Auto bird detector using sound

Supervised Multi classification project using machine learning

DSI 10 Capstone Project

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Problem statement

To find out automatic, cheap and unbiased method to reliably identify birds by acoustic monitoring

Challenges

- Multiple simultaneously vocalizing birds
- Non-bird sound (buzzing insects)
- Background noise (wind , rain , etc..)

Goal

Create a robust neural network model that will identify 30 different bird species with at least 70% accuracy

Create a web app that will take bird sound as input and output predicted bird details

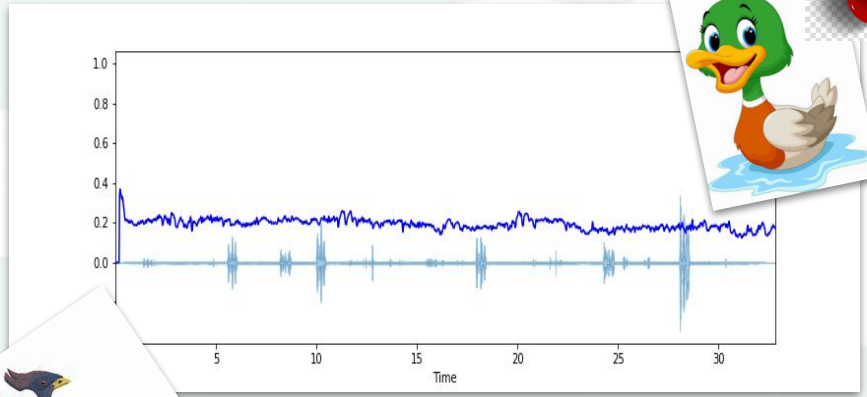
Importance

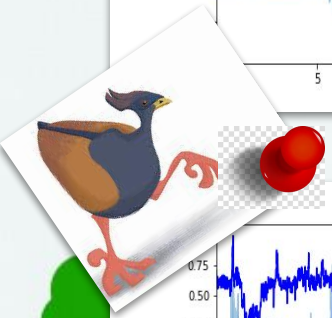
- Biologists
- Conservation and Ecology
- General public interested in birding

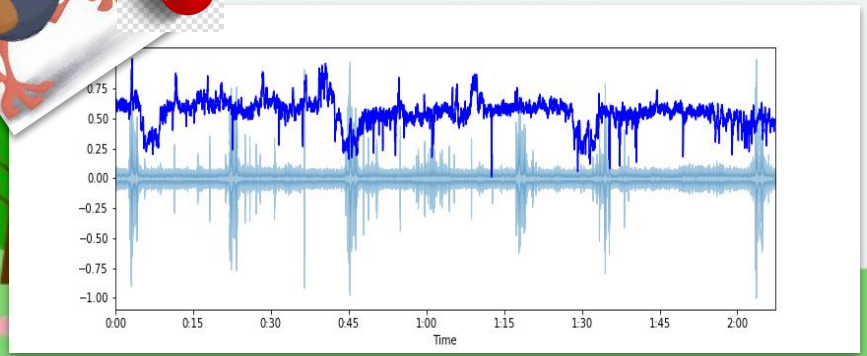
Data

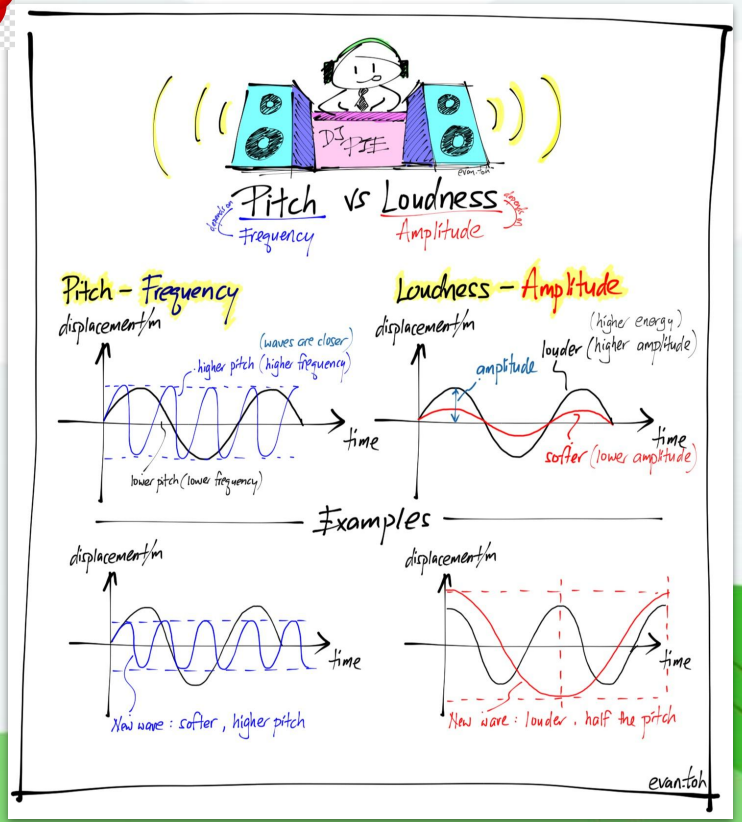
- Collected list of California birds from wikipedia : https://en.wikipedia.org/wiki/List_of_birds_of_California
- Collected bird sound recordings from : https://www.xeno-canto.org
  This project would not have been possible without the recordings from xeno-canto web site
- Top 30 birds seen in California, 500 sound files each
- Total data - 32 GB

EDA on audio data









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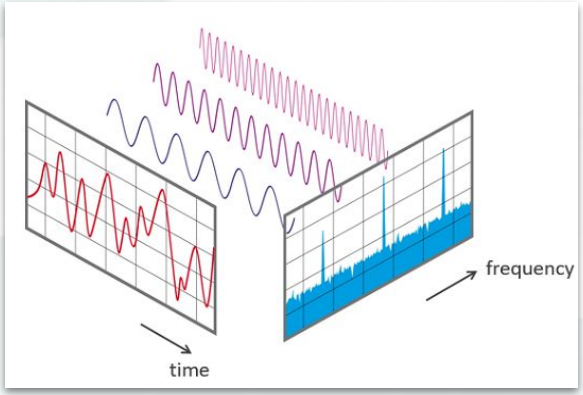
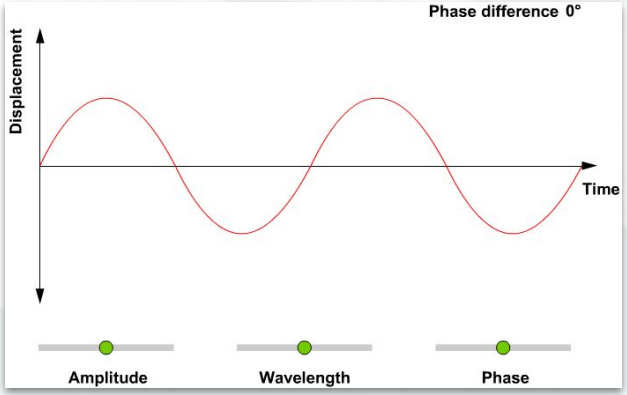
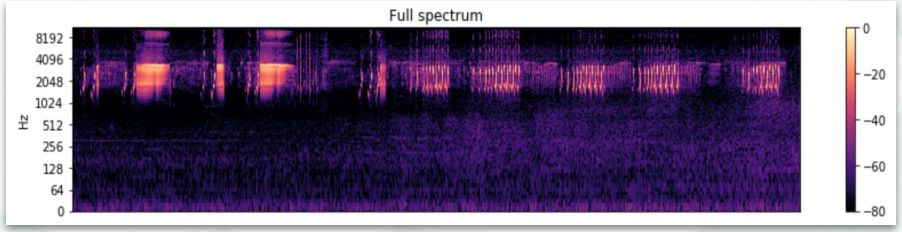
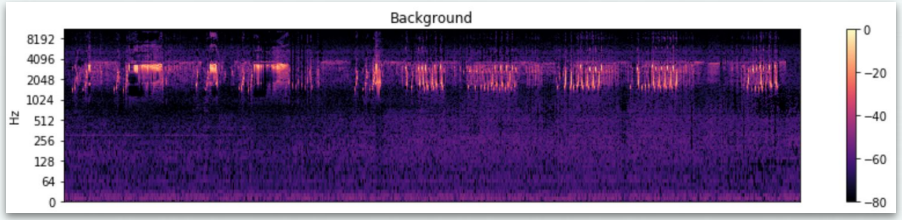


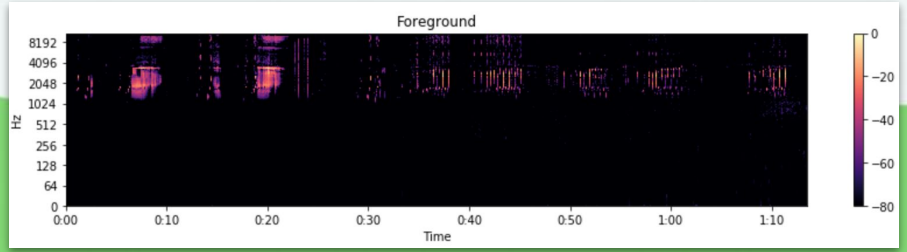


Filtering out background noise

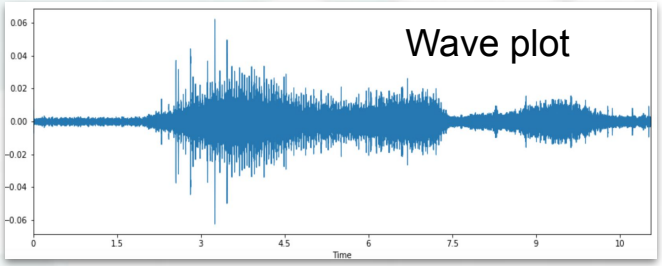
Python package: libRosa : https://librosa.github.io/librosa/

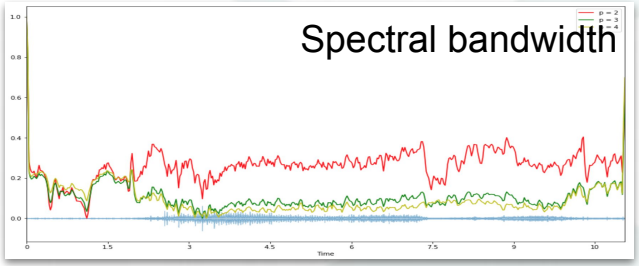


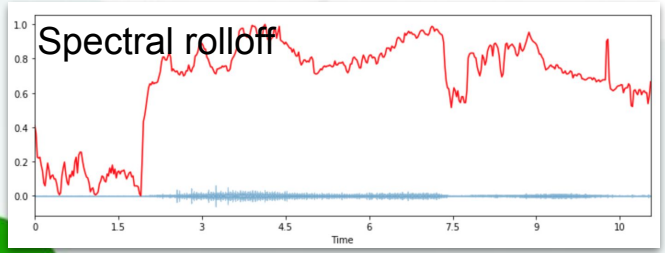


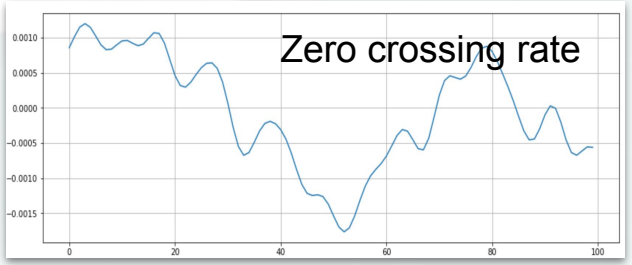


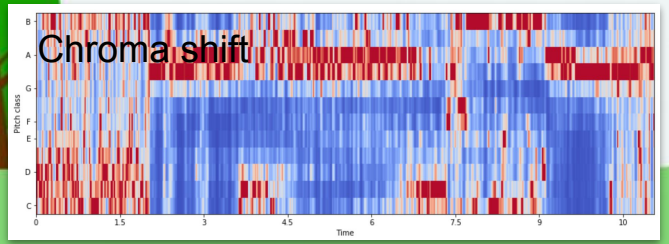
Feature extraction from audio signal

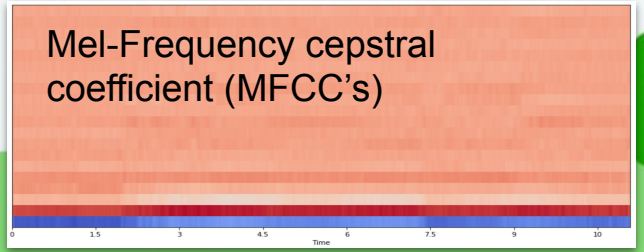






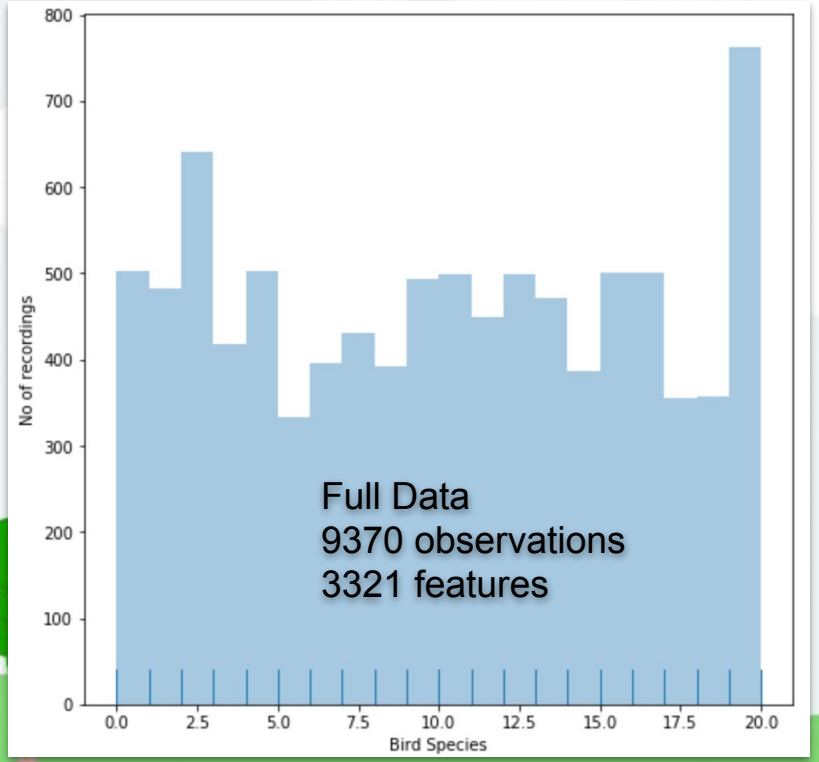


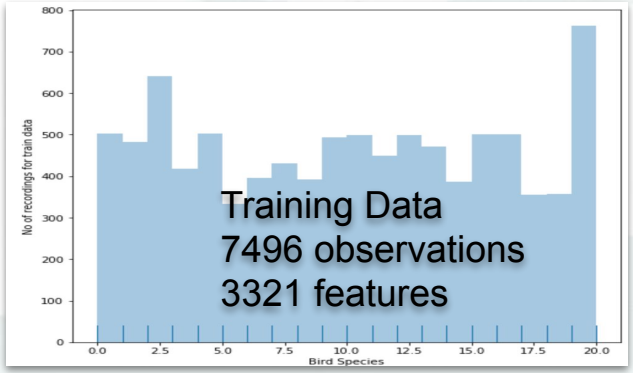


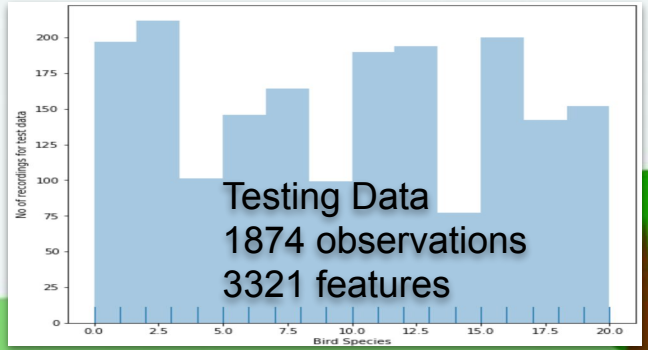


Birds selected for modelling

train_test_split (80/20)

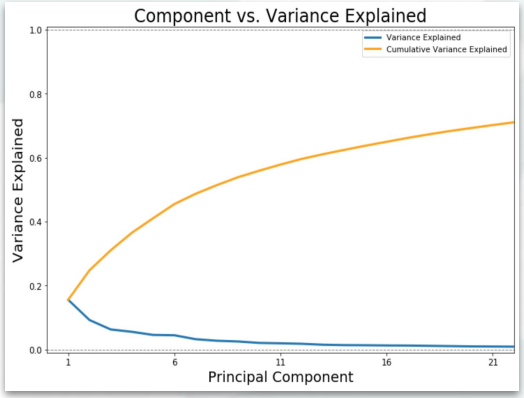


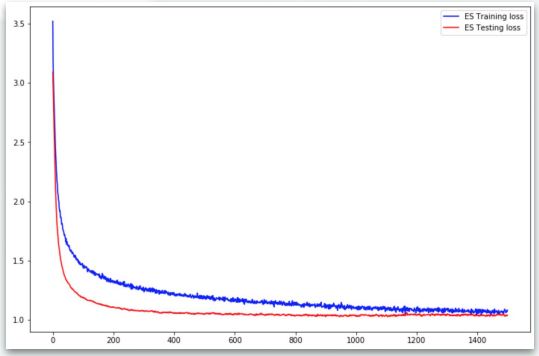


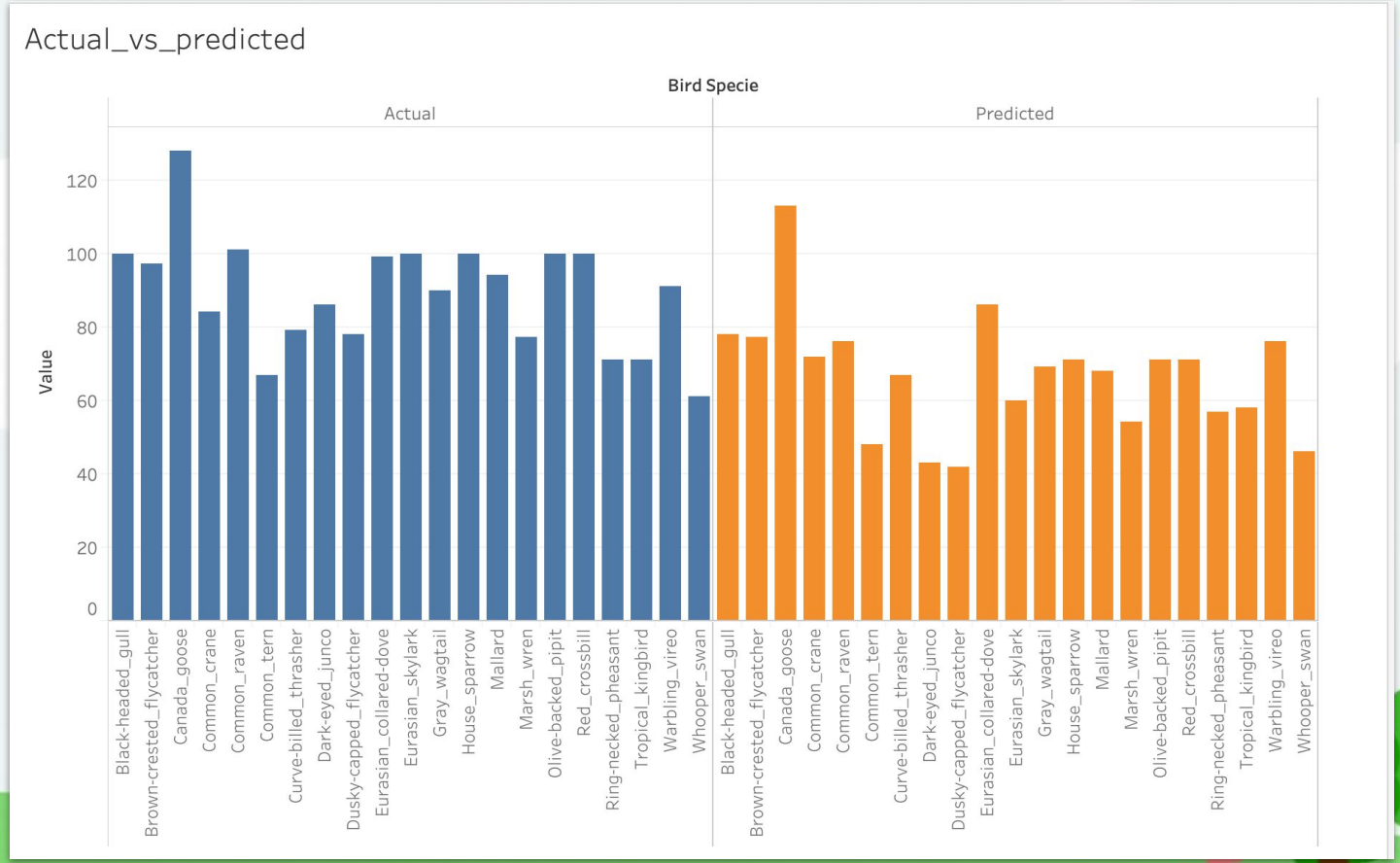


Modelling

- Over 3000 features, reduced to 1000 using PCA
- Neural Network model using 1500 epochs






Actual_vs_predicted
Bird Specie
Actual
Predicted
Value
0
20
40
60
80
100
120
Black-headed_gull
Brown-crested_flycatcher
Canada_goose
Common_crane
Common_raven
Common_tern
Curve-billed_thrasher
Dark-eyed_junco
Dusky-capped_flycatcher
Eurasian_collared-dove
Eurasian_skylark
Gray_wagtail
House_sparrow
Mallard
Marsh_wren
Olive-backed_pipit
Red_crossbill
Ring-necked_pheasant
Tropical_kingbird
Warbling_vireo
Whooper_swan

Report

No of bird species : 21

Accuracy on Test Data : 74%

Recordings correctly identified : 1380/1874

Precision Recall Heatmap

Bird Specie	
Black-headed_gull	0.7700
Brown-crested_flycatcher	0.7300
Canada_goose	0.8800
Common_crane	0.8400
Common_raven	0.7400
Common_tern	0.7100
Curve-billed_thrasher	0.7300
Dark-eyed_junco	0.5900
Dusky-capped_flycatcher	0.5900
Eurasian_collared-dove	0.8600
Eurasian_skylark	0.6500
Gray_wagtail	0.7400
House_sparrow	0.7000
Mallard	0.7700
Marsh_wren	0.7200
Olive-backed_pipit	0.7400
Red_crossbill	0.7100
Ring-necked_pheasant	0.6700
Tropical_kingbird	0.8300
Warbling_vireo	0.7400
Whooper_swan	0.6900

App demo https://birding-app.firebaseapp.com/

Auto Bird Recognizer

Common Name: Common crane

Species: Grus grus

Wiki Link: Common_crane

Xeno-Canto Link: Common_crane

Auto Bird Recognizer

Common Name: Whooper swan

Species: Cygnus cygnus

Wiki Link: Whooper_swan

Xeno-Canto Link: Whooper_swan

Auto Bird Recognizer

Common Name: Tropical kingbird

Species: Tyrannus melancholicus

Wiki Link: Tropical_kingbird

Xeno-Canto Link: Tropical_kingbird

End results compared to goal

Created a neural network model that will identify 21 different bird species with 74% accuracy

Created a web app that will take bird sound as input and output predicted bird details

Next Steps

- Added few filters and found that the accuracy rate goes up to 85%. Try and run all the recordings through that filter.
- Add other information like an image of the bird , location , time of the day , tree information, etc… to identify birds more correctly.
- Researching better techniques to filter audio data
- Create a program that would taken in long hours of audio set and report all the birds in the audio along with the number of birds and the time when each bird is heard

References

- https://www.kdnuggets.com/2020/02/audio-data-analysis-deep-learning-python-part-1.html
- https://levelup.gitconnected.com/audio-data-analysis-using-deep-learning-with-python-part-2-4a1f40d3708d
- https://github.com/m-kortas/Sound-based-bird-species-detection/blob/master/medium.ipynb
- https://www.kaggle.com/c/mlsp-2013-birds
- https://www.researchgate.net/publication/328836649_Bird_Sound_Recognition_Using_a_Convolutional_Neural_Network


THANK YOU !!!