

XII Summer School on Operational Research, Data and Decision Making

May, 19-20, 2020

National Research University Higher School of Economics,
Nizhny Novgorod

Faculty of Informatics, Mathematics and Computer Science

Laboratory of Algorithms and technologies for network analysis



НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
УНИВЕРСИТЕТ
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<https://nnov.hse.ru/en/latna/conferences/ora2020>

School Lecturers.

Darina Dvinskikh (WIAS, Berlin, MIPT, IITP) and **Alexander Gasnikov** (MIPT, HSE, IITP),

Two approaches for population Wasserstein barycenter problem: Stochastic Averaging versus Sample Average Approximation

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

Association rules: from zero to hero

Ilias Kotsireas, Wilfrid Laurier University, Canada,

Decision Tree algorithms and Big Data processing

Panos Pardalos, University of Florida, USA and HSE,

From Local to Global in Numerical Optimization

George Tsaklidis, School of Mathematics, Aristotle University of Thessaloniki, Greece

Estimation of the two-sided jumps of asset returns via Kalman filtering Julius

Zilinskas, University of Vilnius, Lithuania

Non-convex Multi-objective Optimization

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Nikolay Zolotykh, Lobachevsky State University, Nizhny Novgorod

Andrey Savchenko, NRU HSE

Day 1, Tuesday, May 19.

Zoom

15:00 -15:50 Panos Pardalos

From Local to Global in Numerical Optimization

16:00 -16:50 Mario Guarracino

Lecture 1: Association rules: from zero to hero

17:00 – 17:50 Mario Guarracino

Lecture 2: Association rules: from zero to hero

18:00 -18:50 Julius Zilinskas

Non-convex Multi-objective Optimization

Day 2, Wednesday, May 20.

Zoom

15:00 -15:50 Darina Dvinskikh and Alexander Gasnikov

Lecture 1: Two approaches for population Wasserstein barycenter problem:

Stochastic Averaging versus Sample Average Approximation

15:00 -16:50 Darina Dvinskikh and Alexander Gasnikov

Lecture 2: Two approaches for population Wasserstein barycenter problem:

Stochastic Averaging versus Sample Average Approximation

17:00 – 17:50 George Tsaklidis

Estimation of the two-sided jumps of asset returns via Kalman filtering

18:00 -18:50 Ilias Kotsireas

Decision Tree algorithms and Big Data processing

Darina Dvinskikh

Weierstrass Institute for Applied Analysis and Stochastics, Berlin, MIPT, IITP)

Alexander Gasnikov

MIPT, HSE, IITP

Two approaches for population Wasserstein barycenter problem:
Stochastic Averaging versus Sample Average Approximation

In Machine Learning and Optimization community there are two main approaches for convex risk minimization problem: Stochastic Averaging (SA) and Sample Average Approximation (SAA). At the moment, it is known that both approaches are on average equivalent (up to a logarithmic factor) in terms of oracle complexity (required number of stochastic gradient evaluations). What is the situation with total complexity? The answer depends on specific problem. However, generally SA is assumed to be better than SAA. In this paper we show that SAA may outperform SA in the problem of calculating an estimation for population (entropy regularized) Wasserstein barycenter.

Literature

A. Kroshnin, D. Dvinskikh, P. Dvurechensky, A. Gasnikov, N. Tupitsa and C. A. Uribe. On the Complexity of Approximating Wasserstein Barycenter. Proceedings of the 36th International Conference on Machine Learning, PMLR 97:3530-3540, 2019.

P. Dvurechenskii, D. Dvinskikh, A. Gasnikov, C. Uribe and A. Nedich. Decentralize and randomize: Faster algorithm for Wasserstein barycenters. In Advances in Neural Information Processing Systems. P. 10760–10770, 2018.

P. Dvurechensky, A. Gasnikov and A. Kroshnin. Computational Optimal Transport: Complexity by Accelerated Gradient Descent Is Better Than by Sinkhorn's Algorithm. Proceedings of the 35th International Conference on Machine Learning, PMLR 80:1367–1376, 2018.

C.A. Uribe, D. Dvinskikh, P. Dvurechensky, A. Gasnikov, A. Nedić. Distributed computation of Wasserstein barycenters over networks. In 2018 IEEE Conference on Decision and Control (CDC) (pp. 6544-6549). IEEE, December, 2018.

Mario Guarracino,
University of Cassino and ICAR-CNR, Italy
Association rules: from zero to hero

This talk focuses on an unsupervised learning method called Association Rules. This method is often used to discover interesting relationships hidden in large datasets. The disclosed relationships can be represented as rules on frequent itemsets. Association rules have been originally devised for mining transactions in databases.

The research of association rules started as early as the 1960s, although the framework of association rule learning was brought into the database community by Agrawal and colleagues in the early 1990s. It was proposed for discovering regularities between products in a large database of customer transactions recorded by point-of-sale systems in supermarkets. In later years, it expanded to web contexts, such as mining path traversal patterns and usage patterns to facilitate organization of web pages.

We focus on Apriori algorithm, one of the earliest and the most fundamental algorithms for generating association rules. We provide examples and codes to run Apriori in different languages and programming environments.

We will finally explore the existing connections and future research opportunities between Association Rules and Big Network Analytics methodologies.

Ilias Kotsireas,
CARGO lab, Wilfrid Laurier University, Canada
Decision Tree algorithms and Big Data processing

Classification is a well-known Data Mining task. Decision Trees are a well-known classification concept. We will present in detail the ID3 and C4.5 algorithms for building Decision Trees, illustrated with specific examples. We will also review various extensions/parallelization of these algorithms that can be used to process large data sets (Big Data).

Panos Pardalos,
Center for Applied Optimization, University of Florida, USA
and LATNA HSE,
From Local to Global in Numerical Optimization

The lecture will be devoted to a general overview on global optimization in discrete and continuous setting with special attention to actual challenging problems.

George Tsaklidis,

O. Theodosiadou, S. Skaperas, G. Tsaklidis

Department of Mathematics, Aristotle University of Thessaloniki,, Greece

Estimation of the two-sided jumps of asset returns via Kalman filtering.

Change point detection for the case of Nasdaq index. By this presentation, we establish a model for the estimation of the positive and negative (two sided) jumps in the time series of asset returns. For that purpose, the daily Nasdaq returns during the 3 year period 2006-2008 are used. The daily return R is considered to be the difference of the respective daily positive and negative jump, under noise inclusion. Change point analysis is carried out in order to detect the relation between the change points in the time series of the index in comparison with the change points of the two components.

Julius Zilinskas,
Institute of Data Science and Digital Technologies,
University of Vilnius, Lithuania
Non-convex Multi-objective Optimization

Many practical optimization problems involve more than one conflicting objectives. In such a case there is no single optimal solution to a given multi-objective optimization problem, therefore the aim of such problems is to find the Pareto set of non-dominated solutions. Many methods convert the multi-objective optimization problem into a set of single-objective problems. Apart from general disadvantages of such approaches, in non-convex multi-objective optimization even the scalarized single-objective optimization problem is not easily solved - global optimization must be used. On the other hand global optimization algorithms may be adapted to multi-objective case so that their result is the Pareto set eliminating the need to solve the set of optimization problems.