Md Rubel Ahmed

CONTACT INFORMATION

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SUMMARY

- Designed an SoC specification mining framework using Machine Learning
- Optimized an AI accelerator that achieves 70x speedup for non-trivial C++ kernel synthesis
- Top rated instructor for the course learning Computer Architecture with gem5 simulation

EDUCATION

Ph.D. in Computer Science and Engineering   2018 - Sept 2023 [exp.]
University of South Florida, Tampa, FL

M.S. in Computer Engineering   2018 - 2021
University of South Florida, Tampa, FL

B.S. in Computer Science and Engineering   2013 - 2017
Khulna University of Engineering and Technology, Bangladesh

SKILLS

Programming Languages	C/C++, Python
EDA Tools	Vitis HLS, Xilinx ISE Webpack, Vivado HLx
Architectural Simulator	Simplescalar, and gem5
Miscellaneous	Reinforcement Learning, PyTorch, Optuna, UPPAAL, VHDL, Z3 solver, Git, Linux

EXPERIENCE

Research Intern   Sept. 2022 - May 2023
Mitsubishi Electric Research Laboratories, Cambridge, MA
- Developed an ML model for novel applications with innovative techniques
- Improved the efficiency of ML model on FPGA implementation
- Analyzed performance and power trade-offs and achieved low power consumption and high throughput
- Developed a multi-objective optimization framework utilizing the capabilities of both Open AI and Optuna APIs.

Research Assistant   Aug. 2019 - Aug. 2022
The SEES Lab, U. of South Florida, Tampa, FL
- Successfully instrumented and generated traces from SoCs modeled in VHDL, gem5, and Rocket Chip Generators
- Developed an innovative algorithm for automatic specification mining using advanced Data Mining and NLP models
- Mentored and trained Research Experience for Undergrad (REU) students, providing guidance and support for their research and helping to foster the next generation of experts

Instructor   May 2019 - July 2022
University of South Florida, Tampa, FL
- Successfully taught the course Computer Architecture (CDA 4205) in the summer of 2022 and 2019, providing students with a strong foundation in modern computing architecture and ISAs
- Developed labs, and class activities and implemented a backward course design approach to help students understand micro-architecture using gem5
- Designed and administered both summative and formative assessments, held weekly discussion sessions and office hours
- Successfully managed and facilitated the smooth running of three lab sections for the course. Held weekly meetings with lab TAs and provided timely feedback.

Teaching Assistant   Aug. 2018 - July 2022
University of South Florida, Tampa, FL
- FPGA Design (Spring 2020)
- Computer Architecture (Fall 2019)
- System Integration and Architecture (Spring 2019)

Software Engineer   Nov. 2017 - July 2018
Synchronous ICT, Dhaka, Bangladesh
- Leveraged FFMPEG technology to process multimedia data in mobile applications effectively
- Innovatively designed and implemented a cutting-edge data-driven cross-platform mobile application using React JS

RESEARCH PROJECTS

Specification Mining   2018 - 2022
This project aims to study and explore various approaches to mine sequential patterns from SoC traces. It overcomes the challenges associated with traditional pattern mining for SoC traces. This work incorporate an assertion mining approach to find highly correlated patterns. In addition, trace to Finite State Models (FSMs) conversion approach is also proposed. The FSM models can be used for analysis and improvement of flow specifications.

HLS Accelerator Design   2022 - 2023
Design parameter space in HLS creates a multi-object optimization problem. A Quantum Neural Network (QNN) based early failure prediction method is proposed that solves three issues with the existing methods. The QNN model has relatively small set of weights and is less computationally expensive, making it a greener pathway for HLS acceleration.

Healthcare Expansion Planning   2020 - 2021
This project proposes healthcare facility expansion plan using Reinforcement Learning (RL). The objective is to use an RL model to simulate the demand-supply scenario of various natural and man-made situations in order to suggest an optimal hospital facility expansion plan. This is a multi-objective optimization problem.

PUBLICATIONS

J2 Shuvo, Salman Sadiq; Symum, Hasan; **Ahmed, Md Rubel**; Yilmaz, Yasin; Zayas-Castro, Jose L, "Multi-Objective Reinforcement Learning Based Healthcare Expansion Planning Considering Pandemic Events", IEEE Journal of Biomedical and Health Informatics (J-BHI, IF 7.021).

J1 **Md Rubel Ahmed**, Hao Zheng, Parijat Mukherjee, Mahesh C. Ketkar, Jin Yang, "Mining Patterns From Concurrent Execution Traces", IEEE Transactions on Computer-Aided Design of Integrated Circuits & Systems (TCAD, h5 53).

C10 **Md Rubel Ahmed**, Toshiaki Koike-Akino, Kieran Parsons, Ye Wang, "Joint Software-Hardware Design for Green AI", 66th International Midwest Symposium on Circuits and Systems (MWSCAS'23).

C9 **Md Rubel Ahmed**, Toshiaki Koike-Akino, Kieran Parsons, Ye Wang, "AutoHLS: Learning to Accelerate Design Space Exploration for HLS Designs", 66th International Midwest Symposium on Circuits and Systems (MWSCAS'23).

C8 **Md Rubel Ahmed**, Bardia Nadimi, Hao Zheng, "System-on-Chip Message Flow Mining with Masked-Language Models", 66th International Midwest Symposium on Circuits and Systems (MWSCAS'23).

C7 **Md Rubel Ahmed**, "Mining Message Flows from System-on-Chip Execution Traces", ACM SIGDA Student Research Forum at ASP-DAC 2023 (SRF@ASP-DAC 2023).

C6 Hao Zheng, **Md Rubel Ahmed**, Parijat Mukherjee, Mahesh C. Ketkar, Jin Yang, "Model Synthesis for Communication Traces of System Designs", The 39th IEEE International Conference on Computer Design (ICCD'21).

C5 **Md Rubel Ahmed**, Hao Zheng, Parijat Mukherjee, Mahesh C. Ketkar, Jin Yang, "A Comparative Study of Specification Mining Methods for SoC Communication Traces" (ISVLSI'21).

C4 Salman Sadiq Shuvo , **Md Rubel Ahmed**, Hasan Symum, Yasin Yilmaz, "Deep Reinforcement Learning Based Cost-Benefit Analysis for Hospital Capacity Planning", International Joint Conference on Neural Networks (IJCNN'21).

C3 **Md Rubel Ahmed**, Hao Zheng, Parijat Mukherjee, Mahesh C. Ketkar, Jin Yang, "Mining Message Flows from System-on-Chip Execution Traces", The 22nd International Symposium on Quality Electronic Design (ISQED'21).

C2 Salman Sadiq Shuvo, **Md Rubel Ahmed**, Sadia Binta Kabir, Shaila Akter Shetu, "Application of Machine Learning Based Hospital Up-gradation Policy for Bangladesh", 7th Int'l Conf. on Networking, Systems and Security (NSysS'20).

C1 Amit Sutradhar, Md. Samiul Haque Sunny, Manash Mandal, **Rubel Ahmed**, "Design and construction of an automatic electric wheelchair: An economic approach for Bangladesh", 2017 3rd International Conference on Electrical Information and Communication Technology (EICT'17).

POSTERS/PRESENTATION

P8 Md Rubel Ahmed, Toshiaki Koike-Akino, Ye Wang, Kieran Parsons, "Learning to Accelerate High-Level Synthesis", MERL Intern Exit Presentation, March 2023

P7 Md Rubel Ahmed, Hao Zheng, "Model Synthesis for Communication Traces of Systems Designs", WIP paper at 58th Design and Automation Conference (DAC), Dec. 2021.

P6 Md Rubel Ahmed, Hao Zheng, "Model Synthesis for Communication Traces of System-on-Chip Designs", USF Annual Graduate Research Symposium. Sept. 2021

P5 Md Rubel Ahmed, Hao Zheng, "Mining Message Flows from SoC Execution Traces", 57th Design and Automation Conference (DAC), Jun 2020.

P4 Md Rubel Ahmed, Yuting Cao, Hao Zheng, "Specification Mining for SoC Validation using Data Mining Techniques", 56th Design and Automation Conference (DAC), Jun 2019.

P3 Md Rubel Ahmed, Yuting Cao, Hao Zheng, "Message Flow Mining for SoC Validation for Safe and Secure IoT Edge Node Design", Warren B. Nelms Annual IoT Conference, Dec 2019.

P2 Md Rubel Ahmed, Yuting Cao, Hao Zheng, "Execution Trace Mining for SoC Validation for Safe and Secure IoT Edge Node Design", IFIP International Internet of Things Conference, Oct 2019.

P1 Md Rubel Ahmed, Yuting Cao, Hao Zheng, "Specification Mining from Message Flows for SoC Validation", 2019 FICS Research Conference on Cybersecurity, Mar 2019. doi: 10.1109/MDAT.2015.2499272

PREPRINTS

C2 Ahmed, Md Rubel and Zheng, Hao, "Deep Bidirectional Transformers for SoC Flow Specification Mining", publisher: arXiv, 2022, doi:10.48550/ARXIV.2203.13182

C1 Ahmed, Md Rubel and Nadimi, Bardia and Zheng, Hao, "Mining SoC Message Flows with Attention Model", publisher: arXiv, 2022, doi:10.48550/ARXIV.2209.07929.

PROFESSIONAL ACTIVITIES

- Reviewed articles for TCAD, IJCNN
- Treasurer for IEEE-CS USF Student Chapter (2020 - 2022)
- Judge for 2021 USF Undergraduate Research Conference
- Registered volunteer for Meals on Wheels of Tampa
- Volunteer of ISVLSI Conference 2021
- Volunteer of IFIP IoT Annual Conference 2019

AWARDS

- Dissertation Completion Fellowship (worths $9K) from the Office of Graduate Studies at USF'2023
- Student Research Forum at ASP-DAC 2023 (SRF@ASP - DAC 2023)
- USF Engineering Alumni Society Scholarship'22
- NSF travel grant for ISVLSI'21
- USF Student Govt. travel grant for ISQED'21
- Young Fellow (58th DAC, 2021)
- A. Richard Newton Young Student Fellowship award: 56^{th}(2019) and 57^{th}(2020) Design Automation Conference
- Technical Education Scholarship, Bangladesh Govt. (2015 -2016)
- Secondary School Scholarship, Bangladesh Govt. (2010)

PROFESSIONAL TRAINING

- Preparing for College Teaching' Fall 2021
- At-Risk Friends in College' Spring 2021
- Graduate writing workshop' Spring 2020
- USF Grant Writing Workshop' Summer 2020

TALKS

- "Interrupt and Pseudo Multi-threading in Arduino", Arduino Day at FabLab, IUB'2017
- SEES Lab quarterly research summary presentation 2022/2023