Ashok Vardhan Makkuva

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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

PROFESSIONAL APPOINTMENTS

- **Associate Professor – Télécom Paris, IP Paris** *[Nov 25 –]*
  Department of Computer Science, Data and AI
- **Postdoctoral Researcher – EPFL** *[Sep 22 – Sep 25]*
  Department of Computer and Communication Sciences
  Mentor: Michael Gastpar

LEADERSHIP

Organizer and Presenter – NeurIPS 2024 Tutorial, Sandbox for the Blackbox
- 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 top 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]*

SELECT TALKS

1. **From Markov to Laplace: A Markovian Tale of LLMs** *[2025 –]*
   - ENS Paris & Inria Paris, *Host: Francis Bach*
   - ENS Ulm, *Host: Gabriel Peyré*
   - Stanford University, *IT Forum*
   - ETH Zürich, *Hosts: Andreas Krause, Thomas Hofmann*
   - École Polytechnique, *Applied Mathematics Seminar*
   - ITA Workshop, *San Diego*

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

3. **KO codes** *[2021 – 2022]*
   - Talks at top institutions worldwide, including MIT, Stanford, Berkeley, CMU, UCSD, UToronto, ETH Zürich, EPFL, IST Austria, TIFR, and IISc.

4. **Learning in Gated Neural Networks** *[2018 – 2020]*
   - Talks at leading institutions in the US and India, including CMU, MSR, IIT Madras, IIT Bombay, and TIFR.

Select Publications

1. **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).
2. **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).
3. **Fundamental Limits of Prompt Compression: A Rate-Distortion Framework for Black-Box Language Models**
A. Girish, A. Nagle, M. Bondaschi, M. Gastpar, H. Kim*, **A.V. Makkuva***
NeurIPS, 2024.
4. **Optimal transport mapping via input convex neural networks**
A.V. Makkuva*, A. Taghvaei*, J.D. Lee, S. Oh
ICML, 2020.
5. **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 Mobihoc, 2019 (Best paper award).

Full Publication List

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).
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).
17. **Fundamental Limits of Prompt Compression: A Rate-Distortion Framework for Black-Box Language Models**
A. Girish, A. Nagle, M. Bondaschi, M. Gastpar, H. Kim*, **A.V. Makkuva***
NeurIPS, 2024.
16. **Transformers on Markov Data: Constant Depth Suffices**
N. Rajaraman, M. Bondaschi, K. Ramchandran, M. Gastpar, **A.V. Makkuva**
NeurIPS, 2024.
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.
14. **LASER: Linear Compression in Wireless Distributed Optimization**
A.V. Makkuva*, M. Bondaschi*, T. Vogels, M. Jaggi, H. Kim, M. Gastpar
ICML, 2024.
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.
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.
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.
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.
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.

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

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

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

5. **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).

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

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

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

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

Mentoring

- Marco Bondaschi (PhD at EPFL)
Publications (19, 18, 17, 16, 15, 14)
- Ranvir Rana (PhD at UIUC → Co-founder & CTO at Kaleidoscope Blockchain)
Publications (5, Best paper award)
- Xiyang Liu (PhD at University of Washington)
Publications (12, 10, 9) Qualcomm Fellowship Winner
- Mohammad Vahid Jamali (PhD at U. Michigan → Samsung)
Publications (12, 10, 9) Qualcomm Fellowship Winner
- Nived Rajaraman (PhD at UC Berkeley → Postdoc at MSR NYC)
Publications (19, 16)
- Adway Girish (PhD at EPFL)
Publications (18, 17, 15)
- Alliot Nagle (PhD at UT Austin)
Publications (18, 17, 15)
- Chanakya Ekbote (MS at EPFL → MIT Media Lab)
Publications (19, 15)
- Thijs Vogels (PhD at EPFL → MSR Amsterdam)
Publications (14)
- Ashwin Hebbar (MS at UIUC → PhD at Princeton)
Publications (13, 11)
- Viraj Nadkarni (MS at UIUC → PhD at Princeton)
Publications (13)
- Sravan Kumar Ankireddy (PhD at UT Austin)
Publications (11)

Academic Service

Reviewer *[2015 –]*

- Conferences: NeurIPS, ICML, ICLR, AISTATS, ISIT

Teaching

Instructor: Digital Communications and Information Theory, Télécom Paris *[2026]*

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]

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`