

# Maxim Borisyak

## PERSONAL DATA

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## EDUCATION

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NOVEMBER 2015 — PRESENT

PHD, COMPUTER AND INFORMATION SCIENCES;

**National Research University Higher School of Economics,**

**Laboratory of Methods for Big Data Analysis;**

Dissertation: 'Data processing system for cosmic rays observatory based on smart-phones for observing Ultra-High Energy Cosmic Rays.'

Scientific mentor: Andrey Evgenevich Ustyuzhanin.

A student of full-time Advanced Doctoral Programme.

SEPTEMBER 2013 — JULY 2015

MASTER'S DEGREE, APPLIED MATHEMATICS AND PHYSICS;

**National Research University Higher School of Economics,**

**department of Control and Applied Mathematics<sup>1</sup>;**

**Moscow Institute of Physics and Technology,**

**department of Computer Science<sup>2</sup>**

Thesis: 'Application of genetic algorithms for effective autonomous navigation' [[1](#), [2](#)]

Scientific mentor: Andrey Evgenevich Ustyuzhanin.

SEPTEMBER 2009 — JULY 2013

BACHELOR'S DEGREE, APPLIED MATHEMATICS AND PHYSICS,

**Moscow Institute of Physics and Technology,**

**department of Control and Applied Mathematics<sup>1</sup>;**

**Institute for Information Transmission Problems, DATADVANCE,**

**department of Predictive Modeling and Optimization<sup>2</sup>**

Thesis: 'Building, analysis and optimization of data flows in homogeneous distributed systems',

Scientific mentor: Alexander Alexandrovich Prokhorov.

## EMPLOYMENT

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SEPTEMBER 2015 — PRESENT

RESEARCH ASSISTANT, PART-TIME,

**Yandex Machine Intelligence and Research,**

**CERN-Yandex Research & Education programs,**

Application of Machine Learning methods for problems in high-energy physics and astrophysics.

MARCH 2015 — PRESENT

RESEARCH ASSISTANT, PART-TIME,

**National Research University Higher School of Economics,**

**department of Computer Science,**

**Laboratory of Methods for Big Data Analysis.**

Main responsibility is participation in the [CRAYFIS](#) experiment — responsible for Machine Learning, massive data analysis and processing pipeline. Besides solving Machine Learning problems and developing new methods, maintain a small framework [crayimage](#)<sup>3</sup> for image processing and take part in developing Spark-based semi-online service for initial data processing.

A member of high professional potential group, category 'New Researchers'.

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<sup>1</sup>Main department.

<sup>2</sup>Partnership section/base department.

<sup>3</sup>The package can be found at <https://github.com/yandexdataschool/crayimage>.

OCTOBER 2014 — MARCH 2015

RESEARCHER, PART-TIME,

### **Retail Rocket.**

The company provides recommender systems as a service. Was responsible for research in the area and massive data analysis. Developed a number of improvements for the current system, supported migration to the **Spark (Scala)** ecosystem.

JULY 2012 — JUNE 2013

JUNIOR RESEARCHER, PART-TIME,

### **DATADVANCE.**

The company provides solutions for surrogate modelling. The main product is the *pSeven* platform — dataflow engine powered by a number of state-of-the-art algorithms.

My responsibilities included wide range of tasks from software development (C++/Python) to application of Machine Learning to particular optimization tasks (based on the company products) and research in area of scientific dataflow analysis (main responsibility).

The main result is theoretical algorithms for validation and optimization of dataflows for execution in homogeneous computing environment (clusters, clouds). The Bachelor's dissertation is based on this research.

## RESEARCH

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### **Building, analysis and optimization of data flows in homogeneous distributed systems**

Bachelor's thesis. A validation and optimization engine for specific subset of scientific data flows was developed. The main goal of the engine is identification of independent branches of a data flow for its distributed execution, additionally discovering any possible race conditions and pointing to bottlenecks in the data flow.

### **Application of genetic algorithms for effective autonomous navigation**

Master's thesis. In this work, Learning Classifier System was applied to problem of navigation in partially observed maze-like environments. A number of improvements were suggested such as: delayed rewards, convolutional-like filters, geometric features. As the result, an navigation algorithm capable of self-learning was developed, as well as a small framework<sup>4</sup> for developing and testing similar algorithms. The framework written in Scala utilizing Akka framework for asynchronous processing, the UI part is written in Play framework.

### **Towards automation of data quality system for CERN CMS experiment**

This work focuses on Machine Learning methods for data certification in High Energy Physics experiments, on the example of the CERN CMS experiment. The work was presented on 22<sup>nd</sup> International Conference on Computing in High Energy Physics [3, 4].

### **Numerical optimization for Artificial Retina Algorithm**

We propose an modification to Artificial Retina Algorithm for tracking, that allows to considerably reduce total computational cost of procedure. The work was presented on 22<sup>nd</sup> International Conference on Computing in High Energy Physics [5, 6].

### **Cascade Convolutional Networks and muon trigger for the CRAYFIS experiment**

The CRAYFIS experiment proposes to use privately owned mobile phones as a ground detector array for Ultra High Energy Cosmic Rays. In order to detect Ultra High Energy Cosmic Rays a mobile phone should constantly monitor its camera for cosmic ray traces. For this purpose an extension of Convolutional Neural Networks with low computational cost, Cascade Convolutional Networks, was proposed. The work was presented on 22<sup>nd</sup> International Conference on Computing in High Energy Physics [7, 8].

## TEACHING

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NOVEMBER 2015 — PRESENT

MACHINE LEARNING AND DATA MINING, MASTER'S PROGRAMME

**National Research University Higher School of Economics,**

**Faculty of Computer Science,**

Deliver lectures and seminars on Machine Learning and Data Mining. The course covers three big topics:

1. advanced topics in Machine Learning: modeled after course 'Advanced Topics in Machine Learning' for postgraduate students by Attila Kertesz-Farkas;

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<sup>4</sup>The projects can be found at <https://github.com/maxim-borisyak/genetic-machine> and <https://github.com/maxim-borisyak/genetic-machine-interface>.

2. Deep Learning: overview of modern methods in Deep Learning;
3. Big Data: overview of distributed programming with focus on Machine Learning algorithms.

Special attention is given to practice and tools for Machine Learning and Data Mining, e.g. `theano`, `Apache Spark`.

LINK: [course description](#).

## OTHER ACTIVITIES

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2014

### Microsoft Imagine Cup

Was a member of *NanoBee* team with *QuadroBee* project. The key idea of the project is to replace bees (which may face extinction in the near future) with quadcopters designed to pollinate agricultural fields. Was responsible for simulations of quadcopters (with control system based on Robot Operating System).  
RESULT: winner of the Moscow finals.

2016 – PRESENT

### CERN LHCb

A member of the CERN LHCb collaboration.

2016 – PRESENT

### CRAYFIS

A member of the CRAYFIS collaboration.

## REFERENCES

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- [1] M. Borisyak and A. Ustyuzhanin, “Genetic approach in autonomous navigation,” *Proceedings of 57th MIPT scientific conference (Trudy MFTI)*, vol. 2, 2014. In Russian.
- [2] M. Borisyak and A. Ustyuzhanin, “A genetic algorithm for autonomous navigation in partially observable domain,” *arXiv preprint arXiv:1507.07374*, 2015.
- [3] M. Borisyak, A. Ustyuzhanin, M. Stenina, and S. Dmitri, “Towards automation of data quality system for cern cms experiment,” in *Journal of Physics Conference Series*, 2017. (In press.).
- [4] M. Borisyak, A. Ustyuzhanin, M. Stenina, and S. Dmitri, “Towards automation of data quality system for cern cms experiment (contribution page).” <https://indico.cern.ch/event/505613/contributions/2227973/>, 2017.
- [5] M. Borisyak, A. Ustyuzhanin, D. Derkach, and M. Belous, “Numerical optimization for artificial retina algorithm,” in *Journal of Physics Conference Series*, 2017. (In press.).
- [6] M. Borisyak, A. Ustyuzhanin, D. Derkach, and M. Belous, “Numerical optimization for artificial retina algorithm (contribution page).” <https://indico.cern.ch/event/505613/contributions/2227266/>, 2017.
- [7] M. Borisyak, M. Usvyatsov, M. Mulhearn, C. Shimmin, and A. Ustyuzhanin, “Muon trigger for mobile phones,” in *Journal of Physics Conference Series*, 2017. (In press.).
- [8] M. Borisyak, M. Usvyatsov, M. Mulhearn, C. Shimmin, and A. Ustyuzhanin, “Muon trigger for mobile phones (contribution page).” <https://indico.cern.ch/event/505613/contributions/2227267/>, 2017.