Konstantin **Burlachenko**
Ph.D. in Computer Science

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I co-created state-of-the-art systems for machine learning, graphics, computer vision, and physics simulation, leveraging hardware through domain-specific languages and applying contemporary mathematics and computer science. I defended my dissertation, *'Optimization Methods and Software for Federated Learning'* at KAUST, KSA, under the supervision of Prof. Peter Richtárik.

Education

2020 – 2025	KSA, KAUST : CS Ph.D. program. 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*
Conferences and Summer Schools	ICLR 2024; 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

June 2024 – September 2024 — **Internship in Private Federated Learning ML Team, APPLE, Cambridge, UK**
Developing innovative approach for memory-efficient on-device fine-tuning for large language models
Distributed Math Optimization | AI | Federated Learning

August 2021 — **Research Scientist Intern (AI) in AI and Systems Co-Design, META, Menlo Park, USA**
The internship has not happened due to 15 months process of obtaining J1 VISA to USA
Distributed Optimization | AI | Federated Learning

May 2025 – September 2020 — **CS Ph.D. candidacy and a member of Prof. Peter Richtárik Optimization and ML Lab [1] , KAUST, KSA**

- *Narrow area of research :* Federated Learning, Stochastic Distributed Math Optimization
- *Broad area of 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; (2) Grant from Saudi Authority for Data and Artificial Intelligence, 2022;(3) Dean's List Award, 2023; (4) AMD MI50 from AMD Inc., 2023.; (5) Winning grant from Grand Challenge Project Proposal Shaheen III CPU, 2024; (6) Co-secured a 4-year RDIA grant for the lab, 2025.

Distributed Optimization | Federated Learning | Applied and Fundamental Math | Computer Vision | Sytems | Cryptography | C/C++ | CUDA | AVX512 | Python | CMake | Qt/PyQt | PyTorch | TF | Latex | Git | Google Tests | Bash | NLP

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/AI OpenTalks.AI, HUAWEI News
- **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, 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
- **Awards :** Funding support of visiting two NVIDIA GTC conference

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. 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 web documents with embedded video on the WWW
- **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 for investors. Carry internal MATH/CS/PHYS training
- Manage a 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 basic 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 2025	CEMSE Graduate Seminar, KAUST, KSA : Error Feedback for Communication-Efficient First and Second-Order Distributed Optimization. Theory and Practical Implementation.
May 2025	CS Ph.D. Defense, KSA : Thesis : *Optimization Methods and Software for Federated Learning*. Committee members : *Peter Richtárik, Stephen Boyd, Nicholas Lane, David Keyes, Eric Feron, Suhaib Fahmy.*
May 2024	APPLE Inc, UK, USA, KSA remotely : Research talk for Apple Inc.
May 2024	ICLR 2024, Austria : Error Feedback Reloaded
Apr 2024	NVIDIA Inc, USA and KSA remotely : Research talk for NVIDIA Inc.
Mar 2024	MLSS 2024, Japan : Error Feedback Reloaded
Feb 2024	AI Symposium, KSA : Unlocking FedNL : Self-Contained Compute-Optimized Implementation
Dec 2023	ACM DistributedML2023, France : Federated Learning is Better with Non-Homomorphic Encryption.
Jun 2023	SIAM, USA : Fl_PyTorch : Optimization Research Simulator for FL
Mar 2023	VCC OPEN HOUSE 2023 event, KSA : FedNL. Making Newton-Type Methods Applicable to FL.
Dec 2022	EMNLP 2022, Abu Dhabi, UAE : Presenter in KAUST AI Iniative Booth.
Oct 2022	CS Ph.D. Proposal Defense, KSA : Title : *Optimization Methods and Software for Federated Learning*. Committee members : *Peter Richtárik, Eric Feron, Marco Canini.*
Jul 2022	ACM Symposium, 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.
Jul 2021	Spotlight for in ICML-2021, Virtual : MARINA Faster Non-Convex Distributed Learning with Compression.
Apr 2021	NSF-TRIPODS Workshop, Virtual : MARINA : Faster Non-Convex Distributed Learning with Compression.
Feb 2020	OpenTalks.AI conference, Russia : Huawei technologies for AI developers.
Jul 2019	Educational Center Sirius, Russia : Deep Learning Course with D.Kamzolov and A.V. Gasnikov
Dec 2018	MIPT, Russia : Lectures about subtle things around Decision Trees, Gradient Boosting and Random Forest.
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.

Evaluating the Work of Others

1. Reviewer in a peer-reviewed proceeding for ICML'22, AISTATS'23, JMLR'24, ICML'24 Workshop, ICLR'25, ICML'25.
2. Participates in annual review processes for estimating the work of my colleagues in HUAWEI, NVIDIA, and Yandex.

Peer-reviewed Scientific Articles

BurTorch : Revisiting Training from First Principles by Coupling Autodiff, Math Optimization, and Systems 2025

https://arxiv.org/abs/2503.13795 *Under a peer-review process*

PV-Tuning : Beyond Straight-Through Estimation for Extreme LLM Compression 2024

https://arxiv.org/abs/2405.14852 *Presentation and proceedings to NeurIPS -2024, [Oral Paper, Top 0.4%]*

Unlocking FedNL : Self-Contained Compute-Optimized Implementation 2024

https://arxiv.org/abs/2410.08760 *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
Presentation and proceedings to 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
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
Presentation. Workshop Federated Learning and Analytics in Practice 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
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
Presentation and proceedings to NeurIPS -2024 Presentation Workshop Federated Learning and Analytics 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
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
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
Presentation and proceedings to ICML 2021

Personalized federated learning with communication compression 2021 – 2022

https://openreview.net/pdf?id=dZugyhbNFY https://arxiv.org/abs/2209.05148
Proceedings Transactions on Machine Learning Research (TMLR)

Engineering Expertise

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 Math Optimization, Computer Vision, Systems, HPC and GPU Programming, Computer Graphics, Computational Physics.
Sports achievements	The Candidate Master in chess by FIDE; 2-nd Place in the KAUST Tournament, 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 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.

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 Projects

Math Optimization Research Studio — KAUST, 2020

Project report - Math Optimizaiton Research Studio Description Bitbucket repo

CS380 : Math Optimization Research Studio. Command line interpreter with custom script language.

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. Wall-clock relative speedup compared 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 AI/ML.

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 plotting images, graphs, point clouds. 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

References

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