Emil Biju

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Education

Indian Institute of Technology Madras (IIT Madras) *2017 – 2021*
B.Tech (Honors) in Electrical Engineering (**CGPA: 9.70/10**), Minor in Deep Learning Chennai, India

- Graduated as the **second topper** of the Electrical Engineering department.
- Received the top grade (S) in all Computer Science, Mathematics and Humanities courses.
- B.Tech Thesis: Sample-specific Attention Masks for Model Transparency and Adversarial Detection

Publications

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

Experience

Microsoft R&D *June 2021 – Present*
Data & Applied Scientist Bangalore, India

- Working as a researcher at the intersection of data science and cybersecurity, with a focus on OAuth cloud app security.
- Developed over 10 industry-first machine learning solutions spanning knowledge graphs, anomaly detection, computer vision and NLP to model cyberattack patterns, track app behavior and avert security threats.
- Built models that analyze terabytes of daily data, meeting critical objectives on scalability and detection fidelity.
- Published a paper at MLADS 2022 and was promoted to Level 60 as a recognition of exceptional performance.

Microsoft R&D *May – July, 2020*
Data & Applied Scientist Intern Hyderabad, India

- Developed deep learning models to analyze multi-spectral image data for estimating biomass in agricultural fields and identifying prospective areas for oil exploration from satellite images.
- Designed and developed a novel tree-based hierarchical data structure for xarray, an open-source Python package.

General Electric *May – July, 2019*
Data Scientist Intern Bangalore, India

- Developed an algorithm using graph-based keyword clustering and topic ranking to analyze service records, identify failure patterns and suggest improvement opportunities for healthcare machines.
- Demonstrated 11x improvement in the amount of analyzed data and applied for a U.S. patent on the novel methodology.

Scholastic Achievements

- **GRE: 333/340** (Quant:170, Verbal: 163, AWA: 5); **TOEFL: 117/120** (R: 30, W: 30, S: 30, L: 27)
- **IIT Madras Silver Medal:** Awarded the Dr. Dilip Veeraraghavan Memorial Award for featuring as the second topper based on overall CGPA and cumulative performance in H category courses.
- **NTSE Scholar:** Awarded an annual scholarship by the Govt. of India based on the National Talent Search Exam
- **KVPY fellowship:** Awarded the prestigious fellowship by the Indian Institute of Science
- Awarded the **branch change** option for exceptional academic performance in the 1st semester at IIT Madras.
- **Samsung-IITM Pravartak Fellowship:** Awarded for research work on interpretability of Transformer networks.

Research Projects

Adversarial Detection in Transformers using Attention Subnetworks *Jan – Nov, 2021*

B.Tech thesis | Guides: Prof. Pratyush Kumar and Prof. Mitesh M. Khapra, CS Dept. IIT Madras *Paper* | *Webpage*

- Studied the effectiveness of self-attention heads in Transformers for improving model interpretability and detecting adversarial samples.
- Demonstrated that Transformers contain input-specific attention subnetworks that are discriminative of an input's target class and how such networks can be perturbed to discern adversarial inputs.
- Significantly improved (by over 7.5%) the state-of-the-art accuracy in adversarial detection across 10 NLP tasks and 11 attack types.

IndicSwipe: Decoding Gesture Inputs to Indic Language Keyboards *Jan – July, 2020*

Undergraduate research | Guide: Prof. Mitesh Khapra, CS Dept., IIT Madras *Paper* | *Webpage*

- Designed a sequential deep learning framework for decoding swipe-based text inputs to smartphone keyboards and performing transliteration to support Indic languages.
- Developed an architecture combining a Transformer encoder and LSTM layers to capture co-character dependencies, redundancies and break-points in sequences obtained from swipe inputs.
- Used the brain motor control principle of jerk minimization to simulate swipe inputs for curating datasets and achieved state-of-the-art accuracies of 70-95% across 7 Indic languages.

Approximation Algorithms for the Maximum Scatter TSP *Jan – Aug, 2021*

Undergraduate research | Guide: Prof. Raghavendra Rao B.V., CS Dept., IIT Madras *Paper* | *Webpage*

- Devised 6 discrete approximation algorithms for solving the NP-hard maximum scatter travelling salesman problem and demonstrated trade-offs that exist among the stability, speed and accuracy of these algorithms.
- Performed smoothed analysis with 5 perturbation types and 3 edge-cost metrics on real-world datasets to analyze the scalability and practical utility of the algorithms.

Optimised RISC-V CPU implementation *Jan – Aug, 2021*

EE2003 Computer Organization course project, IIT Madras

- Developed a RISC-V CPU with 5-stage pipeline in Verilog and optimized performance using branch prediction and exception handling.
- Performed exhaustive verification of CPU functionality on an FPGA board.

Relevant Coursework

Computer Science: Introduction to Programming , Data Structures and Algorithms, Topics in Design and Analysis of Algorithms, Applied Programming Lab, Introduction to Automata, Languages and Computation

Data Science: Introduction to Machine Learning, Deep Learning, Natural Language Processing, Modern Computer Vision (from Advanced Topics in Signal Processing), Data Mining

Mathematics: Linear Algebra, Probability Foundations, Graph Theory, Differential Geometry, Information Theory

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

Online Courses : Machine Learning (Coursera - Stanford University), Deep Learning: Advanced NLP and RNNs (Udemy), CNNs for Visual Recognition (CS231n - Stanford Online)

Technical Skills

Languages: Python, C, C++, PySpark, SQL, ARM, Verilog
Libraries: TensorFlow, Keras, OpenCV, Numpy, NLTK, Matplotlib, Scikit-learn and other Machine Learning libraries
Interests: Machine Learning, Deep Learning, Natural Language Processing, Data structures and Algorithms

Positions of Responsibility & Other activities

School Head Boy: Elected by the school community, headed the students' council & managed events. [2014 – 15]

School Deputy Head Boy: Elected successively for 2 years & held multiple leadership responsibilities. [2012 – 14]

Coordinator & Strategist, Extra Mural Lectures: Was responsible for inviting prominent personalities and coordinating with the team to organise the flagship guest lecture series at IIT Madras. [2018 – 20]

Founder, Passion JEE : Created a blog to mentor engineering aspirants in India & clocked over 6k views to-date.

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

Public Speaker: Featured as the lead emcee/speaker for several prominent events including welcome speeches to the Vice President of India, top bureaucrats and executives.