Ankur Arjun Mali

E345 Westgate building, University Park, PA 16802
+1 814 954 9415
aam35@psu.edu

I am a graduate student researcher specializing in machine learning with a focus on deep learning. My research interests lie in developing learning algorithms, building neural models capable of lifelong learning, memory models, and state machine representation and extraction from recurrent neural networks.

Education

- 2018-expected 2022 **Ph.D Informatics** *Pennsylvania State University*, Pennsylvania, USA, .
  Advisor: **Dr. C Lee Giles**, Mentor: **Dr. Alexander G Ororbia II**
- 2016–2018 **MS (transferred to Ph.D) Information Science and Technology** *Pennsylvania State University*, Pennsylvania, USA, *GPA:3.87*.
  Advisor: **Dr. C Lee Giles**
- 2009–2013 **B.E (Hons) Computer Engineering** *University of Pune*, Pune, IN, *First Class with Distinction*.
  Advisor: **Dr. Sudeep Thepade**

*** indicates equal contribution**

Publications

[1] A. Gopalakrishnan, **A. Mali**, D. Kifer, L. Giles, and A. G. Ororbia. A neural temporal model for human motion prediction. In *2019 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, pages 12108–12117, 2019.

[2] Alexander G. Ororbia II* and **Ankur Mali***. Biologically motivated algorithms for propagating local target representations. In *The Thirty-Third AAAI Conference on Artificial Intelligence, AAAI 2019, The Thirty-First Innovative Applications of Artificial Intelligence Conference, IAAI 2019, The Ninth AAAI Symposium on Educational Advances in Artificial Intelligence, EAAI 2019, Honolulu, Hawaii, USA, January 27 - February 1, 2019*, pages 4651–4658. AAAI Press, 2019, Oral.

[3] Alexander G. Ororbia II, **Ankur Mali**, Daniel Kifer, and C. Lee Giles. Conducting Credit Assignment by Aligning Local Representations. *CoRR*, abs/1803.01834, 2018,(**Under Review Journal**).

[4] A. Ororbia*, **A. Mali***, C. L. Giles, and D. Kifer. Continual learning of recurrent neural networks by locally aligning distributed representations. *IEEE Transactions on Neural Networks and Learning Systems*, pages 1–12, 2020.

[5] A. G. Ororbia*, **A. Mali***, J. Wu, S. O'Connell, W. Dreese, D. Miller, and C. L. Giles. Learned neural iterative decoding for lossy image compression systems. In *2019 Data Compression Conference (DCC)*, pages 3–12, 2019, Oral.

[6] Alexander Ororbia, **Ankur Mali**, Daniel Kifer, and C. Lee Giles. Lifelong neural predictive coding: Sparsity yields less forgetting when learning cumulatively. *CoRR*, abs/1905.10696, 2019,**Under Review Journal**.

[7] Alexander* Ororbia, **Mali, Ankur***, Matthew Kelly, and David Reitter. Like a baby: Visually situated neural language acquisition. In *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics*, pages 5127–5136, Florence, Italy, July 2019 Oral.

[8] Alexander G. Ororbia*, **Ankur Mali***, Dan Kifer, and Clyde Lee Giles. Reducing the computational burden of deep learning with recursive local representation alignment. 2020, **Under Review conference**.

[9] John Stogin*, **Ankur Mali***, and C Lee Giles. Provably stable interpretable encodings of context free grammars in rnns with a differentiable stack, 2020, **Under Review conference**.

[10] **A. Mali**, A. G. Ororbia, and C. L. Giles. The sibling neural estimator: Improving iterative image decoding with gradient communication. In *2020 Data Compression Conference (DCC)*, pages 23–32, 2020, Oral.

[11] **Ankur Mali**, Alexander G. Ororbia II, and C Lee Giles. The neural state pushdown automaton. *CoRR*, abs/1909.05233, 2019,**Accepted into IEEE TAI**.

[12] **Ankur Mali**, Alexander G. Ororbia, Dan Kifer, and Clyde Lee Giles. Recognizing and verifying mathematical equations using multiplicative differential neural units. 2020, **Accepted AAAI-21** oral.

[13] **Ankur Mali**, Alexander G. Ororbia, Dan Kifer, and Clyde Lee Giles. An empirical analysis of recurrent learning algorithms in neural lossy image compression systems. 2020, **Accepted as DCC 2021**.

[14] **Ankur Mali**, Alexander G. Ororbia, Dan Kifer, and Clyde Lee Giles. Investigating back-propagation alternatives when learning to dynamically count in recurrent neural networks. 2020, **Under Review Journal**.

[15] **Ankur Mali**, Alexander G. Ororbia, Dan Kifer, and Clyde Lee Giles. Recognizing long grammatical sequences using recurrent networks augmented with an external differentiable stack. 2020, **Under Review Journal**.

[16] SD Thepade*, **Ankur Mali***, and K Subhedarpage*. Content Based Video Retrieval using Thepade's Ternary Block Truncation Coding and Thepade's Sorted Ternary Block Truncation Coding with Various Color Spaces. *International Journal of Emerging Technologies in Computational and Applied Sciences*, 8(6):462–466, 2014.

[17] Sudeep D. Thepade*, Krishnasagar Subhedarpage*, **Ankur Mali***, and Tushar S. Vaidya. Performance Gain of Content Based Video Retrieval Technique using Intermediate Block Truncation Coding on Different Color Spaces. *2013 International Conference on Communication and Signal Processing*, pages 1017–1020, 2013, Oral.

[18] Sudeep D Thepade*, Krishnasagar Subhedarpage*, **Ankur Mali***, and Tushar S Vaidya. Color Content Based Video Retrieval using Block Truncation Coding with Different Color Spaces. *International Journal of Computer Applications*, 64(3), 2013.

[19] Sudeep D Thepade*, Krishnasagar Subhedarpage*, **Ankur Mali***, and Tushar S Vaidya. Performance Augmentation of Video Retrieval using Even-Odd Videos with Multilevel Block Truncation Coding. *International Journal of Computer Applications*, 64(9), 2013.

[20] Sudeep D Thepade*, Krishnasagar S* Subhedarpage, and **Ankur Mali***. Performance Rise in Content Based Video Retrieval using Multi-level Thepade's Sorted Ternary Block Truncation Coding with intermediate block videos and even-odd videos. In *Advances in Computing, Communications and Informatics , 2013 International Conference on*, pages 962–966. IEEE, 2013, Oral.

Previous Employment

May 2020–Nov 2020 **Research Intern** *Nvidia Research*, Santa Clara, USA.

- Working on bio-inspired continual learning.

May 2017–August 2017 **Cognitive Analytics and Machine Learning Engineer** *Verisk Analytics*, New Jersey, USA.

- Improved OCR detection results by 12% features from a very deep VGG19 convolution neural network (CNN) and a recurrent neural network with attention. Integrated the attention mechanism to improve recognition results by 7.9%.

Mar 2014– Jun 2016 **Algorithm Engineer, Team Lead** *Curiologic Technologies*, Pune, IN.

- Improved previous face recognition API performance by 32.6% with lowest error rate at 3.46%. Improved multiple face recognition and detection API performance by 16.79%. Developed script to preprocess image data and create one hot encodings to classify data with a CNN architecture.

Research Experience

Jan 2018–Present **Graduate Research Assistant** *The Pennsylvania State University, IIS Lab*, Pennsylvania, USA.

- Working on biologically-plausible learning algorithms, memory-augmented networks for extracting state machines and optimization in machine learning. Working with Dr Lee Giles, Dr Daniel Kifer and Dr. Alexander G. Ororbia II.

Sep 2016–Dec 2017 **Research Assistant** *The Pennsylvania State University, IIS Lab*, Pennsylvania, USA.

- Worked on Medical Image Analysis using Deep Learning and statistical Models. Worked with Dr. James Wang

Sept 2016–Dec 2016 **Research Assistant** *The Pennsylvania State University, Data Science(Pike) Group*, Pennsylvania, USA.

- Crawled Facebook(FB) and Twitter data to extract 40 million users. Developed a novel method which was able to bypass Facebook API limitation. Analyzed 15k Instagram images and classified them into 2 classes based on visual and textual features. Worked with Dr. Dongwon Lee.

Sep 2016–Dec 2016 **Research Assistant** *The Pennsylvania State University, Artificial Intelligence Lab*, Pennsylvania, USA.

- Developed deep neural models for DNA/RNA sequence data. Worked on Bayesian and CNNs to analyze complex DNA/RNA sequences. Worked with Dr. Yasser El-Manzalawy

Sep 2016– Dec 2017 **Research Assistant** *The Pennsylvania State University, Cognitive Science Lab*, Pennsylvania, USA.

- Worked on developing cognitive language models for learning distributed representations of text. Developed a bidirectional recurrent network and an associative Long Short Term Memory (LSTM) model in TensorFlow. Worked with Dr. David Reitter.

Jun 2013– Feb 2014 **External Research Scholar (Associate)** *Image Processing Research Group*, Pune, IN.

- Developed new method Thepade's Sorted Ternary Block Truncation Coding(TSTBTC). Published 5 research papers in the domain of Computer Vision. Worked with Dr. Sudeep Thepade.

Teaching Experience

Aug 2019–Current **Co-Lecturer and Teaching Assistant** *IST597:Foundations of Deep Learning*, Pennsylvania, USA.

- Responsible for designing assignments and course material on Tensorflow 2.0 to teach **Graduate** students.

Aug 2018–Dec 2018 **Co-Lecturer and Teaching Assistant** *IST597:Foundations of Deep Learning*, Pennsylvania, USA.

- Taught graduate students how to develop neural models in **TensorFlow 1.x** .Course also includes providing an hands-on training and developing deep neural networks.

Jun 2017–Current **Technical Lead** *Neural Compression Group, Penn State*, Pennsylvania, USA.

- Technical lead in TensorFlow for neural compression group (on behalf of Dr. Lee Giles, in coordination with Dr. Jian Wu and Dr. Alex Ororbia). Mentored one undergrad and one master student.

Professional Activities and Awards

- **Reviewer**: NeurIPS 2020, ACL 2020, AAAI 2021, ICLR 2021, CVPR 2021, ACL 2021
- **SubReviewer**: WWW 2019, Neural Computation 2019, Machine learning journal (MLJ) 2020 (special issue on grammatical inference), ECML 2020
- **Student Travel Grant:** Federated Logic Conference 2018, University of Oxford, UK.
- **Travel Grant Talk:** ICRA 2016 (Top 4 finalist in HRATC 16), Sweden.
- **Nvidia GPU Grant:** Team successfully received Nvidia grant for ICRA 2016.
- **Content Based Video Retrieval(Talk):** Invited to give talk on content-based video retrieval using Matlab at PCCOE(University of Pune), 2014

Technical and Personal skills

- **Programming Languages:** Proficient in: C, C++, Python, Matlab, OpenCV, LaTeX
- **Robotics Framework:** Robot operating system (ROS).
- **Software/Frameworks:** Tensorflow, PyTorch.
- **Computer Vision API:** Microsoft Azure, Clarifai.

References

- **Dr. C. Lee Giles:** David Reese Professor, The Pennsylvania State University, University Park, PA Email: giles@ist.psu.edu.
- **Dr. Alexander G. Ororbia II:** Assistant Professor, Rochester Institute of Technology, New York Email: ago@cs.rit.edu.
- **Dr. Daniel Kifer:** Associate Professor, The Pennsylvania State University, University Park, PA Email: dkifer@cse.psu.edu