# REU Project: Quantum Machine Learning for Dysarthric Speech Detection

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# Agenda

- Statement of Problem
- Previous related research
- Proposed solution
- Preprocessing
- Spectrogram Comparison
- Results
- Conclusions/ Next steps
- References (and Questions)

# Problem

- Chronic Traumatic Encephalopathy (CTE) is an acquired brain injury that triggers violent behavior
- Currently, CTE can only be diagnosed post-mortem
- Individuals suffering from CTE and their loved ones would greatly benefit from treatment
- CTE is most common in physical contact athletes and military veterans
- Question: is it possible to identify CTE pre-mortem using machine learning? How does Quantum Machine Learning compare to the classical model?

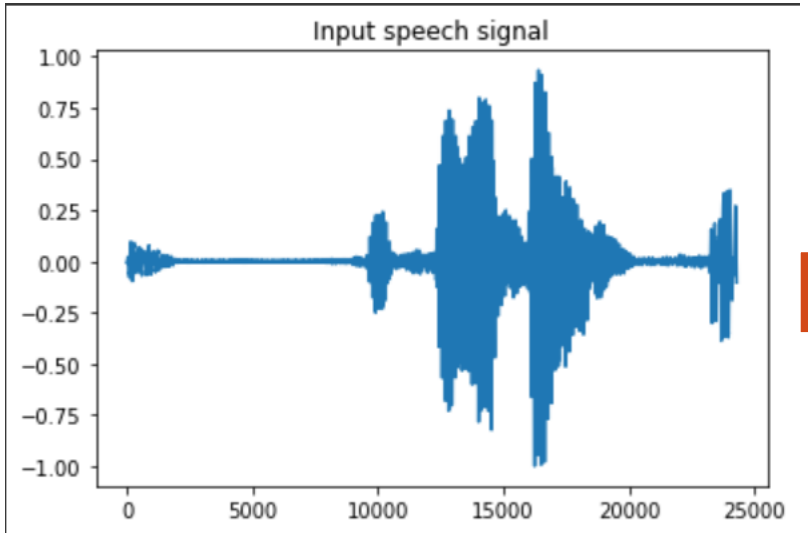
# Proposed solution (to identifying CTE pre-mortem)

In a sample of 66 CTE brains (identified post-mortem), 64% were from individuals who had acquired language impairments (Stern et al., 2013)

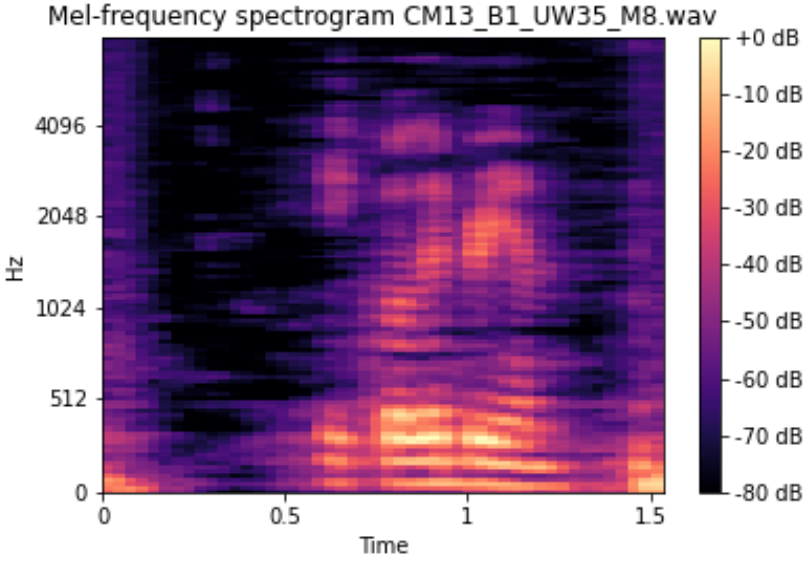
- Using audio samples of 26 speakers, teach machine to discriminate between control and dysarthric speech, as a proof of concept for identifying CTE through speech
- Fine-tune a CNN (PyTorch Squeezenet) to identify dysarthric speech samples of the word “equilibrium”
- Create a Quantum Binary Classifier and compare results with the classical model

Database: UASpeech (Hasegawa-Johnson UIUC)

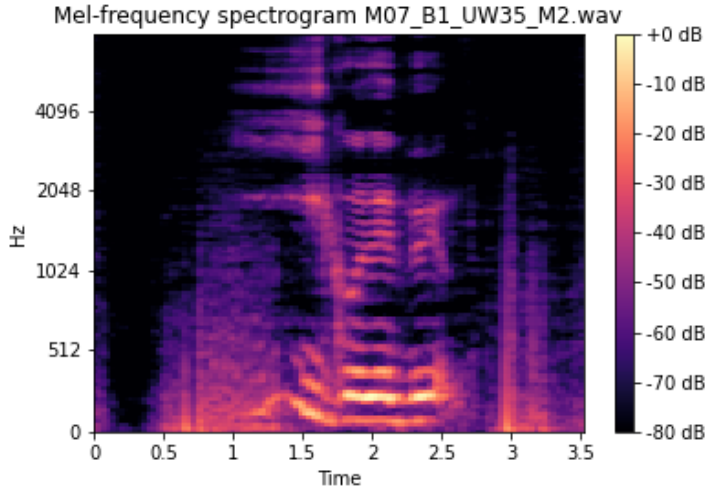
# Preprocessing



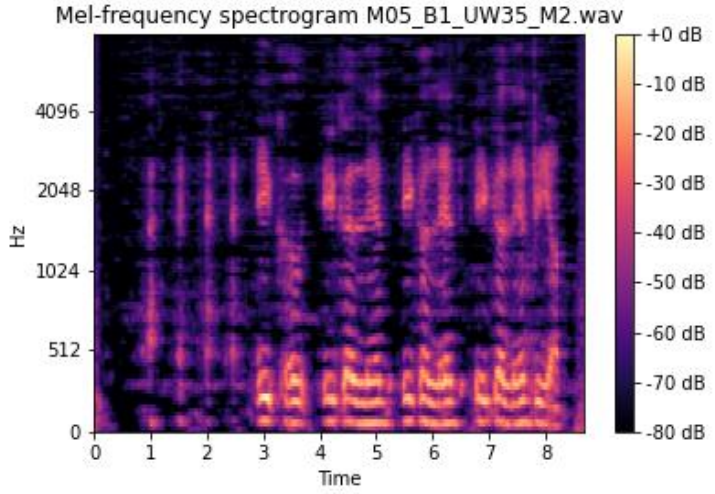

“Equilibrium”



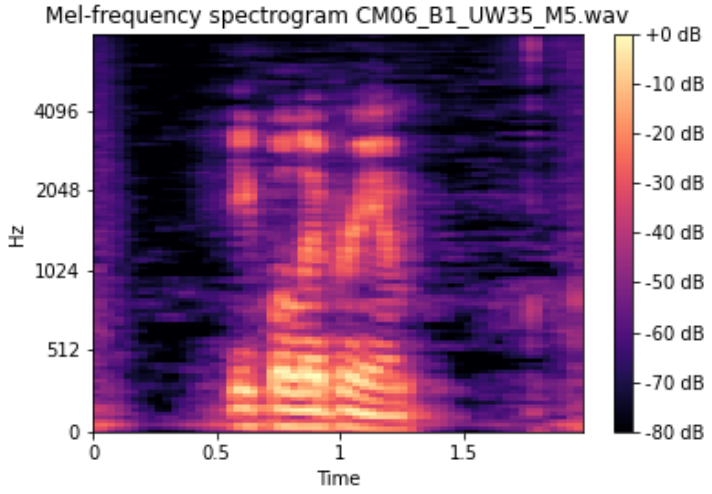
# Spectrogram Comparison of Dysarthric vs Control participants speaking the word “Equilibrium”




Dysarthric Male Voice

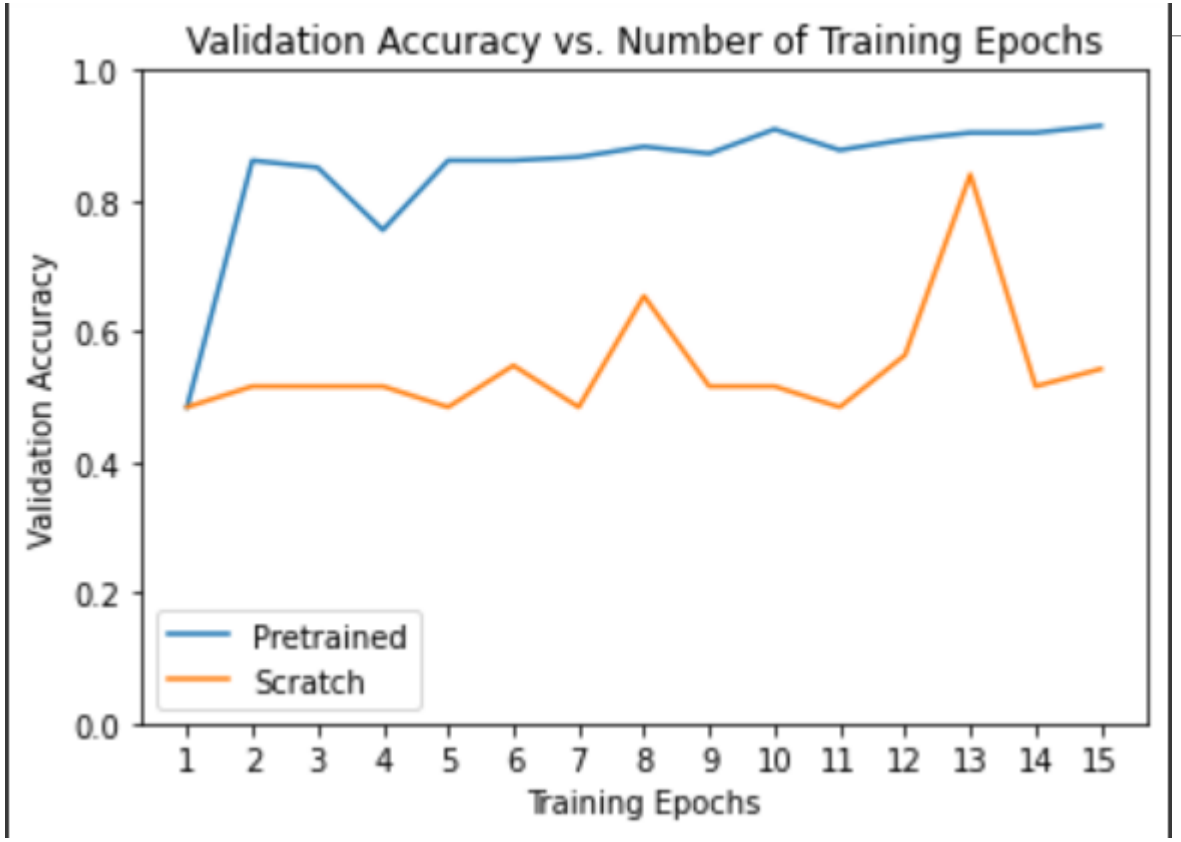



Dysarthric Male Voice




Healthy Control Male Voice

# Results




```
Epoch 11/14
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train Loss: 0.2423 Acc: 0.9149
val Loss: 0.2472 Acc: 0.8936

Epoch 12/14
----------
train Loss: 0.3762 Acc: 0.8298
val Loss: 0.2529 Acc: 0.9043

Epoch 13/14
----------
train Loss: 0.3158 Acc: 0.8723
val Loss: 0.2347 Acc: 0.9043

Epoch 14/14
----------
train Loss: 0.2761 Acc: 0.8777
val Loss: 0.2217 Acc: 0.9149
```

**Best val Acc: 0.914894 Best loss: 0.2217**

# Conclusion/Next steps

## Conclusion

- Proof of concept is successful, with a val accuracy of ~91.5%
- Segmentation code was unsuccessful
- Time Constraint: No Quantum comparison

## Next Steps

- Test larger vocabulary
- Create operating segmentation code
- Test speech samples of individuals diagnosed with CTE
- Build quantum model for comparison

# References


References

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