# Koshik Debanath

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## Research Objective

A highly motivated researcher with extensive experience in Natural Language Processing, Generative AI, and Deep Learning, evidenced by multiple peer-reviewed publications. Seeking to pursue a PhD to develop novel multi-modal models and explore their applications in complex reasoning and misinformation detection.

## Education

**Rajshahi University of Engineering & Technology** — Rajshahi, Bangladesh
*B.Sc. in Computer Science and Engineering* ***CGPA: 3.27 / 4.00*** — *Jan 2018 – Sep 2023*

- **Relevant Coursework:** Linear Algebra, Data Structures and Algorithms, Object Oriented Programming, Discrete Mathematics, Database Management, Applied Statistics & Queuing Theory, Digital Image Processing, Neural Network and Fuzzy System, Artificial Intelligence, Data Mining

## Research Experience

**Young Learners' Research Lab (YLRL)** — Rajshahi, Bangladesh
*Research Member* — *Jan 2024 – Present*

- Conducted interdisciplinary research in NLP, Generative AI, and misinformation detection, resulting in five peer-reviewed publications.
- Collaborated on projects focusing on low-resource NLP for the Bengali language, analysis of political discourse, and classification of AI-generated text.
- Engaged in a collaborative environment to explore cutting-edge ML/DL applications, aligning with the lab's mission to foster impactful research.

## Skills

**Languages:** Python (Expert), C/C++, Java, JavaScript, SQL, MATLAB

**AI/ML Frameworks:** PyTorch, TensorFlow, Keras, Scikit-learn, LangChain, Transformers, OpenCV

**AI/ML Expertise:** Generative AI (LLMs, RAG, Fine-tuning), NLP, Computer Vision, Deep Learning, Time Series Analysis, Prompt Engineering, Explainable AI (XAI), Data Mining

**Tools & Platforms:** Git, Docker, FastAPI, Flask, Django, CI/CD, MLOps, Pinecone, MongoDB, MySQL, SQLite

## Publications

### Journal Articles

- **Debanath, Koshik** and Aich, Sagor and Srizon, Azmain Yakin, *"Bayesian Physics-Informed Neural Networks for Parameter Inference and Uncertainty Quantification in Reaction-Diffusion Models of Wound Healing,"* **Under review** *Mathematical Biosciences* (July 2025). Preprint available at SSRN or DOI.

### Conferences

- **K. Debanath**, A. F. M. M. Rahman and M. A. Hossain, *"An Attention-Based Deep Learning Approach to Knee Injury Classification from MRI Images,"* 2023 26th International Conference on Computer and Information Technology (ICCIT), Cox's Bazar, Bangladesh, 2023, pp. 1-6, doi: 10.1109/ICCIT60459.2023.10441340.
- **K. Debanath**, S. Aich and A. Y. Srizon, *"Advancing Low-Resource NLP: Contextual Question Answering for Bengali Language Using Llama,"* 2025 International Conference on Electrical, Computer and Communication Engineering (ECCE), Chittagong, Bangladesh, 2025, pp. 1-6, doi: 10.1109/ECCE64574.2025.11013841.
- S. Aich, **K. Debanath** and A. Y. Srizon, *"Distinguishing Between Formal and Colloquial: A Multilingual BERT Approach to Bengali Language Classification,"* 2025 International Conference on Electrical, Computer and Communication Engineering (ECCE), Chittagong, Bangladesh, 2025, pp. 1-6, doi: 10.1109/ECCE64574.2025.11013999

- **K. Debanath**, S. Aich and A. Y. Srizon, *"Analyzing Bot Activity and Political Discourse in the 2024 U.S. Presidential Election: A Machine Learning Approach to Misinformation and Manipulation,"* 2nd International Conference on Next-Generation Computing, IoT and Machine Learning (NCIM-2025), Gazipur, Bangladesh, 2025, pp. 1-6, doi:10.1109/NCIM65934.2025.11160229.
- S. Aich, **K. Debanath**, and A. Y. Srizon, *"Distinguishing Human-Written and AI-Generated Text: A Comprehensive Study Using Explainable Artificial Intelligence in Text Classification,"* 2nd International Conference on Next-Generation Computing, IoT and Machine Learning (NCIM-2025), Gazipur, Bangladesh, 2025, pp. 1-6, doi: 10.1109/NCIM65934.2025.11160309.
- **K. Debanath**, *"Physics-Informed Neural Networks for Real-Time Anomaly Detection in Power System Dynamics,"* **Accepted**, To appear in 3rd International Conference on Big Data, IoT and Machine Learning (BIM 2025).

## Experience

**Manaknightdigital Inc.** Toronto, ON, Canada (Remote)
*Data Scientist* *Mar 2023 – Apr 2025*

- **Chatbot Development**:
  - Collected and processed product information using Excel, pandas, and openpyxl.
  - Integrated GPT-4 to respond to user queries and manage token size limitations.
  - Utilized libraries like nltk, sklearn, and Flask for deploying the chatbot.
- **Fraud Detection System**:
  - Performed EDA and feature extraction on transaction datasets.
  - Developed and optimized ML models including Xgboost, SVC, and Logistic Regression.
  - Achieved 90% accuracy in detecting fraudulent transactions and deployed the system using Flask.
- **Data-driven ChatBot for Financial Queries**:
  - Implemented RAG and Pinecone, enhancing data retrieval speed by 40%, enabling faster decision-making for lenders.
  - Improved data retrieval accuracy by 25% using Cohere reranking, resulting in more precise financial advice.
  - Applied Beautiful Soup and PyPDF2 for data scraping and processing.
- **Sports Data Analysis ChatBot**:
  - Scraped and analyzed football data to predict match outcomes.
  - Integrated RAG and Pinecone for efficient data querying and vector database management.
  - Employed Beautiful Soup and PyPDF2 for data collection, analyzing 2 million football data points to achieve a 90% prediction accuracy, supporting strategic betting decisions.
- **Custom Image Generation System**:
  - Developed an image generation platform using Stable Diffusion.
  - Fine-tuned custom models to generate images based on user-defined presets.
  - Utilized PyTorch and transformers for model training and deployment and finally used Docker for containerization.
- **AI-driven Data Matching System**:
  - Organizational data was segmented using models such as Llama-2-7B and then fine-tuned to extract sections and subsections.
  - Applied cosine similarity for matching data to specific tenders.
  - Integrated GPT-4 for generating rationale from corresponding data.
  - Matched organizational data against specific tenders, increasing successful tender submissions by 70%.
- **AI-Powered Collectible Authentication & Appraisal Platform**:
  - Trained deep learning models (PyTorch/TensorFlow, e.g., InceptionV3, ResNet50, CLIP) for image classification (authenticity) and similarity search.
  - Engineered an efficient CLIP+FAISS image similarity system for large-scale appraisal lookups.
  - Developed Flask/FastAPI APIs to serve model predictions (classification, similarity, appraisal).
  - Designed a multi-modal tag identification system using Serverless (RunPod API), TF-IDF, and CLIP/FAISS similarity.

* Implemented asynchronous data pipelines (aiohttp, asyncio, pandas) for large-scale image and metadata ingestion from APIs.
* Developed a Streamlit web application for user image uploads and displaying similarity/appraisal results via API calls.

**Universal Machine Inc.** Sunnyvale, CA, USA (Remote)
*Software Engineer I* *Apr 2025 – Present*

- **YouTube Live Stream Bot**:
  * Developed Chrome Extension automating YouTube Live chat using JavaScript, Chrome APIs, and async requests.
  * Integrated YouTube & OpenAI APIs for real-time chat fetching/posting and AI response generation.
  * Engineered AI features managing conversational history (chrome.storage) and prompt engineering for context/recall.
  * Implemented secure Google OAuth (chrome.identity) and robust error handling for external APIs.
- **cBORG DAO Governance Platform**:
  * Built a full-stack decentralized governance platform using React/Next.js, FastAPI, PostgreSQL, and Ethereum smart contracts for community proposal voting and treasury management
  * Integrated OpenAI GPT-4o to automatically parse natural language chat messages into structured trading proposals (buy/sell/hold) with confidence scoring and real-time voting
  * Implemented SIWE (Sign-In With Ethereum) wallet linking with nonce-based authentication, JWT tokens, and privacy-preserving user identity management
  * Developed live chat with proposal detection, voting dashboards, and mobile-responsive UI using Socket.io, Tailwind CSS, and modern React patterns
  * Created Solidity smart contracts for automated proposal execution and member verification, deployed on Ethereum testnet with Hardhat development framework
  * Implemented rate limiting, CORS protection, encrypted sessions with Redis, and comprehensive authentication flows for secure Web3 application deployment

## Projects

**AI Investment Committee for Binance** | *GitHub* | *Streamlit App*
- Designed a multi-agent AI system with specialized agents to provide cryptocurrency investment recommendations
- **Tech Stack:** Python, OpenAI/Gemini API, Binance API, Streamlit, Pydantic

**Stock Price Forecasting** | *BD App* | *Global App*
- Engineered LSTM models to forecast stock prices for Bangladeshi and global markets, deployed via Streamlit.
- **Tech Stack:** Python, TensorFlow, Keras, LSTM, Pandas, Plotly, Streamlit, 'bdshare'.

**AI vs Human Generated Text Detector** | *WebApp*
- Developed an interactive web application to classify whether a given text is human-written or AI-generated
- Preprocessed and cleaned the dataset, conducted Exploratory Data Analysis (EDA), and applied feature engineering techniques
- Trained and optimized a Support Vector Classifier (SVC) using the *Machine Hack Competition* dataset: LLM Hackathon – Decoding Discourse: AI vs Human
- **Tech Stack:** Flask, scikit-learn, Python, NumPy, Pandas, Matplotlib

**DataSciencePilot (RAG System)** | *GitHub*
- Built a chat-based interface to query custom PDFs using Pinecone for vector search and LLaMA-2 for generation.
- **Tech Stack:** LangChain, Transformers, LLaMA-2, Pinecone, Python.

**CVAnalyzerPro** | *Streamlit App*
- Developed an AI tool to automatically score candidate CVs against company job requirements using LLMs.
- **Tech Stack:** OpenAI API, Gemini API, Streamlit.

**UberRidePrediction** | *PyPi* | *WebApp*
- Packaged an XGBoost model as a Python module to predict Uber fares and deployed it with FastAPI.
- **Tech Stack:** Scikit-learn, XGBoost, CI/CD, FastAPI, Render.

**Pinecone Integration Suite** | *PyPi*
- Authored and published two Python libraries (PineconeUtils, PineconePDFExtractor) to simplify data handling for RAG systems.

- **Tech Stack:** Pinecone, Cohere, OpenAI, PyPDF2.

**Decoding AI vs Human** | *WebApp*
- Developed a web app that allows users to determine if text was written by a human or an AI, trained on MachineHack data.
- **Tech Stack:** Scikit-learn, AWS, Render.

**CaptionCraft** | *StreamlitApp*
- Created a web application to generate image captions using the Google Gemini Pro Vision API.
- **Tech Stack:** Gemini, Streamlit, Python.

**Market Price Prediction** | *GitHub*
- Implemented and compared multiple time-series models to predict product prices.
- **Models:** ARIMA, SARIMAX, LSTM, GRU, XGBoost, Prophet.

**Movie Recommendation** | *WebApp*
- Implemented a KNN model using cosine similarity to recommend movies based on user input.
- **Tech Stack:** Scikit-learn, Pandas, Flask, Scipy.

**Potato Disease Classification** | *GitHub*
- Built a CNN model achieving near-100% accuracy in classifying potato diseases from images.
- **Tech Stack:** TensorFlow, Keras, CNN.

**Diabetes Prediction** | *GitHub*
- Constructed an Artificial Neural Network with PyTorch to predict patient diabetes status.
- **Tech Stack:** PyTorch, Flask, Gunicorn, Pandas.

## Competitions & Achievements

**Hackathon Champion at Machine Hack:** Global Ranking 539 out of 8,861.

**Data Science Student Championship:** Secured 7th position among 1,029 participants.

**LLM Hackathon (Decoding Discourse - AI vs Human):** Ranked 5th out of 227 participants.

**Rental Bikes Volume Prediction Hackathon:** Ranked 3rd.

**News Category Prediction Hackathon:** Ranked 7th.

**Predicting House Prices in Bengaluru:** Ranked 24th out of 2,885 participants with 87% accuracy.

**Subscriber Prediction Talent Search Hackathon:** Ranked 26th out of 5,045 participants.

**Analytics Olympiad 2022:** Ranked 82nd out of 1,029 participants.

**Data Science Student Championship - South Zone:** Ranked 73rd out of 554 participants.

**Decoding Discourse - AI vs Human:** Ranked 5th out of 293 participants.

## Open Source Contributions

- Contributed to **OpenLLMetry**, an open-source observability framework for LLM applications:
  - Resolved a bug where Python data classes passed as parameters were not being serialized and logged in workflows and tasks (PR #2800)
  - Implemented proper serialization support for dataclasses, ensuring they are correctly captured as inputs and outputs in observability logs
  - Added automated tests to verify serialization behavior and prevent regressions
- Contributed to **OpenLLMetry** by fixing a `TypeError` in the OpenAI embeddings metrics handler caused by comparisons between `NoneType` and integers; implemented proper handling of `None` values with error logging.
  - Added automated tests to validate the fix and ensure the robustness of embeddings metrics processing.
  - Improved overall stability by preventing this error from impacting workflow execution.

  (PR #1836)
- Contributed to **Pinecone Canopy**, a Retrieval-Augmented Generation (RAG) framework. (Commit)

## Certifications & Professional Development

**Understanding and Applying Text Embeddings** – *DeepLearning.AI* **[Nov 2024]**

A comprehensive short course on the end-to-end development of applications using text embeddings. Key topics included:

- Fundamentals of creating, understanding, and visualizing embedding spaces.
- Leveraging embeddings for practical applications like semantic search and retrieval.
- Building a complete Q&A system (Retrieval-Augmented Generation) using Google's Vertex AI.