

# M Ganesh Kumar

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## Summary

I am broadly interested in the neural mechanisms supporting intelligence, specifically sample efficient learning for flexible decision-making during uncertainty. I take inspiration from the neural representations and generalization behavior demonstrated by biological systems to develop theoretical models, and stress-test these computational principles using artificial systems. I am also interested in proposing causal mechanisms involved in psychopathology, and to develop personalized tools for intervention. *Keywords: Computational Neuroscience, Machine Learning.*

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## Education

**Max Planck Institute for Biological Cybernetics, Germany** **January 2026 – Present**

- Postdoctoral Fellow
- Department of Computational Neuroscience
- Advisor: [Peter Dayan \(Applied Math\)](#)

**Harvard University, United States** **September 2023 – December 2025**

- Postdoctoral Fellow
- Machine Learning Foundations Group, School of Engineering and Applied Sciences (SEAS)
- Advisor: [Cengiz Pehlevan \(Applied Math\)](#)

**Simons Foundation, Flatiron Institute** **August 2024**

- Summer School 2024: Analytical Connectionism

**National University of Singapore (NUS)** **August 2018 – January 2023**

- Ph.D. in Computational Neuroscience
- Integrative Science and Engineering Programme (ISEP), NUS Graduate School (NGS)
- Doctoral thesis: [Biologically Plausible Computations Underlying One-Shot Learning of Paired Associations](#)
- Advisors: [Andrew Tan \(Physiology\)](#), [Shih-Cheng Yen \(Engineering\)](#)

**National Institute of Education, Nanyang Technological University (NTU)** **January 2021 – April 2021**

- Graduate Exchange Programme: Early Childhood Education & Assessment

**Massachusetts Institute of Technology (MIT)** **August 2019**

- Summer School 2019: Center for Brains, Minds & Machines (CBMM)

**National University of Singapore (NUS)** **August 2013 – July 2017**

- B.Sc. with Honors (Distinction) in Life Sciences (Biomedical Sciences)
  - Double Minors: University Scholars Programme (USP) and Special Programme in Science (SPS)
  - Honors thesis: Wheelchair Control using Motor-Imagery based Electroencephalogram (EEG)
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## Research Experience

2026 – Present	<b>Consultant</b> , Noova Tech
2022 – 2023	<b>Research Scientist I</b> , Center for Frontier AI Research (CFAR), A*STAR
2019 – 2024	<b>Co-Founder, Principal Scientist</b> , Nugen.ai
2017 – 2018	<b>Research Engineer</b> , A*STAR Artificial Intelligence Initiative (A*AI), A*STAR

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## Awards

- Young NUS Fellow, NUS Development Grant 2025 (SGD 20,000)
- Postdoctoral Fellowship in Computer Science 2023, Harvard University
- [MIT's Center for Brains, Minds, Machines 2019 – Fujitsu Laboratories Fellow](#)

- NUS Graduate School Scholarship (NGSS) 2018 for Ph.D.
- [NUSS Gold Medal for Outstanding Achievement 2017](#)
- University Scholars Programme (USP) Senior Honor Roll 2017
- A\*STAR Undergraduate Scholarship (AUS) 2013

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## Publications

Biological Intelligence (B), Artificial Intelligence (A), Neurological Disorders (D)

### Journal Papers

- B: Jorin Overweining, [M Ganesh Kumar](#), Haim Sompolinsky. Hierarchical Spiking Computation with Feedback Alignment for Task-Driven Learning. *Nature Neuroscience* [H5-Index: 153] (In preparation).
- BA: [M Ganesh Kumar](#), Cheston Tan, Camilo Libedinsky, Shih-Cheng Yen, Andrew Tan Yong-Yi. One-shot learning of paired association navigation using biologically plausible schemas. *Journal of Neuroscience* [H5-Index: 89] (Under revision). <https://arxiv.org/abs/2106.03580> [GitHub]
- BA: Jiachuan Wang\*, Vachan Shetru Jagadeesh\*, [M Ganesh Kumar](#), Camilo Libedinsky, Shih-Cheng Yen, Andrew YY Tan & Jai S Polepalli. Hippocampal Neurogenesis with Cbln-4 deletion impairs Fear Conditioning. *Communications Biology* [H5-Index: 106] (Under revision).
- B: Mohammad Yaghoubi, [M Ganesh Kumar](#), Andres Nieto-Posadas, Coralie-Anne Mosser, Thomas Gisiger, Emmanuel Wilson, Cengiz Pehlevan, Sylvain Williams, Mark Brandon (2026). Predictive Coding of Reward in the Hippocampus. *Nature* **651**, 414-420 [H5-Index: 490]. <https://doi.org/10.1038/s41586-025-09958-0> [Github]
- BA: [M Ganesh Kumar](#), Cheston Tan, Camilo Libedinsky, Shih-Cheng Yen, Andrew Tan Yong-Yi (2022). A nonlinear hidden layer enables actor-critic agents to learn multiple paired association navigation. *Cerebral Cortex* **32 (18)**, 3917-3936 [H5-Index: 67]. <https://doi.org/10.1093/cercor/bhab456> [GitHub]

### Peer Reviewed Main Conference Proceedings

- BA: Aditya Singh, Marcel Binz, Peter Dayan, [M Ganesh Kumar](#). Scalable yet Interpretable Meta-RL for Decision-making with Uncertainty. *International Conference on Learning Representations (ICLR) 2027* [H5-Index: 362] (In preparation).
- A: Adam Lee\*, [M Ganesh Kumar](#)\*, Blake Bordelon, Cengiz Pehlevan. CompleteP for RL: Mitigating inconsistencies when scaling Reinforcement Learning. *International Conference on Machine Learning (ICML), Seoul 2026* [H5-Index: 272]. (In press)
- BA: [M Ganesh Kumar](#), Blake Bordelon, Jacob Zavatore-Veth, Cengiz Pehlevan. A Model of Place Field Reorganization during Reward Maximization. *International Conference on Machine Learning (ICML), Vancouver 2025* [H5-Index: 272]. <https://proceedings.mlr.press/v267/kumar25a.html> [GitHub]
- BD: [M Ganesh Kumar](#)\*, Adam Manoogian\*, Cengiz Pehlevan<sup>^</sup>, Shawn Roads<sup>^</sup>. Neurocomputational Underpinnings of Suboptimal Beliefs in Reinforcement Learning Agents. *Cognitive Computational Neuroscience (CCN) Proceedings, Amsterdam 2025* (25% accept). <https://doi.org/10.32470/3kpf810>
- BA: Clarence Lee\*, [M Ganesh Kumar](#)\*, Cheston Tan. DetermiNet: A Large-Scale Diagnostic Dataset for Complex Visually-Grounded Referencing using Determiners. *International Conference on Computer Vision (ICCV), Paris 2023* [H5-Index: 256]. <https://arxiv.org/abs/2309.03483> [GitHub]

- AD: [M Ganesh Kumar](#), Kai Keng Ang, Rosa Q. So. Reject Option to reduce False Detection Rates for EEG-Motor Imagery based BCI. *Engineering in Medicine and Biology Society (EMBC), Korea 2017* [H5-Index: 47]. <https://doi.org/10.1109/EMBC.2017.8037479>

### Peer Reviewed Workshop Proceedings

- BD: Jiachuan Wang, Vachan Shetru Jagadeesh, [M Ganesh Kumar](#), Camilo Libedinsky, Shih-Cheng Yen, Andrew Yong-Yi Tan, Jai S Polepalli. Unsupervised Hebbian Learning Drives Biologically Interpretable Pattern Separation in a Hippocampal–Striatum Network. *AAAI Workshops, Singapore 2026*. (Spotlight)
- A: Aditya Singh, [M Ganesh Kumar](#). Tiny Personal Critic: A Lightweight Critic for Low-Compute Language Model Personalization. *AAAI Workshops, Singapore 2026*.
- BA: Zijun Lim, [M Ganesh Kumar](#), Cheston Tan. Human-like Compositional Learning of Visually Grounded Concepts using Synthetic Environments. *International Conference on Learning Representations (ICLR) Workshops, Singapore 2025*. <https://openreview.net/forum?id=vq39RX6xIU>
- BA: Zijun Lim\*, Haidi Azaman\*, [M Ganesh Kumar](#), Cheston Tan. Compositional visual grounding of word concepts through embodied reinforcement learning. *Computer Vision and Pattern Recognition (CVPR) Workshops, Seattle 2024*. <https://arxiv.org/abs/2309.04504> [GitHub]
- AD: Nathan Cloos, [M Ganesh Kumar](#), Adam Manoogian, Christopher Cueva, Shawn Roads. Generating and Validating Agent and Environment Code for Simulating Realistic Personality Profiles with Large Language Models. *NeurIPS Workshops Foundation Models For Science, Vancouver 2024*. <https://openreview.net/pdf?id=oeIvS0ULNI>

### Book Chapters

- BAD: [M Ganesh Kumar](#), Shamini Ayyadury, Elavazhagan Murugan (2024). Trends, Innovations and Challenges in employing Interdisciplinary Approaches to Biomedical sciences. In *Translational Research in Biomedical Sciences: Recent Progress and Future Prospects, Chapter 20*. Springer Nature. [https://doi.org/10.1007/978-981-97-1777-4\\_20](https://doi.org/10.1007/978-981-97-1777-4_20)

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## Ongoing Projects

- BAD: Praveena Satkunarajah, [M Ganesh Kumar](#), Sarah Power, Ben Zendel. Online EEG-based classification using reservoir computing during timbre perception.
- BD: Niels Pacheco, [M Ganesh Kumar](#), Demba Ba. Interpretable Dictionaries for Seizure Detection.
- A: Leon Guertler, [M Ganesh Kumar](#), Anh Tuan Luu, Cheston Tan. TellMe What You See: Using LLMs to Explain Neurons in Vision Models.

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## Invited talks

Aug 2026	Ministry of Education, Singapore Tamil Teachers Conference
Feb 2026	Department of Physiology, National University of Singapore
Sep 2025	Institute of Cognitive Neuroscience, University College London
Jun 2025	LMU– Harvard Young Scientist’s Forum, Ludwig-Maximilians-Universitat-Munchen
Mar 2025	Department of Computational Neuroscience, Max Planck Institute for Biological Cybernetics
Mar 2025	Spring to Science, Kempner Institute for Biological and Artificial intelligence, Harvard University

Nov 2024	Annual Neuroscience Conference, Society for Neuroscience Singapore Chapter
Jun 2024	Neural Coding and Cognition group, National University of Singapore
Apr 2023	Foundations in Machine Learning group, Harvard University
Dec 2022	Neuroscience Singapore 2022, Society for Neuroscience Singapore Chapter
Nov 2022	Senseable Intelligence group, McGovern Institute for Brain Research, MIT
Oct 2022	Metaconscious group, Brain and Cognitive Science department, MIT
Sep 2022	Department of Computational Neuroscience, Max Planck Institute for Biological Cybernetics
Jun 2022	Three-minute thesis, Department of Physiology, NUS
Feb 2022	Biolins group, Brain and Cognitive Science department, MIT
Sep 2021	Neurobiology seminar, Life Science Institute, NUS

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## Selected Conference Talks/Posters

M Ganesh Kumar, Mohammad Yaghoubi, Mark Brandon, Cengiz Pehlevan. Preserving TD-Driven Place-Field Reorganization at Scale: A Scaling-Limit Perspective. **Computational and Systems Neuroscience (COSYNE) Abstracts 2026**, Lisbon, Portugal.

Jorin Overweining, Hanming Ye, M Ganesh Kumar, Haim Sompolinsky. Tempotron learning in deep neural networks with direct feedback alignment. **Computational and Systems Neuroscience (COSYNE) Abstracts 2026**, Lisbon, Portugal.

M Ganesh Kumar\*, Adam Manoogian\*, Cengiz Pehlevan, Shawn Roads. Neurocomputational Underpinnings of Suboptimal Beliefs in Reinforcement Learning Agents. **Computational Psychiatry Conference 2025**, Tuebingen, Germany. **\*Spotlight Talk with Euro 1000 Travel Award.**

M Ganesh Kumar, Blake Bordelon, Jacob Zavatone-Veth, Cengiz Pehlevan. A Model of Place Field Reorganization during Reward Maximization. **Computational and Systems Neuroscience (COSYNE) Abstracts 2025**, Montreal, Canada. **\*Spotlight poster with USD500 Travel Award.**

Clarence Lee\*, Zijun Lin\*, M Ganesh Kumar, Cheston Tan. Leveraging on synthetic datasets to advance visual grounding on natural language concept comprehension. **16<sup>th</sup> Asia Pacific Computer Vision Conference (APCV) 2024**, Singapore. Talk.

M Ganesh Kumar, Cheston Tan, Camilo Libedinsky, Shih-Cheng Yen, Andrew Tan Yong Yi. One-shot learning of paired associations by a reservoir computing model with Hebbian plasticity. **Computational and Systems Neuroscience (COSYNE) Abstracts 2022**, Lisbon, Portugal. Poster. [[Short Paper](#)]

M Ganesh Kumar, Cheston Tan, Camilo Libedinsky, Shih-Cheng Yen, Andrew Tan Yong Yi. Learning working memory using a reservoir computing model trained by Hebbian plasticity for one-shot navigation to single displaced targets. **Neuroscience to Artificially intelligent systems (NAISys) 2022**, Virtual. Talk.

M Ganesh Kumar, Cheston Tan, Camilo Libedinsky, Shih-Cheng Yen, Andrew Tan Yong Yi. One-shot learning of paired associations by a reservoir computing model with Hebbian plasticity. **Neuroscience 2021, Society for Neuroscience (SfN)**, Virtual. Talk.

M Ganesh Kumar, Cheston Tan, Camilo Libedinsky, Shih-Cheng Yen, Andrew Tan Yong Yi. Learning multiple paired associations with temporal difference error modulated Hebbian plasticity. **Neuroscience to Artificially intelligent systems (NAISys) 2020**, Virtual. Talk.

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## Service

Ad-hoc Journal Reviewer	Nature Communications, PLOS Computational Biology, Frontiers in System Neuroscience, IEEE Transactions on Cognitive and Developmental Systems
Conference Reviewer	Neural Information Processing Systems (NeurIPS), International Conference on Learning Representations (ICLR), International Conference on Machine Learning (ICML), Computational Cognitive Neuroscience (CCN)
Organizing Committee	Society for Neuroscience, Singapore Chapter (SFN.SG)

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## References

Postdoctoral Advisor	Prof. Peter Dayan	Max-Planck Institute for Biological Cybernetics	<a href="mailto:peter.dayan@tuebingen.mpg.de">peter.dayan@tuebingen.mpg.de</a>
Postdoctoral Advisor	Assoc. Prof. Cengiz Pehlevan	Harvard University	<a href="mailto:cpehlevan@seas.harvard.edu">cpehlevan@seas.harvard.edu</a>
Doctoral Advisor	Asst. Prof. Andrew Tan	National University of Singapore	<a href="mailto:phstya@nus.edu.sg">phstya@nus.edu.sg</a>
Pre-Doctoral Advisor	Dr Cheston Tan	A*STAR	<a href="mailto:cheston-tan@i2r.a-star.edu.sg">cheston-tan@i2r.a-star.edu.sg</a>

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## Teaching

Jan 2025 – May 2025	APMTH 50: Introduction to Applied Mathematics	Harvard University
Jun 2022	STEP NUS Braincamp 2022	National University of Singapore
Oct 2021	NUS CET Beginning AI through Neuroscience	National University of Singapore
Jun 2021	Neuroscience, AI & Medicine Workshop	National University of Singapore
Jun 2019	NUS Braincamp 2019	National University of Singapore
Jan 2019 – Dec 2019	LSM4213: Systems Neurobiology	National University of Singapore

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## Mentoring

Aug 2025 - Present	Aditya Singh, Honors Project, Kalinga Institute of Industrial Technology
Aug 2024 - Present	Jiachuan Wang, Ph.D. candidate, NUS
Aug 2023 – Apr 2024	Capstone Student Project, SUTD
Jul 2023 – Jul 2024	Leon Guertler, NTU Honors Project – Research Engineer at A*STAR
May 2023 – Jul 2024	Zijun Lin, NTU Honors Project – pursuing Ph.D. at NTU
Mar 2023 – Aug 2023	Haidi Azaman, NUS Honors Project – pursuing M.Comp. at NUS
Sep 2022 – Mar 2023	Clarence Sheng, A*STAR Internship – pursuing Ph.D. at SUTD
Aug 2021 – Apr 2022	Xi Zhi Low, NUS Honors Project – pursuing M.D. at Duke-NUS
May 2020 – Apr 2021	Hema Prashaad, NUS Honors Project – pursuing M.D. at Duke-NUS
May 2020 – Apr 2021	Franklin Leong, NUS Honors Project – pursuing Ph.D. at ETH Zurich
Jan 2019 – Apr 2020	Graduate research mentor, Special Programme in Science

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## Besides research

Feb 2011 – Present	Appt: S3 Operations Officer, Rank: Major (NS)	Singapore Armed Forces
Aug 2014 – Present	Advisory Panel, Ex-President	NUS Tamil Language Society

- **Entrepreneurship.** I enjoy chatting with people to understand problem statements and figuring out solutions to improve outcomes. I am a Certified Scrum Product Owner (CSPO) and Scrum Master (CSM).
- **Travel.** I love to explore new places, either by riding a [motorcycle](#), car or private plane (FAA certified PPL).
- **Theatre productions.** I have produced, directed, and acted in [student theatre productions](#).
- **Crossfit.** My wife convinced me that crossfit is fun.
- **Family.** I hope to translate my research to improve my family (wife and newborn son) and community's quality of life.