

North Atlantic Right Whale Detection Through Hydrophone Recordings



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Springboard Data Science Capstone Project
July 2021

Thanks to Springboard Mentor: Branko Kovac

Project Statement

The purpose of this project was to be able to classify hydrophone clips as either containing a North Atlantic right whale upcall or not.



Who Cares?

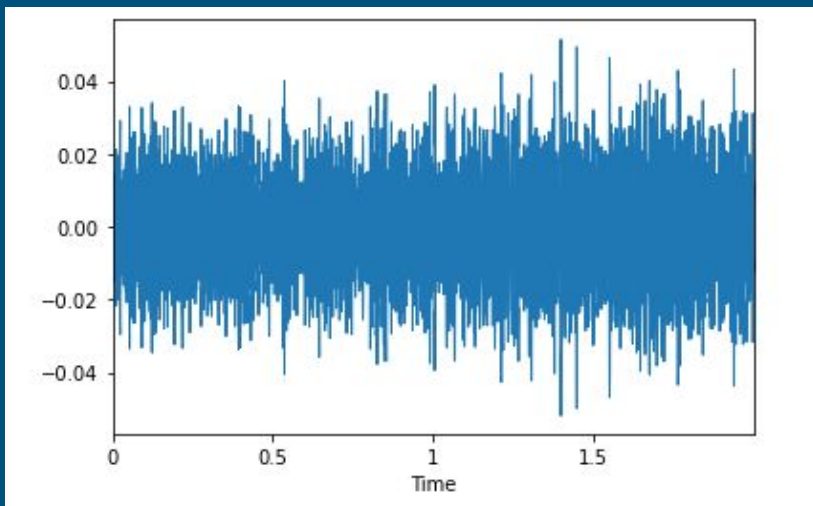
- NOAA
 - Whale Conservation
 - Ship Routing
- Businesses and organizations involved with North Atlantic oceanic travel

Data Information

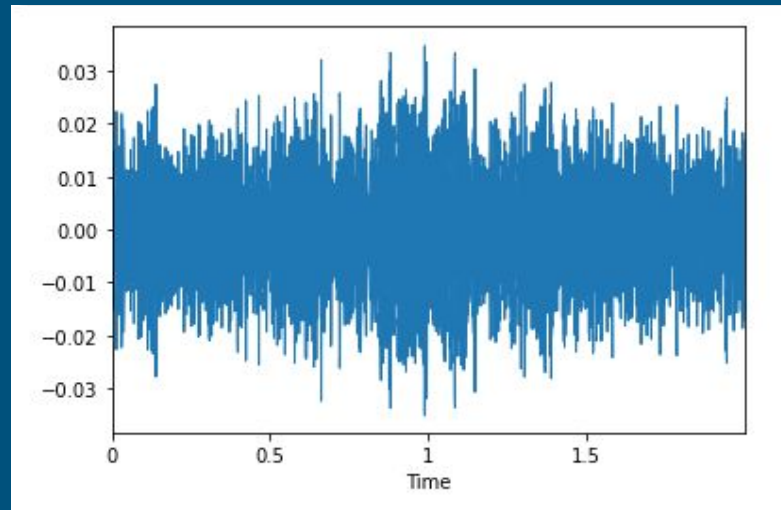
- Original: Real-Time Monitoring Systems for Detecting North Atlantic Right Whales
- Processed into clips and labels by Marinexplore and Cornell University
- Availability: <https://www.kaggle.com/c/whale-detection-challenge/data>

Audio Features: Wave Plot

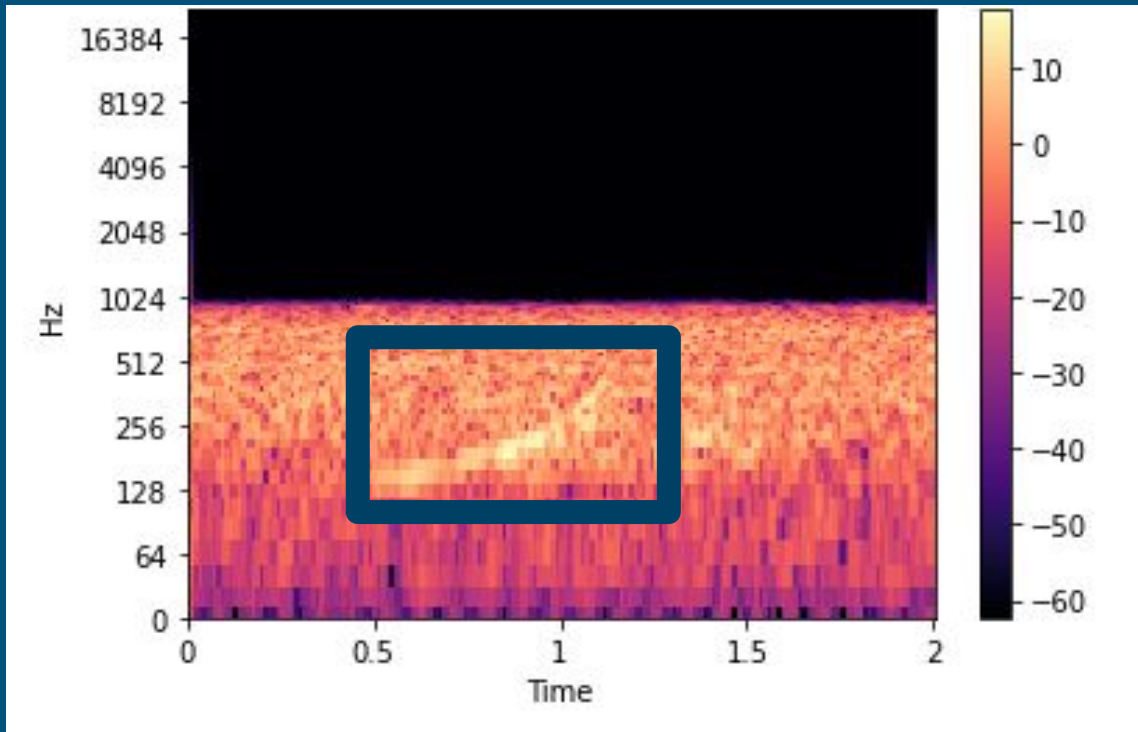
Noise Audio



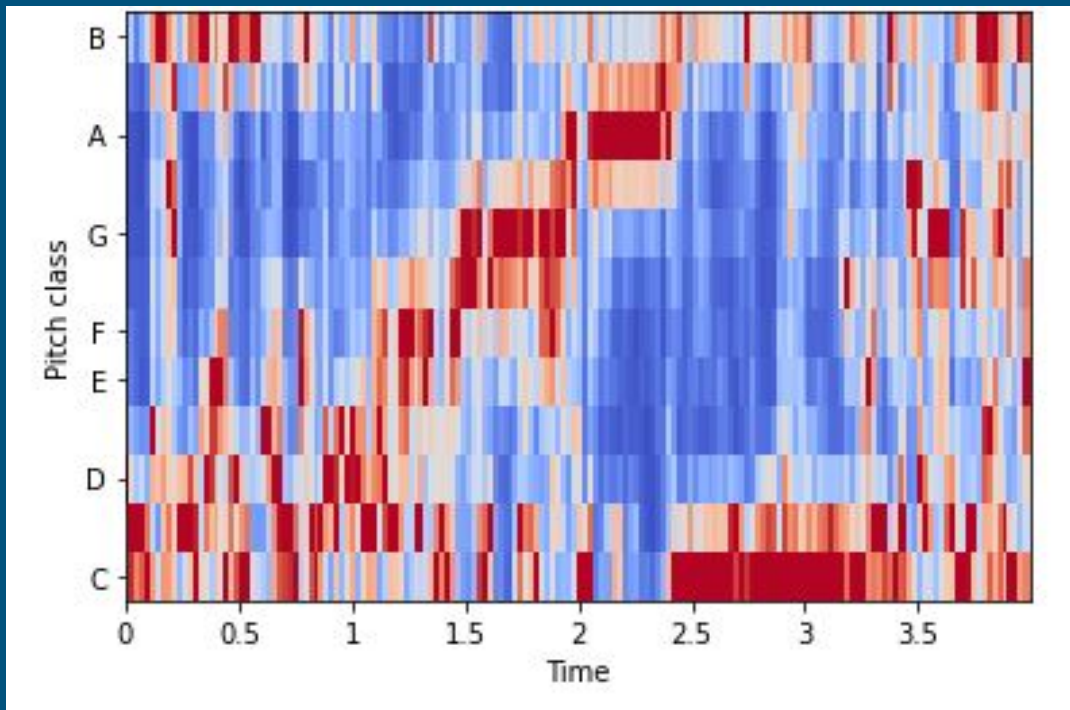
Whale Audio



Audio Feature: Mel Spectrogram



Audio Feature: Chroma



Audio Features: Other

- Mel-frequency Cepstral Coefficients (MFCC): Rate of change in spectral bands.
- Spectral Centroid: measure used to characterise an audio spectrum by finding its center of mass
- Spectral Rolloff: measure of the shape of the signal

Model: CNN

Training Accuracy: 0.93

Testing Accuracy: 0.90

Loss: 0.23

| | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| 0.0 | 0.92 | 0.96 | 0.94 | 4639 |
| 1.0 | 0.84 | 0.71 | 0.77 | 1361 |
| accuracy | | | 0.90 | 6000 |
| macro avg | 0.88 | 0.83 | 0.85 | 6000 |
| weighted avg | 0.90 | 0.90 | 0.90 | 6000 |

Assumptions and Limitations

- It is assumed that all audio clips are labeled correctly.
 - Without manual verification this is not actually known.
- Continuous hydrophone recordings are limited in quality due to storage capacity and ambient noise.
 - Low impact on the ability to identify signals.

Future Work

- Expansion of the model to include more categories including ships and other types of whale.
 - Current audio already contains these sounds, so it could improve accuracy.
 - More types of whales means that similar protocols could be implemented in other areas to protect more whales and help ships avoid collisions.

Conclusions

- Training a convolutional neural network on mel spectrograms resulted in 90% accuracy on testing data.
- Other features did not improve the model.
- Main issue was type 2 errors.
- Future work can be expanded to include categories for ships and other types of whales.

Thank You!

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Project Repository:

<https://github.com/emilybocim/Whale-Audio-Classification>