Advanced ROMs in SciML

SISSA PhD Course

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18 June 2025

Schedule

Day	Time	Type	Room	Topic
Wed 18 June 2025	11-13	Lecture	134	**Introduction to Scientific Machine Learning**
Wed 18 June 2025	14-16	Practice	134	*FFN, CNN, backpropagation, optimization*
Fri 20 June 2025	11-13	Lecture	134	**From projection based to data-driven ROMs**
Fri 20 June 2025	14-16	Practice	134	*RBniCS to MLniCS*
Mon 23 June 2025	11-13	Lecture	134	**GNNs based architectures**
Mon 23 June 2025	14-16	Practice	134	*GCA-ROM, GFN, MeshGraphNet*
Wed 25 June 2025	11-13	Lecture	134	**Time-dependent problems**
Wed 25 June 2025	14-16	Practice	134	*Sindy, NODEs, DMD, OpInf*
Wed 02 July 2025	11-13	Lecture	134	**Neural Operators**
Wed 02 July 2025	14-16	Practice	134	*DeepONet, FNO*

Exam

- Completely open to your interests and needs!

- Develop a useful and challenging parametric benchmark

- Compare different dimensionality reduction strategies

- Try to reproduce the results from a paper and investigate different methodologies

- Send a complete and commented report of the .ipynb project

- No deadlines on my side

References

1. Quarteroni, A., Gervasio, P., Regazzoni, F., 2025. Combining physics-based and data-driven models: advancing the frontiers of research with scientific machine learning. Math. Models Methods Appl. Sci. https://doi.org/10.1142/S0218202525500125

2. Prince, S. Understanding Deep Learning, 2025. MIT Press. https://mitpress.mit.edu/9780262048644/understanding-deep-learning/

3. Bach, F. Learning Theory from First Principles, 2024. MIT Press. https://mitpress.mit.edu/9780262049443/learning-theory-from-first-principles/

4. Peyré, G., 2022. Mathematical foundations of data sciences. https://www.numerical-tours.com

5. Nielsen, M.A., 2015. Neural Networks and Deep Learning. http://neuralnetworksanddeeplearning.com