

MIDTERM RESEARCH REPORT

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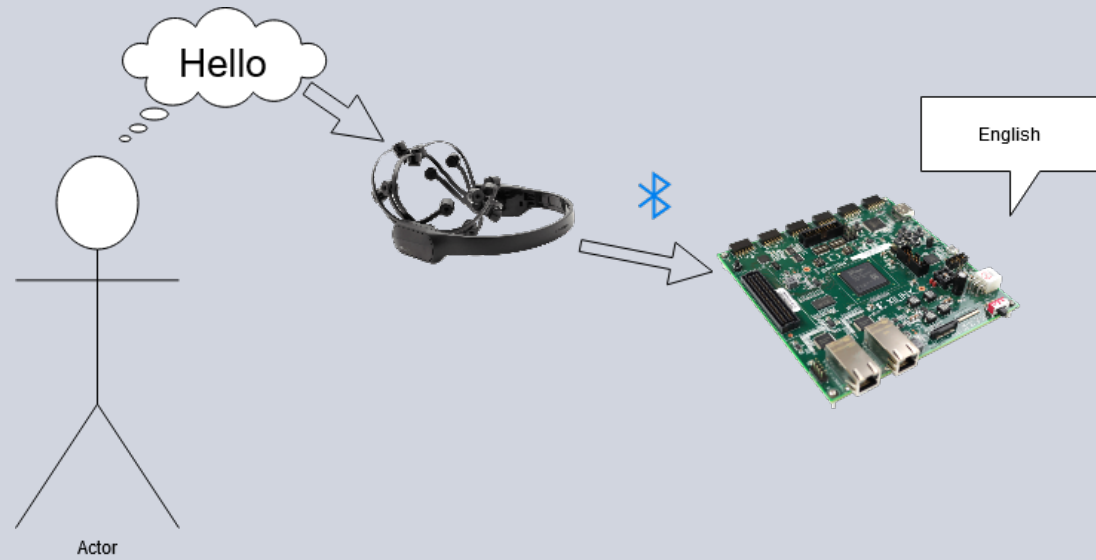


GOALS

- Brainwave Language Prediction
 - Differentiate between imagined English and Japanese
- Real-time using ~~Echo State Network~~

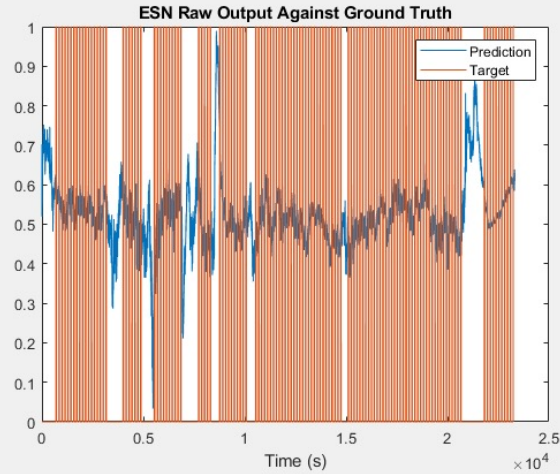
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Neural Network on FPGA

- Preprocess the incoming Bluetooth data
- Calculate output over a given window using a neural network

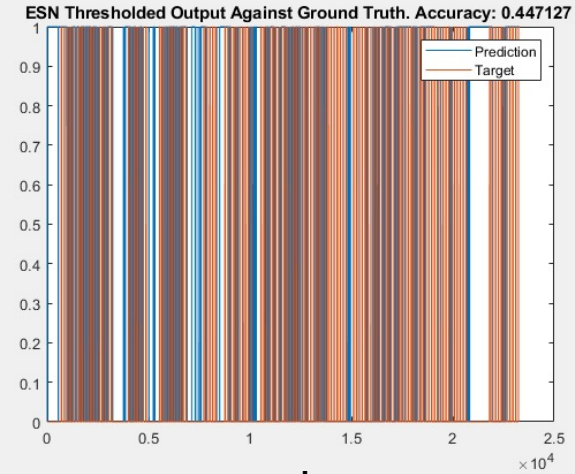


PRELIMINARY TESTING

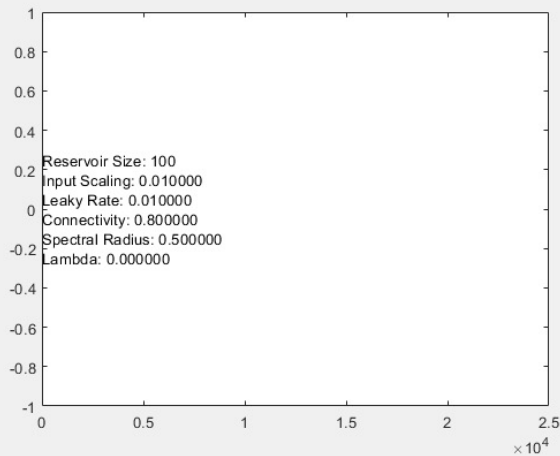
- ESN
 - Unsatisfactory results
 - Difficult to differentiate between classes with high changing frequency (a.)
 - Difficulty finding reasonable threshold outputs (b.)
 - Many various hyperparameters tested (c.)
 - Raw data not inherently easily differentiable (d.)



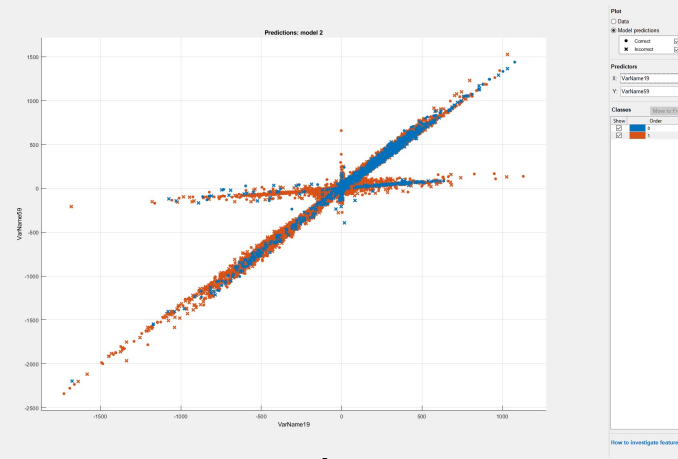
a.



b.



c.



d.

SWITCH TO WINDOW-BASED

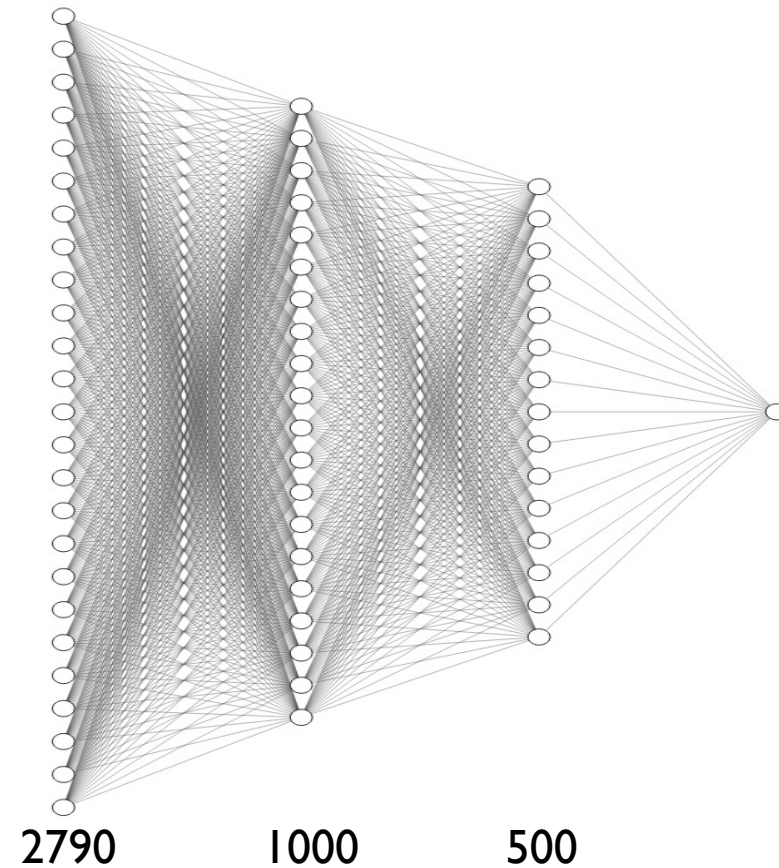
- Following results achieved by Zhao et al. [1]
- Preprocess data by extracting features over a window
 - Mean
 - Median
 - Min
 - Max
 - Standard Deviation
 - Variance
 - Kurtosis
 - Skewness
 - Etc.

1	☆ Tree	Accuracy: 70.7%
	Last change: Fine Tree	2790/2790 features
2	☆ SVM	Accuracy: 94.3%
	Last change: Linear SVM	2790/2790 features
3	☆ SVM	Accuracy: 91.0%
	Last change: Quadratic SVM	2790/2790 features
4	☆ SVM	Accuracy: 87.4%
	Last change: Cubic SVM	2790/2790 features

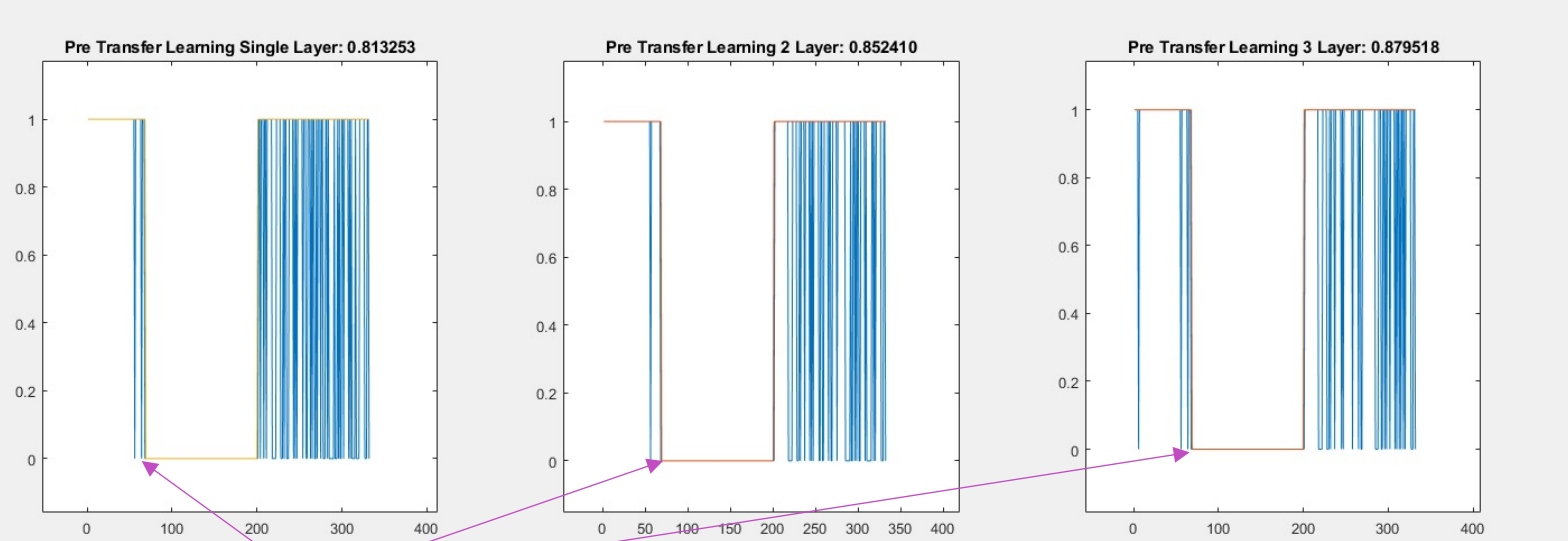
45 features x 62 channels = 2790 input features

PRELIMINARY NEURAL NETWORK TESTING

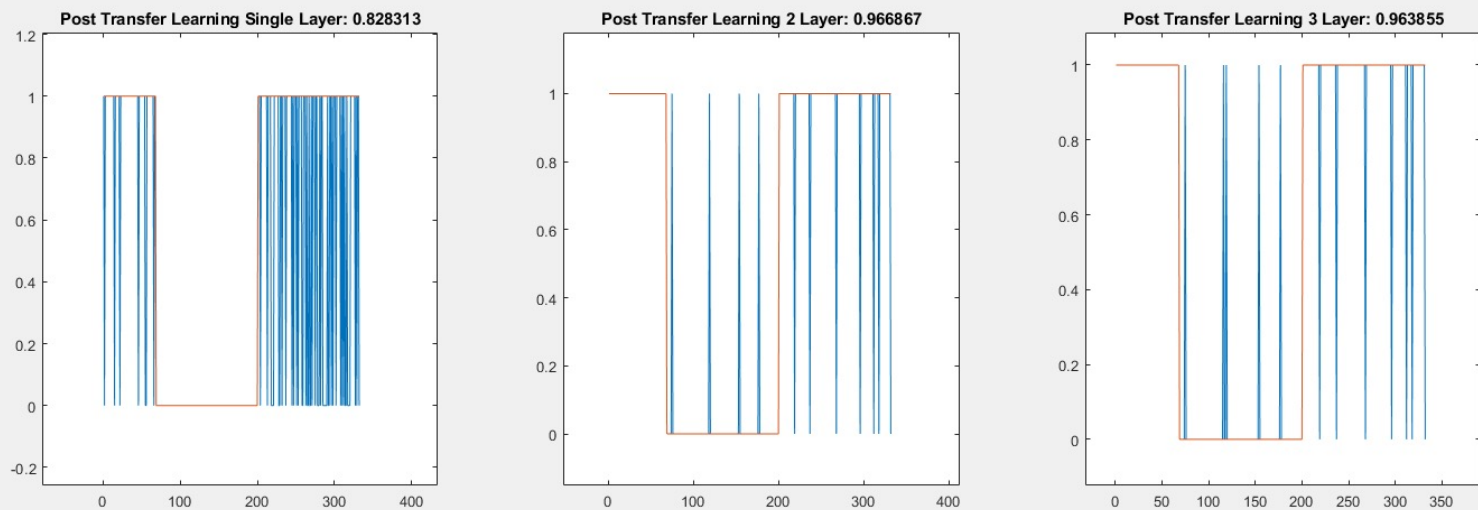
- NN Properties:
 - Normalizing input layer
 - Fully-connected internal layer(s)
 - Softmax activation layer(s)
 - Classification layer



PRELIMINARY NN TESTING

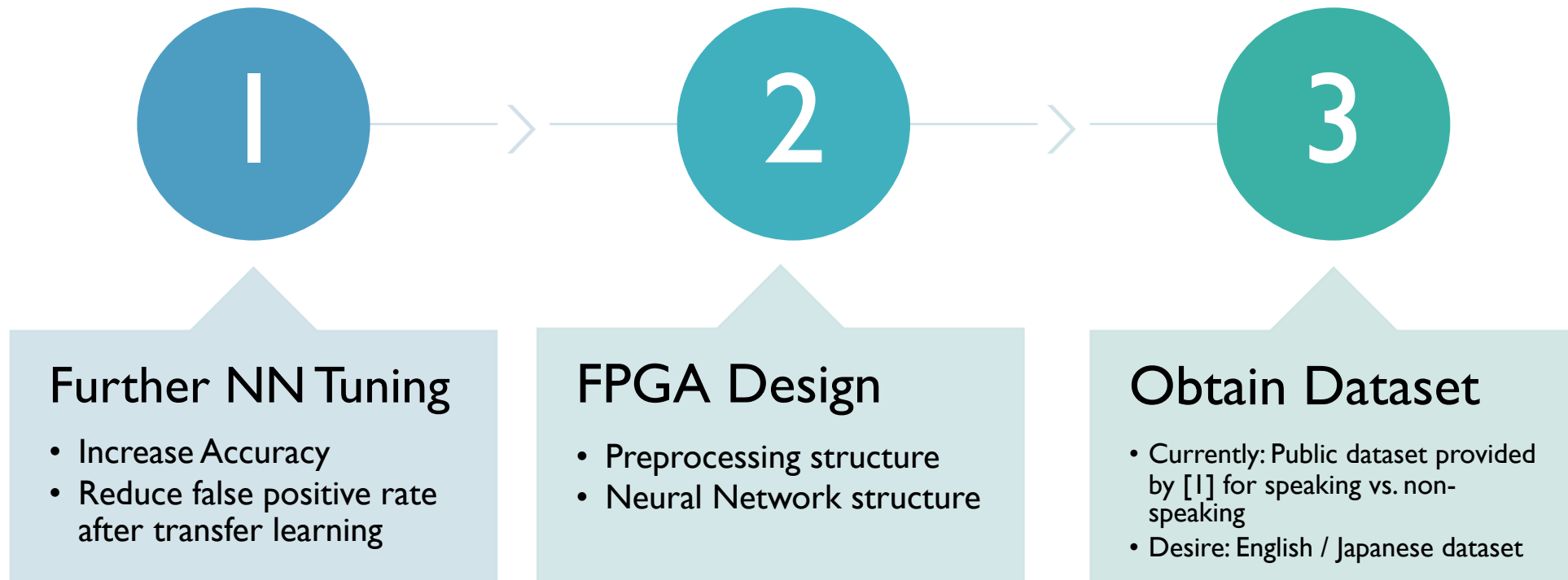


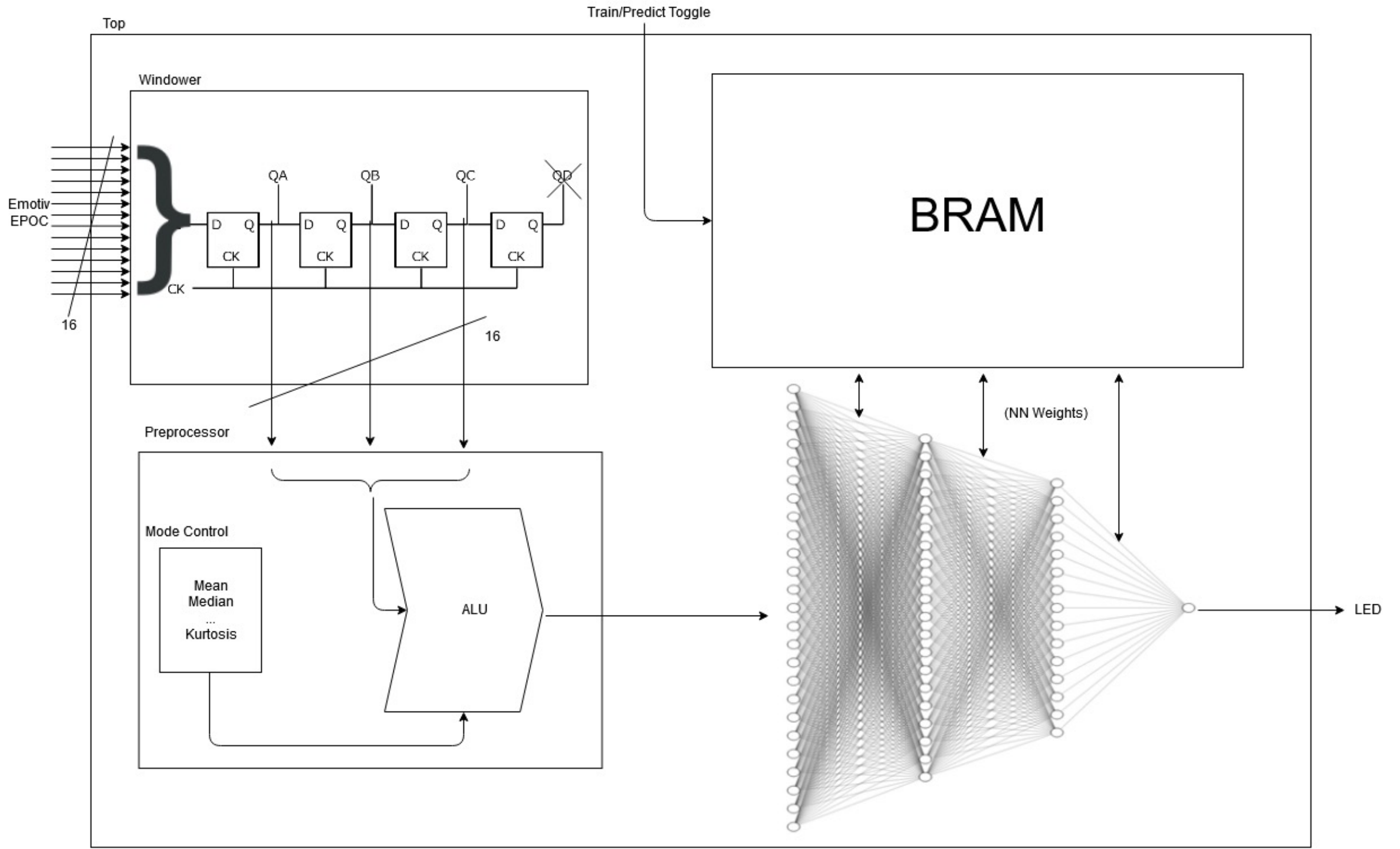
From 75 onward, a completely new person is trained upon



Here they are now trained upon with transfer learning

NEXT STEPS





REFERENCES

- [1] Shunan Zhao and Frank Rudzicz (2015) Classifying phonological categories in imagined and articulated speech. *In Proceedings of ICASSP 2015*, Brisbane Australia.