

# Mohammad-Amir Khani

Amirkabir University of Technology, Tehran, Iran

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## RESEARCH INTERESTS

- Systems and Computational Neuroscience
- Neural Coding
- Digital Signal Processing and Machine Learning
- Electrophysiology
- Artificial Intelligence
- Learning and Memory

## EDUCATION

### Bachelor of Computer Science

*Amirkabir University of Technology*

August 2021 - September 2024 (expected)

- Overall GPA: 3.93/4 (18.15 via 108 units)

### Bachelor of Science in Biomedical Engineering

*Amirkabir University of Technology*

September 2019 - June 2021 (Not Completed)

## RESEARCH EXPERIENCES

### Research Intern (Remote)

*Donders Institute for Brain, Cognition and Behaviour*

Ongoing

*Nijmegen*

- Assisted with research under the guidance of Dr. Abdelrahman Rayan, with Dr. Lisa Genzel as the Principal Investigator.
- Investigated the changes in the aperiodic part of the signal to determine if it reflects sleep cycles in rodents, similar to those observed in humans.
- Conducted Time-Frequency and Topological Data Analysis on LFP data from rodents and EEG signals from humans.

### Undergraduate Research Assistant

*Department of Psychology, Tehran University*

Ongoing

*Tehran*

- Under the supervision of Dr. Ehsan Rezayat.
- Analyzed electrophysiological recordings from multiple sessions targeting IT and FEF in monkeys, alongside eye tracking data, to study reward-based emotional responses.
- Analyzing correlations between pupil dilation (indicative of reward receipt) and specific brain activity patterns.

### Research Intern

*Institute for Research in Fundamental Sciences (IPM)*

July 2023 - November 2023

*Tehran*

- Under the supervision of Dr. Ehsan Rezayat in Brain Computing Lab.
- Analyzing neural data including EEG recordings, spike activity, and local field potentials using techniques such as Time-Frequency Analysis, coherence measures, spike sorting, information theory analysis and Granger causality.
- Designed and implemented psychophysics experiments utilizing Psychtoolbox, PsychoPy and JsPsych to measure visual response times and perceptual decision making.

### Research Intern

*Institute for Research in Fundamental Sciences (IPM)*

July 2022 - September 2022

*Tehran*

- Specialized in Spiking Neural Networks as a research intern in the summer of 2022.
- Explored various encodings, including rate, temporal, and floating point.
- Studied advanced models such as Spiking HMAX, Temporal Error, and Hybrid Neural Network frameworks.
- Gained proficiency in tools like spikeTorch and snnTorch.

## HONORS & REWARDS

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- Ranked in the **top 15%** at the computer science department at Amirkabir University of Technology.
- Ranked in the **top 10%** at the Biomedical Engineering at Amirkabir University of Technology.
- Ranked in the **top 1%** in the Iranian University Entrance Exam, also known as Konkour.

## RELEVANT PROJECTS

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### **Pupillary Responses Relationship and Cross-Region Insights**

**July 2023**

*Neuromatch Academy Final Project*

- Analyzed the Steinmetz dataset with Neuropixel electrode recordings from mouse brains to explore neural phenomena.
- Utilized SVM to accurately predict monitor contrast based on visual cortex activity and LSTMs to forecast pupillary area from midbrain and visual cortex neural data.
- Discovered significant interactions between the visual cortex and midbrain through conditional mutual information analysis, suggesting a role of the visual cortex in iris muscle regulation.

### **Neural Activity Prediction using RNN**

**July 2022**

*Neuromatch Academy Final Project*

- Utilized the Steinmetz dataset, featuring Neuropixel electrode recordings implanted in mice brains, to capture neural activity patterns.
- Applied Recurrent Neural Networks (RNNs) to predict neural responses across brain regions, focusing on midbrain to visual cortex connections.
- Successfully forecasted neural activity shifts within the visual cortex and achieved 96.6% accuracy in predicting wheel-turning behavior by harnessing RNN-derived latent variables in conjunction with SVM.

### **Online Psychophysics Task Development**

**August 2023**

*Internship Project*

- Designed and implemented psychophysics tasks using jsPsych, enhancing online experiment accessibility and flexibility.

## TEACHING EXPERIENCES

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### **Undergraduate Teaching Assistant**

**September 2023 - Present**

*Amirkabir University of Technology*

- Computer Vision | Instructor: Dr. Mostafa Shamsi.

### **Undergraduate Teaching Assistant**

**September 2023 - Present**

*Amirkabir University of Technology*

- Basic Programming | Instructor: Dr. Zahra Ghorbanali.

### **Undergraduate Teaching Assistant**

**February 2023 - July 2023**

*Amirkabir University of Technology*

- Operating Systems | Instructor: Dr. Mohammad Mahdi Bejani.

## COURSES ATTENDED

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### Deep Learning Course

July 2022

*Neuromatch Academy*

- Learning implementation of Deep Neural Networks using PyTorch
- Learning about CNNs, RNNs, Natural Language Processing, and Data Mining skills.
- In the Final project we predict the neural activity of mice from the Steinmetz dataset using RNNs and we predict the behaviors of the mice using SVM.

### Computational Neuroscience Course

July 2023

*Neuromatch Academy*

- Learning Model Fitting, how to use Dimensionality Reduction
- Learning all about dynamical systems and how to apply them to build more biologically plausible models of neurons and networks of neurons.
- Learning Bayesian Decisions, Hidden Dynamics, Optimal Control and Reinforcement Learning and Network Causality

### Selected University Courses

- Statistics & Probability | 20/20 - 4/4
- Foundation of Matrix & Linear Algebra | 20/20 - 4/4
- Computer Vision | 20/20 - 4/4
- Anatomy | 19.5/20 - 4/4
- Artificial Intelligence | 20/20 - 4/4
- Data Mining | 19.25/20 - 4/4
- Research Methodology | 20/20 - 4/4
- Physiology | 20/20 - 4/4

## SKILLS

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<b>Programming</b>	Python, Rust, C ,C++, MATLAB, HTML, CSS, JavaScript
<b>Python Libraries</b>	Numpy, Pandas, Matplotlib, SciPy, TensorFlow, PyTorch, SnnTorch, Scikit-learn, Keras, PsychoPy
<b>Language</b>	<div><ul style="list-style-type: none"><li>• Farsi (Native)</li><li>• Kurdish (Native)</li></ul><ul style="list-style-type: none"><li>• English (Professional)</li><li>• My Overall TOEFL score: 99</li></ul></div>
<b>Other</b>	Git, Github, Microsoft Office, L <sup>A</sup> T <sub>E</sub> X, AFNi, FSL, Django, Docker, Qt, Qt Creator, Psychtoolbox, Psychopy

## REFERENCES

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### Dr. Abdelrahman Rayan

*Donders Institute for Brain, Cognition and Behavior - Radboud University*

- Email: [abdelrahman.rayan@donders.ru.nl](mailto:abdelrahman.rayan@donders.ru.nl)
- Relationship: Supervisor

### Dr. Mostafa Shamsi

*Amirkabir University of Technology*

- Email: [m\\_shamsi@aut.ac.ir](mailto:m_shamsi@aut.ac.ir)
- Relationship: Mentor