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Main Idea

As COVID continues to spread around the world, hospitals are becoming overwhelmed. Doctors and nurses cannot spend as much time with their patients as they used to, leading to a significant increase in human errors. When COVID enters the body, it can slowly lower the oxygen saturation levels. If the blood oxygen level is too low, the blood cannot provide organs with enough oxygen needed for life. To deal with this, hospitals put patients on forced ventilation to provide oxygen. The patient must be intubated, a procedure in which a doctor or nurse inserts an endotracheal tube (ET) into the throat. To ensure the tubes are placed correctly, a physician or radiologist must manually look at an x-ray to verify that they are placed in the optimal position. Not only does this leave room for human error, but delays are also common as radiologists can be busy reading other scans. Implementing an automated process that can provide instant feedback on tube placement could help patients and reduce hospitals' workload. The hospitals would considerably benefit from this process even when the COVID crisis is over. This project will examine the possibility of using machine learning to read x-rays to determine if ET tubes are correctly inserted into a patient. The x-rays of the chest images will first be prepared through preprocessing and then fed to a machine learning model. Finally, the model's performance will be evaluated using the appropriate metrics.

Data Set Description

The data set that will be used for this project contains x-ray images of catheter lines inside the patient's lungs. This is then broken down into a training set containing 3582 test images and 30083 training images; with each image having a unique identifier. The images are not uniform in size and range from 2000-3000 pixels in width and 2000-3000 pixels in height. Also included in the dataset is a train.csv file which has 13 columns including: StudyInstanceUID (unique ID for each image), ETT - Abnormal (endotracheal tube placement abnormal), ETT - Borderline (endotracheal tube placement borderline abnormal), ETT - Normal (endotracheal tube placement normal), NGT - Abnormal (nasogastric tube placement abnormal), NGT - Borderline (nasogastric tube placement borderline abnormal), NGT - Incompletely Imaged (nasogastric tube placement inconclusive due to imaging), NGT - Normal (nasogastric tube placement borderline normal), CVC - Abnormal (central venous catheter placement abnormal), CVC - Borderline (central venous catheter placement borderline abnormal), CVC - Normal (central venous catheter placement normal), Swan Ganz Catheter Present and PatientID (unique ID for each patient in the dataset). This csv file has columns 2-12 in a binary encoding format. Also included are Tensorflow record files for the training and test sets.

Project Milestones

Project milestones will include proposal acceptance, first draft code completion, training/testing, progress report, final code completion, final training and testing, group presentation completion and final report completion.

Expected Results

In this project, the goal is to predict the tube emplacement as accurately as possible. Towards that end, the number of both false positives and false negatives should be kept at a minimum. The former case requires unnecessary operations just to later realize that the tube was placed correctly, not to mention the pain and anxiety the patient must go through during the physical process. Similarly, in the latter case, the wrong prediction of the displacement of the tube causes long-term effects on the patients' lungs and Trachea. Furthermore, since the data is imbalanced, using accuracy as the only metric can not give us a real perspective on the model's performance. For such skewed classification problems, it is suggested to use a variety of metrics such as accuracy, f1-score, recall, etc altogether to yield better performance evaluation results.