Predicting Seizures

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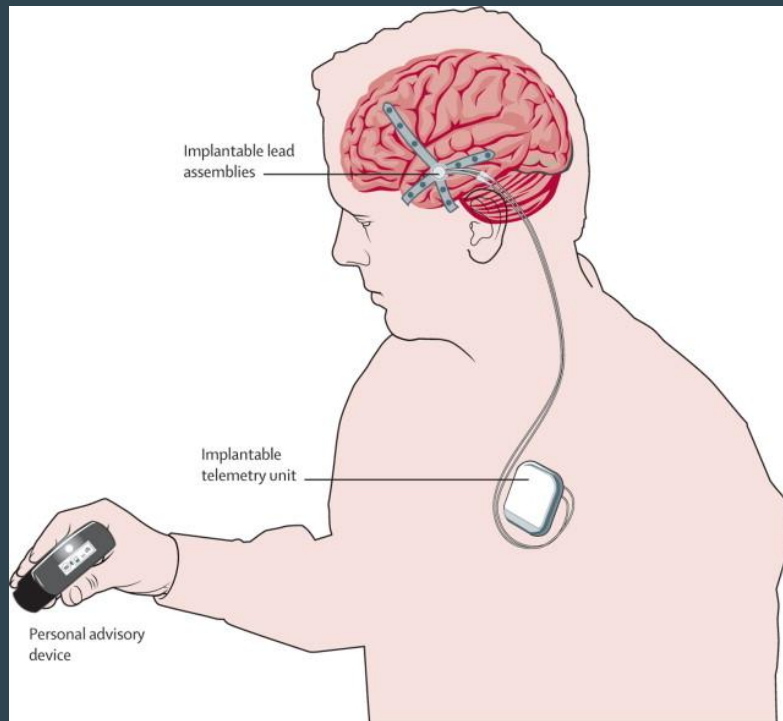
Conor Murphy

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Motivation

World's first clinical trial

Safety concerns

Decreasing seizure related anxiety

Implantable lead assemblies

Implantable telemetry unit
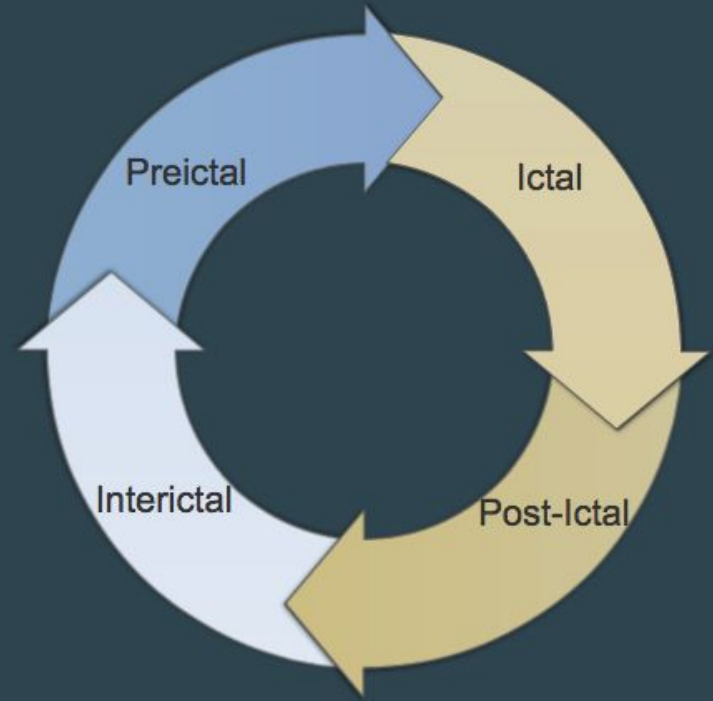
Personal advisory device

Lifecycle of Epilepsy

Interictal - Baseline/between seizures

Preictal - pre-seizure

Ictal - the seizure itself

Post-ictal - period after a seizure
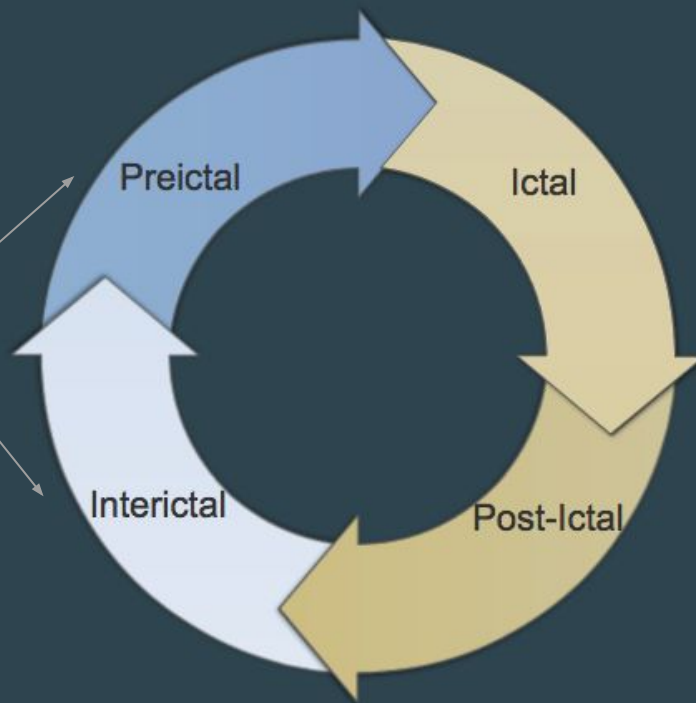
Lifecycle of Epilepsy

Interictal - Baseline/between seizures

Preictal - pre-seizure

Ictal - the seizure itself

Post-ictal - period after a seizure

Most difficult to classify

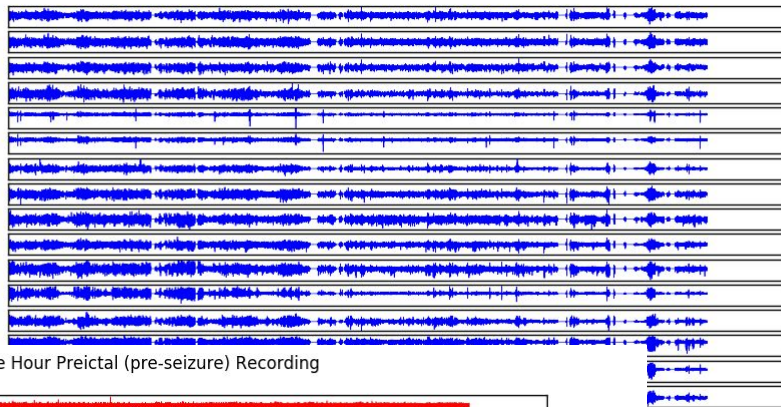Preictal

Ictal

Interictal

Post-Ictal

The Data

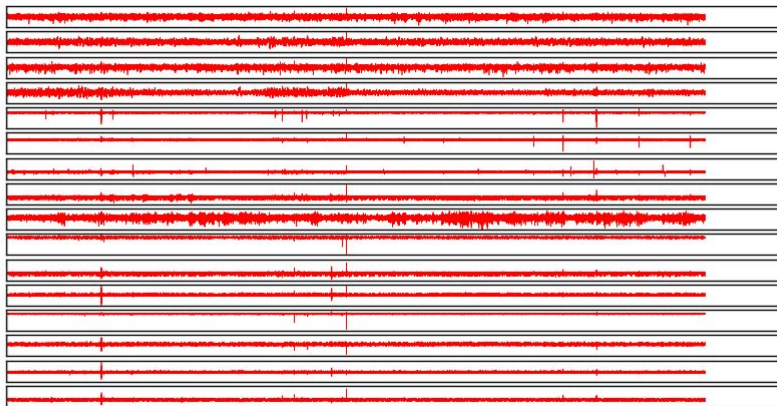≈ 8k 10-minute iEEG recordings
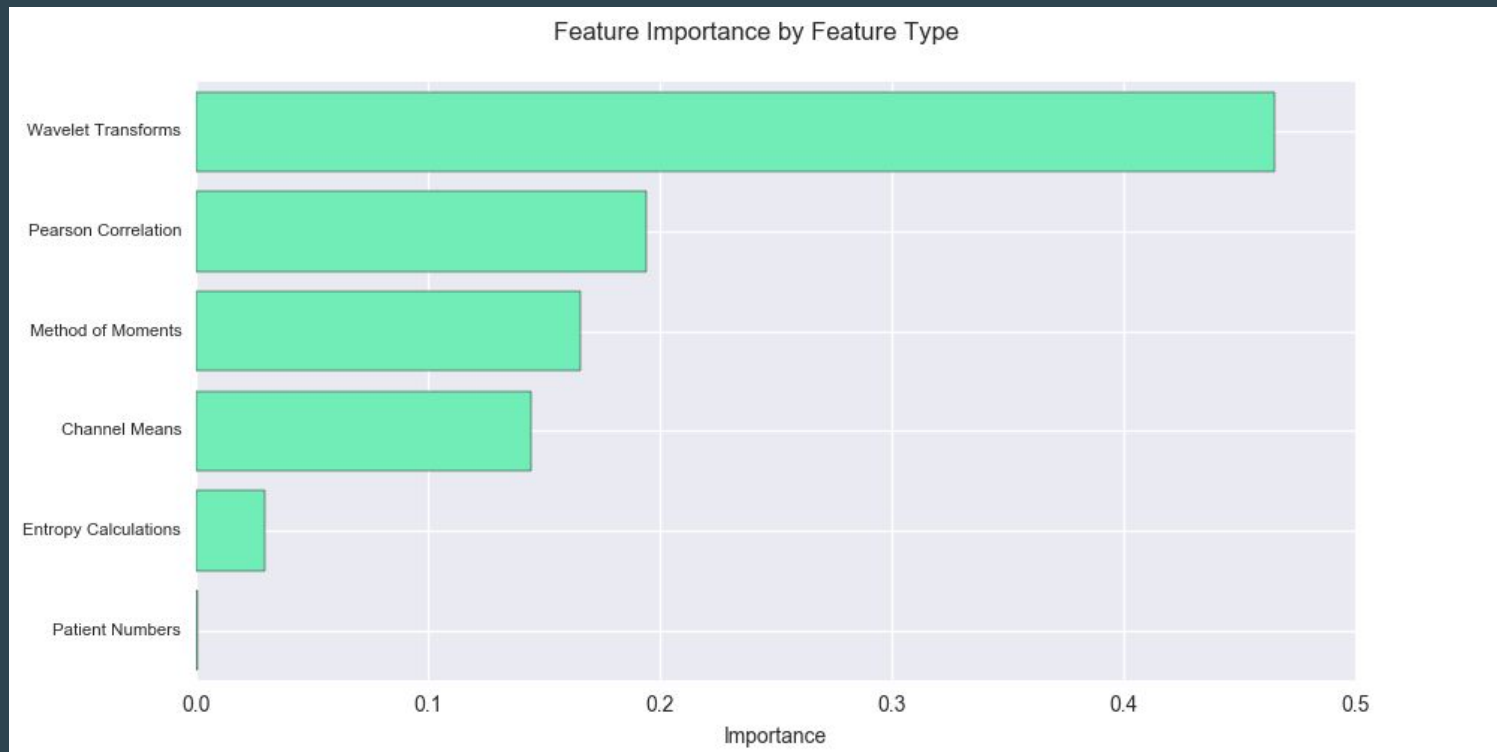
Each recording 240k x 16

40 gb total data

EC2 m4.10xlarge

One Hour Interictal (Baseline) Recording
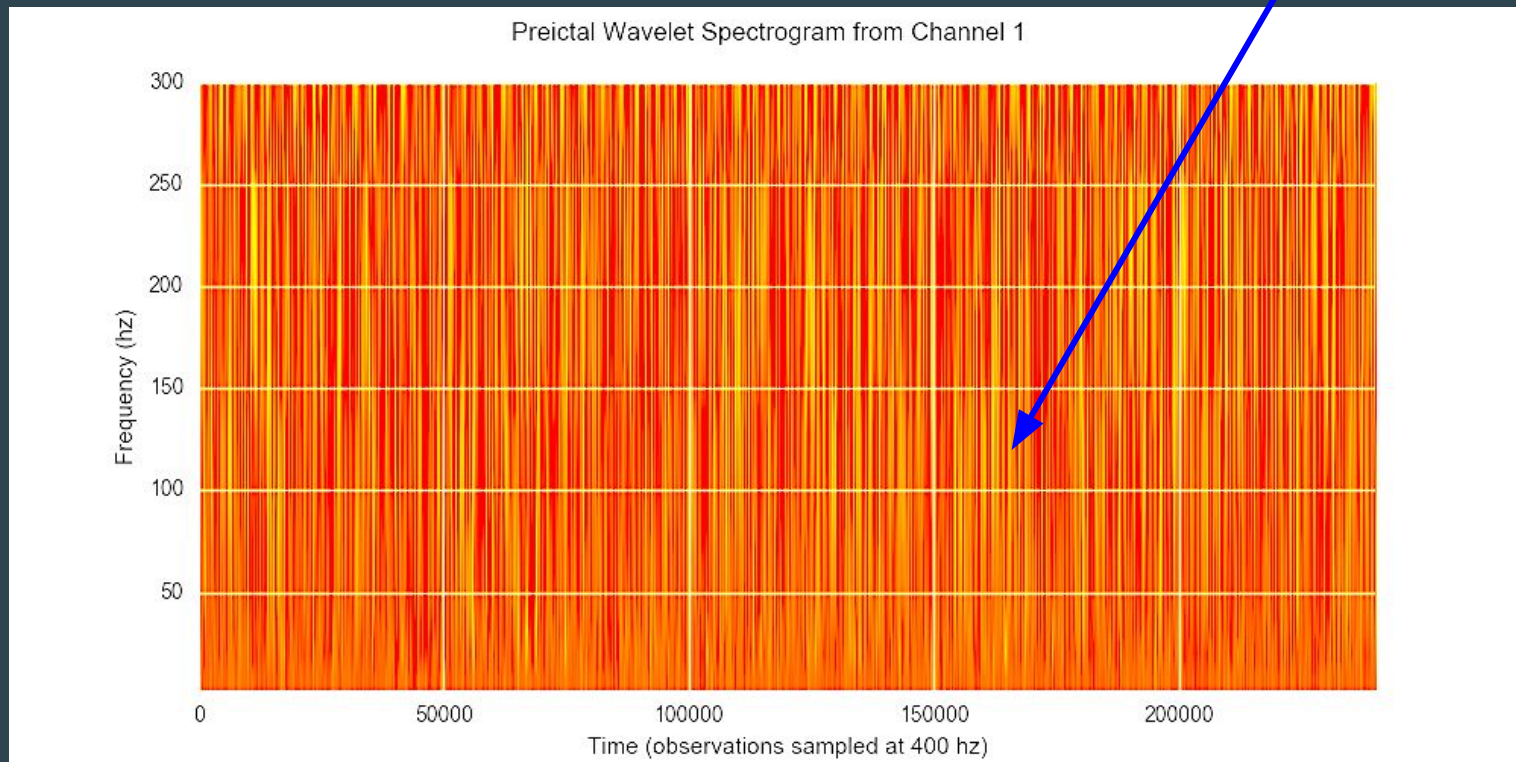
One Hour Preictal (pre-seizure) Recording

Feature Building - 819 total features
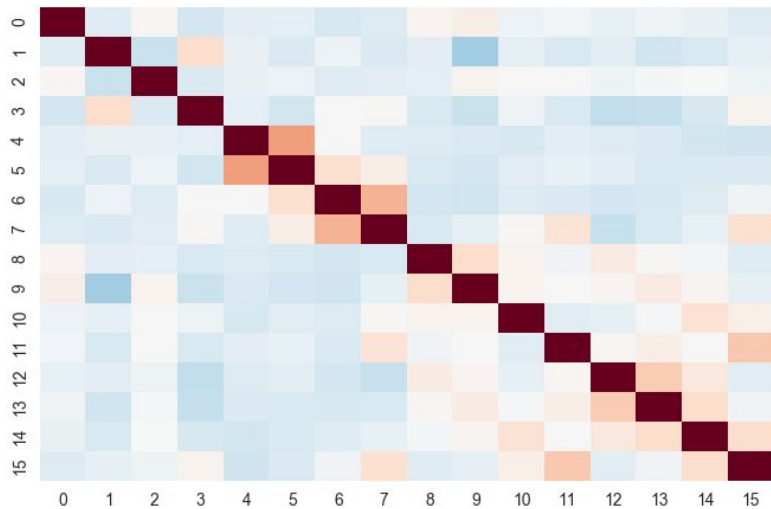

Feature Importance by Feature Type

Wavelet Transformation

Activity at 3 hz (at patient's scale)

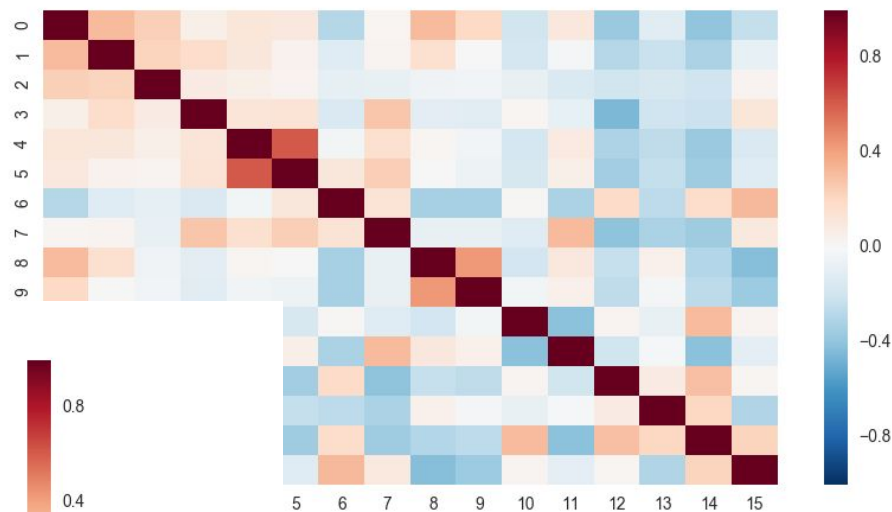Preictal Wavelet Spectrogram from Channel 1

Pearson Correlations

Interictal Channel Coorelations

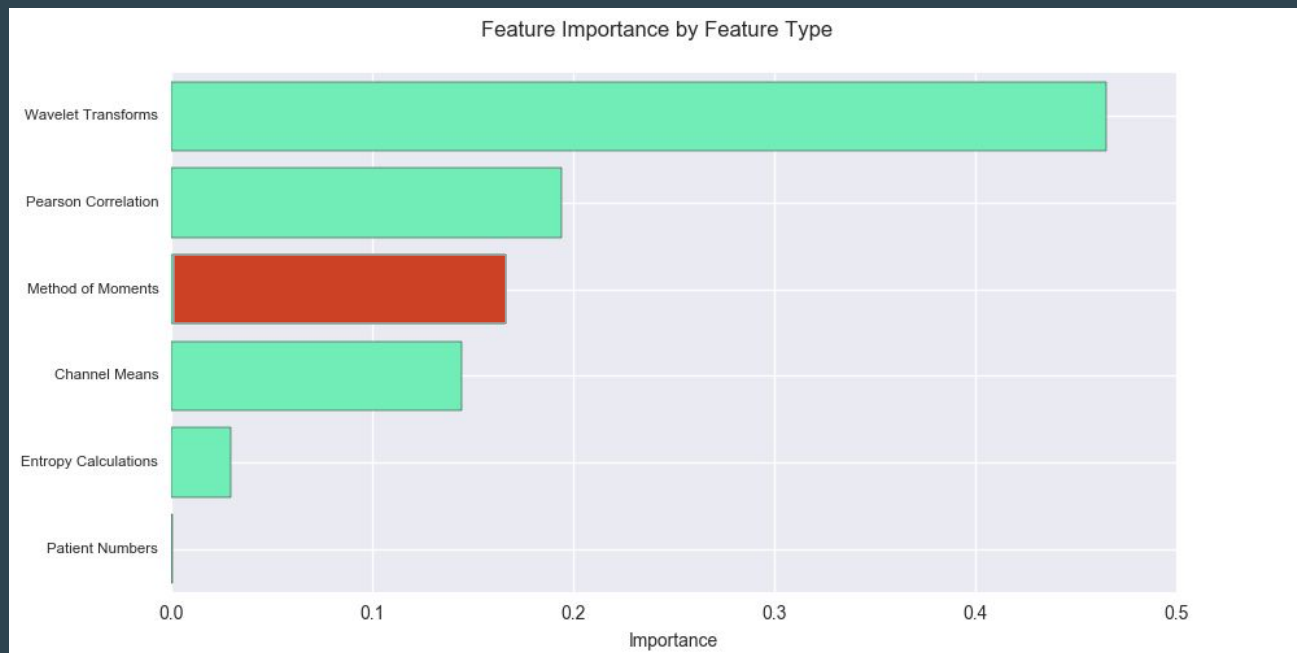Preictal Channel Coorelations

Statistical Moments

- Mean
- Variance
- Skew
- Kurtosis
- Entropy
- Min/Max
- Median

Feature Importance by Feature Type

Feature Type	Importance
Wavelet Transforms	~0.46
Pearson Correlation	~0.19
Method of Moments	~0.16
Channel Means	~0.14
Entropy Calculations	~0.03
Patient Numbers	~0.0

Final Scores

Receiver Operating Characteristic for Validation Predictions
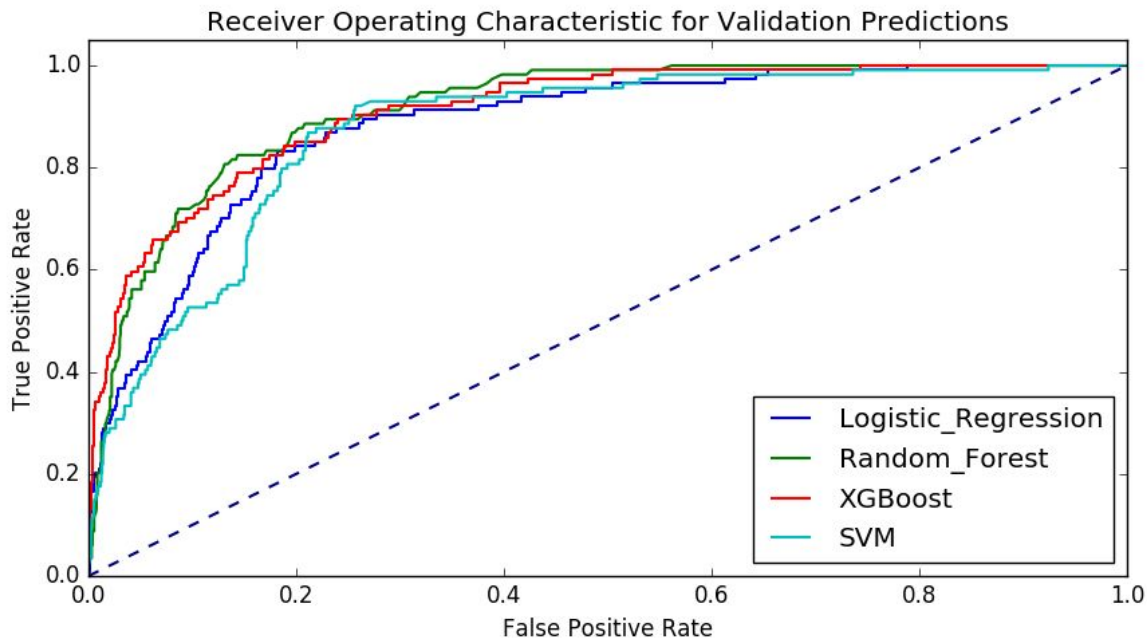
Patient	Logistic Regression	Random Forest	XGBoost	SVM
Combined	0.81 / 0.88	0.88 / 0.91	0.91	0.84 / 0.87

conorbmurphy@gmail.com   5-fold cross validation / score on validation set - ROC AUC   github.com/conorbmurphy/Predicting-Seizures

Next Steps

- Understanding feature interaction
- Bayesian live model
- Side data
  - Metric of severity of patient's epilepsy
  - Calibration of the system to attain better baseline
  - Activity data to address what's influencing a given brain state
- Additional wavelets: Morlet and 'spike-and-wave'
- Convolutional Neural Nets

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Thank you!

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github.com/conorbmurphy/Predicting-Seizures

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