

**DRIEI**  
**PhD Program in Electronic and Computer Engineering**  
**University of Cagliari, Italy**

<b>Course:</b>	Finite-State Dynamical Systems
<b>Instructor:</b>	Kuize ZHANG ( <a href="mailto:zhangkuize@gmail.com">zhangkuize@gmail.com</a> )
<b>SSD:</b>	ING-INF/04 – Automatic Control
<b>Credits / hours:</b>	2.5 credits / 20h
<b>Language:</b>	English
<b>Scheduling:</b>	June 10, 12, 14, 17, 19, 21, 24, 26, 28, and final exam in July
<b>Final Exam:</b>	Written exam
<b>Registration:</b>	Interested students should send an email to the instructor

### Goal of the Course

The course contains basic knowledge on two classes of finite-state dynamical systems --- finite automata and weighted automata. For the former, basic tools --- concurrent composition and observer will be introduced, how to use them to verify basic inference-based properties and concealment-based properties in discrete-event systems modelled by finite automata will be introduced as well. For the latter, only basic definitions will be introduced and compared over semirings and monoids. Students will acquire basic knowledge in control theory and computer science based on these two classes of systems, and will also catch a glimpse of similarities and differences between them.

### Prerequisites

The course is self-contained, so no prerequisites are needed. However, it would be better for the students to have preliminary knowledge on finite automata.

**Intersection with other courses at the University of Cagliari:** no significant intersection

### Course Outline (2 hours per day)

#### Part 1: Finite automata

- Day 1 (June 10): Alphabets, deterministic finite automata, and regular languages
- Day 2 (June 12): Nondeterministic finite automata and powerset construction
- Day 3 (June 14): Homework on finite automata and regular languages

#### Part 2: Finite automata in control

- Day 4 (June 17): Labeled finite-state automata, concurrent composition, and detectability
- Day 5 (June 19): observer, detectability enforcement based on concurrent composition
- Day 6 (June 21): State-based opacity and its verification based on concurrent composition
- Day 7 (June 24): Homework on finite automata in control

#### Part 3: Labeled weighted automata over semirings/monoids

- Day 8 (June 26): Basic definitions in labeled weighted automata over semirings/monoids
- Day 9 (June 28): Homework and tutorials
- Day 10 (in July, to be determined): Final exam