

Caleb Jones Shibu

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Machine Learning - Software Engineer

Python • Pytorch • TensorFlow • OpenCV • LLM

EXPERIENCE

- **Allen Institute** Seattle, WA
Software Engineer II (Machine learning) *March 2024 - March 2025*
 - **Cellpose:** Improved Cellpose model performance by 22% (AUC-ROC) for real-time neuron segmentation by implementing PyTorch-based transfer learning, resulting in automated voltage imaging analysis and reduced manual annotation time by 2 hours per week.
 - **iGluSnFR Simulation Pipeline:** Developed a simulation pipeline for iGluSnFR-expressing dendrites, optimizing 12+ parameters to replicate microscope imaging conditions, enabling ground-truth validation of motion correction algorithms.
 - **iGluSnFR Motion Correction:** Engineered a motion correction pipeline for dendritic imaging that maintained subcellular tracking accuracy during extreme motion, outperforming existing methods like Suite2p, CaImAn and PatchWarp.
 - **iGluSnFR Source Extraction:** Contributed to an OpenCV-based super-resolution microscopy source extraction pipeline to identify synapses within dendrites, advancing iGluSnFR indicator data analysis techniques.
 - **iGluSnFR Image Processing Methods:** Co-authored an upcoming paper detailing novel image processing methods for iGluSnFR indicator data analysis.
- **Biotronics** Ames, IA
Machine Learning Engineer *Jan 2024 - Feb 2024*
 - **ML model explainability :** Enhanced ResNet-50 model interpretability for livestock fat prediction by integrating SHAP (SHapley Additive exPlanations) and Grad-CAM, improving stakeholder trust in predictions by quantifying feature importance.
- **University of Arizona** Tucson, Az
Graduate Research Assistant *Aug 2021 - Dec 2023*
 - **Baseline Task:** Developed network-based finger tapping and imaging rating application using PyGame for the baseline task for Theory of Mind Computer Architecture for Teams (ToMCAT).
 - **Data Acquisition:** Developed ETL pipelines for acquiring and pre-processing Eye-tracking, fNIRS & EEG data from over 100 subjects.
 - **Real-Time Physio Visualization:** Developed a tool using PyQt5 that plots EEG and fNIRS signals which are multicasted over network using LSL within real-time.
 - **Data conversion and labeling:** Developed an automated tool that converts XDF files (containing EEG, fNIRS, and Eye-tracking data) into labeled CSV files. Implemented channel quality assessment and motion artifact filtering for EEG and fNIRS signals, streamlining data preparation for analysis.
 - **Conference paper:** Conducted machine learning based classification experiments using a multi-modal dataset and authored a paper that was submitted to and accepted by NeurIPS 2023 conference.
- **Sree Chitra Tirunal Institute for Medical Sciences & Technology** Kerala, India
Project Scientist *January 2021 - July 2021*
 - **Neurofeedback game:** Built a neurofeedback game application that filtered fNIRS signals in real-time, predicted brain states using a deep learning model, and incorporated predictions into a PyGame interface, advancing brain-computer interface research.
 - **xAI fNIRS system:** Developed an explainable AI application for fNIRS signal classification using DeepSHAP, enhancing interpretability of brain state predictions and got it published at Frontiers in Human Neuroscience .
- **St. Jude Children's Research Hospital** Memphis, TN
Research Intern *September 2020 - January 2021*
 - **Active vs Passive brain activation:** Developed Deep learning-based classification of Active and Passive brain state associated with single trial lower limb motor preparation for stroke patients.

- **Machine Learning Based Classification of fNIRS signals:** Created handcrafted features for fNIRS signals using PCA and ICA for improving the classification accuracy of Machine learning classifiers like SVM and KNN for fNIRS signal classification.
- **Deep Learning Based Classification of fNIRS signals:** Developed a sliding window-based CNN and LSTM Deep Learning model for fNIRS signals by treating signals as an image which boosted the classification from 55% to 97% and solved the issue of data scarcity by increasing the dimension of the dataset. A part of this work was presented at IEEE conference in Japan.

ACADEMIC PROJECTS

- **RL-Bowling:** Developed a reinforcement learning based bowling game using OpenAI Gym environment. (Feb '25)
- **Resume-GPT:** A Streamlit-based chatbot application that utilizes GPT-3.5-turbo, enabling users to interact and ask questions about a person's background based on their resume. (Oct '23)
- **Grocify:** A web application, developed using Django and React and deployed on the Google Cloud Platform, enhances the grocery list-making experience and is accessible on both PC and mobile devices. (May '23)
- **ToMCAT-offline-Viz:** PyQt5-based GUI not only visualizes the TOMCAT dataset but also presents detailed views of EEG and fNIRS signals, providing a thorough understanding of brain activities. Moreover, it offers a topological perspective, mapping these neural signals in a spatial context. This enhances the user's comprehension of cognitive processes and aids researchers in observing how team interactions evolve across various tasks and environments. (May '23)
- **Data poisoning in Machine Learning:** Explored an approach to poison a Machine Learning Model by attaching a Trojan Net which makes the model misclassify with high accuracy (Dec '22)
- **Multi-Modal emotion recognition:** Worked on a diffusion-based deep neural network that classifies emotions from a multimodal dataset. (Aug '22 - Dec '23)
- **fNIRS data augmentation with GANs:** Using Python implemented a GAN model which generated synthetic fNIRS data to solve issues related to fNIRS data acquisition and model training. (Nov '21)
- **Explainable medical image classification:** Developed a model which was able to classify Covid19 chest X-ray with an accuracy of 90% and ISIC Skin cancer dataset with an accuracy of 70%. The model classification was explained using LIME, GradCam HeatMap, and Saliency Maps. (Nov '21)

EDUCATION

- **University of Arizona** Tucson, Az
Masters in Computer Science (Fully-funded) Aug 2021 - Dec 2023
Courses: Advance Topics in Artificial Intelligence, Principles of Machine Learning, Design and Analysis Of Algorithms, Computer Vision, Computer Security, Software engineering, Advanced-Data Visualization
- **Goa University** Goa, India
Bachelor of Computer Science Aug 2014 - May 2018

SKILLS SUMMARY

- **Languages:** (Proficient) Python and MATLAB; (Familiar) C, C++, C#, SQL, Django, PostgreSQL, BASH
- **Tools:** Pytorch, TensorFlow, langchain, Plotly, IPython, Excel, Keras, Scikit-learn, streamlit, pygame, Bash, SSH, GCP, Nextflow, MLflow, OpenAI Gym

PUBLICATIONS

Caleb Jones Shibu, Sujesh Sreedharan, Arun KM, and Chandrasekharan Kesavadas. "Comparison of classification performance of handpicked, handcrafted, and automated-features for fNIRS-BCI system". In: *2020 5th International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS)*. IEEE, 2020, pp. 152–157

Caleb Jones Shibu, Sujesh Sreedharan, Arun KM, Chandrasekharan Kesavadas, and Ranganatha Sitaram. "Explainable artificial intelligence model to predict brain states from fNIRS signals". In: *Frontiers in Human Neuroscience Brain-Computer Interfaces* (2023)

Adarsh Pyarelal, Eric Duong, **Caleb Jones Shibu**, Paulo Soares, Savannah Boyd, Payal Khosla, Valeria Pfeifer, Diheng Zhang, Eric S Andrews, Rick Champlin, Vincent Paul Raymond, Meghavarshini Krishnaswamy, Clayton Morrison, Emily Butler, and Kobus Barnard. "The ToMCAT Dataset". In: *Thirty-seventh Conference on Neural Information Processing Systems Datasets and Benchmarks Track*. 2023. URL: <https://openreview.net/forum?id=ZJWQfgXQb6>

Caleb Jones Shibu. "Decoding Emotional Responses: A Comparative Study of fNIRS and EEG Neuroimaging Techniques". In: (2023). URL: <https://repository.arizona.edu/handle/10150/670846>