FENIL DOSHI

fenil_doshi@fas.harvard.edu ⋄ www.fenildoshi.com

RESEARCH INTERESTS

I am broadly interested in how the human mind encodes and organizes visual sensory information into mid- and high-level representations. In my research, I combine computational models of vision and behavioral psychophysics, to probe how emergent properties of a hierarchical visual processor both support and limit complex cognition.

EDUCATION

Harvard University, Cambridge, MA *2021 - Present*
Ph.D. in Psychology (Cognition, Brain, and Behavior)
Advisor: Dr. George Alvarez and Dr. Talia Konkle

SRM Institute of Science and Technology, Chennai, India *2014 - 2018*
B.Tech in Computer Science and Engineering (GPA: 8.65/10.0)

RESEARCH EXPERIENCE

Harvard University, Dept. of Psychology *Nov 2018 - Present*
Research Assistant (Fellow), Vision Sciences Lab
Faculty Advisor: Dr. George A. Alvarez & Dr. Talia Konkle
Focus: Information processing in human vision and bottlenecks underlying complex cognition:
1.Explored the underlying principles governing the large-scale organization of object information in occipito-temporal cortex.
2. Trained generative models (variational autoencoders) and conducted behavioral psychophysics to discover representations that can explain high-level human judgements in intuitive physics tasks.
3. Used gradient-based methods to synthesize stimuli that maximally drive neural activity in primate V4 layer of the visual cortex and build models of capacity-limits in human visual working memory.

Harvard Medical School (BWH) *Jan 2018 - July 2018*
Research Intern, Shafiee Lab
Faculty Advisor: Dr. Hadi Shafiee
Focus:
Trained convolutional neural networks to identify and qualitatively analyze the structural morphology of cells. Optimized the models to deal with class imbalance using class-sensitive training and sampling.

IIIT-Delhi, Dept. of Computer Science *June 2017 - Aug 2017*
Summer Research Intern
Faculty Advisor: Dr. Saket Anand
Focus:
Lane detection on urban roads using semantic segmentation in autonomous vehicles.

UW-Madison *Sept 2016 - Dec 2016*
Visiting student
Faculty Advisor: Dr. Dane Morgan
Focus:
Used bayesian models and neural networks to predict changes in the mechanical properties of steel components due to alloy configurations.

PUBLICATIONS

Conference Proceedings

1. **Doshi, F.**, Konkle, T.(2021). Organizational motifs of cortical responses to objects emerge in topographic projections of deep neural networks. Talk presented at *Vision Sciences Society, 2021.*
2. **Doshi, F.**, Pailian, H., Alvarez, G.A.(2020). Using Deep Convolutional Neural Networks to Examine the Role of Representational Similarity in Visual Working Memory. In *Vision Science Society, 2020.*
3. Conwell, C., **Doshi, F.**, Alvarez, G.A.(2019). Shared Representations of Stability in Humans, Supervised, & Unsupervised Neural Networks. In *Shared Visual Representations in Human and Machine Intelligence (SVRHM) workshop at NeurIPS 2019.*
4. Conwell, C., **Doshi, F.**, Alvarez, G.A.(2019). Human-Like Judgments of Stability Emerge from Purely Perceptual Features: Evidence from Supervised and Unsupervised Deep Neural Networks. In *Proceedings of the 3rd Conference on Cognitive Computational Neuroscience (CCN), 2019.*
5. Thirumalaraju, P., Bormann, CL., Kanakasabapathy, M., **Doshi, F.**, Souter, I., Dimitriadis, I., Shafiee, H.(2018).Automated sperm morpshology testing using artificial intelligence. In *Fertility and sterility. 2018 Sep 1;110(4):e432.*
6. Chatterjee, S., Archana, V., Suresh, K., Saha, R., Gupta, R., **Doshi, F.(2017)**.Detection of non-technical losses using advanced metering infrastructure and deep recurrent neural networks. In *IEEE International Conference on Environment and Electrical Engineering.*

Manuscripts

1. **Doshi, F.**, Konkle, T. Organizational motifs of cortical responses to objects emerge in topographic projections of deep neural networks. (Paper in Prep)
2. Conwell, C., **Doshi, F.**, Alvarez, G.A.. Human-Like Judgments of Stability Emerge from Purely Perceptual Features in Unsupervised and Supervised Models. (Paper in Prep)
3. Kanakasabapathy, M., Thirumalaraju, P., Kandula, H., **Doshi, F.**, Sivakumar, A., Kartik, D., Gupta, R., Pooniwala, R., Branda, J., Tsibris, A., Kuritzkes, D., Petrozza, J., Bormann, C., Shafiee H. (2021). Adaptive adversarial neural networks for the analysis of lossy and domain-shifted datasets of medical images. In *Nature Biomedical Engineering, 2021.*

HONORS AND AWARDS

- Reimagine Education Award (Silver), Student-led Innovation for Next Tech Lab *2018*
  Quacquarelli Symonds (QS), Wharton School, University of Pennsylvania
- Best Outgoing Student, Class of 2018 *2018*
  Department of Computer Science, SRM Institute of Science and Technology
- National Champion *2017*
  Smart India Hackathon (India's biggest Hackathon)

TECHNICAL STRENGTHS

Programming: Python (Pytorch, Tensorflow, Theano, Keras), Javascript, Matlab, C, C++, C#, Java
Experimental Techniques: Computational Modelling, Behavioral Psychophysics
Statistics/Analysis: Non-parametric statistics, power analyses, simulation, resampling (bootstrapping), model comparison; factor analysis/principal component analysis, singular value decomposition

LEADERSHIP & ADVISING EXPERIENCE

Next Tech Lab, Founding Member and Advisor
Co-founded a student-run research lab at SRM Institute of Science and Technology. Co-led over 160 students concentrating on Artificial Intelligence, Machine Learning, Computational Biology, and Mixed Reality(AR/VR).

SELECT PERSONAL PROJECTS

- **Feature-based categorical attention:** Taking inspiration from work by Lindsay & Miller (2018), I isolated category-specific neurons in a pre-trained (on ImageNet) deep net (VGG-19). Category-wise normalized activation profiles were computed at the resolution of individual neurons and compared with the corresponding normalized gradient-based profiles/curves. Those neurons whose tuning and gradient profiles correlated significantly (hence had behavioral outcomes) were selected. Further analysis (t-tests) provided a stronger selection criterion. During the forward pass, these neurons are then modulated to improve categorization. An open question is to disentangle the attentional signals carried in feedforward, lateral, and top-down connections.
- **Exploring the latent feature space of face representations in a reconstruction-based network using Deep Feature Consistency:** Trained an adversarial variational autoencoder on the CelebA dataset. The KL divergence loss was replaced with an adversarial loss (Makhzani et al., 2016) and the pixel-wise loss was replaced with a deep feature consistent loss (Hou et al., 2016). Smooth interpolations in this latent space showed that the model was able to capture certain semantic aspects of different facial attributes.
- **Neural Artistic Style Transfer for Videos:** Produced results on a frame-by-frame basis and later improved it by initializing every new frame using optical flow from the previous frames.
- **Retrieving the latent space of a Generative Adversarial Network (input noise):** Designed an auxiliary GAN model with a cyclic network to map the generated image space back to its latent space. The discriminator was designed with an additional patch-based loss function and optimized with label smoothing.
- **Deep Sense:** A Restricted Boltzmann Machine (RBM) trained on a bunch of different songs by Hans Zimmer to produce novel monophonic music in his style.