ALIREZA ALIKHANI

MSc candidate in AI · local learning rules, spiking networks, RL · in vivo experience (rodent, songbird)

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Persian (native), English (C1) · Available from spring 2027 at the earliest (September 2027 at the latest)

RESEARCH INTERESTS

How neurons keep learning with local signals: credit assignment without backpropagation, homeostasis and loss of plasticity over long task streams, spiking networks and RL. Longer term, learning signals that go wrong, as in chronic pain.

EDUCATION

Sep 2024 – present — **MSc in Artificial Intelligence and Robotics** (120 ECTS), *Khatam University, Tehran*
GPA 17.64/20 (coursework complete; thesis pending). Expected completion: early 2027.

- **Thesis** (registered title): *Harnessing Brain-Inspired Topologies and Neural Heterogeneity in Reservoir Computing for Robust Temporal Pattern Recognition*. Supervisors: Dr. Mohammadreza Daliri, Dr. Shiva Kamkar.
- Coursework: Machine Learning, Pattern Recognition, Computer Vision, Digital Signal Processing, Cognitive Science.

2018 – Aug 2023 — **BSc in Cellular and Molecular Biology**, *Islamic Azad University, Central Tehran Branch*
GPA 15.35/20. Neurobiology, Biophysics, Biostatistics, Calculus I and II, Physics.

RESEARCH PROJECTS (2026; WRITE-UPS AND CODE AVAILABLE ON REQUEST)

2026 — **Slow per-neuron homeostasis improves late-stream trainability in a continually learning spiking network**

- Two-layer LIF networks (surrogate-gradient training) on 150 permuted-MNIST tasks, with per-neuron firing-rate homeostasis at different speeds.
- Homeostasis acting on the timescale of about one task keeps late-stream accuracy at 0.88, against 0.77 for fast homeostasis and 0.79 without homeostasis; new-task learning (AUC) 0.71 against 0.45 and 0.43. Slow homeostasis beat both in 5 of 5 seeds.

2026 — **Local credit assignment in streaming actor-critic reinforcement learning**

- Streaming AC(λ) (batch size 1, no replay) on MuJoCo tasks, with hidden layers trained by local rules instead of backpropagation.
- Fixed feedback weights that share only the signs of the forward weights came within about 10% of backpropagation's final return (pooled ratio 0.94 [0.87, 1.03]; 0.92 [0.86, 0.99] without one collapsed backprop seed), pooled over four MuJoCo tasks; direct feedback alignment reached 0.61 to 0.81.
- Used Sheppard's arcsine formula (1899), fitted on three tasks and then frozen, to predict how often local and true updates agree in sign; it held out of sample on Humanoid (predicted 0.692, measured 0.695; agreement of updates, not returns).

RESEARCH EXPERIENCE

Apr 2024 – Nov 2025 — **Research Assistant, in vivo electrophysiology**, *IPM, School of Cognitive Sciences, Tehran*
Supervisors: Dr. Abdol-Hossein Vahabie, Dr. Milad Yekani

- Helped set up a new songbird electrophysiology lab at IPM: adapted a rodent stereotaxic frame for birds and built an acoustic isolation chamber.
- Performed chronic implantations of neural recording headstages in zebra finches; developed a stable isoflurane anaesthesia protocol for long procedures.
- Configured recording hardware and grounding for awake, behaving recordings in a project on auditory circuits and the effect of sedatives on song.

Apr 2019 – Feb 2020 **Research Assistant, in vivo surgery and behaviour**, *Iranian National Center for Addiction Studies (INCAS), Tehran*

Supervisors: Prof. Mohammad-Reza Zarrindast, Dr. Mitra Sadat-Shirazi

- 200+ stereotaxic surgeries for research projects (NAc, amygdala and other targets): about 100 for my own project, the rest for PhD students' projects; trained new students.
- Own project on transgenerational effects of opioids: collected behavioural and electrophysiology data; the project was stopped by COVID-19 closures before the final dataset.
- Anaesthesia (ketamine/xylazine, urethane), drug administration (IV, IP, ICV, gavage), behavioural assays (CPP, OFT, EPM, FST), transcardial perfusion.

TEACHING

Spring 2025 **Teaching Assistant, Statistical Pattern Recognition**, Khatam University. Co-designed assignments, programming tasks and quizzes for 30 graduate students.

Fall 2024 **Teaching Assistant, Machine Learning**, Khatam University. Supported 60+ students from several departments in applied ML projects.

INDUSTRY

Dec 2021 – Aug 2022 **Backend Developer**, *Avreen Smart Solutions, Tehran*. Java backend components for a national payment switch; ELK monitoring; Linux server deployment.

Mar 2020 – Nov 2021 **CEO**, *Vista Mehr (family company, medical and technology sector), Tehran*. Ran operations, procurement, logistics and equipment maintenance during the COVID-19 period.

SKILLS

Computation Python, JAX, PyTorch, MATLAB, Java; Gymnasium/MuJoCo; GPU batch simulation of spiking networks; Linux, Git. Experimental design with pre-registration, multi-seed statistics and controls.

Modelling Spiking neural networks (LIF, surrogate gradients, eligibility traces), reinforcement learning (actor-critic, PPO), continual learning, reservoir computing.

Experimental Rodent and avian stereotaxic surgery, chronic implants, acute single-unit recording setup, anaesthesia, behavioural assays, perfusion.

TRAINING

Neuromatch Academy: Computational Neuroscience (2024), NeuroAI (2025). IPM: Principles of Neuroscience (2025), fMRI in Cognitive Neuroscience (2024). Lab safety and animal-lab certificates (INCAS, IPM, IAU).

REFERENCES

Prof. Mohammadreza Daliri, Iran University of Science and Technology · Dr. Shiva Kamkar, Khatam University. Contact details on request.