

Winter School on Data Analytics, October 21-22, 2021. Nizhny Novgorod

6th Winter School on Data Analytics

October 21-22, 2021

Nizhny Novgorod, Russia



Laboratory of Algorithms and Technologies
for Network Analysis of National Research
University Higher School of Economics



Keldysh Institute of Applied Mathematics of
Russian Academy of Science
Moscow Center for Fundamental and
Applied Mathematics

<https://nnov.hse.ru/en/latna/conferences/da2021>

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School Lecturers.

Roman Belavkin (Middlesex University, UK)

Mario Guarracino (University of Cassino and ICAR-CNR, Italy)

Evgenii Lobzaev (University of Edinburgh, UK)

Cristina Masoller (Universitat Politecnica de Catalunya, Spain)

Panos Pardalos (LATNA, HSE and University of Florida)

Co-Chairs of the school

Panos M. Pardalos University of Florida and LATNA, HSE

Alexander I. Aptekarev, Keldysh Institute of Applied Mathematics of the Russian Academy of Science, Moscow Center for Fundamental and Applied Mathematics

Program Committee

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Valentina Kuskova, NRU HSE, Laboratory of Applied Network Research

Dmitriy Malyshev, NRU HSE

Oleg Prokopyev, University of Pittsburgh, USA

Andrey Raigorodskii, Moscow Institute of Physics and Technology, Moscow State University, Yandex

Nikolay Zolotykh, Lobachevsky State University, Nizhny Novgorod

Andrey Savchenko, NRU HSE

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Day 1, Thursday, October 21. Zoom

15:00 -15:50 Panos Pardalos,

AI and the 5th Industrial Revolution

(the lecture is given in the framework of International Conference

'Cultural transfer: formation of creative human capital' dedicated to 25-th anniversary of HSE NN.

16:00 -16:50 Cristina Masoller

Lecture 1: Introduction to nonlinear time series analysis and ordinal analysis

17:00 – 17:50 Mario Guarracino,

Lectures 1: Statistical Learning and Machine Learning: two different twins

18:00 -18:50 Mario Guarracino,

Lectures 2: Assessing statistical learning models accuracy

Day 2, Friday, October 22. Zoom

15:00 -15:50 Cristina Masoller,

Lectures 2: Multivariate time series analysis and applications to climate and biomedical networks

16:00 -16:50 Evgenii Lobzaev

Primer on Variational Inference and its application to Deep Learning

17:00 – 17:50 Roman Belavkin,

Lecture 1: Value of Information theory

18:00 - 18:50 Roman Belavkin,

Lecture 2: Applications of VoI to Machine Learning and Neural Networks

Roman Belavkin,
Middlesex University, UK

Lecture 1: Value of Information theory

Lecture 2: Applications of VoI to Machine Learning and Neural Networks

Mario Guarracino,
University of Cassino and ICAR-CNR, Italy

Lecture 1: Statistical Learning and Machine Learning: two different twins

Abstract: Machine learning and Statistical learning have very much in common, and sometimes the terms are used interchangeably. They share many methods but, looking more closely, the differences are in the purpose: the latter is focused on inference, while the former is focused on finding generalizable predictive patterns. In this lesson we will explore these ideas introducing basic concepts and examples from both fields.

Lecture 2: Assessing statistical learning models accuracy

Abstract: In Statistical learning, we aim at finding the model function f generating the data that we observe. In this lecture we will introduce basic concepts related to model accuracy estimation. We will discuss how to measure the quality of a model, what is overfitting and the bias-variance trade-off.

Evgenii Lobzaev
University of Edinburgh, UK

Lecture: Primer on Variational Inference and its application to Deep Learning

Abstract: Variational inference belongs to a class of statistical inference techniques and proved to be a workhorse in the area of generative modelling in machine learning community. In this primer we will cover some necessary theory to provide better understanding of this class of inference techniques. We will also discuss application of variational inference to Deep Learning, namely Variational Autoencoders (VAEs). Finally, some results from our research on de-novo design of metabolic enzymes, using VAEs, will be presented.

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Cristina Masoller,
(Universitat Politecnica de Catalunya, Spain)

Lecture 1: Introduction to nonlinear time series analysis and ordinal analysis

Abstract: In this lecture I will review different methodologies to analyze complex time series, such as the spatio-temporal representation of a time-series, and the representation of a time-series as a complex network. I will introduce symbolic methods of time-series analysis, and specifically, ordinal analysis, which allows the calculation of the permutation entropy and various complexity measures. Time permitting, I will also discuss the concepts of instantaneous amplitude and phase using the Hilbert transform.

Lecture 2: Multivariate time series analysis and applications to climate and biomedical networks

Abstract: In this lecture I will review different approaches to construct correlation networks from multivariate time series. Will introduce nonlinear correlation measures and causality measures and I will discuss their applications to biomedical and climatological data.

Panos Pardalos,
LATNA HSE and University of Florida, USA

Lecture: AI and the 5th Industrial Revolution

Abstract: Advances in machine learning/data sciences and AI are progressing rapidly and demonstrating the potential to transform our lives. The spectacular success of these areas relies in part on their sophisticated mathematical underpinnings (e.g. optimization techniques and operations research tools), even though this crucial aspect is often downplayed. AI is on the cusp of the 5th Industrial Revolution. In this lecture we will discuss progress from our perspective in the field of AI and its applications in Finance, Economics, Energy, Biomedicine and Smart Manufacturing.