

NAHEED ANJUM ARAFAT

341 W SIDE DR, APT 204, GAITHERSBURG, MD 20878

Last position: Research Fellow, Rolls-Royce@NTU Corporate lab, Nanyang Technological University, Singapore

Email: naheed_anjum@u.nus.edu | website: <https://toggled.github.io/naheed> | contact: +1 (571)-412-6278

RESEARCH INTERESTS & EXPERTISE

My interest and expertise lie in the algorithmic, applied, and topological aspects of non-relational data, such as graphs and their higher-order counterparts: hypergraphs. In recent years, my work has permeated various aspects of graph representation learning, such as designing adversarially robust GNNs, applications to physics simulations, and the trustworthiness of LLMs in Knowledge graph-augmented fact-checking.

- **Graph representation learning:** Designed (1) physics-driven Graph Neural Networks to exploit low-resolution simulation data to efficiently and effectively predict flow field on high-resolution mesh originating from complex aerodynamical systems. (2) topology-driven approaches to improve the robustness of Graph Neural Networks under adversarial attack. (3) algorithms to measure and reduce uncertainty associated with GNNs predictions on uncertain graphs.
- **Higher-order data representations and Topological Data Analysis:** Designed algorithms for (1) finding core nodes in hypergraphs, (2) generating and estimating properties of synthetic hypergraphs with realistic constraints, (3) visualising hypergraphs, (4) approximate computation of topological features.

I have published in reputable Machine learning and Data Science venues such as AAAI, ICML, VLDB, DSAA, ECML-PKDD, DEXA, and journals such as SEC (IF=10). I also have a patent granted at the UK IP Office with Rolls-Royce plc.

EDUCATION

National University of Singapore (NUS)

PhD in Computer Science

Singapore

Aug 2015 - Nov 2020

- **Thesis:** Analysis and generation of data with topology from combinatorial representations

Bangladesh University of Engineering and Technology (BUET)

Bachelors in Computer Science & Engineering

Dhaka, Bangladesh

Mar 2009 - Jul 2014

- **Thesis:** A Fuzzy Dominance Based Evolutionary Algorithm for solving many-objective optimisation problems.

EMPLOYMENT HISTORY

Research Fellow

Rolls-Royce@NTU Corporate Lab, NTU

Singapore

July 2021 - 2024

Research Fellow

Department of Information Systems & Analytics, NUS

Singapore

July 2020 - July 2021

Research Assistant

Department of Computer Science, NUS

Singapore

Nov 2019 - June 2020

Full-time Lecturer

Department of Computer Science, United International University

Dhaka, Bangladesh

Jun 2014 - Jul 2015

Part-time Developer

Software Global Consultancy

Dhaka, Bangladesh

Jan 2014 - Mar 2014

RESEARCH EXPERIENCE

Research Fellow

PI: Associate Professor Adams Wai Kin Kong

Rolls-Royce@NTU Corporate Lab, NTU

July 2021 - 2024

- **Projects:** (1) Super-resolution/-fidelity of CFD simulations. (2) Accelerating unsteady flow simulation with physics-based AI.

Research Fellow

PI: Assistant Professor UM Sungyong

Department of Information Systems & Analytics, NUS

July 2020 - July 2021

- **Project:** Co-evolution of software ecosystem networks.

Research Assistant

PI: Professor Tan Kian Lee

Department of Computer Science, NUS

Nov 2019 - June 2020

- **Project:** Random generation of hypergraphs with prescribed constraints.

RESEARCH PUBLICATIONS

• Conference Proceedings

1. Bishwamitra Ghosh, Sarah Hasan, **Naheed Anjum Arafat**, and Arijit Khan. Consistency of language models for logic facts checking on knowledge graphs. In *ICLR*, 2025
2. **Naheed Anjum Arafat**, Debabrota Basu, Yulia Gel, and Yuzhou Chen. When witnesses defend: A witness graph topological layer for adversarial graph learning. In *Proceedings of the AAAI Conference on Artificial Intelligence*, 2025
3. **Naheed Anjum Arafat**, Ehsan Bonabi Mobaraki, Arijit Khan, Yllka Velaj, and Francesco Bonchi. Estimate and reduce uncertainty in uncertain graphs. In *2024 IEEE 11th International Conference on Data Science and Advanced Analytics (DSAA)*, 2024
4. *Loh Sher En Jessica, ***Naheed Anjum Arafat**, Wei Xian Lim, Wai Lee Chan, and Adams Wai Kin Kong. Finite volume features, global geometry representations, and residual training for deep learning-based cfd simulation. *ICML (spotlight)*, 2024. * = equal contribution
5. Wei Xian Lim, **Naheed Anjum Arafat**, Wai Lee Chan, and Adams Wai Kin Kong. Multi-order loss functions for accelerating unsteady flow simulations with physics-based ai. In *2024 IEEE Conference on Artificial Intelligence (CAI)*, 2024
6. **Naheed Anjum Arafat**, Arijit Khan, Arpit Kumar Rai, and Bishwamitra Ghosh. Neighborhood-based hypergraph core decomposition. volume 16. *Vldb Endowment*, May 2023
7. **Naheed Anjum Arafat**, Debabrota Basu, Laurent Decreusefond, and Stéphane Bressan. Construction and random generation of hypergraphs with prescribed degree and dimension sequences. In *Database and Expert Systems Applications*, pages 130–145, Cham, 2020. Springer International Publishing
8. **Naheed Anjum Arafat**, Debabrota Basu, and Stéphane Bressan. Topological data analysis with ϵ -net induced lazy witness complex. In *Database and Expert Systems Applications*, pages 376–392, Cham, 2019. Springer International Publishing
9. **Naheed Anjum Arafat** and Stéphane Bressan. Hypergraph drawing by force-directed placement. In *International Conference on Database and Expert Systems Applications*, pages 387–394, Cham, 2017. Springer International Publishing

• Journals

1. Siddhartha Shankar Das, Md Monirul Islam, and **Naheed Anjum Arafat**. Evolutionary algorithm using adaptive fuzzy dominance and reference point for many-objective optimization. *Swarm and evolutionary computation*, 44:1092–1107, 2019

• Patents

1. Fluid flow simulation. Inventors: Loh Sher En Jessica, **Naheed Anjum Arafat**, Adams Wai Kin Kong, Wai Lee Chan, Bryce D Conduit. Status (Sep 2024): Granted at UK Intellectual Property Office (<https://www.ipo.gov.uk/p-ipsum/Case/ApplicationNumber/GB2312389.6>)

• Workshops/Posters

1. **Naheed Anjum Arafat**, Debabrota Basu, and Stéphane Bressan. ϵ -net induced lazy witness complexes on graphs. *Workshop on Applications of Topological Data Analysis (ATDA)*, held in conjunction with *ECML-PKDD*, 2019

TEACHING EXPERIENCE

As Graduate Assistant

NUS

Jan 2016 - 2019

I conducted weekly tutorials and held one-on-one consultation sessions for the following courses:

- **Big Data Techniques and Technologies (BT4221)**: Department Of Information Systems and Analytics, School of Computing - Semester 1, 2019.
- **Data Management and Warehousing (BT5110)**: Master Of Science Business Analytics Programme - Semester 1 of 2019, 2018 and 2017.
- **Information Visualisation (CS5346)**: Department of Computer Science, School of Computing - Semester 2, 2018.
- **Discrete Structures (CS1231)**: Department of Computer Science, School of Computing - Semester 1, 2016.
- **Programming Methodology (CS1010E)**: Department of Computer Science, School of Computing - Semester 2 of 2017 and 2016.

As Full-time Lecturer

United International University

I designed course curriculum, prepared lecture notes, assignments, and exam questions, delivered lectures, conducted labs, and evaluated assignments and exam scripts. I was also involved in various administrative duties. The courses include:

- **Advanced Programming Languages**: Summer 2014, Fall 2014, Spring 2015, Summer 2015 trimesters.
- **Data Structures**: Fall 2014, Summer 2015 trimesters.
- **Discrete Mathematics**: Summer 2014 trimester.
- **Structured Programming Language**: Spring 2015 trimester.
- **Electric Circuits**: Fall 2014, Spring 2015, Summer 2015 trimesters.

MENTORING EXPERIENCE

- I held discussion, brainstorming, and coding sessions to train the students in academic research. I also gave suggestions to help improve their presentations and write-ups. The students include:
 - **Sarah Hasan:** PhD student at Aalborg University, Denmark. (2023-2024)
 - **Ehsan Bonabi Mobaraki:** PhD student at Aalborg University, Denmark. (2022-2023)
 - **Loh Sher En Jessica:** PhD student at Nanyang Technological University. (2021-2023)
 - **Bishwamittra Ghosh:** PhD student at National University of Singapore. (2021-2022)
 - **Arpit Kumar Rai:** Undergraduate student at IIT Kanpur (2021-2022)
 - **Debabrata Mahapatra:** PhD student at National University of Singapore (2019)

RESEARCH MANAGEMENT EXPERIENCE

- **Research Equipment Purchasing**
 - I led the acquisition of a high-performance GPU server for experimenting with deep neural networks.
 - * I managed the entire procurement process, from preparing requirement specifications for Invitation-To-Quote (ITQ) and setting clear evaluation criteria to evaluating potential vendors and overseeing the installation, testing & commissioning of the server.
 - * I collaborated with the IT department to ensure seamless integration of the new equipment into ongoing research projects, significantly enhancing the computational capabilities of RR@NTU Corp Lab.
- **Grant Writing**
 - AI Singapore Research Grant. Status: under review
 - * I collaborated with my PI (Adams) on developing the grant proposal by proposing ideas for potential work packages and drafted sections of the grant application, such as discussing state-of-the-art and their limitations.

TALKS

- **Guest Lectures:**
 - * **Big Data Techniques and Technologies module (NUS):** I delivered two guest lectures on 'Practical data analysis using Amazon EMR and Sagemaker services' during Semester 1, 2020 offering of the undergraduate module BT4221.
 - * **Data Management and Warehousing module (NUS):** I delivered a hands-on lecture on 'developing retail-sales data mart using Pentaho' during Semester 1, 2018 offering of the masters module BT5111.
 - * **Information visualisation module (NUS):** I delivered a guest lecture on 'Graph and hypergraph data visualisation tools' during Semester 2, 2018 offering of the master's module CS5346.
- **Seminar Talks:**
 - * **Moscow-Beijing Topology seminar 2022:** I presented my work on Topological data analysis.
 - * **DEXA 2020:** I presented my paper: *Construction and random generation of hypergraphs with prescribed degree and dimension sequences*
 - * **DEXA 2019:** I presented my paper: *Topological data analysis with ϵ -net induced lazy witness complex*.
 - * **E2S2-CREATE seminar:** I gave a talk on *Topological Data Analysis* at E2S2-CREATE Seminar, Feb 2018 attended by 20+ researchers from E2S2 project funded by NRF.

ACADEMIC SERVICES

- **PC Member:** CODS-COMAD (2024-2025), TKDE (2023, 2021), SKIMA (2014).
- **Reviewer:** ICML (2025), ICLR (2025), ICDE (2025, 2018), LoG (2024), NeurIPS (2024), CIKM (2024), Journal of Applied and Computational Topology, DASFAA (2020), DAWAK (2020), VLDB (2017), DEXA (2017).
- **Session Chair:** VLDB 2023 (Learning, Recommendations, Social Networks)
- **Co-organiser:** Co-organised *8th International Conference on Software, Knowledge, Information Management and Applications (SKIMA)*, 2014
- **Session Chair:** Chaired two sessions at *NUS SoC-Telecom ParisTech joint workshop on Data Sciences and Artificial Intelligence*, April 2018 attended by 20+ scholars from Telecom ParisTech and NUS.
- **Session Chair:** Chaired sessions at *NUS School of Computing Research Workshop*, March 2018 attended by 50+ scholars across Asia.

AWARDS & ACHIEVEMENTS

- **Distinguished PC member award:** CODS-COMAD 2024
- **NUS Research Scholarship** for PhD students (2015-2019).
- **Teaching Assistant Training Certificate** issued by the Centre for Development of Teaching & Learning (CDTL), NUS on applying 'Collaborative Learning' approaches.
- **Distinguished Poster Award** at Undergraduate Research Poster Presentation Workshop 2014, Department of Computer Science and Engineering, BUET for presenting my undergraduate Capstone project
- **Inter-University Hardware Project Show Champion** award for showcasing the project titled 'Cell phone operated mini-car with surveillance' at CSE festival 2013, BUET.
- **Imdad-Sitara Khan Scholarship** for high-school studies (2006-2008) and undergraduate studies (2009-2013).

REFERENCES

Available upon request