Object-Oriented Modelling

Object-Oriented Programming

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Outline

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Design Before Code

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business vocabulary

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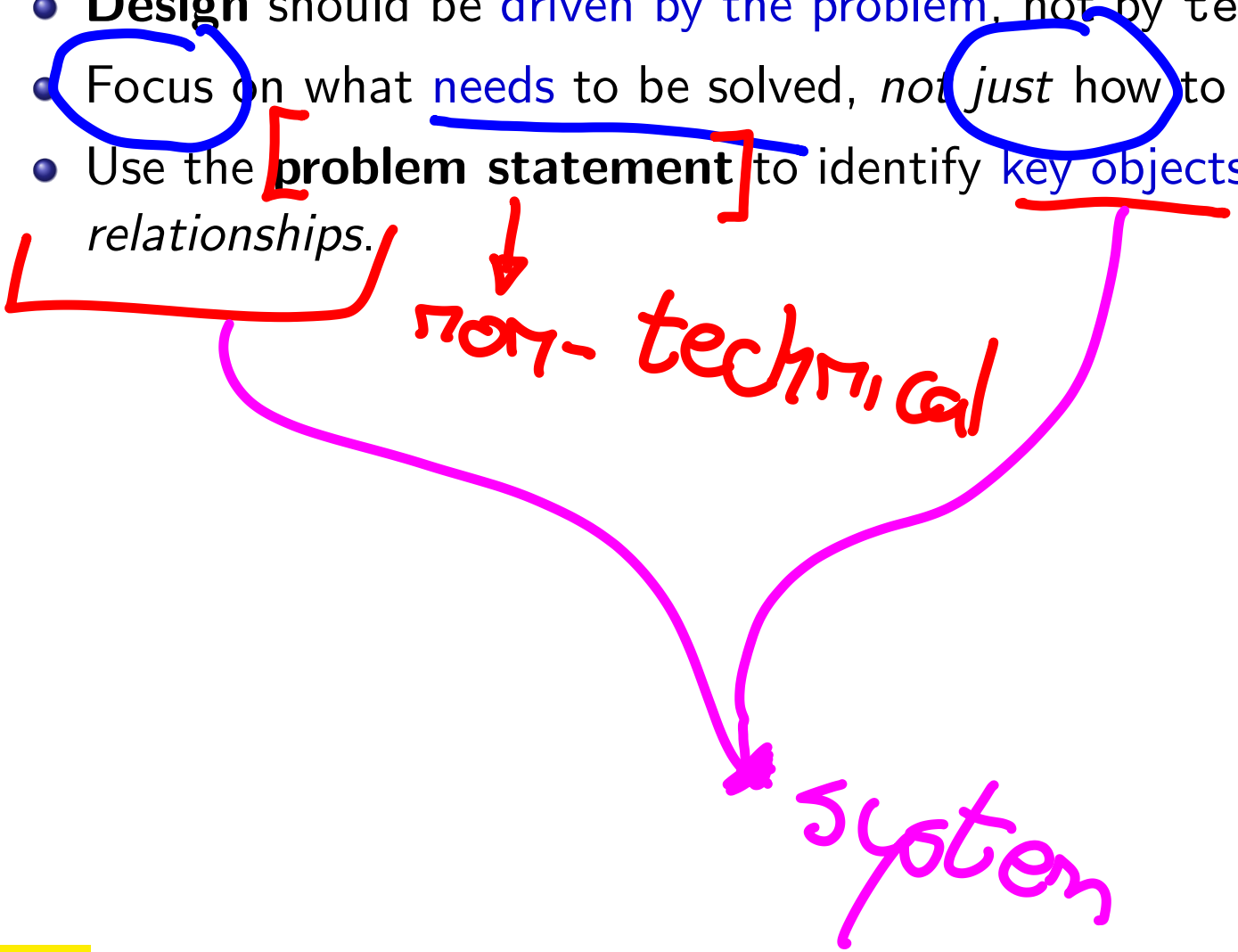


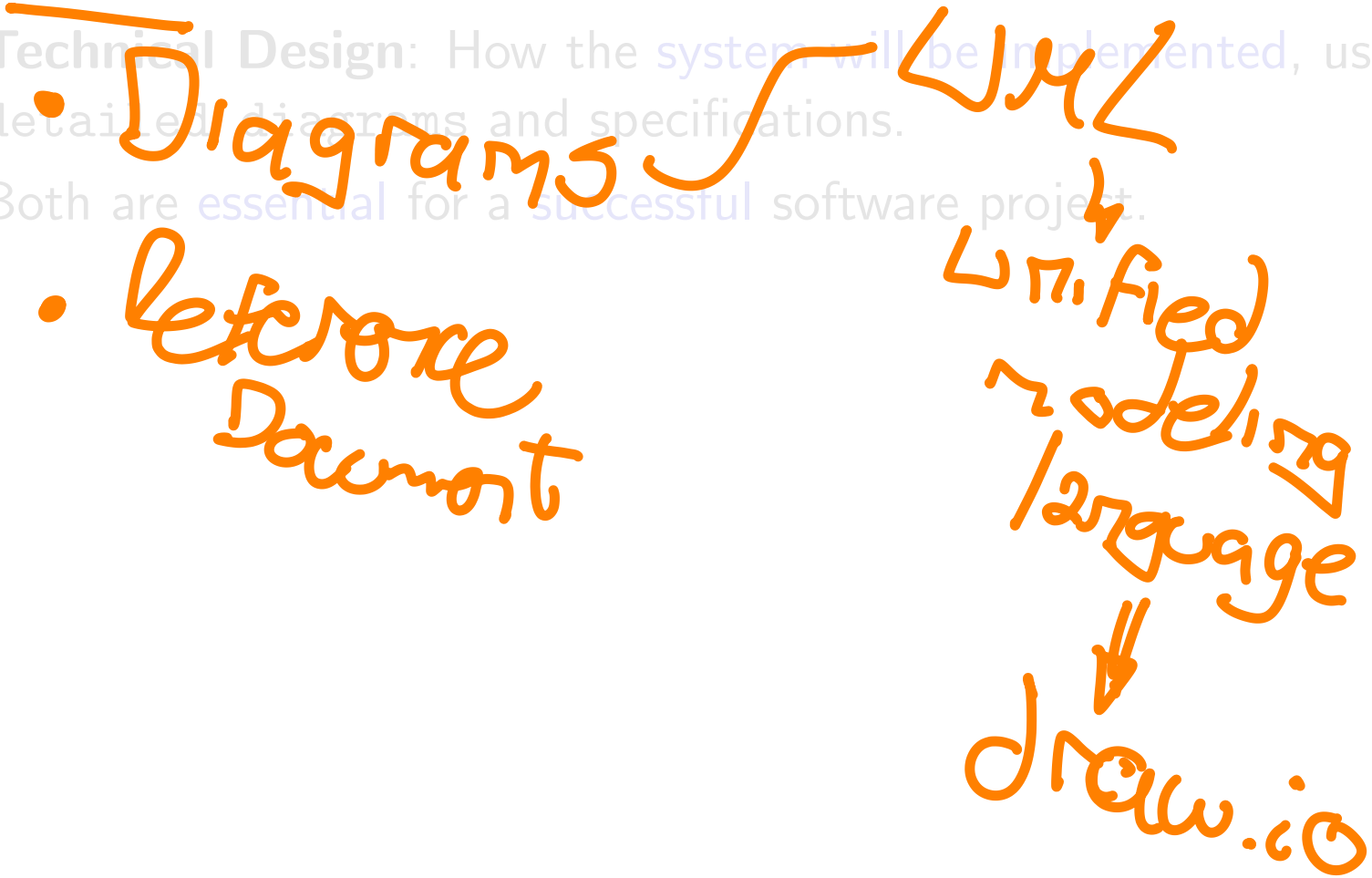
Object-Oriented Approach

- 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.

objects ← elements
relations

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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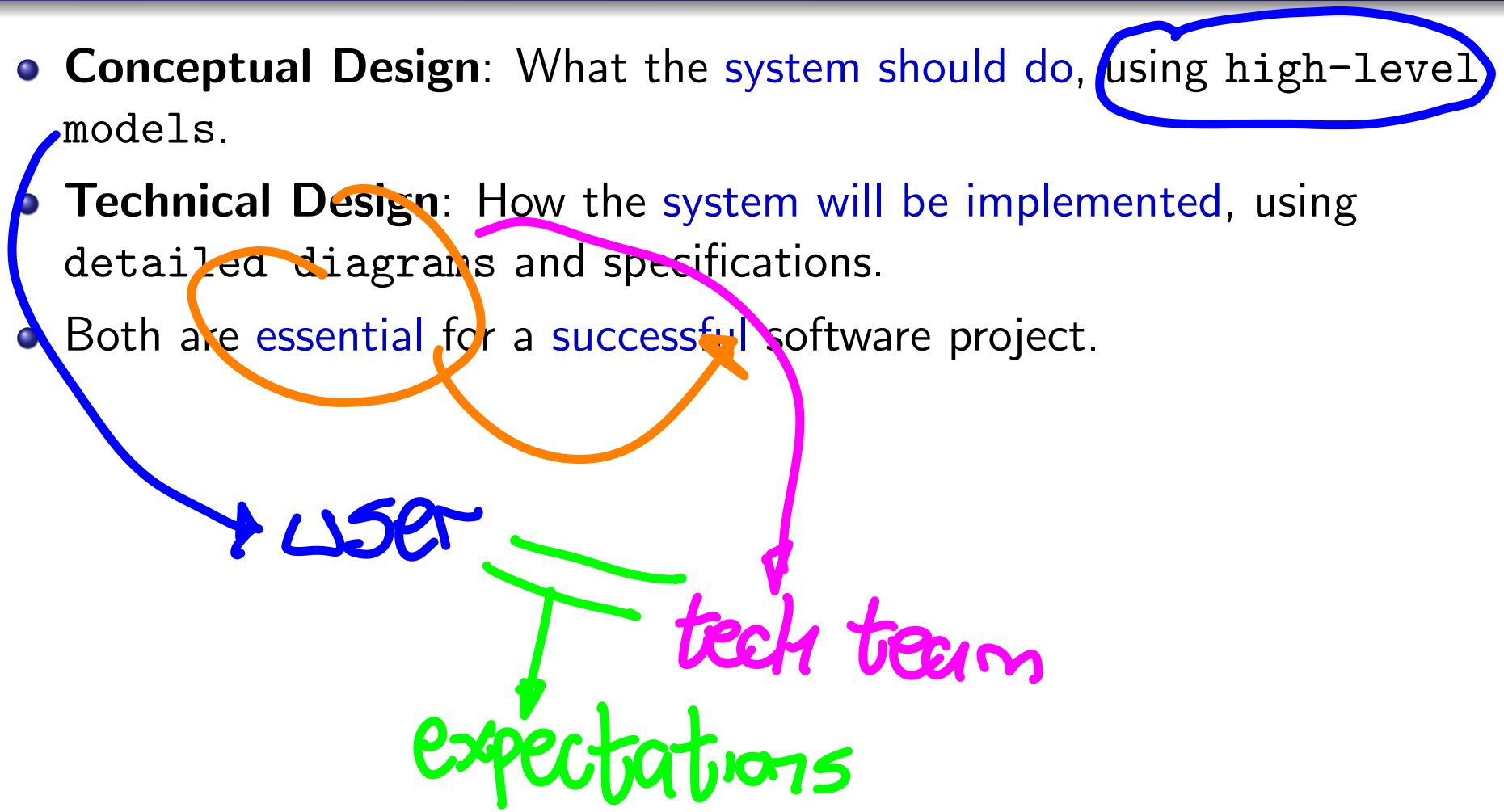

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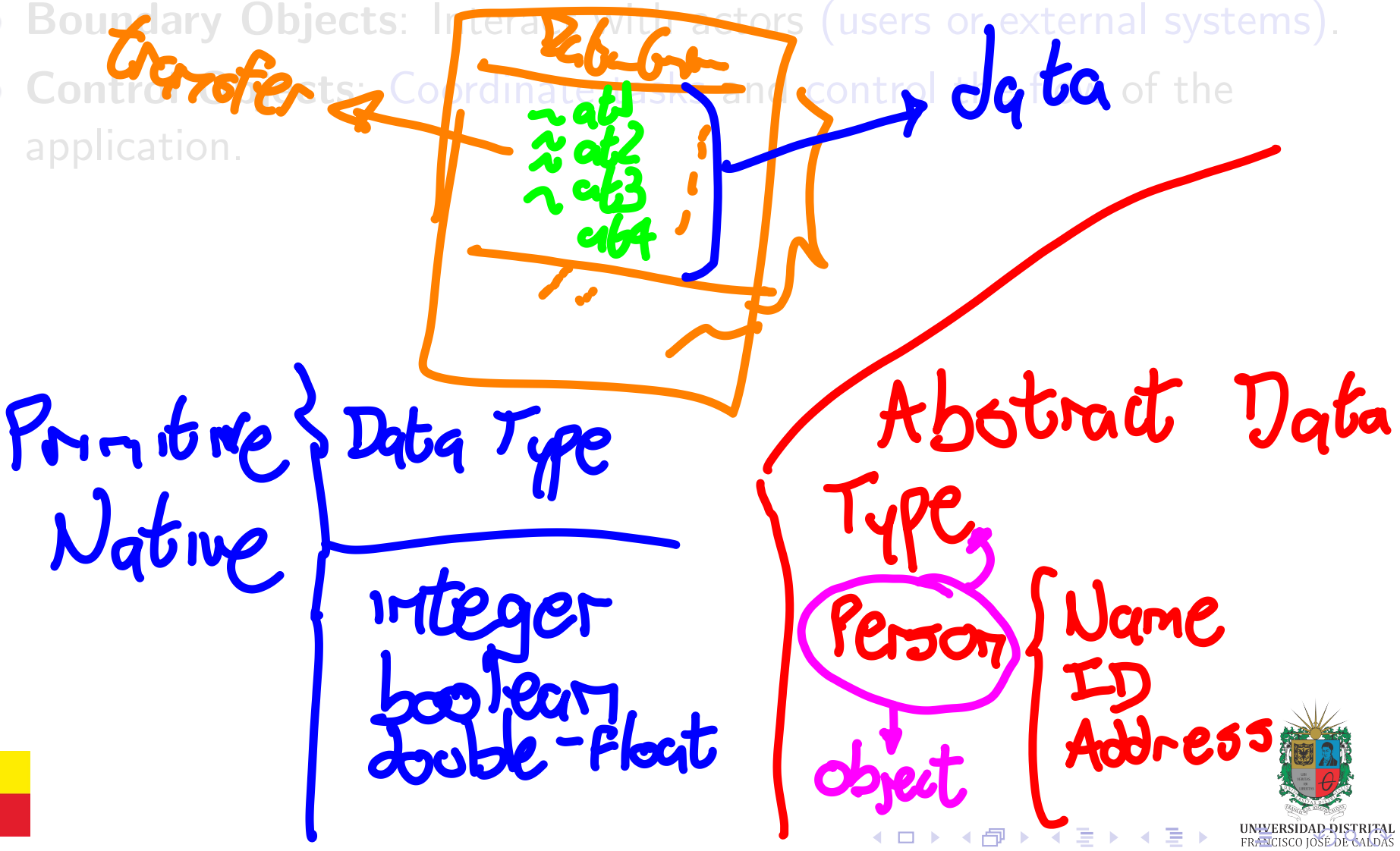
Categories of Objects

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



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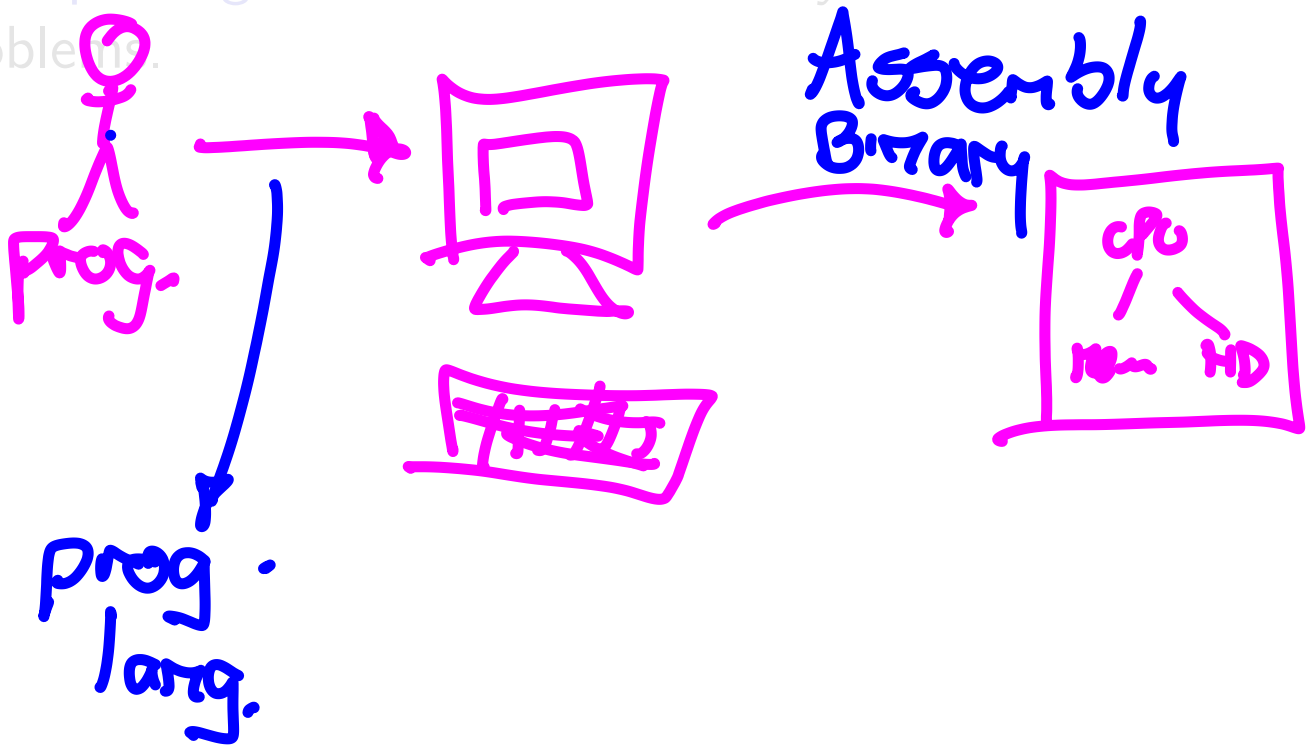
Talk with Machines: Programming Paradigms

- **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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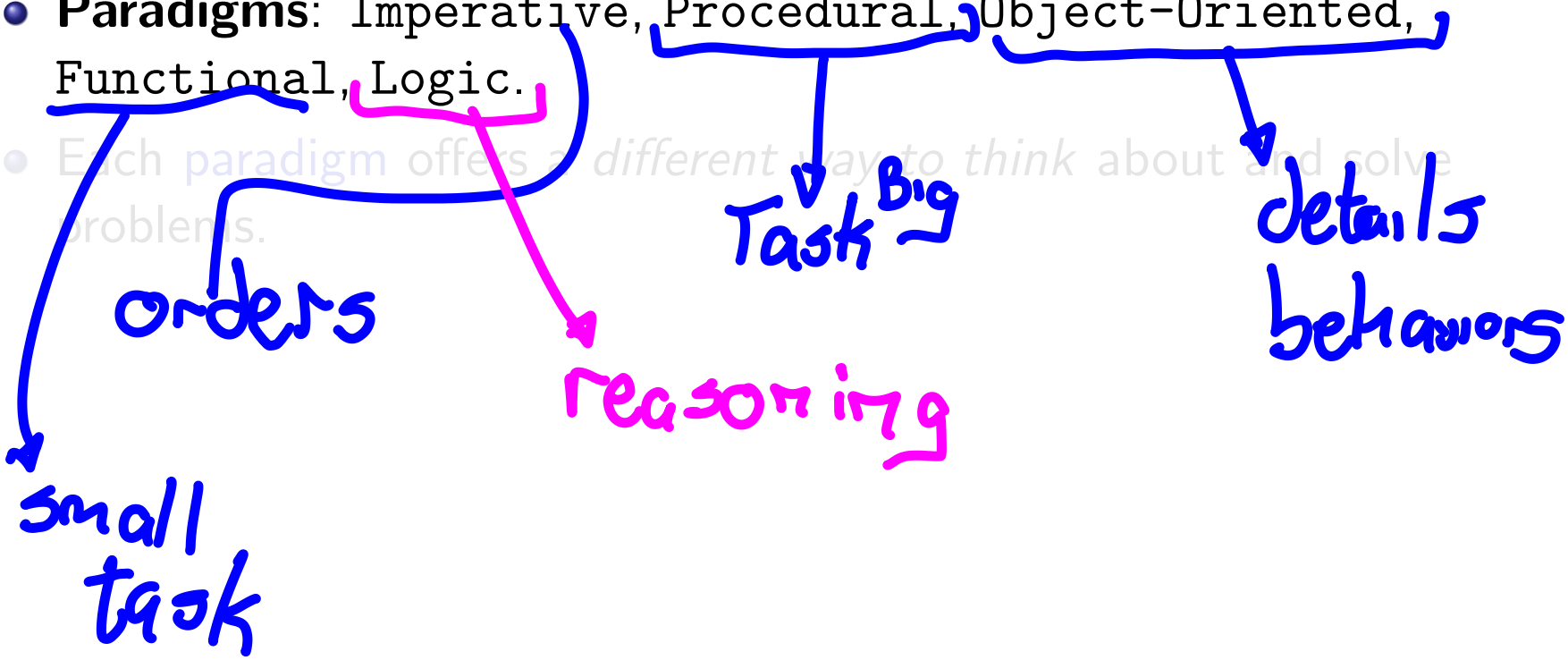

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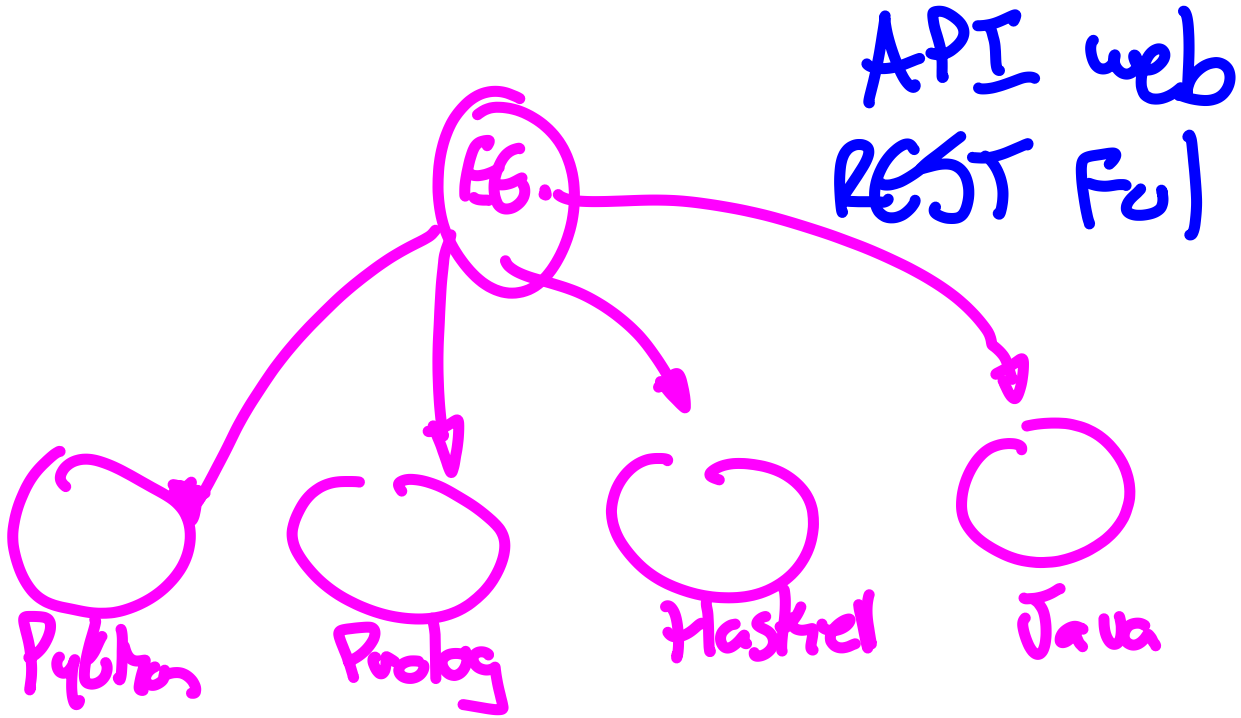
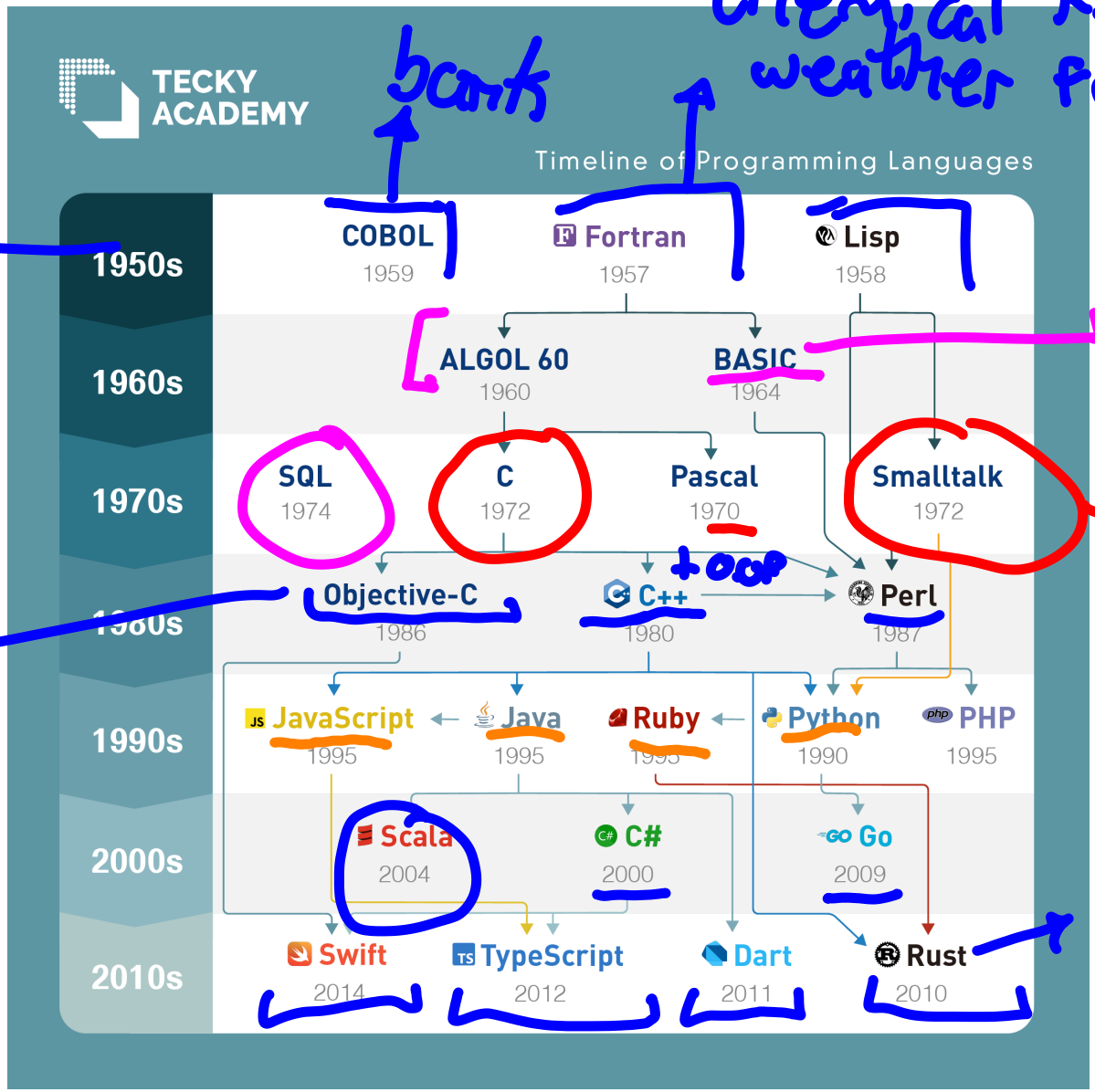


History of Programming Languages



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.
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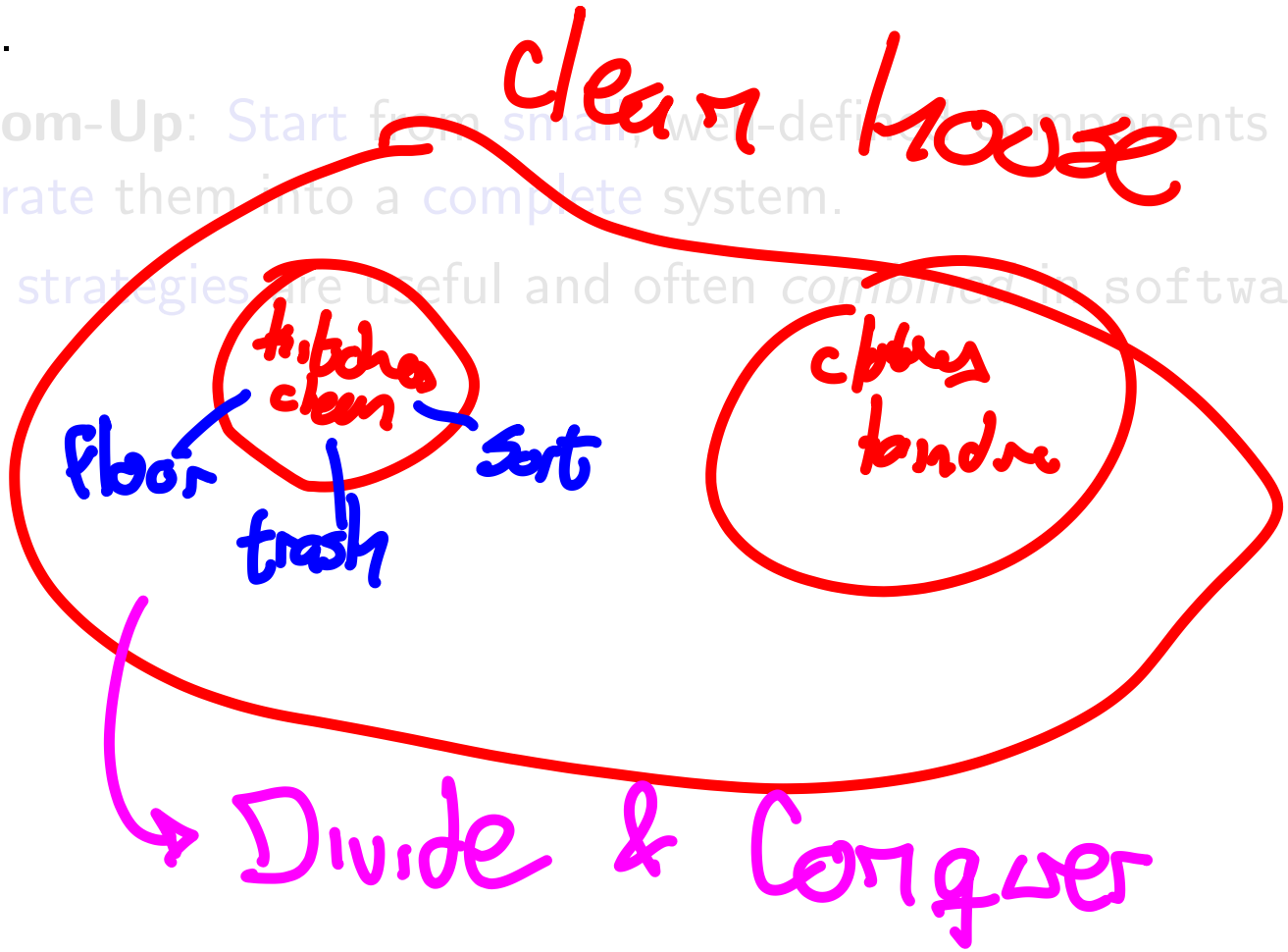

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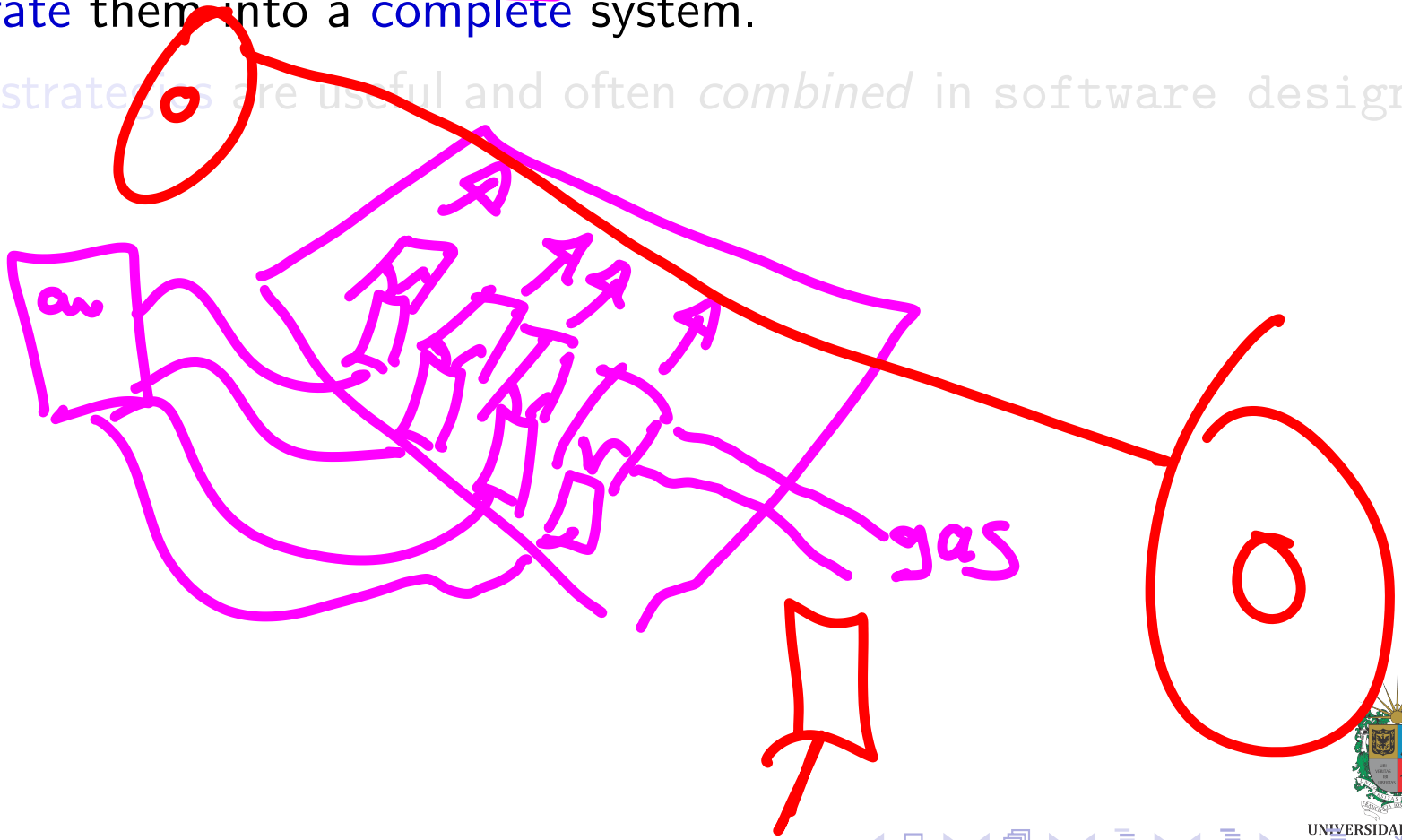

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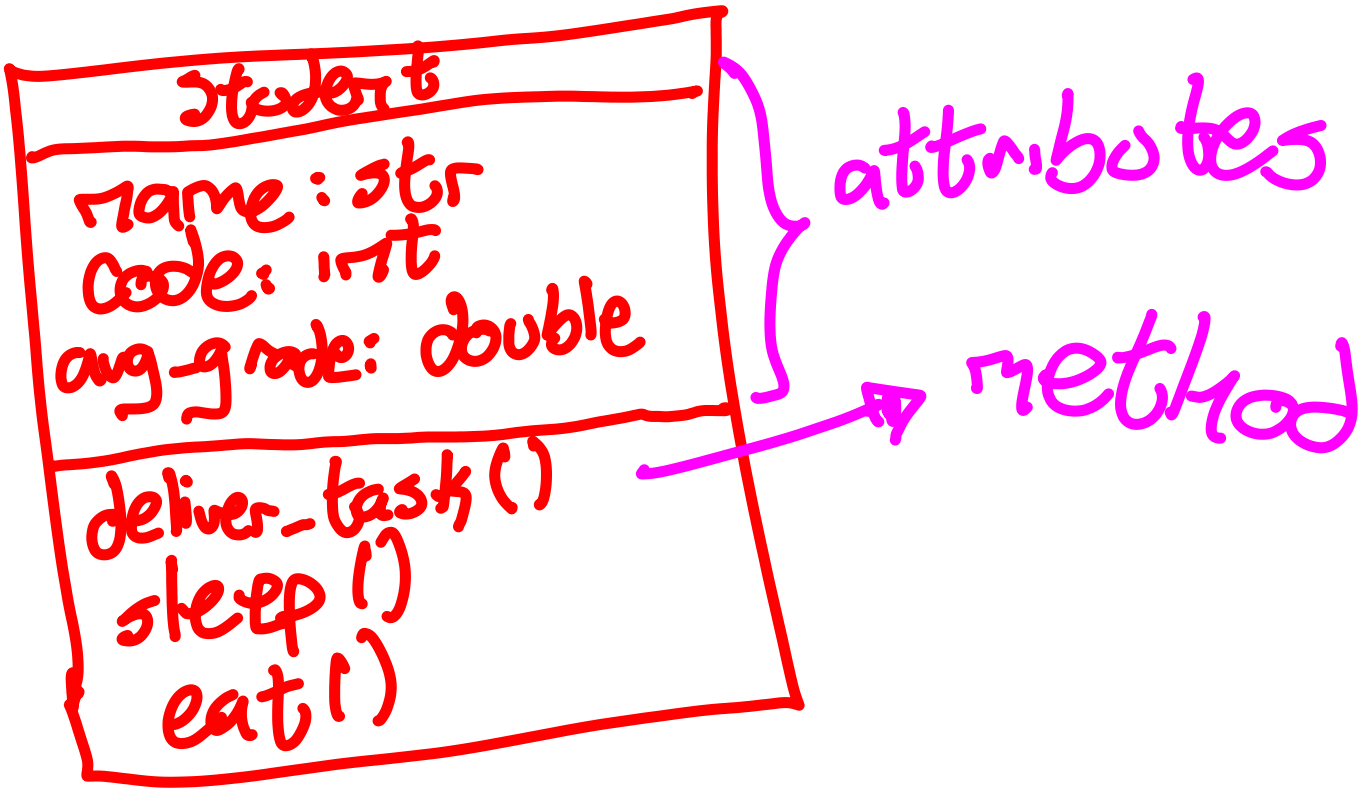

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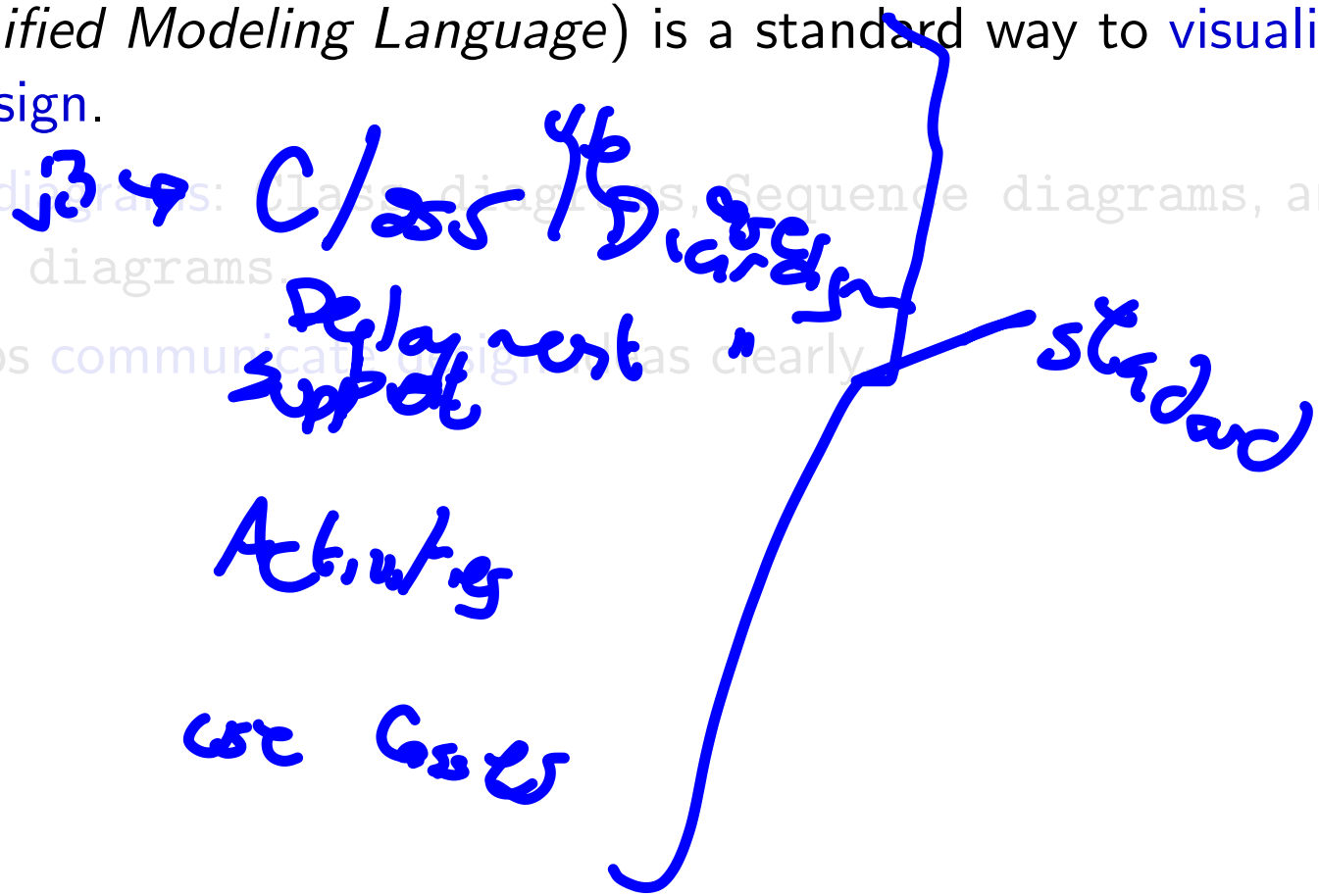
UML Diagrams

- **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 designs as clearly as possible.



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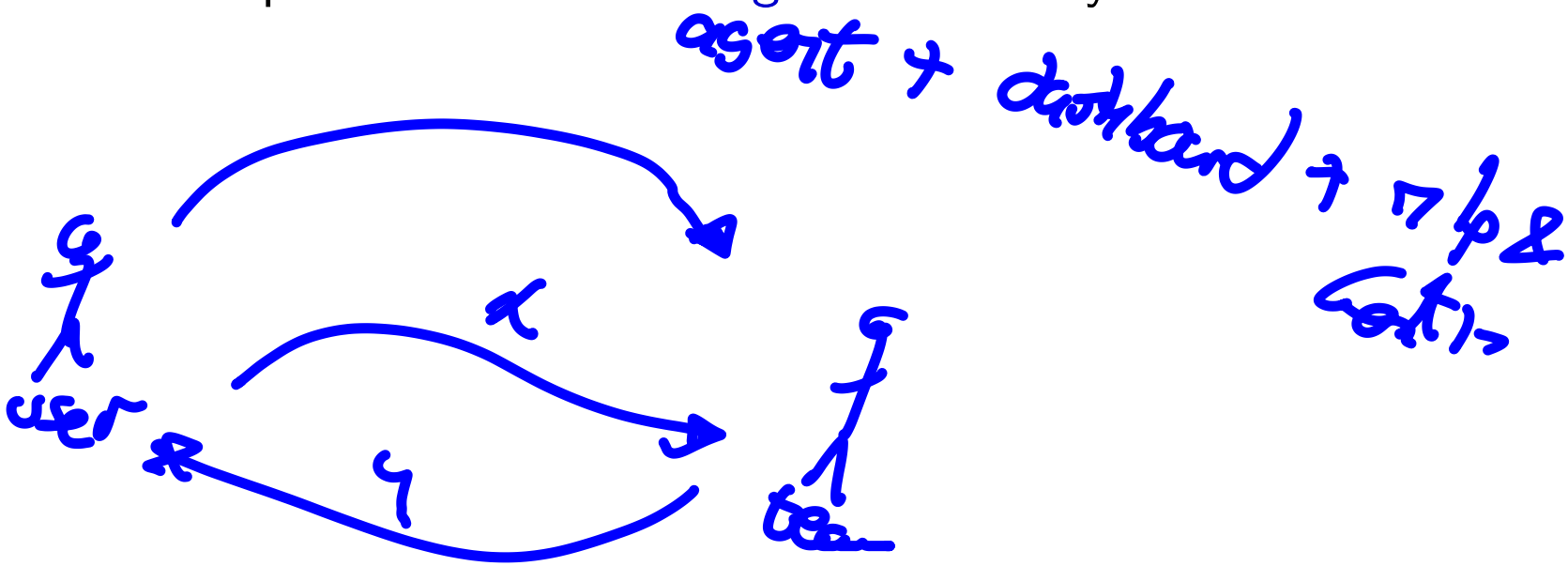

Class Diagrams

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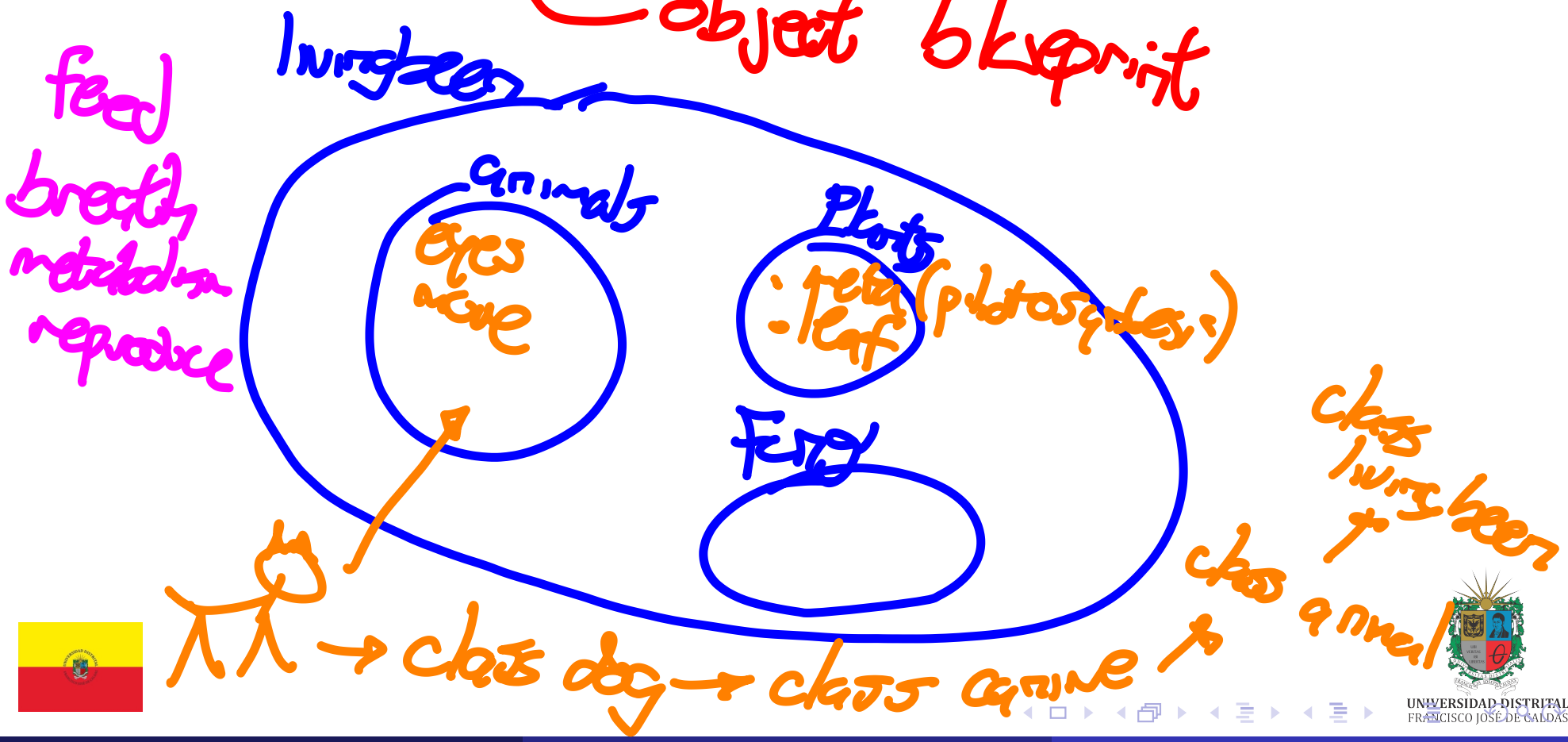
- They display **classes**, their attributes, methods, and relationships.
- Useful for both conceptual and technical design.



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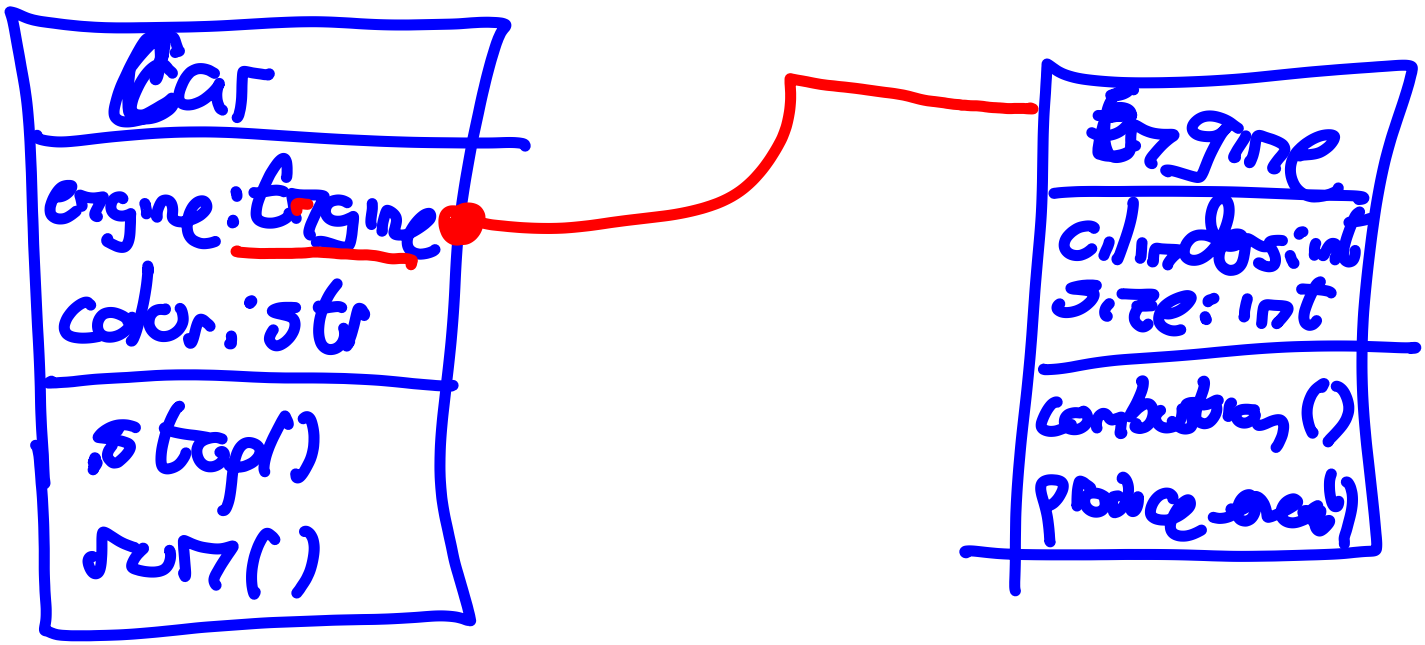

Abstraction

- **Abstraction** means focusing on the essential features of an `object`.
- **Rule of Least Astonishment**: Design so users are not surprised by behavior.
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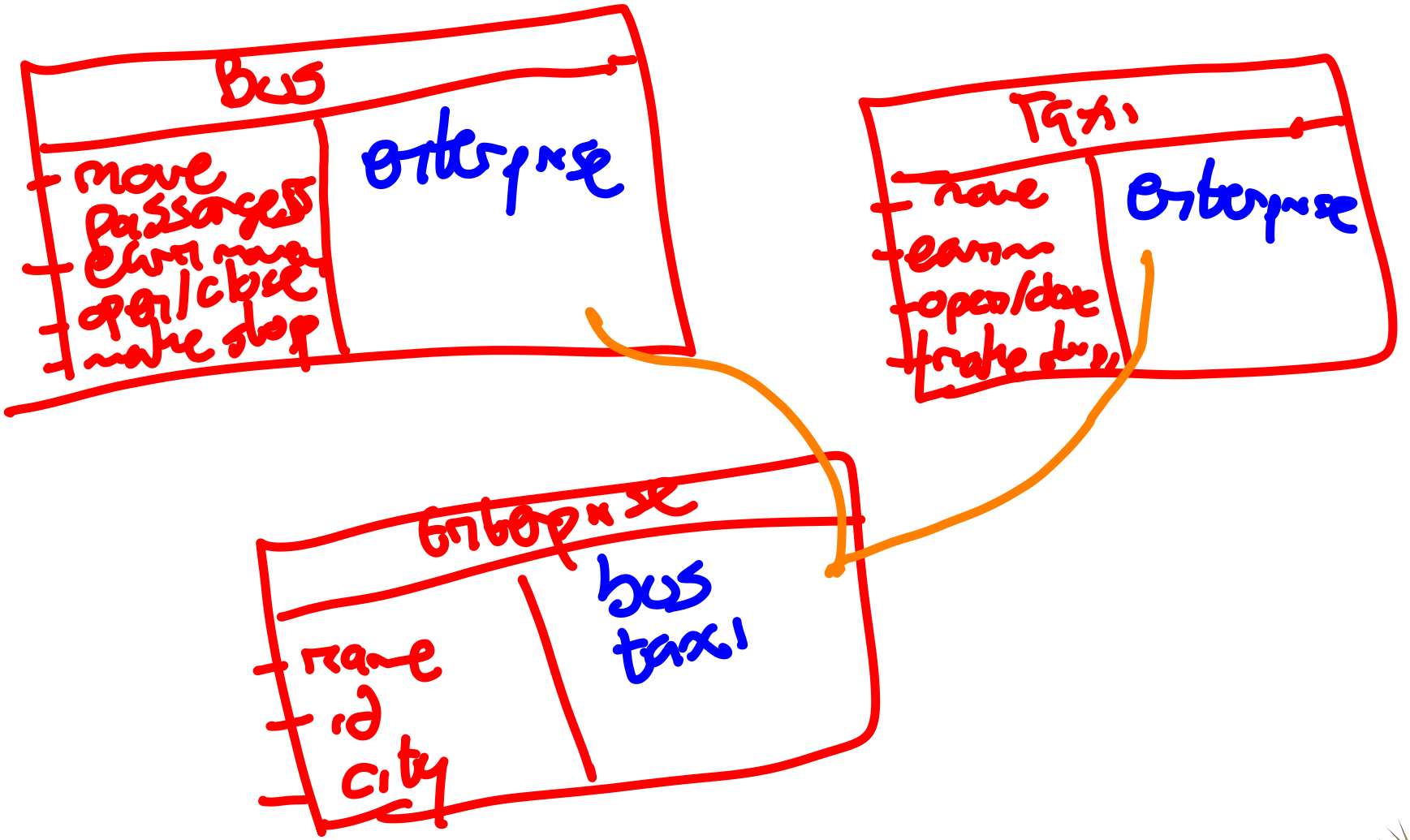
Abstraction & CRC Cards



Encapsulation

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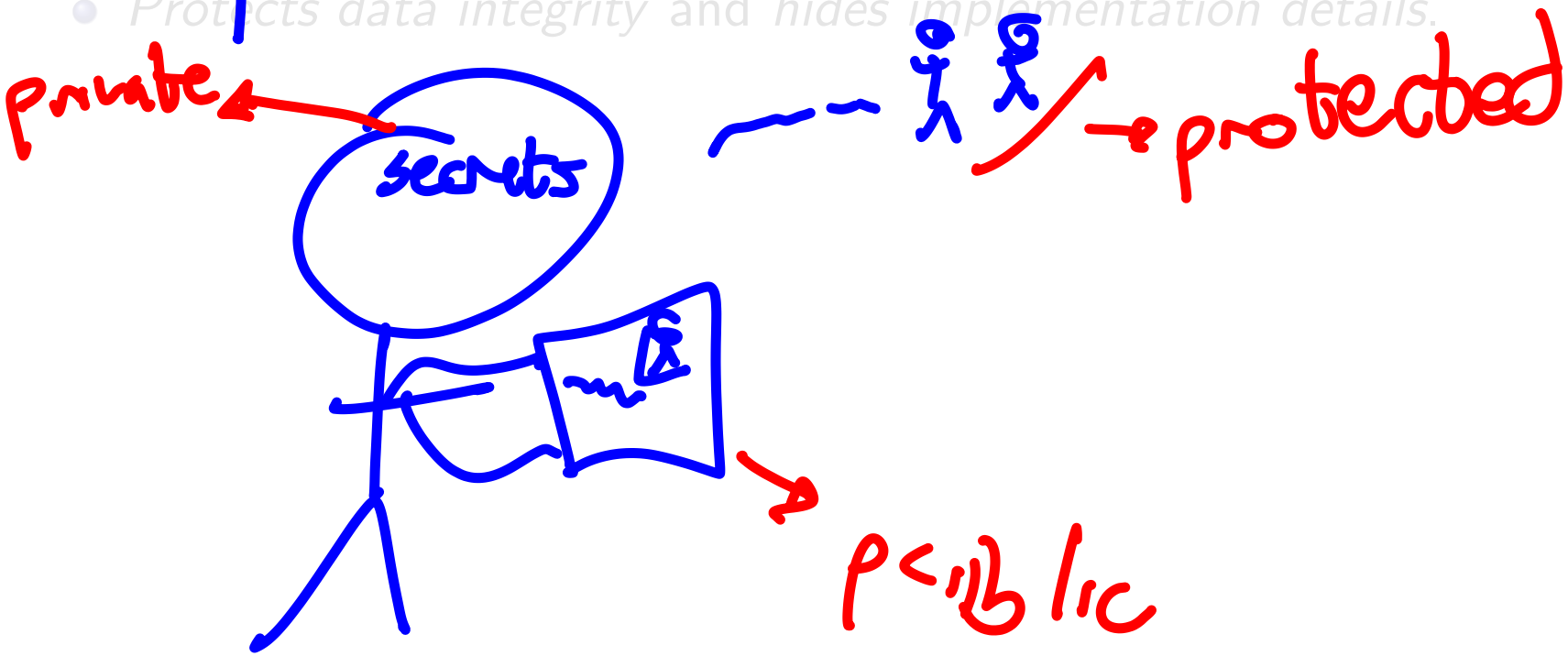

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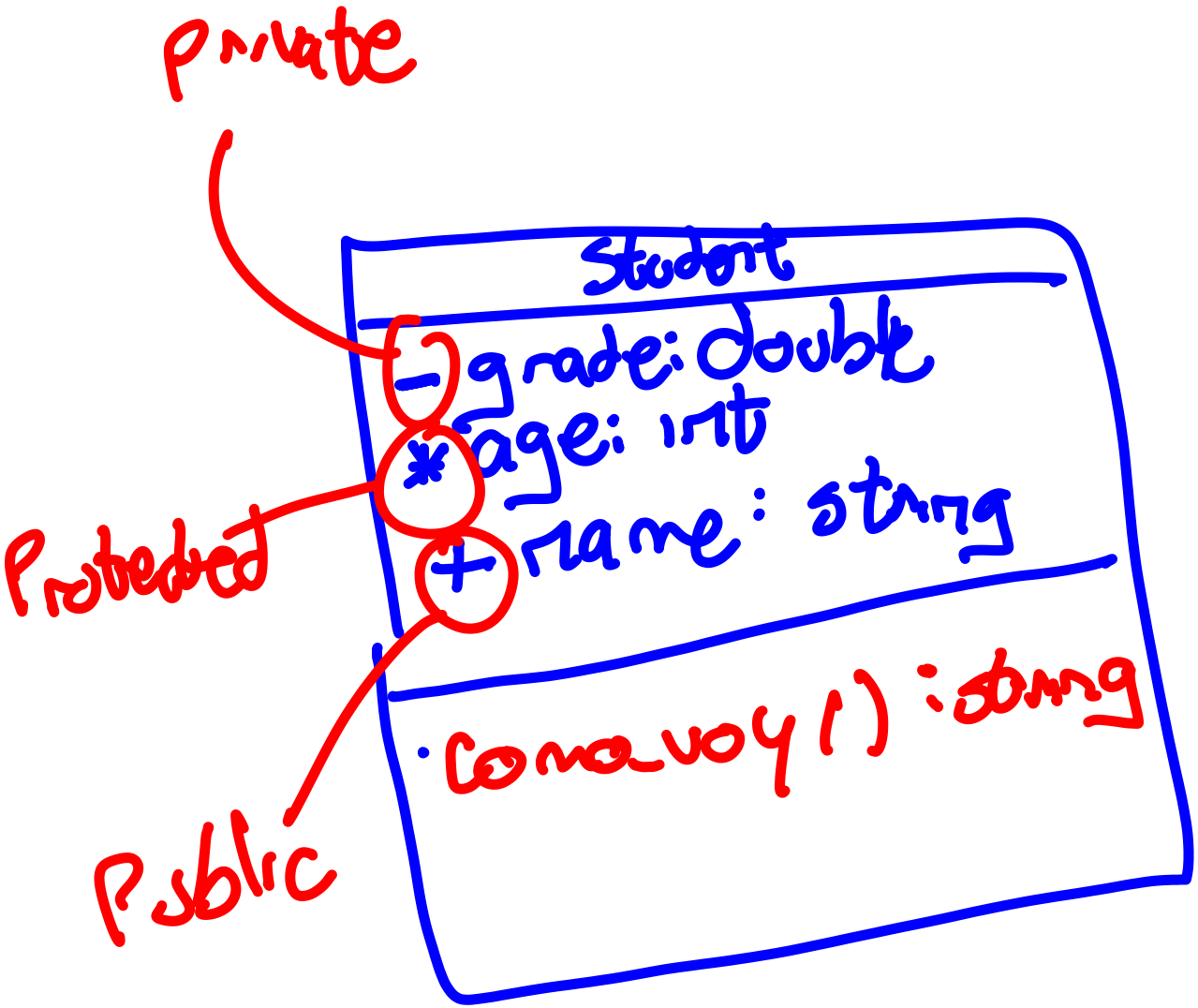
```
public class Student {
    private double grade;
    protect int age;

    public String como_voy() {
        if (grade >= 3.0) {
            return "Bien";
        } else if (grade >= 2.0){
            return "Bandola";
        } else {
            return "Ahi vamos";
        }
    }
```

Encapsulation & UML



Black Box Thinking

- **Objects communicate** through well-defined interfaces.
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- **Black box**: Focus on what an object does, not how it does it.

Demo time!

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Data Integrity: Getters and Setters

- **Getters** and **Setters** are methods to access and modify object attributes.
- They help maintain data integrity by controlling how attributes are accessed and modified.
- Use them to enforce validation rules and business logic.

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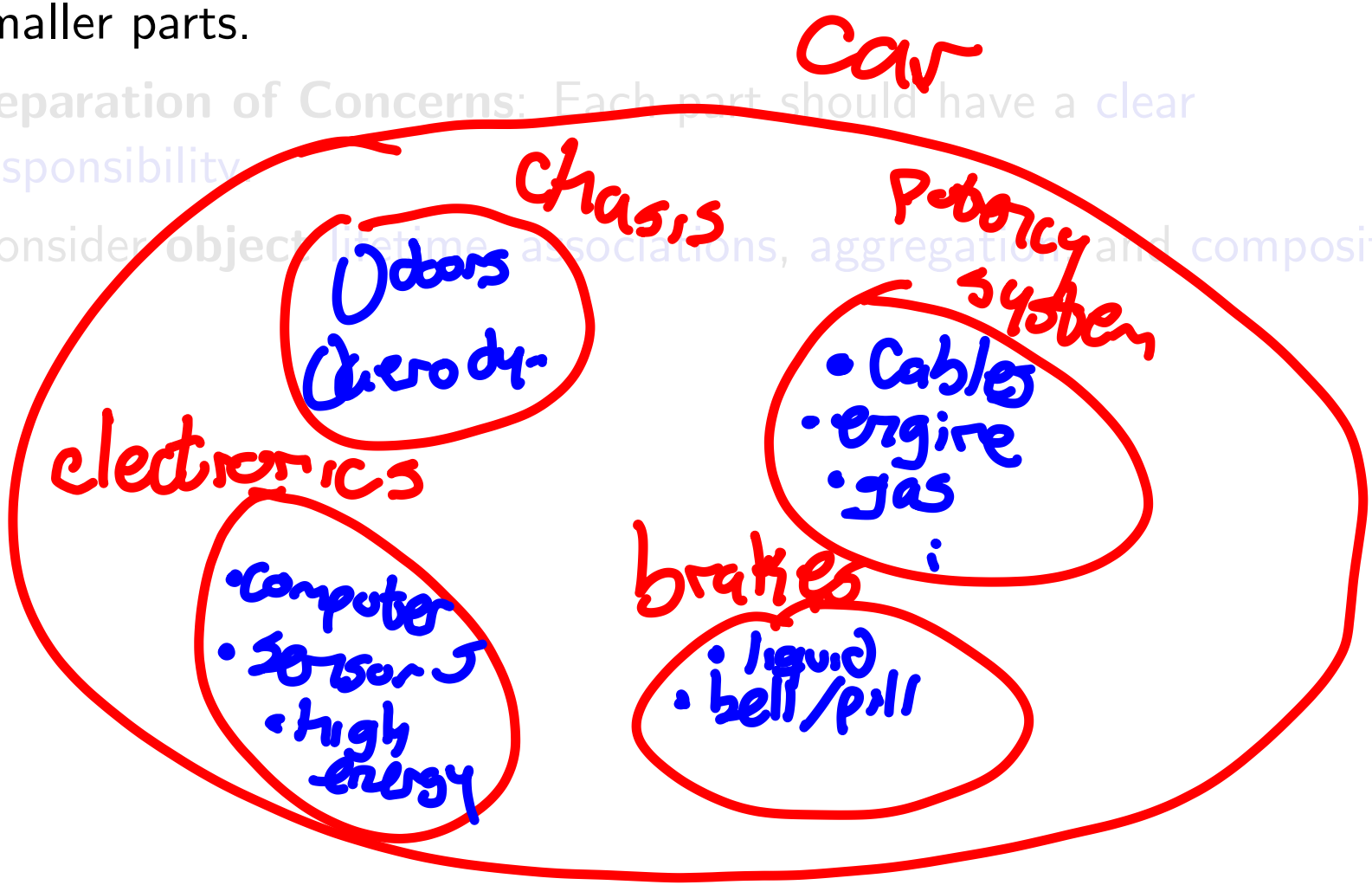
- **Separation of Concerns**: Each part should have a clear responsibility.
- Consider **object** lifetime, associations, aggregation and composition.



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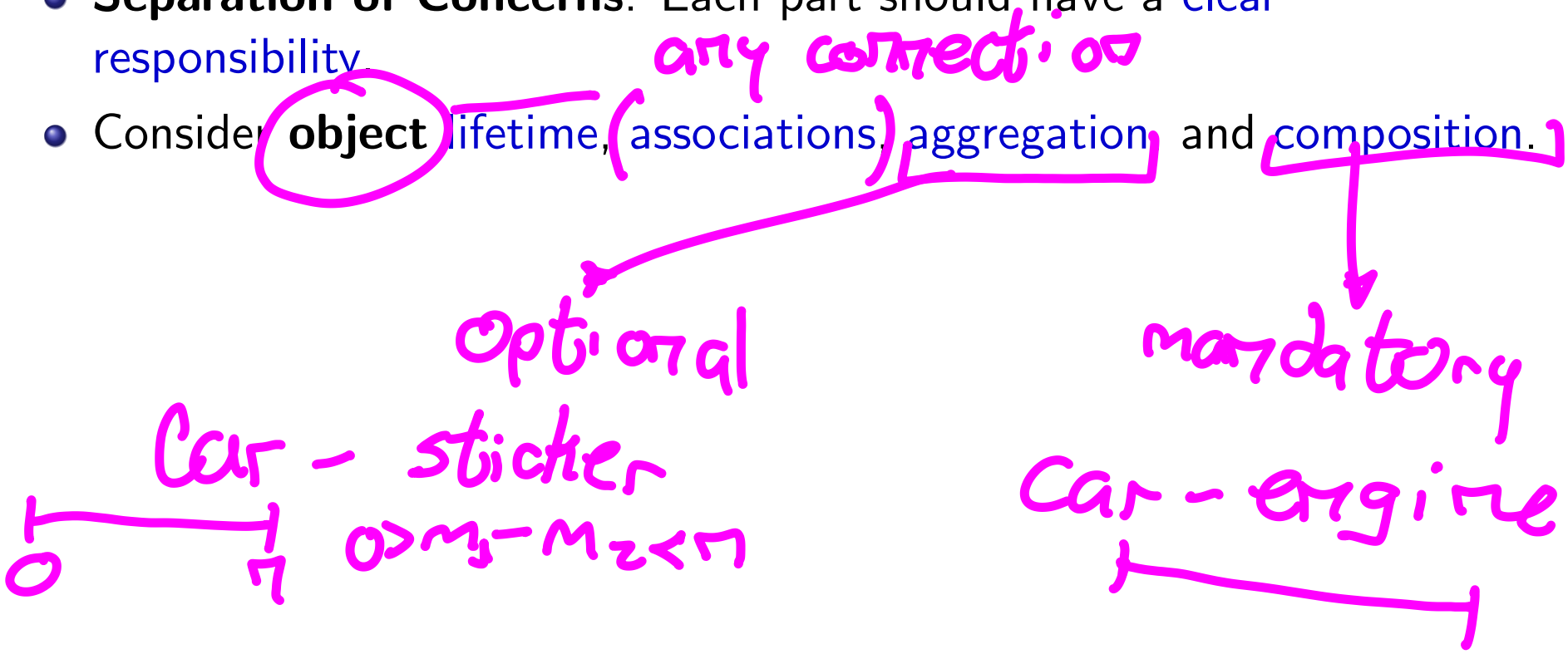

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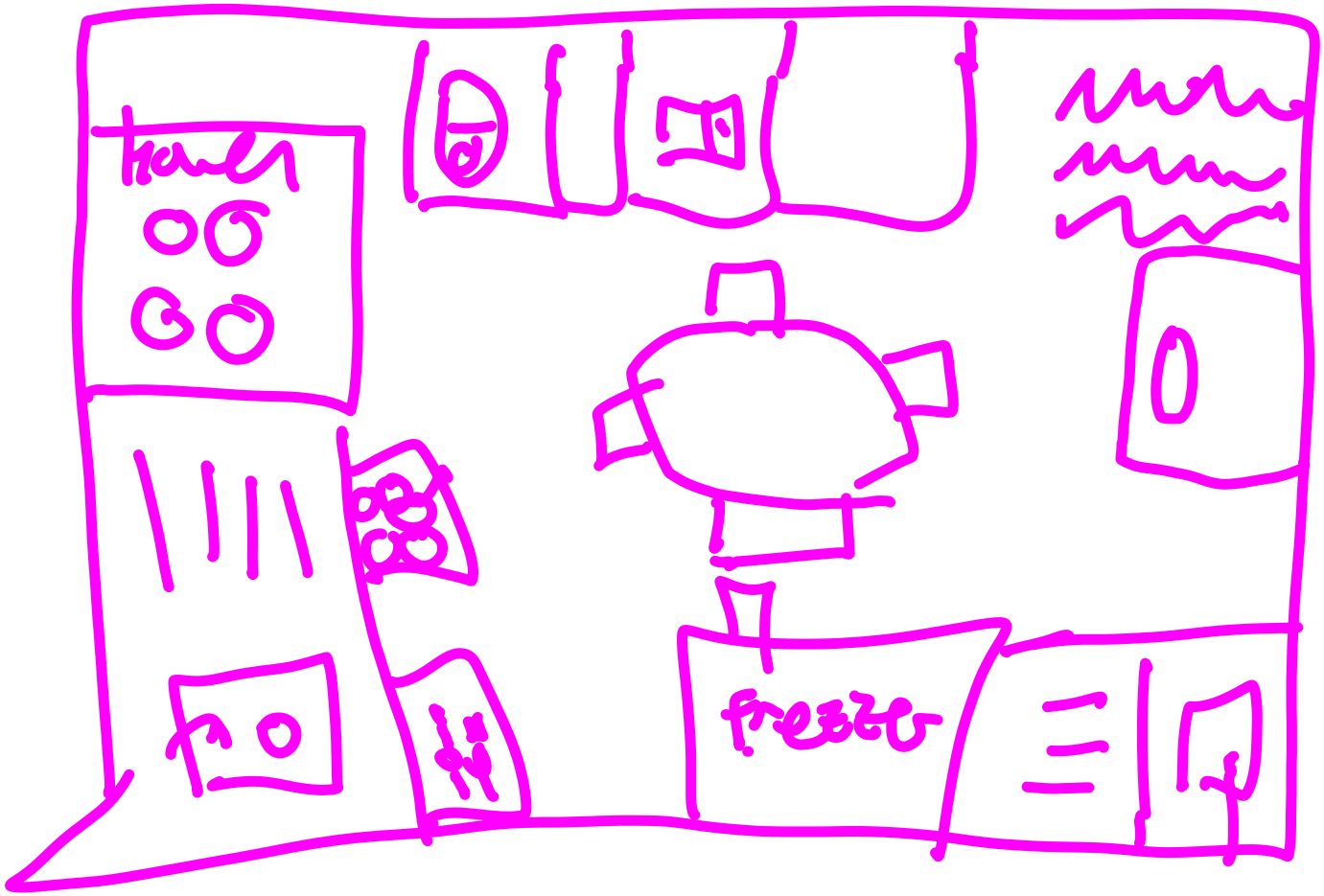
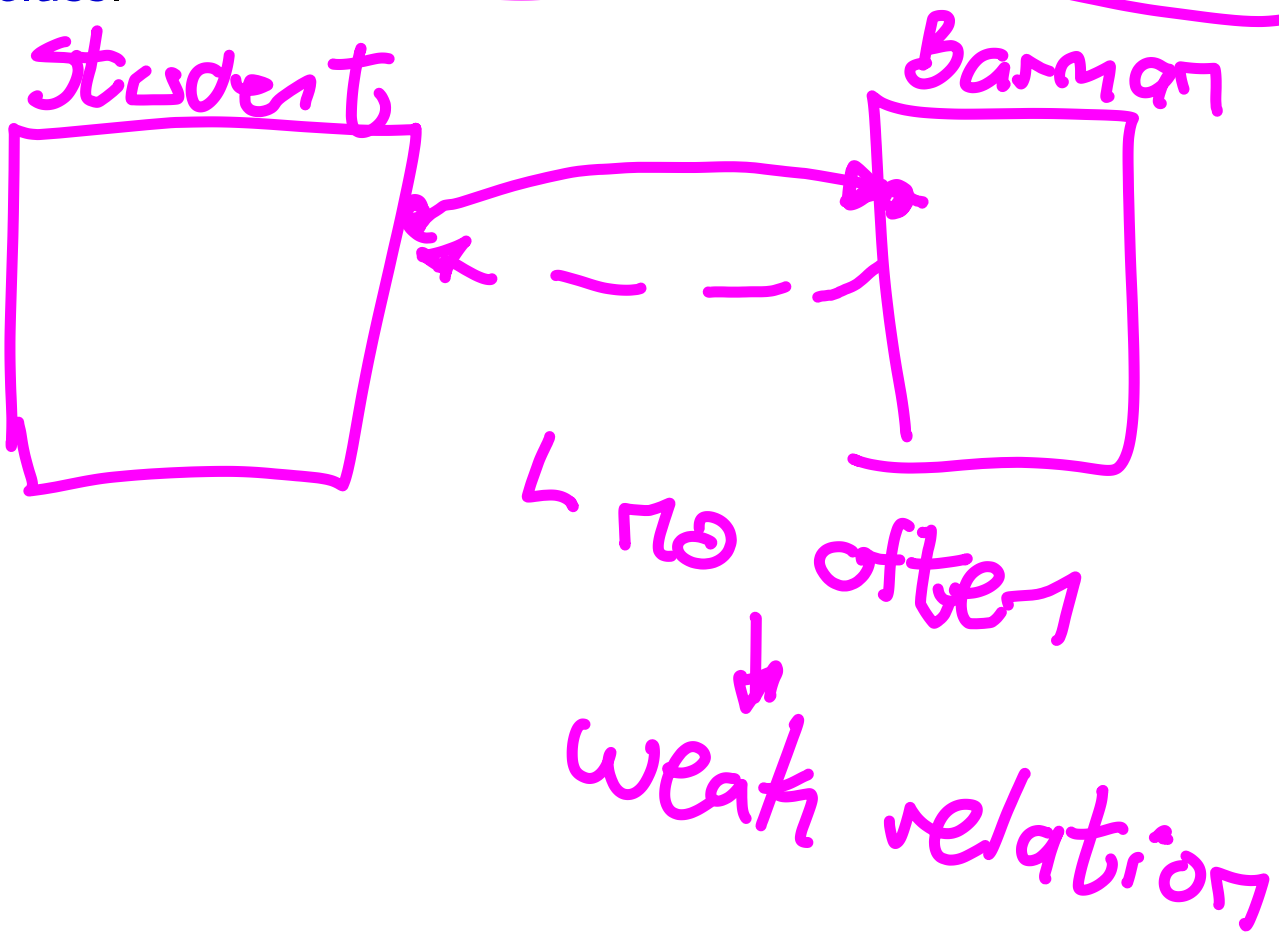
Decomposition Example: Kitchen in a House



Association

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



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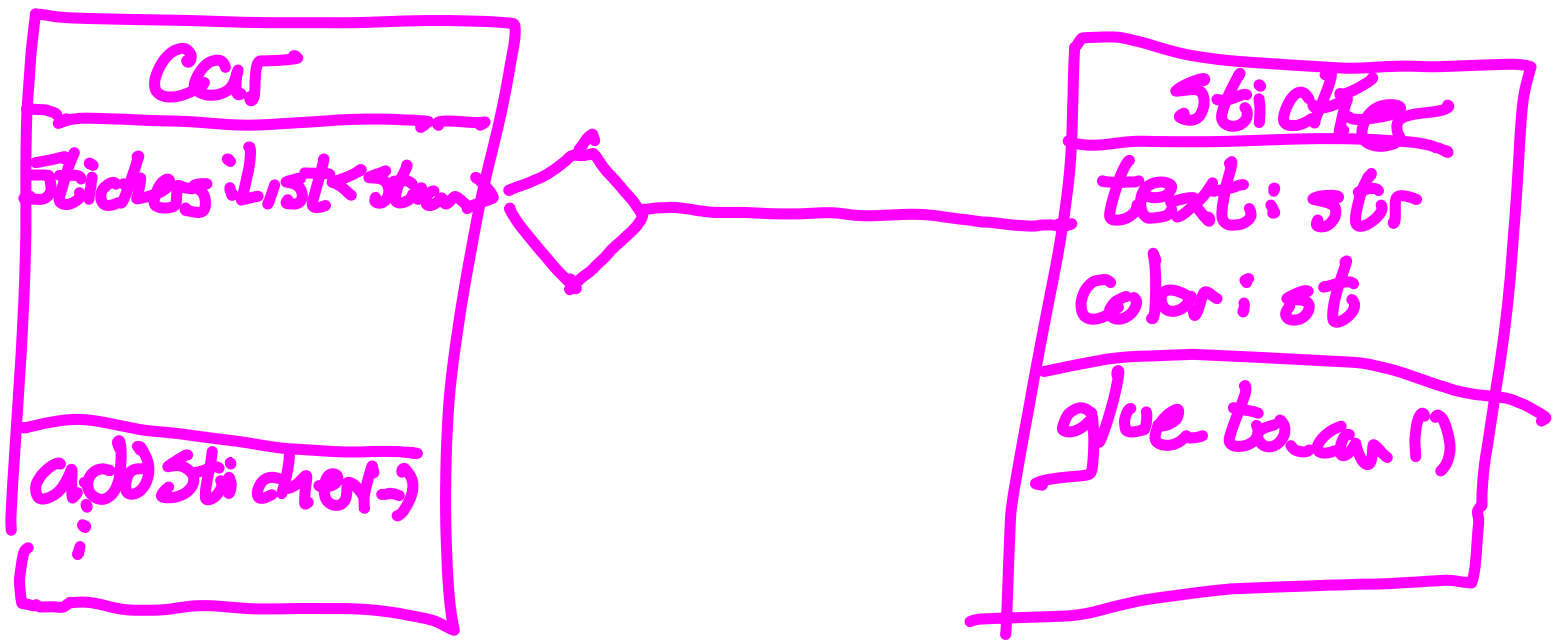

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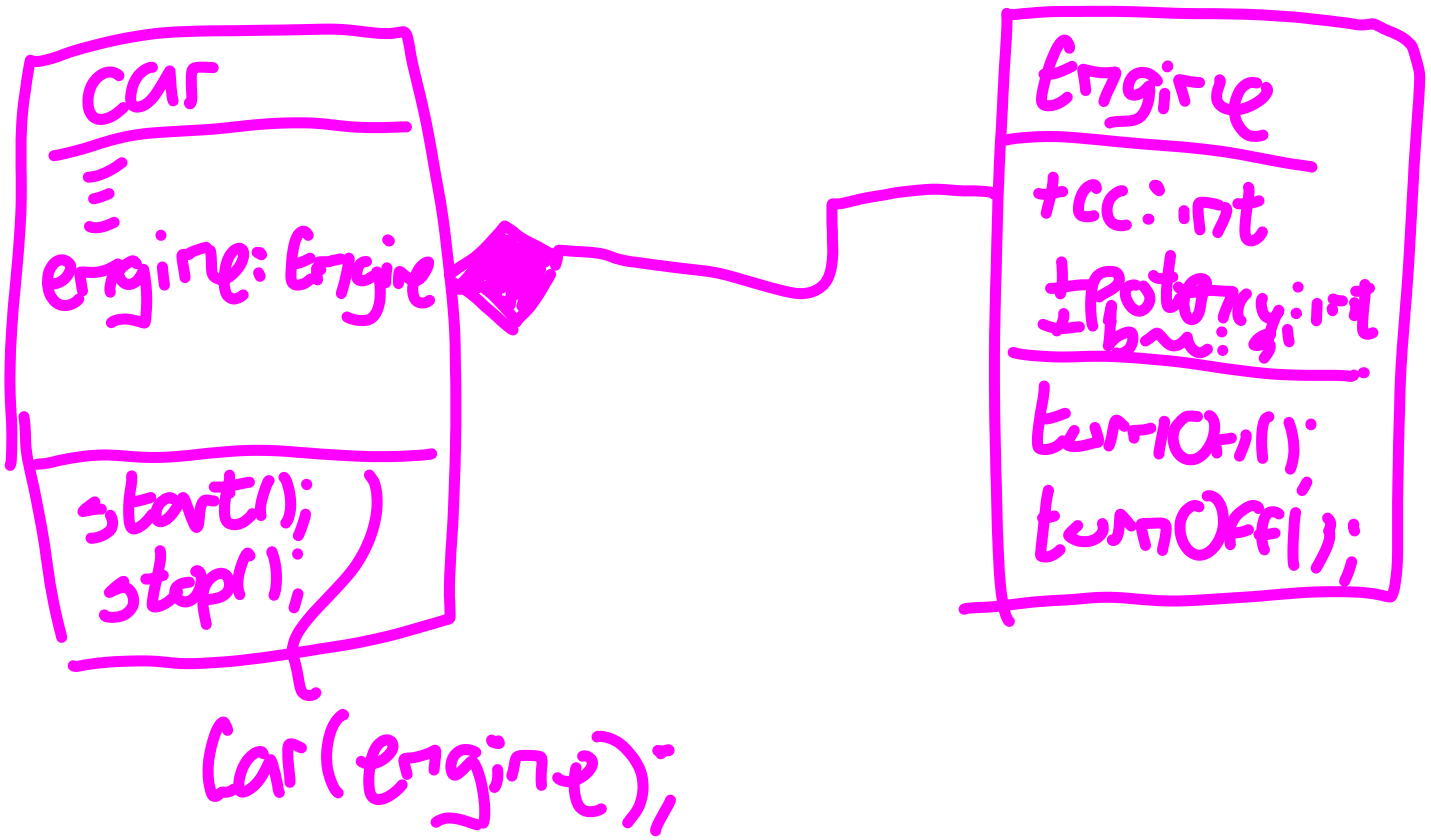

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Generalization

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- Behaviors can be generalized using **inheritance**, interface inheritance, and abstract classes.
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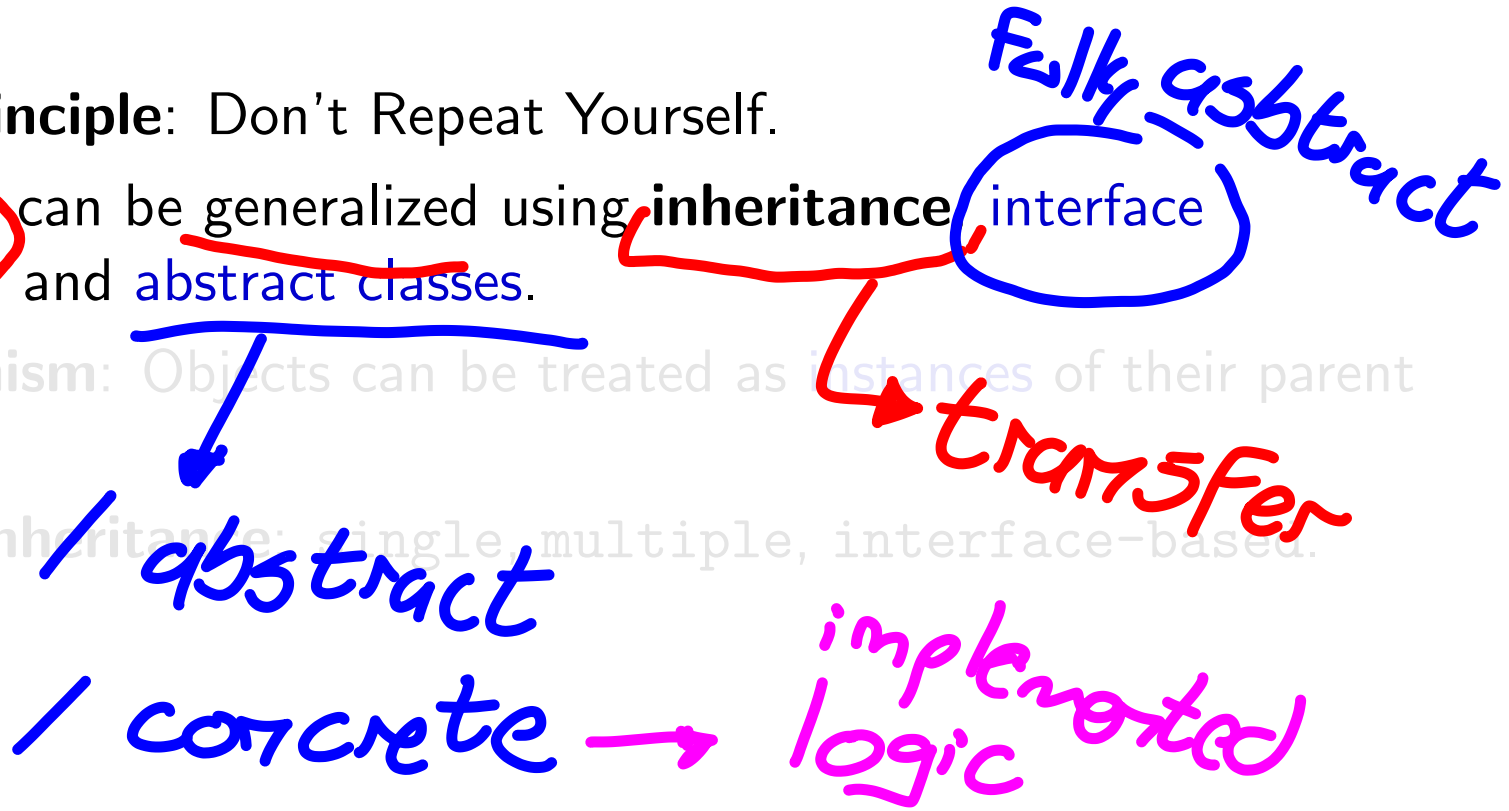

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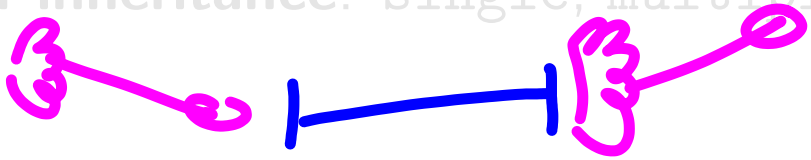

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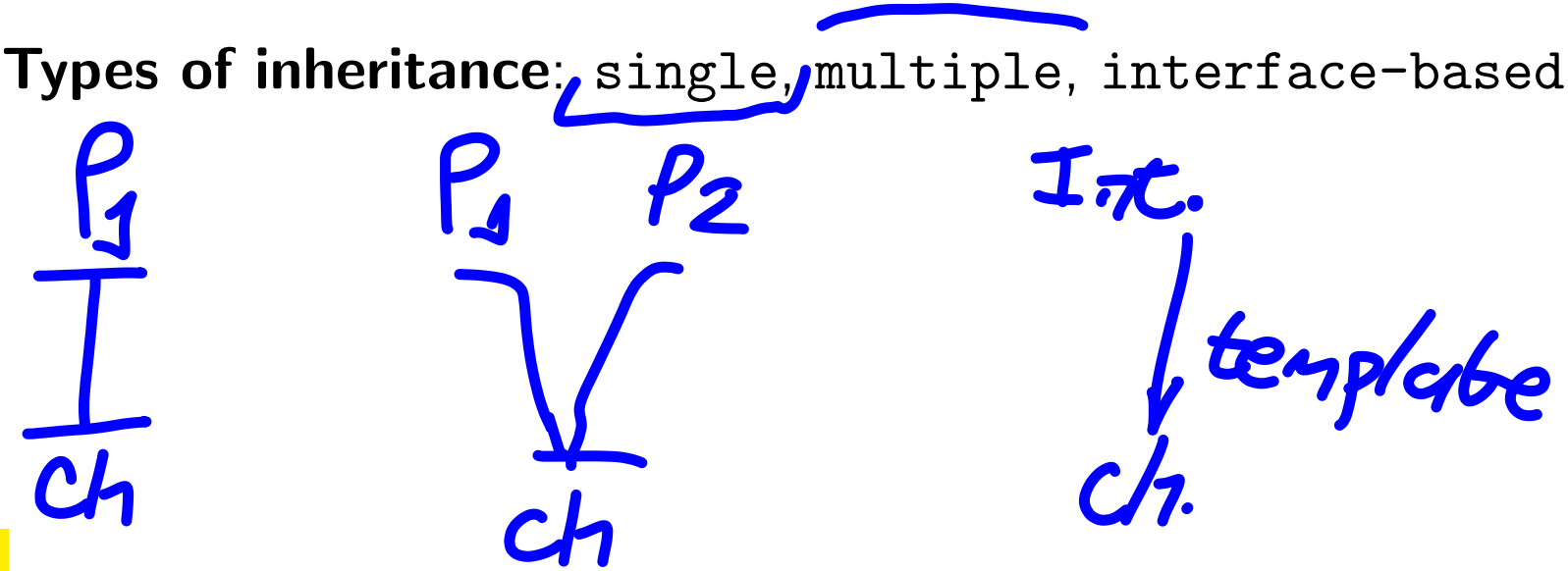

Inheritance

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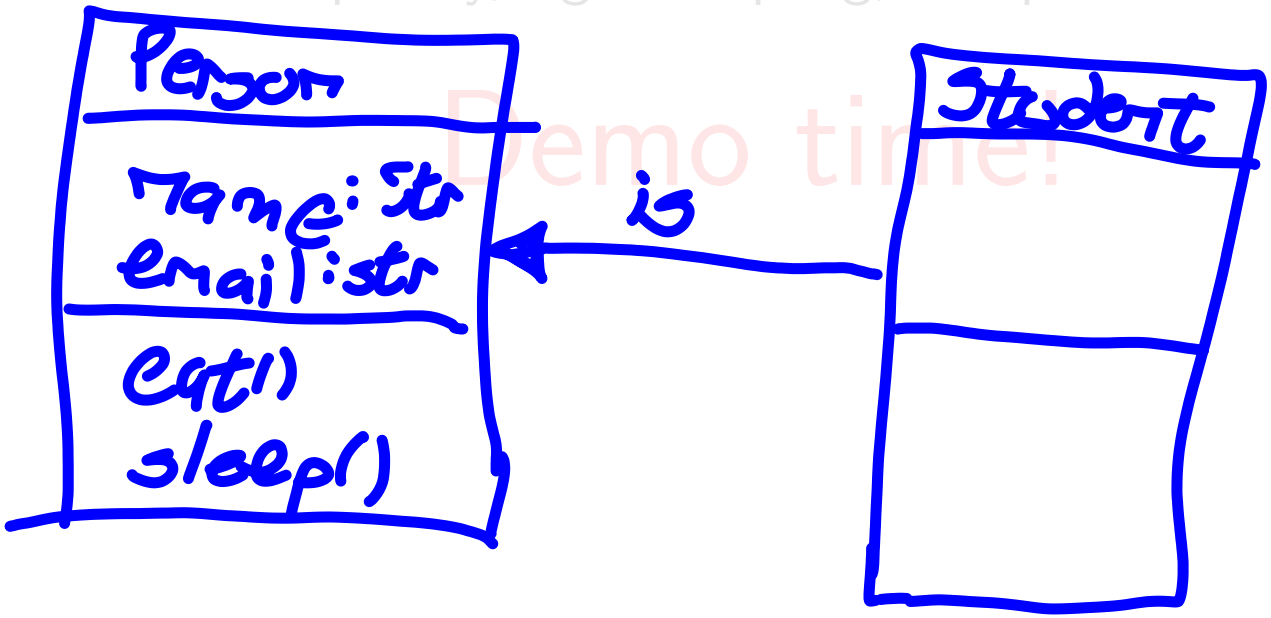

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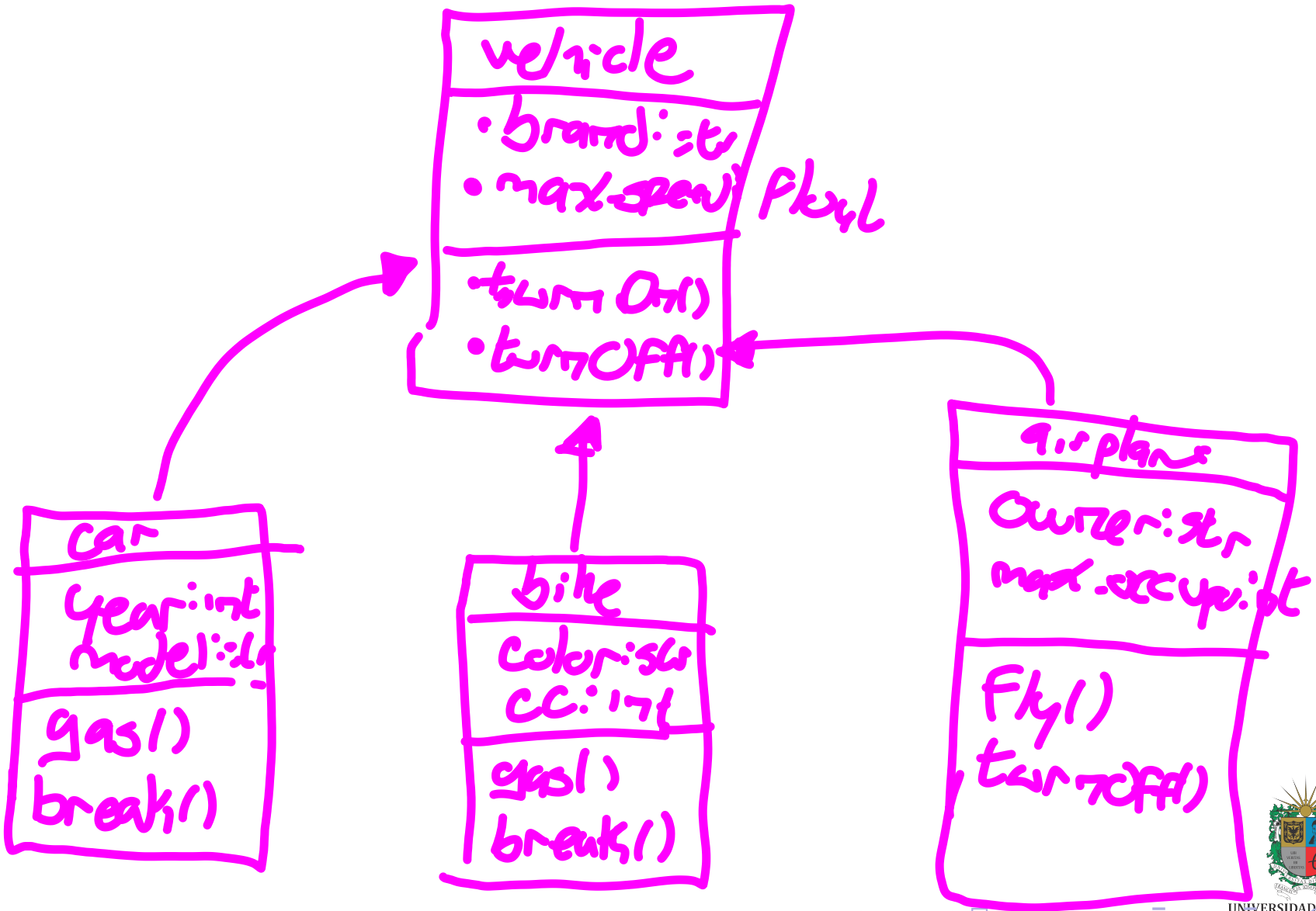
Inheritance & UML



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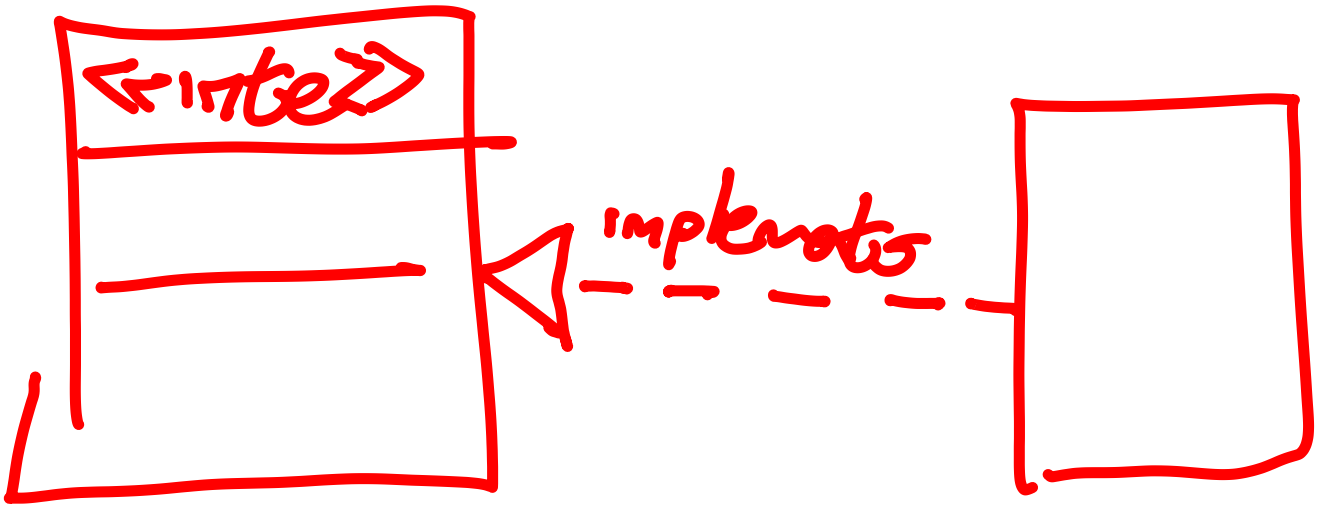
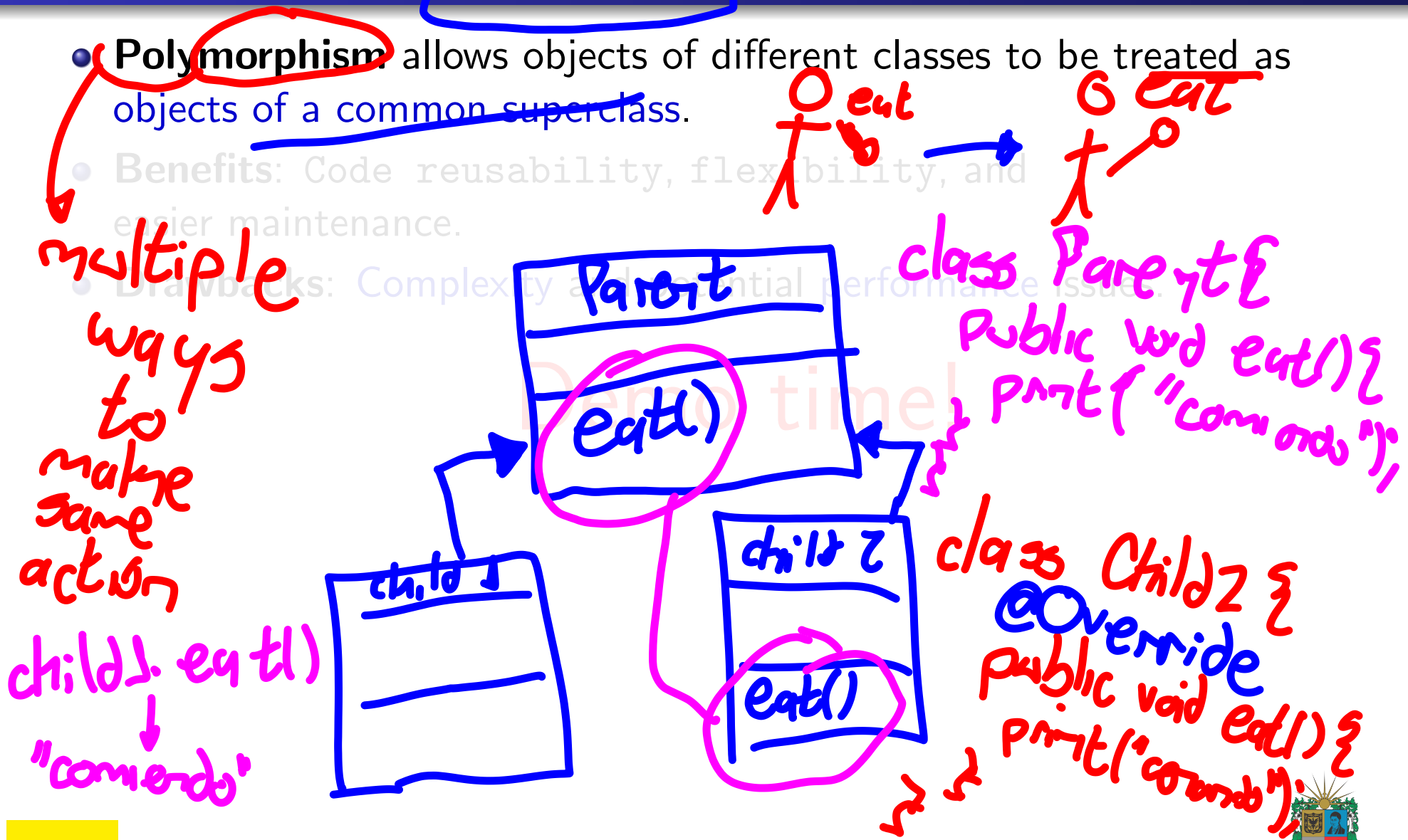


Polymorphism by Inheritance

- **Polymorphism** allows objects of different classes to be treated as objects of a common superclass.
- **Benefits**: Code reusability, flexibility, and easier maintenance.
- **Drawbacks**: Complexity and potential performance issues.

Demo time!



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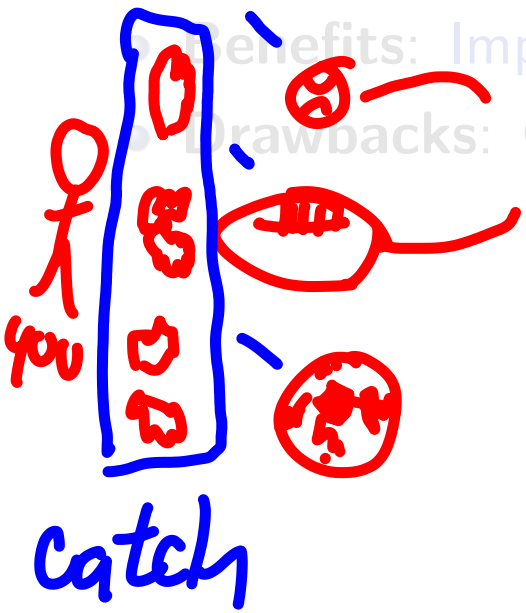


```
class You{
public void catch(int weigth){
    print("catch tennis of "+weigth);
}
public void catch(double size){
    print("catch football of size"+size);
}
public void catch(int size, int air){
    print("soccer");
}
}
```

```
you.catch(5);
you.catch(2,5);
```

Polymorphism by Overloading

- **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.

Demo time!

Outline

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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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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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Outline

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Thanks!

Questions?

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

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