Dr. Younes Bouhadjar

PostDoc researcher

Jülich, Germany

y.bouhadjar@fz-juelich.de | Younes-Bouhadjar | YounesBouhadjar | YounesBouhadjar

Education

Ph.D in Neuromorphic Computing

Aachen, Germany

RWTH Aachen University

10/2018–10/2022

- Thesis: brain inspired sequence learning algorithm and foundations of a memristive hardware implementation
- Supervisors: Dr. Tom Tetzlaff & Dr. Dirk J. Wouters
- Topics: sequence learning, spiking neurons, neural plasticity, probabilistic computing, memristive devices

M.Sc in Micro & Nanotechnologies for Integrated Systems

Grenoble, France

PHELMA INP Grenoble

09/2016–09/2018

- Joint degree between EPFL Switzerland, PHELMA INPG France, and Politecnico di Torino Italy
- Topics: analog and digital circuit design, semiconductor devices, nanoscience, microelectromechanical system design
- GPA: 16.18/20

B.Sc in Physics and Electronics

Grenoble, France

PHELMA INP Grenoble

09/2013–09/2016

- Topics: classical and modern physics, linear algebra, differential equations, probability theory
- GPA: 16.65/20

Work Experience

Postdoctoral Researcher

Jülich, Germany

Neuromorphic Software Ecosystems, Jülich Research Center

Since 10/2022—

- Designing a series of benchmarks that probe the limitations of both transformer and linear transformer models
- Fine-tuning large language models to promote high activation sparsity
- Designing efficient spiking neural networks using lessons from state space modeling
- Contributing to several projects aiming for a hardware friendly implementation of state space models
- Developing energy efficient bio-inspired sequence learning models

Research Assistant

Jülich, Germany

Computational and Systems Neuroscience & Electronic Materials Institutes, Jülich Research Center

10/2018–10/2022

- Developed a model for sequence learning, prediction, and generation in networks of spiking neurons
- Provided a mechanistic explanation of role of oscillation and noise in biological system
- Built neuromorphic hardware for the above sequence learning model centered around memristive devices
- Contributed to the development of neural simulator NEST and NESTML

Research Intern

San Jose, CA, USA

IBM Almaden Research Center

03/2018–09/2018

- Developed and implemented a memory-augmented neural network model inspired by the human working memory
- Implemented psychometric tests to assess the performance of the model
- Implemented machine learning models for visual question answering (VQA)
- Designed and implemented a machine learning framework: `https://github.com/IBM/mi-prometheus`

Research Intern

Yorktown Heights, NY, USA

IBM T. J. Watson Research Center

06/2017–08/2017

- Developed a custom software for operating a novel optical sensor, processing the data, and applying fitting routines for noise removal

Personal Skills

Mathematics

- Probability theory
- Linear algebra
- Non-linear systems
- Differential/integral calculus

Programming

- Python, Matlab, C,C++

Scientific computing

- Simulation, data analysis and visualization with Python
- Modeling and simulation of spiking neural networks in NEST
- Training and inference of neural networks in PyTorch
- Open source development using GitHub
- Linux (Debian)

Tools

- Git, Github, Docker

Publications

Journals

2025 Yik, J., Van den Berghe, K., den Blanken, D., **Bouhadjar, Y.**, … and Reddi, V. J. (2025). The neurobench framework for benchmarking neuromorphic computing algorithms and systems. Nature Communications, 16(1), 1545.

2023 **Bouhadjar, Y.**, Siegel, S., Tetzlaff, T., Diesmann, M., Waser, R., and Wouters, D. J. (2023). Sequence learning in a spiking neuronal network with memristive synapses. Neuromorphic Computing and Engineering, 3(3), 034014.

2023 **Bouhadjar, Y.**, Wouters, D. J., Diesmann, M., and Tetzlaff, T. (2023). Coherent noise enables probabilistic sequence replay in spiking neuronal networks. PLOS Computational Biology, 19(5), e1010989.

2023 Siegel, S., **Bouhadjar, Y.**, Tetzlaff, T., Waser, R., Dittmann, R., and Wouters, D. J. (2023). System model of neuromorphic sequence learning on a memristive crossbar array. Neuromorphic Computing and Engineering, 3(2), 024002.

2022 Oberländer, J, **Bouhadjar, Y.**, and Morrison, A. (2022). Learning and Replaying Spatiotemporal Sequences: A Replication Study. Frontiers in integrative neuroscience, 113.

2022 **Bouhadjar, Y.**, Wouters, D. J., Diesmann, M., and Tetzlaff, T. (2022). Sequence learning, prediction, and replay in networks of spiking neurons. PLOS Computational Biology, 18(6), e1010233.

Proceedings

2024 Feiler, F., Neftci, E., and **Bouhadjar, Y.** (2024). Unsupervised Learning of Spatio-Temporal Patterns in Spiking Neuronal Networks. In 2024 International Conference on Neuromorphic Systems (ICONS) (pp. 366-370).

2023 Siegel, S., Ziegler, T., **Bouhadjar, Y.**, Tetzlaff, T., Waser, R., Dittmann, R., and Wouters, D. (2023). Demonstration of neuromorphic sequence learning on a memristive array. In Proceedings of the 2023 Annual Neuro-Inspired Computational Elements Conference (pp. 108-114).

2023 Benmeziane, H., Ounnoughene, A. Z., Hamzaoui, I., and **Bouhadjar, Y.** (2023). Skip Connections in Spiking Neural Networks: An Analysis of Their Effect on Network Training. arXiv preprint arXiv:2303.13563.

2022 **Bouhadjar, Y.***, Caterina Moruzzi*, Melika Payvand*. (2022). Prediction: An Algorithmic Principle Meeting Neuroscience and Machine Learning Halfway. In Proceedings of the 3rd International Workshop on Human-Like Computing at the 2nd International Joint Conference on Learning & Reasoning (pp. 1-7).

2020 **Bouhadjar, Y.**, Diesmann, M., Wouters, D. J., and Tetzlaff, T. (2020). The speed of sequence processing in biological neuronal networks. In Proceedings of the Neuro-inspired Computational Elements Workshop (pp. 1-2).

2019 **Bouhadjar, Y.**, Diesmann, M., Waser, R., Wouters, D. J., and Tetzlaff, T. (2019). Constraints on sequence processing speed in biological neuronal networks. In Proceedings of the International Conference on Neuromorphic Systems (pp. 1-9).

2018 Jayram, T. S.*, **Bouhadjar, Y.***, McAvoy, R. L., Kornuta, T., Asseman, A., Rocki, K., and Ozcan, A. S. (2018). Learning to remember, forget and ignore using attention control in memory. ArXiv:1809.11087.
(* shared first author)

Software

2023 NESTML 8.0.0 (https://github.com/nest/nestml/releases/tag/v8.0.0)

2023 NESTML 4.0.0 (https://github.com/nest/nestml/releases/tag/v4.0)

2023 NEST 3.0 (https://zenodo.org/records/4739103)

In preparation

2025 **Bouhadjar, Y.**, Fabre, M., Schmidt, F., and Neftci, E. (2025). A modular benchmark for evaluating selectivity in sequence learning Models.

2025 Zajzon, B., **Bouhadjar. Y.**, Tetzlaff, T., Morrison, A., Duarte R. (2025) Sequence learning under biophysical constraints: a re-evaluation of prominent models.

2025 Lober, M., **Bouhadjar. Y.**, Diesmann, M., Tetzlaff, T. (2025) Learning sequence timing and control of recall speed in networks of spiking neurons.

2025 Siegel, S., Yang, M., **Bouhadjar, Y.**, Fabre M., Neftci E., and Strachan, J. P. (2025) QS4D: Quantization-aware training for efficient hardware deployment of structured state-space sequential models memory.

Presentations

Talks

2023 **Bio-inspired sequence learning mechanisms and their implementation in a memristive neuromorphic hardware** — *Hanover, Germany*
NNPC conference

2022 **The neuronal mechanisms of sequence processing in biological networks** — *Online*
AI Summit, Algiers

2021 **Sequence learning, prediction, and generation in networks of spiking neurons** — *Online*
NEST conference (lightning talk)

2021 **Sequence learning, prediction, and generation in networks of spiking neurons** — *Online*
Annual Neuro-Inspired Computational Elements (NICE)

2019 **Constraints on sequence processing speed in biological neuronal networks** — *Knoxville, United States*
International Conference on Neuromorphic Systems (ICONS)

2019 **Constraints on sequence processing speed in biological neuronal networks** — *Jülich, Germany*
INM-ICS retreat

Posters

2024 **Training Spiking Neural Networks to emulate brain-like activity for optimal efficiency** — *La Jolla, United States*
International Conference on Neuromorphic Computing and Engineering

2023 **Probabilistic sequential memory recall in spiking neuronal networks** — *Leipzig, Germany*
Computational Neuroscience Meeting

2022 **Sequence learning in a spiking neural network with memristive synapses** — *Groningen, Netherlands*
Materials, devices and systems for neuromorphic computing (MatNeC), **best poster prize**

2021 **Sequence learning, prediction, and generation in networks of spiking neurons** — *Online*
Annual Computational Neuroscience meeting (CNS)

2021 **Sequence learning, prediction, and generation in networks of spiking neurons** — *Online*
Annual Neuro-Inspired Computational Elements (NICE)

2019 **Constraints on sequence processing speed in biological neuronal networks** — *Berlin, Germany*
Bernstein conference

2019 **Constraints on sequence processing speed in biological neuronal networks** — *Knoxville, United States*
International Conference on Neuromorphic Systems (ICONS)

2019 **Constraints on sequence processing speed in biological neuronal networks** — *Jülich, Germany*
INM-ICS retreat

Teaching Experience

Tutor: Introduction to Computational Neuroscience — *Aachen*

RWTH, Aachen — *01/2018–05/2022*

- Neuron models
- Probabilistic description of neuronal signals

Tutor: Theoretical Neuroscience: Correlation structure of neuronal networks — *Aachen*

RWTH, Aachen — *01/2018–05/2022*

- Measures of pairwise correlation
- Correlations in linear systems
- Decorrelation of neural-network activity by inhibitory feedback

Student Supervision

Tarun Phanindra Maddu — *Jülich, Germany*
Jülich Research center — *10/2024–4/2025*
- Thesis: Learning sequences of lip reading using state space models

Felix Schmidt — *Jülich, Germany*
Jülich Research center — *10/2023–3/2025*
- HiWi: enhancing efficiency in neural networks through the incorporation of dendritic computing

Research Summer Camp — *Jülich, Germany*
School AI Algiers, mentoring 4 master students — *06/2023–09/2023*
- Thesis: Towards an understanding of computation through time encoding in spiking neural networks

Florian Feiler (Master thesis) — *Jülich, Germany*
Jülich Research center — *05/2023–11/2023*
- Thesis: Online Unsupervised Learning in Brain-Inspired Neural Networks

Jette Oberländer (Bachelor thesis) — *Jülich, Germany*
Jülich Research center — *11/2021–09/2022*
- Thesis: Learning and Replaying SpatiotemporalSequences: A Replication Study

Hubertus Borsch (Master thesis) — *Jülich, Germany*
Jülich Research center — *04/2021–04/2022*
- Thesis: Learning spatiotemporal sequences with spiking neural networks

Service & Outreach

ICONS Conference Program Committee — *Virginia, USA*
Arlington — *05/2024–08/2024*
- Reviewed papers

ICONS Conference Program Committee — *NM, USA*
Santa Fe — *05/2023–08/2023*
- Reviewed papers

Doctoral representative — *Jülich, Germany*
Jülich Research center — *01/2020–12/2020*
- Worked on improving the working conditions of doctoral researchers
- General committee work and representative tasks

Helmholtz Junior representative — *Jülich, Germany*
Jülich Research center — *01/2020–12/2020*
- Enhance networking and share best practices
- Helped organize a mental health awareness month

Content Curation — *Jülich, Germany*
Jülich Research center — *01/2021—*
- Managing IT infrastructure
- Support in implementing reproducible research