Konstantin BURLACHENKO
Ph.D. candidacy in Computer Science program, CEMSE division at KAUST

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ℹ Homepage : `https://burlachenkok.github.io`

I have co-created state-of-the-art systems for Machine Learning, Graphics, Vision, and Computational Physics, exploiting hardware via DSL and using contemporary areas of Math and CS. My current focus is Federated Learning, a subfield of Machine Learning co-invented by my advisor in 2016 [1]. It has become a key part of the "US National Artificial Intelligence Research and Development Plan" in May 2023. My dissertation title is *"Optimization Methods and Software for Federated Learning"*.

🎓 EDUCATION

2020-Now	KSA : Ph.D. program in CEMSE/CS Program at KAUST. Member of Prof. Peter Richtárik's Optimization and Machine Learning Lab in KAUST AI initiative led by Jürgen Schmidhuber. *Transcript* : Link-1. *GPA : 3.81/4.0.*
2015-2019	USA, Stanford : Graduate Non-Degree Program. *Transcript* : Link-2. *GPA : 3.96/4.3*
2015-2018	USA, Stanford : Data, Models and Optimization Graduate Certificate Link-3 (Program)
2016 - 2019	USA, Stanford : Artificial Intelligence Graduate Certificate Link-4 (Program)
2003-2009	Russia, Bauman Moscow State Technical University : Master Degree (Bologn process equivalent) in Computer Science and Control Systems. *GPA : Not Applicable.* (Original scans)
Conferences and Summer Schools	ACM CoNEXT 2023; Rising Stars in AI Symposium 2024 and 2023, EMNLP-2022; ICML-2022; ICML-2021; NeurIPS-2021; ACM CoNEXT 2021; Regularization Methods for ML 2021; The PRAIRIE/MIAI AI 2021; Oxford ML-2021; The HSE/MIPT Optimization without Border; ACM SIGGRAPH 2012.

💼 EXPERIENCE

August 2021	**Research Scientist Intern (AI), FACEBOOK INC., USA, Menlo Park** I have read several papers that Dr. Hao-Jun Michael Shi has recommended. The internship has not happened due to the long process of obtaining approval on J1 VISA by USA Embassy which took 15 months. Distributed Optimization · AI · Federated Learning
Now September 2020	**CS Ph.D. candidacy and a member of Prof. Peter Richtárik OPTIMIZATION AND ML LAB [2], KAUST, KSA** ▶ *Narrow area of my research :* Federated Learning(FL), Stochastic Distributed Math Optimization for AI. ▶ *Broad areas of my interests :* Math Optimization, AI/ML, Compute Optimization, Software Systems, GPGPU, Computer Vision, Computer Graphics, Networks, Cryptography, Control, Physical Simulation. ▶ During Sep 2022 - Sep 2023 I was a Member of Center of Excellence in Data Science and Artificial Intelligence SDAIA-KAUST AI (invitation letter). During my affilation I have co-initiated a joint project. ▶ Awards : (1) Dean's Award 2020 KAUST; (2) Grant from Saudi Authority for Data and Artificial Intelligence(SDAIA) 2022;(3) Dean's List Award 2023, KAUST; (4) AMD Instinct MI50 from AMD Inc. 2023. Distributed Optimization · Federated Learning · Applied Math · Computer Vision · Sytems · Cryptography · C/C++ · CUDA · AVX512 · Python · CMake · Qt/PyQt · PyTorch · TF · Latex · Git · Google Tests · Bash
August 2020 March 2019	**Principal Engineer Level 18 | Foundation AI Lab, HUAWEI, Moscow** ▶ R&D in internal ML Systems middleware for HUAWEI HiSilicon and manage team of 6 members. ▶ Present HiSilicon solutions for engineers, scientists working with ML/AI. OpenTalks.AI, HUAWEI News. ▶ R&D in internal projects in Machine Learning/Systems HUAWEI Consumer Business Group. ▶ Awards : Grade "A" for a 2019-2020 Year Progress with a one-time payment bonus. Math Optimization · AI · Custome ISA · C/C++ · Python · TVM · Java · Google Protobuf · CMake · Qt · TF · SQL
March 2019 July 2014	**Senior Developer Technology Engineer Level IC3, NVIDIA, Moscow** ▶ Driveworks SDK - SDK for self-driving cars adopted by automotive partners. Computer vision, machine learning, calibration, egomotion. Implementation and presentation of the modules internally. ▶ PhysX/Apex SDK - An industry standard for game physics simulation, graphical special effects. Internal implementation and communication with extra customers (Blizzard). ▶ cuDNN/cuBLAS libraries - GPU computation libraries used by more than 1M customers in machine learning and HPC. Implementation, Documentation, and collaboration with Mathworks. ▶ RAPIDS - GPU based implementation of SkLearn, XgBoost, Pandas. I was resnposible for SkLearn. CUDA · GLSL · C++ · AARCH64 · SSE2/ARM NEON · Linux · Windows · PS4 · XBox · OpenGL · Google Tests · GitLab · Perl · Python · CMake · Make · Qt · Git · TensorFlow · Computer Vision · Graphics · Deep Learning · CppCheck

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1. *Federated Learning : Strategies for Improving Communication Efficiency [J.Konečný, H.B.McMahan, F.X.Yu, P.Richtarik, A.T.Suresh, D.Bacon, NIPS 2016]*
2. To avoid academic disputes over authorship order and focus on work, the Lab adopts the concept of "Every Author as First Author" arXiv:2304.01393

July 2014 May 2013	**Senior Developer Engineer | Yandex Video Team, YANDEX, Moscow** ▶ Text and statistical machine learning features for Yandex Video Search. ▶ Infrastructure for storage and analysis of all web documents with embedded video on the WWW ▶ Infrastructure to show plots for internal team's processes ▶ **Awards :** Two one-time payment bonuses due to the delivery of products in production. `C++` `Google Protobuf` `JavaScript` `Bash` `Python` `Computer Science` `HTML/JS/CSS` `SVN` `MapReduce` `ML`
April 2013 March 2012	**Team Lead Physics Engine Developer, FITTING REALITY, Moscow** ▶ Develop library for clothing simulation in CUDA and in OpenCL with facade interface to C++/C#. ▶ Custom render engine for clothing visualization compatible with OpenGL 1.2. ▶ Prepare elements of the demo to investors. Carry internal MATH/CS/PHYS trainings. ▶ Manage team of 4 members. ▶ **Awards :** Funding visit of SIGGRAPH 2012, USA conference. `C++` `C` `OpenGL` `GLSL` `Qt` `Posix` `WinAPI` `QMake` `CUDA` `OpenCL` `Physics` `Graphics` `Ogre` `C#`
March 2012 September 2010	**Software Developer Engineer, ACRONIS, Moscow** ▶ Key member of GUI team for Acronis Backup and Recovery 2011 Enterprise ▶ Profiling and optimization of the codebase working in user/kernel space for Windows OS. `C++` `C` `WinAPI` `WinDbg` `VmWare` `Specialized GUI library` `SVN` `SysInternals` `CppCheck` `ASM x86` `AqTime`
September 2010 March 2009	**Senior Software Developer Engineer, CAPITAL RESEARCH, Moscow** ▶ Developed Firefox plugin to create the three-dimensional HTML view for basics HTML elements. `Firefox` `C++` `WinAPI` `HTML/JS/CSS` `Windows` `OpenGL` `GLSL` `SVN`
June 2009 December 2006	**C++ Programming Engineer, FLINT AND CO, Moscow** ▶ Created several computer games with computer vision and graphics part, hardware drivers. ▶ Spent time on factory floors to test and analyze the quality of my solutions. Carry trips to customers. `C++` `SDL` `Posix` `WinApi` `Development Image Library` `Low level programming` `Computer Vision` `OpenGL` `SVN`
November 2006 March 2006	**C++ Programming Engineer (Part time work), ASTRASOFT TECHNOLOGY, Moscow** ▶ Developed visual elements of management system based on Qt and OpenGL. `C++` `Qt` `Windows` `OpenGL` `SVN`

🏆 PRESENTATIONS

MAY-2024	Error Feedback Reloaded at ICLR 2024, Austria. 🔗 link
APR-2024	Remote research talk for NVIDIA. KSA and USA remotely. *Presentation requested by researchers at NVIDIA Inc. working on FL applications and systems.*
FEB-2024	AI Symposium, KSA : Unlocking FedNL : Self-Contained Compute-Optimized Implementation 🔗 link
DEC-2023	ACM DistributedML2023, France : Federated Learning is Better with Non-Homomorphic Encryption.
JUNE-2023	SIAM : Conference on Optimization, USA : Fl_PyTorch : Optimization Research Simulator for FL 🔗 link
MARCH-2023	VCC OPEN HOUSE 2023 event, KSA : FedNL. Making Newton-Type Methods Applicable to FL. 🔗 link
DEC-2022	EMNLP 2022, Abu Dhabi, UAE : Presenter in KAUST AI Iniative Booth.
OCT-2022	CS Ph.D. Proposal Defense, KSA : Dissertation Title : *Optimization Methods and Software for Federated Learning*. Committee members : *Eric Feron, Marco Canini, Peter Richtarik*.
JULY-2022	Workshop at ACM Symposium on Principles of Distributed Computing, Italy : MARINA : Faster non-convex distributed learning with compression.
MAR-2022	AI Symposium KAUST, KSA : FL_PyTorch : Optimization Research Simulator for FL
DEC-2021	ACM DistributedML2021, Rome : Fl_PyTorch : Optimization Research Simulator for Federated Learning.
JULY-2021	Poster and spotlight for in ICML-2021, Virtual : MARINA Faster Non-Convex Distributed Learning with Compression.
APR-2021	Poster at Communication Efficient Distributed Optimization at NSF-TRIPODS Workshop, Virtual : MARINA : Faster Non-Convex Distributed Learning with Compression.
FEB-2020	OpenTalks.AI conference, Russia : Huawei technologies for AI developers.
JULY-2019	Educational center Sirius, Russia. Deep Learning Course with D.Kamzolov and A.V. Gasnikov.
DEC-2018	Moscow Institute of Physics and Technologies, Russia. Guest lectures about subtle things around CART, Gradient Bossting and Random Forest : Slides : Link. Presentions : Session-#1, Session-#2.
APR-2016	GTC 2016, USA : Presenter in Driveworks NVIDIA booth.
AUG-2012	ACM SIGGRAPH 2012, USA : Presenter in CentiLeo booth, and visitor from Fitting Reality.

⚔ JUDGE OF THE WORK OF OTHERS

1. Service as a referee for peer-reviewed journals or conference proceedings for ICML 2022, AISTATS 2023, JMLR 2024.

2. Participates in annual review processes for estimating the work of my colleagues in HUAWEI, NVIDIA, and Yandex.

✏ Scientific Papers

Unlocking FedNL : Self-Contained Compute-Optimized Implementation 2024
🔗 https://burlachenkok.github.io/Unlocking-FedNL-at-KAUST-AI-Simposium/ *Under a peer-review process.*

Error Feedback Reloaded : From Quadratic to Arithmetic Mean of Smoothness Constants 2024
🔗 https://openreview.net/forum?id=Ch7WqGcGmb 🔗 https://arxiv.org/abs/2402.10774
Accepted to presentation and proceedings to Twelfth International Conference on Learning Representations, ICLR-2024.

Federated Learning is Better with Non-Homomorphic Encryption 2023
🔗 https://dl.acm.org/doi/10.1145/3630048.3630182 🔗 https://arxiv.org/abs/2312.02074
Accepted to presentation and proceedings to 4th ACM International Workshop on Distributed Machine Learning.

Error Feedback Shines when Features are Rare 2023
🔗 https://arxiv.org/abs/2305.15264 *Under a peer-review process.*

Federated Learning with Regularized Client Participation 2023
🔗 https://icml.cc/virtual/2023/27049 🔗 https://arxiv.org/abs/2302.03662
Accepted to presentation. Workshop Federated Learning and Analytics in Practice. Workshop at ICML 2023.

Sharper Rates and Flexible Framework for Nonconvex SGD with Client and Data Sampling 2022
🔗 https://openreview.net/forum?id=zKgJ6TWAFE 🔗 https://arxiv.org/abs/2206.02275
Accepted to proceedings Transactions on Machine Learning Research (TMLR).

Federated Optimization Algorithms with Random Reshuffling and Gradient Compression 2022
🔗 https://icml.cc/virtual/2023/27050 🔗 https://arxiv.org/abs/2206.07021
Accepted to presentation. Workshop Federated Learning and Analytics in Practice. Workshop at ICML 2023.

Faster Rates for Compressed Federated Learning with Client-Variance Reduction 2021
🔗 https://epubs.siam.org/doi/pdf/10.1137/23M1553820 🔗 https://arxiv.org/abs/2112.13097
Accepted to proceedings SIAM Journal on Mathematics of Data Science (SIMODS).

FL_PyTorch : Optimization Research Simulator for Federated Learning 2021
🔗 https://dl.acm.org/doi/abs/10.1145/3488659.3493775/ 🔗 https://arxiv.org/abs/2202.03099
Accepted to presentation and proceedings to 2nd ACM International Workshop on Distributed Machine Learning.

MARINA : Faster Non-Convex Distributed Learning with Compression 2021
🔗 https://proceedings.mlr.press/v139/gorbunov21a.html 🔗 https://arxiv.org/abs/2102.07845
Accepted to presentation and proceedings to Thirty-eighth International Conference on Machine Learning, ICML 2021.

Personalized federated learning with communication compression 2021 – 2022
🔗 https://openreview.net/pdf?id=dZugyhbNFY 🔗 https://arxiv.org/abs/2209.05148
Accepted to proceedings Transactions on Machine Learning Research (TMLR).

☰ Engineering Competencies

Programming Languages that I have used	C89/C99, C++20/11/03, C#, Cython, Java ,x86/AArch64, NDA ASM
Scripting Languages that I have used	Python, Bash, Perl, and Cython which is between scipting and compile languages.
DSL Languages that I have used	Gl SL, TVM, Google Protobuf, CUDA, OpenCL, Matlab, R, SQL
Frameworks	Qt, CUDA, WinApi, Posix, OpenGL, OpenCL, PyTorch,TensorFlow,CvxPy
Operating Systems	Windows, Linux based, Orbis, XBox, Android, NDA OS-es
Development Environments	QtCreator, Visual Studio,Eclipse,WinDbg,Android Studio,TexStudio,Nsight
General purpose development tools	SysInternals,AqTime,Cmake,GNU Toolchain,CppCheck,Valgrind,Git,QMake
Typing DSL Languages	Latex, HTML, XML, Markdown
Areas in which I worked	Federated Learning, Stochastic Distributed Math Optimization, Computer Vision, Statistical Learning, System Programming, HPC and GPU Programming, Math Optimization, Computer Graphics, Computational Physics, Distributed Systems.
Sport achievements	The Candidate Master in chess by FIDE. (My FIDE profile). Second Place in the KAUST Chess Tournament in Oct, 2022.

✏️ Technical Notes

Technical Note : From C++98 to C++2x   2022-2024

○ github.com/burlachenkok/CPP_from_1998_to_2020/blob/main/Cpp-Technical-Note.md   ↗ Short Information
The technical note is dedicated for all primary C++ programming language standards : C++03/98/11/14/17/20. The note has
been adopted to AMD Inc. internal education web portal. Also it has been highly assessed by : *(i)* Marco Foco, Head of the
Delegation for Italy ISO C++ JTC1/SC22/WG21; *(ii)* Prof. David Keyes, Director of Extreme Compute Research Center at KAUST.

Technical Note : Exploring Python3 Language from a Computing Perspective   2023

○ github.com/burlachenkok/exploring-python3/blob/main/python3-note.md   ↗ Short Information
The note contains a language tutorial, a description of several libraries, and a description of several low-level profiling tools
for Linux/Posix OS and Windows OS Family. It has been adopted to Introduction to Data Science workshop series at KAUST.

🖥️ Selected Personal And Academic Projects

Math Optimization Research Studio   KAUST, 2020

↗ Project report - Math Optimizaiton Research Studio   ↗ Description   ↗ Bitbucket repo
CS380 : Math Optimization Research Studio. Self-developed command line interpreter with custom script language with
self-developed backend computation in C++/CUDA.

[C++] [Linux] [Windows] [CUDA] [CMake] [Dot] [Google Test] [Python] [Bash]

Experimental Neural Net Framework   Stanford, 2019

↗ Report.CS230 - 2019   ↗ Poster CS230 - 2019   ↗ bitbucket repo   ↗ Presentation
CS230 : Experimental Neural Net Framework. Mentor : Steven Z. Chen(stevenzc@stanford.edu)

[C++] [Linux] [Windows] [CUDA] [Python] [CMake]

Convex optimization solvers with leveraging into GPU/CPU power for AI/ML   Stanford, 2018

↗ Poster CS221 - 2018   ↗ Bitbucket repo
CS221 : Convex optimization solvers with leveraging into GPU/CPU power for AI/ML. Mentor : Steven Diamond

[C++] [Linux] [Windows] [CUDA] [Python] [CMake] [Convex Optimization]

Convex Optimization for Machine Learning   Stanford, 2017

↗ Poster CS229 - 2017.   ↗ Presentation
Stanford, CS229 : Convex Optimization for Machine Learning

[C++] [Visual Studio] [Numerical Linear Algebra] [Convex Optimization] [Python] [CMake]

Plotter++. Standalone tool for plot images, graphs, point clouds, logs. Communication : TCP/IP   Holidays, 2017

○ github.com/burlachenkok/plotter_plusplus   ↗ Presentation
An advanced scientific plotter tool suitable to use in connection with embedded systems.

[C++] [Linux] [Windows] [Embedded Systems] [Qt] [Python]

Lane detection using Fourier based line detector   Stanford, 2016

↗ Report   ↗ Presentation
Lane detection using Fourier based line detector

[Matlab]

HTML report generator for Google Tests   Holidays, 2016

↗ GitHub
Project goal is to generate and compare different Google Test reports from several launches. Project is used by Hyundai
AutoEver, and Hapsoft Consulting.

[Python] [HTML] [XML]

💬 References

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