

# NICOLAS SHU

## Projects



### Deep Learning / Computer Vision

- Automated Semi-Guided Maze Path Planning with Turtlebots
  - Run Turtlebot simulations on Gazebo
  - Image classification using KNN and implement a PID controller in order to find the goal of a maze
- Face Detection with Dalal-Triggs Algorithm
  - Use Histogram of Gradients and sliding window to identify faces
  - Implemented an adaptive non-maximal suppression algorithm to find the best keypoints
- Using Level Sets to Develop Active Shape Models of images
  - Use principal component analysis to assist in obtaining level sets to create evolving active shape models to find contours on images
- Scene Recognition with Bag of Words
  - Implement multiclass SVM classifiers to identify the scene
  - Use SIFT descriptors to create a "bag-of-words" to then create a matching histograms which is to be used by a classifier to identify the scene
- Convolutional Neural Networks
  - Implement CNNs along with loading famous CNNs (e.g. VGG-16, ImageNet and AlexNet) to classify images
  - Image style transferring from paintings to photographs
  - Creating saliency maps of weights in Neural Networks
- Recurrent Neural Networks & Long Short-Term Memory Networks
  - Implement RNNs and LSTMs to visualize an image and describe the image



### Machine Learning / Artificial Intelligence

- Q-Learning Algorithm for Path Planning
  - Followed dynamic programming to implement a Q-Learning algorithm to find the shortest path
  - Use Q-learning to perform path planning on a probabilistic field where the goal dynamically changed
- Online Learning Classification of LIDAR Observations for an Environment
  - Implemented Bayesian Linear Regression, Perceptrons and SVMs to classify environments based on LIDAR data
- Adversarial Search on a Queens Isolation Game with Minimax and  $\alpha$ - $\beta$  Pruning
  - Implemented Minimax and  $\alpha$ - $\beta$  Pruning algorithms to beat a human user on the game and an intelligent agent
  - Implemented the algorithms with iterative deepening to find the best possible path within time limited rounds
- Path Planning via Uniform Cost Search (UCS), A\*, and Bidirectional A\* and UCS
  - Identified shortest path to goals in a map by implementing various algorithms: Uniform Cost Search; A\*; Bidirectional A\*
- Answering Probabilistic Prompts via Probabilistic Algorithms
  - Implement Bayesian Networks to answer probabilistic prompts
  - Implement sampling methods (Gibbs Sampling and Metropolis-Hastings)
- Utilizing Decision Trees and Random Forests for Optimal Classification
  - Implementation of decision trees to make classifications
  - Implementation of cross-validation algorithms via k-fold validate the data
  - Implement a bootstrapping technique (i.e. "bagging") to implement random forests
- American Sign Language Interpretation with Dynamic Time Warping Algs.
  - Use dynamic time warping algorithms to solve temporal unsupervised learning problems
  - Classify/Translate single-handed signs and double-handed signs to words with Hidden Markov Models
- Image Segmentation with Unsupervised Learning Algorithms
  - Implement k-means and Gaussian Mixture Models to segment images based on colors



### Android Development / Embedded Systems

- Shopaholic: An Android App that Searches Products by Locations Near You
  - Implemented a real-time search engine for find products by location, by checking the availability of the product in stores at current time
- Automated Sweeping Robot on an Arduino
  - Implemented a sweeping robot with an Arduino, motors, and dust sensors to sweep a dirty floor with real-time dynamics in order to attempt to replicate a Roomba robot
- Voice-Activated Speech Recognition on a Raspberry Pi
  - Implemented a speech recognition system that would be vocally activated by a keyphrase trained on a particular individual

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## Education

- Georgia Tech
  - Ph.D. in Machine Learning
  - Sept 2017 - Present
  - 3.7/4.0
- Boston University
  - M.S. Biomedical Engineering
  - June 2015 - May 2017
  - 3.9/4.0
- Binghamton University
  - B.S. in Biochemistry
  - Sept 2011 - May 2015
  - 3.6/4.0

## Skills



Python



MATLAB



C++



Kivy



OpenCV



Tkinter



NLTK



PyTorch



Tensorflow



Scikit-Learn



SciPy



Pandas



ROS  
Gazebo



RPi



Arduino



Ae



Pr



Id



Ai



Linux



Arduino

## Experience

### Department of Bioinformatics, Emory University School of Medicine, Atlanta GA

Research Assistant :: May 2017 - Present

- Develop an intelligent agent to understand and contextualize medical language to then bring ontological information of the patient.
- Develop multiple graphic user interfaces to collect data
- Run algorithms to perform blind source separation and speech recognition

### National Emerging Infectious Diseases Laboratories, Boston MA

Research Assistant :: May 2016-July 2017

- Developed fluoroscopic screening assays in synthetic biology for directed evolution experiments for the development of enzyme-based biosensors targeting nicotine.
- Perform multiple microarray assays to optimize hydrogen peroxide detection in cell-free assays
- Bacterial expression and operation of FPLC to purify proteins

### Qiang Group, Binghamton NY

Undergraduate Research Assistant :: Jan 2014 - May 2015

- Characterized biophysical and biochemical properties of cancer-targeting peptides via nuclear magnetic resonance techniques and fluoroscopic techniques
- Peptide synthesis and operation of HPLC to purify peptides

## Teaching

### Georgia Institute of Technology - Department of Electrical Engineering

Graduate Teaching Assistant

Introduction to Signal Processing ( Fall 2017 / Spring 2018 )

### Rola Languages

Portuguese Instructor

Portuguese I, II, III, IV, Low Intermediate, Intermediate, Advanced (Oct 2015 - May 2017 / 14 courses)

### Boston University - Department of Chemistry

Graduate Teaching Assistant

Quantitative Analytical Chemistry (Summer 2016)

Organic Chemistry II (Summer 2016)

### Binghamton University - Department of Chemistry

Graduate Teaching Assistant

Intro. to Chemical Principles I & II (Fall 2013, Spring 2014, Fall 2014, Spring 2015)

## Publications

- S. Hanz, **N. Shu**, J. Qian, N. Christman, P. Kranz, M. An, C. Grewer, W. Qiang "Protonation-Driven Membrane Insertion of a pH-Low Insertion Peptide", Angew Chem Int Ed Engl. 2016, 55(40):12376-81 DOI: 10.1002/anie.201605203.

- N. Shu**, M. Chung, L. Yao, M. An, and W. Qiang "Residue-specific structures and membrane locations of the pH-low insertion peptides by solid-state nuclear magnetic resonance", Nature Communications, 2015, 6 (7787) DOI: 10.1038/ncomms8787

- W. Qiang, R. Akinlolu, M. Nam, and **N. Shu** "Structural Evolution and Membrane Interaction of the 40-Residue  $\beta$ -Amyloid Peptides: Differences in the Initial Proximity between Peptides and the Membrane Bilayer Studied by Solid-State Nuclear Magnetic Resonance Spectroscopy" Biochemistry, 2014, 53 (48), pp 7503-7514 DOI: 10.1021/bi/501003n

## Awards

- Boston University Nanotechnology Innovation Center - Terrier Tank Competition: Winner (\$10,000)
- Boston University | Half-Tuition Scholarship (Fall 15, Spring 16, Fall 16, Spring 17)
- Honorable Mention in Provost's Award for Excellence in Undergraduate Research, 2015
- Undergraduate Summer Research Award. Binghamton University May 2014

## Languages

English

Portuguese

Spanish

