

Systems Sciences Introduction

Semester 2025-I

Workshop No. 1 — Systems Design

Eng. Carlos Andrés Sierra, M.Sc.
Computer Engineering
Universidad Distrital Francisco José de Caldas

Welcome to the first workshop of the *Systems Sciences* course! This workshop focuses on **systems design** for: an *Autonomous Adaptive Agent Simulation*. By exploring cybernetic principles, reinforcement learning, and environment-driven decision-making, you will lay the groundwork for creating a self-regulating, intelligent system.

Workshop Scope and Objectives:

- **Systems Design Framework:** Understand the project's requirements and structure a foundational *systems design* for an autonomous agent.
- **Cybernetic Principles:** Identify feedback loops, sensors, and decision-making mechanisms that enable dynamic adaptation in the simulated environment.
- **Reinforcement Learning Path:** Outline how learning based on rewards be incorporated into the design to optimize agent actions.
- **Scalability & Extension:** Consider multi-agent and collaborative features for future development phases.

Carlos Andrés Sierra, Computer Engineer, M.Sc. in Computer Engineering, Titular Professor at Universidad Distrital Francisco José de Caldas.

Any comment or concern about this document can be sent to Carlos A. Sierra at: *cavirguezs@udistrital.edu.co*.

Methodology and Deliverables:**1. System Requirements Document:**

- *Functional Specifications:* Detail how sensors, actuators, and reward functions integrate into the environment.
- *Use Cases:* Describe agent-environment interactions, including learning objectives and adaptation goals.

2. High-Level Architecture:

- *Component Diagram:* Show major modules (e.g., sensor module, RL module, environment module) and data flow.
- *Feedback Loops:* Illustrate cybernetic control loops for self-regulation within the agent.

3. Preliminary Implementation Outline:

- Identify potential frameworks (Gymnasium, Stable-Baselines3) and explain why they are suitable for your design.
- Sketch a timeline for moving from basic Q-learning to more advanced DQN approaches.

4. GitHub Repository:

- Create a GitHub repository for the course with a folder **Workshop-1** to store your System Requirements Document, Architecture Diagrams, and any auxiliary notes.
- Link your design documentation in a **README.md**, referencing any code snippets and diagrams used.

Deadline: Wednesday, April 9th, 2025, 8:00. Submissions after this deadline may incur penalties in accordance with course policies.

Notes:

- Keep your report in **English** and submit it as a **PDF**.
- Cite external sources (papers, tutorials, articles) as needed.
- Your submission should emphasize the **systems design** aspect, preparing the foundation for future workshops, where you will refine, simulate, and ultimately implement your autonomous agent.

Good luck, and remember: this workshop is your starting point for conceptualizing and designing a self-adaptive, cybernetic agent. Use the principles of systems design to ensure your final project is both robust and future-ready.