Design Patterns

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It’s about sharing knowledge and experience

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It will improve your OO skills

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Language independent.

The book uses Java, but examination will be in C#.

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It takes a while to grok.

Read, reread, think, code, discuss, reread, rethink, code again, ...

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Class lectures

- Strategy
- Observer

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Next: study group

- Strategy
- Observer
- Decorator
- Factory
- Singleton
- Command
- Template Method
- Composite / Iterator
- State

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For each DP: read and discuss

- Explain the pattern to each other
- Execute and step through the code (in pairs)
- Code the examples in C#
  - https://github.com/jkhines/hfpatternsincsharp
- Where in the curriculum did you use this DP already?
- Search on github for other examples / uses
- Think how it could be applied to the DevOps Case (App). Why (not)?

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Evaluation (Examination)

- **Define** a pattern in a concise but exact manner
- **Draw** the standard UML of a DP
- **Recognize** a DP from (pseudo)-code
- **Apply** a DP on a new problem
  - Draw a UML applied to the problem
  - Write the code in C#

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Evaluation (DevOps Case)

- Which DP did you use (at least 2)? Explain the code!
- Did you use DP X? Why (not)?
- Are there other DP you considered not mentioned in the book?

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Intro to Design Patterns

Your first pattern

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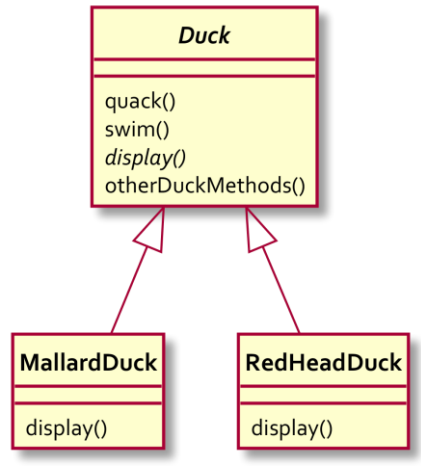
It started with a simple SimUDuck app



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New killer feature: flying ducks

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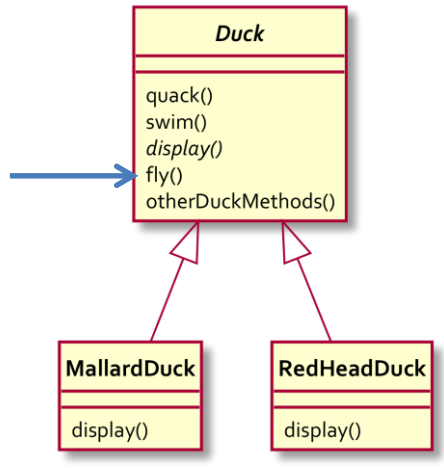
Flying Ducks



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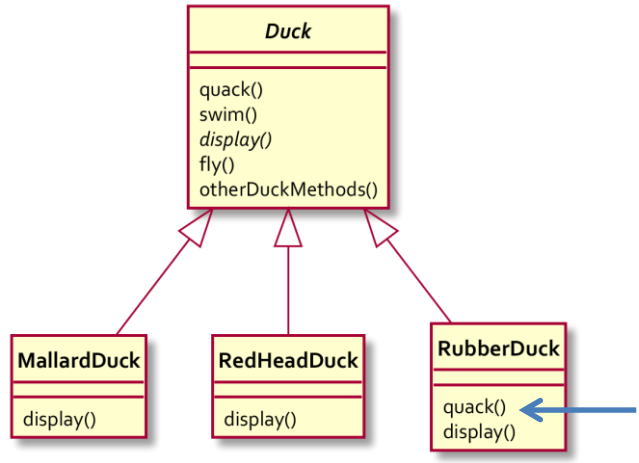
Something went wrong



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RubberDuck

```
quack() { // squeak}

display() { // rubber duck}

fly() { // override to do nothing }
```

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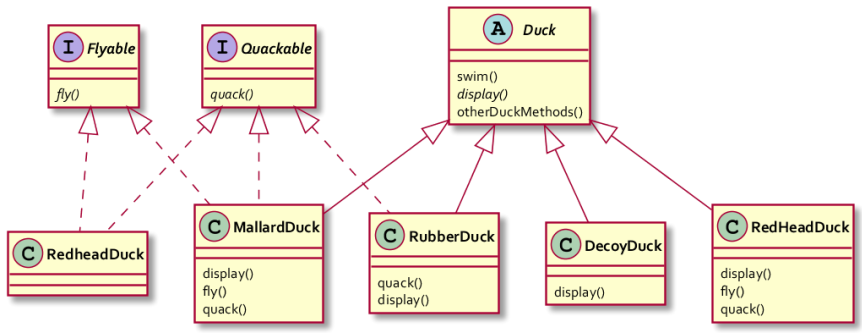
Let's try interfaces



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Some observations

- Flyable/Quackable destroy code reuse
- Change is the one constant in software development
- Design Patterns provide a way to let some part of a system vary independently of all other parts

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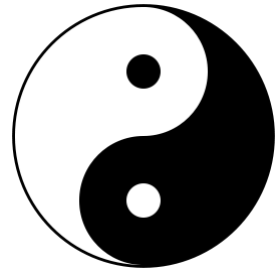
Design Principle 1

Indentify the aspects of your application that vary and separate them from what stays the same.



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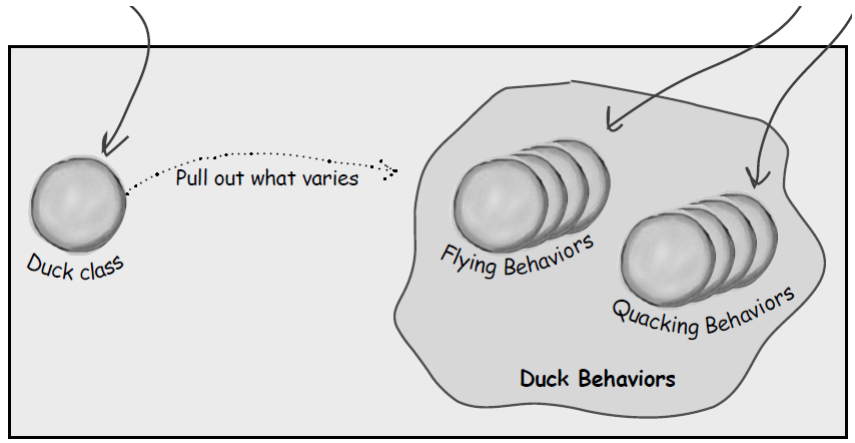
Applied for Duck problem



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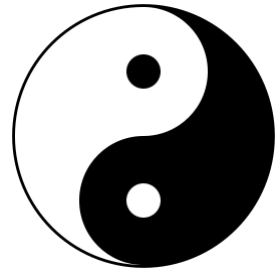
Design Principle 2

Program to an interface,

Not an implementation.



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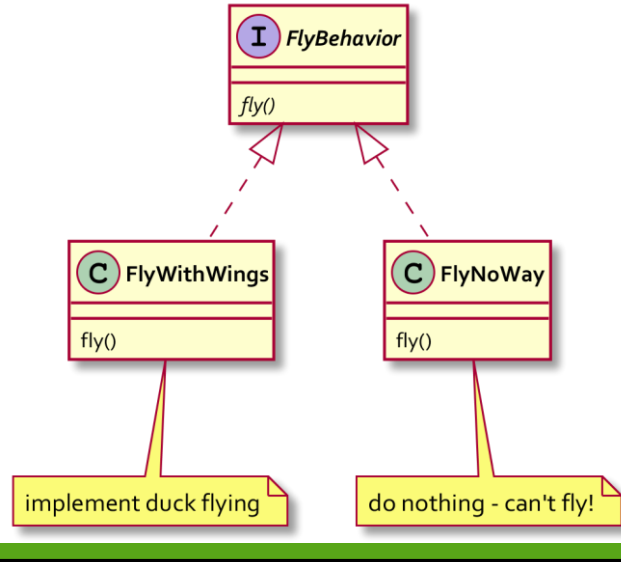
Fly behaviors



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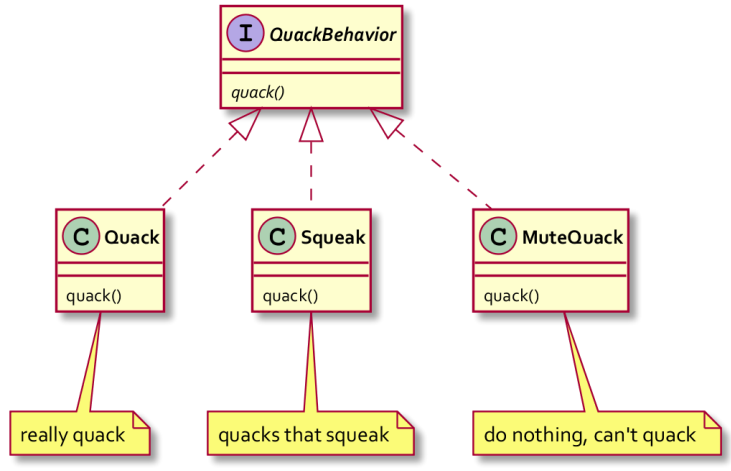
Quack behaviors



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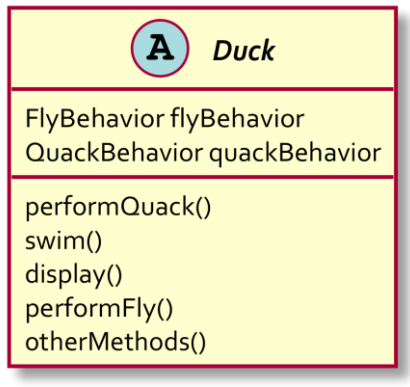
Integrating Duck behavior



- Abstract class
- Instance variables hold reference to behavior at runtime
- performXXX
  - Delegate to behaviors
- Subclasses constructor initialize behaviors

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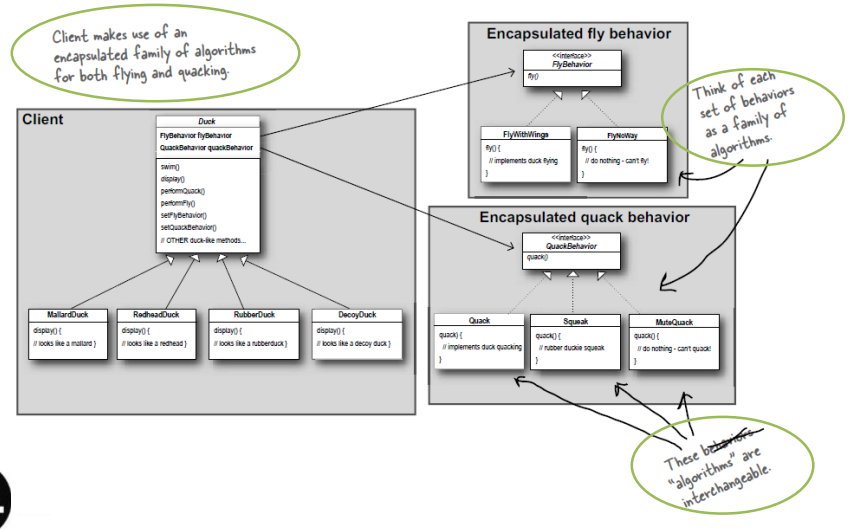
The Big Picture on encapsulated behaviors



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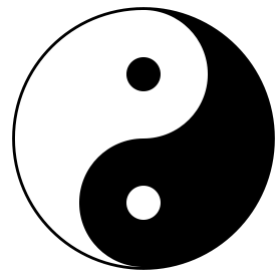
Design Principle 3

Favor composition over inheritance



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The STRATEGY pattern

defines a family of algorithms, encapsulates each one, and makes them interchangeable. Strategy lets the algorithm vary independently from clients that use it.

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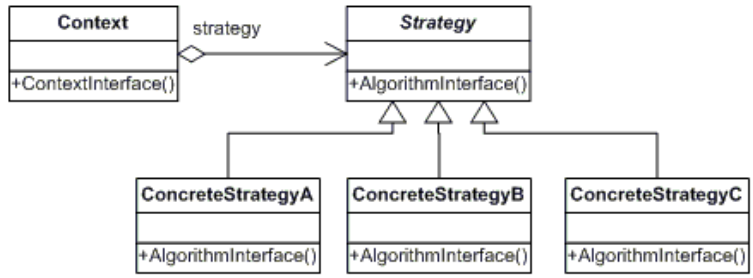
UML



Bron: http://www.dofactory.com/Patterns/PatternStrategy.aspx

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Have I seen this before?

```
interface IArtistRepository
{
    IList<Artist> GetAll();
    void Update(Artist artist);
}
```

```
public class ArtistService
{
    private IArtistRepository _artistRepository;

    public ArtistService(IArtistRepository repo)
    {
        _artistRepository = repo;
    }
}
```

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Observer

Keeping your objects in the know

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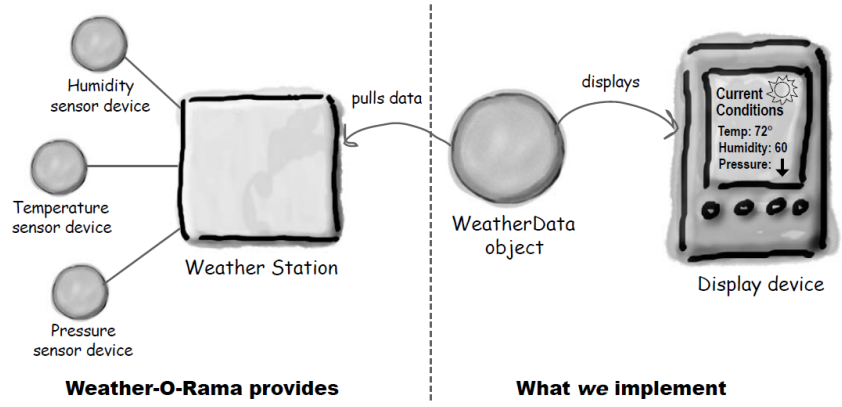
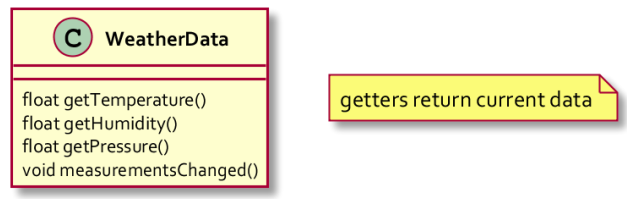
Wheater-O-Rama



WeatherData



measurementsChanged is called by the system, we need to implement it.

Display System

- Current conditions
- Statistics
- Forecast
- Expandable

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First draft

```
public class WeatherData
{
    // instance variable declarations

    public void MeasurementsChanged()
    {
        float temp = GetTemperature();
        float humidity = GetHumidity();
        float pressure = GetPressure();

        currentConditionsDisplay.update(temp, humidity, pressure);
        statisticsDisplay.update(temp, humidity, pressure);
        forecastDisplay.update(temp, humidity, pressure);
    }

    // other methods
}
```

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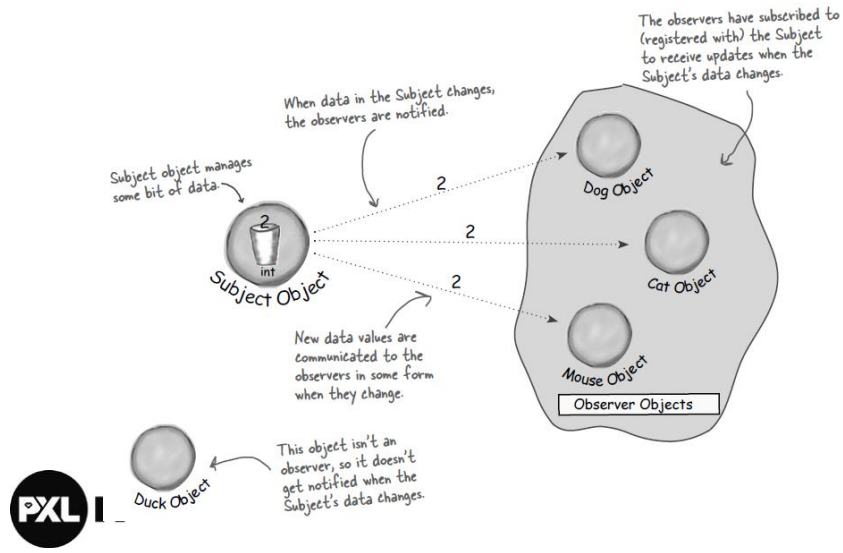
Publishers + Subscribers = Observer



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The Observer pattern

defines a one-to-many dependency between objects so that when one object changes state, all of its dependents are notified and updated automatically.

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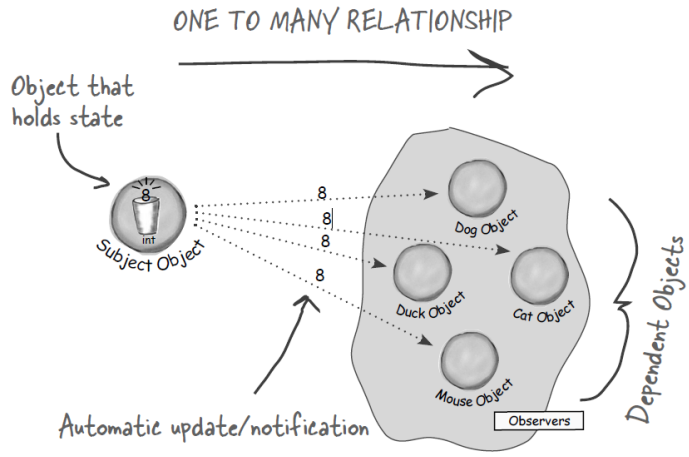
The Observer pattern



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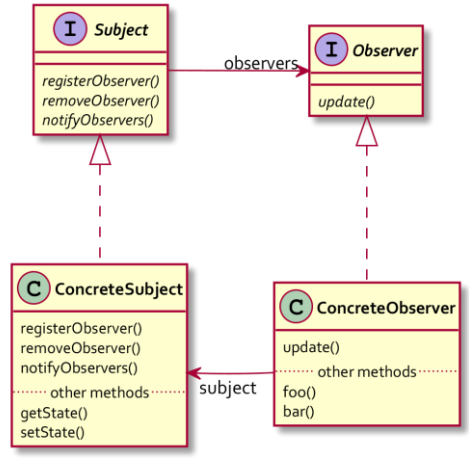
The Observer pattern



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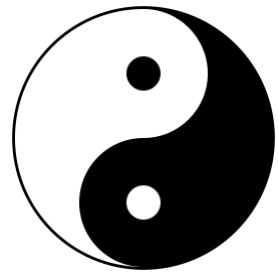
Design Principle 4

Strive for loosely coupled designs between objects that interact.



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Loose Coupling

- Subject knows that an observer implements an interface, that's all
- Add observers anytime
- Subject unmodified when adding new observers
- Reuse of subjects or observers independently
- Changes in subject does not affect observers and vice versa

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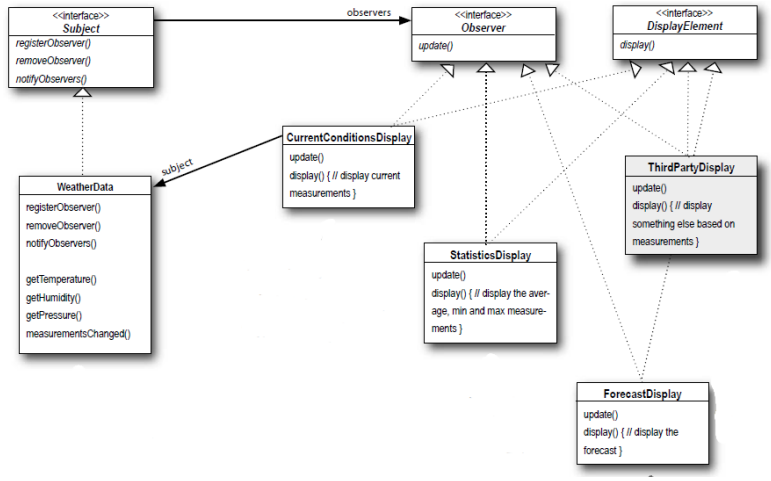
First Implementation



Have I seen this before?

- Events (C#), Observable (Java)
- Whole new programming paradigm: RX
  - https://github.com/ReactiveX/RxJava
  - https://github.com/Reactive-Extensions/Rx.NET
- …

Language integration

- Java
  - Observer, Observable
  - Push vs Pull style
  - Observable:
    - setChanged: state has changed
    - notifyObservers() or notifyObservers(Object arg)
  - Observer: update(Observable o, Object arg)
  - Critique pp. 71

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Language integration

- C#
  - Events and delegates
  - http://stackoverflow.com/questions/1249517/super-simple-example-of-c-sharp-observer-observable-with-delegates

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