Object-Oriented Programming (OOP)
Lecture No. 5

Multiple Inheritance

- We may want to reuse characteristics of more than one parent class

Example – Multiple Inheritance

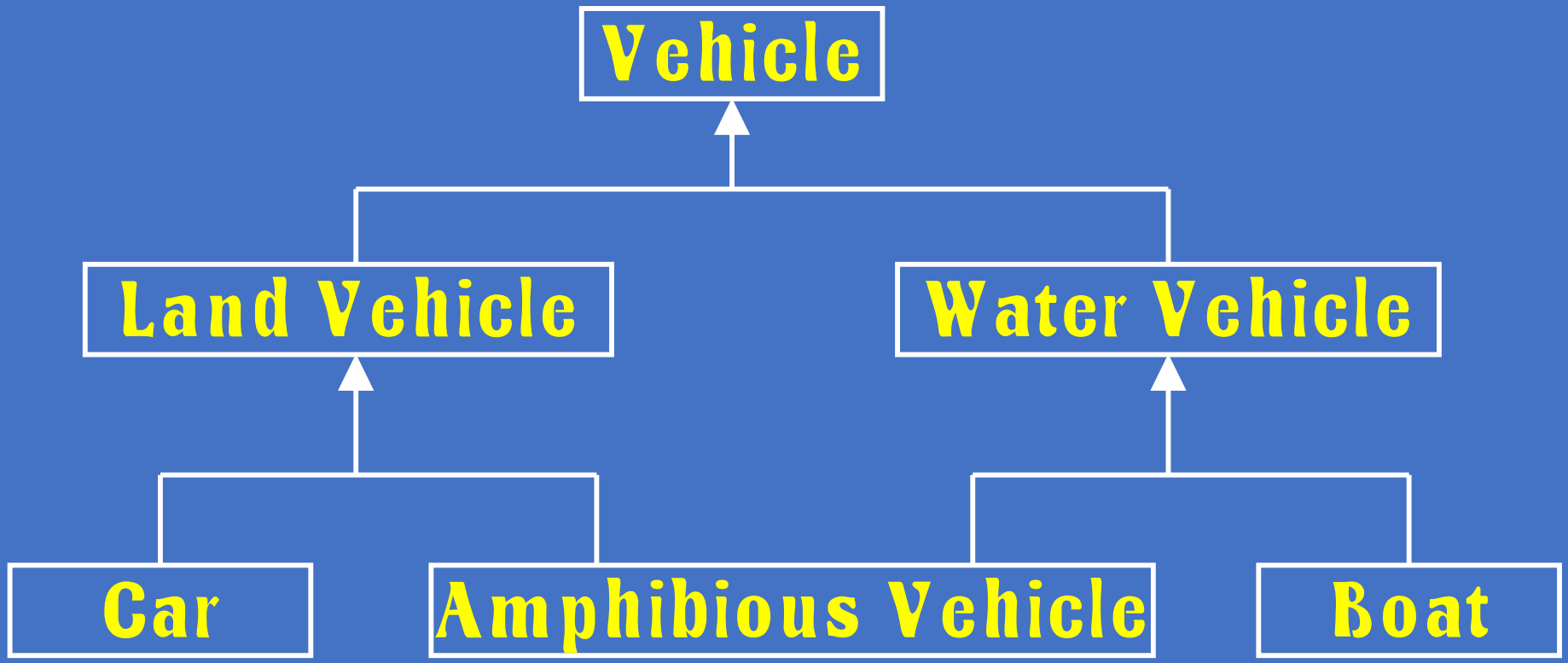
Mermaid

Example – Multiple Inheritance

Example – Multiple Inheritance

Amphibious Vehicle

Example – Multiple Inheritance



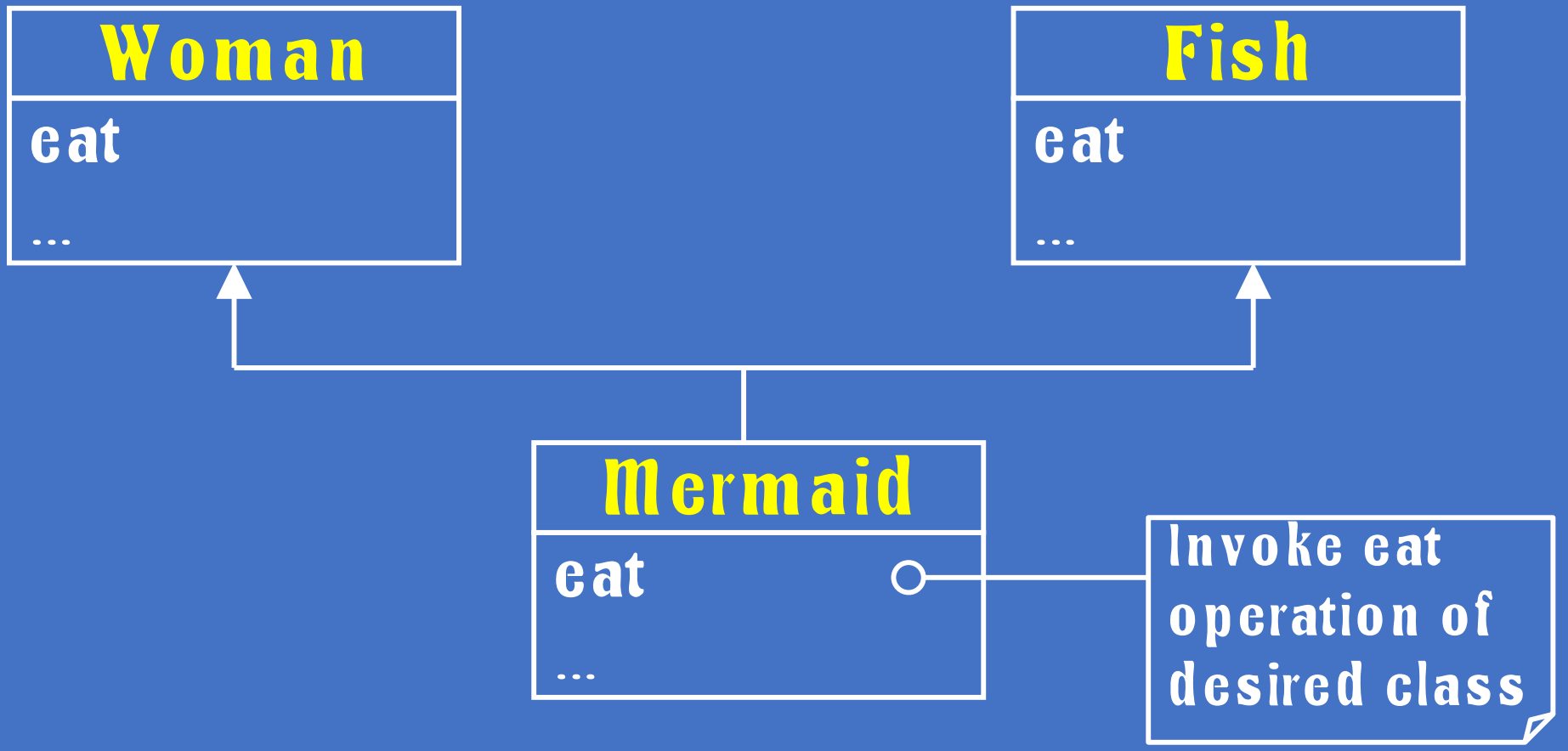
Problems with Multiple Inheritance

- Increased complexity
- Reduced understanding
- Duplicate features

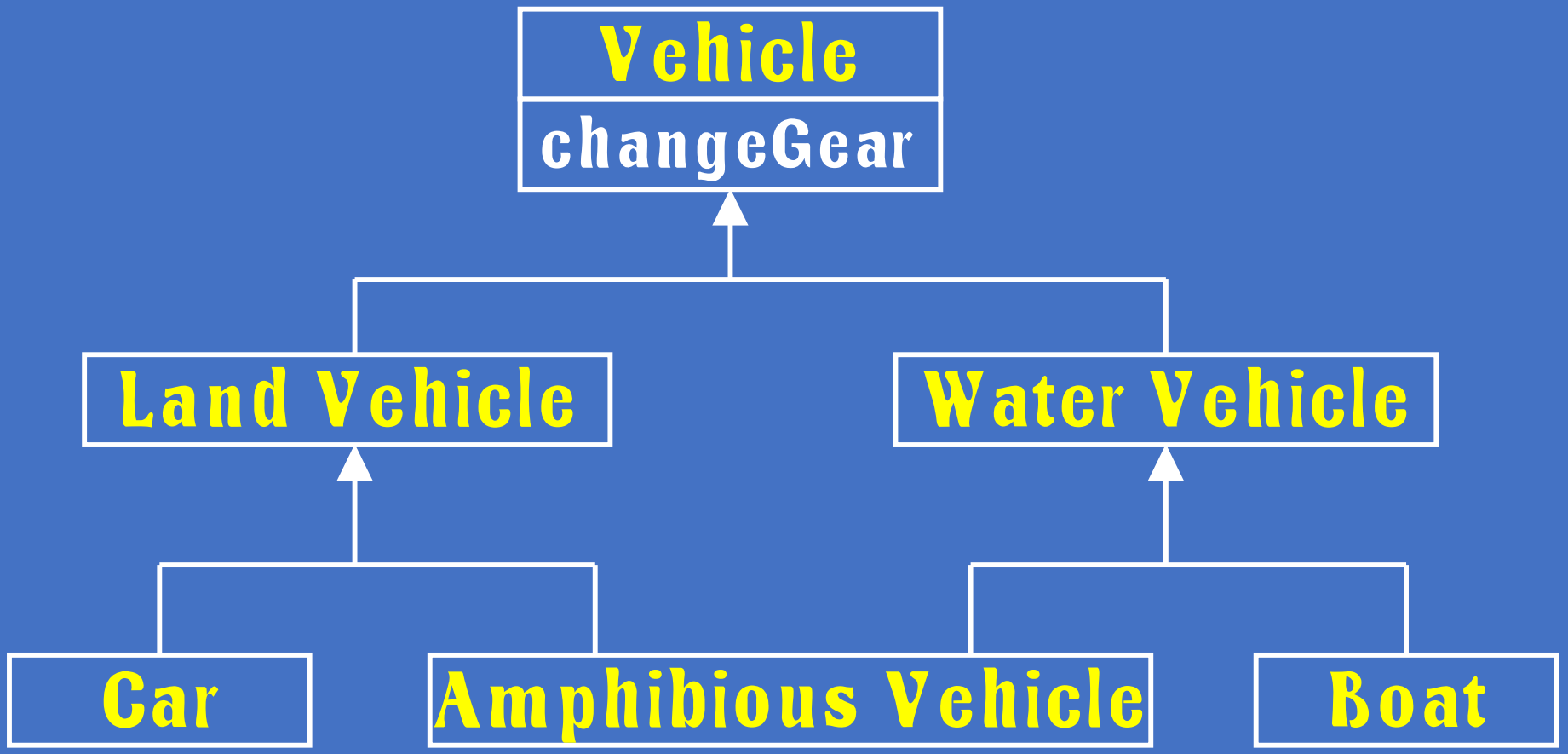
Problem – Duplicate Features

- Which *eat* operation *Mermaid* inherits?

Solution – Override the Common Feature



Problem – Duplicate Features (Diamond Problem)



- Which *changeGear* operation Amphibious Vehicle inherits?

Solution to Diamond Problem

- Some languages disallow diamond hierarchy
- Others provide mechanism to ignore characteristics from one side

Association

- Objects in an object model interact with each other
- Usually an object provides services to several other objects
- An object keeps associations with other objects to delegate tasks

Kinds of Association

- Class Association
  - Inheritance
- Object Association
  - Simple Association
  - Composition
  - Aggregation

Simple Association

- Is the weakest link between objects
- Is a reference by which one object can interact with some other object
- Is simply called as “association”

Kinds of Simple Association

- w.r.t navigation
  - One-way Association
  - Two-way Association
- w.r.t number of objects
  - Binary Association
  - Ternary Association
  - N-ary Association

One-way Association

- We can navigate along a single direction only
- Denoted by an arrow towards the server object

Example – Association

- Ali lives in a House

Example – Association

- Ali drives his Car

Two-way Association

- We can navigate in both directions
- Denoted by a line between the associated objects

Example – Two-way Association

- Employee works for company
- Company employs employees

Example – Two-way Association

- Yasir is a friend of Ali
- Ali is a friend of Yasir

Binary Association

- Associates objects of exactly two classes
- Denoted by a line, or an arrow between the associated objects

Example – Binary Association

- Association "works-for" associates objects of exactly two classes

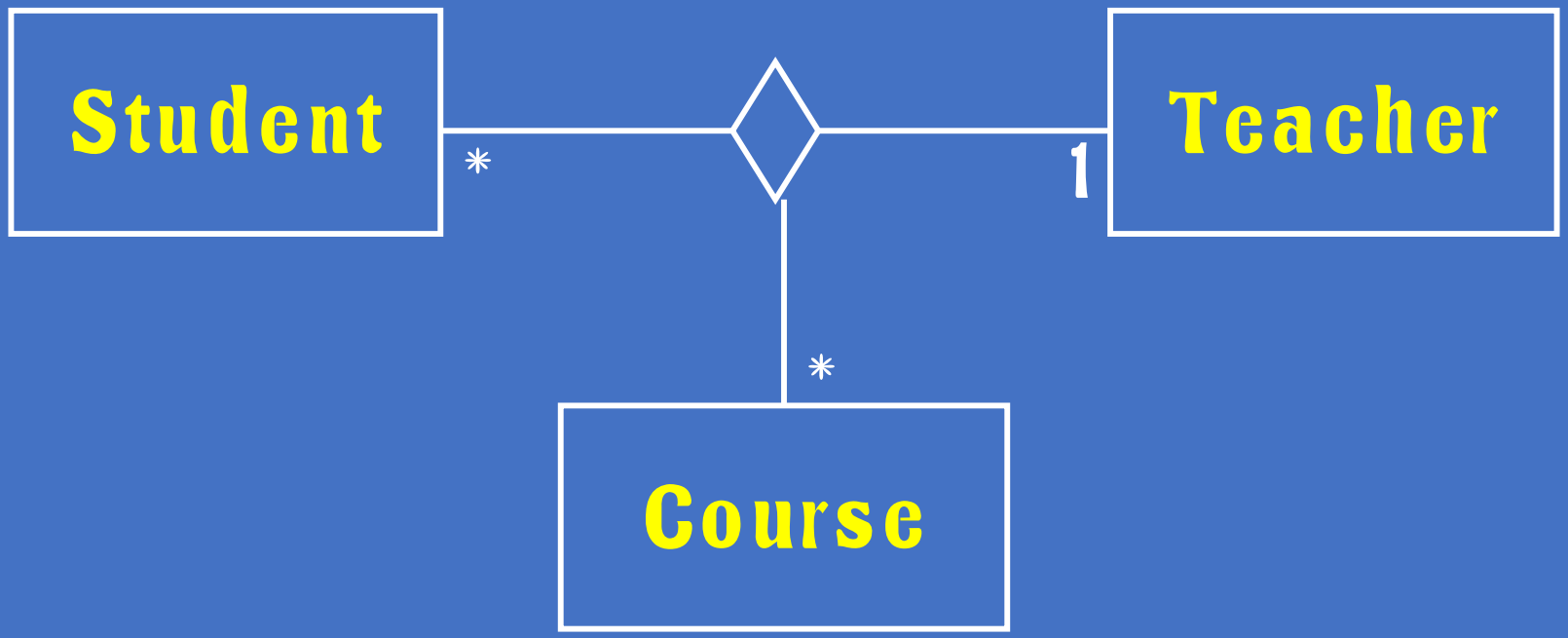
Example – Binary Association

- Association "drives" associates objects of exactly two classes

Ternary Association

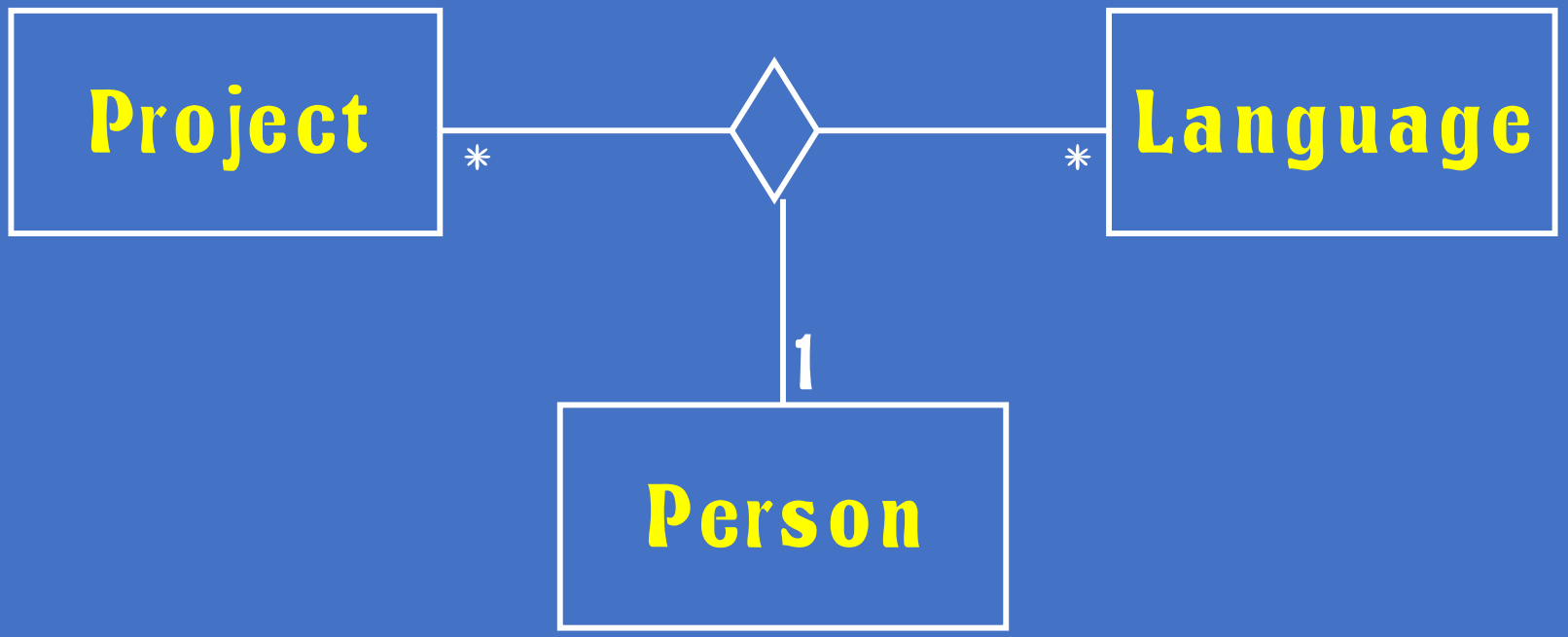
- Associates objects of exactly three classes
- Denoted by a diamond with lines connected to associated objects

Example – Ternary Association



- Objects of exactly three classes are associated

Example – Ternary Association



- Objects of exactly three classes are associated

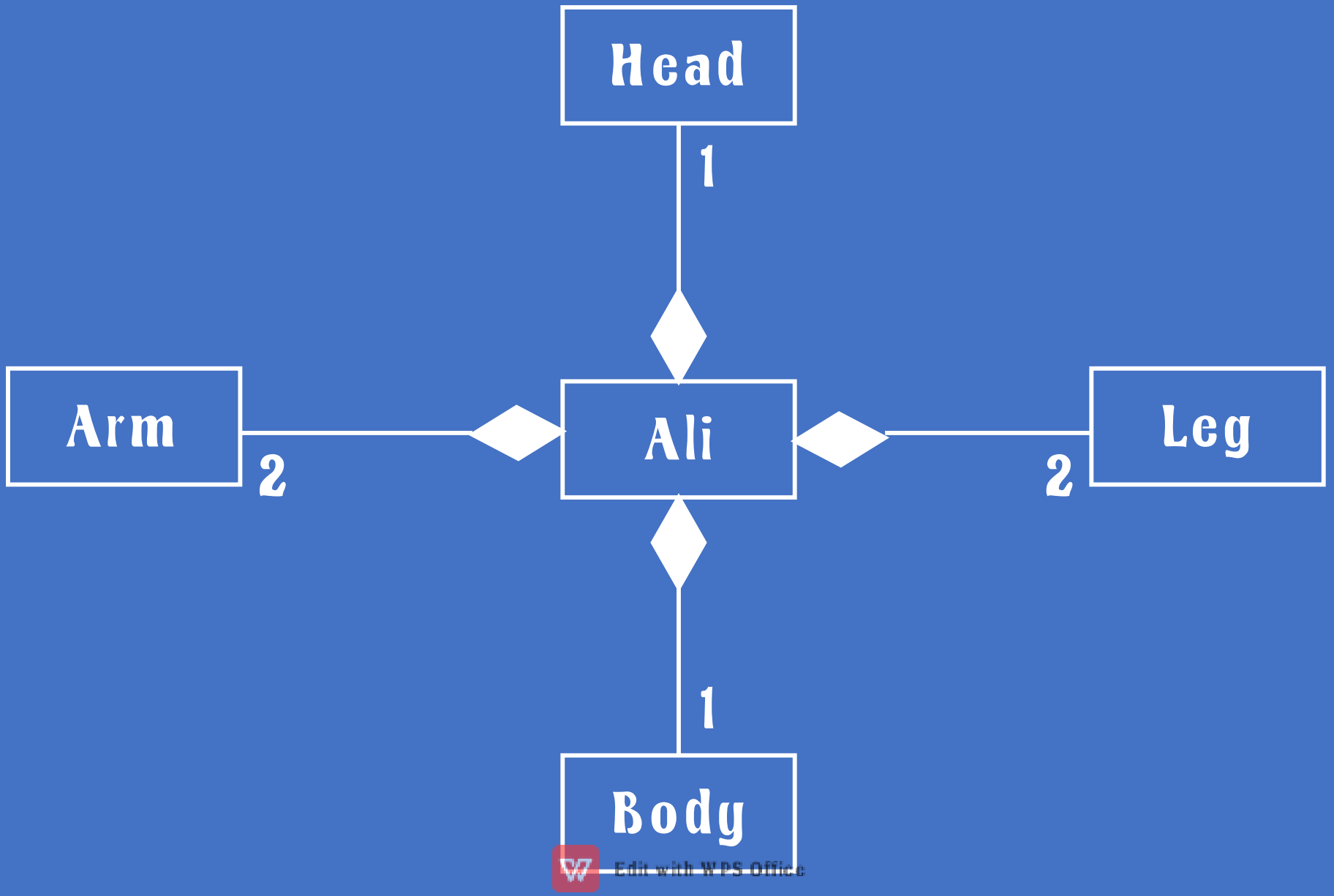
N-ary Association

- An association between 3 or more classes
- Practical examples are very rare

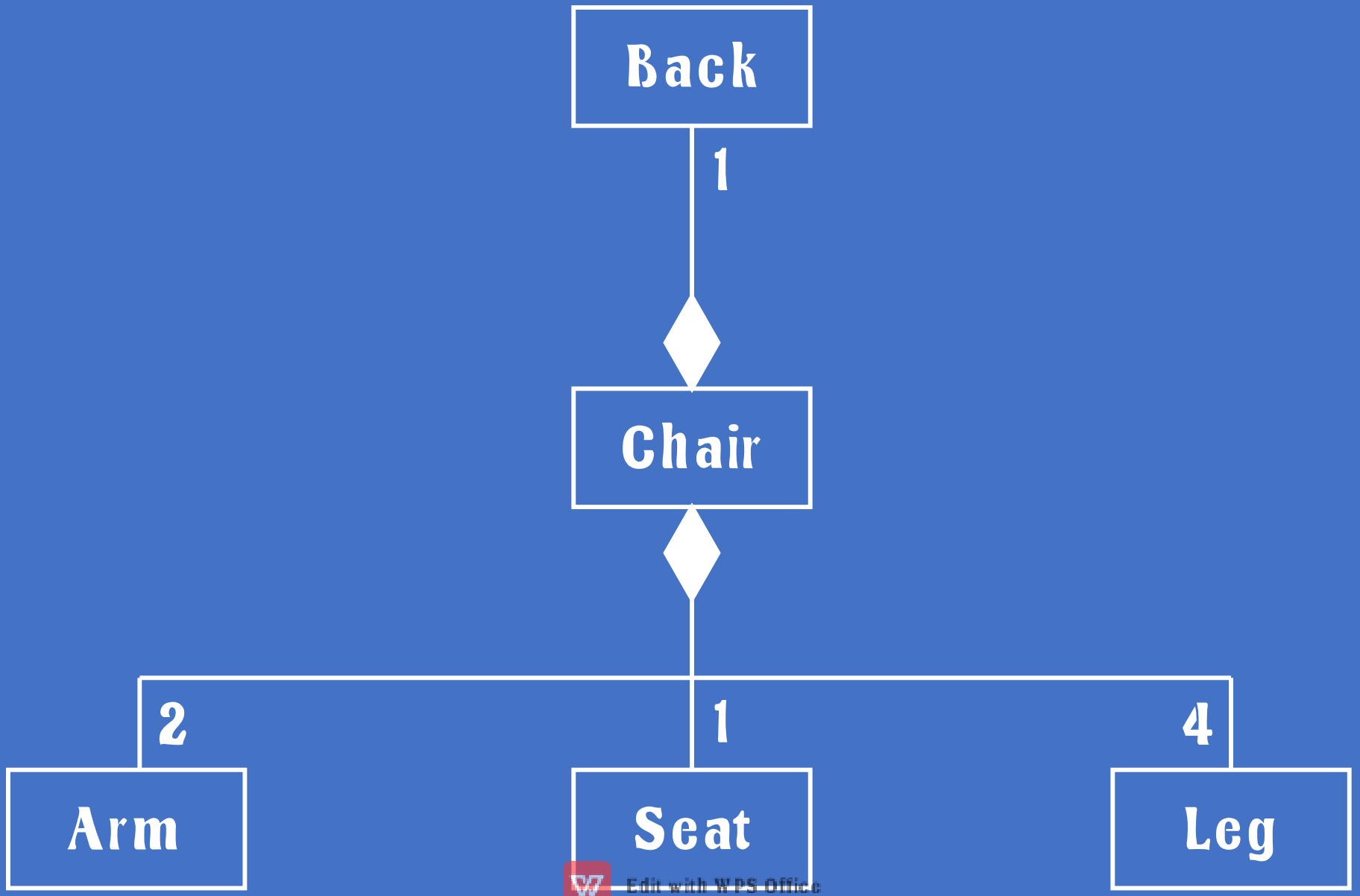
Composition

- An object may be composed of other smaller objects
- The relationship between the “part” objects and the “whole” object is known as Composition
- Composition is represented by a line with a filled-diamond head towards the composer object

Example – Composition of Ali



Example – Composition of Chair



Composition is Stronger

- Composition is a stronger relationship, because
  - Composed object becomes a part of the composer
  - Composed object can't exist independently

Example – Composition is Stronger

- Ali is made up of different body parts
- They can't exist independent of Ali

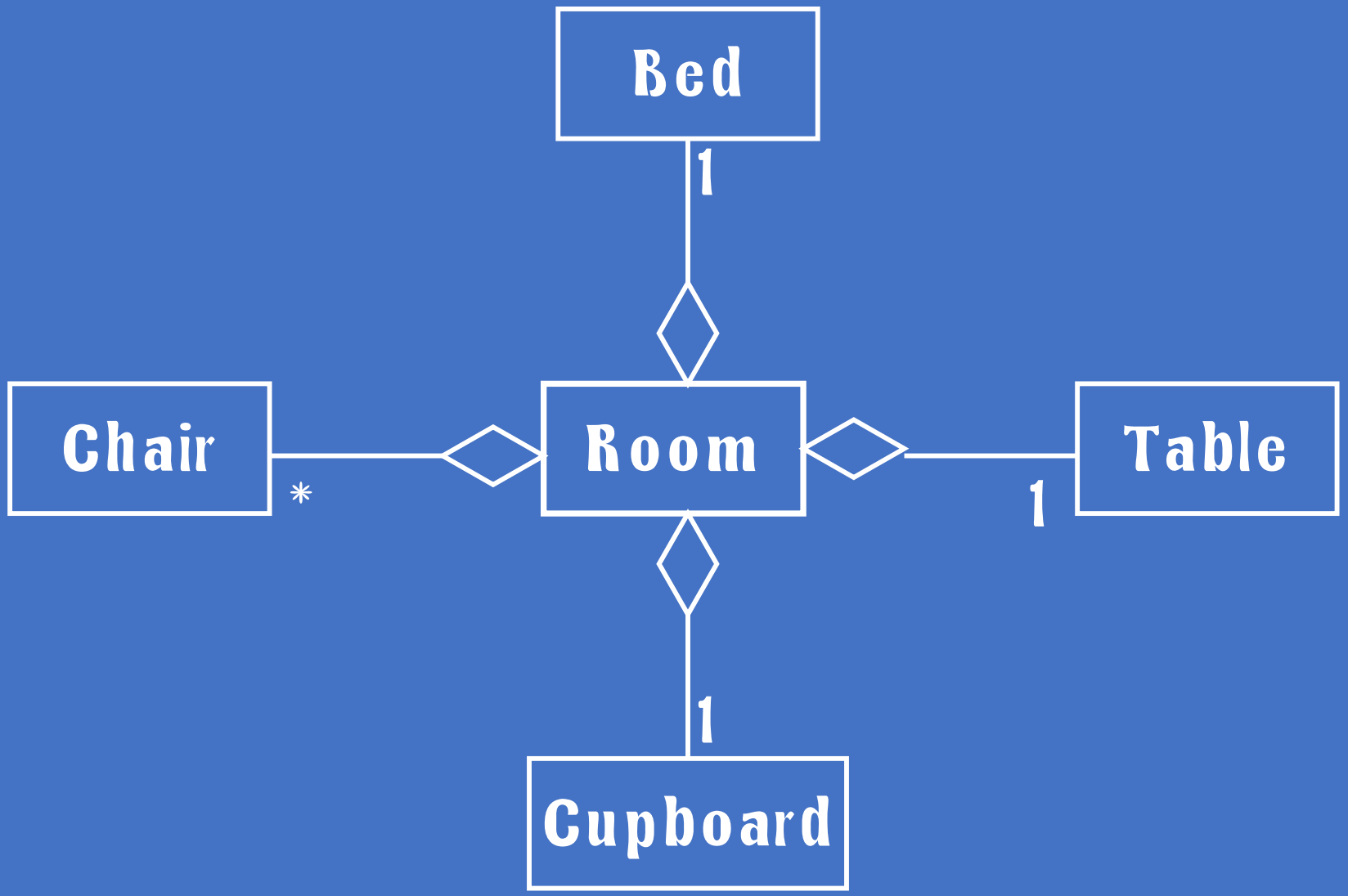
Example – Composition is Stronger

- Chair's body is made up of different parts
- They can't exist independently

Aggregation

- An object may contain a collection (aggregate) of other objects
- The relationship between the container and the contained object is called aggregation
- Aggregation is represented by a line with unfilled-diamond head towards the container

Example – Aggregation



Example – Aggregation

Aggregation is Weaker

- Aggregation is weaker relationship, because
  - Aggregate object is not a part of the container
  - Aggregate object can exist independently

Example – Aggregation is Weaker

- Furniture is not an intrinsic part of room
- Furniture can be shifted to another room, and so can exist independent of a particular room

Example – Aggregation is Weaker

- A plant is not an intrinsic part of a garden
- It can be planted in some other garden, and so can exist independent of a particular garden