

Mateusz Kapusta

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PROFILE

I am a fifth-year Master's student at the Faculty of Physics (FUW) and partially at the Faculty of Mathematics, Informatics, and Mechanics (MIMUW) at the University of Warsaw. I am passionate about various ML applications, starting from audio processing, through computer vision, ending in bioinformatics. I have few years of experience in applying such methods in the field of natural sciences, where I was active for almost three years. 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).

Beyond Deep Learning, I have experience in other areas of computer science, with a strong focus on distributed computing, massive parallelism, low-level programming, and GPU programming. I am especially interested in how these fields intersect with Deep Learning and/or Bayesian modeling. In short, my goal is to make programs run as efficiently as possible—whether on multi-node computer clusters or embedded devices.

EDUCATION

- **Warsaw University - major in Astrophysics** Warsaw, Poland
Faculty of Physics (Msc); GPA: 4.88/5 *Oct. 2023 – Jul. 2025 (expected)*
 - **HPC & acceleration:** Designing GPU + MPI accelerated multi-node numerical code for fluid simulations in Julia, 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 Ampere-based Nvidia GPUs on several nodes of the supercomputer. Project is being developed with the help of EuroHPC development access computing grant EHPC-DEV-2025D02-085 on the Leonardo BOOSTER, where I am a Co-PI.
 - **Deep Learning:** Working on the transformer-based neural net for Neural Posterior estimation. The model utilizes the Simulation-Based Inference (SBI) to replace MCMC-based models and accelerate the inference for datasets, where data is set-like (common in physical sciences). 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. Project involved substantial R&D component, as I had to stitch two models from completely separate research subfields. 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 astrophysical 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 (mainly in Python), 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.
 - **Deep Learning:** Attended courses designed for the Machine Learning Master's program (at 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, OOP), Statistical Data Analysis I (R, machine learning, data processing, statistical inference), Statistical Data Analysis II (Bayesian inference, deep learning, genomics), Deep Neural Networks (NLP, CV, RL), High Performance Computing (C++, CUDA, MPI, performance analysis), Numerical Analysis (C, performance benchmarking, low-level programming).
- **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 skills:** MPI, OpenMP, CUDA, SIMD intrinsics, git, bash, very good knowledge of Linux OS, SQL, very solid background in Mathematics (including statistics and probability theory).

POSTERS & PUBLICATIONS

- **M. Kapusta** "Iris-ML: Neural Posterior Estimation for the Spectral Energy Distribution fitting." poster at ML in PL 2024 machine learning conference (November 2024, Warsaw).

AWARDS

- Rector scholarship in academic year 2020/2021, 2021/2022, 2022/2023, 2023/2024 and 2024/2025.
- Minister's scholarship in academic year 2024/2025. One of 398 recipients in Poland.
- University Physics Competition 2021: Part of Faculty of Physics team winning 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