

# Caleb Jones Shibu

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## 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

## EXPERIENCE

- Allen Institute** Onsite  
*Software engineer 2* March 2024 - present
  - Cellpose:** Boosted Cellpose model performance by 22% (AUC-ROC) for real-time neuron segmentation in SLAP2 microscopy using PyTorch-based transfer learning, automating voltage imaging analysis and reducing manual annotation time by a few hours/week."
  - iGluSnFR Simulation Pipeline:** Engineered simulation pipeline for iGluSnFR-expressing dendrites, optimizing 12+ parameters (motion amplitude, synapse density) to replicate Bergamo microscope imaging conditions, enabling ground-truth validation of motion correction algorithms.
  - iGluSnFR Motion Correction:** Engineered motion correction pipeline for dendritic imaging that maintains subcellular tracking accuracy (1-2.5 RMSE) during extreme motion amplitudes (>50% frame displacement), outperforming Suite2p (5-6 RMSE), CaImAn (10-20 RMSE), and Patchwarp (6-7 RMSE) in whole-cell locomotion datasets.
  - iGluSnFR Source Extraction:** Contributed to an OpenCV-based super-resolution microscopy-based source extraction pipeline to identify synapses within dendrites.
  - iGluSnFR Image Processing Methods:** Co-authored an upcoming paper detailing novel image processing methods for iGluSnFR indicator data analysis.
- Biotronics** Remote  
*Machine learning engineer* Jan 2024 - Feb 2024
  - IMF 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 - ToMCAT* 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:** Acquired fNIRS & EEG data from multiple subjects.
  - Real-Time Physio Visualization:** Developed a tool using PyQt5 that plots EEG and fNIRS signals which are multicasted over the network using LSL in real-time.
  - Data conversion and labeling:** Developed a script that converts XDF files (contains EEG, fNIRS, and Eye-tracking data) into labeled CSV files. Calculated channel quality and filtered out the motion artifacts from the fNIRS signals
  - 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:** Using Python built an application that filtered fNIRS signals in real-time, predicted brain state in real-time using a deep learning model and model predictions were input to a PyGame.
  - xAI fNIRS system:** Using DeepSHAP developed an explainable AI application for fNIRS signal classification .

- **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.

- **Sree Chitra Tirunal Institute for Medical Sciences & Technology**

Kerala, India

*Research intern*

*June 2019 - September 2020*

- **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

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- **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)
- **Grocity:** 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)

## PUBLICATIONS

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**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>