



UNIVERSITÀ
DI PAVIA

Ph.D. Program in Electronics, Computer Science and Electrical Engineering

COURSE

Industrial programming

OBJECTIVES: The aim of this course is to deepen knowledge of programming languages and methods used in industry.

PROGRAM

Module 1: "Introduction to Programmable Logic Controllers"

This lesson is a brief overview and orientation to the Programmable Logic Controller or PLC. The purpose and basic parts of a PLC will be discussed, as well as different types of PLCs and PLC specifications. In particular the main subject will be:

- PLC Basic training
- Overview: Technical features, Wiring.
- Basic Function: Analog, Ethernet, High Speed I/O
- Programming software: Memory, Label, Execution Type
- Programming Language: ST, FBD, Ladder (IEC1131)
- Simulation & Debug

Module 2: "Introduction to real world Agentic Development"

Introduction to the use of Codex and AI coding agents in professional software engineering. Topics include code comprehension, implementation, debugging, testing, refactoring, and integration into established development workflows, with particular attention to effective task specification, validation of generated code, and human oversight.

Module 3: "Programming Parallel Processors"

The course explores the transition from traditional sequential programming to parallel programming, which is necessary to harness the evolution of modern multi-core processors and GPUs. Key program points:

- Study of multi-core CPUs and GPUs (Streaming Multiprocessors), analyzing the SIMT and CUDA execution model (grids, blocks, and threads).
- Techniques to overcome data transfer bottlenecks using shared memory, coalescing, and tiling.
- Provide the foundations for designing high-performance software, avoiding execution divergence, and fully exploiting modern heterogeneous systems.

Module 4: "Local Agentic Computer Vision for Industrial Applications"

This module introduces the development of agent-based computer vision applications running entirely on local hardware. Using Google Agent Development Kit and open-weight language models, students will learn how AI agents can orchestrate conventional computer vision algorithms, machine-learning models, sensors, and acquisition devices through high-level natural-language instructions. A practical industrial visual-inspection demonstrator will be

developed, in which an agent interprets the operator's request, selects the appropriate vision tools, executes the required processing pipeline, validates the results, and generates structured outputs.

Key program points:

- Local deployment of open-weight language models and integration with Google ADK.
- Design of tool-using and multi-agent architectures.
- Integration of camera acquisition, calibration, image processing, object detection and dimensional measurement as agent tools.
- Agent orchestration, state management and error handling.
- Validation and human-in-the-loop mechanisms for industrial applications.

EVALUATION: Each student will be asked to choose a topic, and develop a short project.

ATTENDANCE: The course will take place in online mode, according to the following schedule:

- 29/09/2026 "Introduction to Programmable Logic Controllers" 13:30
- 07/10/2026 "Introduction to real world Agentic Development" 14:30
- 15/10/2026 "Introduction to Programming Parallel Processors" 14:00
- 20/10/2026 "Local Agentic Computer Vision for Industrial Applications" 14:00

LECTURES: 15h; **CREDITS:** 4 CFU

DATES: 29/09-07/10-15/10-20/10

Ph.D. Coordinator

Prof.ssa Ilaria Cristiani

Seminar in English