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Analysis of Images, Social Networks and Texts


8th International Conference, AIST 2019
Kazan, Russia, July 17–19, 2019
Revised Selected Papers

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Preface

This volume contains the refereed proceedings of the 8th International Conference on Analysis of Images, Social Networks, and Texts (AIST 2019)¹. The previous conferences (during 2012–2018) attracted a significant number of data scientists – students, researchers, academics, and engineers – working on interdisciplinary data analysis of images, texts, and social networks.

The broad scope of AIST made it an event where researchers from different domains, such as image and text processing, exploiting various data analysis techniques, can meet and exchange ideas. We strongly believe that this may lead to the cross-fertilisation of ideas between researchers relying on modern data analysis machinery.

Therefore, AIST 2019 brought together all kinds of applications of data mining and machine learning techniques. The conference allowed specialists from different fields to meet each other, present their work, and discuss both theoretical and practical aspects of their data analysis problems. Another important aim of the conference was to stimulate scientists and people from industry to benefit from the knowledge exchange and identify possible grounds for fruitful collaboration.

The conference was held during July 17–19, 2019. The conference was organised in Kazan, the capital of the Republic of Tatarstan, Russia, on the campus of Kazan (Volga region) Federal University².

This year, the key topics of AIST were grouped into six tracks:

1. General Topics of Data Analysis chaired by Sergei O. Kuznetsov (Higher School of Economics, Russia) and Amedeo Napoli (Loria, France)
2. Natural Language Processing chaired by Natalia Loukachevitch (Lomonosov Moscow State University, Russia), Andrey Kutuzov (University of Oslo, Norway), and Elena Tutubalina (Kazan Federal University, Russia)
3. Social Network Analysis chaired by Vladimir Batagelj (University of Ljubljana, Slovenia) and Valentina Kuskova (Higher School of Economics, Russia)
4. Analysis of Images and Video chaired by Marcello Pelillo (University of Venice, Italy) and Andrey V. Savchenko (Higher School of Economics, Russia)
5. Optimisation Problems on Graphs and Network Structures chaired by Panos M. Pardalos (University of Florida, USA) and Michael Khachay (IMM UB RAS and Ural Federal University, Russia)
6. Analysis of Dynamic Behaviour Through Event Data chaired by Wil M. P. van der Aalst (RWTH Aachen University, Germany) and Irina A. Lomazova (Higher School of Economics, Russia)

¹ <http://aistconf.org>

² <https://kpfu.ru/eng>

The Programme Committee and the reviewers of the conference included 160 well-known experts in data mining and machine learning, natural language processing, image processing, social network analysis, and related areas from leading institutions of 24 countries including Argentina, Australia, Austria, Canada, Czech Republic, Denmark, France, Germany, Greece, India, Iran, Italy, Japan, Lithuania, the Netherlands, Norway, Qatar, Romania, Russia, Slovenia, Spain, Taiwan, Ukraine, and the USA. This year, we received 134 submissions: mostly from Russia but also from Australia, Belarus, Finland, Germany, India, Italy, Norway, Pakistan, Russia, Spain, Sweden, and Vietnam.

Out of 134 submissions, only 27 full papers and 8 short papers were accepted as regular oral papers. Thus, the acceptance rate of this volume was around 24% (not taking into account 21 automatically rejected papers). An invited opinion talk and a tutorial paper are also included in this volume. In order to encourage young practitioners and researchers, we included 36 papers in the companion volume after their poster presentation at the conference. Each submission was reviewed by at least three reviewers, experts in their fields, in order to supply detailed and helpful comments.

The conference featured several invited talks and an industry session dedicated to current trends and challenges.

The invited talks from academia were on Computer Vision and NLP, respectively:

- Ivan Laptev (Inria, Paris; VisionLabs): “Towards Embodied Action Understanding”
- Alexander Panchenko (Skolkovo Institute of Science and Technology, Russia): “Representing Symbolic Linguistic Structures for Neural NLP: Methods and Applications”

The invited industry speakers gave the following talks:

- Elena Voita (Yandex, Russia): “Machine Translation: Analysing Multi-Head Self-Attention”
- Yuri Malkov (Samsung AI Center, Russia): “Learnable Triangulation of Human Pose”
- Oleg Tishutin and Ekaterina Safonova (Iponweb, Russia): “Fraud Detection in Real-Time Bidding”.

The program also included a tutorial on high-performance tools for deep models:

- Evgenii Vasilyev (Lobachevski State University of Nizhni Novgorod, Russia), Gleb Gladilov (Intel Corporation, Russia): “Intel® Distribution of OpenVINO™ Toolkit: A Case Study of Semantic Segmentation”

An invited opinion talk on comparison of academic communities formed by the authors of Russian-speaking NLP-oriented conferences was presented by Andrey Kutuzov and Irina Nikishina under the title “Double-Blind Peer-Reviewing and Inclusiveness in Russian NLP Conferences.”

We would like to thank the authors for submitting their papers and the members of the Programme Committee for their efforts in providing exhaustive reviews.

According to the programme chairs, and taking into account the reviews and presentation quality, the Best Paper Awards were granted to the following papers:

- Track 1. General Topics of Data Analysis: “Histogram-Based Algorithm for Building Gradient Boosting Ensembles of Piece-Wise Linear Decision Trees” by Alexey Gurianov
- Track 2. Natural Language Processing: “Authorship Attribution in Russian with New High-Performing and Fully Interpretable Morpho-Syntactic Features” by Elena Pimonova, Oleg Durandin, and Alexey Malafeev
- Track 3. Social Network Analysis: “Analysis of Students Educational Interests Using Social Networks Data” by Evgeny Komotskiy, Tatiana Oreshkina, Liubov Zabokritskaya, Marina Medvedeva, Andrey Sozykin, and Nikolai Khlebnikov
- Track 4. Analysis of Images and Video: “Data Augmentation with GAN: Improving Chest X-rays Pathologies Prediction on Class-Imbalanced Cases” by Tatiana Malygina, Elena Elicheva, and Ivan Drokin
- Track 5. Optimisation Problems on Graphs and Network Structures: “Efficient PTAS for the Euclidean Capacitated Vehicle Routing Problem with Non-Uniform Non-Splittable Demand” by Michael Khachay and Yuri Ogorodnikov
- Track 6. Analysis of Dynamic Behaviour Through Event Data: “Method to Improve Workflow Net Decomposition for Process Model Repair” by Semyon Tikhonov and Alexey Mitsyuk

We would also like to express our special gratitude to all the invited speakers and industry representatives.

We deeply thank all the partners and sponsors. Especially, the hosting university, our main sponsor and the co-organiser this year, the National Research University Higher School of Economics, as well as Springer, who sponsored the Best Paper Awards.

Our special thanks go to Springer for their help, starting from the first conference call to the final version of the proceedings. Last but not least, we are grateful to Airat Khasianov and Valery Solovyev from the Higher Institute of Information Technology and Intelligent Systems of KFU, and all the organisers, especially to Yuri Dedenev, and the volunteers, whose endless energy saved us at the most critical stages of the conference preparation.

Here, we would like to mention that the Russian word “aist” is more than just a simple abbreviation (in Cyrillic) – it means “a stork”. Since it is a wonderful free bird, a

symbol of happiness and peace, this stork gave us the inspiration to organise the AIST conference series. So we believe that this young and rapidly growing conference will likewise bring inspiration to data scientists around the world!

October 2019

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Invited Talks

Towards Embodied Action Understanding

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Abstract. Computer vision has come a long way towards automatic labelling of objects, scenes and human actions in visual data. While this recent progress already powers applications such as visual search and autonomous driving, visual scene understanding remains an open challenge beyond specific applications. In this talk I outline limitations of human-defined labels and argue for the task-driven approach to scene understanding. Towards this goal I describe our recent efforts on learning visual models from narrated instructional videos. I present methods for automatic discovery of actions and object states associated with specific tasks such as changing a car tire or making coffee. Along these efforts, I describe a state-of-the-art method for text-based video search using our recent dataset with automatically collected 100M narrated videos. Finally, I present our work on visual scene understanding for real robots where we learn agents to discover sequences of actions for completing particular tasks.

Keywords: Action understanding • Text-based video search • Visual scene understanding • Narrated videos

Representing Symbolic Linguistic Structures for Neural NLP: Methods and Applications

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Abstract. In this talk, I will speak of several papers, which will be presented at ACL 2019: some of them on the main conference, some at the workshops and related events. The central topic of many of them will be how one can make use of symbolic linguistic structures, such as knowledge bases and graphs of taxonomic relations in the era of neural NLP models. It is not obvious to directly encode graph structures due to their sparseness in a neural network (and almost any lexical resource could be considered as a form of a multi-label weighted graph). On the other hand, hundreds of man-years were spent to manually encode some linguistic information into these resources and it may be a big miss to not use them. However, to date, most of the neural NLP models rely on word and character embeddings which are derived from text only, potentially limiting their performance.

Keywords: Natural language processing • Symbolic linguistic structures • Word embeddings • Knowledge bases • Taxonomic relations

Invited Industry Talks

Machine Translation: Analysing Multi-head Self-attention

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Abstract. Attention is an integral part of the state of the art architectures for NLP. At a high-level, attention mechanism enables a neural network to “focus” on relevant parts of its input more than the irrelevant parts. If an attention mechanism is designed in a way that it is able to focus on different input aspects simultaneously, it is called “multi-head attention”. Multi-head attention is a key component of the Transformer, a state-of-the-art architecture for neural machine translation. Multi-head attention was shown to make more efficient use of the model’s capacity, but its importance for translation and roles of individual “heads” are not clear.

In this talk, I briefly describe standard attention in sequence to sequence models, as well as the Transformer architecture with multi-head self-attention. Then, we evaluate the contribution made by individual attention heads to the overall performance of the Transformer and analyse the roles played by them. I show that the most important and confident heads play consistent and often linguistically-interpretable roles. When pruning heads using a method based on stochastic gates and a differentiable relaxation of the L_0 penalty, we observe that specialised heads are last to be pruned. Our novel pruning method removes the vast majority of heads without seriously affecting performance.

The talk is based on our recent work [1].

Keywords: Natural language processing • Text annotation • Text classification • Sequence labelling

Reference

1. Voita, E., Talbot, D., Moiseev, F., Sennrich, R., Titov, I.: Analyzing multi-head self-attention: specialized heads do the heavy lifting, the rest can be pruned. *ACL* (1), 5797–5808 (2019)

Learnable Triangulation of Human Pose

Yury Malkov

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Abstract. We present two novel solutions for multi-view 3D human pose estimation based on new learnable triangulation methods that combine 3D information from multiple 2D views. Crucially, both approaches are end-to-end differentiable, which allows us to directly optimise the target metric. We demonstrate transferability of the solutions across datasets and significantly improve the multi-view state of the art on the Human3.6M dataset.

Keywords: Natural language processing · Word embeddings · Lexico-semantic relations

Fraud Detection in Real Time Bidding

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Abstract. In the talk, we address the types of fraud in RTB (Real Time Bidding) ecosystem (bots, ad stacking, spoof sites). Then we discuss what kind of fraud can be resolved by means of various approaches including machine learning, e.g. modified bid clustering for good traffic (human) and bad (bot). We also discuss which clustering method is better, which way of learning (supervised/unsupervised) is suitable, how feature selection may help in terms of fighting fraud. As for the technical part, we discuss the impact of different parameters (e.g., size of learning sample, number of Google Cloud Engine machines needed) and possible ways of computational optimisation.

Keywords: Real time bidding • Fraud detection • Web advertising • Machine learning

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