

# Madhur Panwar

Research Fellow, Microsoft Research India

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## EDUCATION

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- **Birla Institute of Technology and Science, Pilani (BITS Pilani)** Pilani, India
  - *B.E. Computer Science and M.Sc. Mathematics (Dual Degree)* 2016 – 2021
    - CGPA: 9.32/10.00 (**Distinction division**)
    - Receptient of Pratibhashali Award (Department of Mathematics)

## EXPERIENCE

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- **Microsoft Research** Bangalore, India
  - *Research Fellow – Advisor: [Dr. Navin Goyal](#)* Aug 2022 - Present
    - Understanding the emergent abilities of large language models and how they represent natural language. Our work on In-Context Learning and Bayesian Inference has been **accepted at ICLR 2024** and **various NeurIPS 2023 Workshops**.
- **Adobe** Noida, India
  - *Software Development Engineer – Manager: [Ganesh R](#)* Jul 2021 - Jul 2022
    - Developed the Landing Pages feature in [Adobe Journey Optimizer \(AJO\)](#), allowing marketers to design and serve landing pages to millions of end users. Received Spot Award for fixing a Customer Service Outage and won the New Hire Coding Bootcamp. Mentored summer internship projects for three students across Machine Learning and Software Engineering domains.
- **Nanyang Technological University** Singapore
  - *Undergraduate Thesis – Advisors: [Prof. Chng Eng Siong](#), [Prof. Poonam Goyal](#)* Jan 2021 - Jun 2021
    - Developed a fully Pythonic pipeline for speaker diarization using the x-vector representations and LSTM-based spectral clustering. [[thesis](#)]
- **Amazon** Hyderabad, India
  - *Software Development Engineer Intern – Manager: [Pankaj Jain](#)* Aug 2020 - Dec 2020
    - Developed a new module end-to-end for generating the node launch configuration of a major Amazon carrier. The developed features were deployed to production.
- **Adobe** Noida, India
  - *Research Intern – Advisors: [Balaji Krishnamurthy](#), [Milan Aggarwal](#)* May 2020 - Jul 2020
    - Worked at the Media and Data Science Research (MDSR) Lab and developed novel approaches to topic modeling. This research has been published as **a long paper at ACL 2021 (Oral)**.
- **University of Victoria** British Columbia, Canada
  - *Mitacs Globalink Research Intern – Advisor: [Prof. Ralph Evins](#)* May 2019 - Aug 2019
    - Worked on the development of an open-source project, [BESOS](#), that has been [published in The Journal of Open Source Software \(JOSS\)](#). Formulated and solved building energy optimization problems.
- **Indian Institute of Remote Sensing, Indian Space Research Organisation** Dehradun, India
  - *Research Intern – Advisor: [Dr. Shashi Kumar](#)* May 2018 - Jul 2018
    - Developed a system to calibrate Synthetic Aperture Radar (SAR) satellite imagery and a plugin to detect oil spills in SAR images.

## PUBLICATIONS

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(\* = EQUAL CONTRIBUTION)

- [1] **In-Context Learning through the Bayesian Prism** [[pdf](#)]  
[Madhur Panwar\\*](#), [Kabir Ahuja\\*](#), [Navin Goyal](#)  
*The Twelfth International Conference on Learning Representations* [ICLR '24]
- [2] **TAN-NTM: Topic Attention Networks for Neural Topic Modeling** [[pdf](#)]  
[Madhur Panwar\\*](#), [Shashank Shailabh\\*](#), [Milan Aggarwal\\*](#), [Balaji Krishnamurthy](#)  
*In Proceedings of the 59th Annual Meeting of the Association for Computational Linguistics* [ACL '21 (Oral)]

[3] **In-Context Learning and Bayesian Inference** [pdf]

Madhur Panwar\*, Kabir Ahuja\*, Navin Goyal

*NeurIPS 2023 Workshop - Robustness of Few-shot and Zero-shot Learning in Large Foundation Models (R0-FoMo)*

[4] **Surprising Deviations from Bayesian View in In-Context Learning** [pdf]

Madhur Panwar, Kabir Ahuja, Navin Goyal

*NeurIPS 2023 Workshop - I Can't Believe It's Not Better (ICBINB): Failure Modes in the Age of Foundation Models*

[5] **Transformers Can Learn To Solve Linear-Inverse Problems In-Context** [pdf]

Kabir Ahuja\*, Madhur Panwar\*, Navin Goyal

*NeurIPS 2023 Workshop - Deep Learning and Inverse Problems*

[6] [Re] **AdaBelief Optimizer: Adapting Stepsizes by the Belief in Observed Gradients** [pdf]

Anirudh Buvanesh\*, Madhur Panwar\*

*ReScience C*, vol. 8, no. 2, 2022 (accepted under *ML Reproducibility Challenge 2021*)

[ReScience C'22]

Presented at *NeurIPS 2022 Journal Track (Spotlight)*

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PATENTS

[1] **System and Methods for Neural Topic Modeling using Topic Attention Networks** [pdf]

Shashank Shailabh, Madhur Panwar, Milan Aggarwal, Pinkesh Badjatiya, Simra Shahid, Nikaash Puri, S Sejal Naidu, Sharat Chandra Racha, Balaji Krishnamurthy, Ganesh Palwe

*US Patent Application No. 17/644,856 | Adobe Inc.*

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SELECTED RESEARCH PROJECTS

• **ICL and Emergent Abilities**

Advisor: [Dr. Navin Goyal](#)

Apr 2023 - Present

- Working on uncovering the cause of emergent abilities, such as in-context learning, in transformer language models.
- Found that in-context learning can be viewed from a Bayesian perspective. In [our paper](#), we discuss various problems where transformers simulate the Bayesian predictor and where they deviate from it.
- This work has been **accepted at ICLR 2024 and NeurIPS 2023 Workshops: R0-FoMo, ICBINB, Deep Inverse**.

• **Interpretation of World Models**

Advisor: [Dr. Navin Goyal](#)

Aug 2023 - Present

- Constructing specialized worlds with specific linguistic elements to train and interpret language models.
- Found that small (2-layer) LMs are capable of answering questions about the final state in a synthetic world where people transact objects among each other.

• **Speaker Diarization**

Advisors: [Prof. Chng Eng Siong](#), [Prof. Poonam Goyal](#)

Jan 2021 - Jun 2021

- Traditional diarization systems were modular with different components trained independently. I developed a fully Pythonic end-to-end pipeline for speaker diarization by jointly training the x-vector representation network and LSTM-based spectral clustering component. [thesis]
- Analysed the x-vectors' ability to recognize an audio input across various data augmentations.
- Discovered a limitation of x-vector representations: *the learned speaker discriminative characteristics are dependent on the sampling rate of training data*.
- Contributed to the open source project - [Kaldi Speech Recognition Toolkit](#). [pull request]

• **Topic Modeling**

Advisors: [Balaji Krishnamurthy](#), [Milan Aggarwal](#)

May 2020 - Feb 2021

- Developed a novel topic-aware attention mechanism for better document encodings in topic modeling.
- Designed a query recommendation system for [Adobe Support Communities](#) using topic modeling and deployed it to production.
- Applied topic models for downstream tasks like document classification and supervised keyphrase generation.
- This research has been published as [a long paper at ACL 2021 \(Oral\)](#).

• **Process Sequence Extraction**

Advisor: [Prof. Poonam Goyal](#)

Jan 2020 - May 2020

- Built a finite-state machine to process the transcript of an instructional video and output a captioned sequence of frames that defines the task in the video.

## ACHIEVEMENTS, HONOURS AND AWARDS

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- **Research Week with Google, 2023** | Selected by Google Research India among nationwide applicants to attend the "Research Week with Google" event. [certificate]
- **Institute Merit Scholarship, 2016 - 2021** | Received scholarship at BITS Pilani for being in the top 4% of students across all academic departments for all 10 semesters.
- **Hacktoberfest [🍁], 2021** | Contributed to open source projects like [microsoft/ML-For-Beginners](#), [pytorch-ignite](#), [kedro](#) & [TheAlgorithms/Java](#), and was one among the first 50,000 participants to complete the Hacktoberfest challenge.
- **Pratibhashali Award, 2020** | Conferred by the Department of Mathematics, BITS Pilani, for notable achievements in research and academics. [certificate]
- **Mitacs Globalink Research Internship (GRI) [🍁], 2019** | I was one among the 64 Indian applicants selected for this program by [Mitacs](#) in consultation with AICTE [AICTE report, page 47]. Under GRI, Mitacs provides funding to conduct research in Canada. This competitive program involves international undergraduate applicants from 15 countries.
- **INSPIRE Scholarship [🍁], 2015** | Awarded by [DST](#), Government of India, for securing a place among the **top 1% students** in the Indian School Certificate Examination conducted by [CISCE](#).
- **Putani Vignana International Science Talent Examination, 2010** | **Ranked third nationwide.** [certificate]

## SERVICES AND TEACHING ASSISTANTSHIPS

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- **Served as a reviewer** for ICML 2024, ACL 2024 and NeurIPS 2023 R0-FoMo Workshop.
- **NeurIPS Volunteer, 2022** | Helped attendees with their queries at the helpdesk and with the execution of certain virtual events at the NeurIPS 2022 conference.
- **ACL Volunteer, 2021** | Served as a Helpdesk Volunteer at ACL 2021 virtual conference.
- **Logic in Computer Science (CS F214) - Teaching Assistant, 2019** | Responsibilities included helping students with the coursework and assignments.
- **Student Faculty Council (SFC) - Member, 2018 - 2019** | Responsibilities included highlighting the academic concerns of students to faculty members and the HoD, Department of Mathematics.

## RELEVANT COURSEWORK

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- **Computer Science:** Data Structures & Algorithms, Object Oriented Programming, Image Processing, Cryptography
- **Mathematics:** Mathematics I (Multivariate Calculus), Mathematics II (Linear Algebra, Complex Variables and Calculus), Mathematics III (Differential Equations), Probability & Statistics, Discrete Mathematics, Algebra I (Abstract Algebra), Non-Linear Optimization, Numerical Analysis, Number Theory