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Profile

I am a fifth-year master's student with a strong academic background in computer science, mathematics and physics, complemented by research experience in astronomical data analysis. My interdisciplinary studies have provided me with a solid foundation in applied mathematics, including machine learning, numerical methods, and stochastic processes. In my research, I have focused on analyzing large datasets and developing Bayesian models to describe them, leading to few peer-reviewed publications in astronomical data analysis. These projects have extensively utilized Python, providing me with strong software engineering skills. My experience in developing deep-learning models resulted in a poster presented at the national machine learning conference ML in PL 2024. Willing to work in-pearson in Wrocław office.

Work Experience

- **Research Assistant – Astronomical Observatory, Warsaw University** July 2022 – Present
  Python, Machine Learning and C
  - Developed various statistical tools (ANNOVA, MCMC) in Python, with performance-critical components implemented in C using SIMD intrinsics.
  - Analyzed massive astronomical datasets, cross-matching catalogs and selecting candidate objects using statistical filters.
  - Built and tuned various Bayesian models to analyze astronomical data, performed inference with MCMC, contributing to model selection and validation.
  - Research output includes few publications in the field of astronomical data analysis.
  - Employed in NCN grant 2021/41/B/ST9/00252.
- **C/C++ Intern – Polish Academy of Sciences** July 2021 – July 2022
  - Ported legacy C++98 code to modern C++17 in part of the LORENE library. Enabled MPI task launching to scale calculations across multiple nodes of computational cluster.
  - Ported slow MATLAB code to C++ with OpenMP parallelism for scalable performance. Reached > 30 times speedup on modern desktop computers.

Projects

- **Computational Fluid Dynamics on GPU-s** Oct 2024 – Present
  - Built high-performance multi-node GPU accelerated simulation code to simulate relativistic fluids in both C++ and Julia.
  - Developed custom CUDA kernels and performed extensive benchmarking with Nsight Compute to pinpoint exact bottlenecks of the application (compute - memory bandwidth - intercommunication).
  - Supported by EURO-HPC-DEV-2025D02-085 development grant on the Italian supercomputer Leonardo, where I am PI.
- **Deep Learning for Simulation Based Inference** Oct 2023 – Present
  Deep Learning & Bayesian Modeling
  - Developed a transformer-based neural network for Bayesian inference via Simulation-Based Inference (SBI), aiming to replace slow MCMC methods.
  - Designed a custom hybrid architecture combining Set Invariant Transformers and Masked Autoregressive Flow.
  - Model allows to compute fast approximation of the posterior for any graphical model with set-like observed variables.
  - Implemented model in PyTorch and tracked experiments using Neptune.ai.
  - Final model reached 4 orders of magnitude speedup vs MCMC for usual use-cases.
  - Work presented as a poster at ML in PL 2024; a peer-reviewed publication is in preparation.

Programming Skills

- **Languages:** Python (advanced), C/C++ (advanced), Julia (advanced), SQL (intermediate), R (basic), Rust (basic), Excel.
- **Python frameworks/libraries:** Numpy, Pandas, PyTorch, TensorFlow, JAX/Flax, scikit-learn, Pyro, PyMC, BlackJAX, XGBoost, Matplotlib,
- **Tools:** MPI, OpenMP, CUDA, SIMD, Git, Bash, Linux (expert-level)
- **DevOps & Workflow:** Neptune.ai, Docker, CI/CD, CMake.

Awards

- Rector's Scholarship: 2020–2025 (awarded 5 consecutive years)
- Gold Medal – University Physics Competition 2021 (team)
- Finalist – Polish Physics Olympiad (67th, 69th - 10th place)
- Finalist – Polish Mathematical Olympiad (70th)
- Winner – 62nd Polish Astronomical Olympiad
- Bronze Medal – 11th International Olympiad on Astronomy and Astrophysics
- Silver Medal – 1st Global e-Competition on Astronomy and Astrophysics (2020)

Education

- **University of Warsaw – MSc in Physics & Computer Science** Warsaw, Poland
  Faculty of Physics; GPA: 4.88/5 *Oct 2023 – September 2025 (expected)*
- **University of Warsaw – BSc in Physics & Computer Science** Warsaw, Poland
  Inter-faculty Individual Studies in Mathematics and Natural Sciences; GPA: 4.96/5 *Oct 2020 – Jul 2023*

  Interdisciplinary curriculum across the Faculty of Physics (FUW) and Faculty of Mathematics, Informatics, and Mechanics (MIMUW). Specialization in Machine Learning, Data Analysis, High Performace Computing.
- **III High School** Wrocław, Poland
  Graduated with Distinction; GPA: 4.8/5 *Sep 2017 – Jul 2020*

Extracurriculars

- Active member of the Statistical Journal Club at the Astronomical Observatory, presenting cutting-edge research on statistics and deep learning in astronomy.
- Jury at various science competitions including "16th International Olympiad on Astronomy and Astrophysics" and Naboj math competition (2023, 2024, 2025).

Posters

- **Kapusta, M.** "Iris-ML: Neural Posterior Estimation for Spectral Energy Distribution Fitting." Poster presented at ML in PL 2024.

Languages

- English – C1 (TOEFL 103)
- Polish – Native
- German – A2/B1