Object-Oriented Modelling

Object-Oriented Programming

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2025-I

Outline

1. Creating Models in Design

2. Evolution of Programming Languages

3. Four Design Principles

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1 Creating Models in Design

2 Evolution of Programming Languages

3 Four Design Principles

Design Before Code

- **Design** should come before coding.
- Jumping into *code without a plan* leads to confusion and rework.
- **Good design** clarifies the problem and guides the solution.

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Object-Oriented Approach

- The **object-oriented approach** models the system as a collection of interacting objects.
- Each `object represents` a real-world entity or concept.
- **Objects** encapsulate data and behavior.

1 2

Conceptual Design and Technical Design

- **Conceptual Design**: What the system should do, using `high-level models`.
- **Technical Design**: How the system will be implemented, using `detailed diagrams` and `specifications`.
- Both are essential for a successful software project.

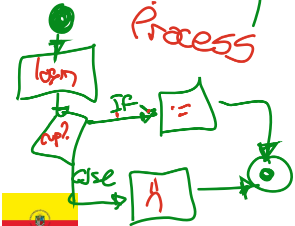
Mockups | Requirements → Functional

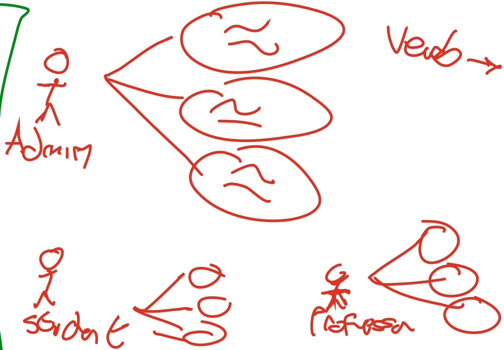
Verb → action

Activity Diagram

(Flowchart)

Process





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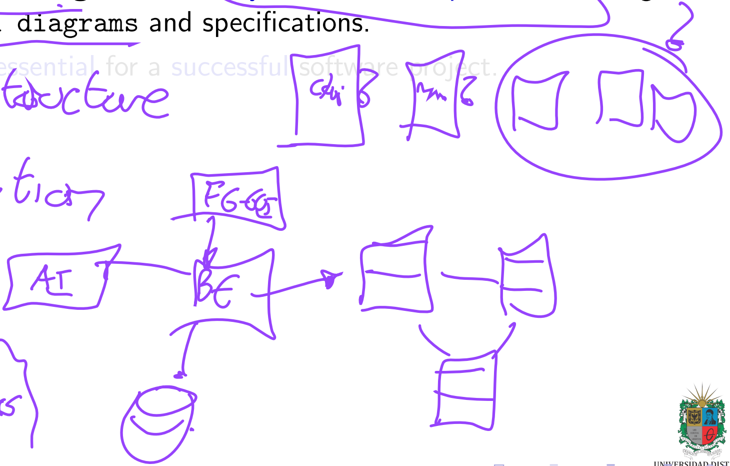
Infrastructure

Application

Techs
Libs
Frameworks



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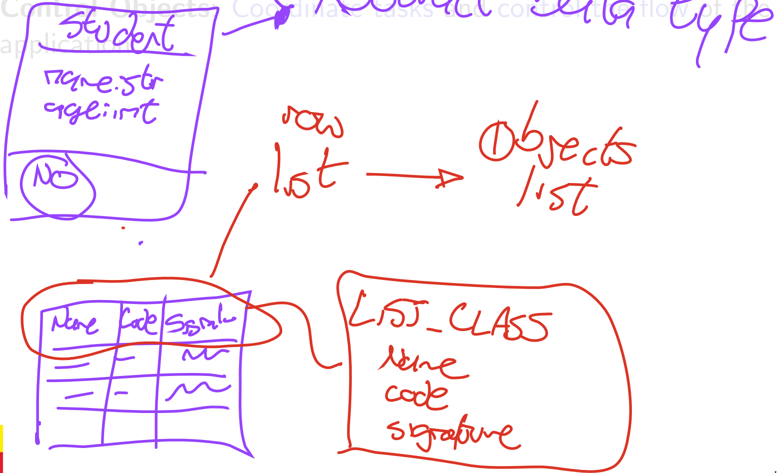
Conceptual → High Comprehension

Technical → Make decisions

↳ code

Categories of Objects

- **Entity Objects**: Represent information and data.
- **Boundary Objects**: Interact with actors (users or external systems).
- **Control Objects**: Coordinate tasks and control the flow of the application.



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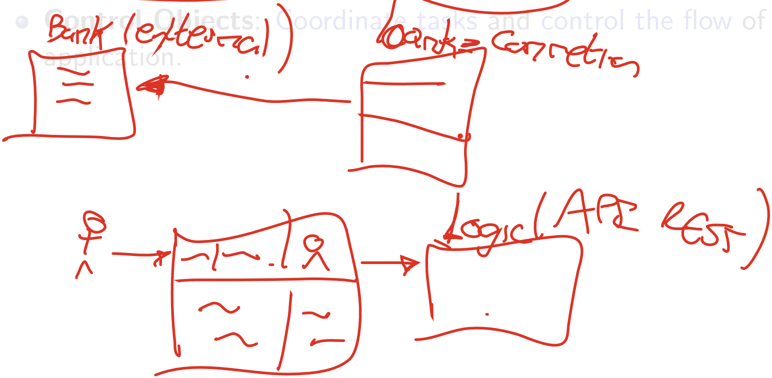

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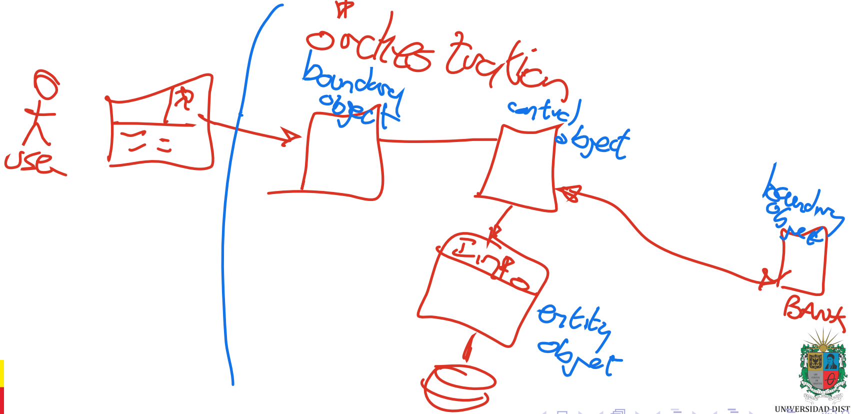

Documentation in Software

- **Documentation** is essential for communication and maintenance.
- Includes requirements, design diagrams, user manuals, and code comments.
- Good **documentation** helps new team members *understand* the *system* quickly.

Employee rotation

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design

develop

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Talk with Machines: Programming Paradigms

- **Programming languages** are tools to communicate with machines.
- **Paradigms**: `Imperative, Procedural, Object-Oriented, Functional, Logic.`
- Each paradigm offers a *different way to think* about and solve problems.

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Rutina

① Paradigm

② Multi-paradigm

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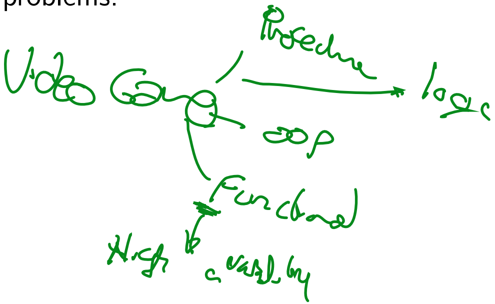
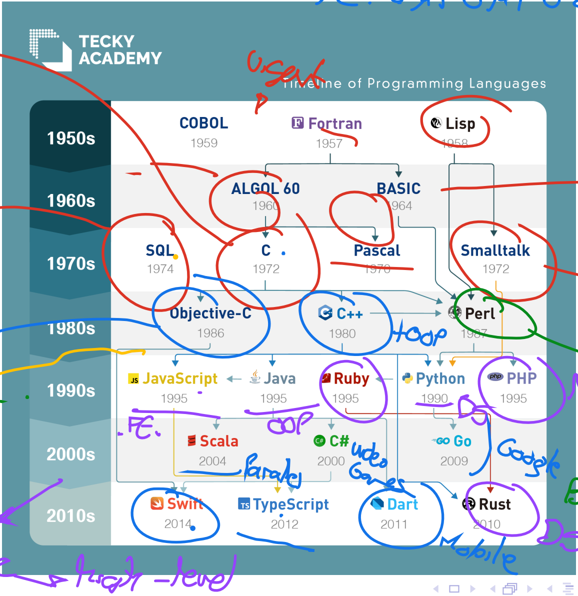
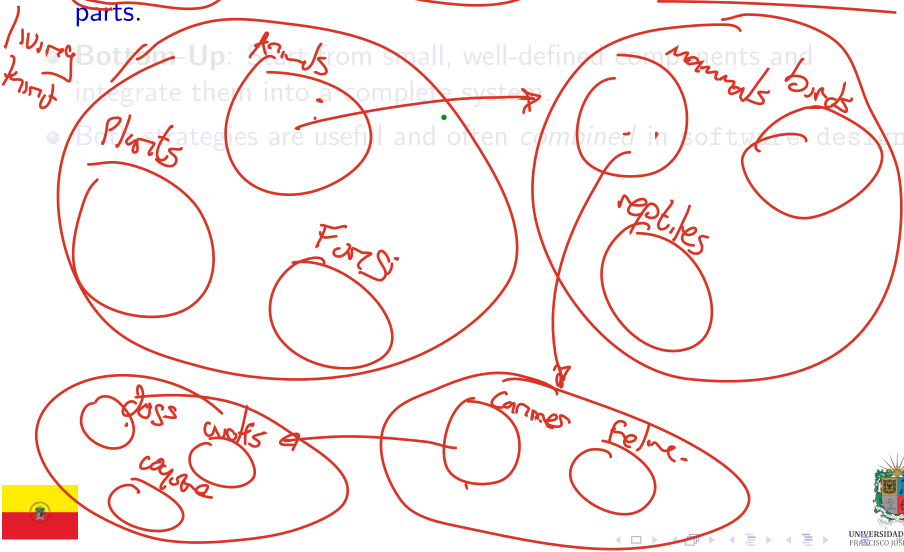


History of Programming Languages



Strategies to Solve Problems

- **Top-Down**: Start from the big picture and break it down into smaller parts.
- **Bottom-Up**: Start from small, well-defined components and integrate them into a complete system.
- Both strategies are useful and often *combined* in software design.



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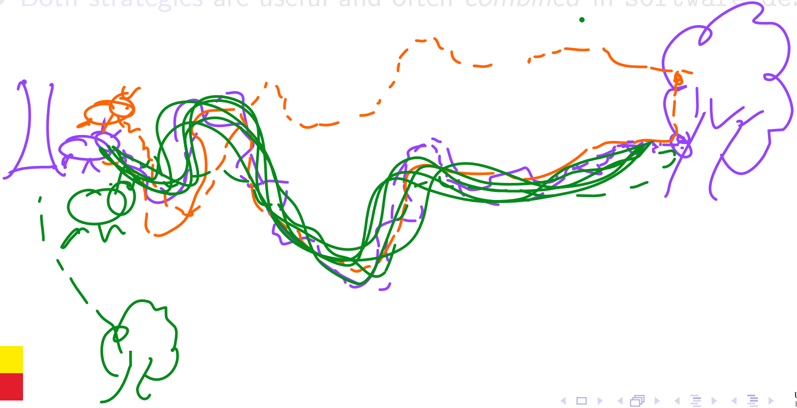

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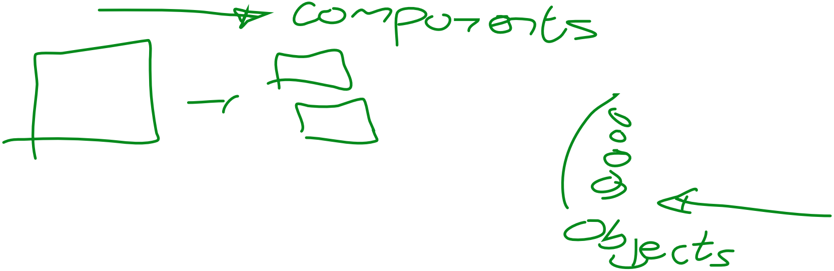

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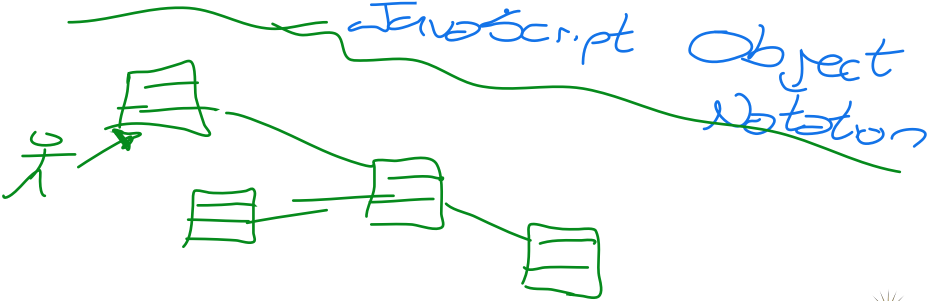
Object-Oriented Design and Contracts

- **Object-Oriented Design (OOD)** organizes software as a collection of objects.
- **Contracts**: Define responsibilities and expectations between objects.
- **Contracts** help ensure correctness and robustness.

Backend → objects (JSON)



JavaScript Object Notation

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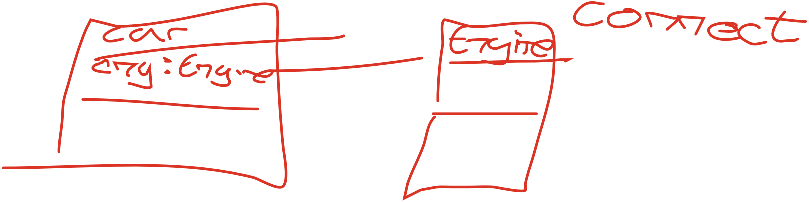

UML Diagrams

- **UML** (*Unified Modeling Language*) is a standard way to visualize system design.
- Common diagrams: `Class diagrams`, `Sequence diagrams`, and `Use case diagrams`.
- **UML** helps communicate design ideas clearly.

Static

use-cases

⋮

Dynamic

activity

⋮

no code

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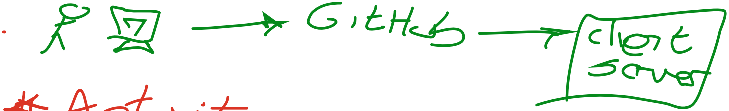
* Deployment → Production



* Activity

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↓

→ simples, free from tech

→ flexible

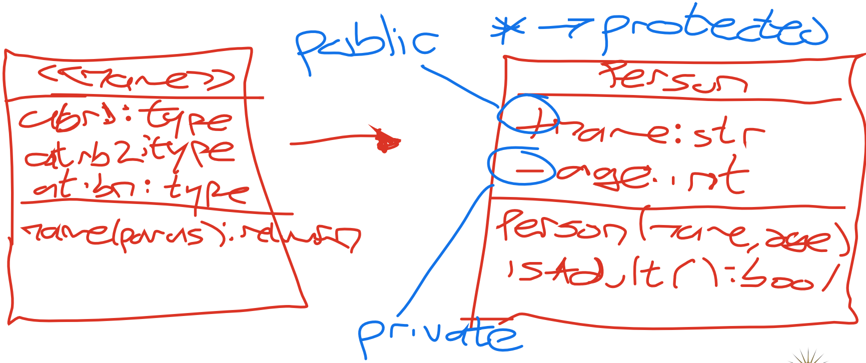
Class Diagrams

→ O.O.P.

- **Class diagrams** show the structure of the system.
- They display **classes**, their attributes, methods, and relationships.

1 2 3

- Useful for both conceptual and technical design.



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Abstraction

- **Abstraction** means focusing on the essential features of an `object`.
- **Rule of Least Astonishment**: Design so users are not surprised by behavior.
- Consider context, basic attributes, and basic behaviors when *designing abstractions*.

simple version)

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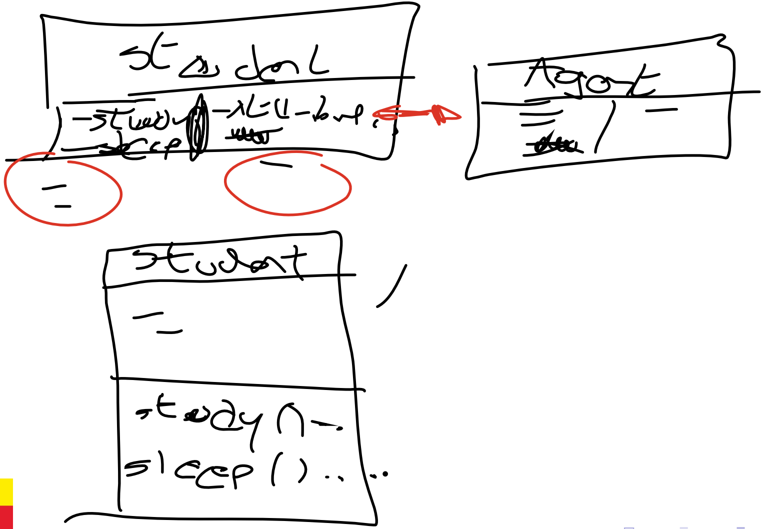
Routine

Abstraction & CRC Cards



Encapsulation

- **Encapsulation** bundles attributes and methods together.
- Expose only what is necessary (*access levels*: `public`, `private`, `protected`).
- *Protects data integrity* and *hides implementation details*.

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✓ ✓ ✗

Best Architecture

Encapsulation

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- *Protects data integrity* and *hides implementation details*.

,No damage

PSJ

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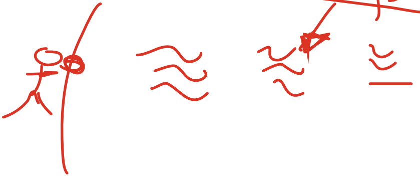
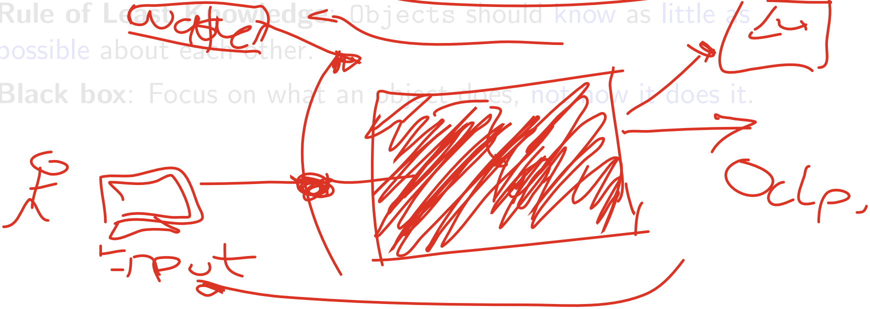


Black Box Thinking

- **Objects communicate** through well-defined interfaces.
- **Rule of Least Knowledge**: `Objects should` know as little as possible about each other.
- **Black box**: Focus on what an object does, not how it does it.



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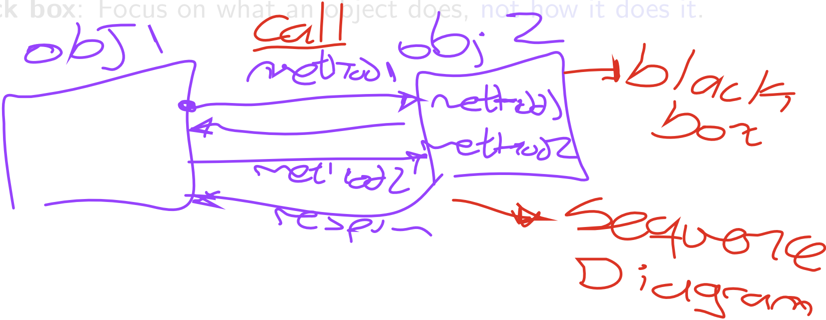

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Documentation

Class → Methods ← description

inputs

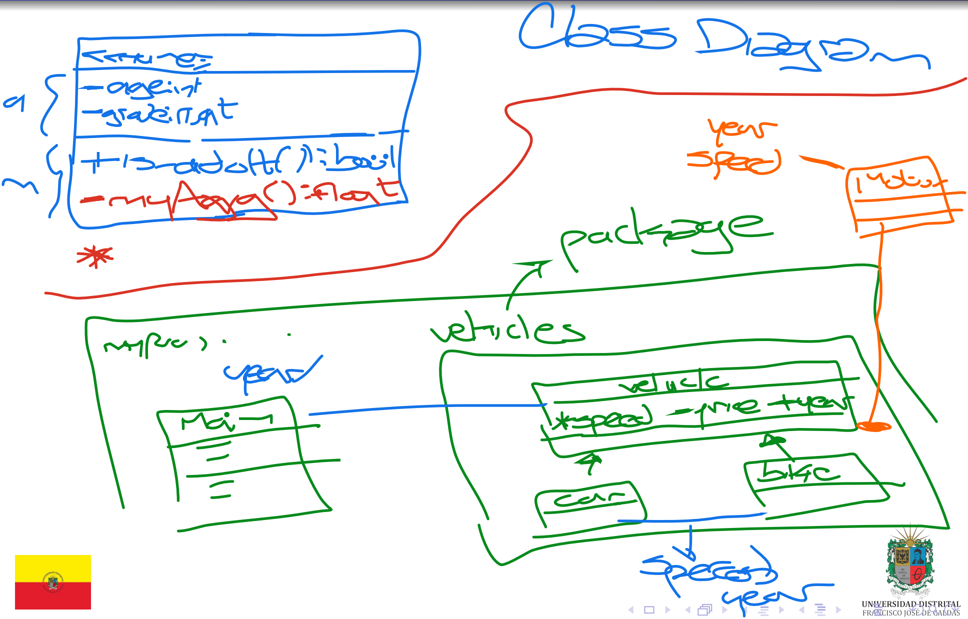
outputs

Data Integrity: Getters and Setters

```
public getName(){
    //Ask grants → Approve
                 → reject
    return name;
}

public setAge(int newAge){
    //Ask grant, value range
    age = newAge; // if newAge<0
                  → error
}
```

Encapsulation & UML

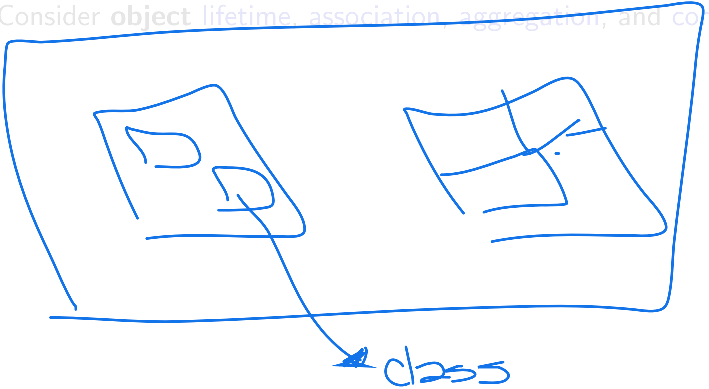


Decomposition

- **Decomposition**: Divide and conquer by breaking the system into smaller parts.

Top-Down

- **Separation of Concerns**: Each part should have a clear responsibility.
- Consider **object** lifetime, association, aggregation, and composition.



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are Cards

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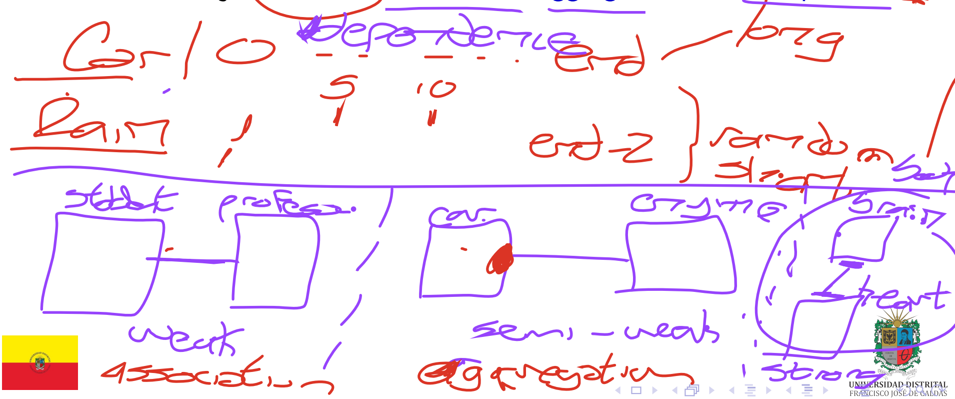
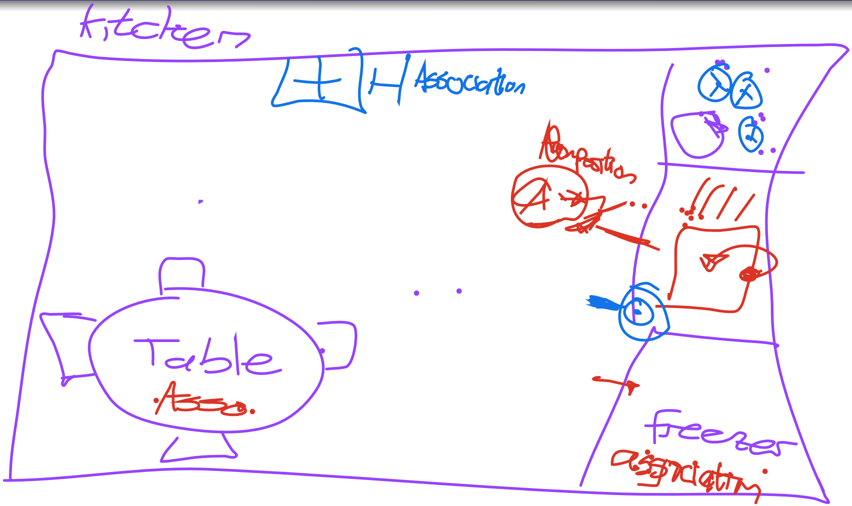
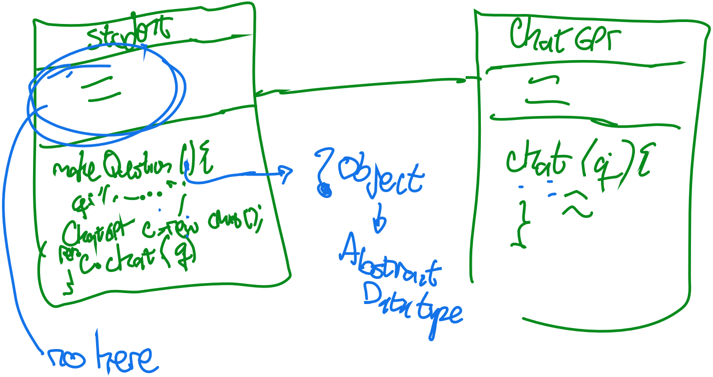


Decomposition Example: Kitchen in a House



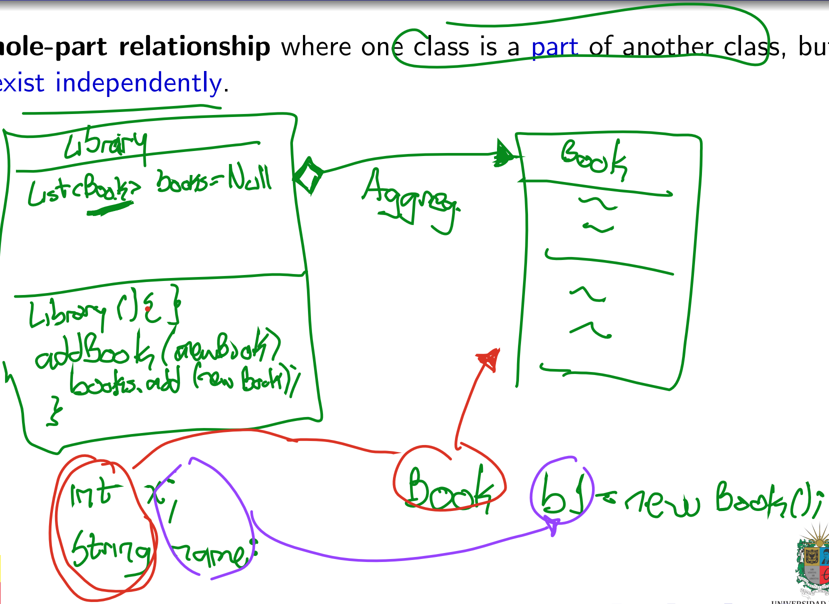
Association

A **relationship** between two classes where one class uses or interacts with another class.



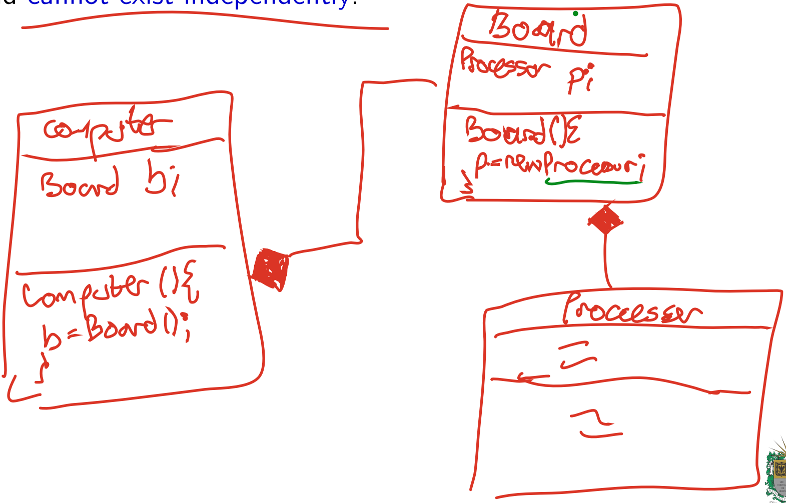
Aggregation

A **whole-part relationship** where one class is a part of another class, but can exist independently.



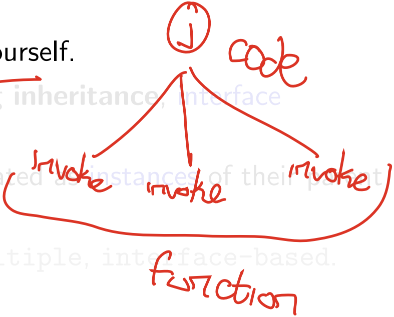
Composition

A **stronger whole-part relationship** where one class is a part of another class and cannot exist independently.



Generalization

- **Generalization** eliminates redundancy by extracting common features.
- **D.R.Y. Principle**: Don't Repeat Yourself.
- Behaviors can be generalized using **inheritance**, interface inheritance, and abstract classes.
- **Polymorphism**: Objects can be treated as instances of their parent class.
- **Types of inheritance**: `single, multiple, interface-based.`



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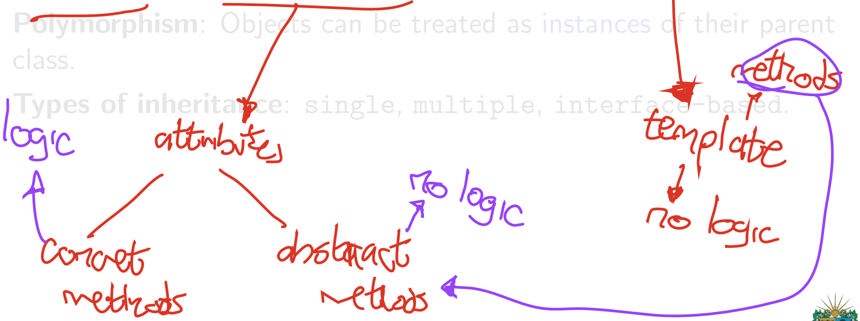

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inheritance

over-charge

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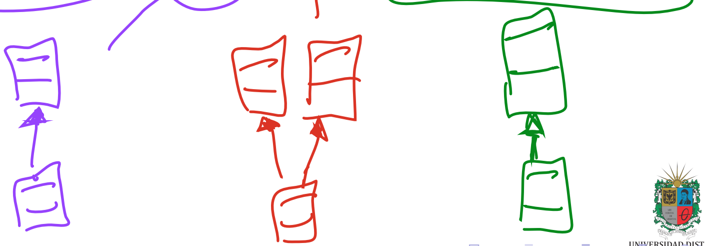

Inheritance

- **Inheritance** allows a class to inherit properties and methods from another class.
- **Base class**: The class being inherited from.
- **Derived class**: The class that inherits from the base class.
- **Benefits**: Code reusability, easier maintenance, and polymorphism.
- **Drawbacks**: Complexity, tight coupling, and potential fragility.

genetic → info → propertie

Habits → behaviors

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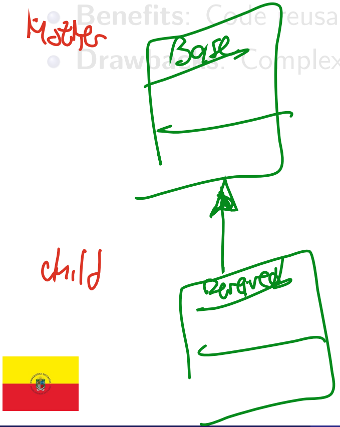

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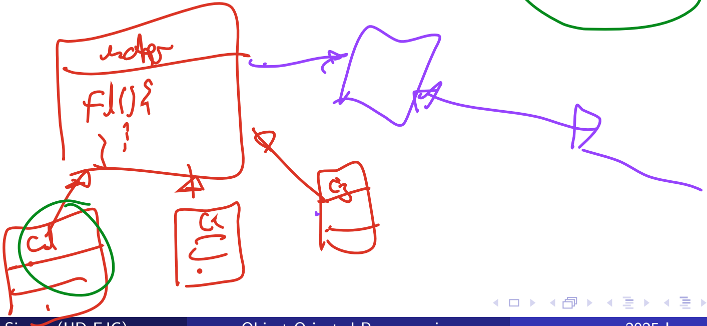
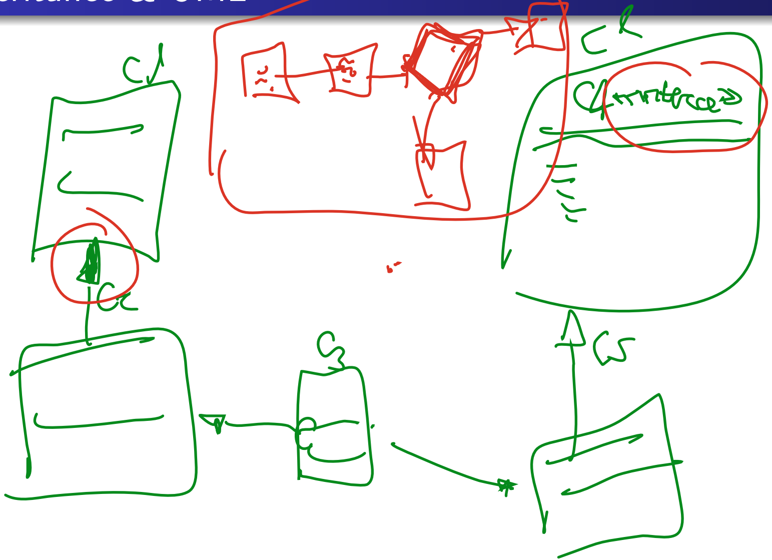


Inheritance & UML



Interface Inheritance

- **Interface inheritance** allows a class to implement an interface without inheriting its implementation.
- Interfaces define a contract that classes must adhere to.
- Benefits: Flexibility, code reusability, and easier maintenance.
- Drawbacks: Complexity and potential performance issues.

Type text here

```
public interface Car{
  public abstract void brake();
  public abstract int getSpeed();
}
```

abstract

```
public class DeLorean implements Car{
  public void brake(){
     System.out.println("DeLorean is braking");
  }

  public int getSpeed(){
     return 100;
  }
}
```

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A(a,b)

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~– A(5,3)

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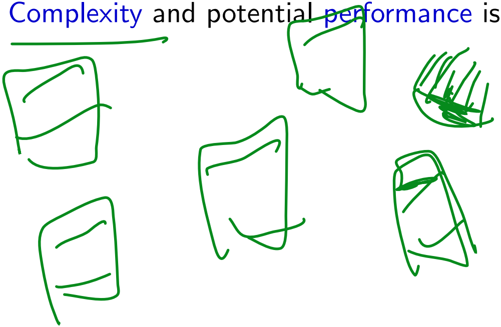

Polymorphism by Inheritance

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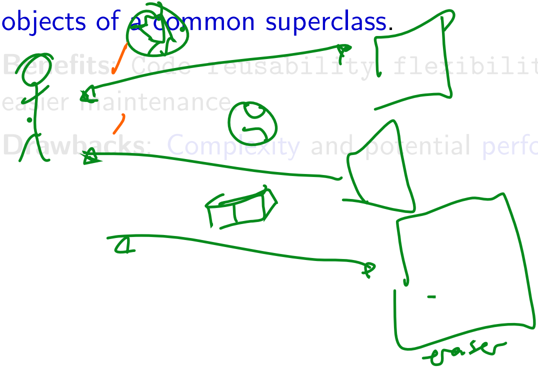

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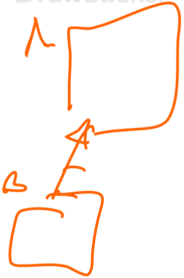
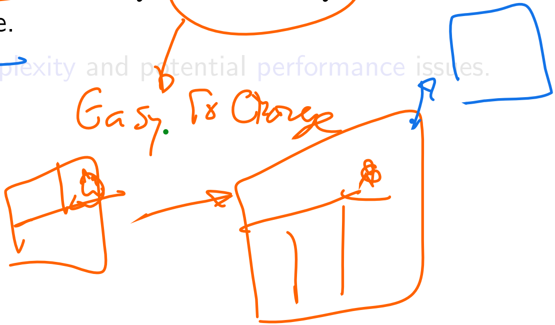
Easy. To Change





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```
Car {
    public calculate_speed(){
        this.speed = d/t;
    }
}
```

```
DeLorean extends Car {
    public calculate_speed(){
        this.speed = atomic
                     +
                     engine
    }
```

Polymorphism by Overcharge

- **Polymorphism by overloading** allows multiple methods with the same name but different parameters.
- **Benefits**: Improves readability and reduces complexity.
- **Drawbacks**: Can lead to confusion if not used carefully.

```
public int sum(int a, int b){
}

public double sum(double a, double b){
}

public []byte sum([]byte a, []byte b){
}
```

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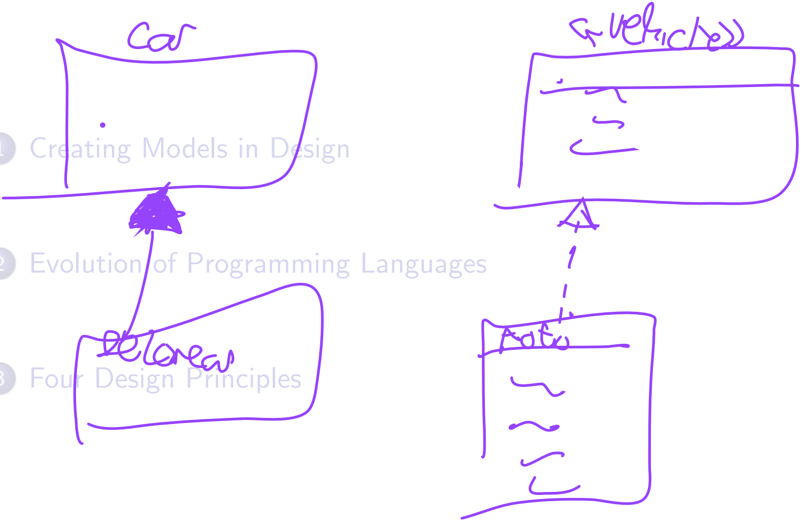
Outline

1. Creating Models in Design
2. Evolution of Programming Languages
3. Four Design Principles



Thanks!

Questions?

Repo: *https://github.com/EngAndres/ud-public/tree/main/courses/object-oriented-programming*