Ranak Roy Chowdhury

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SUMMARY

Research & Industry Experience: 6+ years of experience on machine learning for time-series data in Supply Chain, Demand Forecasting, Wearable Motion, IoT, Speech, Audio & Music applications.
Programming Languages: Python, C, C++, Java, Matlab, SQL, PostgreSQL, Bash Script
Libraries/Services: PyTorch, TensorFlow, Keras, AWS, Scikit-learn, fairseq, Hugging Face, NumPy, pandas, SciPy, Matplotlib, Seaborn, statsmodels, Pillow, OpenCV, NLTK, CoreNLP, Gensim, spaCy

WORK EXPERIENCE

Amazon Web Services, Inc.   **Applied Scientist II - L5** *(Forecasting)*   **Sep 2024 – Present**
Developed and launched a scalable Demand Forecasting toolkit for AWS Supply Chain, used by hundreds of B2B and B2C clients across Retail, CPG, and Manufacturing. Delivered $378M in net cash flow gains by minimizing stock-outs, reducing excess inventory, and cutting manual forecasting workload for Demand Planners. Key contributions include:
- Designed a custom forecast evaluation metric that quantifies the business impact of forecast error by balancing overstock vs. stockout costs, providing clear monetary tradeoffs in terms of revenue, cash flow, and profitability.
- Engineered hierarchical forecasting across temporal, spatial, and product hierarchies using top-down, bottom-up and middle-out approaches, plus statistical and ML-based reconciliation, improving accuracy at all aggregation levels.
- Created a personalized validation and performance reporting framework tailored to each customer's business model — factoring in seasonality and vendor lead times — to reduce unnecessary retraining and model churn.
- Devised a neural split-peak attention method to handle sparse demand. It models peak demand using self-attention and non-peak demand using masked convolution, reducing post-peak bias and improving forecast accuracy.
- Enhanced model performance through multivariate feature integration, like holidays, price changes, and promotions.
- Resolved the cold-start problem via product lineage and lifecycle graph and used similarity-based matching.

Amazon Web Services, Inc.   **Applied Scientist II Intern** *(Audio, Music & LLM)*   **Jun 2023 – Sep 2023**
- Developed an LLM with music integration that generates text responses, containing music genre, instruments used, mood, and theme, based on music files. Built a pre-trained encoder on top of Encodec features using Masked Prediction on 0.5 million data (2227 hours music). Used downsampled audio as prefix to text prompts to FLAN-T5 Language Model that generated musical captions. Evaluated on 0.12 million data (957 hours music). [Link]

Qualcomm, Inc   **Research Fellow** *(Wearable Sensing)*   **Oct 2022 – Sep 2023**
- Established a physics-informed data denoising scheme that integrates physics equations as constraints into training loss, ensuring the cleaned data complies with fundamental physical constraints, thereby improving data quality. [Link]
- Built a two-stage pipeline that uses contextual knowledge about sensor name and location to align sensory data with text, followed by low-level biomechanical details to address Zero-Shot Learning in Human Activity Recognition.

Amazon Web Services, Inc.   **Applied Scientist II Intern** *(Speech, LLM)*   **Jun 2022 – Sep 2022**
- Built an accent-robust pre-trained model for speech. We improve performance on several downstream tasks, like Speech Recognition by 20.4% and Speaker Verification by 6.3%, across 12 minority accents with a few minutes of training data. Used Domain Adversarial Training with Masked Reconstruction to induce an accent-invariant output and Accent Classification with Contrastive Learning to infuse accent knowledge into the model acoustic space. [Link]

Nokia Bell Labs   **Data Science Intern** *(Multimodal Time-series & Text Modeling)*   **Jun 2021 – Aug 2021**
- Established a human-in-the-loop ML workflow to ease ticket resolution by assigning tickets to correct departmental units for a telecom client. Conducted data cleaning, preprocessing, and visualization on ticket metadata and massive time-series semistructured system-level log corpus. Designed statistical feature extractors and deep classifiers. [Link]

Amazon Web Services, Inc.   **Software Development Engineer Intern** *(Explainable AI)*   **Jun 2020 – Sep 2020**
- Built a SHAP-based ML Interpretability framework from SQL surface for AWS Redshift, enabling users to write SQL queries to introspect ML model predictions. Reduced data transfer by minimizing AWS S3 access which improved execution speed by 2x and reduced memory footprint by 90% over existing workflow using AWS Sagemaker. [Link]

Bangladesh University of Eng. and Tech.   **Research Assistant** *(Online Data Compression)*   **Jan 2019 - Aug 2019**
- Innovated a data dimensionality reduction algorithm for streaming data, that uses a data-driven heuristic to learn a robust, noise-resilient eigenspace. Algorithm proven by spectral analysis and Bhattacharyya Distance. [Link]
- Built and deployed a web application, based on Real Time PCA, to generate real-time analytics on streaming data fetched from Twitter, Google Search Trends, Bangladeshi Online News Portals and Dhaka Stock Exchange.

UC San Diego   **Graduate Student Researcher** *(Self-supervised learning for time-series)*   **Sep 2019 – Aug 2024**
- Innovated a Zero-Shot Wearable Human Activity Recognition framework that integrates contextual knowledge about activities from LLMs and sensory environment information to improve Zero-Shot F1 Score by 20%.
- Pioneered the first survey on how LLMs can solve time-series tasks through prompting, time-series quantization, alignment of time-series with text, using vision as bridge, and using LLMs as output tools.
- Built an encoder-decoder architecture to model label name semantics that harnesses the shared sub-structure of label names to distill knowledge across classes, improving accuracy of human activity recognition tasks by 1.7%.

- Developed a Multi-level Optimized Mask Autoencoder that improves image classification by integrating model pretraining with fine-tuning to allow fine-tuning performance guide an optimal masking strategy for pretraining.
- Crafted self-supervised pretraining method for irregular, asynchronous time-series through sampling density-aware contrastive learning and time-sensitive data reconstruction techniques, improving few-shot performance.
- Devised a globally-attentive multiscale Super-Resolution GAN that uses irregularly spaced sparse data to generate high-resolution spatiotemporal data for regions with no physical sensors, reducing reconstruction loss by 3.7%.
- Innovated a Fourier-transform (FT) inspired weight initialization and learnable Short-Time FT layer redesign to integrate time and frequency information, improving F1 score for sensory time-series classification by 2.3%.
- Developed a multimodal vision-language model to generate rationale for visual question answering. Fine-tuned ViLBERT and GPT2 to generate rationale in three inference steps: grounding, contextualization, and reasoning.

EDUCATION

PhD in CS - University of California San Diego   **Sep 2019 – Aug 2024**
Thesis: Robust and Data-Efficient Learning for Time-series
Research Interests: Time-series, Speech, Music, Healthcare, IoT, Sensor Fusion, Spatio-temporal data

MS in CS - University of California San Diego   **Sep 2019 – Jun 2022**
Major: Artificial Intelligence and Machine Learning. *Coursework*: Neural Networks/Pattern Recognition,
Learning Algorithms, Deep Learning for Sequences, Probabilistic Reasoning & Learning, Trustworthy ML

BSc in CSE - Bangladesh University of Engineering and Technology   **Jul 2014 – Oct 2018**
Major: Artificial Intelligence. *Coursework*: Database, Computer Networks, Software Development,
Operating System, Computer Graphics, Digital Image Processing, Machine Learning, Pattern Recognition

PUBLICATIONS

Google Scholar: https://scholar.google.com/citations?hl=en&user=hTA5EgkAAAAJ
ResearchGate: https://www.researchgate.net/profile/Ranak-Roy-Chowdhury
- **Ranak Roy Chowdhury**, Ritvik Kapila, Ameya Panse, Xiyuan Zhang, Diyan Teng, Rashmi Kulkarni, Dezhi Hong, Rajesh K. Gupta, Jingbo Shang. ZeroHAR: Contextual Knowledge Augments Zero-Shot Wearable Human Activity Recognition. **AAAI** 2025.
- Han Guo, Ramtin Hosseini, Ruiyi Zhang, Sai Ashish Somayajula, **Ranak Roy Chowdhury**, Rajesh K. Gupta, Pengtao Xie. MLO-MAE: Downstream Task Guided Masking Learning in Masked Autoencoders Using Multi-Level Optimization. **TMLR** 2025. [Link]
- Xiyuan Zhang, Diyan Teng, **Ranak Roy Chowdhury**, Shuheng Li, Dezhi Hong, Rajesh Gupta, Jingbo Shang. UniMTS: Unified Pre-training for Motion Time Series. **NeurIPS** 2024. [Link]
- Xiyuan Zhang, **Ranak Roy Chowdhury**, Rajesh K. Gupta, Jingbo Shang. Large Language Models for Time Series: A Survey. **IJCAI** 2024. [Link]
- **Ranak Roy Chowdhury**, Rohit Paturi, Sundararajan Srinivasan. MusicLLM: Music Understanding with LLMs.
- Xiyuan Zhang**, Ranak Roy Chowdhury**, Dezhi Hong, Rajesh K. Gupta, Jingbo Shang. SHARE: Unleashing the Power of Shared Label Structures for Human Activity Recognition. **CIKM** 2023. [Link]
- **Ranak Roy Chowdhury,** Jiacheng Li, Xiyuan Zhang**, Dezhi Hong, Jingbo Shang, Rajesh K. Gupta. PrimeNet: Pre-training for Irregular Multivariate Time-Series. **AAAI** 2023. [Link] *(awarded travel grant)*
- Xiyuan Zhang, Xiaohan Fu, Diyan Teng, Chengyu Dong, Keerthivasan Vijayakumar, Jiayun Zhang, **Ranak Roy Chowdhury**, Junsheng Han, Dezhi Hong, Rashmi Kulkarni, Jingbo Shang, Rajesh K. Gupta. PILOT: Physics-Informed Data Denoising for Real-Life Sensing Systems. **SenSys** 2023. [Link]
- **Ranak Roy Chowdhury**, Anshu Bhatia, Haoqi Li, Srikanth Ronanki, Sundararajan Srinivasan. MARS: Self-supervised Multi Task Pre-training for Accent Robust Speech Representation. [*under submission*]
- Xiyuan Zhang**, Ranak Roy Chowdhury**, Jingbo Shang, Rajesh K. Gupta, Dezhi Hong. STAug: Towards Diverse and Coherent Augmentation for Time-Series Forecasting. **ICASSP** 2023. [Link]
- **Ranak Roy Chowdhury**, Xiyuan Zhang**, Jingbo Shang, Rajesh K. Gupta, Dezhi Hong. TARNet: Task-Aware Reconstruction for Time-Series Transformer. **KDD** 2022. [Link] *(awarded travel grant)*
- Xiyuan Zhang**, Ranak Roy Chowdhury**, Dezhi Hong, Jingbo Shang, Rajesh K. Gupta. ESC-GAN: Extending Spatial Coverage of Physical Sensors. **WSDM** 2022. [Link]
- **Ranak Roy Chowdhury**, Dezhi Hong, Rajesh K. Gupta, Jingbo Shang. RIoT: Towards Robust Learning for Internet-of-Things. [*under submission*]
- Shuheng Li, **Ranak Roy Chowdhury**, Jingbo Shang, Rajesh K. Gupta, Dezhi Hong. UniTS: Short-Time Fourier Inspired Neural Networks for Sensory Time Series Classification. **SenSys** 2021. [Link]
- **Ranak Roy Chowdhury**, Abdullah Adnan, Rajesh Gupta. Real Time Principal Component Analysis. **TDS** 2020. [Link]
- **Ranak Roy Chowdhury**, Abdullah Adnan, Rajesh Gupta. Real Time Principal Component Analysis. **ICDE** 2019.[Link]

HONORS and AWARDS

- Lead organizer of the inaugural workshop on "AI for Supply Chain: Today and Future" at SIGKDD 2025. [Link]
- Invited keynote speaker at SIGKDD 2023 Workshop on Machine Learning in Finance. [Link]
- Qualcomm Innovation Fellowship 2022. One of the *19 winners among 132 participants* across North America. [Link]
- Halıcıoglu Data Science Institute Graduate Fellowship 2019. One of the *10 winners among 3906 applicants*. [Link]
- Attended Heidelberg Laureate Forum 2020 & Cornell, Maryland, Max Planck Pre-doctoral Research School 2019.
- PhD Research Fellowship awarded by the CSE Department, UC San Diego to support graduate studies.
- Dean's List and Merit Scholarship awarded by CSE, BUET for outstanding undergraduate academic performance.