Design Principles

Interfaces Over Implementations,
Composition Over Inheritance

Code to an Interface, Not an Implementation

Design Principle:
Code to an Interface, Not an Implementation

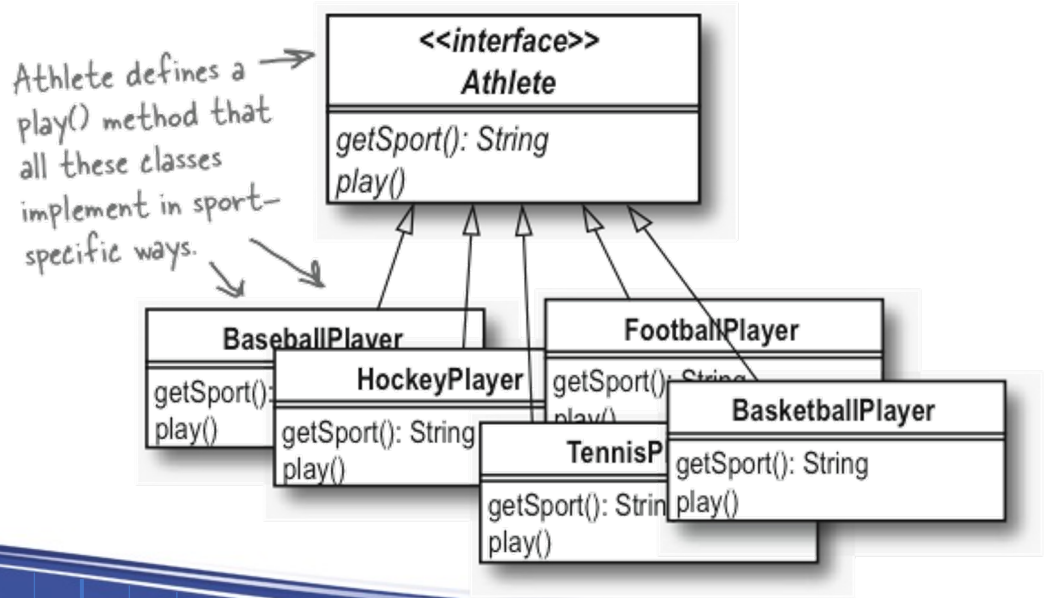
When faced with the choice between interacting with subclasses or interacting with a supertype, choose the supertype. Your code will be easier to extend and will work with all of the interface's subclasses – even those not yet created.

Code to an Interface, Not an Implementation

- Note: we are talking about the concept of an interface here – not the actual interface construct in languages like Java
- The interface we are talking about could be an interface , abstract class, or even a concrete superclass
- This design principle really says: Code to a Supertype, Not a Subtype

Modelling Athletes and Teams

- Suppose we have the following hierarchy:



Modelling Athletes and Teams

- We wish to model a team of athletes

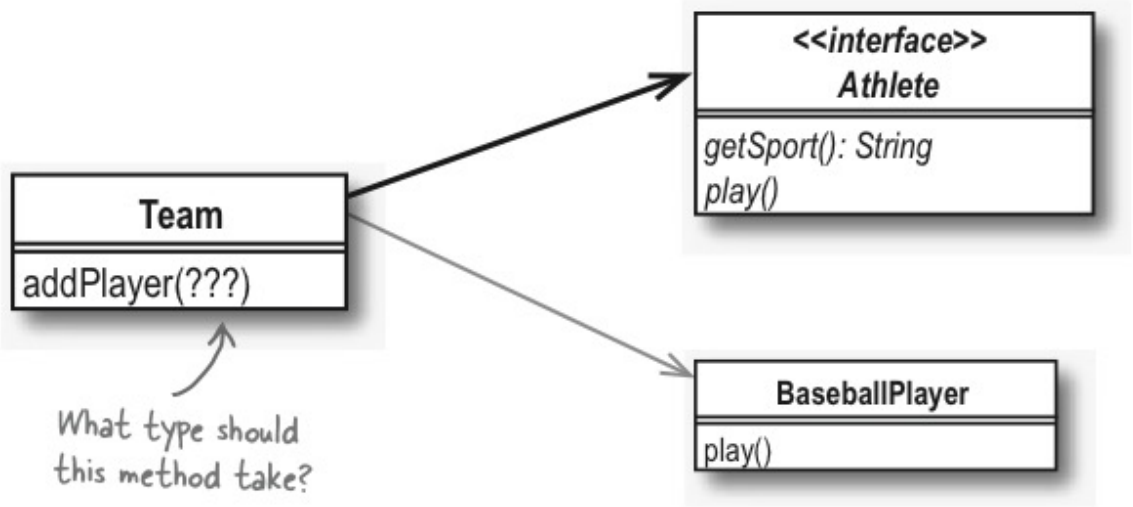
- One option: create a class `Team` and then subclass that for each specific team type:
  - `BaseballTeam`
  - `FootballTeam`
  - `TennisTeam`
  - …

Modelling Athletes and Teams

- Issues
  - Creates a large inheritance hierarchy
    (KISS principle – Keep It Simple, Stupid)
  - Results in extensive code duplication
    (DRY principle – Don’t Repeat Yourself)
  - Have to add a new subclass for each new sport we wish to support

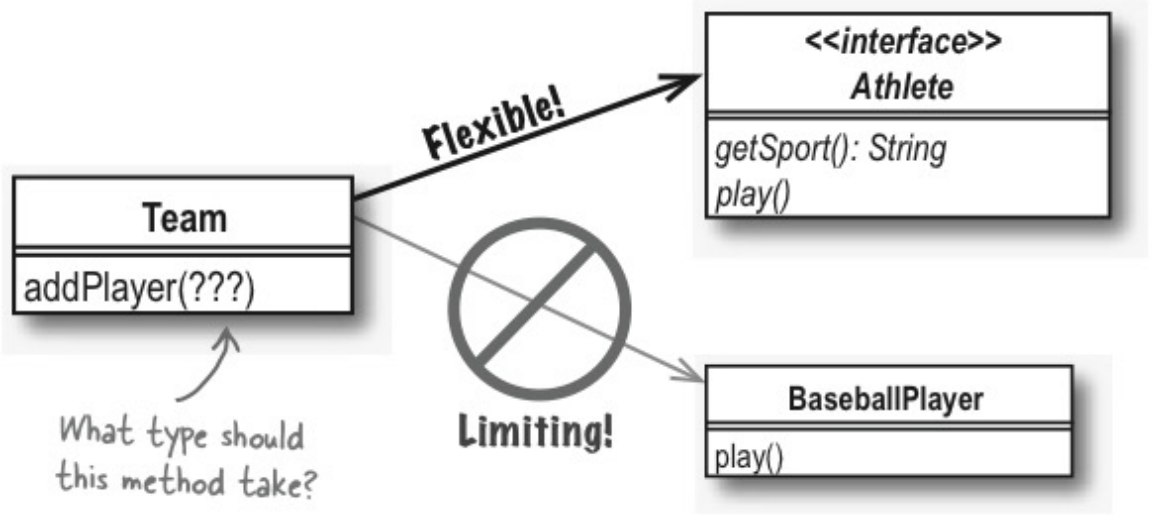
Code to an Interface, Not an Implementation

- A better way…



Code to an Interface, Not an Implementation

- A better way…



Code to an Interface, Not an Implementation

- Benefits
  - Adds flexibility
    - Code can now work with any type of `Athlete` – even those we haven't created yet
  - Simplified architecture
  - Reduced duplication
    - Having a hierarchy of teams (`BaseballTeam`, `FootballTeam`, …) would result in extensive duplication of code
    - `addPlayer` would duplicate in each class

always choose base type at first.

Favour Composition Over Inheritance

Design Principle:

Favour Composition Over Inheritance

By favouring delegation, composition, and aggregation over inheritance, we can produce software that is more flexible, and easier to maintain, extend, and reuse.

Favour Composition Over Inheritance

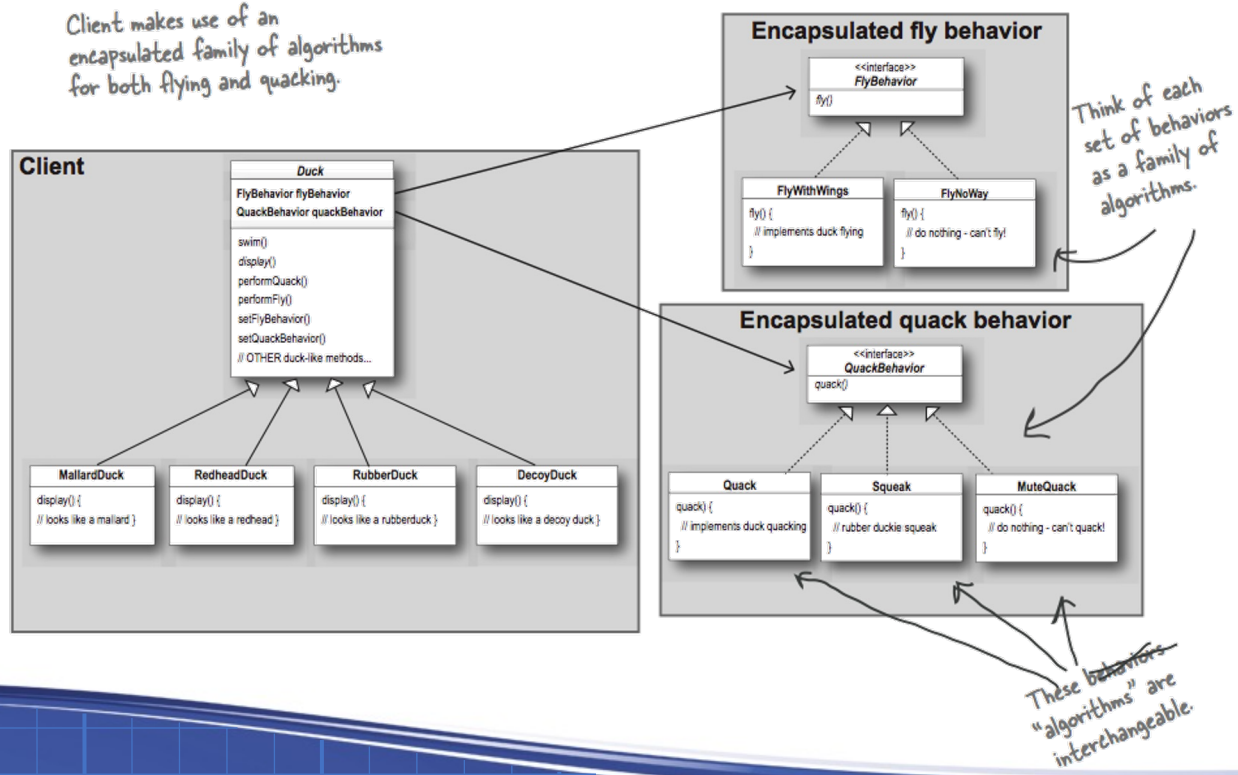
- Inheritance establishes an **IS-A** relationship

- Composition/aggregation establish a **HAS-A** relationship – this can often be preferable

something HAS A .... behavior, that is, adding feature to an object.

- We already saw an example of this in the duck simulation…

Favour Composition Over Inheritance



Favour Composition Over Inheritance

- Instead of inheriting their behaviour, the ducks get their behaviour by being *composed* with the right behaviour object
- Benefits:
  - Creating systems using composition gives us more flexibility
  - Encapsulate a family of algorithms into their own set of classes
  - Can easily extend the code with new behaviours
  - Can change behaviour at run-time
  - Reduce code duplication

Favour Composition Over Inheritance

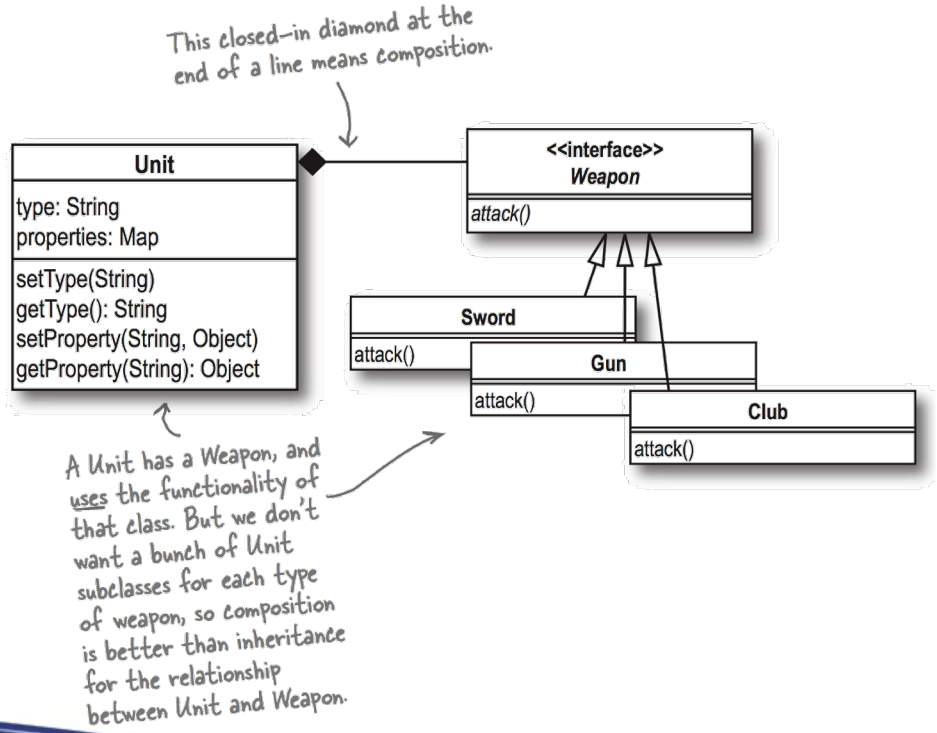
Rule of thumb:

- If you need to use functionality in another class, but you don't need to *change* that functionality, consider using delegation instead of inheritance.

Composition

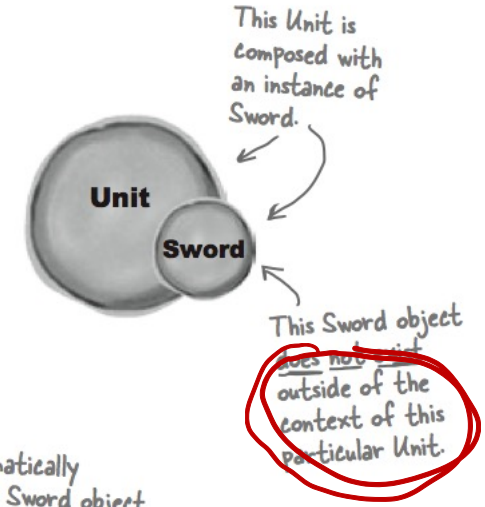
- An object composed of other objects *owns* those objects
- When the object is destroyed, so are all the objects of which it is composed

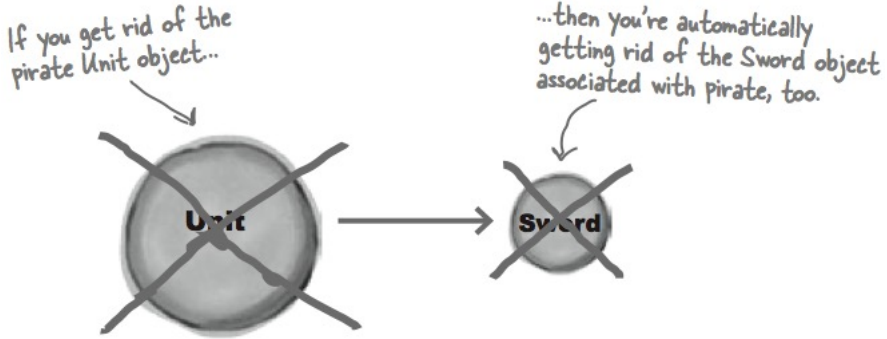
Composition



Composition

```
Unit* pirate = new Unit();
pirate->SetProperty("weapon", new Sword());
```



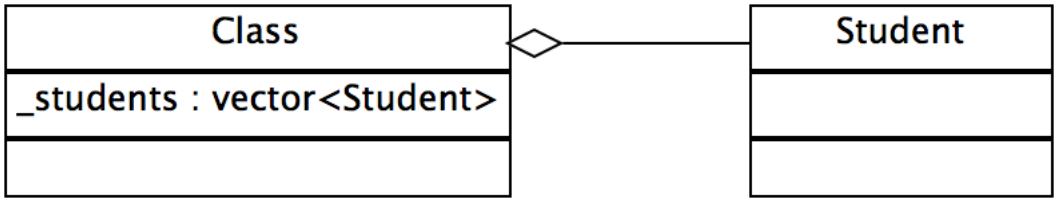


Composition

- Note: we are not necessarily seeking to model the real world exactly here:
  - Yes, a weapon could exist on its own in the real world
  - The question you should be asking yourself is whether or not in your model, you need to track a weapon outside of a unit
  - If not, use **composition** (*OWNS-A*)
  - If so, use **aggregation** (*HAS-A*)

Aggregation

- An object comprised of other objects *uses* those objects
- Those objects exist outside of the object
- When the object is destroyed, the objects that comprise it remain



Composition vs. Aggregation

- When deciding which to use, simply ask: Do I need this object outside of the class?
  - If no, use *composition* (black diamond of death)
  - If yes, use *aggregation* (white diamond of life)