Systems Engineering

Systems Analysis & Design

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Outline

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What is Systems Engineering?

- **Systems Engineering** is a discipline that studies the design, implementation, and maintenance of complex systems.
- This **discipline** is based on interdisciplinary fields, such as control engineering, industrial engineering, software engineering, mechanical engineering, electrical engineering, organizational studies, project management, and others.
- **Systems Engineering** is a holistic approach to engineering that focuses on how to design and manage complex systems over their lifecycle.

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- **Systems Engineering** is a holistic approach to engineering that focuses on how to design and manage complex systems over their lifecycle.

Requirements -> Analysis & Design -> Code -> Test -> Deploy

Systems Engineer as a Professional

- A **Systems Engineer** is a professional who is responsible for designing, implementing, and maintaining complex systems.
- A **Systems Engineer** must have a broad understanding of engineering, mathematics, science, and technology.
- A **Systems Engineer** must be able to analyze and solve problems in a systematic and holistic way.

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Xerox

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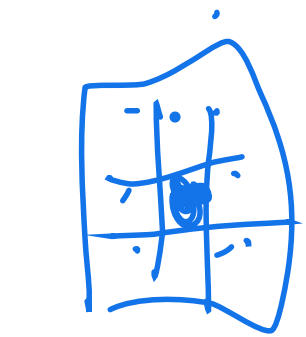
Human Activities

- **Human activities** are complex systems that involve multiple components, interactions, and feedback loops.
- **Systems Engineering** can be applied to understand, analyze, and improve human activities.
- **Systems Engineering** can help us design and manage complex systems such as organizations, cities, economies, and societies.



Game Of Life

live − 3 → live
live < 3 → dead
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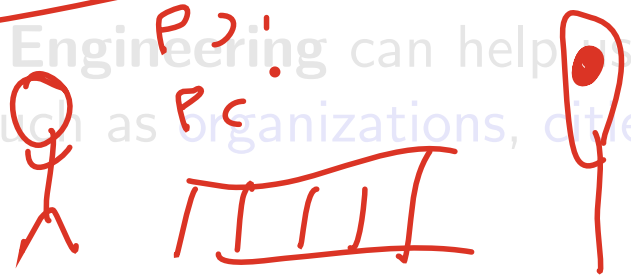

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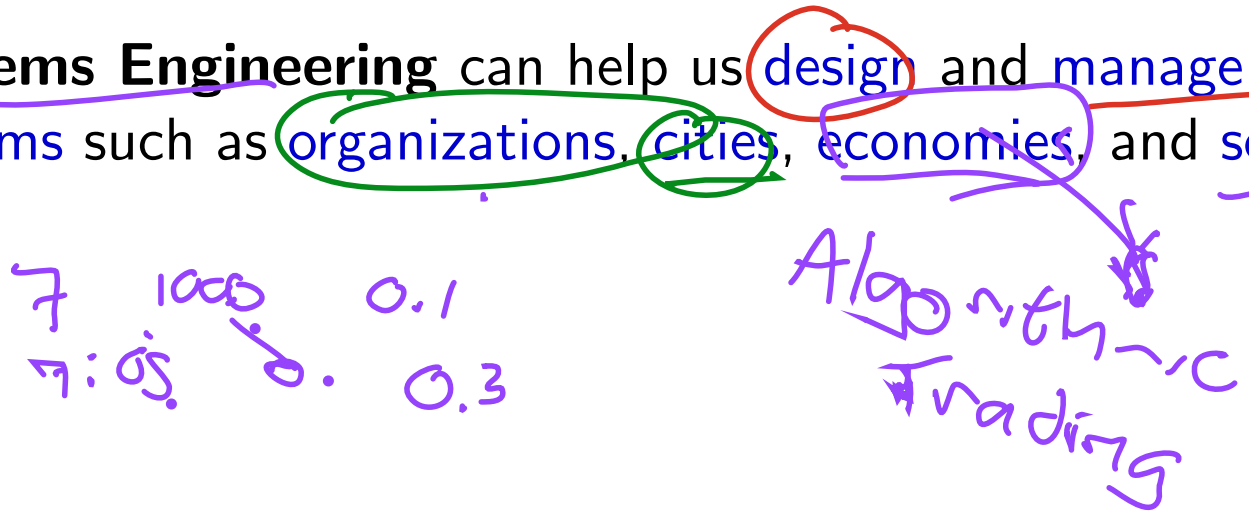

Human Activities: Complexity

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- **Organizations** are complex systems that involve multiple departments, teams, and individuals.

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Organizations as Systems

- **Organizations** can be viewed as: a rational system, a natural system, or an open system.
- A **rational system** is a formal organization that is designed to achieve specific goals as a machine.
- A **natural system** is an informal organization that is emergent and adaptive based on human interactions.
- An **open system** is an organization that is interconnected with its environment and adapts to changes.

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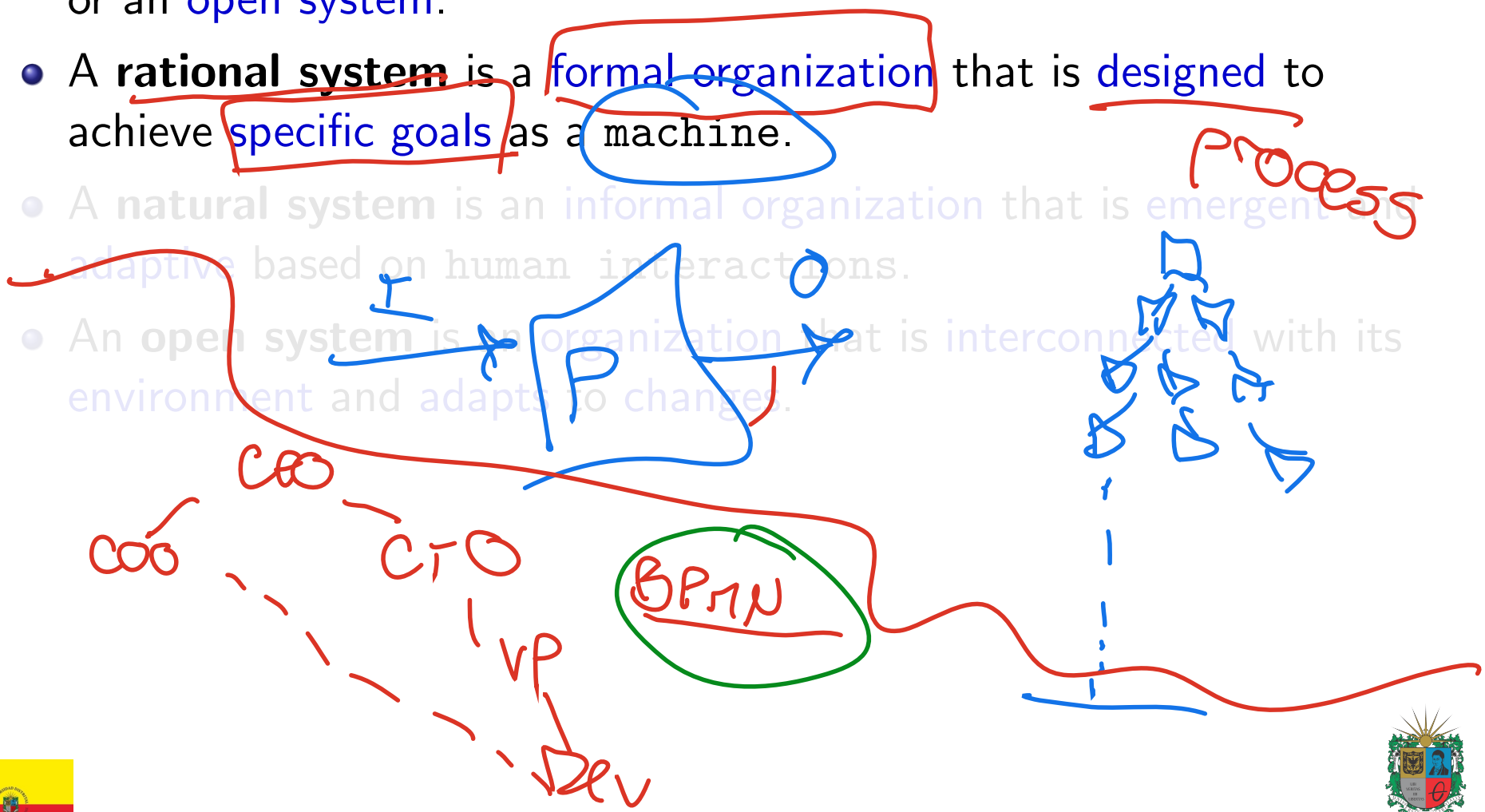

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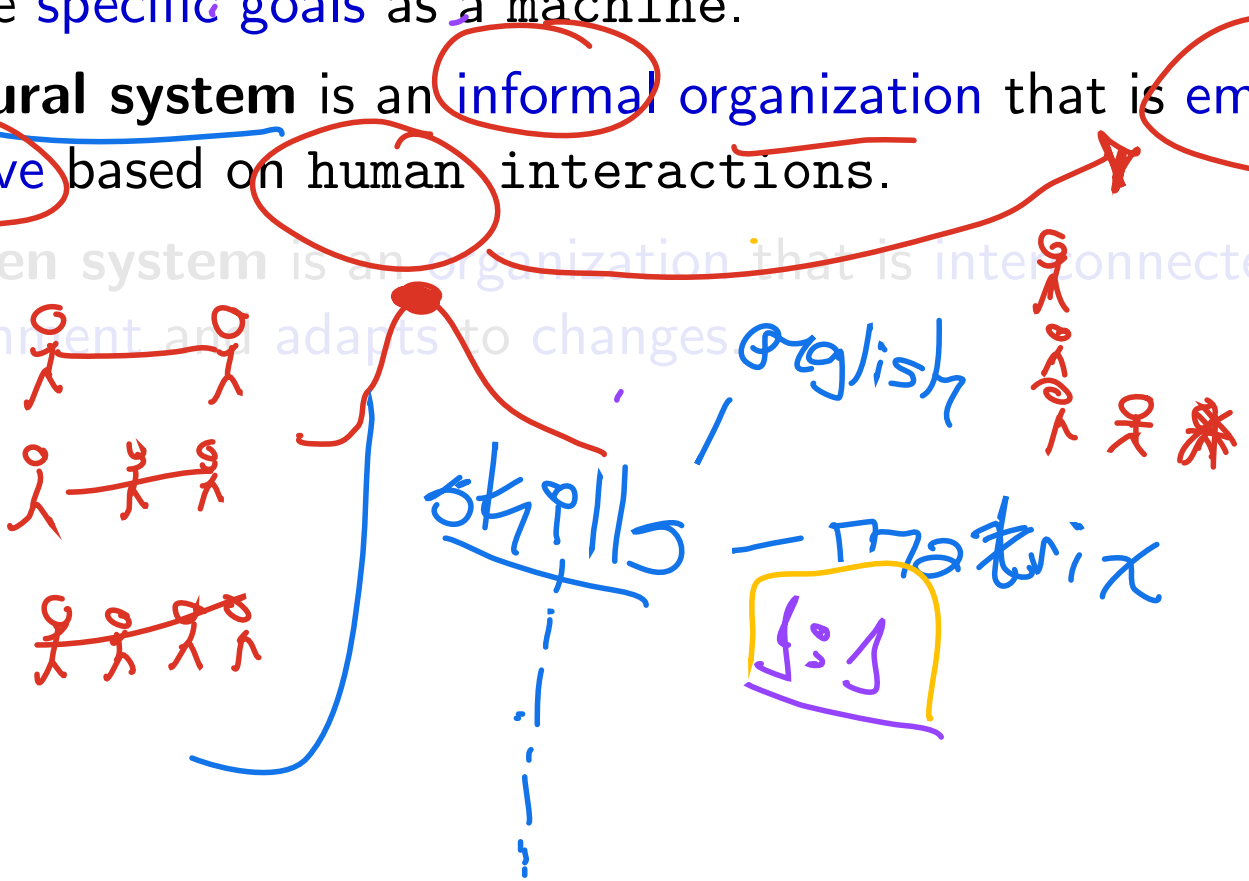

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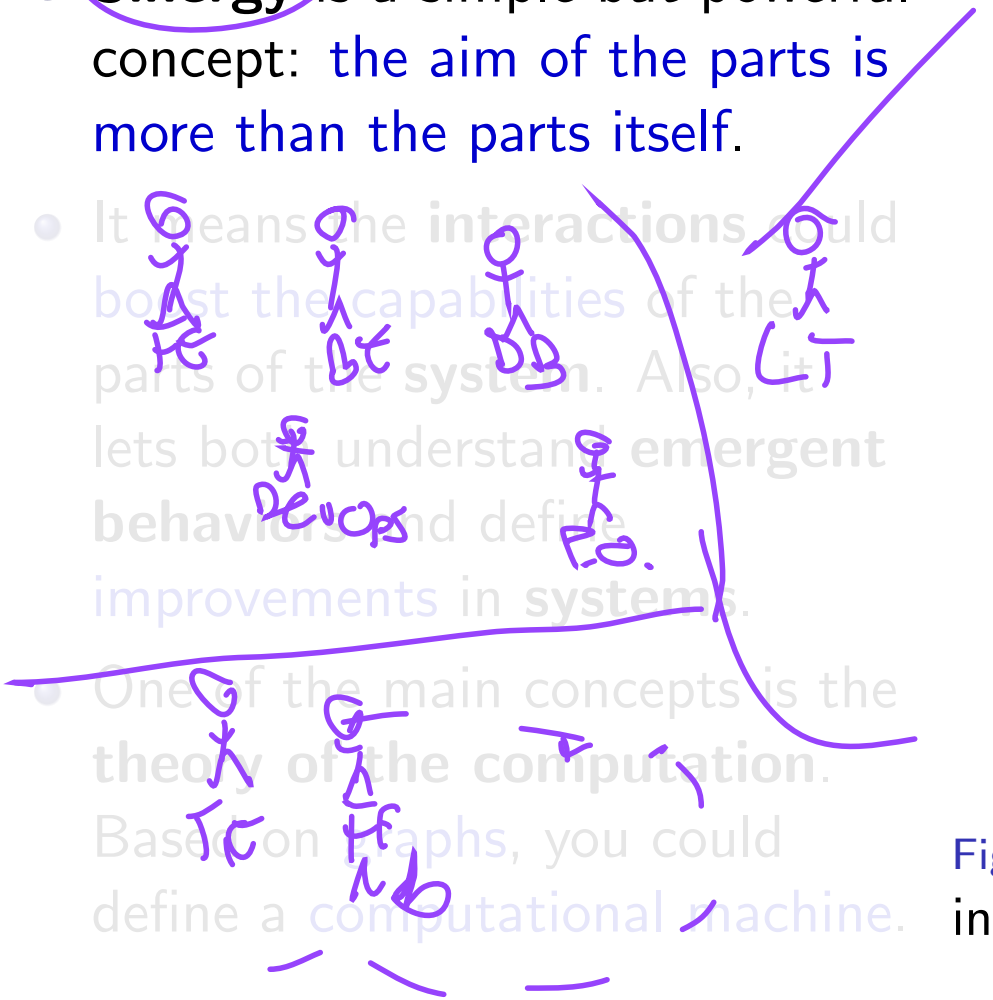
Sinergy

- **Sinergy** is a simple but powerful concept: the aim of the parts is more than the parts itself.
- It means the **interactions** could boost the capabilities of the parts of the **system**. Also, it lets both understand **emergent behaviors** and define improvements in **systems**.
- One of the main concepts is the **theory of the computation**. Based on Graphs, you could define a computational machine.



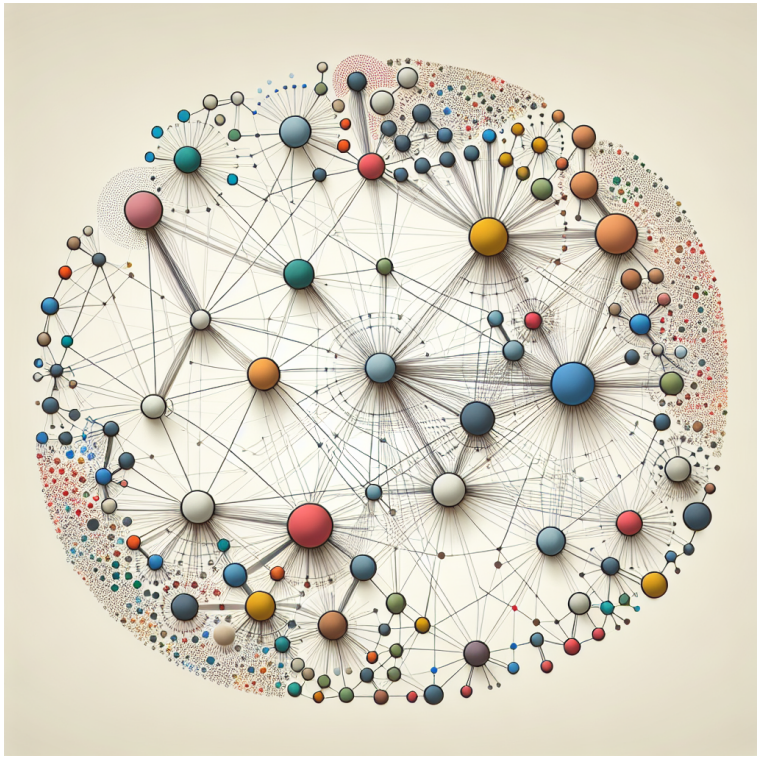


Figure: Prompt: Define a draw of clusters in social networks.

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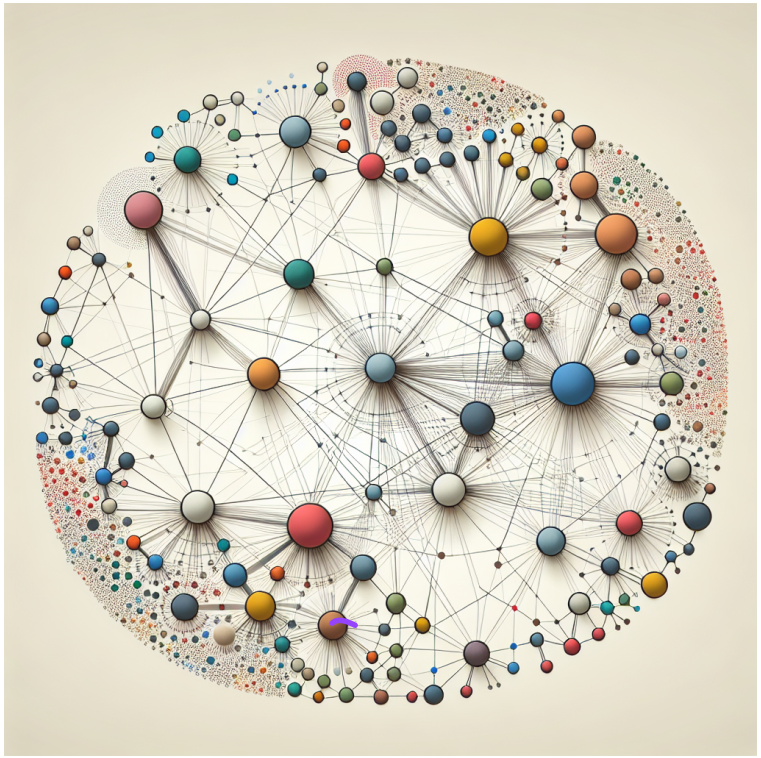

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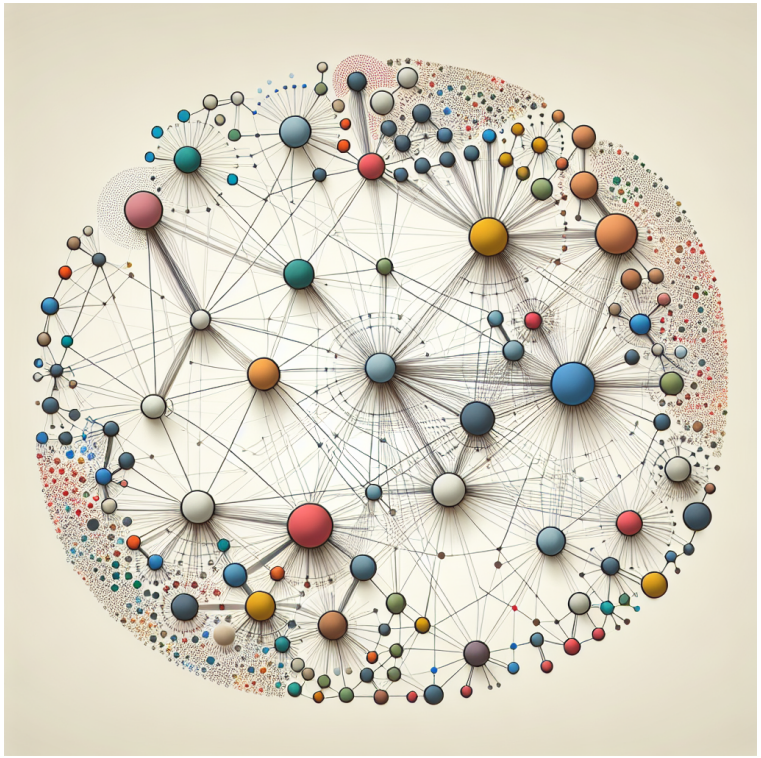

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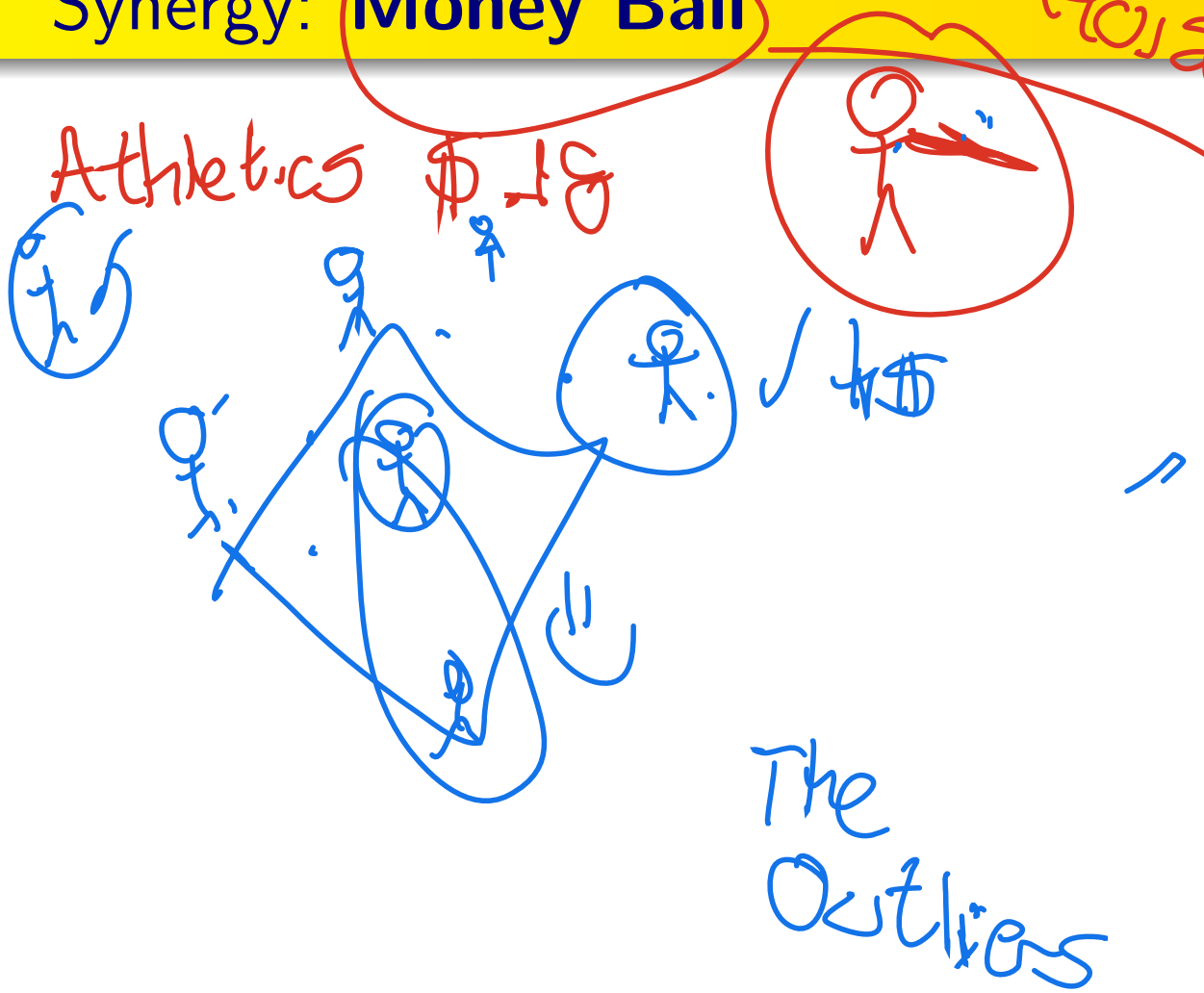
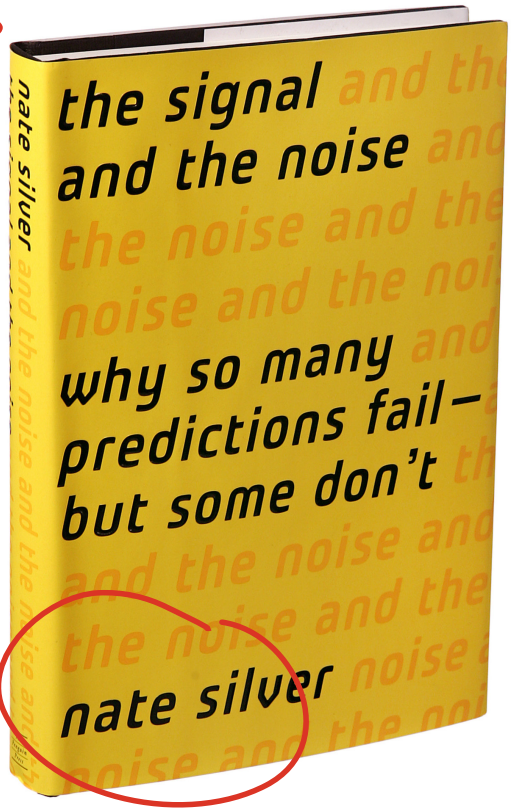
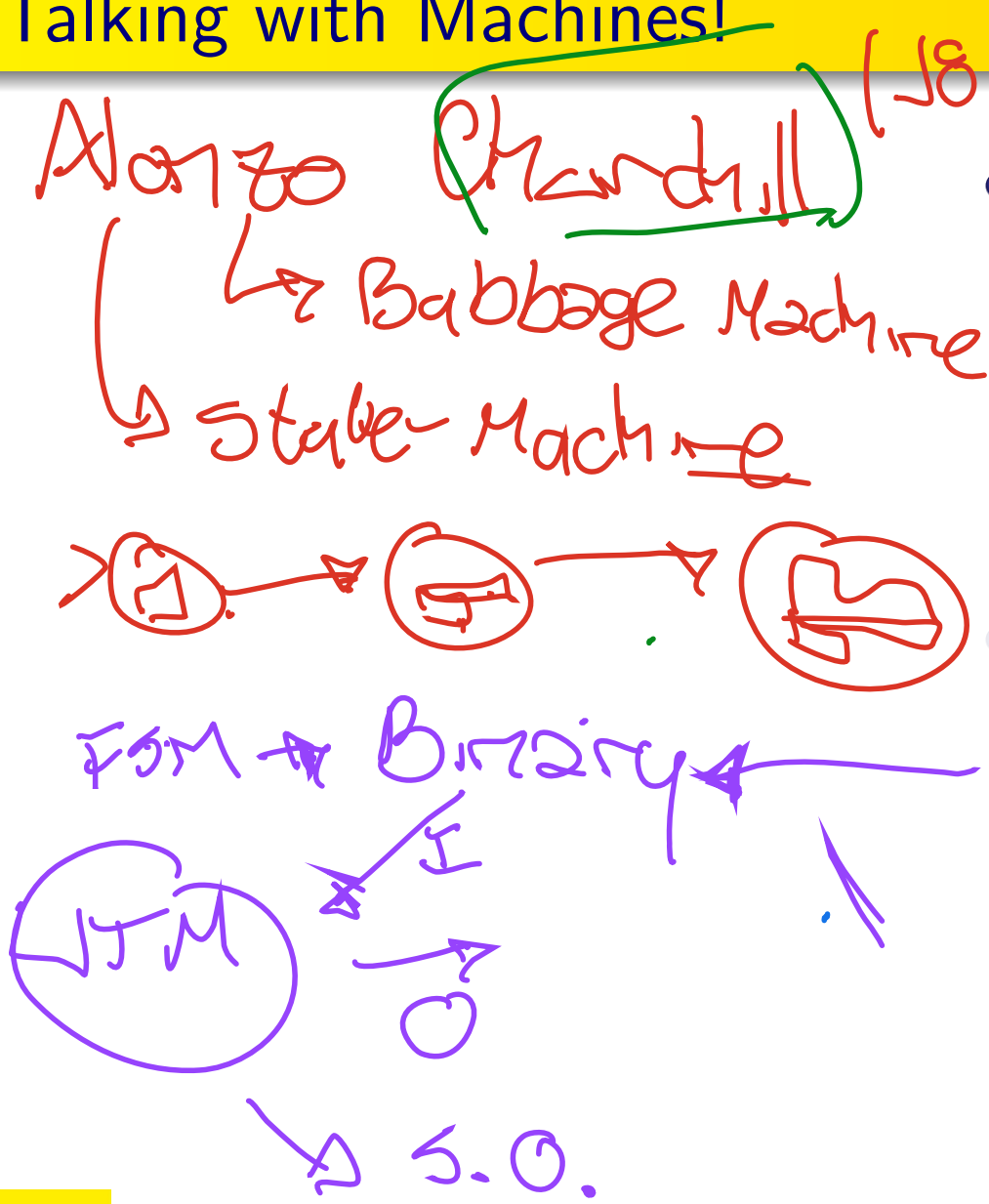
Synergy: **Money Ball**





Talking with Machines!



- **Alan Turing** proposed a hundred years ago an Universal Machine, capable of take any algorithm defined as a state machine, and process it in a binary language.
- Forty years after, **Noam Chomsky** proposed the formal language based on generative grammars. Here is were the high-level programming languages appear.

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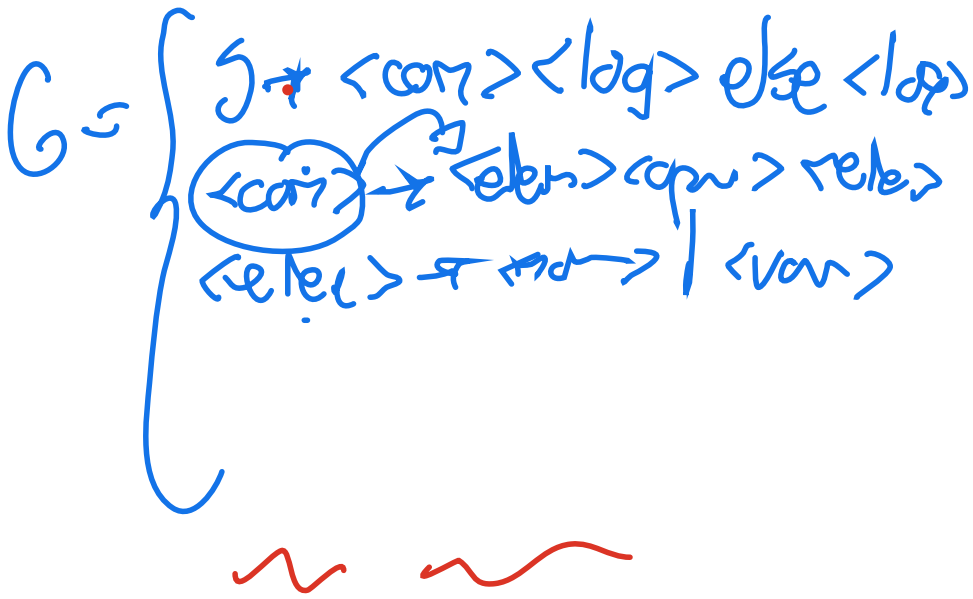

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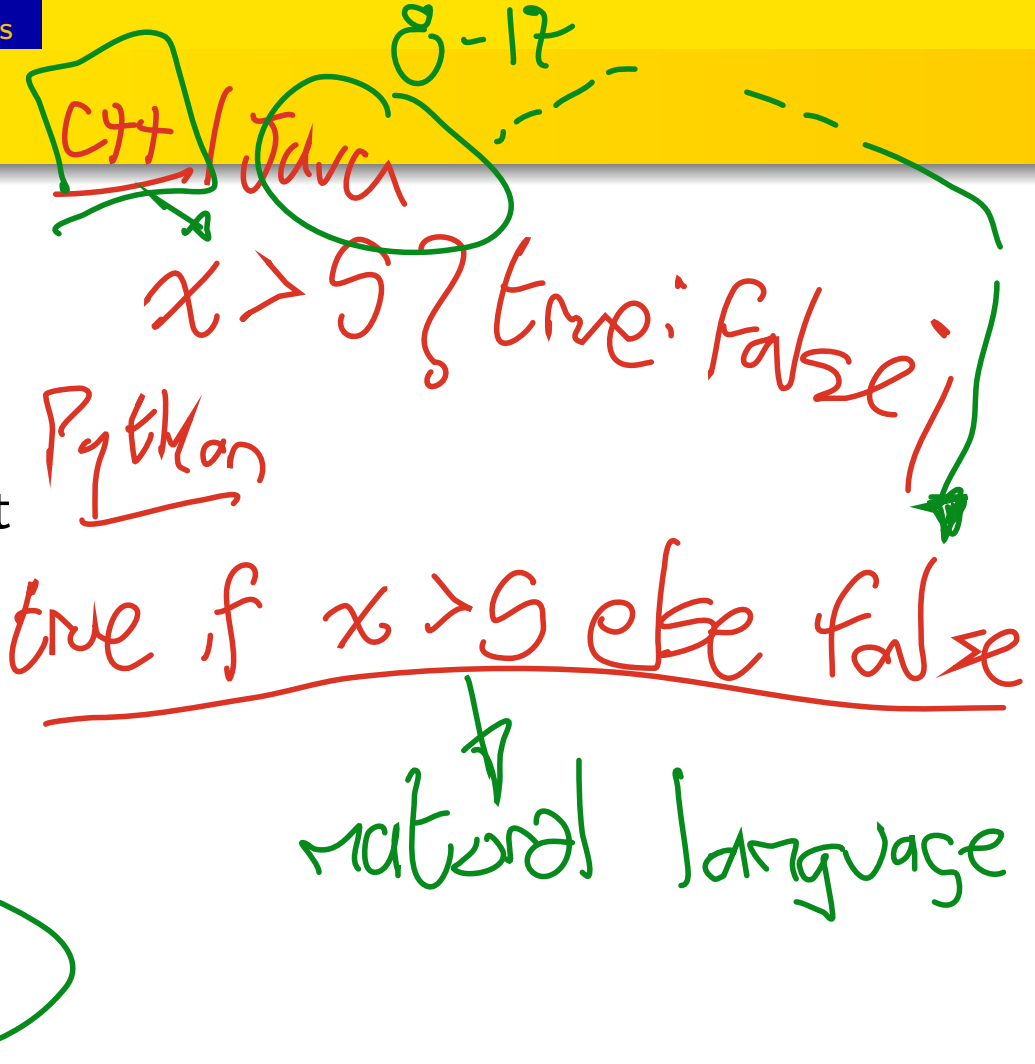
Programming Languages

- **Programming Lenguajes** with more capabilities, easier comprehension had been created. Also, more people start to code into specific domain programming languages.
- **Andrej Kaparty**, hero in Tesla Company and now in Open.AI said: *nowadays, english is the more important programming language.*



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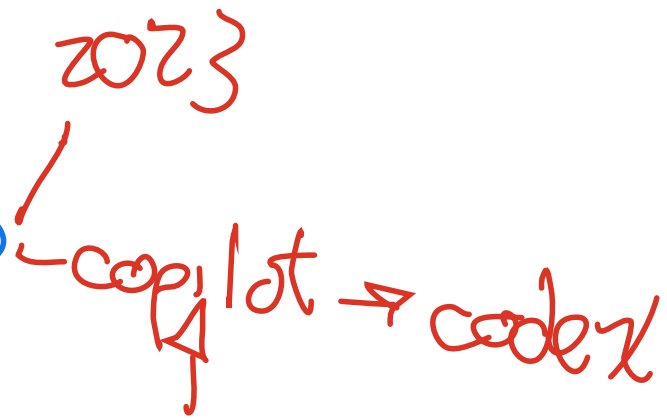

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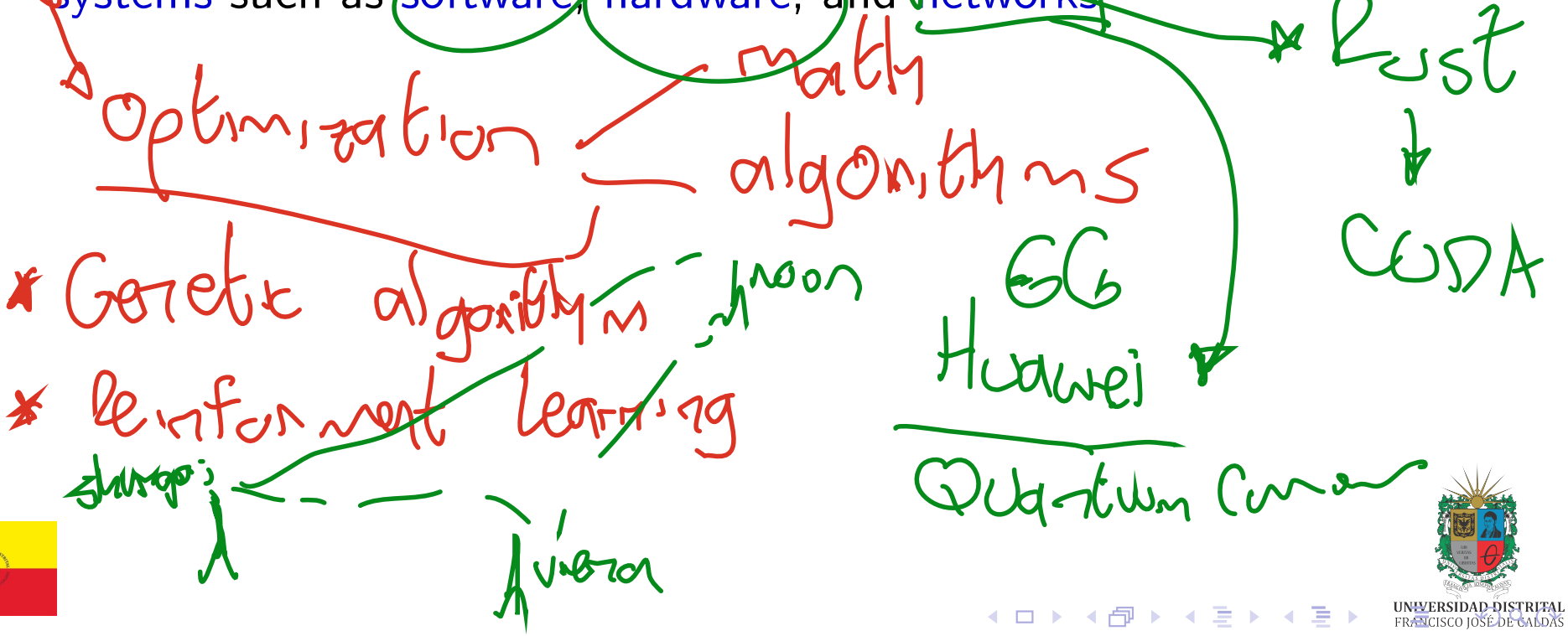
Applications of Systems Engineering

- **Systems Engineering** can be applied to understand, analyze, and improve complex systems.
- **Systems Engineering** can be applied to design and manage complex systems such as organizations, cities, economies, and societies.
- **Systems Engineering** can be applied to design and manage complex systems such as software, hardware, and networks.



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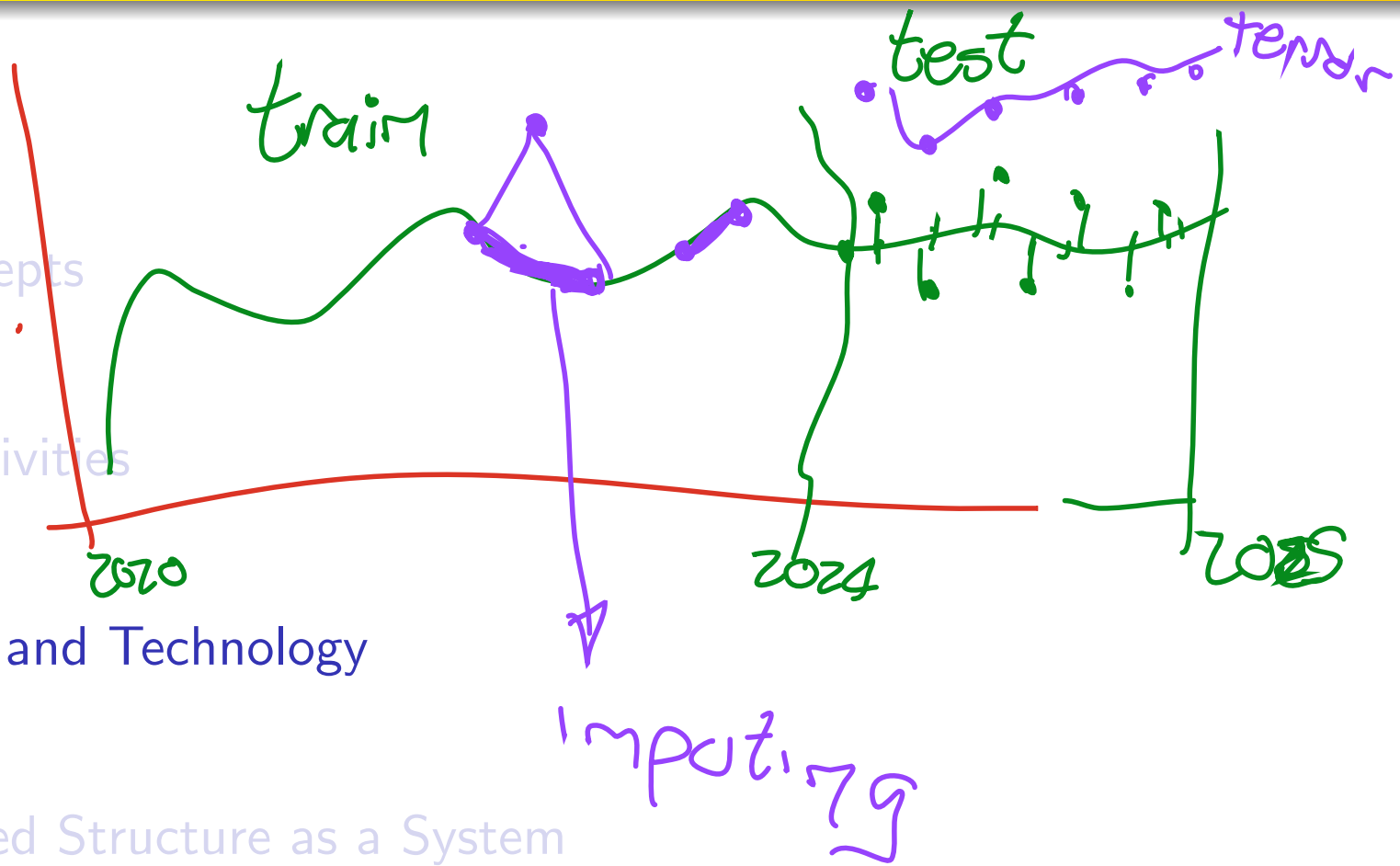
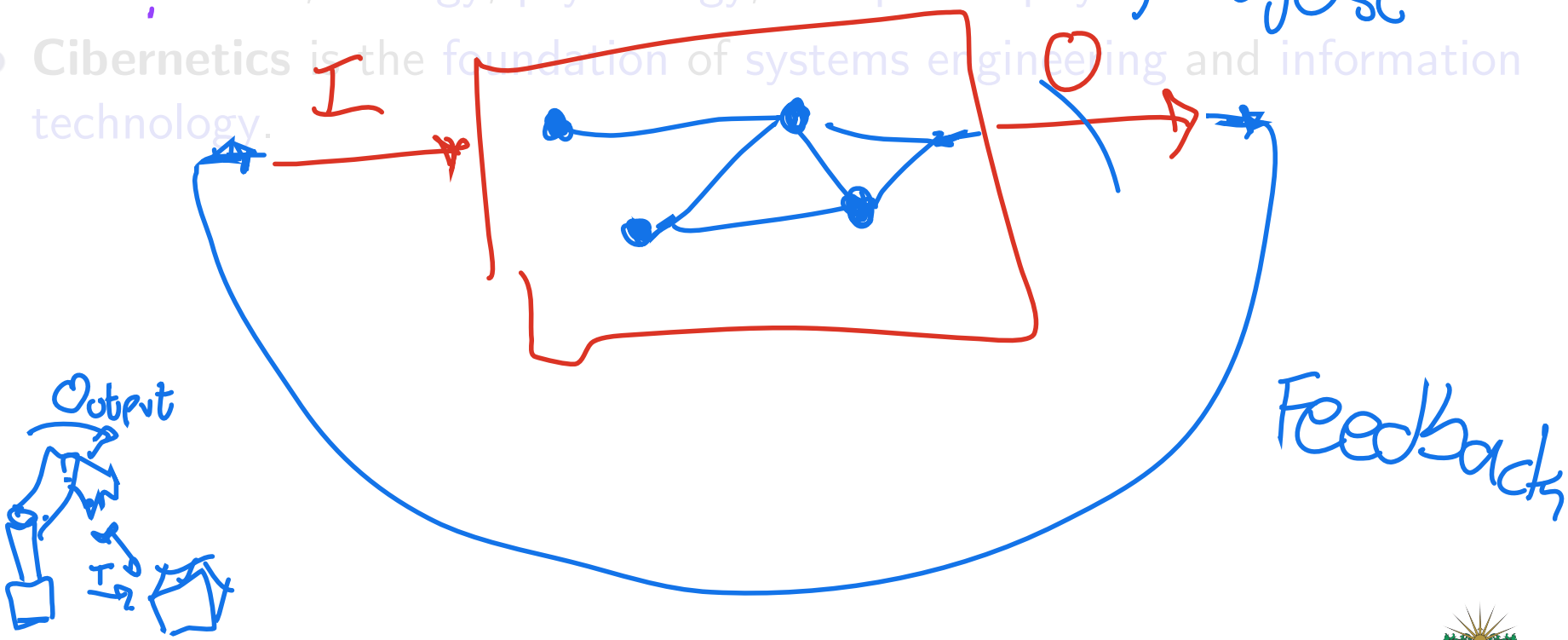


Cibernetics

- **Cibernetics** is the study of systems, control, and communication in animals, machines, and organizations.
- Cibernetics is a transdisciplinary field that combines engineering, mathematics, biology, psychology, and philosophy.
- **Cibernetics** is the foundation of systems engineering and information technology.



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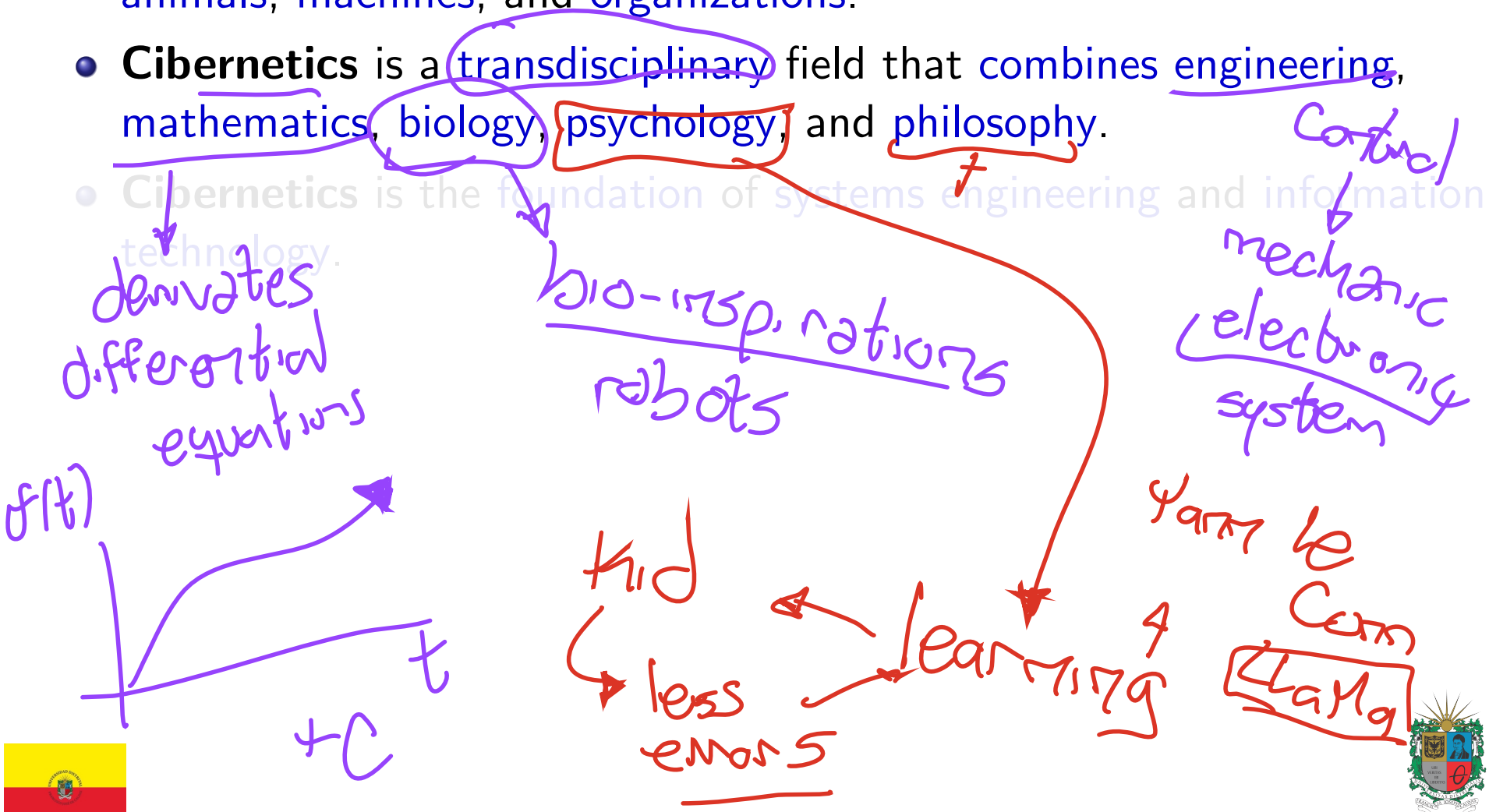

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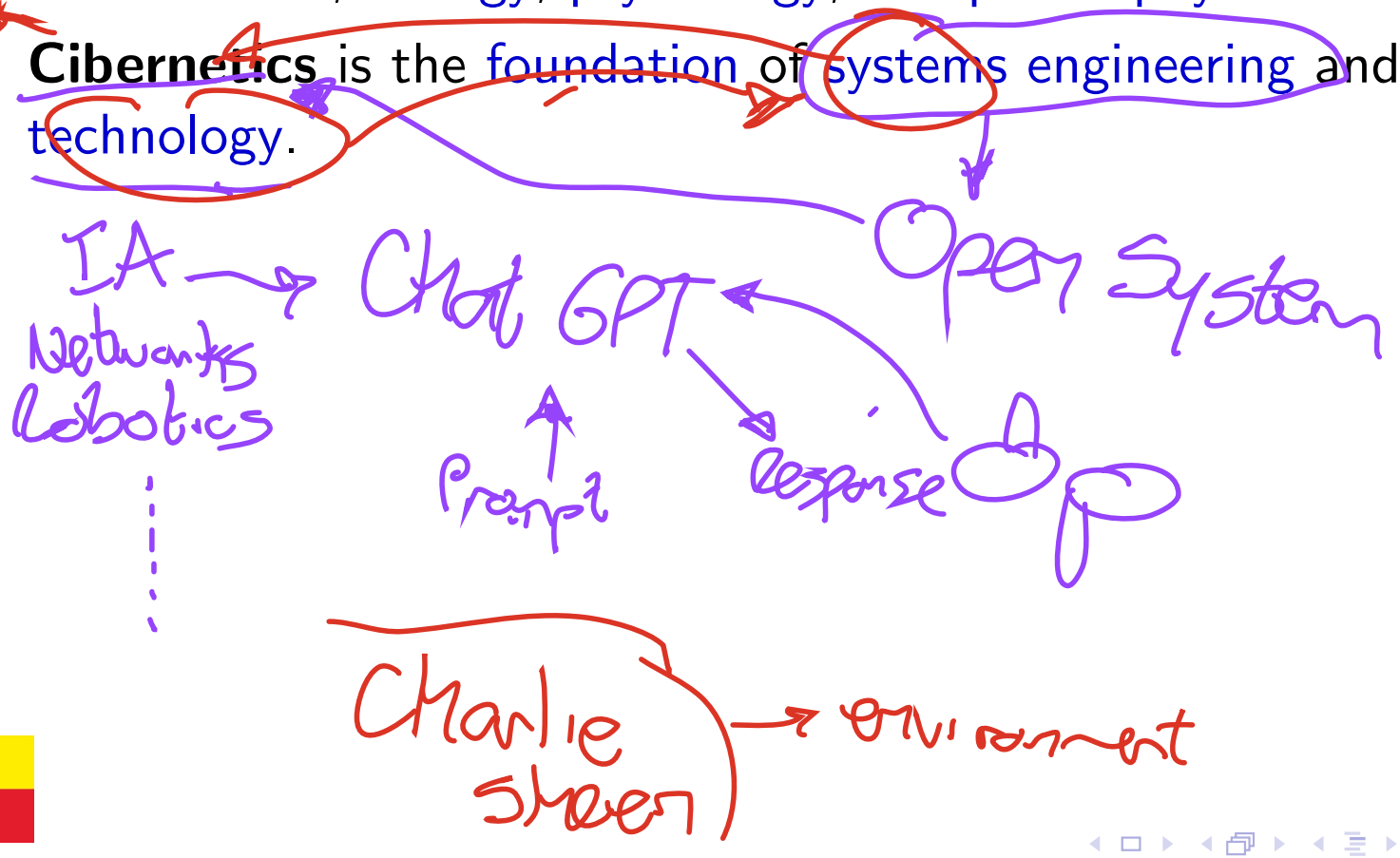

Technology

- **Technology** is the application of scientific knowledge to solve problems and improve systems.
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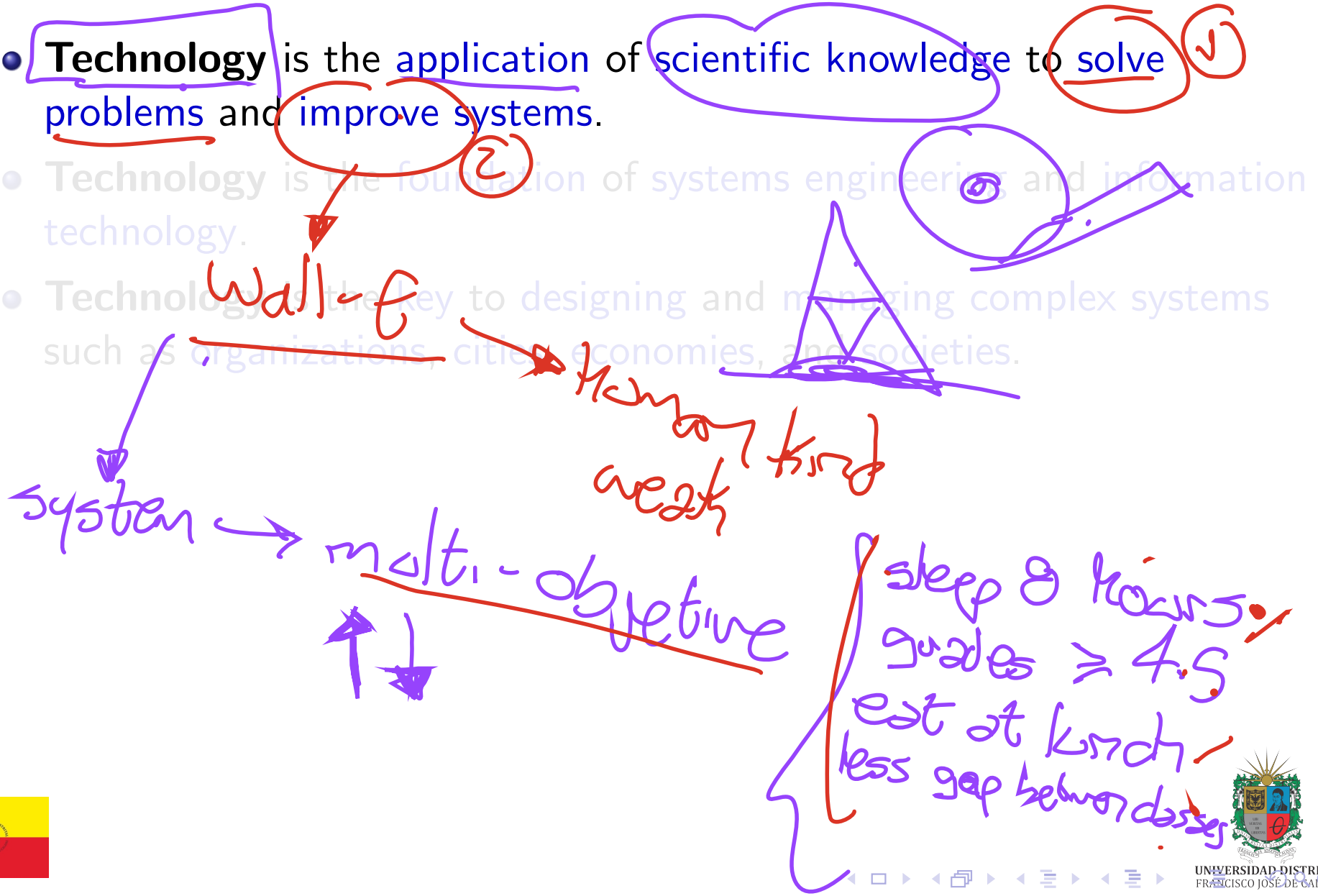
- **Technology** is the key to designing and managing complex systems such as organizations, cities, economies, and societies.



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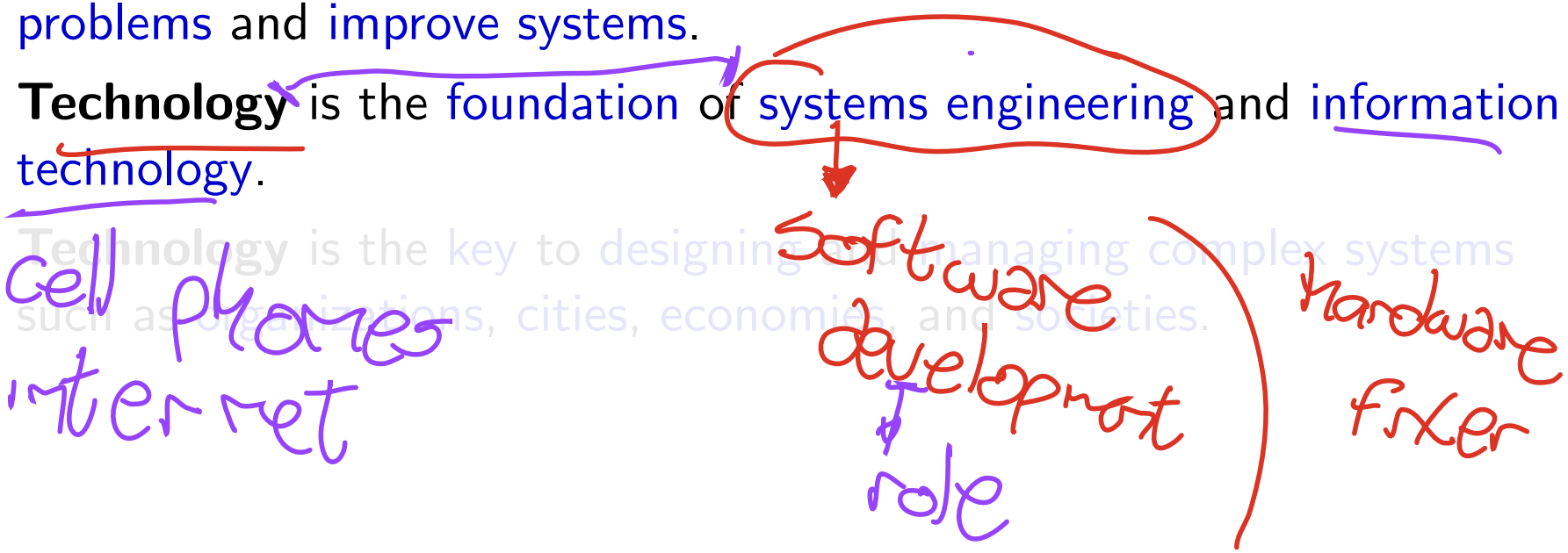

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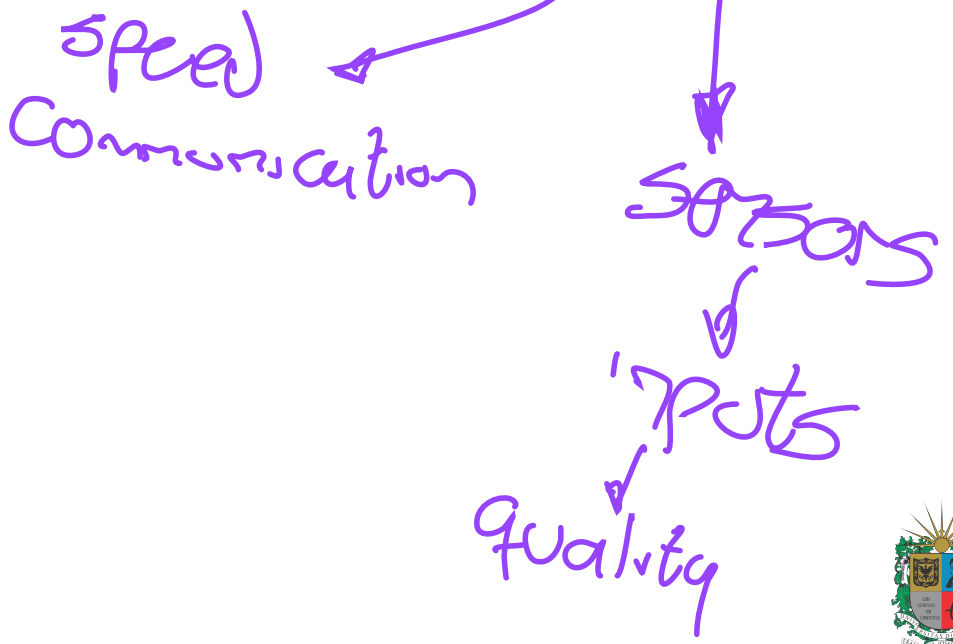

Technology: **AI**

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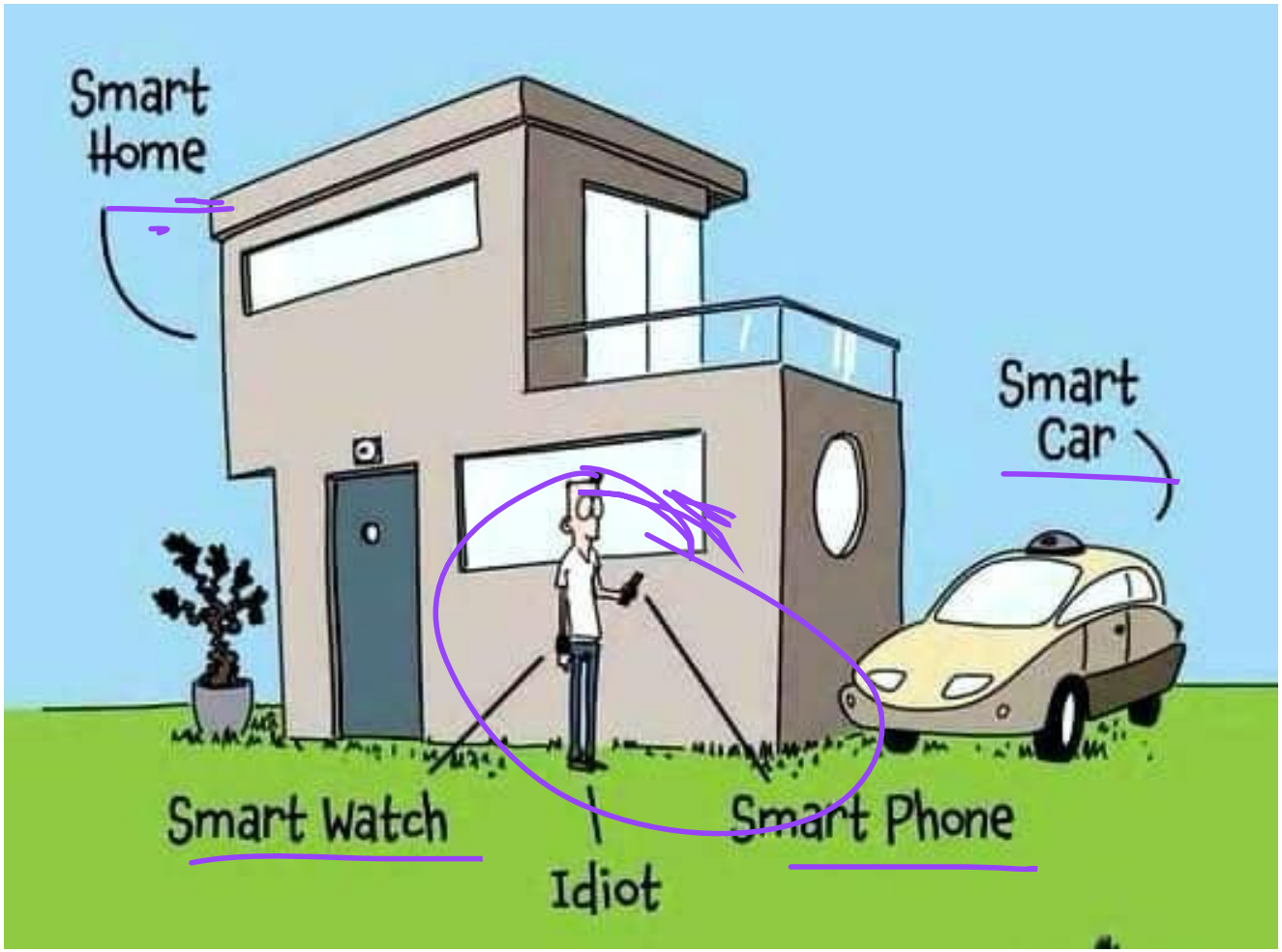
Artificial Intelligence **not** as a System



Cibernetics & Technology in Systems Context

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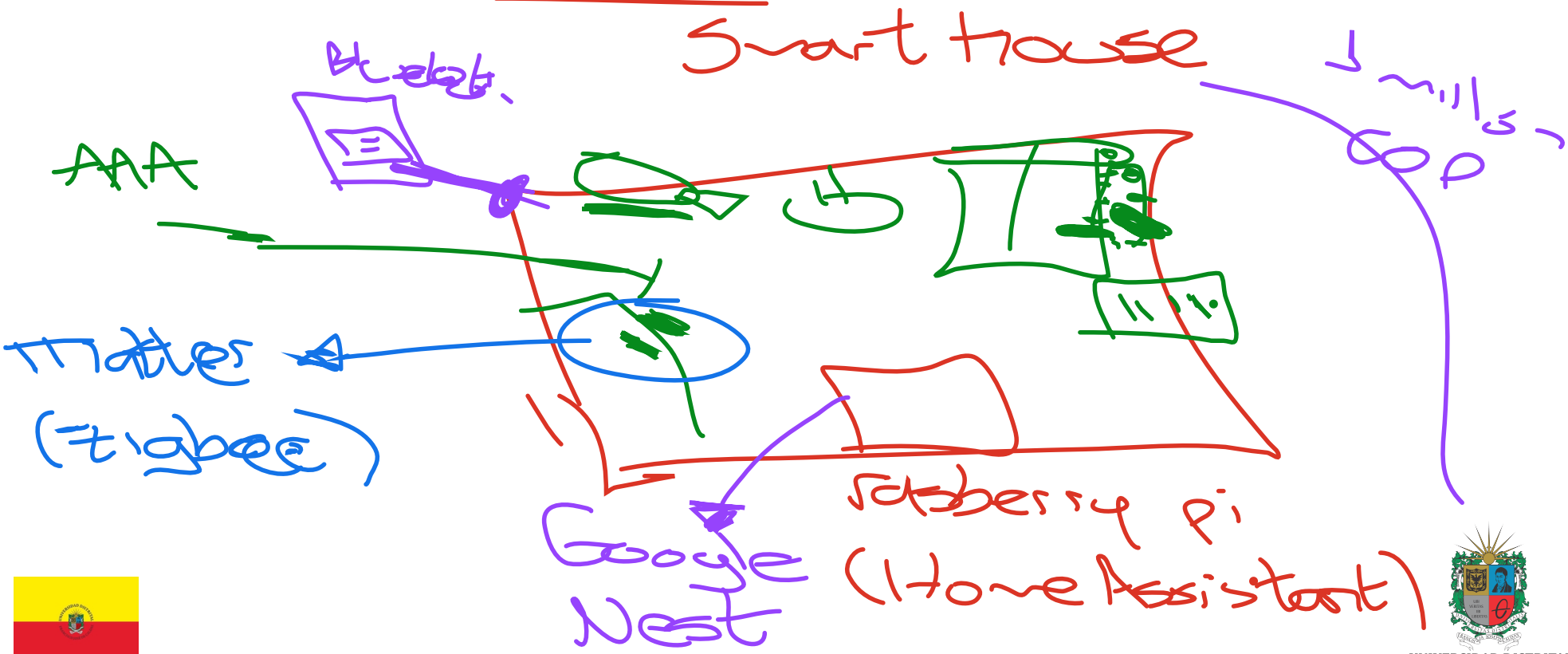
- **Cibernetics** and **technology** are the foundation of artificial intelligence and smart systems.



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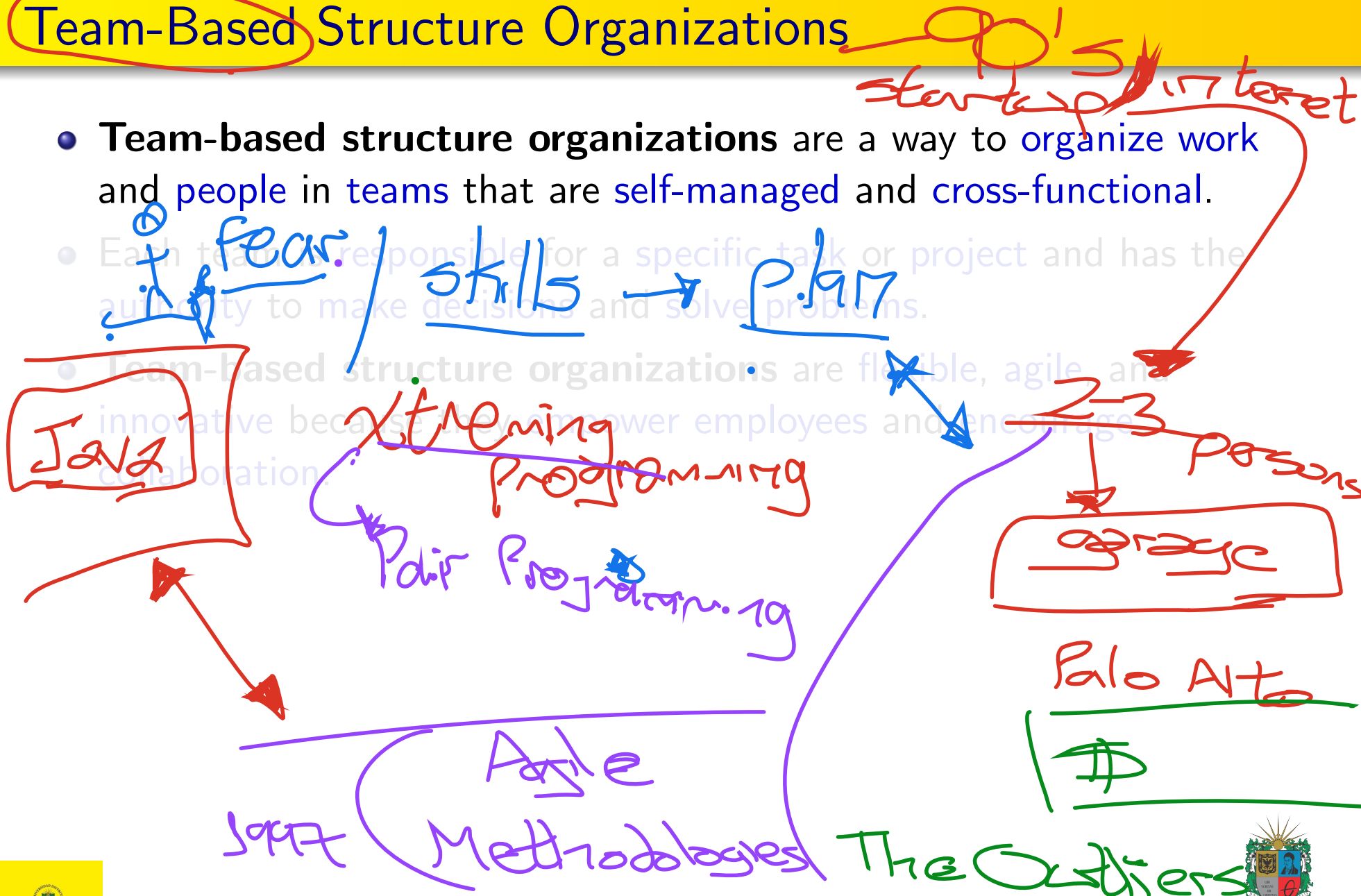
Team-Based Structure Organizations

- **Team-based structure organizations** are a way to organize work and people in teams that are self-managed and cross-functional.
- Each team is responsible for a specific task or project and has the autonomy to make decisions and solve problems.
- **Team-based structure organizations** are flexible, agile, and innovative because they empower employees and encourage collaboration.



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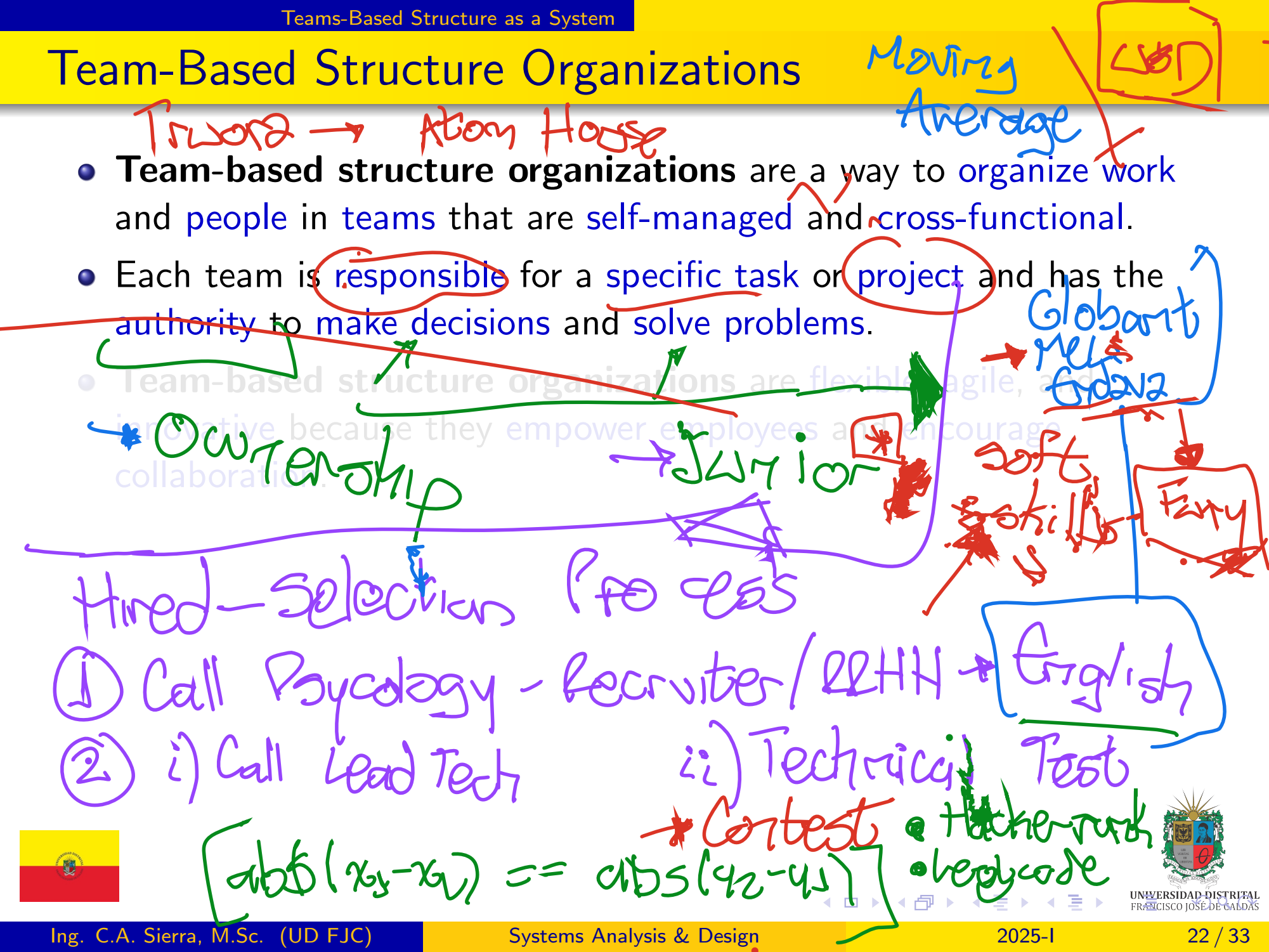

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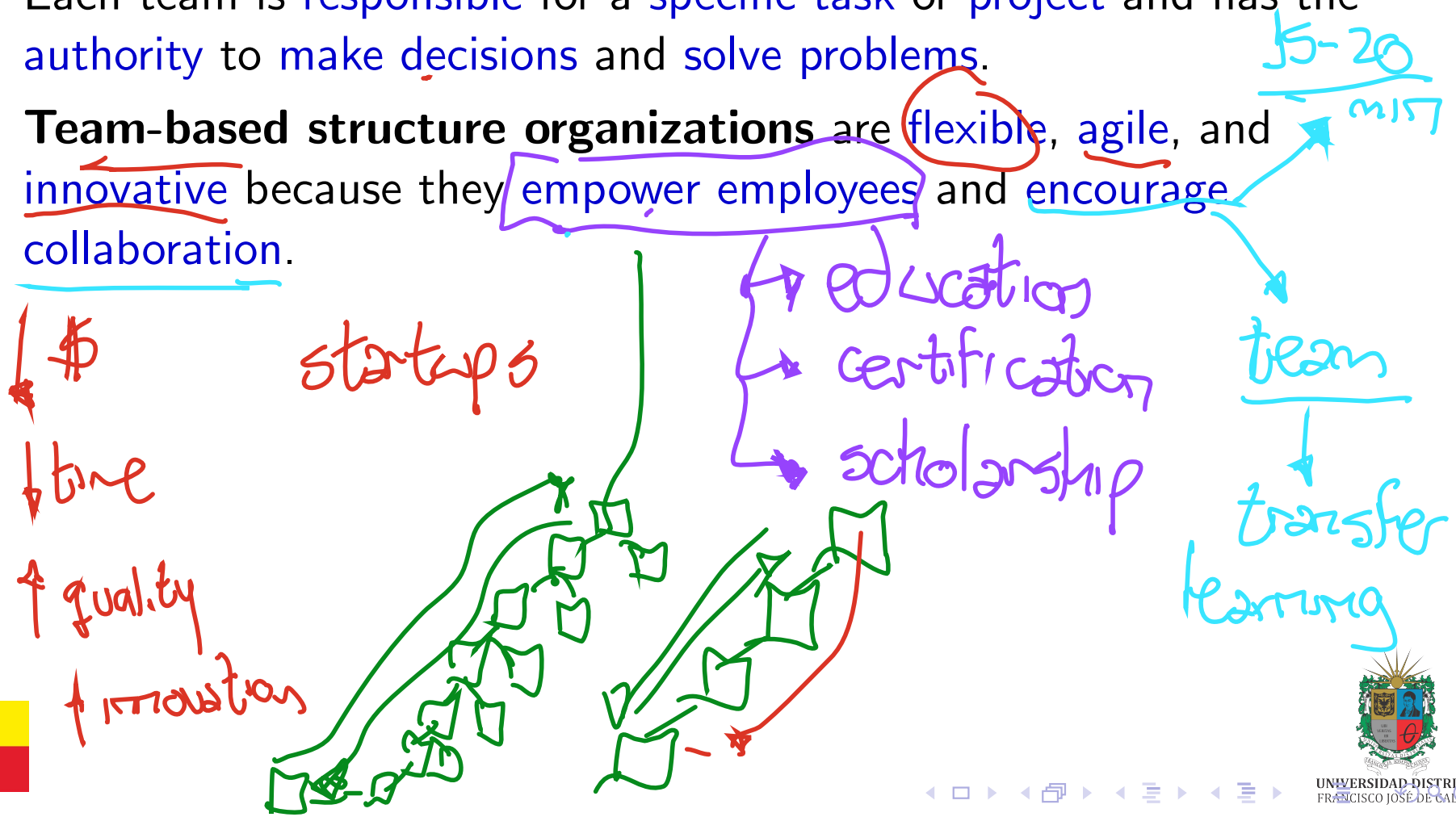
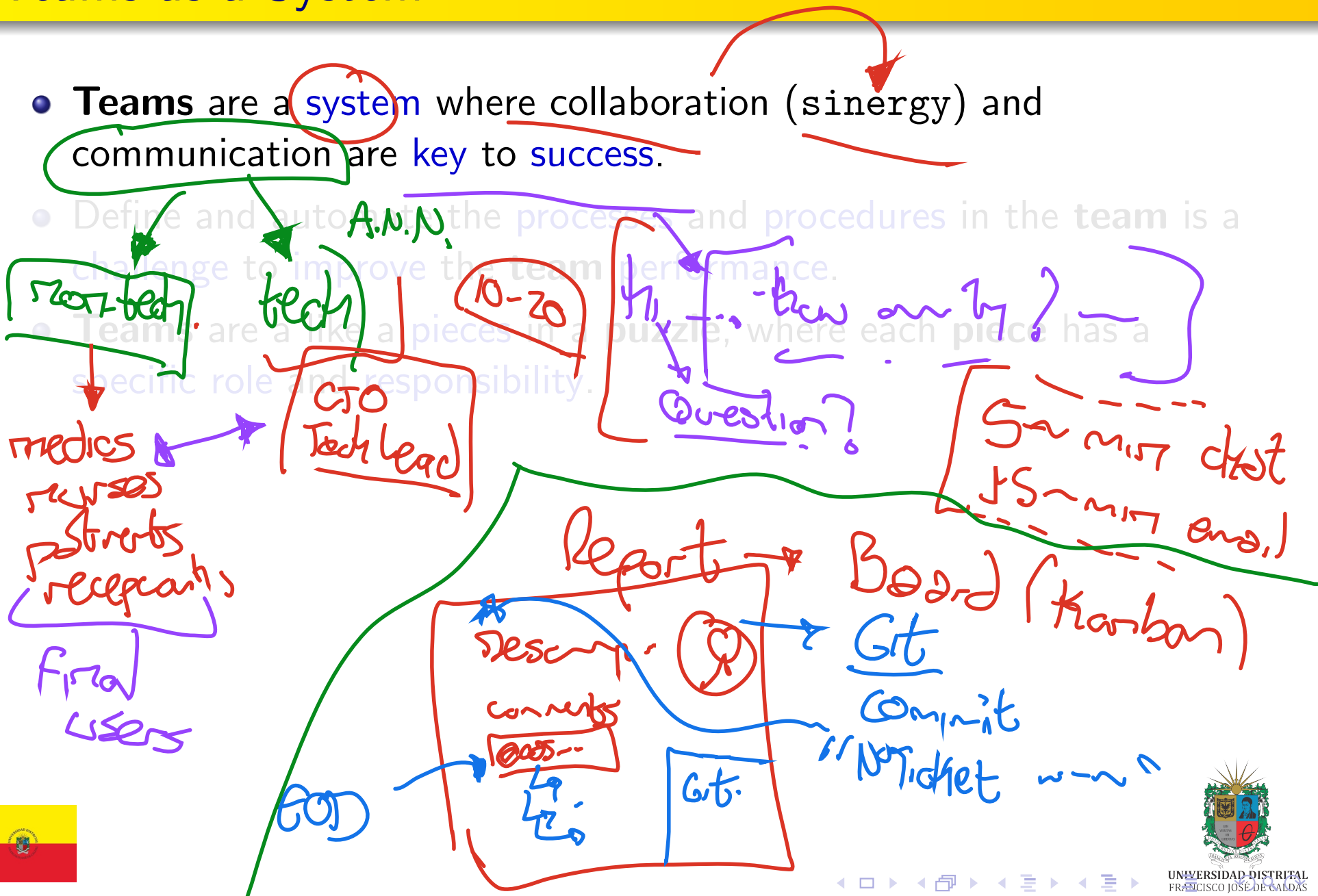


Teams as a System

- **Teams** are a system where collaboration (`sinergy`) and communication are key to success.



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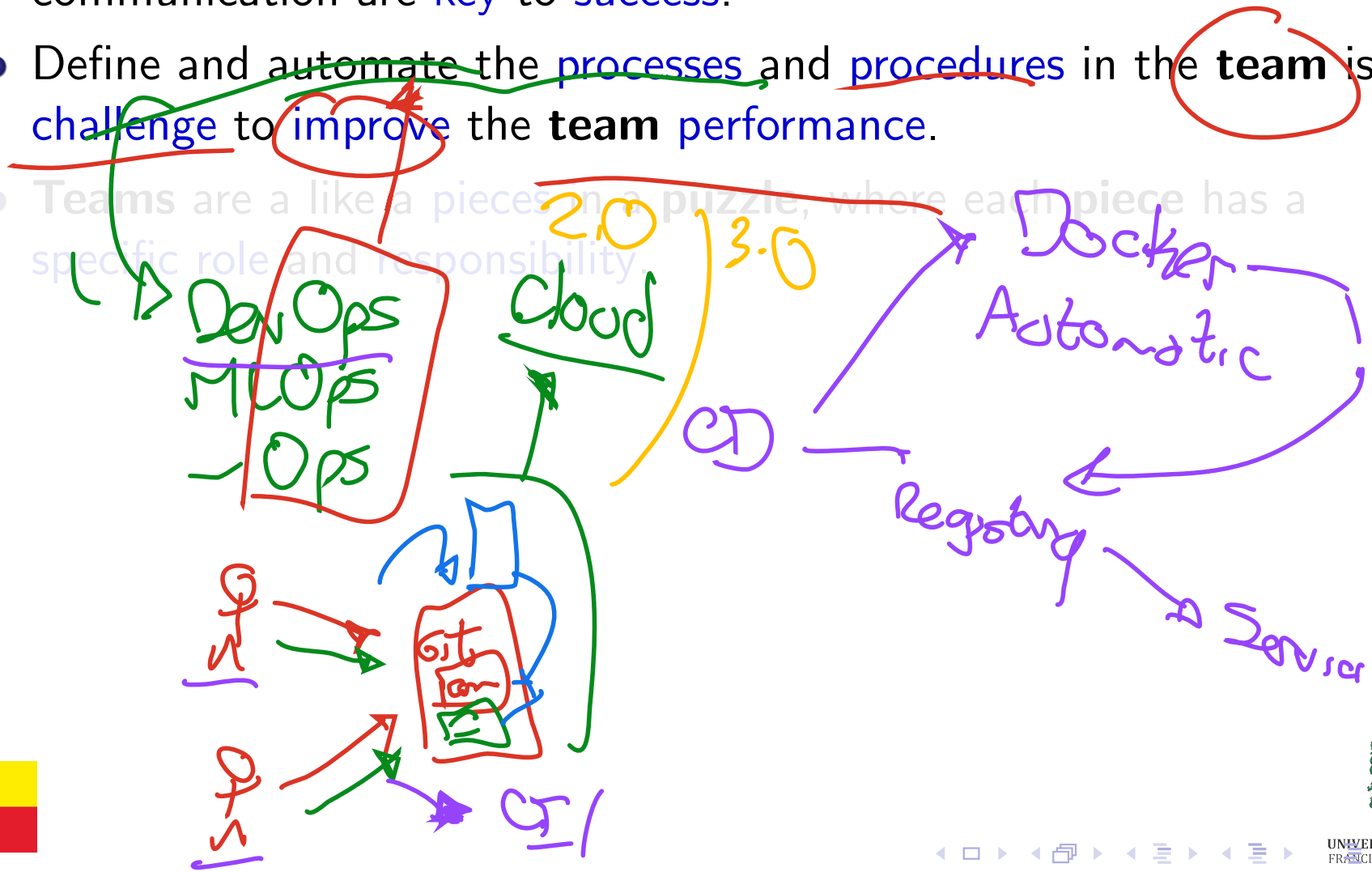
- Define and automate the processes and procedures in the **team** is a challenge to improve the **team** performance.
- **Teams** are a like a pieces on a **puzzle**, where each **piece** has a specific role and responsibility.



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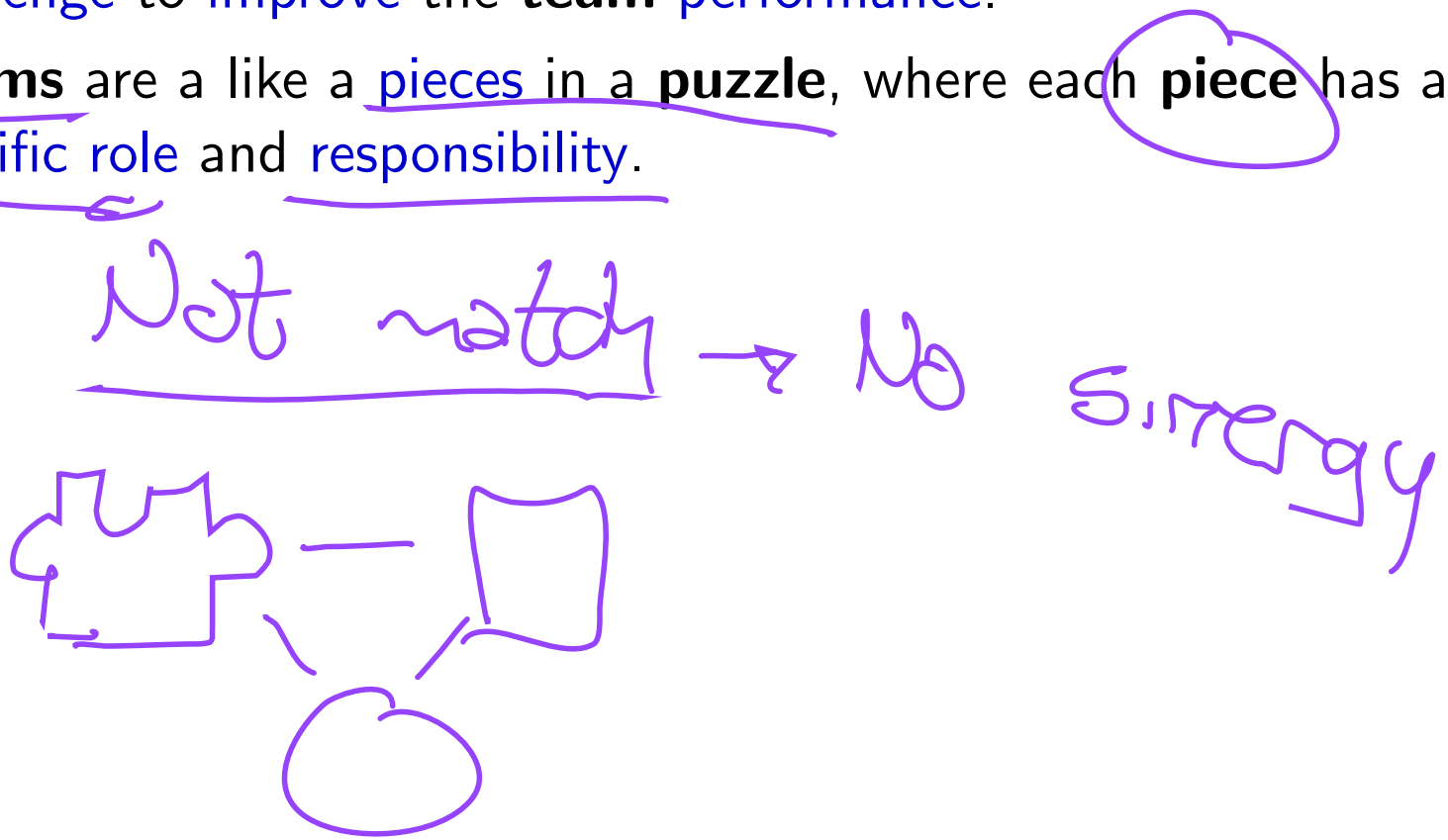
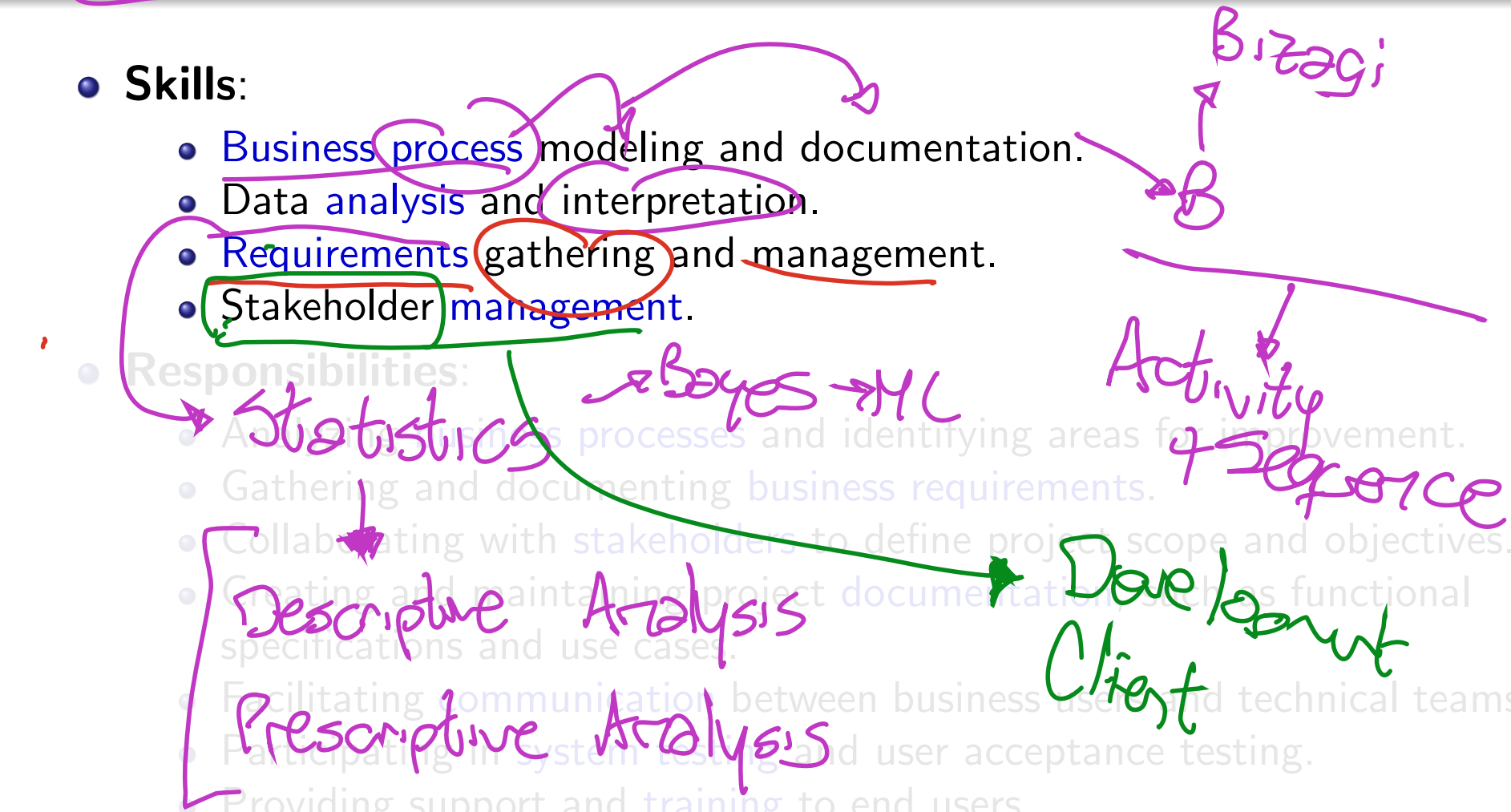


Soft Skills

- **Soft skills** are personal attributes that enable someone to interact effectively and harmoniously with other people.
- Typical Soft Skills:
  - Communication skills (verbal and written).
  - Teamwork and collaboration.
  - Problem-solving and critical thinking.
  - Adaptability and flexibility.
  - Time management and organization.
  - Leadership and management.
  - Emotional intelligence.
  - Creativity and innovation.
  - Conflict resolution.
  - Networking and relationship building.
  - Customer service and client management.

Computer Analyst

- **Skills**:
  - Business process modeling and documentation.
  - Data analysis and interpretation.
  - Requirements gathering and management.
  - Stakeholder management.
- **Responsibilities**:
  - Analyzing business processes and identifying areas for improvement.
  - Gathering and documenting business requirements.
  - Collaborating with stakeholders to define project scope and objectives.
  - Creating and maintaining project documentation, such as functional specifications and use cases.
  - Facilitating communication between business users and technical teams.
  - Participating in system testing and user acceptance testing.
  - Providing support and training to end users.



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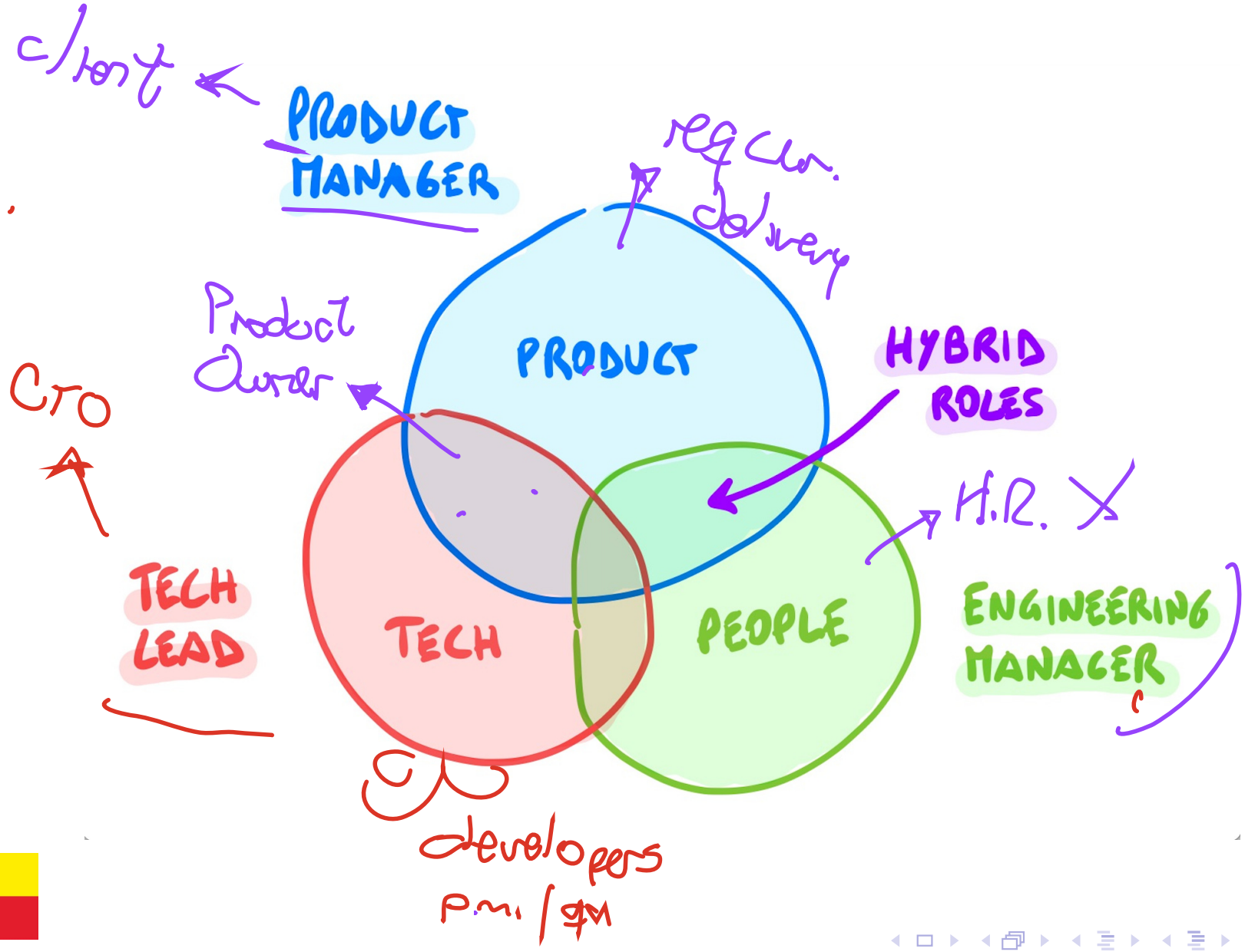
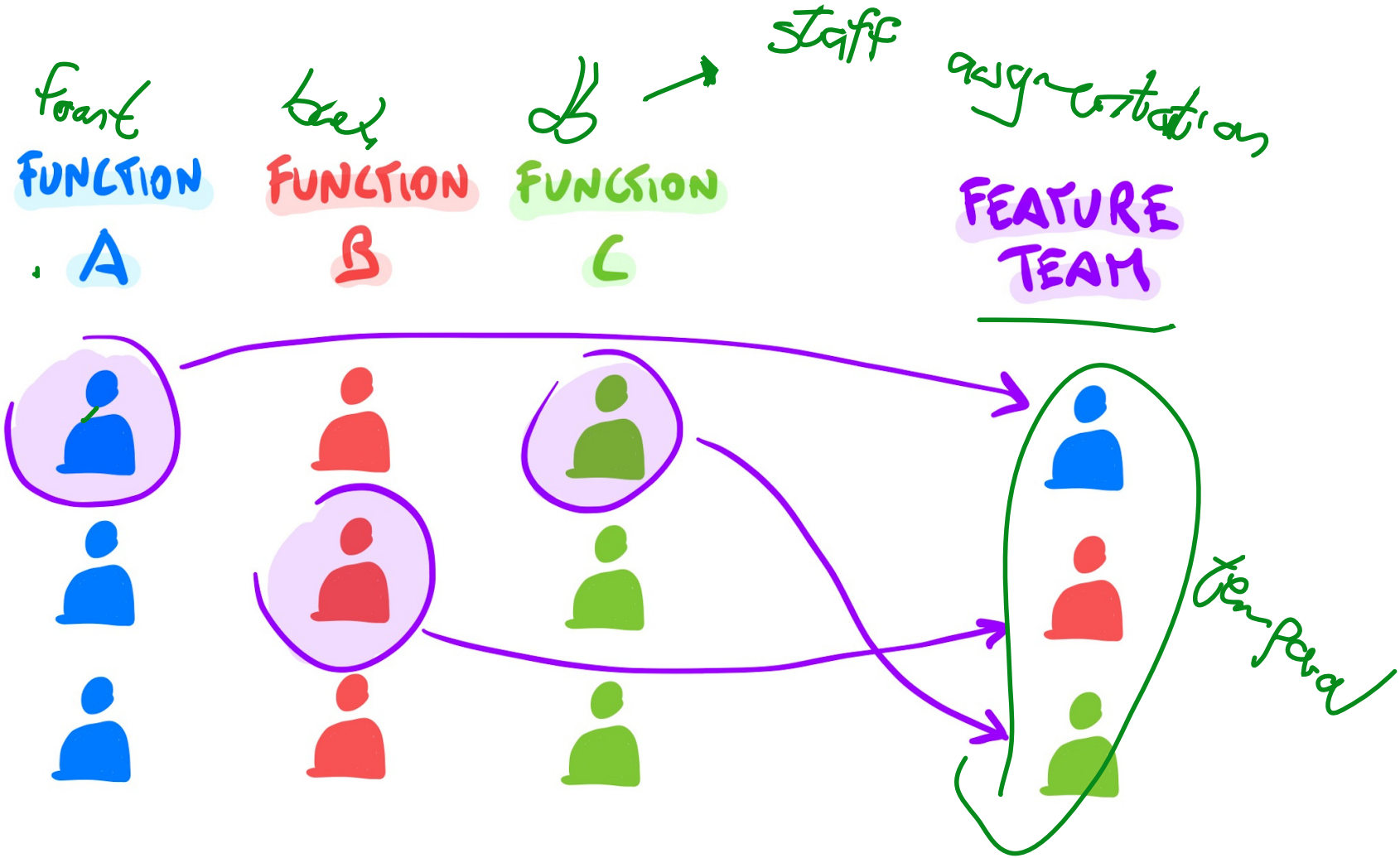
  - Collaborating with stakeholders to define project scope and objectives.
  - Creating and maintaining project documentation, such as functional specifications and use cases.
  - Facilitating communication between business users and technical teams.
  - Participating in system testing and user acceptance testing.
  - Providing support and training to end users.

Tech Company Typical Structure



Feature Teams



What is to be a leader? I

- **Leading** a team is not a role. It is a decision, you could be a **leader** anytime and anywhere.
- **Teamwork culture** is pretty important. It creates habits, open communication, safety spaces for inclusion.
- **Psychological safety** is a key point to have an effective team. You could develop *technical skills*, but it is not enough.
- **Hierarchy** is very important. Anarchism tends to fail. Hierarchy exists by **status** and **power**.
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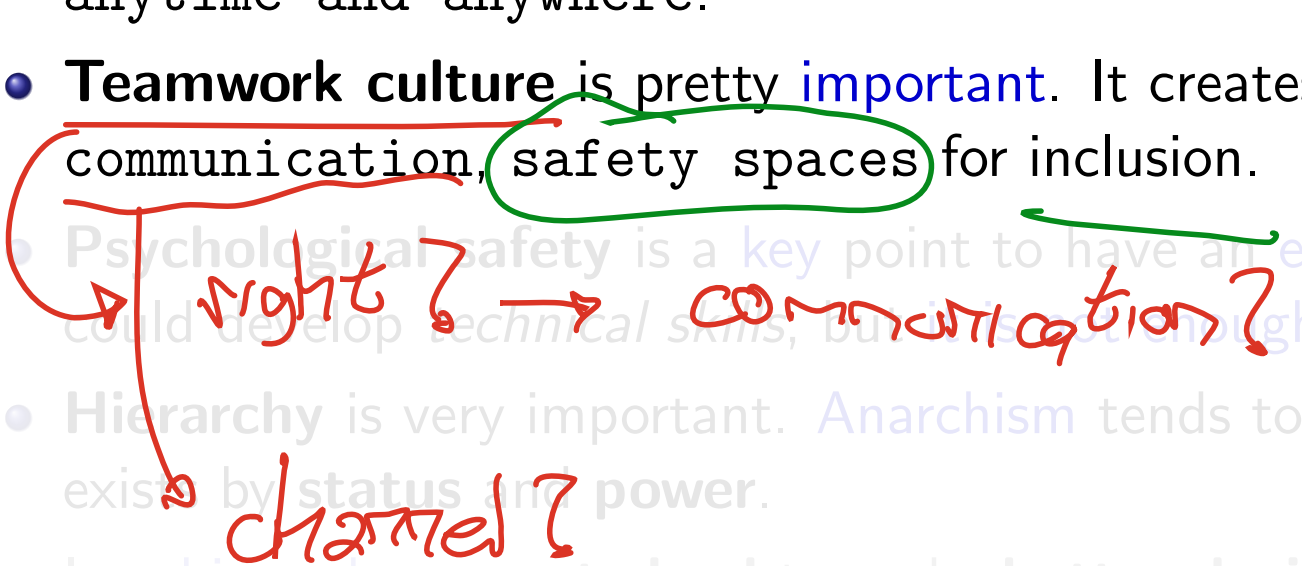

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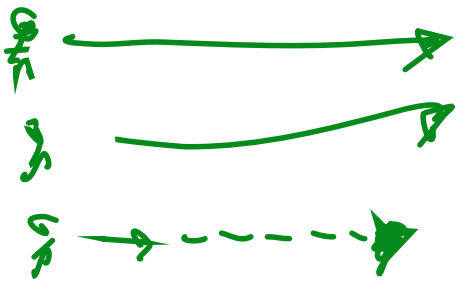

What is to be a leader? II

- With **crystal-clear communications** and clarity about business goals and achievements, people feel more comfortable pursuing the same goals as a **team**.
- A **good leader** should focus on outcomes rather than outputs. This helps bring **business value** rather than just complete tasks.
- **Failure** is always an option. Learn how to **deal** with srtbacks; do not punish — just fix and learn.
- Some believe you're born a leader, while others think that a leader can be devveloped over time. Either way, **context** and **the desire** for self-growth are vital.
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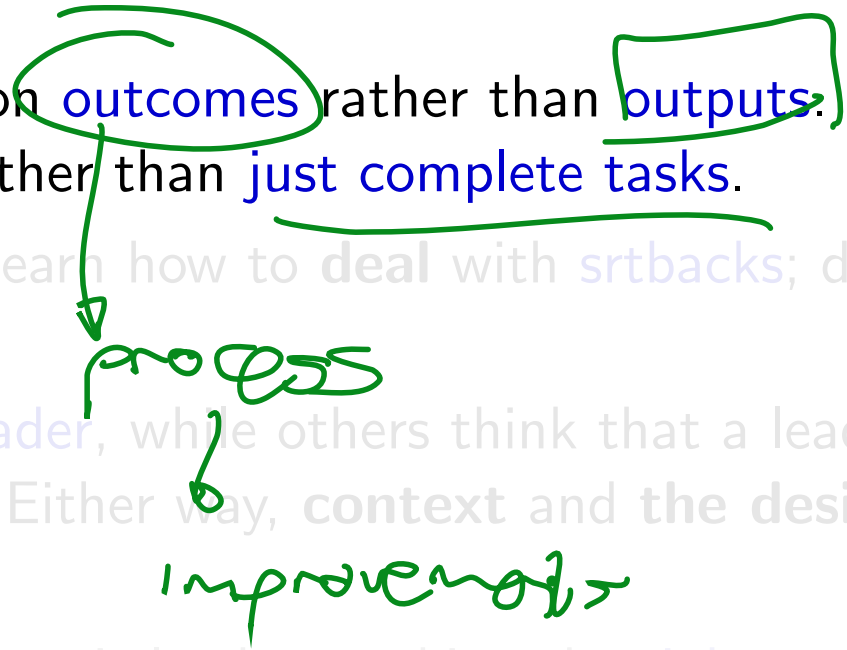

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The Outliers

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What is to be a leader? III

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- A **good leader** builds trust relationships and has the emotional intelligence to comunicate effectively and understand others.
- To develop as a leader some good guidelines are the **three C's**: Curiosity, Courage, and Commitment.

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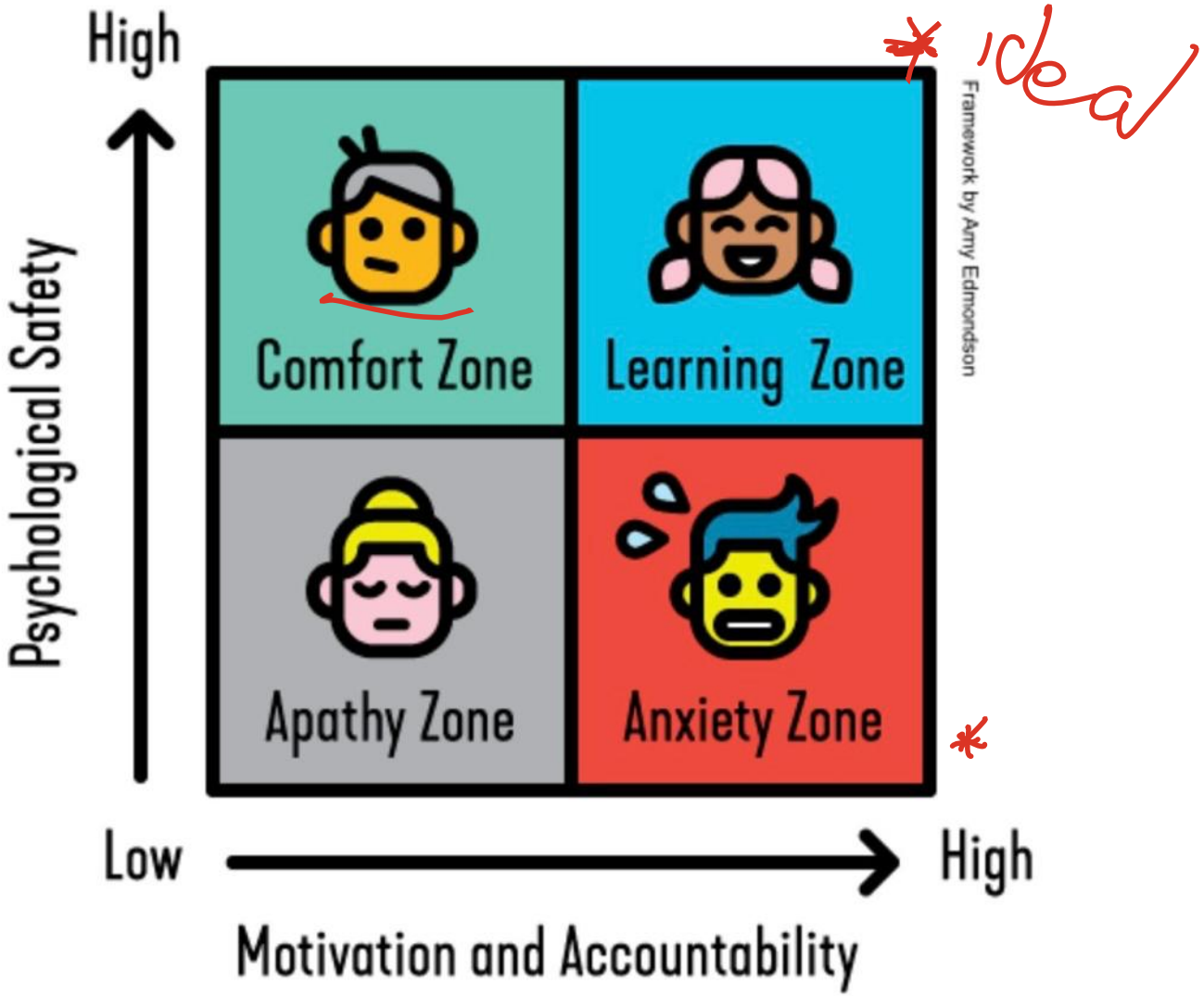
Working Zones



Outline

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Thanks!

Questions?

Repo: *https://github.com/EngAndres/ud-public/tree/main/courses/systems-analysis*

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