hybrid-vocal-classifier: a Python package for automated labeling of birdsong

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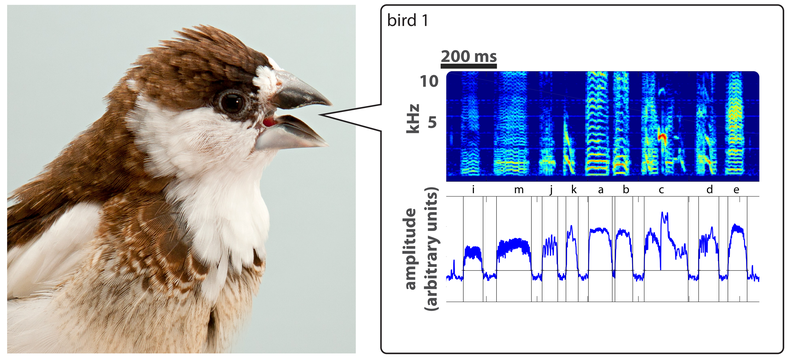
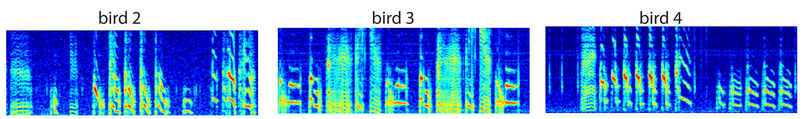
Introduction

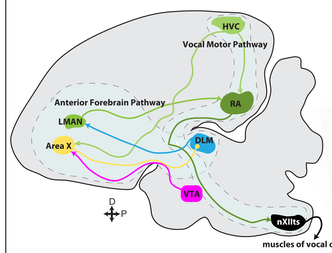
Songbirds as a model system in neuroscience:

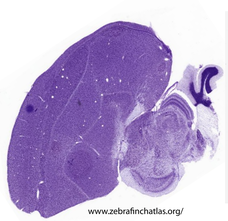
- Birdsong shares many characteristics with speech
  + Learned during sensitive period
    - In many species, each individual has a unique song with high simliarity to that of its tutor

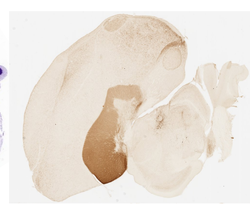




- Songbird brain contains a network of discrete areas for learning and producing song: the **song system**

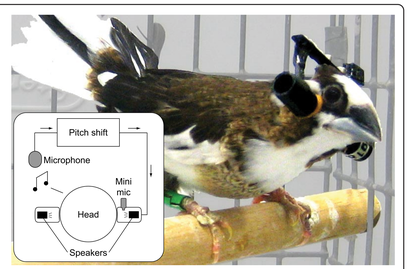






- Evolved in songbirds
- But from brain areas shared with humans and all other vertebrates
- Understanding the song system can help us understand our own brain

-Possible to combine:
  + behavioral experiments
  + recordings of brain activity
  + experimental manipulations
- to understand how the brain learns and maintains motor skills like speech



adapted from Sober Brainard 2009

Problem:
Many experiments require labeling song "syllables"
Labeling song by hand consumes many person-hours.
A major bottleneck that prevents conversion of data to results.

the hybrid-vocal-classifier package

https://github.com/NickleDave/hybrid-vocal-classifier

Goals:

1. make it easy for songbird scientists to automate labeling of song syllables

2. do so with open-source code, built with existing libraries that have been road-tested by a broad community

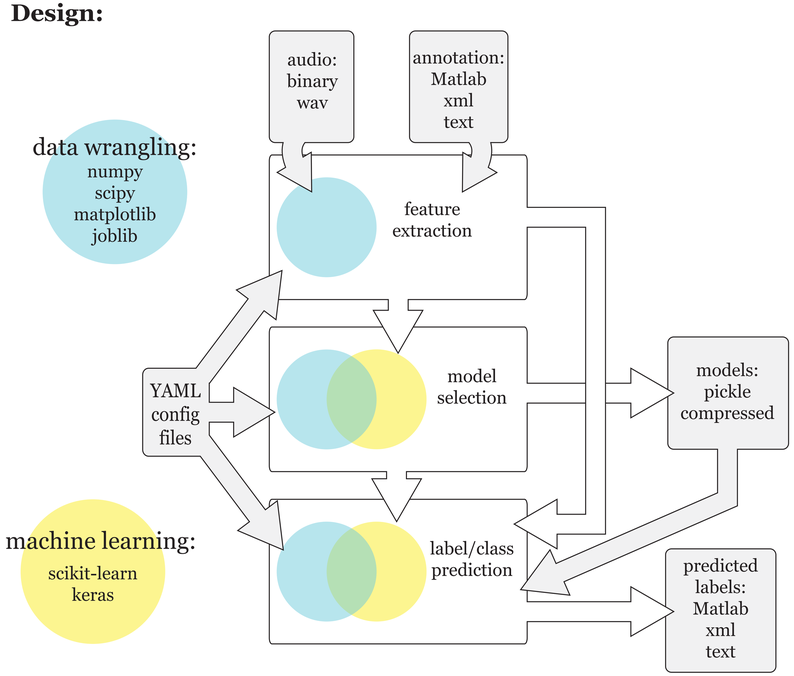
3. make it easy to compare different machine learning methods

4. provide a large hand-labeled dataset for benchmarking
https://figshare.com/articles/Bengalese_Finch_song_repository/4805749

What does an hvc script look like?

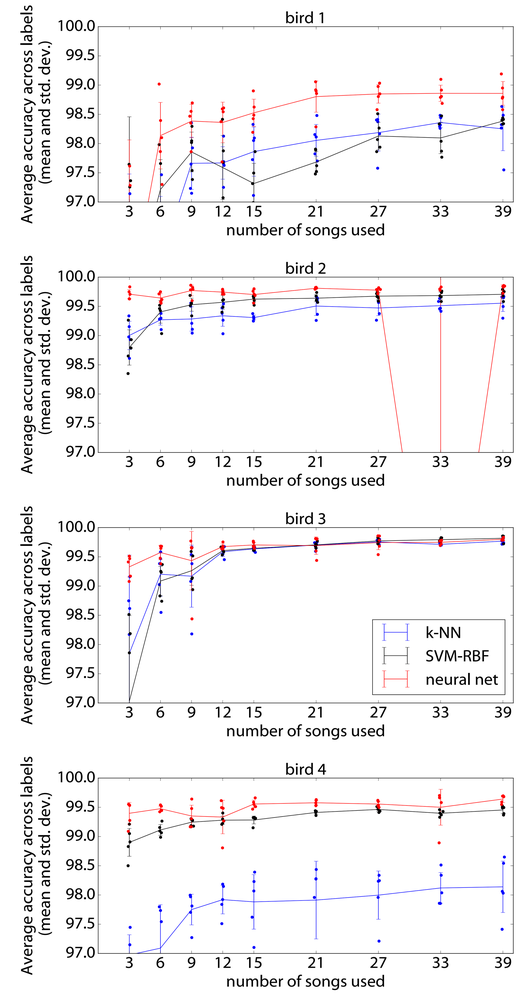
```
import hvc
hvc.extract('extract_config.yml')
hvc.select('select_config.yml')
hvc.predict('predict_config.yml')
```

Design:



Results

A convolutional neural net achieves higher accuracy with much less training data than support vector machines and k-Nearest Neighbors classifiers



Discussion

Future work:
- Parallelize:
  + Feature extraction
  + Training models
- Other algorithms
  + Recurrent neural networks for segmentaton

Acknowledgements

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