Object-Oriented Modelling

Object-Oriented Programming

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2025-I

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Outline

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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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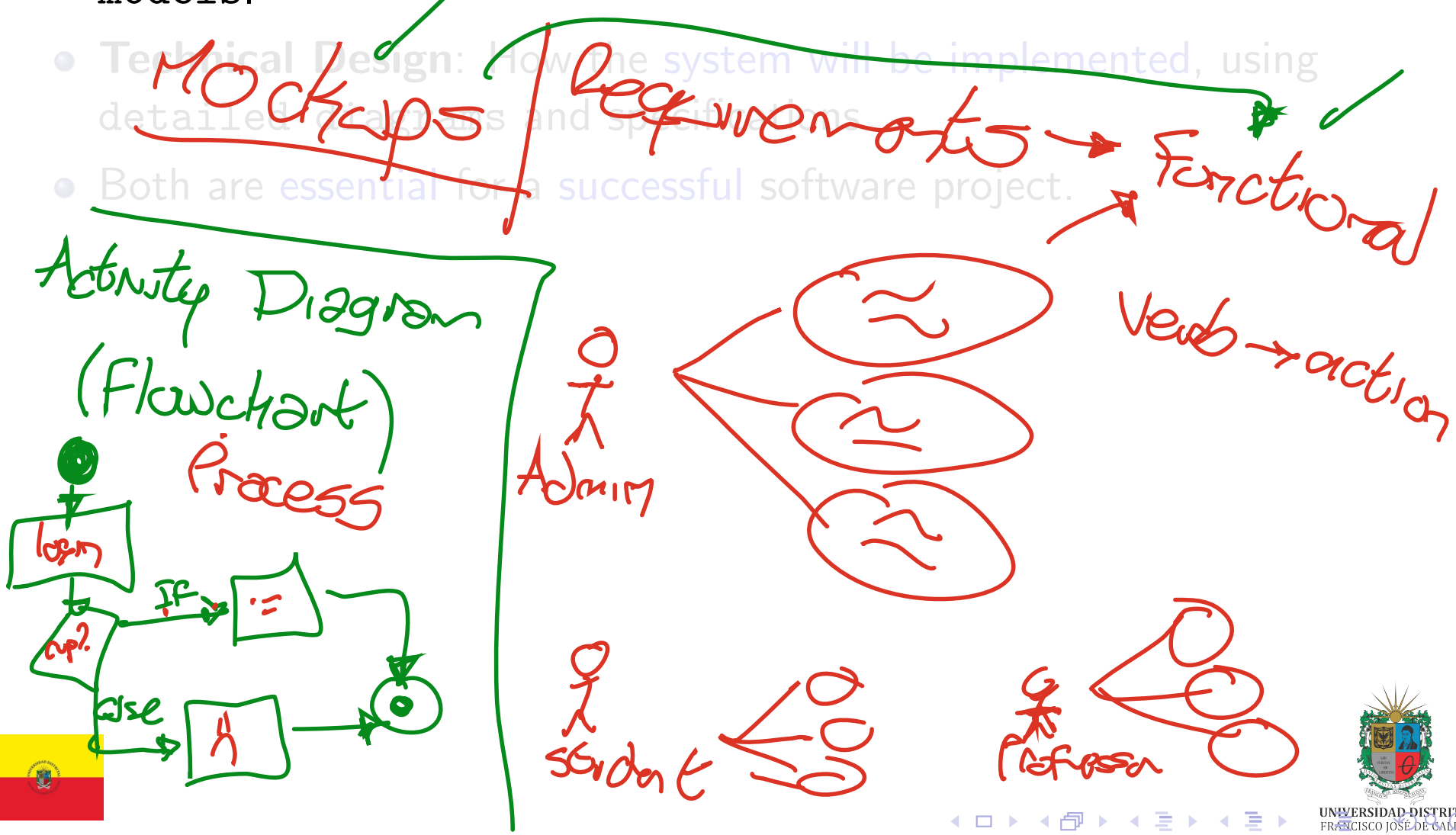
Object-Oriented Approach

- 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.

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.



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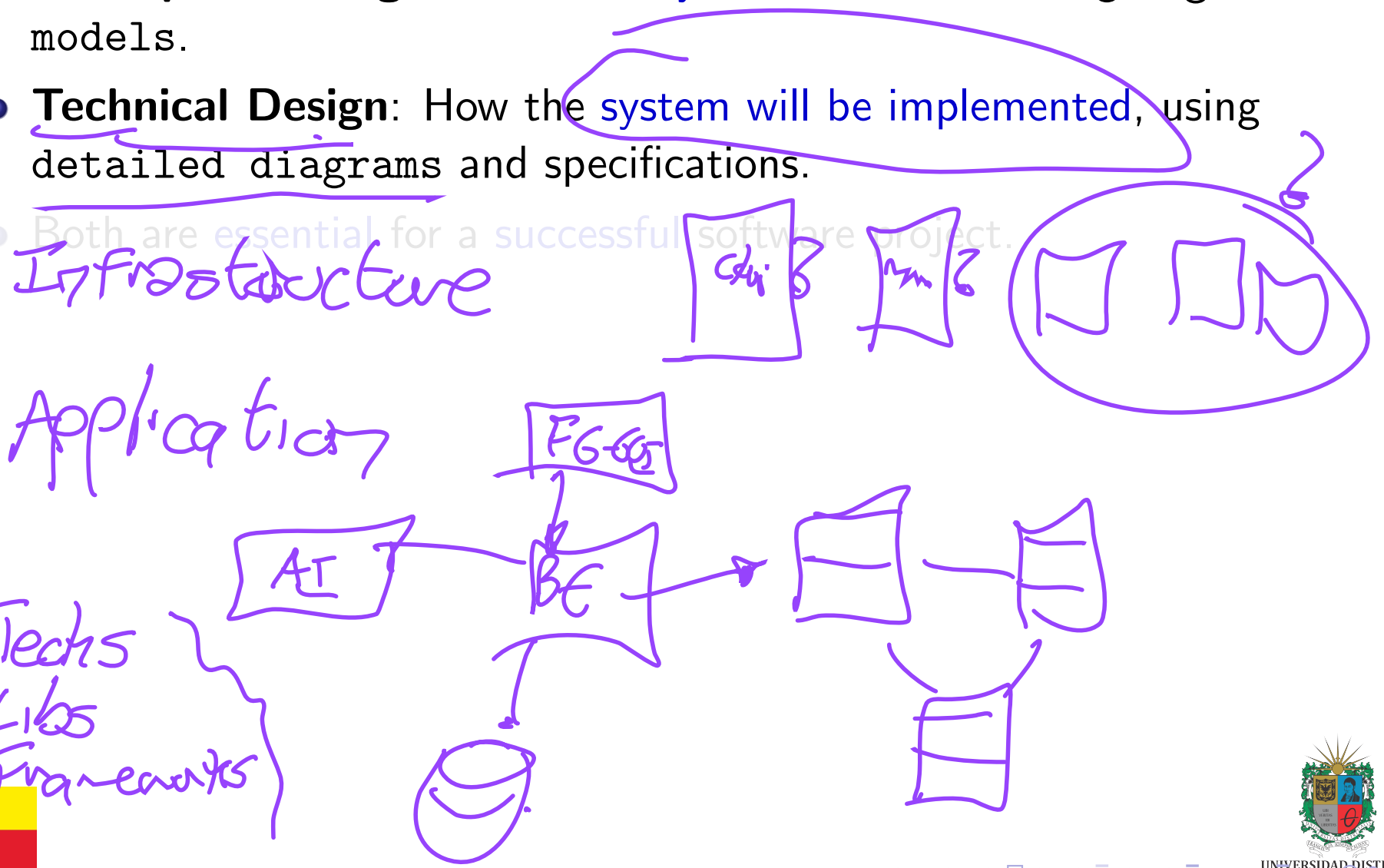

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Conceptual → High Comprehension

Technical → Make decisions

↳ code

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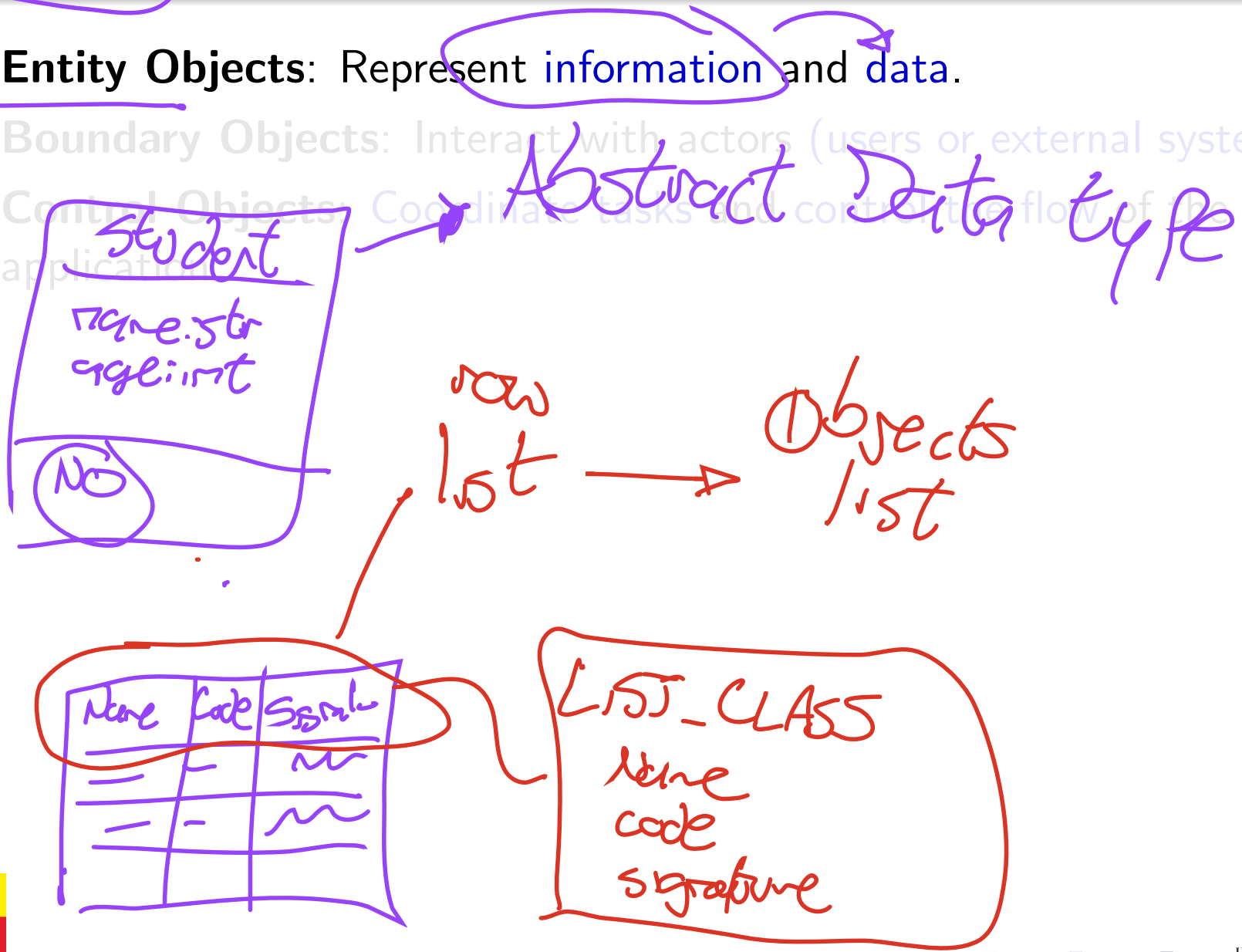
Categories of Objects

- **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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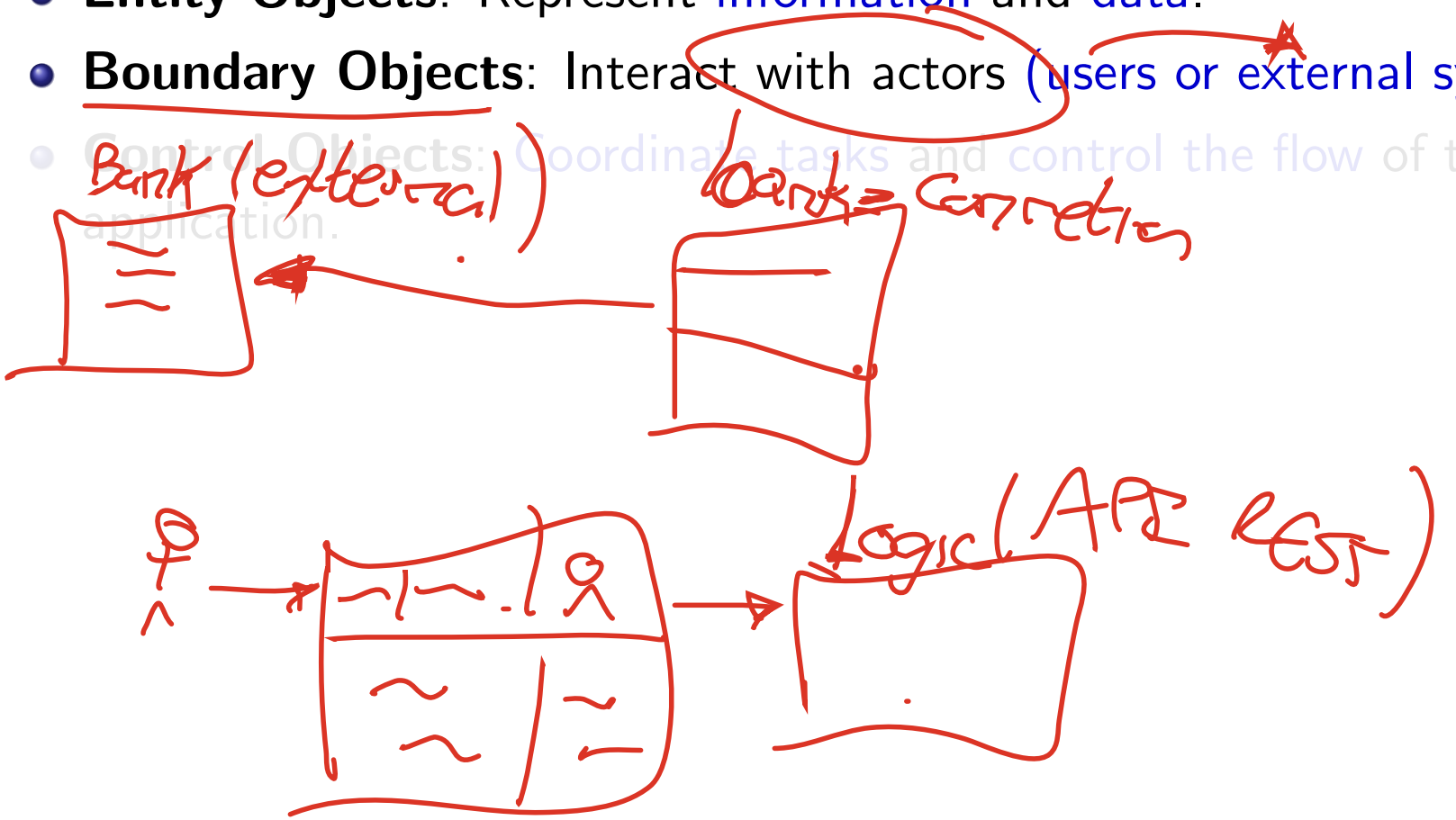

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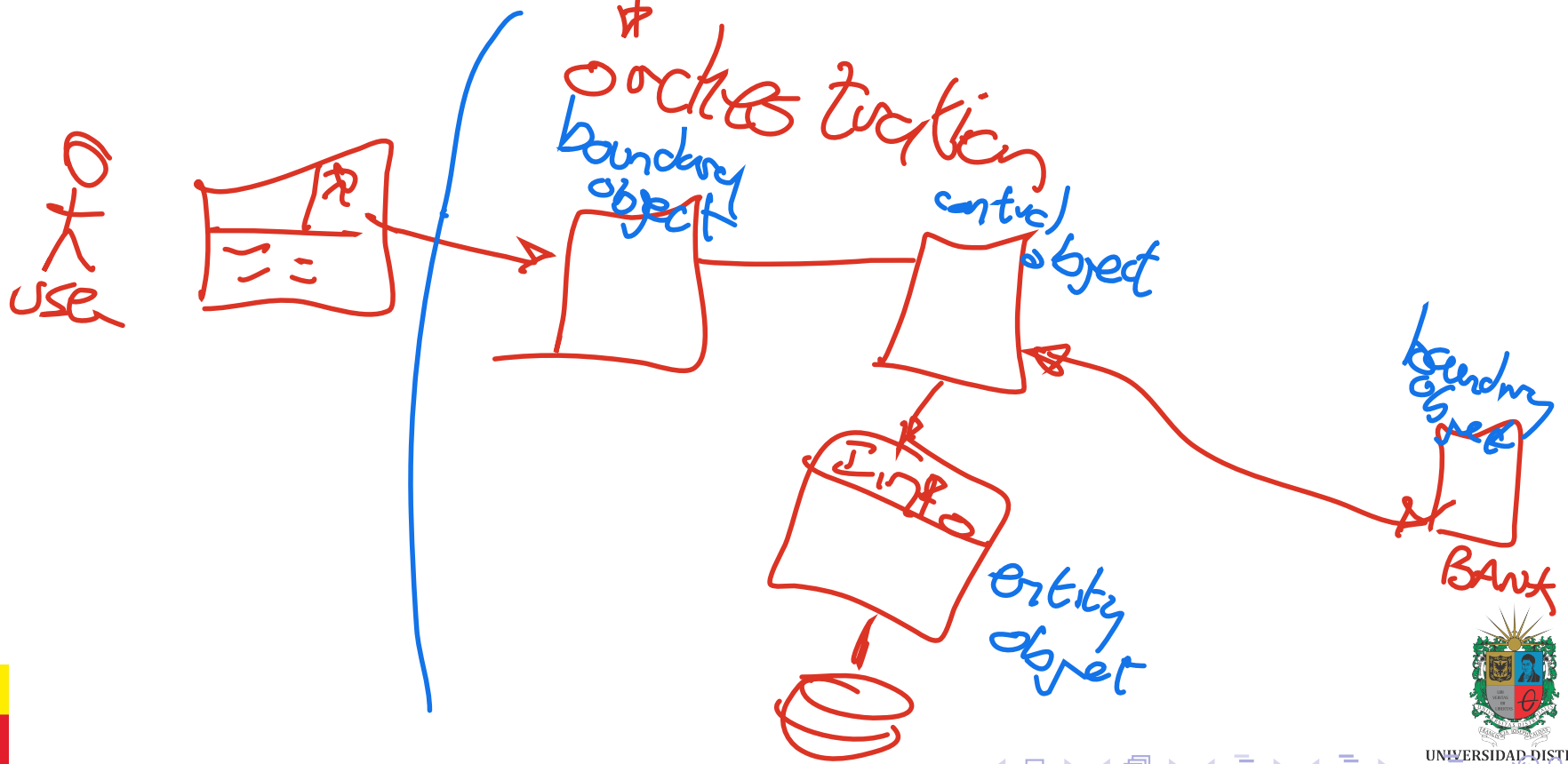

Documentation in Software

- **Documentation** is essential for communication and maintenance.
- Includes requirements, design diagrams, user manuals, and code comments.
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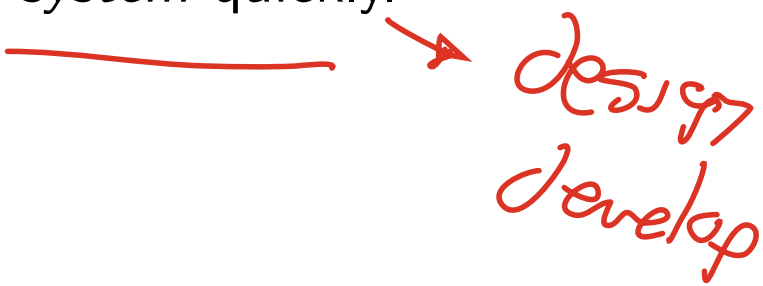

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Talk with Machines: Programming Paradigms

- **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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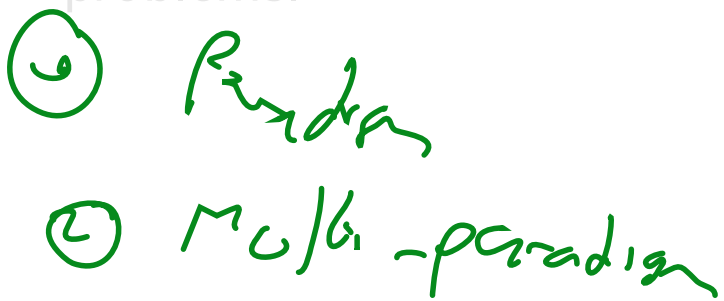

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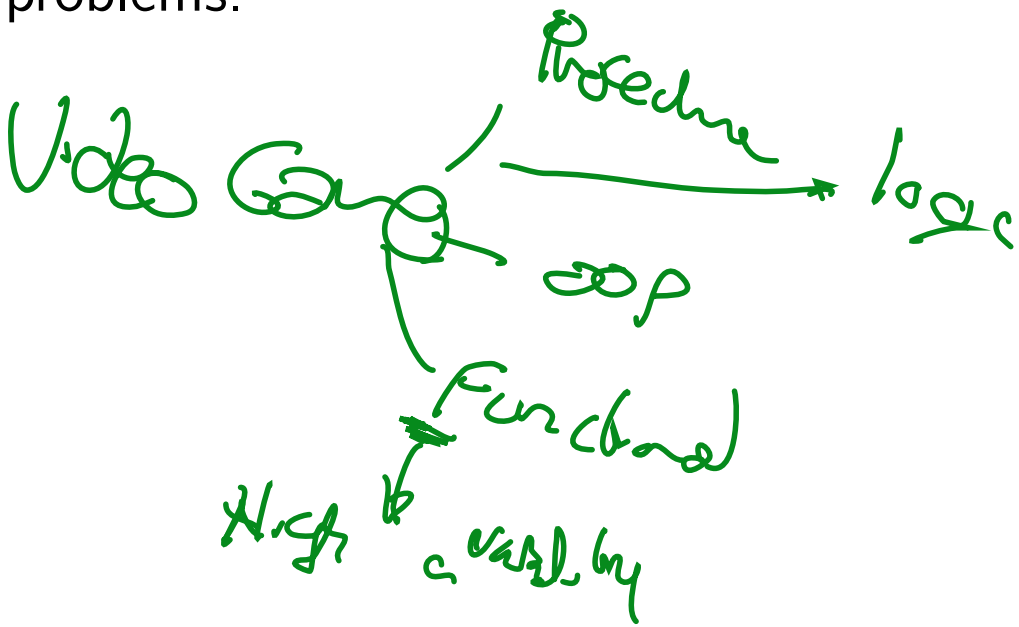
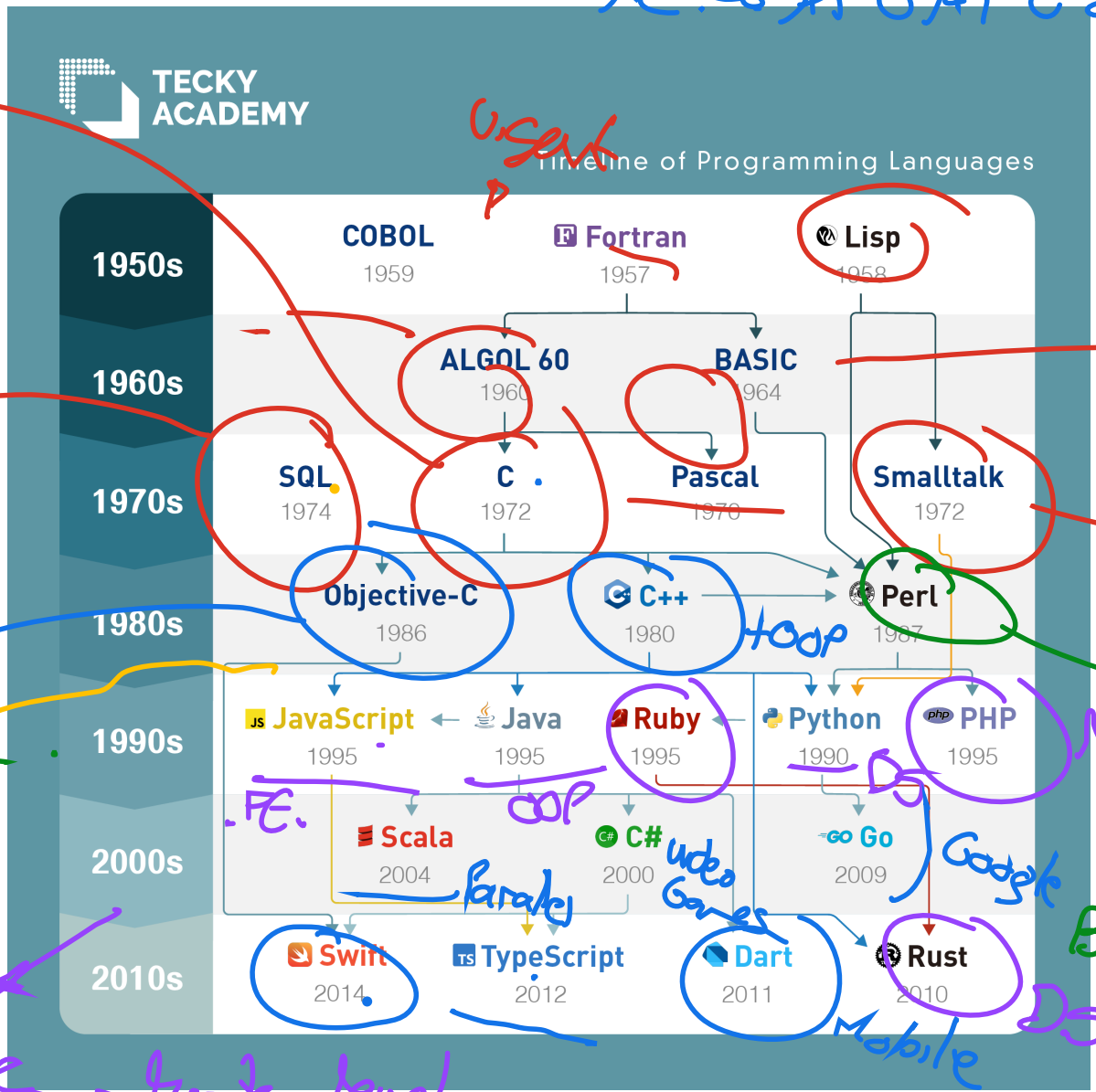
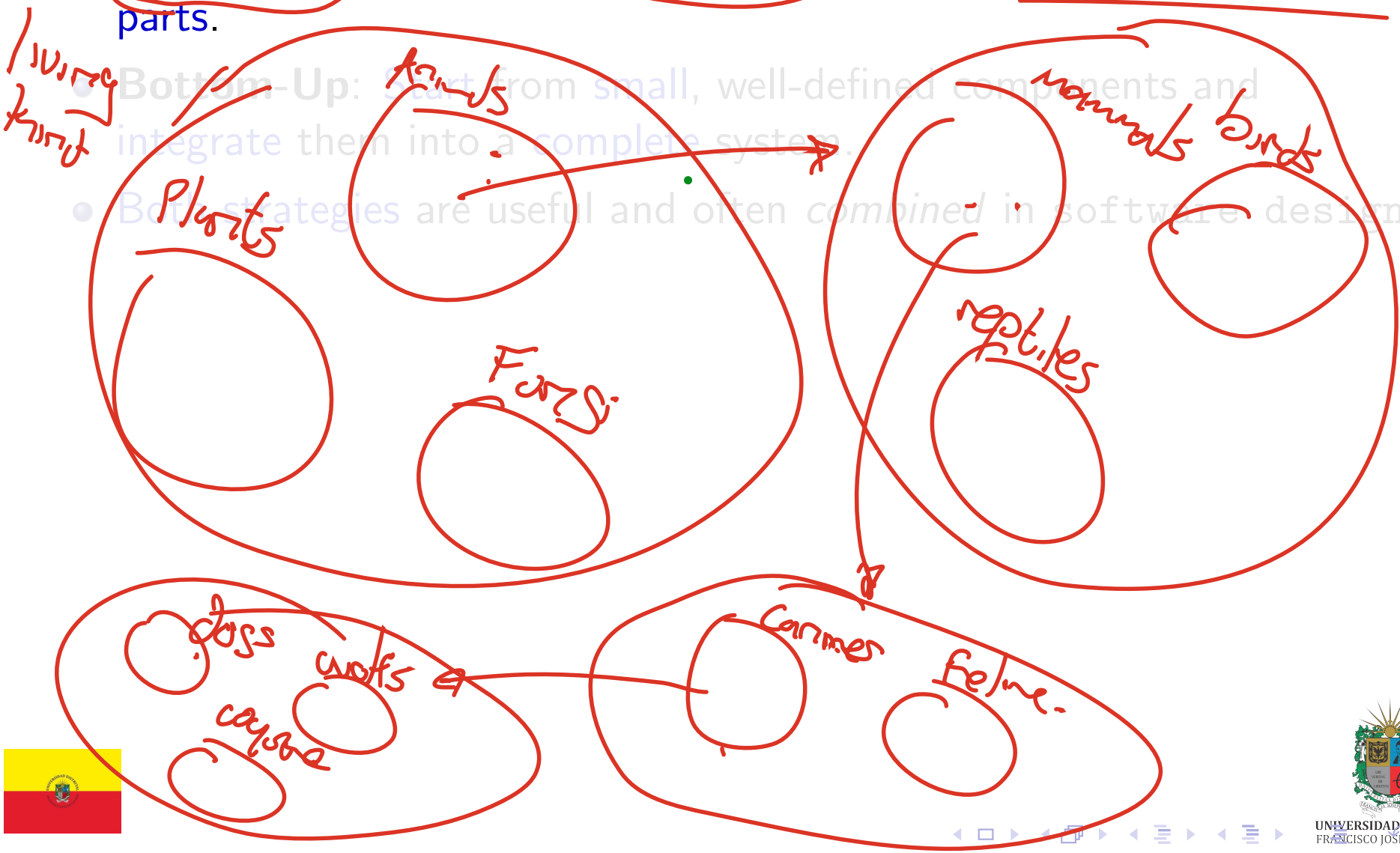


History of Programming Languages



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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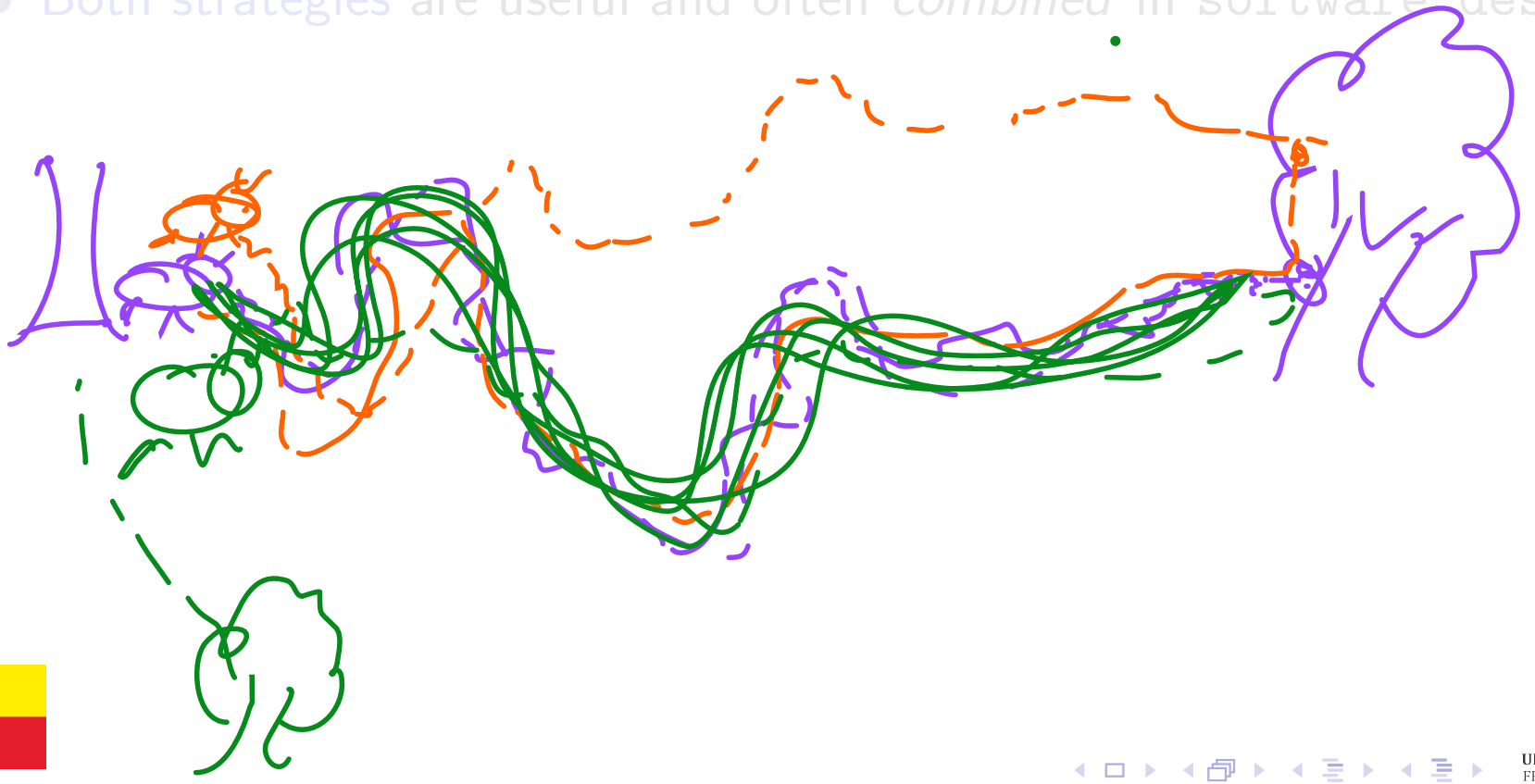

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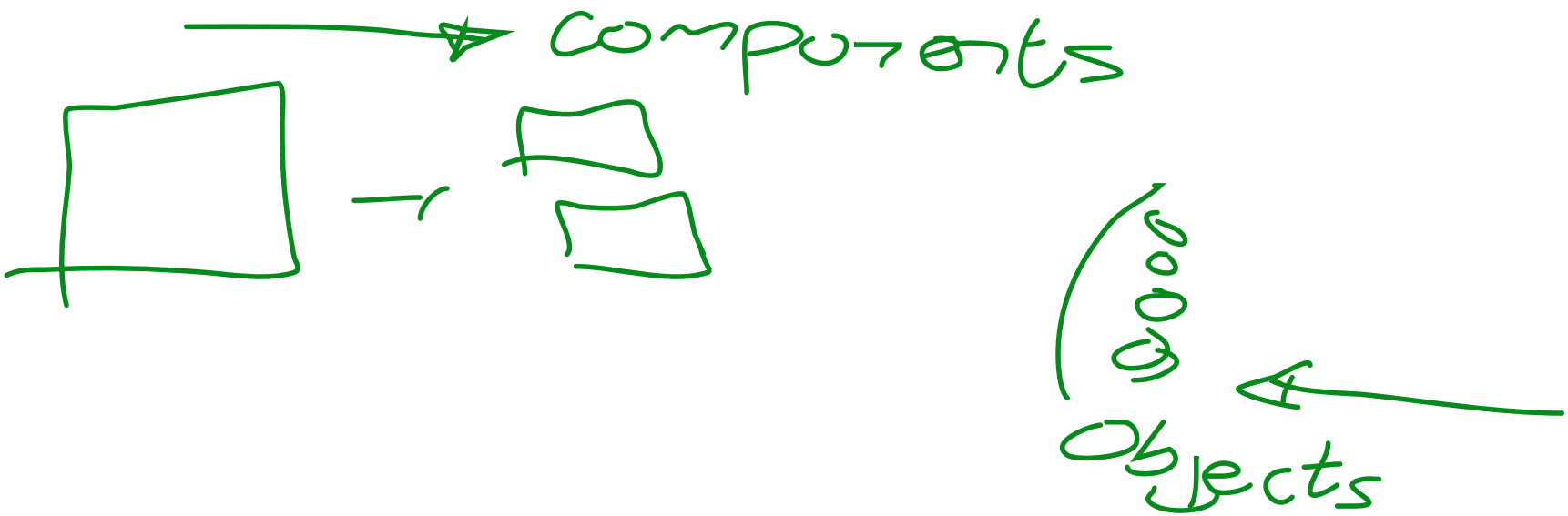

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Object-Oriented Design and Contracts

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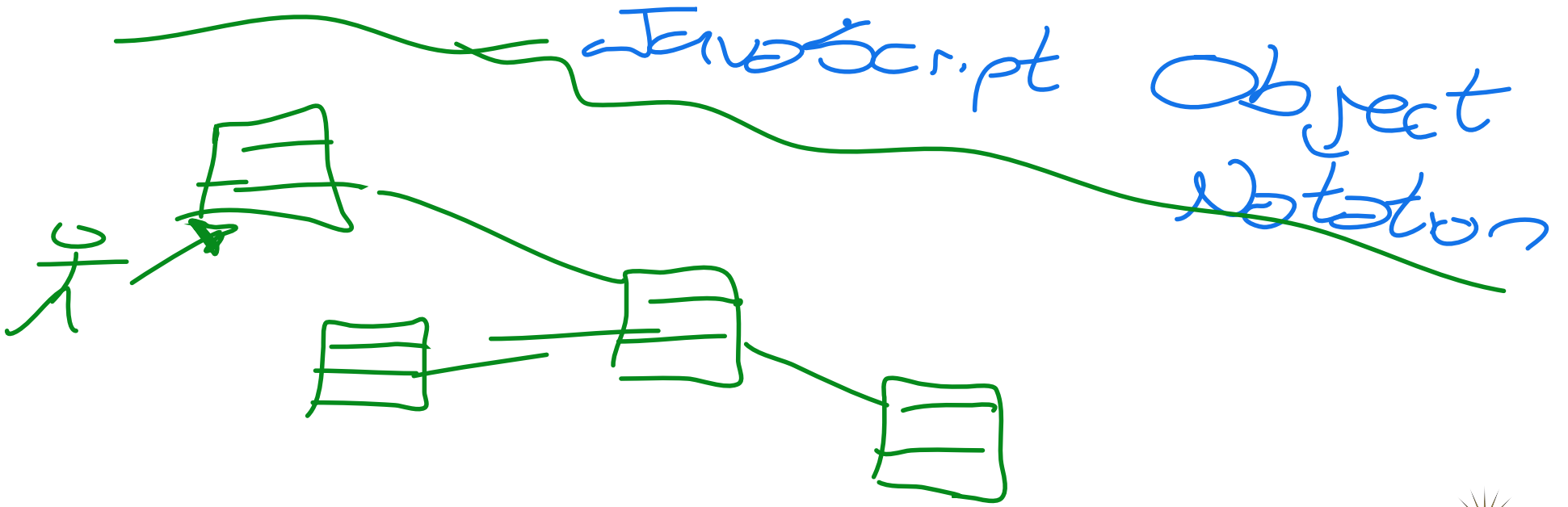
- **Contracts**: Define responsibilities and expectations between objects.
- **Contracts** help ensure correctness and robustness.



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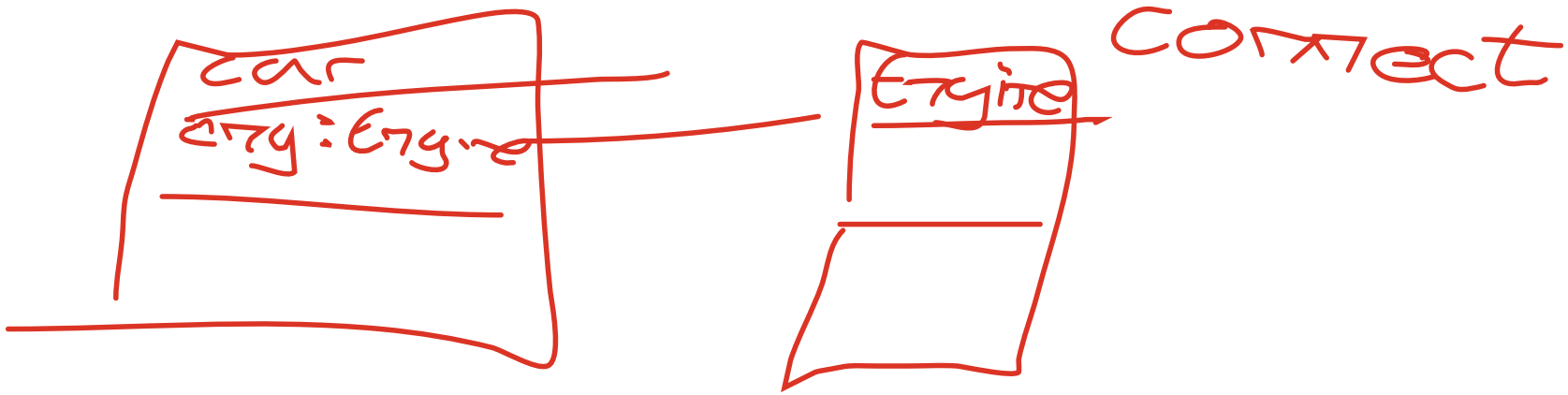

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UML Diagrams

- **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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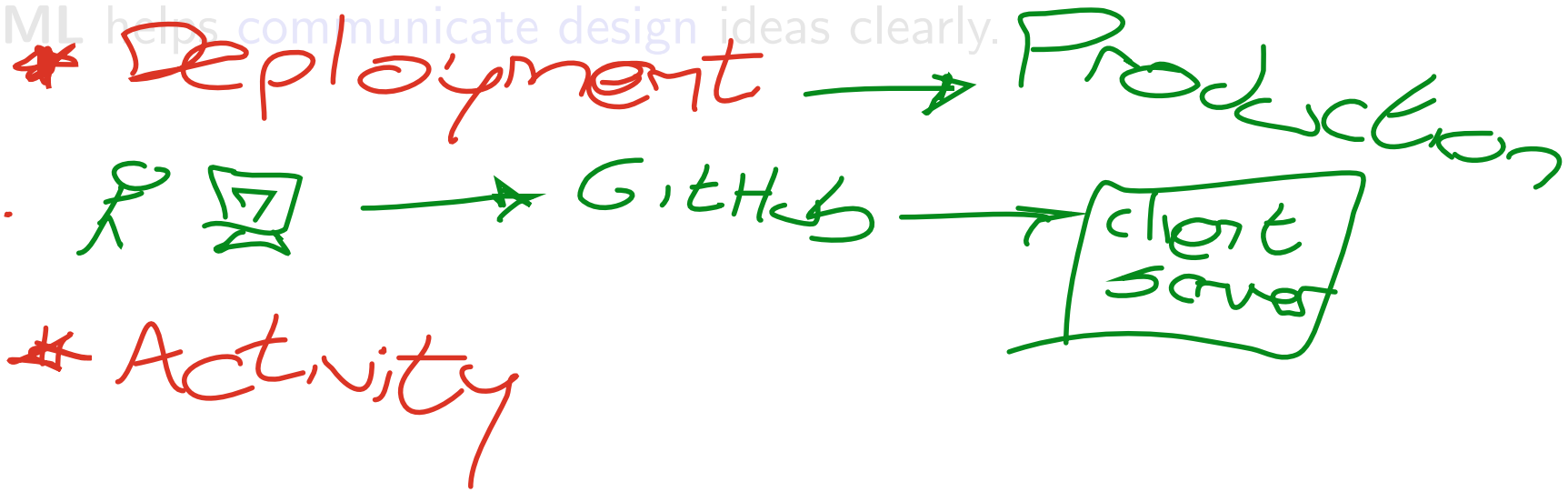

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→ simple, free from tech

→ flexible

Class Diagrams

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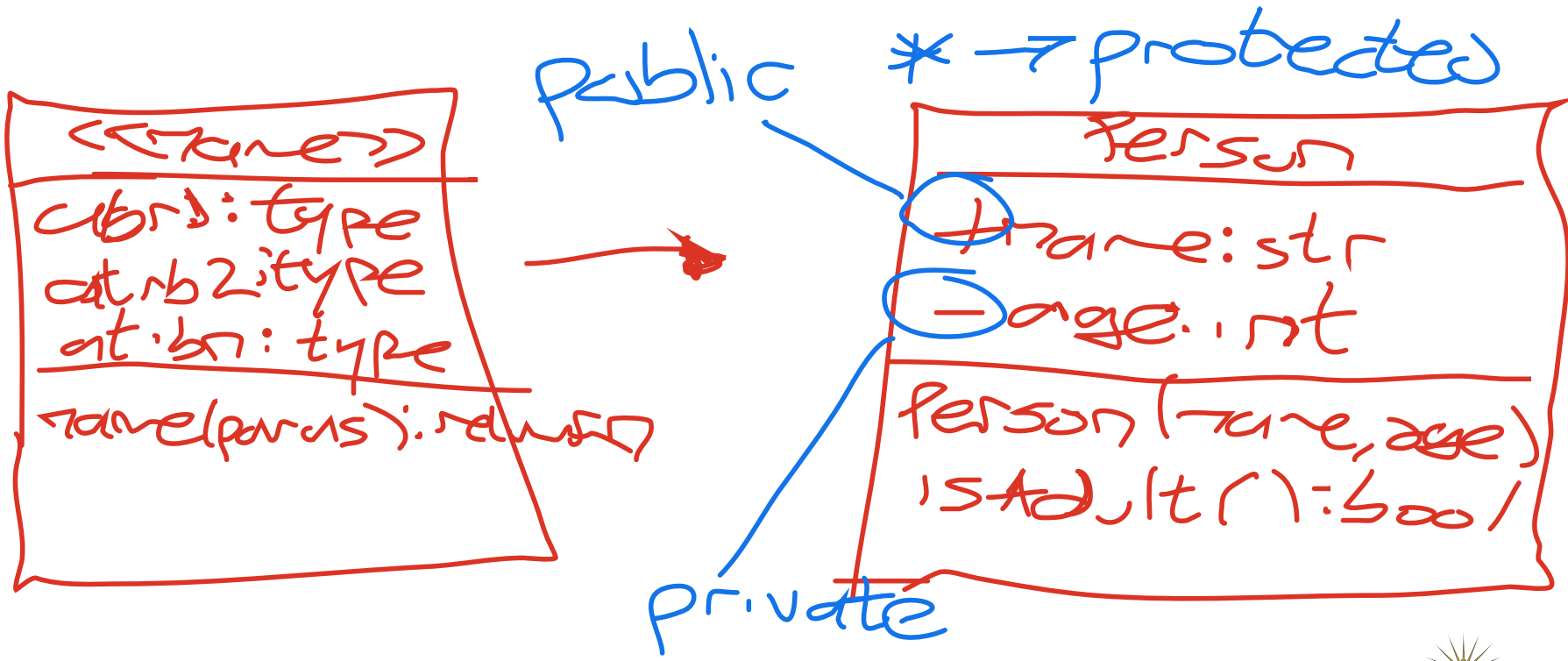
- They display **classes**, their attributes, methods, and relationships.
- Useful for both conceptual and technical design.



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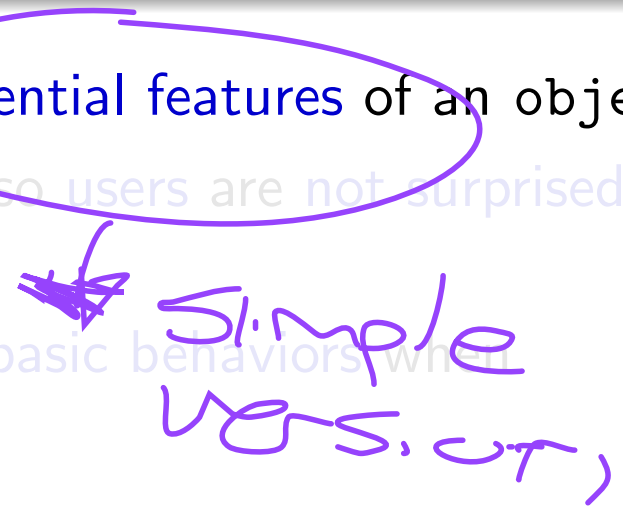
Abstraction

- **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*.



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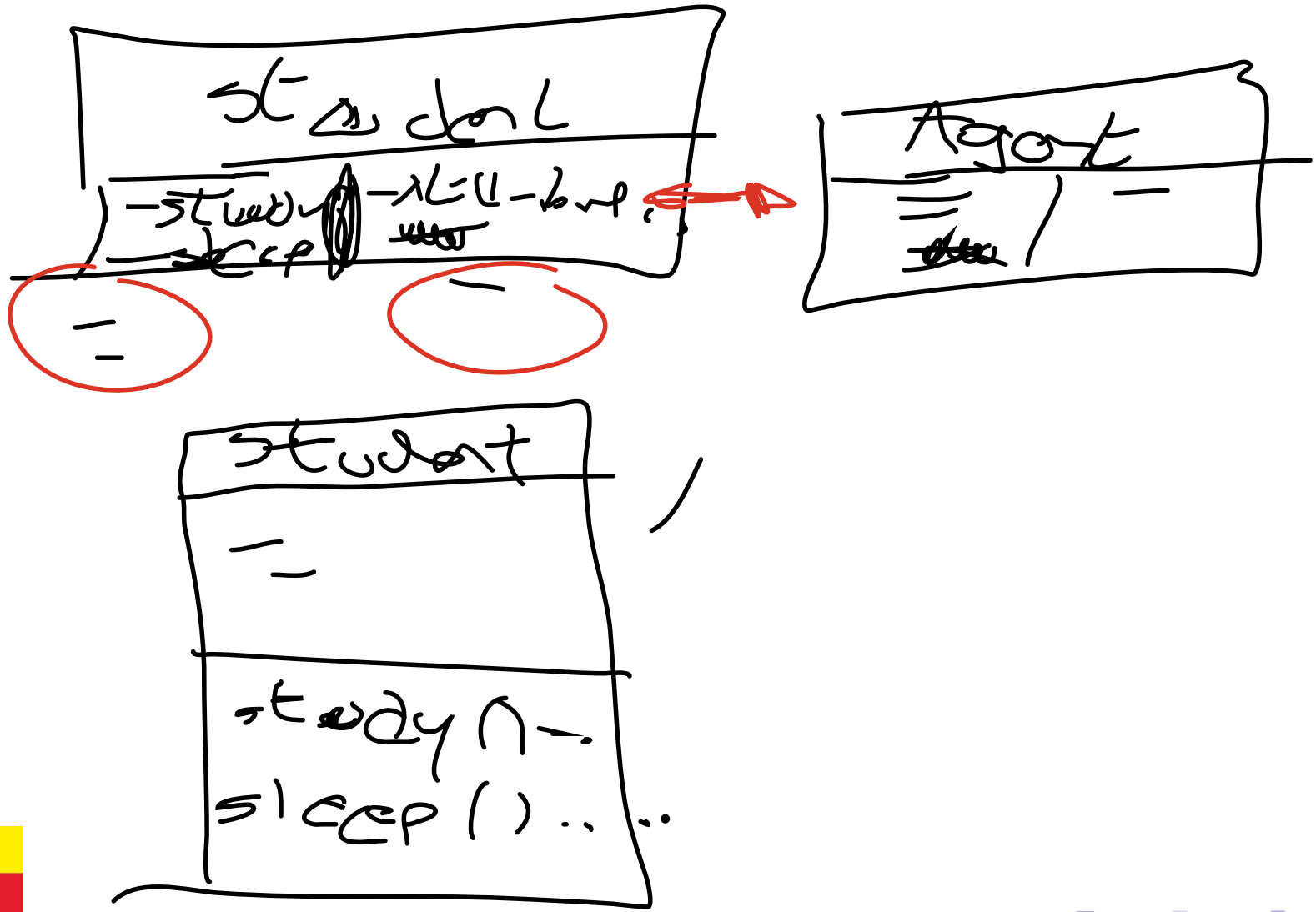
Abstraction & CRC Cards



Encapsulation

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

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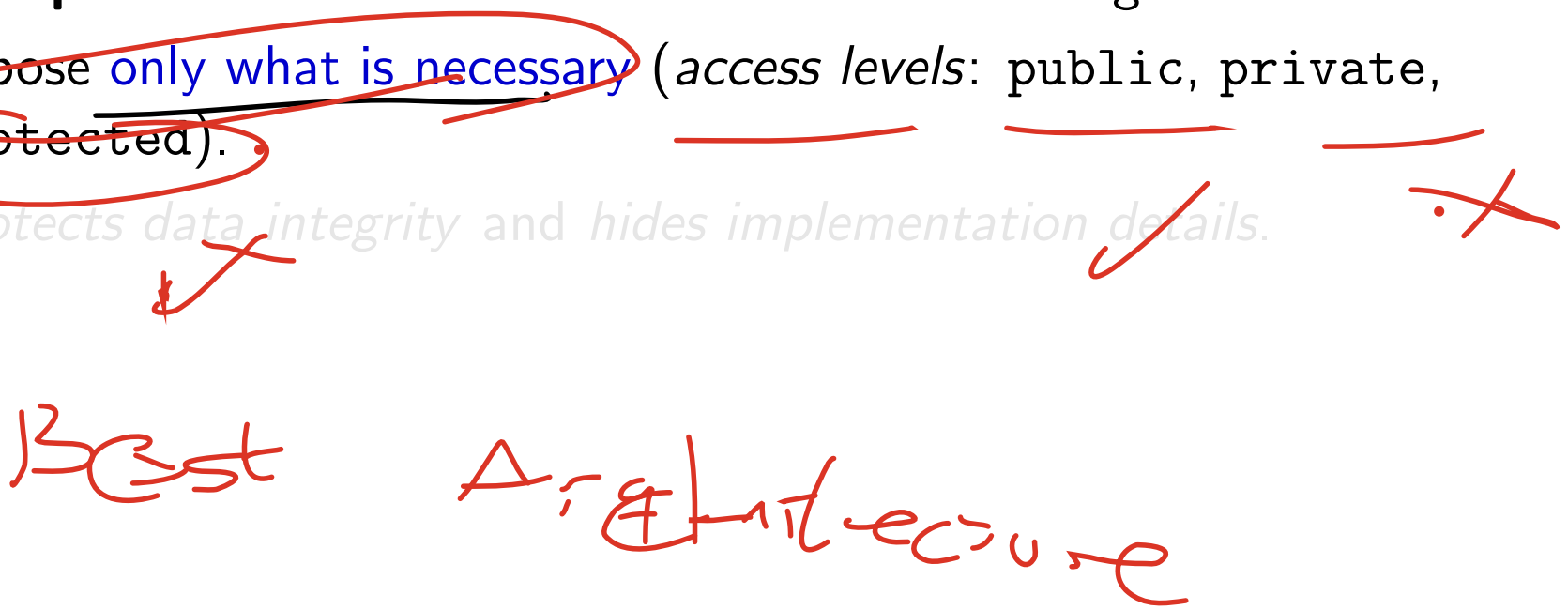

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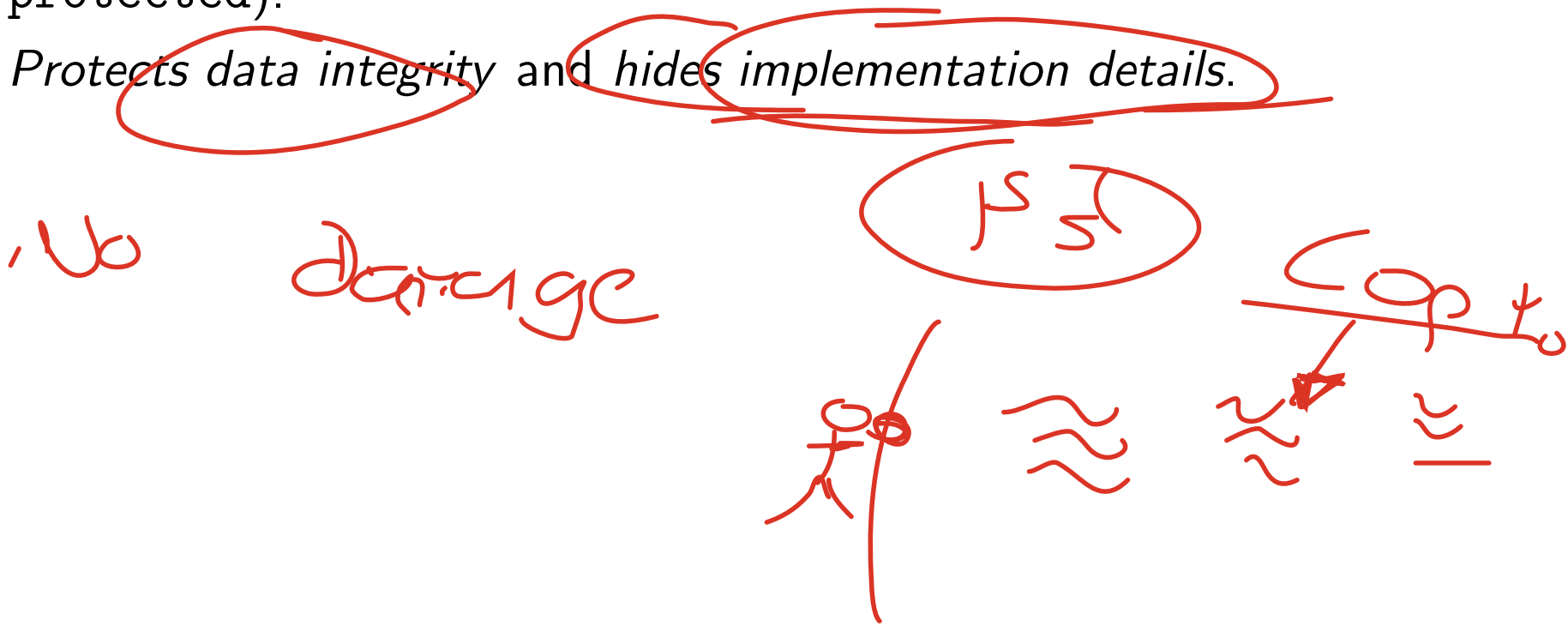
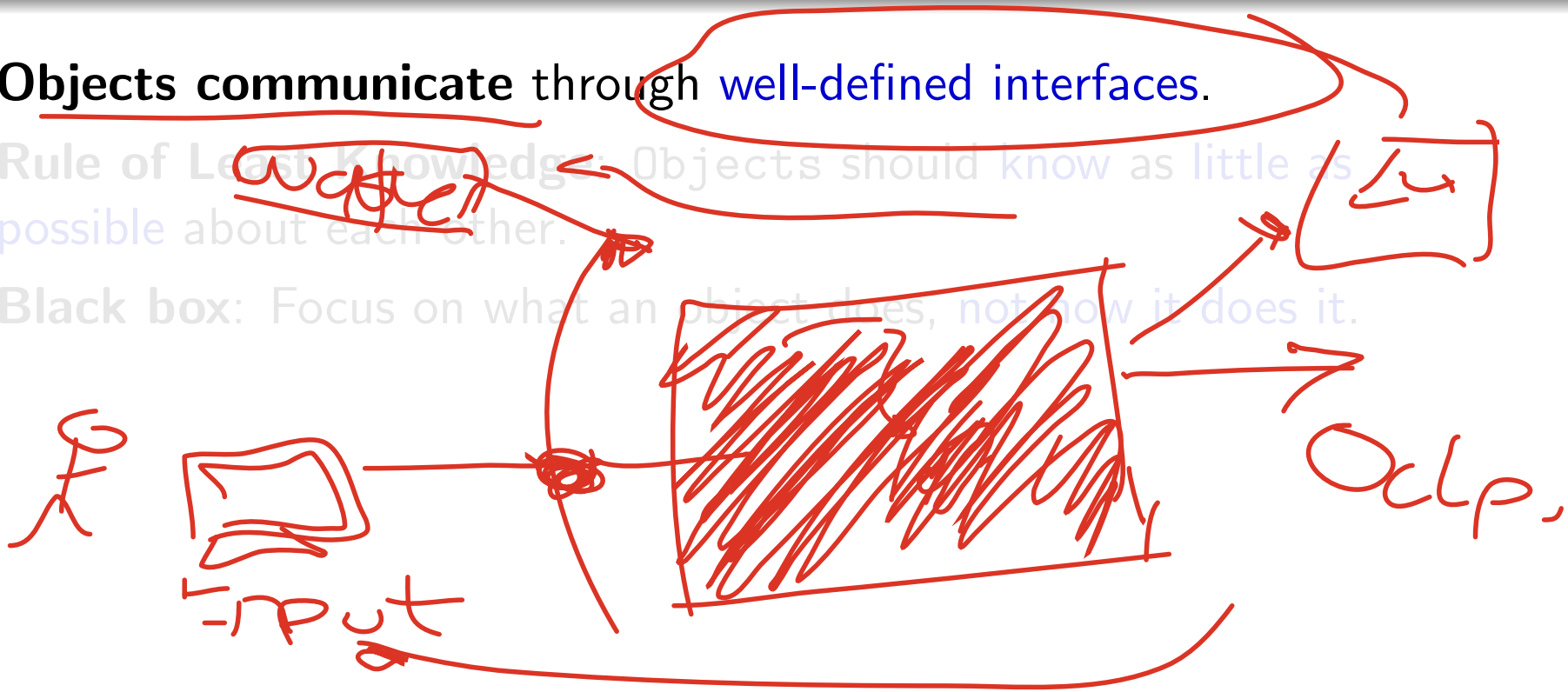


Black Box Thinking

- **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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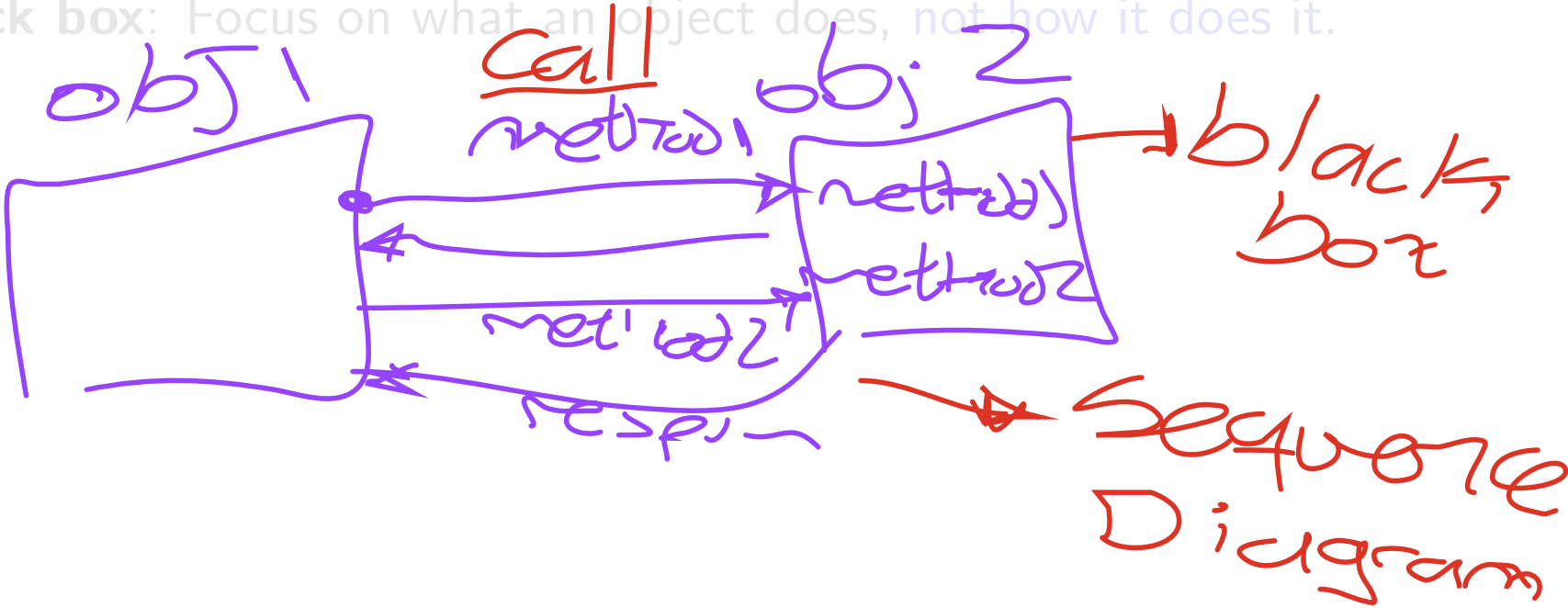

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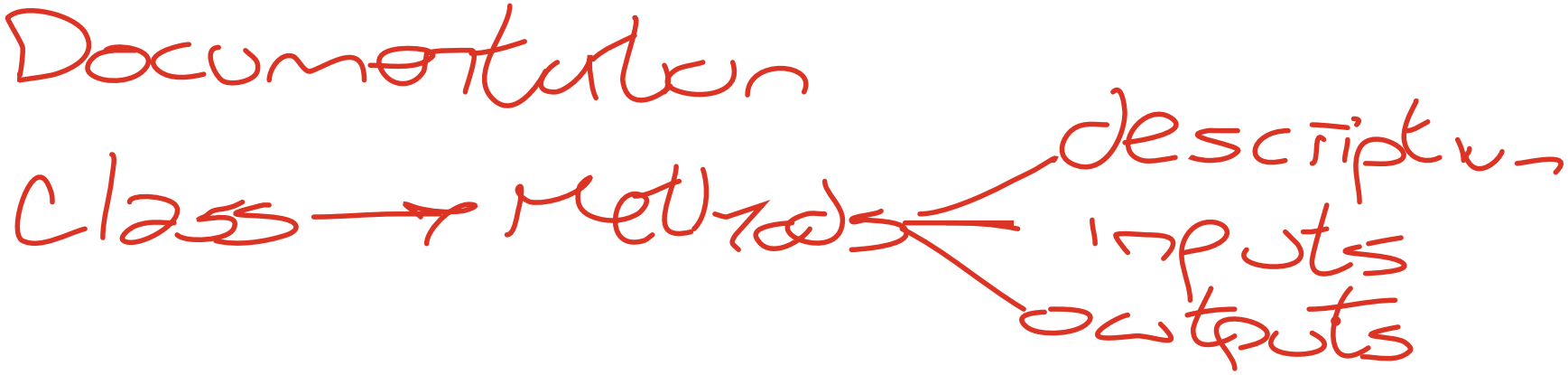

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Data Integritry: Getters and Setters

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

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

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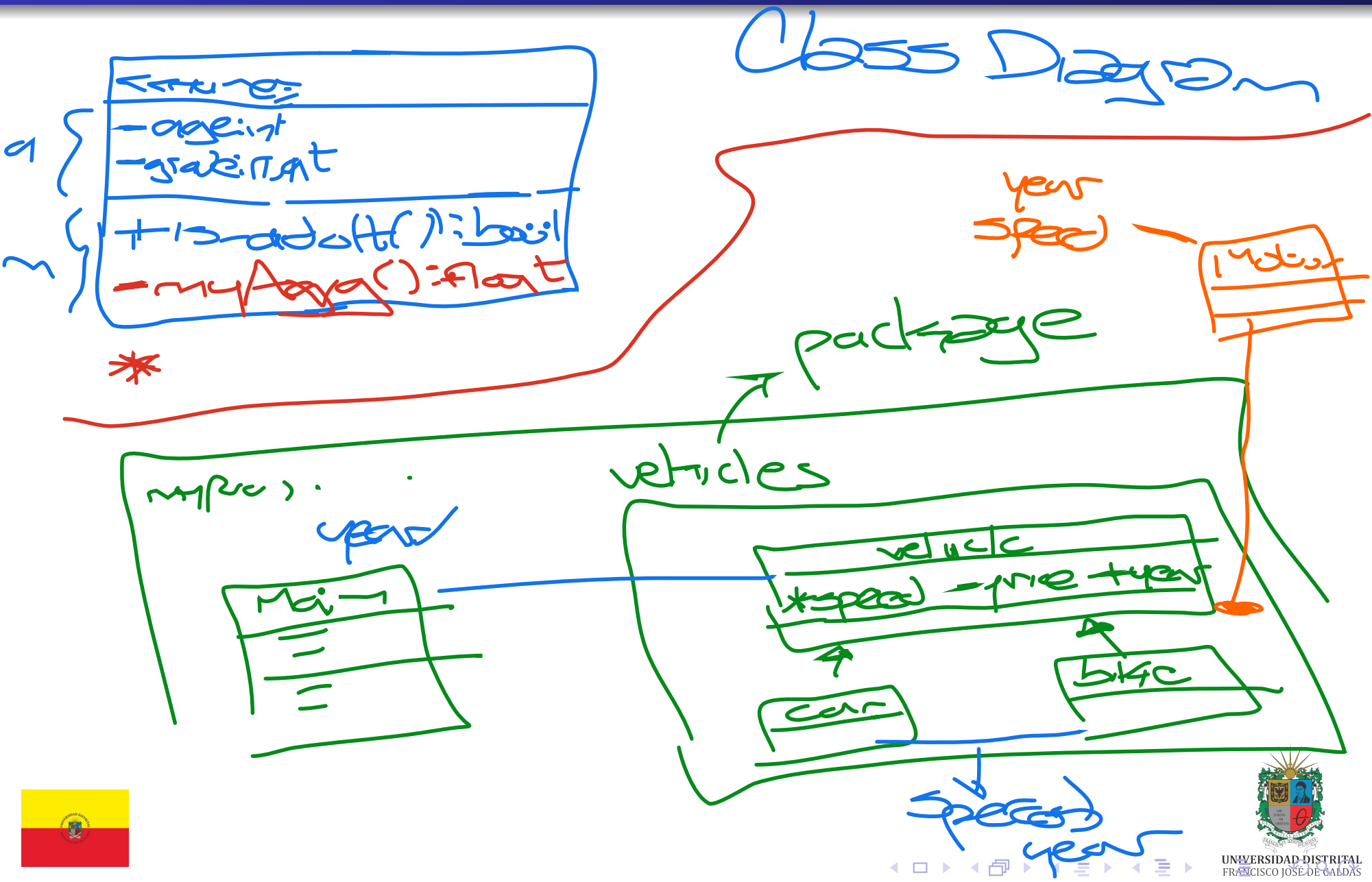
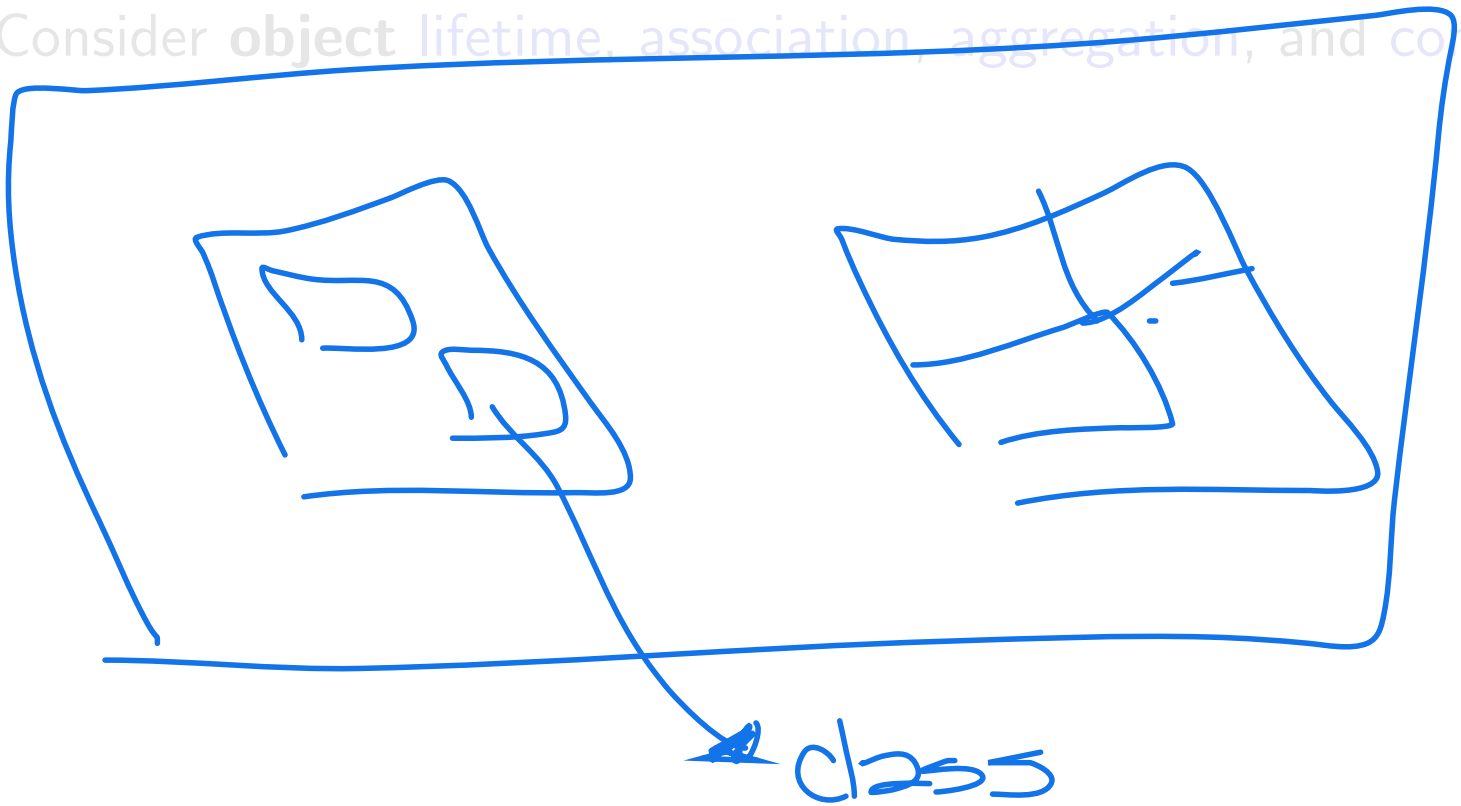
Encapsulation & UML



Decomposition

- **Decomposition**: Divide and conquer by breaking the system into smaller parts.
- **Separation of Concerns**: Each part should have a clear responsibility.
- Consider **object** lifetime, association, aggregation, and composition.



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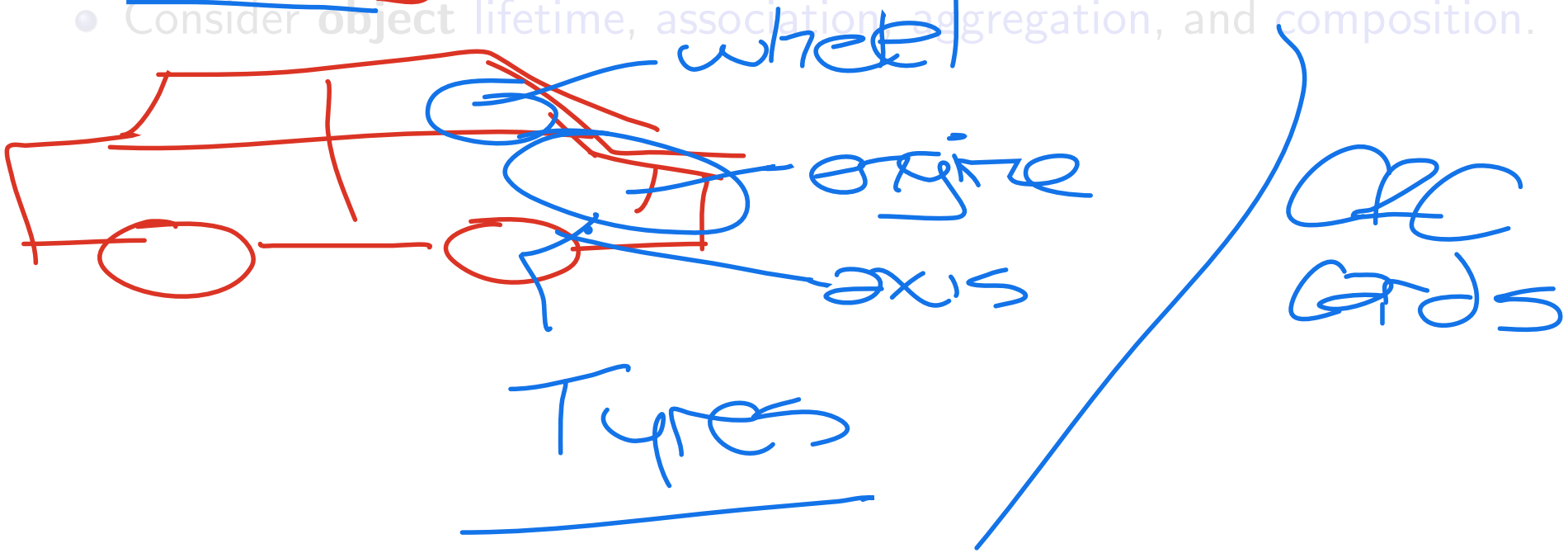

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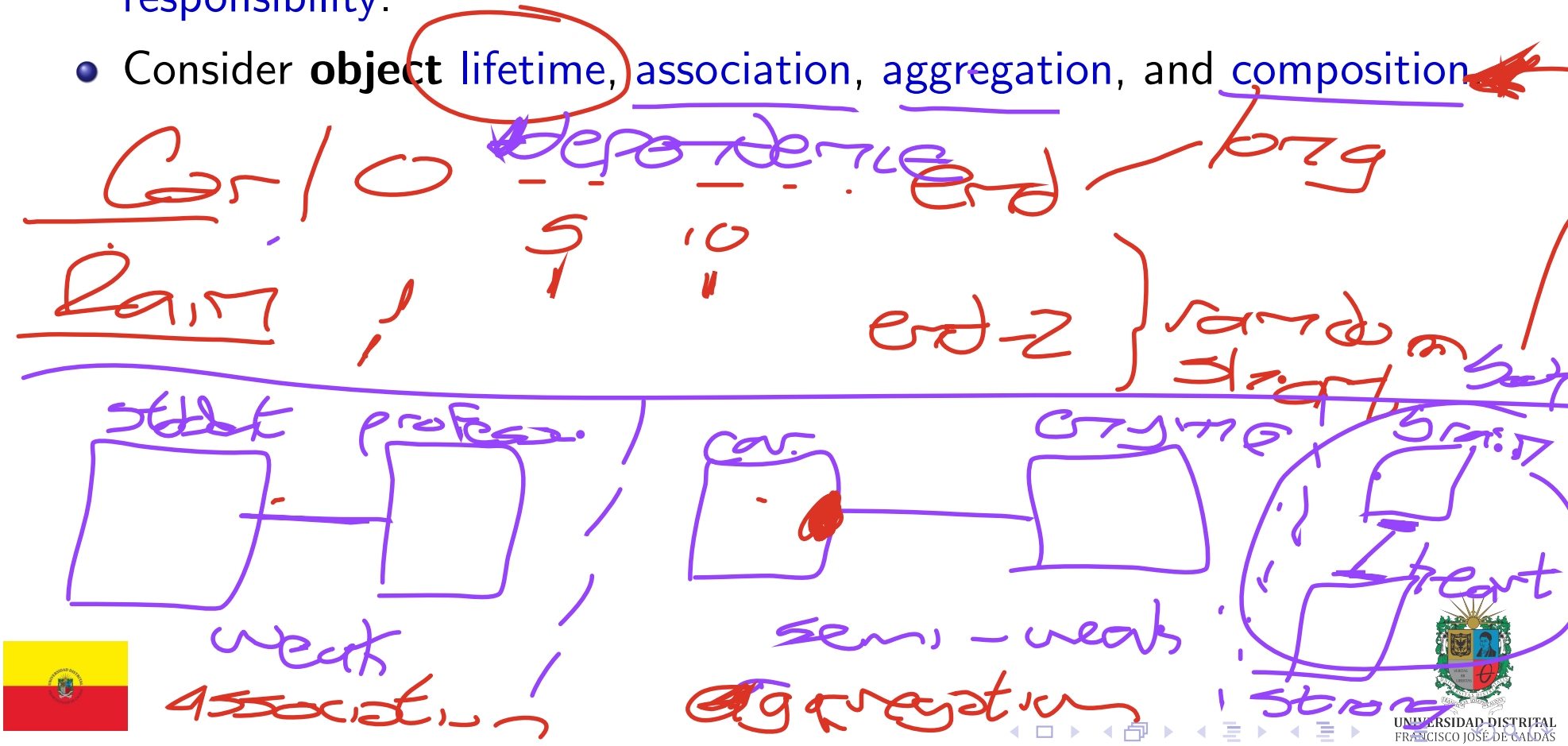
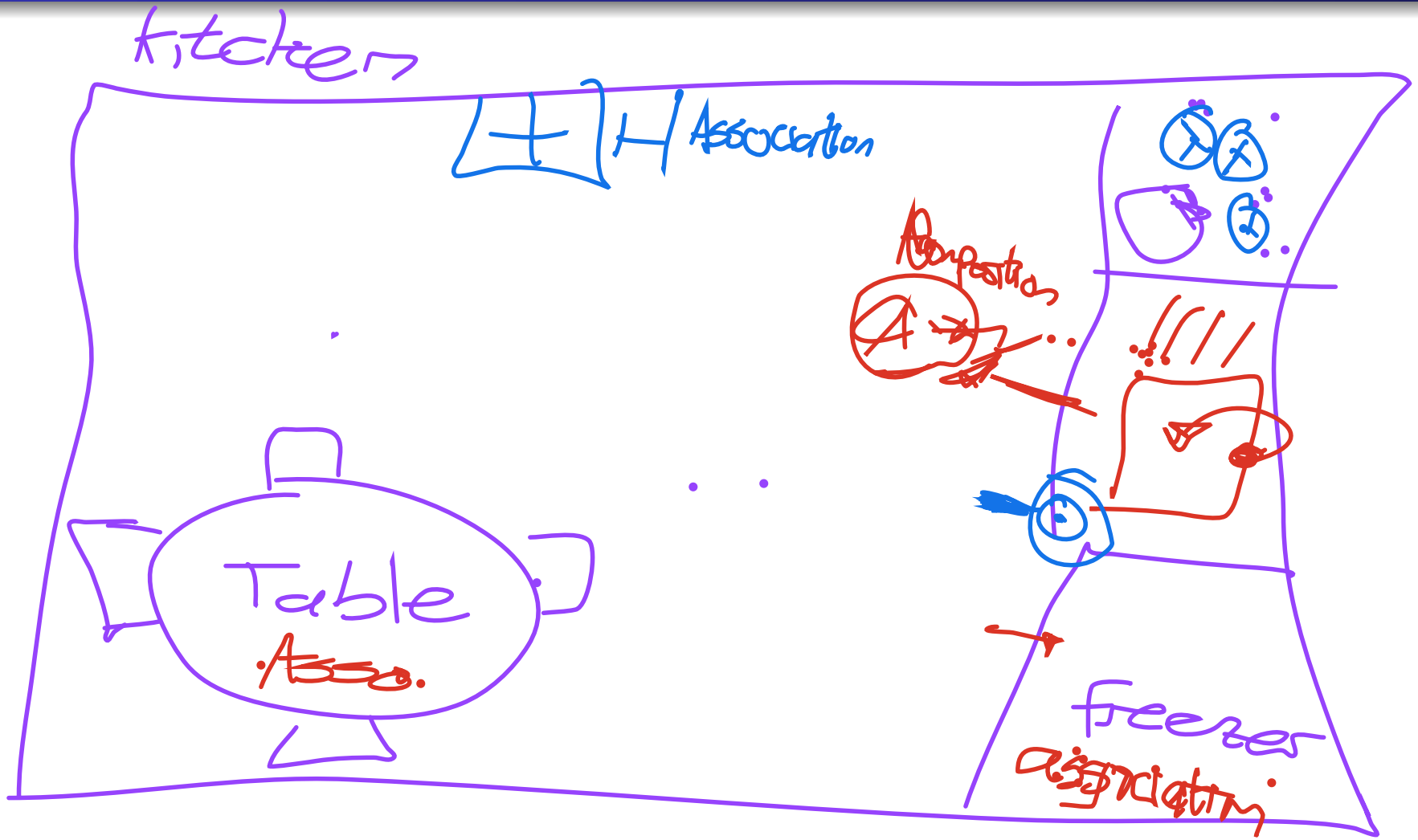
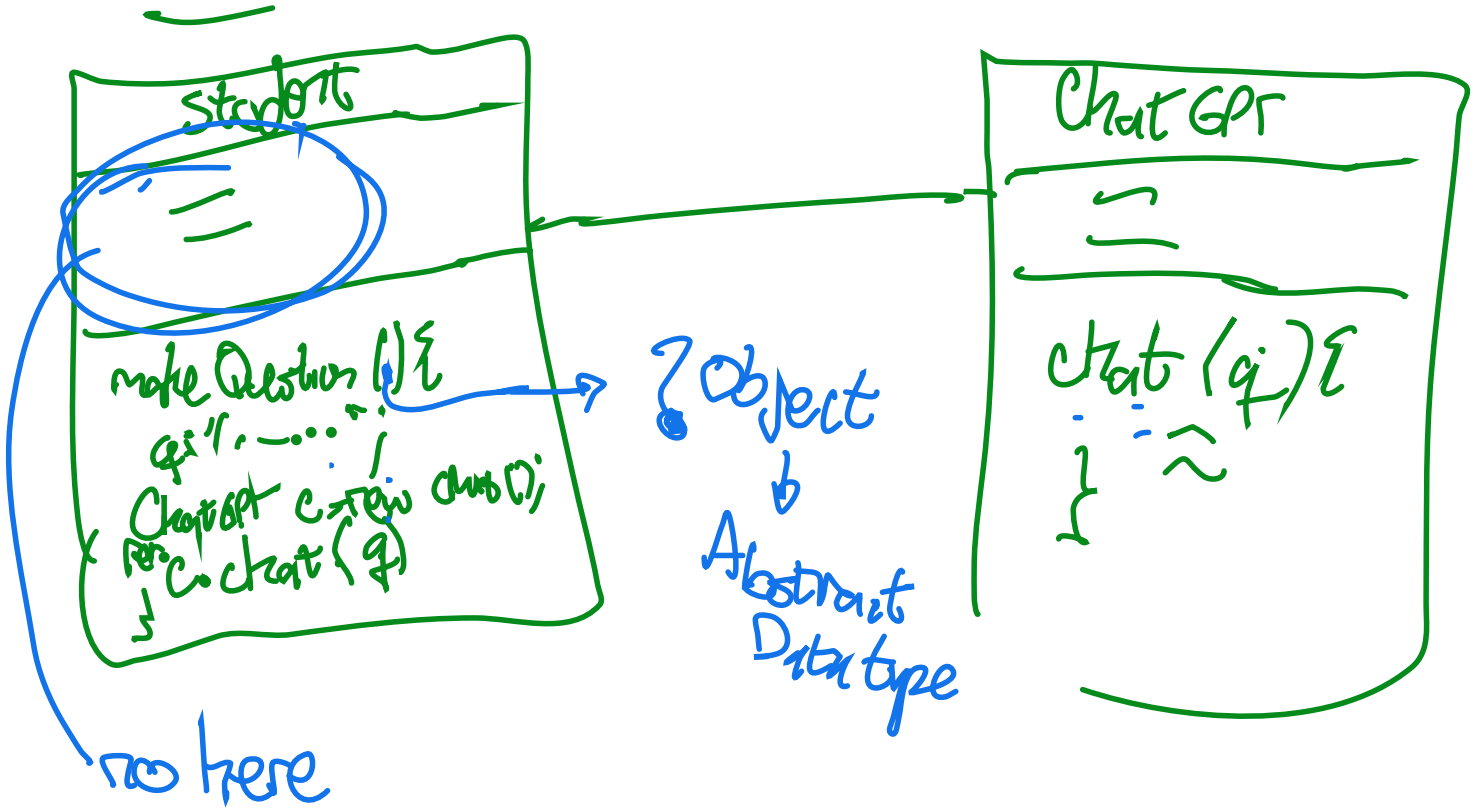


Decomposition Example: Kitchen in a House



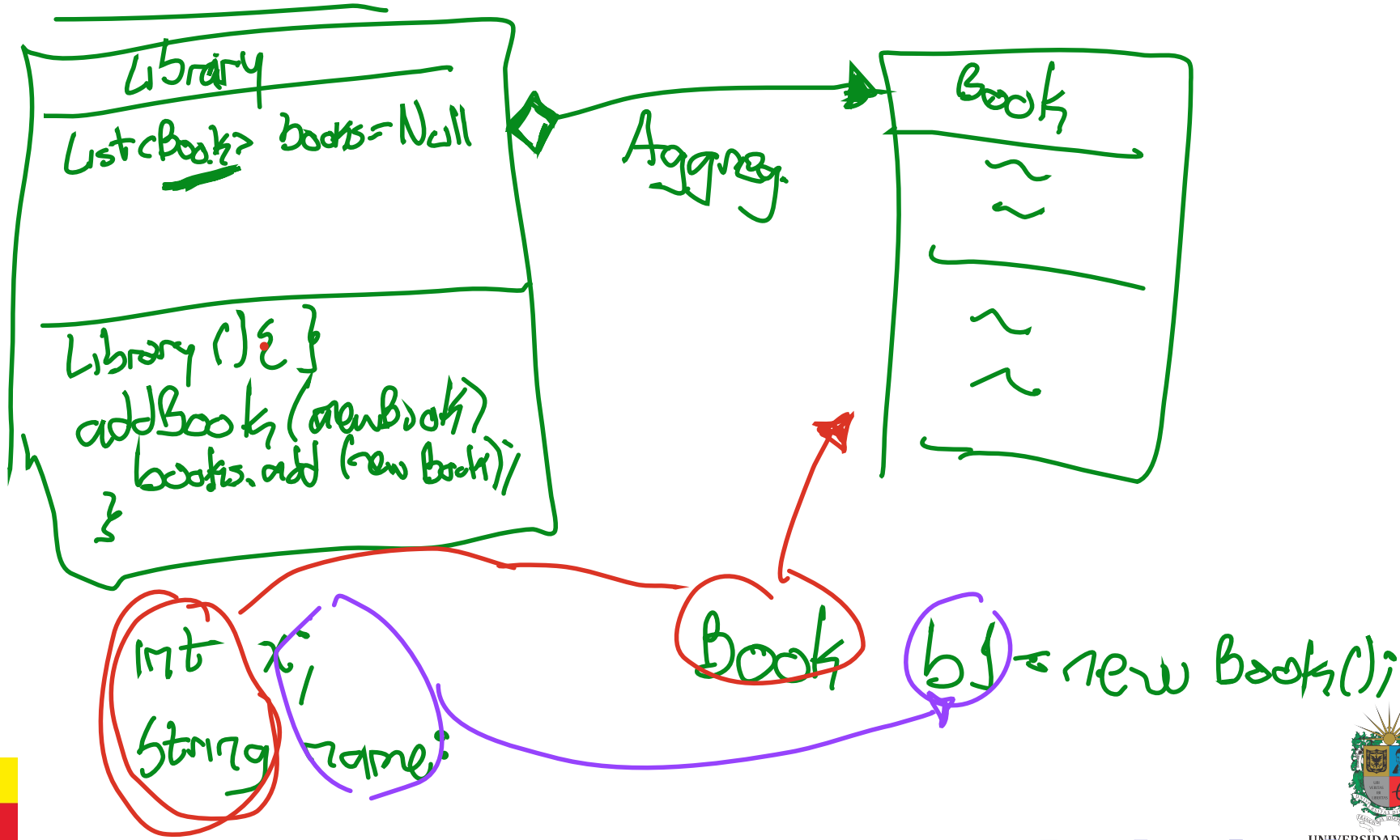
Association

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



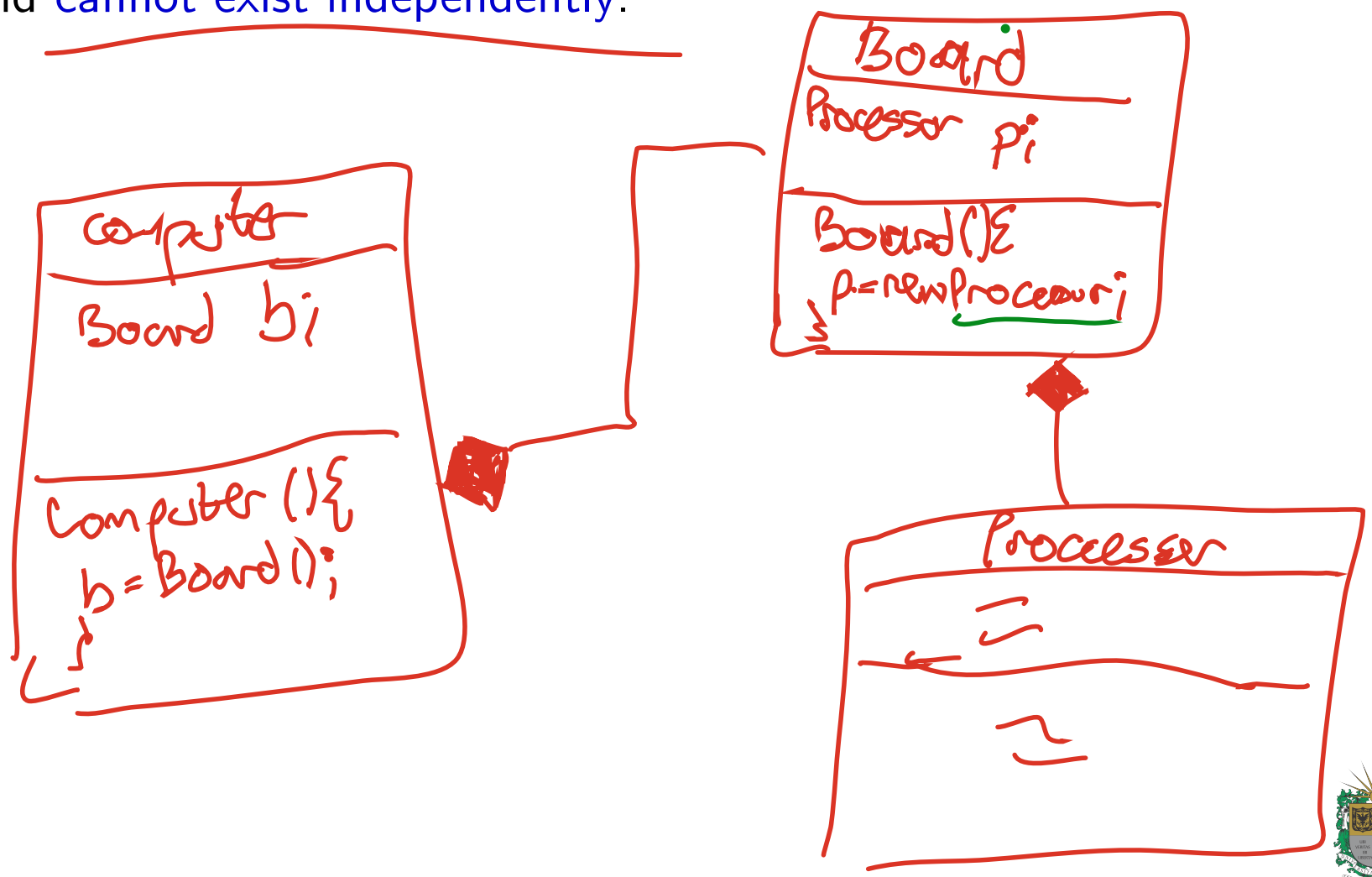
Aggregation

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



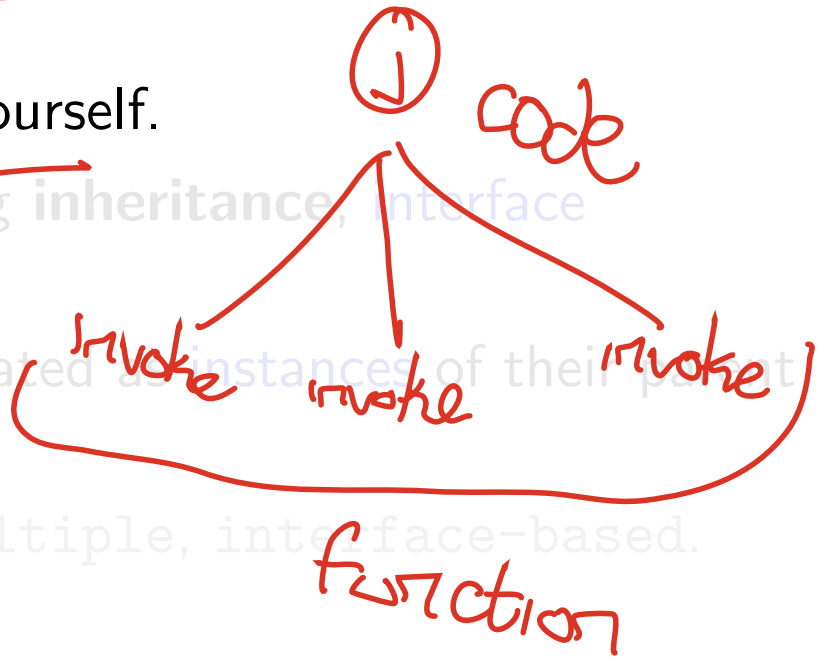
Composition

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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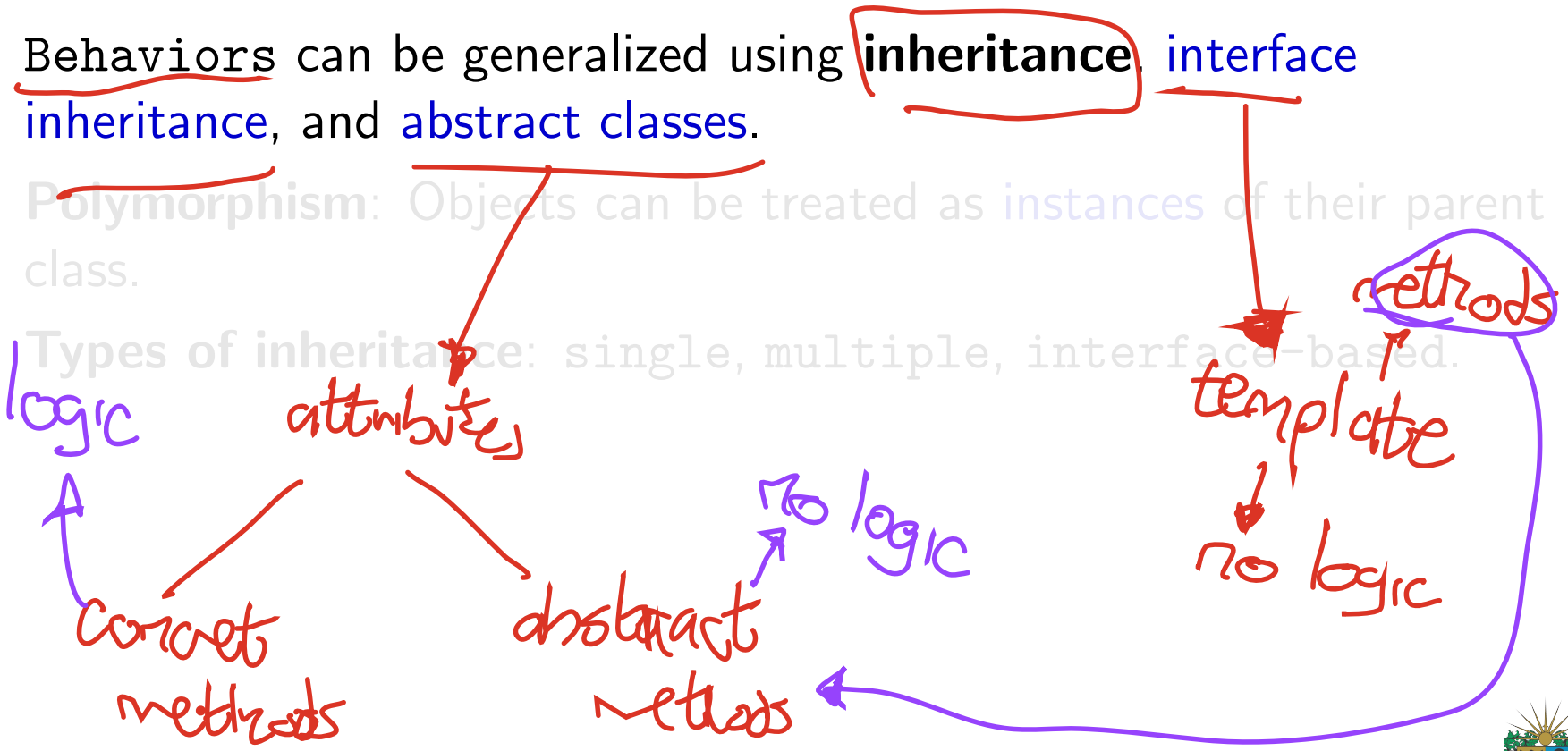

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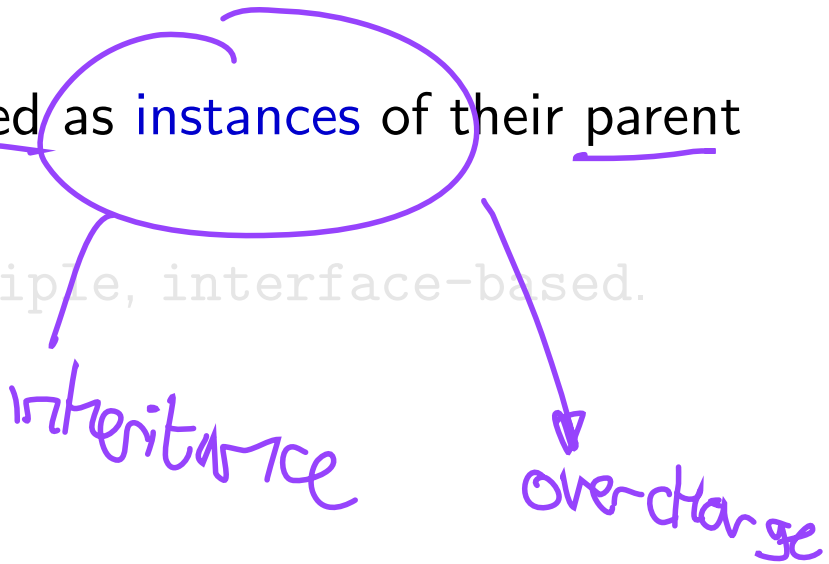

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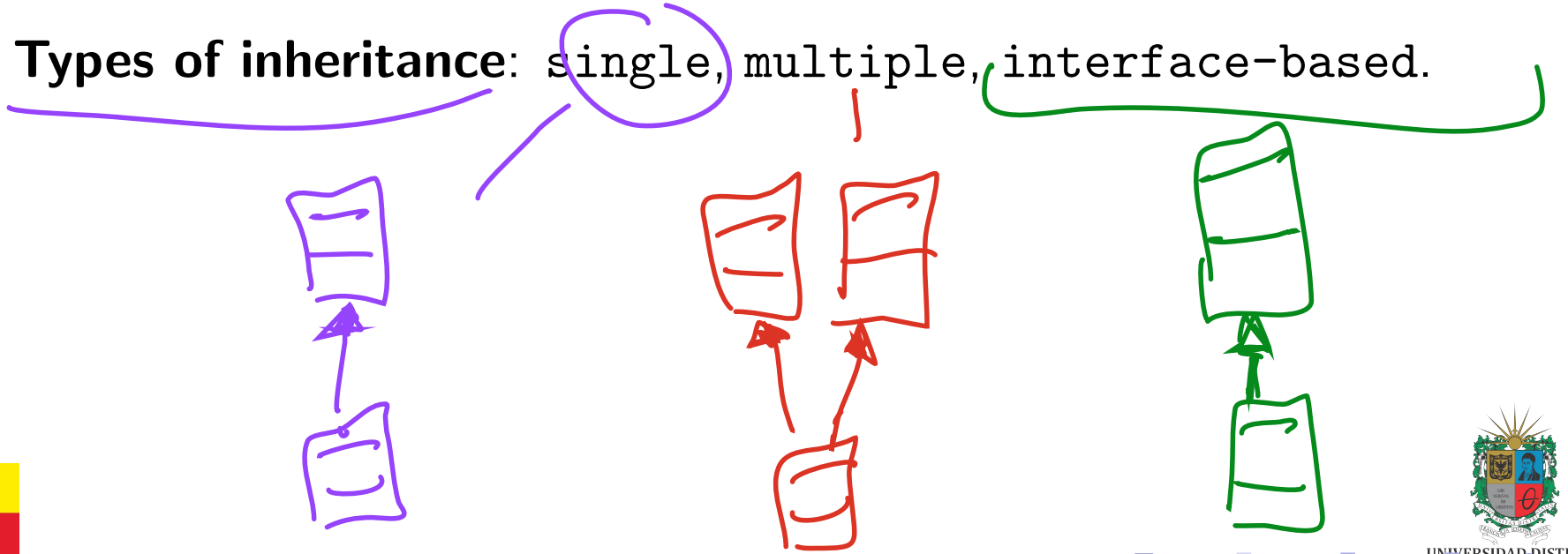

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- **Base class**: The class being inherited from.
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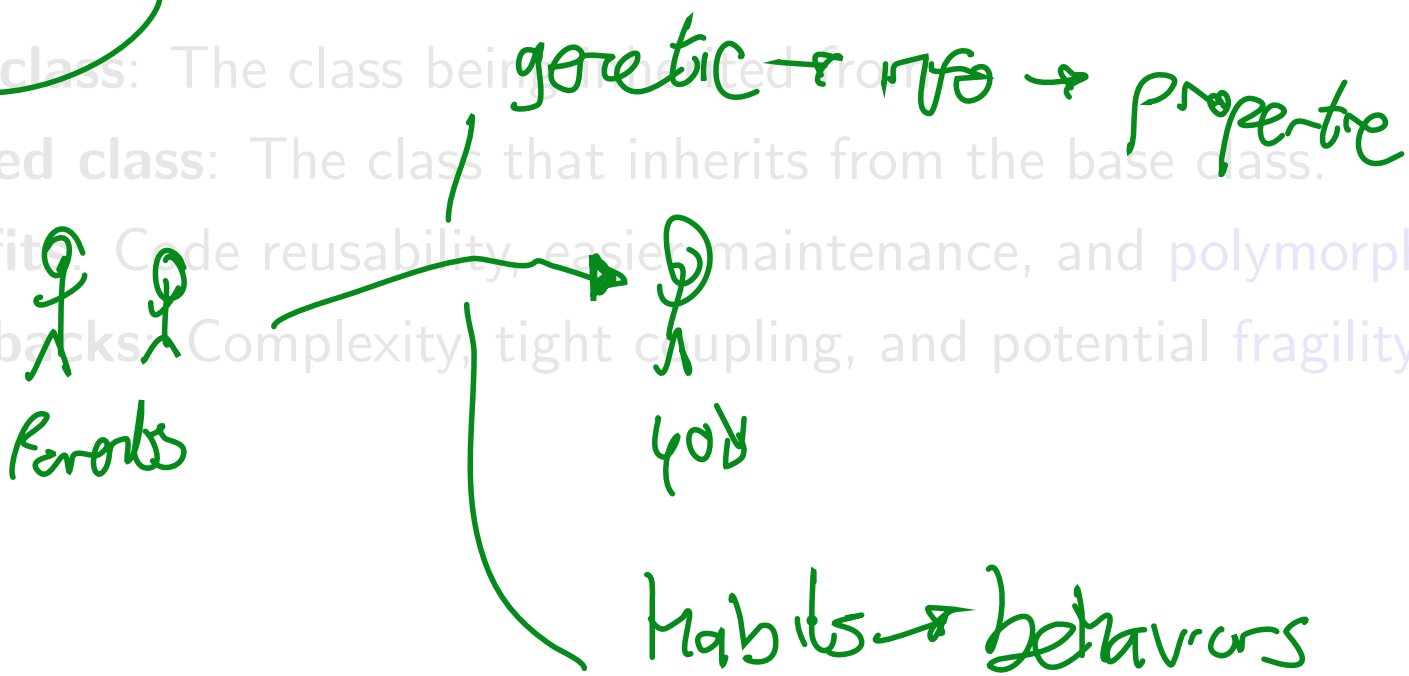

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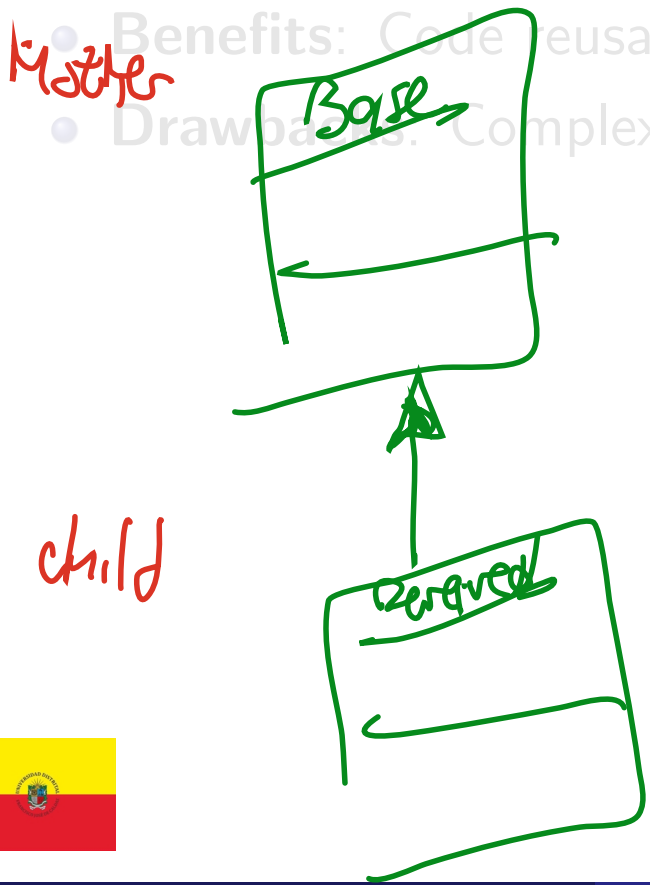

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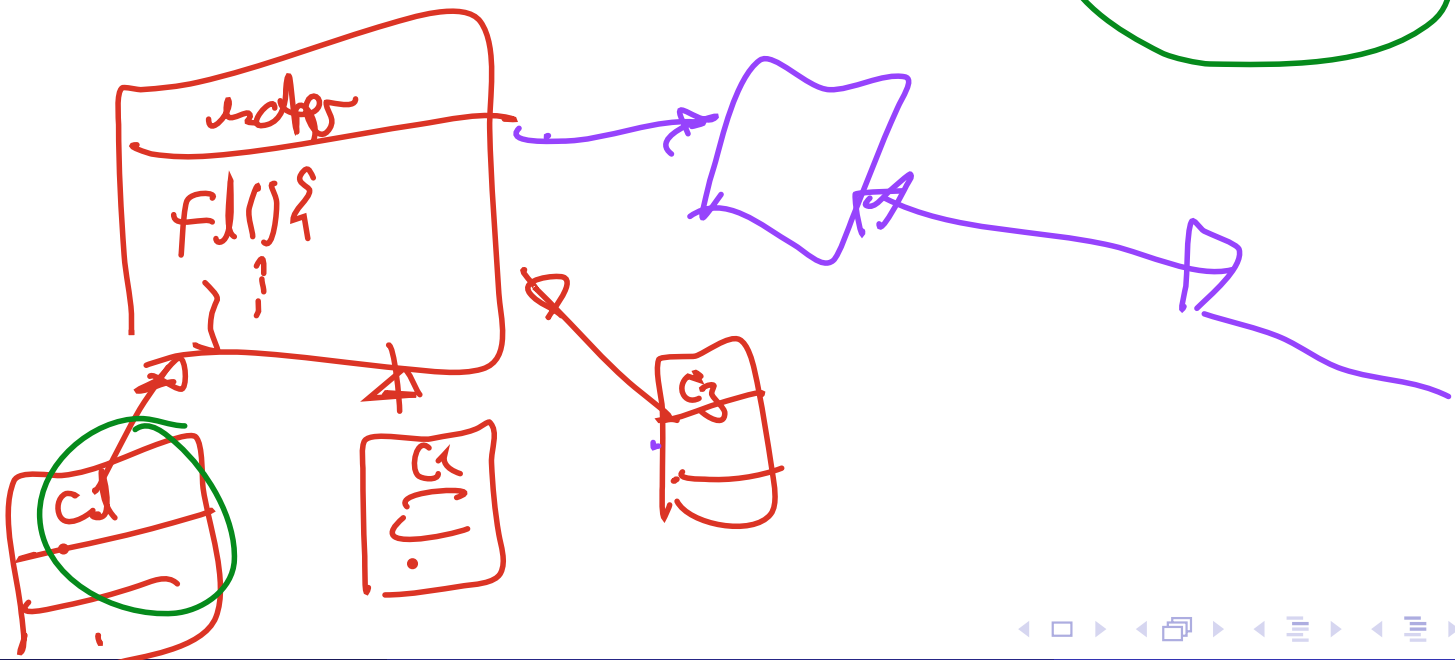
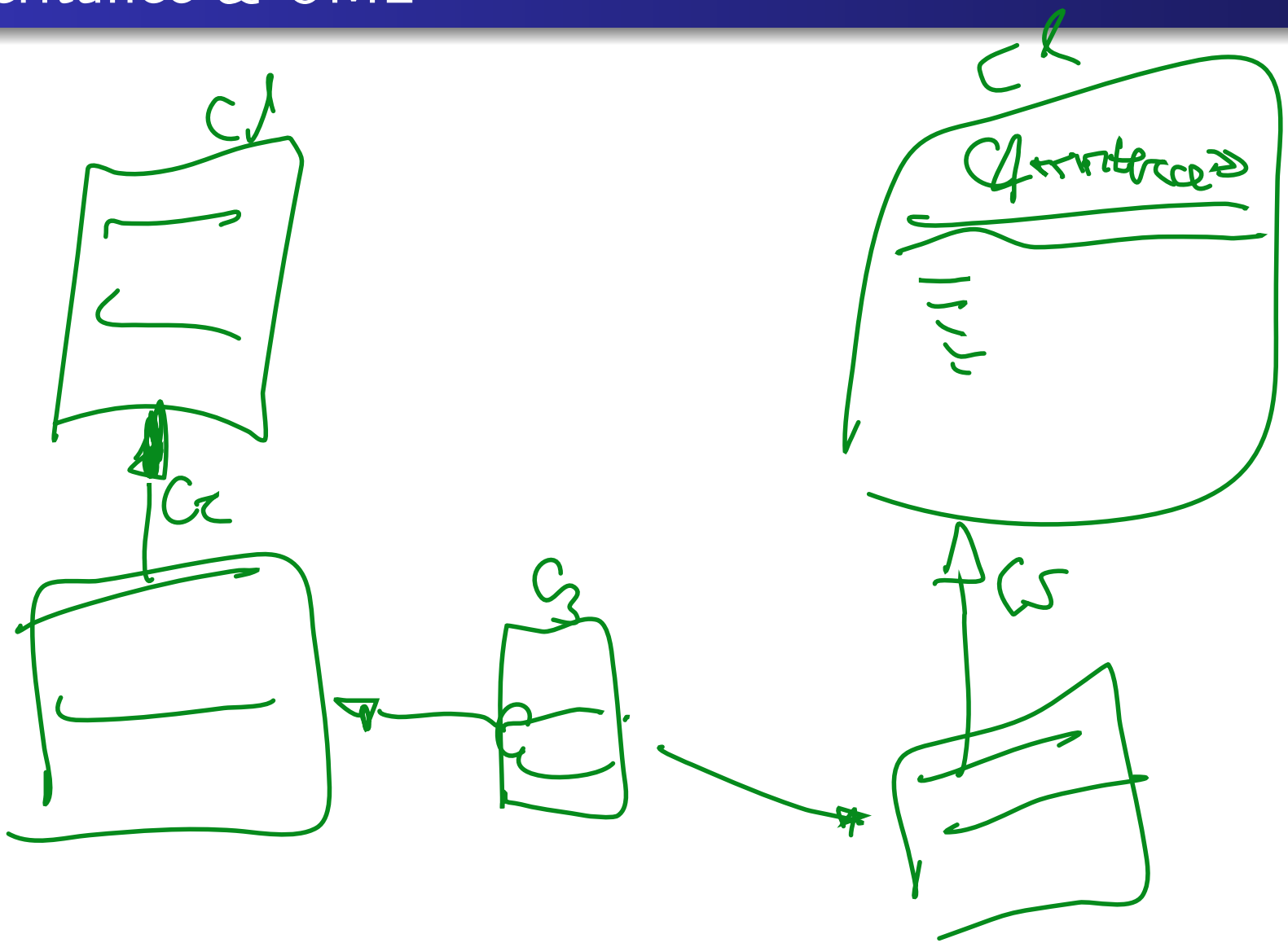


Inheritance & UML



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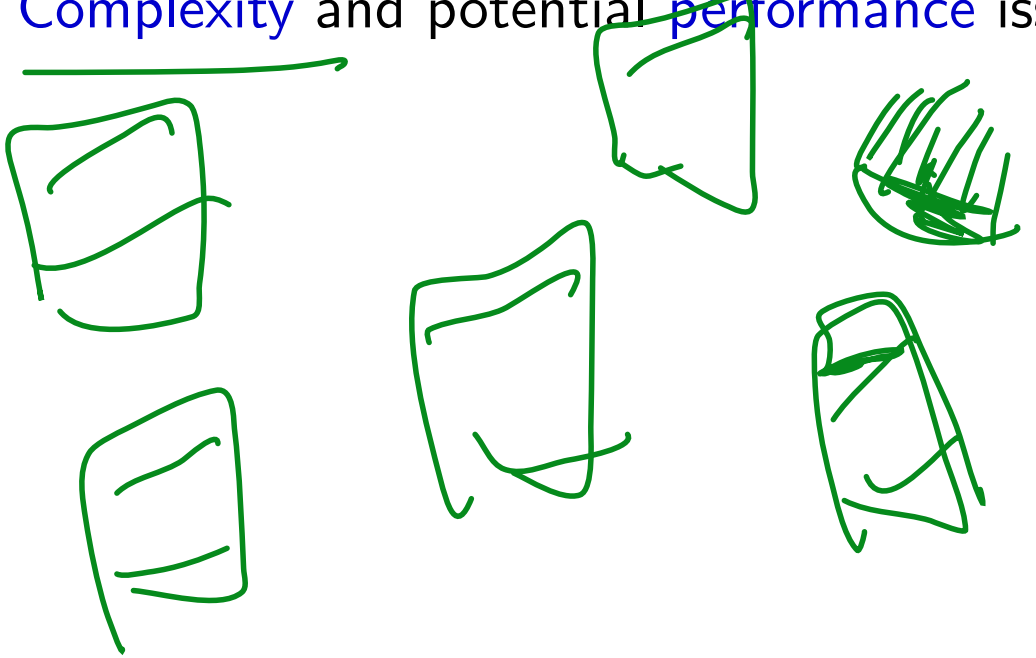

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Outline

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Thanks!

Questions?

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

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