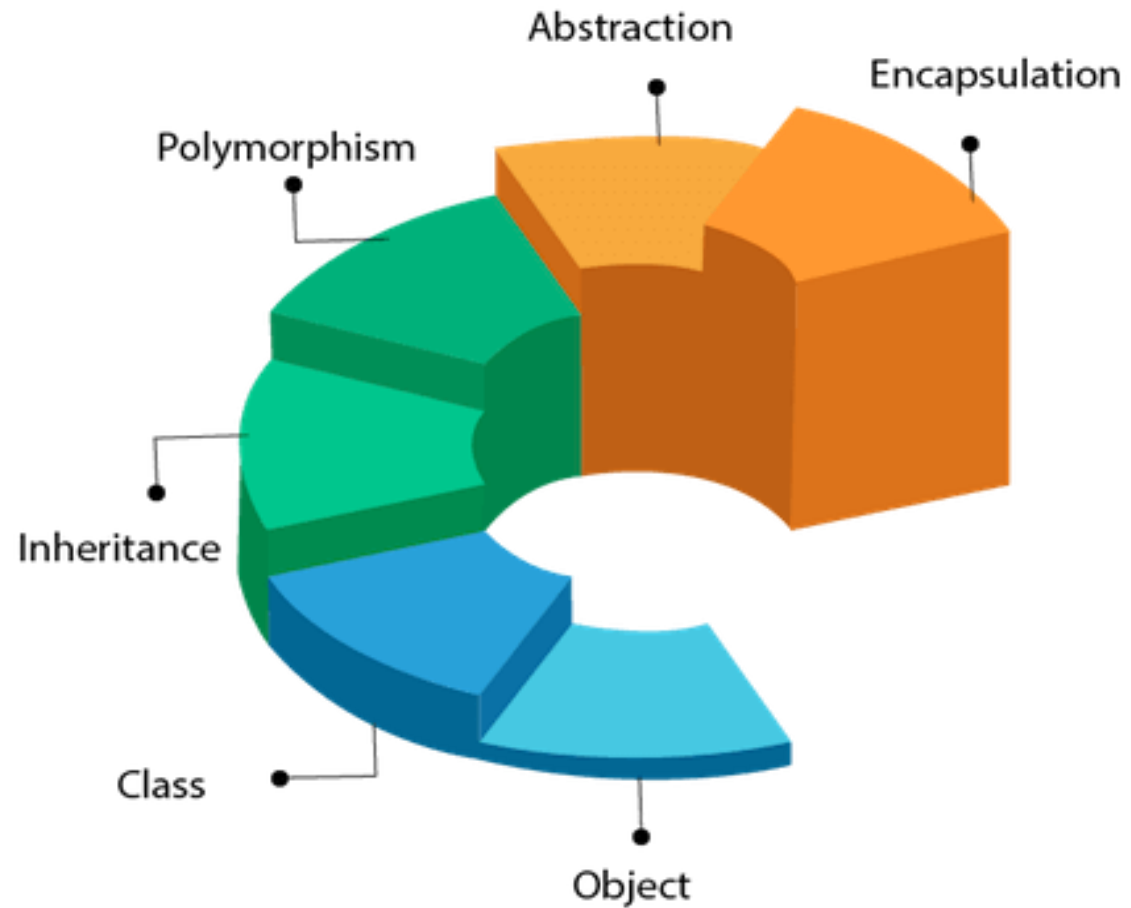# OBJECT-ORIENTED PROGRAMMING

AARHUS
UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

SWD
30 AUGUST 2021

HENRIK BITSCH KIRK
ASSOCIATE PROFESSOR

OOPs (Object-Oriented Programming System)

ENCAPSULATION

" Write shy code - modules that don't reveal anything unnecessary to other modules and that don't rely on other modules' implementations.
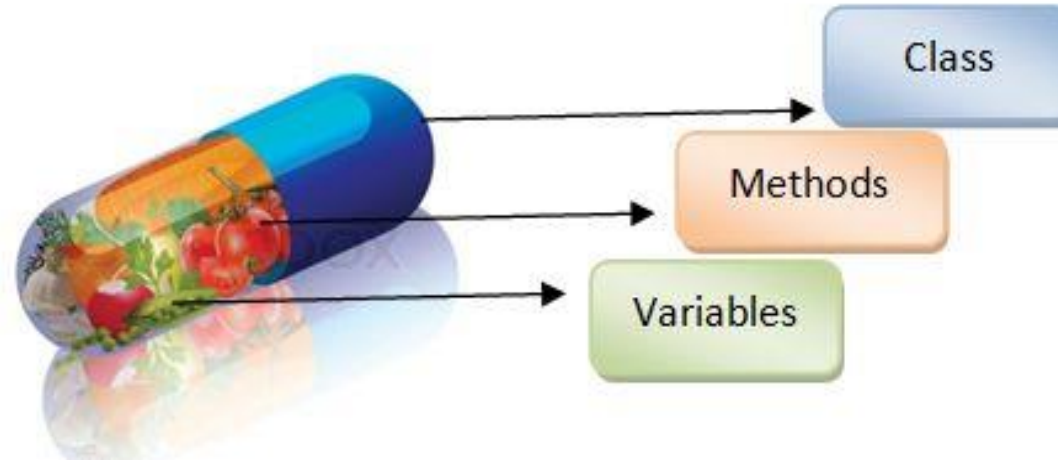- DAVE THOMAS

ENCAPSULATION

Discuss

What are the benefits of encapsulation?

What are the drawbacks?

Class

Methods

Variables

"Details required to return a result from a class method should be hidden from the calling method"

EVIL CLIENT

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EVIL CLIENT

```csharp
public class TurbineManager {
    public List<WindTurbine> turbines;
}
```

```csharp
public class EvilClient {
    public void DestroyTurbines(TurbineManager tm)
    {
        tm. turbines.Clear();
    } }
```

```csharp
public class TurbineManager {
    private List<WindTurbine> turbines;
    public WindTurbine GetTurbine(string id);
}
```

```csharp
public class EvilClient {
    public void DestroyTurbines2(TurbineManager tm) {
        tm.GetTurbine("A323").Id = "PWND";
        tm.GetTurbine("PWND").MaxSpeed = -1000;
    } }
```

```csharp
public class TurbineManager {
    private List<WindTurbine> turbines;
    public void SetMaxSpeed(string tag, int
speed);
    public void SetLocation(string tag, Coo
coord);
}
```

```csharp
public void DestroyTurbines3(TurbineManager tm)
{
    tm.SetMaxSpeed("A323", -1000);
}
```

ABSTRACTION

’’ The purpose of abstraction is not to be vague, but to create a new semantic level in which one can be absolutely precise
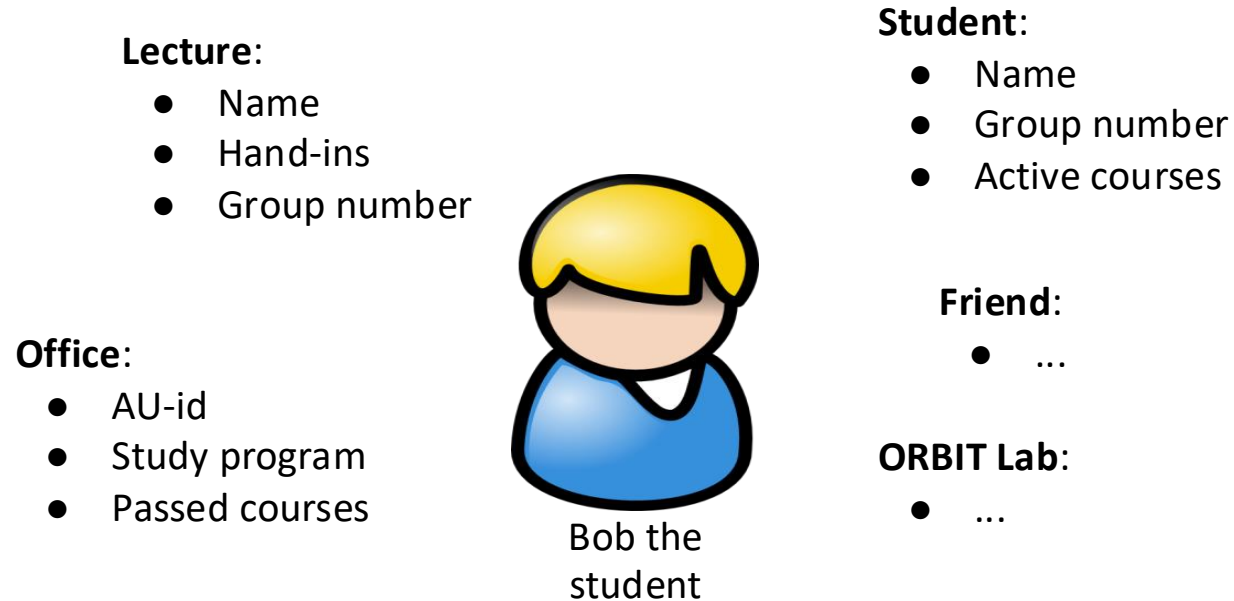
- EDSGER DIJKSTRA

ABSTRACTION

—

Discuss

What does abstraction mean?

ABSTRACTION – AN EXAMPLE

Lecture:
- Name
- Hand-ins
- Group number

Student:
- Name
- Group number
- Active courses

Office:
- AU-id
- Study program
- Passed courses

Friend:
- …

ORBIT Lab:
- …

Bob the student

These are all different abstractions of Bob.

Which one to use depends entirely on the context in which Bob is represented.

Creating the right abstraction of entities is very important to your design. Include the relevant, and exclude the irrelevant.

INHERITANCE

" There is nothing wrong with inheritance, or even multiple inheritance. It's a language feature just like any other. It can be used wisely or foolishly
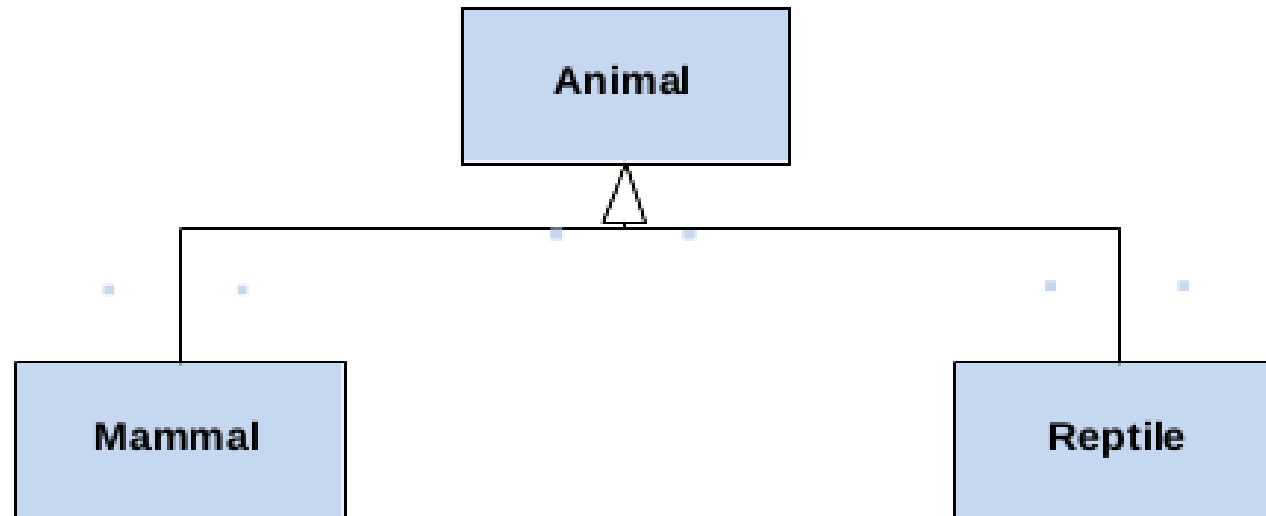
- ROBERT C. MARTIN

INHERITANCE

Discuss:

Inheritance is commonly described as an "is-a relationship" between classes – how do you understand this?

Explain the concepts "specialization" and "generalization" with regards to inheritance.

INHERITANCE

Mammal inherits from Animal means...

Everywhere an object of class Animal is used, an object of class Mammal can be used ("compile-time" or "is-a" inheritance)

Every property that is desirable for clients of class Animal must be the same for class Mammal ("run-time" or "behaves-like" inheritance)

**Spoiler**: This is Liskov's Substitution Principle
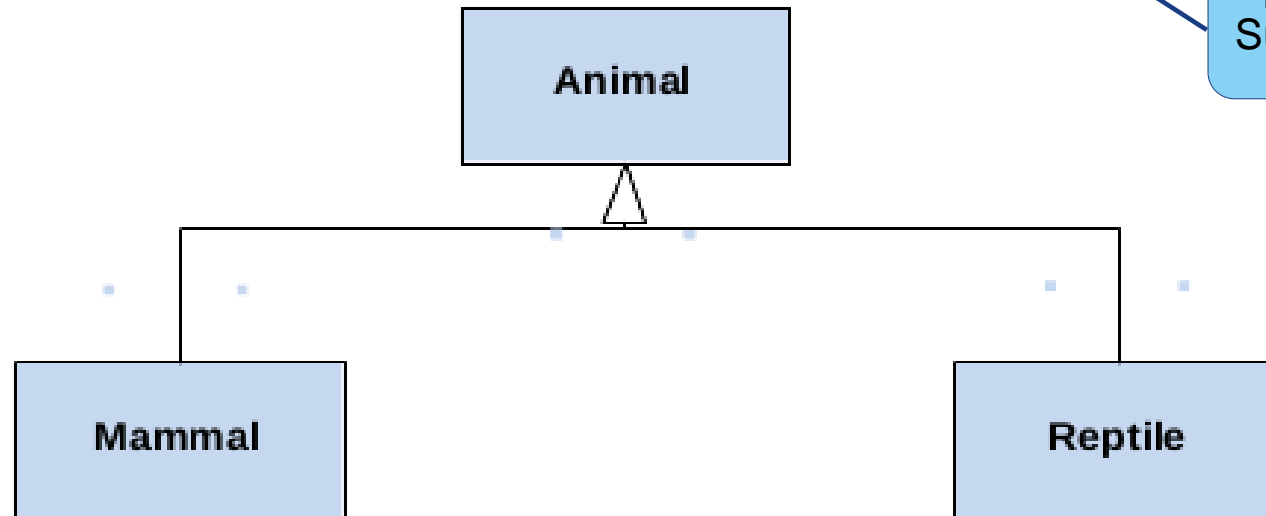
INHERITANCE – A QUIZ

Your turn: In 10 minutes...

1. Arrange the classes Bird, Penguin and Swallow in an inheritance hierarchy

2. Suppose you must add a method LayEgg() to Bird. Does your hierarchy still hold?

3. Suppose you must add a method Fly() to Bird. Does your hierarchy still hold

4. If the hierarchy breaks: How will you handle it?
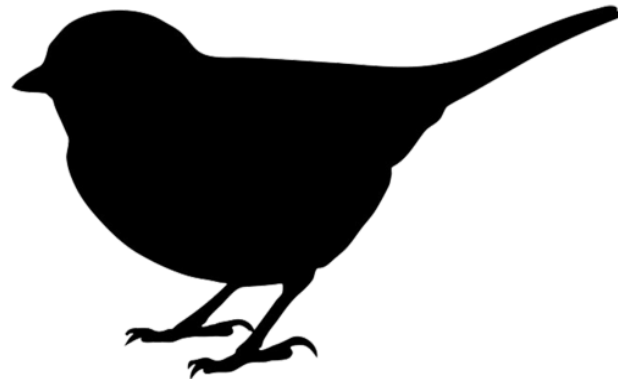
POLYMORPHISM

> So much complexity in software comes from trying to make one thing do two things.
>
> \- RYAN SINGER

POLYMORPHISM

"strategy (RTS) game. Polymorph" = "many forms"

Polymorphism is used when we need type-specific behaviour from our objects. The behaviour of a given object varies depending on its type.

Polymorphism is best understood from the side of the client, so let's take an example: Battle strategies in a real-time

When a unit spots an enemy unit, it may either
- Engage
- Defend
- Run away

TRIARII

Wealth, experience and age make these battle-hardened veterans a fearsome force.

148 (160)   0   XP:

Weapon Damage	35
Melee Attack	48
Armour	115
Health	55
Base Morale	73

POLYMORPHISM – RTS GAME

- Implementation using a *polymorph* strategy

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