Object-Oriented Analysis & Design

Object-Oriented Programming

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Outline

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Object-Oriented

- **Object-oriented** is a way of thinking about problems. It is not just a way of programming.
- **Object-oriented thinking** involves analyzing a problem, breaking it down into *component parts* (i.e., objects) and the interactions between them.
- From **object-oriented thinking** we can design and implement a software solution, a straightforward way to represent `real-world elements`.
- The **main idea** is simple: anything in the real world can be represented as an object by simply defining its `details` and `behaviors or responsibilities`.
- **Tip:** A good exercise is to look around you and try to identify `objects and their interactions`.

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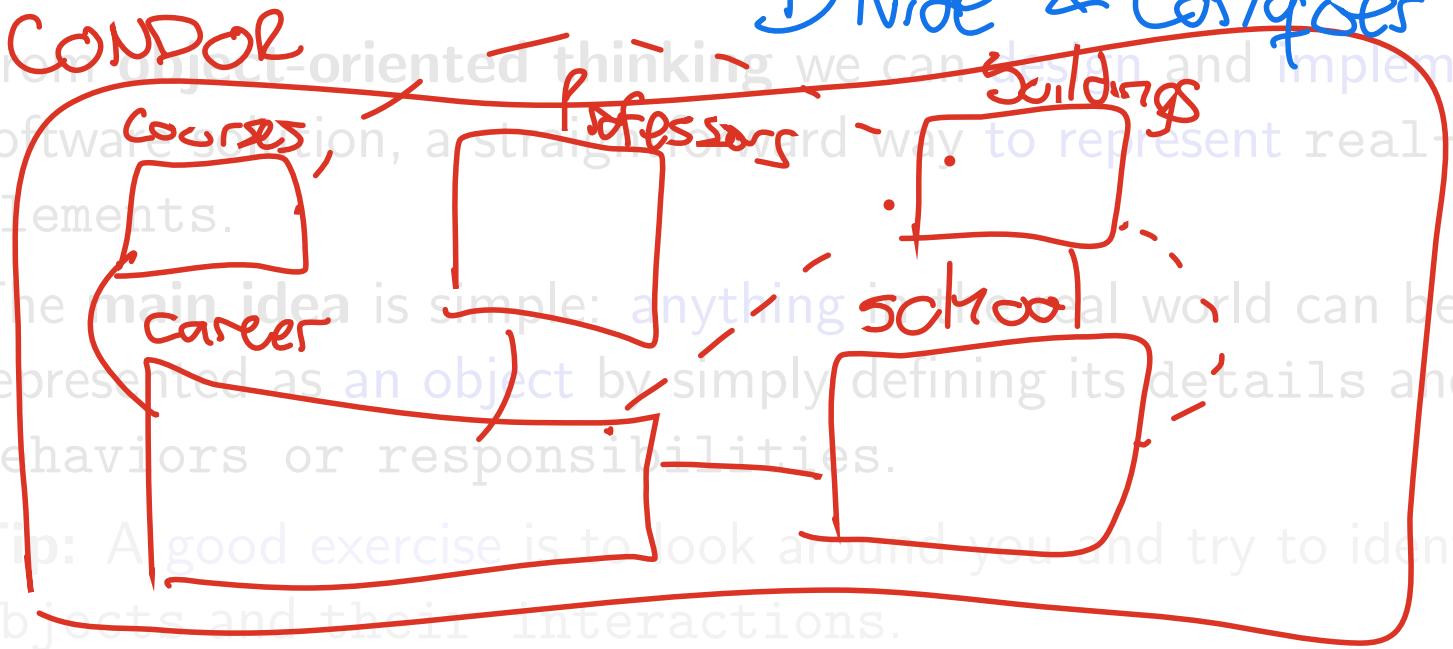

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Software Implications

- Using **object-oriented thinking**, we can model a software system as a collection of objects that interact with each other. This approach applies a form of divide and conquer strategy.
- Using **objects** to represent code entities helps improve software quality metrics such as reusability, maintainability, scalability, and flexibility.
- **Objects** also help keep the code organized, easy to understand, and make it easier to fix errors.
- As **objects** increase the modularity of the code, it becomes easier to test and debug the software. Moreover, changes can be applied without affecting the entire system.
- Using **objects** enables code reuse, reducing the overall amount of code and keeping the project simple. In addition, you can create your own libraries for reuse in other projects.

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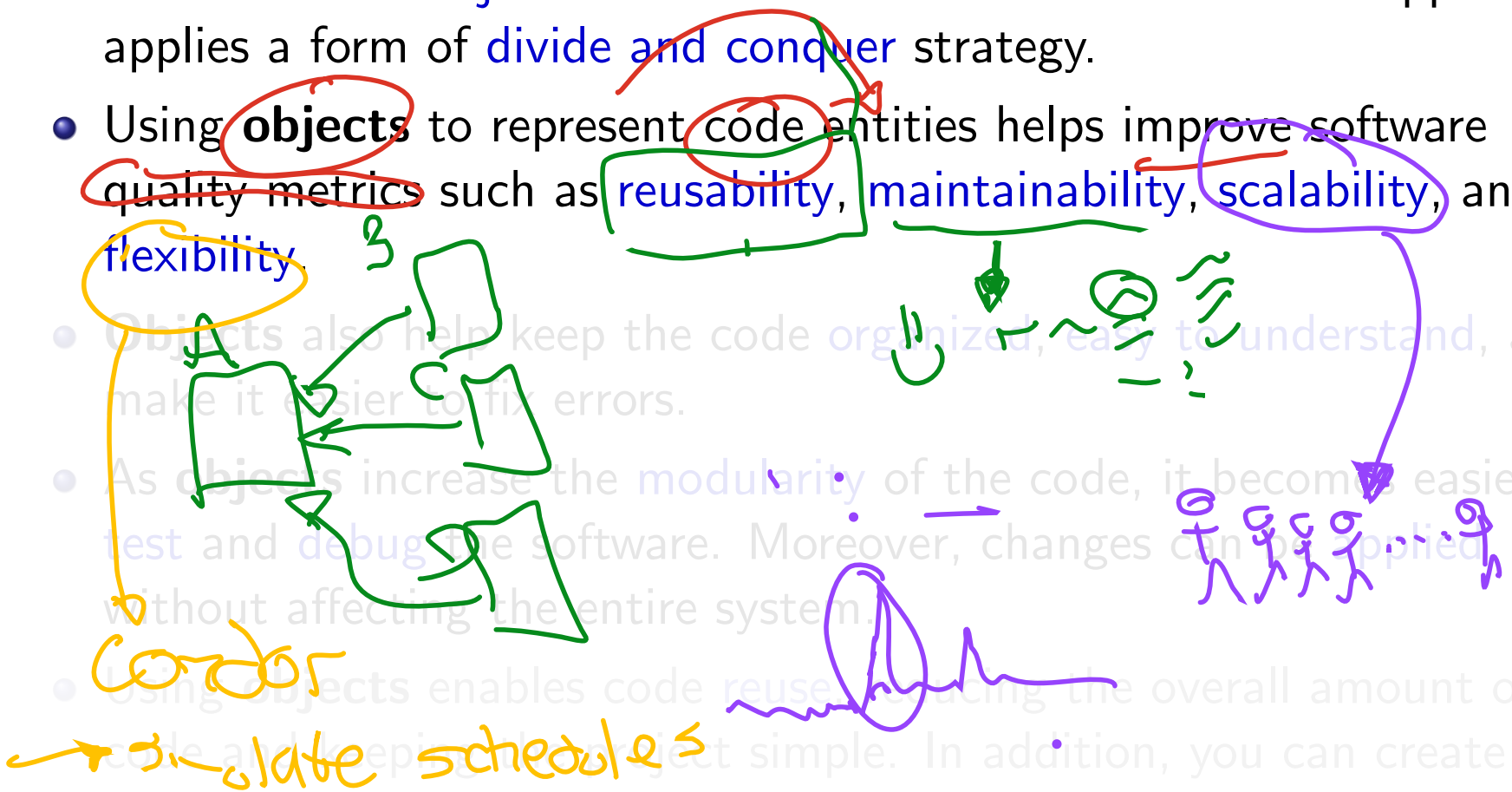

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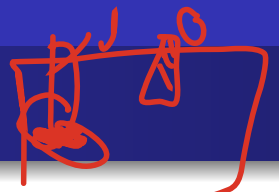

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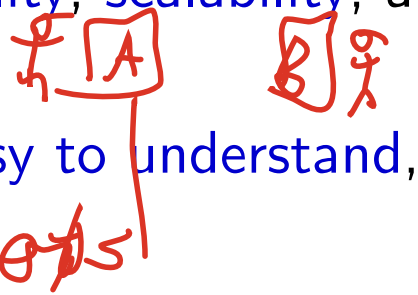

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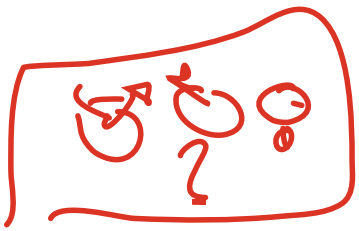
What is abstraction?

- **Abstraction** is the process of filtering out the `characteristics` of an object that we are interested in, and ignoring the rest.
- **Abstraction** is a way to simplify the complexity of the real world by focusing on the `relevant` parts.
- **Abstraction** is a way to represent the `essential` features of an object, hiding the `unnecessary` details.
- **Abstraction** is a way to model the `real world` in a simple and understandable way.



Abstraction Schemas

There are two types of **abstraction schemas**:

- **Data Abstraction:** This type of abstraction focuses on the data that an object contains. It is a way to hide the implementation details of an object and expose only the relevant data.
- **Behavior Abstraction:** This type of abstraction focuses on the behavior of an object. It is a way to hide the implementation details of an object and expose only the relevant behavior.

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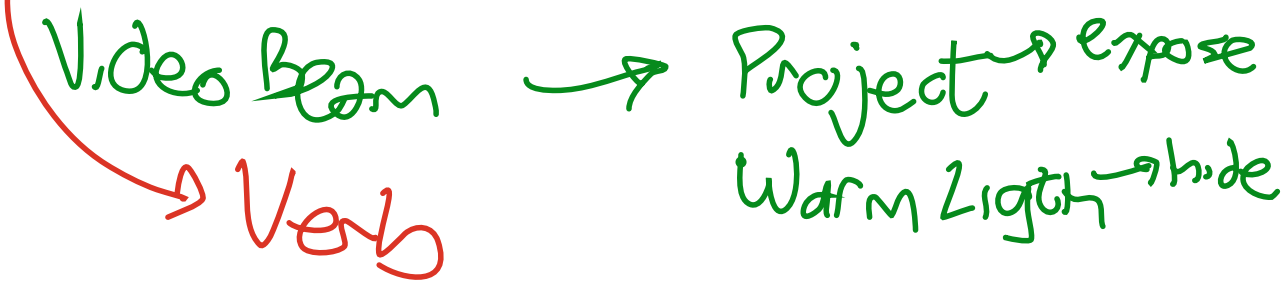

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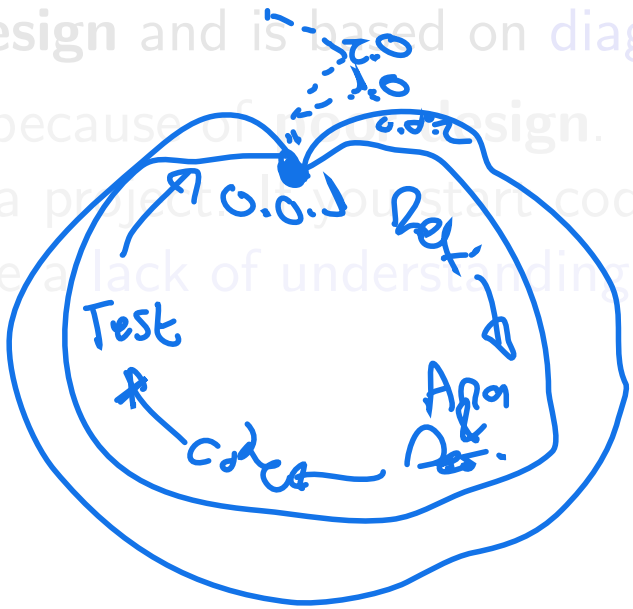
- Based on the **requirements**, it is possible to create the conceptual design, starting with `mockups`.
- The **conceptual design** is then transformed into a detailed design, which includes the `architecture` and `components`; this is generally called **technical design** and is based on diagrams.
- Many projects fail because of poor design. A good design is essential for the **success** of a project. If you start coding without a good design, there will be a lack of understanding of the `requirements`.



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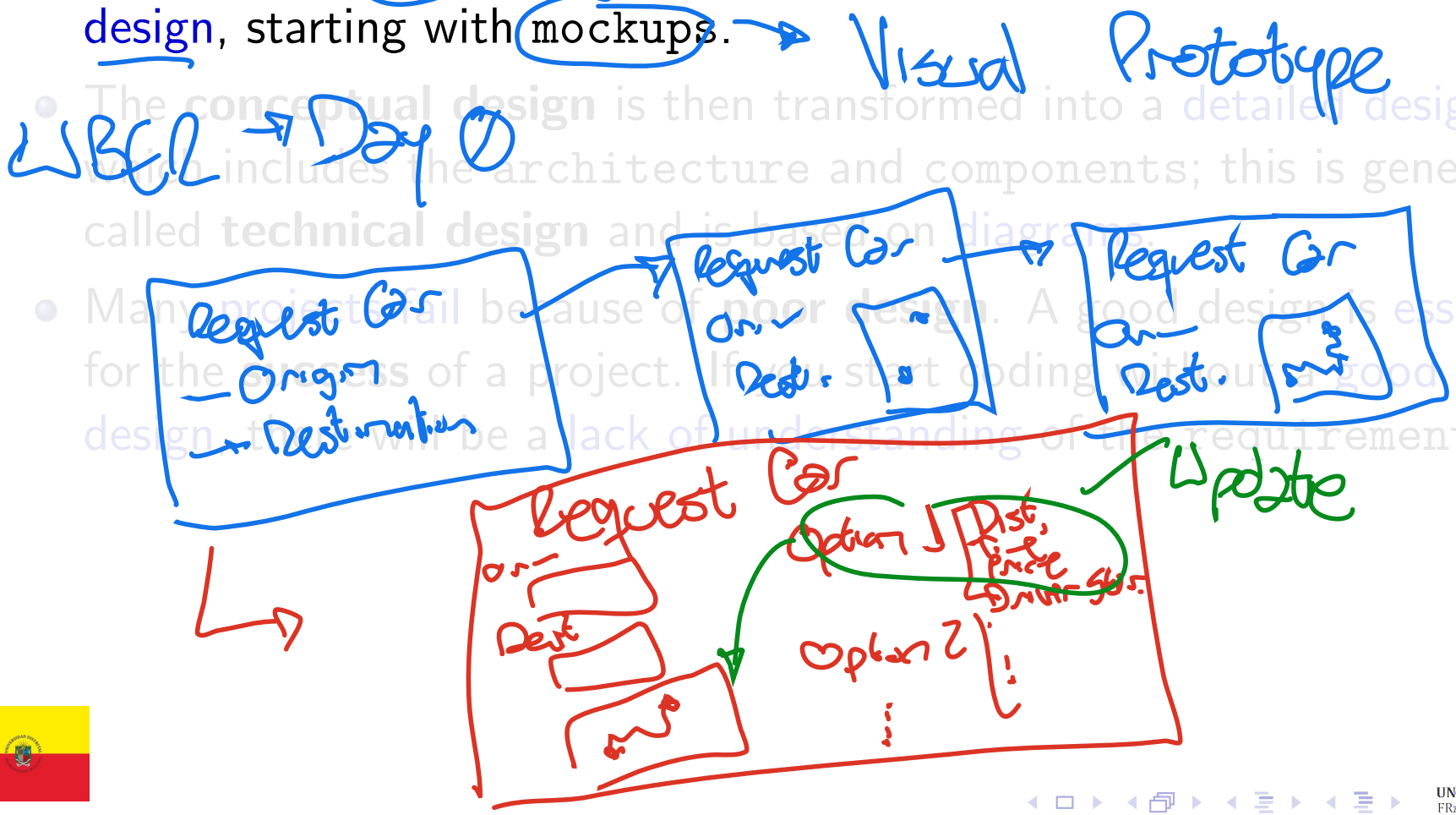

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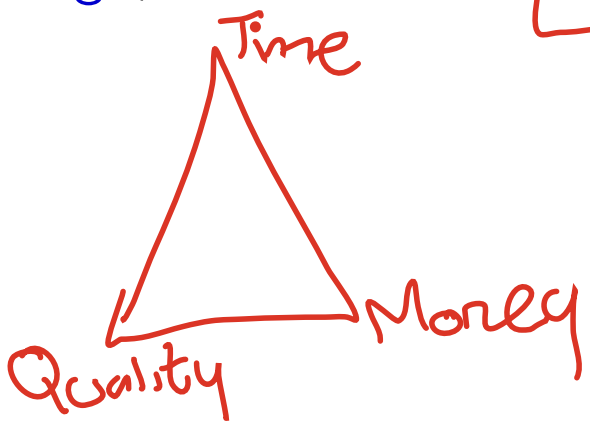
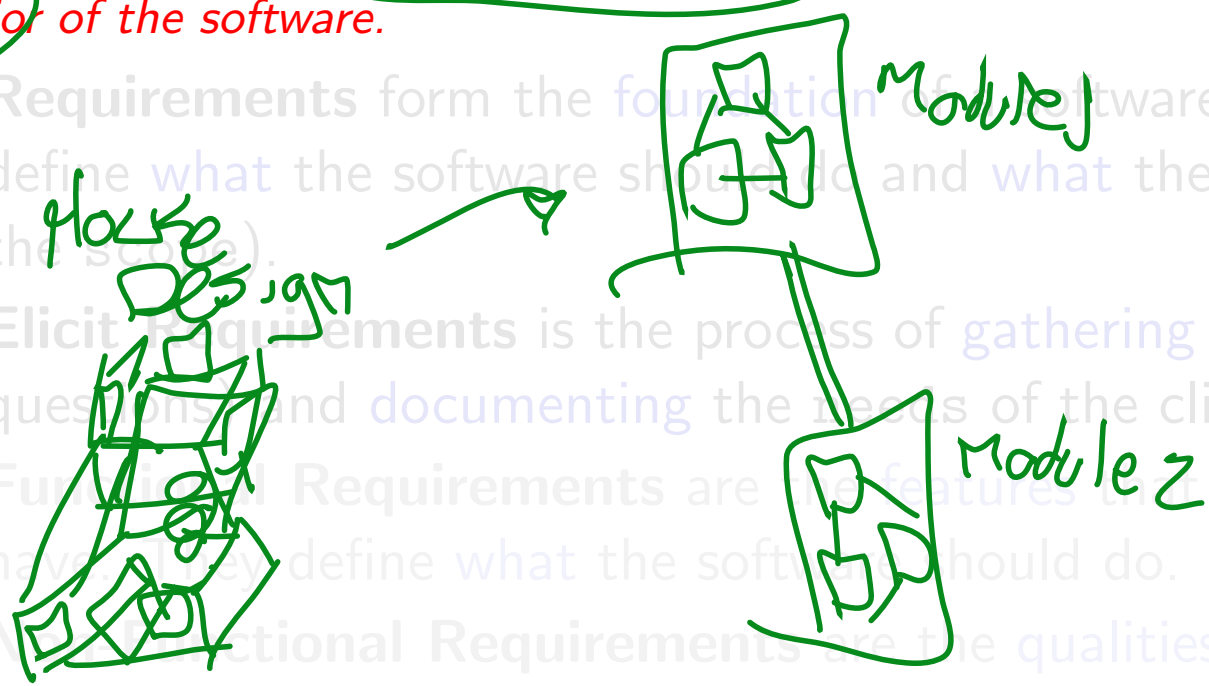


Requirements

Definition

Requirements are conditions or capabilities that must be implemented in a `software product`.

It is important to think like a software architect: consider both the structure and the behavior of the software.



- **Requirements** form the foundation of the software project. They define what the software should do and what the clients want (i.e., the scope).
- **Elicit Requirements** is the process of gathering (i.e., asking the right questions) and documenting the needs of the clients.
- **Functional Requirements** are the features that the software should have. They define what the software should do.
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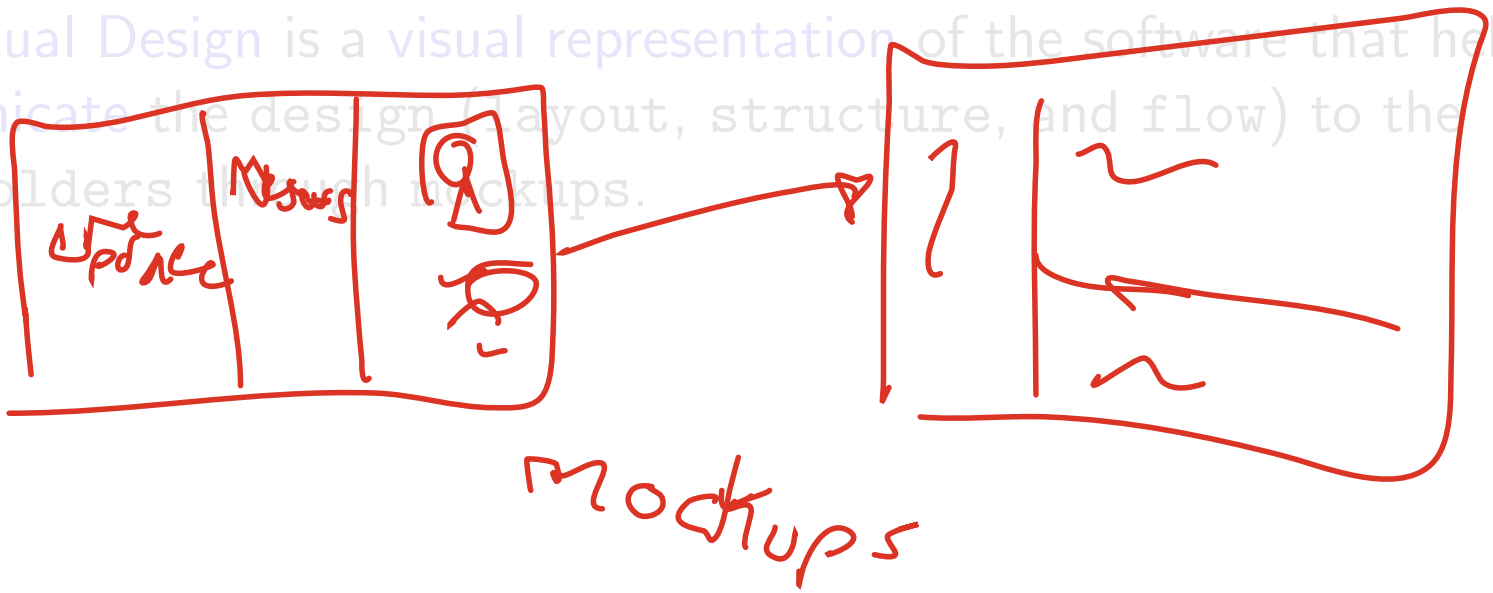
Conceptual Design

- Once the initial set of requirements are defined, the next step is to create a **conceptual design** of the software.
- **Conceptual Design** is a high-level design that defines the `structure` and `behavior` of the software. It is achieved by the recogniition of the appropiates components, connections, and responsabilities.
- Conceptual Design is a visual representation of the software that helps communicate the design (`layout`, `structure`, and `flow`) to the stakeholders through mockups.



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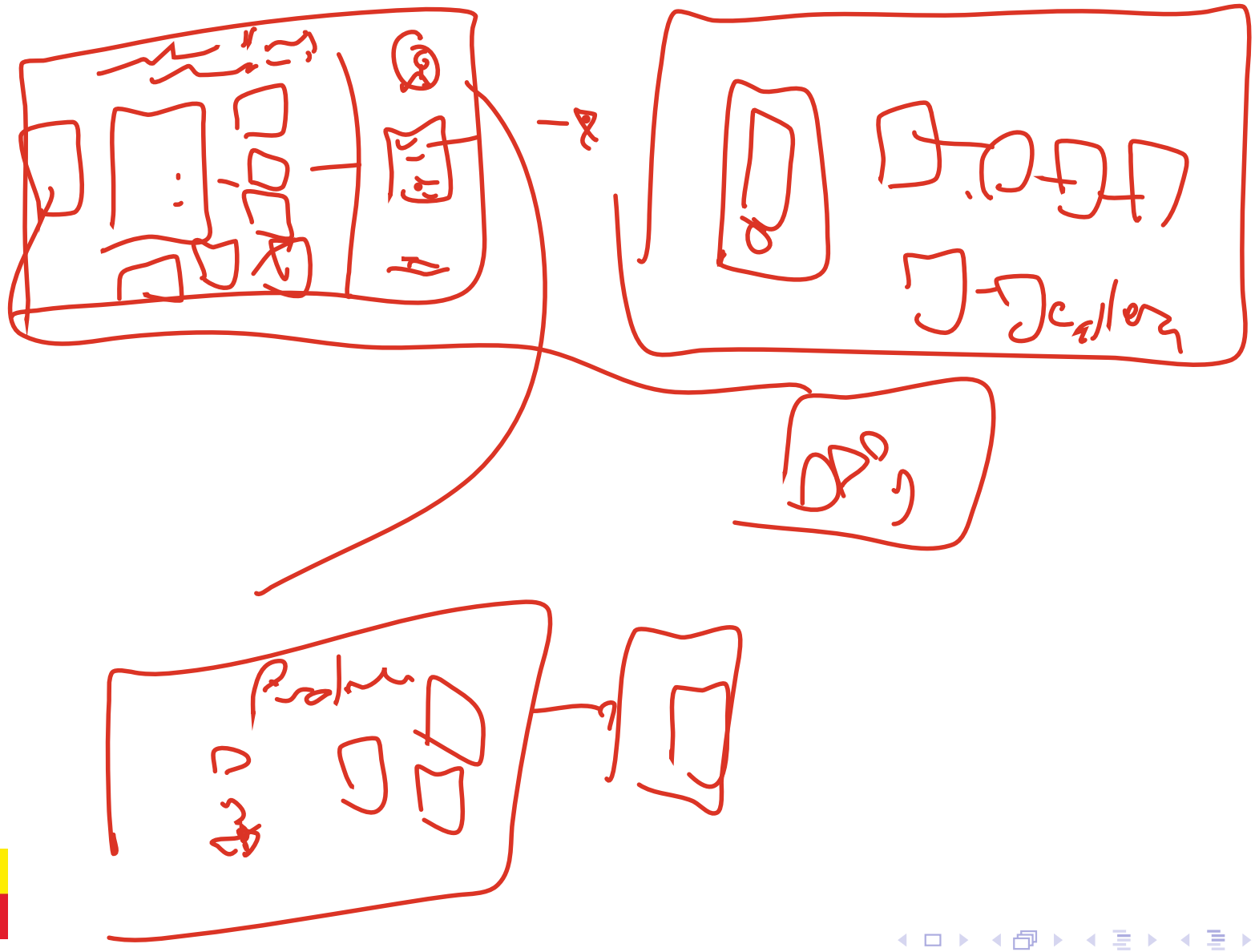
Mockup Example: *Cell-Phone On-Line Store*



User Stories

- **User stories** are short, simple descriptions of a feature or function of a system.
  - They are written from the perspective of the user and describe what the user wants to achieve.
  - They are used to capture the requirements of a system in a simple and understandable way.

the application should let the users change the visual theme based in local machine time.

User Story → need in client words

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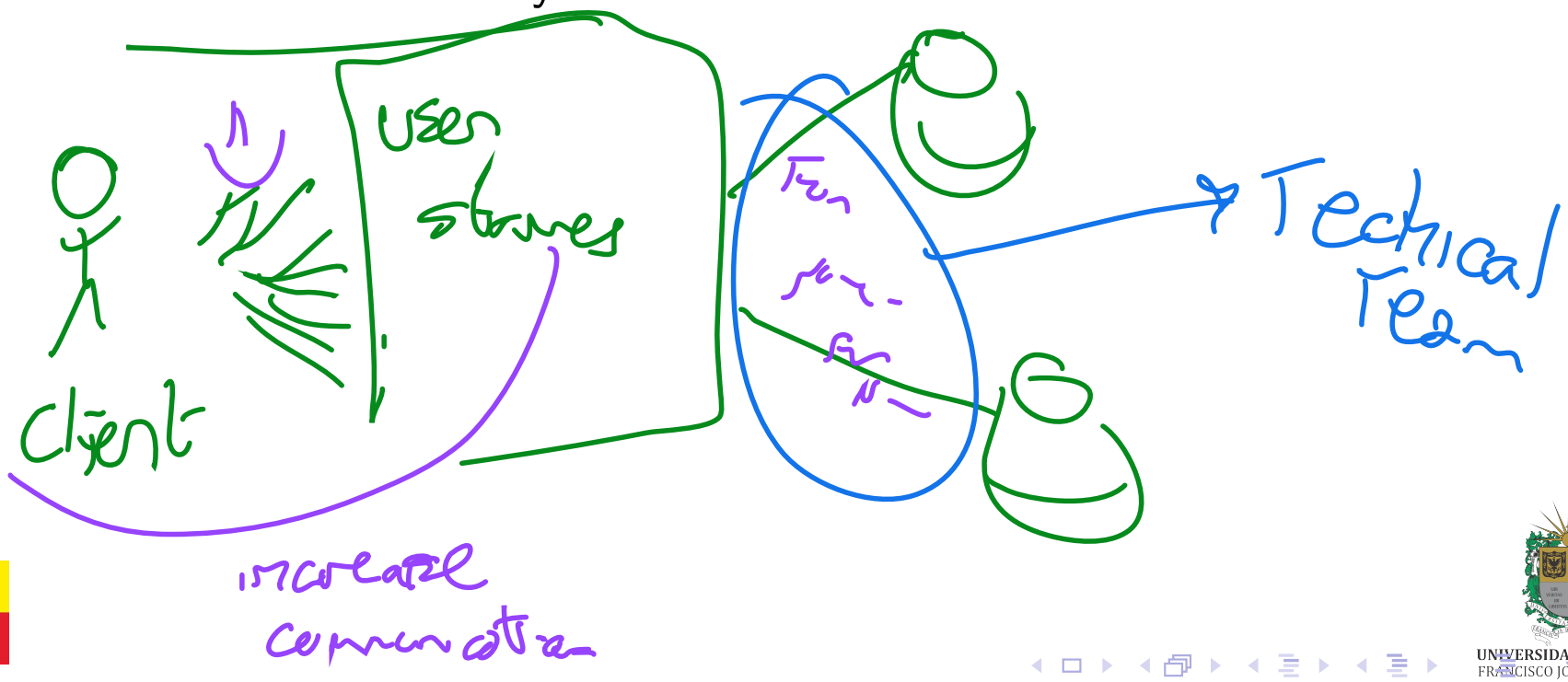

User Stories: Format Example

User Story

Title: Student Enrollment	Priority: High / medium / Low	Estimate: 1 weeks / 2
User Story: As a [description of user], I want [functionality] so that [benefit].	As a student, I want to enroll courses online so that I can avoid queues and save time	
Acceptance Criteria: Given [how things begin] When [action taken] Then [outcome of taking action]	Given NO students when they enroll courses & watch schedule then each one must see an graphic weekly schedule	

Sprint / 2 weeks

tech team → task { front. / non-func.

ProductPlan

Use Cases

- **Use cases** are descriptions of how a system will be used by its users.
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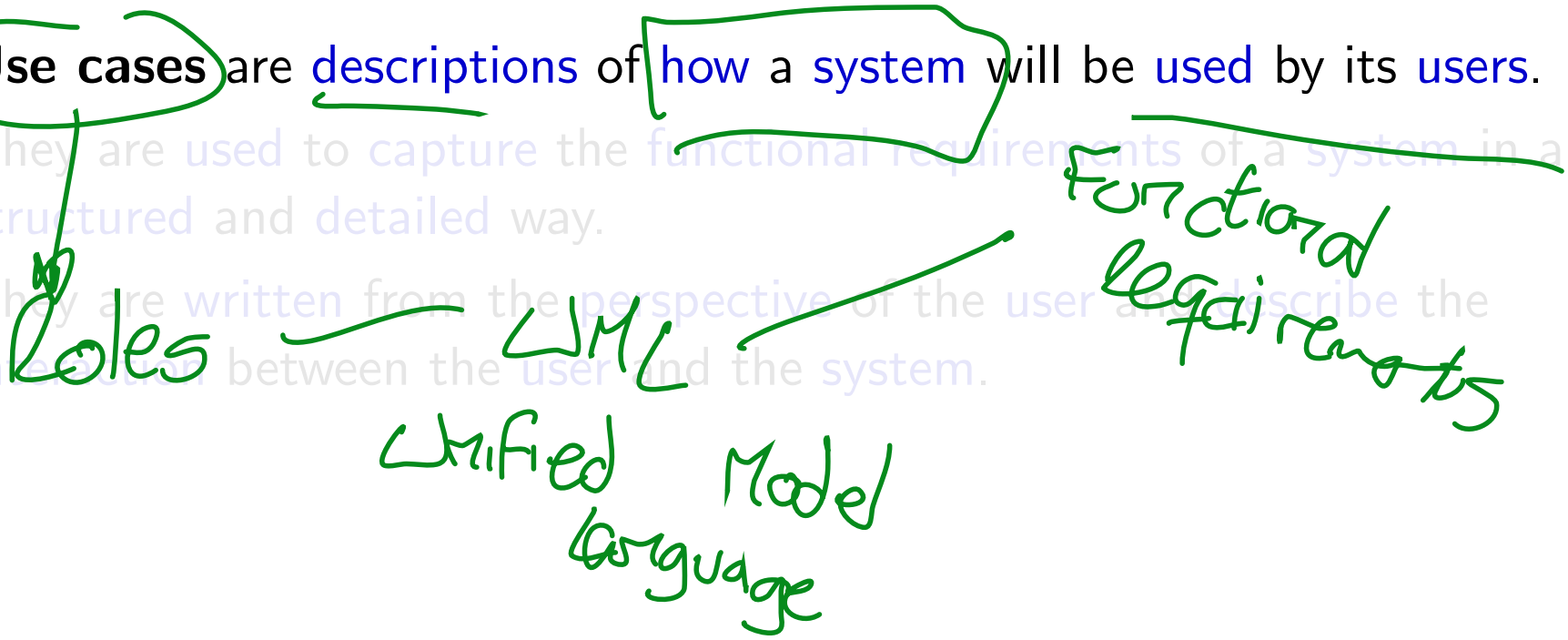

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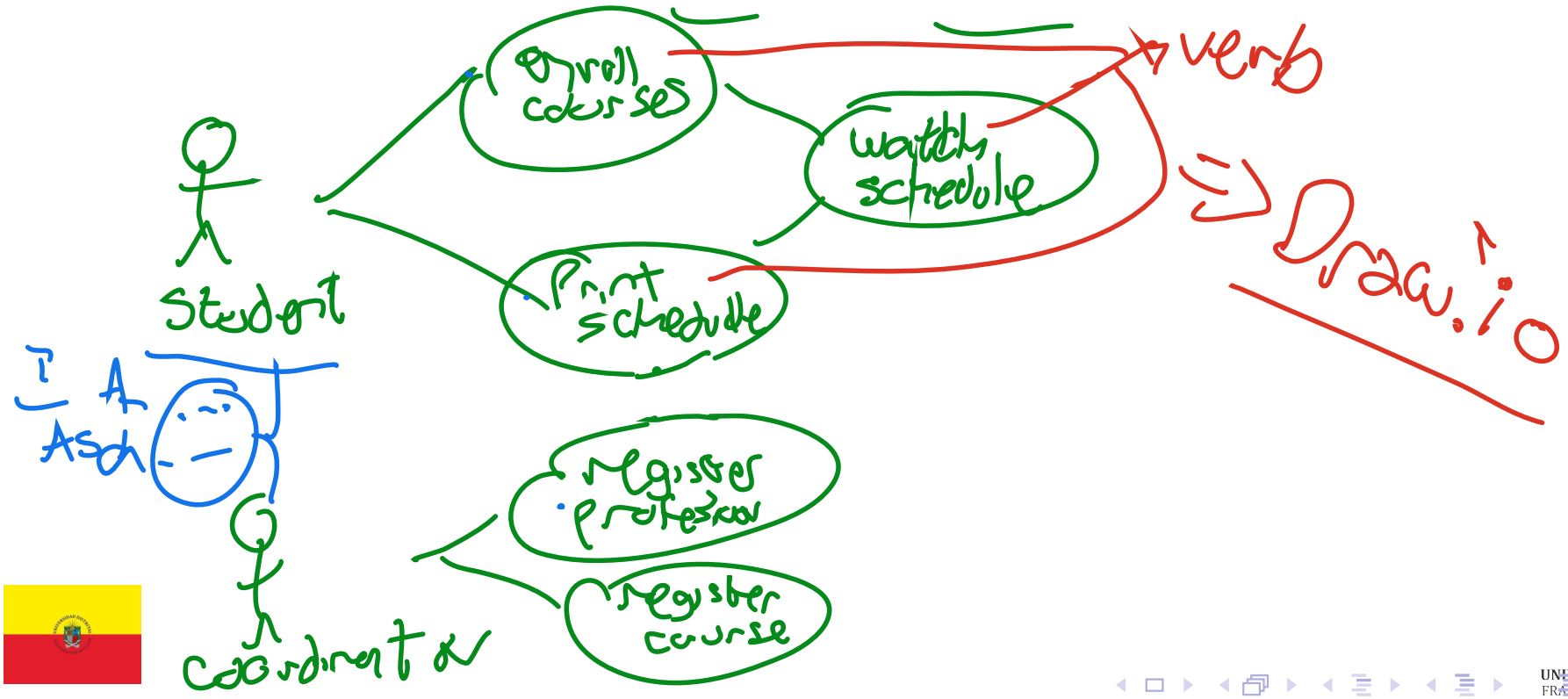

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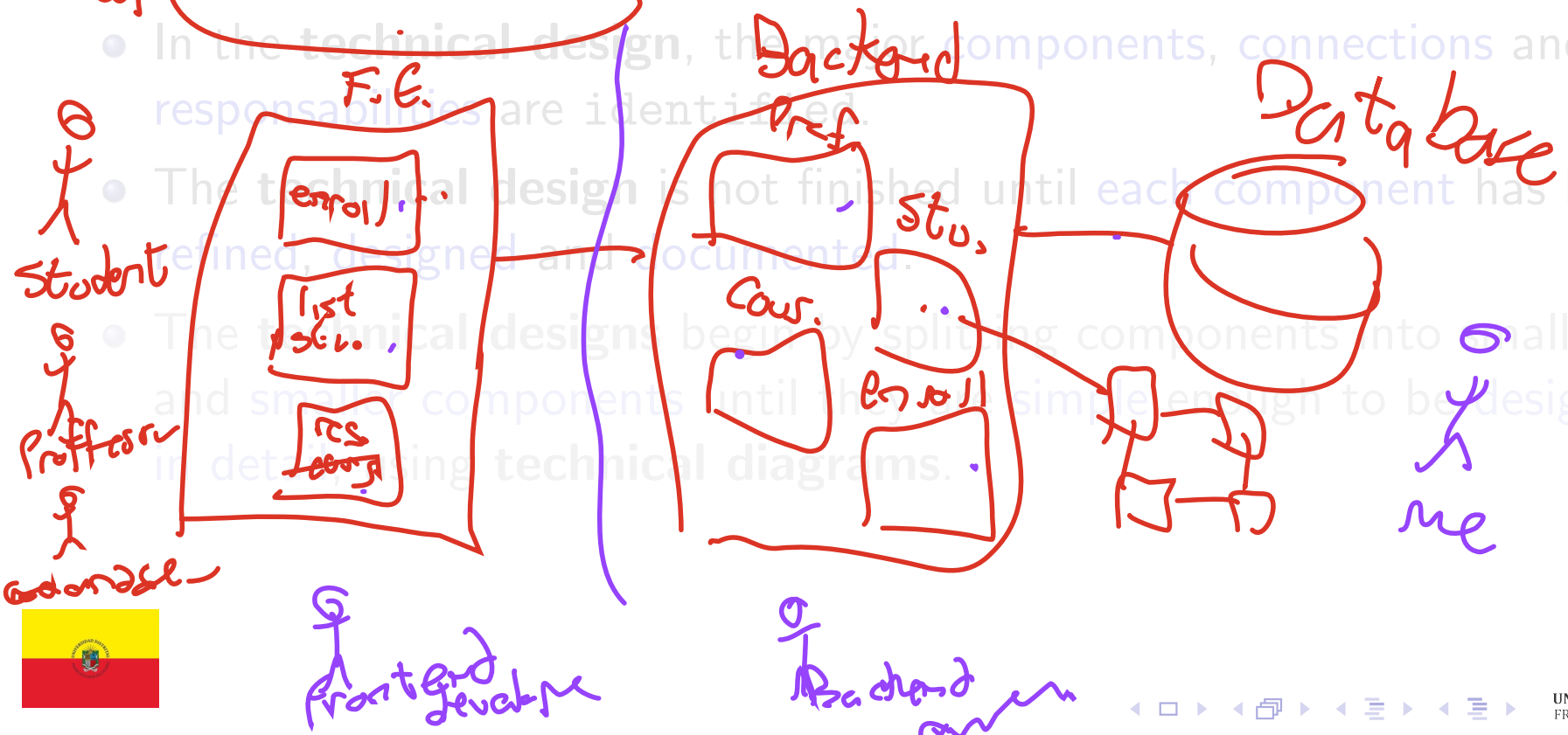

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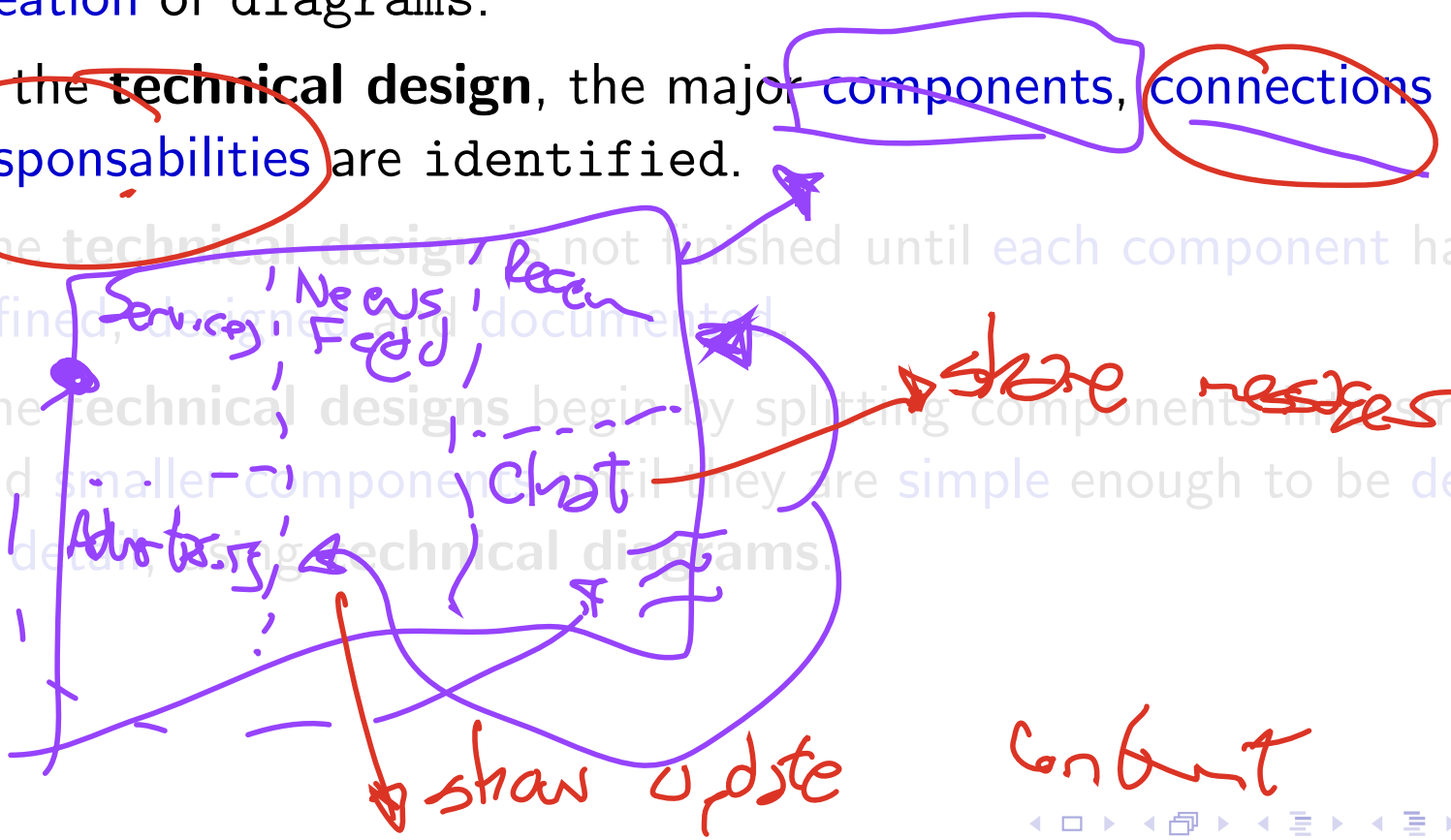

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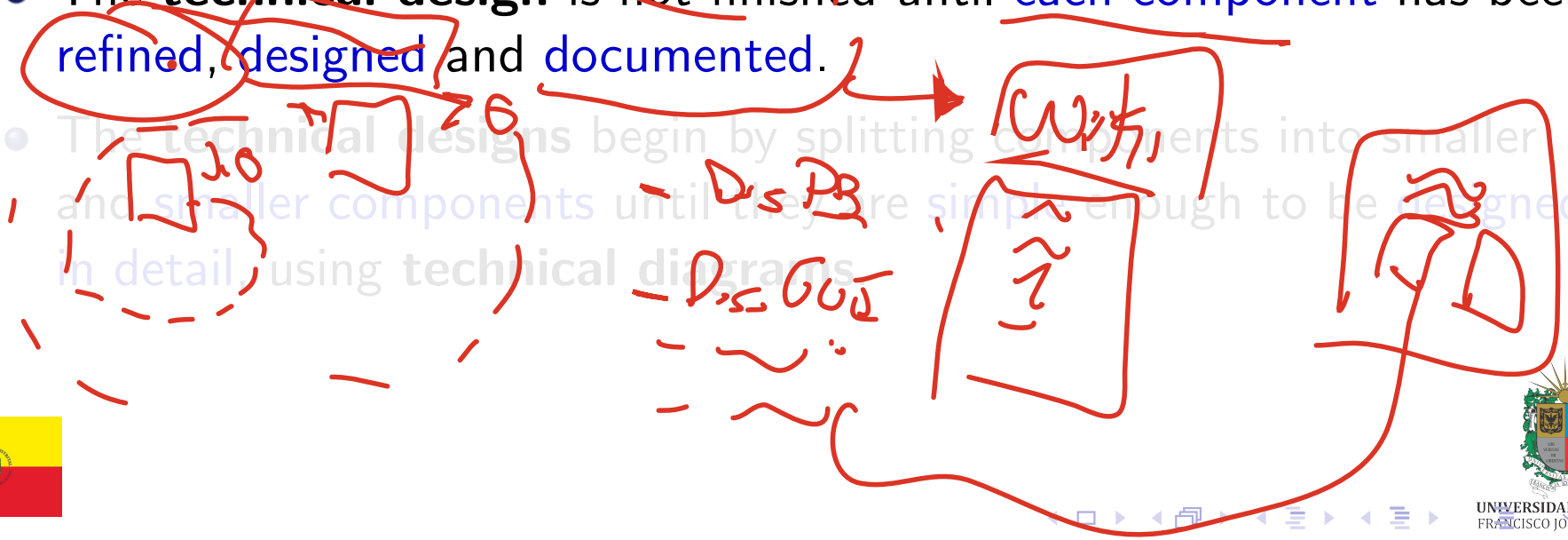

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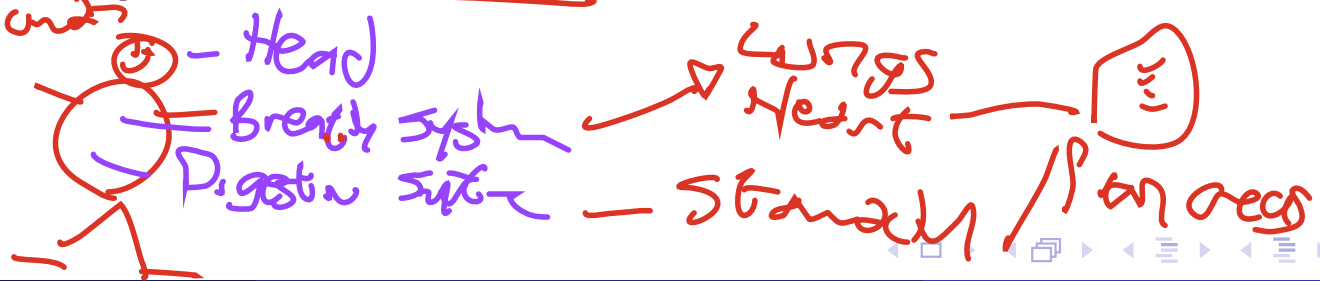

Compromise in Requirements and Design

- **Requirements** and **Design** are interrelated. **Requirements** are the foundation of the **design**.
- **Constant communication** and **feedback** is key to creating the right solution that satisfies the **client needs**.
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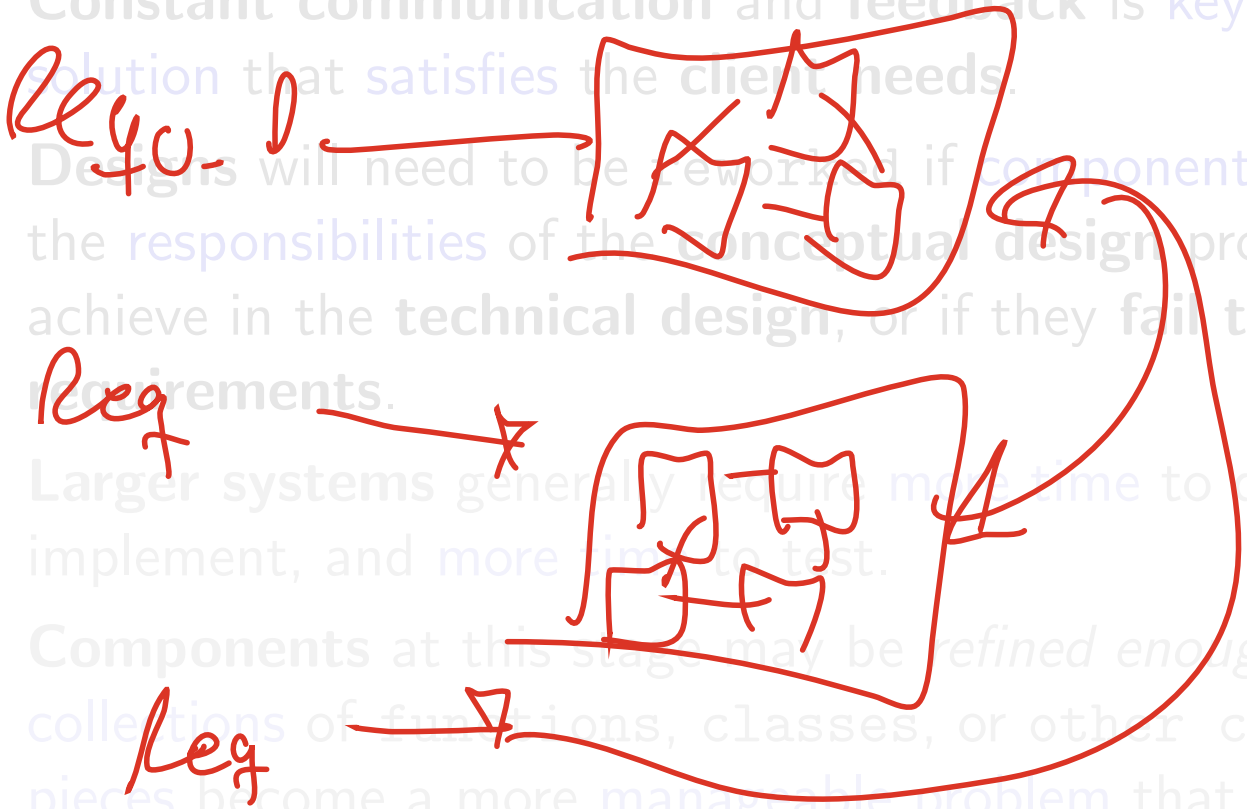

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1 Frontend → $3.000.000
1 Database → $3.500.000
2 Backend → $3.000.000
Lead → $7.000.000
$16.500.000

~$ 100.000.000
Cloud?
devices?
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...

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code, test, debug

Outline

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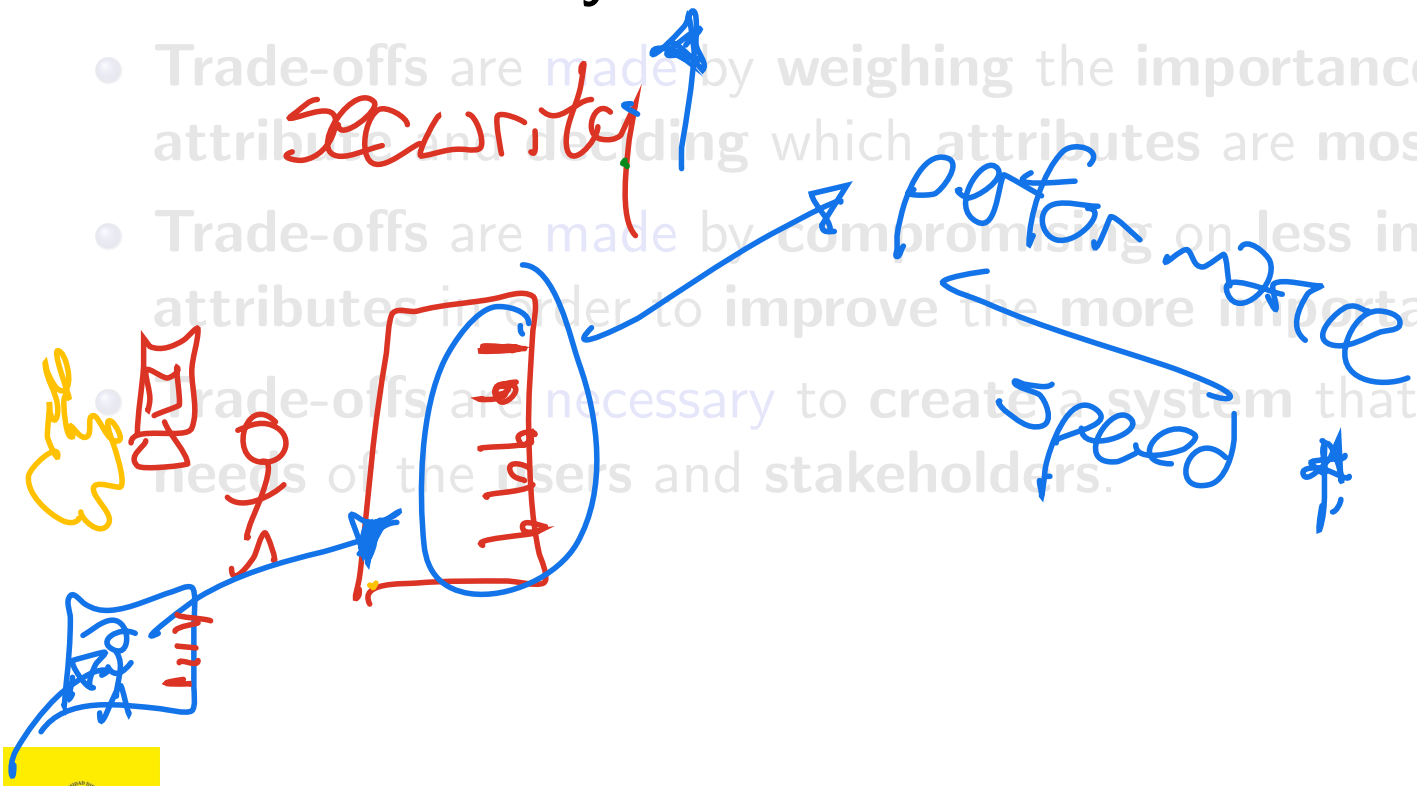
Trade-Offs

- **Trade-offs** are inevitable in **software design**. **Quality attributes** are often competing and contradictory.
- **Trade-offs** are necessary to balance the **competing quality attributes** of a **system**.
- **Trade-offs** are made by **weighing** the **importance** of each **quality attribute** and **deciding** which **attributes** are **most important**.
- **Trade-offs** are made by **compromising** on **less important quality attributes** in order to **improve** the **more important attributes**.
- **Trade-offs** are necessary to **create a system** that **satisfies** the **needs** of the **users** and **stakeholders**.



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Context and Consequences

- **Context** is the environment in which a **system** will be **used**. It includes the **users**, the **stakeholders**, and the **constraints** of the **system**.
- **Context** provides important information when deciding on the balance of `qualities in design`.
- **Consequences** are the results of the **decisions** that are made during the **design** of a **system**. They include the **trade-offs** that are made and the **impact** that they have on the **system**.
- A **good practice** is to seek other perspectives on technical designs. This can be done by *asking* other developers for their opinion, or by having a design review session.
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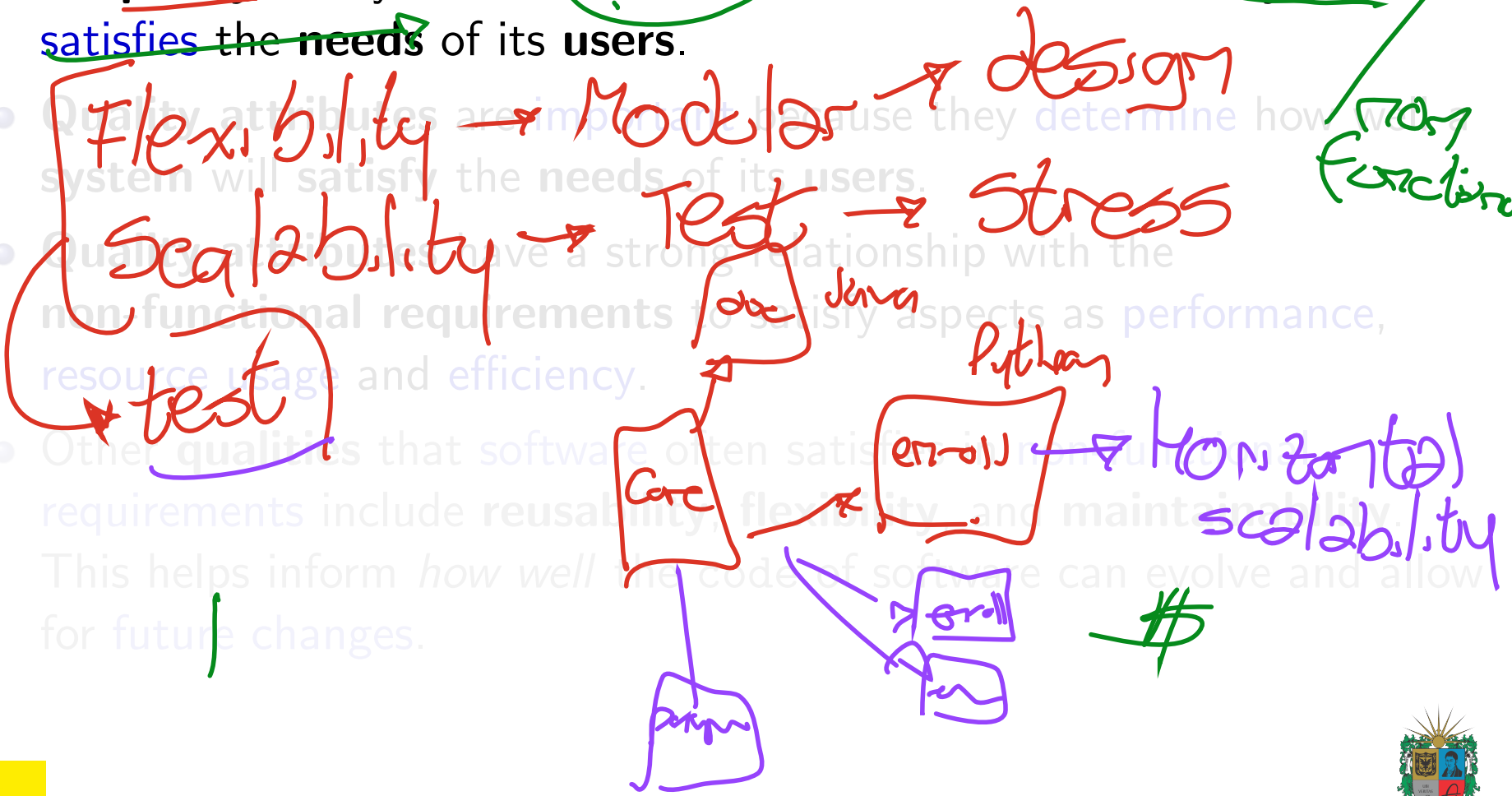

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- Quality attributes have a strong relationship with the **non-functional requirements** to satisfy aspects as performance, resource usage and efficiency.
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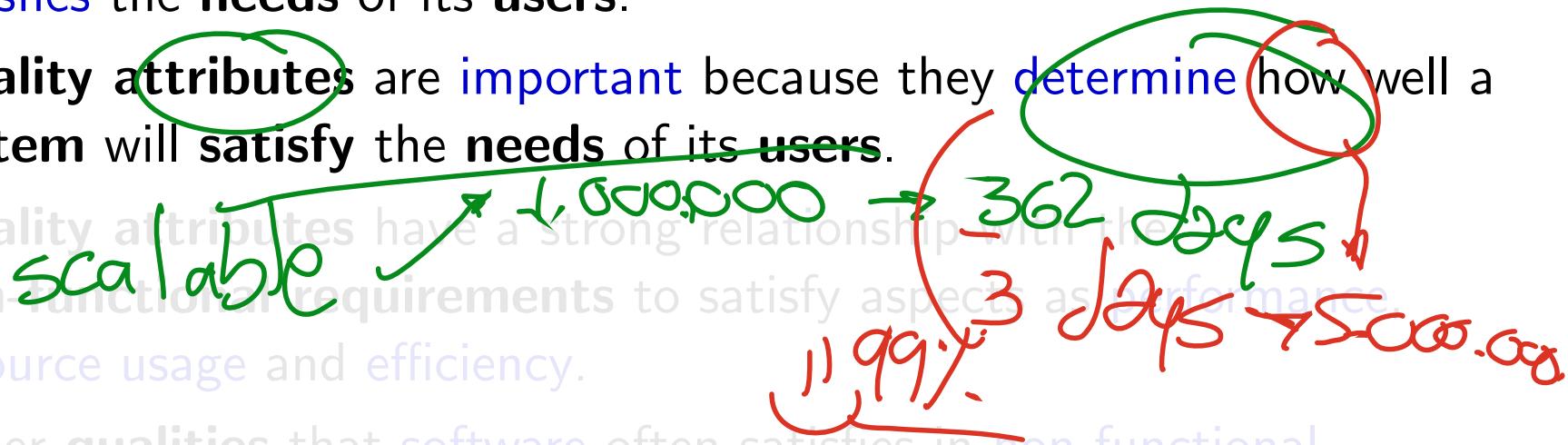

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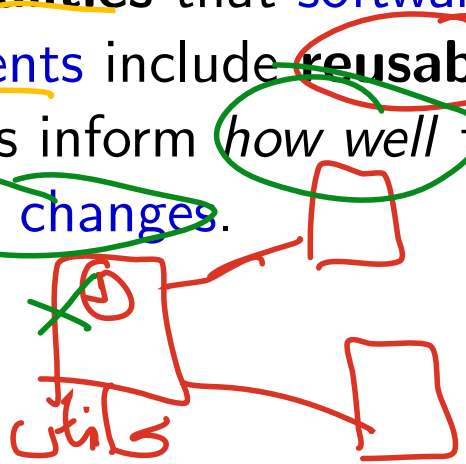
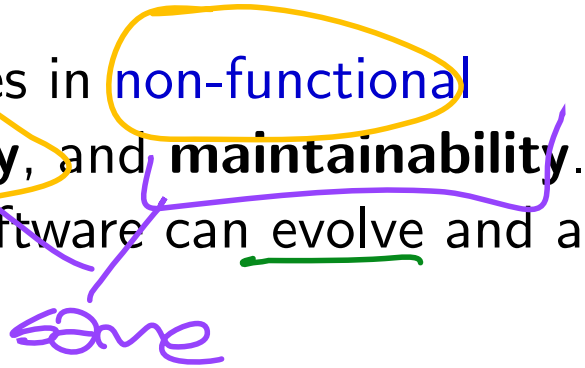
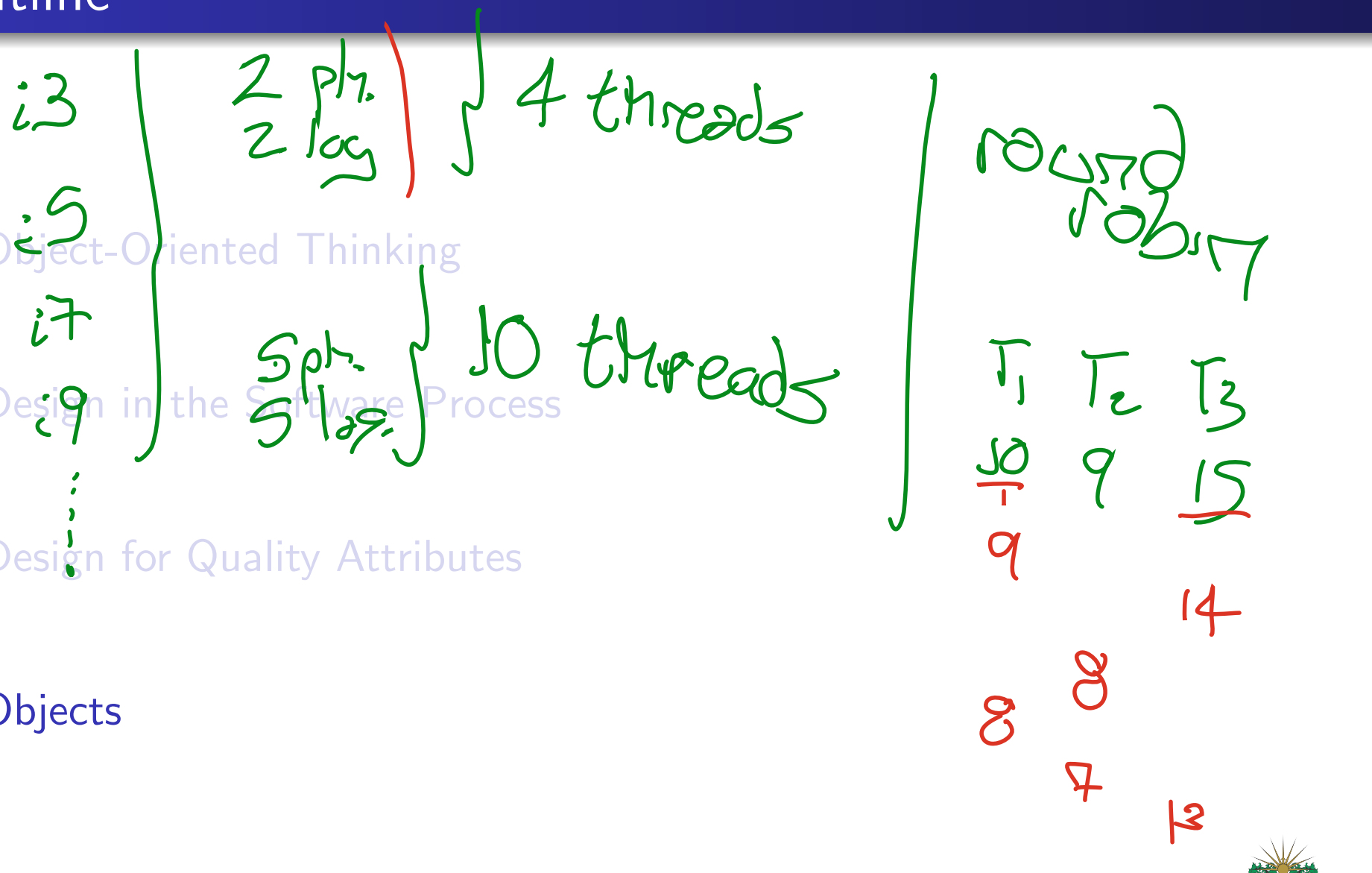




Outline



Basics of Object-O riented 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).

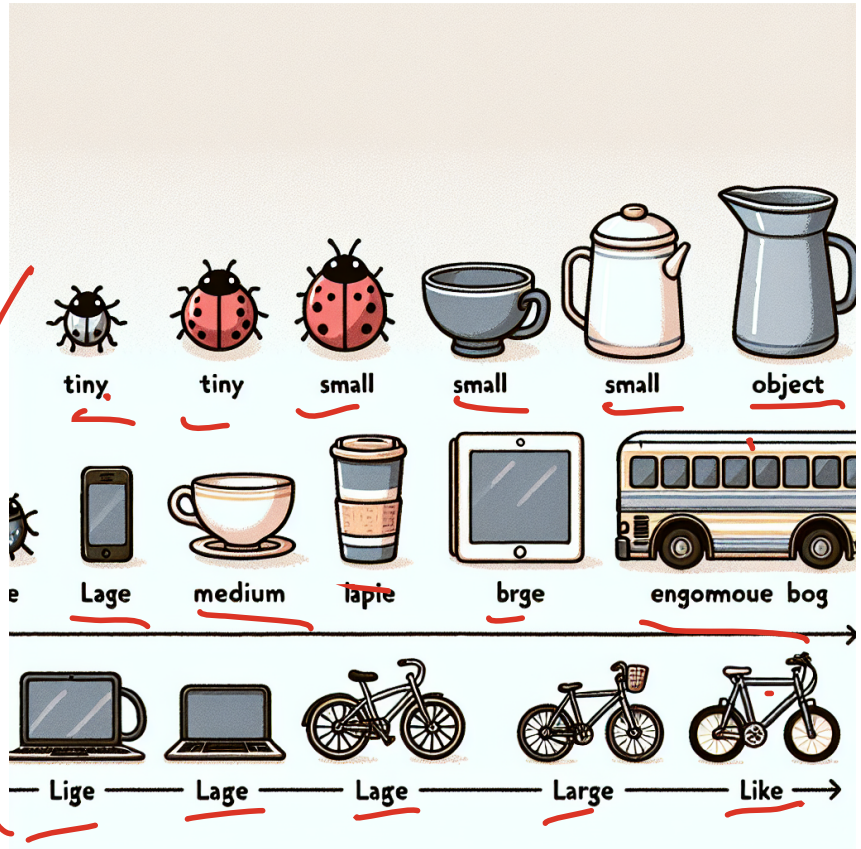


Figure: Prompt: Draw several objects sorted by size.

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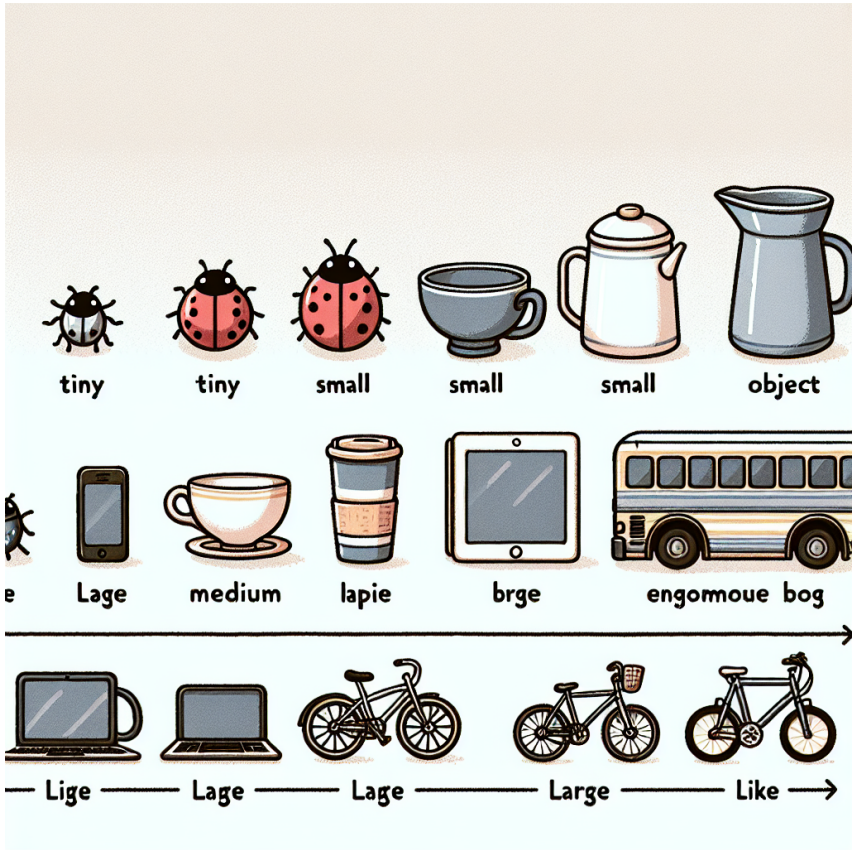
behavior



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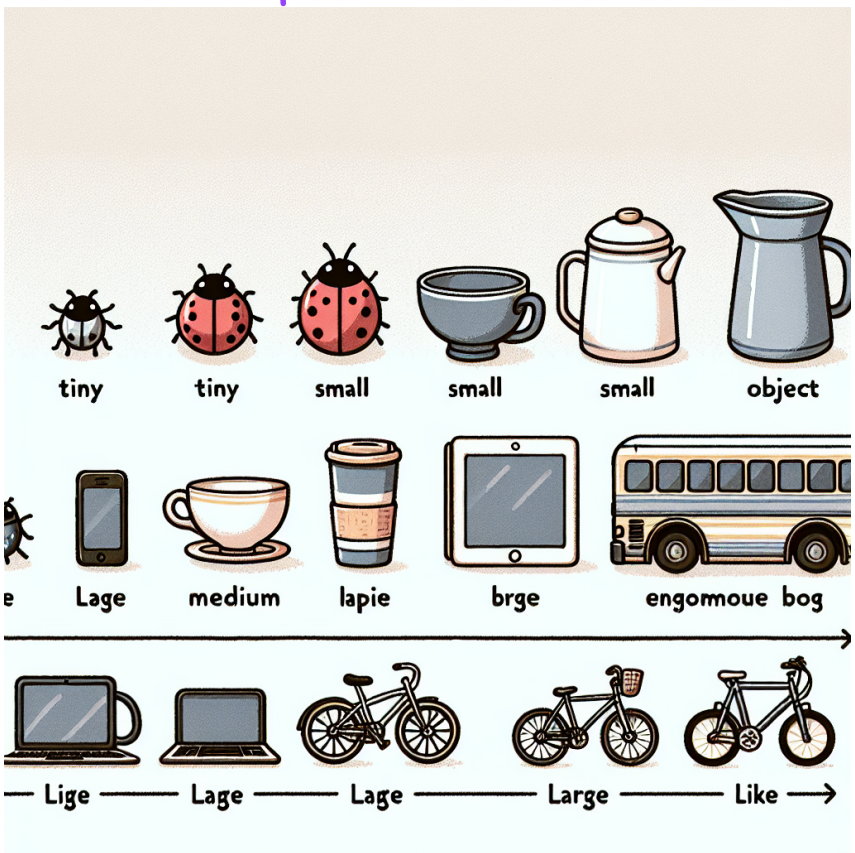
Basics of Object-Oriented Design II



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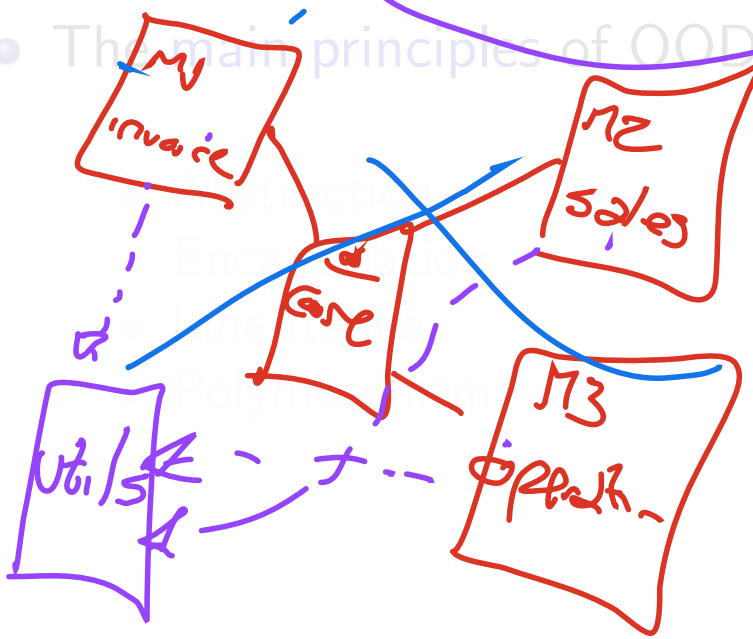
- The idea is to design a **system modularly**, and to make it easier to maintain, and to understand. Also the idea is emphasize the reuse of code.
- The main principles of OOD are:



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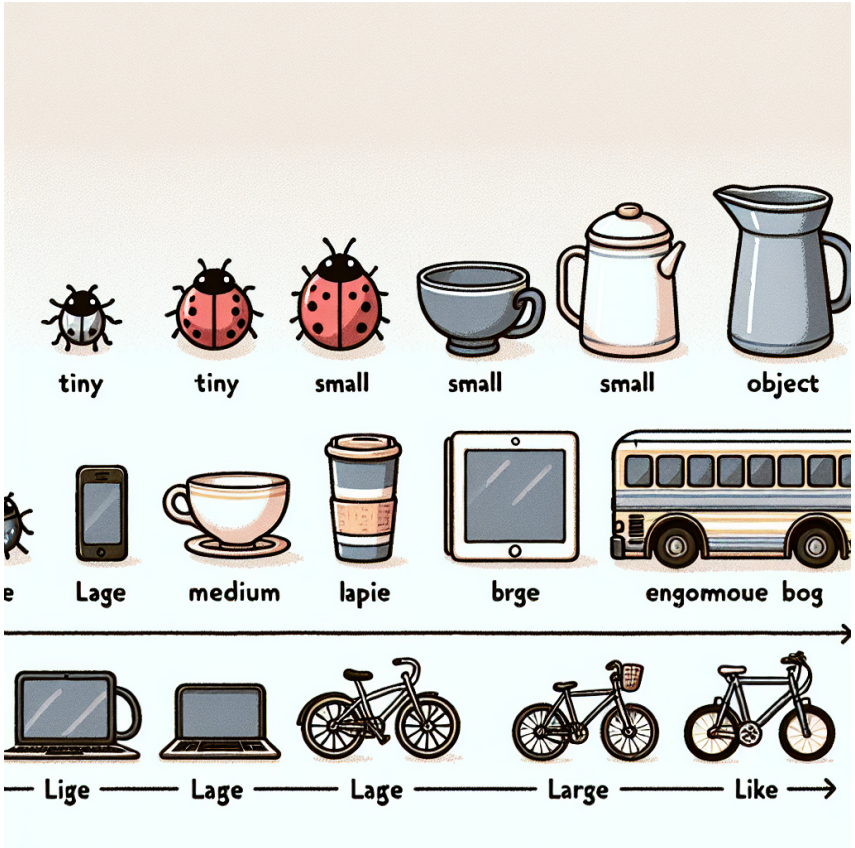

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- The main principles of OOD are:
  - Abstraction
  - Encapsulation
  - Inheritance
  - Polymorphism

Nube Pública (gov) → AWS, Azure, Oracle, GCP ∞ de partners

CRC Cards → Class - Responsability - Collaborators

objects representation

Class: Ball → singular	
Responsibility	Collaborator
rolling jump moving reshape	player field

A collection of similar objects (ex. Customer)

Additional classes that are interacted with to fulfull responsibilities (ex. Product Order)

What class knows or does (ex. Orders product)

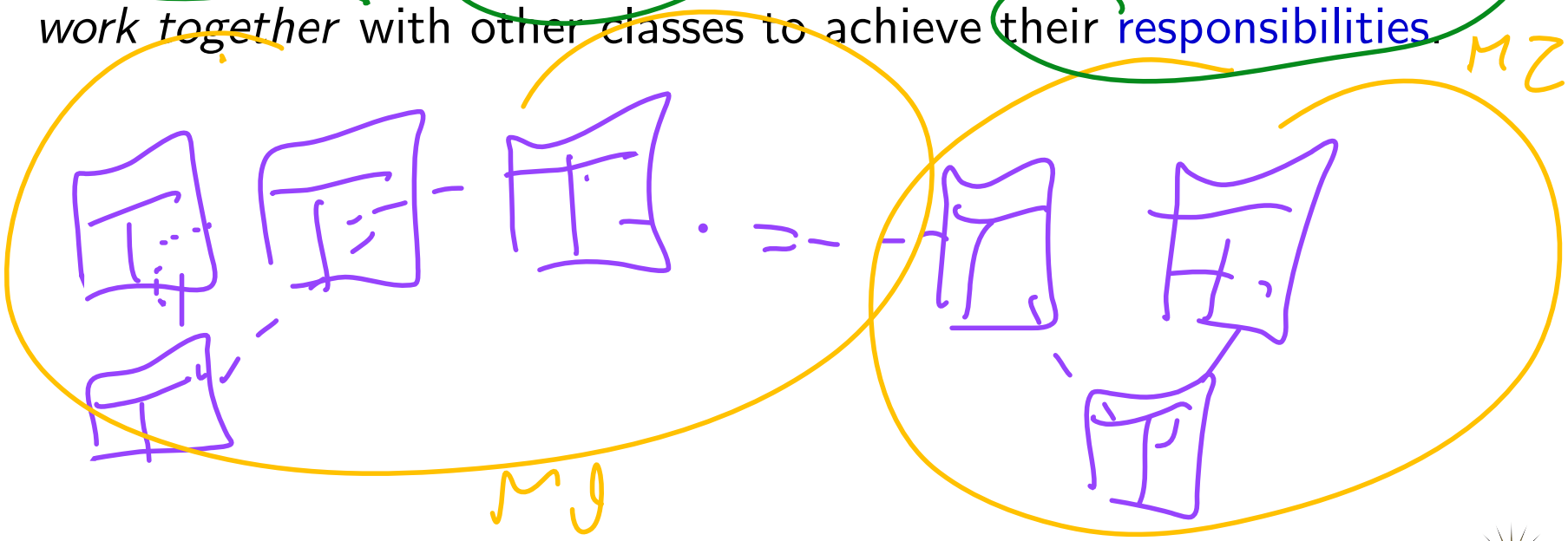
balls

clase

caminos

Prototyping and Simulation

- **CRC cards** are useful tools, but they are most powerful when used for prototyping and simulation for `conceptual design`.
- **CRC cards** are excellent tools to bring to software development team meetings. All the cards can be placed on the table, and `facilitate a discussion` or a `simulation` with the team of *how these classes work together* with other classes to achieve their responsibilities.



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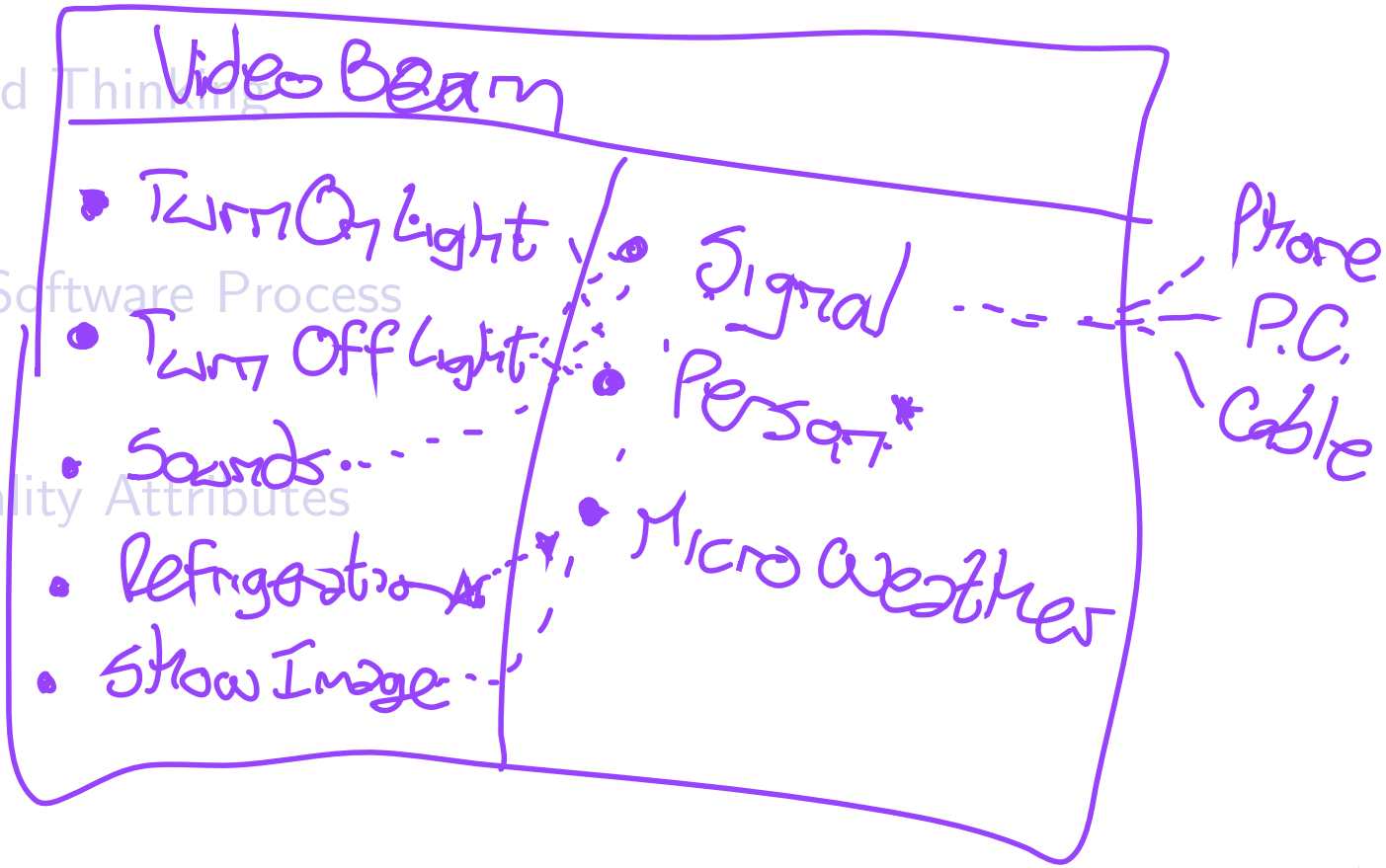

Thanks!

Questions?

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

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