ANUP BHOWMIK

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RESEARCH INTEREST

My primary research interests lie in the broad area of **Software Engineering, specifically in AI, NLP, and HCI**, with a focus on developing high-performance applications and software tools to enhance developer and user experiences while addressing real-world software engineering challenges.

RESEARCH EXPERIENCE

Performance Testing and Benchmarking of LLMs   `LLM` `Fuzzing` `Data Mining`

Supervised by : Dr. Probir Roy

September 2024 – Present

- Created pipelines for data mining from Github. Collected 500+ pull requests by mining around 40,000 C and C++ repositories.
- Extended the pipeline for parallel processing in multiple machines to speed up the mining.
- Explored Evolutionary Algorithms and Fuzzing to curate input combinations fitted for the test cases.
- Currently working on -
  - Test case generation for different types of methods, written in C/C++ using LLMs.
  - Validation of the datasets.

Automated API Testing   `NLP` `Software Testing` `LLM` `Fine-tuning`

Supervised by : Dr. Anindya Iqbal

June 2024 – September 2024

- Developed an NLP-based automated testing tool.
- Dataset generation for fine-tuning:
  - White-box: Leveraged (EvoMaster) and wrote a driver class to access the bytecode for JVM languages.
  - Black-box: Incorporated prompt engineering techniques like few-shot prompting, chain of thoughts, ReAct, etc, and ideas like NLPtoREST.
- Fine-tuned LLaMA 3.1 to automatically generate test cases with more than 80% code coverage.

Analysis of Aging in Spatially Resolved Tissue Samples   `Optimal Transport` `PyTorch` `Machine Learning`

Supervised by : Dr. Mohammad Saifur Rahman, Md. Abul Hassan Samee

June 2023 – Present   📍 Thesis book

- Developed a novel method using Optimal Transport for precise alignment of a special type of tissue sample data (MERFISH) that outperforms state-of-the-art alignment methods in terms of cellular-neighborhood and cell-type preservation.
- Used vectorization, PyTorch and CUDA for performance boost.
- Predicted aging factors (cell types and genes) that are most responsible for aging using machine learning with up to 68% accuracy.
- Used SHAP (SHapley Additive exPlanations) analysis to explain the model.

EDUCATION

Bachelor of Science (BSc), Computer Science & Engineering

Bangladesh University of Engineering & Technology

April 2019 – July 2024

CGPA : 3.84/4.0

WORK EXPERIENCE

Software Engineer II   `DevOps` `React JS` `Azure Cloud` `Kubernetes` `Terraform`

Pridesys IT Ltd.

June 2024 – Present

- Conducted user studies and data analysis for UI/UX redesign, enhancing usability through HCI research.
- Deployed the backend and database of the cloud ERP on ACS (Azure Cloud Service) using AKS (Azure Kubernetes Service), ACR (Azure Container Registry), and Cloud storage.
- Incorporated CI/CD with GitHub actions, accelerating integration and deployment across multiple microservices.
- Currently leading the development of frontend (React) application.

Research Assistant   `React JS` `Google Maps Api`

Institute of Water And Flood Management, BUET

2022 – 2023

- Developed a web-based early warning system for river erosion. The deployed project can be viewed here.
- The paper is published in the Proceedings of the 4th IAHR Professionals Congress under the title "Development of riverbank erosion warning system for braided river".
- The project "Early Warning System River Erosion" was funded by the Ministry of ICT, Bangladesh.

EXPERTISE AND SKILLS

- **Programming Languages:** C/C++, Java, Python, JavaScript, TypeScript, x86 Assembly, SQL, CSS, Bash.
- **Tools & Frameworks:** Git and GitHub, Oracle DBMS, PostgreSQL, Bison, Flex, Latex, Android Studio, Docker, Firebase, Figma.
- **Libraries:** ReactJS, NodeJs, OpenGL, PyTorch, Numpy, Pandas, Scikit-learn , SciPy, Matplotlib.

NOTABLE ACADEMIC PROJECTS

Logistic Regression with AdaBoost   `Machine Learning` `Dataset Preporcessing` `Classification` `Python` ⌂

Implemented a Logistic Regression (LR) classifier and used it with AdaBoost algorithm. Pre-processed specific datasets differently based on the nature of the data. Evaluated the performance of the models using accuracy, sensitivity, precision, and F1.

Software Engineering Design Patterns   `Observer pattern` `Creational pattern` `OOP` `Java` ⌂

Showcased various software design patterns through practical code examples and detailed documentation.

Creative Production Management Project   `ERD` `State Diagram` `BPMN` `Mock UI` ⌂

Developed a complete software engineering project that follows all the formal steps starting from scope fixation, diagrams (ERD, BPMN, Class Diagram, Sequence Diagram and State Diagram) followed by implementation.

AI Minesweeper   `Python` `PyGame` `AI` ⌂

Implemented a knowledge engineering based AI agent to automatically play the classic Minesweeper game.

Compiler   `Bison` `Flex` ⌂

Built a subset of C compiler from scratch which includes steps of creating a symbol table, building a lexical analyzer, semantic analyzer, and on-the-fly intermediate code generation.

HONORS & AWARDS

Dean's Award

Received Dean's List Scholarship award for excellent undergraduate results.

RISE Student Research Grant, 2023

Research and Innovation Centre for Science and Engineering (RISE)

Received RISE Student Research Grant for excellent research contribution. ID: S2023-03-165.

Best Poster Award, 2021 "Is It Really Dead?" - Digging into Dead Brains through Analyzing Its Behavior in Response to Inducing External Impulses   DOI 🔗

Supervised by : A. B. M. Alim Al Islam

Won the best poster at the 8th International Conference on Networking, Systems and Security (NSysS 2021).

LEADERSHIP EXPERIENCE

Publication Committee Chair | IEEE Computer Society BUET Student Branch Chapter

Mar 2023 – May 2024

Vice President, Top Management | BUET Career Club

May 2023 – January 2024