Shubhashis Roy Dipta

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Socials:

Research Interest

Artificial Intelligence, Machine Learning, Natural Language Processing
Vision Language Model, Large Language Model
Multimodal Event Understanding & Generation

Education

Jan 2021–June 2026 **University of Maryland, Baltimore County (UMBC), USA**
Ph.D. in Computer Science
Topic: Multimodal Event Understanding & Generation
Advisor: Dr. Frank Ferraro
GPA – 4.00/4.00

Jan 2021–May 2023 **University of Maryland, Baltimore County (UMBC), USA**
M.Sc. in Computer Science
Phi Kappa Phi (Top 10% of STEM)
GPA – 4.00/4.00 (Top 1% of Class)

Jan 2013–Dec 2016 **Military Institute of Science & Technology (MIST), Bangladesh**
B.Sc. in Computer Science & Engineering
Ranked 9th in University Rover Challenge 2015, USA (Top 3%)
Participated in 30+ National & International Programming Competitions
GPA – 3.51/4.00

Publications

Total Citations: 76; h-index: 5; (Source: Google Scholar) (*Equal Contribution)

NAACL 2024 [10] **Shubhashis Roy Dipta***, and Sai Vallurupalli*. "UMBCLU at SemEval-2024 Task 1A and 1C: Semantic Textual Relatedness with and without machine translation" Proceedings of the 17th International Workshop on Semantic Evaluation (SemEval)

NAACL 2024 [9] **Shubhashis Roy Dipta**, and Sadat Shahriar. "HU at SemEval-2024 Task 8A: Can Contrastive Learning Learn Embeddings to Detect Machine-Generated Text?." Proceedings of the 17th International Workshop on Semantic Evaluation (SemEval)

ACL 2023 [8] **Shubhashis Roy Dipta**, Mehdi Rezaee, and Francis Ferraro. "Semantically-informed Hierarchical Event Modeling." Proceedings of the 11th Joint Conference on Lexical and Computational Semantics (*SEM 2023)

Springer 2022 [7] Sadia Islam, Shafayat Bin Shabbir Mugdha, **Shubhashis Roy Dipta**, [4 other Co-Authors]. "MethEvo: an accurate evolutionary information based methylation site predictor." Neural Computing and Applications

Preprint (arXiv) [6] Sourajit Saha*, and **Shubhashis Roy Dipta***. "SeeBel: Seeing is Believing." arXiv preprint arXiv:2312.10933

Elsevier 2020 [5] **Shubhashis Roy Dipta**, [5 other Co-Authors]. "SEMal: Accurate protein malonylation site predictor using structural and evolutionary information." Computers in biology and medicine

Genes 2020 [4] Md Easin Arafat, [9 Co-Authors including **Shubhashis Roy Dipta**]. "Accurately predicting glutarylation sites using sequential bi-peptide-based evolutionary features." Genes 11, no. 9

IEEE Access 2020 [3] Md Wakil Ahmad, [7 Co-authors including **Shubhashis Roy Dipta**]. "Mal-light: Enhancing lysine malonylation sites prediction problem using evolutionary-based features." IEEE access

IEEE 2017 [2] Md Mainul Hasan Polash, [13 Co-authors including **Shubhashis Roy Dipta**]. "Explorer-0100: An autonomous next generation Mars rover." 20th international conference of computer and information technology (ICCIT) - Project Paper for The European Rover Challenge 2017, Poland (**Ranked 22nd**)

IEEE 2015 [1] Tanvir Ahmed Fuad, [13 Co-authors including **Shubhashis Roy Dipta**]. "MAYA: A fully functional rover designed for the mars surface." 18th International Conference on Computer and Information Technology (ICCIT) - Project Paper for The University Rover Challenge 2015, USA (**Ranked 9th**)

Research Projects

Jan 2023–Ongoing **Multimodal Object State Tracking & Generation**

*Which of the **States** of the **Entities** will change? and **How**?*

Advised by Dr. Frank Ferraro

- Extending the previous SHEM [8] work, we are exploring if the (noisy) image can be used as an external knowledge source or guide the model to generate state changes.
- To be robust to the noisy or missing images during testing, we have used controlled semi-supervision during training time.
- The model can be used on Search & Rescue (SAR) robots, where tracking state changes is crucial, even if the images are noisy or blurred.
- To make it feasible for edge devices, we are exploring small ($\leq 9B$) vision-language models for this task.

Jan 2023–Ongoing **Multimodal Counterfactual Event Understanding & Generation**

*What will happen to the **Bike Race** if the **Weather** is **Stormy** instead of **Sunny**?*

Advised by Dr. Frank Ferraro

- Exploring a novel dataset generation technique that uses a state-of-the-art VLM model as a generator and humans as evaluators.
- Developing a novel dataset for counterfactual generation with text and images from real-life events.
- Exploring small ($\leq$ 9B) open-source VLM models that can be used in edge devices for crucial situations where the machine has to understand the real-life situation, find out all alternate situations that can hinder the goal completion, and act accordingly, i.e., SAR robots.
- Present a comprehensive ablation on the importance of different modalities in predicting crucial events and generating alternative outcomes.
- Present a comprehensive analysis of the performance of current SOTA models (open vs. closed, small vs. large) in Counterfactual generation.

Jan 2021–Jan 2023 **Semantically-informed Hierarchical Event Modeling & Abstraction** [8]

"Bill went to hospital, Doctors started treatement" – compressed down to "CURE"

Advised by Dr. Frank Ferraro

- The project leverages semantic frames and FrameNet relations to guide event representation and compression.
- Experimental results demonstrate the effectiveness of the hierarchical model in event modeling tasks, outperforming existing approaches and showing improvements in various event modeling tasks.
- The model incorporates structural and ontological hierarchy in event sequences, showcasing the importance of leveraging semantic ontologies for event modeling.
- This project highlights the benefits of structured and semantic hierarchical knowledge for event modeling.
- The proposed model, SHEM, is a doubly hierarchical, semi-supervised event modeling framework that outperforms previous state-of-the-art methods by up to 8.5% on two datasets and four evaluation metrics.

Jan 2023–Ongoing **Question-Answering using Semi-Supervised Graph Injection**

*Can we answer questions **from a graph**? Or can we **induce the graph** even if the graph is absent?*

Advised by Dr. Frank Ferraro

- Text to (directional) graph generation and graph to question-answering.
- There are an abundant number of question-answering datasets, but question-answering datasets with induced graphs are scarce.
- With the above assumption, we have explored how to use the small-size graph dataset with semi-supervision so that our model can generate the graph event it's absent.
- This semi-supervision setting is important, as the graph datasets are small or sometimes mislabeled (noisy) in real life. This setting makes our model robust to those noisy & small datasets.

See more projects at the end of this CV.

Open-Source Contributions

PyTorch-Lightning

LeetHub

Industrial Experience

June 2024–Aug 2024 **Incoming Research Intern,** SCALE.AI
- Will be working in the Vision-Language Team.

Jan 2019–Jan 2021 **Founder & Chief Technology Officer,** UNISHOPR.COM
Amazon-like e-commerce site with cross-border shipping
- Single-handedly led a cross-functional team of 10, achieving **1,000+** active e-commerce users and **$100,000+/month** in orders.

Apr 2019–Jan 2021 **Full Stack Software Engineer,** SAPIEN.NETWORK
USA-based Startup, Worked on decentralizing our social experience data
- Implemented Multi-factor Authentication and SSO.
- Implemented post caching using Redis.
- Implemented Google ReCaptcha to prevent bots and frauds.
- Worked with Elixir to implement a scalable chat messenger.
- Implemented push notifications in iOS, Android & Web.
- Integrated SendGrid for 3rd party mailing service.
- Integrated ActiveCampaign for campaign management, marketing and referral contest.
- Was responsible for fixing Backend and Frontend issues.

Oct 2018–Mar 2019 **Machine Learning Engineer,** BACKPACKBANG.COM
USA-based Y Combinator (YC) Startup
- Implemented search using a fusion of product and word embeddings.
- Boosted sales by ∼23% by developing a product recommendation system using Product2Vec embedding.
- Engineered a Chatbot combining AI algorithms with logic-based if-else, decreasing response time by ∼1 hour.
- Decreased server cost by ∼10% by implementing an AWS Lambda-based ML pipeline for online learning.
- Build a model to predict the dimension of a product from the known datasets, which helped the traveler team allocate the luggage by ∼20% more efficiently.
- Implemented a microservice to refresh the inventory every 12 hours, which is later fetched by Facebook Ads, decreasing marketing labor cost by ∼10%.
- Worked with deployments on Google Cloud using Docker & Kubernetes.
- Implemented crawler scripts to automatically curate data from Amazon, eBay, or other US-based e-commerce sites.

Feb 2018–Sep 2018 **Frontend Engineer,** SELISE
- Implemented robust, scalable & reusable UI components that were used throughout the company projects, enabling fast production release.

Academic Experience

May 2021–Ongoing **Graduate Research Assistant**[8,9,10]**,** UMBC
Advisor: Dr. Frank Ferraro
- Event Modeling: Achieved **8.5% improvement** over prior state-of-the-art approaches in 2 datasets and across 4 evaluation metrics by designing a novel, hierarchical, semi-supervised event modeling framework. (Published on *SEM 23 & Orally presented at ACL 2023).
- Multimodal Counterfactual: Pioneering first-of-its-kind multimodal counterfactual dataset, merging text and images for nuanced alternate timeline, a novel contribution to counterfactual reasoning and multi-modal real-life event understanding.
- Graph Convolutional Network: Collaboratively developing a Graph Convolutional Network for language understanding and reasoning on 2 complex datasets (**250k+ data-driven event graphs**), advancing research in the field of graph-based deep learning.
- Mentoring: Supervising and providing research guidance to an undergraduate who is a member of an underrepresented group in CS.
- Developed a base template for quick prototyping of experiments and fast exploration.

Jan 2021–May 2021 **Graduate Teaching Assistant,** UMBC
Course: Operating System
- Responsible for helping students, evaluating class projects, and final papers.
- Designed kernel programming challenge as a class project.

Jan 2019–Jan 2021 **Research Assistant**[3,4,5,7]**,** VOLUNTEER
Advisor: Dr. Iman Dehzangi
- Explored Language Models in Bio-informatics protein sequences (**Published 4 journals**).

Jan 2014–Dec 2016 **Competitive Programming Trainer,** MIST
- Trainer of Competitive Programming in MIST Programming Club (2015–16).
- Trainer of Data Structures & Algorithm in MIST Computer Club (2014–15).
- Solved **3000+** problems in various online judges – GitHub

Jan 2015–Feb 2015 **Teaching Assistant,** MIST
- *Courses Taught:* C, C++, Data Structures, Algorithms

Academic Services

Reviewed 9 papers at NLP/AI conferences and Bioinformatics journals.

Mar 2024 The 18th International Workshop on Semantic Evaluation (SemEval)
Jan 2024 Scientific Reports, Nature
Jan 2024 Plant Methods, Nature
Jan 2024 The 9th Workshop on Noisy and User-generated Text (W-NUT), EACL
Dec 2023 Plant Methods, Nature
May 2023 *SEM 2023, ACL (Secondary Reviewer)
Mar 2023 Computational and Structural Biotechnology, ScienceDirect

Honors & Awards

2020 **70th** in Cornell Birdcall Identification, KAGGLE (**Top 6% - Bronze Medal**)
2020 Featured on the DocuSign Blog, DOCUSIGN
2018 **8th** in ACM ICPC Dhaka Regional, BANGLADESH (**Top 3%**)
2016 **13th** in ACM ICPC Dhaka Regional, BANGLADESH (**Top 10%**)
2016 **22nd** in European Rover Challenge[2], POLAND (**Top 11%**)
2015 **9th** in European Rover Challenge[2], POLAND (**Top 3%**)

Extra Curriculars

2023–Ongoing Maintains a Note-Garden based on ML, NLP, Research
2018 **Judge** in National High School & College Programming Contest, BANGLADESH
2018 **Judge** in MIST Intra Programming Contest , BANGLADESH
2014–2016 **Instructor** of Data-structures & Algorithms in MIST Computer Club, BANGLADESH

Leadership Experience

2016 **President** of MIST Programming Club , BANGLADESH
2015 **Head of Volunteer** of MIST Programming Club , BANGLADESH
2012 **Vice-President** in Notre Dame Science Fair, BANGLADESH
2011 **General Volunteer** in Notre Dame Science Fair, BANGLADESH

Skills

Languages Python, SQL, Pandas, C/C++
Frameworks PyTorch, PyTorch Lightning, Scikit-Learn, Huggingface, Streamlit, Gradio
Visualization Matplotlib, Altair, Seaborn

WebD	Flask, HTML/CSS, JavaScript, Node.JS, React
Database	PostgreSQL, MongoDB
Utilities	Conda, Git, Jupyter Notebook

Relevant Courses

Graduate
- Introduction to Natural Language Processing (A+)
- Introduction to Machine Learning (A+)
- Principles of Artificial Intelligence (A+)
- Knowledge Graph (A+)
- Data Visualization (A+)
- Design and Analysis of Algorithms (A+)
- Crowd Sourcing & Computing (A+)

Undergraduate
- Artificial Intelligence (A+)
- Basic Graph Theory (A+)
- Computer Graphics (A)
- Pattern Recognition (A)
- Numerical Analysis (A)

Projects (cont'd)

Machine Learning

2019–2020 **Language Model + Rotation Forest on Protein Sequences** [5]

Are protein sequences as easily encoded by SOTA LLM models as regular text?

- Developed a novel predictor named SEMal for predicting Malonylation sites in proteins.
- SEMal combines structural & evolutionary features and protein sequence embedding to encode the features.
- Outperformed existing SOTAs like kmal-sp, MaloPred, and LEMP in terms of sensitivity, specificity, precision, accuracy, F1-score, and Matthews Correlation Coefficient (MCC) for both Human and Mouse species.
- Utilizes Rotation Forest (RoF) as the classifier on top of the encoded features.
- The web server for SEMal is available online.

2020 **Kaggle - Cornell Birdcall Identification**

Bird chirping detection in complex soundscape recordings

- **70th** among 1391 teams (**TOP 6% - Bronze Medal**).
- Used EfficientNet on the spectrogram images with an ensemble of framed timespan.

2020 **Kaggle - Quora Insincere Questions Classification**

Identify and flag Insincere Questions on Quora Dataset

- Combination of multiple word embedding with smart pre-processing to increase the coverage.
- Explored the performance of the Convolutional Neural Network (CNN) on the language word embedding to exploit the local knowledge.
- The local features output from CNN is used through LSTM to exploit the global context knowledge.
- Achieved a F1-score of 0.68.

Data Science

2019 **SeeBel: Seeing is Believing** [6]

A innovative way to visualize vision segmentation during training per step/epoch

Advised by Dr. Rebecca Williams

- **Increased interpretability by ~60%** (user survey) in computer vision segmentation tasks by designing a real-time visualization tool for semantic segmentation.
- Dataset statistics gives us the analysis of the dataset. On the other hand, AI model performance visualization gives us an idea of the model's capability.
- But there is a gap between the input statistics and output visualization – the training time visualization.
- This visualization tool bridges the gap between dataset statistics and AI model performance by visualizing the task during training.

2019 **Amazon-Crawler & Search Engine**

A cost-efficient Amazon crawler to refresh the product inventory on a daily basis

- Designed a distributed web crawler using 200 Google Compute Engine instances to extract 1M products.
- Explored and analyzed different cost-efficient and scalable strategies for 10M to 100M items.
- **Enhanced the retrieval of 1M data** by implementing a resource-efficient search engine using Elasticsearch.

Data Structures & Algorithms

2022 **N-Puzzle Solver – Poster, Report**

Compared various search strategies, identified optimal approaches based on minimal time complexity

Advised by Dr. Adam W. Bargteil

- Explored and analyzed various search strategies, including Uninformed, Informed, and Local Search, for solving N-Puzzle problems.
- Implemented algorithms such as Breadth-First Search, Depth-First Search, Dijkstra's algorithm, Best-First Search, A*, Iterative Deepening A*, and Hill Climbing Search.
- Evaluated strategies based on completeness, admissibility, time complexity, and space complexity.
- Conducted experiments on 8-puzzle and 15-puzzle problems with diverse initial configurations.
- Presented detailed analysis including path cost, time, and number of nodes expanded for each algorithm.
- Identified BFS, Dijkstra, A*, IDA*, and IDDFS as optimal and promising approaches for the 8-Puzzle problem based on minimal time complexity.

2013-2017 **A Large Collection of Algorithms**

A large collection of algorithm templates – implemented in C++ & Python

- This repository includes algorithm templates for various topics, such as graphs, dynamic programming, number theory, data structure, advanced search techniques, game theory, string, mathematics, and geometry.
- This repository served as the foundation template for numerous online and in-person programming contests I participated in & **3000+** problems I solved –