GASSER ELBANNA

Graduate Research Student at MIT/HMS | MSc. Student at EPFL | Bertarelli Fellow

gelbanna@mit.edu | gasserelbanna.github.io | github.com/GasserElbanna | linkedin.com/in/gasser-elbanna | google scholar

EDUCATION

MSc. in Life Sciences Engineering (Neuroscience & Neuro-engineering)
Sep 2020 – Ongoing

School of Life Sciences, EPFL, Switzerland

Average Grade: 5.6/6.0

BSc. in Systems and Biomedical Engineering
Aug 2015 – Jul 2020

Faculty of Engineering, Cairo University, Egypt

Grade: Distinction with Honors

EXPERIENCE

Graduate Research Student | Bertarelli Fellow
March 2022 – Ongoing

MIT/Harvard Medical School

Cambridge, MA, USA

- Exploring invariances and limitations in self-supervised speech models in speaker identity processing tasks.
- Conducting behavioral experiments using **GORILLA** to evaluate humans and models performance in speaker identity discrimination task.
- Mapping models' representations to brain activations.

Voice AI Intern
August 2021 – February 2022

Logitech Europe SA

EPFL Innovation Park, Switzerland

- Improve a self-supervised speech model (BYOL-S) via designing a hybrid training protocol to learn from data-driven and handcrafted features (Hybrid BYOL-S) using **PyTorch Lightning**.
- Using speech representation models (BYOL-A, TRILL, YAMNET, VGGish,...etc) to study voice stress analysis (Cognitive & Physical Load).

Audio Signal Processing Intern
July 2021 – Sep 2021

IDIAP Research Institute

Martigny, Switzerland

- Build CNN model using **Pytorch** for estimating breathing patterns from voice samples.
- Experiment with different model architectures, loss functions and hyper-parameters to optimize performance.

ML & Data Visualization Research Assistant
March 2021 – Oct 2021

Machine Learning and Optimization Laboratory

EPFL, Switzerland

- Detecting and visualising patterns in medical data to guide targeted interventions and medical training (Epidemiology).
- Implement supervised and unsupervised anomaly detection ML Models for the Dynamic Project and using **Tableau** as a web-based dashboard development tool for visualization integrated with **Python** scripts to run ML models.

Computer Vision Intern
May 2020 – August 2020

Advintic

Cairo, Egypt

- Building a Deep learning-based Computer Vision system to detect main heart coronaries using U-Net Architecture in **TensorFlow**.

Research Intern
Aug 2019 – Oct 2019

ONE Lab (Opto-Nano-Electronics Lab), Cairo University

Cairo, Egypt

- Build a text to speech keyboard for autistic children by installing Linux image on a **Raspberry Pi** and install an open source TTS client **Festival**, then automate the process of speech generation.

ACHIEVEMENTS & AWARDS

Logitech Publication Award
July 2022

Logitech Europe SA

- Received 1,000 CHF to attend Interspeech 2022 Conference.

HEAR Competition in NeurIPS 2021
December 2021

Logitech AI Team

- Ranked 1st on LibriCount task (9% improvement) and Ranked 3rd overall (19 downstream audio tasks).

Bertarelli Fellowship in Translational Neuroscience and Neuro-engineering
February 2021

Harvard Medical School

- Carry out a MSc. Thesis in SIG lab for one year at MIT/HMS.

3D Printed Motoneuron at ModelDB
April 2020

Yale University

- vemoto6 Neuron Model

SKILLS

Technical Development
Python and MATLAB

Desktop Development
C and C++

Deep Learning Frameworks
Tensorflow, Keras, Pytorch, RLlib, Ray and VoxelMorph

Modeling
NEURON, NMODL and HOC Language

Graphics and Visualization
OpenGL, VTK and Tableau

Embedded Systems
Raspberry Pi, ESP and Arduino

Miscellaneous
Git, LaTeX, Qt Designer, Linux and GORILLA

PROJECTS

Me Too Quotes Analysis Sep 2021 – Dec 2021

Course Project at Data Science Lab

- Analyze Quotebank data in addition to twitter dataset to study the impact of traumatic/non-traumatic incidents on resurrecting the MeToo movement using NLP in **Python**.
- Build a web blog with the data story to illustrate the results.

Learning Adaptive Behavior Through Competition

July 2021 – Sep 2021

Semester Project at Mathis Group for Computational Neuroscience and AI

- Design a training procedure which allows an agent to succeed in a progressively larger and more complex set of environments.
- Changing dynamics due to environmental perturbations and generating unsupervised curriculum for adaptation using **RL-lib**.

Impact of Motivation on Performance and Neuronal Activity in Mice Engaged in a Sensory Detection Task

Feb 2021 – June 2021

Semester Project at Laboratory of Sensory Processing

- Analyze behavioral parameters (Engagement, Performance and Cumulative Reward) and Psychometric functions in mice whisker-deflection detection task.
- Analyze neural parameters (Firing Rate and PCA) recorded from S1, mPFC and tjM1 brain regions.
- Correlation analysis between neural and behavioral parameters.

Applying VoxelMorph Framework to C. Elegans Brain Data for image regisration Oct 2020 – Dec 2020

Course Project at Laboratory of Physics of Biological Systems

- Apply image registration on 3D volumes of brain data in **TensorFlow**.
- Create a deformation field for each 3D volume in a specific time frame relative to first frame.

Analytical Surface EMG Model connected to Motoneuron Model for ALS Early Detection

Aug 2019 – Aug 2020

BSc. Graduation Project

- Building a motoneuron model using **NEURON** simulating early ALS biophysical features and a sEMG model using **Python**.

Computer Vision GUI May 2020

- Building user-friendly GUI to implement Hough Transform, Harris Corner Detector, Template Matching and SIFT Algorithms on given images using **openCV** and **PyQt5**.

Mini Autonomous Car Oct 2019

- Building a self-driving car which detects lanes using **OpenCV** (Hough transform & Contouring).
- Detecting obstacles using ultrasonic sensor connected with **Arduino** that overrides the steering control in case avoiding obstacles.

Wireless Data Transfer Sep 2019

- Generating pseudo random numbers that simulate patient data and transfer it wirelessly to a server using **BLE chip**.
- Visualizing the data acquired from the server in a web app developed using **Django** to simulate real-time vital signal tracking.

Wireless WiFi-based Indoor Localization for Elderly

Sep 2019

- Indoor localize elderly people through **ESP** embedded in a bracelet using WiFi technology.

Volume Rendering Application for Head and Ankle Images

April 2019

- Loading DICOM images for ankle and head then apply Surface Rendering using adjustable ISO value and Ray Cast Rendering using adjustable transfer function using **VTK and Qt Designer**.

MRI Simulator Software March 2019

- Implement a generalized MRI simulator with the preparation sequences (IR, T2 Prep. and Tagging) and pulse sequences (GRE, SSFP and SE) in a GUI using **PyQt5**.
- Implement a computational shepp-logan for testing and validation.

PUBLICATIONS

Conferences & Journals

- Elbanna, Gasser et al. (2022b). "BYOL-S: Learning Self-supervised Speech Representations by Bootstrapping". In: *Proc. HEAR-PMLR 2021*.
- Elbanna, Gasser et al. (2022). "Hybrid Handcrafted and Learnable Audio Representation for Analysis of Speech Under Cognitive and Physical Load". In: *Proc. Interspeech 2022*, pp. 386–390. DOI: 10.21437/Interspeech.2022-10498.
- Cordey ..., **Elbanna** et al. (2021). "Blood virosphere in febrile Tanzanian children". In: *Emerging Microbes & Infections*. Vol. 10. 1. Taylor Francis, pp. 982–993. DOI: 10.1080/22221751.2021.1925161.

Pre-prints & In-progress

- Gasser Elbanna, Satrajit Ghosh (2023). "Towards understanding speaker identity coding in self-supervised models". In: *In-progress for ICML 2023*.
- El Hajal ..., **Elbanna** et al. (2022). "Efficient Speech Quality Assessment using Self-supervised Framewise Embeddings". In: *Submitted to ICASSP 2022*.
- Elbanna, Gasser et al. (2022a). "Effect of backward speech on speaker recognition in self-supervised models". In: *Abstract submitted to Speech Units Workshop 2022*.

Blogs & Invited Talks

- *(Lecture) Speech Processing for the SHBT-200 graduate course at Harvard* (2022).
- *(Talk) What do Machines Hear? at Harvard-MIT Speech Biomarker Group* (2022).
- *(Blog) Gender and Racial Disparities in Voice Applications* (2022).
- *(Talk) HEAR Competition Presentation at NeurIPS 2021* (2021).