

**SALONE DELL'ORIENTAMENTO 2026**

**CORSO DI LAUREA MAGISTRALE**

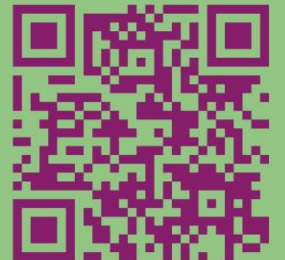
# **INGEGNERIA INFORMATICA**

*COMPUTER ENGINEERING*



**Politecnico  
di Torino**

**SCOPRI TUTTI I  
CORSI DI STUDIO  
A.A. 2026/27  
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# Automation and Intelligent Cyber-Physical Systems

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# Cyber-physical systems: looking for a definition

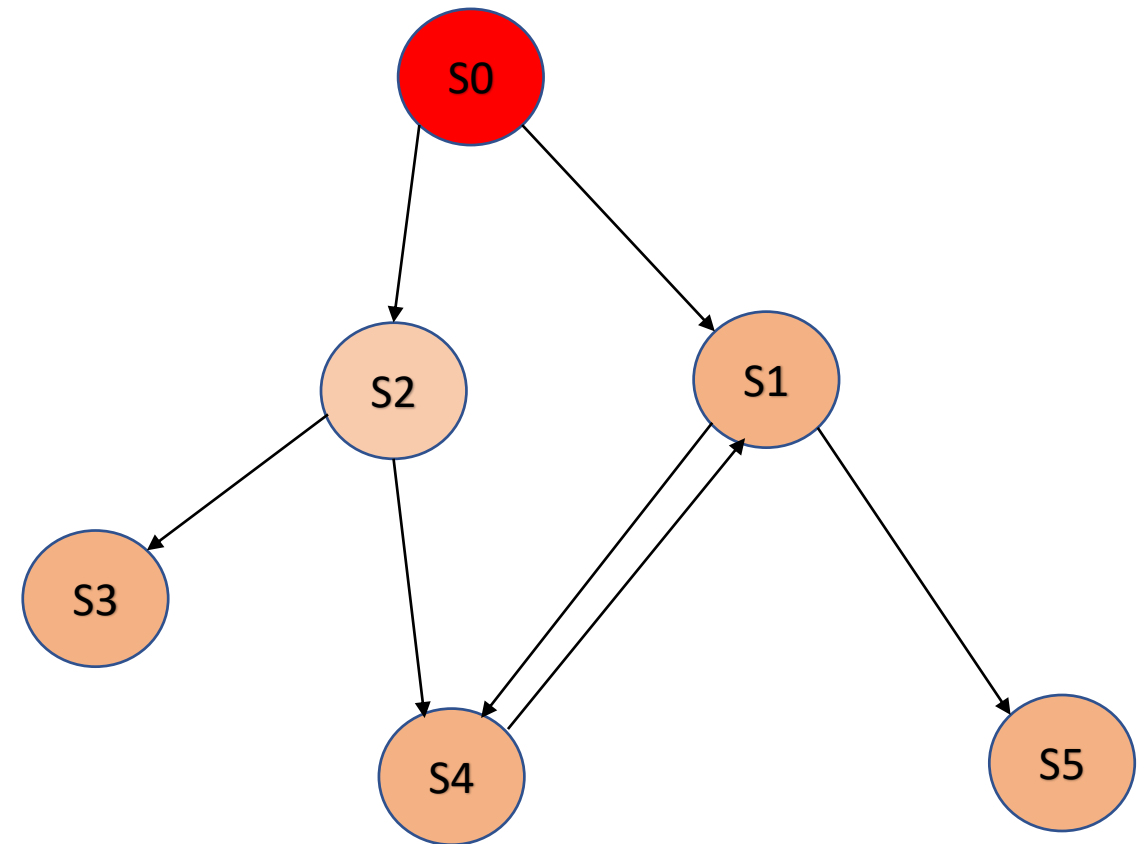
- A **cyber-physical system (CPS)** is a collection of devices interacting through a communication networks to perform complex cooperative tasks
- Each device can:
  - perform computations
  - share information over the communication networks
  - interact with the physical world

# Some examples of CPS

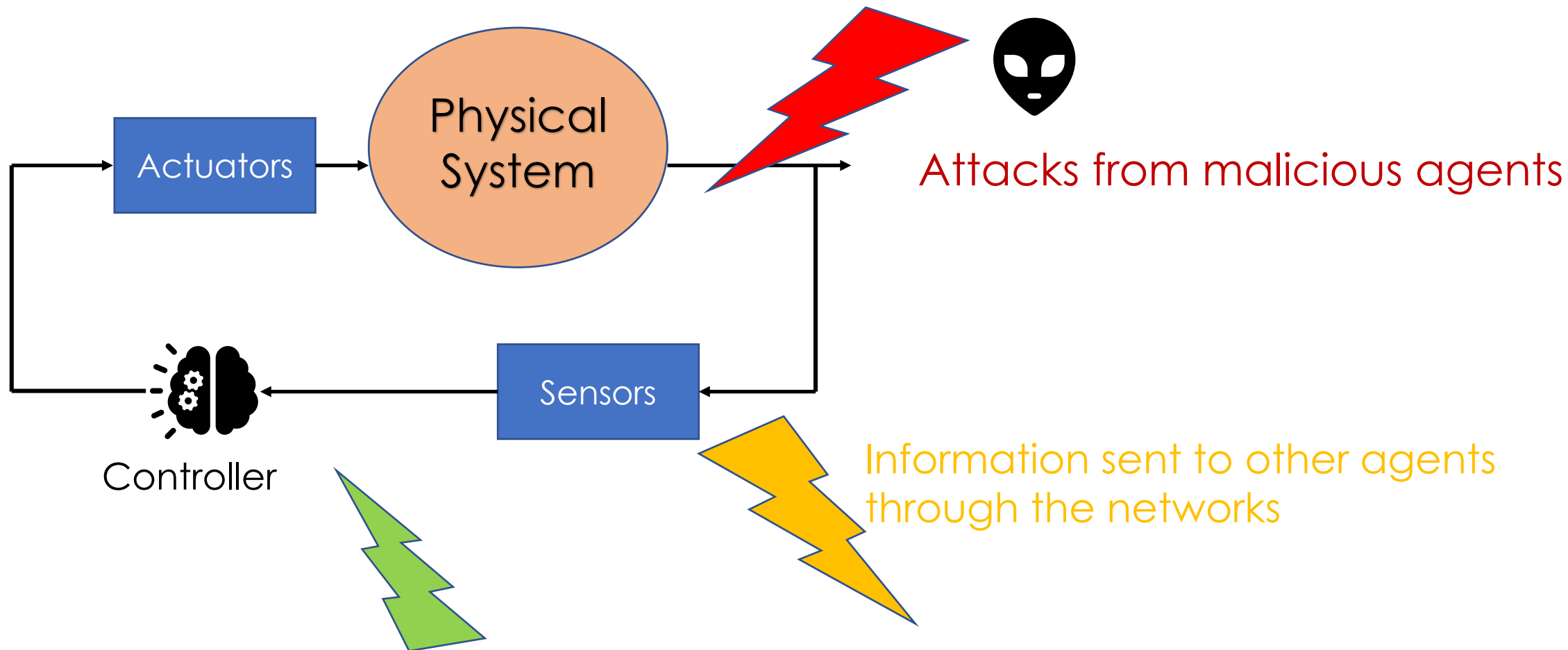
- Mobile multi-robots teams
- Networks of industrial robots
- Teams of drones
- Smart grids
- Sensor networks
- Formation of autonomous vehicles
- Traffic networks
- Biological networks
- Opinion dynamics
- Many more...

# Multi agent systems

- A cyber-physical system can be modeled as a multi-agents system
- Multi-Agent systems are (typically) assumed to be spatially distributed
- Complex systems made up of many interacting subsystems can be modeled as CPS as well



# General structure of a single agent



Information received from other agents from the networks

# Automation and Intelligent CPS

- Automation (generically speaking) deals with the problem of designing machines and algorithms able to replace human action to perform complex task
- Control theory is the key tool of Automation
- Automation of complex systems can be reformulated as the problem of designing intelligent CPSs
- The number of problems that can recasted as the problem of controlling a complex CPS is limiteless....
- **Examples of applications:** Aerospace applications, Industrial robotics, intelligent vehicles, smart grids, control over various kind of networks (communication, vehicles, opinion dynamics, epidemics models,..)

# What will you learn (more specifically)?

- Convex optimization and engineering applications

Why you need to study convex optimization?

- Several problems arising in engineering/science can be formulated in terms of mathematical optimization; most of them leads to convex optimization problem
- Modelling, estimation and control algorithms involves (convex) optimization

You will learn:

- How to formulate engineering/science problems in terms of convex optimization
- How to efficiently solve such problem

# What will you learn (more specifically)?

- Modelling and control of cyberphysical systems

Why you need to study modeling and control of cyberphysical systems?

- Complex real world systems involves a large number of physical subsystems
- The subsystems interact to perform a cooperative task
- CPSs are subjected to external attacks
- Standard techniques focused on modeling/estimation/control of each single subsystem are not able to optimize the behavior the entire complex system and counteracts the possible attacks

You will learn:

- How to model complex systems as a multi agent systems
- How to design effective estimation/localization algorithms in presence of attacks via sparse optimization
- How to design effective algorithm for cooperative control of CPSs (e.g., synchronization, formation control)

# What will you learn (more specifically)?

- Nonlinear control and aerospace applications

Why you need to study nonlinear control?

- The majority of real-world systems are nonlinear dynamical systems
- Effective control of such systems require the knowledge of mathematical tools and practical algorithms explicitly derived to cope with the presence of nonlinear effects

You will learn:

- How to analyze the properties of nonlinear dynamical systems
- How to design effective nonlinear controllers for nonlinear systems
- How to apply such algorithms to real-world problems in the aerospace field

# What will you learn (more specifically)?

- Reinforcement learning methods for control

Why you need to study nonlinear control?

- Many modern control problems involve complex, uncertain, or partially unknown systems where model-based approaches are difficult to apply
- Reinforcement learning enables data-driven control policies that can learn optimal behaviors through interaction with the environment

You will learn:

- The fundamentals of machine learning
- The fundamental of reinforcement learning
- How to design and implement RL algorithms for control

# What will you learn (more specifically)?

- Robot learning, Robotics/Sistemi robotici

Why you need to study robot learning and robotics?

- Robotics is nowadays ubiquitous, both in the traditional assembly and automation environments, and in emerging applications like assistance to humans, robotic surgery, health care, space exploration, agriculture

You will learn:

- How to mathematically model the behavior of a robots
- How to design control algorithms for both industrial and mobile robots
- How to apply reinforcement learning techniques to robots and autonomous systems in general

# What will you learn (more specifically)?

- Laboratory of Robust identification and control

→ provides fundamental tools for data-based modeling and control of dynamical systems

- Estimation, filtering, and system identification

→ provides fundamental notions on theory and algorithms for estimation, filtering and systems identification of dynamical systems

# What will you learn (more specifically)?

- Networks dynamics and learning

Why you need to study networks dynamics and learning?

- Complex real world systems involves a large number of (physical) subsystems **sharing information through a (communication) networks**
- The behavior of the overall systems strongly depends on the interactions between subsystems
- Analysis and optimization of complex systems requires the knowledge of advanced mathematical tools (distributed optimization, game theory, Markov chain)

You will learn:

- How to construct and compare mathematical models for interconnected systems arising in information, social, economic, biological, and infrastructure networks
- How to design propose cooperative distributed algorithms on networks
- How to apply theory and algorithms to energy and transportation systems, opinion and epidemics dynamics, social and economic networks

# Suggested optional courses

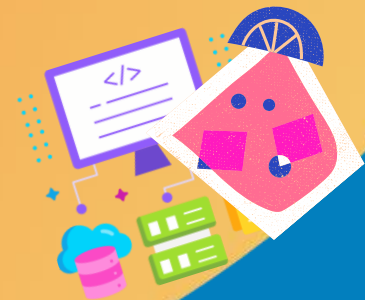
- Modern design of control systems
  - provides fundamental notions on theory and algorithms for robust control of uncertain systems
- Digital control technologies
  - provides fundamental notions on theory and algorithms for digital control of dynamical systems



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#TOMORROW STARTS TODAY



# Aperitivo di Benvenuto

Venerdì **27 Marzo** 2026

H. **17:30**

**2° piano** Dipartimento **DAUIN**, **Corso Castelfidardo 34/d** (ingresso lato MixTo)

Occasione perfetta per fare nuove conoscenze, scoprire i laboratori DAUIN del collegio ICM ed incontrare i docenti dei relativi corsi di studio!