UT SOUTHWESTERN
MEDICAL CENTER

A DEEP LEARNING APPROACH TO PREDICT SUCCESSFUL VS UNSUCCESSFUL MEMORY

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WOULDN'T YOU RATHER FOCUS ON INSIGHTS FROM YOUR DATA

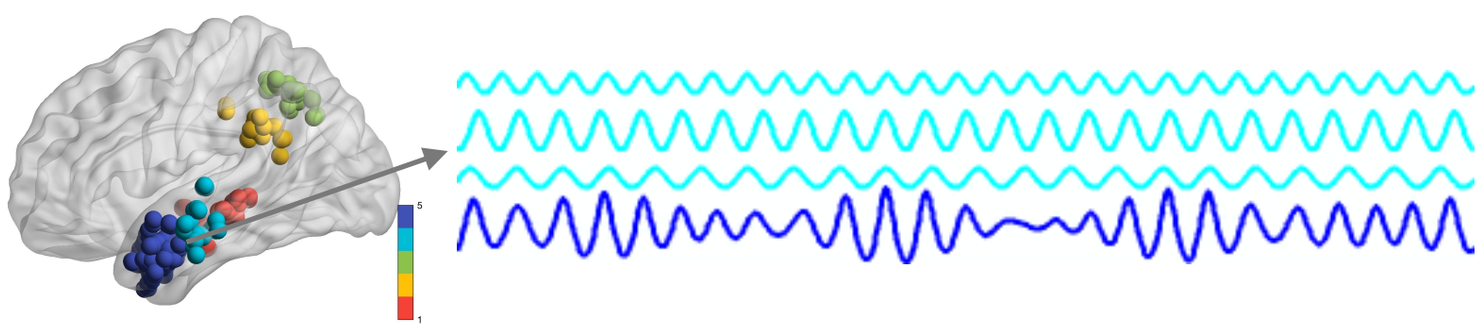
INSTEAD OF

BUILDING AN INFRASTRUCTURE AROUND IT ?

BRAIN–COMPUTER INTERFACE (BCI) TO ENHANCE MEMORY VIA NEURON–STIMULATION

Top-down approach

Record brain activity during memory paradigm



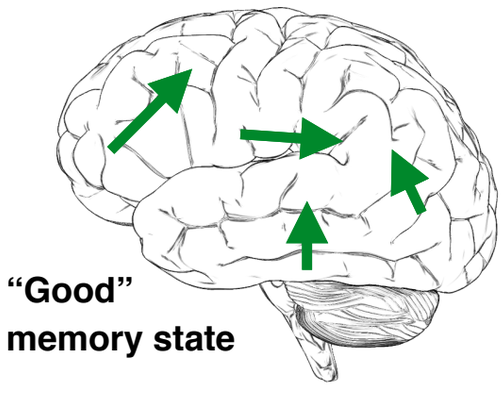
Create a classifier that represents brain activity at all regions when “good” memories are formed

offline

Repeat memory paradigm and deliver electrical stimulation when the brain is not in a “good” encoding state

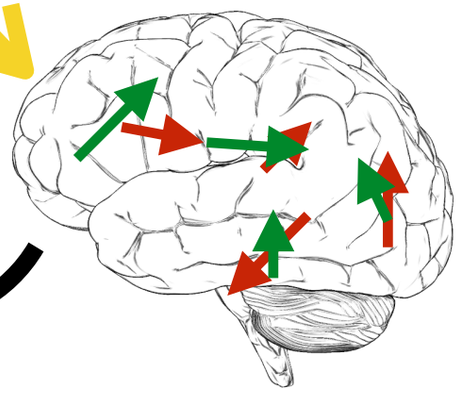
closed-loop (using BCI)

Identify optimal stimulation site and parameters to enhance the classifier estimate

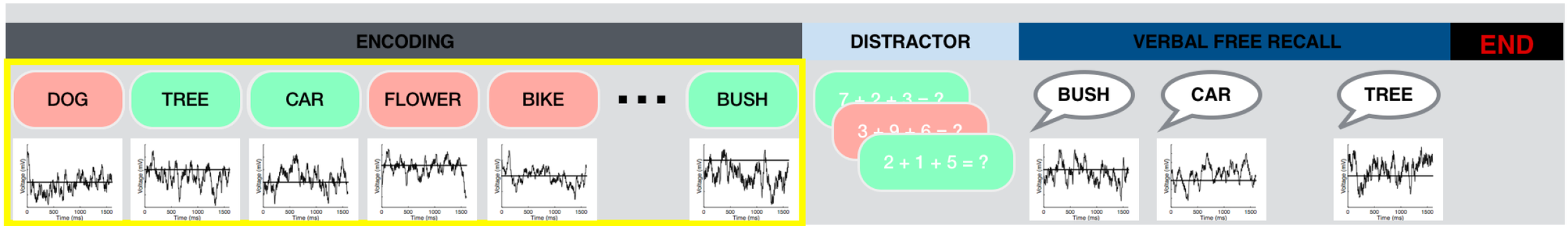


STIMULATE

when bad” memory state



EXPERIMENTAL PARADIGM



DATA: 100 patients

200 words : Recall

1000 words : Non Recall

PREDICT CLASSES

R : Recall Successful - 1

N : Non Recall Unsuccessful - 0

Problem

Class Imbalance (1:5)

SMOTE Algorithm

Solution

Class balance (1:1)

PROJECT ROADMAP

Data Preparation

Data Preprocessing (Artifact Removal)

Feature Extraction (Power, Phase)

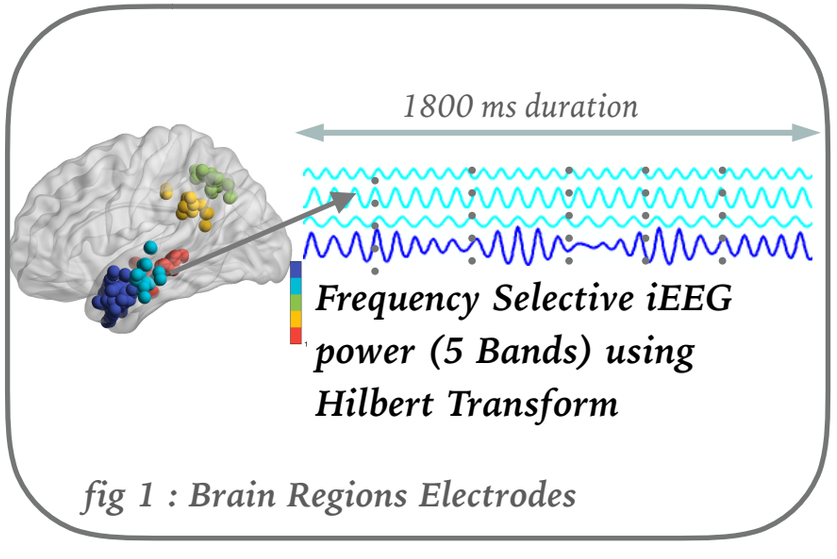
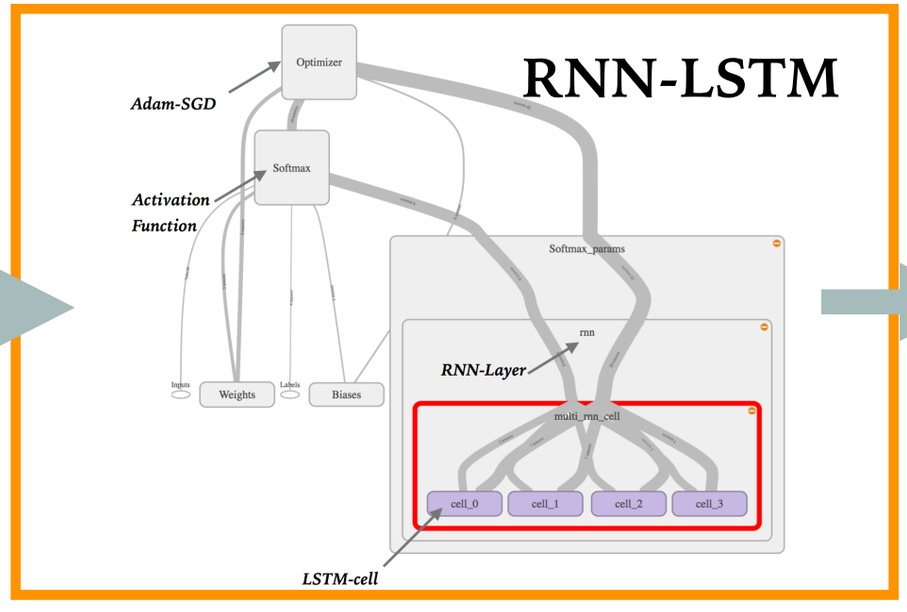


fig 1 : Brain Regions Electrodes

Classifier Model

RNN-LSTM

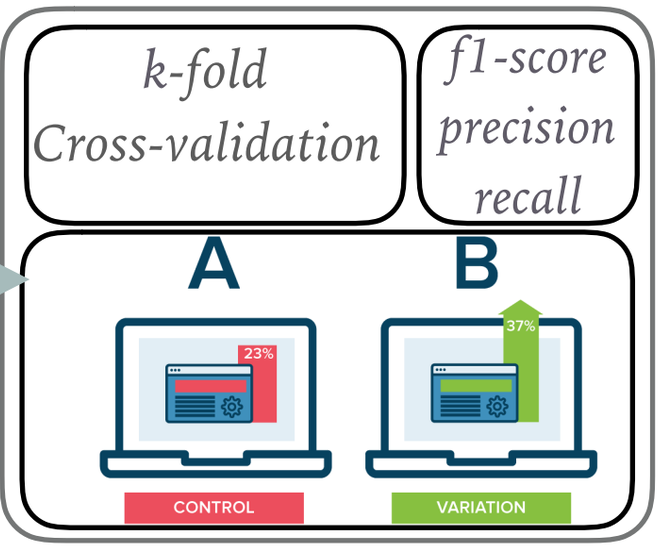
Regularization (Drop-out + l2-Regularize)



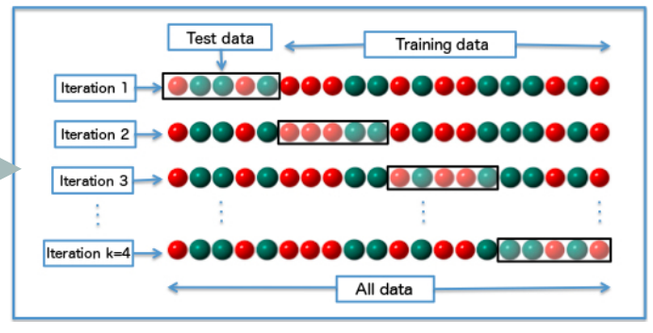
Testing

k-fold Cross-validation

f1-score precision recall



k-fold : Cross-validation



DEEP RECURRENT NEURAL NETWORK [LSTM] MODEL

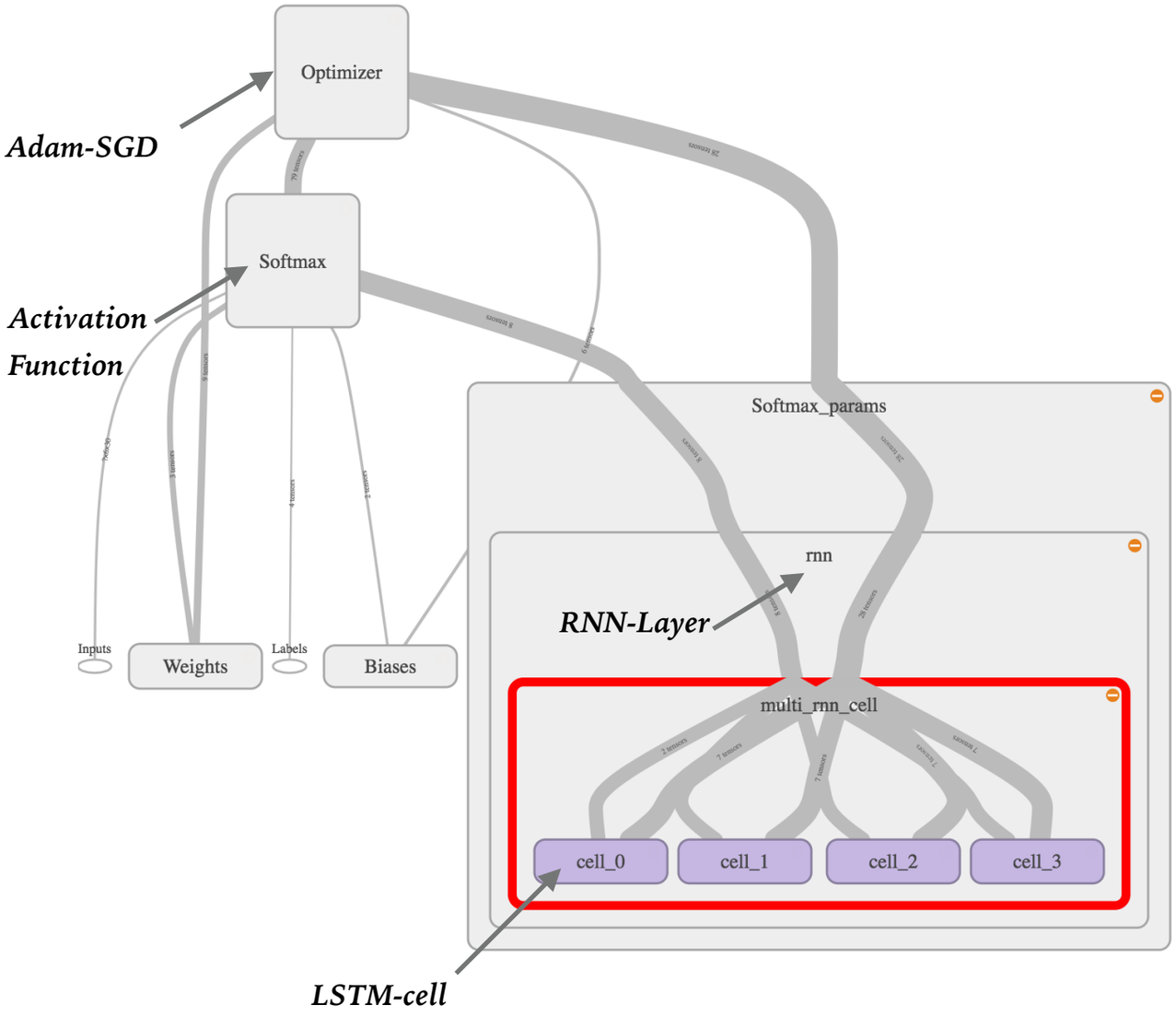


fig 2 : Rnn-LSTM model using Tensorflow

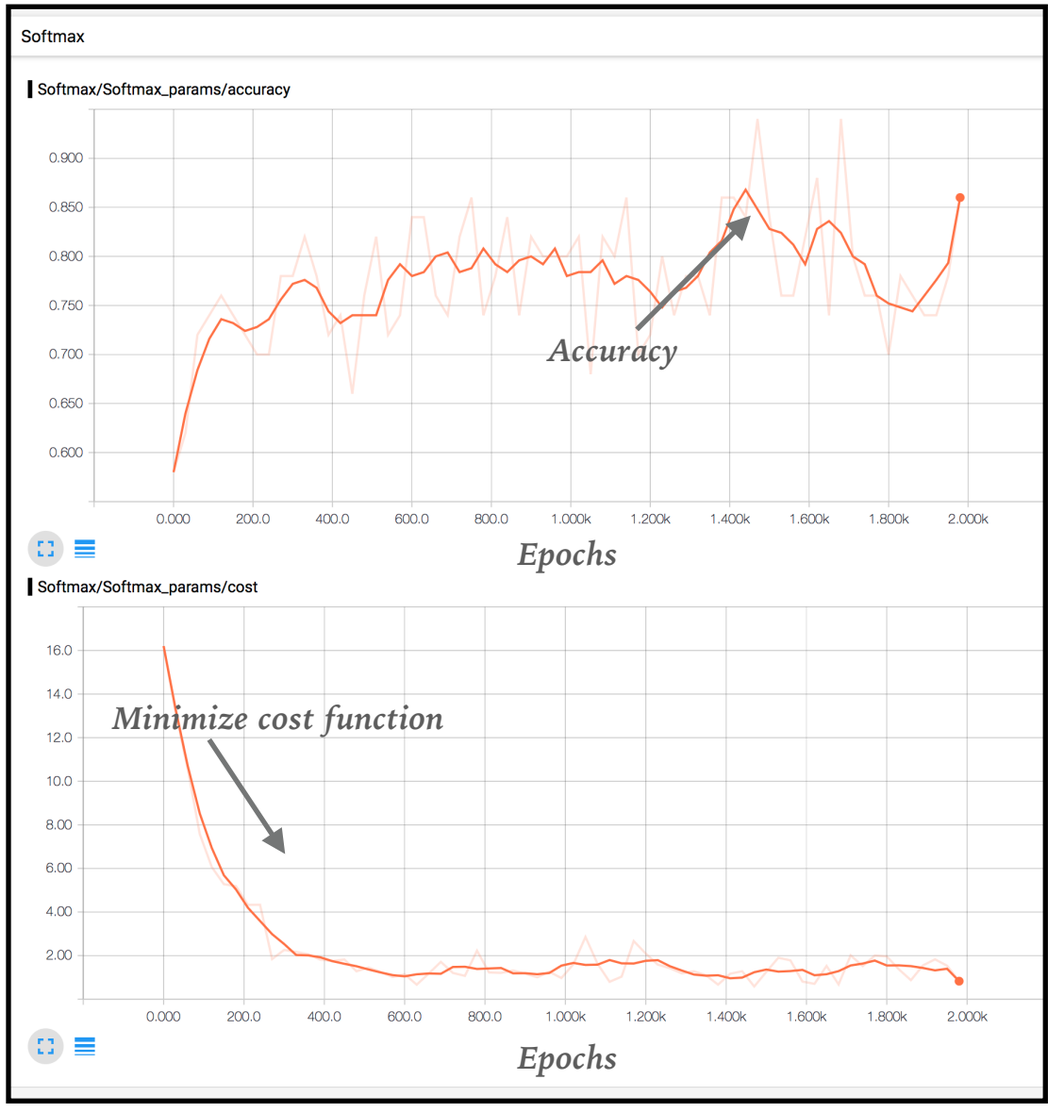


fig 3 :Accuracy and Cost during training the model

RESULTS

Rnn-LSTM vs Logistic Regression

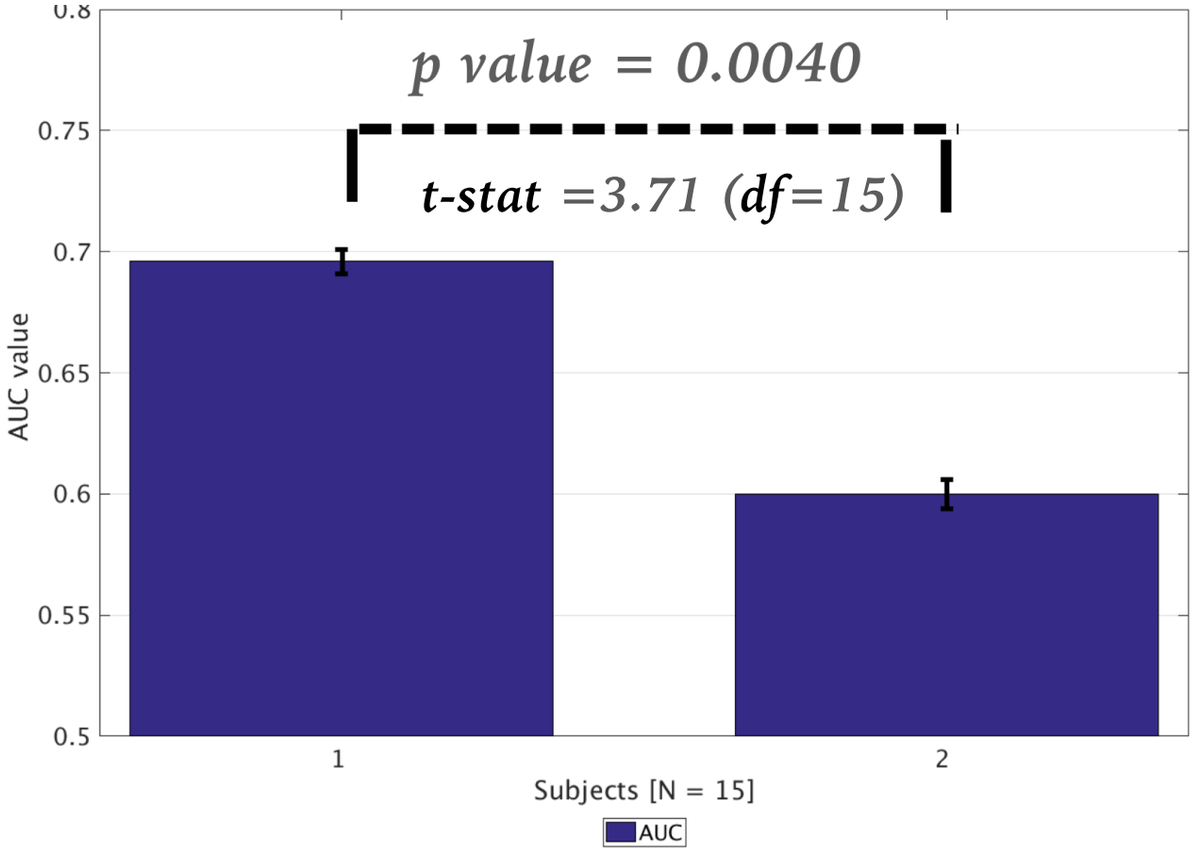


fig 5a : Classifier Comparison : RNN-LSTM vs Logistic Regression

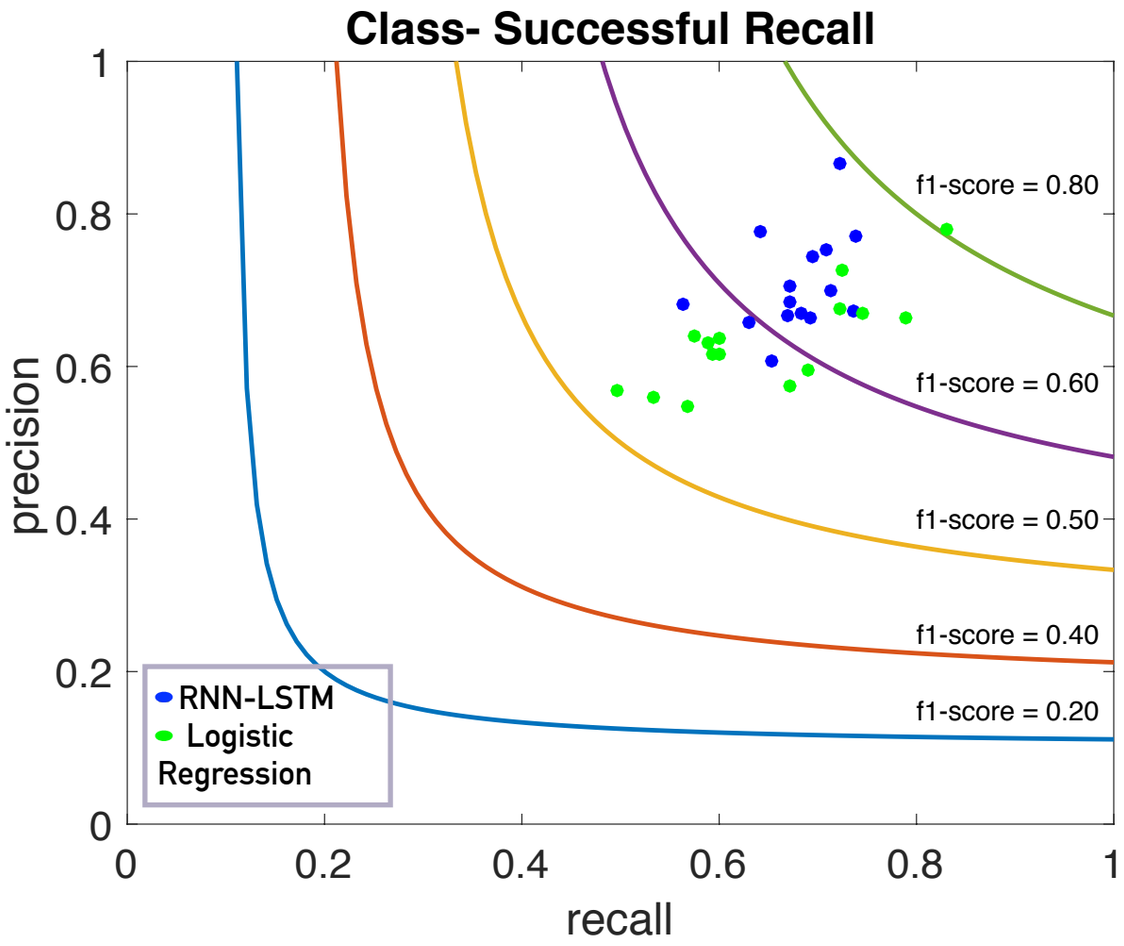


fig 5b : f-score Isomap : RNN-LSTM vs Logistic Regression

FUTURE SCOPE

- Design a fully automated BCI
- Identify good brain sites and parameters for neuron-stimulation
- Embed the classifier model into the BCI product release

SUMMARY AND CONCLUSIONS

- The project showcases a **deep recurrent neural network** based approach to classify successful and unsuccessful memory in epileptic patients
- **L2-regularization** and **Dropout regularization** are used to make the model robust to over-fitting.
- The proposed algorithm achieves a better **f1-score** and a higher **AUC** than logistic regression and showed a significant ($\boldsymbol{pvalue = 0.004}$) improvement in the classifier prediction

“

If you torture your data enough,
It will Confess…!

-Ronald Coase