Istituto
Dalle Molle
di studi
sull'intelligenza
artificiale

IDSIA

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Deep Learning for System Identification

Date: From June 30 to July 4, 2025

Location: Politecnico di Milano, Milano, Italy

Organizer: SUPSI – Scuola Universitaria Professionale della Svizzera Italiana

Lecturer: Marco Forgione, e-mail: marco.forgione@supsi.ch;

Room: Alessandra Alario seminar room, building 21 of DEIB.

Summary of the Course

This course introduces students to deep learning tools for nonlinear system identification. The topics covered include:

- Introduction to system identification
- Linear-in-the-parameter models and LASSO
- Introduction to deep learning
- Feedforward network, RNN, and LSTM for identification of dynamical systems
- Neural state-space models
- Neural networks with LTI blocks: dynoNet and beyond
- Meta learning for system identification

In the exercise sessions, students will apply the methodologies presented in the preceding lesson. These sessions will be conducted in Python, using the PyTorch deep learning framework. An introduction to PyTorch will be provided during the course.

Prerequisites

- Basic knowledge of dynamical systems
- Basic knowledge of Python. We encourage conducting exercise sessions in groups (max. 3 persons), with at least one member of the group having basic knowledge of PyTorch.
- We recommend installing all the required software packages before the start of the course. Instructions are given in the README.md file of the GitHub repository.

Final exam is possible to receive a Certificate of Accreditation of 3 ECTS credits upon completion of an oral (remote) exam. If interested, please inform us at the beginning of the course.

Tentative Schedule

Day 1 (Monday, June 30)

Time	Title/Topic	Lecturer
13:30-14:00	Registration	
14:00-15:30	Introduction to SYSID	M. Forgione
15:30-16:00	Break	
16:00-17:30	Introduction to SYSID	M. Forgione

Day 2 (Tuesday, July 1)

Time	Title/Topic	Lecturer
09:00-10:30	Deep Learning	M. Forgione
10:30-11:00	Break	
11:00-12:30	PyTorch – Low-level commands	M. Forgione
12:30-14:00	Lunch break	
14:00-15:30	PyTorch – Higher-level abstractions	M. Forgione
15:30-16:00	Break	
16:00-17:30	Exercise (Regression in PyTorch)	M. Forgione

Day 3 (Wednesday, July 2)

Time	Title/Topic	Lecturer
09:00-10:30	PyTorch – System Identification	M. Forgione
10:30-11:00	Break	
11:00-12:30	Exercise (NARX/RNN)	M. Forgione

Day 4 (Thursday, July 3)

Time	Title/Topic	Lecturer
09:00-10:30	Neural State Space	M. Forgione
10:30-11:00	Break	
11:00-12:30	Exercise (Neural State Space)	M. Forgione
12:30-14:00	Lunch break	
14:00-15:30	dynoNet	M. Forgione
15:30-16:00	Break	
16:00-17:30	Exercise (dynoNet)	M. Forgione

Day 5 (Friday, July 4)

Time	Title/Topic	Lecturer
09:00-10:30	Meta learning for SYSID	M. Forgione
10:30-11:00	Break	
11:00-12:30	Exercise (Meta learning static regression)	M. Forgione