



Image Classification: Fruits 360

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Fruits 360 Dataset



- 40 Fruits
- 71,000+ Images
- 53,000+ Training Images
- 17,000+ Testing Images
- Image Size: 100x100
- Fruits Planted In Shaft Of Low Speed Motor (3 rpm) & Short Movie Was Recorded

Objective:

Accurately Classify Unseen Images of Fruits Into 1 of 40 Classes



What We See

08 02 22 97 38 15 00 40 00 75 04 05 07 78 32 12 50 77 91 08
49 49 99 40 17 81 18 37 40 87 17 40 98 43 69 46 04 56 62 00
81 49 31 73 55 79 14 29 93 71 40 47 53 88 30 03 49 13 36 65
92 70 99 23 04 60 11 42 49 24 49 54 01 32 56 71 37 02 36 91
22 31 14 71 51 67 43 89 41 92 36 54 22 40 40 28 46 33 13 60
24 47 32 40 89 03 45 02 44 78 33 76 34 84 20 35 17 12 90
32 98 81 28 64 23 47 10 26 38 40 47 59 54 70 66 18 38 44 70
47 24 20 48 02 62 12 20 95 43 94 39 43 05 40 91 46 49 94 21
24 55 58 05 64 79 99 24 97 17 78 78 94 83 14 88 34 89 43 72
21 36 23 09 75 05 74 44 20 45 55 14 00 41 39 97 34 31 33 95
78 17 53 28 22 75 31 47 55 94 03 80 04 62 14 14 09 53 56 92
16 39 05 42 96 35 31 47 55 58 88 24 00 17 54 24 36 29 85 57
86 54 00 48 35 71 89 07 05 44 44 37 44 60 21 58 51 54 17 58
19 80 81 48 05 94 47 69 28 73 92 13 86 32 17 77 04 69 35 40
04 52 08 83 97 35 99 14 07 97 57 32 16 26 26 79 33 27 98 66
88 34 46 87 57 62 20 72 03 46 33 67 46 55 12 32 43 93 53 69
04 42 14 73 38 25 39 11 24 94 72 18 08 46 29 32 40 42 76 36
20 49 34 41 72 30 23 88 34 42 99 49 82 47 59 85 74 04 34 16
20 73 35 29 78 31 90 01 74 31 49 71 48 84 81 14 23 97 05 54
01 70 54 71 83 51 54 49 16 92 33 48 41 43 52 01 89 19 47 48

What Computers See

Original Image,
Resized, Greyscale

(nothing fancy here)

Map/Convert values
between set range

(break up linearity)

After repeating steps
2-4, insert into artificial
neural network



Convolutional Layer:

Feature Detection/Patterns (edges, curves)

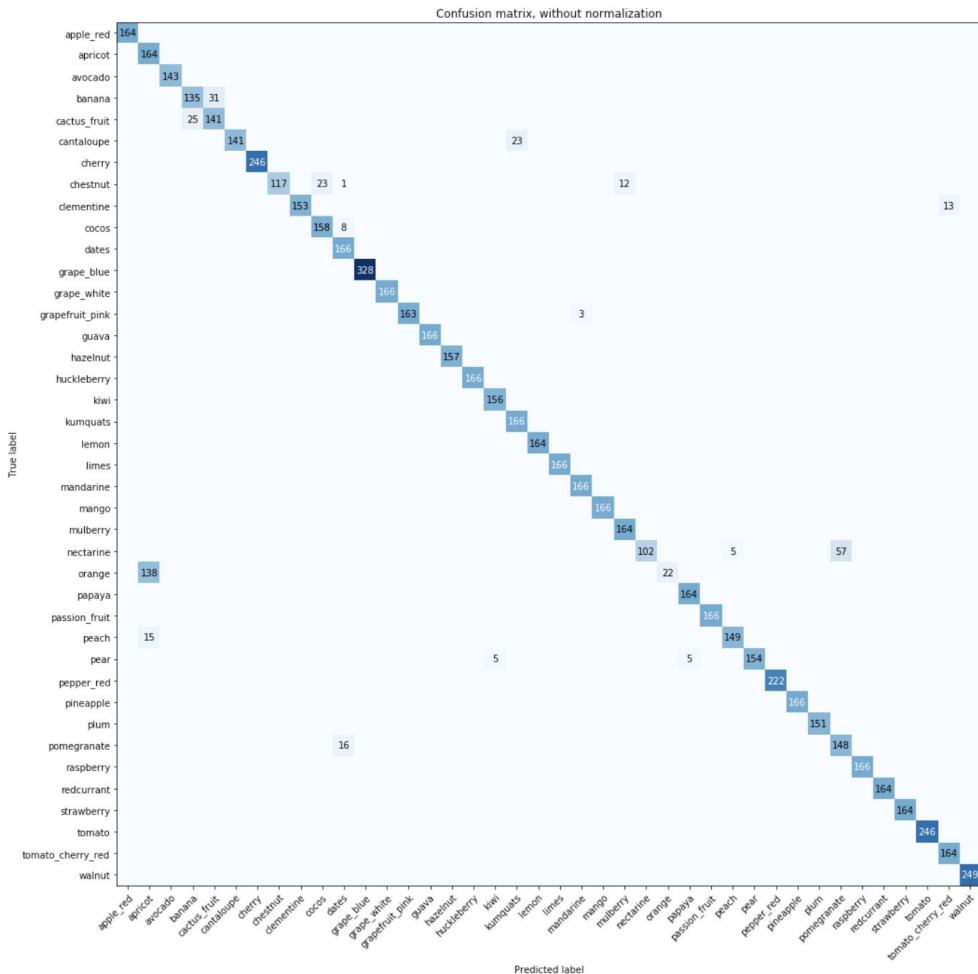
Spatial Invariance:

Prepare CNN to detect different orientations,
positions, angles, etc of object in image

Results

- Training Accuracy: 96.37%
- Validation Accuracy: 96.88%
- Testing Accuracy: 94.57%
 - *the actual important one*

Not terrible...but

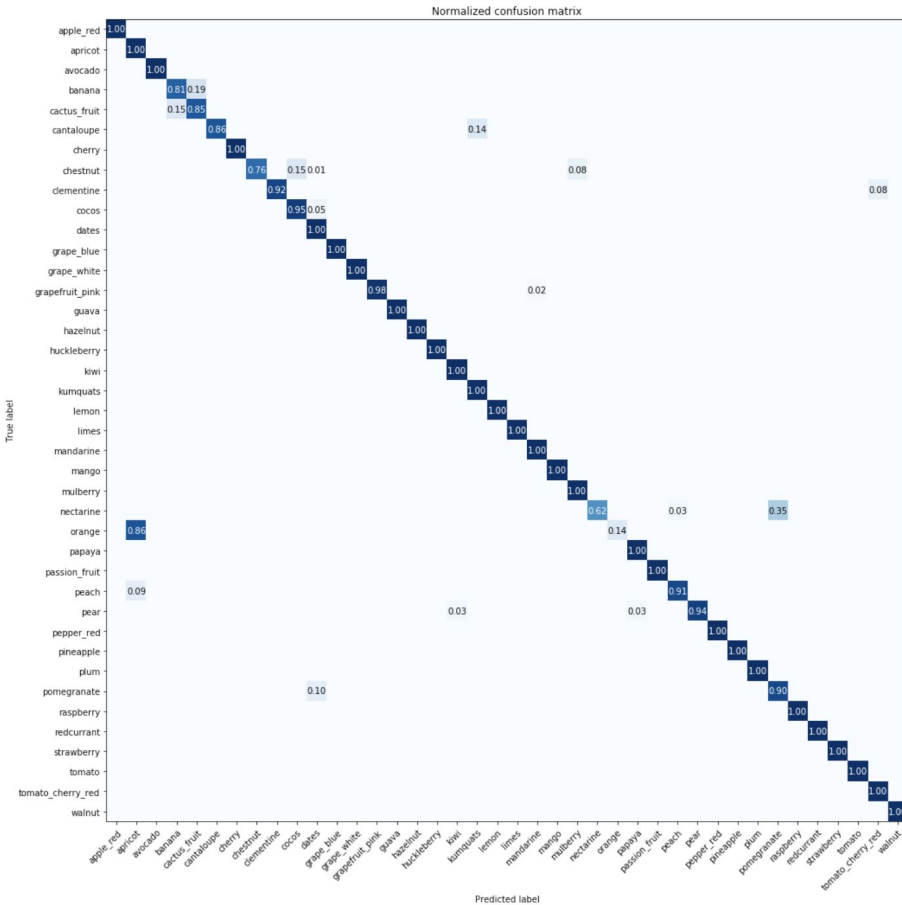


Key Takeaways:

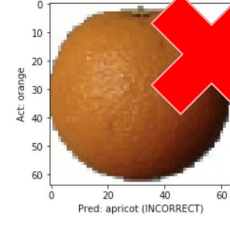
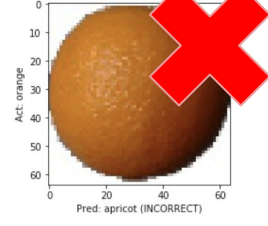
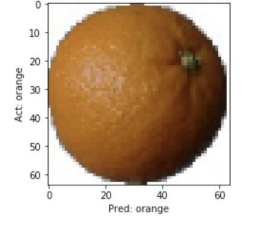
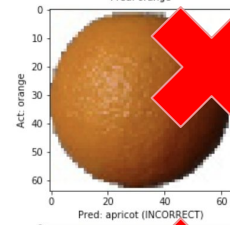
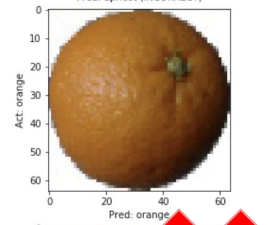
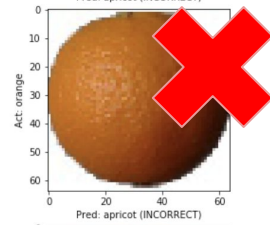
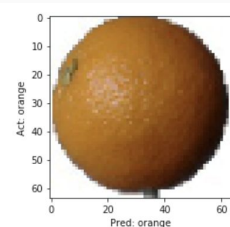
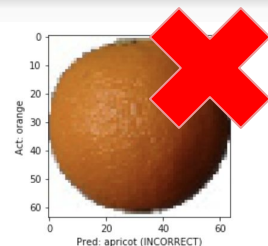
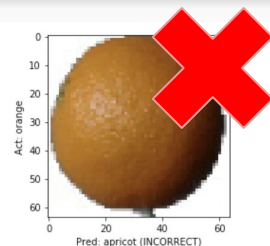
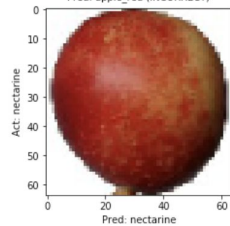
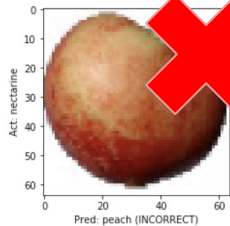
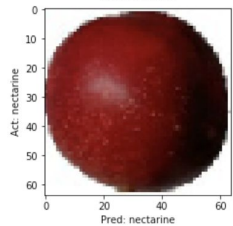
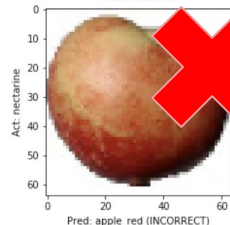
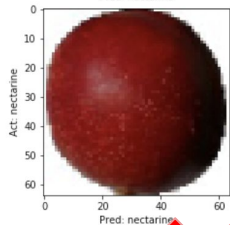
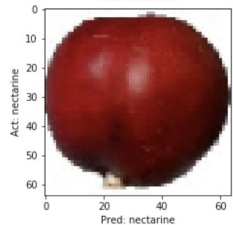
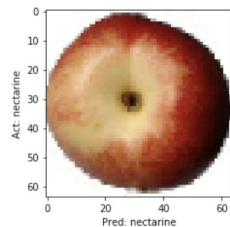
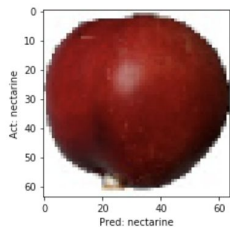
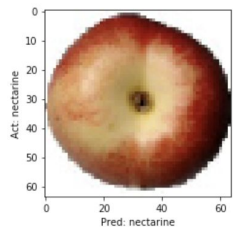
- Out of the 160 Oranges
 - 138 **INCORRECTLY** predicted as apricot (86.25%)
 - 22 **CORRECTLY** predicted as orange (13.75%)
- Out of the 159 Nectarines
 - 57 **INCORRECTLY** predicted as pomegranate (35.80%)
 - 102 **CORRECTLY** predicted as nectarine (64.20%)
- Out of the 164 Pears
 - 5 **INCORRECTLY** predicted as kiwi (3%)
 - 5 **INCORRECTLY** predicted as papaya (3%)
 - 154 **CORRECTLY** predicted as pear (93.9%)

Interestingly,

- Prediction accuracy/error was not bidirectional
 - Oranges highly misclassified as nectarines
 - Nectarines not highly misclassified as oranges
- Only one fruit (pear) was misclassified as two different fruits (kiwi, papaya)
 - Every other fruit, when misclassified, was predicted as the same class



Preview Predictions



Key Takeaways

- Computers see images in arrays of numbers - they don't naturally see color, edges, or anything until trained
- High Quality dataset (potentially) made image classification challenge less challenging (though it wasn't easy, I promise)
 - All images were centered, on a white screen, and essentially had 360 rotation
- Prediction accuracy is not bilateral
 - When a computer gets "confused" by what it's looking at, it doesn't
- Why were oranges so accurately classified?
 - Why only one class?
 - How do you address this?
 - More data
 - Image augmentation

Any Questions?

Thanks!