Arindam Chowdhury

Curriculum Vitae
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Duncan Hall, Room 1037
6100 Main St, Houston, TX 77005
+1 8326606791
ac131@rice.edu
archo48.github.io

Education

2019 – July 2024 **Ph.D, Data Science**, Rice University, Houston, Tx, USA.
Advised by Santiago Segarra
CPI: 3.96/4.0

June 2017 **M.Tech, Signal Processing**, IIT Guwahati, Assam, India.

May 2014 **B.Tech, Electronics and Communications**, NIT Durgapur, WB, India.

Research Interests

Graph Neural Nets, Graph Transformers, Knowledge Graphs, Large Language Models, Reinforcement Learning, Distributed Learning.

Technical Skills

Programming: Python, Cpp, MATLAB, Octave
Cloud Computing: AWS EC2, Sagemaker, Google Colab
Libraries: OpenCV, Pandas, Numpy, Scikit-learn, Tensorflow, PyTorch, NetworkX, PyG, DGL
Platforms: Docker, Git

Professional Experience

Summer 2023 **Applied Scientist Intern**, Amazon, San Diego.
Sagemaker, Pandas, Pytorch, PyG, DGL.
- Developed a heterogeneous temporal graph model for real-time customer fraud detection on large-scale time-varying user-attribute graphs (knowledge graphs). Improved recall from $\mathbf{0.95}$ to $\mathbf{0.98}$.
- Devised efficient inference strategy by leveraging customer ego-graph. $\sim \mathbf{80}\%$ reduction in wall-clock time.

Summer 2022 **Applied Scientist Intern**, Amazon, San Diego.
Sagemaker, Pandas, NetworkX, Pytorch, DGL.
- Devised an attention score-based entity-sampling strategy for efficient training of heterogeneous graph transformer models to improve recall of abusive customer detection from $\mathbf{0.75}$ to $\mathbf{0.81}$ under significant class imbalance $\sim \mathbf{70:1}$.
- Combined methods from *Pandas* library and *DGLDataset* class to automate large-scale graph construction from tabular user-attribute data ($>\mathbf{55M}$ rows). $\sim \mathbf{15}\%$ reduction in wall-clock time.

2017–2019 **Researcher**, TCS Innovation Labs, Gurgaon.
AWS EC2, OpenCV, Tensorflow.
- Designed a connectionist architecture combining deep convolutional and sequence models for end-to-end recognition of offline handwritten text [10][a]. Accuracy improvement by $\mathbf{3.5}\%$ over SOTA.
- Developed a reasoning-based neural model for information extraction from images of statistical plots for automatic summarizing for the visually impaired[9]. $\sim \mathbf{10}\%$ improvement in accuracy over SOTA.
- Developed deep object detection & recognition models for automatic digitization of inspection sheets that contain hand-marked schematics of factory floor [b][c].

Research Projects

Spring 2023 – current **GNN-based distributed computational offloading**

- Combine graph learning with classical heuristics for decentralized computational offloading in multi-hop mobile ad hoc networks.

Fall 2022 – current **Constrained reinforcement learning for episodic resource allocation**

- Developed a deep RL-based framework for sequential resource allocation in wireless ad-hoc networks (WANETs) under instantaneous and episodic constraints[1]. $\sim \mathbf{17}\%$ improvement in episodic sum-rate over greedy approach.
- Current work focuses on developing a generalized model for handling multiple episodic-constraint types for QoS optimization in mobile ad-hoc networks (MANETs).

Spring 2020 – Fall 2022 **GNN-based efficient resource allocation for wireless**

- Developed a hybrid framework to augment an iterative algorithm (WMMSE) with graph neural network (GNN) based learning modules for fast and efficient power allocation in SISO [7,8] and MIMO [2,6] wireless networks using algorithm unfolding. $\mathbf{30}$ times faster inference. $\mathbf{25}\%$ improvement in throughput.
- Theorized and empirically validated stability bounds on the hybrid algorithm with respect to input perturbations [5].

Fall 2021 **Application of Neural Tangent Kernels on graphs**

- Developed an efficient framework to extend Graph Neural Tangent Kernel(GNTK) for inductive node-level downstream tasks with skip connections on large graphs [4]. $\sim \mathbf{2}\%$ improvement in accuracy.

Fall 2020 **Distributed training of Graph Convolutional Networks**

- Developed a distributed framework for efficient training of wide graph convolutional networks (GCN) through partitioning of the hidden layers in case of large graphs [3]. Speed-up by $\sim \mathbf{7}\times$ in training time.

Selected Publications

[1] *Learning Non-myopic Power Allocation in Constrained Scenarios*, **A. Chowdhury**, S. Paternain, G. Verma, A. Swami, S. Segarra. Asilomar CSSC (2023).

[2] *Deep Graph Unfolding for Beamforming in MU-MIMO Interference Networks*, **A. Chowdhury**, G. Verma, A. Swami, S. Segarra. IEEE Trans. on Wireless Comm (2023).

[3] GIST: Distributed Training for Large-Scale Graph Convolutional Networks, C. Wolfe, J. Yang, F. Liao, **A. Chowdhury**, C. Dun, A. Bayer, S. Segarra, A. Kyrillidis. Journal of App. and Comp. Topology (2023).

[4] *Label Propagation across Graphs: Node Classification using Graph Neural Tangent Kernels*, A. Bayer, **A. Chowdhury**, S. Segarra. IEEE ICASSP (2022).

[5] *Stability Analysis of Unfolded WMMSE for Power Allocation*, **A. Chowdhury**, F. Gama, S. Segarra. IEEE ICASSP (2022).

[6] *ML-aided power allocation for Tactical MIMO*, **A. Chowdhury**, G. Verma, C. Rao, A. Swami, S. Segarra. IEEE MILCOM (2021).

[7] *Unfolding wmmse using graph neural networks for efficient power allocation*, **A. Chowdhury**, G. Verma, C. Rao, A. Swami, S. Segarra. IEEE Trans. on Wireless Comm (2021).

[8] *Efficient power allocation using graph neural networks and deep algorithm unfolding*, **A. Chowdhury**, G. Verma, C. Rao, A. Swami, S. Segarra. IEEE ICASSP (2021).

[9] *ChartNet: Visual Reasoning over Statistical Charts using MAC-Networks*, M. Sharma, S. Gupta, **A. Chowdhury** and L. Vig. IEEE IJCNN (2019).

[10] *An Efficient End-to-End Neural Model for Handwritten Text Recognition*, **A. Chowdhury** and L. Vig. BMVC (2018).

Accepted Patents

[a] **A. Chowdhury** and L. Vig, *Systems and Methods for End-to-End Handwritten Text Recognition using Neural Networks*, US Patent 10,839,246.

[b] L. Vig, G. Shroff, **A. Chowdhury**, Vishw, Rohit, Gunjan, Swati, Monika, and A. Srinivasan, *Method and System for Information Extraction from Document Images using Conversational Interface and Database Querying*, US Patent 10,936,897.

[c] R. Rahul, **A. Chowdhury**, Animesh, S. Mittal and L. Vig, *Digitization of Industrial Inspection Sheets by Inferring Visual Relations*, US Patent 10,970,531.

Relevant Course Work

Linear Algebra & Optimization
Statistical Signal Processing
Pattern Recognition & Machine Learning
Signal Processing Algorithms & Architectures
Optimization: Algorithms, Complexity & Approximation
Random Processes
Computer Vision
Information Theory
Network Science and Analytics
Multi-Agent Dynamic Systems

Academic Activities

Reviewer *Spring 2020 - Present*

Journals: IEEE TSP, TWC, TMLCN, TSIP, OJCOMS, TNNLS, J-SAC
Conferences: ASILOMAR, IEEE ISIT, ICASSP, VTC

Rice University Teaching Assistant

Signals, Systems, and Transforms *Spring 2021, Spring 2022, Spring 2023*
(Prof. Santiago Segarra, ELEC 242)
Network Science and Analytics *Fall 2020*
(Prof. Santiago Segarra, ELEC 573)
Data and Dynamical Systems *Fall 2019*
(Prof. Athanasios Antoulas, ELEC 519)

Awards

IEEE SPS Travel Grant - ICASSP 2022

References

Santiago Segarra
Assistant Professor
Rice University, USA
segarra@rice.edu

Ananthram Swami
Senior Research Scientist
US Army Research Laboratory (ARL)
ananthram.swami.civ@army.mil

Gunjan Verma
Computer Scientist
US Army Research Laboratory (ARL)
gunjan.verma.civ@army.mil

Santiago Paternain
Assistant Professor
Rensselaer Polytechnic Institute, USA
paters@rpi.edu

Lovekesh Vig
Chief Scientist, DL&AI
TCS Innovation Labs, India
lovekesh.vig@tcs.com