

# Kalyan Roy

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## Education

### North South University

**BS in Computer Science and Engineering (CGPA 3.22/ 4.00)**

Dhaka, Bangladesh

Aug 2014 – Dec 2019

- ✓ **Notable Courses:** Discrete Mathematics, Probability and Statistics, Data Structure and Algorithms, Design and Analysis of Algorithms, Artificial Intelligence, Neural Networks

## Work Experience

### North South University

**Research Assistant**

Dhaka, Bangladesh

Nov 2019 – Jun 2024

- ✓ **Supervisor:** [Dr. Ahsanur Rahman](#)
- ✓ **Research Areas:** Algorithms, Graph Theory, Data Mining
  - Jointly developed and implemented an exact algorithm to find dense subgraphs in a graph, addressing an **NP-complete** problem. Reduced its computational time compared to existing algorithms using effective pruning and optimization techniques. Experiments showed significant runtime speedups: **38.6x** and **6.5x** over ODES and PCE respectively on real graphs, and **39.7x** and **3.1x** on synthetic graphs.
  - Researched an approximation algorithm for near-minimal vertex cover. Used various graph theory approaches to significantly reduce timing compared to exact algorithms.
  - Enhanced graph algorithms using mathematical analysis and complexity theory, incorporating techniques from differential equations, combinatorics, and other relevant fields.
  - Co-implemented and tested algorithms in C, C++, and Python. Used efficient data structures and C++ STL features to improve overall efficiency.
  - Evaluated algorithm performance using real-world and synthetic datasets, analyzing behavior across various networks including social, technological, and biological. Created visualizations and statistical analyses to present results.

### North South University

**Teaching Assistant**

Dhaka, Bangladesh

Jan 2019 – Sep 2019

- ✓ **Courses:** Design and Analysis of Algorithms, Data Structure and Algorithms, Computing Concepts (C Programming)
  - Conducted regular office hours and tutoring sessions to support student learning.
  - Developed engaging assignments and question papers to challenge and motivate students.
  - Evaluated and graded student assignments and examinations.
  - Assisted course instructors in maintaining academic records and supported overall course management.

## Research Interests

*Algorithms, Graph Theory, Cryptography, Machine learning*

## Research Papers

**"A Fast Exact Algorithm to Enumerate Maximal Pseudo-cliques in Large Sparse Graphs"**

**SIGKDD '24**

- ✓ DOI : [10.1145/3637528.3672066](https://doi.org/10.1145/3637528.3672066)

**"A Step Towards Information Extraction : Named Entity Recognition in Bangla Using Deep Learning"**

**Journal of Intelligent & Fuzzy Systems**

- ✓ DOI : [10.3233/JIFS-179349](https://doi.org/10.3233/JIFS-179349)

**"Crime Prediction Using Multiple-ANFIS Architecture and Spatiotemporal Data"**

**IS '18**

- ✓ DOI : [10.1109/IS.2018.8710564](https://doi.org/10.1109/IS.2018.8710564)

## Notable Projects

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### ***A Fast Exact Algorithm to Enumerate Maximal Pseudo-cliques in Large Sparse Graphs***

*Oct 2018 – Jun 2024*

Played an integral role in developing FPCE (Fast Pseudo-Clique Enumerator), an exact algorithm for identifying dense portions of a network. FPCE is a reverse search algorithm that employs effective pruning techniques from graph theory, such as Order Bound, Turan Filtering, and Edge Bound. These techniques significantly improved efficiency compared to existing methods. On real graphs, it achieved an average 38.6x speedup over ODES and 6.5x over PCE. On synthetic graphs, it attained mean speed gains of 39.7x versus ODES and 3.1x versus PCE. This work was published as a conference paper in the KDD '24: Proceedings of the 30th ACM SIGKDD Conference on Knowledge Discovery and Data Mining.

### ***An Approximation Algorithm For Vertex-cover Problem***

*Jun 2020 – Jun 2024*

Worked on designing and implementing of an approximation algorithm aimed at finding the minimal or near-minimal vertex cover of a network. Significantly enhanced the algorithm performance by applying established theorems from graph theory along with formulating novel theorems. The research project is ongoing, with further advancements and refinements in progress.

### ***Bangla Automatic License Plate Recognition (ALPR)***

*Jan 2019 – Sep 2019*

Collaborated with a company named Headblocks to improve their automatic license plate recognition (ALPR) system for Bangla license plates in challenging conditions such as low light, blur, skewness, etc. The developed system, with an improved model and pre-processing pipeline, had a 3.7x better accuracy than the original system.

### ***A Step Towards Information Extraction : Named Entity Recognition in Bangla using Deep Learning***

*May 2018 – Nov 2018*

Played a pivotal role in preparing a unique and non-existent Bangla language dataset for the co-developed deep learning-based Named Entity Recognition system utilizing DCN-BiLSTM. Collaboratively prepared a dataset of 71,284 tokenized Bangla sentences, annotated with four categories (person, location, organization, and object) using the IOB tagging scheme. An Express JS-based data annotation tool was employed to prepare the dataset. The research was subsequently published in the Journal of Intelligent & Fuzzy Systems.

### ***Crime Prediction Using Multiple-ANFIS Architecture and Spatiotemporal Data***

*Jan 2018 – Apr 2018*

Co-implemented a model for predicting crime occurrences using fuzzy inference systems (FIS) and spatiotemporal data. A hybrid approach was implemented, combining FIS and ANFIS models for various crime types, resulting in enhanced overall accuracy. The research findings were presented and published as a conference paper at the 2018 International Conference on Intelligent Systems (IS).

### ***A Unified Platform for Face Recognition - Deep Learning and Conventional Approach***

*Jan 2018 – Apr 2018*

Jointly developed a unified platform for face recognition that integrated deep learning and conventional models. The platform incorporated YOLOv2, Haar feature-based cascade classifier, and other techniques to enable performance comparisons between different face recognition models.

## Skills

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- ✓ **Languages:** C/C++ (Proficient), Python, Bash, R, Java
- ✓ **Machine Learning & Deep Learning Stack:** PyTorch, TensorFlow, OpenCV
- ✓ **Data Management and Cataloging:** SQL, MySQL
- ✓ **Backend Development & Testing:** Node.js
- ✓ **Version Control:** Git
- ✓ **Debugger and Profiler:** Valgrind, GNU Profiler

## Special Accomplishments

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- ✓ Qualified for the International Collegiate Programming Contest (ICPC) Dhaka Regional Site by placing among the top teams out of approximately 1,500 participating teams in the preliminary round. *2018 & 2019*
- ✓ Awarded 2nd place in the Bangladesh Mathematical Olympiad (BdMO) Regional Competition. *2012*