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

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i HOMEPAGE: https://burlachenkok.github.io

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I have co-created systems for ML, Graphics, Vision, and Physics Simulation, exploiting hardware via DSL and using contemporary areas of Math&CS. My current focus is Federated Learning, a subfield of ML co-invented by my advisor in 2016, which becomes a key part of the "US National AI R&D Plan" in 2023. My dissertation is "Optimization Methods and Software for Federated Learnina".

EDUCATION

2020-Now	KSA: Ph.D. candidacy 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, Total Credits: 28.	
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: MS in CS. GPA: Not Applicable. (Original scans)	
Conferences and	ICLR 2024; ACM CoNEXT 2023; Rising Stars in Al Symposium 2024 and 2023, EMNLP-2022; ICML-2022; ICML-	
Summer Schools	2021; NeurlPS-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

June 2024 September 2024

Internship in Private Federated Learning ML Team, APPLE, Cambridge, UK

This planned internship involves broadly making, conceiving, or improving inventions, ideas in ML/FL. Distributed Math Optimization | Al | Federated Learning

August 2021

Research Scientist Intern (AI), FACEBOOK/META, Menlo Park, USA

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 | Al | Federated Learning

Now September 2020

CS Ph.D. candidacy and a member of Prof. Peter Richtárik Optimization and ML Lab², KAUST, KSA

- Narrow area of my research: Federated Learning(FL), Stochastic Distributed Math Optimization for Al.
- ▶ Broad areas of my interests: Math Optimization, AI/ML, Compute Optimization, Software Systems, GPGPU, Computer Vision, Computer Graphics, Networks, Cryptography, Control, Physical Simulation.
- ► Sep 2022 Sep 2023 Member of SDAIA-KAUST AI (invitation letter).
- ▶ 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, Russia

- ▶ R&D in internal ML Systems middleware for HUAWEI HiSilicon and HUAWEI CBG.
- ▶ Present HiSilicon solutions for engineers, scientists working with ML/Al. OpenTalks.Al, HUAWEI News.
- ▶ Awards: Grade "A" for a 2019-2020 Year Progress with a one-time payment bonus.

Math Optimization Al 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, Russia

- ▶ 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 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 |

^{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, Russia

- ► 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, utilized by 10 internal teams.
- 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, Russia

- ▶ 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, Russia

- ➤ 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, Russia

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, Russia

- ► 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, Russia

▶ Developed visual elements of management system based on Qt and OpenGL.

C++ Qt Windows OpenGL SVN

* Presentations

MAY-2024 UK, USA, KSA remotely: Research talk for APPLE Inc.

MAY-2024 ICLR 2024, Austria: Error Feedback Reloaded 🗗 link 🔀 poster

APR-2024 USA and KSA remotely: Research talk for NVIDIA Inc.

FEB-2024 Al 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 Al Iniative Booth.

OCT-2022 CS Ph.D. Proposal Defense, KSA: Dissertation Title: Optimization Methods and Software for Federated Lear-

ning. Committee members: Eric Feron, Marco Canini, Peter Richtarik.

JULY-2022 ACM Symposium on Principles of Distributed Computing, Italy:

MARINA: Faster non-convex distributed learning with compression.

MAR-2022 Al 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 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.Al conference, Russia: Huawei technologies for Al 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.

X JUDGE OF THE WORK OF OTHERS

- 1. Referee in a peer-reviewed proceeding for ICML'22, AISTATS'23, JMLR'24, ICML'24 Workshop Advancing NN Training.
- 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 In https://burlachenkok.github.io/Unlocking-FedNL-at-KAUST-Al-Simposium/ Under a peer-review process.	2024
ERROR FEEDBACK RELOADED: FROM QUADRATIC TO ARITHMETIC MEAN OF SMOOTHNESS CONSTANTS 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-2	2024 024.
FEDERATED LEARNING IS BETTER WITH NON-HOMOMORPHIC ENCRYPTION Thttps://dl.acm.org/doi/10.1145/3630048.3630182 Thttps://arxiv.org/abs/2312.02074 Accepted to presentation and proceedings to 4th ACM International Workshop on Distributed Machine Learning.	2023
Error Feedback Shines when Features are Rare https://arxiv.org/abs/2305.15264	2023
FEDERATED LEARNING WITH REGULARIZED CLIENT PARTICIPATION Thttps://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.	2023
SHARPER RATES AND FLEXIBLE FRAMEWORK FOR NONCONVEX SGD WITH CLIENT AND DATA SAMPLING https://openreview.net/forum?id=zKgJ6TWAFE https://arxiv.org/abs/2206.02275 Accepted to proceedings Transactions on Machine Learning Research (TMLR).	2022
FEDERATED OPTIMIZATION ALGORITHMS WITH RANDOM RESHUFFLING AND GRADIENT COMPRESSION 1. https://icml.cc/virtual/2023/27050 https://arxiv.org/abs/2206.07021 1. Accepted to presentation. Workshop Federated Learning and Analytics in Practice. Workshop at ICML 2023.	2022
FASTER RATES FOR COMPRESSED FEDERATED LEARNING WITH CLIENT-VARIANCE REDUCTION 1. https://epubs.siam.org/doi/pdf/10.1137/23M1553820 1. https://arxiv.org/abs/2112.13097 1. Accepted to proceedings SIAM Journal on Mathematics of Data Science (SIMODS).	2021
FL_PyTorch: Optimization Research Simulator for Federated Learning 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.	2021
MARINA: FASTER NON-CONVEX DISTRIBUTED LEARNING WITH COMPRESSION If https://proceedings.mlr.press/v139/gorbunov21a.html If https://arxiv.org/abs/2102.07845 Accepted to presentation and proceedings to Thirty-eighth International Conference on Machine Learning, ICML 2020	2021
Personalized federated learning with communication compression the https://openreview.net/pdf?id=dZugyhbNFY https://arxiv.org/abs/2209.05148 Accepted to proceedings Transactions on Machine Learning Research (TMLR).	2021 – 2022

≡ 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 Ditbucket repo Presentation CS230 : Experimental Neural Net Framework. Wall-clock speedup relative to Google Tensor Flow x3.5.

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 Al/ML. Lasso regression speedup with GPU is x12.6 compared to CPU standart solvers.

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. Several solvers that work x8 faster than SkLearn.

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

HTML REPORT GENERATOR FOR GOOGLE TESTS

HOLIDAYS, 2016

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

66 References

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Andrew Ng

Timour Paltashev

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