

# AYUSH KUMAR SHAH

5<sup>th</sup> year Ph.D. student in Computer Science

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## EDUCATION

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**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*

## PROFESSIONAL EXPERIENCE

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**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

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- A. K. Shah**, A. Dey, L. Luo, B. M. Amador, P. Philippy, M. Zhong, S. Ouyang, D. M. Friday, D. Bianchi, N. Jackson, R. Zanibbi, and J. Han, "Multimodal Search in Chemical Documents and Reactions", *submitted to 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, 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, doi: 10.1007/978-3-030-86331-9\_2

## RESEARCH EXPERIENCE

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**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

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- 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*
- 46<sup>th</sup> 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

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- 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

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| <b>Programming Languages</b> | Python, R, Matlab, C, C++, JAVA  |
| <b>Python Packages</b>       | Pytorch, Tensorflow, Scikit-Learn, OpenCV, Nltk, Pandas, Numpy, Matplotlib, Fastapi, BeautifulSoup, Regex, NetworkX, Jupyter |
| <b>Database</b>              | MySQL, MongoDB   |
| <b>Miscellaneous</b>         | Git, Github, Bash, L <sup>A</sup> T <sub>E</sub> X, Jira, Linux, Arduino, Raspberry-pi                                       |

## TALKS

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- Oral presentation** on “ChemScraper: Leveraging PDF Graphics Instructions for Molecular Diagram Parsing” at the 18<sup>th</sup> 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*