UDACITY

PROJECT SPECIFICATION

Pneumonia Detection from Chest X-Rays

Exploratory Data Analysis

CRITERIA	MEETS SPECIFICATIONS
The student can create visualizations of the metadata that inform model training	• Students create distributions of diseases and comorbidities in their dataset • Students create distributions of basic demographics of the patients who make up their datasets (such as age, gender, patient position,etc.) • Students can use the above distributions to draw conclusions about how they will need to set up their model training
The student can visualize relevant properties of pixel-level data	• Students use python's imshow to visualize medical images during EDA • Students create distributions of intensity values of the pixel-level data within images and compare them both **within and across** diagnoses • Students use both of these methods of inspecting images to draw meaningful conclusions about what their model will train on

Model Building & Training

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The student creates an	• Students create a set of training data and a set of validation data that each have the appropriate

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appropriate train-test split of the data	proportions of positive and negative cases for their intended use (training and validation)
The student implements appropriate data augmentation to their training data	• Student implements a class such as ImageDataGenerator from Keras to augment their training data only • Student **should not** augment testing/validation data • Student uses types of augmentation that are appropriate for medical imaging. There are no required types of augmentation • Students should normalize the imaging data so the model weights do not go to infinity.
The student evaluates the performance of their model using the appropriate statistics	• Student monitors the training progress of their model using log loss • Student changes training parameters to avoid overfitting and compares performances of different training paradigms. • Student trains enough epochs until the loss is “stable” • After training, student uses precision, recall, and F1 score to actually evaluate the utility of their model. • Find a threshold to classify if an image is pneumonia or not. • Students should show precision-recall curve and a curve of F1-score vs. threshold
The student can integrate their model with real-world medical imaging data	• Student can check DICOM header for **image position, image type and body part** on ALL .dcm files to check validity for their model using the pydicom python package. • Student can read imaging data in from a .dcm file, preprocess the image and feed it into their model using the pydicom python package.

FDA Description and Validation Plan

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The student can describe the intended population and the clinical impact of their model	• Student should provide an intended use statement • Student should point to data from their EDA to describe who their algorithm is indicated for and what the clinical setting is in which their algorithm would be used • Student should describe limitations of their algorithm and how false positives or false negatives might affect a patient
The student can describe how their model was designed and trained	• Students provide a flowchart or architecture diagram of their model • Students should describe the DICOM checks they use before sending an image through their algorithm • Students should describe the preprocessing steps they use. • Students should describe the architecture of the classifier • Students should describe augmentation and its parameters used • Students describe the parameters used for training • Students should show the behavior of training and validating loss • Students should describe the performance statistics and threshold used in final validation
The student can describe the dataset used to train the algorithm and how the ground truth	• Students should provide information for the training set • Students should provide information for the validating set • Students should describe how the ground truth of the NIH dataset is created, the benefit and limitations.

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ground truth was created	
The student describes how they would create a FDA Validation set, ground truth, and what performance metric they would hold their algorithm to for FDA validation of their model.	• Students should describe the **ideal** dataset that they would receive from a clinical partner for their FDA Validation Dataset • Students should describe how they would **ideally** create ground truth for this FDA Validation Dataset • Students should describe the performance metric and **the metic value** that they would hold their algorithm to, supported by literature

Suggestions to Make Your Project Stand Out!

- Create some of your own custom image augmentation (such as different image filtering techniques) rather than solely using those predefined by Keras' ImageDataGenerator.
- Try creating two 'nested' models to specifically predict pneumonia. One that predicts pneumonia and/or infiltrates at the top level, and then a second model that specifically predicts pneumonia from the positive cases returned by the first model.
- Have your model output a class activation map in addition to a single binary prediction of pneumonia. This map will help a clinician to understand what the model is detecting as probable pneumonia in each image.