Md Abdur Rahaman

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Education

Georgia Institute of Technology, GA, USA
PhD in Computational Science and Engineering | Expected April 2024

University of New Mexico, NM, USA
M.S. in Computer Science, July 2019

Experience

Graduate Research Associate – June 2019 to present.
Center for Translational Research in Neuroimaging and Data Science (TReNDS) – a joint research lab with Georgia State University, Georgia Institute of Technology, and Emory University

Research Area: Machine learning, Multi-modal deep learning, Pattern recognition, NLP, Computational Neuroscience
Roles: Designing Computational models for learning discriminative, semantically meaningful, and informative patterns from medical imaging data. **Selected focus:** Biclustering, Data summarization, Model interpretability

Data Science Research Intern – September 2021 to December 2021
Nokia Bell Labs

I worked with the log analytics group and developed a log summarizer to compress the machine logs (billions of lines).

- Applied BERT models for learning log representation to detect a system failure.
- A multi-modal framework for combining system logs and user's error descriptions to route the failure alert.

Graduate Research Assistant – May 2017 to April 2019
Mind Research Network at the University of New Mexico

- Designed biclustering & tri-clustering approaches for Neuroimages without specifying the model order (k).

Projects

mBAM: deep multi-modal data fusion and classification

- A multi-modal latent space fusion using spatial and modality-wise attention inspired by the 'Bottleneck Attention Module'.
- A classifier based on functional entropy maximization that combines Neuroimages (fMRI, sMRI) and genomics data. The model is regularized with gradient blending and dynamically weighted loss.
- Empirical analysis of various deep fusion techniques.

SpaDE: Semantic locality preserving Auto-decoder for deep biclustering

- Auto encoder-based feature learning with a novel bi-clustering regularization – uncovering data point's true manifold.
- Formulated the regularization terms for semantic locality preservation (increases biological relevance) and sparsity.
- Designed a latent space-based meta-heuristic for two-dimensional cluster assignment of samples and features.

Statelet: a data summarization framework that discovers a set of 'k' representatives (shapes) from an extensive collection of the brain's dynamic functional network connectivity time course.

- Repurposed Earth Mover Distance (EMD) for motifs comparison. A Kernel Density Estimator (KDE) for smoothing motif's frequency space. The Voronoi partitions it into k-subspaces with the representatives of maximal prevalence and diversity.
- Large-scale motifs are summarized into a small subset of recurrent discriminative patterns.

BrainGraph: a graph neural network (GNN) with Transformer

- Spatio-temporal attention to representing the brain's functional connectivity as a dynamic graph with a set of nodes (brain networks) and weighted edges (Statistical dependencies known as functional connections).
- 'BrainGraph' learns the coordination among the functional hubs of the brain for better cognition.

IBRNN: Information-theoretic introspection method for Recurrent Neural Networks (RNNs) and LSTM using mutual information (MI)

- CBOW for word2vec embedding of the text corpus and bi-LSTM for the downstream task.
- Inspired by information Bottleneck theory, compute MI around labels, features, and layers and quantifies feature compression.

mriCAV: Used concept activation vector (CAV) for model interpretability

Introspect the fully trained deep classifiers by finding active concepts - orthogonal vectors towards learned features. Neuroimaging concepts include brain networks, signals, and connections associated with neuropsychiatric disorders like schizophrenia.

N-BiC: a biclustering approach needless of specifying the number of clusters (k).

Adaptation to depth-first search (DFS) to semi-exhaustively explore all possible combinations of instances.

Skills

Languages: C++, Python, C#, Java, JavaScript, Jquery **Tools:** Visual Studio, Free Surfer, FSL, SPM, Git, MATLAB, Anaconda
Cloud Technologies: AWS, Google, Docker, Spark **Libraries:** PyTorch, TensorFlow, OpenCV, Stanford CoreNLP, NLTK, Scikit Learn