DEEP COVNET: A DEEP CONVNET FOR COVID 19 DETECTION FROM CT SCAN IMAGES

Rowan M. Amin, Sara Zayan

Arab Academy for Science and Technology, Alexandria, Egypt

ABSTRACT

This document describes the approach followed in classifying the dataset containing CT scans of Covid19 and Cap patients as well as Normal CT scans .A prepossessing was applied on the data for easier manipulation . The network VGG16 is used in training as well as focal loss because of this imbalanced data and finally a majority vote approach was considered to classify each patient

Index Terms— Cross-modal Retrieval, Deep Learning, Representation Learning

1. INTRODUCTION

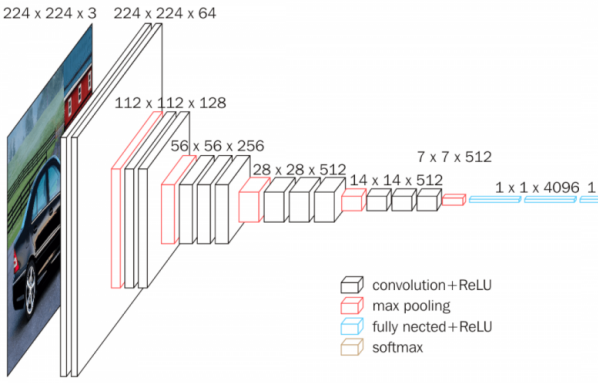
A strain of coronavirus that has not previously been detected anywhere has been an ongoing outbreak in the recent year .It is a pandemic that is known to be very dangerous and fatal especially for people with chronic diseases .Hence, continued research and learning about this topic has never been more important.

2. DATASET

This multi-diseases Dataset contains CT scans of 3 classes of patients, Covid19(collected between February 2020 to April 2020),Community Acquired Pneumonia(CAP)(collected between April 2018 to December 2019) and Normal (collected between Jan 2019 to May 2020).Diagnosis of Covid19 patients is based on clinical parameters and the clarification of three experienced thoracic radiologists The data is in the Digital Imaging and Communications in Medicine (Dicom) format and 30 % of the data is randomly chosen for Validation.Besides the patient-level labels, a subset of 55 COVID-19, and 25 CAP cases were analyzed by the radiologist to identify and label slices with evidence of infection. The labeled subset of the data contains 4, 993 number of slices demonstrating infection and 18, 416 number of slices without infection.The dataset is then divided into training, validation, and test sets which are described as follows: Training and Validation Dataset:This dataset includes volumetric CT scans with all slices of 171 patient positive for COVID-19, 60 CAP, and 76 normal cases. All CT scans in this dataset are obtained by a SIEMENS, SOMATOM Scope scanner with the normal radiation dose and the slice thickness of 2mm. Slice-level labels are available for a subset of 55 COVID-19, and 25 CAP cases [1]

3. RELATED WORK

VGG16(Simonyan and Zisserman 2014) is widely used for image recognition.Firstly, we initialized the model. Secondly ,since this data is class imbalanced , Focal loss(FL) was used. It is an improved version of cross entropy as it gives more weights to easily misclassified examples (less likely to be predicted) and gives less weights to easy examples(more likely to be predicted) [2]



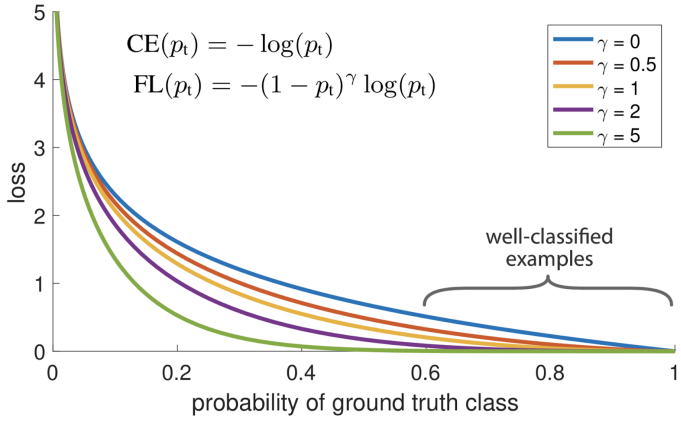
The framework of the proposed VGG16 [3]

3.1. Focal loss equation

Formally, the focal loss is expressed as follows: L = L = -(1-pt)*gamma $\log(pt) Where gamma 0 is a pre fixed positive scala value = \begin{cases} \alpha & \text{if } y = 1 \\ 1 - \alpha & \text{otherwise} \end{cases}$

where alpha is a prefixed value between 0 and 1 to balance the positive labeled samples and negative labeled samples, It is really common to balance classes.It is clear that the weight term alphat(1-pt) and the cross entropy loss is dependent on the value of pt When it is larger the weight is smaller, when is smaller the weight is larger.

[4]



Focal Loss

3.2. Feature extraction

Feature extraction is really important as it increases the accuracy of the learned model. It decreases the dimension of the data by removing unnecessary information . Furthermore ,by getting a limited number of features , over-fitting is prevented.It is really crucial to extract features out of medical images to analyze and fix issues.In general ,Medical images fall into two types , one can be interpreted by anyone which is visible light medical images and the second one is only interpreted by medical specialist which is invisible light medical imaging . Both types needs segmentation and feature extraction [5]

[6]

3.3. Test and Prediction

A prediction was executed on each image in each patient and saved in a csv file.Furthermore ,a majority voting was executed to predict the class of each patient according to the classification of each image in the patient that occurred previously [7]

4. EXPERIMENTAL RESULTS

The Validation accuracy was 59 % using the VGG16.A majority voting was executed on each patient in each of the three test folders. Finally ,Results were put on three csv files

5. CONCLUSION

This project of a multi-class classification based on a dataset consisting of medical images was a very good practise for real world problems. with validation accuracy 59% , feature extraction was executed and finally a multi class classification was executed on each patient in each Test class

6. REFERENCES

[1] David Power, Eugenia Politou, Mark Slaymaker, Steve Harris, and Andrew Simpson, "A relational approach to the capture of dicom files for grid-enabled medical imaging databases," in *Proceedings of the 2004 ACM symposium on applied computing*, 2004, pp. 272–279.

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

[3] Will Nash, Tom Drummond, and Nick Birbilis, "A review of deep learning in the study of materials degradation," *npj Materials Degradation*, vol. 2, no. 1, pp. 1–12, 2018.

[4] Tsung-Yi Lin, Priya Goyal, Ross Girshick, Kaiming He, and Piotr Dollár, "Focal loss for dense object detection," in *Proceedings of the IEEE international conference on computer vision*, 2017, pp. 2980–2988.

[5] Chiranji Lal Chowdhary and DP Acharjya, "Segmentation and feature extraction in medical imaging: a systematic review," *Procedia Computer Science*, vol. 167, pp. 26–36, 2020.

[6] Isabelle Guyon, Steve Gunn, Masoud Nikravesh, and Lofti A Zadeh, *Feature extraction: foundations and applications*, vol. 207, Springer, 2008.

[7] Edward O Wiley, Kristina M McNyset, A Townsend Peterson, C Richard Robins, and Aimee M Stewart, "Niche modeling perspective on geographic range predictions in the marine environment using a machine-learning algorithm," 2003.