Konstantin BURLACHENKO

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

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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[1], which becomes a key part of the "US National AI R&D Plan" in 2023. My dissertation is *"Optimization Methods and Software for Federated Learning"*.

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 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**

Developed a strategy combining existing and novel ideas to solve a critical practical problem

Distributed Math Optimization | AI | Federated Learning

August 2021 — **Research Scientist Intern (AI) in AI and Systems Co-Design, 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 | 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
- *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.; (5) Winning a grant from Grand Challenge Project Proposal Shaheen III CPU 2024.

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

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
APR-2024	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.
JUNE-2023	SIAM : Conference on Optimization, USA : Fl_PyTorch : Optimization Research Simulator for FL
MARCH-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 : Dissertation Title : *Optimization Methods and Software for Federated Learning*. 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	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	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	MIPT, Russia : Lectures about subtle things around Decision Trees, Gradient Bossting 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.

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

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 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 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. 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 AI/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

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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