

LUS Images classification with uncertainty detection and image similarity

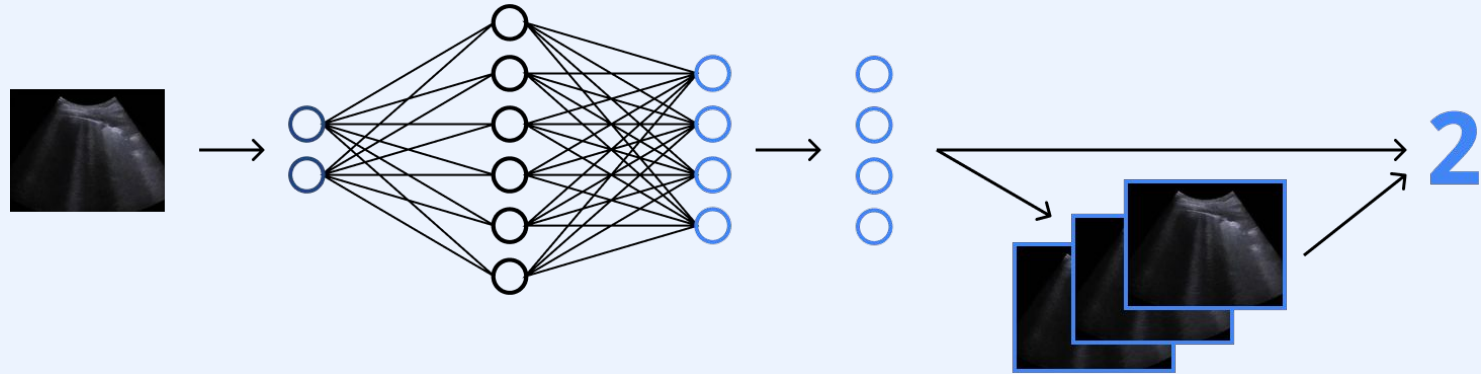
Medical Imaging Diagnostic

0

Quick overview

1 2 3

1. Frame into a classification model
2. Softmax output is analyzed by a classifier
3. If *false*, analyze the closer images score
4. Final score



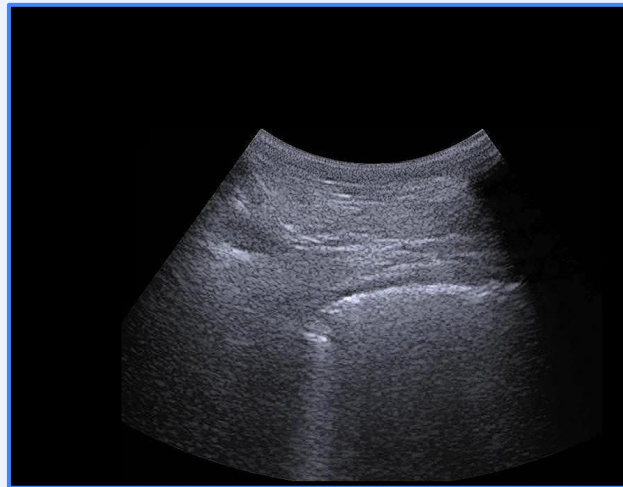
1

Briefly on data

234

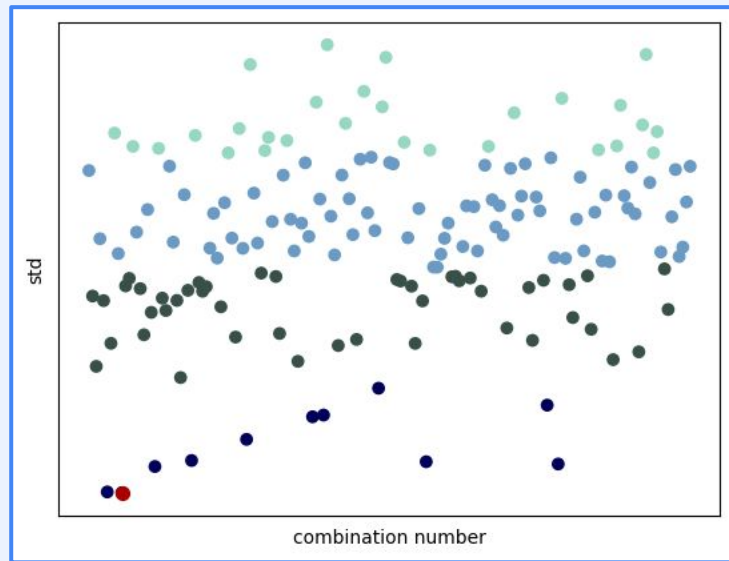
Lung Ultrasound Images

1. Images are scored from 0 to 3
2. This project works frame-wise
3. Augmentation was required
4. They seems in grayscale, but images are RGB



Dividing patients

To balance training, computed all possible 8-patients combinations stds between the number of frames per score -> took the smallest one



0	1	2	3
7888	7540	7189	7592

2

First classifier

3 4 5

Choosing the model

- ResNet18
- VGG16
- SqueezeNet
- CNN from scratch

Added layers to fine-tune,
but easy overfitting.

Working solution was to
only add a layer to output
the 4 classes

Augmentation

“Deep learning for classification and localization of covid-19 markers in point-of-care lung ultrasound”

E. Torri, R. Inchingolo, A. Smargiassi,
G. Soldati, P. Rota,
A. Passerini, R. J. G. van Sloun, E.
Ricci, and L. Demi

- affine transformations
- multiplication with a constant
- Gaussian blurring
- horizontal flipping

3

Confidence

456

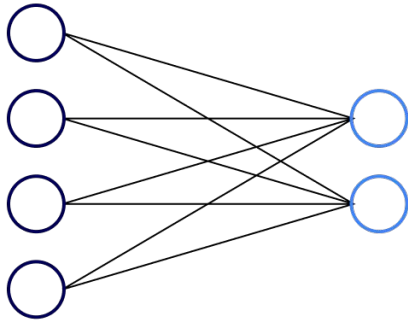
Threshold?

Independently from correct or wrong prediction and from the scores, the highest confidence in the softmax values were very similar

Understand the behaviour

Saving the softmax values and the prediction correctness

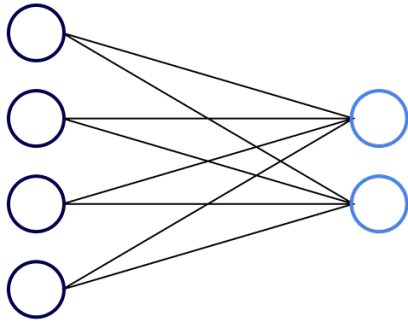
Neural Network



Sigmoid activation function

Basic model, any addition
layer resulted in worse
performance

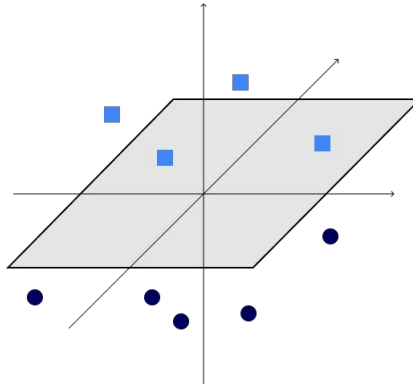
Neural Network



Sigmoid activation function

Basic model, any addition layer resulted in worse performance

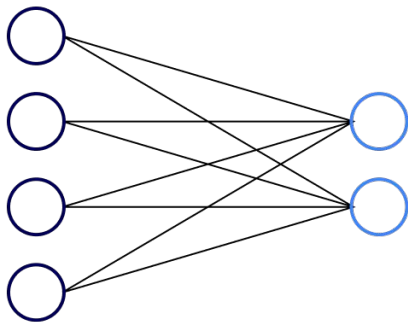
SVC



Support Vector Classifier

It required perfectly balanced dataset

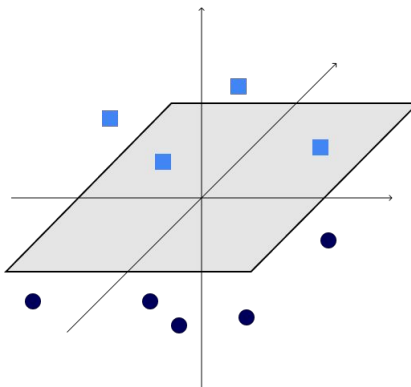
Neural Network



Sigmoid activation function

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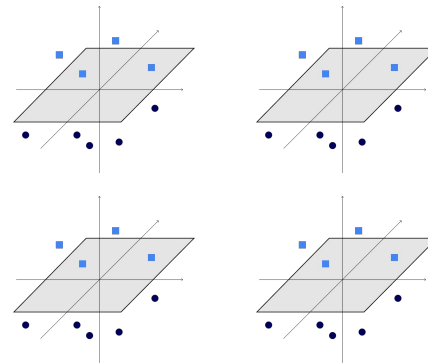
SVC



Support Vector Classifier

It required perfectly balanced dataset

4 SVCs



One for each class

The SVC used depended on the predicted score

4

Similarity

56

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- VGG16
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Hash

t-SNE

- similarity-wise (lighter, entire training set used)
- image-wise
- resnet18 embedding

First, this is not a classification method, is a...

Due to high time demanding, I chose the same number of images for each score for each training patients (and the same for testing).

Averaged the most X close images scores

For sim-wise ~Y%, for image-wise Z%

for a single frame, it required ~30 sec for each image

5

Final results

6

Results

Only model

Only tsne

Model -> bin -> t/f -> tsne

6

Extra

Example screen of similar images

It can also show the similar images, so in a “real world scenario”, if there is uncertainty in a prediction, the X closest images can be plot:

And that's it, thank you

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