

Barbara Makovec

📍 Vienna, Austria ✉ makovecbarbara1@gmail.com in [linkedin.com/in/barbara-makovec](https://www.linkedin.com/in/barbara-makovec)
🐙 github.com/makov3c

PROFILE

Master's student at TU Wien with a bachelor's degree in Computer Science and Mathematics from the University of Ljubljana. Works on generative and probabilistic models: a solo thesis extending tensor network generative models to heterogeneous embeddings, and a first-authored paper on retrieval-grounded reasoning over legal documents.

PUBLICATIONS

- Makovec, B., Rei, L., Novalija, I. (2024). *Preparing AI for Compliance: Initial Steps of a Framework for Teaching LLMs to Reason About Compliance*. RuleML+RR 2024: 8th International Joint Conference on Rules and Reasoning. <https://ceur-ws.org/Vol-3816/paper63.pdf>
- Makovec, B. (2024). *LLM asistent za preverjanje skladnosti s pravnimi dokumenti*. Frik++, 2, 24–26. <https://glasilo-fri.si/stevilka-2/>

RESEARCH

Generative Modelling with Matrix Product States on Tabular Data

2026

Bachelor's thesis, University of Ljubljana; supervisor Assoc. Prof. Bojan Žunkovič

- Introduced heterogeneous embeddings to matrix product state generative modelling: a single model in which each attribute carries its own embedding type and physical dimension, one-hot for nominal and Fourier for ordinal attributes. Existing MPS Born machine implementations fix one embedding and a uniform physical dimension of two across all variables, which makes mixed nominal and ordinal tabular data awkward to represent; this removes that restriction while keeping every exact quantity the model class provides
- Derived and applied a Gram matrix transform making non-orthonormal embeddings orthonormal, which is what allows embeddings to be mixed freely while preserving exact normalisation, exact marginal and conditional distributions, and exact ancestral sampling
- Implemented the model from scratch in NumPy: DMRG-style two-site sweeps with singular value decomposition truncation adapting bond dimension to the data during training
- Confirmed chain distance as the limiting factor on learned correlations through a controlled permutation experiment, recovering a dependency the original ordering missed
- Thesis: hdl.handle.net/20.500.12556/RUL-185121

Research Intern

May – October 2024

Jožef Stefan Institute, Department of Artificial Intelligence, Ljubljana

- Designed a Retrieval-Augmented Generation system for structured reasoning over large collections of legal documents (European Union Artificial Intelligence Act), prioritising traceable and verifiable retrieval
- Built dense semantic retrieval pipelines with Elasticsearch and vector embeddings to surface contextual relationships between regulatory concepts
- Developed preprocessing and transformation pipelines converting unstructured legal text into structured, SQL-backed datasets for efficient querying and downstream reasoning
- Applied chain-of-thought prompting and retrieval grounding to produce compliance judgments supported by explicit source references
- First author on the resulting peer-reviewed paper <https://ceur-ws.org/Vol-3816/paper63.pdf>
- Code: <https://github.com/makov3c/legal-AI>

PROJECTS

Temporal Graph Learning for Collective Animal Movement

Sep 2025 – Jan 2026

Four-person course project following Stanford CS224W, Machine Learning with Graphs

- Contributed the Graph Attention Network spatial encoder and baseline model construction to a team project predicting collective fish movement as a temporal graph learning problem

- Worked within a pipeline combining per-frame graph attention with a temporal transformer, trained on autoregressive rollouts in PyTorch and PyTorch Geometric
- Writeup: <https://medium.com/@anja.laharnar/42da52ce5780>
- Code: github.com/Lavennie/MLG-Fish

Self-Hosted Linux Server

2023 – present

- Administers a personal Debian server running web hosting, mail and file services, configured with networking, transport layer security certificates and automated backups
- Deploys and maintains small web services independently, handling monitoring, updates and incident recovery

SKILLS

- **Python:** PyTorch and PyTorch Geometric; NumPy implementations of numerical algorithms from scratch; data preprocessing and evaluation pipelines
- **Machine learning:** probabilistic generative models, tensor networks, graph neural networks, transformers, retrieval-augmented generation
- **Systems and high-performance computing:** batch jobs on a university Slurm cluster; coursework in GPU Computing and Architectures, Advanced Multiprocessor Programming, and Distributed Systems
- **C++ and Go:** algorithms and data structures in coursework and competitive programming
- **Databases and retrieval:** relational schema design, SQL, Elasticsearch, vector search
- **Linux and tooling:** Debian administration, networking, backups, monitoring; Git
- **Languages:** Slovene (native), English, German

EDUCATION

Master of Science in Software Engineering

2026 – present

TU Wien, Vienna, Austria

- Expected graduation 2028
- *Selected coursework:* GPU Computing and Architectures, Advanced Multiprocessor Programming

Bachelor of Science in Computer Science and Mathematics

2023 – 2026

University of Ljubljana, Slovenia

- Grade average 8.5 / 10
- *Selected coursework:* Graph Theory, Algorithms and Data Structures, Distributed Systems, Databases, Machine Learning on Graphs