Darshil Doshi

Curriculum Vitae

A concrete understanding of AI is key to safety and alignment. My primary research aim is to bridge the gap between deep learning practice and its systematic understanding, through the *Science of Deep Learning*. My areas of interest include scaling, emergent abilities and interpretability.

Education

2025 **Ph.D. in Physics**, *University of Maryland, College Park*
Research advisors : Andrey Gromov, Maissam Barkeshli
Area of research : Science of Deep Learning

2020 **M.S. in Physics**, *Brown University*
Research advisor : Andrey Gromov
Area of research : Condensed Matter Physics

2017 **B.Tech. in Electrical Engineering with a Minor in Physics**, *Indian Institute of Technology, Gandhinagar*

Research Experience

2025 - Present **Postdoctoral Fellow**, *Johns Hopkins University*
Joint appointment as DSAI fellow and Physics of Learning fellow
- Deep Learning

2022 - 2025 **Graduate Research Assistant**, *University of Maryland, College Park*
Mentor: Andrey Gromov
- Deep Learning

2020 - 2022 **Graduate Research Assistant**, *Brown University*
Mentor: Andrey Gromov
- Deep Learning
- Condensed matter physics

2017 - 2018 **Junior Research Fellow**, *Indian Institute of Technology Gandhinagar*
Mentor: Baradhwaj Coleppa
- Particle physics

Teaching Experience

2018 - 2020 **Graduate Teaching Assistant**, *Brown University*

Publications

[1] T. Tao, **D. Doshi**, D. Kalra, T. He, and M. Barkeshli.
"(How) Can Transformers Predict Pseudo-Random Numbers".
ICML 2025.

[2] T. He, **D. Doshi**, A. Das, and A. Gromov.
"Learning to grok: Emergence of in-context learning and skill composition in modular arithmetic tasks".
NeurIPS 2024 (Oral).

[3] **D. Doshi**, A. Das, T. He, and A. Gromov.

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"To grok or not to grok: Disentangling generalization and memorization in corrupted algorithmic datasets".
ICLR 2024.

[4] T. He, **D. Doshi**, A. Das, and A. Gromov.
"Exploring model depth and data complexity throught the lens of cellular automata".
NeurIPS 2024 Workshop SciML.

[5] **D. Doshi**, T. He, A. Das, and A. Gromov.
"Grokking Modular Polynomails".
ICLR 2024 Workshop BGPT.

[6] **D. Doshi**, T. He, and A. Gromov.
"Critical Initialization of Wide and Deep Neural Networks using Partial Jacobians: General Theory and Applications". In
NeurIPS 2023 (Spotlight).

[7] T. He, **D. Doshi**, and A. Gromov.
"AutoInit: Automatic Initialization via Jacobian Tuning".
arXiv:2206.13568, 2022.

[8] **D. Doshi** and A. Gromov.
"Vortices as Fractons".
Nature Communications Physics, 4(44), 2021.

Invited Talks

- University of Cambridge (Jan 2025)
  "Science of Deep Learning: From initialization to emergent structures"
- Johns Hopkins University (Jan 2025)
  "Science of Deep Learning: From initialization to emergent structures"
- École Polytechnique Fédérale de Lausanne (Oct 2024)
  "Science of Deep Learning: From initialization to emergent structures"
- **7th Workshop on Neural Scaling Laws**, ICML 2024, Vienna, AT (July 2024)
  "Emergence of in-context learning and skill composition"
- **SciML Webinar**, Carnegie Mellon University (Oct 2022)
  "Critical Initialization of Deep Neural Networks using Jacobians"
- **CFPU SMLI Seminar**, Brown University (Sept 2021)
  "Functional Space Approach to Deep Neural Networks"

Contributed Talks

- **APS Global Symposium 2025**, Anaheim, USA
  "Learning to grok: Emergence of in-context learning and skill composition in modular arithmetic tasks"
- **IAIFI Summer School 2023**, Northeastern University
  "Grokking: a playground for feature learning"
- **NeurIPS 2024 (Oral)**, Vancouver, Canada
  "Learning to grok: Emergence of in-context learning and skill composition in modular arithmetic tasks"
- **ICML 2024 workshop on Mechanistic Interpretability**, Vienna, AT
  "Learning to grok: emergence of in-context learning and skill composition in modular arithmetic tasks"

- **APS March Meeting 2024**, Minneapolis, USA
  "To grok or not to grok: disentangling generalization and memorization in corrupted algorithmic datasets"
- **IAIFI Summer School 2023**, Northeastern University
  "Grokking: a playground for feature learning"
- **Pollica Summer Workshop 2023**, Pollica, Italy.
  "Grokking Modular Arithmetic"
- **APS March Meeting 2023**, Las Vegas, USA
  "Jacobians in Deep Neural Networks: Criticality and beyond"
- **APS March Meeting 2022**, Chicago, USA
  "Criticality in Deep Neural Networks using Jacobian(s)"
- **APS March Meeting 2021**
  "Vortices as Fractons"

Awards and Honors

- **Award of Excellence as a Graduate Teaching Assistant**, Brown University Department of Physics (2019)
- **Dean's list for academic excellence**, IIT Gandhinagar
  - Academic year 2013-14 semesters I, II
  - Academic year 2014-15 semesters I, II

Technical Skills

- Machine Learning: Python, Pytorch
- Cluster computing: Slurm
- Shell scripting
- Mathematica
- Latex

Selected Services

- Reviewer for NeurIPS, ICML, ICLR, ACML, AISTATS, IEEE-TPAMI
- Co-organizer, Technical Summit *Amalthea* at IIT Gandhinagar
- Co-organizer, Cultural Event *Blithchron* at IIT Gandhinagar

Languages

English, Gujarati, Hindi, (Sanskrit, Urdu)

References

- **Dr. Andrey Gromov** (Ph.D. Advisor)
  Meta FAIR
  Menlo Park, California, USA
  Email : gromovand@meta.com

- **Dr. Maissam Barkeshli**
  University of Maryland, College Park
  College Park, Maryland, USA
  Email : maissam@umd.edu

- **Dr. Irina Rish**
  University de Montreal; Mila
  Montreal, Quebec, CA
  Email : irina.rish@gmail.com

- **Dr. Baradhwaj Coleppa**
  Indian Institute of Technology Gandhinagar
  Gandhinagar, Gujarat, India
  Email : baradhwaj@iitgn.ac.in

- **Dr. Arup Lal Chakraborty**
  Indian Institute of Technology Gandhinagar
  Gandhinagar, Gujarat, India
  Email : arup@iitgn.ac.in