Linghao Kong

Email: linghao@mit.edu | LinkedIn: linkedin.com/in/linghaokong | Website: lin-k76.github.io

Education

- **Massachusetts Institute of Technology** (MIT) — Cambridge, MA
  - PhD candidate in Electrical Engineering and Computer Science (GPA: 4.91/5.00) — *Sep 2022 – Present*
    - Being advised by Professor Nir N. Shavit
  - SM in Electrical Engineering and Computer Science (GPA: 4.91/5.00) — *Sep 2022 – May 2024*
    - Advised by Professor Nir N. Shavit
    - Thesis: "Sparse Expansion and Neuronal Disentanglement"
- **Columbia University in the City of New York** (CU) — New York, NY
  - BA in Computer Science and in Neuroscience and Behavior (GPA: 3.97/4.00) — *Sep 2018 – May 2022*
    - Honors: *magna cum laude*, Dean's List for all semesters

Research Experience

- **PhD Candidate**, *Shavit Lab*, MIT — *Sep 2022 – Present*
  - Investigating the relationship between neuronal entanglement and sparsity in large language models to discover new techniques to induce sparsity in such models to vastly save computational power
  - Analyzing the MICrONS anatomical and functional connectome of the mouse visual cortex to better characterize the border between visual areas and to model the degree of synchrony in neurons
  - Modeling the octopus hippocampus and fruit fly anatomical connectomes as artificial neural networks to investigate the capacity and capabilities of biological neural networks
- **Research Assistant**, *Peter Sims Laboratory*, CU — *Jan 2019 – Aug 2022*
  - Leveraged machine learning model scGen to identify fates of multiple cancer cell types following perturbations
  - Identified the cause of low efficiency in the novel SCOPE-Seq2 technique to be false hybridization
  - Utilized various biochemical assays to demonstrate the inability of emetine-stalled puromycylated polypeptides to remain bound to ribosomes, despite widespread acceptance of their ability to do so in the field of active translation
- **Research Assistant**, *Laboratory for Fluorescence Dynamics*, UC Irvine — *Aug 2015 – Jul 2018*
  - Implemented skills accumulated over three years for independent research project on cancer cell metabolism
  - Became adept in lab techniques such as passaging, transfecting, amplifying DNA, and generating stable cell lines
  - Self-taught in the ImageJ Macro language to expedite batch analysis of images
- **Research Participant**, *COSMOS Summer Research Program*, UC Irvine — *Jul 2016 – Aug 2016*
  - Studied effects of different drugs on the growth rate of tumor spheres and modeled such growth in MATLAB

Professional Experience

- **Research Intern**, *Machine Learning Research Team*, Red Hat — *May 2025 – Aug 2025*
  - Developed and analyzed scaling laws for speedup with speculative decoding in server-scale inference of large language models, extending prior approaches limited to the synchronous case and informing the design of more effective speculator models
- **Research Intern**, *Machine Learning Research Team*, Neural Magic (acquired by Red Hat) — *Jun 2024 – Aug 2024*
  - Spearheaded initiative to quantize LLMs to new FP8 data format to maintain performance while reducing cost – primary contributor to top-8 trending, most extensive FP8 model collection on Hugging Face with over 2 million total downloads, work featured by NVIDIA and MarkTechPost
  - Tested a variety of different approaches, such as knowledge distillation and speculative decoding, to create more performant compressed LLMs

Publications (* denotes equal contribution, † denotes co-correspondence)

- **Kong, L.***, Subramanian, I.*, Shavit, Y., Adler, M., Alistarh, D., & Shavit, N. N. (2025). **Expand neurons, not parameters**. arXiv preprint. https://arxiv.org/abs/2510.04500
- **Kong, L.**, Ning, A., Adler, M., & Shavit, N. N. (2025). **Negative pre-activations differentiate syntax**. arXiv preprint. https://arxiv.org/abs/2509.24198
- Tumma, N.*, **Kong, L.***†, Sawmya, S., Wang, T. T., & Shavit, N. N.† (2024). **A connectomics-driven analysis reveals novel characterization of border regions in mouse visual cortex**. *Neural Networks*, 190, 107688 (**Neural Netw**). https://doi.org/10.1016/j.neunet.2025.107688
- Sawmya, S.*, **Kong, L.***, Markov, I., Alistarh, D., & Shavit, N. N. (2025). **Wasserstein distances, neuronal entanglement, and sparsity**. *The 13th International Conference on Learning Representations* (**ICLR 2025, Spotlight Presentation**). https://openreview.net/pdf?id=cnKhHxN3xj

- Hobson, B. D., **Kong, L.**, Angelo, M. F., Lieberman, O. J., Mosharov, E. V., Herzog, E., Sulzer, D., & Sims, P. A. (2022). **Subcellular and regional localization of mRNA translation in midbrain dopamine neurons**. *Cell Reports*, 38(2) (**Cell Rep**). https://doi.org/10.1016/j.celrep.2021.110208
- Hobson, B. D., **Kong, L.**, Hartwick, E. W., Gonzalez, R. L., Jr., & Sims, P. A. (2020). **Elongation inhibitors do not prevent the release of puromycylated nascent polypeptide chains from ribosomes**. *eLife* 9, e60048 (**eLife**). https://doi.org/10.7554/eLife.60048
- **Kong, L.***, Murata, M. M.*, & Digman, M. A. (2018). **Absence of REV3L promotes p53-regulated cancer cell metabolism in cisplatin-treated lung carcinoma cells**. *Biochemical and Biophysical Research Communications*, *496*(1), 199-204 (**BBRC**). https://doi.org/10.1016/j.bbrc.2018.01.026

Conferences and Workshops (* denotes equal contribution)

- **Kong, L.***, Ning, A., & Shavit, N. N. (2025, July). **Input differentiation via negative computation** [Poster presentation]. *The 3rd Workshop on High-dimensional Learning Dynamics at the 42nd International Conference on Machine Learning* (**ICML 2025 Workshop HiLD**), Vancouver, BC, Canada.
- **Kong, L.***, Durresi, H., Mi, L., & Shavit, N. N. (2025, March). **Presynaptic input synchrony at scale** [Poster presentation]. *Computational and Systems Neuroscience* (**COSYNE 2025**), Montreal, QC, Canada.
- Sawmya, S.*, **Kong, L.***, Markov, I., Alistarh, D., & Shavit, N. N. (2024, August). **Neuronal disentanglement and Sparse Expansion** [Poster presentation]. *New England Mechanistic Interpretability Workshop Series* (**NEMI 2024**), Boston, MA, United States.
- Hobson, B. D., **Kong, L.**, Angelo, M. F., Lieberman, O. J., Mosharov, E. V., Herzog, E., Sulzer, D., & Sims, P. A. (2021, October). **Subcellular and regional localization of mRNA translation in midbrain dopamine neurons** [Poster presentation]. *2021 Columbia Undergraduate Research Symposium*, New York, NY, United States.
- Hobson, B. D., **Kong, L.**, Hartwick, E. W., Gonzalez, R. L., Jr., & Sims, P. A. (2020, October). **Elongation inhibitors do not prevent the release of puromycylated nascent polypeptide chains from ribosomes** [Poster presentation]. *2020 Columbia Undergraduate Research Symposium*, New York, NY, United States.
- **Kong, L.**, Hobson, B. D., & Sims, P. A. (2019, October). **Toward visualization of active translation in dopaminergic neurons** [Poster presentation]. *2019 Columbia Undergraduate Research Symposium*, New York, NY, United States.
- **Kong, L.***, Murata, M. M.*, & Digman, M. A. (2017, October). **Fighting the (chemotherapeutic) resistance: restoring p53 function and silencing REV3L suppresses the cancerous metabolic phenotype in cisplatin treated human non-small lung carcinoma cells** [Poster presentation]. *2nd World Congress on Cancer Research and Therapy* (**WCCRT 2017**), San Diego, CA, United States.

Honors and Achievements

- Amazon AI PhD Fellowship – MIT Nominee, results pending *2025*
- Apple Scholars in AI/ML PhD Fellowship – One of three MIT nominees *2025*
- Spotlight Presentation at ICLR – Top 5% of submissions *2025*
- Pillar VC Travel Grant for ICML 2025 – Awardee *2025*
- COSYNE New Attendee Travel Grant – Awardee *2025*
- Cerebras Research Fellowship – Awardee *2024*
- NSF Graduate Research Fellowship Program – Honorable Mention *2024*
- Columbia University I.I. Rabi Scholar – One of 17 students in class awarded yearly research funding *2018 – 2022*
- American Invitational Mathematics Examination (AIME) qualifier – Top 5% nationally *2015 – 2018*
- USA Biology Olympiad (USABO) semifinalist – Top 10% nationally *2015*

Teaching Experience

- **Teaching Fellow**, *Department of Electrical Engineering and Computer Science*, MIT *Sep 2025 – Present*
  - Developing problem sets and holding weekly office hours for the following courses:
  - 6.4610 Natural Language Processing *Fall 2025*
- **Research Mentor,** *Department of Electrical Engineering and Computer Science*, MIT *Dec 2022 – Present*
  - Mentoring undergraduate students to conduct research in mechanistic interpretability, model efficiency, and connectomics. Graduated mentees:
  - Heidi Durresi, now PhD candidate at MIT *Sep 2023 – Sep 2024*
  - Neehal Tumma, now PhD candidate at MIT *Dec 2022 – May 2024*
- **Course Assistant**, *Computer Science Department*, CU *Jan 2021 – May 2022*
  - Guided students to implement the mathematical and theoretical principles taught in class in Python-based applications and problem sets through weekly office hours and biweekly lab sessions in the following courses:
  - COMS W4701 Artificial Intelligence *Spring 2022*
  - COMS W4733 Computational Aspects of Robotics *Fall 2021*
  - COMS W4701 Artificial Intelligence *Summer 2021*
  - COMS W3251 Computational Linear Algebra *Spring 2021*

- **Vice President**, *Orange County Math Circle* (OCMC), Orange County, CA *Nov 2013 – May 2018*
  - Oversaw logistics of all other math clubs within OCMC; resolved club issues in weekly diagnostic meetings
  - Directed volunteers to serve 2800+ students yearly; trained others to better instruct students

Invited Talks

- Talk on *Wasserstein Distances, Neuronal Entanglement, and Sparsity*, Red Hat, Cambridge, MA, USA *Mar 2025*

Extracurricular Activities

- **Editor in Chief**, *Columbia Science Review*, CU *Sep 2018 – May 2022*
  - Supervise over 40 writers and editors to ensure the smooth operation of an online and a biannual publication
  - Coordinate between different teams, including illustrators and layout designers, to produce a cohesive product
- **Vice President**, *Columbia Synapse*, CU *Sep 2019 – May 2021*
  - Oversee the organization of events to help unite the community in support of those with traumatic brain injuries, including research panels, socials, as well as of a large conference held during March 13th and 14th, 2021
- **RASC-AL Mission Member**, *Columbia Space Initiative*, CU *Nov 2018 – May 2020*
  - Semifinalist for NASA's RASC-AL competition to design a lunar lander, focused on thermal management