Mateusz Kapusta
https://github.com/Wesenheit
Email : mr.kapusta@student.uw.edu.pl
Mobile : +48 530 510 849

Profile

I am a fifth-year Master's student at the Faculty of Physics (and partially at the Faculty of Mathematics, Informatics and Mechanics), University of Warsaw. My main interest lies in the low-level programming, distributed computing, GPU programming and performance benchmarking. In general, I like to make code fast, no mater if it runs on multi-node cluster or embedded device. Moreover, I am also involved in several projects from the field of data analysis and Deep Learning, where I am mainly working in Python (with parts of the code written in C for acceleration). Especially, I like when both low-level programming and Deep Learning intersect. Much of my work has been made possible by the strong technical foundation I developed at MIMUW, where I studied within the College of Interdisciplinary Studies (MISMaP).

Education

- **Warsaw University - major in Astrophysics** Warsaw, Poland
  Faculty of Physics (Msc); GPA: 4.88/5 *Oct. 2023 –*
  - **HPC & acceleration**: Designing CUDA + MPI accelerated multi-node numerical code for the hydrodynamics in Julia (with mirror code written in C/C++ for comparison), aiming at petascale-size systems. Utilizing profiling tools like Nsight-Compute to pinpoint the bottlenecks of the application (memory bandwidth - compute - communication). Most of the work was centered around writing custom CUDA kernels. Performing aggressive optimization to run as fast as possible on an Ampere-based Nvidia GPUs on several nodes of the supercomputer. Work is supported by the EuroHPC developer grant EHPC-DEV-2025D02-085, where I am a Co-PI.
  - **Deep Learning**: Working on the transformer-based neural net for the Bayesian data analysis. The model utilizes the Simulation-Based Inference (SBI) to replace MCMC-based models and accelerate the inference for modern set-like dataset. During the project, I designed my own hybrid model (Set Invariant Transformer + Masked Autoregressive Flow) and implemented it with the PyTorch library. During the project almost everything was implemented and trained from scratch. Obtained results were presented as a poster at national-level conference ML in PL 2024, and will be presented in peer-reviewed publication in the future.
- **Warsaw University - major in Astrophysics (minor in Computer Science)** Warsaw, Poland
  Inter-faculty Individual Studies in Mathematics and Natural Sciences (Bsc); GPA: 4.96/5 *Oct. 2020 – Jul. 2023*

  Pursuing interdisciplinary studies, divided between Faculty of Physics (FUW) and Faculty of Mathematics, Informatics and Mechanics (MIMUW).
  - **C/C++ programming**: Working on MPI task launching with LORENE library. Porting some routines from old C++98 standard to utilize some of the modern C++11 standard. Porting old matlab code to C++ with OpenMP parallelization, allowing to scale calculations on a computer cluster.
  - **Data Analysis & acceleration**: Working with astronomical databases, data cleaning and analysis. Mining massive datasets, creating pipelines to process them, and analyzing the results. Creating statistical software, implementing various statistical methods (MCMC, ANOVA, and more). Utilizing low-level C programming with SIMD instructions to speed up the processing of time-series data, writing Python wrappers with Python C-API. During my studies I obtained basic research experience.
  - **Deep Learning**: Attended courses designed for the Machine Learning Master's program (ar MIMUW), in the field of deep learning. Courses covered not only basic material from various fields like Computer Vision, Natural Language Processing, and Reinforcement Learning, but also more advanced ones including modern state-of-the-art architectures like transformers, rainbow agents, advanced detection models like FCOS, and more. Moreover, I gained expert-level knowledge from the field of Bayesian modelling including traditional methods (MCMC, VI) and hybrid ones like Variational Autoencoders, Normalizing Flows and more.
- **IIIrd High School** Wroclaw , Poland
  Graduated with distinction; GPA: 4.8/5 *Sep. 2017 – July. 2020*

Relevant university education

- **Programming courses**: Programming I & II (Python, C++, data structures & algorithms), Statistical Data Analysis I (R, machine learning, data processing), Statistical Data Analysis II (Bayesian modeling, deep learning, genomics), Deep Neural Networks (NLP, CV, RL), High Performance Computing (C++, CUDA, MPI, performance analysis).
- **Extracurricular activities**: Attending Statistical Journal Club (SJC) at the Astronomical Observatory, University of Warsaw. Active contribution to the journal club, presenting new computational advances at the intersection of Astronomy and Statistics/Deep Learning.

Programming Skills

- **Languages**: Python (advanced), C/C++ (advanced), Julia (advanced), R (beginner), Rust (beginner)
  ML libraries: Torch, TensorFlow, Jax/Flax/Haiku, scikit-learn, Pyro, PyMc, blackjax
- **Additional skils**: MPI, OpenMP, CUDA, SIMD intrinsics, git, bash, very good knowledge of Linux OS.

Computational grants

- EHPC-DEV-2025D02-085 - Development acess on the Leonardo BOOSTER partition, 18k GPU hours.

Awards

- Rector scholarship in academic year 2020/2021, 2021/2022, 2022/2023, 2023/2024 and 2024/2025.
- University Physics Competition 2021: Part of Faculty of Physics team wining gold medal
- Finalist of 69th and 67th Polish Physics Olympiad
- Finalist of 70th Polish Mathematical Olympiad
- Winner of 62th Polish Astronomical Olympiad
- Bronze Medalist at 11th International Olympiad on Astronomy and Astrophysics
- Silver medal at 1st Global e-Competition on Astronomy and Astrophysics (in place of 14th International Olympiad on Astronomy and Astrophysics), 2020

Language

- English - C1 (103 TOEFL)
- Polish - native speaker
- German - A2/B1