“Transfer Learning Using VGG-16 to Detect Crop Diseases”

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Introduction

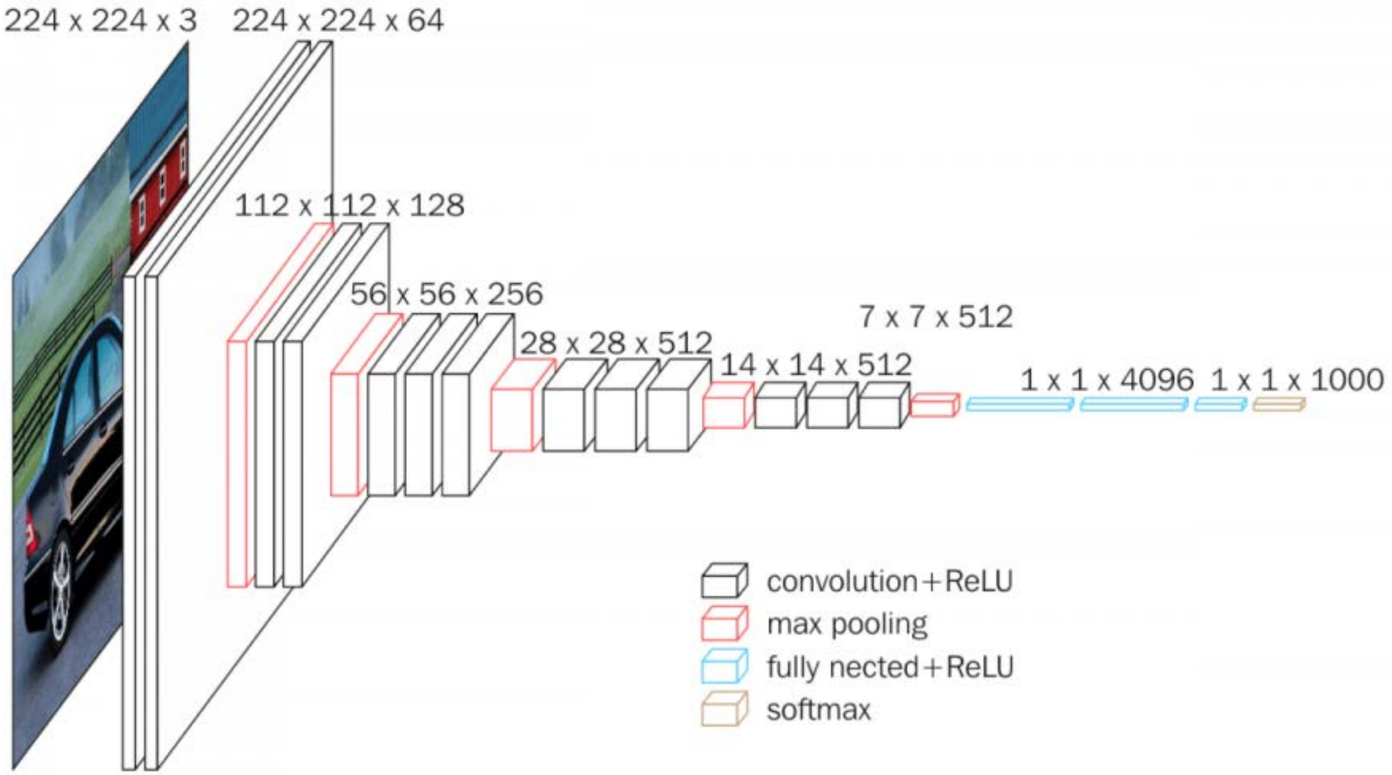
- Machine Learning -> Agriculture
- Computer vision models applied to disease detection
- Northern Leaf Blight causes ~$2 billion in damage per year
- Lack of data readily available
- Transfer learning can help!

Data Sets

PlantVillage

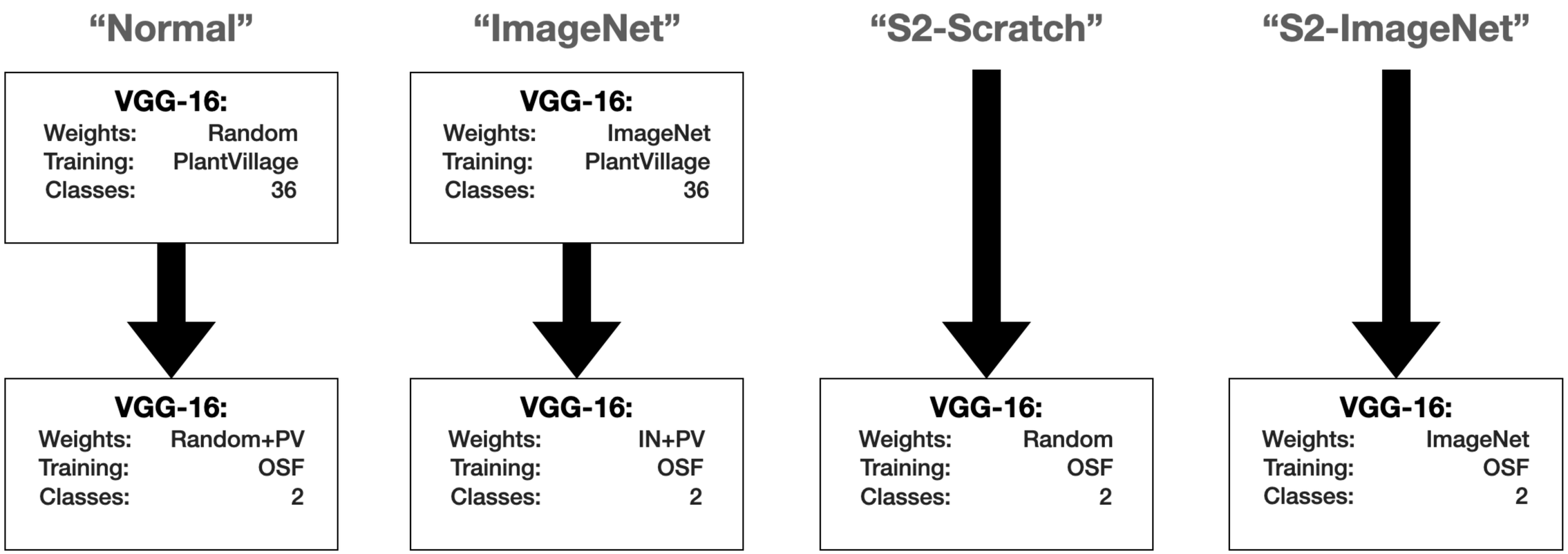
OSF

Hello, VGG-16



ImageNet

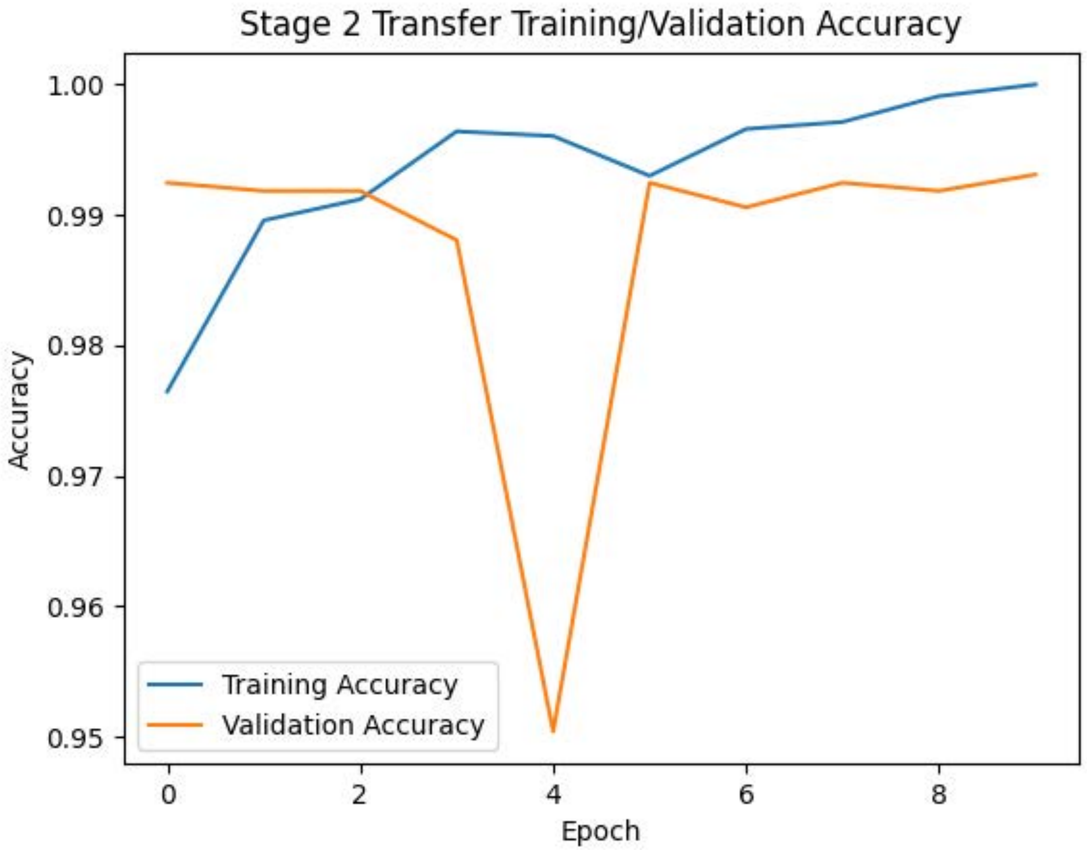
Experimental Models

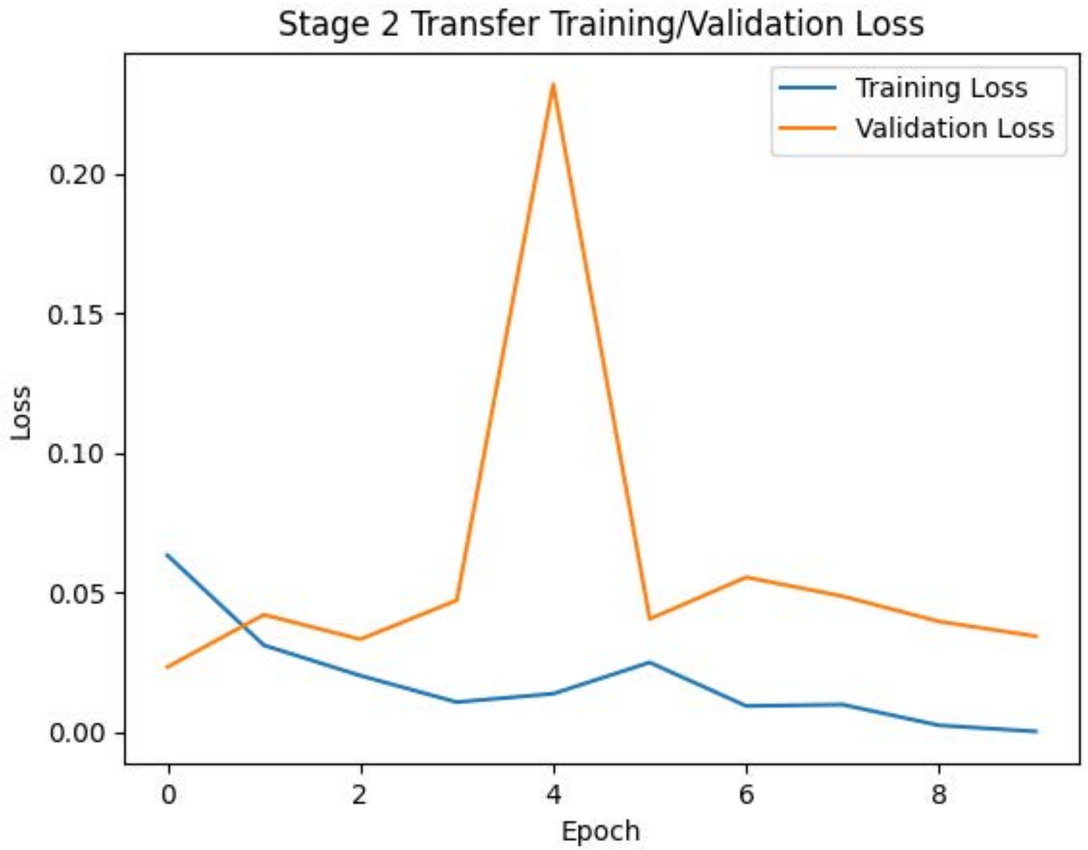


Results

Transfer Model	**Evaluation Criteria**		**Test Results**			
	Epochs	*Learning Rate*	*Stage 1 Acc.*	*Stage 1 Loss*	*Stage 2 Acc.*	*Stage 2 Loss*
Normal	**5**	**0.0001**	0.9247	0.2953	0.95226	0.1142
	10	0.01	0.1058	3.284	0.8543	0.4155
	10	0.001	0.1054	3.284	0.8328	3.165
	10	0.0001	0.9234	0.3153	0.9422	0.1429
ImageNet	5	0.0001	0.9459	0.1663	0.9899	0.03172
	10	0.01	0.9376	4.667	0.9899	0.3899
	10	**0.001**	0.9340	0.5017	**0.9925**	**0.02814**
	10	0.0001	**0.9553**	**0.1341**	0.9874	0.03538
S2-Scratch	5	0.0001	—	—	0.9673	0.1952
	10	0.01	—	—	0.8543	3.882
	10	0.001	—	—	0.8543	0.4153
	10	**0.0001**	—	—	0.9849	0.07688
S2-ImageNet	5	0.0001	—	—	0.9887	0.03575
	10	0.01	—	—	0.9874	0.7633
	10	**0.001**	—	—	0.9899	0.06181
	10	0.0001	—	—	0.9899	0.2811

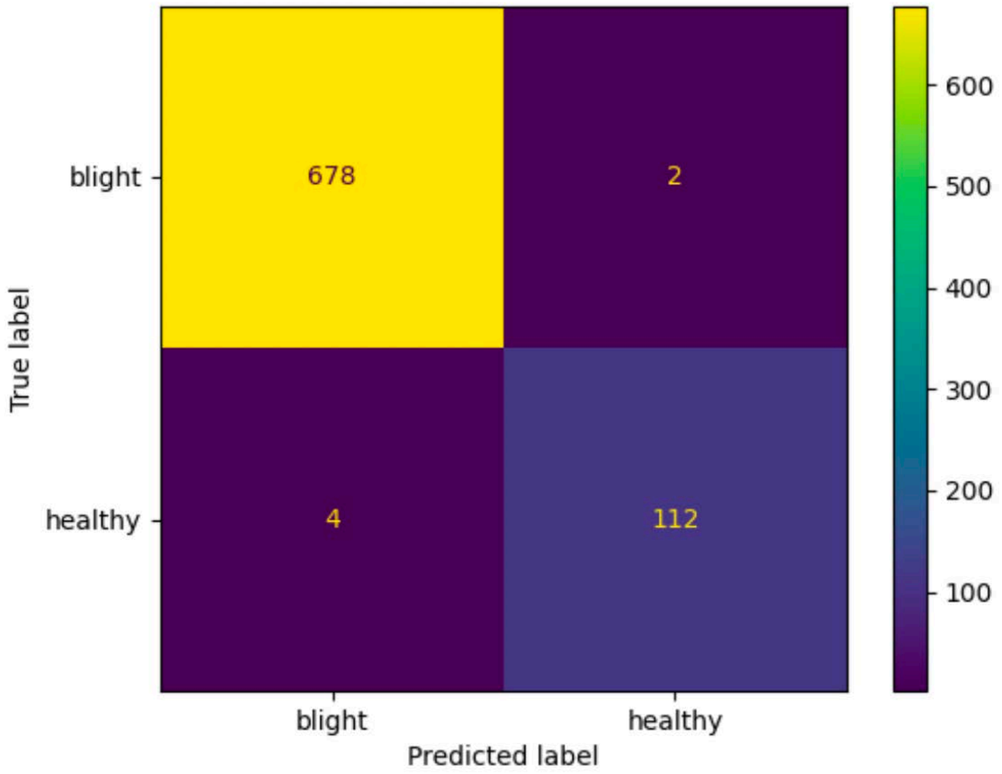
Results

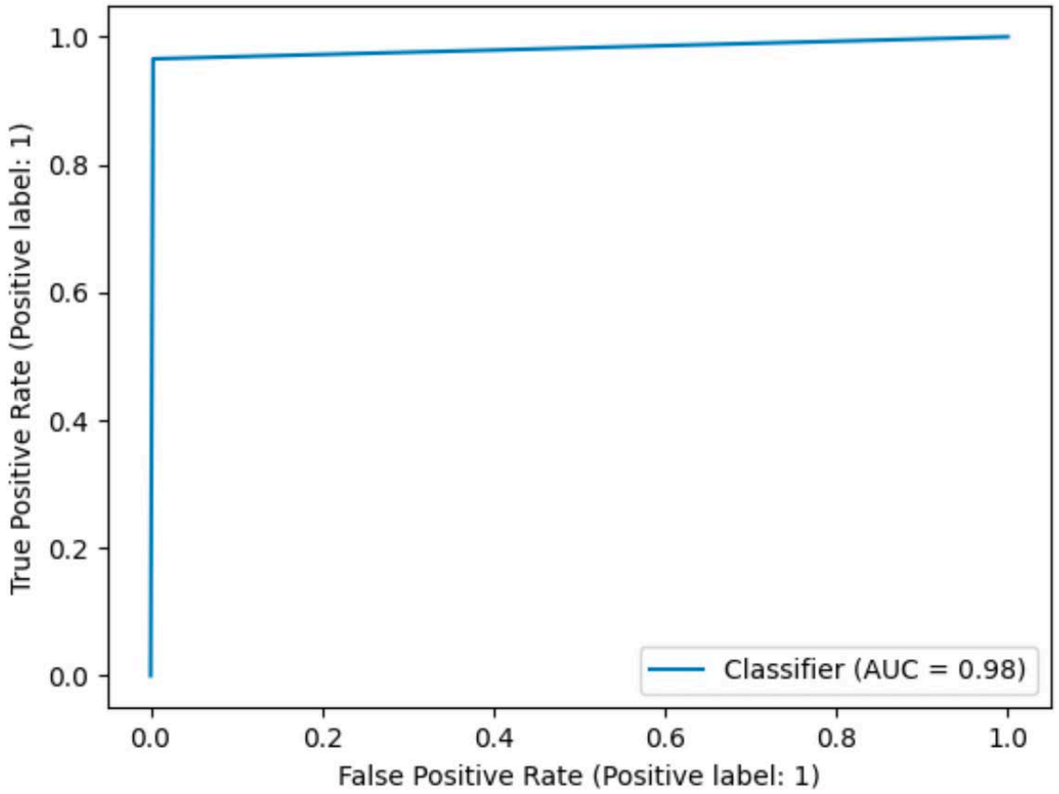




ImageNet Transfer Model: 0.9925 test accuracy

Results


blight
healthy
678
2
4
112
True label
blight
healthy
Predicted label
600
500
400
300
200
100


1.0
0.8
0.6
0.4
0.2
0.0
True Positive Rate (Positive label: 1)
0.0
0.2
0.4
0.6
0.8
1.0
False Positive Rate (Positive label: 1)
Classifier (AUC = 0.98)

Observations

- More data=better results!
- ImageNet weights were very helpful
- Imbalanced class distribution
- Would like to repeat with larger data set
- Overall nearly all models ended up being effective

References

1. T. Wiesner-Hanks and M. Brahimi, “Image set for Deep Learning: Field images of maize annotated with disease symptoms,” OSF, 28-Mar-2018. [Online]. Available: https://osf.io/p67rz/wiki/home/. [Accessed: 15-Dec-2021].
2. M. Salathe, “An open access repository of images on plant health to enable the development of Mobile Disease Diagnostics,” arXiv.org, 12-Apr-2016. [Online]. Available: https://arxiv.org/abs/1511.08060. [Accessed: 15-Dec-2021].
3. K. Simonyan and A. Zisserman, “Very deep convolutional networks for large-scale image recognition,” arXiv.org, 10-Apr-2015. [Online]. Available: https://arxiv.org/abs/1409.1556. [Accessed: 15-Dec-2021].


Questions?