

# AMIR JOUDAKI

## Foundations of AI, AI for biomedicine, NLP/LLMs

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## EXPERIENCE

### Direct Ph.D. candidate

#### ETH Zurich

📅 Jan 2017 – now    📍 Zurich, Switzerland

Research in mathematical foundations of AI, AI for biomedicine. Authored 7 papers (5 first-authored) in top-tier venues in AI/ML and computational genomics. Supervised 10 MSc thesis/semester projects, organised teaching. PhD supervisors: Gunnar Ratsch & Francis Bach.

### Machine Learning Consultant

#### SkillLab

📅 Jan 2022 – July 2022    📍 Zurich, Switzerland

Research and development of a NLP/LLM prototype for extraction of occupations and skills from unstructured text, allowing human feedback to fine tune modeling.

### Researcher

#### Sharif University of Technology

📅 Oct 2011 – Jan 2014    📍 Iran, Tehran

Researched on computational neuroscience, Authored 3 publications (2 first-authored) on network-based analysis of EEG recordings and their diagnostic value.

## EDUCATION

### Direct Ph.D. in Artificial Intelligence

#### ETH Zurich

📅 March 2019 – now    📍 Zurich, Switzerland

Direct PhD is a highly selective program (<5% of all PhD admissions), with 2 years of MSc courses followed by 4 years of PhD research.

**PhD Thesis:** *Mathematical foundations of AI; AI for biomedicine*

**MSc Thesis:** *Scalable algorithms for biological sequence analysis*

MSc GPA 5.68/6 (top 10%)

Algorithms Lab (5.75/6)

### M.Sc. in Cognitive Neuroscience

#### International School for Advanced Studies (SISSA)

📅 Feb 2014 – Feb 2017    📍 Trieste, Italy

**Thesis:** *Modeling activity of electrophysiological recordings in vivo in rats*

### B.Sc. in Computer Engineering

#### Sharif University of Technology

📅 Sept 2008 – Sept 2011    📍 Tehran, Iran

## DETAILS

### Nationality

Iranian

## PROGRAMMING SKILLS

Python

PyTorch

Scikit-Learn

Numpy

C++

MPI

CUDA

Numba

Docker

Spark

LaTeX

## AWARDS



### Direct Doctorate Fellowship

Among two out of more than one hundred students selected for direct PhD program at ETH computer science department, 2017



### Ranked 42<sup>nd</sup>

Among more than 50,000 participants in National Higher Education Entrance Exam, 2011.



### Ranked 369<sup>th</sup>

Among more than 400,000 participants in National University Entrance Exam, 2007.

## LANGUAGES

English: C2/Native

Persian: Native

German: A1.2

# PUBLICATIONS

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## Mathematical foundations of AI

- Alex Meterez\*, Amir Joudaki\*, Francesco Orabona, Alex Immer, Gunnar Ratsch, Hadi Daneshmand, “Batch normalization without gradient explosion: Towards training without depth limits”, Under review (\*: equally contributed).
- Amir Joudaki, Hadi Daneshmand Francis Bach, “On the impact of activation and normalization in obtaining isometric embeddings at initialization”, NeurIPS 2023.
- Amir Joudaki, Hadi Daneshmand Francis Bach, “On Bridging the Gap between Mean Field and Finite Width in Deep Random Neural Networks with Batch Normalization”, ICML 2023.
- Hadi Daneshmand, Amir Joudaki, Francis Bach, “Batch Normalization Orthogonalizes Representations in Deep Random Networks”, **spotlighted NeurIPS 2021 (top 3% of submissions)**.
- Alexandre Bense, Amir Joudaki, Tim G. J. Rudner, Vincent Fortuin, “PCA Subspaces Are Not Always Optimal for Bayesian Learning”, NeurIPS 2021 workshop (DistShift).

## Genomic Sequence Analysis

- Kacper Kapusniak, Manuel Burger, Gunnar Ratsch, Amir Joudaki, “Learning Genomic Sequence Representations using Graph Neural Networks over De Bruijn Graphs”, NeurIPS workshop 2023 (Graph Learning Frontiers).
- Amir Joudaki\*, Alexandru Meterez\*, Harun Mustafa, Ragnar Groot Koerkamp, Andre Kahles, Gunnar Raetsch, “Aligning distant sequences to graphs using long seed sketches”, Journal of Genome Research 2023 (Cold Spring Harbor Laboratory press). (\*: equally contributed).
- Amir Joudaki, Gunnar Ratsch, Andre Kahles, “Fast Alignment-Free Similarity Estimation By Tensor Sketching”, proceedings of RECOMB 2021.
- Mikhail Karasikov, Harun Mustafa, Amir Joudaki, Sara Javadzadeh-No, Gunnar Ratsch, André Kahles, “Sparse Binary Relation Representations for Genome Graph”, Journal of computational biology: a journal of computational molecular cell biology 27.4 (2020): 626-639.

## Dimensionality Reduction

- Amir Najafi, Amir Joudaki, “Nonlinear Dimensionality Reduction via Path-Based Isometric Mapping”, IEEE transactions on pattern analysis and machine intelligence, 38(7), 1452-1464.

## Functional Brain Networks Analysis

- Amir Joudaki\*, Elham Barzegaran\*, Mahdi Jalili\*, Andrea O. Rossetti, Richard S. Frackowiak, and Maria G. Knyazeva, “Properties of functional brain networks affect frequency of psychogenic non-epileptic seizures”, Frontiers in Human Neuroscience, 6:335. (\*: equally contributed).
- Amir Joudaki, Niloufar Salehi, Mahdi Jalili, Maria Knyazeva, “EEG-based functional brain networks: does the network size matter?”, PLoS ONE 7(4): e35673.

# RESEARCH PROJECT SUPERVISION

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- MSc thesis, (Alex Meterez, 2023) “Non-explosive gradients and batch normalization to obtain dynamic isometry”
- MSc thesis, (Alec Flowers, 2023) “Impact of normalization layers on isometry and generalization”
- MSc thesis, (Kacper Kapusniak, 2023) “Modelling genome graphs using graph neural networks”
- MSc thesis (Victoria Barenne, 2023) “Doctor in the loop: applying activation learning in medical settings to reduce costs”
- MSc thesis (Alexandre Bense, 2022), “PCA Subspaces Are Not Always Optimal for Bayesian Learning.”
- MSc thesis (Yichen Liu, 2021) “Scalable distance measures for nearest-neighbor retrieval of ICU patient contexts”
- MSc thesis (Lucien Schlöpfer, 2021) “Characterising ODE-RNN Performance on Irregular Time Series”
- Semester project, (Christof Erdmann, 2023) “Foundational representations for single cell sequencing”
- Semester project (Alex Meterz, 2022), “Guiding sequence to graph alignment by sequence sketching.”
- Semester project (Alexandre Bense, 2021), “PCA Subspaces Are Not Always Optimal for Bayesian Learning.”

# REFERENCES

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Francis Bach, Professor of Computer Science department at INRIA in the Ecole Normale Supérieure, in Paris, France.  
Gunnar Ratsch, Professor of computer science at ETH, Biomedical Informatics lab, Zurich, Switzerland  
Francesco Orabona, Associate Professor at Boston University, Boston, USA.  
Ragnar Martens, Team Lead Product at SkillLab, Amsterdam, Netherlands.  
Mahdi Jalili, Professor of Engineering, Royal Melbourne Institute of Technology, Melbourne, Australia.  
Ghislain Fourny, senior scientist and distinguished lecturer at computer science department, ETH Zurich.