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
Knowledge Computing Lab; Advisor: Prof. Yao-Yi Chiang

M.Sc. in Computer Science, University of Minnesota Twin Cities 2024–2026

B.Sc. in Applied Mathematics and Computer Science, Lomonosov Moscow State University 2019–2023
Thesis: *Process Analytics Methods for Anomaly Detection Tasks in System Log Data*

RESEARCH AREA

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

RESEARCH EXPERIENCE

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

IMOLA (NSF). TRASA: Topology-Preserving Road Network Extraction from Historical Maps (ongoing)

- Develop **TRASA**, a topology-preserving road network extraction pipeline combining graph-based line detection, segmentation guidance, and node-type classification for historical topographic maps.
- Build algorithms for topology reconstruction, converting raw line predictions into routable graph structures with node and edge 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. **Sofia Kirsanova**, Zekun Li, Stefan Leyk, Craig A. Knoblock, Yao-Yi Chiang. *TRASA: Topology-Preserving Road Network Extraction from Historical Topographic Maps.* ***SIGSPATIAL*****, 2026**.
2. Jihun Pyo, Yuxi Jiao, Daehan Jung, Zekun Li, Leeje Jang, **Sofia Kirsanova**, Jina Kim, Yijun Lin, Qian Liu, Jie Xie, Hooman Askari, Ning Xu, Muhao Chen, Yao-Yi Chiang. *FRIEDA: Benchmarking Multi-Step Cartographic Reasoning in Vision-Language Models*. ***ICLR*****, 2026**.

3. 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*. ***SIGSPATIAL***, **2025**.
4. **Sofia Kirsanova**, Weiwei Duan, Yao-Yi Chiang. *Detecting Legend Items on Historical Maps Using GPT-4o with In-Context Learning*. ***SIGSPATIAL*** GeoSearch Workshop, **2025**.
5. Haoji Hu, Jina Kim, Jinwei Zhou, **Sofia Kirsanova**, Janghyeon Lee, Yao-Yi Chiang. *Context-aware Trajectory Anomaly Detection*. ***SIGSPATIAL*** GeoAnomalies Workshop, **2024**.
6. Oleg E. Gorokhov, **Sofia Kirsanova**. *Detection of anomalies in system log data using process analytics methods.* ***Lomonosov Readings***, **2023**.
7. Oleg E. Gorokhov, Mikhail I. Petrovsky, Igor V. Mashechkin, **Sofia Kirsanova**. *Methods for detecting critical events in system log data.* ***Tikhonov Readings***, **2022**.
8. **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.**, Li, Z., Leyk, S., Knoblock, C. A., Chiang, Y.-Y. *TRASA: Topology-Preserving Road Network Extraction from Historical Topographic Maps.* ACM SIGSPATIAL 2026, Applications Track, Riverside, CA, USA, **2026**.
- **Kirsanova, S.**, Li, Z., Leyk, S., Knoblock, C. A., Chiang, Y.-Y. *TRASA: Topology-Preserving Road Network Extraction from Historical Topographic Maps.* Frontiers of Generative AI & Science Workshop, University of Minnesota, Minneapolis, MN, Aug **2026**.
- **Kirsanova, S.**, Duan, W., Chiang, Y.-Y. *Detecting Legend Items on Historical Maps Using GPT-4o.* GeoSearch Workshop, ACM SIGSPATIAL 2025, Minneapolis, MN, USA, **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), Online, Apr **2025**.

AWARDS

ACM SIGSPATIAL 2026 Travel Award ($500) 2026

SELECTED SERVICE AND INDUSTRY EXPERIENCE

External Reviewer, ACM SIGSPATIAL 2026 Applications, Workshops (UrbanAI, GeoAI, GeoAnomalies), **2026**.

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.

SKILLS

Core Research: Computer Vision, Document Image Analysis, Layout Understanding, Geospatial Deep Learning, Multimodal Models, Vision Transformers, OCR & LLM-based Extraction

Machine Learning: PyTorch, scikit-learn, CNNs, transformer architectures, training/evaluation pipelines, dataset curation, experiment tracking

Geospatial & Data Tools: QGIS, PostGIS, PostgreSQL, geospatial data processing, map digitization workflows

Programming: Python, C, C++, Java, SQL, Bash, JavaScript/TypeScript

Languages: Russian (native), English (fluent), German (intermediate)