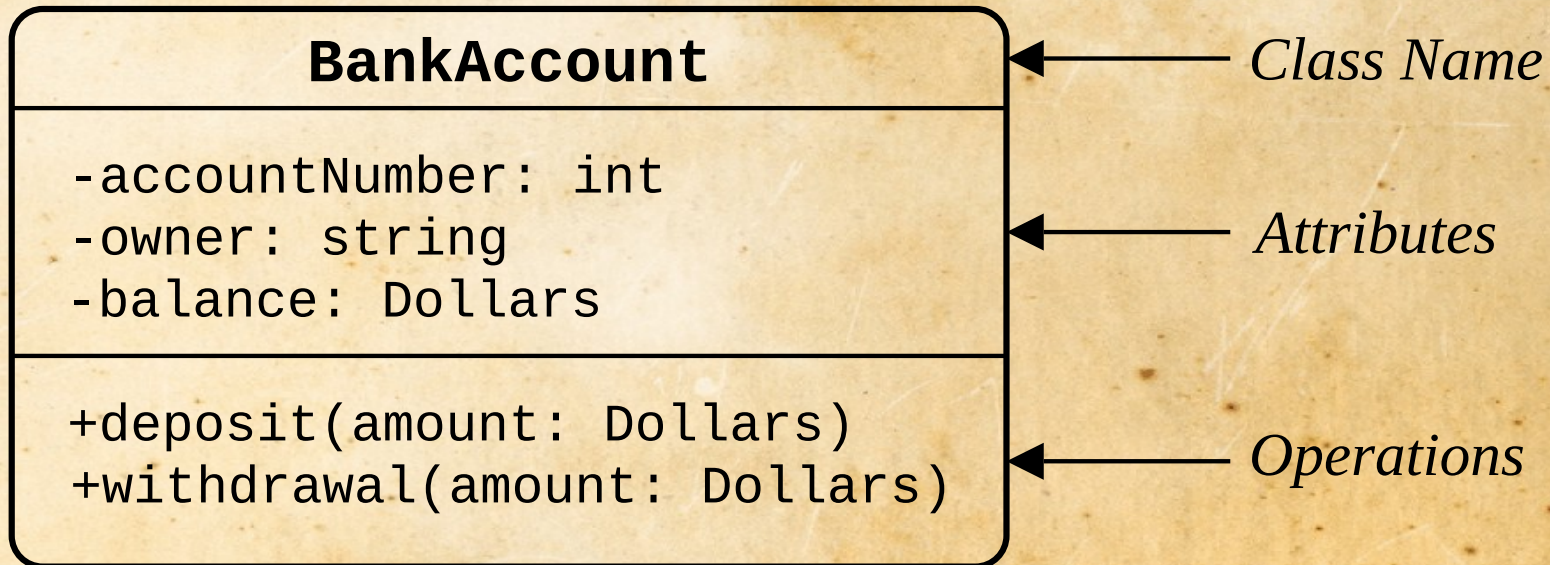
UML Class Diagram

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



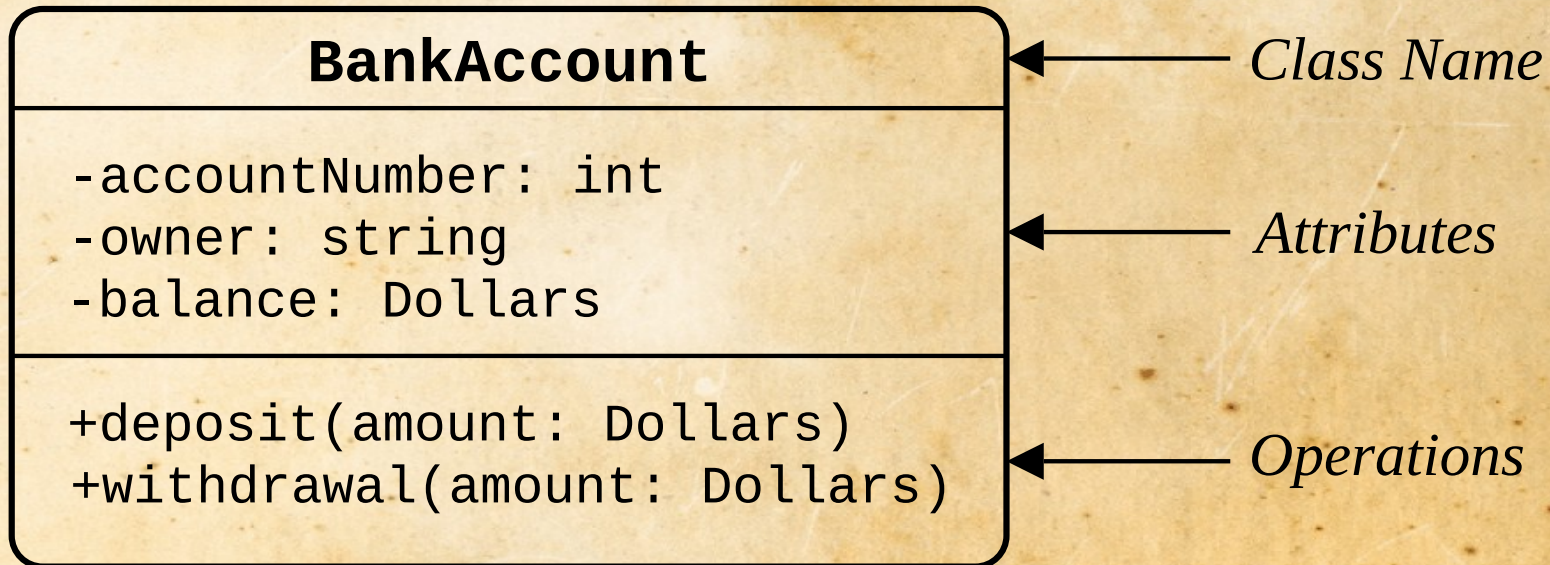
UML Class Diagram

- 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



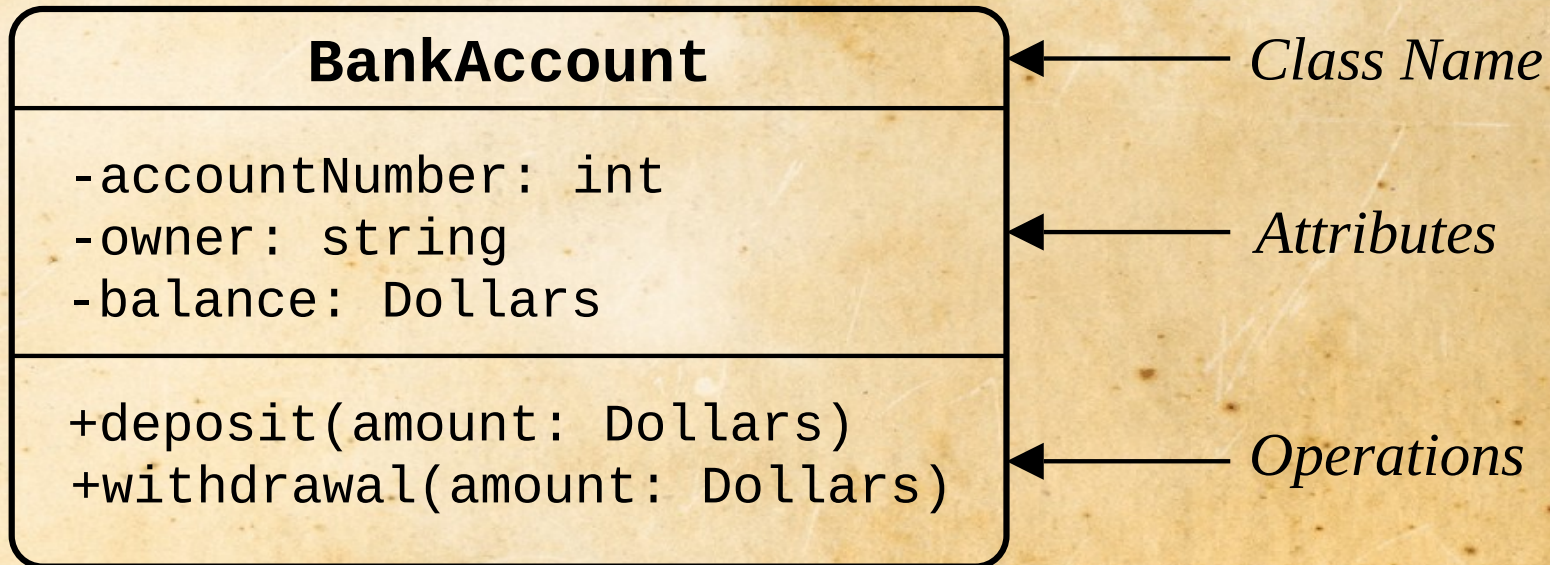
UML Class Diagram

- 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**



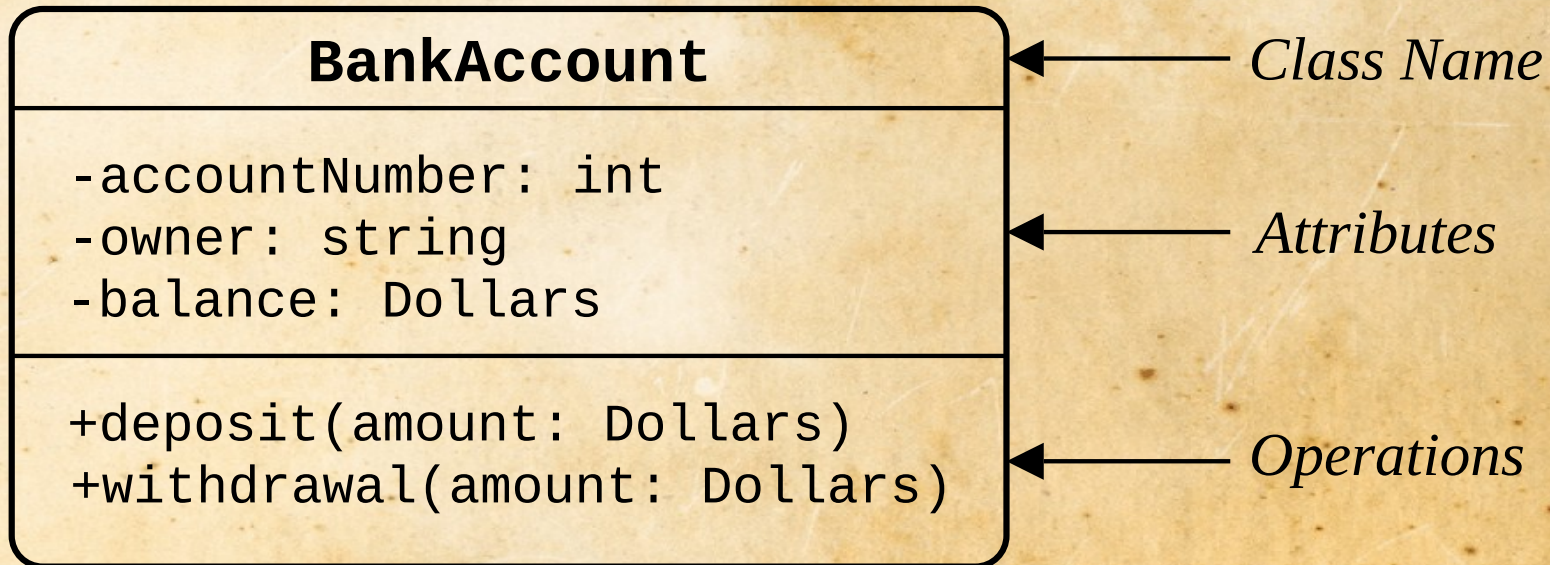
Attributes (*Fields*)

- 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

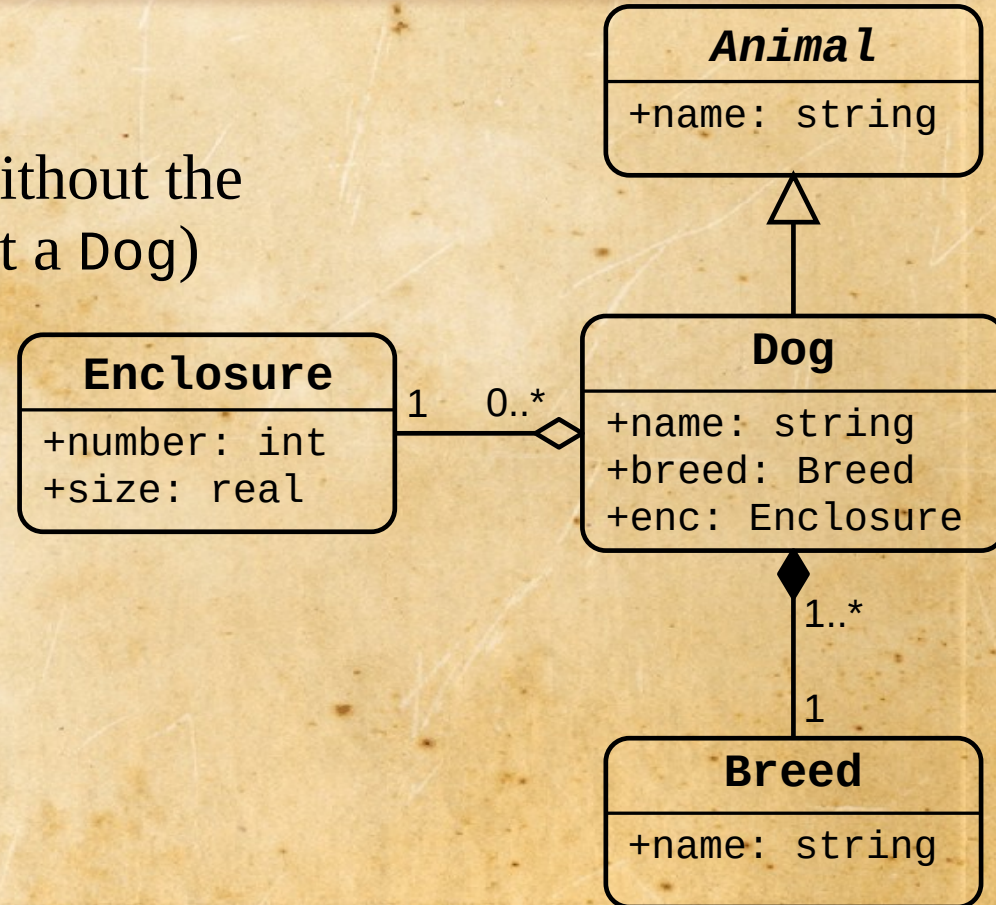
- Sets the accessibility for *field* or *method*.
 - + *public* – accessible to all
 - ~ *package (default)* – accessible by classes within the same package
 - # *protected* – accessible by the class and subclasses
 - *private* – only accessible within the class
- *Attributes (fields)* generally should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

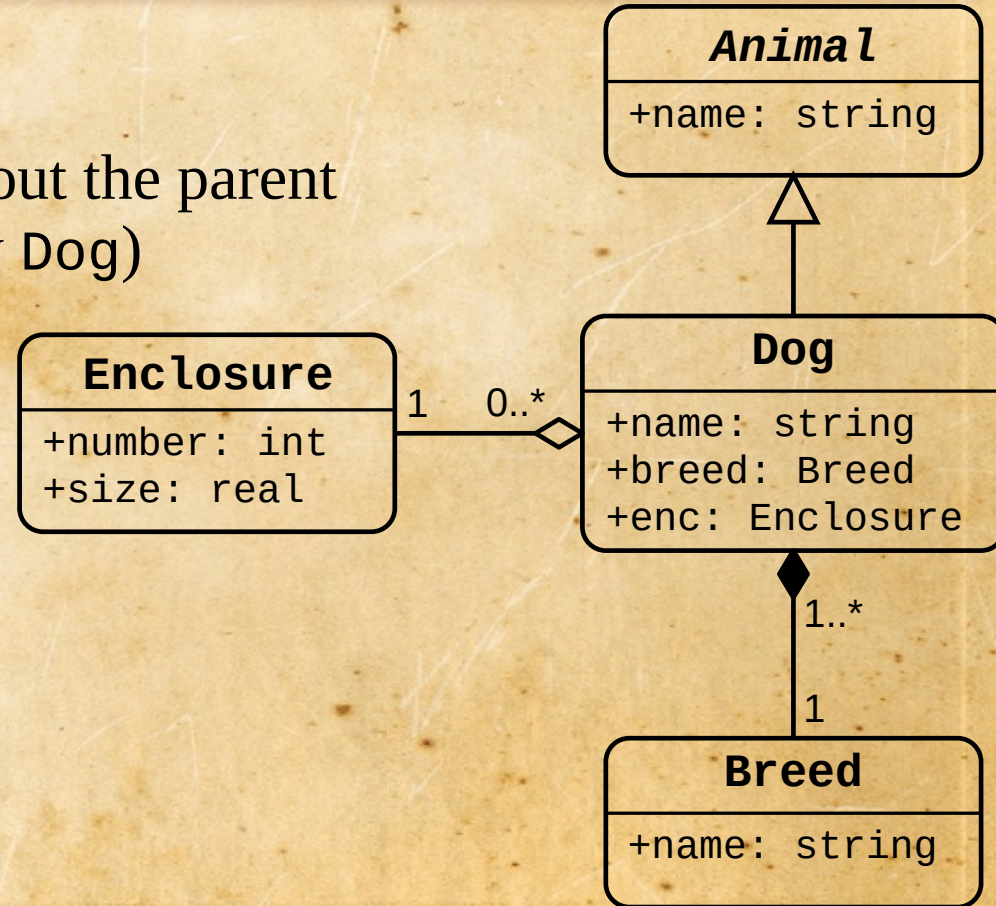
Relationship: *Composition*

- 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



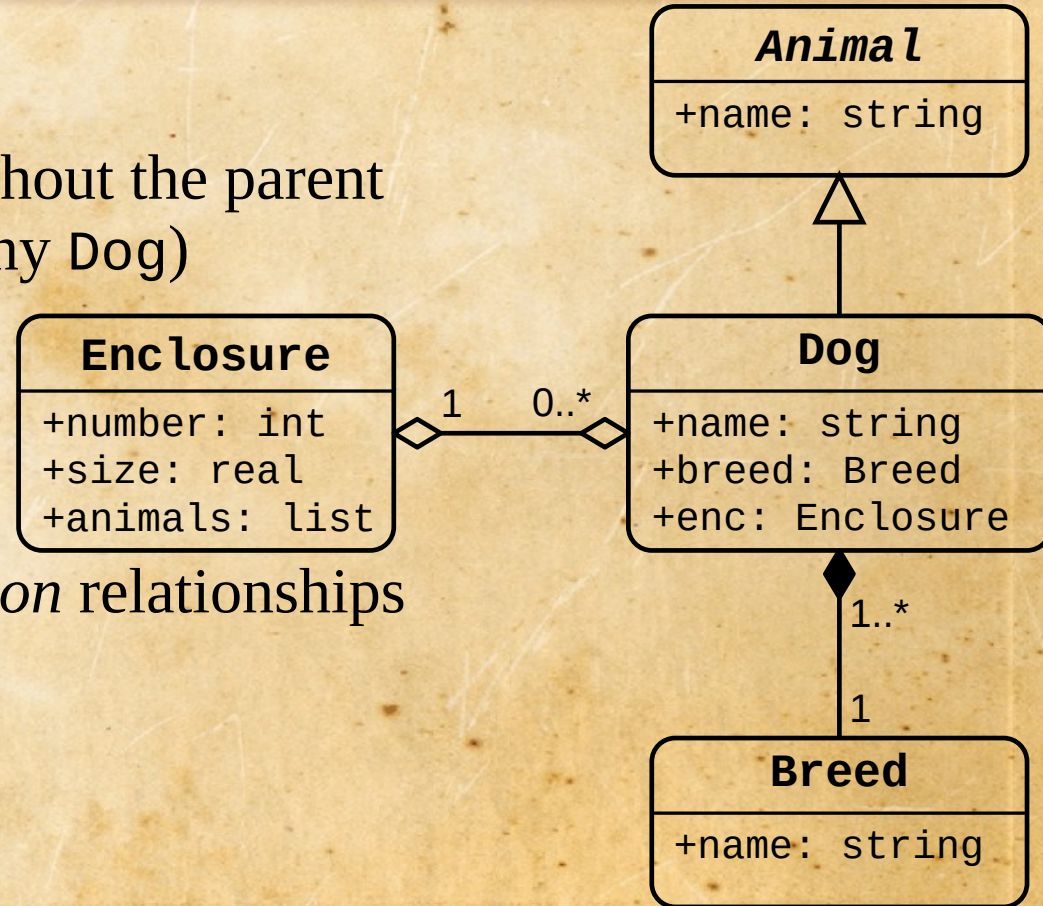
Relationship: *Aggregation*

- 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, ◇, on the containing class



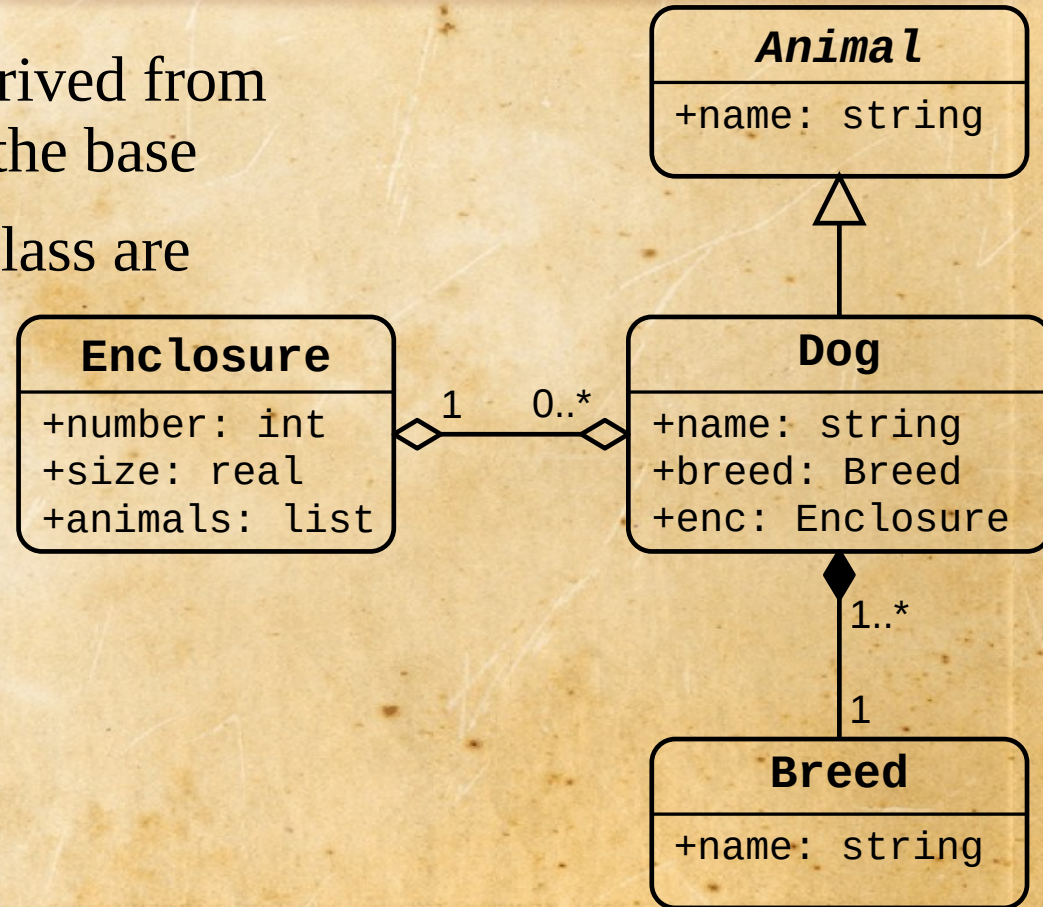
Relationship: *Aggregation*

- 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



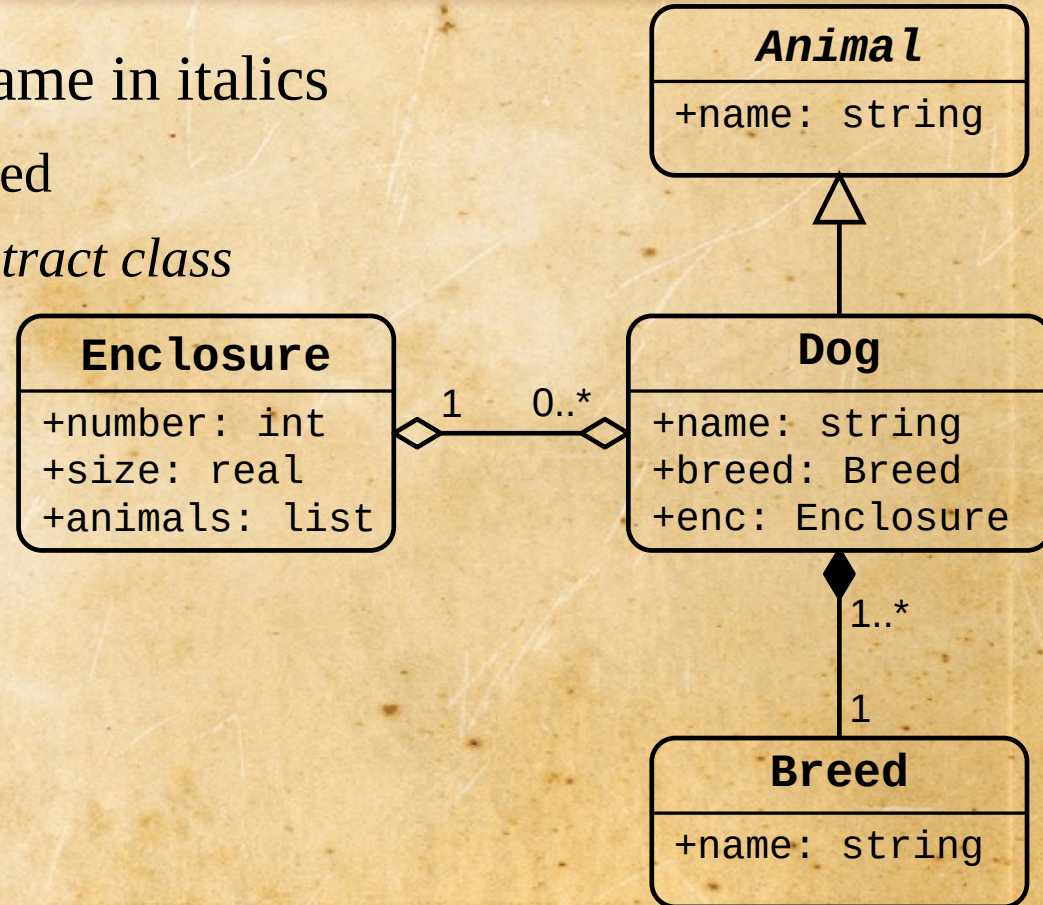
Relationship: *Inheritance*

- 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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