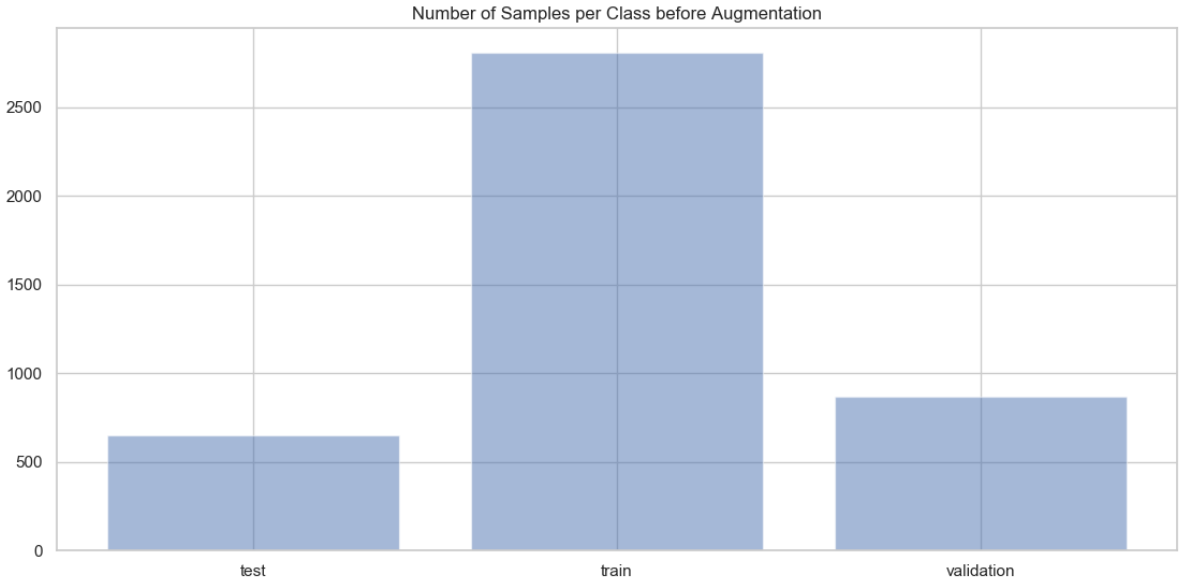
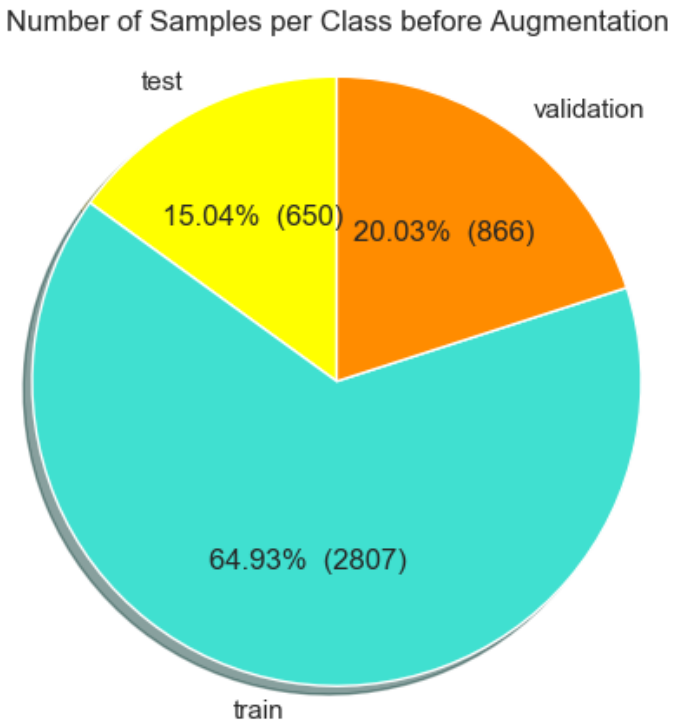
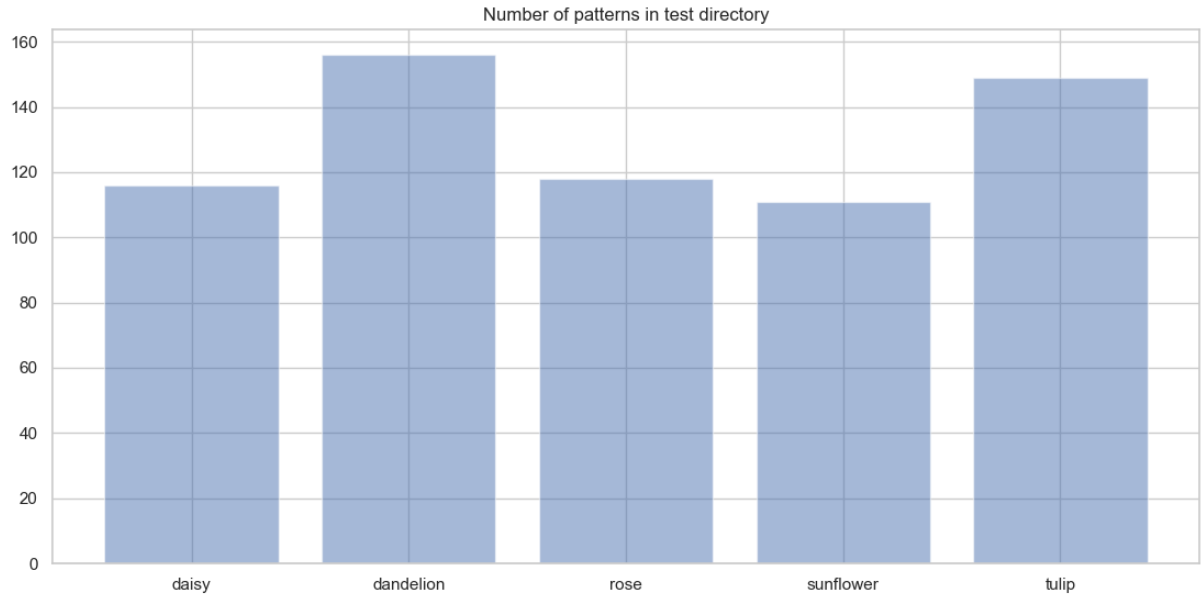
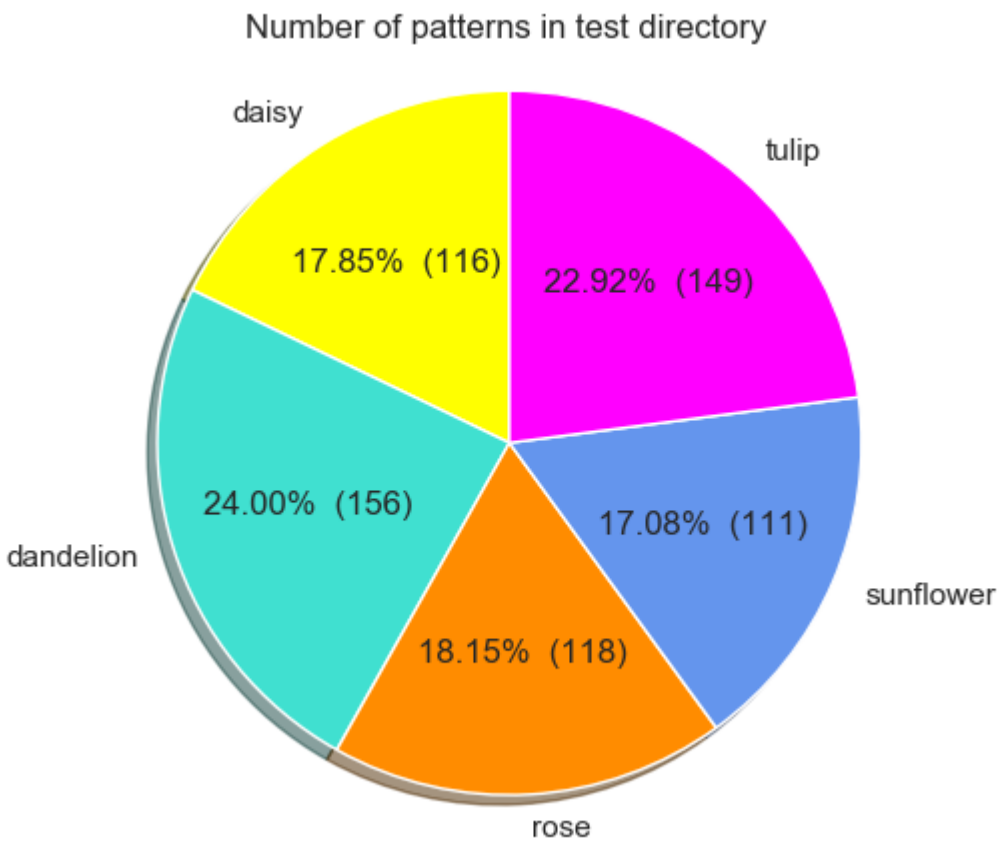
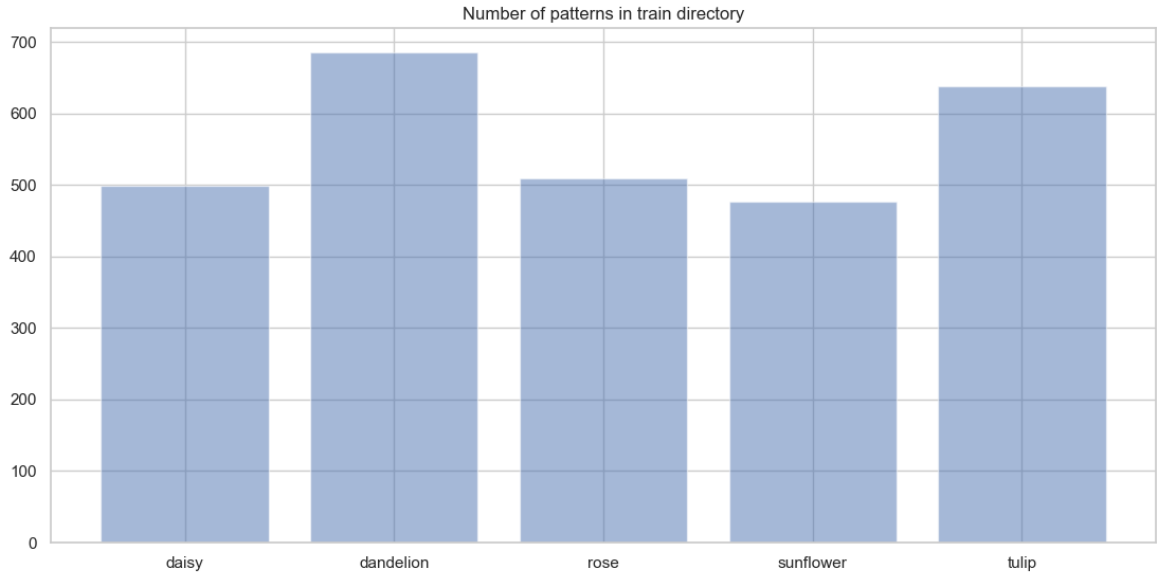
# NEW SET DISTRIBUTION AUG-NORM

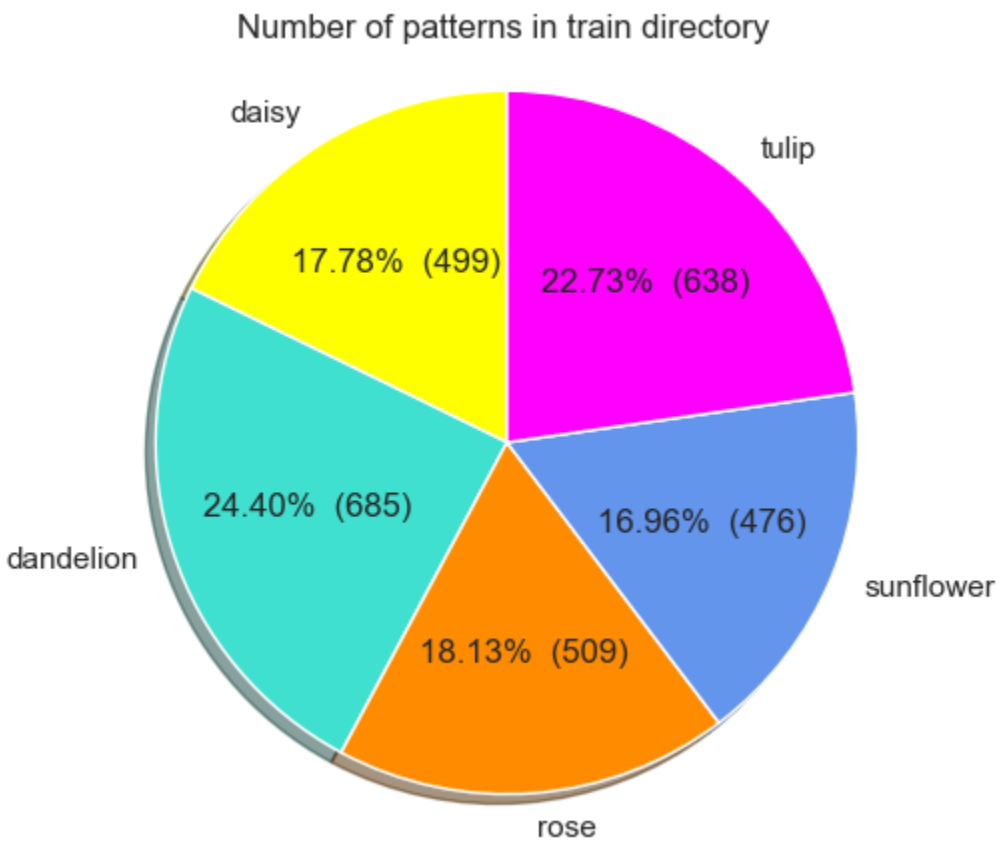


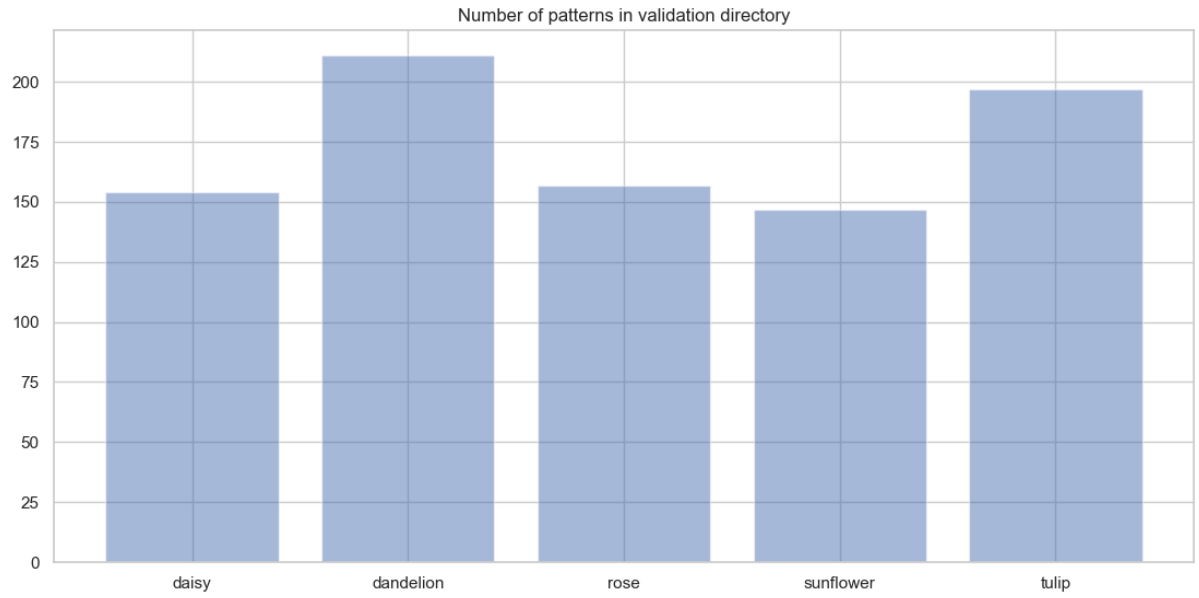



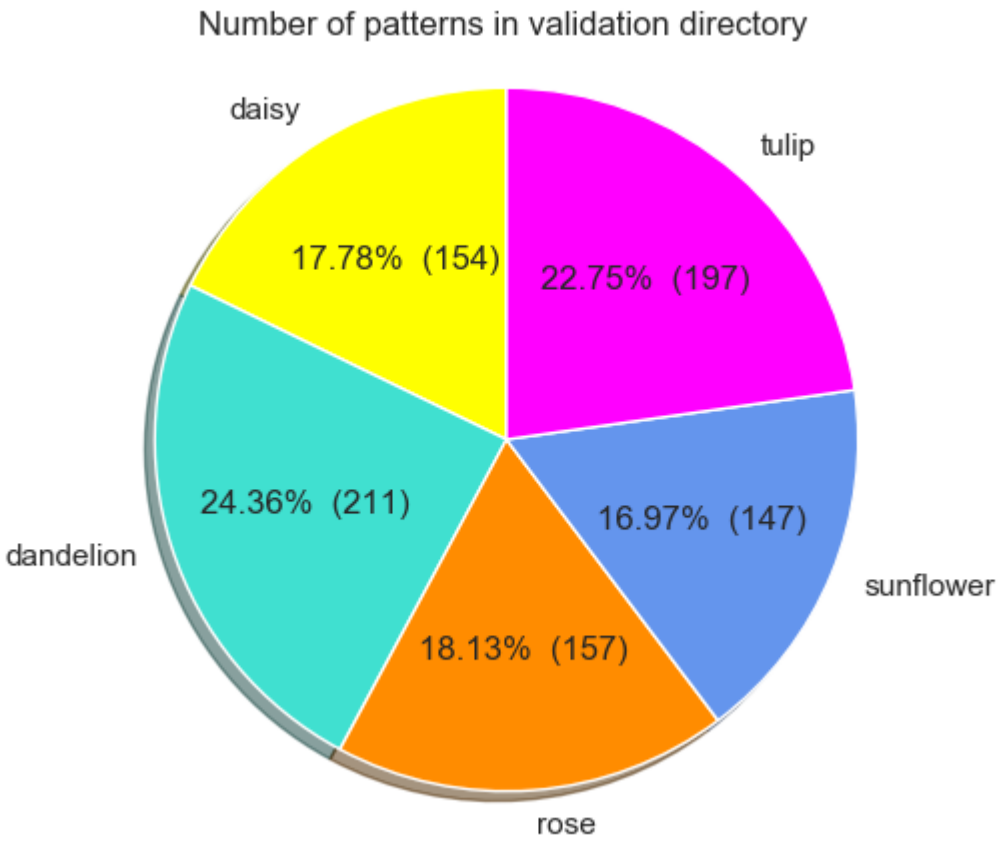

Number of patterns in test directory
160
140
120
100
80
60
40
20
0
daisy
dandelion
rose
sunflower
tulip


Number of patterns in test directory
daisy
tulip
17.85% (116)
22.92% (149)
24.00% (156)
dandelion
17.08% (111)
sunflower
18.15% (118)
rose

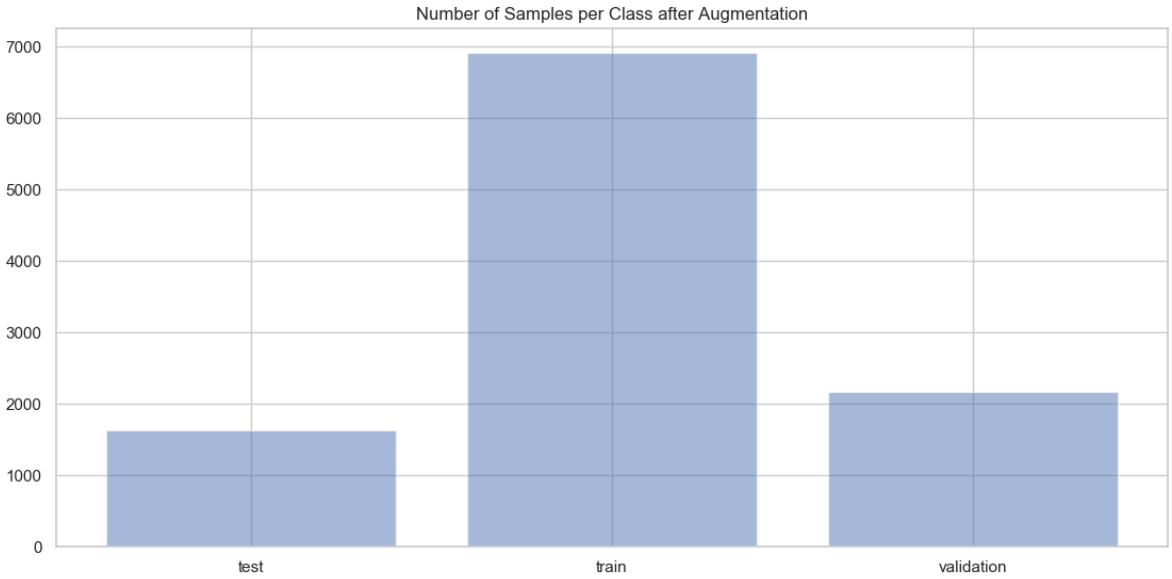

Number of patterns in train directory
700
600
500
400
300
200
100
0
daisy
dandelion
rose
sunflower
tulip

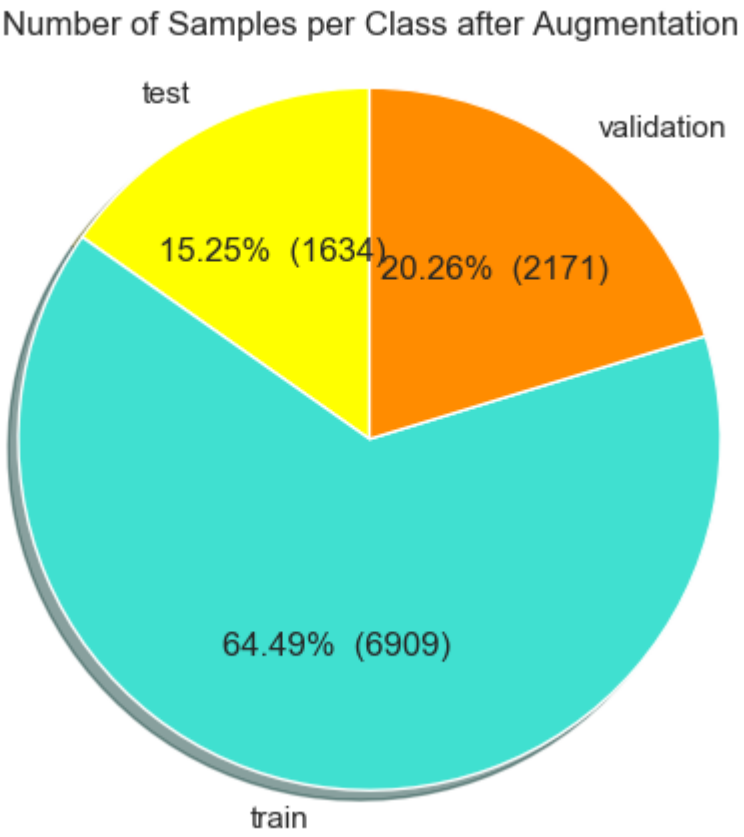

Number of patterns in train directory
daisy
tulip
17.78% (499)
22.73% (638)
24.40% (685)
16.96% (476)
dandelion
sunflower
18.13% (509)
rose

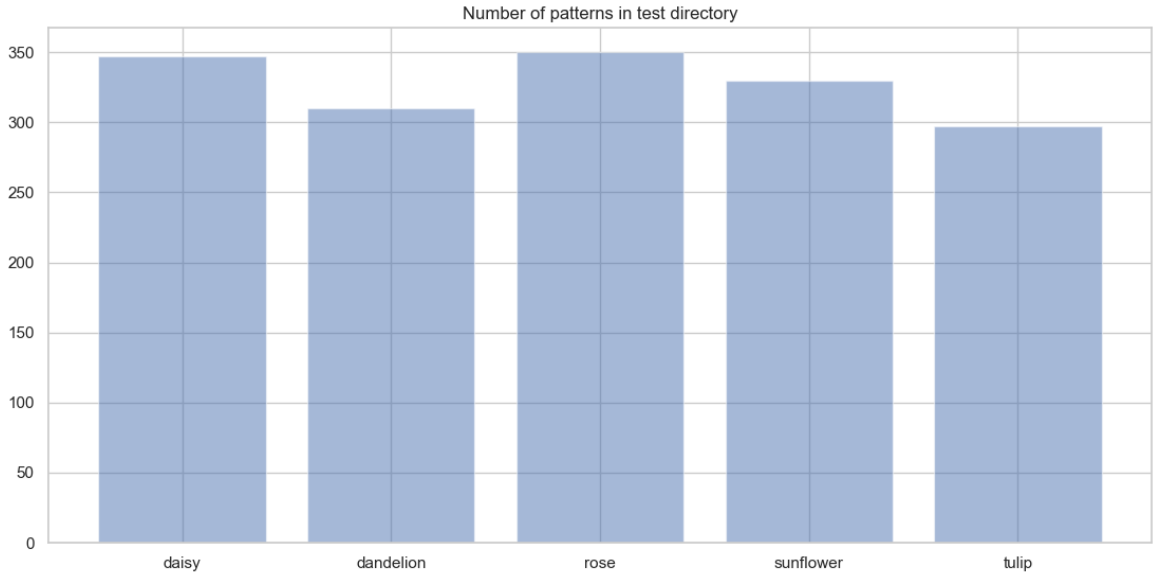

Number of patterns in validation directory
200
175
150
125
100
75
50
25
0
daisy
dandelion
rose
sunflower
tulip

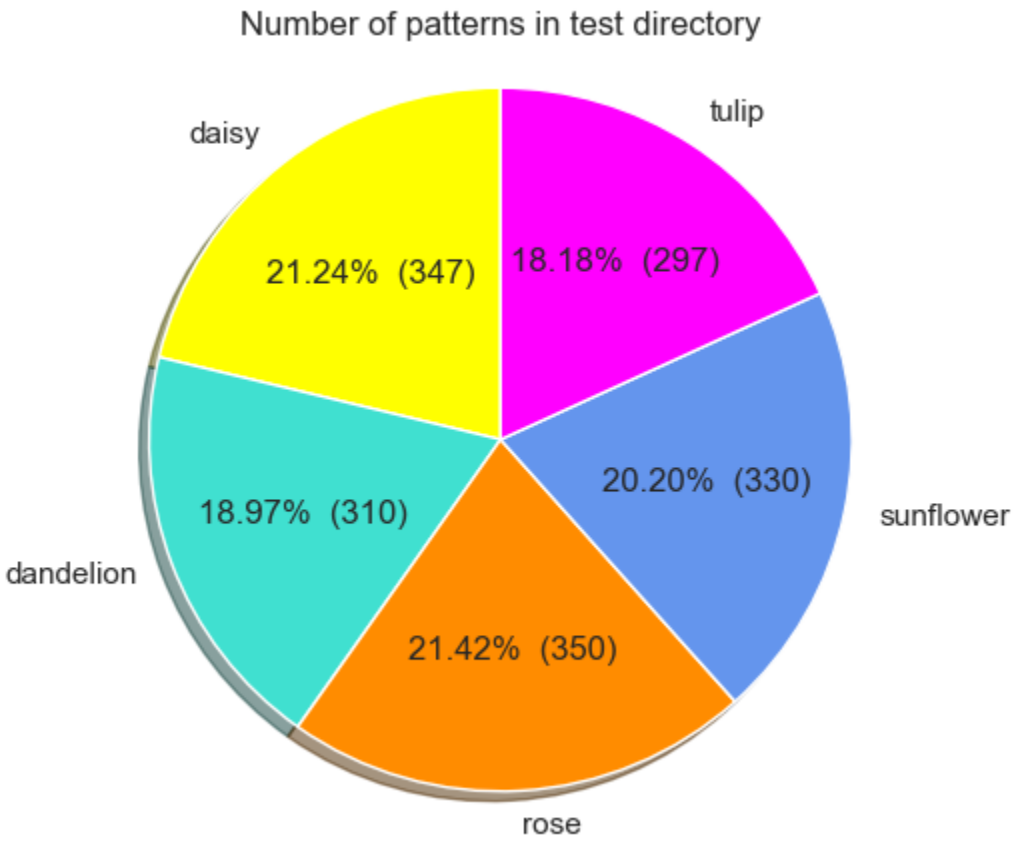

Number of patterns in validation directory
daisy
tulip
17.78% (154)
22.75% (197)
24.36% (211)
16.97% (147)
dandelion
sunflower
18.13% (157)
rose

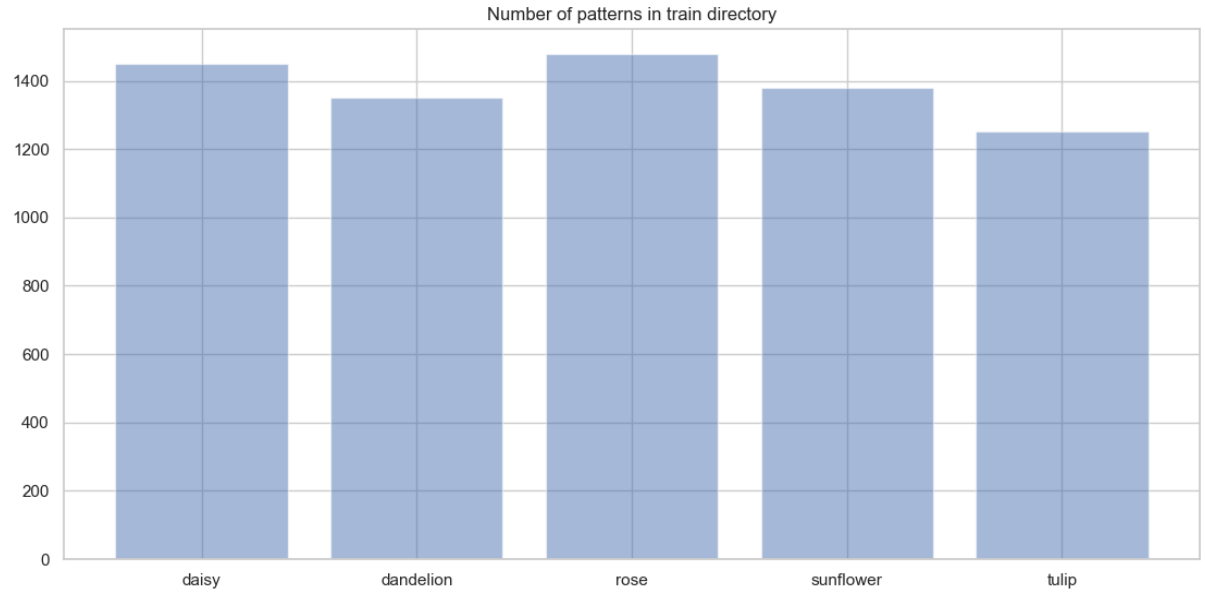
# AFTER AUGMENTATION

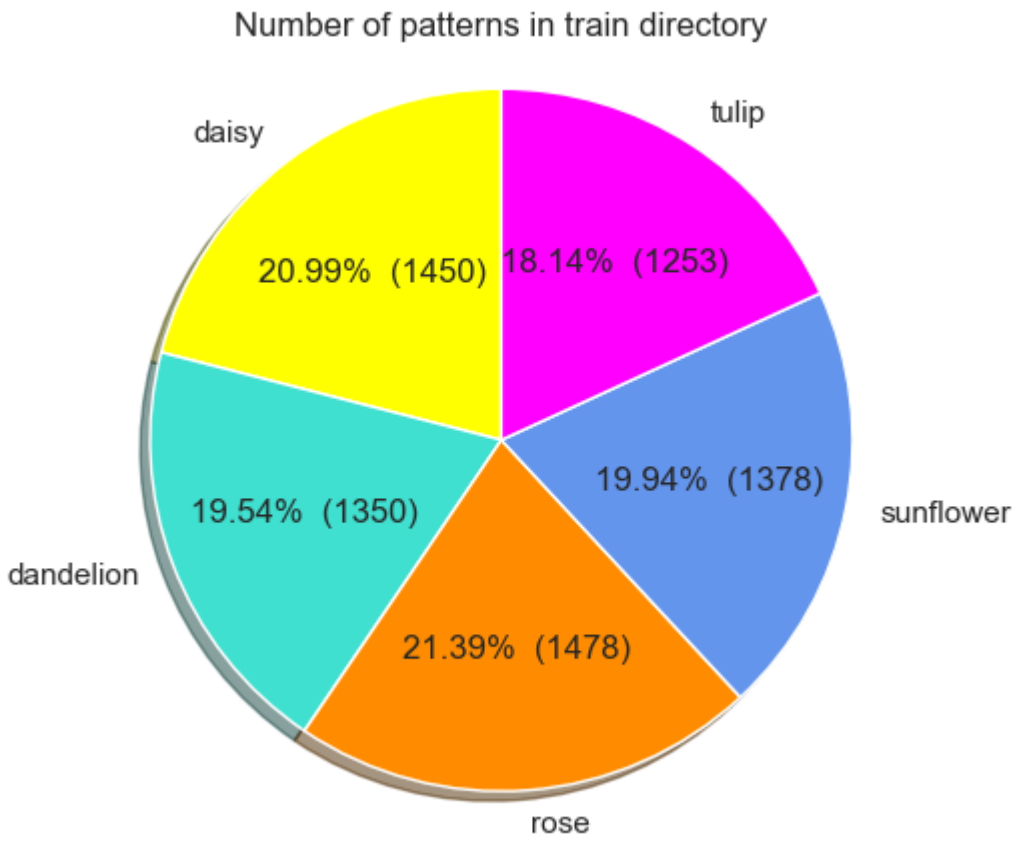


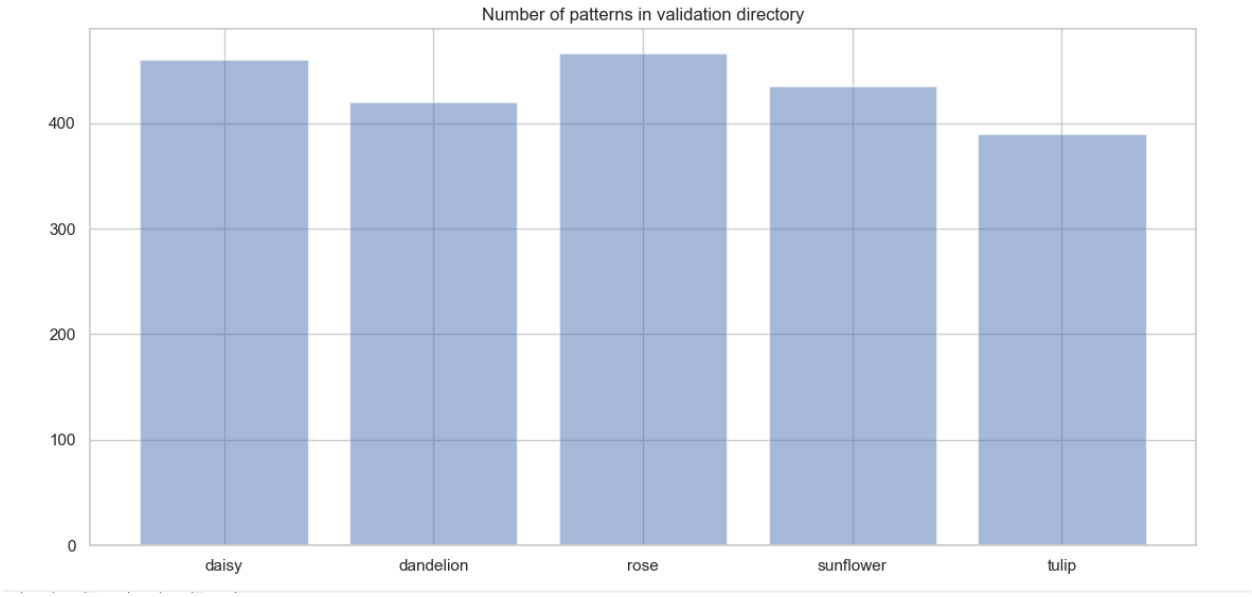



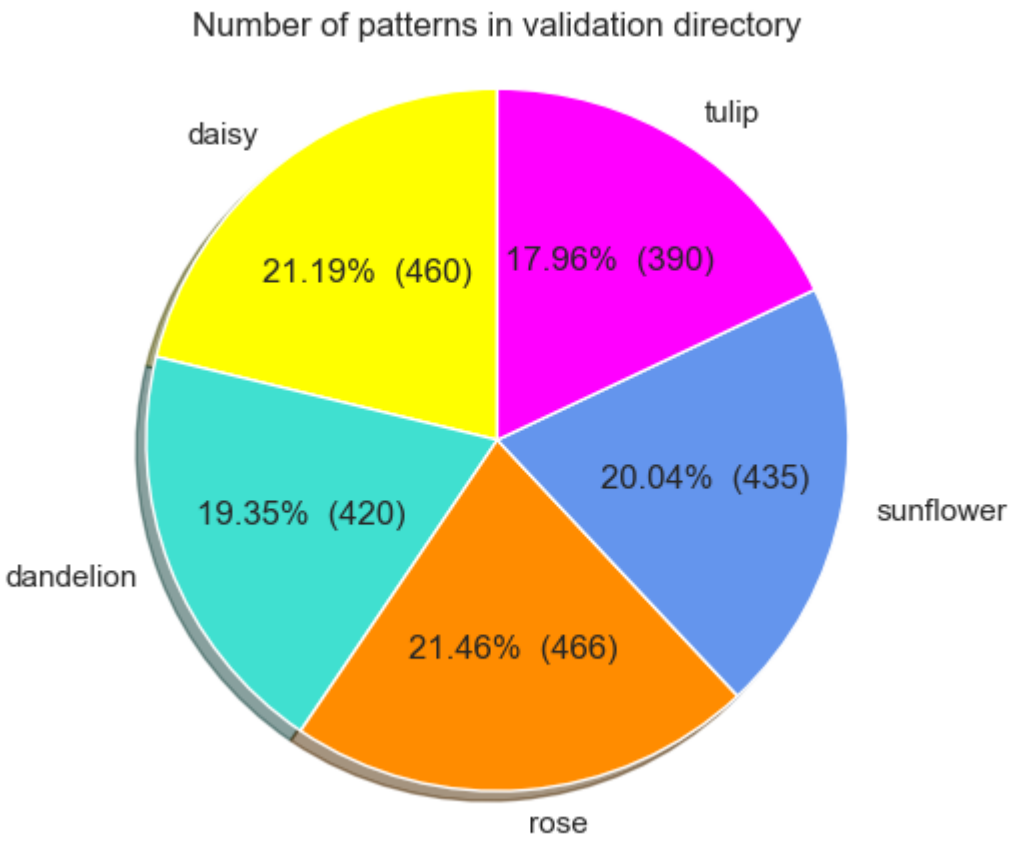

Number of patterns in test directory
350
300
250
200
150
100
50
0
daisy
dandelion
rose
sunflower
tulip


Number of patterns in test directory
daisy
tulip
21.24% (347)
18.18% (297)
20.20% (330)
sunflower
18.97% (310)
dandelion
21.42% (350)
rose


Number of patterns in train directory
1400
1200
1000
800
600
400
200
0
daisy
dandelion
rose
sunflower
tulip


Number of patterns in train directory
daisy
tulip
20.99% (1450)
18.14% (1253)
19.94% (1378)
sunflower
19.54% (1350)
dandelion
21.39% (1478)
rose


Number of patterns in validation directory
400
300
200
100
0
daisy
dandelion
rose
sunflower
tulip


Number of patterns in validation directory
daisy
tulip
21.19% (460)
17.96% (390)
20.04% (435)
sunflower
19.35% (420)
dandelion
21.46% (466)
rose

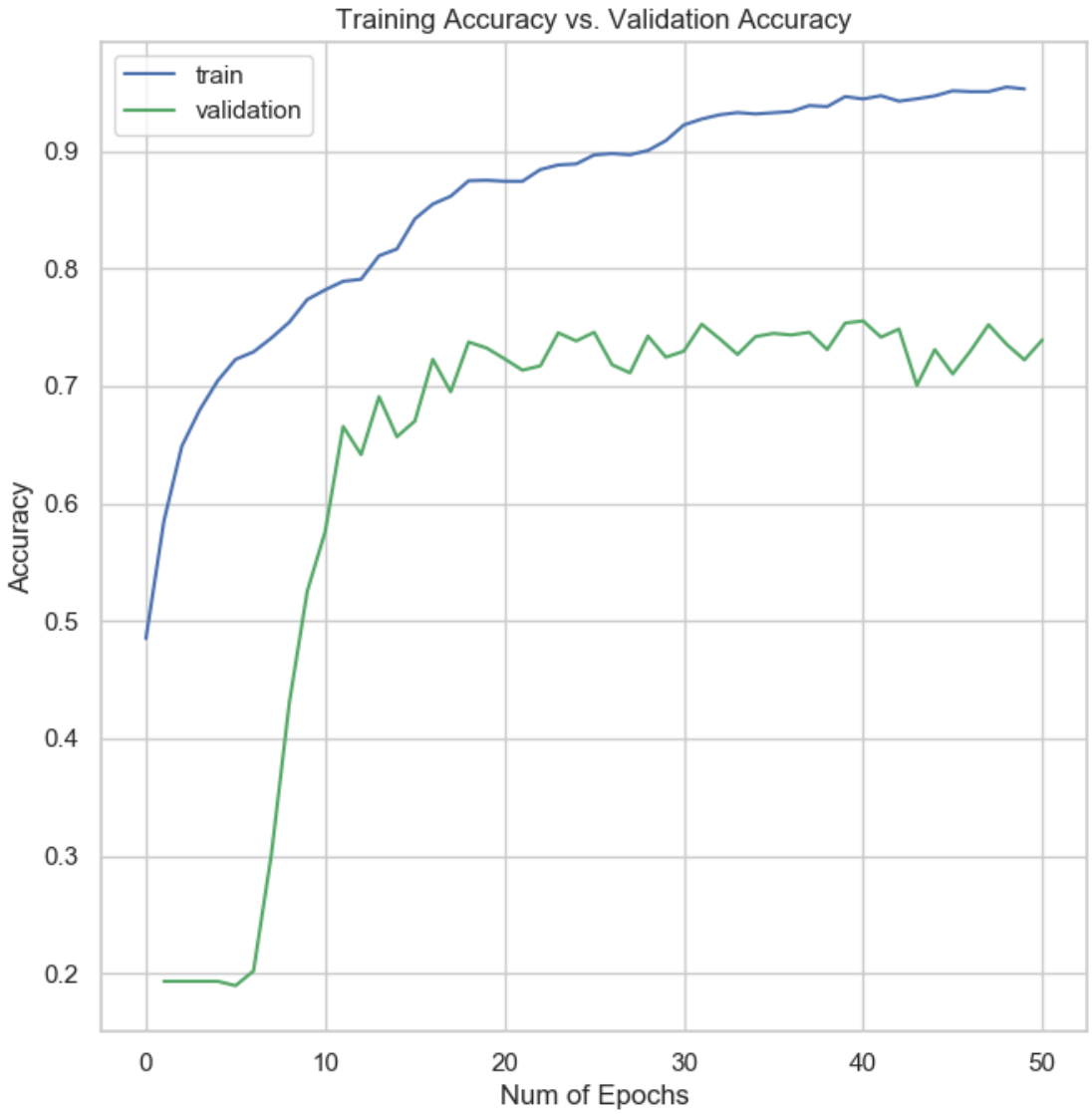
```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_1 (Conv2D)            (None, 128, 128, 32)      2432
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 64, 64, 32)        0
_________________________________________________________________
batch_normalization_1 (Batch (None, 64, 64, 32)        128
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 64, 64, 64)        18496
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 32, 32, 64)        0
_________________________________________________________________
batch_normalization_2 (Batch (None, 32, 32, 64)        256
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 32, 32, 96)        55392
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 16, 16, 96)        0
_________________________________________________________________
batch_normalization_3 (Batch (None, 16, 16, 96)        384
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 16, 16, 96)        83040
_________________________________________________________________
max_pooling2d_4 (MaxPooling2 (None, 8, 8, 96)          0
_________________________________________________________________
batch_normalization_4 (Batch (None, 8, 8, 96)          384
_________________________________________________________________
flatten_1 (Flatten)          (None, 6144)              0
_________________________________________________________________
dropout_1 (Dropout)          (None, 6144)              0
_________________________________________________________________
dense_1 (Dense)              (None, 512)               3146240
_________________________________________________________________
activation_1 (Activation)    (None, 512)               0
_________________________________________________________________
dense_2 (Dense)              (None, 5)                 2565
=================================================================
Total params: 3,309,317
Trainable params: 3,308,741
Non-trainable params: 576
_________________________________________________________________
```

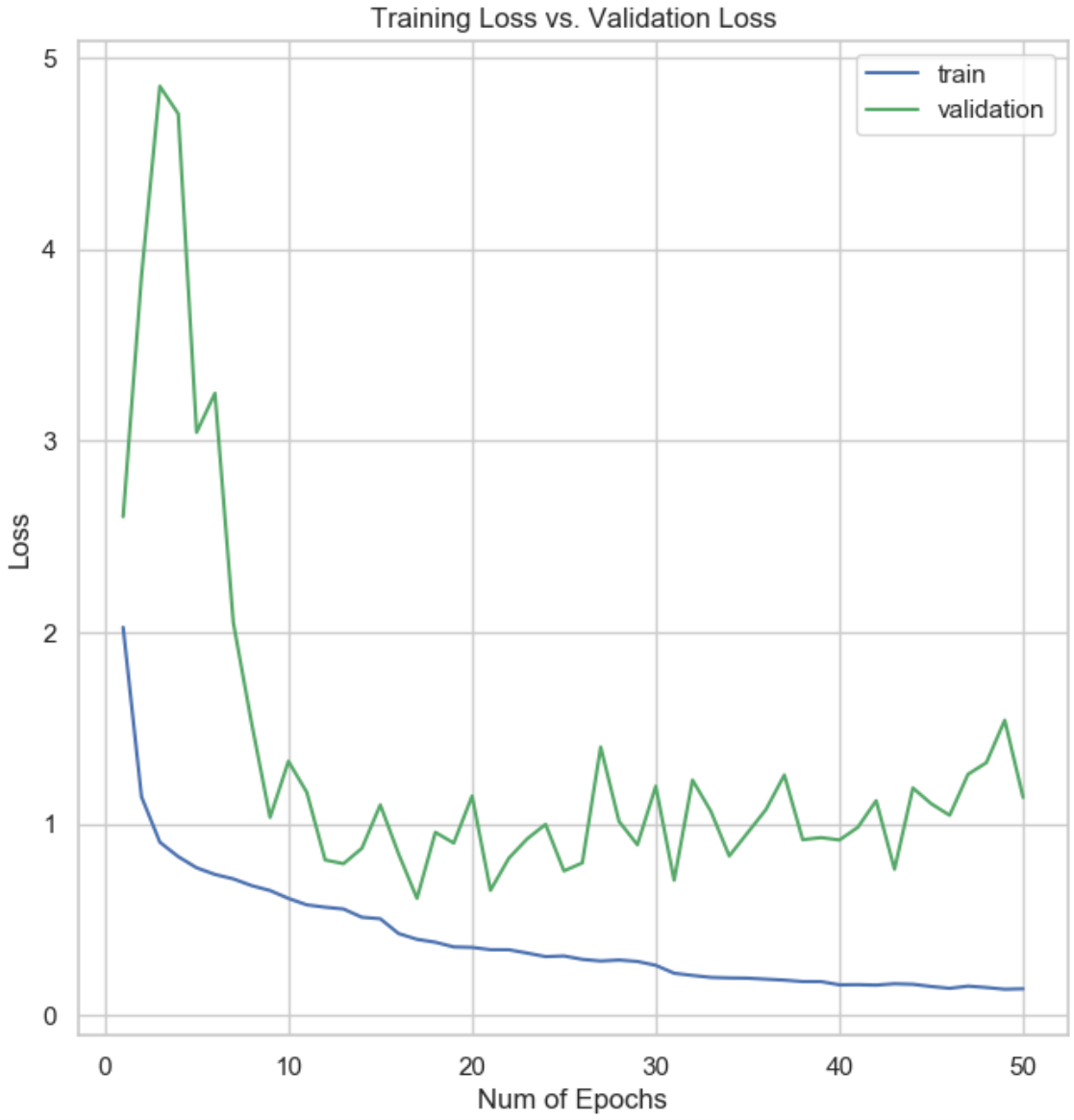
```
Epoch 31/50
changing learning rate to .0003 at epoch 30
new learning rate =  0.0003
```

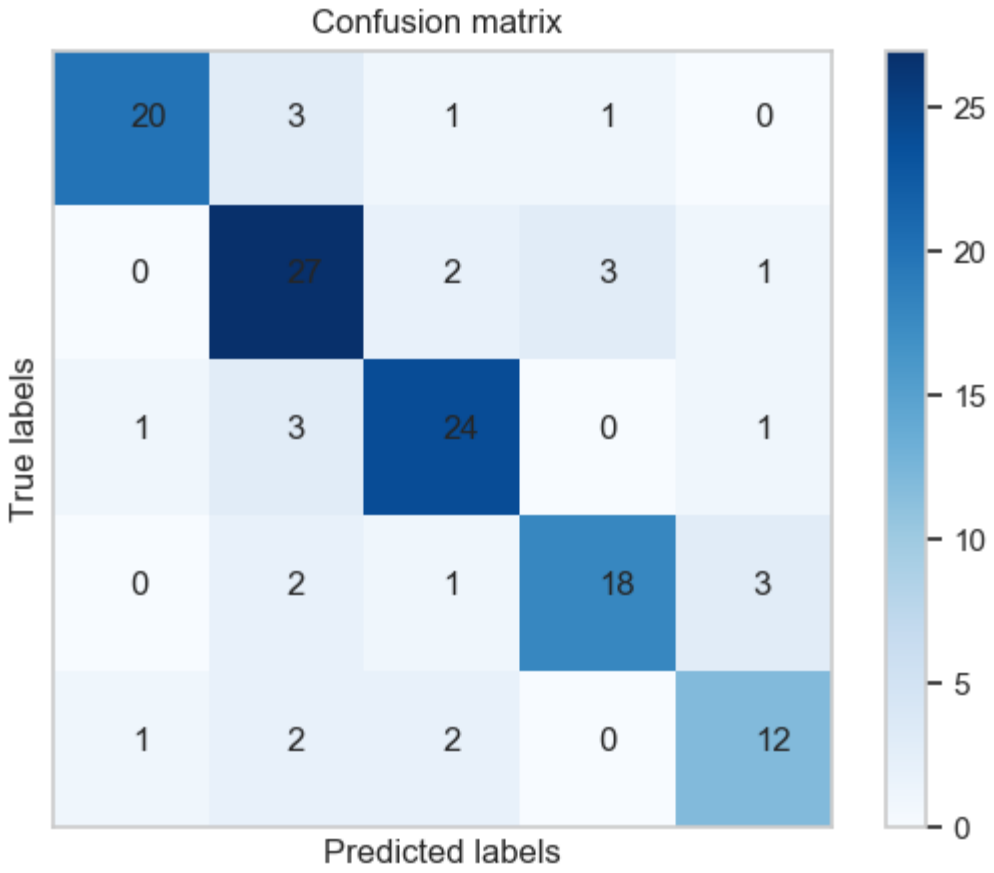
```
Epoch 16/50
changing learning rate to .0005 at epoch 15
new learning rate =  0.0005
```

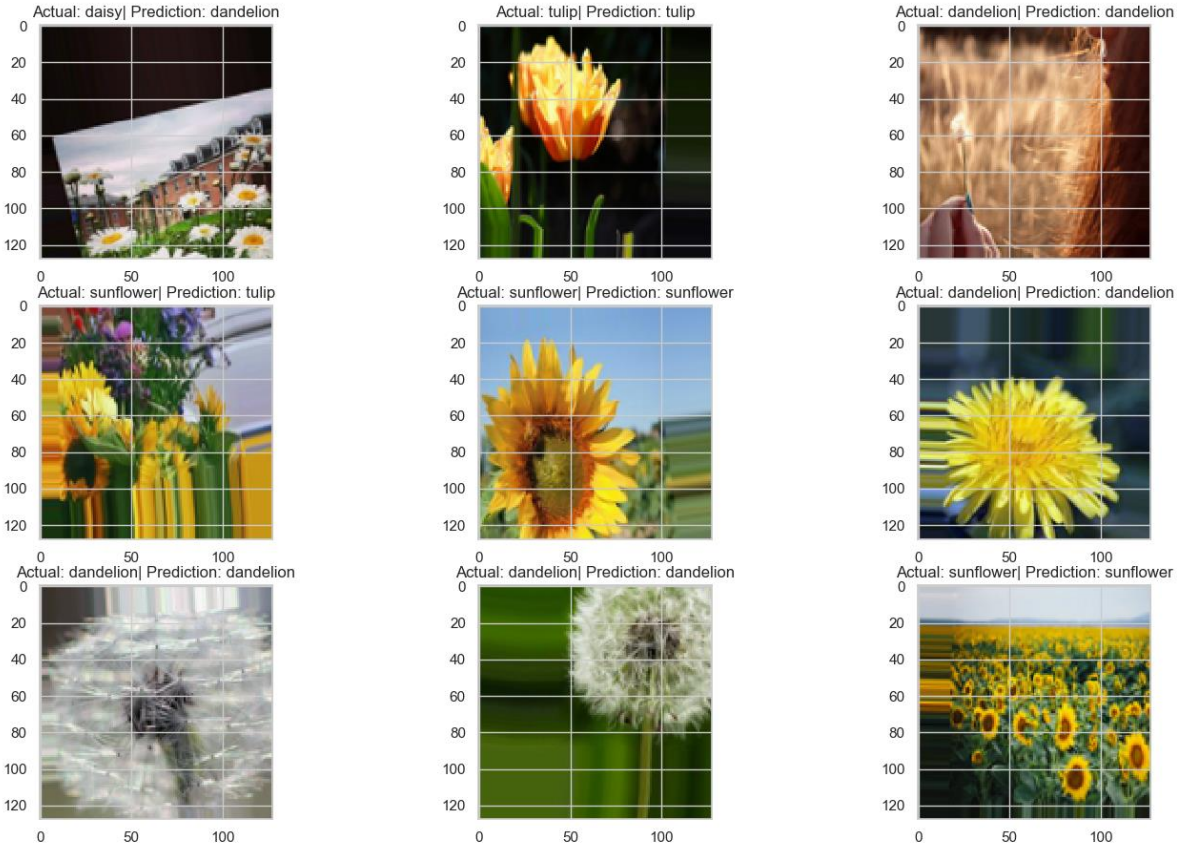
# RESULTS

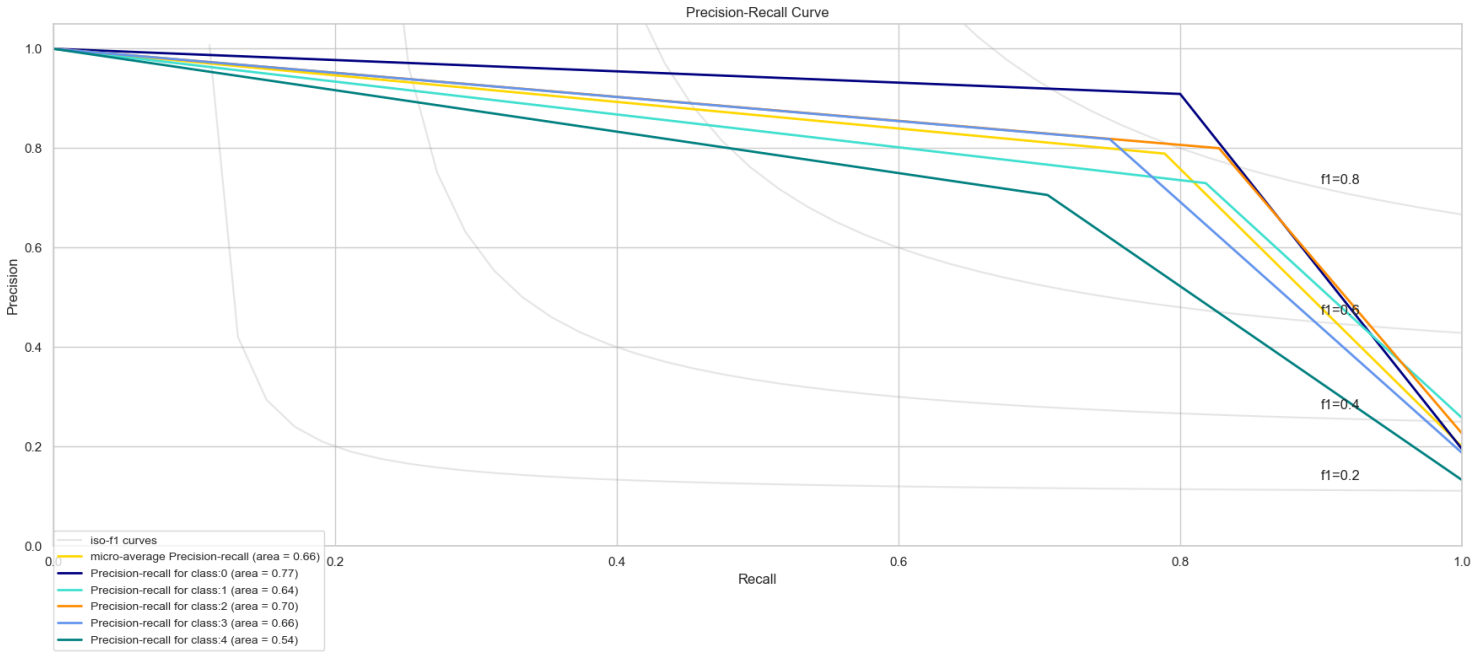
| acc | val_acc | loss | val_loss |
|---|---|---|---|
| 0.485 | 0.193 | 2.03 | 2.6 |
| 0.585 | 0.193 | 1.14 | 3.86 |
| 0.649 | 0.193 | 0.903 | 4.85 |
| 0.68 | 0.193 | 0.828 | 4.71 |
| 0.704 | 0.19 | 0.77 | 3.05 |
| 0.723 | 0.202 | 0.735 | 3.25 |
| 0.729 | 0.302 | 0.712 | 2.05 |
| 0.741 | 0.431 | 0.676 | 1.52 |
| 0.754 | 0.526 | 0.651 | 1.03 |
| 0.774 | 0.576 | 0.61 | 1.33 |
| 0.782 | 0.666 | 0.576 | 1.16 |
| 0.789 | 0.642 | 0.564 | 0.811 |
| 0.791 | 0.691 | 0.554 | 0.791 |
| 0.811 | 0.657 | 0.511 | 0.872 |
| 0.817 | 0.67 | 0.503 | 1.1 |
| 0.842 | 0.723 | 0.426 | 0.842 |
| 0.855 | 0.695 | 0.396 | 0.61 |
| 0.861 | 0.737 | 0.38 | 0.955 |
| 0.875 | 0.732 | 0.356 | 0.899 |
| 0.875 | 0.723 | 0.354 | 1.15 |
| 0.874 | 0.713 | 0.342 | 0.652 |
| 0.874 | 0.717 | 0.341 | 0.82 |
| 0.884 | 0.745 | 0.324 | 0.921 |
| 0.888 | 0.738 | 0.305 | 0.997 |
| 0.889 | 0.746 | 0.309 | 0.753 |
| 0.897 | 0.718 | 0.291 | 0.795 |
| 0.898 | 0.711 | 0.282 | 1.4 |
| 0.897 | 0.743 | 0.288 | 1.01 |
| 0.9 | 0.725 | 0.28 | 0.89 |
| 0.909 | 0.73 | 0.26 | 1.2 |
| 0.922 | 0.753 | 0.219 | 0.704 |
| 0.927 | 0.74 | 0.207 | 1.23 |
| 0.931 | 0.727 | 0.197 | 1.06 |
| 0.933 | 0.742 | 0.194 | 0.832 |
| 0.932 | 0.745 | 0.193 | 0.953 |
| 0.933 | 0.743 | 0.188 | 1.07 |
| 0.934 | 0.746 | 0.183 | 1.25 |
| 0.939 | 0.731 | 0.175 | 0.917 |
| 0.938 | 0.754 | 0.175 | 0.928 |
| 0.946 | 0.755 | 0.158 | 0.915 |
| 0.944 | 0.742 | 0.159 | 0.981 |
| 0.947 | 0.749 | 0.156 | 1.12 |
| 0.942 | 0.701 | 0.164 | 0.762 |
| 0.944 | 0.731 | 0.161 | 1.19 |
| 0.947 | 0.71 | 0.149 | 1.1 |
| 0.951 | 0.73 | 0.14 | 1.04 |
| 0.95 | 0.752 | 0.151 | 1.26 |
| 0.95 | 0.736 | 0.144 | 1.32 |
| 0.954 | 0.722 | 0.135 | 1.54 |
| 0.953 | 0.739 | 0.137 | 1.14 |


Training Accuracy vs. Validation Accuracy
train
validation
Accuracy
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
10
20
30
40
50
Num of Epochs

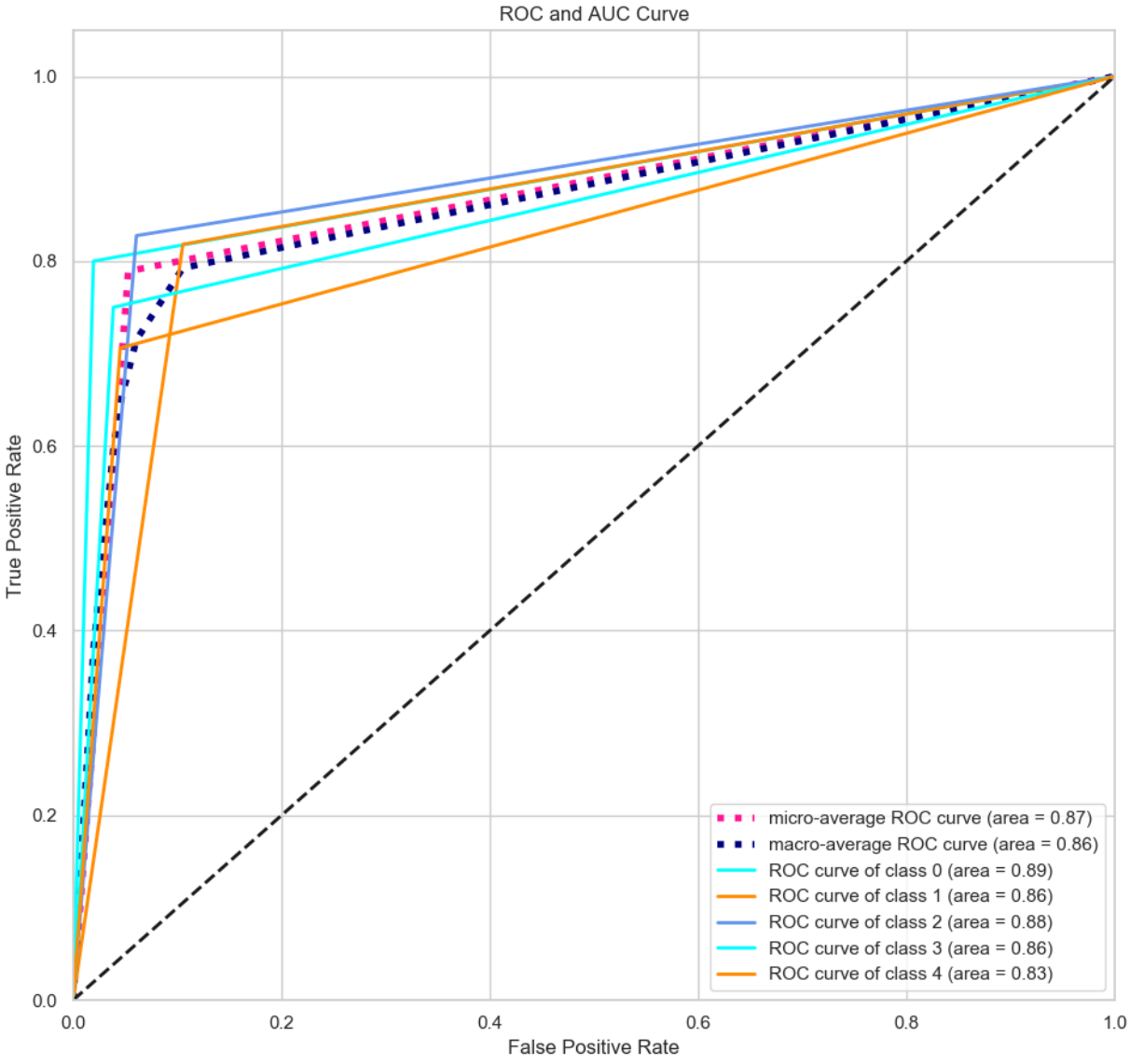

Training Loss vs. Validation Loss
train
validation
Loss
Num of Epochs
0
1
2
3
4
5
0
10
20
30
40
50


Confusion matrix
20 3 1 1 0
0 27 2 3 1
1 3 24 0 1
0 2 1 18 3
1 2 2 0 12
True labels
Predicted labels
25
20
15
10
5
0

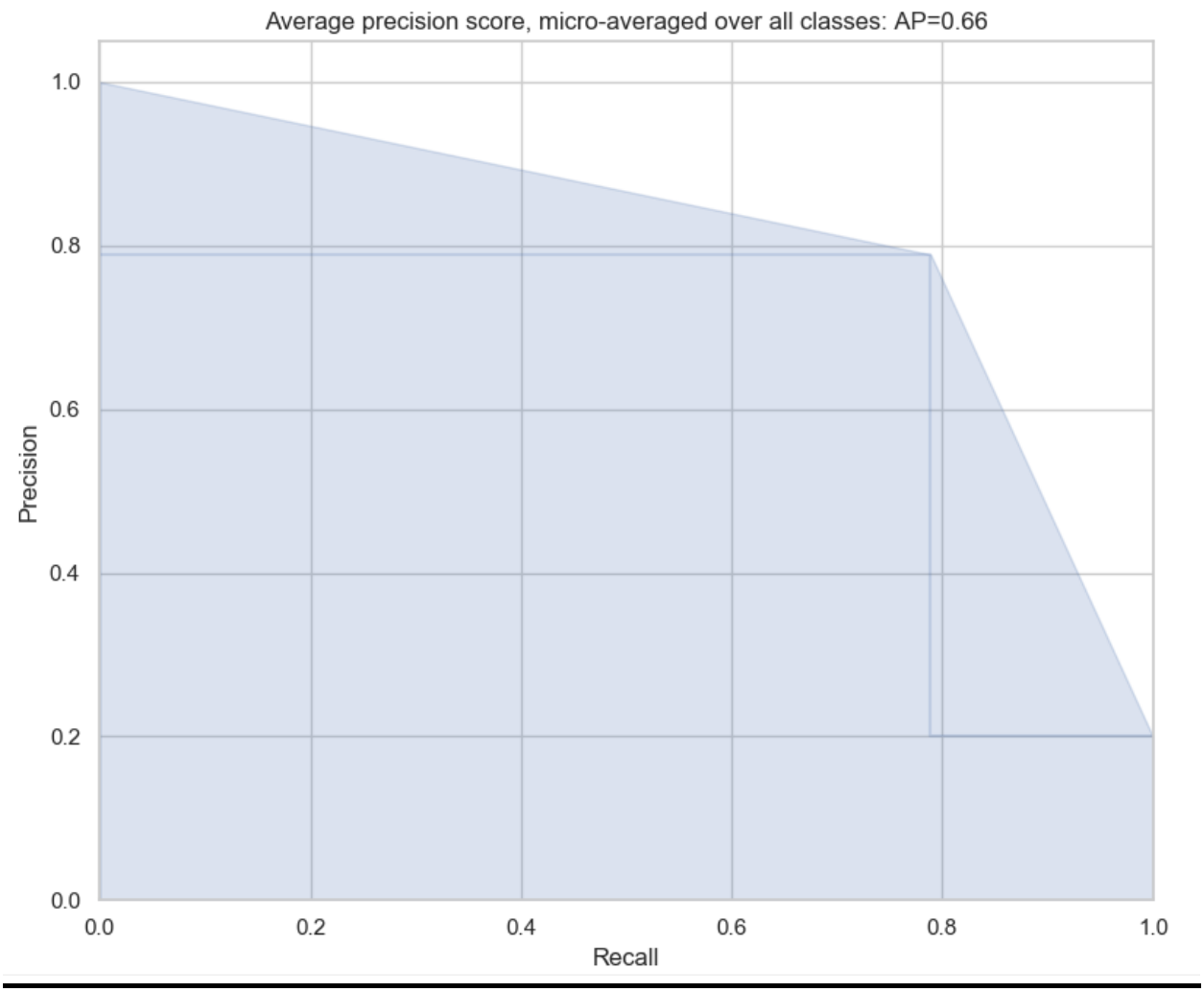

Actual: daisy| Prediction: dandelion
Actual: tulip| Prediction: tulip
Actual: dandelion| Prediction: dandelion
Actual: sunflower| Prediction: tulip
Actual: sunflower| Prediction: sunflower
Actual: dandelion| Prediction: dandelion
Actual: dandelion| Prediction: dandelion
Actual: dandelion| Prediction: dandelion
Actual: sunflower| Prediction: sunflower




| | precision | recall | f1-score | support |
|---|---|---|---|---|
| daisy | 0.91 | 0.80 | 0.85 | 25 |
| dandelion | 0.73 | 0.82 | 0.77 | 33 |
| rose | 0.80 | 0.83 | 0.81 | 29 |
| sunflower | 0.82 | 0.75 | 0.78 | 24 |
| tulip | 0.71 | 0.71 | 0.71 | 17 |
| accuracy | | | 0.79 | 128 |
| macro avg | 0.79 | 0.78 | 0.78 | 128 |
| weighted avg | 0.79 | 0.79 | 0.79 | 128 |




```
ROC_AUC_Score: 0.863285710028401
Average precision score, micro-averaged over all classes: 0.66
```


Average precision score, micro-averaged over all classes: AP=0.66
Precision
Recall
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0