Ashok Vardhan Makkuva

CONTACT Email: ashokevardhan@gmail.com Homepage: https://ashokvardhan.github.io/

INTERESTS Reliable and interpretable ML, ML theory, information theory, and statistics

EDUCATION

University of Illinois at Urbana-Champaign (UIUC)
Ph.D., Electrical and Computer Engineering, 2017 - 2022 **4.0/4.0**
– Advisor: Pramod Viswanath
M.S., Electrical and Computer Engineering, 2015 - 2017 **4.0/4.0**
– Advisor: Yihong Wu

Indian Institute of Technology Bombay (IIT Bombay)
B.Tech., Electrical Engineering, 2011 - 2015 **9.62/10.0**
– Advisor: Vivek Borkar

APPOINTMENTS

- **Associate Professor - Télécom Paris, Institut Polytechnique de Paris** *[Nov 25 –]*
  Department: Information Processing and Communications Laboratory (LTCI)
- **École Polytechnique Fédérale de Lausanne (EPFL)** - Postdoctoral Researcher *[Sep 22 – Sep 25]*
  Mentor: Michael Gastpar

PROFESSIONAL EXPERIENCE

- **Amazon AWS AI Labs**, NYC - Applied Data Science Intern *[May 19 – Aug 19]*
  Mentors: Ashish Khetan, Zohar Karnin
- **Morgan Stanley Strats & Modeling**, Mumbai - Quant Analyst Intern *[May 14 – Jul 14]*
  Mentor: Manikantan Srinivasan

LEADERSHIP

Organizer and Presenter—NeurIPS 2024 Tutorial, Sandbox for the Blackbox
- Delivered a tutorial at NeurIPS, the world's largest AI conference, attended by over 20K researchers
- Led the design, coordination, and presentation of cutting-edge content on the novel structured sandbox approach to demystify black-box LLMs

SELECT AWARDS

- **DAAD AInet Fellowship**: Awarded to outstanding international AI researchers for an exclusive postdoctoral research visit to top German universities *[2025]*
- **NeurIPS Spotlight Award**: What One Cannot, Two Can (3% out of 21,575 papers) *[2025]*
- **ICLR Spotlight Award**: Attention with Markov (5% out of 11,670 papers) *[2025]*
- **Best Paper Award**: ACM Mobihoc *[2019]*
- **Joan and Lalit Bahl Fellowship, UIUC** (awarded twice) *[2019, 2020]*
- Sundaram Seshu International Student Fellowship, UIUC *[2018]*
- **Qualcomm Innovation Fellowship Finalist** (among 174 applicants) *[2018]*
- **All India Rank 32**: Awarded fellowship in IISc for undergraduate studies (declined) *[2011]*
- Bronze medal, Mathematics Olympiad, IIT Bombay *[2013]*
- Gold Medal for All India Rank 8 in the International Mathematics Competition, SOF *[2010]*

REFERENCES

- **Pramod Viswanath**, Professor, Princeton University pramodv@princeton.edu
- **Michael Gastpar**, Professor, EPFL michael.gastpar@epfl.ch
- **Sewoong Oh**, Professor, University of Washington sewoong@cs.washington.edu
- **Martin Jaggi**, Associate Professor, EPFL martin.jaggi@epfl.ch
- **Çaglar Gulcehre**, Assistant Professor, EPFL & Microsoft AI caglar.gulcehre@epfl.ch

INVITED TALKS

1. **Sandbox for the Blackbox: How LLMs Learn Structured Data** *[2025]*
   - ITCS, *Data Science Seminar*

2. **Attention with Markov: A Markovian Tale of Transformers (US and Europe)** *[2023 – 2025]*
   - Stanford University, *IT Forum*
   - ETH Zürich, *Data Analytics Seminar & Learning and Adaptive Systems Seminar*
   - San Diego, *Information Theory and Applications workshop (ITA) 2024*

3. **KO codes (US, Canada, Europe, and India)** *[2021 – 2022]*
   - MIT, *SiA Group Seminar*
   - Stanford University, *ISL Colloquium*
   - UC Berkeley, *BASiCS Group Seminar*
   - Carnegie Mellon University, *TheSys Group Seminar*
   - University of Toronto, *ECE department seminar*
   - ETH Zürich, *Signal and Information Processing Lab Seminar*
   - EPFL, *Information Processing Group Seminar*
   - UCSD, *Prof. Arya Mazumdar's group seminar*
   - IST Austria, *ITML Group Seminar*
   - TIFR, *School of Technology and Computer Science Seminar*
   - IISc, *EE & CS Joint Seminar*

4. **Learning in Gated Neural Networks (US and India)** *[2018 – 2020]*
   - University of Washington, *Machine learning and Optimization Seminar*
   - Carnegie Mellon University, *Machine learning Seminar*
   - IIT Madras, *EE & CS Joint Seminar*
   - IIT Bombay, *EE Department Seminar*
   - TIFR, *School of Technology and Computer Science Seminar*
   - Microsoft Research India, *Theory Group Seminar*

MENTORING

- Marco Bondaschi (PhD at EPFL)
  Publication #19, #18, #17, #16, #15, and #14
- Nived Rajaraman (PhD at UC Berkeley → Postdoc at MSR NYC)
  Publication #19, #17
- Adway Girish (PhD at EPFL)
  Publication #18, #16, and #15
- Alliot Nagle (PhD at UT Austin)
  Publication #18, #16, and #15
- Chanakya Ekbote (MS at EPFL → MIT Media Lab)
  Publication #19, #16
- Thijs Vogels (PhD at EPFL → MSR Amsterdam)
  Publication #14
- Ranvir Rana (PhD at UIUC → Co-founder & CTO at Kaleidoscope Blockchain)
  Publication #4 (ACM Mobihoc '19), **Best paper award**
- Xiyang Liu (PhD at University of Washington)
  Publication #12 (JSAIT '23), #10 (ICML '21), and #9 (ISIT '21), **Qualcomm Fellowship Winner**
- Mohammad Vahid Jamali (PhD at U. Michigan → Samsung)
  Publication #12 (JSAIT '23), #10 (ICML '21), and #9 (ISIT '21), **Qualcomm Fellowship Winner**
- Ashwin Hebbar (MS at UIUC → PhD at Princeton)
  Publication #13 (ICML '23) and #11 (ISIT '22)
- Viraj Nadkarni (MS at UIUC → PhD at Princeton)
  Publication #13 (ICML '23)
- Sravan Kumar Ankireddy (PhD at UT Austin)
  Publication #11 (ISIT '22)

Academic Service

Reviewer *[2015 –]*

- Conferences: NeurIPS, ICML, AISTATS, ISIT

Teaching

Graduate Teaching Assistant: 3 semesters at UIUC, 5 semesters at IIT Bombay *[2013 – 2020]*

- UIUC: Information Theory (ECE 563), Representation Learning (ECE 598), Detection and Estimation Theory (ECE 561)
- IIT Bombay: Linear Algebra (MA 106), Differential Equations I-II (MA 108, MA 208), Complex Analysis (MA 205) & Electricity and Magnetism (PH 103)

Scholastic Achievements

- Secured **10/10** GPA at IIT Bombay, Spring 2014 - 2015
- Secured **All India Rank 14** in 41st National Mathematical Talent Competition *[2010]*
- Secured **All India Rank 32** in AIEEE among 10,65,100 students *[2011]*
- Secured **All India Rank 287** in IIT-JEE among 4,85,000 students *[2011]*

Patents

- **Non-linear encoding and decoding for reliable wireless communication** *[2022]*
  A.V. Makkuva, X. Liu, M.V. Jamali, H. Mahdavifar, S. Oh, P. Viswanath [google patents]

Publications

19*. What One Cannot, Two Can: Two-Layer Transformers Provably Represent Induction Heads on Any-Order Markov Chains
C. Ekbote, M. Bondaschi, N. Rajaraman, J. D. Lee, M. Gastpar, P. P. Liang*, **A.V. Makkuva***
*NeurIPS, 2025 (**Spotlight, 3% out of 12,575 papers**)* [arxiv]

18*. Attention with Markov: A Curious Case of Single-layer Transformers
A.V. Makkuva*, M. Bondaschi*, A. Girish, A. Nagle, M. Jaggi, H. Kim, M. Gastpar
*ICLR, 2025 (**Spotlight, 5% out of 11,670 papers**)* [arxiv]

17*. Fundamental Limits of Prompt Compression: A Rate-Distortion Framework for Black-Box Language Models
A. Girish, A. Nagle, M. Bondaschi, M. Gastpar, **A.V. Makkuva***, H. Kim*
NeurIPS, 2024 [arxiv]

16. Transformers on Markov Data: Constant Depth Suffices
N. Rajaraman, M. Bondaschi, K. Ramchandran, M. Gastpar, **A.V. Makkuva**
NeurIPS, 2024 [arxiv]

15. Local to Global: Learning Dynamics and Effect of Initialization for Transformers
A.V. Makkuva*, M. Bondaschi*, C. Ekbote, A. Girish, A. Nagle, H.Kim, M. Gastpar
NeurIPS, 2024 [arxiv]

14. LASER: Linear Compression in Wireless Distributed Optimization
A.V. Makkuva*, M. Bondaschi*, T. Vogels, M. Jaggi, H. Kim, M. Gastpar
ICML, 2024 [arxiv]

13. CRISP: Curriculum based Sequential Neural Decoders for Polar Code Family
S.A. Hebbar*, V. Nadkarni*, **A.V. Makkuva**, S. Bhat, S. Oh, P. Viswanath
ICML, 2023 [arxiv]

12. Machine Learning-Aided Efficient Decoding of Reed-Muller Subcodes
M.V. Jamali, X. Liu, **A.V. Makkuva**, H. Mahdavifar, S. Oh, P. Viswanath
IEEE Journal on Selected Areas in Information Theory (JSAIT), 2023 [arxiv]

11. TinyTurbo: Efficient Turbo Decoders on Edge
S.A. Hebbar*, R. Mishra*, S.K. Ankireddy, **A.V. Makkuva**, H. Kim, P. Viswanath
IEEE International Symposium on Information Theory (ISIT), 2022 [arxiv]

10*. KO codes: Inventing Nonlinear Encoding and Decoding for Reliable Wireless Communication via Deep-learning
A.V. Makkuva*, X. Liu*, M.V. Jamali, H. Mahdavifar, S. Oh, P. Viswanath
ICML, 2021 [arxiv]

9. Reed-Muller Subcodes: Machine Learning-Aided Design of Efficient Soft Recursive Decoding
M.V. Jamali, X. Liu, **A.V. Makkuva**, H. Mahdavifar, S. Oh, P. Viswanath
ISIT, 2021 [arxiv]

8*. Optimal transport mapping via input convex neural networks
A.V. Makkuva*, A. Taghvaei*, J.D. Lee, S. Oh
ICML, 2020 [arxiv]

7. Learning in Gated Neural Networks
A.V. Makkuva, S. Oh, S. Kannan, P. Viswanath
AISTATS, 2020 [arxiv]

6. Breaking the gridlock in Mixture-of-Experts: Consistent and Efficient Algorithms
A.V. Makkuva, S. Oh, S. Kannan, P. Viswanath
ICML, 2019 [arxiv]

5. Learning One-hidden-layer Neural Networks under General Input Distributions
W. Gao*, **A.V. Makkuva***, S. Oh, P. Viswanath
AISTATS, 2019 [arxiv]

4. Barracuda: The Power of ℓ-polling in Proof-of-Stake Blockchains
G. Fanti, J. Jiao, **A.V. Makkuva**, S.Oh, R. Rana, P. Viswanath
ACM International Symposium on Mobile Ad Hoc Networking and Computing (ACM Mobihoc), 2019 (**Best paper award**) [arxiv]

3. Equivalence of additive-combinatorial linear inequalities for Shannon entropy and differential entropy
A.V. Makkuva, Y. Wu
IEEE Transactions on Information Theory, 2018 [arxiv]

2. On additive-combinatorial affine inequalities for Shannon entropy and differential entropy
A.V. Makkuva, Y. Wu
ISIT, 2016 [ieee xplore]

1. Event-driven stochastic approximation
N. Sahasrabudhe, **A.V. Makkuva**, V.S. Borkar
Indian Journal of Pure and Applied Mathematics, 2016 [springer]