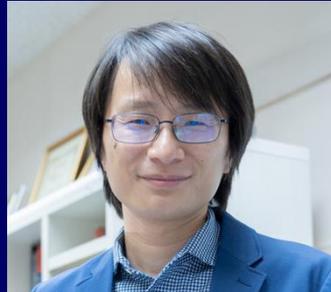


M18 PARIS-SACLAY
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Bootcamp for Supervisory Control of Discrete-Event Systems, with Hands-On Python Software Tool



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Summary of the course

Supervisory control theory of discrete-event systems (DES) provides a rigorous framework for the analysis and control of complex, event-driven systems such as automated manufacturing, warehouse, traffic, and more recently AI-driven systems. Unlike continuous-time systems governed by differential equations, DES evolve through discrete states and event-driven transitions. This course introduces the fundamentals of DES and their supervisory control, from automaton models to closed-loop control synthesis, with a strong emphasis on hands-on learning. Students will explore automaton creation, system properties, synchronous product, controllability, and optimal supervisory control. A key feature of the course is the integration of **PyTCT**, a Python-based software tool developed for teaching, simulation, and design of supervisory controllers. Through guided exercises, students will not only understand theoretical concepts but also acquire hands-on skills to design correct, nonblocking, and optimal controllers for DES.

Outline

1. Introduction and Modeling of DES

- Discrete-event dynamics: states, events, transitions
- Automaton representation and modeling principles
- Software tool: PyTCT

2. Properties of Automata

- Reachability, coreachability, trimness, nonblocking
- Behavioral analysis and structural properties
- Implementation and verification with PyTCT

3. Composition of Systems

- Synchronous product of automata
- Modeling multi-component and multi-agent systems
- Conflict detection and resolution

4. Supervisory Control Loop

- Control requirements and specifications
- Supervisor synthesis for closed-loop systems
- Case studies: safety enforcement, resource allocation

5. Controllability and Optimality

- Controllability: definition and characterization
- Supremal controllable sublanguages
- Optimal supervisory control design using PyTCT

6. Advanced Topics

- Observability
- Distributed control of multi-agent systems
- Data-driven approaches

