Minal Suresh Patil

Contact Information	Mit-huset Dept. of Computer Science Umeå Universitet Umeå, 901 87 Sweden	*Voice:* (+46) 0738192248 *Fax:* 090-786 61 26 *E-mail:* minalsp@cs.umu.se *WWW:* https://minalspatil.github.io

Research Interests My research interests lie at the intersection between formal methods, verification and software engineering, particularly in applying formal methods to ensure provable reliability guarantees to AI-enabled software systems.

Keywords Safe and Trustworthy AI, Formal Methods, Verification, Cyber-Physical Systems

Education

Umeå Universitet, Umeå, Sweden — **Oct. 2020 - present**

Ph.D. Candidate
Wallenberg AI, Autonomous Systems and Software Program

- Topic: On the Role Formal Methods for Safe AI
- Advisor: Kary Främling

University College London, London, United Kingdom — **Sept. 2018 - Sept. 2019**

MSc., Data Science and Visualisation

- Dissertation - *Can we understand how demographics, product usage, revenue and product movements affect customers up-sell and cross-sell journey in the telecommunications sector?* 🔗
- Advisor: Kira Kempinska

R.V. College of Engineering, Bengaluru, India — **Sept. 2011 - Sept. 2015**

B.E., Computer Science

- Dissertation Topic - Fuzzy Graph Clustering for Image Segmentation

Publications

M.S. Patil and Kary Främling. **Enhancing Vulnerable Class Robustness in Adversarial Machine Learning.** *In Proceedings of IEEE World Congress on Computational Intelligence (IEEE-WCCI): International Joint Conference on Neural Networks (IJCNN), 2024*

M.S. Patil and Kary Främling. **Investigating Lipschitz Constants in Neural Ensemble Models to Improve Adversarial Robustness.** *In Proceedings of 7th International Conference on System Reliability and Safety (IEEE-ICSRS), 2023.* 🔗

M.S. Patil and Kary Främling. **Improving Neural Network Verification Efficiency through Perturbation Refinement.** *In Proceedings of 32nd International Conference on Artificial Neural Networks (ICANN), 2023.* 🔗

M.S. Patil and Kary Främling. **Do Intermediate Feature Coalitions Aid in the Explainability of Black-Box Models?.** *In Proceedings of 1st World Conference on eXplainable Artificial Intelligence, 2023* 🔗

M.S. Patil. Towards Preserving Semantics Structure in Argumentative Multi-Agent via Abstract Interpretation. *In Proceedings of 3rd Online Handbook of Argumentation for AI (OHAAI), 2022* 🔗

M.S. Patil. Modelling Control Arguments via Cooperation Logic in Unforeseen Scenarios. *In*

Proceedings of Thinking Fast and Slow and Other Cognitive Theories in AI of Fall Symposium Series at 36th Association for the Advancement of Artificial Intelligence (AAAI), 2022 📄

M.S. Patil. Explainability in Autonomous Pedagogically Structured Scenarios. *In Proceedings of Workshop on Explainable Agency in Artificial Intelligence at 36th Association for the Advancement of Artificial Intelligence (AAAI), 2022* 📄

M.S. Patil. Towards Explainable Agency in Multi-Agents Systems Using Inductive Learning and Answer Set Programming. *In 6th International Conference on Automation, Control and Robotics Engineering (IEEE-CACRE), 2021 (oral presentation)*

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<tr><td>PAPERS IN
PREPARATION</td><td>**M.S. Patil** and Kary Främling. **Aligning Code Models With Formal Feedback.**</td></tr>
<tr><td>PATENTS</td><td>• Patil, M.S. 2019. *Method and System for Geo-Psychographic Segmentation Using Location Data and Learning models.* Indian Patent 201841034549, filed September 11, 2018.</td></tr>
<tr><td>PROFESSIONAL
EXPERIENCE</td><td>**Scania CV AB**, Södertälje, Sweden</td></tr>
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PAPERS IN
PREPARATION

M.S. Patil and Kary Främling. **Aligning Code Models With Formal Feedback.**

PATENTS

• Patil, M.S. 2019. *Method and System for Geo-Psychographic Segmentation Using Location Data and Learning models.* Indian Patent 201841034549, filed September 11, 2018.

PROFESSIONAL
EXPERIENCE

Scania CV AB, Södertälje, Sweden

PhD Research Intern   **Feb. 2024 - Sept. 2024**

- Leading the development of secure code generation of C++ code to meet formal specifications through Large Language Models.
- Establishing a framework for fine-tuning code models through formal feedback from automatic deductive verifiers with reinforcement learning.

Virgin Media, London, United Kingdom

Research Intern   **Oct. 2018 - Sept. 2019**

- Developed a halo-forecasting model for customer up-selling opportunities, leveraging a blend of location data, transaction histories, and customer profiles, resulting in an accuracy of 83.4%.
- Implemented advanced ensemble methods, including Random Forest and Gradient Boosting, to improve the predictive performance of the model.
- Analysed and processed a large-scale dataset of 70,852 customers and over one million transactions, extracting actionable insights for targeted up-selling strategies, resulting in a 15% increase in customer conversion rates.

Propinquity Labs, Bengaluru, India

Geospatial Data Scientist   **June 2016 - Sept. 2018**

- Led and managed a high-performing team of deep learning geospatial scientists and engineers to develop cutting-edge solutions for geospatial data analysis and interpretation.
- Spearheaded the implementation of a spectral land-use change detection model for environmental monitoring in satellite imagery, improving precision by 20% and reducing false positive rates by 30%.
- Conducted a comprehensive evaluation of different deep learning architectures and performance metrics for geospatial image analysis, optimizing model selection based on accuracy, precision, and computational efficiency.

Sensus Labs, San Francisco, California, United States

Navigation Guidance Engineer **May 2015 - June 2016**

- Developed filter-based navigation algorithms (Kalman Filters and other linear and non-linear filters) to fuse information from a variety of sensors (IMU, GPS, magnetometer, static/differential pressure, cameras, etc.) reducing position error by 30% compared to traditional sensor fusion techniques.

- Conducted a comparative analysis of different Kalman filter variants for warehouse logistics tracking system in GPS-denied environments, optimising performance metrics such as mean squared error (MSE) and root mean squared error (RMSE).

- Collaborated with a team of engineers to develop a real-time navigation guidance system for autonomous systems, achieving sub-centimeter accuracy in various navigation scenarios.

SERVICES EXTRAAMAS 2023 (Reviewer), ICANN 2023 (PC-member)

COMPUTER SKILLS
- Languages: C++, Python, OCaml, Rust, SQL
- Verification Tools: Lean and Coq (proof assistants), TLA+ model checker, Frama-C, Dafny
- Frameworks: PyTorch, TensorFlow, Vertex AI, GCP
- Tools and Technologies: Docker, Kubernetes, Git
- Operating Systems: Unix/Linux