# Anand Brahmbhatt

Princeton University
Homepage
ab7728@princeton.edu
Google Scholar

## Education

**Princeton University** *Aug 2024 - present*
*PhD student in Computer Science and Engineering* **GPA: 3.925/4.0**
Advisor: Prof. Elad Hazan **Gordon Y.S. Wu Fellow**
*Research Focus:* Provable **LLM architecture design** via modeling language as a dynamical system.

**Indian Institute of Technology Delhi** *2018 - 2022*
*B.Tech in Computer Science and Engineering* **GPA: 9.685/10**
Advisors: Prof. Parag Singla & Prof. Mausam **Department Rank 5**

## Work Experience

**Google Research India** *Jul 2022 - Jul 2024*
*Pre-Doctoral Researcher*
Advisors: Dr. Rishi Saket & Dr. Aravindan Raghuveer
*Research Focus:* **Aggregated Data** – Learning Algorithms, Privacy Quantification, Benchmark Development.

**Adobe Research** *May 2021 - Aug 2021*
*Research Intern*
Advisors: Dr. Shiv Saini & Dr. Atanu R Sinha
*Research Focus:* Designing fair and efficient **Cloud Resource Allocation** mechanisms.

## Research Projects

**Efficient Learning and Control of Dynamical Systems** *Princeton University*
Advisors: Prof. Elad Hazan *Jan 2025 - ongoing*

❖ **Spectral Learning of Non-linear Dynamical Systems** *May 2025 – Aug 2025*

- Modeled language as a non-linear dynamical system, motivating provable **LLM architecture** design.
- Reduced non-linear systems to high-dim linear, and asymmetric LDSs to real-diagonalizable, enabling spectral learning.
- Designed a provable algorithm based on **spectral filtering**, exploiting its independence from hidden dimension.
- Introduced a new **complexity measure** for learning such systems, matching known lower bounds. **[P.1]**

❖ **Efficient Online Non-Stochastic Control** *Jan 2025 - May 2025*

- Proposed new methods for controlling linear dynamical systems under **adversarial** disturbances and convex costs.
- In the **full observation** setting, matched the best-known regret against linear state-feedback controllers, while improving runtime from polynomial to **polylogarithmic** in the inverse stability margin. **[P.2]**
- Obtained similar results in the more challenging **partial observation** setting against a broader class of **LDCs**. **[P.3]**

**Algorithms for Aggregated Data** *Google Research India*
Advisors: Dr. Rishi Saket & Dr. Aravindan Raghuveer

❖ **Learning from Label Proportions (LLP) with Linear Thresholds (LTFs)** *Sep 2022 - Feb 2023*

- Studied the **NP-Hard LLP with LTF** problem after imposing realistic **distributional assumptions**.
- Proposed a **PCA** based algorithm to PAC learn LTFs (in this relaxed case) with **polynomial sample complexity**.
- Work presented as **Spotlight paper (top 3% of all submissions)** at NeurIPS 2023. **[C.1]**

❖ **Aggregation algorithms for Differential Privacy** *Feb 2023 - Sep 2023*

- Studied the implications of random aggregation to attain **label differential privacy** (label DP).
- Suggested two aggregation methods for label DP: one **without noise**, the other with **minimal additive noise**.
- Established the dependence of privacy and utility on bag size and number of bags for both mechanisms. **[P.4]**

❖ **Benchmark for Learning from Label Proportions (LLP)** *Jul 2022 - May 2023*

- Created a **benchmark of LLP datasets** by Criteo CTR prediction dataset using different realistic techniques.
- Introduced **metrics** to assess **LLP dataset learnability** and demonstrated benchmark diversity using these metrics.
- Evaluated **9 SOTA LLP techniques** on our benchmark and provided insights to aid future exploration. **[C.2]**

**Fairer Cloud Resource Allocation** *Adobe Research*
Advisors: Dr. Shiv Saini & Dr. Atanu R Sinha *May 2021 - Aug 2021*

- Designed a **Shapley-Value** based approach for fairer cloud resource allocation using historic meter (usage metrics) data.
- Presented a fresh method for pinpointing the **most suitable meters** for resource allocation.
- Identified resource under-utilization by modelling ideal utilization on internal Adobe usage data. **[Pat.1]**

**Quantifying Closeness to Cordiality of Graphs** *Summer Research Project, IIT Delhi*
Advisor: Prof. Amitabha Tripathi *Apr 2020 - Jul 2020*

- Proposed two measures of **distance from cordiality** for graphs.
- Computed these measures or bounds on these measures for general classes of graphs.
- Proved an overarching theorem of bound on these measures under graph join operations. **[J.1]**

## Publications & Patents

### Conference and Journal Publications

* - equal contribution, # - alphabetical

1. **PAC Learning Linear Thresholds from Label Proportions** **[C.1]**
   **Anand Brahmbhatt***, R. Saket* and A. Raghuveer. ***Spotlight** @ **NeurIPS**, 2023.*
2. **LLP-Bench: A Large Scale Tabular Benchmark for Learning from Label Proportions** **[C.2]**
   **Anand Brahmbhatt***, M. Pokala*, R. Saket and A. Raghuveer. ***CIKM**, 2024.*
3. **Measures of Closeness to Cordiality for Graphs** **[J.1]**
   **Anand Brahmbhatt**#, K. Rai# and A. Tripathi#. *Discrete Applied Mathematics Vol 370, Pages 157-166, 2025.*

### Preprints

1. **Universal Learning of Nonlinear Dynamics** **[P.1]**
   E. Dogariu, **Anand Brahmbhatt** and E. Hazan. *arXiv:2508.11990, 2025.*
2. **A New Approach to Controlling Linear Dynamical Systems** **[P.2]**
   **Anand Brahmbhatt**#, G. Buzaglo#, S. Druchyna# and E. Hazan#. *arXiv:2504.03952, 2025.*
3. **Efficient Spectral Control of Partially Observed Linear Dynamical Systems** **[P.3]**
   **Anand Brahmbhatt**#, G. Buzaglo#, S. Druchyna# and E. Hazan#. *arXiv:2505.20943, 2025.*
4. **Label Differential Privacy via Aggregation** **[P.4]**
   **Anand Brahmbhatt**, R. Saket, S. Havaldar, A. Nasery and A. Raghuveer. *arXiv:2310.10092, 2023.*

### Patents

1. **Cloud-Based Resource Allocation Using Meters** **[Pat.1]**
   A. Sinha, S. Saini, S. Nair, S. Marathe, M. Gupta, **Anand Brahmbhatt**, A. Chauhan. *US Patent 20230259403, 2023.*

## Awards and Honors

- Awarded the **Gordon Y.S. Wu Fellowship** for incoming graduate students at Princeton University. *2024*
- **Department Rank 5** amongst 90+ students in the CSE Department at IIT Delhi. *2018 - 2022*
- **All India Rank 917** in JEE Advanced (IIT-JEE) 2018 among 150,000 candidates. *2018*
- Awarded KVPY Fellowship from Government of India - **All India Rank 514**. *2018*

## Relevant Courses

| | |
|---|---|
| **Machine Learning** | Theoretical Machine Learning, Convex Optimization, Natural Language Processing, Introduction to Machine Learning, Introduction to Artificial Intelligence |
| **Theoretical Computer Science** | Advanced Algorithm Design, Complexity Theory, Discrete Mathematical Structures, Analysis & Design of Algorithms, Data Structures & Algorithms |
| **Systems** | Operating Systems, Computer Networks, Database Management Systems, Computer Architecture, Digital Logic & System Design, Signal & Systems |
| **Mathematics** | Real & Complex Analysis, Probability Theory, Linear Algebra, Differential Equations |