

Alex MATHAI

Computer Science Researcher

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RESEARCH INTERESTS

I am passionate about solving challenging research problems. My areas of interest include **LLM Agents x Cybersecurity**, **LLM Agents x Coding**, **LLM training and fine-tuning**, **Knowledge Graphs** and **Graph Neural Networks**.

I am currently a PhD student at Columbia University and am grateful to be advised by Prof. Baishkahi Ray, Prof. Junfeng Yang, and Prof. Suman Jana.

EDUCATION

Years	Degree	GPA	Rank
2023-28 (expected)	Ph.D. in Computer Science, Columbia University	N/A	–
2023-25	MS in Computer Science, Columbia University	4 / 4	–
2016-20	B.E. in Computer Science, Birla Institute of Technology and Science Pilani	9.63 / 10	6 th /123

AWARDS AND SCHOLARSHIPS

Year(s)	Award
2023-26	Google Cyber NYC awards to pursue research (with Google Deepmind) at the intersection of AI and Security
2024-25	Amazon AI trusted challenge to help train code LLMs that generate secure code.
2022	IBM Research Distinguished Paper Award Given to the top 2 papers from IBM Research India and Singapore
2016-20	Institute Merit Scholarship Awarded to top 3% students for Exceptional Academic Performance

RESEARCH PAPERS

TRIM : REDUCING AI-GENERATED CODESLOP VIA AGENT TRAJECTORY MINIMIZATION  **UNDER SUBMISSION**
Alex Mathai, Shobini Iyer, Aleksandr Nogikh, Franjo Ivancic et al.

REFINE : ENHANCING PROGRAM REPAIR AGENTS THROUGH CONTEXT-AWARE PATCH REFINEMENT  **EMNLP FINDINGS 2026**
Anvith Pabba, Simin Chen, Alex Mathai, Anindya Chakraborty, Baishakhi Ray

LIVE-KBENCH : OUTRUNNING LLM CUTOFFS : A LIVE KERNEL CRASH RESOLUTION BENCHMARK FOR ALL  **ICML 2026**
Chenxi Huang*, Alex Mathai*, Jihwan Kim, Suwei Ma et al.

KAGENT : AN EXECUTION-GUIDED CRASH RESOLUTION AGENT FOR THE LINUX KERNEL  **DL4C WORKSHOP, ICML 2026**
Alex Mathai*, Chenxi Huang*, Jihwan Kim, Suwei Ma et al.

KGYM : A PLATFORM AND DATASET TO BENCHMARK LLMs ON LINUX KERNEL CRASH RESOLUTION  **NEURIPS 2024**
Alex Mathai*, Chenxi Huang*, Petros Maniatis, Aleksandr Nogikh et al.

COMEX : A TOOL FOR GENERATING CUSTOMIZED SOURCE CODE REPRESENTATIONS  **ASE 2023**
Debeshee Das, Noble Saji Mathews, Alex Mathai, Srikanth Tamilselvam et al.

MONOLITH TO MICROSERVICES : REPRESENTING APPLICATION SOFTWARE THROUGH HETEROGENEOUS GNNs  **IJCAI 2022**
Alex Mathai, Sambaran Bandyopadhyay, Utkarsh Desai, and Srikanth Tamilselvam.

INCREMENTAL ANALYSIS OF LEGACY APPLICATIONS USING KNOWLEDGE GRAPHS FOR APP MODERNIZATION  **CODS-COMAD 2022**
Saravanan Krishnan, Alex Mathai, Amith Singhee, Atul Kumar, et al.

RECLIVE : REAL-TIME CLASSIFICATION AND QoE INFERENCE OF LIVE VIDEO STREAMING SERVICES  **IEEE IWQOS 2021**
Sharat Chandra Madanapalli, Alex Mathai, Hassan Habibi Gharakheili, and Vijay Sivaraman.

US PATENTS

MULTIPLE GRANULARITY DATA FLOW ANALYSIS IN MAINFRAME APPLICATIONS

[US PATENT, 2025](#)

A patent for data flow analysis in old monolithic code.

DETERMINING SEMANTICS INFORMATION FOR PROGRAM STATEMENTS

[US PATENT, 2025](#)

A patent to perform semantic analysis using symbolic methods in old monolithic code.

AUTOMATICALLY IDENTIFYING APPLICATION PROGRAMMING INTERFACES BASED ON APPLICATION ARTIFACTS

[US PATENT, 2024](#)

A patent to automatically extract API signatures from old monolithic code.

SYSTEM AND METHOD TO EXPLAIN CANDIDATE MICROSERVICES FROM MONOLITH

[US PATENT, 2022](#)

A patent that uses explainable AI models like **GNN explainer** to justify the microservice recommendations we make when decomposing monoliths.

HETEROGENEOUS GRAPH GENERATION FOR APPLICATION MICROSERVICES

[US PATENT, 2021](#)

A patent for the creation of a heterogeneous graph from an application codebase. Clustering is then performed on this graph to create multiple smaller clusters representing microservices.

INDUSTRIAL AND ACADEMIC RESEARCH EXPERIENCE

Aug 2026	Research Intern, Google Dev AI Research Verifying AI/Human Authored Security patches for Fuzzing bugs , NYC, USA
May 2026	> I developed patch verification techniques to stress test AI/Human authored patches for security bugs. I collaborated with Jose Cambroner and Michele Tufano in the Dev AI research team. > I showed that it's possible to <i>exhaustively</i> test patches for a class of bugs called "Fuzzing" bugs. Our results show that ~ 25% of patches for signed-integer overflow bugs can be rejected by proving that they are incomplete or that they introduce subtle arithmetic errors. > Most promisingly, I developed verification techniques that can deterministically trigger (100% reproduction rate!) extremely rare data races—data races that occur one in a thousand or million times. > This feature is now being rolled out as a tool into Gemini for Google. It will also be used to generate synthetic data to improve the code reasoning capabilities of LLMs for security patches. LLM Agents Verification Engines (like CBMC and ESBMC) Agentic Frameworks
Aug 2025	Applied Scientist Intern, Amazon Code Whisperer Codebase Bug Localization, CA, USA
May 2025	> I developed techniques for effective bug localization from a large codebase given a natural language issue. I collaborated with Joe Hsu at Amazon AI. > I showed upto 6% performance improvements on the perfect recall of code snippets that are relevant to bug localization. I achieved this by training custom embedding models on the development history (i.e. commit history) of the codebase. LLMs Agentic Frameworks
Current	PhD Student, Columbia University LLM Agents for million line+ codebase debugging, NYC, USA
Sept 2023	> I am currently designing effective LLM Agents that resolve bugs in massive million line+ system software codebases like the Linux kernel. This is in collaboration with Deepmind : Petros Maniatis and Google : Franjo Ivančić and Aleksandr Nogikh > We aim to show that LLMs can be effectively used even in challenging situations, i.e., in low-resource languages, in complex codebases, and for tough-to-debug crashes. LLMs Agentic Frameworks

Aug 2023 Aug 2020	Research Engineer, IBM Research Modernizing Monoliths to Microservices , BANGALORE, India > Worked with Amith Singhee on the knowledge graph (KG) modeling of large monolith applications, and with Srikanth Tamilselvam on KG partitioning to generate candidate microservices. > Played a pivotal role in (i) KG construction using static analysis, (ii) KG Inference using graph traversal algorithms and (iii) KG Partitioning using graph neural network based representation learning coupled with unsupervised clustering to generate groups (microservice recommendations). Java Python Neo4j SQL Pytorch
Dec 2019 Aug 2019	University of New South Wales (UNSW) Time Series Analysis Research, SYDNEY, Australia > Worked with Vijay Sivaraman and Hassan Habibi on creating deep learning models that can classify and isolate live streaming network traffic in real-time for 5000 Australian homes. > Played a lead role in crafting and extracting time-series features at gigabyte scales. These features were resilient to challenging settings like network congestion and varying bandwidth capacities. Pytorch Python Numpy Matplotlib
Aug 2019 May 2019	IBM Research Labs Natural Language Research Engineer, BANGALORE, India > Generated adversarial text using black-box techniques to break NLP models trained for classification. > Integrated deep learning models with a genetic algorithm for a hybrid AI system. > Implemented LSTM classifiers, sequence to sequence translation models and language models. Pytorch Python NLTK Numpy Matplotlib FairSeq TorchText InferSent GloVe
Aug 2018 May 2018	Indian Space Research Organization Computer Vision Research Engineer, DEHRADUN, India > Developed an Image Segmentation API for high-resolution satellite images. > Implemented U-Nets for the segmentation of tarred roads and deep water bodies. > Preprocessed 500 GB of multi-spectral geospatial data for its use in the computer vision model. Tensorflow Python Matplotlib Shapely Gdal Osr Pandas Descartes

</> TECHNICAL EXPERTISE

Programming	Python, Java
Frameworks	Pytorch, Tensorflow, Flask-restx
Databases	Microsoft SQL Server, Neo4j Graph DB
Operating Systems	Mac OS X, Windows 7/8/10, Linux Redhat, Linux Ubuntu

LEADERSHIP ROLES

2018-19	Machine Learning Special Interest Group Coordinator, ACM BITS Pilani Chapter (India's best ACM chapter 4 years in a row)
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