

OBJECT-ORIENTED MODELLING

Object-Oriented Programming

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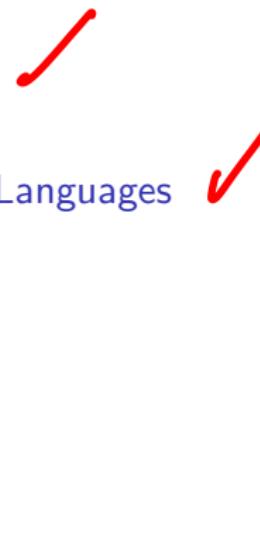
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2025-III



Outline

- 1 Creating Models in Design
- 2 Evolution of Programming Languages
- 3 Four Design Principles
- 4 SOLID Principles



Outline

1 Creating Models in Design

2 Evolution of Programming Languages

3 Four Design Principles

4 SOLID 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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1

2



Understanding the Requirements

- Requirements must be well understood before design.
 - Ask questions, clarify ambiguities, and document all requirements.
 - Requirements define the scope and direction of the design.
- list → need*



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business vocabulary



Design Based on the Problem

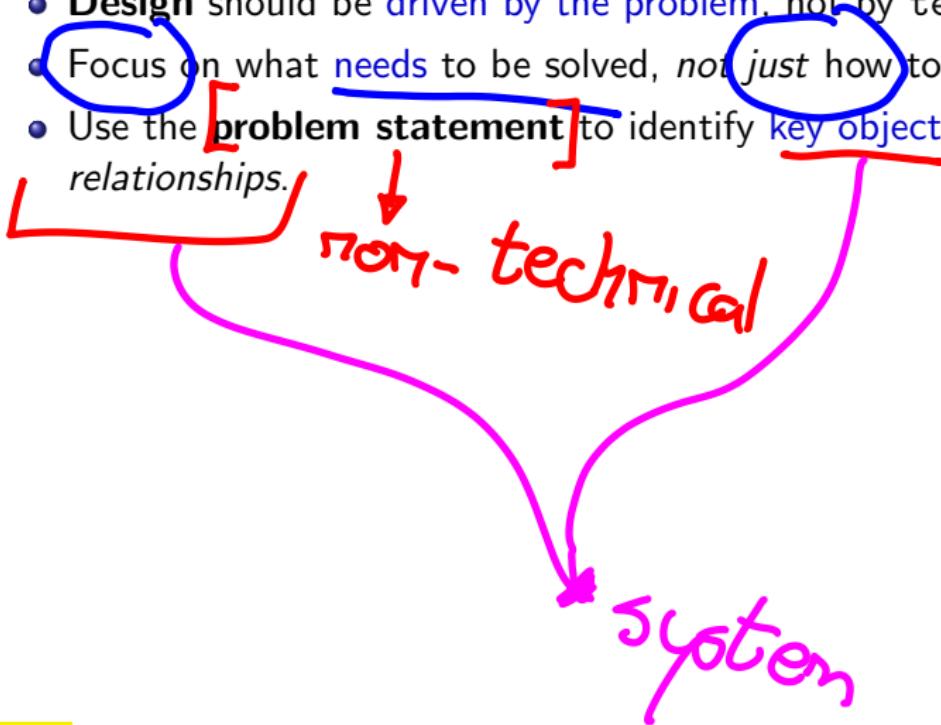


- **Design** should be driven by the problem, not by technology.
- Focus on what needs to be solved, *not just* how to implement it.
- Use the **problem statement** to identify key objects and their *relationships*.



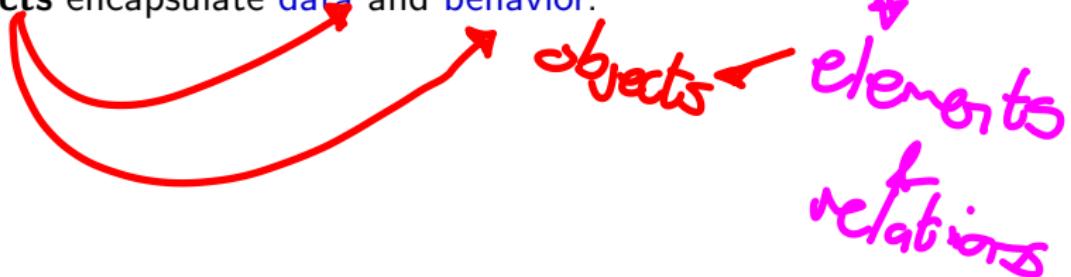
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Object-Oriented Approach

- 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.

• **Diagrams**

• **UML**

• **Unified modeling language**

• **draw.io**



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+ user

tech team

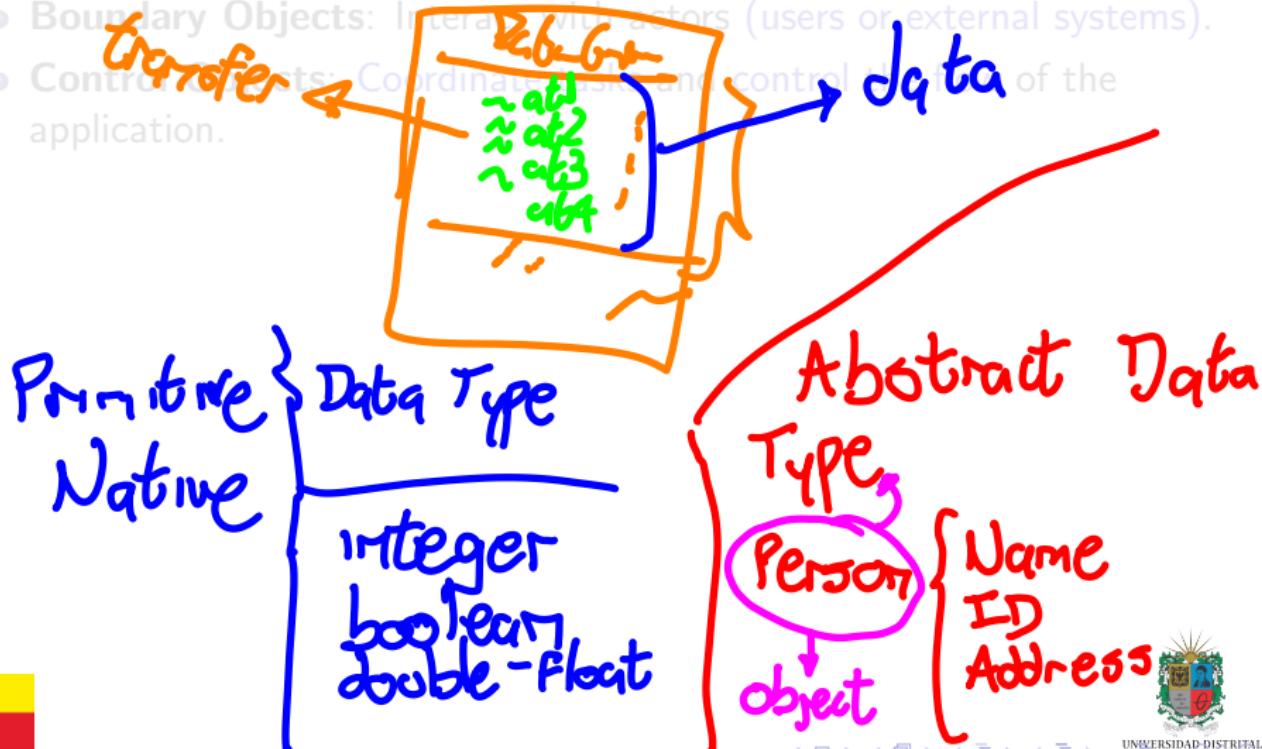
expectations



Categories of Objects

- **Entity Objects:** Represent **information** and **data**.

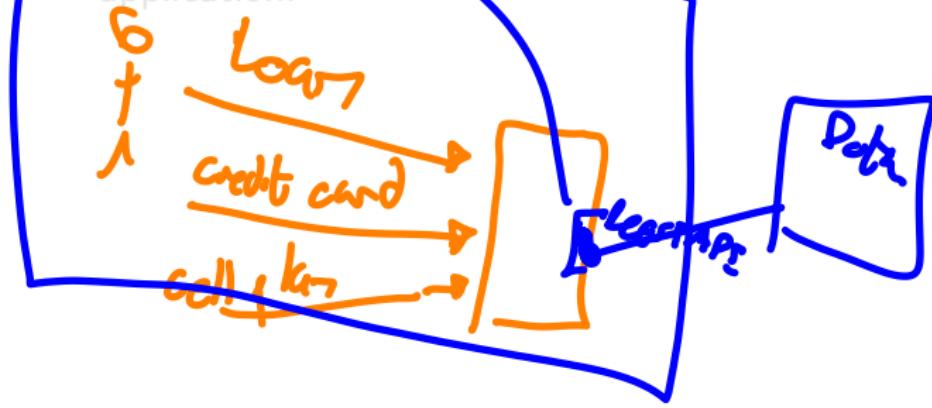
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- **Control Objects:** Coordinate logic and control flow of the application.



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logic
most of the objects



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.



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old



solve problems

Findar
nous
solucionar



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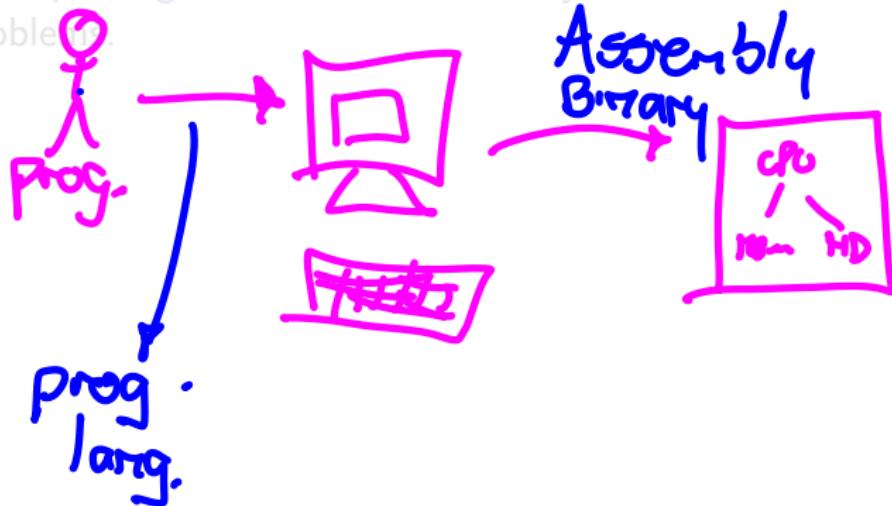
3 Four Design Principles

4 SOLID Principles



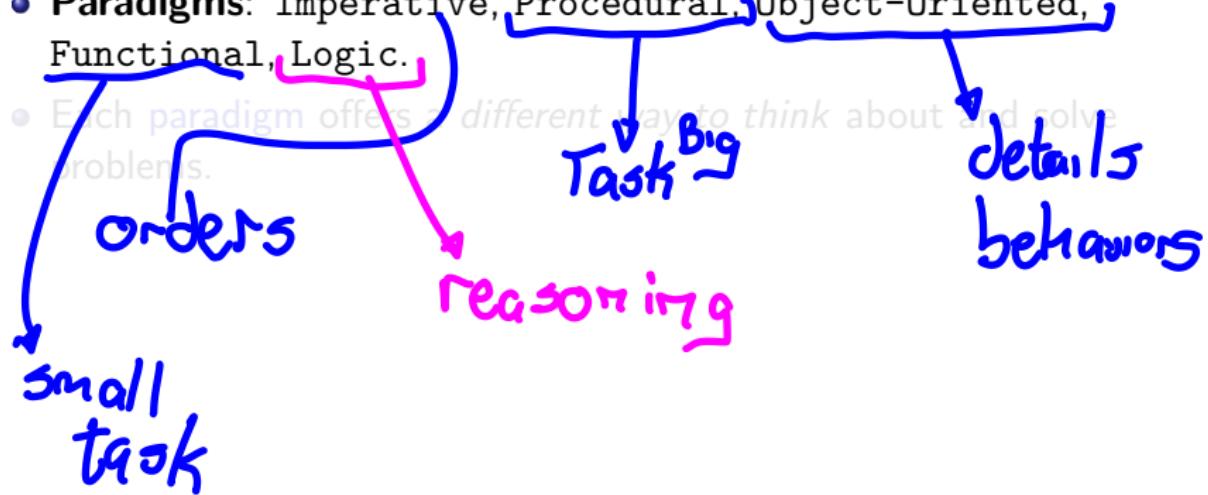
Talk with Machines: Programming Paradigms

- 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.



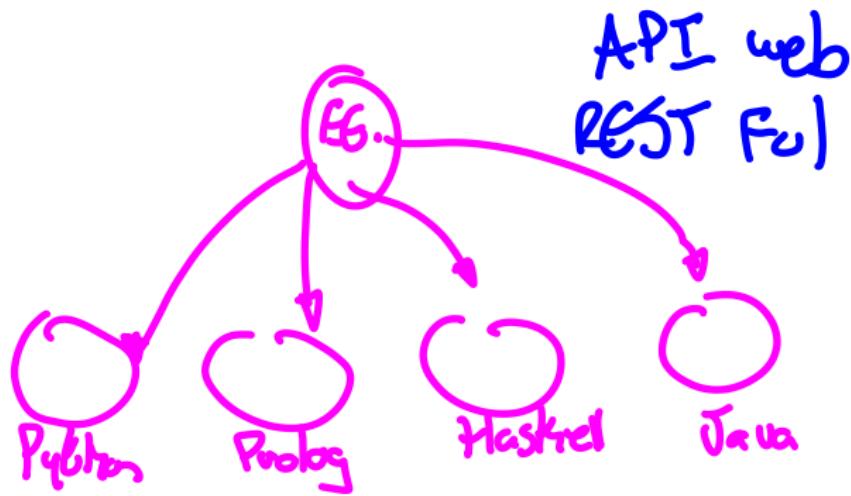
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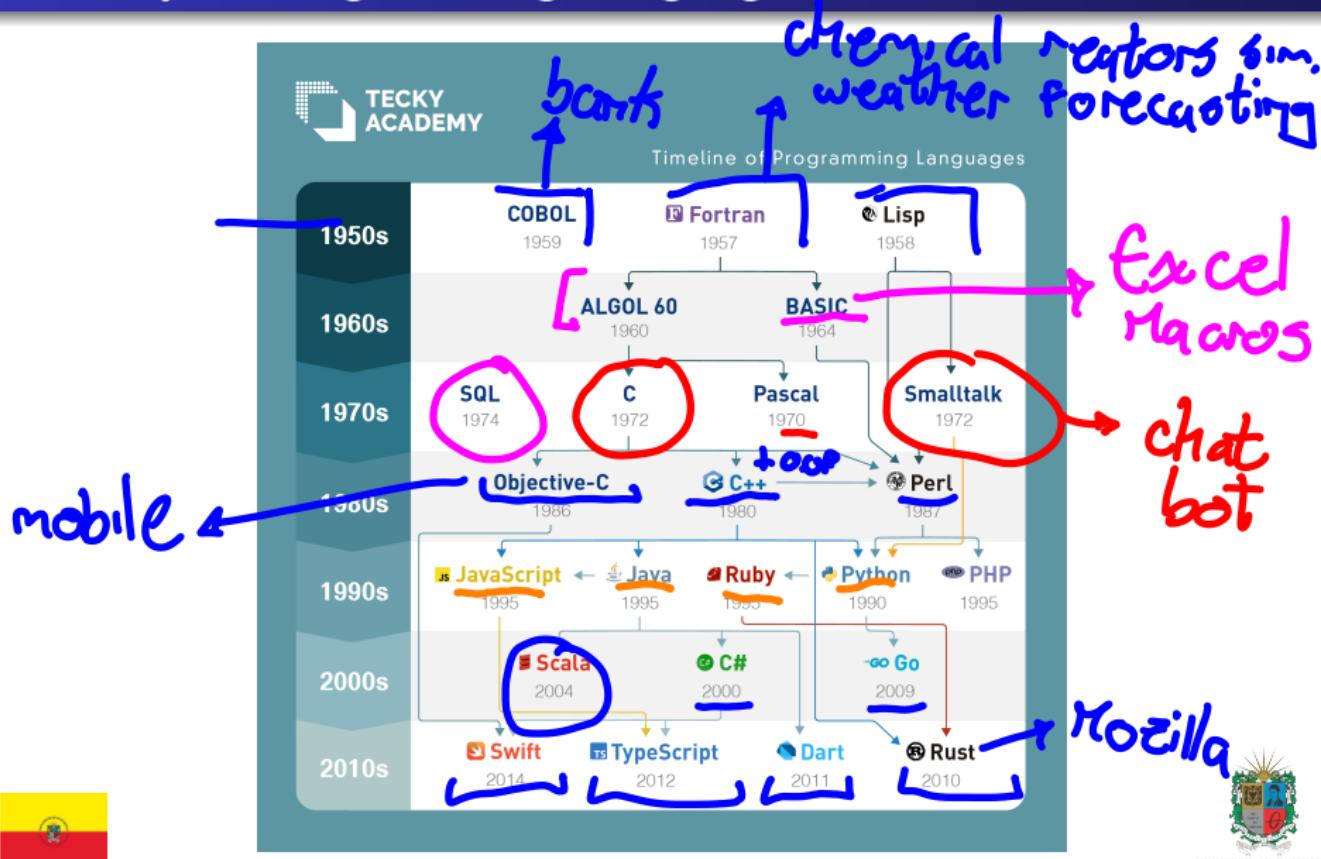


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History of Programming Languages



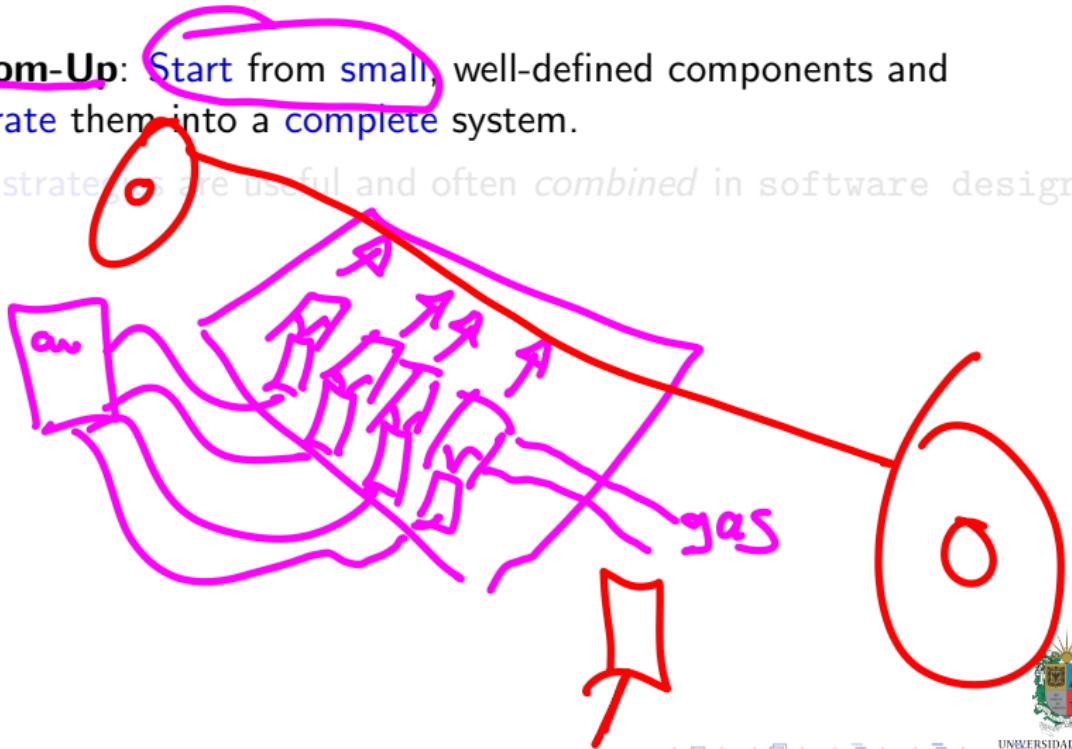
Strategies to Solve Problems

- **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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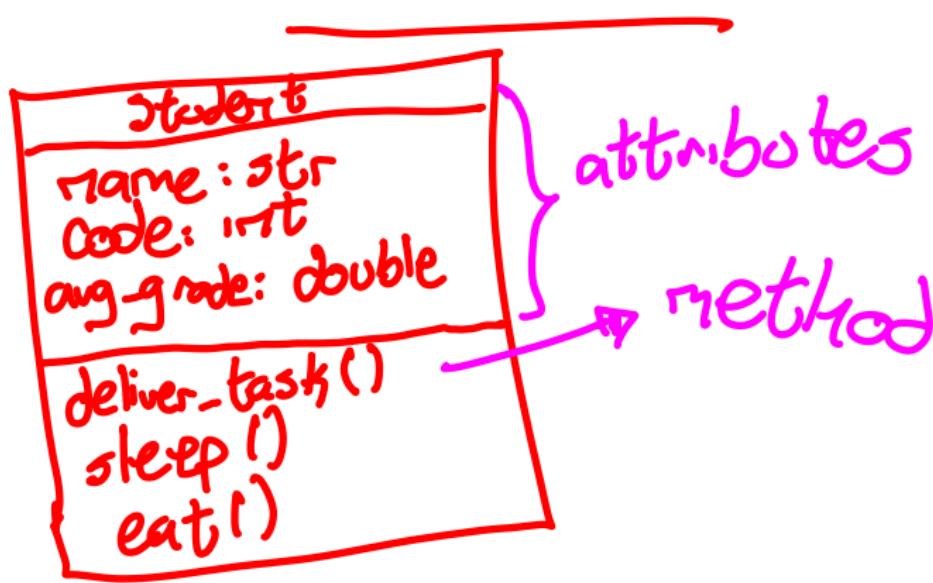
Object-Oriented Design and Contracts

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



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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 communication by having clearly defined standards

Diagram illustrating the components of UML:

- Class Diagram
- Deployment Diagram
- Activity Diagram
- Use Case Diagram

A large bracket on the right side groups "Deployment Diagram", "Activity Diagram", and "Use Case Diagram" under the heading "standard".



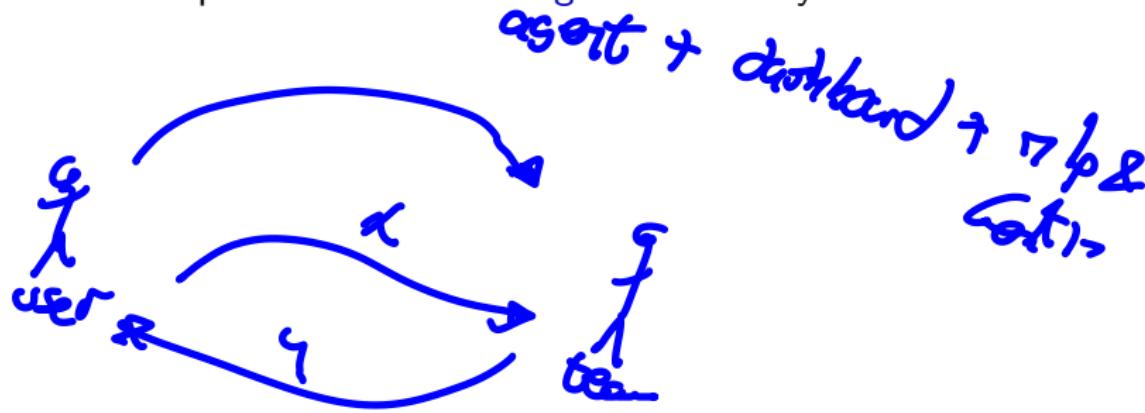
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 - UML helps communicate design ideas clearly.
- oop* *calls*
- Requirements*



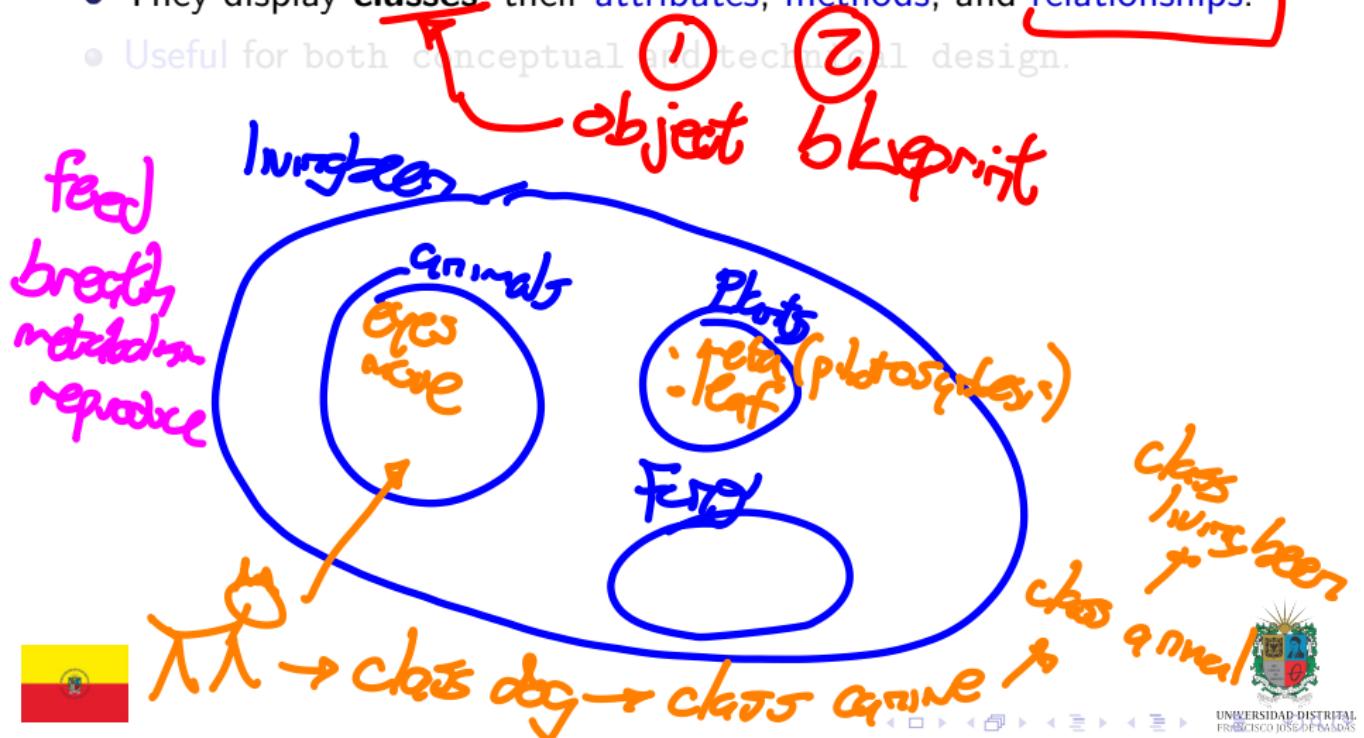
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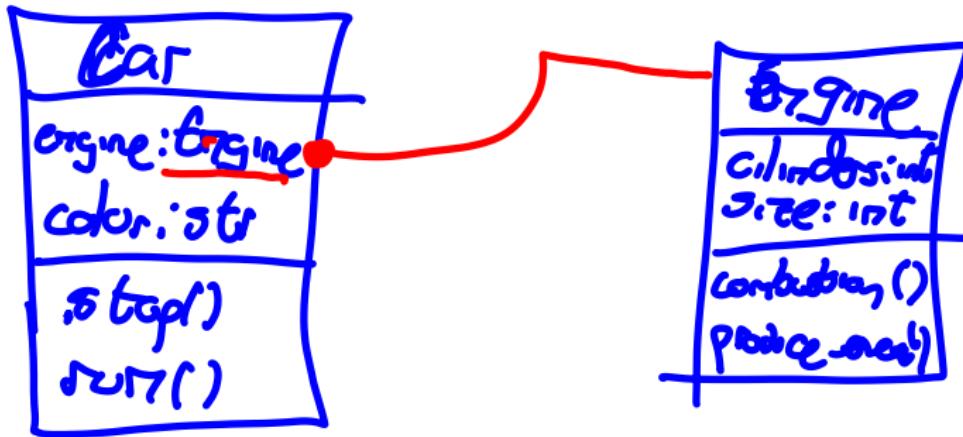
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- They display **classes**, their **attributes**, methods, and **relationships**.
- Useful for both conceptual and **technical design**.



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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*.

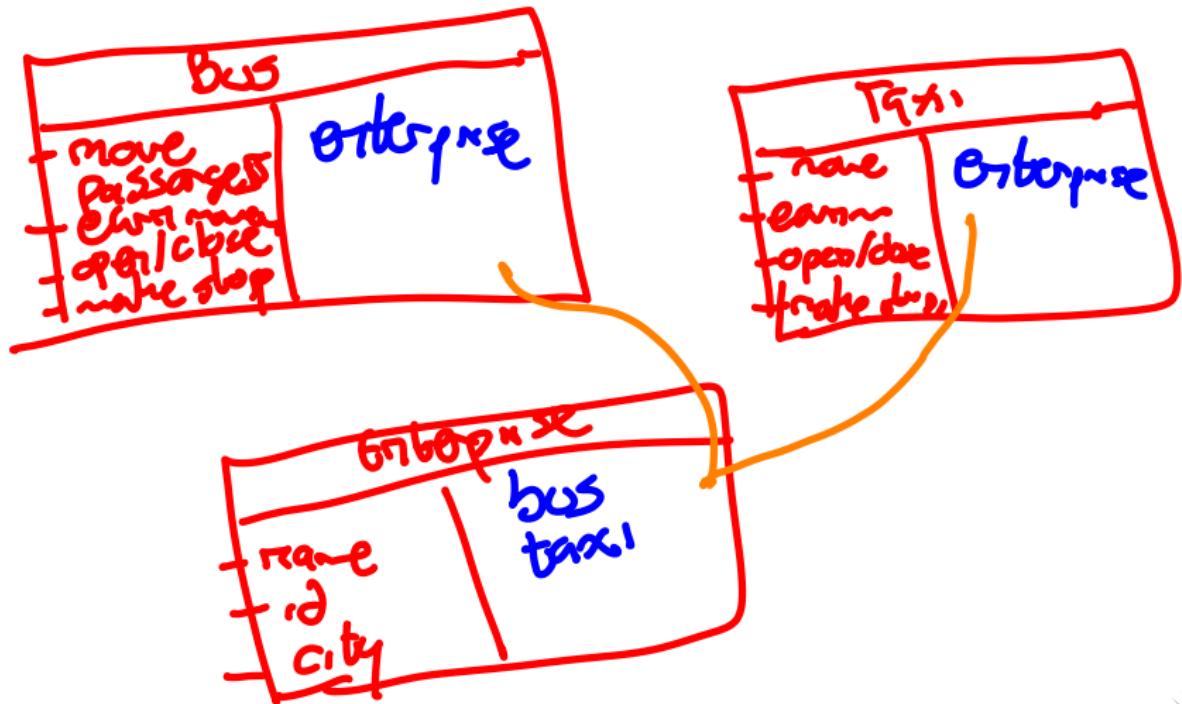


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Abstraction & CRC Cards



Encapsulation

- **Encapsulation** bundles attributes and methods together.



Expose only what is necessary (access levels: public, private, protected).

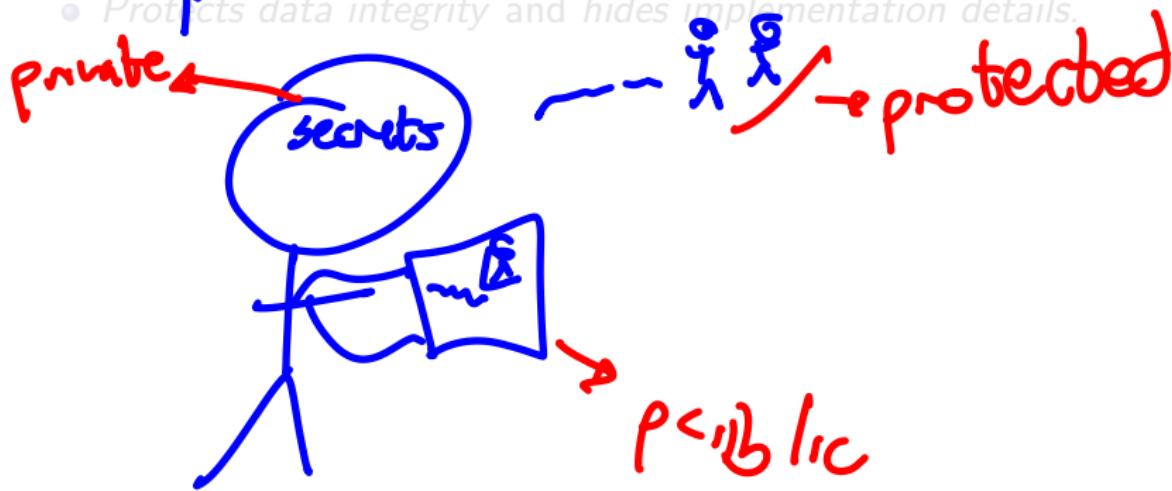
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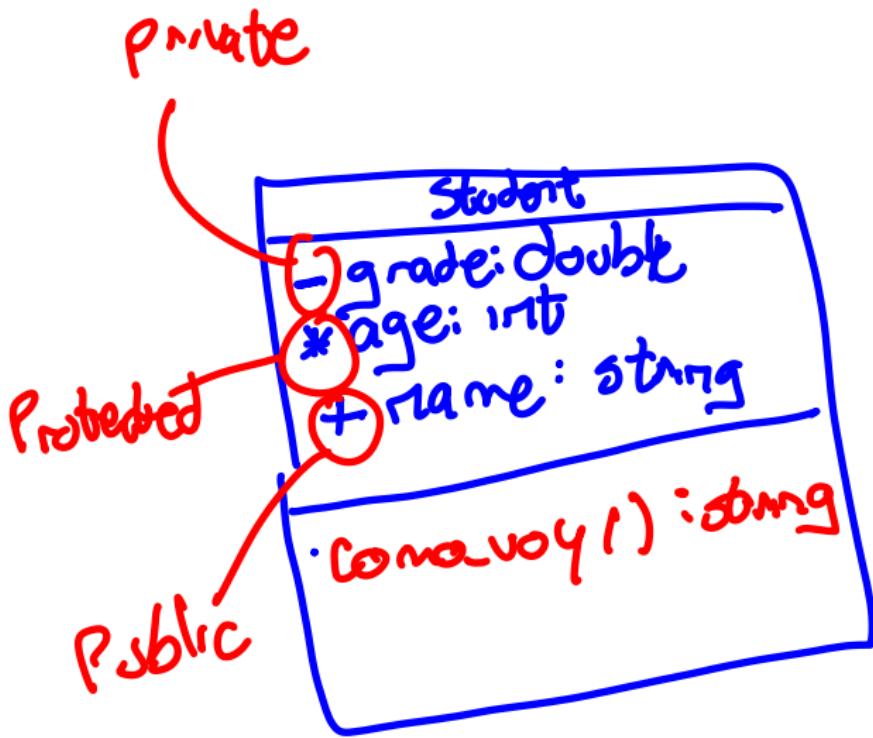
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```
public class Student {  
    private double grade;  
    protected int age;  
  
    public String cond-way() {  
        if (grade >= 3.0) {  
            return "Bien";  
        } else if (grade >= 2.0) {  
            return "Aprobado";  
        } else return "Alta vacante";  
    }  
}
```



Encapsulation & UML



Black Box Thinking

- Objects communicate through well-defined interfaces.
- Rule of Least Knowledge: Objects should know as little as possible about one another.
- 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.

Demo time!



Data Integrity: Getters and Setters

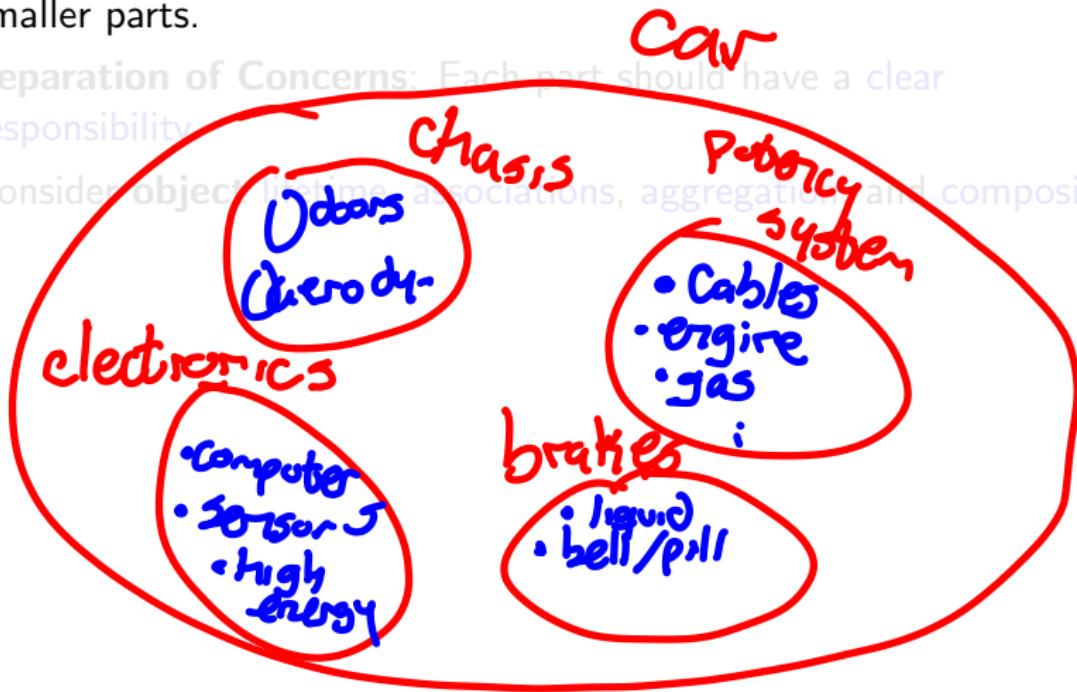
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Decomposition

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



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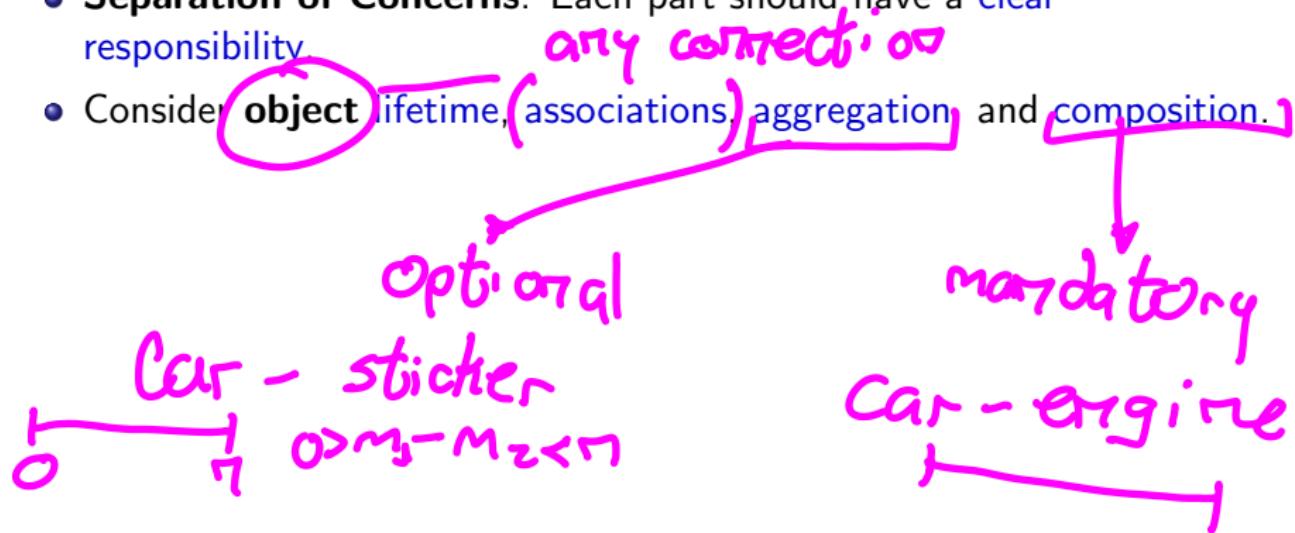
object

role

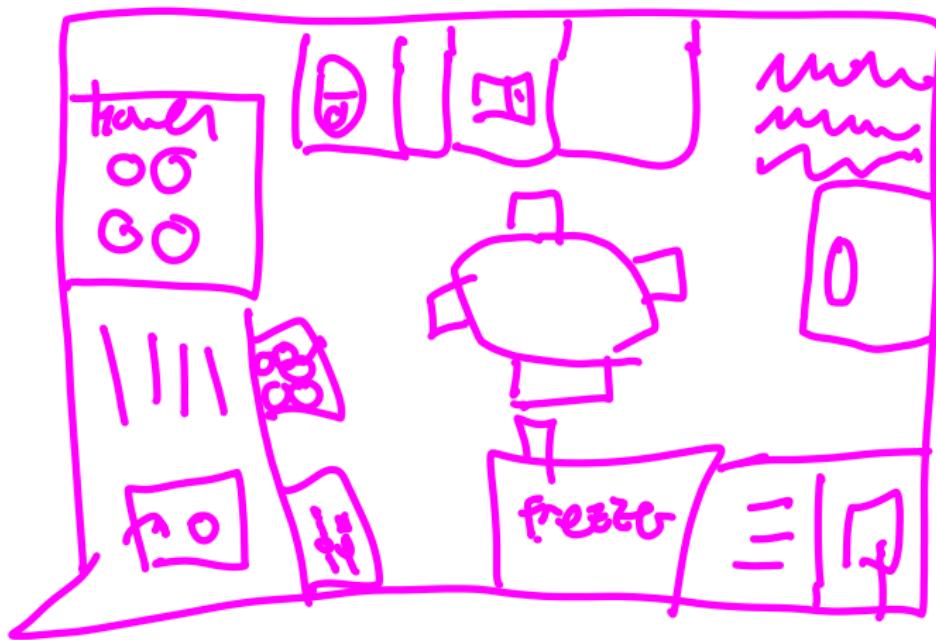


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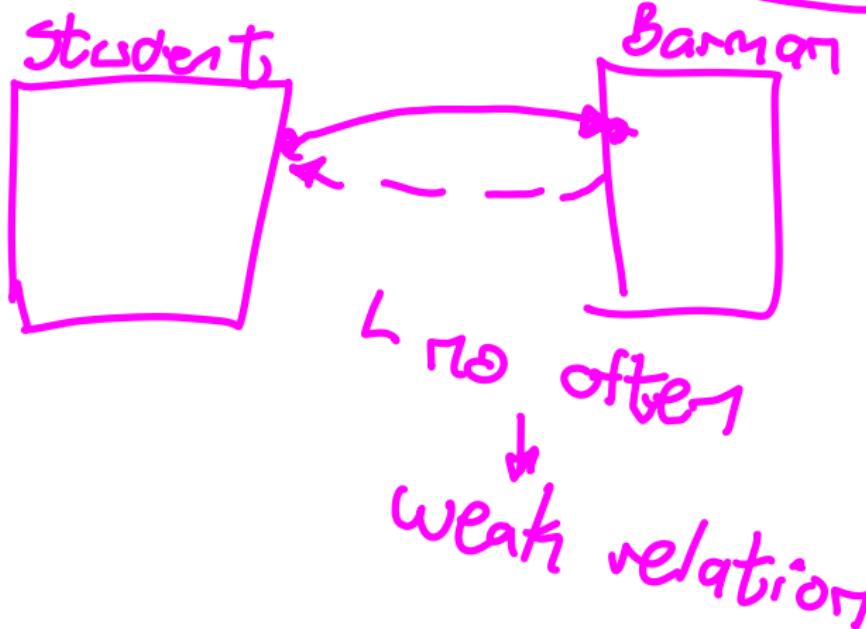


Decomposition Example: Kitchen in a House



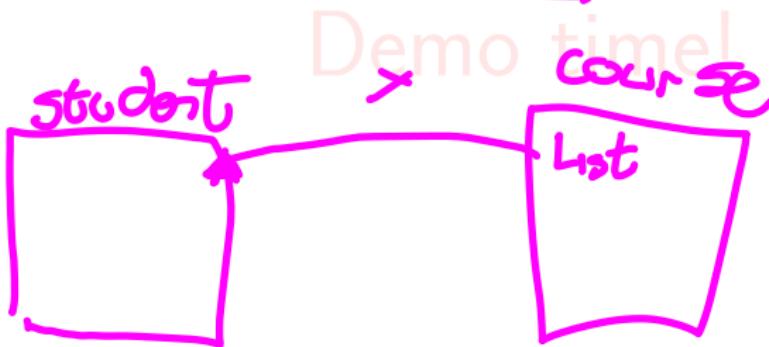
Association

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



Aggregation

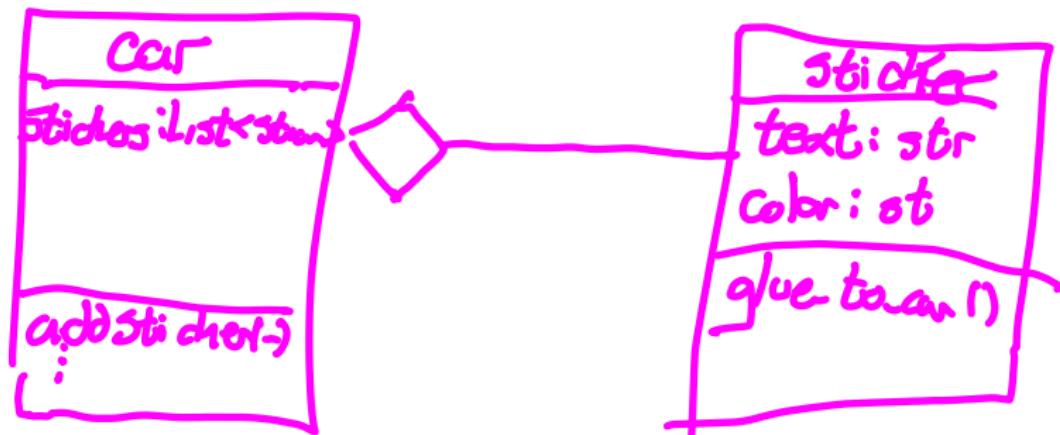
An **aggregation** is a **whole-part relationship** where one class is a **part** of another class, but **can exist independently**.



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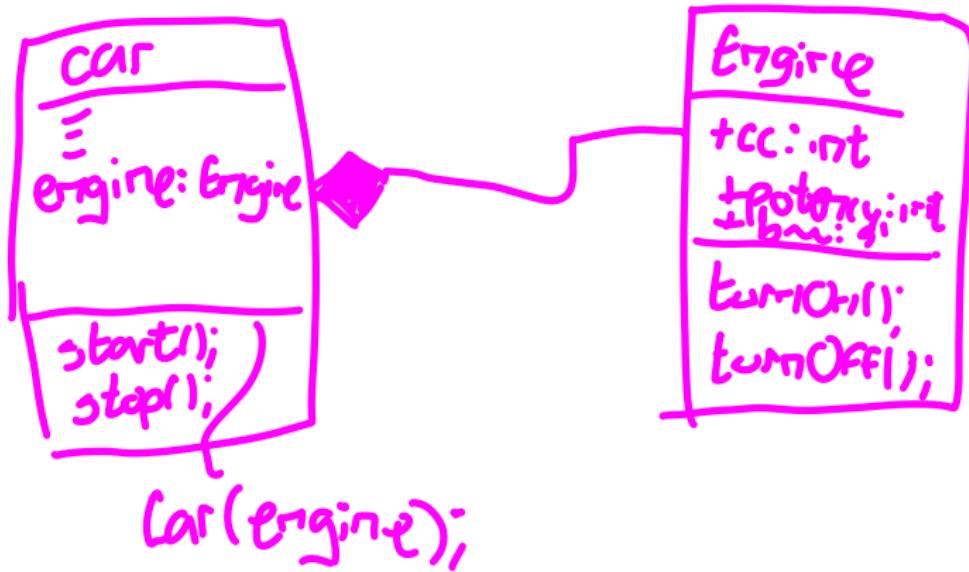
Demo time!



Composition

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

Demo time!



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

Demo time!



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: Subclasses can be treated as instances of their parent class.
 - Types of inheritance: single, multiple, interface-based.



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/ abstract

/ concrete →

implemented logic

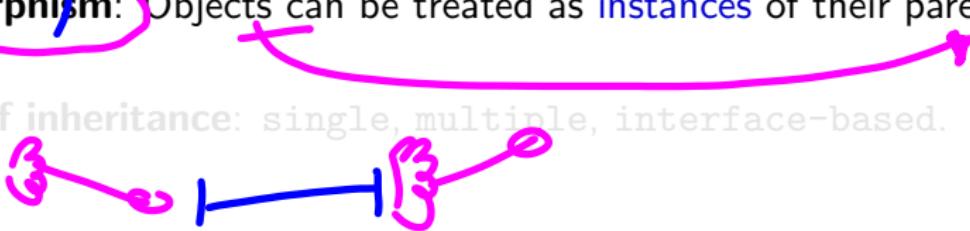


Transfer



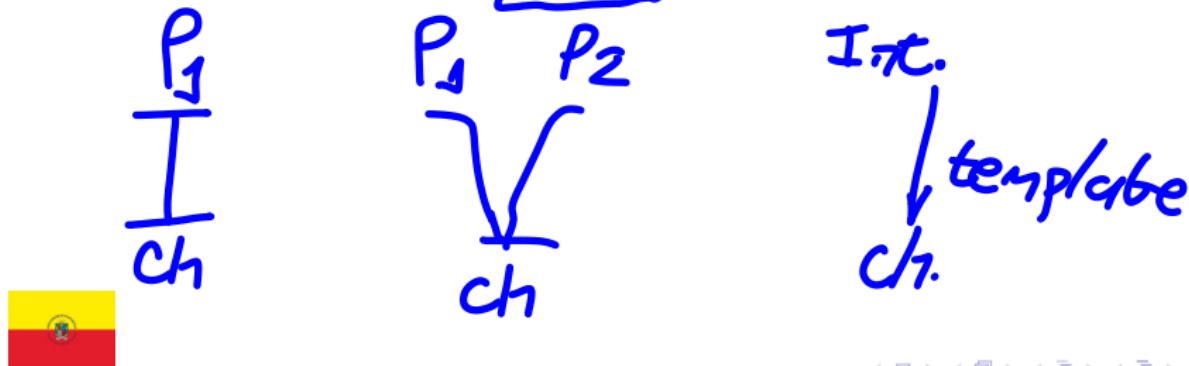
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Inheritance

- **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.
- data + behaviour*

Demo time!



Inheritance

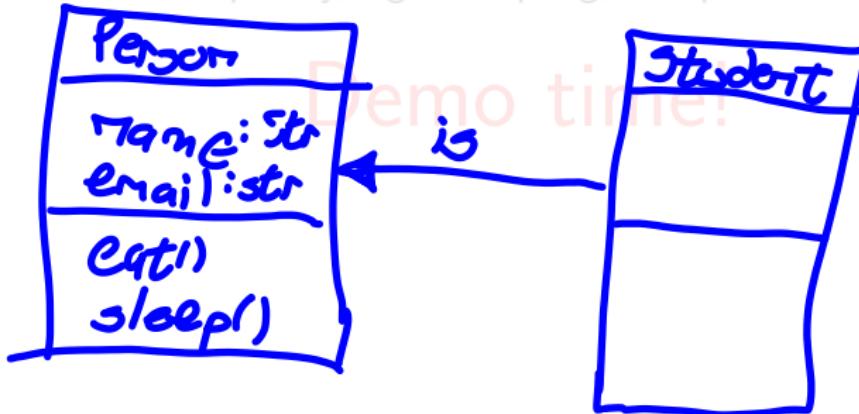
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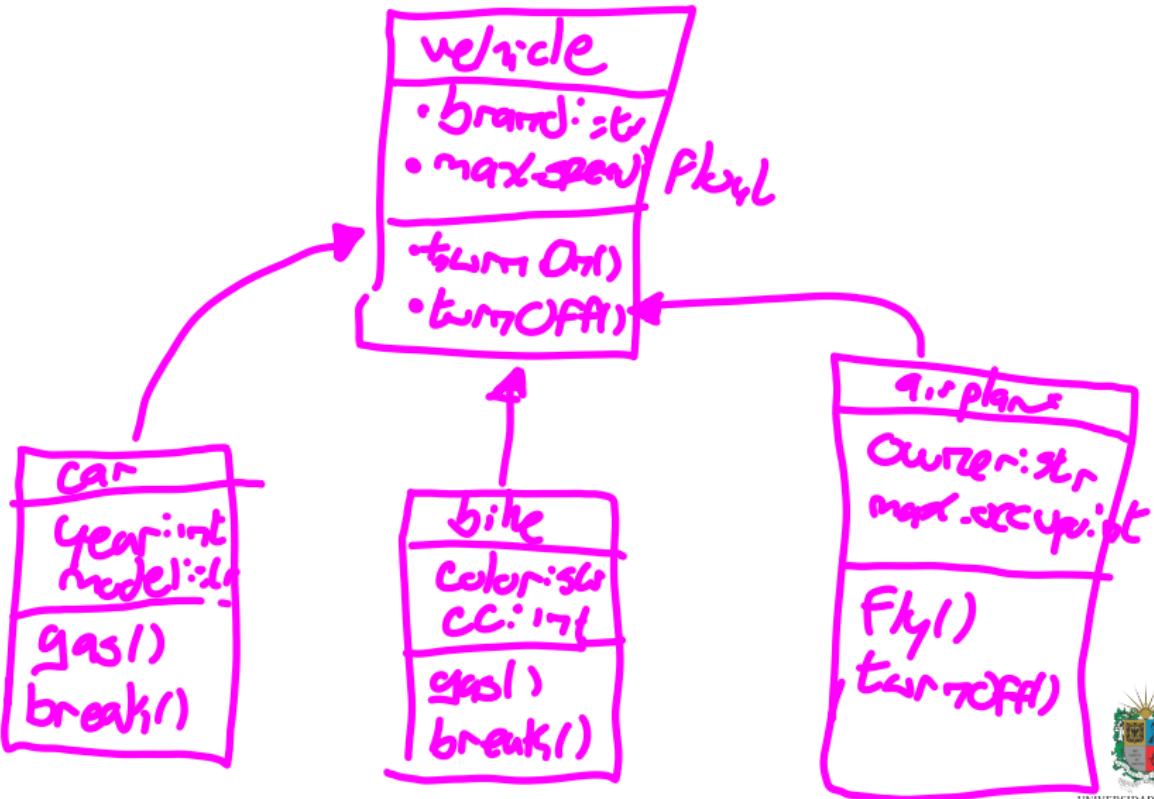
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- by inheritance*

Demo time!



Inheritance & UML



Interface Inheritance

- **Interface inheritance** allows a class to implement an interface without inheriting its implementation.
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abstract *Concrete*

Demo time!

no logic template *logic*



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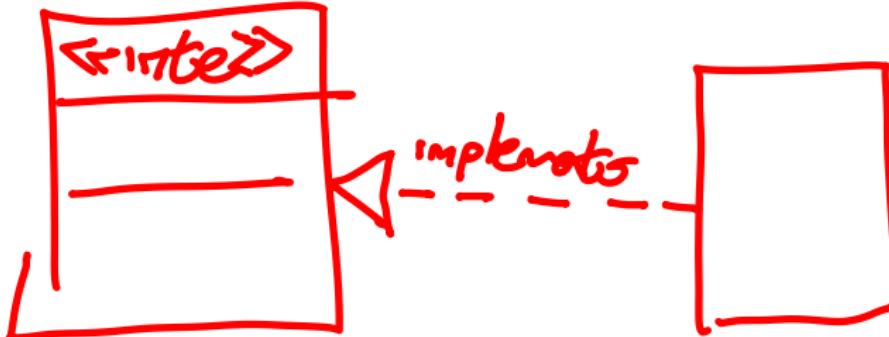
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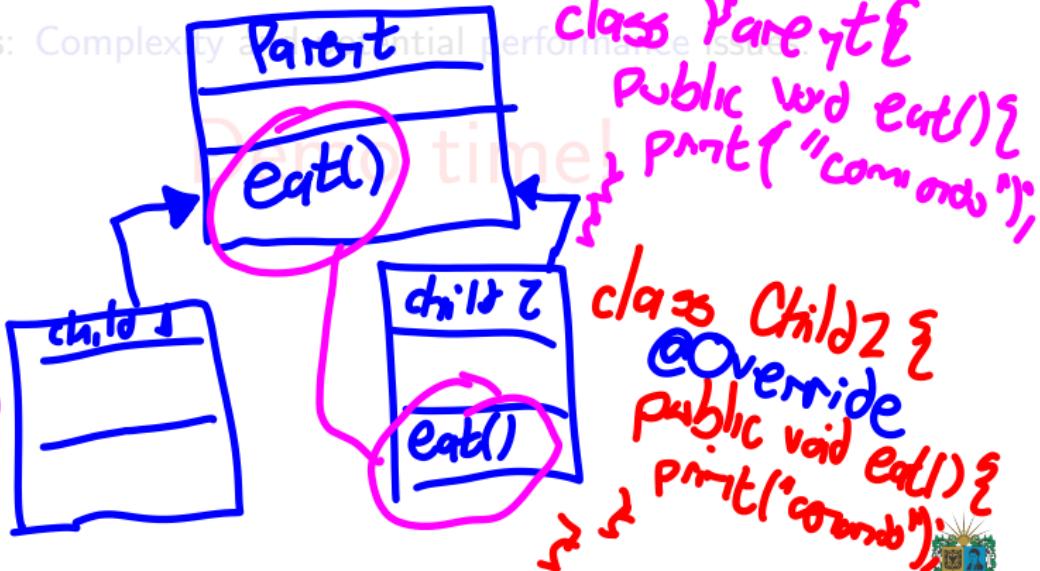
Demo time!



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.

multiple ways to make same action
child1.eat() "comiendo"



Polymorphism by Inheritance

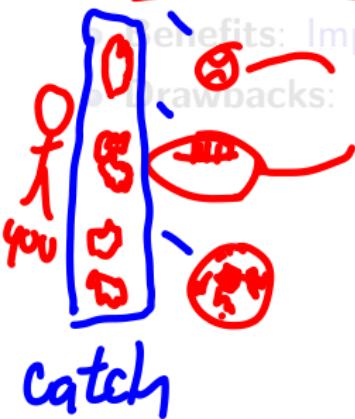
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Demo time!



Polymorphism by Overloading

- **Polymorphism by overloading** allows **multiple methods with the same name** but **different parameters**.



Demographic

```

class Yogi {
    public void catch1(int weight) {
        print("catch tennis of "+weight);
    }
}

```

```

public void catch(double size) {
    print("catch football of size "+size);
}

public void catch(int size, int air) {
    print("soccer");
}

```



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!



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3 Four Design Principles

4 SOLID Principles



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 affecting the correctness of that program.
 - **Interface Segregation Principle (ISP):** Client should never be forced to implement an interface that it does not 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.
- responsability
activities*



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Main.java

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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.

`obj = new X();`

`obj.abc();`



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Good Practices

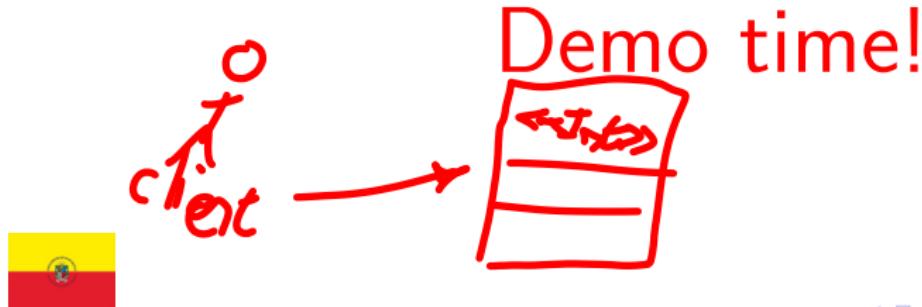
- **Composition over Inheritance** Inheritance should be used only when there is a clear relationship between the base class and the derived class. In other cases, **composition** should be used. Inheritance is a powerful tool, but it is not always the best tool for the job. Inheritance is a way to achieve 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.

Demo time!



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Outline

1 Creating Models in Design

2 Evolution of Programming Languages

3 Four Design Principles

4 SOLID Principles



Thanks!

Questions?



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

