Object-Oriented Programming

Advanced Programming

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2024-III

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Outline

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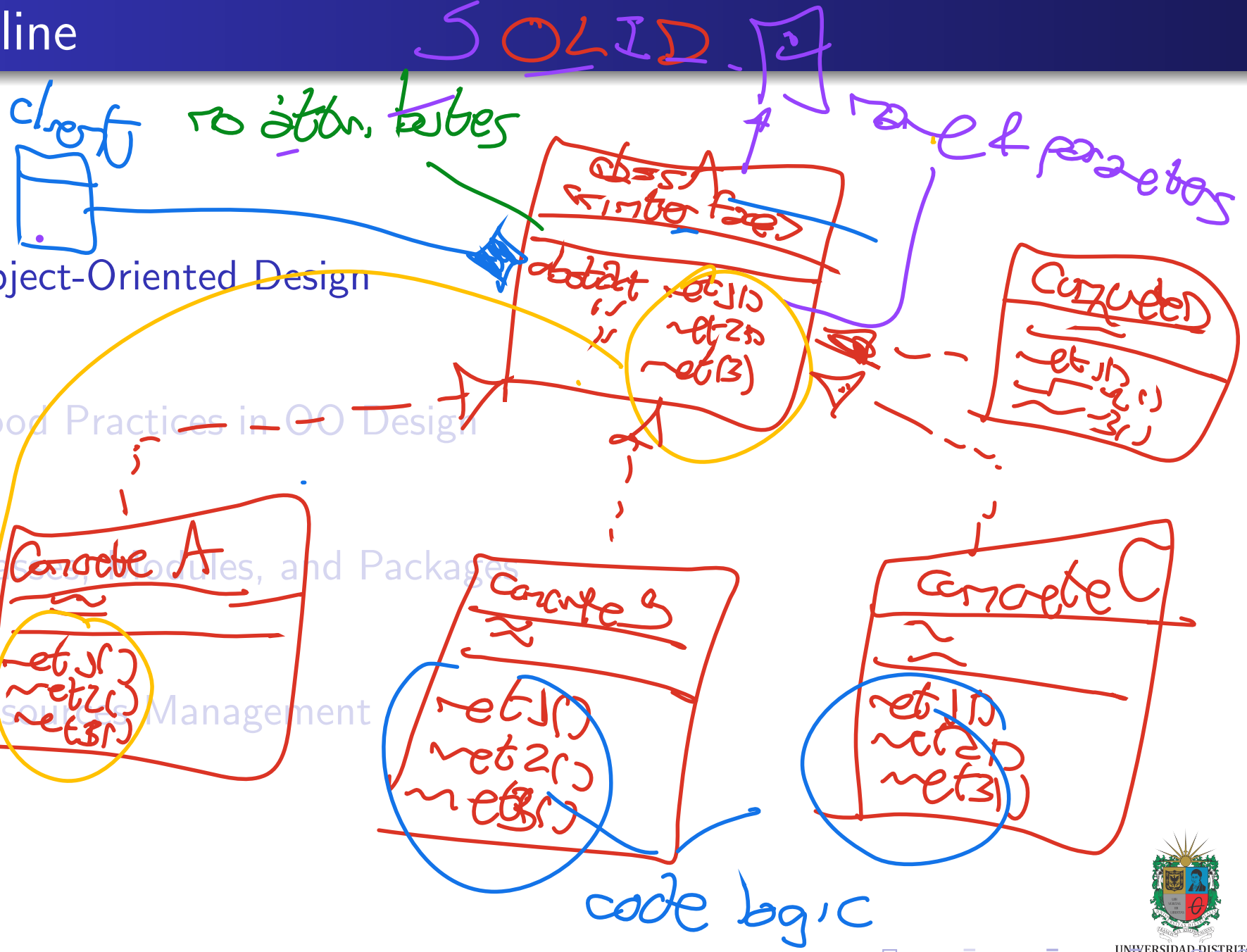
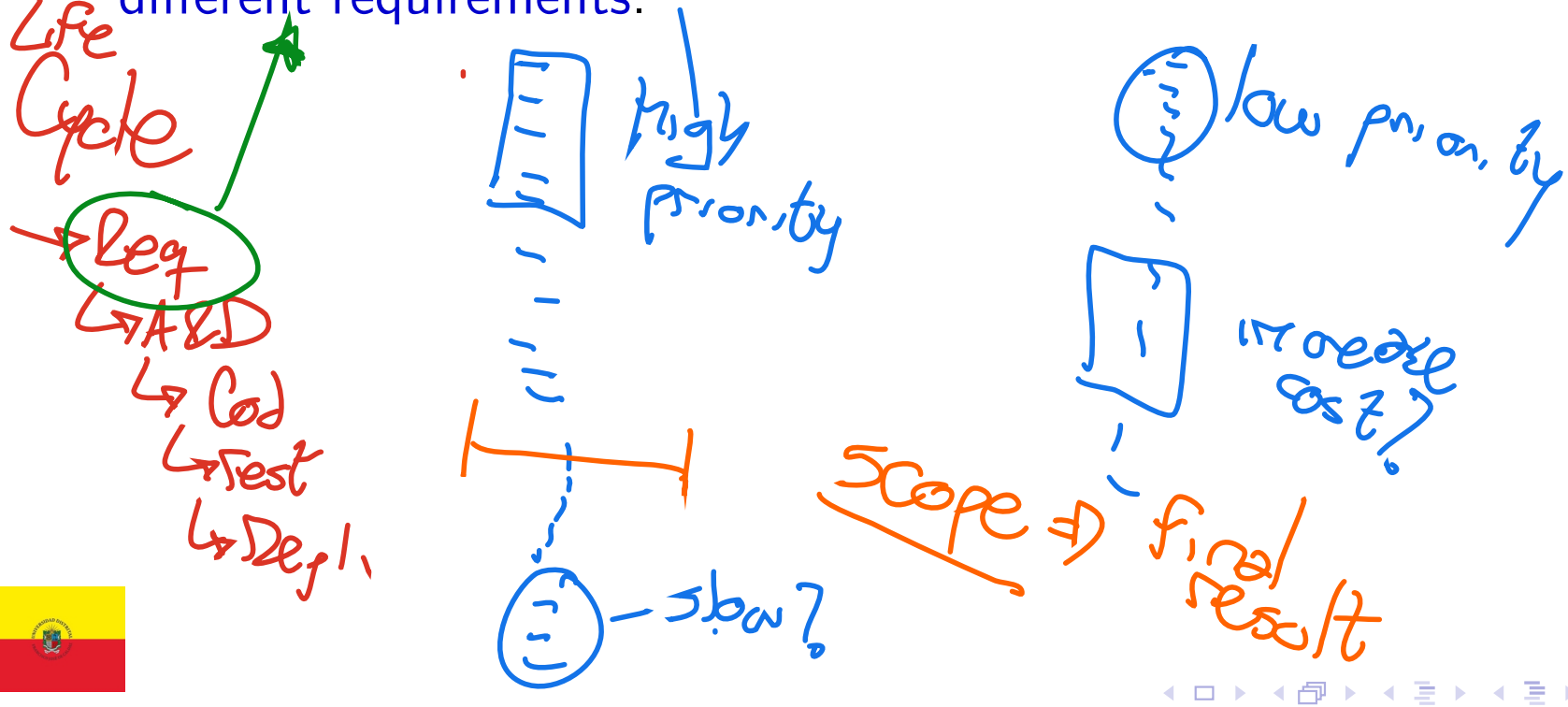


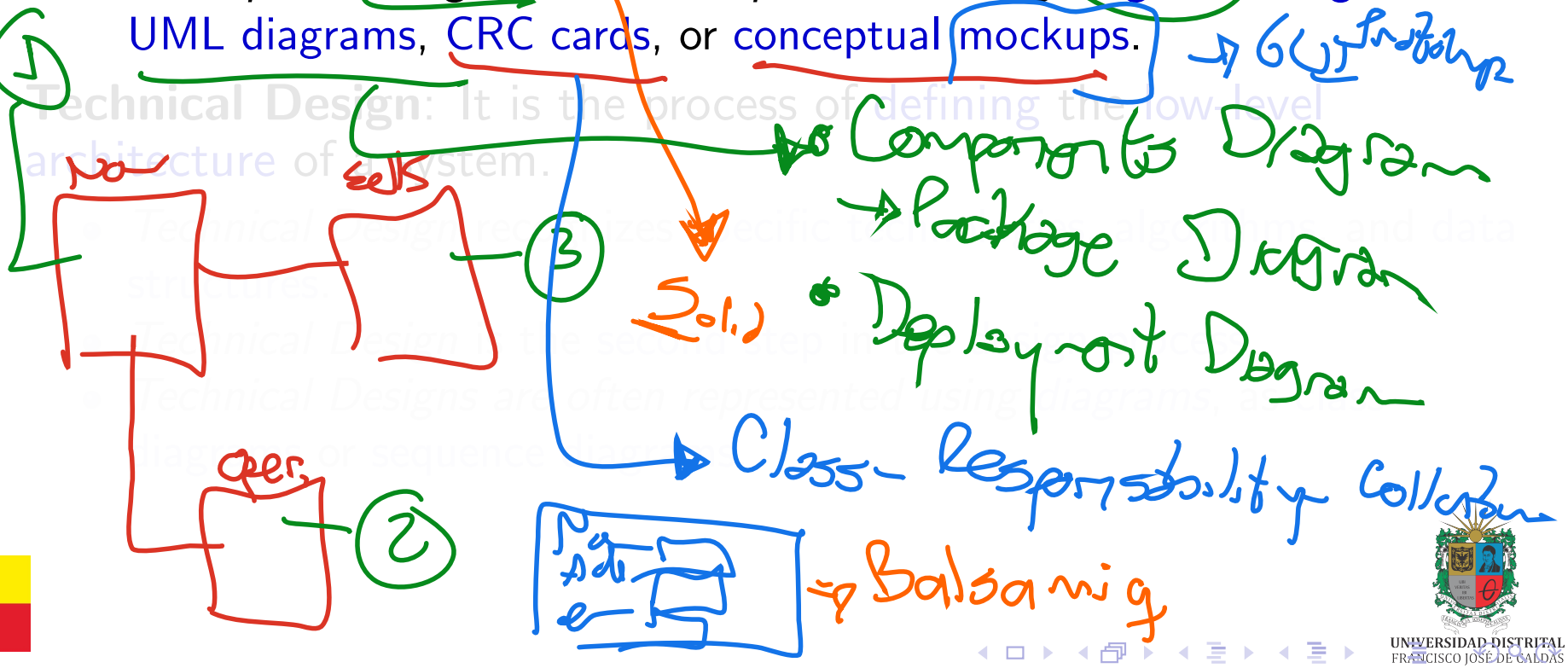
Requirements

- **Requirements Analysis**: It is the process of defining the requirements of a system.
- **Requirements**: They are the functional and non-functional specifications of a system.
- **Trade-offs**: They are the compromises that have to be made between different requirements.



Conceptual Design, Technical Design

- **Conceptual Design**: It is the process of defining the high-level architecture of a system.
  - *Conceptual Design* recognizes appropiate components, relationships, and responsabilities.
  - *Conceptual Design* is the first step in the design process.
  - *Conceptual Designs are often represented using diagrams*, as general UML diagrams, CRC cards, or conceptual mockups.



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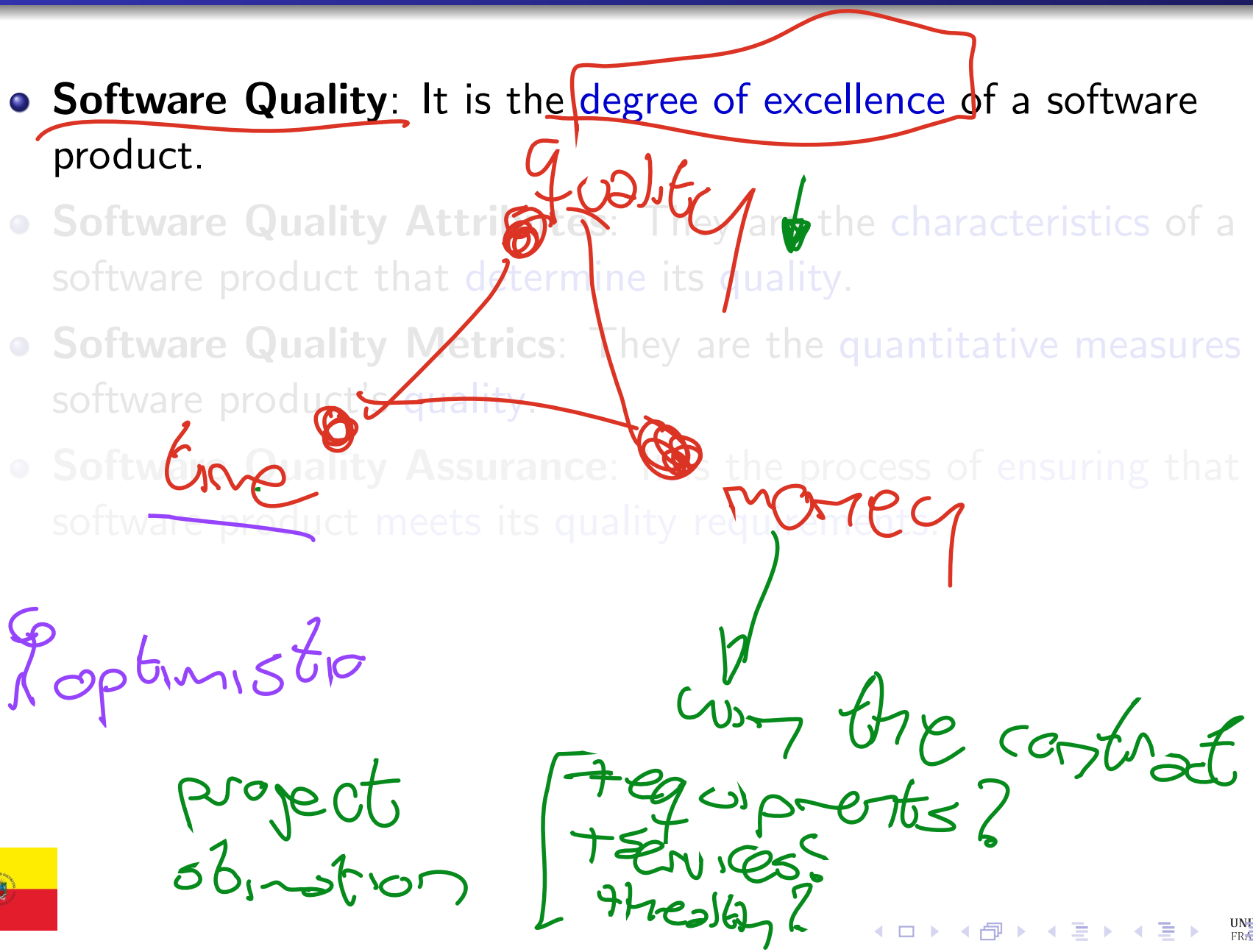
- **Technical Design**: It is the process of defining the low-level architecture of a system.
  - *Technical Design* recognizes specific technologies, algorithms, and data structures.
  - *Technical Design* is the second step in the design process.
  - *Technical Designs are often represented using diagrams*, as class diagrams or sequence diagrams.

Software Quality

- **Software Quality**: It is the degree of excellence of a software product.
- **Software Quality Attributes**: They are the characteristics of a software product that determine its quality.
- **Software Quality Metrics**: They are the quantitative measures of a software product's quality.
- **Software Quality Assurance**: It is the process of ensuring that a software product meets its quality requirements.



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CRC Cards

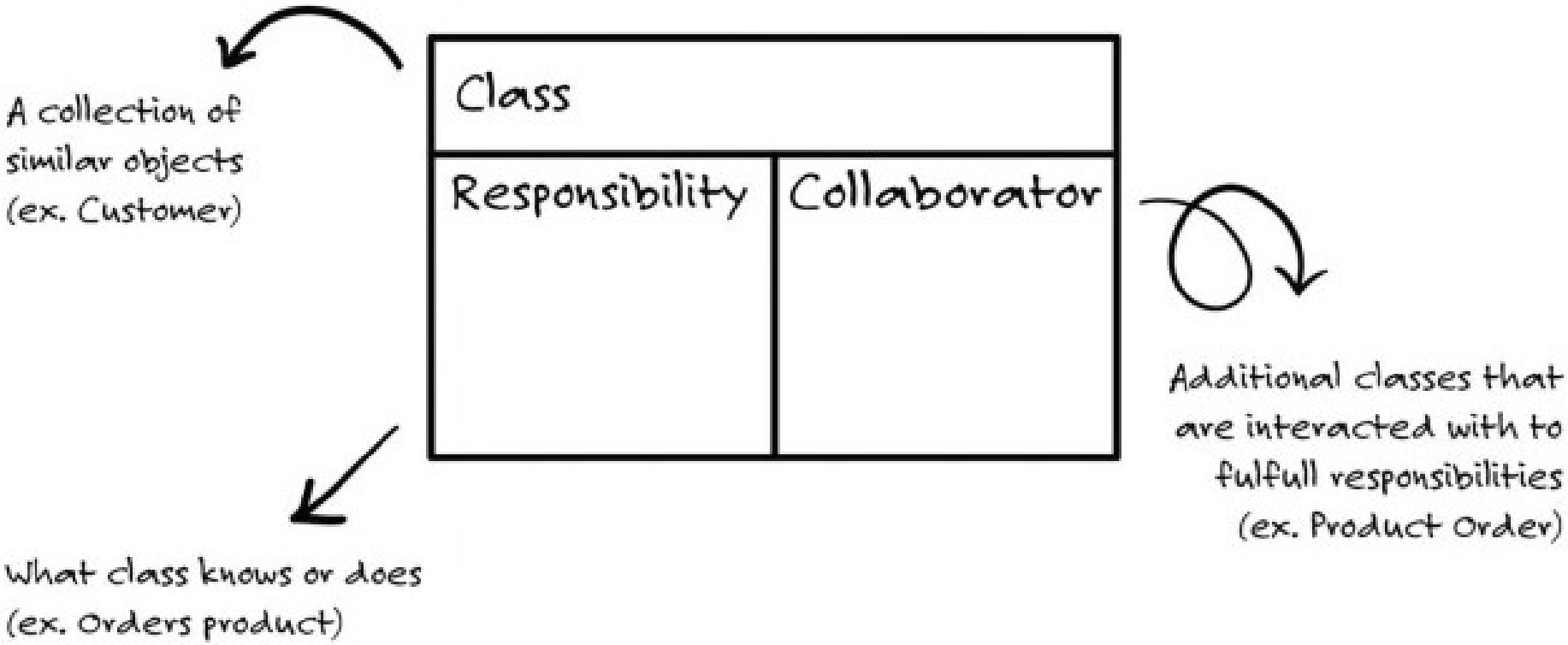

Figure: Prompt: Easy way to design with Classes & Objects.

Basics of Object-Oriented Design I

- **Object-oriented** has become one of the most traditional and popular **paradigms** in software development.
- It is based on the concept of **objects**, which can contain data, in the form of **fields** (often known as attributes or properties), and code, in the form of **procedures** (often known as methods).

Figure: Prompt: Draw several objects sorted by size.

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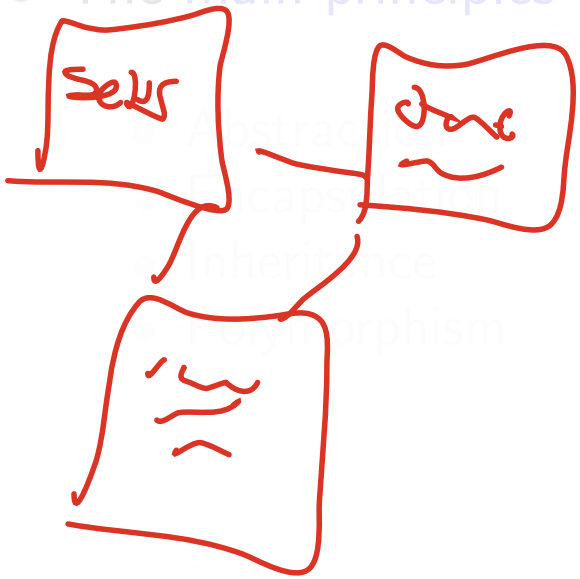
Figure: Prompt: Draw several objects sorted by size.

Basics of Object-Oriented Design II

Figure: Prompt: Draw several objects sorted by size.

- The idea is to design a **system modularly**, and to make it easier to maintain, and to understand. Also the idea is emphasize the reuse of code.
- The main principles of OOD are:
  - Abstraction
  - Encapsulation
  - Inheritance
  - Polymorphism



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Objects Categories

- **Concrete Objects**: They are objects that can be instantiated.
- **Abstract Objects**: They are objects that cannot be instantiated.
- **Active Objects**: They are objects that can perform actions.
- **Passive Objects**: They are objects that store data.
- In general, there are three types of objects in **OOD**:
  - Entity Objects: They represent persistent information, such as the problem space.
  - Boundary Objects: They represent the interface between the system and the external world.
  - Control Objects: They represent the control of the system.

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→ DB connection

→ APIs external

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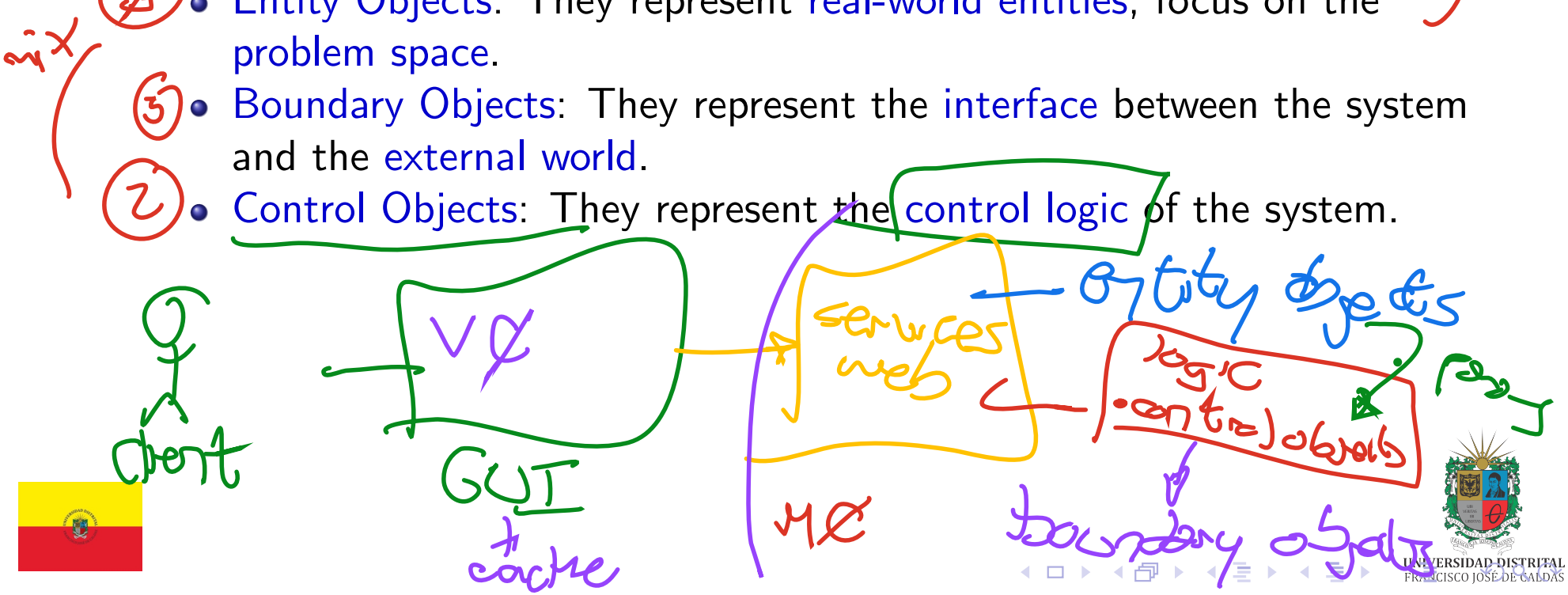
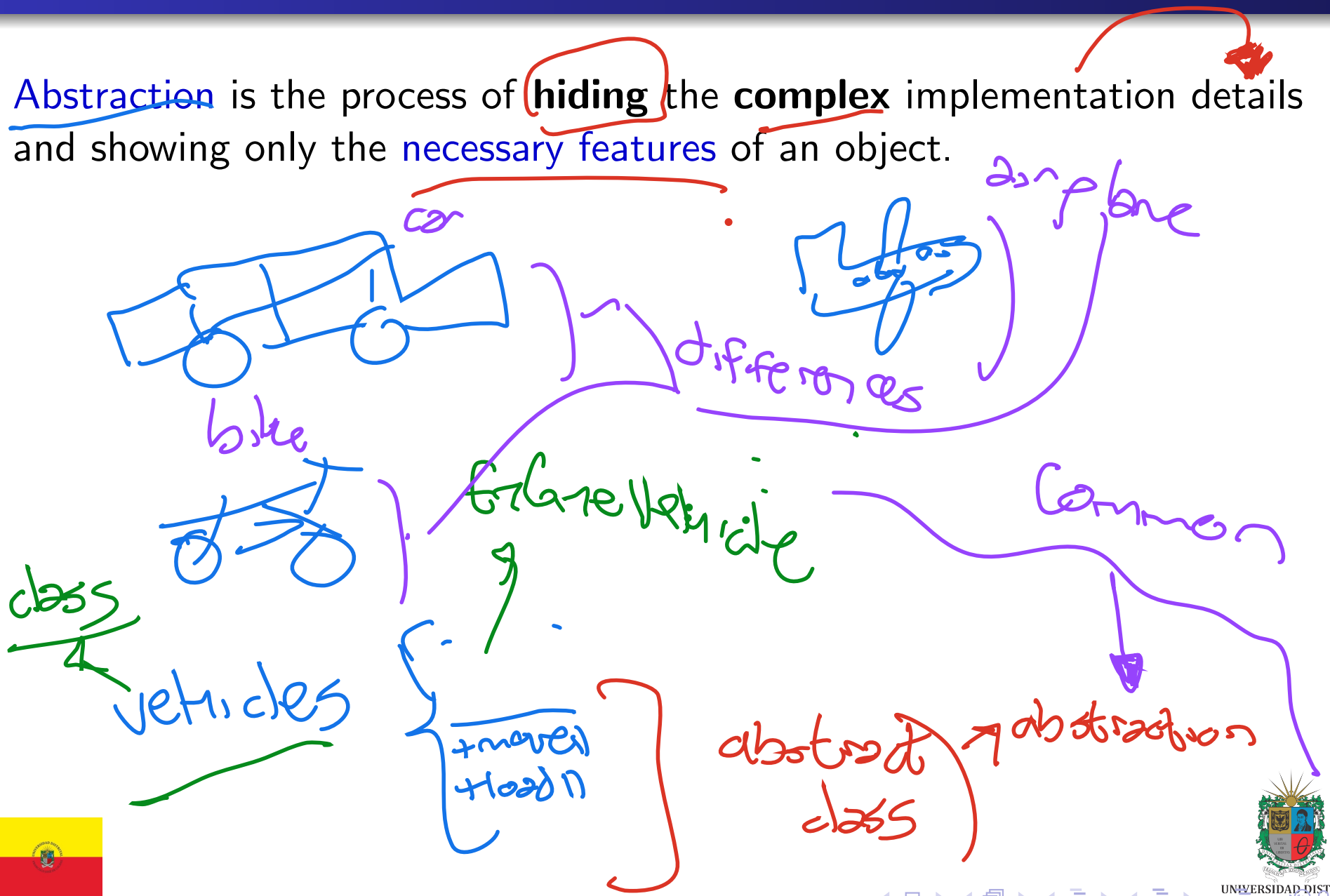


Abstraction in OOD

Abstraction is the process of **hiding** the **complex** implementation details and showing only the necessary features of an object.



Encapsulation in OOD

Encapsulation is the process of **hiding** the internal state of an object and requiring all interactions to be performed through an object's **methods**.

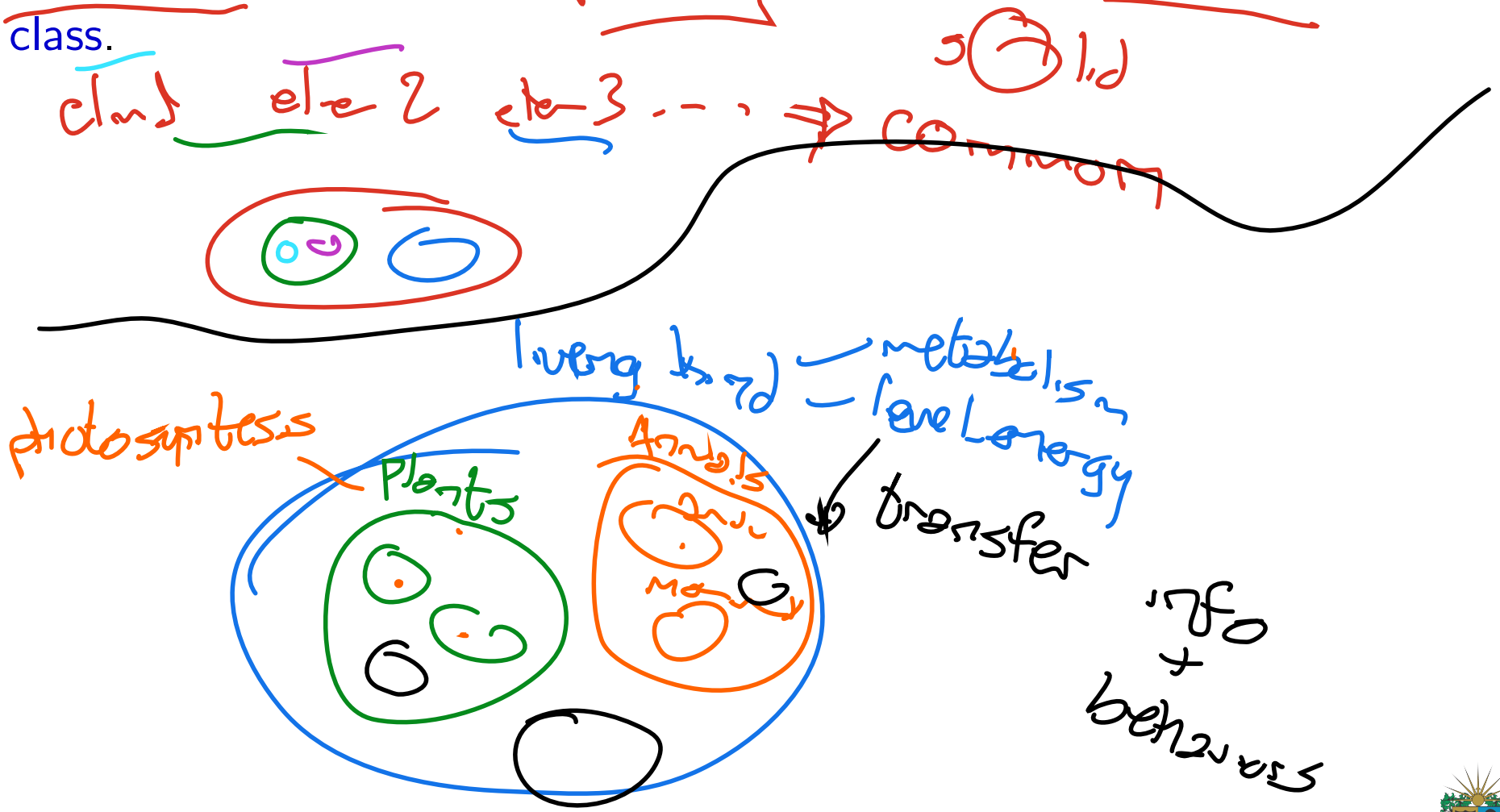
private attributes + getters & setters

```
private int age;

public void setAge(int newAge){
    if (newAge > 0){
        this.age = newAge;
    }
}

public String getCategory(){
    if(this.age<30){
        return "A";
    }else if(this.age<55){
        return "B";
    }else return "C";
}

public bool isAdult(){
    return this.age>=18? true:false;
}
```

data integrity

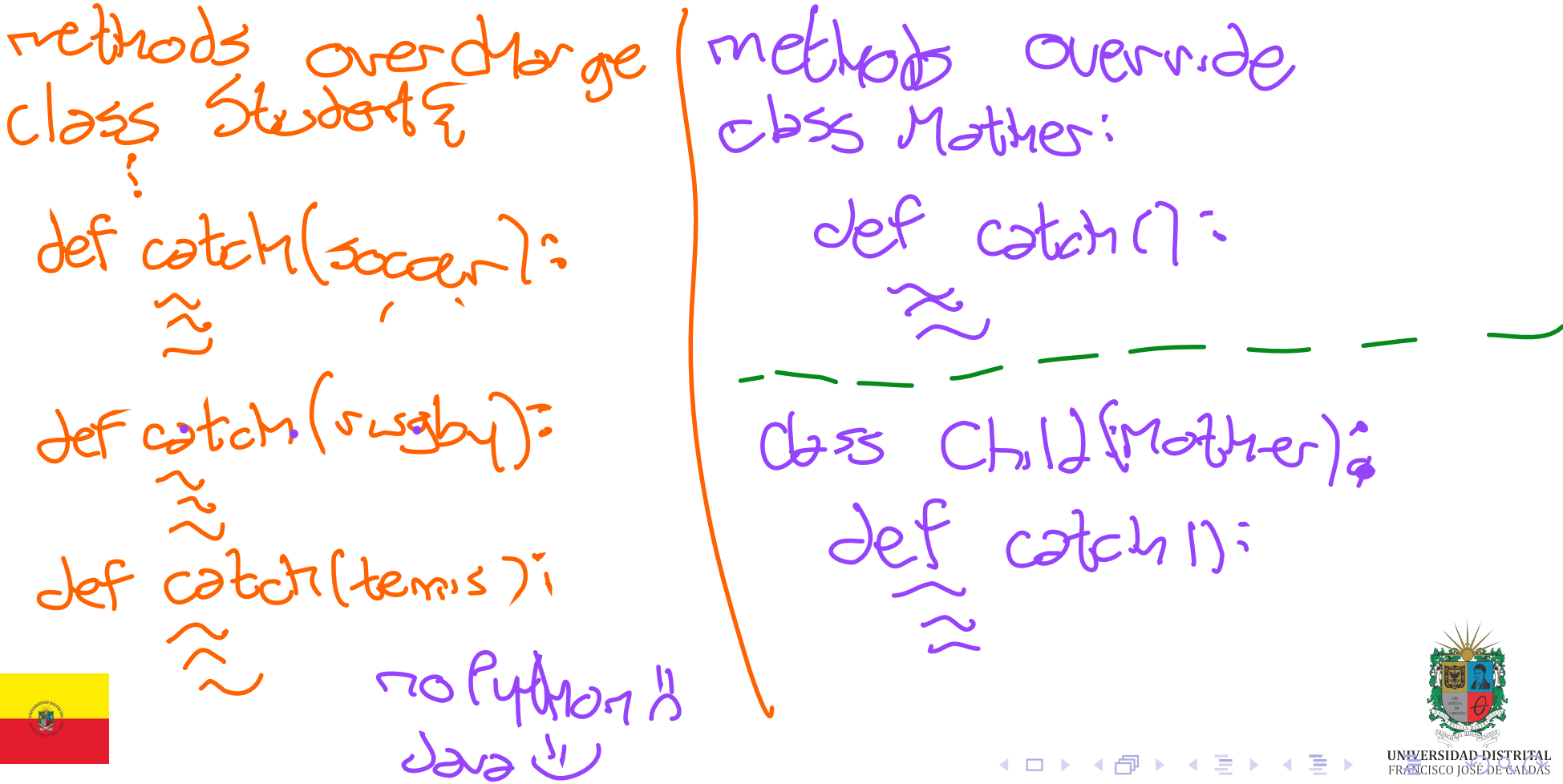
Inheritance in OOD

Inheritance is the process of creating a new class by **extending** an existing class.



Polymorphism in OOD

Polymorphism is the ability of an object to take on many forms. The most common use of polymorphism in OOP occurs when a parent class reference is used to refer to a child class object.



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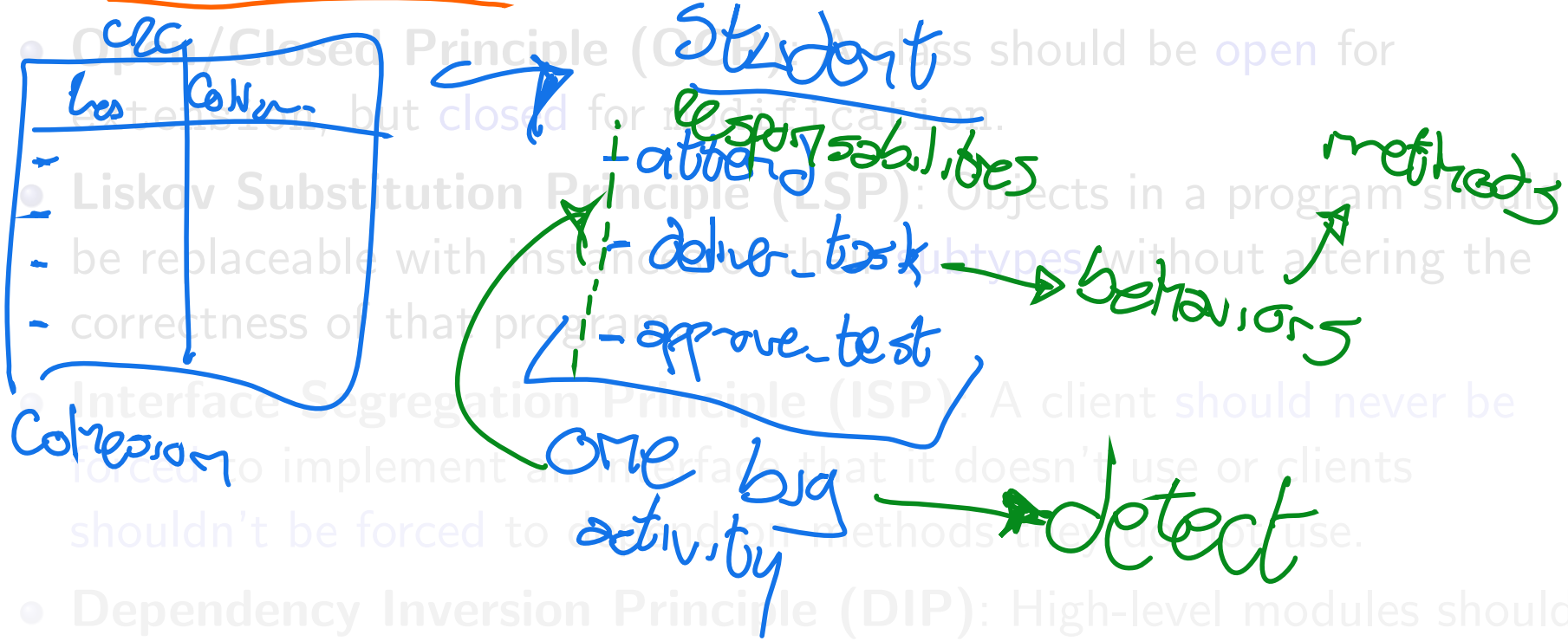
SOLID Principles

- **Single Responsibility Principle (SRP)**: A class should have only one reason to change.



- **Open/Closed Principle (OCP)**: A class should be open for extension, but closed for modification.
- **Liskov Substitution Principle (LSP)**: Objects in a program should be replaceable with instances of their subtypes without altering the correctness of that program.
- **Interface Segregation Principle (ISP)**: A client should never be forced to implement an interface that it doesn't use or clients shouldn't be forced to depend on methods they do not use.
- **Dependency Inversion Principle (DIP)**: High-level modules should not depend on low-level modules. Both should depend on abstractions. Abstractions should not depend on details. Details should depend on abstractions.

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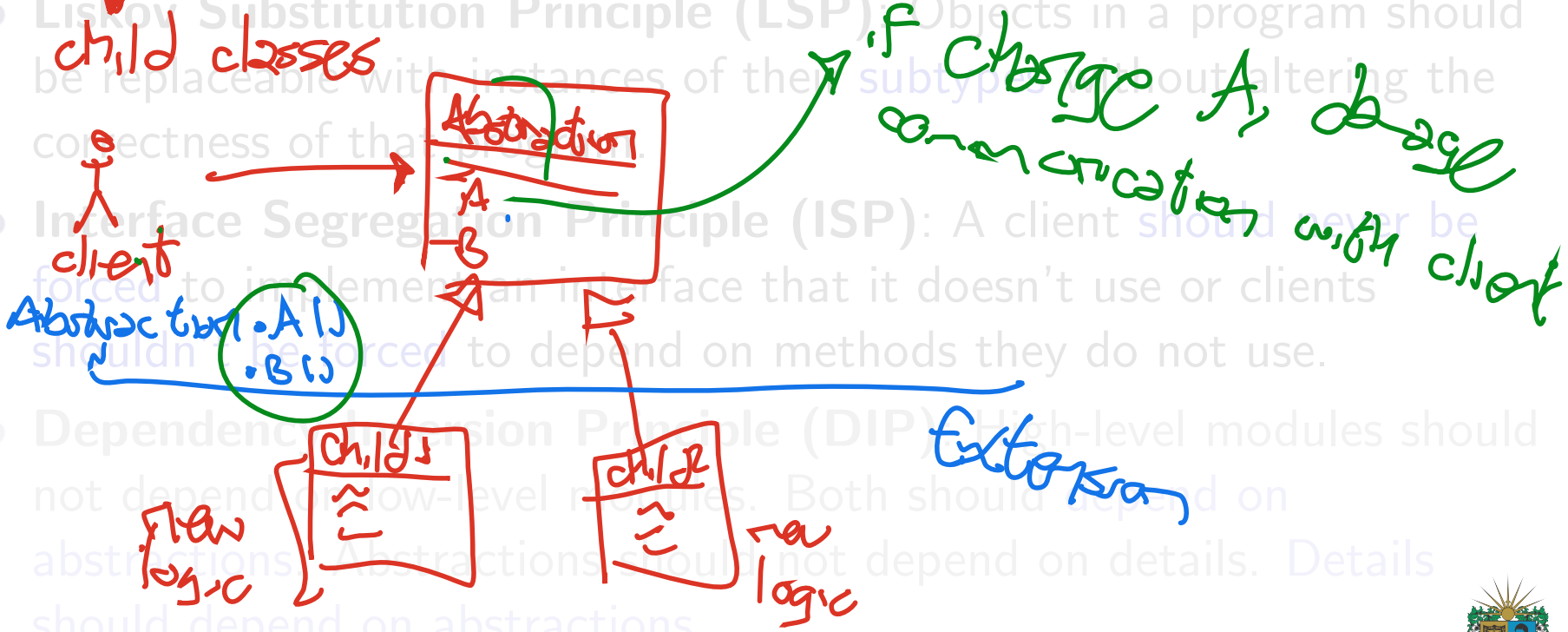

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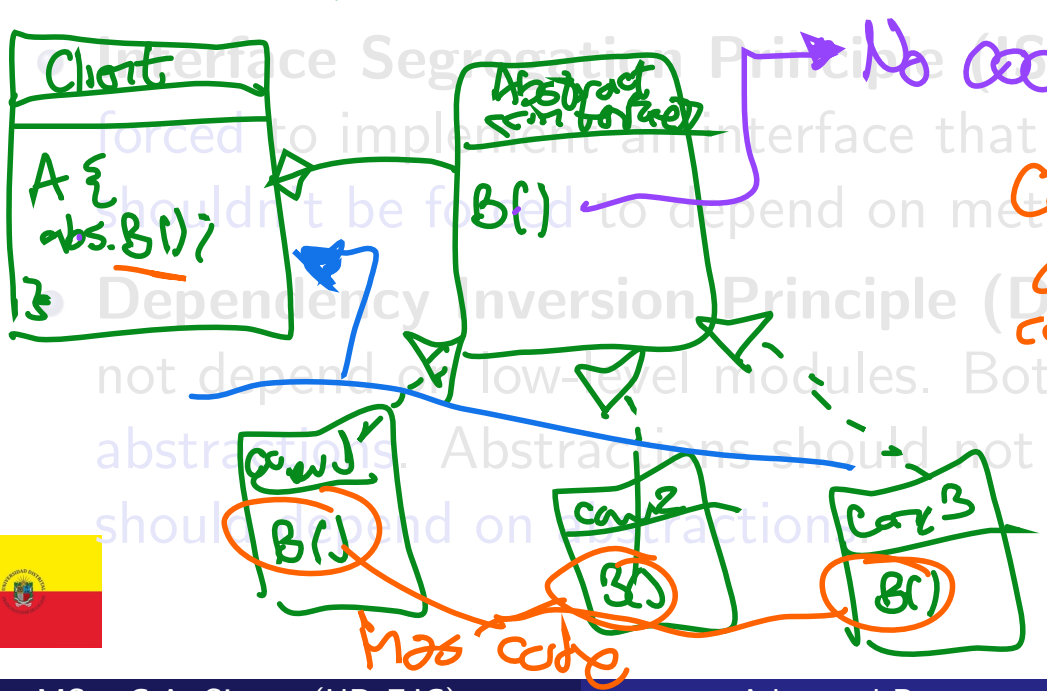

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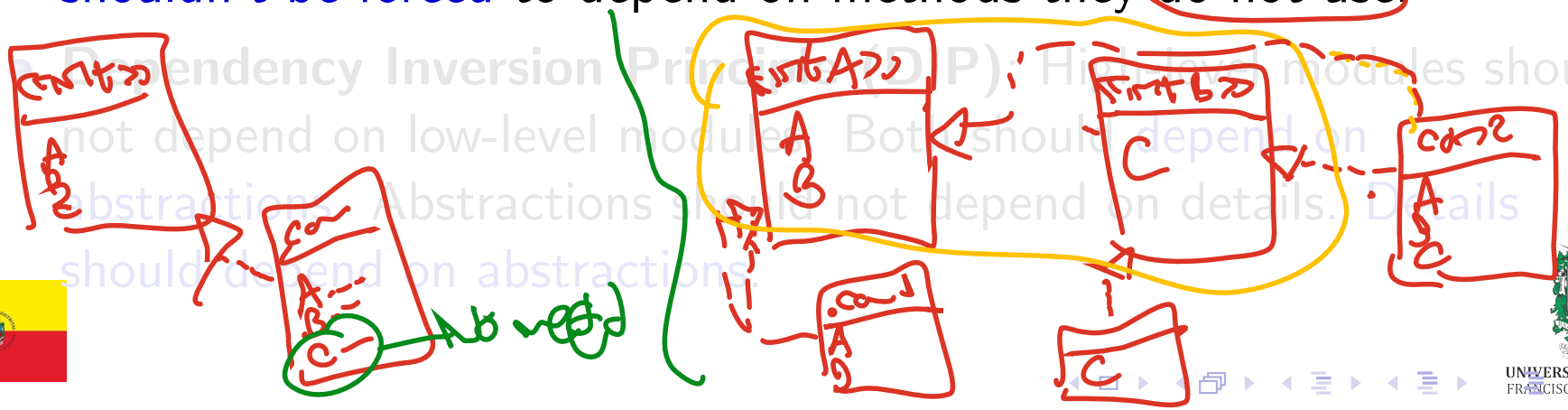

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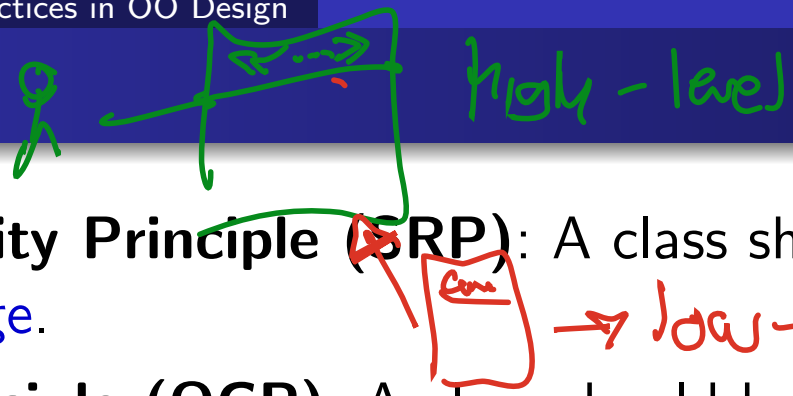

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↳ child implements abstractions

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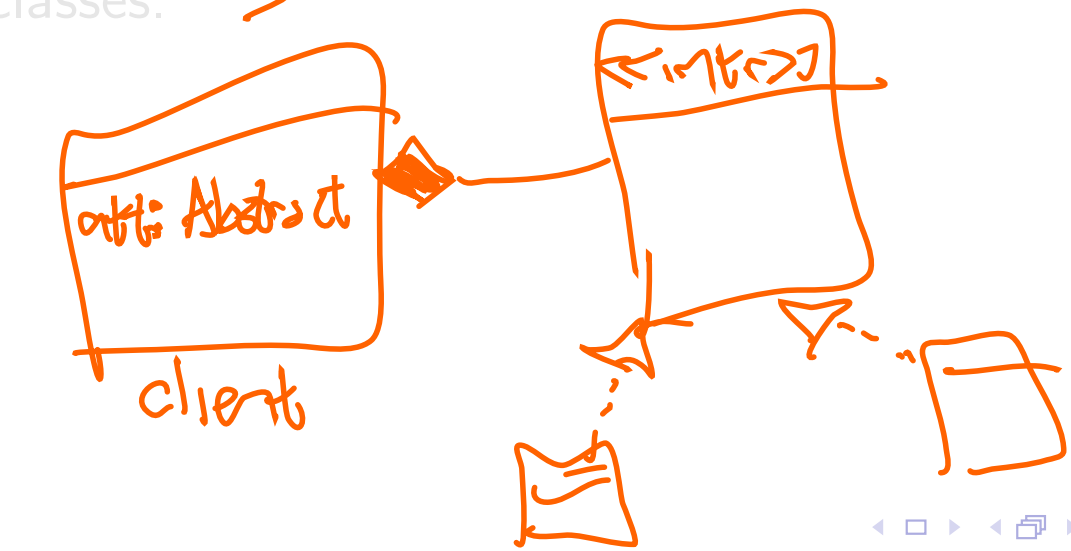
Good Practices

- **Composition over Inheritance**: Inheritance should be used only when there is a clear relationship between the base class and the derived class. In other cases, composition should be used. Inheritance is a powerful tool, but it is not always the best tool for the job. Inheritance is a way to achieve polymorphism, but it is not the only way to achieve polymorphism.
- **Code to Interfaces, not Implementations**: This principle is about designing your classes so that they depend on interfaces rather than concrete classes.



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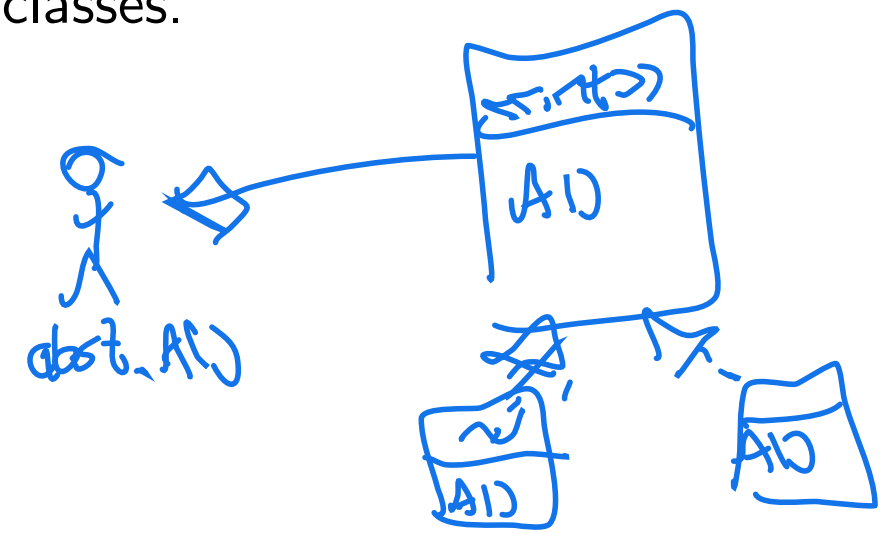

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Modules in Python

Modules are Python files that consist of Python code. They can define functions, classes, and variables.

- **Importing Modules**: To use a module, you have to import it using the `import` statement.
- **Creating Modules**: To create a module, you just have to save the code you want in a file with the file extension `.py`.
- **Built-in Modules**: Python has a set of built-in modules that you can use without installing them.

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Packages are a way of structuring `Python's module namespace` by using *dotted module names*.

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- **Virtual Environments**: Virtual environments are a way of creating isolated environments for your **Python projects**.
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- **File Management**: It is the process of `managing` computer files.
- **Network Management**: It is the process of `managing` computer networks.
- **Process Management**: It is the process of `managing` computer processes.

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Resources in Computation

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Objects Serialization

- **Serialization**: It is the process of converting an object into a stream of bytes.
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- **Pickling**: It is the process of serializing an object in `Python`.
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- **JSON**: It is a lightweight data-interchange format that is easy for humans to read and write and easy for machines to parse and generate.

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Memory Management

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- **Reference Counting**: It is a technique used by `Python` to manage memory.
- **Memory Profiling**: It is the process of analyzing the memory usage of a program.
- **Memory Leaks**: They are a common problem in programming where memory is allocated but never deallocated.
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Threds, Processes, and Concurrency

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- **Processes**: They are the largest unit of execution that can be scheduled by an operating system.
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- **Distributed Computation**: It is the process of executing multiple tasks on multiple machines.
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Outline

Thanks!

Questions?

Repo:
github.com/engandres/ud-public/tree/main/courses/advanced-programming

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