Priority read list for pneumonia detection in chest x-rays

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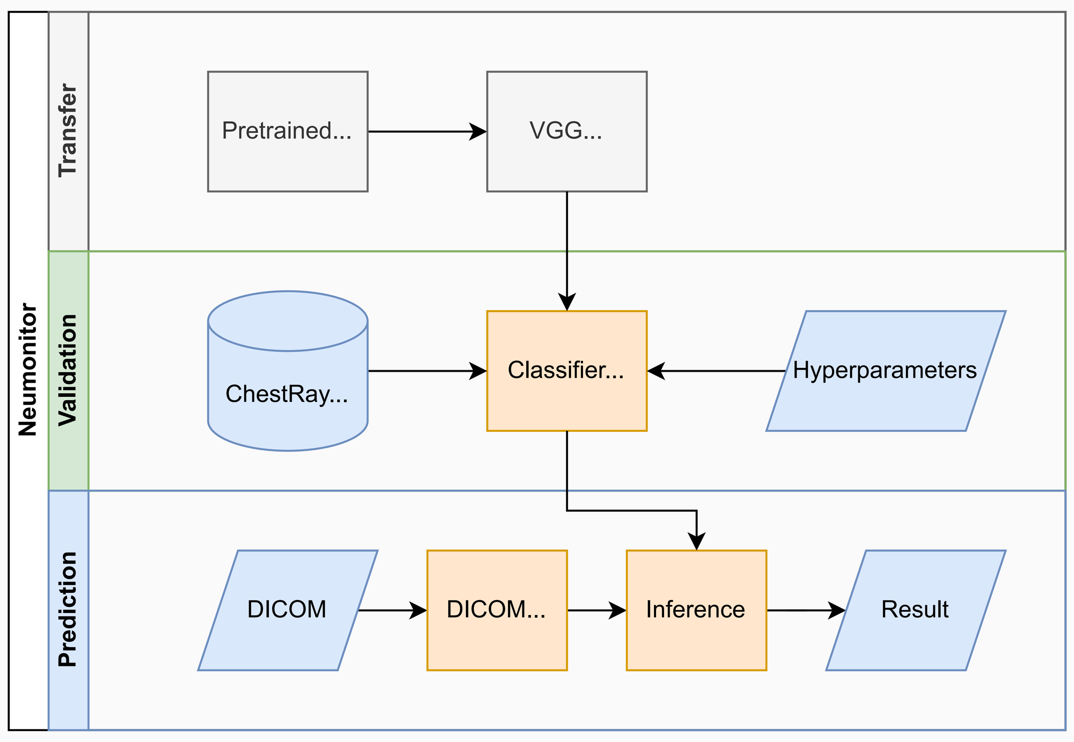
Abstract

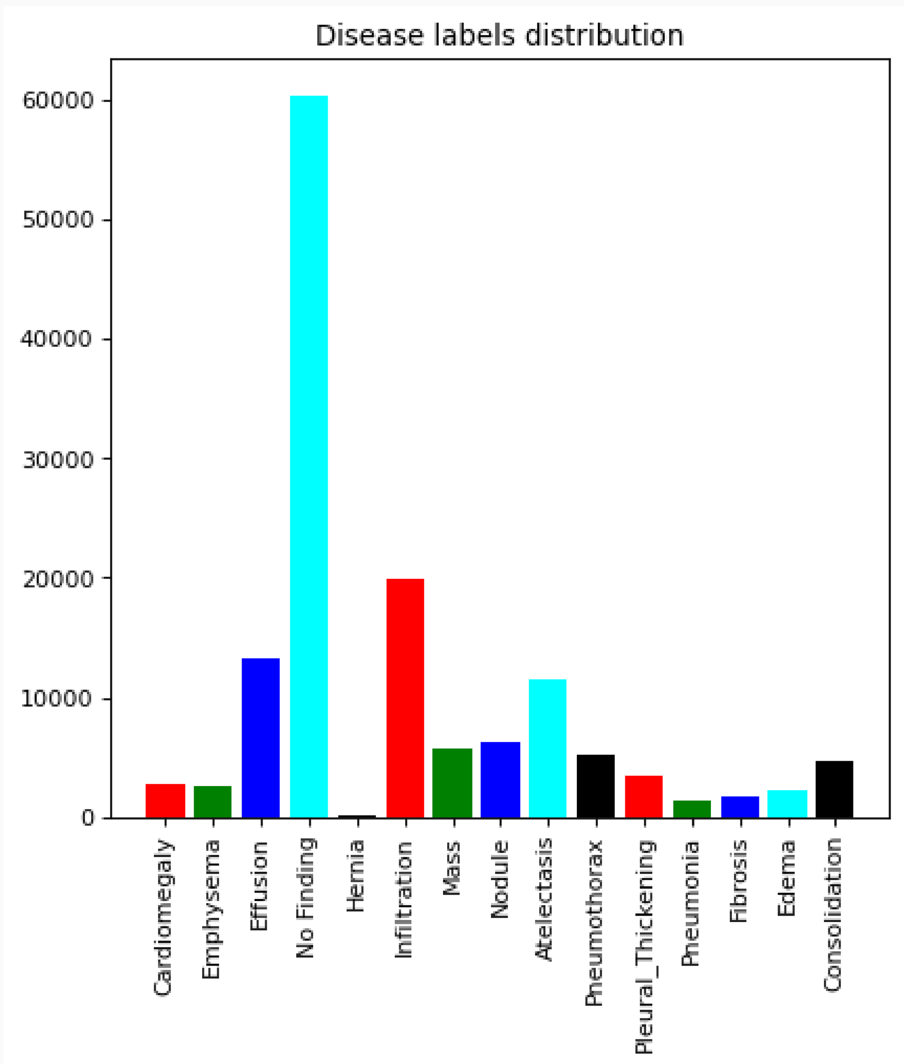
To fight pneumonia fast and accurate diagnoses are required, however, the number of radiologists is limited and their work time is usually spent in negative diagnostics. Therefore, selecting the most probable cases for being first analyzed by the radiologist can speed up the treatment of critical cases. On the other hand, deep learning algorithms have proved to be very efficient in the classification of images, however, their performance is still limited in medical applications given that they are usually pre-trained in natural environments, e.g. ImageNet, and the amount of available medical images is still small with respect to current natural environments databases. Therefore, instead of directly classifying images we use deep learning methods to provide a priority read list based on the logits inferred by a state-of-the-art neural network. Our method is set according to an evaluation of the sensibility, specificity and F1 scores reached by VGG for the classification of Pneumonia in the NIH Chest X-ray Dataset.

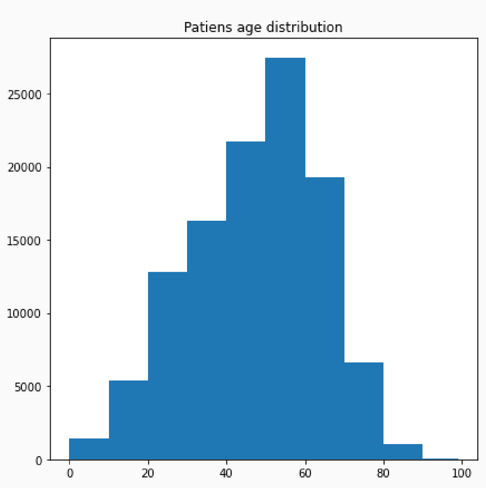
Neumonitor

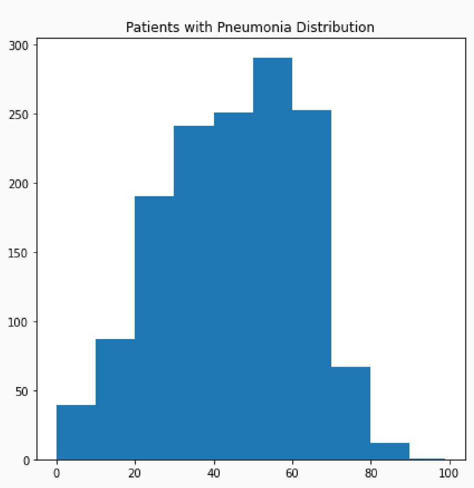


NIH chest X-ray dataset

"The NIH Chest X-ray Dataset is comprised of 112,120 X-ray images with disease labels from 30,805 unique patients. To create these labels, the authors used Natural Language Processing to text-mine disease classifications from the associated radiological reports. The labels are expected to be >90% accurate and suitable for weakly-supervised learning." [2]

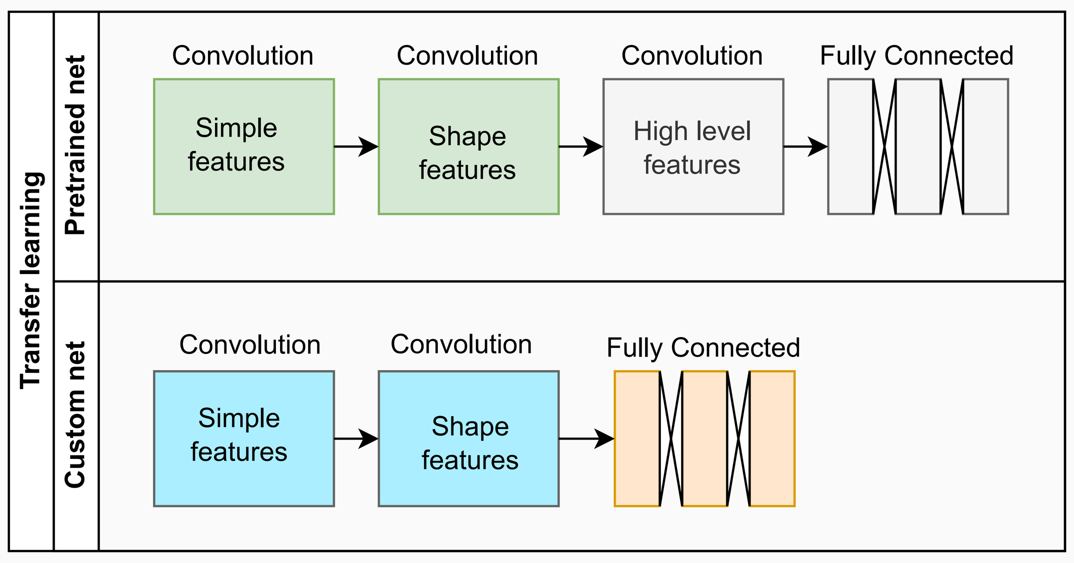






Transfer Learning

In general, transfer learning reuses a pre-trained model into a similar task. We use VGG [1] architecture pre-trained with Imagenet. Since the NIH chest x-ray dataset is different from the natural images in Imagenet we only keep the initial convolutional layers.



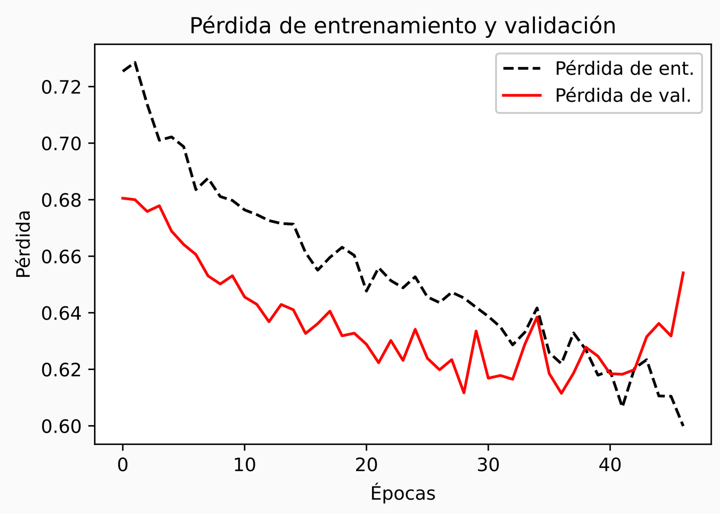
The convolutional layers are freezed while the fully connected layers are replaced by new ones.

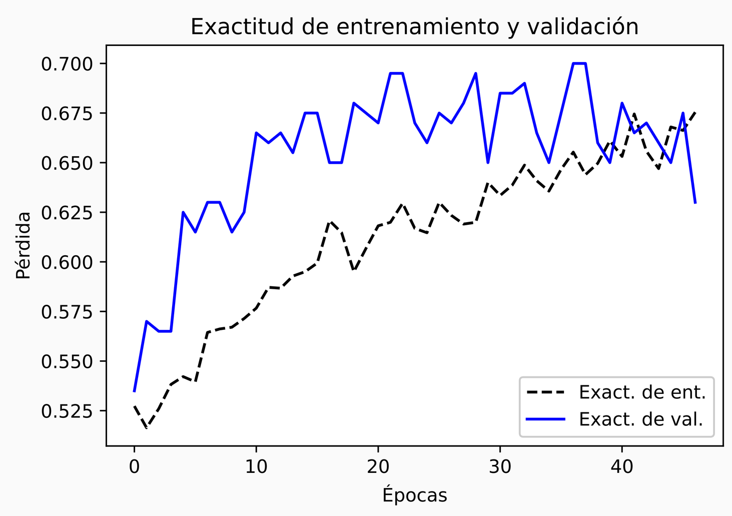
Data Preprocessing

We selected two classes: *'pneumonia'* and *'no pneumonia'*. Data is balanced by subsampling. Stratification is also performed. Data augmentation includes: horizontal flip, height shift (0.1), with shift (0.1), random rotation (20 deg.), shear (0.1) and zoom (0.1)

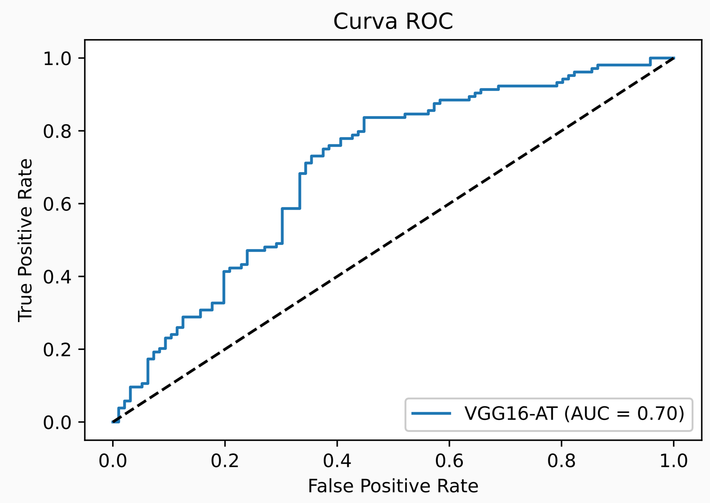
Classifier Training

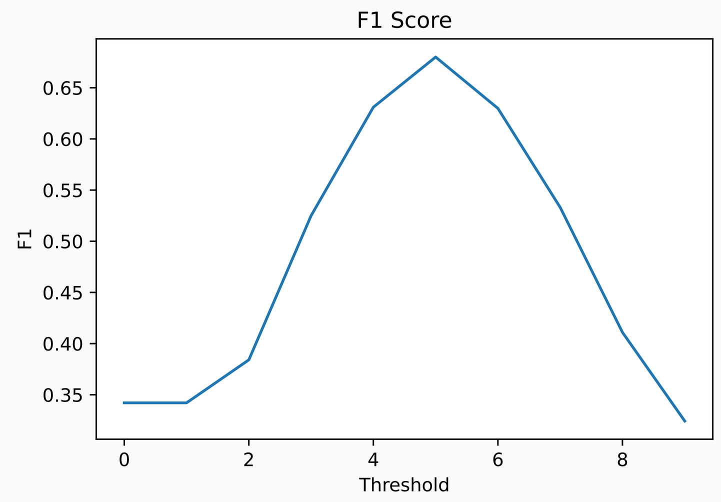
VGG16 was tuned using Adam optimizer, binary cross entropy and batch size 200 during a maximum numbre of iterations



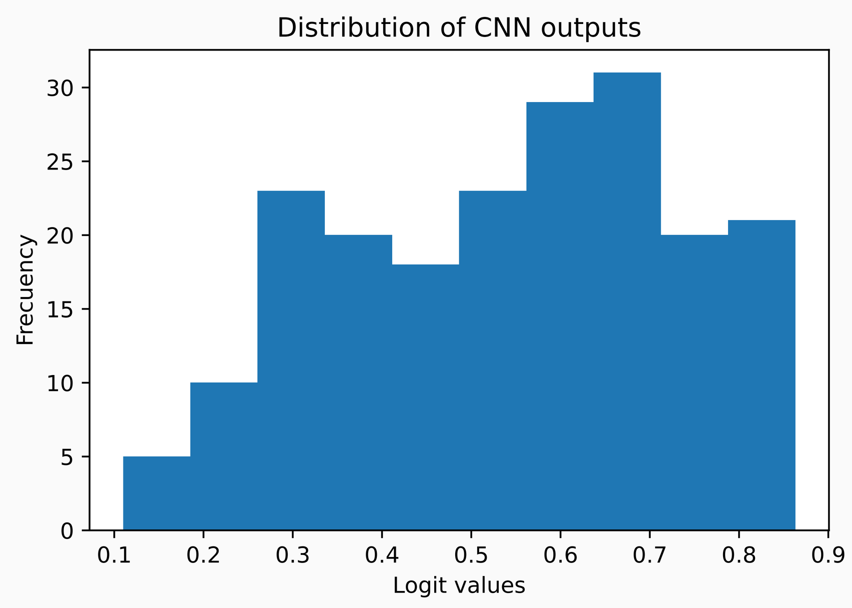


Analysis





Priority read list



For each incoming image:

1. Make a forward pass.
2. Insert to the DICOM file the logit value.
3. Send to the radiologits the DICOM file with the highest logit value.

Conclusions

We have presented a method based on deep learning for building a priority read list for pneumonia detection. The method uses the logits obtained from the network outputs to select which images are read first by the radiologist. The next step in this research is to test more networks and compare their performace.

References

[1] Karen Simonyan and Andrew Zisserman. Very deep convolutional networks for large-scale image recognition. *arXiv preprint arXiv:1409.1556*, 2014.

[2] Xiaosong Wang, Yifan Peng, Le Lu, Zhiyong Lu, Mohammadhadi Bagheri, and Ronald M Summers. Chestx-ray8: Hospital-scale chest x-ray database and benchmarks on weakly-supervised classification and localization of common thorax diseases. In *Proceedings of the IEEE conference on computer vision and pattern recognition*, pages 2097–2106, 2017.

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