CIT 103 & CIT 104

Object Oriented Programming

By

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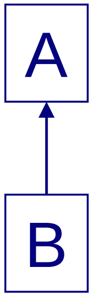
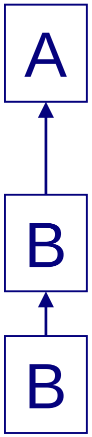
Types of Inheritance

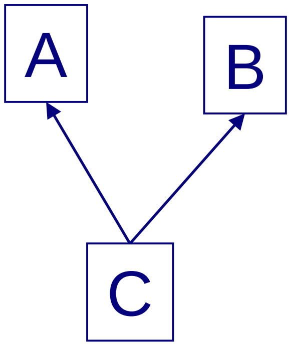
> Generally, there are five types:



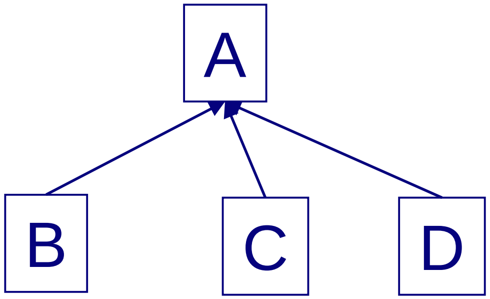
Single



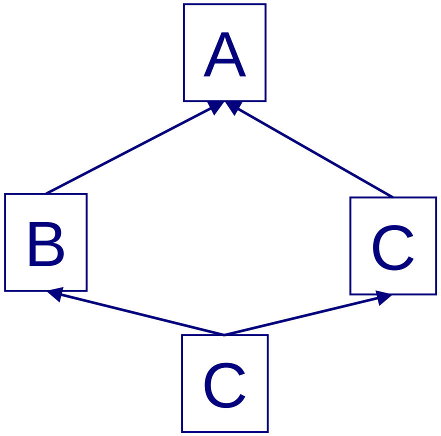
Multilevel



Multiple



Hierarchical



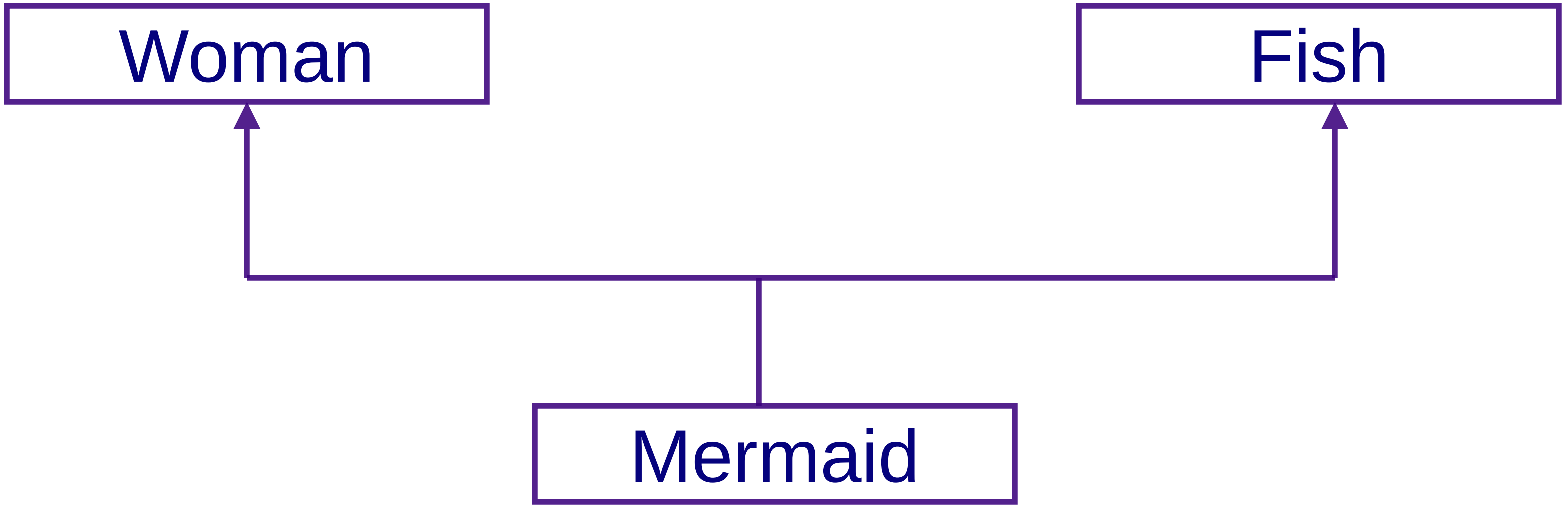
Hybrid

Multiple Inheritance

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

Mermaid

Example – Multiple Inheritance



Woman

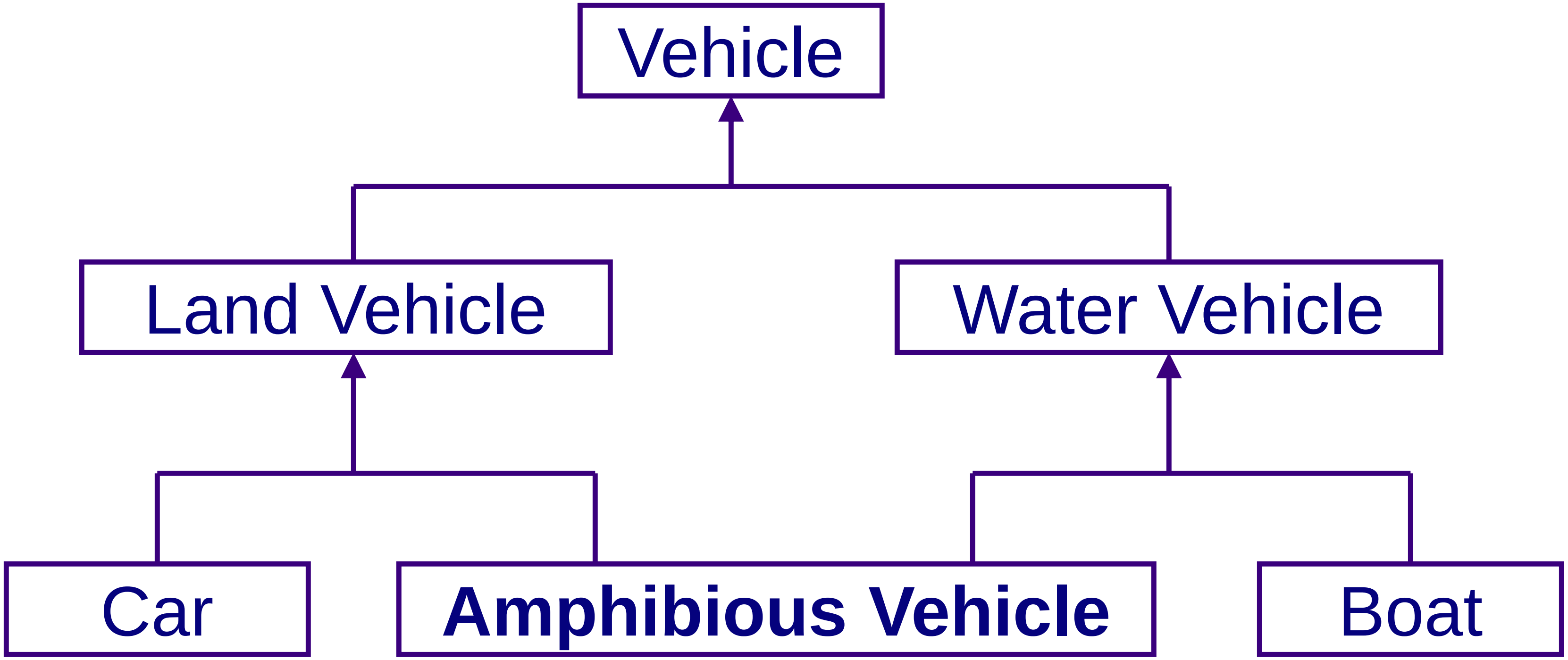
Fish

Mermaid

Example – Multiple Inheritance

Amphibious Vehicle

Example – Multiple Inheritance



Vehicle

Land Vehicle

Water Vehicle

Car

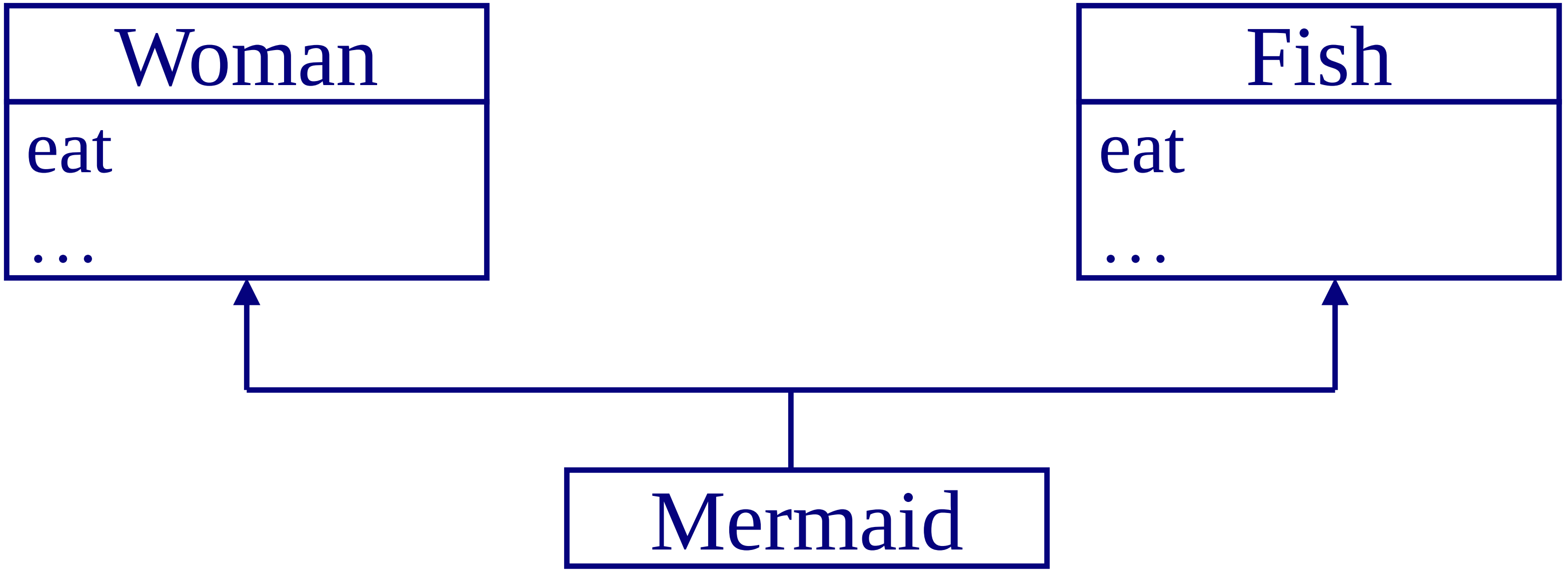
Amphibious Vehicle

Boat

Problems with Multiple Inheritance

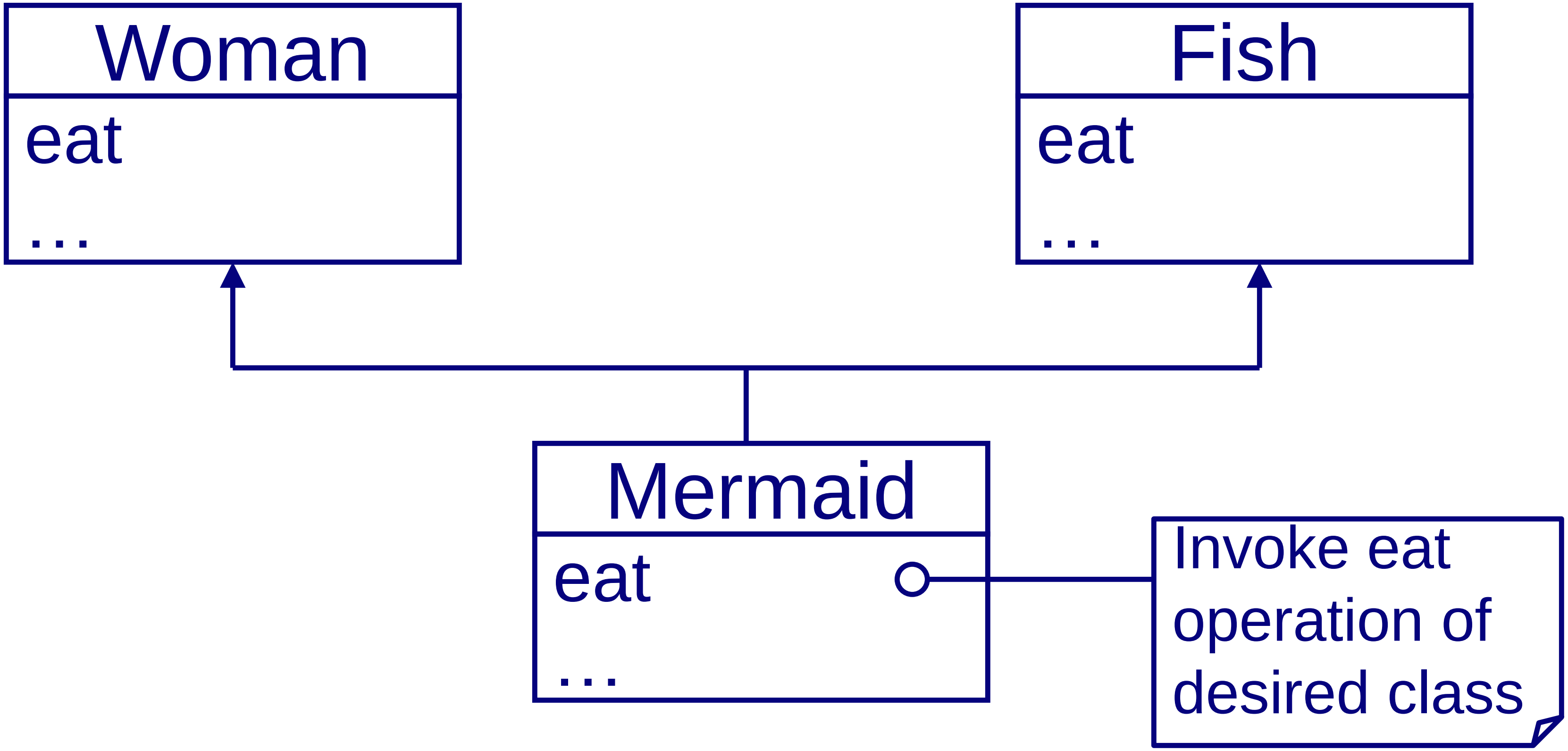
- Increased complexity
- Reduced understanding
- Duplicate features (Diamond Problem)

Problem – Duplicate Features



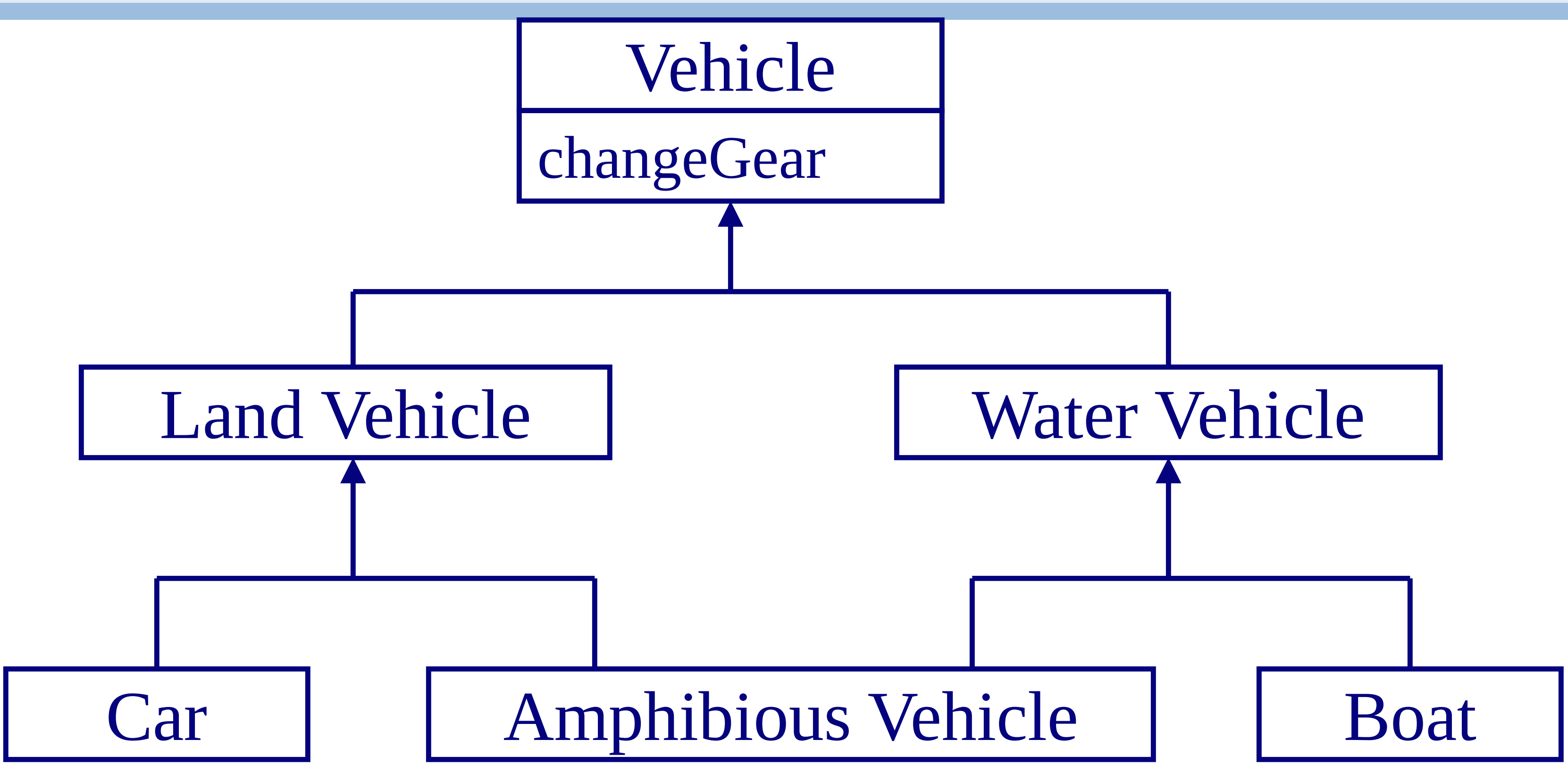
> Which *eat* operation *Mermaid* inherits?

Solution – Override the Common Feature



Invoke eat operation of desired class

Problem – Duplicate Features



> Which ***changeGear*** operation Amphibious Vehicle inherits?

General 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

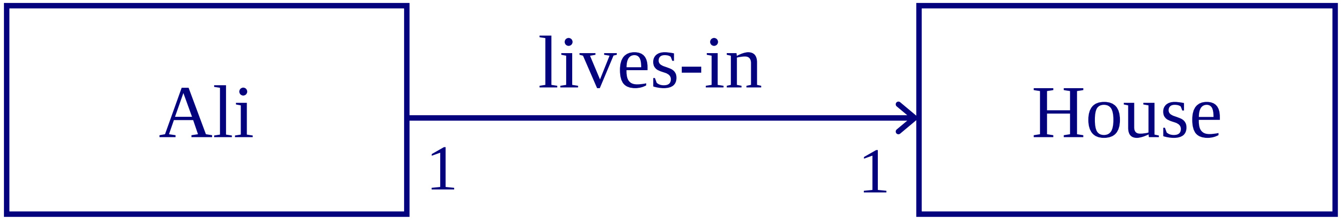
- Is the **weakest link** between objects
- Is a reference by which **one** object can interact with some **other** object
- Is simply called as “**association**”

Kinds of Simple Association

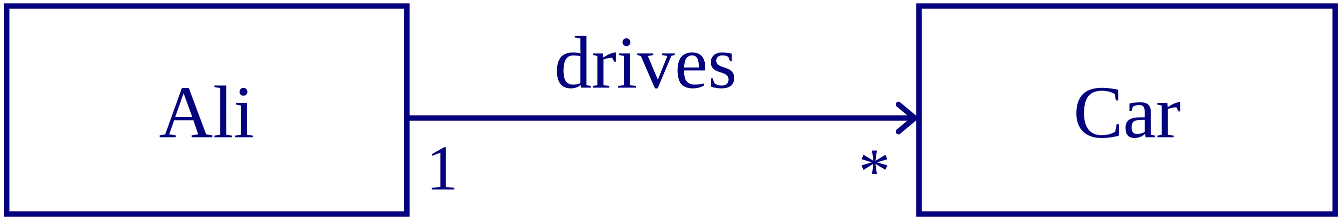
- **w.r.t navigation**
  - One-way Association
  - Two-way Association
- **w.r.t number of objects**
  - Binary Association
  - Ternary Association
  - N-ary Association

One-way Association

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



Ali lives in a House

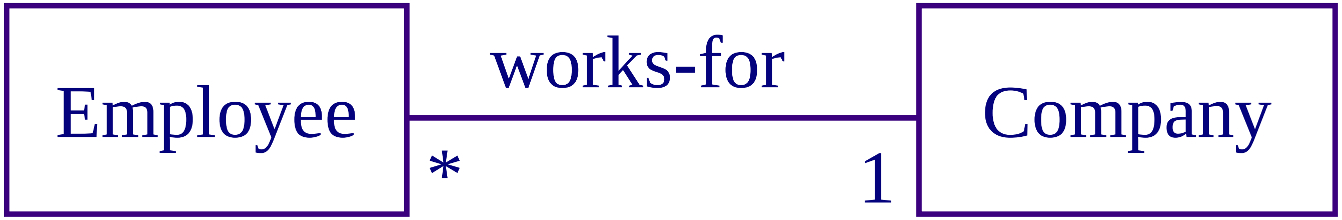


- Ali drives his Car

Two-way Association

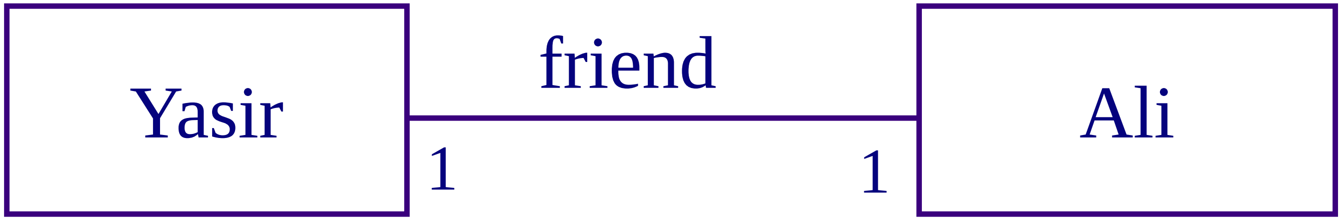
> We can navigate in both directions

> Denoted by a line between the associated objects



> Employee works for company

> Company employs employees



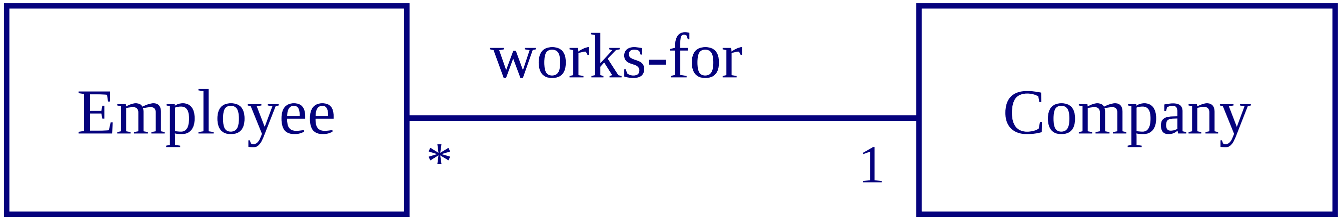
> Yasir is a friend of Ali

> Ali is a friend of Yasir

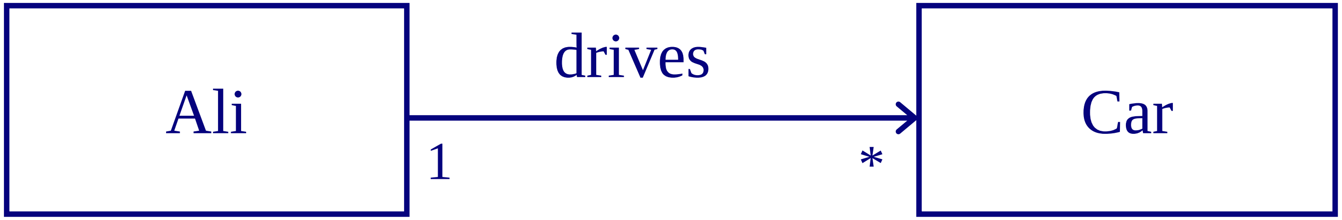
Binary Association

> Associates objects of exactly two classes

> Denoted by a line, or an arrow between the associated objects



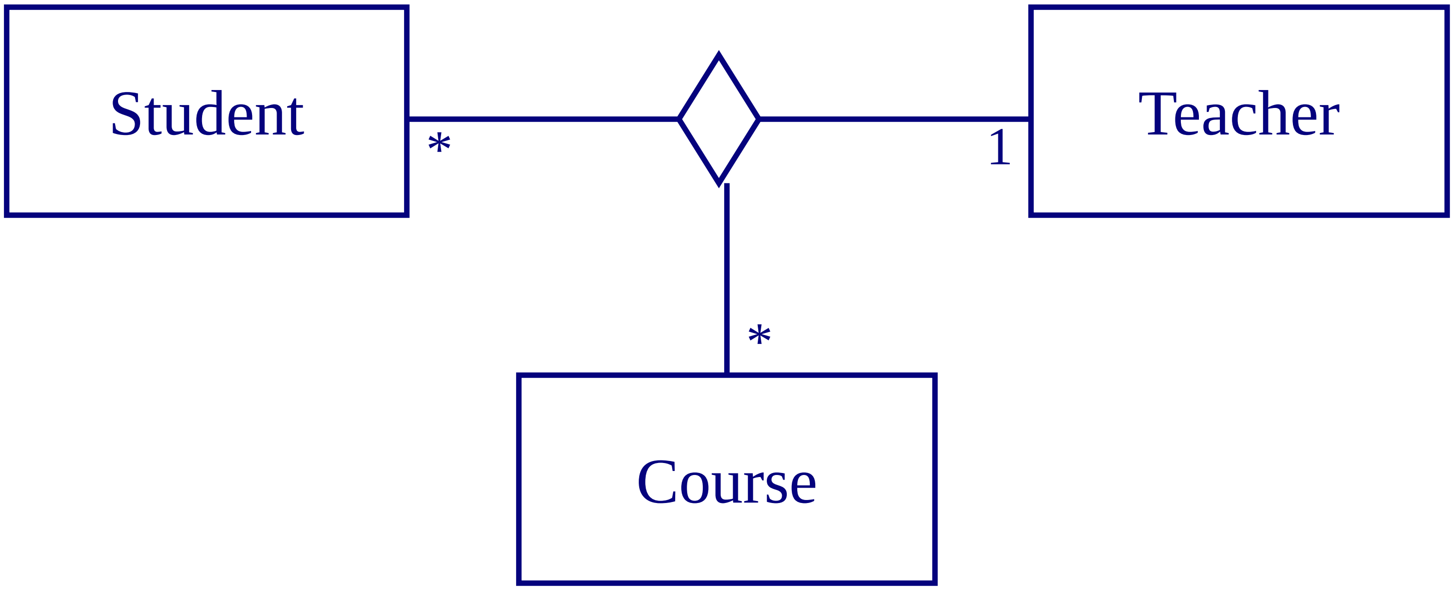
> Association “works-for” associates objects of exactly two classes



> Association “drives” associates objects of exactly two classes

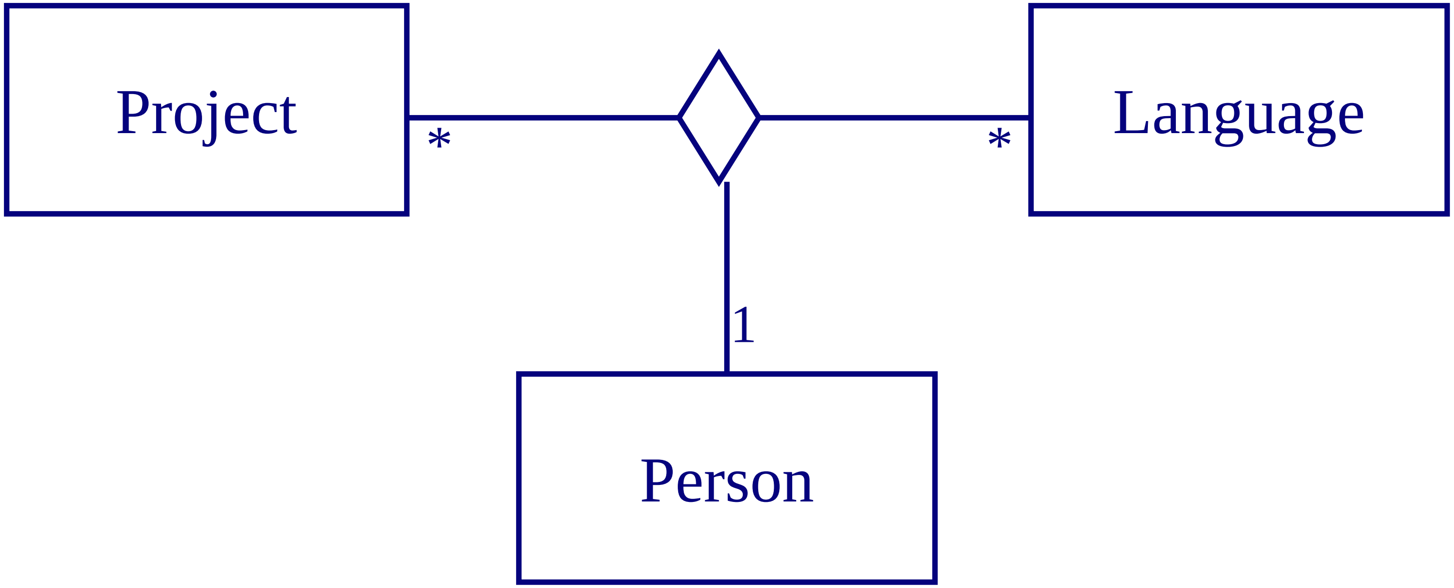
Ternary Association

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



- Objects of exactly three classes are associated

Example – Ternary Association



> Objects of exactly three classes are associated

N-ary Association

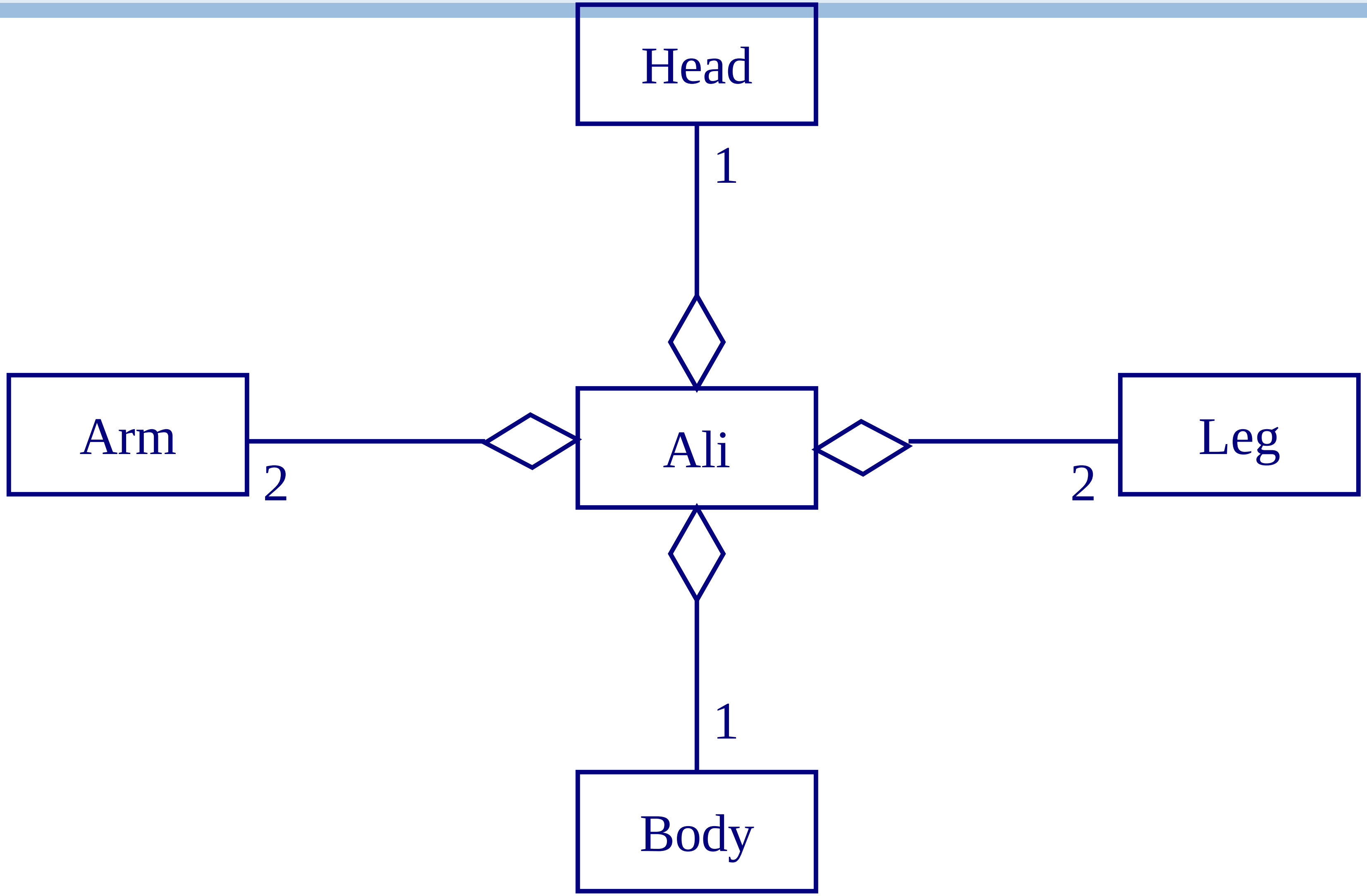
> An association among more than 3 classes

> Practical examples are very rare

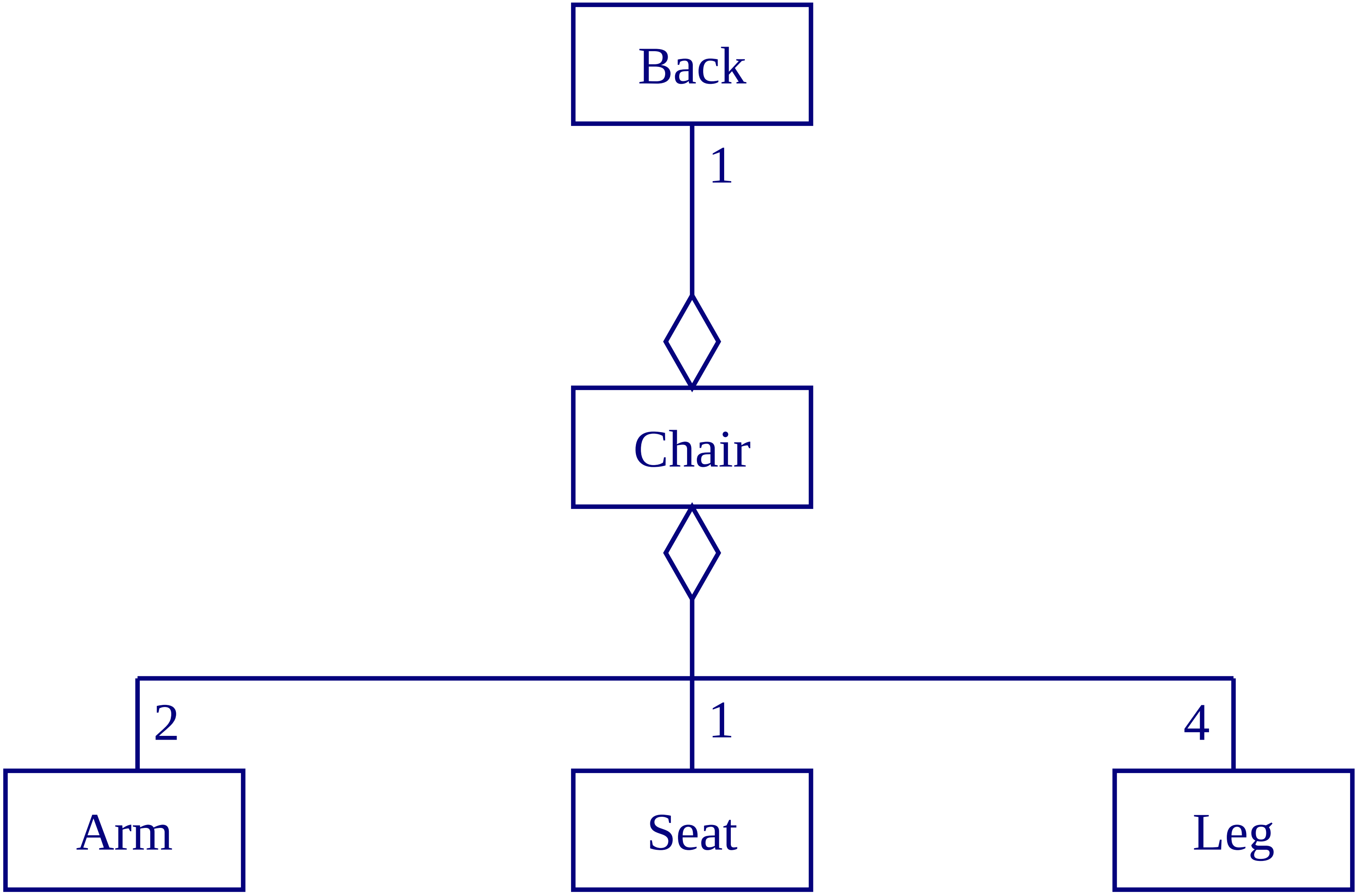
Composition

- 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



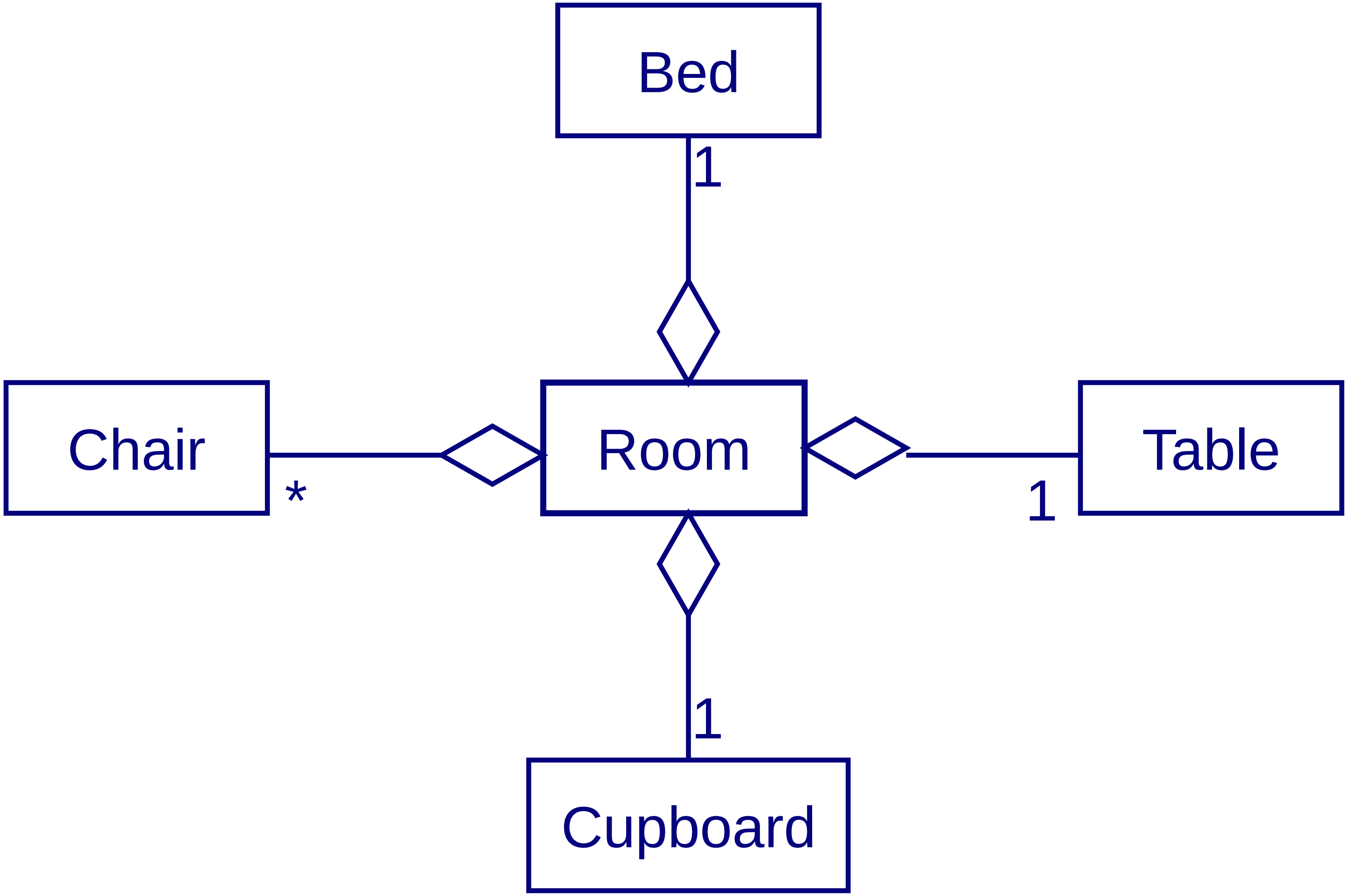
Composition is Stronger

- Composition is a stronger relationship, because
  - Composed object becomes a part of the composer
  - Composed object can’t exist independently
- Ali is made up of different body parts
- They can’t exist independent of Ali
- Chair’s body is made up of different parts
- They can’t exist independently

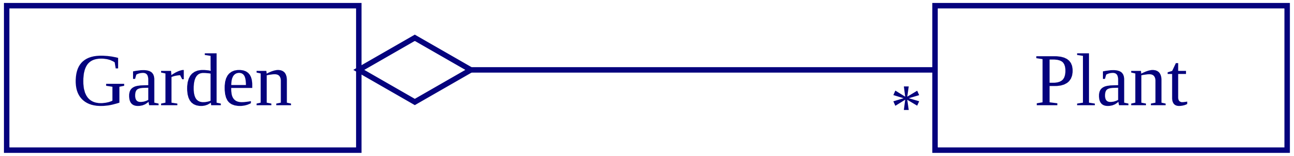
Aggregation

- 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

- 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

- Furniture is not an intrinsic part of room
- Furniture can be shifted to another room, and so can exist independent of a particular room
- Aggregation is weaker relationship, because
  - Aggregate object is not a part of the container
  - Aggregate object can exist independently