

# Fraol Batole

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## EDUCATION

### Iowa State University

Ph.D., Computer Science, GPA: 3.67/4.0

Ames, Iowa

Expected May 2025

### Addis Ababa Science and Technology University

BSc, Software Engineering, GPA: 3.75/4.0

Graduated Magna cum laude

Founded Innovation Club

Addis Ababa, Ethiopia

September 2014 - June 2018

## RESEARCH EXPERIENCE

### Laboratory for Software Engineering, Iowa State University

Graduate Research Assistant

Ames, Iowa

February 2021 to Present

- Researched and implemented software engineering (SE) methodologies to enhance auto-code completion tools, relatively improving state-of-the-art tools.
- Investigated language models and SE techniques to clean protein function mis-annotations in large databases.
- Analyzed top-tier conference papers to create insightful presentations that effectively communicated ideas.
- Collaborated with post-docs and lab members to write and publish top-tier conference papers, contributing to advancing scientific knowledge in software engineering and deep learning.

## RESEARCH PROJECTS

### Toward Precise Static Detection of Deep Learning Usage Protocol Violations

Under review

Iowa State University

June 2022 to August 2023

- Investigating the limitations of state-of-the-art static analysis tools to detect a deep learning bug.
- Developed a graph-based representation of deep learning programs to address identified limitations.
- Introducing a combination of two static analysis-based techniques to identify deep learning bugs.
- Achieved a 20% increase in precision and a 30.8% increase in recall over the state-of-the-art methods by utilizing the developed techniques.

### Reducing Complexity in LLMs for Code Representation via Source Code Abstraction

Under review

Iowa State University

June 2022 to August 2023

- Used static analysis techniques to extract contextual information from Python and Java source codes.
- Design three abstraction-based pre-training objectives tailored for a source code representation.
- Introduced a small Seq-Seq Model that unifies the 3 pre-training objectives for effective code representation.
- Our model shows competitive performance on two software engineering tasks (i.e., Code Clone Detection and Code Translation), while being the least complex model compared to the baselines.

### Decomposing Sequential neural networks to enable reuse

Accepted

Iowa State University

February 2022 to September 2022

- Evaluated 4+ types of RNN architectures and developed experimental models to evaluate the approaches.
- Analyzed the RNNs neuron activity to find the best decomposition strategy.
- Experiments show that decomposing a trained model has a small cost (Accuracy: -0.6%, BLEU score: +0.10%).
- Reduced the need for model retraining by efficiently reusing and replacing the decomposed modules.

## TECHNICAL SKILLS

**Programming languages:** Python, Java, C++

**DL/ML libraries:** TensorFlow/Keras, Pytorch, Pytorch-lightning, Hugging Face Libraries, Pandas, NumPy

**Research areas:** Software Engineering, Program Analysis, Deep Learning, and Natural Language Processing

## PUBLICATIONS

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1. **Batole, Fraol.**, N Nguyen, Tien., and Hridesh Rajan. "Modular Marvels: Few-Shot Learning's Role in Detecting and Localizing Software Design Issues" (To be submitted at PLDI'24 ).
2. **Batole, Fraol.**, Manke, Ruchira., N Nguyen, Tien., Dyer, Robert., and Hridesh Rajan. "Toward Precise Static Detection of Deep Learning Usage Protocol Violations" (To be submitted at PLDI'24 ).
3. **Batole, Fraol.**, Patel, Smit., Yadavally, Aashish., N Nguyen, Tien., and Hridesh Rajan. "Can David Compete Against Goliath? Code Abstraction Pre-training Strategy for Large Language Models" (Submitted at OOPSLA'24 ).
4. Imtiaz, Sayem., **Batole, Fraol.**, Sing, Astha., Cruz, Breno., Pan, Rangeet., and Hridesh Rajan. "Decomposing Sequential neural networks to enable reuse." Proceedings of the 45th International Conference on Software Engineering (ICSE). 2023.

## ADDITIONAL EXPERIENCE

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### CS Department, Iowa State University

Ames, Iowa

Graduate Teaching Assistant

January 2021 to May 2022

- Taught 80+ students the principles of programming language, program debugging, and developing test cases.
- Headed the Principles of Programming course, working closely with a team of 3 teaching assistants to facilitate a collaborative and inclusive learning environment.
- Designed and delivered highly effective lectures and exercises during recitation periods.

### MED Innovation

Addis Ababa, Ethiopia

Software Engineer

August 2019 to November 2019

- Collaborated with a team of 2 members to design and implement a customer relationship management (CRM) system using Spring Boot and Vaadin.
- Implemented CRM 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 improvements to the user experience (UX) for 2 projects, resulting in enhanced site navigation and improved customer satisfaction.
- Successfully completed the project on time, delivering high-quality work and effectively communicating proposed ideas to senior executives.

## LEADERSHIP

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### SmartMasa

Addis Ababa, Ethiopia

Co-Founder

January 2019 to August 2019

- Led the teams to pitch a precision farming project to large incubation centers and investors in Ethiopia, resulting in more than \$10K funding and support for the initiative.
- Demonstrated exceptional leadership, and technological skills while working on a web and mobile-based precision farming project, aimed at improving the lives of smallholders.

## SERVICES AND AWARD

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- Awarded a Google Cloud Research Credits program (\$10,000) 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