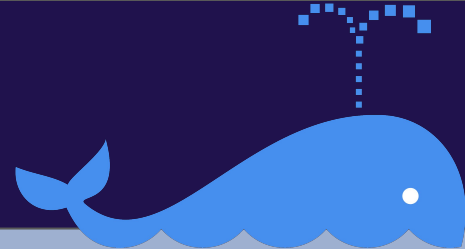


Humpback Whale Identification

Jasmine Cao, Melissa Cheung, Adan Constanzo,
Mher Oganessian, Smitkumar Kaushikkumar Patel

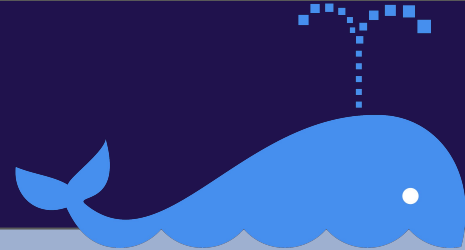


Purpose



- Proving better surveillance
 - Why?
 - Human intervening
 - Warm Oceans
 - Migration
 - How?
 - Images use from Happywhale's database
 - Analyzing
 - Identifying

Dataset

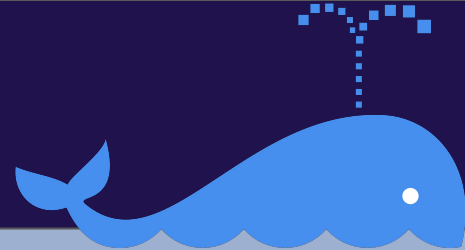


- **25k** Images Total
 - **5k** Unique Whale Species
 - **9.6k** Whales Unidentified
- Different Dimension
 - **RGB**
 - **Grayscale**
- Given **train.csv**
 - Two Columns
 - **Image Name**
 - **Whale Identification**



	A Image	A Id	
	25361 unique values	new_whale w_23a388d Other (5003)	38% 0% 62%
1	0000e88ab.jpg	w_f48451c	
2	0001f9222.jpg	w_c3d896a	
3	00029d126.jpg	w_20df2c5	
4	00050a15a.jpg	new_whale	
5	0005c1ef8.jpg	new_whale	
6	0006e997e.jpg	new_whale	
7	000a6daec.jpg	w_dd88965	
8	000f0f2bf.jpg	new_whale	
9	0016b897a.jpg	w_64404ac	
10	001c1ac5f.jpg	w_a6f9d33	
11	001cae55b.jpg	w_581ba42	
12	001d7450c.jpg	new_whale	
13	00200e115.jpg	new_whale	
14	00245a598.jpg	new_whale	
15	002b4615d.jpg	new_whale	
16	002f99f01.jpg	new_whale	
17	00355ff28.jpg	w_cb622a2	

Modification to the Challenge

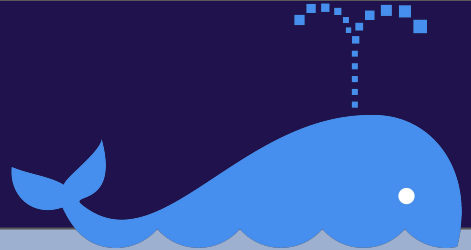


- Reduce Complexity
 - Classifying
 - 5k Whales → Top 10 Whales

Thank You

 Dr. Mohammad Pourhomayoun! 

Pre-Processing




- Data Cleaning

- Large portion of dataset is labeled as “**new_whale**,” meaning **unknown species**
- **9664** images labeled as “**new_whale**” were removed (**38%** of dataset)
- Used **top ten** recurring species (**570 samples**)

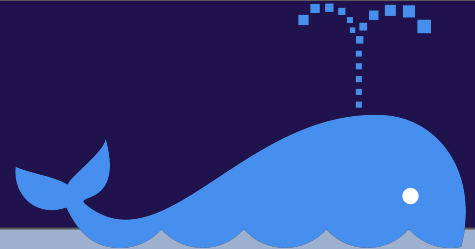
- Image Size Reduction

- Dimensions for each image was **inconsistent**
- Images were resized to **100x100 pixels**
- Scaled the aspect of image to **prevent loss of information**

- Augmenting Images

- Increase image occurrence from **570**  **3306**
- Images copies consisted of: rotating, shifting, horizontal flipping, and zooming in on image

Pre-Processing Cont.



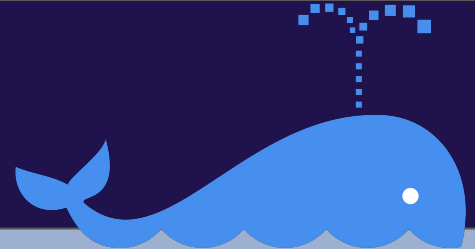
- Preparing our Features

- Features consisted of pixel and **RGB** values of images
- Images imported using **keras.preprocessing.image**
- Images condensed to multidimensional array of 100x100x3, then appended to **training/testing set**
- Each image divided by **255** for **RGB**

- Preparing our Labels

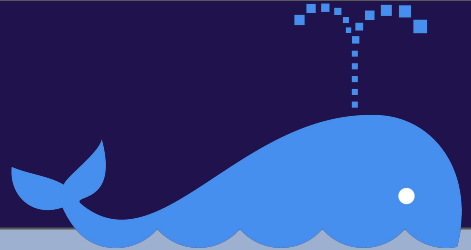
- **Over 10** unique whales used
- Used **One Hot Encoding** for determining species

Methodology



- **Support Vector Machine (SVM)**
 - **Hyperplanes**
 - Separate & Classify Data
 - Categorize Dataset
 - **Maximum-Margin Line**
 - Separation between two or more classification
- **Convolutional Neural Network (CNN)**
 - Applies **Filters** to reduce complexity
 - Collect Features
 - **Edge Detection**
 - Applying **Best Filter** to increase prediction accuracy

Support Vector Machine (SVM)



- **Data Preparation**

- Create dataframe where image pixels were the features
 - Done by **flattening images** and putting into **np.array**
- Scale the features to reduce computation using **preprocessing.scale**
- Then split into **testing and training** datasets

- **Complexity Reduction**

- Using **PCA** reduce down to 100 features

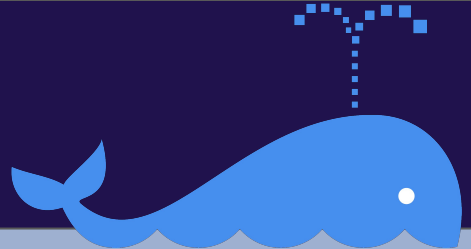
- **Training the Model**

- Initially gave us accuracy of **0.167**

- **Accuracy Improvement**

- Used **GridSearchCV** to test different hyperparameter values (initially, **C=1**)
- Best **C=10**, with Accuracy of **0.4368**

Convolutional Neural Network (CNN)



- CNN Architecture

- Inspired by **VGG_16** model
- Increased the numbers by **powers of 2** as the layer got deeper
- Both **Max2DPooling** and **Dropout** were used

```
def cnn_model():
    keras.backend.clear_session()

    model = Sequential()

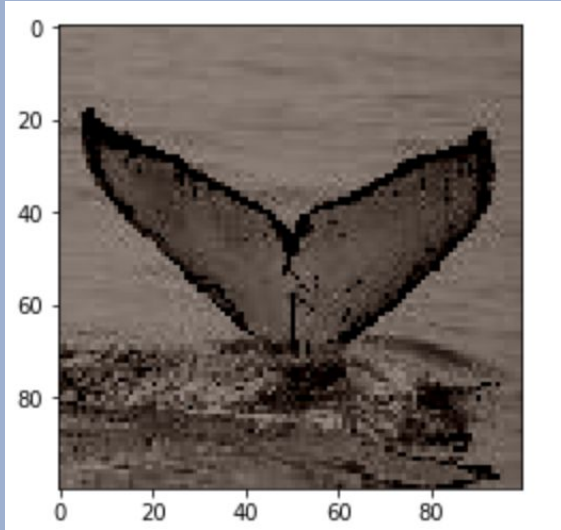
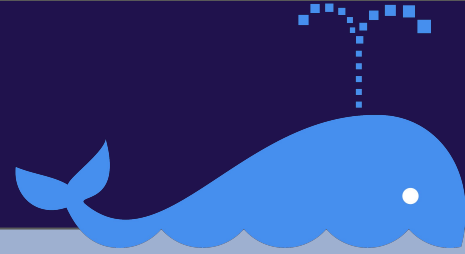
    model.add(Convolution2D(32, (3, 3), strides=(1,1), activation='relu', input_shape = (100, 100, 3)))
    model.add(MaxPooling2D((2, 2), strides=(2, 2)))
    model.add(Dropout(0.2))

    model.add(Convolution2D(64, (3, 3), strides=(1,1), activation='relu'))
    model.add(MaxPooling2D((2, 2), strides=(2, 2)))
    model.add(Dropout(0.2))

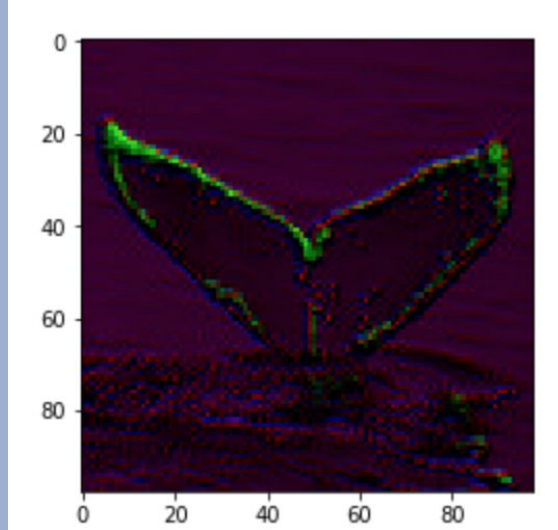
    model.add(Convolution2D(128, (3, 3), strides=(1,1), activation='relu'))
    model.add(MaxPooling2D((2, 2), strides=(2, 2)))
    model.add(Dropout(0.2))

    model.add(Flatten())
    model.add(Dense(650, activation="relu"))
    model.add(Dropout(0.8))
    model.add(Dense(10, activation='softmax'))
    return model
```

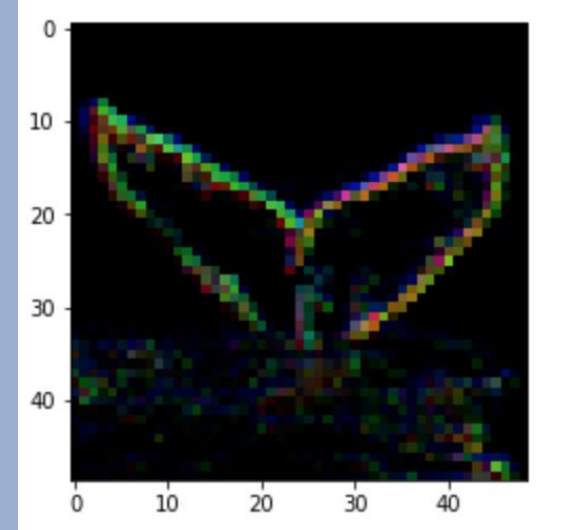
Convolutional Neural Network (CNN)



Original 100x100
image

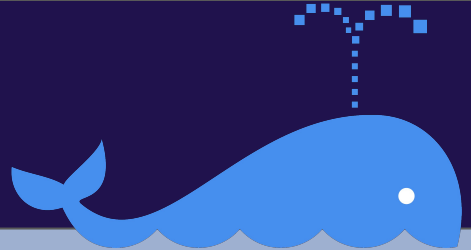


One (3x3) filter applied
to original image



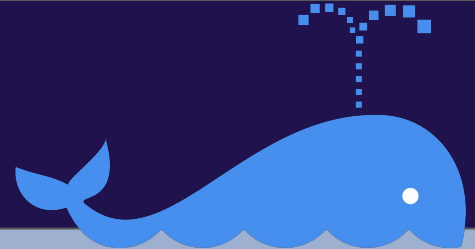
Three (3x3) filter applied
to original image (with
dropout)

Convolutional Neural Network (CNN)



- Data Preparation
 - Used downsized color images, 100x100x3
- Training the Model
 - Due to memory limitations:
 - Batch size was set to 64
 - Epochs to 45
 - Initial accuracy of 0.71
- Accuracy Improvement
 - Use of image augmentation to increase dataset size
 - Used Keras library, ImageDataGenerator, for augmentation
 - Added new images to training set, leaving testing set untouched
 - Training set size increased from 456 → 2280
 - New accuracy of 0.83

Results



Support Vector Machine



Accuracy: **0.43**

Convolutional Neural Network (non-augmented images)



Accuracy: **0.71**

Convolutional Neural Network (augmented images)



Accuracy: **0.83**

The background is a light blue sky with two white clouds at the top. Three white birds are flying in the sky. At the bottom, there is a dark blue wavy line representing the ocean. A blue whale is swimming in the water, with a splash of water coming out of its blowhole.

Thank You!

Questions?