AYUSH KUMAR SHAH

Ph.D. student in Computer Science

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Research Interests: Pattern recognition, computer vision, detection and recognition of graphical structures, deep learning

EDUCATION

PhD in Computing and Information Sciences *Aug 2020 – Present*
Rochester Institute of Technology (RIT) *Rochester, NY, USA*
CGPA: 3.92/4
Advisor: Dr. Richard Zanibbi
Research Group: Document and Pattern Recognition Lab (DPRL)

Area of focus: extraction and visual parsing of graphical structures and notations, focusing on mathematical formulas and chemical diagrams in documents.
Relevant Courses: Pattern Recognition, Computer Vision, Mathematics for Deep Learning, Natural Language Processing, Software Engineering

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

PUBLICATION

- **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

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

- Worked on the MathSeer project, a system to make finding mathematical information easier by creating innovative search engines, interfaces, and algorithms for extracting and recognizing math
- Built a new open-source math formula extraction pipeline for PDF files
- Adopted distributed parallelization methods with multiple GPUs and implemented custom dataloader with dynamic batch size to fully utilize the GPU, which increased the speed of the math formula parser by 6 times
- Built new tools for visualization and evaluation of parsing results and errors
- Worked on a PDF symbol extractor that identifies precise bounding box locations in born-digital PDF documents
- Developed a simple and effective algorithm to perform detection of math expressions using visual features alone
- Wrote an API for recognizing handwritten and typeset formulas and output the corresponding LaTeX and MathML
- Currently working on improving the accuracy of the math formula parser by experimenting better visual features and attention mechanisms
- Currently working on adopting the parser to work with more complex graphical structures like chemical diagrams

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

WORK EXPERIENCE

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

- Worked on the ML pipeline: data cleaning and pre-processing, model building, tuning hyperparameters, model training, and model evaluation in NLP and Computer Vision domain.
- Developed a product classifier using chemical attributes to optimize business decisions for products that go unsold using boosting algorithms including Gradient Boosting, Random Forests, XGBoost, LightGBM.
- Built an intelligent character recognition system using CNN and RNN to predict handwritten texts (both English and Nepali) in manually-filled form fields with an accuracy of 95%.
- Analysed data provided by a subscription-based e-commerce client for building a recommendation system, which led to an increase in revenue through cross-selling.
- Designed, reviewed, and refined reading materials, quizzes, assignments, and projects for Fusemachines AI Education Programs - "Foundations in AI: Mathematics for AI" (linear algebra, calculus, probability and statistics, etc.), "Micro Degree™ in Artificial Intelligence: Machine Learning, Computer Vision" (regresssion, image processing, feature detection, image classification, object recognition, etc.)

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

- Designed and implemented daily lesson plans and coding sessions for the course "Foundations in AI: Computer Science and Mathematics" to undergraduate BSc.CSIT students. The course topics include: Introduction to AI, Fundamentals of CS, Python Programming, Data Structure, Database Management System.

HONORS AND AWARDS

RIT Ph.D. Merit Scholarship/Assistantship. Financial Support for Ph.D. at RIT. *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

PROJECTS

Nepali Plagiarism Detector *2019*
An application that detects plagiarised Devanagari text files using a self-built rule-based stemming algorithm and Cosine similarity.

Guitar chord recognizer *2019*
An application that predicts the chords when the Mel spectrograms of guitar sound are fed into a CNN.

AI Plays GTA 5: Simulating self-driving vehicles *2019*
A bike-riding agent in a virtual environment (GTA5), built using CNN, used for simulating self-driving vehicles.

Sarangi: Nepali lyrics emotions extraction *2018*
A framework that categorizes songs written in the Devanagari script into four emotions using Naive Bayes.

AutoCar *2018*
A self-driving car that can detect lanes, stop sign, traffic light and avoid a collision, built using Canny edge detection, Hough transform, Haar cascade classifier, and Arduino programming.

MathMate – advanced mathematical calculator *2018*
An android app that solves different types of mathematical equations, numerical computations, and calculus problems showing involved steps.