David Imolai

Research Fellow · LLM agents, security and evaluation infrastructure

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Building LLM agents and evaluation infrastructure for autonomous penetration testing at ELTE. My contributions centre on Python implementation, CTF benchmarks and containerised execution, alongside research presentations and open-source tooling.

work experience

Research Fellow @ Eötvös Loránd University · Budapest, Hungary 2024-04 – present

Building LLM-based agents for autonomous penetration testing at ELTE's AI Research Group, with a focus on Python agent infrastructure, CTF benchmarks and containerised tool execution.

- Implemented substantial parts of HackSynth in Python, connecting command planning, tool execution and observation summarisation into an autonomous penetration-testing loop.
- Developed and validated the PicoCTF and OverTheWire benchmark integrations for HackSynth's 200-challenge evaluation suite: 120 PicoCTF and 80 OverTheWire tasks.
- Designed and optimised the Docker attackbox setup, including tool installation, container lifecycle management and connectivity to challenge environments.
- Presented research at student conferences and, with my research partner, at the LLAIS workshop within ECAI 2025 in Bologna, explaining the systems and findings to an international audience.

publications

Improving LLM Agents with Reinforcement Learning on Cryptographic CTF Challenges

arXiv · 2025-06-02 · Lajos Muzsai, David Imolai, András Lukács

- Worked on crypto benchmark preparation and validation, and LLM infrastructure design and implementation.

HackSynth: LLM Agent and Evaluation Framework for Autonomous Penetration Testing

arXiv · 2024-12-02 · Lajos Muzsai, David Imolai, András Lukács

conferences and research awards

Presenter at LLAIS, a workshop at ECAI 2025 25 Oct 2025

The European Conference on Artificial Intelligence (ECAI) · Bologna, Italy

Presented "Improving LLM Agents with Reinforcement Learning on Cryptographic CTF Challenges", co-authored with Lajos Muzsai and András Lukács. Accepted as a full presentation at the LLAIS workshop, held within ECAI.

1st: 37th National Student Research Conference (OTDK), ICT section 2025-04-25

OTDT & Budapest University of Technology and Economics

First place in the Cybersecurity session of the Informatics section, jointly with Lajos Muzsai, for HackSynth. Supervised by András Lukács; presented at BME during the 23–25 April conference.

3rd: ELTE Faculty of Informatics TDK Conference 2025-12-17

Eötvös Loránd University, Faculty of Informatics

Third place in the Informatics section for "Improving LLM Agents with Reinforcement Learning on Cryptographic CTF Challenges".

education

BSc in Computer Science 2023-09 – present

Eötvös Loránd University, Faculty of Informatics · Budapest, Hungary

- Member of the John von Neumann Honors Program, a selective program for high-achieving students in computer science and mathematics.
- Member of Eötvös József College for Advanced Studies, participating in its academic community and student research conferences.
- Erasmus+ exchange at the Technical University of Munich, April–September 2026, studying in an international environment and using German in everyday university life.

honours and awards

National Higher Education Scholarship 2026/27 academic year

Hungarian Ministry of Education

Awarded for outstanding academic and professional achievement, for the third consecutive academic year (2024/25, 2025/26 and 2026/27).

Exceptional Student of the Informatics Faculty 2026-05-07

Eötvös Loránd University, Faculty of Informatics

Faculty distinction for academic and scientific work, received for the second consecutive year.

ELTE recognition for student innovation, HackSynth 2025-11-05

Eötvös Loránd University

Recognition for outstanding student innovation in the Hungarian Startup University Program. Awarded to the HackSynth team at ELTE's Innovation Days.

projects

TikZ-UMLD 2024 – now

Modernising a LaTeX package for drawing UML diagrams with TikZ, because I would rather draw them inside LaTeX than in an external tool.

- Extended TikZ-UML with object diagrams, enumerations, operation modifiers and rendering fixes.
- Rebuilt the English manual and worked examples, with reproducible release builds; published version 1.0.0 on CTAN.

skills

Large Language Models Artificial Intelligence Research Methods Penetration Testing
Automated Testing Scientific Writing Technical Presentations

programming and markup

Python LaTeX Haskell

languages

Hungarian (Native) English (C2) German (C1)