AYUSH KUMAR SHAH

5^{th} year Ph.D. student in Computer Science

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EDUCATION

PhD in Computing and Information Sciences, CGPA: 3.93/4 *Aug 2020 – Present*
Rochester Institute of Technology (RIT) *Rochester, NY, USA*
Area of focus: extraction and visual parsing of graphical structures and notations from documents
Relevant Courses: Pattern Recognition, Computer Vision, Deep Learning Mathematics, NLP, Software Engineering.

Bachelors in Computer Engineering, CGPA: 3.96/4 *Aug 2015 – Oct 2019*
Kathmandu University *Kavre, Nepal*
Relevant Courses: Artificial Intelligence, Data Structures and Algorithms, Algorithm and Complexity, Software Engineering, Probability and Statistics, Machine Learning, Speech and Language Processing, C, C++.

PROFESSIONAL EXPERIENCE

Amazon - Alexa Speaker Understanding AI Sunnyvale, California
Applied Scientist Intern *May 2022 – Aug 2022*

- Improved speaker identification results in voice assistants like Alexa by reducing training time and annotation costs through semi-supervised learning.

Fusemachines Kathmandu, Nepal
Machine Learning Engineer *June 2019 – Aug 2020*

- Optimized client's business decisions for chemical products that go unsold using boosting classifiers.
- Automated bank data extraction by building a 95% accurate handwritten text (English & Nepali) recognizer.
- Prepared Fusemachines AI Education Programs course materials for AI Democratization.

PUBLICATION

- **A. K. Shah**, A. Dey, L. Luo, B. M. Amador, P. Philippy, M. Zhong, S. Ouyang, D. M. Friday, N. Jackson, R. Zanibbi, and J. Han, "Multimodal Search in Chemical Documents and Reactions", *submitted to* Proceedings of the 48th International ACM **SIGIR** Conference on Research and Development in Information Retrieval, in SIGIR '25.
- **A. K. Shah**, B. M. Amador, A. Dey, M. Creekmore, B. Ocampo, S. Denmark, and R. Zanibbi, "ChemScraper: Leveraging PDF Graphics Instructions for Molecular Diagram Parsing," in Document Analysis and Recognition (Journal) - **IJDAR** 2024, vol. 27, Sep. 2024, pp. 395-414, doi: 10.1007/s10032-024-00486-7.
- **A. K. Shah**, and R. Zanibbi, "Line-of-Sight with Graph Attention Parser (LGAP) for Math Formulas," in Document Analysis and Recognition - **ICDAR** 2023, Cham: 2023, pp. 401–419, doi: 10.1007/978-3-031-41734-4_25.
- B. M. Amador, M. Langsenkamp, A. Dey, **A. K. Shah**, and R. Zanibbi. "Searching the ACL Anthology with Math Formulas and Text" in Proceedings of the 46th International ACM **SIGIR** Conference on Research and Development in Information Retrieval, in SIGIR '23. ACM 2023, Jul. 2023, pp. 3110–3114, doi: 10.1145/3539618.3591803
- **A. K. Shah**, A. Dey, and R. Zanibbi, "A Math Formula Extraction and Evaluation Framework for PDF Documents," in Document Analysis and Recognition - **ICDAR** 2021, Cham, 2021, pp. 19–34, doi: 10.1007/978-3-030-86331-9_2

RESEARCH EXPERIENCE

17th International Conference on Document Analysis and Recognition San José, California
Program Committee (PC) Member *2023*

- Reviewed and evaluated five research paper submissions, and provided feedback and recommendations to authors.

Document and Pattern Recognition Lab (DPRL), RIT Rochester, New York
Graduate Research Assistant *Aug 2020 – Present*

- Developed a fast and accurate molecular diagrams parser, with automated annotated data generation for training visual chemical parsers, and novel graph-based evaluation metrics and error analysis tools.

- Enhanced accessibility of mathematical information through a documents search system within the ACL Anthology, integrating both text and mathematical formulas search for users with context-aware word and formula matching.
- Improved expression recognition rate of math formulas by 15% using improved attention and context features using modified graph attention network (GAT) and spatial pyramidal pooling.
- Accelerated math formula recognition by 6 times by implementing a custom dataloader with dynamic batch size for full GPU utilization in a distributed parallelization framework.
- Aided the document recognition community by introducing a valuable open-source visualization tool, facilitating the evaluation of graphical recognition results and the identification of specific errors within documents in context.

Research Interests: Pattern recognition, recognition of graphical structures, computer vision, speaker understanding, large language models, multi-modal deep learning, natural language processing

HONORS AND AWARDS

RIT Ph.D. Merit Scholarship/Assistantship. Financial Support for Ph.D. at RIT, which includes support via NSF Grants. *2020 – Present*

Kathmandu University Merit-based scholarship (4x). $440 worth scholarship awarded for securing the highest GPA in the Computer Engineering cohort (4/7 semesters). *2015 – 2019*

Fusemachines Artificial Intelligence Scholarship Program. Selected among thousands of candidates nationwide for fuse.ai Artificial Intelligence Scholarship Online Course. Nov 2018

American Society of Nepalese Engineers Merit Award. A merit worth $200, rewarded to the entrance topper of each university in Nepal, seeking admission for undergraduate degrees. May 2016

46th International Physics Olympiad (IPhO) Contestant. One of the largest olympiads for high school Physics enthusiasts with 5 contestants, each from 100 participating countries. June 2015

TEACHING EXPERIENCE

Rochester Institute of Technology Rochester, New York
Graduate Teaching Assistant *Aug 2022 – Dec 2022*

- Course: CSCI 335: Machine Learning

Samriddhi College Kathmandu, Nepal
Computer Science Instructor *Jan 2020 – June 2020*

- Course: "Foundations in AI: Computer Science and Mathematics"

TECHNICAL SKILLS

Programming Languages	Python, R, Matlab, C, C++, JAVA
Python Packages	Pytorch, Tensorflow, Scikit-Learn, OpenCV, Nltk, Pandas, Numpy, Matplotlib, Fastapi, BeautifulSoup, Regex, NetworkX, Jupyter
Database	MySQL, MongoDB
Miscellaneous	Git, Github, Bash, LaTeX, Jira, Linux, Arduino, Raspberry-pi

TALKS

Oral presentation on "ChemScraper: Leveraging PDF Graphics Instructions for Molecular Diagram Parsing" at the 18^{th} International Conference on Document Analysis and Recognition ICDAR 2024, Athens, Greece. *Sept 3, 2024*

Poster presentation on "ChemScraper: Extracting Molecule Diagrams from PDF Vector and Raster Images with CDXML and SMILES Output" at the Molecule Maker Lab Institute (MMLI) All-Institute Retreat at **University of Illinois Urbana-Champaign (UIUC)**. *Sept 12, 2023*

Research Idea Ring (RIR) talk on "Line-of-sight with Graph Attention Parser (LGAP) for Math Formulas" at RIT. *April 17, 2023*

Poster presentation on "Reconstructing the Structure of Molecular Diagrams in PDF Documents using a CNN-Attention-Based Parsing Model" at the Molecule Maker Lab Institute (MMLI) All-Institute Retreat at **University of Illinois Urbana-Champaign (UIUC)**. *Sept 28, 2022*

Guest lecture on "Bayesian Decision Theory" for RIT's undergraduate course - Intro to Machine Learning (40 students). *Sept 5, 2022*

Research Idea Ring (RIR) talk on "A Fast and Interpretable Context-aware Parser for Isolated Formulas and Chemical Diagrams" at RIT. *April 7, 2022*