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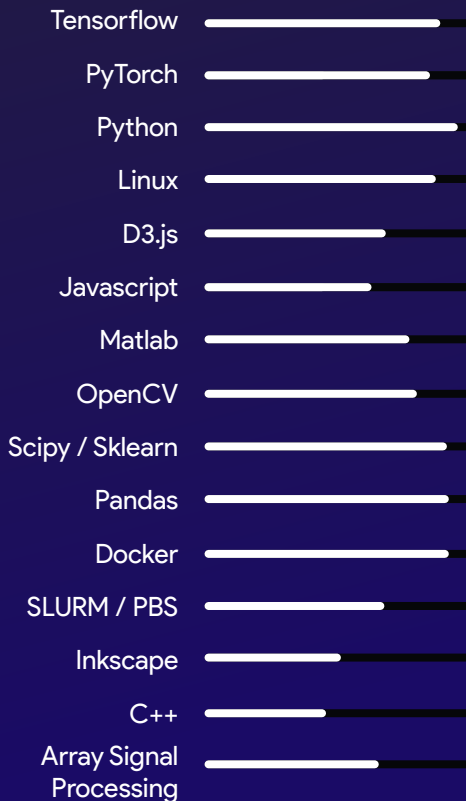
EDUCATION

 **GEORGIA TECH**
PhD Machine Learning, 2023 3.7/4.0
MS Electrical Eng., 2021 3.7/4.0
MS Computer Sci., 2021 3.7/4.0
Specialization: Machine Learning

 **BOSTON UNIVERSITY**
MS Biomed. Eng., 2017 3.9/4.0
Late Entry Accelerated Program
Specialization: Robotics

 **BINGHAMTON UNIVERSITY**
BS Biochemistry, 2015 3.6/4.0

SKILLS



AUDIOSOCKETS

- Created a Python package with socket programming which would allow one to break from the synchronous behavior of Python, and allow one to do real-time audio processing via distributed computing with low latency
- Software was used in 30+ embedded devices for real-time processing and storage of data under a built environment

SHORT-TIME SPEAKER IDENTIFIER

- Created a speaker identification system which achieved over 87% accuracy over 1148 speaker classes under a two-second window

FEW-SHOT (FS) AND ZERO-SHOT SPEAKER IDENTIFIER

- Hybridized an x-vector system with prototypical networks to identify speakers, reaching accuracies up to 87%
- Coupled FS system with detection theory to detect new speakers within only 2.5 seconds, reaching F1 scores up to 0.92
- Created system to simultaneously detect new speakers and identify registered speakers in real-time via zero-shot learning

SPEECH/NOISE/MUSIC CLASSIFIER

- Created a speech/noise/music classifier which achieved over 96% macro F1 score in 0.5s, 1s, 2s windows of audio using a Bahdanau attention layer

3D AUDIO DIRECTION OF ARRIVAL WITH MICROPHONE ARRAY

- Expanded array signal processing techniques to create a 3D direction of arrival framework for audio signals
- Implemented MUSIC and SRP-PHAT algorithms in two dimensions
- Created a 3D visualizer to analyze a 2D signal which evolves in time, using D3.js

MAXIMUM COVERAGE CONTROL OF OMNIDIRECTIONAL SENSORS OVER NON-SIMPLY CONNECTED ENVIRONMENTS

- Created a new framework to perform max. cov. control in a swarm of directional and omnidirectional agents
- Designed control barrier functions and improved on Lloyd's algorithm to allow swarm to maximize coverage in non-simply connected environments
- Ran Monte-Carlo simulations to estimate the optimal number of devices in a built environment before reaching diminishing returns

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

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 CLASSIF. OF LIDAR OBSERVATIONS FOR AN ENVIRONMENT

- Implemented Bayesian linear regression, perceptrons, and SVMs to classify environments based on LIDAR data

FACE DETECTION WITH DALAL-TRIGGS ALGORITHM

USING LEVEL SETS TO DEVELOP ACTIVE SHAPE MODELS OF IMAGES

IMAGE SEGMENTATION WITH GAUSSIAN MIXTURE MODELS AND KNN

SCENE RECOGNITION WITH BAG OF WORDS

ADVERSARIAL SEARCH ON A QUEENS ISOLATION GAME WITH MINIMAX AND ALPHA-BETA PRUNING

ASL INTERPRETATION WITH DYNAMIC TIME WARPING ALGORITHMS AND HMMS

- Few-shot Learning
- Statistical Signal Processing
- Array Signal Processing
- Networked Control
- Probabilistic Graphical Models
- Classical Computer Vision

- Photography
- Transformers
- Attention Networks
- Speech Processing
- Kalman Filters

AUDIO / SPEECH PROC.

CONTROLS

CLASSIC ML

OTHER TOPICS OF PROFICIENCY

ESP LAB, GEORGIA INSTITUTE OF TECHNOLOGY, ATLANTA GA

Graduate Research Assistant

May 2022–Present

- Created a speech/noise/music classifier with an attention layer with accuracy of above 96%, while maintaining a low footprint of 335MB in memory, making it suitable for embedded systems
- Expanded the MUSIC and SRP-PHAT algorithms to 2D in order to determine direction of arrival of signals arriving at simulated microphone arrays
- Wrote a GUI to process LIDAR data to map the interior of a home, using D3.js
- Created method to hybridize few-shot learning with probabilistic models in detection theory to detect appearance of new classes within 2.5 seconds, obtaining F1 scores up to 0.92
- Created method to convert few-shot algorithm to zero-shot learning, allowing speaker identifier to detect new speakers, auto-enroll speakers, and identify speakers with adaptive statistics in a coupled online algorithm. This is capable of working on 2.5s of audio of never-seen before speakers.
- Developed a networking framework for Python communication of different computers via a local area network
- Setup a networked platform between multiple RPis and a server to run auto-enrollment and speaker identification in real-time, storing de-identified speaker information in a time-series database InfluxDB
- Created a front-end dashboard using React.js to show real-time digestible information from InfluxDB

CLIFFORD LAB, EMORY UNIVERSITY SCHOOL OF MEDICINE, ATLANTA GA

Graduate Research Assistant

May 2018–April 2022

- Cooperatively organized and performed an installation of 35+ RPis across a built environment for the monitoring of people with mild-cognitive impairment, including cameras, microphones, and temp/humidity/light sensors
- Calibrated 140 microphones in 35 microphone arrays to be used in a built environment
- Setup initial time-series database InfluxDB to log data collected from various devices in a built environment
- Implemented a speech recognition system that would be vocally activated by a keyphrase trained on a particular individual

IROBOT, BEDFORD MA

Machine Learning Intern

May 2019–Aug 2019

- Developed computer vision algorithms to assist robots to achieve improved docking
- Utilized green screens to create augmented datasets of different docking stations
- Won 1st place intern competition for creating novel robot to bring to market

NATIONAL EMERGING INFECTIOUS DISEASES LABORATORIES, BOSTON MA

Graduate Research Assistant

May 2016–July 2017

QIANG GROUP, BINGHAMTON NY

Undergraduate Research Assistant

Jan 2014–May 2015

GEORGIA TECH: Instructor of Record

- GTA Preparation



- 1) CENTER FOR THE INTEGRATION OF RESEARCH, TEACHING AND LEARNING – ASSOCIATE LEVEL
- 2) QPR GATEKEEPER CERTIFICATE

GEORGIA TECH: Teaching Assistant

- Artificial Intelligence (Sum2022, F2022, Spr2022, F2023)
- Advanced Digital Signal Processing (Sum2023)
- Introduction to Signal Processing (F2017, Spr2018)

BOSTON UNIVERSITY: Teaching Assistant

- Quantitative Analytical Chemistry (Sum. 2016)
- Organic Chemistry II (Sum. 2016)

1. **N. Shu**, D. Anderson, "Coupled Auto-Enrollment and Speaker Identification Platform in Real-Time" (Under preparation)
2. **N. Shu**, D. Caulley, D. Anderson, "A Complete Derivation of the Probabilistic Linear Discriminant Analysis" (Under preparation)
3. **N. Shu**, D. Anderson "Detection of New Speakers via Hybrid X-Vectors Few-Shot Learning System" ICASSP 2023 (Under Review)
4. Y. Wang, **N. Shu**, D. Anderson, "HAPPi: A Hybrid Attentional Prototypical Networks Framework with Pi-Model for Few-Shot Sound Classification" Knowledge-Based Systems (Under Review)
5. G. Clifford, J. Zelko, **N. Shu**, P. Suresha, A. Cakmak "System and Methods for tracking behavior and detecting abnormalities" US Patent App. 17/430, 414, 2022
6. C. Feustel, **N. Shu**, G. Clifford, D. Anderson, C. Zimring "Practical High-Fidelity Sensing of the Sleep Environment in the Home" Proc. Pervasive Technologies Related to Assistive Environments, 2022
7. S. Hanz, **N. Shu**, J. Qian, N. Christman, P. Kranz, M. An, C. Grever, 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.
8. **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
9. W. Qiang, R. Akinlolu, M. Nam, and **N. Shu** "Structural Evolution and Membrane Interaction of the 40-Residue β -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/501003nvs