Neural Network Training: COVID CT Scans

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1 Abstract

COVID-19 has had a massive impact on the entire world, and one of the biggest problems is testing for positive cases. Using the work of other researchers as a starting point, members of the internship program at the Maryland Innovation and Security Institute (MISI) have taken on a project to contribute in this area. This paper addresses the training of machine learning models that are meant to identify COVID-positive patients based on lung CT scans.

1.1 Introduction

This project was based on the work of a group of researchers at UC Berkeley and UC San Diego [1]. Their model, that they called Self-Trans, was able to very accurately identify whether or not someone had COVID-19 based on CT scans of their lungs. As part of the internship program at MISI, our group was tasked with creating an API for training other models. In addition to this, we will also compare the models trained by other teams working on this project at MISI to the model used by the researchers.

2 Models Used

The Self-Trans model uses transfer learning, and is based on DenseNet-169. The difference between them is that Self-Trans uses self-supervised learning in addition to transfer learning, while DenseNet-169 only uses transfer learning. Team five created their own model, the details of which can be found in their paper. Team six used a Bilinear Convolutional Neural Network (CNN) that was modified to allow for faster training.

3 Results

Self-Trans was an improvement on the base DenseNet-169. Self-Trans has an F1 score of 0.85 and an accuracy of 0.86, while DenseNet-169 has an F1 score of 0.81 and an accuracy of 0.83. Team five's model has a best accuracy of 0.72, and team six's model has an accuracy of 0.64.

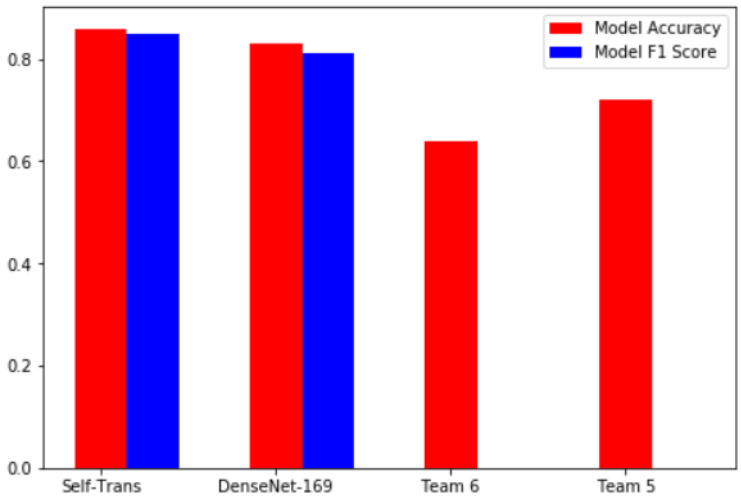

Figure 1: Model Results

4 Discussion

In practice, training a model tends to be a balance between fitting a model to a problem without over-fitting it to the point that it is not generalizable [2].

According to the researchers, they presented a model "which synergistically integrates contrastive self-supervised learning with transfer learning to learn powerful and unbiased feature representations for reducing the risk of overfitting" [1]. This method of training can explain how they obtained a model that is very accurate. Using this modified version of transfer learning allows the model to be applied even when the specific data (in this case lung CT scans) is low in quantity. The researchers used a pretrained model that had been made for lung nodal analysis. This likely prevented overfitting to the COVID-CT dataset.

Team six's model did not use transfer learning in this same way, which likely explains why their model was not as successful as Self-Trans. Having a model that already is able to evaluate lung CT scans would likely have improved the performance.

When training their mode, team five also used augmentations on their data to improve accuracy. This could explain their improve performance over team six. However, team five also did not use transfer learning, which is likely the reason that it had a lower accuracy to Self-Trans.

5 Conclusion

Creating models that can accurately diagnose COVID-19 is not an easy task. Despite that, teams five and six were able to create models that had some success in doing so. Unfortunately, no improvements were made over Self-Trans. Even though the researchers at UC Berkeley and UC San Diego have found a fairly effective way of doing so, there is still room for improvement.

References

[1] Xuehai He, Xingyi Yang, Shanghang Zhang, Jinyu Zhao, Yichen Zhang, Eric Xing, and Pengtao Xie. Sample-efficient deep learning for covid-19 diagnosis based on ct scans. *medrxiv*, 2020.

[2] Eli Stevens. *Deep Learning with PyTorch*. O'Reilly Media, 2019.