Abubakar Abid

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EDUCATION

Stanford University ***Sep 2016 – Present***
PhD Candidate in Electrical Engineering *GPA: 4.2 / 4.3*
GRE Verbal: 170/170, Quantitative: 170/170
- **Research Interests:** Deep Learning, Precision Medicine Using AI, Interpretable Machine Learning

Massachusetts Institute of Technology ***Sep 2011 – Jun 2016***
Masters of Engineering in Computer Science *GPA: 5.0 / 5.0*
Bachelors of Science in Computer Science *GPA: 4.9 / 5.0*
- **Research Interests:** Physiological Modeling, Machine Learning for Diagnostics, Bioinformatics

AWARDS & FELLOWSHIPS

AI Grant Finalist	2017
Paul and Daisy Soros Fellowship	2016
Stanford Graduate Fellowship	2016
Draper Fellowship	2015
Winner of Hacking Medicine Hackathon (1st place)	2014
Tau Beta Pi Service Fellowship	2014
EECScon Oral Presentation Award (2nd place)	2014
Microsoft-iCampus Web Application Award (2nd place)	2014

PUBLICATIONS

Abubakar Abid*, Amirata Ghorbani*, James Zou, "Mutation-Convolution-Max Layers Enhance Deep Learning of DNA Motifs." *NIPS Workshop on Computational Biology, 2017.* **[Spotlight Talk, Acceptance Rate: 12%]**

Amirata Ghorbani*, **Abubakar Abid***, James Zou, "Interpretation of Neural Networks is Fragile." *Submitted to International Conference on Learning Representations (ICLR), 2018*

Abubakar Abid, Rebecca Mieloszyk, George Verghese, Baruch Krauss, Thomas Heldt, "Model-Based Estimation of Respiratory Parameters from Capnography, with Application to Diagnosing Obstructive Lung Disease." *IEEE Transactions on Biomedical Engineering, 2017*

Abubakar Abid*, Vivek Bagaria*, Martin Zhang*, James Zou, "Contrastive Principal Component Analysis." *ICML Workshop on Computational Biology, 2017.* **[Top Paper Award]**

Abubakar Abid, Jonathan M. O'Brien, Taylor Bensel, Cody Cleveland, Lucas Booth, Brian R. Smith, Robert Langer, Giovanni Traverso, "Wireless Power Transfer to Millimeter-Sized Gastrointestinal Electronics Validated in a Swine Model." *Scientific Reports, 2017*

RESEARCH EXPERIENCE

Identifying Protein-DNA Binding Sites with Mutation-Convolution-Max (MCM) Layers *Fall 2017 – Present*
Advisor: Prof. James Zou, Stanford

- Developed the MCM layer, a new neural network architecture for functional genomics applications, such as the detection of transcription factor-binding sites in DNA
- Proposed a metric to understand the tradeoffs between classical convolution layers and MCM layers
- Demonstrated improved performance of MCM layers on synthetic data; current work includes training and evaluating MCM networks on large-scale genomics datasets

Fragility of Interpretability in Deep Neural Networks *Summer 2017 – Present*
Advisor: Prof. James Zou, Stanford

- Demonstrated that interpretation methods for deep networks, such as saliency maps and influence functions, are susceptible to adversarial attacks that change interpretation while maintaining prediction
- Analyzed properties of neural networks to show that this fragility is a result of the high dimensionality as well as the non-linearities present in these networks
- Exposed a security concern that must be addressed in order for ML to be deployed in medical settings

Unsupervised Learning with Massive, Structured Noise *Spring 2017*
Advisor: Prof. James Zou, Stanford

- Analyzed limitations of principal component analysis (PCA) for unsupervised learning in the presence of structured noise, and proposed a novel method, contrastive PCA, with better theoretical properties
- Evaluated contrastive PCA on a variety of experiments including single-cell RNA sequencing, ancestry determination based on SNPs, as well as trisomy detection from protein expression data

Machine Learning on Datasets with Unordered (Permuted) Labels *Winter 2016*
Advisors: Prof. Ada Poon & Prof. James Zou, Stanford

- Proposed a novel algorithm to efficiently perform least-squares regression with permuted labels (for use in settings where the data is shuffled e.g. because of privacy concerns or experimental protocol)
- Proved theoretical guarantees for the performance of the algorithm even in the presence of noise
- Demonstrated the algorithm on large-scale health records and nucleotide affinity datasets

Deep 3D Convolutional Networks for fMRI-Based Diagnosis of Autism *Fall 2016*
Advisors: Prof. James Zou, Stanford

- Investigated whether deep learning can be used to diagnose autism in infants based on 3D spatial features extracted from fMRI scans
- Built a 3D convolutional neural network in tensorflow, pretrained it using unsupervised autoencoders, and then tested it on preprocessed fMRI features from the ABIDE dataset
- Trained network showed ability to predict patient age and gender, but yielded lower accuracies ($\sim$60%) for autism diagnosis than traditional ML techniques based on hand-engineered features

Simulation and Design of a Phased Array System for Wireless Charging *Summer 2015*
Research Engineer, Supply Inc, Menlo Park, CA

- Led the design of an optimized phased array system for a long-range wireless phone charging system
- Simulated antenna configurations in MATLAB to determine optimal array spacing and phase shifts
- Wrote code for power management, signal tracking, and communication protocols in C++ and assembly to run on distributed microcontrollers embedded in phone cases

Estimating Respiratory Parameters by Mathematical Modeling of Lung Physiology *2014 – 2016*
Advisors: Prof. George Verghese & Prof. Thomas Heldt, MIT

- Designed a lumped-parameter model for respiration based on lung physiology and fluid dynamics
- Applied the model to estimate respiratory parameters from capnography, a non-invasive and inexpensive measurement of CO_2 in breath, with accuracy similar to gold-standard pulmonary function tests
- Developed a MATLAB model shown to be a cost-effective diagnostic test for COPD and asthma

PROVISIONAL PATENT

"Tracheostomy Tube Monitoring Device" (2015) U.S. Provisional Patent Application No.: 62/132,924

PROFESSIONAL SKILLS

Programming Languages: Python, MATLAB, Java, C, C++, HTML, CSS, Javascript, Django, Node.js

Data Analysis Libraries: Numpy, Scipy, Scikit-Learn, Pandas, Tensorflow, Keras, Tesseract OCR

Analytical Background: 4-time USA Math Olympiad qualifier, 2-time USA Physics Olympiad semifinalist