# SOFIA KIRSANOVA

PhD Student in Computer Science
University of Minnesota Twin Cities

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## EDUCATION

**Ph.D. in Computer Science**, University of Minnesota Twin Cities 2024–Present
Department of Computer Science and Engineering, Knowledge Computing Lab
Advisor: Prof. Yao-Yi Chiang
*Research interests: computer vision; document image analysis and layout understanding; multimodal deep learning*

**B.Sc. in Computer Science**, Lomonosov Moscow State University 2019–2023
College of Computational Mathematics and Cybernetics
Major: Computer Science and Software Engineering
Thesis: *Process Analytics Methods for Anomaly Detection Tasks in System Log Data*
Advisors: Oleg Gorokhov, Mikhail Petrovsky

## RESEARCH AREA

**Computer Vision** **Vision Transformers** **Multimodal Models** **Geospatial Deep Learning**
**Layout Understanding** **Automated Digitization** **Line Extraction & Topological Reconstruction**

## RESEARCH EXPERIENCE

**Graduate Research Assistant**, *Knowledge Computing Lab, University of Minnesota, USA* 2024–Present

*IMOLA (NSF). Automated Road Network Extraction & Topological Mapping (ongoing)*

- Develop deep-learning methods for extracting road networks from maps, with a focus on detecting road centerlines, intersections, bridges, and other linear transportation features across varying cartographic styles.
- Build algorithms for topology reconstruction, converting raw line predictions into routable graph structures with nodes and edges classification and connectivity correction.
- Design evaluation pipelines to assess extraction quality across large heterogeneous map collections with patch difficulty modeling, structured error attribution, and cross-region generalization metrics.

*CriticalMAAS (DARPA). Legend Detection & Map Layout Analysis (completed)*

- Developed deep-learning methods for detecting legend symbols and text regions and linking them into structured legend items across diverse cartographic styles.
- Combined fine-tuned LayoutLMv3 with GPT-4o structured prompting for layout-aware legend parsing in the **DIGMAPPER** map-digitization pipeline.
- Achieved **96%** symbol-detection F1, **97.8%** text-detection F1, and **97.1%** symbol–description linking accuracy.

**Undergraduate Researcher**, *Lomonosov Moscow State University, Moscow, Russia* 2019–2023

*Methods for Detecting Critical Events in System Log Data*
*Advisors: Oleg Gorokhov, Mikhail Petrovsky*

- Developed NLP-inspired preprocessing and semantic extraction techniques for unstructured system logs.
- Built CNN-based anomaly detectors achieving **98%** accuracy on processed logs and **82%** on raw logs.
- Proposed process-mining-based clustering for modeling log-event sequences at scale.

*Monte Carlo Algorithms for Connect6*
*Advisor: Olga Oparina*

- Benchmarked heuristic algorithms for stochastic gameplay modeling and showed Monte Carlo methods outperform classical heuristics.

## PUBLICATIONS

1. Weiwei Duan, Michael Gerlek, Steven Minton, Craig Knoblock, Fandel Lin, Theresa Chen, Leeje Jang, **Sofia Kirsanova**, Zekun Li, Yijun Lin, Yao-Yi Chiang. *DIGMAPPER: A Modular System for Automated Geologic Map Digitization*. arXiv:2506.16006, **2025**.
2. **Sofia Kirsanova**, Weiwei Duan, Yao-Yi Chiang. *Detecting Legend Items on Historical Maps Using GPT-4o with In-Context Learning*. GeoSearch '25, ACM SIGSPATIAL Workshops, **2025**.
3. Haoji Hu, Jina Kim, Jinwei Zhou, **Sofia Kirsanova**, Janghyeon Lee, Yao-Yi Chiang. *Context-aware Trajectory Anomaly Detection*. GeoAnomalies '24, ACM SIGSPATIAL Workshops, **2024**.
4. **Sofia Kirsanova**. *Detection of anomalies in system log data using process analytics methods.* Lomonosov Readings, **2023**.
5. **Sofia Kirsanova**. *Methods for detecting critical events in system log data.* Tikhonov Readings, **2022**.
6. **Sofia Kirsanova**. *Evaluation and Comparison of Algorithms for the Connect6 Game with Monte Carlo Method.* Journal of Moscow Polytechnic University Scientific Fair, **2020**.

## CONFERENCE PRESENTATIONS

- **Kirsanova, S.**, Duan, W., Chiang, Y.-Y. *Detecting Legend Items on Historical Maps Using GPT-4o with In-Context Learning.* GeoSearch '25, ACM SIGSPATIAL Workshops, Nov **2025**.
- **Kirsanova, S.**, Duan, W., Chiang, Y.-Y. *Detecting Legend Items on Historical Maps.* MN GIS/LIS Consortium Conference, Duluth, MN, Oct **2025**.
- **Kirsanova, S.**, Chiang, Y.-Y. *Detecting Legend Items on Historical Maps.* Big Ten GIS Conference (BTAA GIN), Apr **2025**.

## WORK EXPERIENCE

**Machine Learning Researcher**, *Rotec Digital Solutions, Moscow, Russia* Sep 2023–Apr 2024

- Developed ML models for anomaly detection in industrial sensor and time-series data for predictive maintenance.
- Integrated models into monitoring pipelines using PyTorch, scikit-learn, PostgreSQL, ClickHouse, MLflow, DVC, Airflow, Optuna.

**Full-stack Java Developer**, *MOLNET, Moscow, Russia* Apr 2022–Apr 2023

- Implemented backend systems using Java, Spring, JSP, Maven, REST APIs, and PostgreSQL.
- Built web interfaces with React, TypeScript, Bootstrap; used Docker, Git, and Linux in daily development.

**Freelance Writer**, *JetBrains Academy (remote)* Jan 2022–Mar 2023

- Authored educational modules on probability, statistics, data structures, and algorithms for online CS courses.

## SERVICE

**Best Poster Committee**, Spring 2025 Data Science Poster Fair, University of Minnesota 2025

**Jury Member**, All-Russian "Nauchnyj Avangard" Research Competition (CS section) 2024, 2025

## ADDITIONAL EXPERIENCE

**Graduate Teaching Assistant**, *University of Minnesota Twin Cities* 2025–Present
CSCI 2033: Elementary Linear Algebra (Fall 2025); CSCI 4801: Software Development Process (Spring 2026)

## SKILLS

**Core ML & CV:** Computer Vision, Document Image Analysis, Multimodal Learning, Vision Transformers, Layout Understanding, Structured Prediction, OCR/LLM-based Extraction

**Machine Learning:** PyTorch, scikit-learn, CNNs, transformer models, training/evaluation pipelines

**Programming:** Python, C, C++, Java, SQL

**Languages:** Russian (native), English (fluent), German (beginner)