Systems Thinking

Systems Analysis

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Outline

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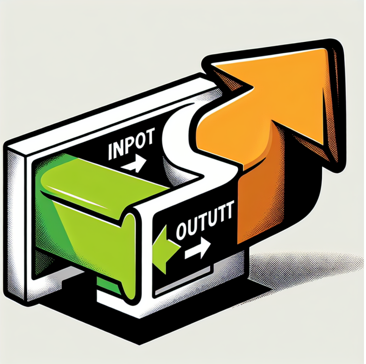
Introduction to Systems Thinking I

- A **system** is just a set of elements interconnected with a common purpose.
- Not all elements must be connected to each others, but every **connection** should be meaningful.
- The more the **connections**, the more the system complexity. Representation must be feasible.
- Each element must have **at least** one connection. Isolated elements makes no sense in a system.



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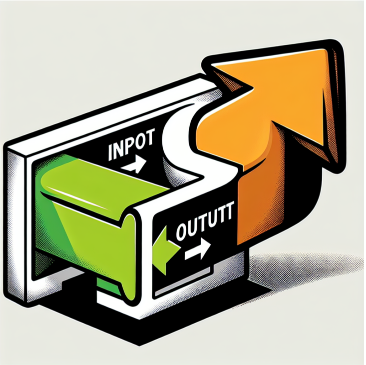

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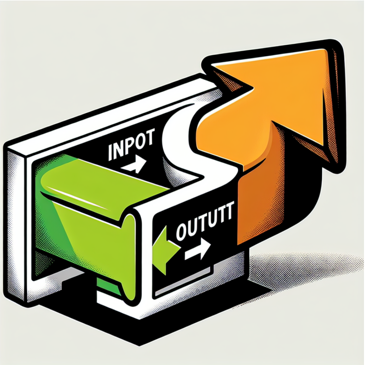

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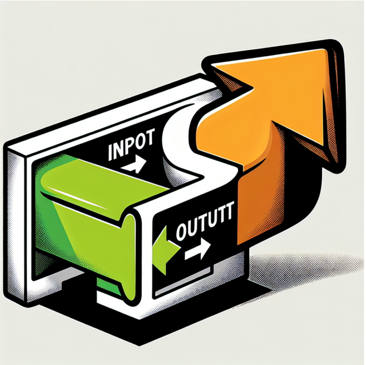

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Complexity on Systems

Introduction to Systems Thinking II

- In **systems thinking**, if you just split parts and forget relationships, you will lost the full picture.
- It is called **holistic** approach, try to see all the picture with all the meaning details.
- Define the **box boundaries** is sometimes tricky, as we said, not too complex, not too simple. It is like the desired universe balance of Thanos.

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- Another important concept is the **homeostasis**, it means to put a system in an equilibrium state. That is hard, **systems** are both not in equilibrium and resilient to change. **Chaotic attractors** study is useful here.
- A **system** is more than the sum of the parts. It means, relationships, behaviors, recovery capacity, are forgotten when you see the system just as its parts.

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- **Systems thinking** is a way to understand and represent problems in order to find the best possible solution.
- Think in a **problem as a system** lets you understand details, involved elements, relevant information.
- **Systems** should be viable, auto-sostenible, provides internal feedback loops, and also looks like a whole live-entity.

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- **Computation** helps to represent behaviors in a mathematical way. Also, it lets to find patterns and information, simplify process; an example of all this is the Artificial Intelligence.
- **Top-Down** approach is useful when you want to see the full picture, and then split it into parts.
- **Bottom-Up** approach is useful when you want to see the parts and then connect them to get the full picture.

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Introduction to Systems Thinking VI

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- The most simple **system definition** is: for some inputs, after apply them a designed process, you will get some outputs.
- In a **deterministic** world the same inputs get the same outputs. Real-life is not deterministic.

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- **Stochastic processes** make use of probability, and this gets a better real-world behaviors representation.
- Here **Chaos Theory** becomes a useful tool. To make it simple, chaos could be defined as a harmonic balance between rules and randomness.

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Systems Structure

Case of Study: Trasportation System

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General Systems Theory I

- In **general systems theory** the idea is to see a problem since different autonomous study areas, it helps to create a better full-picture of a problem or situation.
- Systems are **dynamical**, for that reason you need to define boundaries and constraints to control analysis. Also, some systems are highly susceptible to changes from the environment.

Figure: Prompt: Draw systems a different levels in the context astronomy.

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Representation of a System

General Systems Theory VIII

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- **Black-box** is a type of model when you want to get the desired output based on specific input, but yo don't want to expose the **process** to achieve it.

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- **Critical Systems Practice** is a methodology to deal with **Critical Systems Thinking** study field. CSP has 4 main stages: *Explore*, *Produce*, *Intervene*, and *Check* — *EPIC*.

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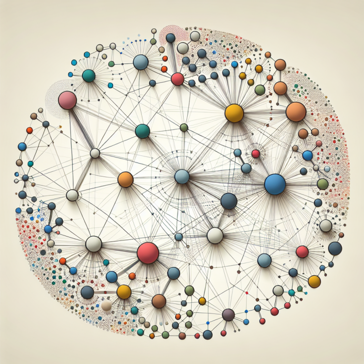
- One of the main concepts is the **theory of the computation**. Based on graphs, you could define a computational machine.



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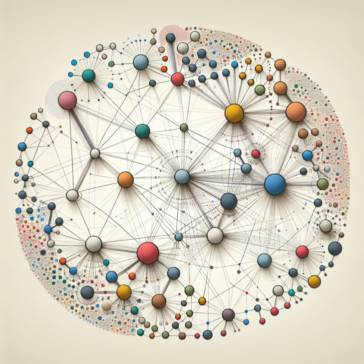

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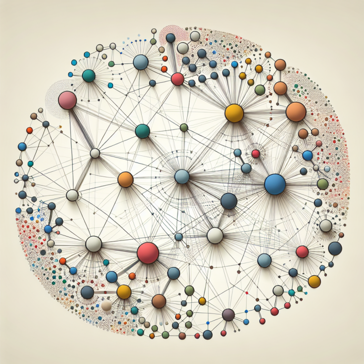

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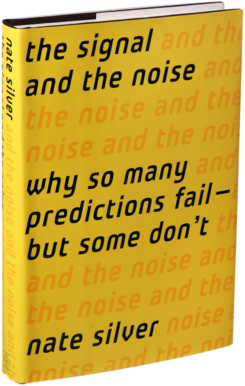
Synergy: **Money Ball**



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Thanks!

Questions?

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