David Imolai

Software engineer, Researcher · Cybersecurity, DevOps, and AI

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All my work, education, projects, competitions, awards, publications and skills.

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.

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.
- Studied algorithms and data structures, discrete mathematics, mathematical analysis, operating systems and computer networks.
- Developed an understanding of functional and object-oriented programming, alongside low-level systems concepts and practical software development.
- Built Safarimacik, a Godot/C# game with an automated testing and release pipeline; the project was accepted into the Software Technology course's Hall of Fame.
- Erasmus+ exchange at the Technical University of Munich, April–September 2026, studying in an international environment and using German in everyday university life.
- Built the Kotlin/Spring backend for a three-person DevOps course project at TUM, with API contracts, PostgreSQL integration, Kubernetes deployment and monitoring. Finished the course with a grade of 1.7 (1.0 is best).
- Extended my security studies at TUM with rootkits and hardware security, alongside DevOps and scientific writing.

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.
- Presented the work to an international audience at the LLAIS workshop within ECAI 2025.

HackSynth: LLM Agent and Evaluation Framework for Autonomous Penetration Testing

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

- Designed and implemented large parts of the autonomous penetration-testing agent in python.
- Worked on the PicoCTF and OverTheWire benchmark implementations, after solving many of the challenges by hand.
- Designed, implemented, and optimized the Docker attackbox setup.

leadership

Project Owner, Hungarian Startup University Program Feb–Jul 2025

National Innovation Agency - HSUP

Project owner for HackSynth in HSUP 2024/25: led technical direction and coordination, developed the business plan with a multidisciplinary team, and pitched at Demo Day.

Captain of the Hungarian CyberSecurity Team Since Aug 2024

Hungarian CyberSecurity Team (HCST)

Captain of the Hungarian CyberSecurity Team, coordinating communication and cooperation among players, coordinating with coaches and watchdogs, while continuing to solve challenges, manage infrastructure, etc. Representing Hungary at ECSC every year since 2022, and captaining the team since 2024.

projects

Cooking Assistant Apr–Jul 2026

A cooking assistant with a Kotlin/Spring backend, Python AI services, and a deployment and observability stack built for a TUM DevOps course.

- Implemented the Kotlin/Spring API, user authentication, recipe storage and endpoint tests.
- Built container and CI/CD workflows and declarative Kubernetes deployment manifests.
- Added Prometheus metrics, Grafana dashboards, Alloy/Loki logs and Tempo tracing across services.

EdenMod and its infrastructure Jun 2026 – now

A Fabric mod connecting our Wynncraft guild to Discord, with account verification, guild-management tools, verified updates and a NixOS-hosted backend.

- Developed authentication, guild-log synchronisation and reward reconciliation for a Java Minecraft mod.
- Implemented JAR attestation verification and maintained automated GitHub/Modrinth releases and JUnit tests.
- Maintained a NixOS deployment with Podman services, PostgreSQL, reverse proxying, encrypted secrets and scheduled database backups.
- Act as the community's primary contact for infrastructure failures, diagnosing problems and restoring services when something breaks.
- Added WebAuthn passkey login and PKCE support to the guild's Next.js web application.

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.

Safarimacik Feb–May 2025

A Godot game built with two teammates for the Software Technology course, accepted into its Hall of Fame.

- Developed a Godot/C# safari-management game with two teammates.
- Built GitLab CI/CD for automated tests, coverage, documentation and Linux/Windows releases.

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.

Erasmus+ study scholarship April–September 2026

Eötvös Loránd University & Technical University of Munich · Munich, Germany

Erasmus+ scholarship for a study semester at the Technical University of Munich, April–September 2026.

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.

National Higher Education Scholarship 2025/26 academic year

Hungarian Ministry of Culture and Innovation

Awarded for outstanding academic and professional achievement. The second of three consecutive academic-year awards, following 2024/25 and preceding 2026/27.

Exceptional Student of the Informatics Faculty 2025-05-08

Eötvös Loránd University, Faculty of Informatics

Faculty distinction for outstanding academic and scientific work.

National Higher Education Scholarship 2024/25 academic year

Hungarian Ministry of Culture and Innovation

Awarded for outstanding academic and professional achievement.

certificates

Cambridge C2 Proficiency 2026-03-14

Cambridge University Press & Assessment

English C2 Proficiency, Grade A, with an overall Cambridge English Scale score of 223.

telc Deutsch B2 2024-08-31

telc

German B2 certificate, graded Gut (good), with 278.5 of 330 points.

conferences and research awards

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".

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.

Speaker at ITBN CONF-EXPO 2025 2025-09-24

ITBN · Budapest, Hungary

Spoke about IT security competitions alongside two other panelists, discussing what participants gain from them and where the competition ecosystem could improve.

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.

XXVI. Eötvös Conference 2025-04-04

ELTE Eötvös József College

Lajos Muzsai and I presented HackSynth at the college's 4–5 April student conference, explaining the planner–summariser loop and its evaluation framework.

1st: ELTE Faculty of Informatics TDK Conference 2024-12-17

Eötvös Loránd University, Faculty of Informatics

Presented HackSynth to the jury together with my research partner; first place for our research.

competitions

15th: European CyberSecurity Challenge 2026 12–16 Oct 2026

Hungarian CyberSecurity Team, ENISA & ECCC · Bochum, Germany

Represented Hungary as team captain for the third consecutive year. We finished 15th among the competing countries excluding guest teams, and 17th overall out of 42 teams. The competition combined jeopardy challenges with an attack/defence round, where teams had to keep their own services running while exploiting the others'.

4th: Hungarian CyberSecurity Challenge 2026 2026-04-26

NBSZ NKI - National Cyber Security Center

4th of 54 competitors in the senior category; 13th of 172 overall. The individual competition ran on 23–26 April.

21st: European CyberSecurity Challenge 2025 6–9 Oct 2025

Hungarian CyberSecurity Team, ENISA & ECCC · Warsaw, Poland

Represented Hungary as team captain, coordinating cooperation and communication between players while also solving challenges. We placed 13th in the jeopardy round and 21st of 34 countries in the official final standings.

8th: Hungarian CyberSecurity Challenge 2025 2025-04-24

NBSZ NKI - National Cyber Security Center

8th in the senior category and 12th overall in the individual competition, held on 24–27 April.

13th: Hack The Box Cyber Apocalypse CTF 2025 2025-03-26

Hack The Box

Team result with the Hungarian Cyber Security Team, out of 8,130 teams. We solved all 77 challenges and scored 57,025 points during the 21–26 March competition.

26th: European CyberSecurity Challenge 2024 8–11 Oct 2024

Hungarian CyberSecurity Team, ENISA & ECCC · Turin, Italy

My first ECSC as captain of the Hungarian team, combining team coordination with solving challenges. Hungary finished 26th of 31 countries in the official final standings.

4th: Hungarian CyberSecurity Challenge 2024 2024-04-25

NBSZ NKI - National Cyber Security Center

Fourth place in the Junior category of this national CTF competition.

42nd: Hack The Box University CTF 2023 2023-12-10

Hack The Box

Team ELTE finished 42nd out of 955 teams, solving 12 of 22 challenges for 3,525 points during the 8–10 December competition.

24th: European CyberSecurity Challenge 2023 24–27 Oct 2023

Hungarian CyberSecurity Team, ENISA & ECCC · Hamar, Norway

My second year representing Hungary at ECSC as a team member. Hungary finished 24th of 28 countries in the official final standings.

3rd: Hungarian CyberSecurity Challenge 2023 2023-04-27

NBSZ NKI - National Cyber Security Center

Third place in the Junior category of this national CTF competition.

21st: European CyberSecurity Challenge 2022 13–17 Sep 2022

Hungarian CyberSecurity Team, ENISA & ECCC · Vienna, Austria

My first ECSC, representing Hungary after placing third in the junior category of the national qualifier. Hungary finished 21st of 28 countries in the official final standings.

3rd: Hungarian CyberSecurity Challenge 2022 2022-07-28

NBSZ NKI - National Cyber Security Center

Third place in the Junior category of this national CTF competition.

skills

Large Language Models Artificial Intelligence Research Methods Scientific Writing
Cybersecurity Penetration Testing Capture The Flag (CTF) Rootkits Hardware Security
Authentication and Session Management Release Signing and Attestation Verification Linux
Linux System Administration NixOS Nix Flakes and Reproducible Environments DevOps
Infrastructure as Code Docker and Docker Compose Kubernetes CI/CD Pipeline Design Git
Network Engineering Database Backups and Recovery Observability Prometheus
Grafana Dashboards and Alerting Loki and Log Collection
Distributed Tracing and Grafana Tempo Backend Development REST API Design
WebSocket Protocols and Reconnection Handling Asynchronous Programming PostgreSQL
React and Next.js Astro and Static Site Generation Automated Testing JUnit
pytest and Async Testing Static Analysis and Type Checking Test Coverage and CI Reporting
Godot and Game Development UML and Software Modelling TikZ and PGF Operating Systems
Functional Programming Object-Oriented Programming Low-Level Programming
Small-Team Management Team Leadership Project Management Project Ownership
Community Development Business Development Public Speaking Technical Presentations
Intercultural Collaboration Prioritisation Under Time Pressure Analytical Problem Solving

programming and markup

LaTeX JavaScript TypeScript Haskell Python C C++ C# HTML CSS PHP Java Kotlin
Nix Bash and Shell Scripting SQL YAML JSON Markdown SVG Make

languages

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