LUS Images classification with uncertainty detection and image similarity

Medical Imaging Diagnostic

Davide Modolo - Università degli Studi di Trento

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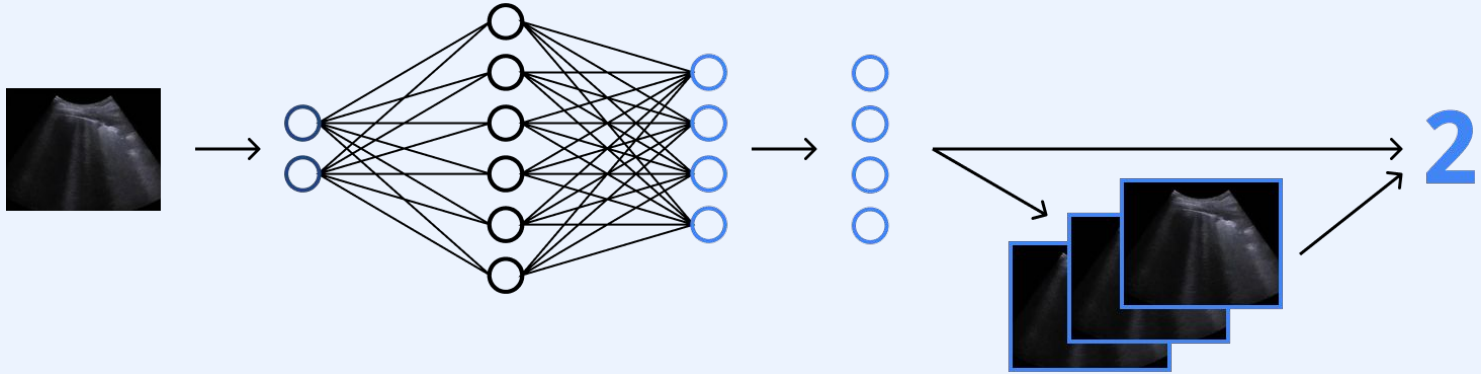
Quick overview

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



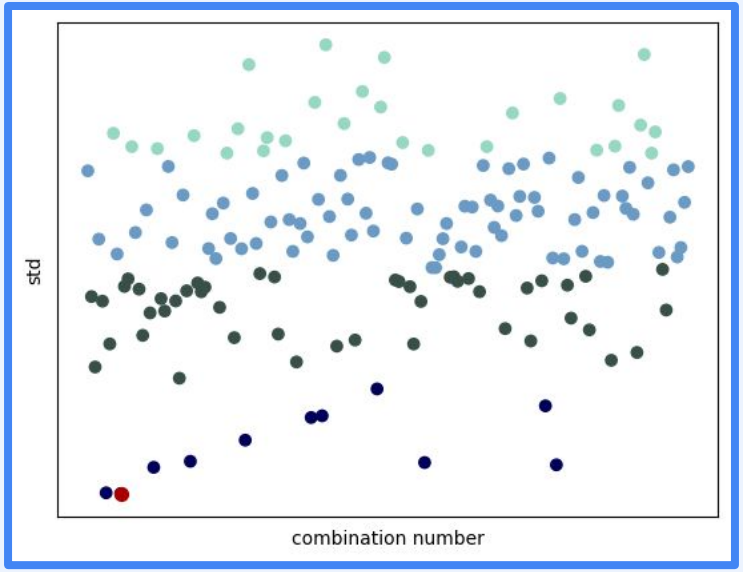
1 Briefly on data

Lung Ultrasound Images

1. images are scored from 0 to 3
2. my approach works frame-wise
3. some augmentation has been done
4. even if they seems in greyscale, there are three channels that I kept in the png conversion

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”

- 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

Save the softmax values + correctness

Model based

Created a model, but it was not learning ~50%

Support Vector Classifier

First bad, so I chose the same number of correct and wrong predictions

balanced dataset -> good 64%

4 Similarity

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

Results

Only model

Only tsne

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

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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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