COVID-19 and Tuberculosis Detection Using X-Ray Images in Resource Limited Settings

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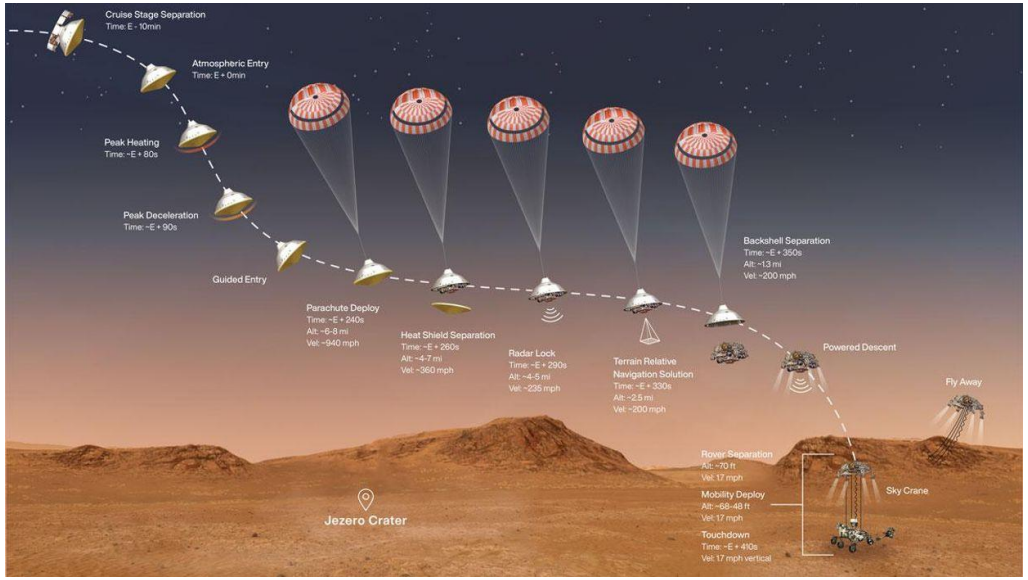
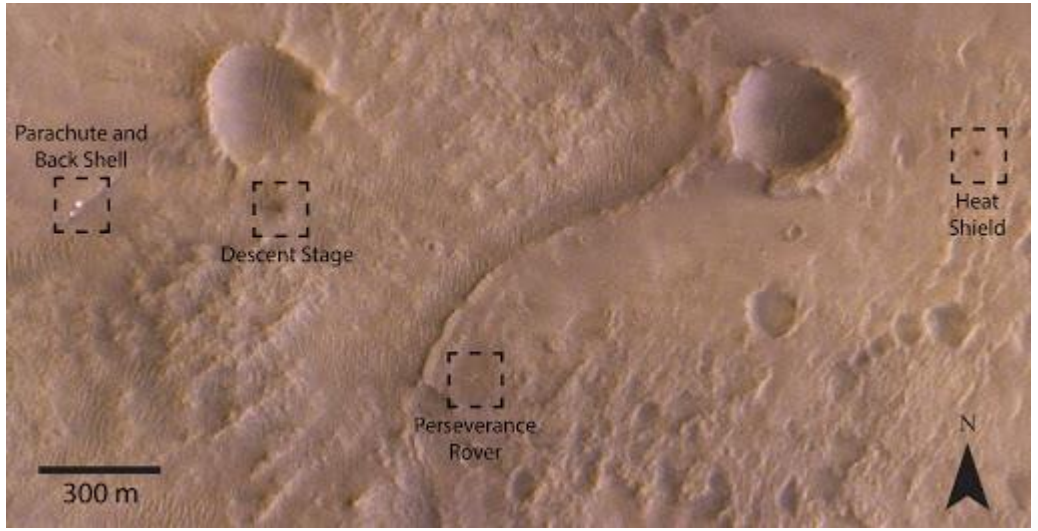
Machine learning versus deep learning

https://www.researchgate.net/profile/Oday-Hassen/publication/337306950/figure/fig4/AS:850985119395840@1579902071052/Key-Demarcation-Points-in-Deep-Learning-and-Machine-Learning.jpg

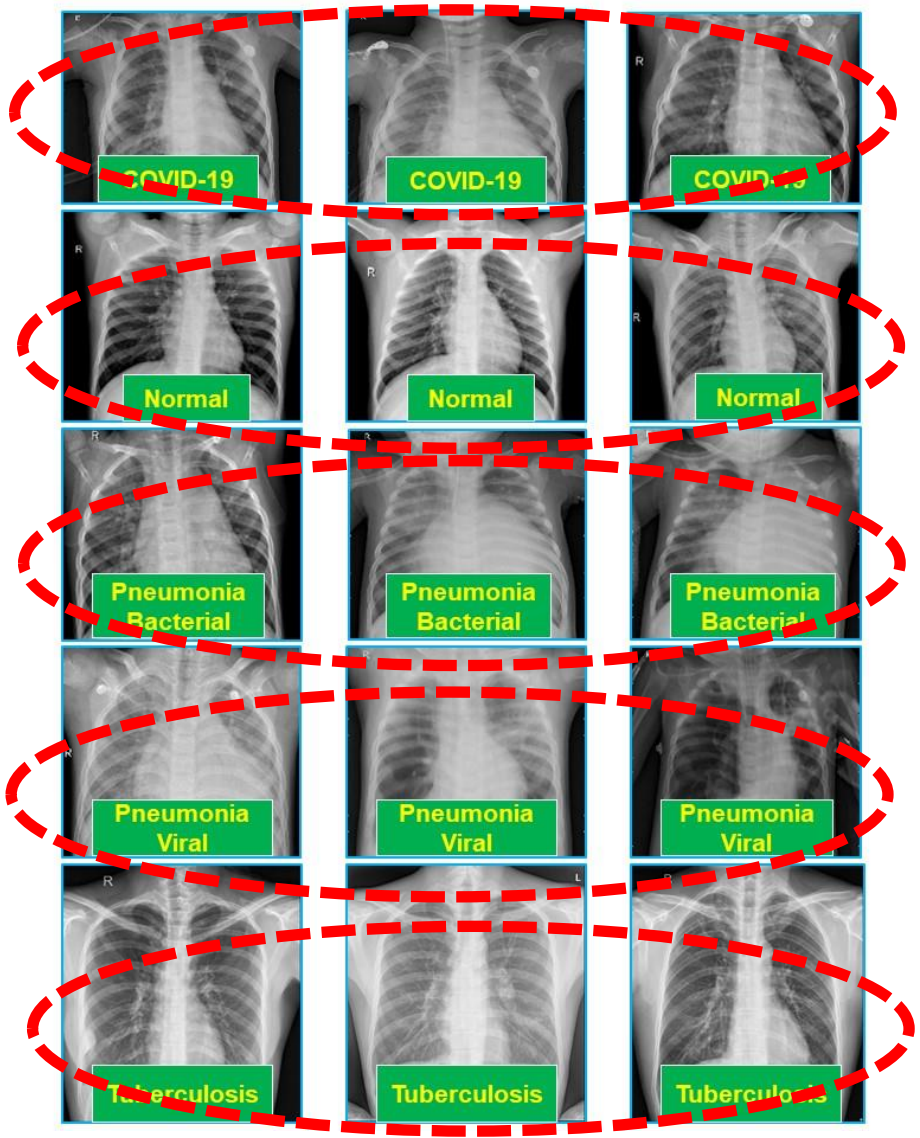
Presentence chose landing site on Mars





https://lh3.googleusercontent.com/proxy/L_Fbnc_RgWyDkLXWaoSwnq330K2R6-iiCjie1P6VUsSq4jZBvuHTZNPJFoRFIjZ6udWFxvHsyngzlQSb7EMFcC1obZqL_x6_n7B7IW6eSWXVZ__8ndw4kR9wl46nsIi7sbI

Research problem



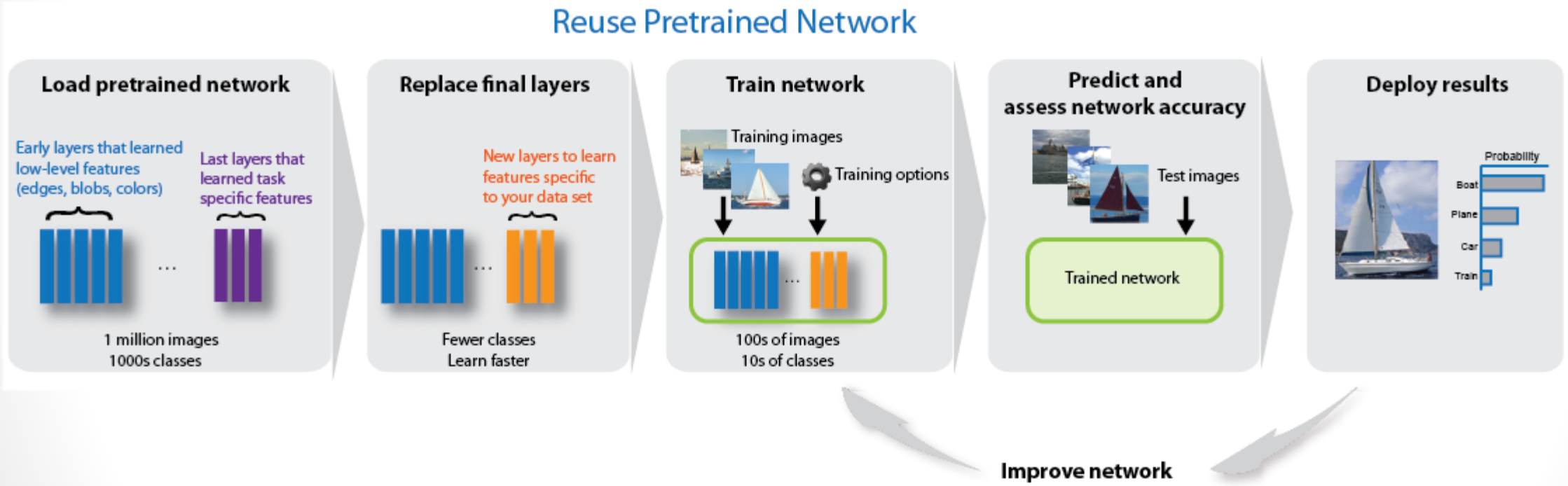
Challenges with CNN

- Need big data
- Long training time
- Need good

Computer (GPU)

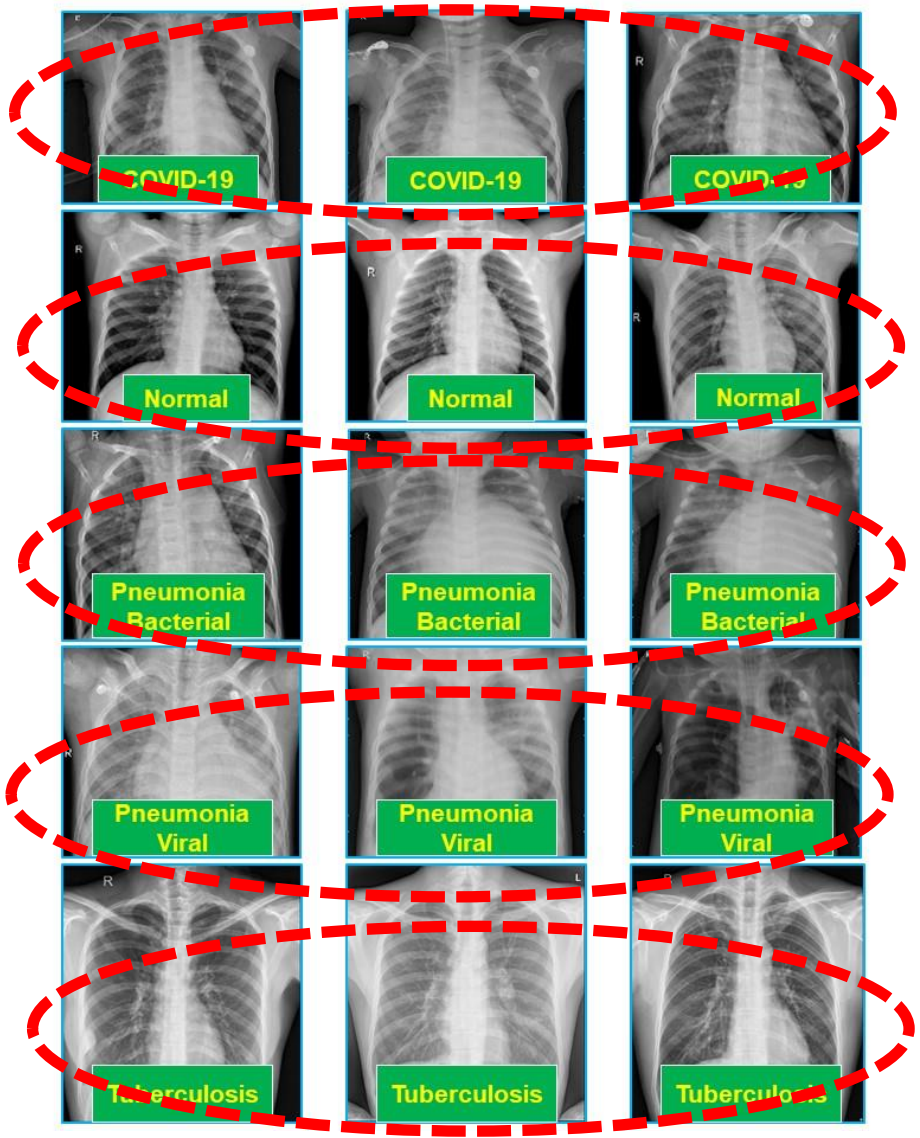
https://i.ytimg.com/vi/j8taOvhHcoU/maxresdefault.jpg

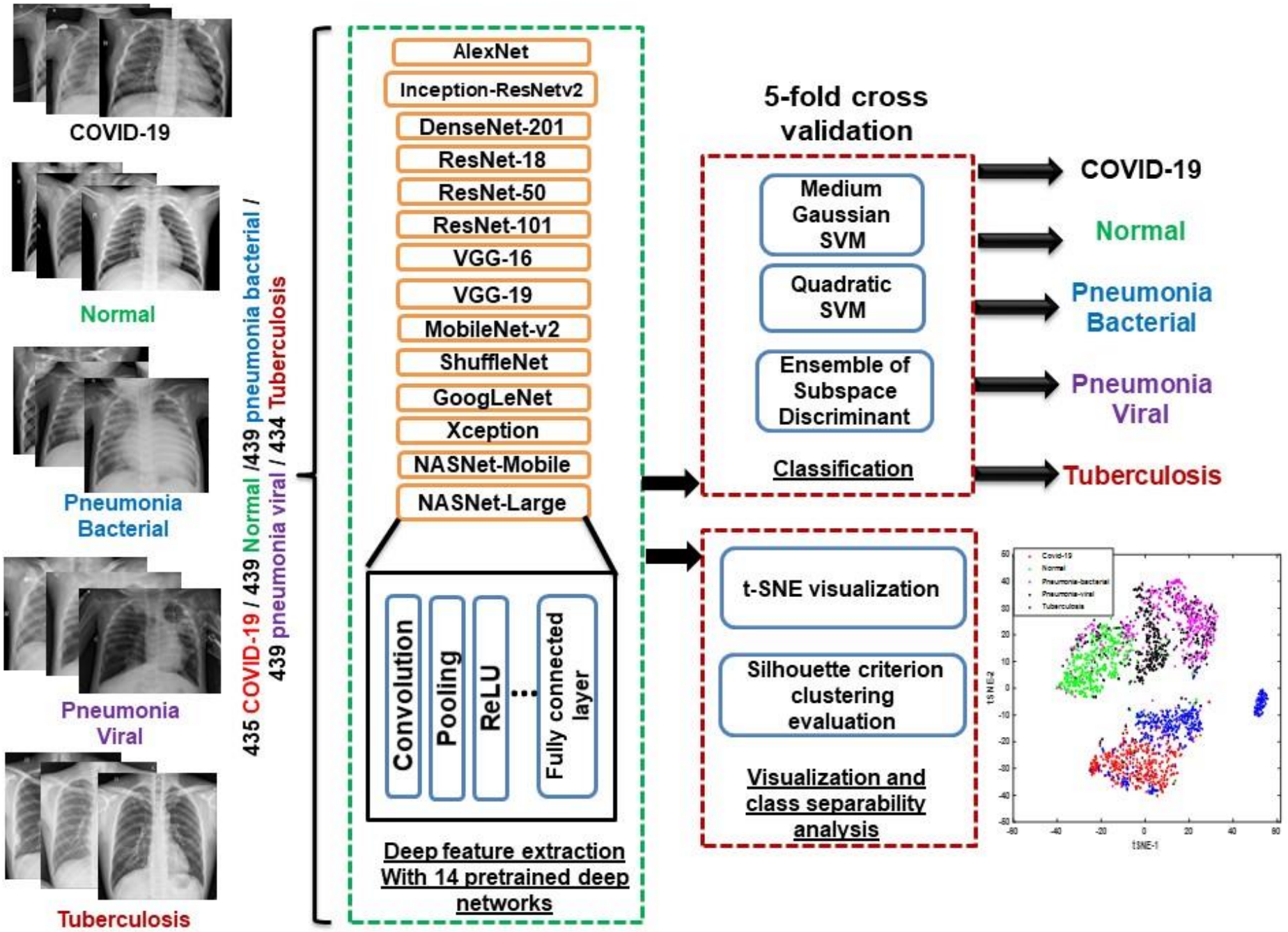
Transfer Learning



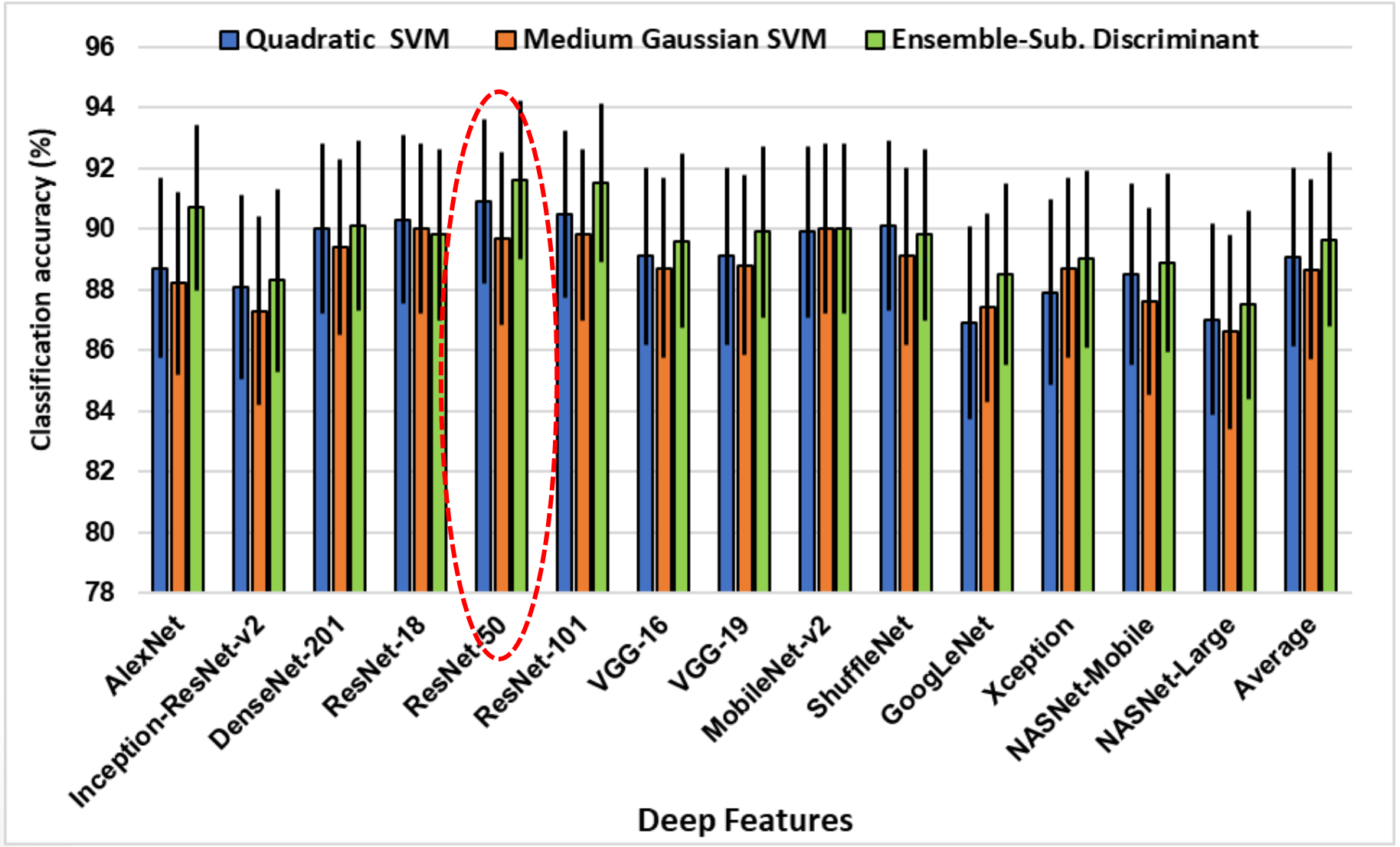
https://www.mathworks.com/help/deeplearning/transferlearningworkflow.png

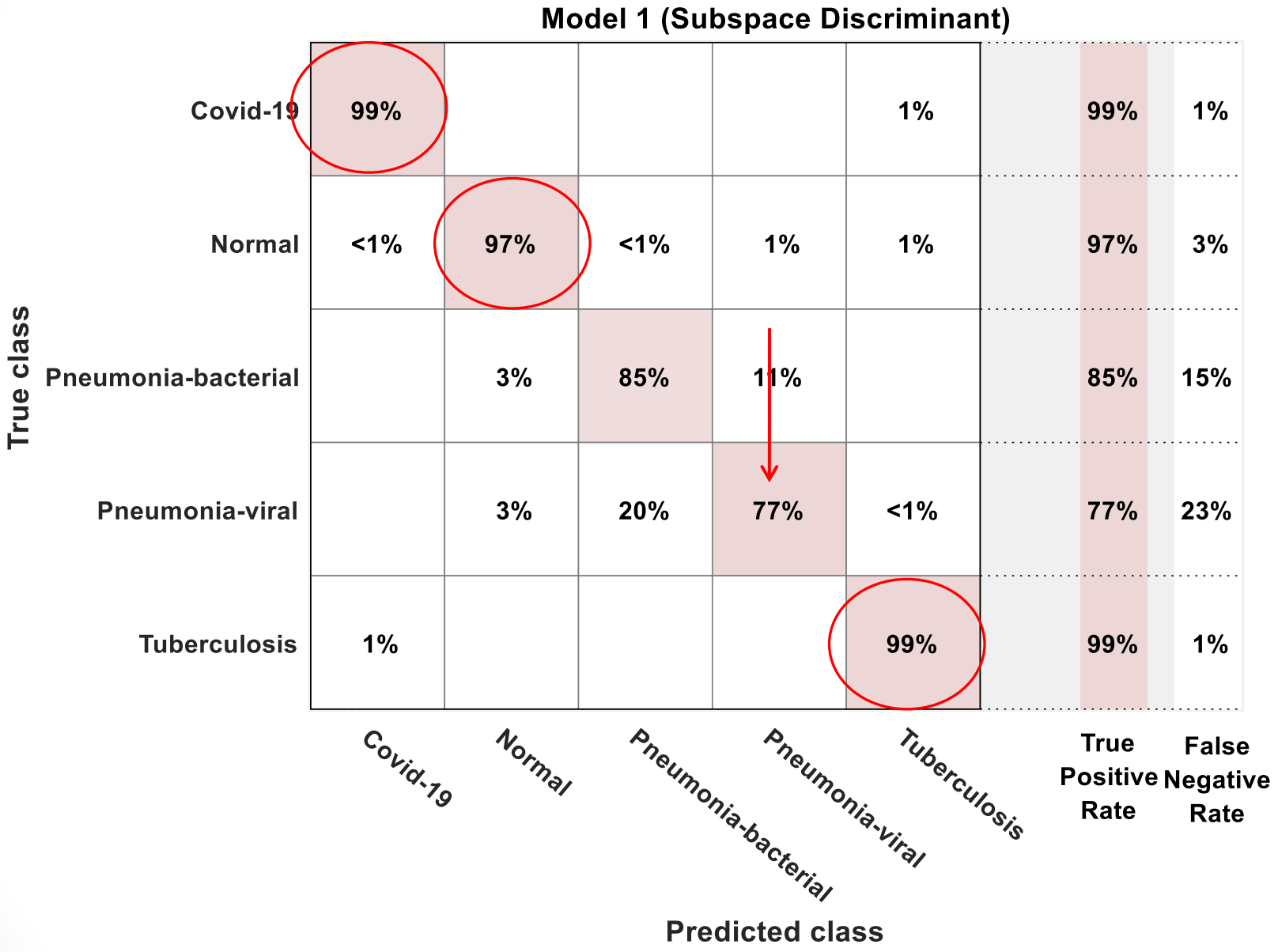
Our Work


COVID-19
COVID-19
Normal
Normal
Normal
Pneumonia Bacterial
Pneumonia Bacterial
Pneumonia Bacterial
Pneumonia Viral
Pneumonia Viral
Pneumonia Viral
Tuberculosis
Tuberculosis

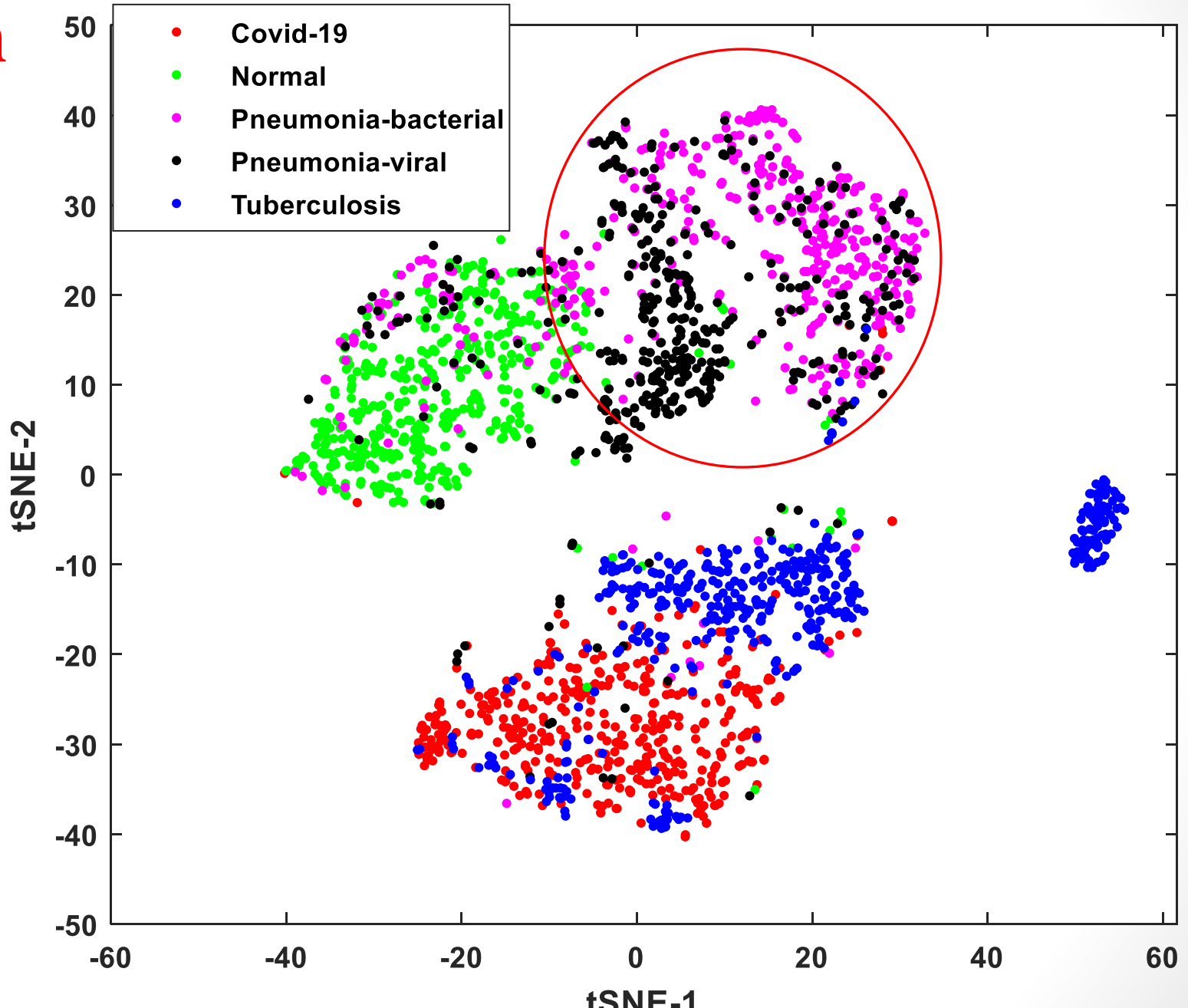

COVID-19
Normal
Pneumonia Bacterial
Pneumonia Viral
Tuberculosis
435 COVID-19 / 439 Normal /439 pneumonia bacterial / 439 pneumonia viral / 434 Tuberculosis
AlexNet
Inception-ResNetv2
DenseNet-201
ResNet-18
ResNet-50
ResNet-101
VGG-16
VGG-19
MobileNet-v2
ShuffleNet
GoogLeNet
Xception
NASNet-Mobile
NASNet-Large
Convolution
Pooling
ReLU
Fully connected layer
Deep feature extraction With 14 pretrained deep networks
5-fold cross validation
Medium Gaussian SVM
Quadratic SVM
Ensemble of Subspace Discriminant
Classification
COVID-19
Normal
Pneumonia Bacterial
Pneumonia Viral
Tuberculosis
t-SNE visualization
Silhouette criterion clustering evaluation
Visualization and class separability analysis
Covid-19
Normal
Pneumonia-bacterial
Pneumonia-viral
Tuberculosis
tSNE-1
tSNE-2

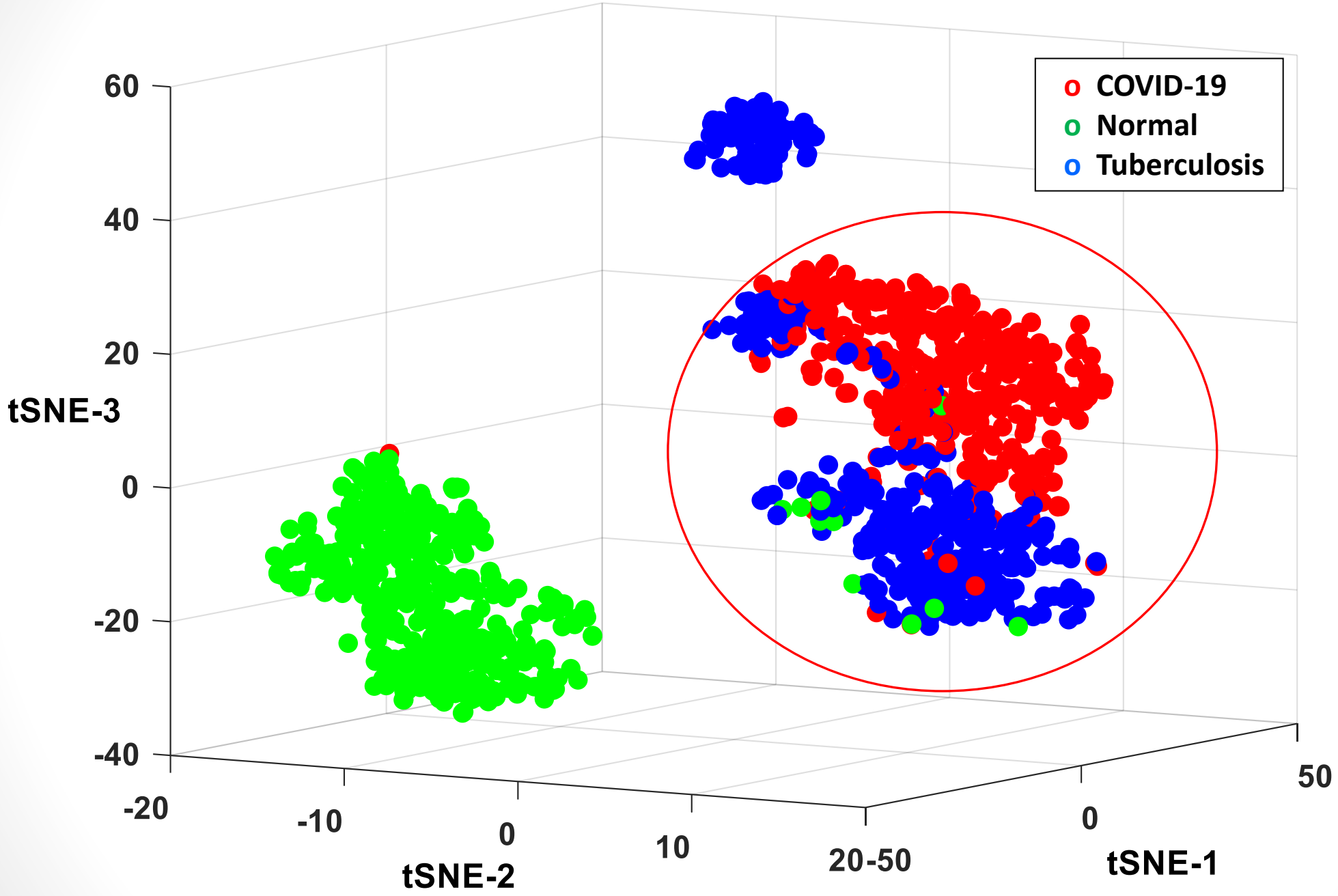
Results


Quadratic SVM
Medium Gaussian SVM
Ensemble-Sub. Discriminant
Classification accuracy (%)
96
94
92
90
88
86
84
82
80
78
AlexNet
Inception-ResNet-v2
DenseNet-201
ResNet-18
ResNet-50
ResNet-101
VGG-16
VGG-19
MobileNet-v2
ShuffleNet
GoogLeNet
Xception
NASNet-Mobile
NASNet-Large
Average
Deep Features


Model 1 (Subspace Discriminant)
True class
Covid-19
Normal
Pneumonia-bacterial
Pneumonia-viral
Tuberculosis
99%
1%
99%
1%
<1%
97%
<1%
1%
1%
97%
3%
3%
85%
11%
85%
15%
3%
20%
77%
<1%
77%
23%
1%
99%
99%
1%
Covid-19
Normal
Pneumonia-bacterial
Pneumonia-viral
Tuberculosis
True Positive Rate
False Negative Rate
Predicted class

T-SNE visualization




COVID-19
Normal
Tuberculosis
60
40
20
0
-20
-40
tSNE-3
-20
-10
0
10
20-50
0
50
tSNE-2
tSNE-1

Conclusion

- 1) We constructed a five-class COVID 19 dataset, named COVID-19 five-class balanced dataset, including a large number of COVID-19 and tuberculosis images, which was not investigated before to the best of our knowledge.

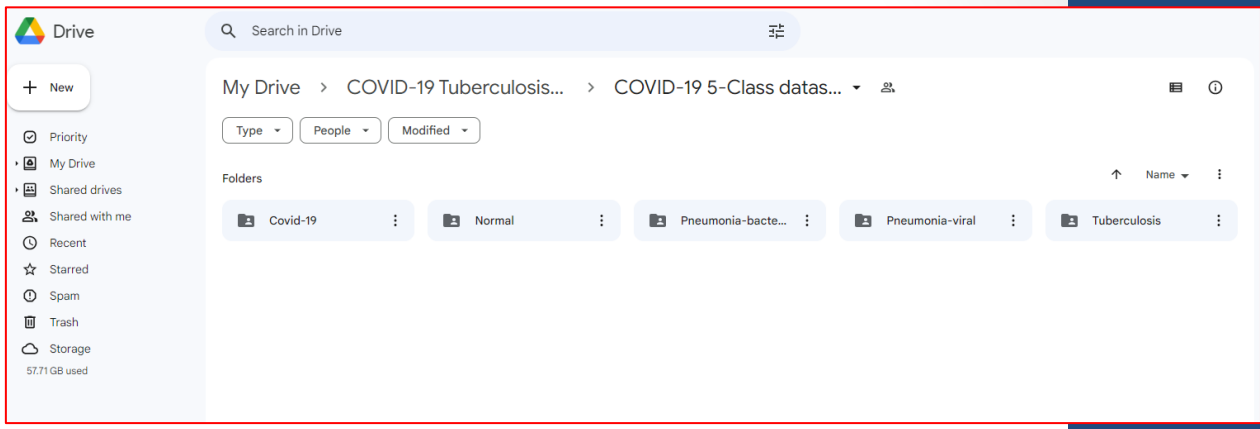
- 2) A pipeline of features from 14 individual state-of-the-art pretrained deep networks combined with machine learning classifier are investigated using a five-fold cross validation scheme to avoid overfitting, without the need to train the pretrained networks.

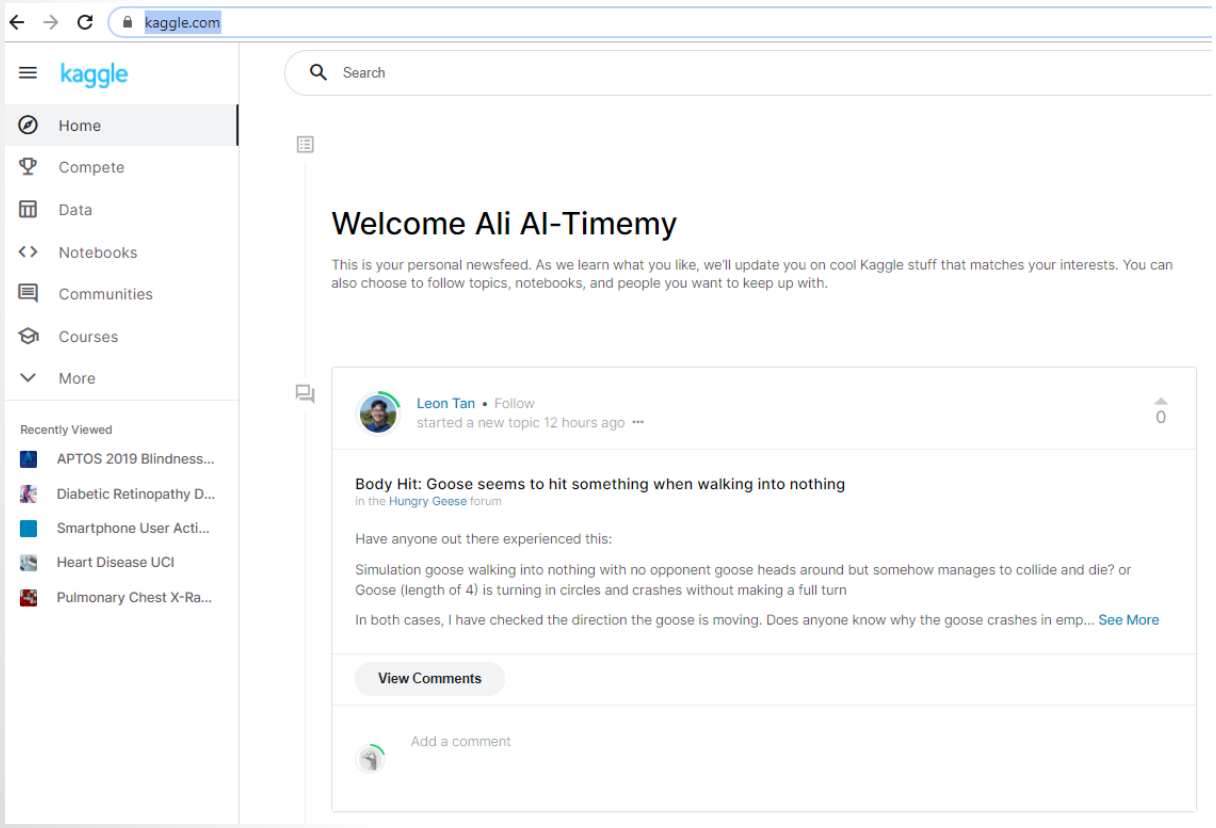
- 3) The proposed pipeline can run on a CPU machine, which makes it simple and efficient, and suitable for low-middle income countries.

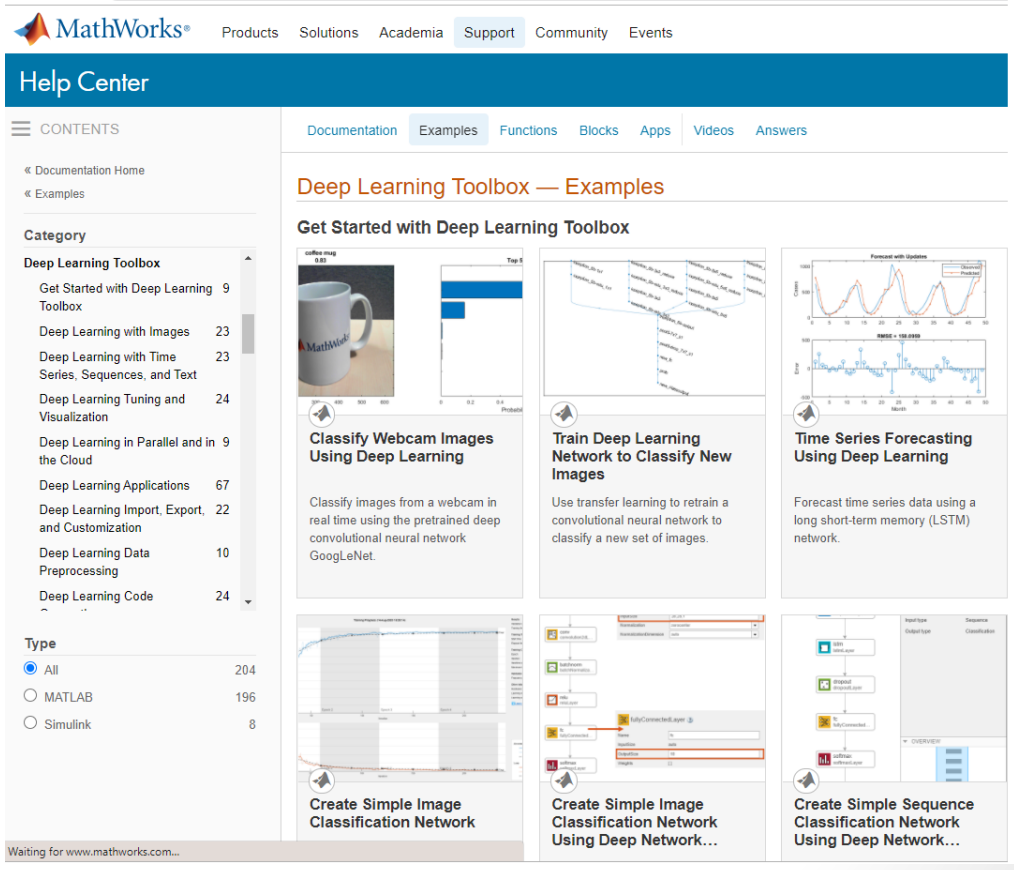
- 4) Five-class separability analysis of COVID-19 DF using Silhouette criterion clustering evaluation and high dimensional t-SNE visualization were investigated to understand the separation of the 2186 5-class images.

Where should I start

- Kaggle
- Python or Matlab







Thanks for your attention