Fraol Batole

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EDUCATION

Tulane University   **New Orleans, Lousiana**
Ph.D., Computer Science, GPA: 4.0/4.0   *Aug 2024 - Present*

Iowa State University   **Ames, Iowa**
MSc., Computer Science, GPA: 3.62/4.0   *May 2024*
Relevant Coursework: Advanced Software Engineering, Machine Learning

Addis Ababa Science and Technology University   **Addis Ababa, Ethiopia**
BSc, Software Engineering, GPA: 3.75/4.0   *September 2014 - June 2018*
Graduated Magna cum laude
Founded Innovation Club

RESEARCH EXPERIENCE

Laboratory for Software Engineering, Tulane University   **New Orleans, Lousiana**
Graduate Research Assistant   *February 2021 to Present*
- Led research initiatives in collaboration with IBM and JetBrains Research, developing novel static analysis techniques to enhance LLMs in software engineering tasks, focusing on code generation and code refactoring.
- Developed and released MM-Assist, an IntelliJ IDEA plugin that leverages LLMs for automated code refactoring, achieving 4x performance improvement over existing solutions.
- Driving LLM research on Google Cloud Platform as a Research Innovator'23, developing smaller models for code.

SELECTED RESEARCH PROJECTS

LLM, IDE, and Semantic Embedding to Assist Move Method Refactoring   **Tulane University**
A collaboration project with JetBrains Research   *August 2024 to present*
- Developed MM-Assist, an LLM-powered IntelliJ plugin for automated MoveMethod refactoring, achieving 73% accuracy and 4x improvement over existing tools through hallucination filtering and RAG.

A Comprehensive Study on LLM-based Agent Bug Characteristics   **Tulane University**
Under submission   *August 2024 to present*
- Conducted first comprehensive study of LLM-based agent system bugs by analyzing 1,016 bug reports, revealing tool integration (45%) and model integration (16%) as primary challenges.

Decomposing Sequential neural networks to enable reuse   **Iowa State University**
Presented at ICSE'23   *February 2022 to September 2022*
- Proposed the first approach to decompose RNNs (Vanilla, LSTM, GRU) into reusable modules, enabling model modifications without retraining while maintaining performance (-0.6% accuracy impact).

TECHNICAL SKILLS

Programming Languages: Python, Java, C++

Data Analysis Techniques: Pandas, NumPy

Machine Learning Libraries: TensorFlow/Keras, Pytorch, Pytorch-lightning, Hugging Face Libraries

Research Areas: Software Engineering (Program Analysis), **Deep Learning** (DNNs,RNNs, LLMs), **NLP**

PUBLICATIONS

Conference Paper:
1. **Fraol Batole*,** Abhiram Bellur***,** Malinda Dilhara**,** Yaroslav Zharov, Timofey Bryksin, Kai Ishikawa, Haifeng Chen, Masaharu Morimoto, Motoura Shota, Takeo Hosomi, Tien N Nguyen, Hridesh Rajan, Nikolaos Tsantalis, Danny Dig. "LLM, IDE and Semantic Embedding to Assist Move Method Refactoring" – International Conference on Software Maintenance and Evolution (ICSME'25).

2. **Fraol Batole,** David OBrien, Tien N Nguyen, Robert Dyer, and Hridesh Rajan. "An LLM-Based Agent-Oriented Approach for Automated Code Design Issue Localization." Proceedings of the 47th International Conference on Software Engineering (ICSE). 2025.
3. Sayem Imtiaz, Astha Sing, **Fraol Batole,** and Hridesh Rajan. "IRepair: An Intent-Aware Approach to Repair Data-Driven Errors in Large Language Models" In 32nd ACM International Conference on the FSE 2025.
4. Abhiram Bellur, **Fraol Batole** "IDE Native, Foundation Model Based Agents for Software Refactoring" 2nd IDE Workshop co-located with the 47th IEEE/ACM International Conference on Software Engineering.
5. Sayem Imtiaz, **Fraol Batole,** Astha Sing, Breno Cruz, Rangeet Pan, and Hridesh Rajan. "Decomposing RNN to enable reuse." Proceedings of the 45th International Conference on Software Engineering (ICSE). 2023.
   Preprint:
1. Abhiram Bellur**,** Mohammed Raihan, **Fraol Batole,** Yaroslav Zharov, Timofey Bryksin, Kai Ishikawa, Haifeng Chen, Masaharu Morimoto, Motoura Shota, Takeo Hosomi, Tien N Nguyen, Hridesh Rajan, Nikolaos Tsantalis, Danny Dig. "An IDE-Integrated Multi-Agent Framework for Coordinated Identifier Renaming" – Under submission
2. **Fraol Batole,** David OBrien, Steven Vo, Tien N Nguyen, and Hridesh Rajan. "A Comprehensive Study on LLM-based Agent Bug Characteristics" – Under Submission
3. **Fraol Batole,** Ruchira Mank, Tien N Nguyen, Robert Dyer, and Hridesh Rajan. "Typestate-based Fault Localization of API Usage Violations in a Deep Learning Program" – Under Submission
4. **Fraol Batole,** Smit Patel, Aashish Yadavally, Tien N Nguyen, and Hridesh Rajan. "CAPS: Code Abstraction Pre-training Strategy for Large Language Models" – Under Submission
5. Samuel W. Flint, **Fraol Batole**, David OBrien, Robert Dyer "Do LLMs Generate Code with Type Annotations?" – Under Submission
6. David OBrien, **Fraol Batole,** Robert Dyer, Tien N Nguyen, and Hridesh Rajan. "Issue-Based Programming Language Evolution" – Under Submission

ADDITIONAL EXPERIENCE

CS Department, Iowa State University   **Ames, Iowa**
Graduate Teaching Assistant   *January 2021 to May 2022*
- Taught principles of programming, debugging, and test case development to over 80 students, adapting teaching methods to accommodate diverse learning styles.

MED Innovation   **Addis Ababa, Ethiopia**
Software Engineer   *August 2019 to November 2019*
- Collaborated with a cross-functional team of 2 members to design and implement the integration of an existing customer relationship management (CRM) system using Spring Boot and Vaadin.
- The integrated CRM system resulted in a 10% increase in the company's customer retention rate within 2 months, providing measurable business value.

Kifiya Financial Service   **Addis Ababa, Ethiopia**
Software Engineering Intern   *January 2017 to August 2017*
- Identified and proposed user experience (UX) improvements for 2 projects, collaborating with the design team to create intuitive and user-friendly interfaces.

LEADERSHIP

SmartMasa   **Addis Ababa, Ethiopia**
Co-Founder   *January 2019 to August 2019*
- Co-founded SmartMasa, a precision farming startup aimed at improving the lives of smallholder farmers in Ethiopia through innovative web and mobile-based solutions.
- Led a team of 5 to pitch the precision farming project to large incubation centers and investors, securing over $10K in funding and support.

AWARDS AND PROFESSIONAL DEVELOPMENT

- Awarded **1.5 million Access credits** from an NSF-funded program for advanced computing   **February 2024**
- Awarded a Google Cloud Research Credits program ($12,000)   **June 2023**
- Selected for **the Google Cloud Research Innovator program'23**   **March 2023**
- Contributor at Towards AI   **December 2022**
- Black in AI Travel grant to attend NeurIPS'22   **November 2022**
- Student Volunteer at SPLASH'21 Conference (Chicago, IL)   **November 2021**