

# SONEYA BINTA HOSSAIN

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## EDUCATION

<b>Ph.D., Computer Science</b>	August 2019 - Present
University of Virginia, Charlottesville, VA	
<b>M.S., Computer Science</b>	August 2019 - December 2020
University of Virginia, Charlottesville, VA	CGPA: 4.00
<b>B.Sc., Computer Science</b>	February 2011 - February 2016
Bangladesh University of Engineering and Technology, Dhaka, Bangladesh	CGPA: 3.65
<b>Thesis:</b> Balanced Coverage in Fault-Tolerant Broadcasting for Wireless Multi-hop Networks	

## EXPERIENCE

<b>Graduate Research Assistant, LESS Lab, University of Virginia</b>	August 2019 - present
• Advisor: Dr. Matthew Dwyer	
<b>Applied Scientist Intern, Amazon Web Services</b>	Summer'22, Summer'23
• Mentor: Antonio Filieri, Willem Visser (Summer'22), Qiang Zhou (Summer'23)	
<b>Graduate Teaching Assistant, Department of CS, University of Virginia</b>	August 2019 - present
• Courses Assisted: Graduate Compilers (CS 6620), Undergraduate Compilers (CS 4620)	
• Responsibilities: Contributed to compilers feature design and development, graded assignments, held TA office hours.	
<b>Software Development Engineer, REVE Systems (R&amp;D)</b>	March 2016 - May 2019
<b>Undergraduate Research Assistant, BUET</b>	March 2015 - March 2016
• Advisor: Dr. A.K.M. Ashikur Rahman	

## PUBLICATIONS

### 1. A Deep Dive into Large Language Models for Automated Bug Localization and Repair

Soneya Binta Hossain, Nan Jiang, Qiang Zhou, Xiaopeng Li, Wen-Hao Chiang, Yingjun Lyu, Hoan Nguyen, Omer Tripp  
Proceedings of the ACM on Software Engineering (FSE 2024)

### 2. Ensuring Critical Properties of Test Oracles for Effective Bug Detection

Soneya Binta Hossain

2024 IEEE/ACM 46th International Conference on Software Engineering: Companion Proceedings (ICSE-Companion '24)

### 3. Neural-Based Test Oracle Generation: A Large-scale Evaluation and Lessons Learned

Soneya Binta Hossain, Antonio Filieri, Matthew Dwyer, Sebastian Elbaum, Willem Visser

Proceedings of the 31th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE 2023) (22.6% acceptance rate)

### 4. Measuring and Mitigating Gaps in Structural Testing

Soneya Binta Hossain, Matthew Dwyer, Sebastian Elbaum, Anh Nguyen-Tuong

Proceedings of the 45th International Conference on Software Engineering (ICSE '23) (26% acceptance rate)

### 5. TOGLL: Correct and Strong Test Oracle Generation with LLMs

Soneya Binta Hossain, Matthew Dwyer (In Submission)

### 6. Hybrid Predictive Mutation Testing via Graph Transformer Networks

Will Leeson, Soneya Binta Hossain, Matthew Dwyer, (In Submission)

### 7. LLM Based Code Generation Through Self-Debugging and Explanation

Nan Jiang, Xiaopeng Li, Shiqi Wang, Qiang Zhou, Soneya Binta Hossain, Baishakhi Ray, Varun Kumar, Xiaofei Ma (In Submission)

### 8. Oracle-based Test Adequacy Metrics: A Survey

Soneya Binta Hossain, Matthew Dwyer (available on arXiv)

## ARTIFACTS

## 1. Artifact: Measuring and Mitigating Gaps in Structural Testing

Soneya Binta Hossain, Matthew Dwyer, Sebastian Elbaum, Anh Nguyen-Tuong

Proceedings of the 45th International Conference on Software Engineering (ICSE '23)

## RESEARCH PROJECTS

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### 1. Strong and Correct Test Oracle Generation With LLMs (PhD Project)

Test oracles serve as indispensable assets in software testing, facilitating efficient bug detection. This work introduces TOGLL, a novel LLM-based method for test oracle generation. TOGLL generates up to 4.9x more correct oracles that can detect 10x more unique bugs than previous SOTA.

### 2. Automated Bug Localization and Repair With LLMs (Internship Project at AWS)

[\[paper\]](#)

Software bugs cost software developers and companies significant time and money. Even when detected, fixing bugs can be time-consuming and challenging. This work introduces TOGL, an LLM-based method for bug localization and repair that achieves SOTA performance across several bug benchmarks.

### 3. Predictive Mutation Testing With GNNs (Ph.D. Project)

Mutation testing is a powerful testing technique for evaluating a test suite's effectiveness. Unfortunately, the substantial cost of mutation testing for large systems hinders its broader adoption. This research addresses this issue by proposing a graph-neural network-based approach that predicts mutation test outcomes, thereby eliminating the need—and associated expense—of executing the test suites, which is the main bottleneck.

### 4. A Large-scale Evaluation of SOTA Test Oracle Generation Methods (Ph.D. + Internship Project)

[\[paper\]](#) [\[artifact\]](#) [\[talk\]](#)

In a large-scale study of 25 real-world Java systems, we evaluated several state-of-the-art learning-based and search-based automated test oracle generation methods in terms of their ability to produce correct and strong test oracles capable of detecting elusive bugs.

### 5. Measuring and Mitigating Gaps in Structural Testing (Ph.D. Project)

[\[paper\]](#) [\[artifact\]](#) [\[talk\]](#) [\[poster\]](#)

This work introduces *coverage gaps*, a metric designed to identify under-tested program structures by analyzing the test oracles in a test suite. Next, it proposes a recommender method that leverages coverage gaps and recommends ways to enhance the test suite with additional test oracles. Our experimental results indicate that these additional oracles not only improve testing for under-tested codes but also enhance the overall fault-detection effectiveness of the test suite.

### 6. MuSlicer: A Language Agnostic Dynamic Program Slicing Tool (Internship Project)

This tool implements the classic dynamic slicing algorithm. Program execution trace and muGraph (an extended abstract syntax tree) are used to construct a dynamic program dependency graph (DPDG). Next, from the DPDG, a breadth-first traversal is performed w.r.t the slicing criterion to compute the dynamic slice.

### 7. STG-I: A Dynamic Symbolic Constraint Generation Tool Based on LLVM IR (Ph.D. 1st year project)

[\[GitHub\]](#)

This tool, working on LLVM IR, instruments the bitcode to record execution traces. In a program, variables can be marked as symbolic or unknown. When the program runs on concrete inputs, it produces symbolic constraints. These constraints can be utilized for dynamic symbolic execution or for computing input domain coverage through quantification.

## INDUSTRY PROJECTS

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### 1. iTel Billing: A VoIP billing management system

- Led the iTel Billing team, significantly contributed to feature design and development, and ensured continued system stability and bug resolution.

### 2. REVE Secure: A two-factor authentication system

- Integrated with the iTelBilling web system

### 3. Payment Solutions

- Developed and maintained several payment solutions: world wide Mobile Top UP Service and Money Transfer

## SERVICE

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Research Mentor, Department of CS, University of Virginia

- Guided Nicki Choquette and Kasra Lekan (CS, UVa) in their research project “Insight into SEER”, a replication study of an FSE’22 research paper.
- Mentored Ashley Hart (CS, University of Florida) during her UVa LESS lab internship, leading to the development of a Boolean satisfiability solver.

#### **Student Mentor, University of Virginia**

- Mentee: Srikar Chittari (CpE, UVa), Eric Weng (CS, UVa)
- Guided through the graduate school application process

#### **Leadership Chair, Computer Science Graduate Student Group (CSGSG), UVa**

Jan’20 - Dec’22

- Planned and organized CS Research Symposium in 2020 and 2021
- Helped with CS department faculty recruitment and coordinated prospective student visits in the department
- Organized social events for graduate students

#### **Social Chair, Association of Bangladeshi Students (ABS), UVa**

August’21 - Summer’22

- Represented Bangladeshi students at the University of Virginia, organized events showcasing Bangladeshi culture and history to foster diversity within the broader community

#### **AWARDS AND SCHOLARSHIPS**

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- Finalist, Physical Sciences and Engineering Category, UVA Research Computing Exhibition 2024
- Best Research Poster Award (student choice) in CS Research Symposium, 2023
- John A. Stankovic Outstanding Graduate Research Award (2022-2023)
- Travel Grant by Computing Research Association (CRA) to attend Grad Cohort, San Francisco, CA, 2023
- End-of-Year Computer Science Department Outstanding Service Award (2021-2022),
- Best Poster Award in Fall CS Research Symposium, 2021
- Travel Grant by Computing Research Association (CRA) to attend Grad Cohort, New Orleans, LA, 2020
- PhD Fellowship, Department of CS, University of Virginia, 2019
- Outstanding Undergraduate Thesis Award, Department of CSE, BUET, 2016
- Travel Grant by Grace Hopper Celebration of Women in Computing (GHCI), Bangalore, India, December 2015.
- Top Ten Database Project Award, Department of CSE, BUET, 2014
- Dean’s and Merit list Award, Department of CSE, BUET, 2013-2014
- Talentpool Scholarship in 8th, 10th, and 12th Grade, Bangladesh Ministry of Education (2004-2012)

#### **TECHNICAL SKILLS**

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**Programming:** Java, Python, LLVM, C, C++, Bash,

**Machine Learning or AI Tools:** TensorFlow, PyTorch, scikit-learn

**Database:** MySQL, Oracle

**Version Control:** Git