Emad Mahmodi

Security & Machine Learning Researcher · Software and Algorithms Engineer
Binary Analysis & Systems Security · Anomaly Detection & Concept Drift · AI for Security · Algorithms & HPC

emad.mahmodi.eng@gmail.com · +98 911 300 2150 · Amol, Mazandaran, Iran
emad-mahmodi.github.io · github.com/Emad-Mahmodi · Google Scholar · linkedin.com/in/emad-mahmodi

PROFILE

Researcher and engineer with over ten years across academia and industry, working where machine learning meets systems and security. First-author publication on drift-aware anomaly detection in *Expert Systems with Applications*; three peer-reviewed papers in total (Google Scholar h-index 3), one graduate course taught, and two M.Sc. theses supervised through to publication. In parallel, a decade of production engineering and applied machine learning in C++ and Python: automotive ECU firmware reverse engineering (TriCore, PowerPC/VLE), binary security auditing, LLM and RAG pipelines for binary analysis, and parallel/GPU algorithms on large irregular data. Core strength is turning hard, structured data — binaries, graphs, network traffic — into models and software that hold up outside the training distribution.

RESEARCH INTERESTS

- **Anomaly detection and concept drift** — non-stationary streams, skewed distributions, cross-domain generalization, and honest reporting of out-of-distribution performance.
- **AI for security** — LLM and RAG pipelines for automated binary analysis, function-name recovery and firmware documentation.
- **Binary analysis and systems security** — automotive ECU firmware (ISA reconstruction, Seed/Key, checksum extraction), vulnerability research, anti-debugging and obfuscation.
- **Algorithms and high-performance computing** — parallel and GPU (CUDA/OpenMP) algorithms on irregular, power-law graphs; performance engineering.

EDUCATION

M.Sc. in Computer Science (Software Engineering) 2014 – 2017
Ferdowsi University of Mashhad, Iran · GPA 15.09/20
Thesis: *Adaptive rule-based phishing detection against URL obfuscation* (18/20). Supervisors: Dr. Hadi Sadoghi Yazdi (Pattern Recognition Lab), Dr. Abbas Ghaemi Bafghi.

B.Sc. in Computer Science (Software Engineering) 2008 – 2013
Shomal University of Amol, Iran · GPA 14.02/20
Final project: *Design and development of a machine learning-based recommender system for personalizing user experience in e-commerce websites* (20/20).

PUBLICATIONS

E. Mahmodi, H. Sadoghi Yazdi, A. Ghaemi Bafghi (2020). “A drift-aware adaptive method based on minimum uncertainty for anomaly detection in data streams with skewed distribution.” *Expert Systems with Applications*, Elsevier.

H. Koohi, Z. Kobti, T. Farzi, E. Mahmodi (2024). “UDIS: Enhancing Collaborative Filtering with Fusion of Dimensionality Reduction and Semantic Similarity.” *Electronics*, 13(20), 4073. MDPI.

R. Barzegar Nozari, H. Koohi, E. Mahmodi (2020). “A Novel Trust Computation Method Based on User Ratings to Improve the Recommendation.” *International Journal of Engineering (IJE)*.

E. Mahmodi, et al. “Intelligent detection scheme using adaptive feature reduction for phishing attack.” *Future Generation Computer Systems*, Elsevier. — under review

K. Mahmoudi, E. Mahmodi. “Distributed deep learning approach for sentiment analysis using BiLSTM & GloVe embedding.” *International Journal of Engineering (IJE)*. — submitted

RESEARCH AND ACADEMIC EXPERIENCE

R&D Programmer / Data Scientist 2015 – 2020

Ferdowsi University of Mashhad — DCSL & Pattern Recognition Lab

- Designed and implemented the drift-aware, uncertainty-weighted anomaly-detection method behind the *Expert Systems with Applications* (2020) paper, including the streaming evaluation pipeline.
- Built data-mining and recommender-system pipelines in C++, Python and SQL underpinning the ESWA (2020) and IJE (2020) publications.

Lecturer & M.Sc. Thesis Advisor 2017 – 2024

Shomal University, Amol · part-time

- Taught the graduate course *Principles of Data Mining* (2019–2020).
- Advised two M.Sc. theses on recommender systems (group recommendation; collaborative filtering with dimensionality reduction and semantic similarity) — both students co-authored publications with me.
- Reviewer, 10th International Conference on Computer and Knowledge Engineering (ICCKE 2020) — 4 papers.

INDUSTRY EXPERIENCE

Senior Software Developer & Lead Reverse Engineer 2022 – present

Negar-Khodro

- Architected **ECUProg v2**, a multi-protocol automotive ECU programming platform (C++17 / Qt 6) deployed in 5,000+ workshops: 49% lower memory footprint and 62% less JTAG CPU overhead.
- Led reverse engineering of TriCore (Infineon) and PowerPC (VLE) ECU firmware; reconstructed UDS and KWP2000 diagnostic logic, Seed/Key handshakes and checksum schemes.
- Lead R&D in AI-driven firmware analysis: built LLM and RAG pipelines — including retrieval design and prompt engineering over stripped ECU binaries — for automated code summarization, function-name recovery and firmware documentation lookup.
- Developed custom Ghidra and Radare2 extensions (Java/Python) for binary de-obfuscation and automated ISA analysis.
- Designed *Negaremap*, a Persian-language ECU remapping platform, and implemented high-speed diagnostic gateways using a service-oriented architecture.

Senior System Programmer & Data Scientist 2020 – 2022

NIUniverse

- Applied machine learning to suspicious network-traffic analysis for the detection of anomalous and malicious activity.
- Applied reinforcement learning to computer-vision components of autonomous-driving systems.
- Binary security auditing and vulnerability research on diagnostic software layers: bypassed anti-debugging and V-table obfuscation.
- Built high-speed PC-to-hardware drivers and protocol simulators.

SELECTED PROJECTS

- **Cross-Domain IDS Generalization** — PyTorch reimplementation of the drift-aware, uncertainty-weighted online ensemble (ESWA 2020), trained on one attack distribution and evaluated on a genuinely different one; quantified and reported a 21-point in-domain → cross-domain F1 gap rather than tuning it away. github.com/Emad-Mahmodi/adaptive-ids-generalization
- **GPU-Accelerated Graph Analytics** — reproducible empirical study of BFS, PageRank, WCC and Louvain on skewed, power-law security graphs. C++17, OpenMP, CUDA. github.com/Emad-Mahmodi/gpu-graph-study
- **Context-Augmented RAG for Binary Analysis** — lightweight function-name recovery for stripped binaries; an independent take on the ReCopilot idea with no model training. github.com/Emad-Mahmodi/binary-rag-copilot
- **PISAD ECU Simulator (PowerPC)** — hardware-level firmware emulator for security auditing and fault-injection research; used in a Seed/Key handshake audit of the Bajaj MSE2 ECU.
- **Locomotive GT26 Control System** — compile-time and run-time state machines in C++ for railway control infrastructure, with FPGA-to-PC interfacing via Verilog and shared memory.

TECHNICAL SKILLS

Languages: C/C++17/20, Python, Java, MATLAB, SQL, Verilog, Assembly (TriCore, PowerPC, x86).

Machine learning: PyTorch, scikit-learn, anomaly detection, concept drift, ensemble methods, LLM fine-tuning, RAG and prompt engineering.

Algorithms & HPC: CUDA, OpenMP, OpenCL, SIMD (AVX2/SSE), parallel graph algorithms, performance engineering and profiling.

Reverse engineering & security: Ghidra, IDA Pro, Radare2, binary diffing, anti-debugging and de-obfuscation, UDS / CAN-Bus / OBD-II.

Software engineering: Qt/QML, Git, CMake, CI/CD, Linux, data pipelines and ETL on large structured datasets.

CERTIFICATES

- Machine Learning (Stanford / Coursera) · IBM Data Science · LPIC-1 and LPIC-2 Linux Professional.
- Languages: Persian (native), English (advanced).