

# Classifying Budgerigars

A common Parakeet

## Team 8:

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# The Data Set

Blue

White

Yellow

Wild

Other

The dataset consists of 5 classifications of budgies. The classifications focus on color variations of budgies, with “other” being images where outlier cases where more than one budgie is present. “Wild” budgies are variants that are both yellow and green.

# Data Preprocessing

Initial  
Database +  
INaturalist  
Database

419 img



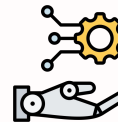
Manual  
Process

Mislabeled img

Imgs < 9Kb

No parakeets  
img

309 img

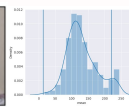
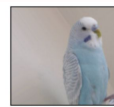
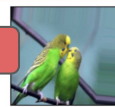
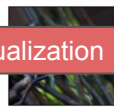
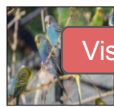
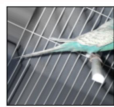
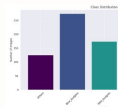


Fastdup  
Process

Anomalous  
(Dark, Bright, Blurry)

Outliers  
(Similarity < 0.6)

Duplicates  
(Identity > 0.9)



Visualization

Test: 30%

Train: 70%

Val: 20%:Train

Splitting



Rotation  
60 degrees

Shift range  
0.2

Horizontal flip

Augmen  
tation



Resize  
224 \* 224

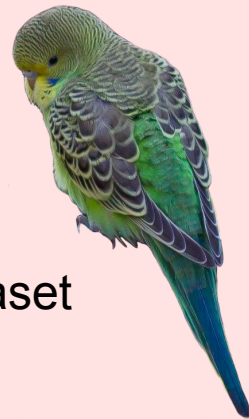
RGB alpha  
Channel

Channel Range  
(0 -> 1)

Normali  
zation



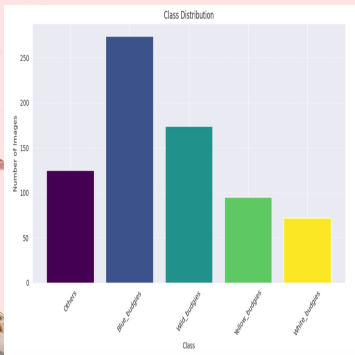
264 img



# Res-Net 18

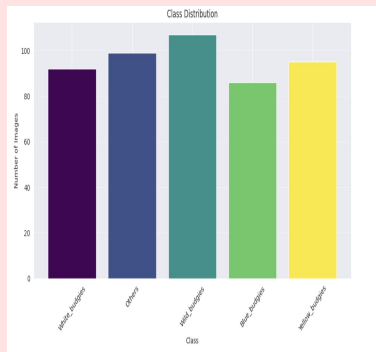
Class Balancing: more equal class representation in the training dataset

Before Balancing: Accuracy ~78%



```
Confusion Matrix:
[[26  3  0  1  0]
 [ 5  3  0  2  0]
 [ 1  0  7  0  0]
 [ 0  1  0 14  0]
 [ 0  0  0  3  7]]
Accuracy: 0.7808
Precision: 0.7830
Recall: 0.7808
F1 Score: 0.7725
Time: 2.8 sec
=====
```

After Balancing: Accuracy ~85%



```
Confusion Matrix:
[[34  6  2  0  1]
 [ 6 33  2  2  1]
 [ 0  0 35  0  0]
 [ 0  4  0 30  0]
 [ 0  0  0  3 33]]
Accuracy: 0.8594
Precision: 0.8584
Recall: 0.8594
F1 Score: 0.8581
Time: 2.3 sec
=====
```





# Res-Net 18

“Others” Dataset contained  
incorrect images of single birds

After moving incorrect images:

```
Confusion Matrix:  
[[50  1  0  1  0]  
 [ 3 33  0  3  0]  
 [ 0  0 42  0  0]  
 [ 0  0  0 30  1]  
 [ 0  0  0  2 41]]  
Accuracy: 0.9469  
Precision: 0.9503  
Recall: 0.9469  
F1 Score: 0.9470  
Time: 2.3 sec
```

Accuracy ~94%



Best Optimizer: Adam

```
Epoch 10/10:  
Confusion Matrix:  
[[52  1  0  0  0]  
 [ 0 36  0  4  0]  
 [ 0  0 45  0  0]  
 [ 0  2  0 33  0]  
 [ 0  0  0  0 39]]  
Accuracy: 0.9670  
Precision: 0.9676  
Recall: 0.9670  
F1 Score: 0.9671  
Loss: 0.008  
Time: 2.1 sec
```

Accuracy: ~95%





# MobileNet V2

## Trying Different Optimizers

optimizer: SGD  
batch size: 64  
learning rate: 5e-5

```
Confusion Matrix:
[[43  4  5  0  0]
 [ 3 33  1  5  0]
 [ 0  0 42  0  0]
 [ 0  0  0 35  0]
 [ 0  1  0  2 35]]
Accuracy: 0.8995
Precision: 0.9043
Recall: 0.8995
F1 Score: 0.8983
Loss: 0.081
Time:3.4 sec
```

Accuracy: ~89%

optimizer: Adam  
batch size: 16  
learning rate: .001

```
Confusion Matrix:
[[49  0  3  0  0]
 [ 5 32  1  4  0]
 [ 0  0 41  0  1]
 [ 0  1  1 31  2]
 [ 0  0  0  0 38]]
Accuracy: 0.9139
Precision: 0.9166
Recall: 0.9139
F1 Score: 0.9120
Loss: 0.004
Time:2.7 sec
```

Accuracy: ~91%

optimizer: AdamW  
batch size: 64  
learning rate: .001  
weight decay: .01

```
Confusion Matrix:
[[51  0  1  0  0]
 [ 1 41  0  0  0]
 [ 1  0 41  0  0]
 [ 0  0  0 35  0]
 [ 0  0  0  1 37]]
Accuracy: 0.9809
Precision: 0.9812
Recall: 0.9809
F1 Score: 0.9809
Loss: 0.000
Time:2.7 sec
```

Accuracy: ~98%

# Resnet 152

Optimizer: Adam

Testing: 100% | ██████████ | 2/2 [00:00:00]  
[[25 2 0 1]  
[ 4 4 0 2 0]  
[ 0 0 6 0 0]  
[ 0 1 0 14 1]  
[ 0 1 0 0 10]]  
25 epochs,  
1 accumulation step  
Test Accuracy: 0.8082191780821918  
Test Precision: 0.764080459770115  
Test Recall: 0.8034848484848485

Testing: 100% | ██████████ | 2/2 [00:00:00]  
[[28 2 0 0 0]  
[ 3 6 0 1 0]  
[ 1 0 5 0 0]  
[ 0 1 0 15 0]  
[ 0 1 0 0 10]]  
15 epochs,  
2 accumulation step  
Test Accuracy: 0.8767123287671232  
Test Precision: 0.8825  
Test Recall: 0.842651515151515

Optimizer: SGD

Testing: 100% | ██████████ | 2/2 [00:00:00]  
Test Confusion Matrix:  
[[29 0 0 1 0]  
[ 4 5 0 1 0]  
[ 0 0 5 1 0]  
[ 0 0 0 15 1]  
[ 0 1 0 2 8]]  
15 epochs,  
3 accumulation step  
Test Accuracy: 0.8493150684931506  
Test Precision: 0.8702020202020201  
Test Recall: 0.7929545454545455

Balanced Data Set  
Optimizer: Adam

Testing: 100% | ██████████ | 5/5 [00:01:00]  
[[49 2 2 0 0]  
[ 0 37 0 3 0]  
[ 0 0 45 0 0]  
[ 0 1 0 34 0]  
[ 0 0 0 1 38]]  
15 epochs,  
2 accumulation step  
Test Accuracy: 0.9575471698113207  
Test Precision: 0.9554367301231803  
Test Recall: 0.9590631695348677

# Model Comparisons



## Res-Net 18

**90-94%+ Accuracy (2.1 seconds per epoch)**

BEST: Batch Size 64, Adam Optimizer, 10-15 Epochs,

Epoch 10/10:

Confusion Matrix:

```
[[52  1  0  0  0]
 [ 0 36  0  4  0]
 [ 0  0 45  0  0]
 [ 0  2  0 33  0]
 [ 0  0  0  0 39]]
```

Accuracy: 0.9670

Precision: 0.9676

Recall: 0.9670

F1 Score: 0.9671

Loss: 0.008

Time: 2.1 sec

## Mobile Net V2

**98%+ Accuracy (2.7 seconds per epoch)**

BEST: Batch Size 64, Optimizer AdamW, lr: .001, WD: .01,

Confusion Matrix:

```
[[51  0  1  0  0]
 [ 1 41  0  0  0]
 [ 1  0 41  0  0]
 [ 0  0  0 35  0]
 [ 0  0  0  1 37]]
```

Accuracy: 0.9809

Precision: 0.9812

Recall: 0.9809

F1 Score: 0.9809

Loss: 0.000

Time: 2.7 sec



## Res-Net 152

**95%+ Accuracy (2.75 seconds per epoch)**

BEST: Batch Size: 50, Optimizer Adam, 15 Epochs, 2 Accumulation Steps

Testing: 100% | 

```
[[49  2  2  0  0]
 [ 0 37  0  3  0]
 [ 0  0 45  0  0]
 [ 0  1  0 34  0]
 [ 0  0  0  1 38]]
```

Test Accuracy: 0.95754716

Test Precision: 0.9554367

Test Recall: 0.9590631695



# What We Learned

- Choosing models that do not exceed our computational resources.
- Importance of good data preprocessing.
- Importance of finding a good optimizer and learning rate through trial and error.
- Inspecting our results through visualizations such as confusion matrices that show which classes are being misclassified and how often.
- One oversight is that we did not explore different loss functions.

