MICHELANGELO NAIM

Curriculum Vitae et Studiorum

Basis Research Institute
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As a Research Scientist II at Basis Research Institute, I specialize in the intersection of artificial intelligence, mathematics, and physics. My research focuses on advancing the frontiers of AI, particularly in language models, reasoning systems, and memory architectures. I combine theoretical insights from mathematics and physics with practical engineering to develop novel approaches to machine learning challenges. My work spans from fundamental research in computational theories of intelligence to the implementation of efficient and scalable AI systems.

Experience

Aug 2024 - present — **Basis Research Institute**, NYC, USA. Research Scientist II
- Lead research initiatives in computational intelligence, focusing on reasoning, learning, and decision-making systems with a team of three engineers / interns
- Develop novel approaches combining inductive and transductive reasoning for the Abstraction and Reasoning Corpus (ARC), achieving near human-level performance on complex visual puzzles
- Created a web interface for ARC using self-learning front-end development and JavaScript
- Create and implement efficient fine-tuning strategies for large language models
- Combine neural networks with program synthesis for abstract reasoning tasks
- Design and implement solutions for processing and analyzing large-scale training datasets

Jan 2022 - Aug 2024 — **MIT - Massachusetts Institute of Technology**, Cambridge, USA. K. Lisa Yang Integrative Computational Neuroscience (ICoN) Postdoctoral Fellow
- Developed autonomous generative AI agents with sophisticated memory and reasoning architectures (Kaiya et al. [1])
- Designed and implemented a novel hierarchical memory system mirroring human cognitive architecture, incorporating working, short-term, and long-term memory components
- Created intelligent information summarization and retrieval mechanisms enabling AI systems to make discerning choices about information management
- Research contributed to founding of Altera, a company founded by advisor Robert Yang to develop and scale these memory systems for real-world applications

Education

Oct 2017 - Oct 2021 — **Weizmann Institute of Science**, Rehovot, Israel. PhD in Neuroscience. Advisor: Misha Tsodyks. Thesis title: "Episodic memory from first principles".

Oct 2015 - Sept 2017 — **Sapienza - Università di Roma**, Rome, Italy. Master's degree in Physics, 110/110 cum Laude. Thesis advisors: Giorgio Parisi and Alessandro Treves (SISSA). Thesis title: "Analysis of a Potts Neural Network".

Oct 2012 - Sept 2015 — **Sapienza - Università di Roma**, Rome, Italy. Bachelor's degree in Physics. 110/110 cum Laude. Thesis advisor: Federico Ricci Tersenghi. Thesis title: "Phase transitions in the Ising Model".

Intellectual Property

Jan 2024 — **Named Inventor on Software Disclosure**, "Generative Agents with Large Language Models", Case No. 25635, submitted to MIT Technology Licensing Office.

Technical Skills

Programming — **Expert:** Python, PyTorch **Proficient:** C++, SQL

ML/AI — **Areas:** Large Language Models, Reinforcement Learning, Transformer Architectures, Attention Mechanisms

Selected Projects

Hierarchical Memory Systems — Designed and implemented a novel memory architecture for AI agents that mirrors human cognitive processes, enabling more natural and adaptive AI behavior.

ARC Reasoning System — Developed a hybrid system combining neural networks with program synthesis for solving abstract reasoning tasks, achieving near human-level performance on benchmark datasets.

Visiting Institutions

Sept 2019 - Dec 2019	**Institute for Advanced Study**, Princeton, NJ.
Aug 2018 - Sept 2018	**Kavli Institute for Theoretical Physics**, Santa Barbara, CA.

Awards and Honors

Apr 2024	**MIT Staff Excellence Award for Morale Booster**: This award acknowledges individuals who have improved the overall work environment.
Feb 2020	**The 2020 Lee A. Segel Memorial Prize in Theoretical Biology.**
Mar 2018 - Oct 2021	**M-GATE**: Participated in this Marie Sklodowska-Curie Innovative Training Network funded by Horizon2020 as one of 15 early-stage researchers.
Jan 2017 - Jul 2017	**Undergraduate Scholarship at SISSA**: Awarded for a Master's thesis project in theoretical physics applied to neural networks, supervised by Alessandro Treves at SISSA and Giorgio Parisi in Rome.
Oct 2013 - Jun 2015	**Percorso d'Eccellenza (Honor Classes) - Bachelor's Degree**: Selected for advanced coursework and problem-solving, reserved for the top 10% of students.

Highlighted Publications

[3] Zhao Kaiya, <u>Michelangelo Naim</u>, Jovana Kondic, Manuel Cortes, Jiaxin Ge, Shuying Luo, Guangyu Robert Yang, and Andrew Ahn. "Lyfe Agents: Generative agents for low-cost real-time social interactions". In: *arXiv preprint arXiv:2310.02172* (2023).

[2] Wen-Ding Li, Keya Hu, Carter Larsen, Yuqing Wu, Simon Alford, Caleb Woo, Spencer M Dunn, Hao Tang, <u>Michelangelo Naim</u>, Dat Nguyen, et al. "Combining induction and transduction for abstract reasoning". In: *arXiv preprint arXiv:2411.02272* (2024).

[1] <u>Michelangelo Naim</u>, Mikhail Katkov, Sandro Romani, and Misha Tsodyks. "Fundamental law of memory recall". In: *Physical Review Letters* 124.1 (2020), p. 018101.