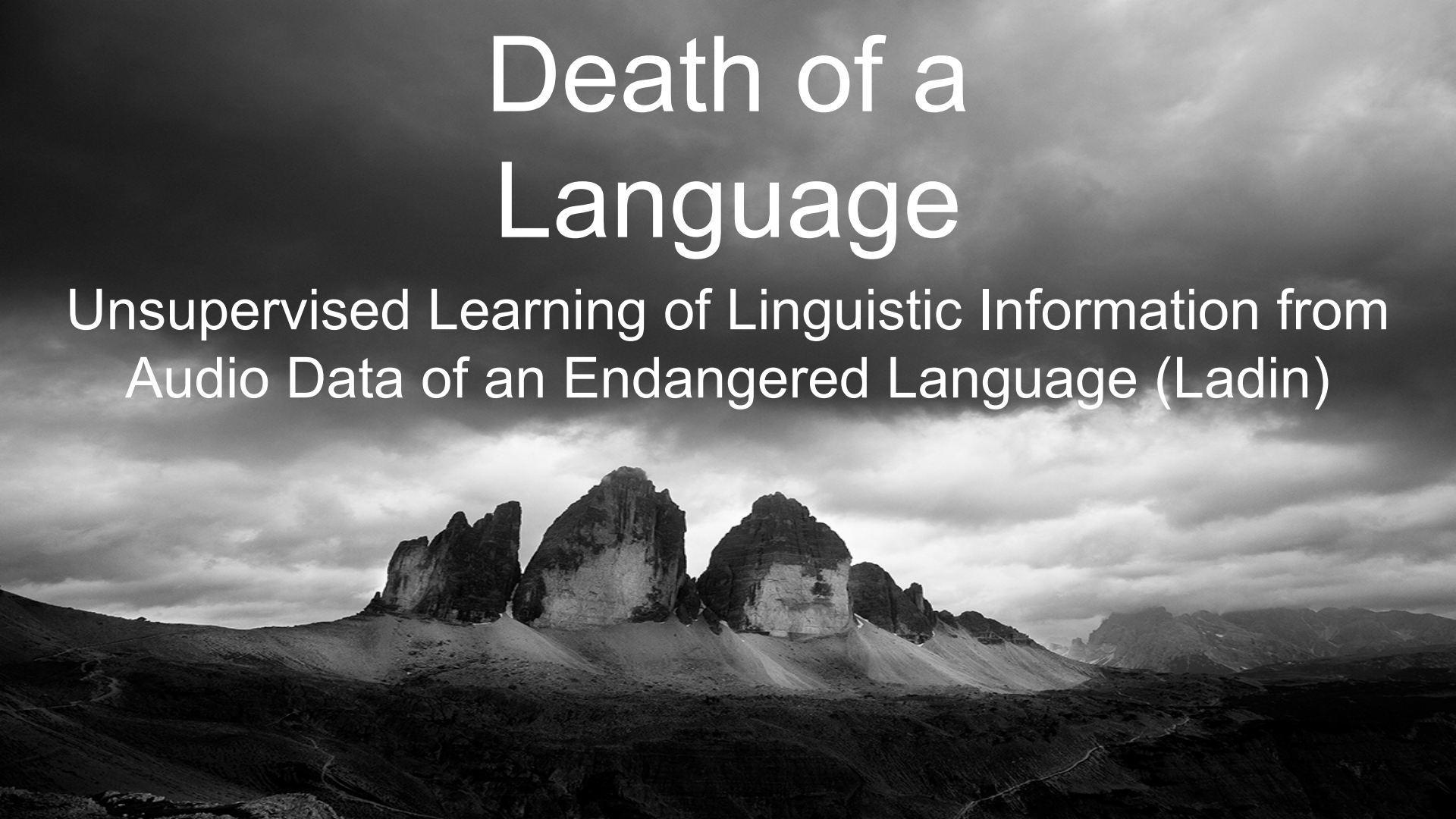
Death of a Language

Unsupervised Learning of Linguistic Information from Audio Data of an Endangered Language (Ladin)

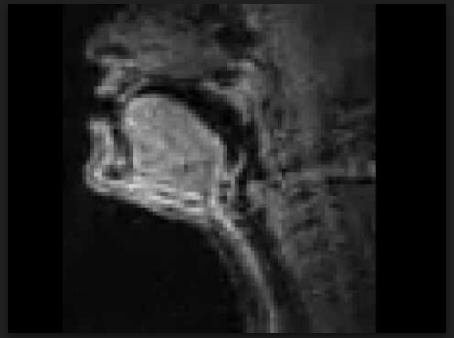


Motivations

- 80% of the world's 6,500 languages will vanish within a century
- Need to preserve these languages for human culture
- We aim to create a (possibly) unsupervised approach to determine phonemes of a language given an audio file

Our Approach

- Creation of sound in the vocal tract can be represented with dynamical systems.
  - Dynamical systems can be used to represent many natural phenomena (neuron activity, chemical reactions, biomechanics)
- Using deep learning, we are trying to approximate this dynamical system to classify different sounds we can produce (phonemes)



Our Approach

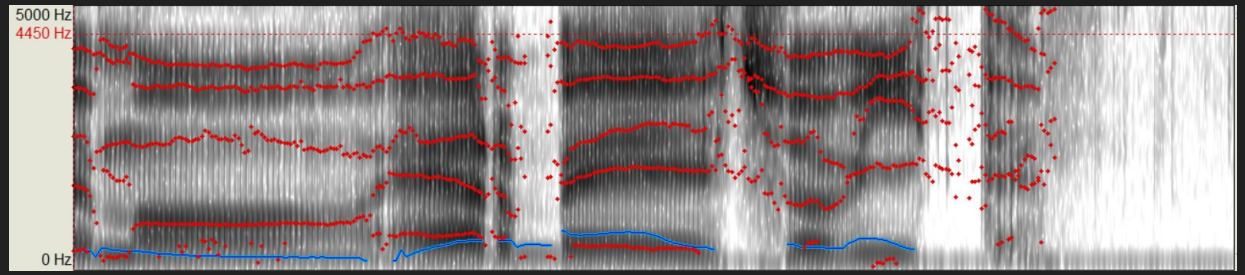
~20,000

Native speakers worldwide

~ 3.5 Hours of Audio Data

Spectrogram

- Common step for audio processing
- Utilizes the Fourier Transform
  - Takes waveform as input, transforms this into a combination of smaller waveforms with varying coefficients
- We can then plot the value of these coefficients over time to create a spectrogram
  - Darker color = higher value for each coefficient on Y axis



Hillenbrand Dataset

- A dataset of American English Vowels
- Used to train an LSTM model that predicts vowel class and formants from spectrogram

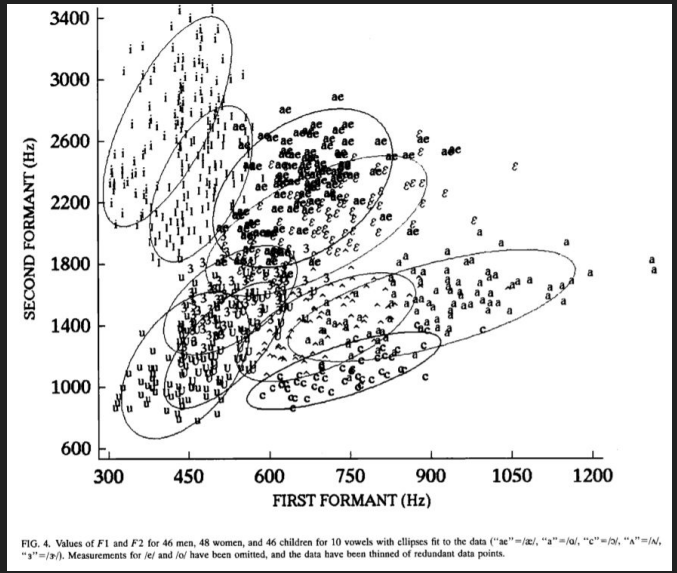
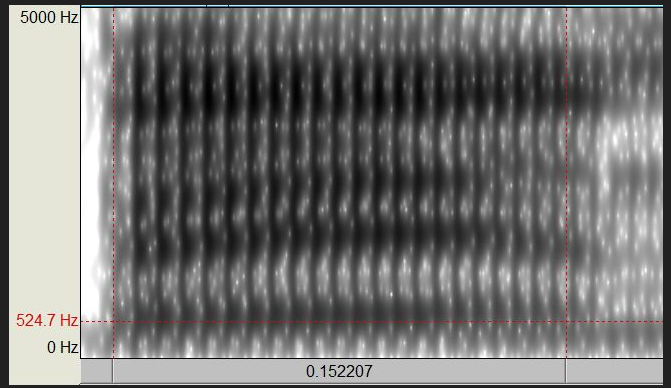
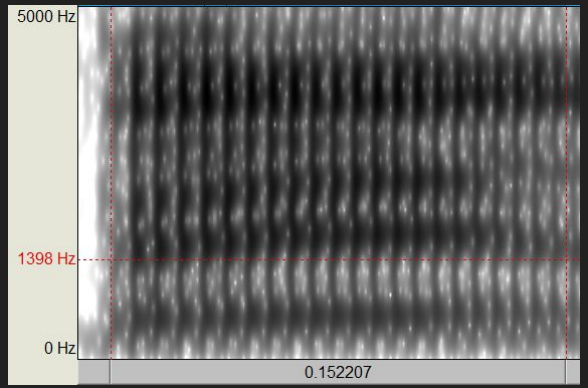


FIG. 4. Values of $F1$ and $F2$ for 46 men, 48 women, and 46 children for 10 vowels with ellipses fit to the data ("ae"=/æ/, "a"=/ɑ/, "c"=/ɔ/, "A"=/ʌ/, "3"=/ɝ/). Measurements for /e/ and /o/ have been omitted, and the data have been thinned of redundant data points.

Results of the dataset

- Simple phoneme boundary detection algorithm
- Vowel classification
  - Not suitable for Ladin due to differences in vowel quality and inventory
  - Tendency to assign front vowels
- Formant classification
  - Quantifies vowels by identifying first and second formants





Future Steps

- Apply similar methods to consonants
- Subcategorize consonants
- More robust phoneme boundary detection