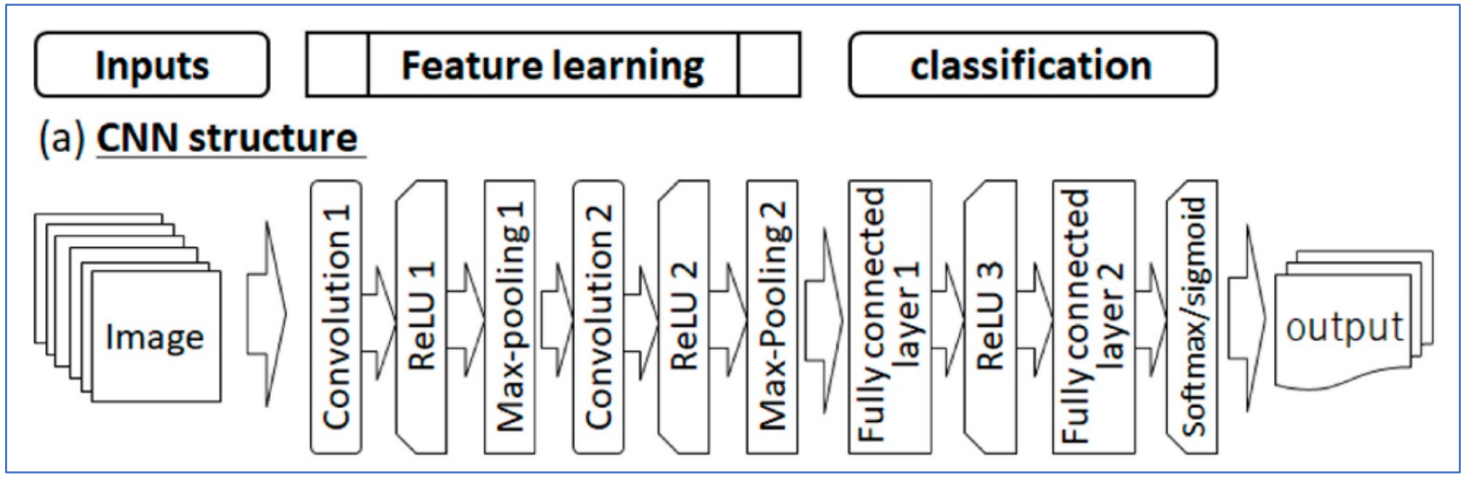
Classification Transfer Learning

Benjamin Rothenhäusler

b.rothenhaeusler@gmail.com

Transfer Learning

Dataset A

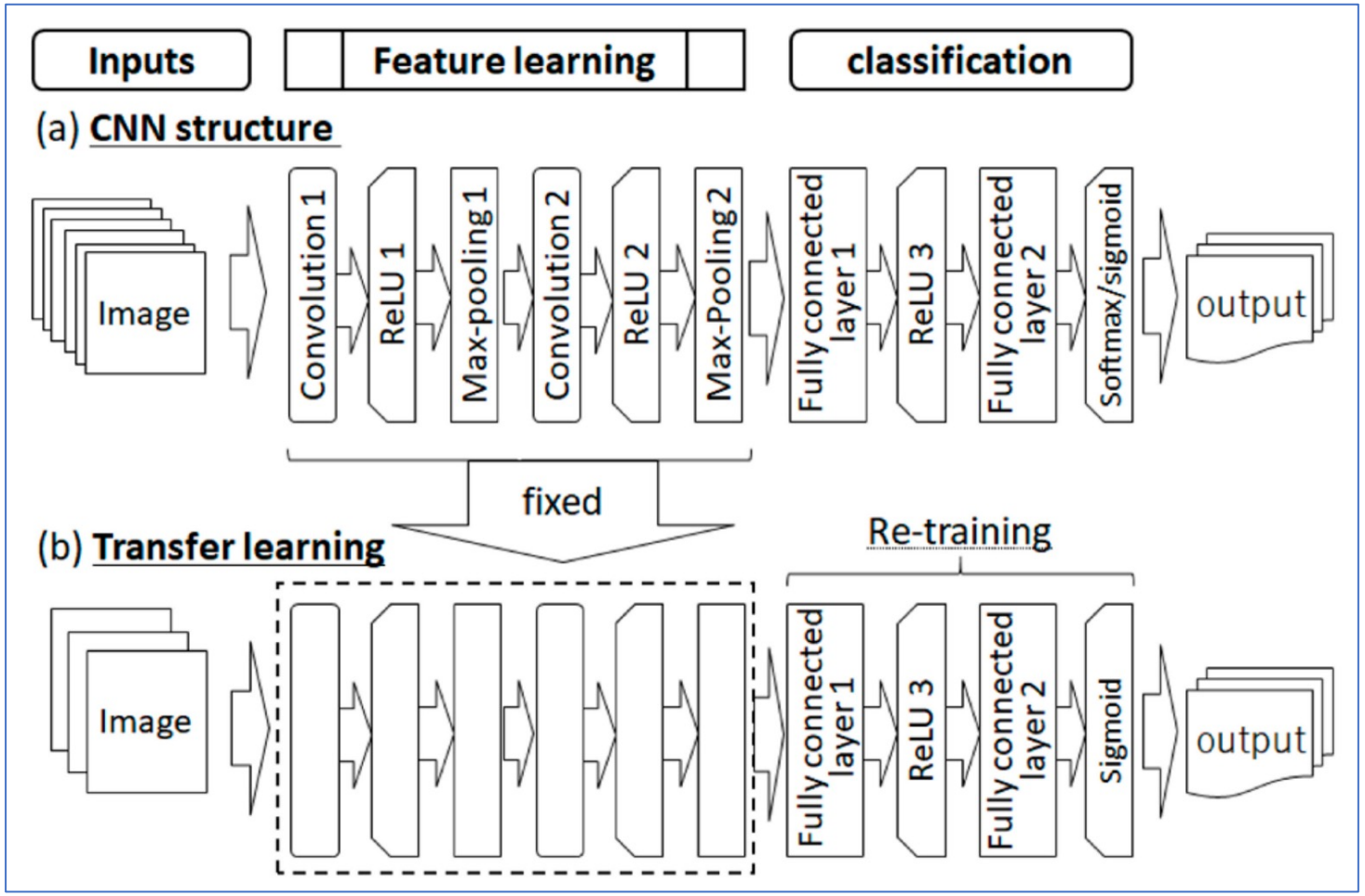


https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.mdpi.com%2F2073-4441%2F12%2F1%2F96%2Fpdf&psig=AOvVaw2DI7TKy0TLcxOukZesXu5W&ust=1638877503315000&source=images&cd=vfe&ved=2ahUKEwjF98vMjM_0AhXQhv0HHVQ2AsAQjhx6BAgAEAAo

Transfer Learning

Dataset A

Dataset B

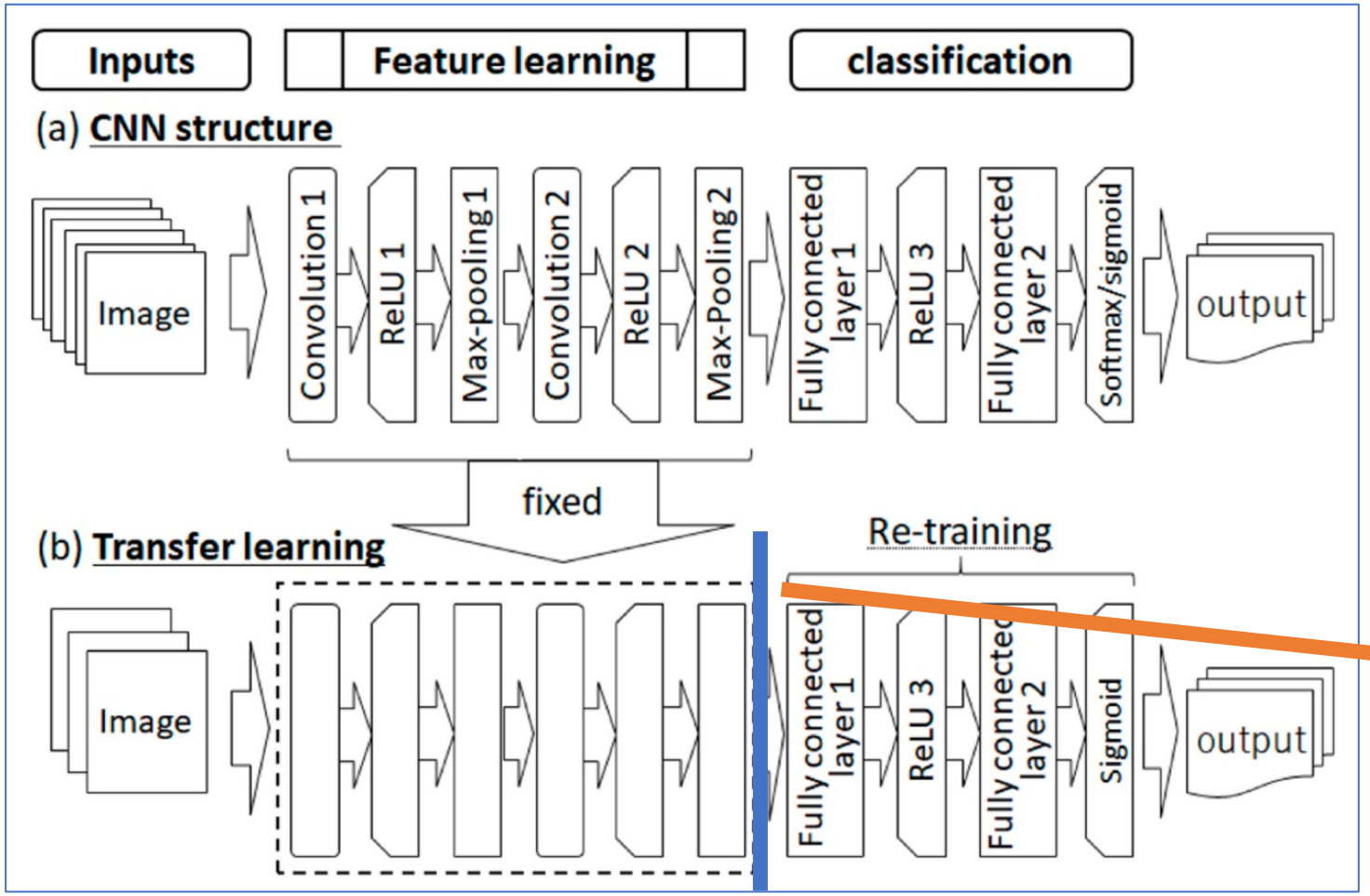


https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.mdpi.com%2F2073-4441%2F12%2F1%2F96%2Fpdf&psig=AOvVaw2DI7TKy0TLcxOukZesXu5W&ust=1638877503315000&source=images&cd=vfe&ved=2ahUKEwjF98vMjM_0AhXQhv0HHVQ2AsAQjhx6BAgAEAAo

Transfer Learning

Dataset A

Dataset B



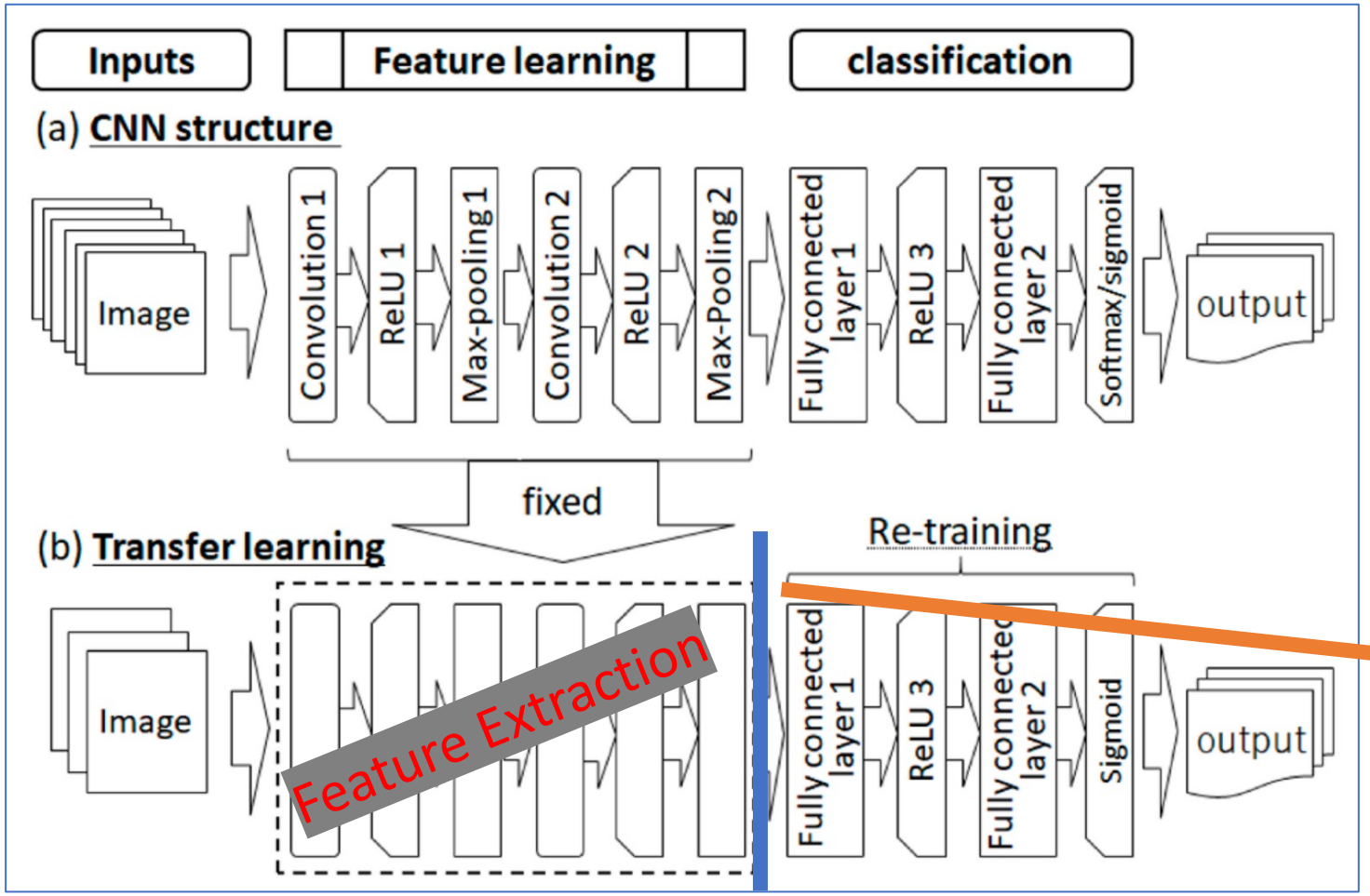
Multiclass Classification

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.mdpi.com%2F2073-4441%2F12%2F1%2F96%2Fpdf&psig=AOvVaw2DI7TKy0TLcxOukZesXu5W&ust=1638877503315000&source=images&cd=vfe&ved=2ahUKEwjF98vMjM_0AhXQhv0HHVQ2AsAQjhx6BAgAEAAo

Transfer Learning

Dataset A

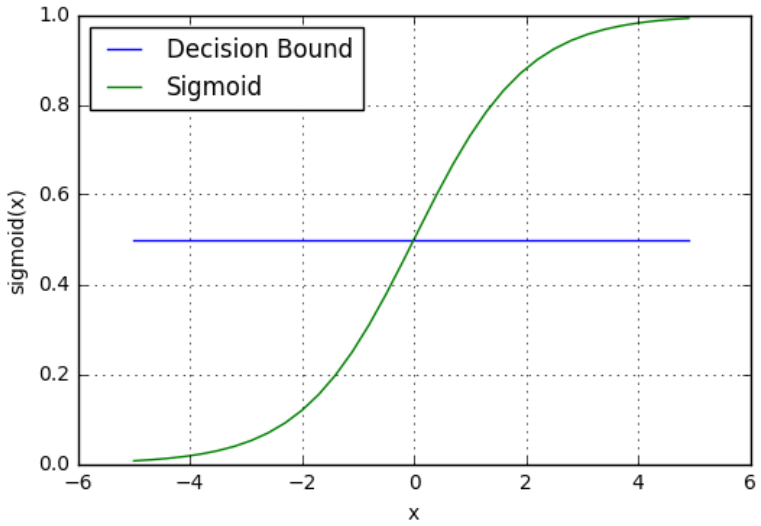
Dataset B



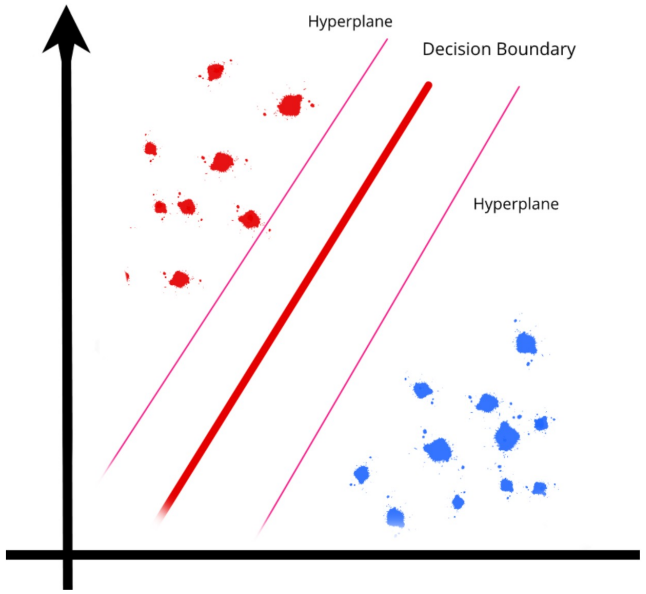
Multiclass Classification

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.mdpi.com%2F2073-4441%2F12%2F1%2F96%2Fpdf&psig=AOvVaw2DI7TKy0TLcxOukZesXu5W&ust=1638877503315000&source=images&cd=vfe&ved=2ahUKEwjF98vMjM_0AhXQhv0HHVQ2AsAQjhx6BAgAEAAo

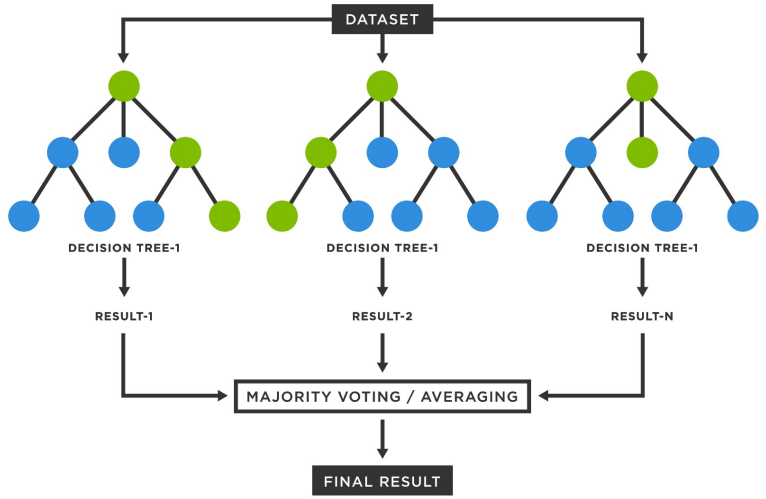
Multiclass Classification



https://ml-cheatsheet.readthedocs.io/en/latest/_images/logistic_regression_sigmoid_w_threshold.png

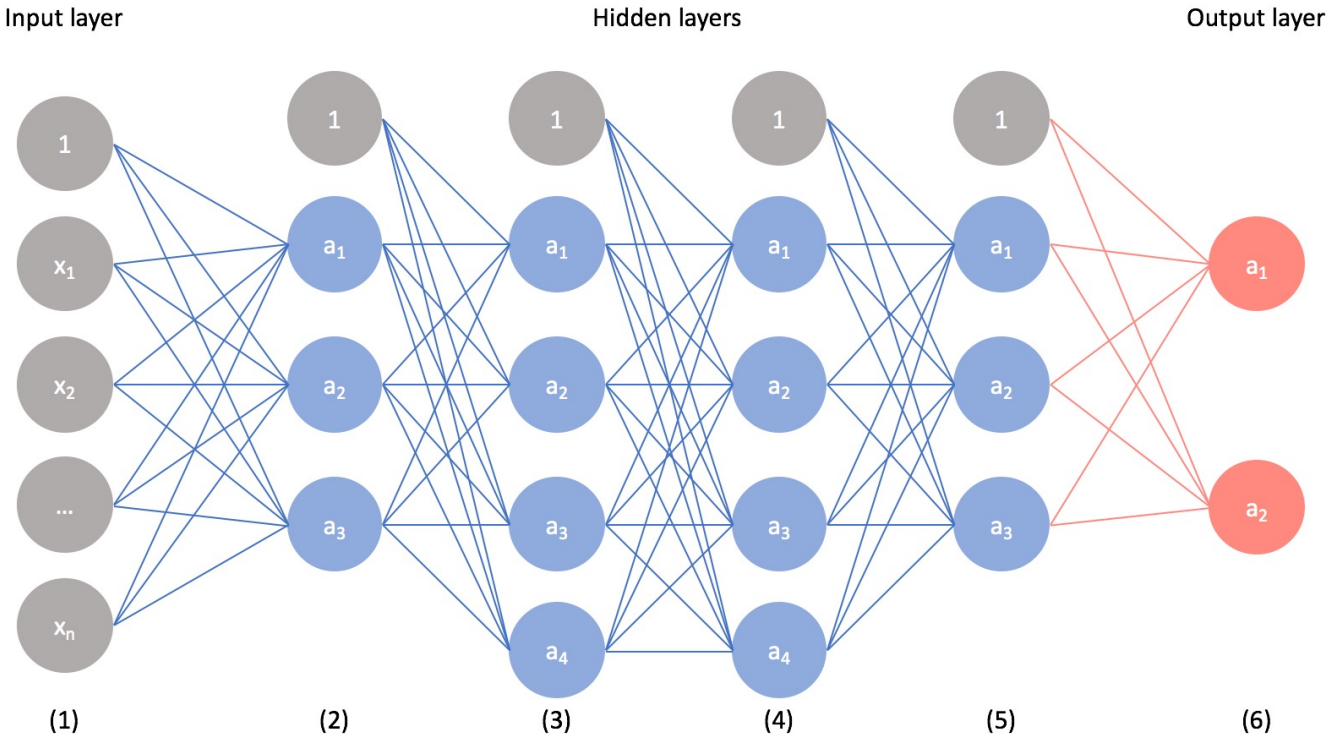


https://towardsdatascience.com/breaking-down-the-support-vector-machine-svm-algorithm-d2c030d58d42



https://www.tibco.com/sites/tibco/files/media_entity/2021-05/random-forest-diagram.svg

Multiclass Classification

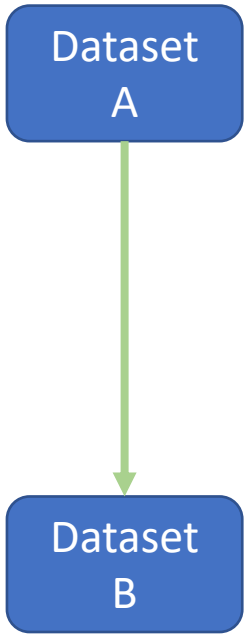


https://www.jeremyjordan.me/content/images/2017/07/Screen-Shot-2017-07-26-at-1.44.58-PM.png

Transfer Learning: Rationale

- Computational cost
- Time cost
- CS Domain Knowledge
- Few shot learning

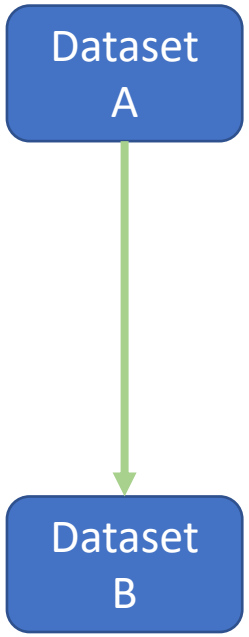
Transfer Learning: my case



Imagenet: **ILSVRC training data**

- 1000 classes
- Mostly objects and animals
- 1,281,167 training images
- 50,000 validation images

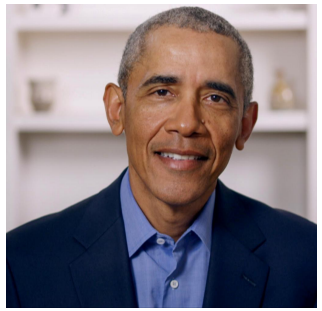
Transfer Learning: my case



Imagenet: **ILSVRC training data**

https://upload.wikimedia.org/wikipedia/commons/d/d2/Donald_Trump_August_19%2C_2015_%28cropped%29.jpg

+



https://img.welt.de/img/iconist/service/mobile235753924/4022501367-ci102l-w1024/Graduate-Together-America-Honors-the-High-School-Class-of-2020.jpg

+

https://image.stern.de/31553988/t/1F/v4/w960/r1.7778/-/joe-biden-ukraine-russland.jpg

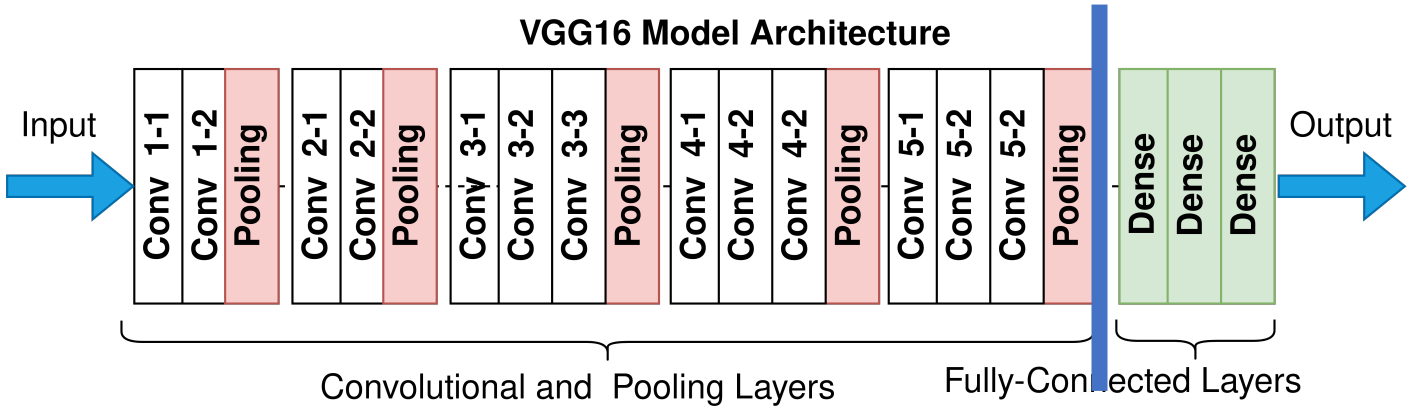
Dataset

Curated Google Image search

	Trump	Obama	Biden
N	80	65	70

	Percent
Train	70
Evaluation	15
Test	15

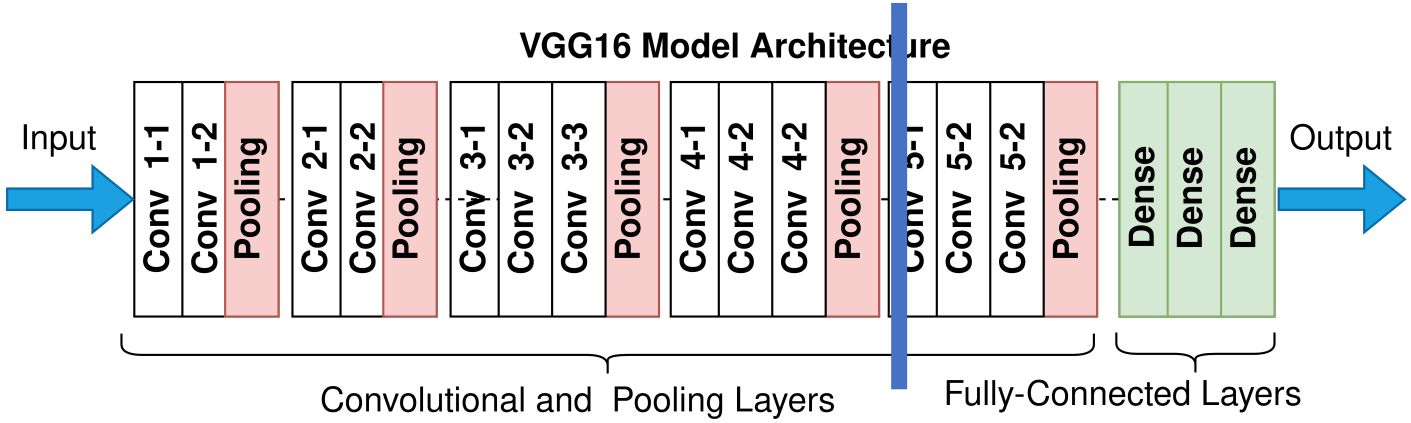
Transfer Network: VGG-16



https://commons.wikimedia.org/wiki/File:VGG16.png

ImageNet Accuracies:
Top-1: 74%
Top-5: 91.9%

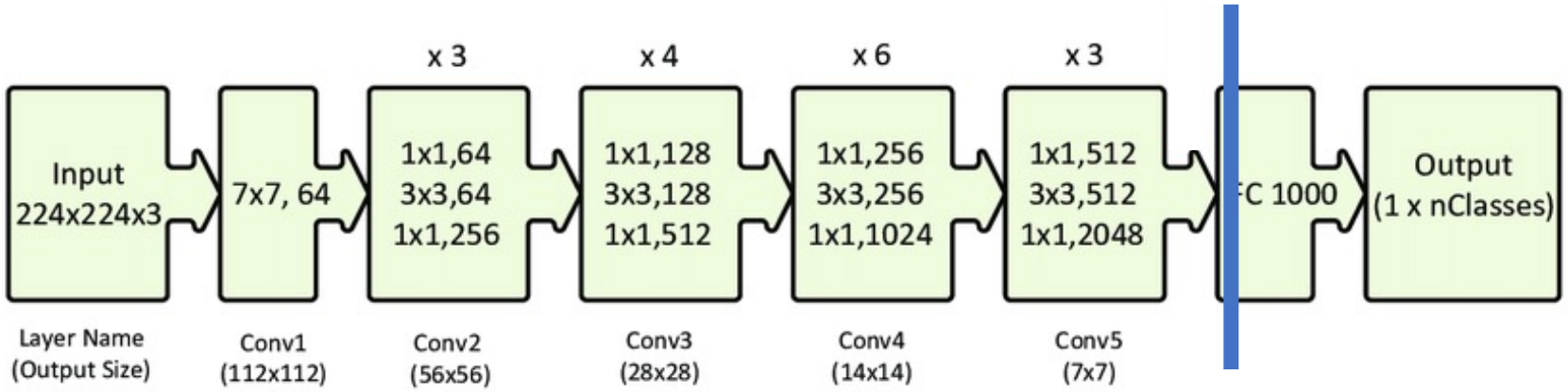
Transfer Network: VGG-16



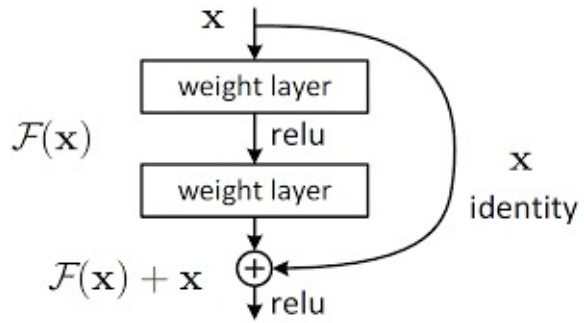
https://commons.wikimedia.org/wiki/File:VGG16.png

ImageNet Accuracies:
Top-1: 74%
Top-5: 91.9%

Transfer Network: ResNet-50



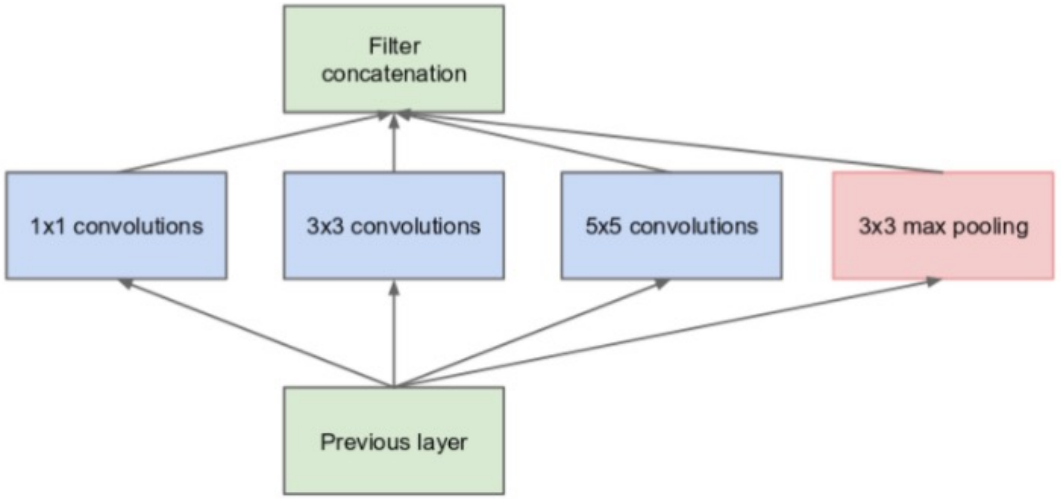
https://www.researchgate.net/figure/ResNet-50-architecture-26-shown-with-the-residual-units-the-size-of-the-filters-and_fig1_338603223



https://neurohive.io/en/popular-networks/resnet/

ImageNet Accuracies:
Top-1: 83.2%
Top-5: 96.5%

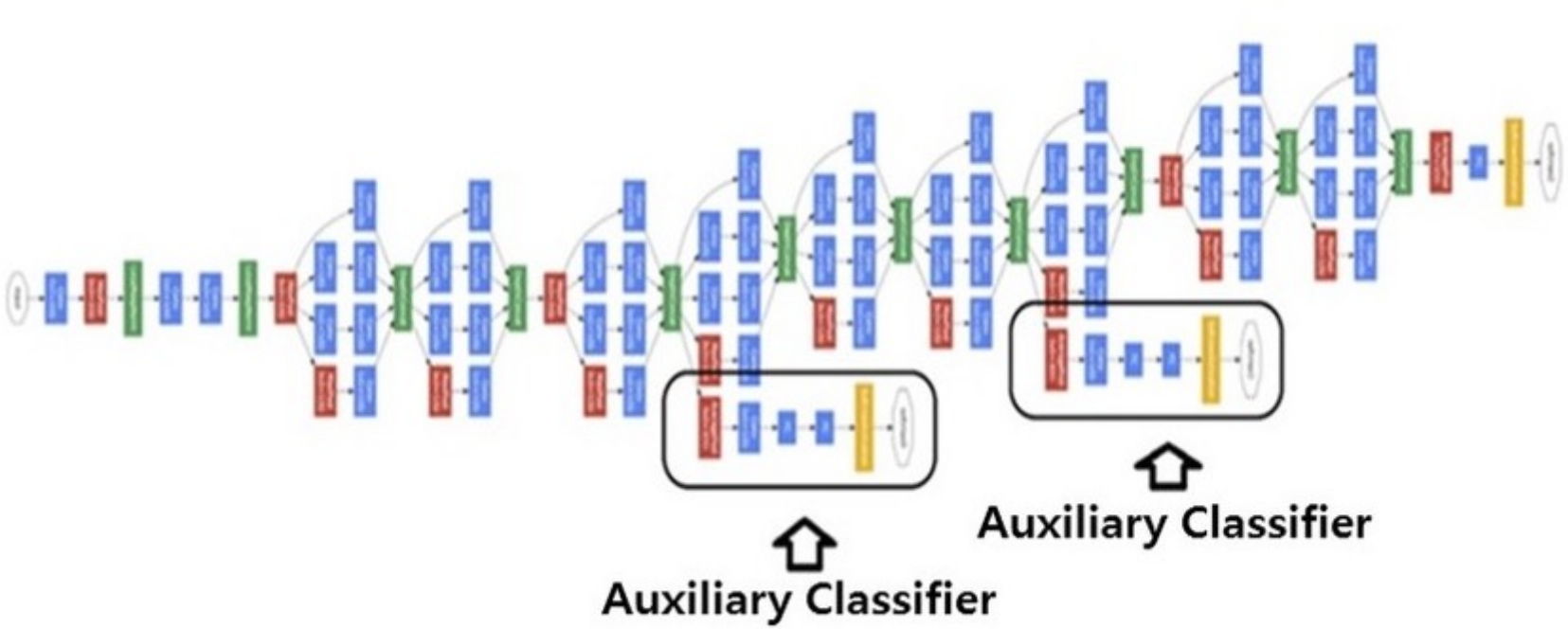
Transfer Network: Inception V3



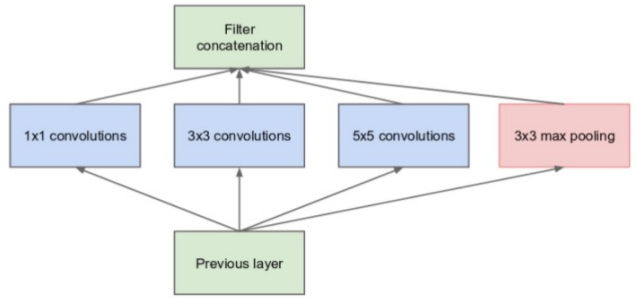
https://towardsdatascience.com/a-simple-guide-to-the-versions-of-the-inception-network-7fc52b863202

ImageNet Accuracies:
Top-1: 78.9%
Top-5: 94.49%

Transfer Network: Inception V3



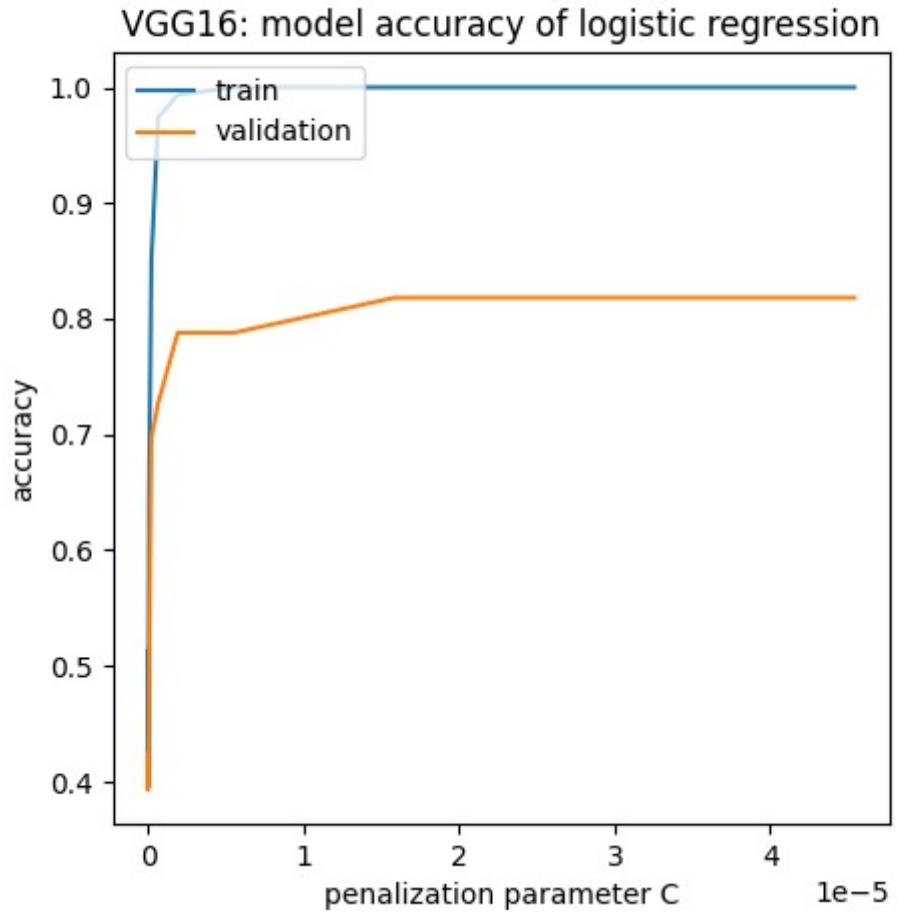
https://production-media.paperswithcode.com/methods/GoogleNet-structure-and-auxiliary-classifier-units_CM5xsxk.png



https://towardsdatascience.com/a-simple-guide-to-the-versions-of-the-inception-network-7fc52b863202

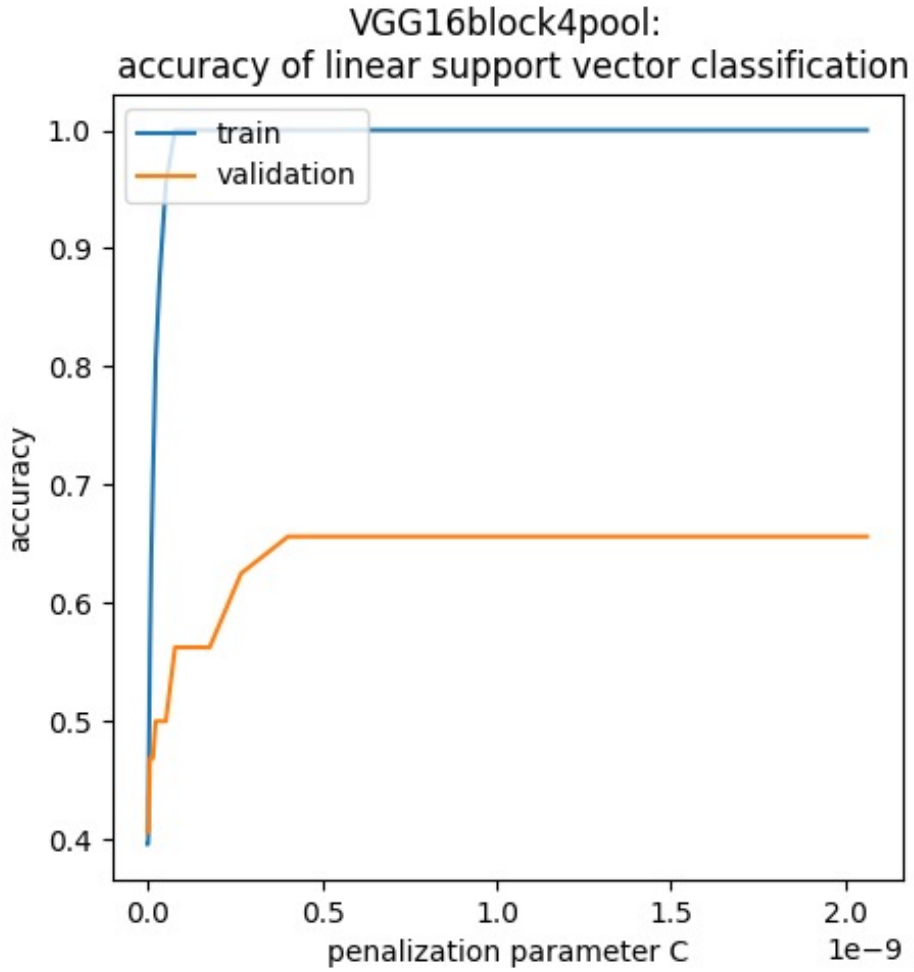
ImageNet Accuracies:
Top-1: 78.9%
Top-5: 94.49%

Results: Logistic Regression



Network	Test Accuracy
VGG-16	.6875
VGG-16 (block4pool)	.625
InceptionV3	.594
ResNet50	.75

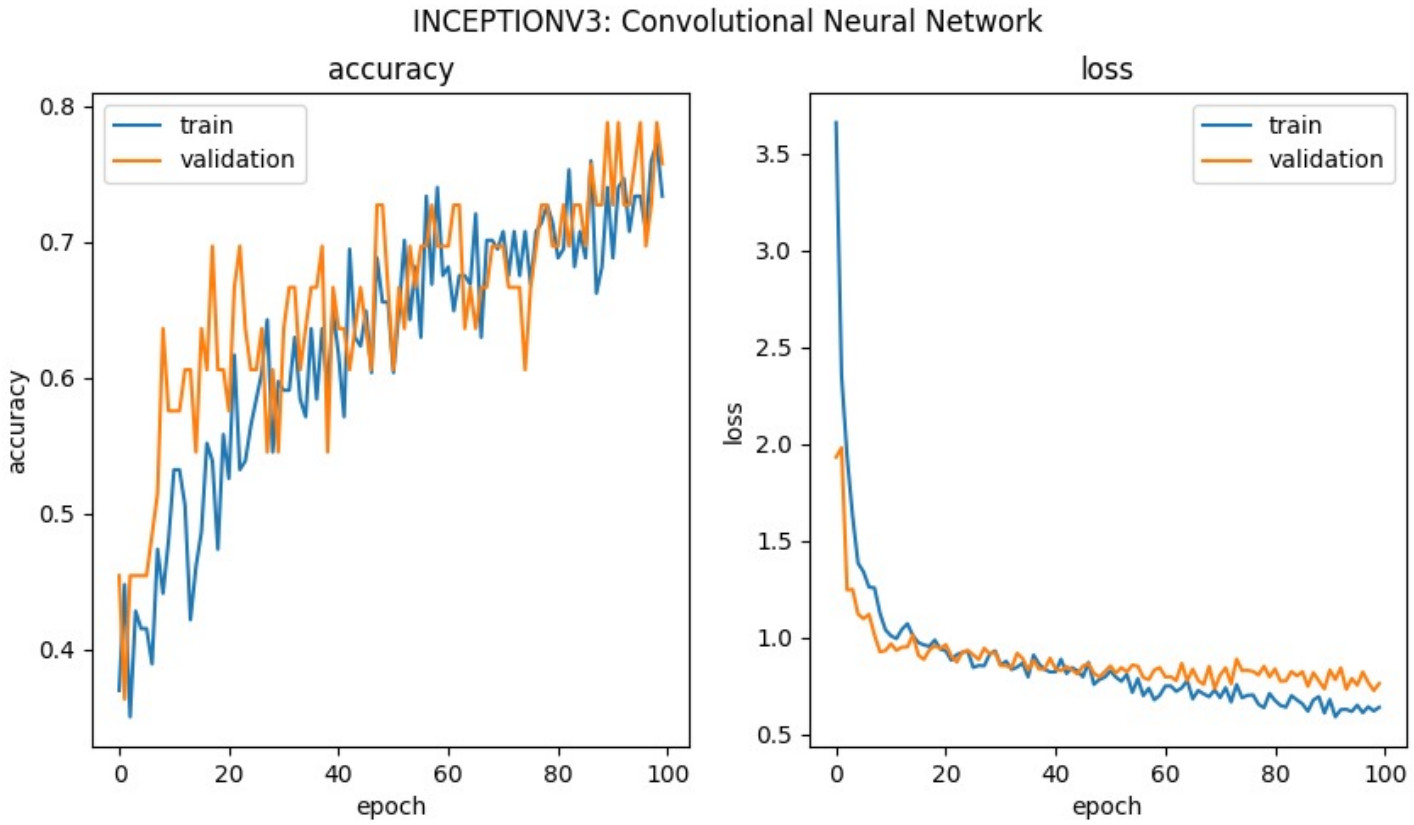
Results: SVC



Network	Test Accuracy
VGG-16	.75
VGG-16 (block4pool)	.594
InceptionV3	.545
ResNet50	.75

[gross overfitting]

Results: Convolutional Neural Network

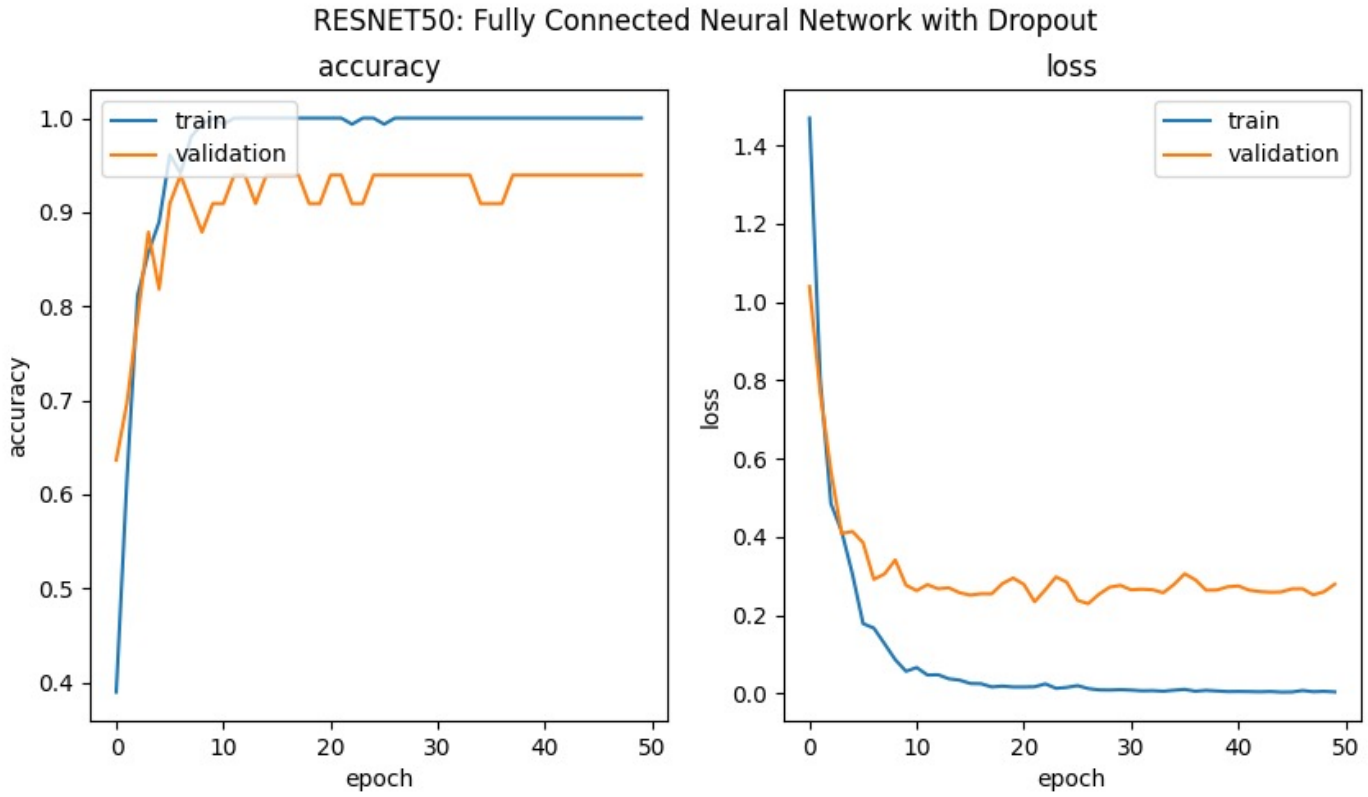


Network	Test Accuracy
VGG-16	.50
VGG-16 (block4pool)	.62
InceptionV3	.5625
ResNet50	.437

Layer (type)	Output Shape	Param #
conv2d_31 (Conv2D)	(None, 148, 148, 32)	896
max_pooling2d_31 (MaxPooling	(None, 74, 74, 32)	0
conv2d_32 (Conv2D)	(None, 72, 72, 128)	36992
max_pooling2d_32 (MaxPooling	(None, 36, 36, 128)	0
global_average_pooling2d_19	(None, 128)	0
dropout_20 (Dropout)	(None, 128)	0
dense_44 (Dense)	(None, 64)	8256
dense_45 (Dense)	(None, 3)	195

Total params: 46,339
Trainable params: 46,339
Non-trainable params: 0

Results: Fully Connected Neural Network



Network	Test Accuracy
VGG-16	.843
VGG-16 (block4pool)	.781
InceptionV3	.406
ResNet50	.875

```
Layer (type)                 Output Shape              Param #
=================================================================
global_average_pooling2d_20  (None, 2048)              0
_________________________________________________________________
dropout_21 (Dropout)         (None, 2048)              0
_________________________________________________________________
dense_46 (Dense)             (None, 100)               204900
_________________________________________________________________
dense_47 (Dense)             (None, 3)                 303
=================================================================
Total params: 205,203
Trainable params: 205,203
Non-trainable params: 0
```

Questions

Sources

ResNet

https://arxiv.org/abs/1512.03385v1

VGG-16

https://arxiv.org/abs/1409.1556v6

InceptionV3

https://arxiv.org/abs/1512.00567v3

Libraries:

https://keras.io/

https://scikit-learn.org/stable/

Specific implementations:

https://appliedmachinelearning.blog/2019/07/29/transfer-learning-using-feature-extraction-from-trained-models-food-images-classification/

https://www.datatechnotes.com/2020/07/classification-example-with-linearsvm-in-python.html