

# Emil Biju

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## EDUCATION

### Stanford University

*Starting Sept. 2023*

M.S. in Electrical Engineering, Focus Area: Machine Learning/AI

California, USA

- Coursework focused on machine learning, deep learning, NLP and signal processing.
- Research in interpretable machine learning and applications to deep learning and LLMs.

### Indian Institute of Technology Madras (IIT Madras)

*2017–2021*

B.Tech (Honours) in Electrical Engineering (**CGPA: 9.70/10**), Minor in Deep Learning

Chennai, India

- Graduated as the department's **second topper** out of 53 students.
- Received the top grade (S) in all courses from the Computer Science, Mathematics, and Humanities departments.
- [B.Tech Thesis](#): Sample-specific Attention Masks for Model Transparency and Adversarial Detection

## PUBLICATIONS IN MACHINE LEARNING & ALGORITHMS

1. **Input-specific Attention Subnetworks for Adversarial Detection** [\[Paper\]](#)  
Emil Biju, A. Sriram, P. Kumar, M. Khapra; Published at [ACL 2022 \(Findings\)](#), Dublin, Ireland
2. **Joint Transformer/RNN Architecture for Gesture Typing in Indic Languages** [\[Paper\]](#)  
Emil Biju, A. Sriram, M. Khapra, P. Kumar; Published at [COLING 2020](#), Barcelona, Spain
3. **Perturbation Analysis of Practical Algorithms for the Maximum Scatter TSP** [\[Paper\]](#)  
Emil Biju, S. Raman; Published at [ALENEX workshop @ SODA 2022](#), Virginia, U.S.A.
4. **Vocabulary-constrained Question Generation with Rare Word Masking & Dual Attention** [\[Paper\]](#)  
Emil Biju; 🏆 Best Paper Honorable Mention; Published at [ACM CODS-COMAD 2021](#), Hyderabad, India

## PROFESSIONAL EXPERIENCE

### Microsoft R&D

*June 2021–Present*

Data & Applied Scientist (Full-time, **2 years**)

Bangalore, India

- Working as a researcher at the intersection of data science and cybersecurity, with a focus on OAuth cloud app security
- Developed 10 industry-first machine learning solutions spanning knowledge graphs, anomaly detection, computer vision, and NLP to model cyber attack patterns, track app behavior, and avert security threats.
- Built & deployed models that analyze terabytes of data every day meeting stringent goals on latency and efficacy.
- **Filed a patent**, published a **paper** at MLADS 2022 & received an **early promotion** for exceptional work.

### Microsoft R&D

*May–July 2020*

Data & Applied Scientist Intern

Hyderabad, India

- Developed CNN and Transformer-based deep learning models to analyze multi-spectral satellite images for estimating biomass in agricultural fields and identifying prospective areas for oil exploration.
- Designed a data structure for the open-source package, **xarray** to support tree-based hierarchical data storage.

### GE Healthcare R&D

*May–July 2019*

Data Scientist Intern

Bangalore, India

- Used graph-based keyword clustering and topic ranking to analyze text in service records of healthcare machines.
- Set up an automated pipeline to flag common failure patterns and suggest quality improvement opportunities.
- Reduced the time taken to extract insights from service records by 11x and was appreciated by company leaders.

## SCHOLASTIC ACHIEVEMENTS

- **IIT Madras Silver Medal**: Awarded the Dr. Dilip Veeraraghavan Memorial Award by IIT Madras for featuring as the institute's second topper based on overall CGPA and cumulative performance in H category courses.
- **NTSE Scholarship**: Awarded by the Govt. of India based on a nationwide exam with 0.1% acceptance rate.
- **KVPY Fellowship**: Awarded by the Govt. of India based on a nationwide exam and interview with 2.5% acceptance rate to identify students with scientific research potential.
- **Samsung-IITM Pravartak Fellowship**: Awarded for research work on interpretability of Transformer models.
- **Best Paper Honorable Mention**: Awarded for my publication at ACM CODS-COMAD 2021.
- **GRE**: 333/340 (Quant:170, Verbal: 163, AWA: 5); **TOEFL**: 117/120 (R: 30, W: 30, S: 30, L: 27)

## RESEARCH PROJECTS

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### Adversarial Detection in Transformer Models using Attention Subnetworks

Jan–Nov 2021

B.Tech thesis | Guide: [Prof. Pratyush Kumar](#), IIT Madras

[Paper](#) | [Webpage](#)

- Studied the self-attention framework in Transformers to improve their interpretability and robustness.
- Demonstrated that Transformers contain input-specific attention subnetworks that are interpretable and can be used to detect adversarial inputs.
- Improved the state-of-the-art accuracy in adversarial detection by 7.5% across 10 NLP tasks and 11 attack types.

### IndicSwipe: Decoding Swipe Gesture Inputs to Indic Language Keyboards

Jan–July 2020

Undergraduate research | Guide: [Prof. Mitesh Khapra](#), IIT Madras

[Paper](#) | [Webpage](#)

- Curated a training dataset of swipe gestures for 300k words in 7 Indic languages by using the brain's motor control principle of jerk minimization to simulate swipe inputs to a smartphone keyboard.
- Developed a Transformer-LSTM model for accurate swipe decoding and an ELMo-inspired word embedding model for fast/parallelized spelling correction. Achieved state-of-the-art accuracies of 70-95% across 7 languages.

### Approximation Algorithms for the Maximum Scatter TSP

Jan–Aug 2021

Undergraduate research, IIT Madras

[Paper](#) | [Webpage](#)

- Devised 6 discrete approximation algorithms for the NP-hard maximum scatter traveling salesman problem.
- Performed smoothed analysis with various perturbations and edge-cost metrics to benchmark the stability, speed and accuracy of these algorithms. Demonstrated their practical utility using real-world datasets.

### Risk propagation in Knowledge Graphs for detecting Cyberattack Campaigns

Sept–Nov 2022

Cybersecurity research team, Microsoft | Primary contributor

**Patent filed**

- Built a knowledge graph representing OAuth cloud apps and their metadata properties, developed an algorithm to propagate risk scores between nodes, and used  $k$ -connectedness to detect dense campaign clusters.
- Uncovered 4 real-world cyberattack campaigns involving over 2,000 malicious apps that have now been disabled.

### App Governance Copilot using GPT-3

Jan–Aug, 2023

Cybersecurity research team, Microsoft | Lead contributor

- Developed a GPT-3 based assistant specialized in cybersecurity for assisting SOC analysts in investigation, hunting and remediation of security threats from malicious OAuth cloud applications.
- Demonstrated how LLMs can be extended to domain-specific APIs and services through few-shot prompting for seamless interaction.

## RELEVANT COURSEWORK

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**Computer Science:** Introduction to programming, Data Structures and Algorithms, Topics in Design and Analysis of Algorithms, Introduction to Automata, Languages and Computation

**Machine Learning:** Introduction to Machine Learning, Deep Learning, Natural Language Processing, Advanced Topics in Signal Processing (Computer Vision/image processing), Data Mining

**Mathematics:** Linear Algebra, Probability Foundations, Graph Theory, Series & Matrices, Differential Geometry

**Electrical:** Computer Organization, Digital Signal Processing, Information Theory, Microprocessors, Digital Systems, Analog systems, Circuits & networks, Internet of Things, Electromagnetics, Electrical Machines, Solid State Devices

## TECHNICAL SKILLS

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**Programming Languages:** Python, C, C++, PySpark, SQL, ARM, Verilog

**Libraries:** TensorFlow, Keras, OpenCV, Numpy, NLTK, Matplotlib, Scikit-learn, and other ML libraries

**Interests:** Machine learning, Deep learning, NLP, Signal processing, Discrete algorithms

## LEADERSHIP ROLES & EXTRA-CURRICULAR ACTIVITIES

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**Founder, Passion JEE:** Created a [blog](#) to mentor engineering aspirants in India & clocked over 6k views to date.

**Learning champ, Microsoft:** Curated learning material for new employees and organized learning sessions for 1000+ employees in the cybersecurity team.

**Academic Service:** Served as a paper reviewer for the MLADS 2021 conference and a mentor for college freshers.

**Coordinator, Extra Mural Lectures:** Invited top speakers and organized the flagship guest lecture series of IITM.

**School Head Boy:** Popularly elected by the school community and headed the students' council in my 10th grade.

**Public Speaker:** Featured as the lead emcee/speaker at several prominent events in college and at work.