

## Real Time Seizure Recognition via EEG, AI, and Nonlinear Dynamics

For decades, my wife's deep frontal lobe seizures were misdiagnosed by doctors who at one point admitted her to a mental hospital even though her mother was a diagnosed epileptic, and at other points accidentally overdosed her. Last year, my wife had brain surgery to correct her Epilepsy. We now know that the main cause of these misdiagnoses was the inability for an EEG to detect "deep brain" seizures.

Diagnosed with brain cancer at the 20-week anatomy scan after finding a mass in her brain, our daughter, Nicolette was misdiagnosed by the first pediatric neurologist whose only solution was to add more dangerous meds to stop the seizures from killing her. One of these meds blinded Nicolette in one eye. This specialist would ignore our attempts to help find solutions and quickly put us in our place, never hesitating to let us know she was the expert, and we were nobodies. Finally, Nicolette was correctly diagnosed when this doctor traveled to a conference, and in short order and at 6 months of age, a neurosurgeon removed half of Nicolette's brain. Nicolette's condition was so unique, we were asked to donate the removed brain to science.

Unfortunately, this was only one part to Nicolette's story, but of the many trials and tribulations, one had a lasting effect. And it dealt, again, with EEGs. Ohtahara patients, if they live, generally develop Lennox-Gastaut Syndrome (LGS), Dravet Syndrome, or West Syndrome. This diagnosis depends on a known pattern in an EEG. Because half of Nicolette's brain was removed, changing her brain anatomy, this pattern was not there, so any medications that could treat these conditions were denied by insurance companies. This created tremendous stress for my family about Nicolette dying from an untreated condition stemming from a lapse in technology: the inability for an EEG to find a known pattern in the electrical output of a brain. Thus began a 6 year journey to learn the mathematics of Nonlinear Dynamics, python, and Data Science so I could find ways to read the brain's electrical output so other families in this situation, hospitals, and insurance companies would have better tools to diagnose rare conditions.

The original goal was to predict seizures via Bayesian Inference. This failed due the mathematics of Chaos Theory. The data analysis continued, eventually discovering a common "volcano" pattern, complete even with a volcano cauldron, that all EEG patients displayed going into a seizure. This allowed me to put a program into the EEG that, as long as there was an EEG on file for the patient, would allow the EEG to sound an alarm for the family in the room if the brain displayed the "volcano" pattern. This effectively eliminated the fear of sleeping through a deadly, silent seizure.

But what about patients admitted to an ER and hooked up to an EEG, or for those with no baseline on file? I generalized the previous solution to include any patient, even if it was their first EEG. Taking in real-time EEG readings, running them through my proprietary python program, and finally through a TensorFlow Deep Learning model, any particular moment in an EEG reading can be identified as a seizure or not.

A more detailed account found at: [Github](#)

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<https://github.com/eipiisneg1>

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### Summary

Born with Ohtahara Syndrome, Cortical Dysplasia, and after donating half her brain to science, Nicolette drove me to learn how to model such complicated processes via mathematics, python, and data science. Finding underlying structures in data and solving complex problems is my driving force.

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### Technical Skills

Programming Languages: **Python Object Oriented Programming**

Modeling: **Tensorflow Deep Learning, Sklearn, Statsmodels**

Analysis: **Data Science, SQL, Higher Mathematics**

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### Projects

- **[Seizure Prediction:](#)**

Using a variety of models within **Tensorflow**, **Sklearn** and **Statsmodels**, it's shown that seizure prediction falls into the mathematical theory of **Chaos**, so can't be predicted by definition. However, I discovered I was asking the wrong question and found a simple and effective strategy using **Python**, **Fast Fourier Transforms**, and **unsupervised clustering algorithms** to lower family stress and optimize hospital resource allocation.

- **[Real Time Seizure Recognition via EEG:](#)**

A way to identify a **seizure** in real time even if the patient did not have a previous baseline EEG on file. Using **mathematics**, **feature engineering**, and **Tensorflow**, the solution was found to a very complex problem that could revolutionize **Epilepsy** diagnosis and **seizure modeling**.

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### Experience

- **Springboard Data Science Fellow**

Certification 2023

6-month intensive course in data science, machine learning, Python and SQL.

- **Previous Career in Corporate Restaurant Management**

Carolinas/Georgia

A productive career in an industry governed by hospitality, analytics, training, change, and team building.

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### Education

University of South Carolina

Bachelor's Degree - Psychology