

# INF43: Introduction to Software Engineering

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# Announcement

- Phase 2 Assignment:
  - May 8 (Friday) 9:00 pm

# Types of UML Diagrams

- Some types of diagrams used more often than others
- Structure Diagrams
- Behavior Diagrams (Interaction Diagrams)

Structural (Static)	Class Diagram Component Diagram
Behavioral (Dynamic)	Use Case Diagram Sequence Diagram State Machine Diagram Interaction Diagram

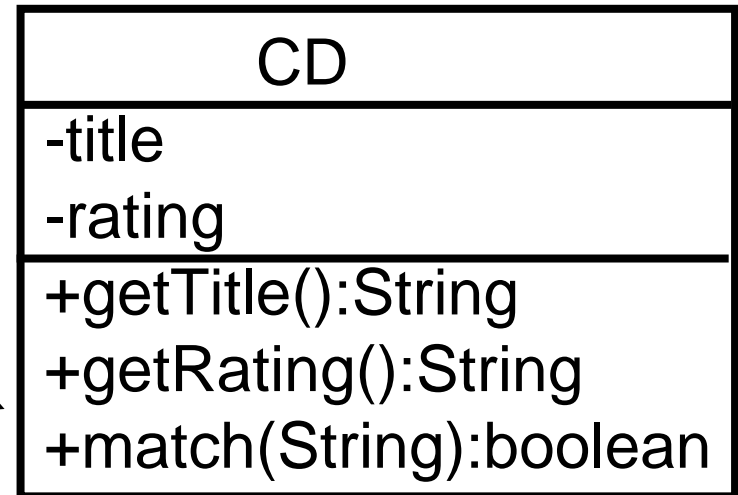
# Class Diagram

- Class diagram
  - Class
    - Class name
    - Attribute
    - Operation
  - Relationships
    - Association
    - Aggregation
    - Composition
    - Generalization

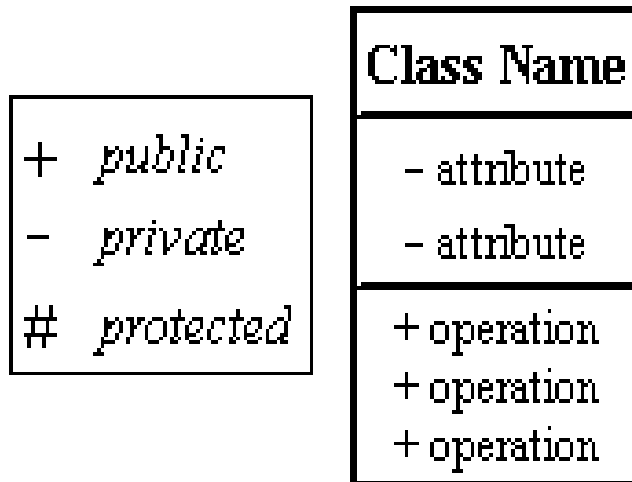
# Class

- Classes can have three parts

- Name
- Attributes (properties)
- Operations (behavior)

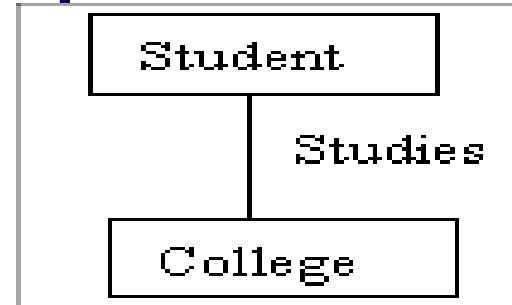


- Classes can show visibility and types.

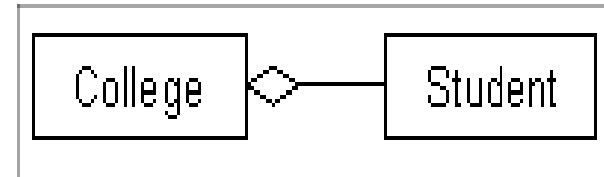


# Relationships

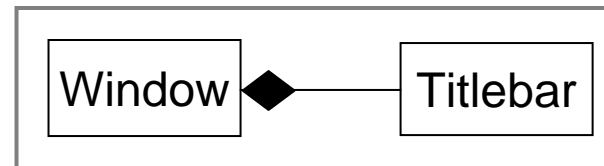
- Association →  
... has a ...



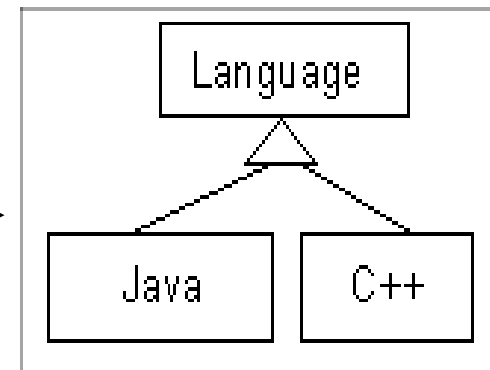
- Aggregation →  
... owns a ...



- Composition →  
... is part of ...

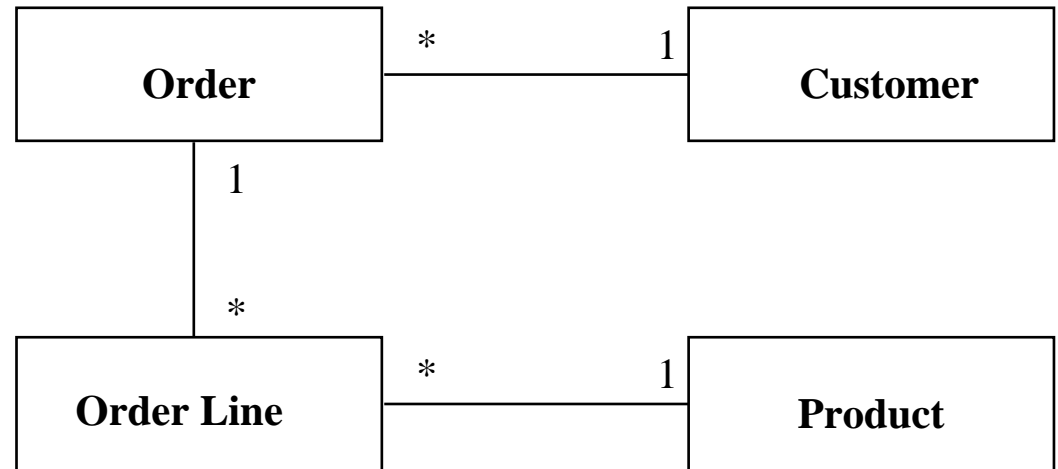


- Generalization →  
... is a ...



# Relationships: Association

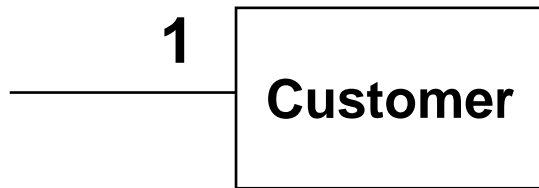
- A structural relationship that specifies that objects of one thing are connected to objects of other



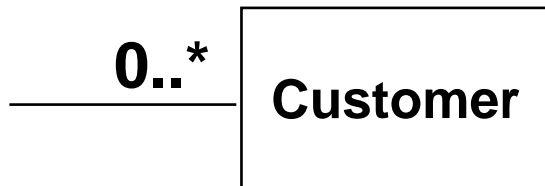
- An Order has to come from a single Customer.
- A Customer may make several Orders over time.
- Each of these Orders has several Order Lines, each of which refers to a single Product.

# Relationships: Association - Cardinality

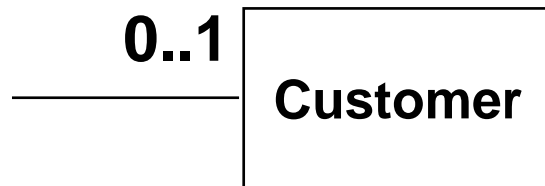
- How many objects participate in a relationship. Also known as *multiplicity*.



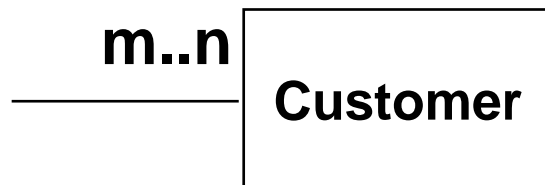
Exactly one



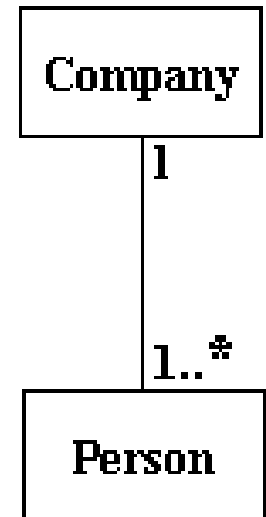
Many (zero or more)



Optional (zero or one)



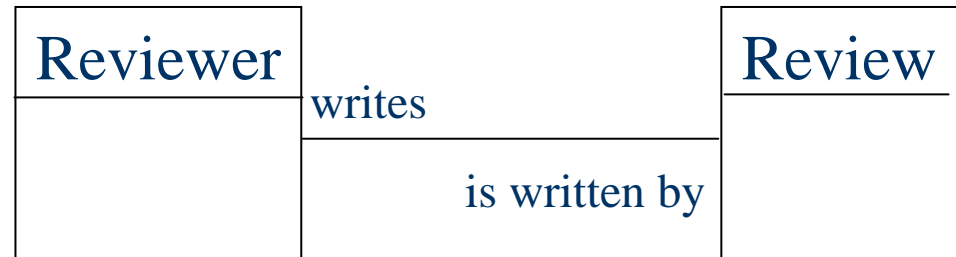
Numerically specified e.g 3..6  
or 2..5 or 1,000..\*





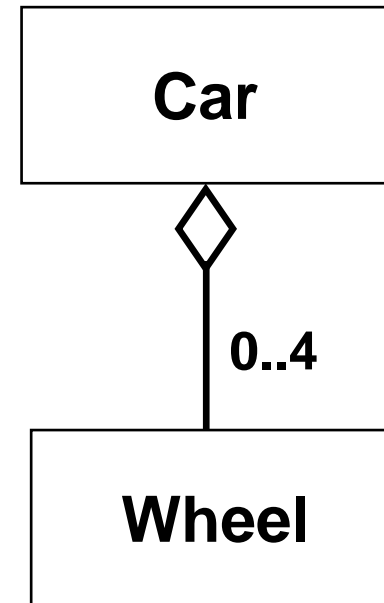
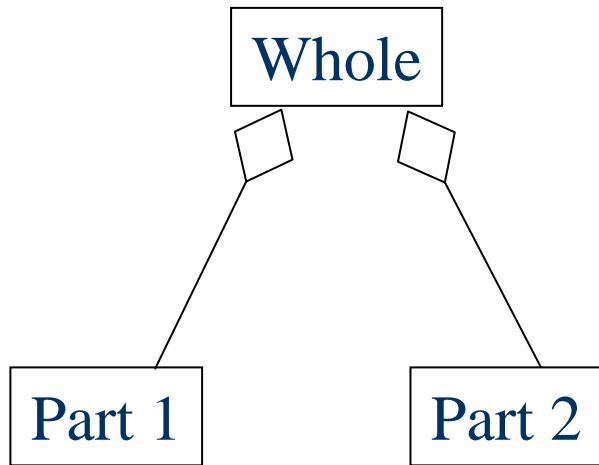
# Relationships: Association - Roles (Navigability and Name)

- An association role can appear on top of the link between two classes with a triangle indicating the direction of the role
- An association role changes accordingly to the viewpoint selected
- **Note:** It's uncommon to name both the association and the class roles.



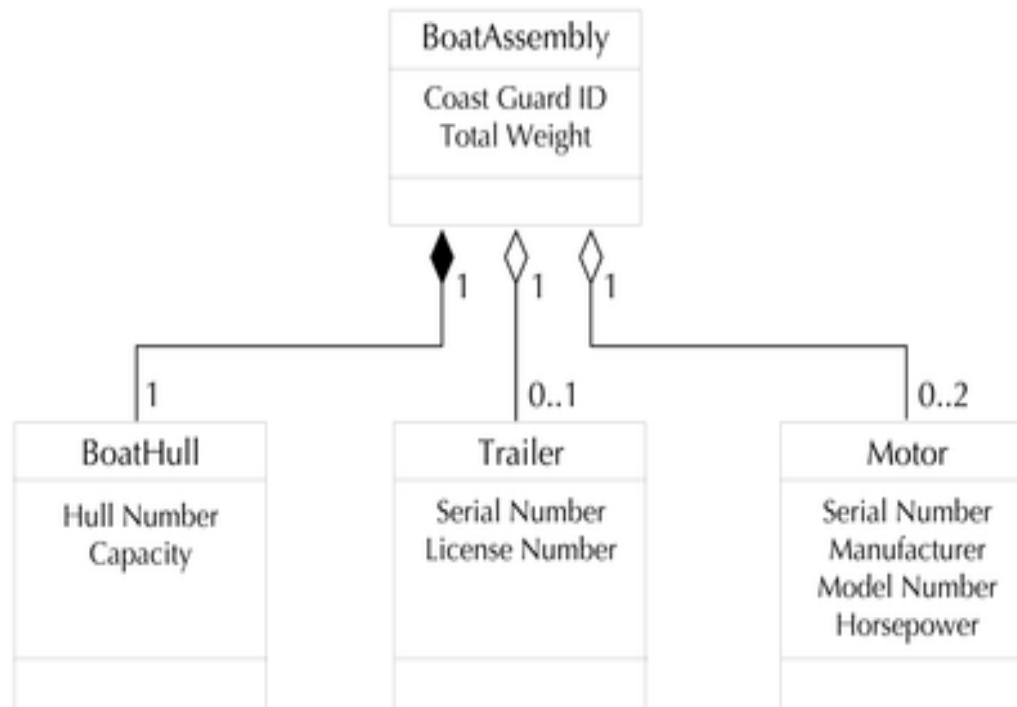
# Relationships: Aggregation

- **Aggregation** is a whole/part relationship



# Relationships: Composition

- **Composition** is a stronger whole/part relationship.
- The part cannot exist without the whole.



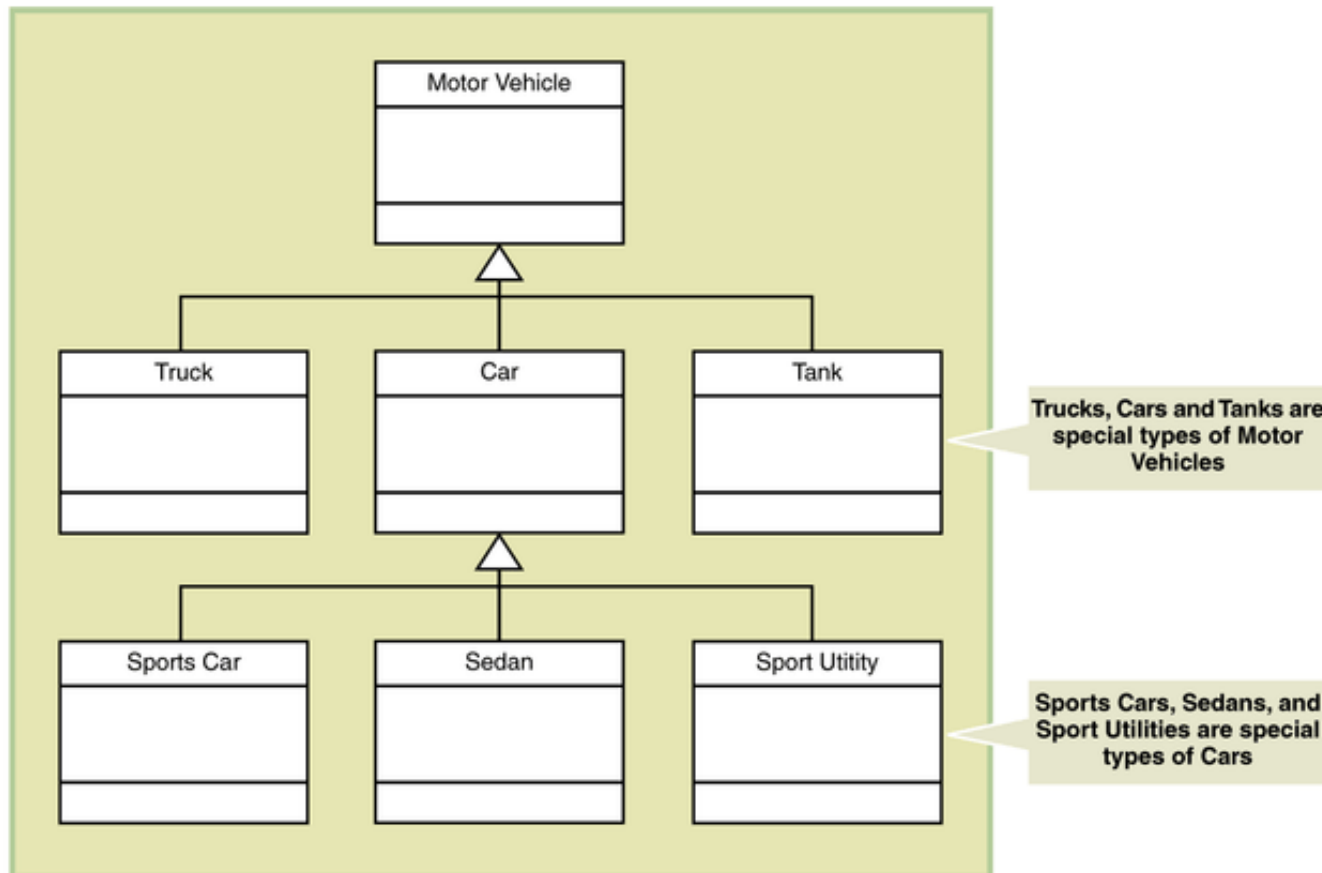
# What's with the diamond?

- Diamond specifies composition or aggregation.
- Example
  - Departments are parts of university.
  - Each department has a number of professors
  - If department closes, departments cease to exist.
  - Not so with professors
- Hence, university is a **composition** (solid diamond) of departments but department is an **aggregation** (hollow diamond) of professors.



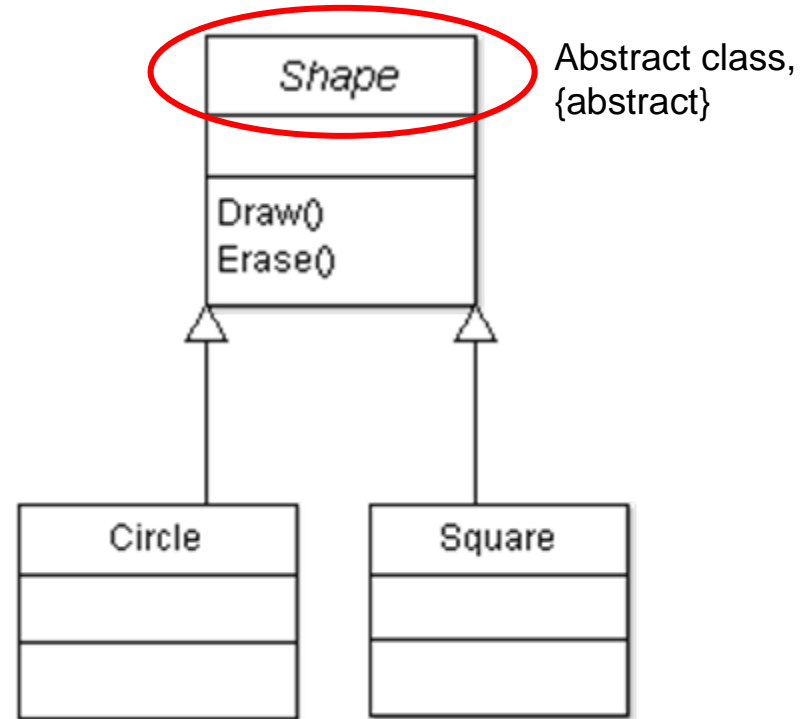
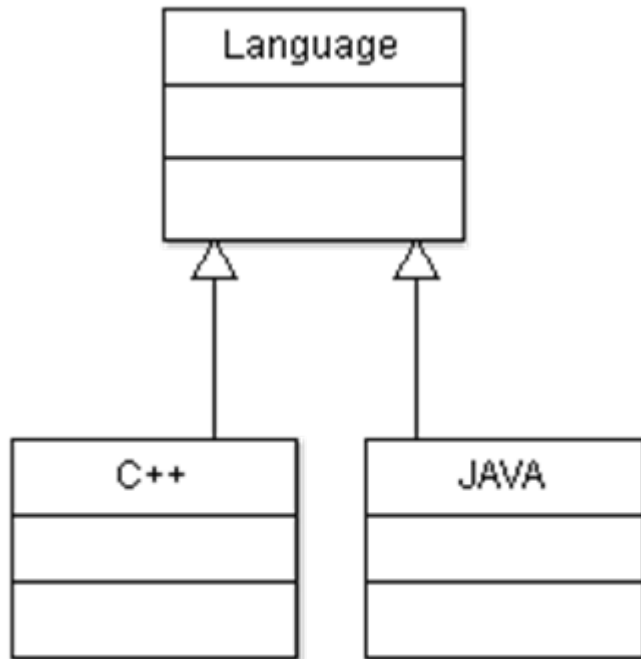
# Relationships: Generalization

- **Generalization/Specialization** is a relationship between a general thing and a more specific kind of that thing (“is-a” relationship)



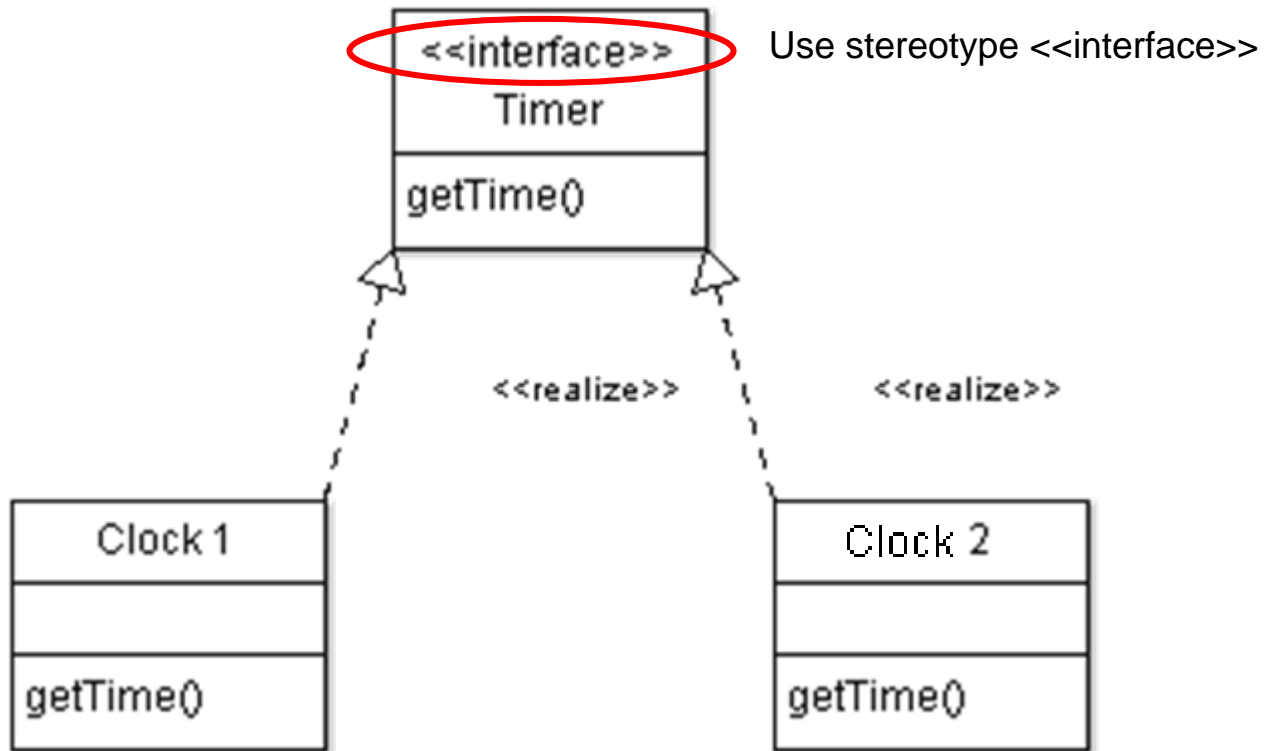
# Inheritance

- Generalization/specialization
- Inheritance w/ abstract class



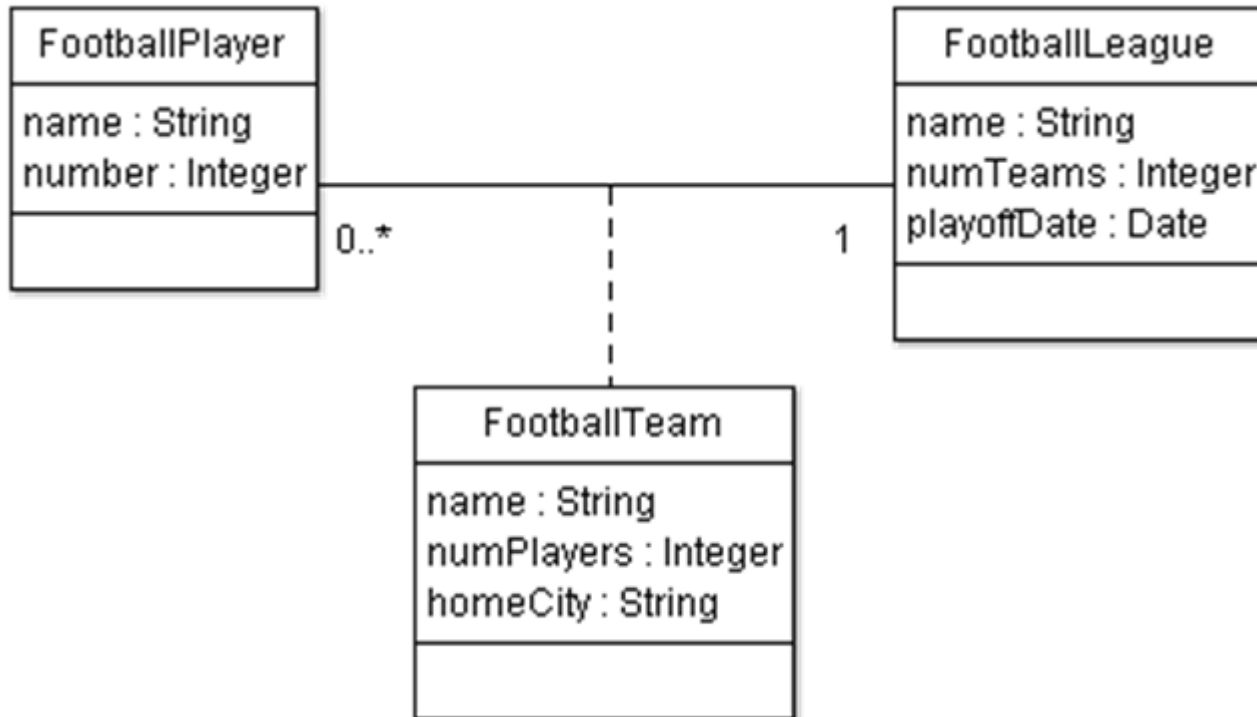
# Interface Class

- Interfaces are realized (implemented) by classes








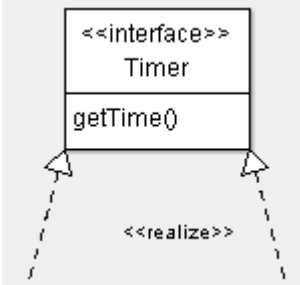
# Association Class

- If the association between two elements is complex, you can represent the connection using an association class.





# Summary of notations

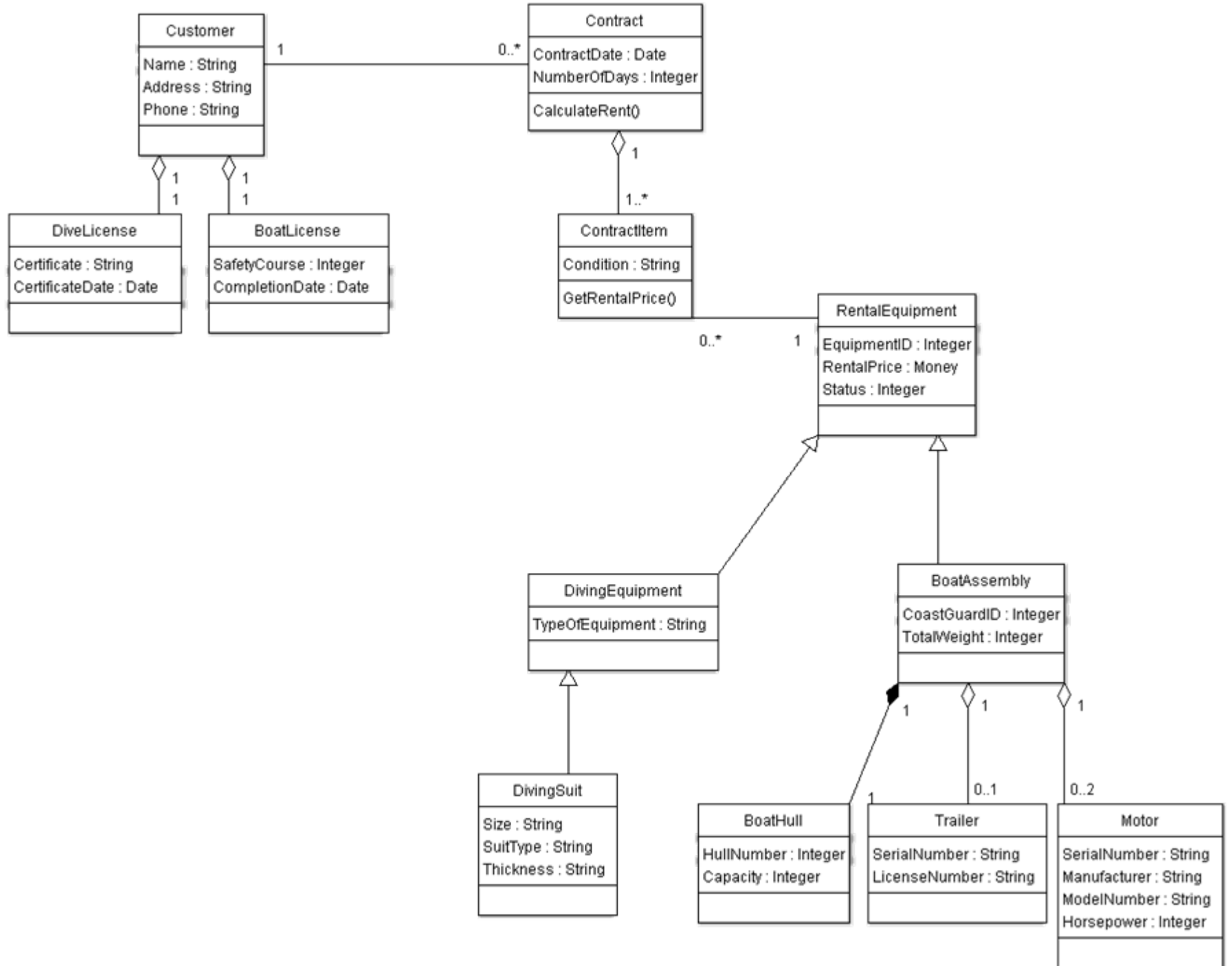
Association	
Aggregation	
Composition	
Generalization/Specialization	
Association Class	
Interface Class and realization	

# Dick's Dive 'n' Thrive (DDT)

- DDT is a small business that rents diving equipment and boats.
- Due to tremendous growth of DDT, the owner, Dick, wants to build a new system for rental.

# DDT Requirements

- Customers can rent either diving equipment or boats from DDT. Each customer has different license (boat license or dive license).
- When the customer has made a decision about what to rent, a rental agreement, or contract, is produced and signed.
- DDT rents all of the usual diving equipment such as tanks, regulators, weight belts, diving suits, and depth gauges. Especially, diving suits come in various sizes, thicknesses, and types (dry and wet).
- Some boats are rented with a trailer, some without a motor, and some with one or two motors. Trailers and motors always stay with the same boat; they are never rented by themselves or taken away from the boat they belong to (except to be serviced or replaced).
- A customer can rent one piece of equipment or many pieces of equipment; for example diving customer can rent only regulator or a collection of items for diving. A customer who already rented a boat can rent a diving equipment. Thus, A contract contains many items of equipment. (In other words, each piece of rental equipment is rented many times, and over time it is associated with many contracts).



# ATM: Requirements

- Has a card reader, a customer console, an envelope acceptor, a cash dispenser, a receipt printer, and an operator panel. The ATM will communicate with the bank's computer over an appropriate communication link.
- A customer will be required to insert an ATM card and enter a personal identification number (PIN)
  - Both of which will be sent to the bank for validation as part of each transaction.
  - The customer will then be able to perform one or more transactions.
- The ATM must be able to provide the following services/transactions to the customer:
  - Cash withdrawal with approval obtained from the bank.
  - Deposit with approval.
  - Transfer of money between any two accounts linked to the card.
  - Balance inquiry of any account linked to the card.
- The ATM will provide the customer with a printed receipt for each successful transaction
- The ATM will have a key-operated switch that will allow an operator to start and stop the servicing of customers.
- The ATM will also maintain an internal log of transactions
  - Entries will be made in the log
    - ATM is started up and shut down
    - for each message sent to the Bank (along with the response back, if one is expected),
    - for the dispensing of cash,
    - for the receiving of an envelope.

