# Milad Zarei-Maleki

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## Education

**Iran University of Science and Technology (IUST)** Tehran, Iran
*Bachelor of Science in Computer Engineering; Cumulative GPA:* ***18.69 / 20.00*** *(US:* ***3.96+*** */ 4.0)* *Sep 2022 – Present*

- **Final Project Topic:** Design and Evaluation of Low-Overhead Dynamic Runtime Tracing and Function Interception in High-Performance Packet Processing Systems
- **Thesis Supervisor:** Dr. Seyed Vahid Azhari
- **Academic Standing:** First-Class Honors (Ranked in top echelon across 141 graded credits in School of Computer Engineering)

**Allameh Tabatabaei High School** Tehran, Iran
*Diploma in Mathematics and Physics Discipline* *Sep 2018 – Jun 2022*

- Ranked **1st** among all graduating students across the high school in the Iranian National University Entrance Exam (Konkour).
- Ranked ∼**500th** nationwide among 145,000+ examinees (**Top 0.35%**) in the National University Entrance Examination (2022).

## Research Interests

**Systems Software & Operating Systems** | **Low-Overhead Dynamic Runtime Tracing & Kernel Observability** | **High-Performance Packet Processing (DPDK & eBPF)** | **Distributed Systems & Edge Computing Optimization** | **Dynamic Program Analysis & Compiler Tooling** | **Microarchitectural Profiling & Performance Diagnostics**

## Research Experience

**Research Assistant** May 2026 – Present
*Deep Observability Lab, Iran University of Science and Technology* *Supervisor: Dr. Seyed Vahid Azhari*

- Engineered low-overhead conditional tracing extensions for `uftrace` in C/C++, developing dynamic function interception routines to evaluate execution predicates, call graph depth, and memory states at runtime.
- Instrumented DPDK (`dpdk-testpmd`) packet processing pipelines using compiler profiling hooks (`-pg` / `__fentry__`) and DWARF-aware runtime struct resolution, isolating L3/L4 protocol routines (`swap_ipv4`, `rte_ipv4_hdr_len`) under high packet rates with bounded trace overhead.
- Constructed automated headless benchmarking harnesses managing hugepages, virtual TAP interfaces, and isolated network namespaces in Linux.
- Contributed 3 upstream pull requests to official `uftrace`: fixed sub-64-bit signed argument normalization in condition filters (`uftrace_eval_cond()`), authored test cases for negative integer filtering (`t306_arg_cond3`), and resolved Android/POSIX shared memory leaks.

**Research Assistant Intern** Jan 2025 – Aug 2025
*Distributed and Scalable Computation Systems Research Lab, IUST* *Supervisor: Dr. Reza Entezari-Maleki*

- Conducted comprehensive literature surveys on edge/fog computing architectures, task offloading policies, and resource allocation models in distributed computing environments.
- Designed and implemented `JORP`, a modular, vectorized Python simulation framework modeling joint radio and computational resource allocation to minimize global average task delay under multi-cell wireless interference constraints.
- Benchmarked multi-user latency profiles against theoretical models, verifying convergence properties and identifying optimal task partition tradeoffs across heterogeneous edge server nodes.

## Academic & Systems Projects

**xv6: In-Kernel Dynamic Deadlock Detection Engine** | *C, x86 Assembly, xv6, QEMU* GitHub

- Engineered in-kernel deadlock detection for multi-threaded processes in xv6 using an active Resource Allocation Graph (RAG) mapped within dedicated kernel memory pages.
- Implemented custom system calls (`requestresource`, `releaseresource`, `read/writeresource`) tracking thread-to-resource acquisition and request dependencies.
- Integrated a depth-first search (DFS) cycle-detection algorithm with recursion stack state tracking and spinlock protection, preemptively rejecting resource requests that introduce circular waits.

**Microarchitectural Profiling: KVM vs. QEMU TCG** | *C, Linux perf, QEMU, KVM, Bash* GitHub

- Evaluated host microarchitectural memory and cache behavior comparing hardware-assisted virtualization (KVM on Intel VT-x) against dynamic binary translation (QEMU TCG cross-architecture emulation: x86_64 to aarch64).
- Pinned isolated vCPUs using `taskset` to analyze instruction and data cache hit rates across memory-bound workloads, including pointer chasing, GEMM matrix multiplication, and multi-threaded sysbench.
- Instrumented hardware performance counters via Linux `perf` (`stat`, `mem`, `record`) and generated FlameGraphs to isolate SoftMMU and translation block compilation hotspots.

**fluidrs: Real-Time Eulerian Fluid Dynamics Simulation Engine** | *Rust, Raylib, Dear ImGui* GitHub

- Designed and implemented a real-time 2D Eulerian fluid simulation engine from scratch in Rust, solving incompressible Navier-Stokes equations for velocity and density advection.
- Implemented vectorized Jacobi relaxation algorithms for numerical pressure Poisson projection, enforcing mass conservation and divergence-free velocity fields at sustained 60+ FPS.
- Constructed interactive parameter tuning interfaces (fluid density, viscosity, vorticity confinement, customizable color gradients) using Dear ImGui decoupled from GPU-accelerated Raylib rendering.

**JORP: Joint Radio & Computational Resource Allocation Simulator** | *Python, NumPy, SciPy, Matplotlib*

- Built a high-performance simulation environment in Python/NumPy to replicate and benchmark edge computing task offloading algorithms formulated in recent IEEE literature (Hu et al.).
- Simulated multi-user wireless transmission channels, interference, and computation queueing dynamics across mobile devices and distributed edge servers.
- Quantified global average task latency reduction under variable computational workloads, generating structured statistical evaluations and Pareto-optimal trade-off graphs.

## Teaching Experience & Academic Mentorship

**All teaching assistant appointments listed below were unpaid, non-contractual positions.*

**Head Teaching Assistant – Computer Workshop** Fall 2023, Fall 2024, Fall 2025

*School of Computer Engineering, IUST* *Supervisor: Dr. Marzieh MalekiMajd*

- Directed and modernized curriculum for 3 consecutive academic years; designed and delivered lecture modules on GNU/Linux system fundamentals, Bash scripting, Git version control, and C development tools for freshman students each semester.
- Managed and coordinated teams of 10+ teaching assistants, organizing weekly recitations, practical lab assignments, and project grading rubrics.

**Head Teaching Assistant – Software Engineering** Spring 2026, Fall 2026

*School of Computer Engineering, IUST* *Supervisor: Dr. Mehrdad Ashtiani*

- Supervised the practical lab curriculum for 80+ undergraduate engineering students across 2 semesters, managing teams of student Product Owners (POs) and Scrum Masters (SMs) through Agile (Scrum) software development sprints and code reviews.

**Head Teaching Assistant – Programming Fundamentals** Fall 2024, Spring 2025

*School of Computer Engineering, IUST* *Instructors: Dr. M. MalekiMajd & Dr. M. Ashtiani*

- Coordinated an instructional staff of 38 TAs to support 100+ students; authored comprehensive problem sets, laboratory exercises, and designed an interactive Terminal User Interface (TUI) final course project in C/C++.

**Teaching Assistant – Operating Systems** Fall 2025, Fall 2026

*School of Computer Engineering, IUST* *Instructors: Dr. R. Entezari-Maleki & Dr. S. V. Azhari*

- Designed a major practical course project focused on extending the xv6 kernel's CPU scheduling and virtual memory swapping subsystems.
- Authored practical problem sets and hands-on assignments solidifying students' grasp of virtual memory concepts and memory management.

**Teaching Assistant – Advanced Programming (C#)** Spring 2024, Spring 2025, Spring 2026

*School of Computer Engineering, IUST* *Supervisor: Dr. Marzieh MalekiMajd*

- Appointed for 3 semesters for the core Object-Oriented Programming (OOP) course in C#; managed a sub-team of TAs to design and deliver practical programming assignments (Spring 2024, Spring 2025).
- Designed and authored the comprehensive final project assignment in Spring 2026, held preparation workshops, and supervised project evaluation and grading.

**Teaching Assistant – Theory of Languages & Automata** Spring 2025, Spring 2026

*School of Computer Engineering, IUST* *Supervisor: Dr. Reza Entezari-Maleki*

- Designed weekly problem sets and quizzes covering regular expressions, context-free grammars, Pushdown Automata, and Turing machines across two academic semesters.
- Designed, authored, and graded the final project assignment, evaluating student project submissions and automata implementations.

## Leadership & Extracurricular Activities

**Computer Engineering Student Association (CESA), IUST** Tehran, Iran

*Core Member, Publication Manager of Turing Magazine & Initiative Lead*

- **Turing Magazine:** Managed editorial and technical publishing operations for the department's scientific student journal; directed an 8-member committee of student authors and peer reviewers to publish 2 comprehensive magazine issues.
- **CESA Libre Initiative:** Founded and spearheaded the "CESA Libre" open-source initiative, organizing and conducting hands-on technical workshops on Linux environments, terminal productivity, and modal editing (Vim/Neovim) for 60+ attendees.

## Technical Skills

**Systems & Linux**: Linux Systems Programming, Dynamic Kernel Tracing (`uftrace`, `perf`, `strace`), Userspace eBPF (`bpftime`, `libbpf`), QEMU, Memory Management (Paging/Swapping), x86 Assembly, GDB
**Programming Languages**: C, C++, Rust, Python, Go, C#, Bash/Shell Scripting, SQL, VHDL
**Networking & Distributed Systems**: TCP/IP Protocols, DPDK, TUN/TAP Interfaces, Isolated Network Namespaces, Sockets, REST APIs, Microservices, WireGuard / Sing-box Protocols
**Databases & Storage**: PostgreSQL, MySQL, SQLite, SQLAlchemy ORM, Relational Schema Design, Query Optimization
**Developer Tools & Frameworks**: Git/GitHub, Docker, Linux System Administration, CMake, Raylib, Dear ImGui, NumPy, SciPy, Matplotlib
**Embedded & IoT**: ESP8266, ESP32, ESP-NOW Protocol, Arduino, AVR / ATmega32 Interfacing

## Standardized Test Scores & Languages

**English Proficiency**: TOEFL iBT: **5.5 / 6.0** (Score Equivalent: 110 / 120)
**Languages**: Persian (Native) | English (Fluent / Full Professional Proficiency) | Azeri (Conversational)

## Academic References

**Dr. Seyed Vahid Azhari** azharivs@iust.ac.ir
Assistant Professor, School of Computer Engineering, Iran University of Science and Technology (IUST)
*B.Sc. Thesis Advisor & Director of Deep Observability Lab*

**Dr. Reza Entezari-Maleki** entezari@iust.ac.ir
Assistant Professor, School of Computer Engineering, Iran University of Science and Technology (IUST)
*Director of Distributed and Scalable Computation Systems Lab; Course Instructor for Operating Systems*

**Dr. Mehrdad Ashtiani** m_ashtiani@iust.ac.ir
Assistant Professor, School of Computer Engineering, Iran University of Science and Technology (IUST)
*Faculty Supervisor for Software Engineering and Advanced Software Design*