Muntabir Hasan **Choudhury**

Ph.D. in Computer Science

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Sterling, VA

I am a researcher with a Ph.D. in Computer Science from Old Dominion University, specializing in cutting-edge advancements in AI, Machine Learning, Natural Language Processing, and Big Data analysis. My work focuses on developing innovative solutions and leveraging the potential of large language models and generative AI to address complex real-world challenges. Always driven to explore new frontiers in these technologies, I am actively seeking new opportunities to collaborate and contribute to impactful projects in AI/ML and data science.

Research Experience

December 2024 – August 2019

Graduate Research Assistant | Old Dominion University | Norfolk, VA, United States

- Developed ETDSuite, an AI-driven smart library leveraging multimodal AI, NLP, and CV models to transform raw ETD documents into structured JSON format, improving digital accessibility and searchability.
- Designed and implemented Large Language Model (LLM)-based methods for parsing citation strings from ETDs, enhancing automated bibliographic data extraction.
- Developed machine learning models using NLP techniques to accurately extract and structure metadata from ETDs, improving indexing and retrieval efficiency.
- Applied machine learning techniques to enhance metadata quality, addressing challenges in document accessibility and search optimization.
- Created a multimodal AI framework using a top-down approach to segment ETD documents (e.g., tables, figures, chapters), integrating vision-language models for structured content analysis.
- Contributed to research in computational reproducibility, replicability, and topological relationship-based image analysis, expanding AI applications in scholarly big data.
- Mentored students, published research papers, authored research proposals, and presented findings at top-tier computer science conferences and journals.

Natural Language Processing | Computer Vision | Machine Learning | Deep Learning | Scholarly Big Data | Digital Libraries

Professional Experience

Present – May 2024

ORISE Fellow | U.S. Food & Drug Administration | Silver Spring, MD, United States

- Conducting methodological research in data science, evaluating and applying advanced machine learning techniques to enhance quality surveillance algorithms for drug products.
- Exploring modern AI environments, integrating LLM methods such as prompt tuning, fine-tuning, and Retrieval-Augmented Generation (RAG) to improve data-driven decision-making.
- Implemented multi-GPU training with data parallelism to process large-scale datasets, significantly reducing computation time and improving deep learning model performance.
- Proposed and employed deep learning algorithms using pre-trained embeddings and transfer learning, optimizing drug product quality analysis with enhanced accuracy and efficiency.
- Additionally, Investigated and optimized server, network, and storage architectures in both virtual and physical environments, enhancing the scalability and efficiency of quality surveillance systems.

Python | SQL | PyTorch | Natural Language Processing | Data Science | Large Language Models | Databricks

August 2021 – June 2021

Machine Learning Intern | Bihrle Applied Research Inc | Hampton, VA, United States

- Contributed to the BNSF Railway and FAA's Pathfinder Program, developing AI-driven technologies for drone-based supplemental inspection of railway infrastructure.
- Designed and optimized machine learning and deep learning algorithms for Rail-Inspector, a cloud-based AI software that analyzes aerial imagery of railroad tracks for train detection.
- Created a high-quality ground truth dataset by labeling 1,000+ train images, improving the accuracy of deep learning-based segmentation models.
- Implemented a train detection model and fine-tuned a Fully Convolutional Network (FCN) for train segmentation, optimizing model performance and reducing false detections.
- Achieved 96% detection accuracy, contributing to the successful partial deployment of the segmentation model into the production pipeline.

Python | SQL | C++ | Anaconda | TensorFlow | PyTorch | OpenCV | Computer Vision | Image Processing

August 2020 – June 2020

Research Intern | Los Alamos National Laboratory | Los Alamos, NM, United States

- Conducted research at Los Alamos National Laboratory (LANL) on historical archives containing handwritten mathematical expressions (HME) embedded within text and images.
- Developed a framework for offline HME recognition, integrating computer vision techniques for feature extraction and preprocessing.
- Preprocessed images by building ground truth datasets and applying OpenCV-based segmentation, blurring, and binary thresholding to enhance feature quality.
- Designed and trained a deep learning model using LeNet5-CNN, employing vector normalization, one-hot encoding, and sampling techniques, achieving 89% accuracy in handwritten expression recognition.

Python | Anaconda | TensorFlow | Keras | OpenCV | Git | Deep Learning | Computer Vision

July 2019 – September 2018

Application Performance Engineer | Resource9 Group Inc | Long Island City, NY, United States

- Utilized AppDynamics to configure health rules, policies, and alerts at the tier and node levels, enabling proactive detection of application slowdowns and server infrastructure issues.
- Managed and monitored 10+ mission-critical applications using AppDynamics, analyzing transaction snapshots by drilling down into the full call stack to identify and resolve performance bottlenecks.
- Diagnosed and resolved hardware-level issues, including memory leaks, garbage collection inefficiencies, heap utilization concerns, and thread contention, improving system stability and efficiency.
- Addressed business transaction-related issues by configuring POCO and POJO entry points, optimizing application performance, and integrating monitoring agents (Java, .NET, DB, EUM, and machine agents).
- Provided technical guidance by educating customers on best practices and implementation strategies to enhance application performance and reliability.

Application Monitoring | Linux | Java | .NET | Docker | AWS | Git

August 2017 – June 2017

Undergraduate Research - Data Analytics | Elizabethtown College | Elizabethtown, PA, United States

- Researched "Etown Means Business – Impact on Philanthropy at Elizabethtown College".
- Analyzed the dataset using data visualization techniques such as box plot, scatter plot, and histogram.
- Identified duplicate records in the database and queried the database using SQL to collect, update, and insert records.
- Implemented machine learning models such as multivariate linear regression to predict variables which made a great impact on philanthropy.

SQL | R | RDBMS | Machine Learning

Education

December 2024 – August 2019

Old Dominion University | Norfolk, VA, United States

- **Ph.D.** in **Computer Science**
- **GPA :** 3.84/4.00
- **Research Interest :** AI/ML, NLP, Computer Vision, Scholarly Big Data, Digital Libraries.

May 2018 | Elizabethtown College | Elizabethtown, PA, United States
August 2014
- **Bachelor of Science** in **Computer Engineering**
- **Minor :** Information Systems
- **GPA :** 3.36/4.00

Projects

AutoMeta
August 2019 - January 2021

github.com/lamps-lab/AutoMeta Presentation JCDL 2021

A metadata extractor application to extract metadata fields from scanned book-length documents such as electronic theses and dissertations (ETDs) by leveraging NLP techniques. It uses ML-based methods such as **Conditional Random Field (CRF)**, which incorporates text and visual features. The model was trained and evaluated using **AutoMeta-ETD500**, and achieved F1 score of **83% – 96%**.

OCR | Machine Learning | Digital Libraries | Scholarly Big Data | NLP

ETDPC
March 2021 - August 2023

github.com/lamps-lab/ETDMiner/tree/master/etd_segmentation

A two-stream novel multi-modal classification model with cross-attention that uses vision encoder (**ResNet50v2**) and text encoder (**BERT with Talking-Heads Attention**) to classify ETD pages into 13 categories. The model was trained and evaluated using **ETDPC-ETD500**, and achieved F1 score of **84% – 96%**.

AWS Textract | Tensorflow | Computer Vision | Deep Learning | Machine Learning | LLMs | NLP | Digital Libraries | Scholarly Big Data

MetaEnhance
May 2022 - December 2022

github.com/lamps-lab/ETDMiner/tree/master/metadata_correction

An application to improve the metadata quality of ETDs by filling out the *missing values*, correcting the *incorrect values* and *misspellings*, and *canonicalizing the surface values* by leveraging the SOTA ML and DL models. The framework was evaluated against **MetaEnhance-ETDQual500** and achieved nearly perfect F1-scores in detecting errors and F1-scores ranging from **85% – 100%** for correcting five of seven key metadata fields.

OCR | Python | Machine Learning | Deep Learning | NLP | Digital Libraries | Metadata Quality

TechDrawFinder
June 2023 - September 2023

github.com/lamps-lab/TechDrawFinder

TechDrawFinder, the first multimodal vector search engine, allows users to search for 67,516 segmented technical drawings in design patents. TechDrawFinder supports text-to-figure and figure-to-figure queries by leveraging the joint embeddings generated by OpenAI's Contrastive Language-Image Pre-training (CLIP) model, a multimodal framework.

Django | Bootstrap | CLIP by OpenAI | FAISS

LMParsCit
March 2024 - November 2024

github.com/lamps-lab/LMParsCit

This project leverages LLMs (e.g., **llama3-8b-instruct**, **GPT-3.5 turbo**, and **GPT-4o-mini**) to extract key metadata fields—like title, author, venue, and year—from references across a range of bibliography types (e.g., journals, conference proceedings, tech reports). It also supports multiple bibliography styles (e.g., IEEE, ACM, APA) and achieved an F1 score of **99%** on **CORA-ref** and **ETDCite**.

Django | Bootstrap | CLIP by OpenAI | FAISS

Peer Reviewed International Conferences and Journals

1. **IAAI'24** – ETDPC : A Multimodality Framework for Classifying Pages in Electronic Theses and Dissertations. **Muntabir Hasan Choudhury**, Lamia Salsabil, William A. Ingram, and Edward A. Fox, Jian Wu. pre-print link paper link
2. **JCDL'23** – MetaEnhance : Metadata Quality Improvement for Electronic Theses and Dissertations of University Libraries. **Muntabir Hasan Choudhury**, Lamia Salsabil, Himarsha R. Jayanetti, Jian Wu, William A. Ingram, and Edward A. Fox. (**Best Paper Award**) pre-print link paper link
3. **ICDAR'23** – A Study on Reproducibility and Replicability of Table Structure Recognition Methods. Kehinde Ajayi, **Muntabir Hasan Choudhury**, Sarah Rajtmajer, and Jian Wu. paper link pre-print link
4. **Sci-K'22** – A Study of Computational Reproducibility using URLs Linking to Open Access Datasets and Software. Lamia Salsabil, Jian Wu, **Muntabir Hasan Choudhury**, William A. Ingram, Edward A. Fox, Sarah J Rajtmajer, and C. Lee Giles. paper link
5. **SDU@AAAI'22** – Segmenting Technical Drawing Figures in US Patents. Md Reshad Ul Hoque, Xin Wei, **Muntabir Hasan Choudhury**, Kehinde Ajayi, Martin Gryder, Jian Wu, and Diane Oyen. paper link
6. **JCDL'21** – Automatic Metadata Extraction Incorporating Visual Features from Scanned Electronic Theses and Dissertations. **Muntabir Hasan Choudhury**, Himarsha R. Jayanetti, Jian Wu, William A. Ingram, and Edward A. Fox. paper link pre-print link

7. **JCDL'20** – A Heuristic Baseline Method for Metadata Extraction from Scanned Electronic Theses and Dissertations. **Muntabir Hasan Choudhury**, Jian Wu, William A. Ingram, and Edward A. Fox. paper link
8. **IJDL** – Building Datasets to Support Information Extraction and Structure Parsing from Electronic Theses and Dissertations. William A. Ingram, Jian Wu, Sampanna Yashwant Kahu, Javaid Akbar Manzoor, Bipasha Banerjee, Aman Ahuja, **Muntabir Hasan Choudhury**, Lamia Salsabil, Winston Shields and Edward A. Fox. paper link

Posters & Extended Abstracts

1. **JCDL'23** – ETDSuite : An Library for Mining Electronic Theses and Dissertations. **Muntabir Hasan Choudhury**.
2. **ODU'23** – MetaEnhance : Metadata Quality Improvement for Electronic Theses and Dissertations. **Muntabir Hasan Choudhury**, Lamia Salsabil, Himarsha R. Jayanetti, Jian Wu. link video link
3. **JCDL'20** – A Heuristic Baseline Method for Metadata Extraction from Scanned Electronic Theses and Dissertations. **Muntabir Hasan Choudhury**, Jian Wu, William A. Ingram, and Edward A. Fox. (**Best Poster Award**) link video link

Reviewed Papers

2024 **PeerJ Computer Science** – One Manuscript review
2023 **Scientometrics** – One Manuscript review
2023 **ACM/IEEE Joint Conference on Digital Libraries 2023** – One Paper Review
2022 **ACM/IEEE Joint Conference on Digital Libraries 2022** – One Paper Review
2020 **ACM/IEEE Joint Conference on Digital Libraries 2020** – 10 Poster Abstracts Review

Honors and Awards

2023 **Dominion Scholar Award** from **Old Dominion University Computer Science**
2023 **Best Short Paper Award** from **ACM/ IEEEJoint Conference on Digital Libraries (JCDL 2023)**
2023 **Received Travel Grant of $500** from **Old Dominion University SEES Award**
2023 **Received Travel Grant of $1,420** from **ACM SIGIR**
2022 **Outstanding Teaching Assistant Award** from **Old Dominion University**
2020 **Best Poster Award** in **ACM/ IEEE Joint Conference on Digital Libraries (JCDL 2020)**
2020 **Dr. Hussain Abdel-Wahab Graduate Fellowship** from **Old Dominion University Computer Science**
2020 Received **AML Summer Research Fellowship** from **Los Alamos National Laboratory**
2018 **Sigma Pi Sigma** Honor – **National Physics Honor Society**
2017 **Sigma Alpha Pi** Honor – **The National Society of Leadership and Success**
2016 **Dean's List** Honor – **Elizabethtown College**
2014 **International Scholarship** Recipient – **Elizabethtown College**

Teaching and Mentoring

Spring 2023
Fall 2021

CS 722/822 : Machine Learning | Old Dominion University | Norfolk, VA, United States
Supervisor : Dr. Fengjiao Wang and Dr. Jiangwen Sun

- Helped students to understand the theoretical concepts of the mathematics behind machine learning models, including regression models, neural networks (e.g., CNN), clustering, and KNN.
- Created homework and exam solutions, graded homework, project reports, and codes.
- Hold TA sessions each week to help students with their homework assignments.

Supervised Learning | Unsupervised learning | Linear Regression | Logistic Regression | Neural Network)

Fall 2022
Fall 2019

CS 418/518 : Web Programming | Old Dominion University | Norfolk, VA, United States
Advisor/Supervisor : Dr. Jian Wu

- Assisted students with their semester project on search engine development using LAMP (Linux, Apache, MySQL, and PHP) technologies and ElasticSearch.
- Helped students with document indexing using **Elasticsearch**, graded assignments and project reports, and reviewed programming code.
- Prepared datasets and delivered them to the students for the semester project.
- Provided demo to the students on using Wikifier API and example code to call Wikifier API to identify keyphrases from the text and store the keyphrase in JSON object.
- Gave a talk as a guest speaker regarding industry experience.

Linux | Apache | MySQL | PHP | Elasticsearch | Guest Lecture

Programming Skills/Frameworks/Others

Languages & Technologies	Python, PHP, C, SQL, HTML, CSS, Django, Bootstrap, Elasticsearch, AWS S3
AI technologies & APIs	Keras, Tensorflow, PyTorch, OpenCV, scikit-learn, NLP toolkit
Development Tools	Anaconda, Jupyter Notebook, Visual Studio Code, SVN, git, Docker, AWS
Operating Systems	Linux, Mac OS X, Windows Server

References

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