# **Gautham Govind Anil**

# Pre-Doctoral Researcher, Google DeepMind

## **EDUCATION**

#### **Indian Institute of Technology Madras**

2019 - 2024

Dual Degree - B.Tech. in Electrical Engineering + M.Tech. in Data Science Departmen

Department Rank: 1, 9.72/10

#### **PUBLICATIONS & PREPRINTS**

Fine-Tuning Diffusion Models via Intermediate Distribution Shaping 📙

[In Submission]

GG Anil, SU Haque, N Kannen, D Nagaraj, S Shakkottai, K Shanmugam Presented @ PUT Workshop, ICML 2025

Interleaved Gibbs Diffusion for Constrained Generation

[In Submission]

**GG Anil**, S Yadav, D Nagaraj, K Shanmugam, P Jain

Presented @ DeLTA Workshop, ICLR 2025

Infinite Width Limits of Self Supervised Neural Networks 📙

M Fleissner, **GG Anil**, D Ghoshdastidar

[AISTATS 2025]

When Can We Approximate Wide Contrastive Models with NTKs and PCA?

**GG Anil**, P Esser, D Ghoshdastidar

[AAAI 2025]

QuGAP: Generating Universal Adversarial Perturbations for Quantum Classifiers 🔀

**G Anil\***, V Vinod\*, A Narayan

[AAAI 2024]

#### RESEARCH EXPERIENCE

## Pre-Doctoral Researcher, Google DeepMind

Aug '24 - Present

Advisors: Dr. Dheeraj Nagraj, Dr. Karthikeyan Shanmugam, Dr. Prateek Jain

# Fine-Tuning Diffusion Models via Intermediate Distribution Shaping 🔁

- Marginal KL intractable for diffusion models; policy gradient methods rely on relaxations of marginal KL.
- Unified rejection sampling fine-tuning methods as GRAFT; theoretically established equivalence to PPO.
- Introduced P-GRAFT to fine-tune intermediate latents; mathematical justification via bias-variance tradeoff.
- Proposed Inverse Noise Correction for reversible flow models to fine-tune even without explicit rewards.
- Developed methods show 8.81% improvement in VQAScore for Text-to-Image generation across datasets.

## Interleaved Gibbs Diffusion for Constrained Generation

- Existing discrete-continuous diffusion frameworks assume factorizability across elements during reversal.
- They do not capture constraints well; demonstrated 7% improvement in 3-SAT by foregoing factorizability.
- Introduced a novel discrete-continuous diffusion framework achieving exact reversal with ideal denoisers.
- SOTA performance across layout, molecule and tabular generation without domain-specific architectures.

#### **Visiting Student Researcher, Technical University of Munich**

Oct '23 - Mar '24

Advisor: Prof. Debarghya Ghoshdastidar

## Infinite Width Limits of Self-Supervised Neural Networks 🔀

- Prior works implicitly assume convergence to NTK for wide neural nets trained using non-contrastive losses.
- Rigorously established NTK constancy for one hidden layer wide neural nets under Barlow Twins loss.
- New proof technique to account for Barlow Twins' training dynamics; leveraged Grönwall's inequality.
- Derived generalization error bounds for Kernel Barlow Twins; connected to finite neural nets through NTK.

#### Approximating Wide Contrastive Models with NTKs and PCA

- Equivalences between optimization objectives of (kernel) contrastive learning and PCA are known.
- First to analyze training dynamics for contrastive losses; proved NTK constancy for cosine-similarity losses.
- NTK does not lead to closed form solution; imposed orthogonality constraints to derive explicit solution.
- Established closeness between PCA and Grassmannian gradient descent for cosine-similarity losses.

<sup>\*</sup>Equal Contribution

Advisor: Prof. Apurva Narayan

#### Generating Universal Adversarial Perturbations for Quantum Classifiers

- UAPs are well established for classical machine learning models; notion ill-defined for Quantum Classifiers.
- Conceptualized and theoretically proved existence of additive UAPs; proposed QuGAP-A for generation.
- Introduced QuGAP-U for generation of unitary UAPs; leveraged a novel fidelity-based loss for high fidelity.
- QuGAP-U achieved full misclassification at over 20% higher quantum state fidelity compared to prior SOTA.

# **EXPLORATORY PROJECTS**

#### Audio-Visual Segmentation under Prof. AN Rajagopalan 💆

Jan '23 - May '23

- Utilized disjoint image and audio datasets for AV segmentation; on par performance with curated datasets.
- Proposed and evaluated a modular AV segmentation pipeline using audio labels; improved mIoU by 15%.

#### Reinforcement Learning Methods under Prof. Balaraman Ravindran 🗘

Jan '23 - May '23

- Implemented DQN and Actor-Critic methods on OpenAI gymnasium (AcroBot/ CartPole, MountainCar).
- Empirically compared and contrasted SARSA and Q-Learning as well as SMDP and Intra-option Q-Learning.

#### Combinatorial Optimization using Quantum Annealing under Prof. Anil Prabhakar 🖓 Jan '22 - May '22

- Formulated QUBOs for solving combinatorial optimization problems such as Vehicle Routing and Clustering.
- Empirically demonstrated improved time complexity for proposed quantum annealing based algorithm.

## Multi-Robot Coverage Planning under Prof. Balaji Srinivasan 🗘

Oct '21 - Dec '2'

- Developed a multi-agent coverage path planner inspired by Boustrophedon Cellular Decomposition.
- Trained semantic segmentation modules for trash detection; first position in Inter-IIT Robotics challenge.

#### Remote Sensing using SAR with GalaxEye Space Solutions Pvt. Ltd.

Jun '21 - Aug '21

- Proposed a novel method for Range Cell Migration Correction by modifying Range Doppler Algorithm.
- Implemented the algorithm for FMCW SAR; lowered ADC sampling rate and achieved 50% speed boost.

## **KEY COURSEWORK**

Pattern Recognition & Machine Learning, Reinforcement Learning, Modern Computer Vision, Mathematical Foundations of Data Science, Estimation Theory, Control Theory, Probability, Statistics & Stochastic Processes, Linear Algebra, Multivariate Calculus, Data Structures & Algorithms, Big Data Lab, Introduction to Data Analytics, Quantum Computation & Quantum Information, Digital Signal Processing, Computer Organization.

#### ACHIEVEMENTS

- 2024 Selected for 2-year pre-doctoral researcher program at Google DeepMind India.
- 2024 Received American Express Leadership Award for Excellence in Data Science.
- 2023 Selected for 6-month research internship at Technical University of Munich through DAAD-KOSPIE.
- 2023 Selected for 12-week research internship at The University of British Columbia through MITACS-Globalink.
- **2021** Selected as an Undergraduate Young Research Fellow at IIT Madras, from over 200 candidates.
- 2019 Secured All India Rank 187 (top 0.02%) among 1.1 million candidates in JEE (Main).
- 2019 Secured All India Rank 415 (top 0.2%) among 0.2 million candidates in JEE (Advanced).

#### **TALKS & PRESENTATIONS**

- 2025 Poster @ PUT Workshop, ICML 2025, Vancouver Convention Centre, Canada
- 2024 Talk @ TFAI, Technical University of Munich, Germany
- 2024 Poster @ AAAI 2024, Vancouver Convention Centre, Canada
- 2022 Poster @ Young Research Fellow Showcase Event, Indian Institute of Technology Madras

#### **VOLUNTEERING**

- **2024** Volunteer @ AAAI 2024, Vancouver: Coordinated workshop sessions.
- 2022 Coordinator @ Jobs & Internships Cell, IIT Madras: Handled logistics for on-campus job fairs.
- 2021 Audiobook Narrator @ NSS, IIT Madras: Audiobooks for enabling individuals with visual impairment.
- 2020 Mentor @ Avanti Fellows, IIT Madras: Mentored over 60 underprivileged high school students.
- 2020 Content Writer @ NSS, IIT Madras: Wrote high school level articles on Physics & Chemistry.