



UNIVERSITÀ DEGLI STUDI  
DELL'INSUBRIA

# Statistical Physics of Deep Learning

Lake Como School of Advanced Studies, June 13-17, 2022

[Home](#)[Organizing Committee](#)[Lecturers](#)[Program](#)[Application](#)[Registration](#)[Accommodation](#)[Venue](#)[Contact Us](#)

## Home

### Statistical Physics of Deep Learning

The success enjoyed over the last decade by deep neural networks in machine learning tasks raises fundamental questions about their working principle. Their surprising generalization capability and the reason why they work optimally in a strongly overparametrised regime are still largely open problems. The architecture and training protocol for a given task are still chosen mainly by empirical knowledge, rather than based on theoretical guidelines.

Methods rooted in statistical physics, such as disordered systems, phase transitions or chaos theory, have begun to provide conceptual insights into these questions. At the same time, deep learning algorithms have been applied to a wide array of different problems faced by physicists, ranging from particle physics and cosmology to many-body physics and biological physics. Neural networks are thus becoming an important topic in the training of physicists, computer scientists and applied mathematicians. The school is designed to give an overview of the statistical-mechanical principles underlying deep learning.

The school is aimed primarily at the growing audience of early-stage researchers (graduate students, advanced master students and postdocs) interested in fundamental aspects of machine learning, beyond a simple black-box approach. Our lectures will provide a critical introduction to deep neural network rooted in a statistical physics perspective. It will expose the participants to applications to a wide range of problems, mainly of physical nature.

The school is addressed to PhD students and postdocs and it is designed to have lectures, hands on tutorials and some seminars on specific topics.





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[Home](#)[Organizing Committee](#)[Lecturers](#)[Program](#)[Application](#)[Registration](#)[Accommodation](#)[Venue](#)[Contact Us](#)

## Lecturers

### Main Lecturers

- **Sebastian Goldt** (SISSA, Trieste Italy)
- **Andrew Saxe** (University College London, UK)
- **Simona Cocco** (Ecole Normale Supérieure, Paris, France)

### Topic Lecturers

- **Massimo Cencini** (CNR, Rome, Italy)
- **Simona Cocco** (Ecole Normale Supérieure, Paris, France)
- **Claudio Nordio** (Chief Risk Officer, Illimity Banca, Milan, Italy)
- **Riccardo Zecchina** (Università Bocconi, Milano, Italy)
- **Francesca Mignacco** (IPhT/CEA, Saclay, France)
- **Pietro Rotondo** (INFN Sezione di Milano, Italy)





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[Home](#)

[Organizing Committee](#)

[Lecturers](#)

[Program](#)

[Application](#)

[Registration](#)

[Accommodation](#)

[Venue](#)

[Contact Us](#)



## Organizing Committee

- **Francesco Ginelli** (Università dell'Insubria, Como, Italy)
- **Marco Gherardi** (Università di Milano, Italy)
- **Guido Tiana** (Università di Milano, Italy)
- **Alessandro Laio** (SISSA, Trieste, Italy)

[< Back to Lake Como School of Advanced Studies](#)





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DELL'INSUBRIA

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[Home](#)[Organizing Committee](#)[Lecturers](#)[Program](#)[Application](#)[Registration](#)[Accommodation](#)[Venue](#)[Contact Us](#)

## Program

TBA

**Monday 13th to Thursday 16th:** Lectures will begin at 9.00 and conclude by 18.00, with breaks for Lunch and coffee catered at school venue.

**Friday 17th:** Lectures will begin at 9 and conclude by 14.00

[Click Program](#)

<b>Monday 13th</b> 9.00 - 10.30 Lecture by S. Goldt 10.30 - 11.00 Coffee break 11.00 - 12.30 Lecture by A. Saxe 12.30 - 14.00 Lunch Break 14.00 - 16.00 Tutorial session Goldt/Saxe 16.00 - 16.30 Coffee break 16.30 - 18.00 Tutorial Session Goldt/Saxe	<b>Tuesday 14th</b> 9.00 - 10.30 Lecture by S. Goldt 10.30 - 11.00 Coffee break 11.00 - 12.30 Lecture by A. Saxe 12.30 - 14.00 Lunch Break 14.00 - 16.00 Tutorial session Goldt/Saxe 16.00 - 16.30 Coffee break 16.30 - 18.00 Lecture by S. Cocco
<b>Wednesday 15th</b> 9.00 - 10.30 Lecture by S. Goldt 10.30 - 11.00 Coffee break 11.00 - 12.30 Lecture by A. Saxe 12.30 - 14.00 Lunch Break 14.00 - 16.30 Tutorial session Goldt/Saxe 16.00 - 16.30 Coffee break 16.30 - 18.00 Tutorial by S. Cocco	<b>Thursday 16th</b> 9.00 - 10.30 Lecture by S. Goldt 10.30 - 11.00 Coffee break 11.00 - 12.30 Lecture by A. Saxe 12.30 - 14.00 Lunch Break 14.00 - 14.50 Topic seminar: Simona Cocco 14.50 - 15.40 Topic seminar: Claudio Nardio 15.40 - 16.10 Coffee break 16.10 - 17.00 Topic seminar: Massimo Cencini 17.00 - 18.00 Round table I: Applications 18.00 - 19.00 Poster session 19.30 - Social dinner at "Le Sasse del Parco del Grumello"
<b>Friday 17th</b> 9.00 - 9.50 Topic seminar: F. Mignacco 9.50 - 10.40 Topic seminar: P. Rotondo 10.40 - 11.10 Coffee break 11.10 - 12.00 Topic seminar: R. Zecchina 12.00 - 13.00 Round table II: Fundamental issues 13.00 - 14.00 Lunch break and closing	

