Matej Jusup

matej.jusup@gmail.com | mjusup@ethz.ch | +41764505807
matej-jusup.com | google scholar | github

Education

- **ETH Zurich** — Zurich, Switzerland
  PhD in Artificial Intelligence — *Sep 2020 – Present*
  Thesis Title: Efficient Mean-Field Learning Algorithms for Large-Scale Vehicle Repositioning
  Supervisors: Prof. Francesco Corman and Prof. Andreas Krause
  Affiliations: Institute for Transport Systems and Planning | Associated Researcher at ETH AI Center
  Expected graduation: Mid 2025 (06/25)

- **University of Zagreb** — Zagreb, Croatia
  MSc in Mathematical Statistics; graduated with honors — *Oct 2013 – Feb 2017*
  Master thesis: Network Optimization in Railway Transport Planning
  Supervisors: Prof. Marko Vrdoljak and Prof. Andreas Dress

- **University of Bielefeld** — Bielefeld, Germany
  Erasmus student exchange — *Sep 2015 – Jul 2016*

- **University of Zagreb** — Zagreb, Croatia
  BSc in Mathematics — *Oct 2010 – Jul 2013*

Relevant Courses:
Probabilistic artificial intelligence | Advanced probability | Mathematical statistics | Stochastic processes | Time-series analysis
Linear algebra | Linear optimization | Markov chains | Numerical analysis | Operations research | Data structures and algorithms

Work Experience

- **Google** — Zurich, Switzerland
  Student Researcher - hosted by Eric Malmi and Aliaksei Severyn — *Apr 2024 - Sep 2024*

  Output:
  Publication: https://deepmind.google/research/publications/139455/
  Gemini Chess Gem: https://gemini.google.com/gem/chess-champ
  Planning with Language Models:
  Enhanced large language models (LLMs) with search-based planning techniques to improve multi-step reasoning in board games such as Chess, Chess960, Connect Four, and Hex.
  Efficient Asynchronous Monte-Carlo Tree Search:
  Addressed the challenge of balancing exploration and exploitation in low simulation count settings by designing dynamic virtual counts.
  Other responsibilities:
  Collaborated on pre-training a transformer model to capture value and transition functions across multiple games.
  Developing internal search, where the language model infers the search procedure by generating a linearized tree of potential futures.

- **Cantab Predictive Intelligence (startup)** — Zagreb, Croatia
  AI Researcher - team leader — *Mar 2019 - Jul 2020*

  Behavioral Credit Scoring:
  Built a PySpark gradient-boosting model to predict consumer default risk probability, achieving market-leading Gini metric results of up to 75%.
  AI-Driven Marketing Campaign:
  Devised a data-driven campaign for promoting a heart disease drug to doctors on behalf of a top pharmaceutical company, which led to a 10% sales increase during A/B testing.
  Statistical analysis was conducted using Statsmodels, SciPy, and Python plotting packages.
  Personalized Newsletter and E-Commerce Recommender Systems:
  Constructed a hybrid recommender system combining content-based and collaborative filtering, which achieved a 1.5% click-through rate during the proof-of-concept phase.
  Utilized Databricks, Python, PyTorch, and AWS in the technology stack.
  Delivery Delay Estimation:
  Developed a customer support system for a shopping mall during the COVID-19 pandemic, which predicted delivery delays using a time-series ARIMA model supplemented with supervised learning techniques.
  The technology stack comprised Pandas, NumPy, and Sklearn.

- **Morgan Stanley** — Budapest, Hungary
  AI Researcher — *Oct 2017 - Mar 2019*

  Systemic Risk Model Execution Efficiency:
  Created a parallel version of a hill climber heuristic that made the optimization problem practically tractable. The heuristic's runtime was limited to 3 minutes and, on average, generated solutions within 5% of the optimum, with the reported worst-case being 15% for tractable test-set instances. Employed a technology stack encompassed Python, CPLEX, and OR-Tools.

Treasury Department Cash Traceability:
Constructed an uncollateralized debt tracking system by amalgamating diverse daily feeds to generate comprehensive firm-wide reports within seconds. Employed Q/kdb+, Python, PyQ kernel, and SQL for the development.

E-Trading Execution Limits Calibration:
Fine-tuned an in-house model to prevent real-time executions during high-risk scenarios, employing a statistical analysis of e-trading clients. Utilized Pandas for the calibration process.

Software Developer — Budapest, Hungary
Dec 2016 - Oct 2017

Implemented and unit-tested features for the Java-based margin calculator microservice.

Technology Analyst Program — New York & London
Aug 2016 - Dec 2016

Participated in a 15-week annual grad program among 50 globally selected interview-passing students.

- **University of Zagreb, Department of Mathematics** — Zagreb, Croatia
  Junior Teaching Assistant for Euclidean Spaces course — *Oct 2013 - Mar 2014*
  Selected to deliver problem-solving lectures by achieving the highest course score among 70 students.

Publications

1. J. Schultz, J. Adamek, M. Jusup, M. Lanctot, M. Kaisers, S. Perrin, D. Hennes, J. Shar, C. Lewis, A. Ruoss, T. Zahavy, P. Veličković, L. Prince, S. Singh, E. Malmi, N. Tomašev (2024), Mastering Board Games by External and Internal Planning with Language Models, arXiv:2412.12119
2. L. Liu, S. Liu, M. Jusup (2024), Monte Carlo Planning for Stochastic Control on Constrained Markov Decision Processes, arXiv:2406.16151
3. M. Jusup, B. Pasztor, T. Janik, K. Zhang, F. Corman, A. Krause, I. Bogunovic (2023), Safe model-based multi-agent mean-field reinforcement learning, The 23rd International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS 2024)
4. V. Tkachuk, S.A. Bakhtiari, J. Kirschner, M. Jusup, I. Bogunovic, C. Szepesvari (2023), Efficient planning in combinatorial action spaces with applications to cooperative multi-agent reinforcement learning, Artificial Intelligence and Statistics 2023 (AISTATS 2023)
5. M. Jusup, J. Kirschner, T. Birchler, S. Curi, I. Bogunovic, A. Krause, F. Corman (2022), Real-time railway (re-) scheduling without human-expert knowledge, 22nd Swiss Transport Research Conference (STRC 2022)
6. M. Jusup, A. Trivella, F. Corman (2021), A review of real-time railway and metro rescheduling models using learning algorithms, In 30th International Joint Conference on Artificial Intelligence (IJCAI-21)

Talks

- **Google DeepMind Booth at Neural Information Processing Systems (NeurIPS 2024)** — Vancouver, Canada
  Mastering Chess With Language Models — *Dec 2024*
- **A Conference on Autonomous Agents and Multi-Agent Systems (AAMAS 2024)** — Auckland, New Zealand
  Safe model-based multi-agent mean-field reinforcement learning — *May 2024*
- **ETH Zurich AI Center Associated Researchers Meetup** — Zurich, Switzerland
  A vehicle repositioning using a safe mean-field reinforcement learning — *Sep 2023*
- **Workshop on Stochastic Modelling and Monte-Carlo Tree Search (invited)** — TU Munich, Germany
  Neural-MCTS applications in train routing — *Sep 2022*
- **STRC 2022 – 22st Swiss Transport Research Conference** — Monte Verità, Switzerland
  Real-time railway (re-)scheduling without human-expert knowledge — *May 2022*
- **STRC 2021 – 21st Swiss Transport Research Conference** — Monte Verità, Switzerland
  A Review of real-time railway and metro rescheduling models using learning algorithms — *Sep 2021*
- **IJCAI 2021 – RL for Intelligent Transportation Systems Workshop** — Montreal, Canada
  A Review of real-time railway and metro rescheduling models using learning algorithms — *Aug 2021*
- **DevArena – software development conference (invited)** — Zagreb, Croatia
  Machine Learning - From Idea to Production — *Oct 2019*

Personal Projects

- **Collaboration with Norbert Fogarasi – On Partial Sorting in Restricted Rounds (2017)**
  Improved a naive C++ implementation of the algorithm by reducing $\mathcal{O}(n^2\, n!)$ to $\mathcal{O}(n^2)$ space complexity

Programming Skills

Advanced: Python

Work experience: PyTorch | PySpark | Q/kdb+ | C++

Minor experience: TensorFlow | SQL | Java | JavaScript | C | R | Matlab

VCS & Other: Git | GitHub | Databricks | AWS | MS Azure

Languages

English: Professional working proficiency
Croatian: Native proficiency
German: Basic

Interests and Awards

Chess: Won silver medal at individual Croatian junior (under 20 years) championship in 2011.
The official FIDE Elo rating places me among the top 3% of globally registered chess players.
On www.chess.com within 3 thousand best players among over 100 million registered users (99.999% percentile).

Academic Referees

Prof. Andreas Krause at ETH | *google scholar* | krausea@ethz.ch | +41446326496 (assistant)
Prof. Francesco Corman at ETH | *google scholar* | francesco.corman@ivt.baug.ethz.ch | +41446333350
Asst. Prof. Ilija Bogunovic at UCL | *google scholar* | i.bogunovic@ucl.ac.uk