Yingcong Li

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<https://yingcong-li.github.io/>

**EDUCATION**

* **University of Michigan, Ann Arbor**

PhD in Electrical Engineering and Computer Science (Jan. 2024–EST: Apr. 2025)

* **University of California, Riverside**

PhD in Electrical and Computer Engineering (Jun. 2020–Dec. 2023)

MS in Electrical and Computer Engineering (Sep. 2019–Jun. 2020)

* **University of Science and Technology of China**

BS inElectrical Engineering and Information Science (Jun. 2015–Sep. 2019)

**RESEARCH EXPERIENCE**

Google scholar: <https://scholar.google.com/citations?user=9uWgjIUAAAAJ&hl=en&oi=ao>

**Research at SOTA Lab**  *Advisor: Samet Oymak* (Jun. 2020–Present)

* **Optimization Theory for Sequence Models.** Conducted research on the optimization of model training, focusing on sequence models like Transformers and State-space Models. Specifically, studied the optimization landscape of linear Transformers [2,3], State-space Models [3], and Gated Linear Attention [1] in the context of in-context learning. Developed a theoretical framework that equates the optimization geometry of self-attention in Transformers to max-margin SVM problems [4,7,8] and Markov models [5].
* **Emergent Abilities of Autoregressive Models.** Investigated both empirical and theoretical performance of autoregressive models, such as Mamba and Transformers. Empirically studied the emergent behavior of Mamba compared to Transformers under task-mixture settings [6]. Analyzed generalization bounds of Transformers in in-context learning and applied insights to dynamical systems [10]. Researched the emergent “chain-of-thought” reasoning in Transformers, supporting its compositional learning capabilities through in-context filtering from both empirical evidence and theoretical exploration [9].
* **Statistical Learning and Model Architectures.** Extensively studied statistical learning with a focus on sample efficiency and model architecture across diverse learning paradigms. Tackled challenges of data dependency in in-context learning [10], and analyzed sample complexity in multitask [11,13] and continual learning [14] scenarios using heterogeneous model architectures.

**PUBLICATIONS**

\* Equal contribution.

**3 NeurIPS (1 spotlight), 2 ICML, 1 AISTATS, 3 AAAI papers**

1. Yingcong Li, Davoud Ataee Tarzanagh, Ankit Singh Rawat, Maryam Fazel, Samet Oymak. “Gating is Weighting: Understanding Gated Linear Attention through In-context Learning” *in submission*, 2024.
2. Xiangyu Chang, Yingcong Li, Muti Kara, Samet Oymak, Amit Roy-Chowdhury. “Provable Benefits of Task-Specific Prompts for In-context Learning” *in submission*, 2024.
3. Yingcong Li, M. Ankit Singh Rawat and Samet Oymak. “Fine-grained Analysis of In-context Linear Estimation.” *Thirty-eighth Conference on Neural Information Processing Systems* (**NeurIPS**), 2024.
4. Yingcong Li**\***, Yixiao Huang\*, M. Emrullah Ildiz, Ankit Singh Rawat and Samet Oymak. “Mechanics of Next Token Prediction with Self-Attention.” *Artificial Intelligence and Statistics* (**AISTATS**), 2024.
5. M. Emrullah Ildiz, Yixiao Huang, Yingcong Li, Ankit Singh Rawat, and Samet Oymak. “From Self-Attention to Markov Models: Unveiling the Dynamics of Generative Transformers” *The Forty-first International Conference on Machine Learning* (**ICML**), 2024.
6. Li, Yingcong, Xupeng Wei, Haonan Zhao, and Taigao Ma. "Can Mamba In-Context Learn Task Mixtures?" *In ICML 2024 Workshop on In-Context Learning.*
7. Tarzanagh, Davoud Ataee\*, Yingcong Li**\***, Christos Thrampoulidis, and Samet Oymak. “Transformers as Support Vector Machines.” *in submission*, 2023.
8. Tarzanagh, Davoud Ataee, Yingcong Li, Xuechen Zhang, and Samet Oymak. “Max-Margin Token Selection in Attention Mechanism” *Thirsty-seventh Conference on Neural Information Processing Systems* (**NeurIPS, spotlight**), 2023.
9. Yingcong Li, Kartik Sreenivasan, Angeliki Giannou, Dimitris Papailiopoulos, and Samet Oymak. “Dissecting Chain-of-Thought: Compositionality through In-Context Filtering and Learning.” *Thirty-seventh Conference on Neural Information Processing Systems* (**NeurIPS**), 2023.
10. Yingcong Li, M. Emrullah Ildiz, Dimitris Papailiopoulos, Samet Oymak “Transformers as Algorithms: Generalization and Stability in In-Context Learning” *The Fortieth International Conference on Machine Learning* (**ICML**), 2023.
11. Yingcong Li, Samet Oymak “Provable Pathways: Learning Multiple Tasks over Multiple Paths” *The Thirty-Seventh AAAI Conference on Artificial Intelligence* (**AAAI**), 2023.
12. Yuzhen Qin, Yingcong Li, Fabio Pasqualetti, Maryam Fazel, Samet Oymak “Stochastic Contextual Bandits with Long Horizon Rewards” *The Thirty-Seventh AAAI Conference on Artificial Intelligence* (**AAAI**), 2023.
13. Yingcong Li and Samet Oymak, “On the Fairness of Multitask Representation Learning,” IEEE International Conference on Acoustics, Speech and Signal Processing (**ICASSP**), 2023.
14. Yingcong Li, Mingchen Li, M Salman Asif, Samet Oymak “Provable and Efficient Continual Representation Learning” *arXiv preprint*, 2022.
15. Xiangyu Chang\*, Yingcong Li**\***, Samet Oymak, Christos Thrampoulidis “Provable Benefits of Overparameterization in Model Compression: From Double Descent to Pruning Neural Networks” *The Thirty-Fifth AAAI Conference on Artificial Intelligence* (**AAAI**), 2021.

**TALKS**

* **Invited talk at ICML 2024 1st ICL workshop** (Jul. 2024)

*Exploring Model Expressivity and Optimization Landscape in in-context Learning*

* **Guest lecture at UMich EECS 553: Machine Learning** (Oct. 2023)

*Understanding In-context Learning and Chain-of-thought*

* **Guest lecture at UCR EE/CS228: Introduction to Deep Learning** (Jun. 2023)

*Prompt as Parameter-efficient Transfer Learning*

* **Presentation at AAAI 2023** (Feb. 2023)

*Provable Pathways: Learning Multiple Tasks over Multiple Paths*

**PROFESSIONAL ACTIVITIES**

* **38th Conference on Neural Information Processing Systems (NeurIPS2024)** *presenter* (Dec. 2024)
* **41st International Conference on Machine****Learning (ICML2024)** *invited talk* (Jul. 2024)
* **Midwest Machine Learning Symposium (MMLS 2024)** *presenter* (May. 2024)
* **37th Conference on Neural Information Processing Systems (NeurIPS2023)** *presenter* (Dec. 2023)
* **40th International Conference on Machine****Learning (ICML2023)** *presenter* (Jul. 2023)
* **2023 Information Theory and Applications workshop (ITA2023)** *presenter* (Feb. 2023)
* **37th AAAI Conference on Artificial Intelligence (AAAI2023)** *presenter* (Feb. 2023)
* **MURI Workshop** *presenter* (Sep. 2022)
* **39th International Conference on Machine****Learning (ICML2022)** *attendance* (Jul. 2022)
* **C Language programming** *teaching assistant* (Sep. 2017–Feb. 2018)

**SERVICE**

* **Reviewer for** NeurIPS, ICLR, AAAI, AISTATS, ICASSP, TOPML, and SIGKDD

**HONORS & AWARDS**

* **NeurIPS 2023 Scholar Award** (2023)
* **AAAI-23 Student Scholarship** (2023)
* **UCR Dean’s Distinguished Fellowship Award** (2020–2021)
* **USTC Bronze Award of Scholarship for Undergraduates** (2017 & 2016)