Machine Learning Engineer Nanodegree

Capstone Proposal

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Proposal

Domain Background

According to the BMU, Each year an estimated more than 1.7 billion billion people are affected by musculoskeletal conditions worldwide (BMU, 2017). These conditions are the most common cause of severe, long-term pain and disability (Woolf & Pfleger, 2003), with 30 million emergency department visits annually and increasing. The most common site for fractures were the hands and feet, followed by the leg and arm bones and the trunk.

Using CNN we can detect abnormalities in bones using MURA dataset.

Problem Statement

Given a dataset of X-Ray radiographs images, an algorithm needs to be detect an abnormalities in the bones and determines whether they are fractured or not automatically with better than human performance?

Datasets and Inputs

Large, high-quality datasets have played a critical role in driving progress of fields with deep learning methods . MURA, a large dataset of radiographs, containing 14,863 musculoskeletal studies of the upper extremity. Each study contains one or more views (images) and is manually labeled by radiologists as either normal or abnormal. MURA, contains 9,045 normal and 5,818 abnormal musculoskeletal radiographic studies of the upper extremity including the shoulder, humerus, elbow, forearm, wrist, hand, and finger. MURA is one of the largest public radiographic image datasets.

INPUT -

The MURA abnormality detection task is a binary classification task, where the input is an upper extremity radiograph study — with each study containing one or more views (images) — and the expected output is a binary label $y \in \{0, 1\}$ indicating whether the study is normal or abnormal, respectively.

STUDY	TRAIN		VALIDATION		TOTAL
	Normal	Abnormal	Normal	Abnormal	
Elbow	1094	660	92	66	1912
Finger	1280	655	92	83	2110
Hand	1497	521	101	66	2185
Humerus	321	271	68	67	727
Forearm	590	287	69	64	1010
Shoulder	1364	1457	99	95	3015
Wrist	2134	1326	140	97	3697
Total no. of studies	8280	5177	661	538	14656

Following are the file descriptions and URL's from which the data can be obtained:

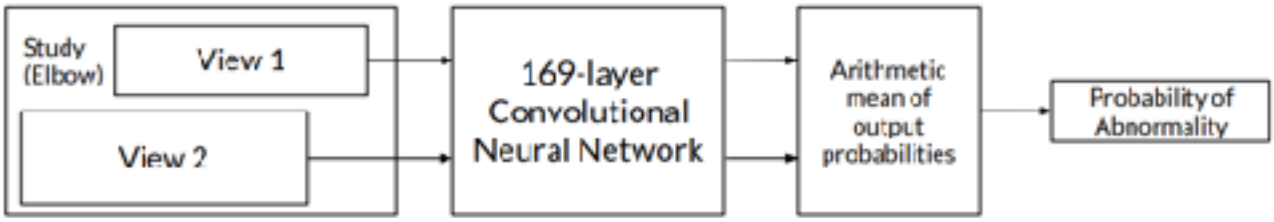
- MURA-v1.1.zip - zipped folder of all (train/valid) images and csv files too.
- Link - https://stanfordmlgroup.github.io/competitions/mura/

Solution Statement

A deep learning algorithm will be developed using Tensorflow/Keras and will be trained with training data and validation data will be used to evaluate how model is doing. Specifically a CNN will be implemented in Tensorflow/Keras.The model takes as input one or more views for a study. On each view, Convolutional neural network predicts the probability of abnormality. We compute the overall probability of abnormality for the study by taking the arithmetic mean of the abnormality probabilities output by the network for each image. The model makes the binary prediction of abnormal if the probability of abnormality for the study is greater than 0.5.

Benchmark Model

The model with public leaderboard with kappa score of 0.778 will be used as benchmark model. They train a 169-layer DenseNet baseline model to detect and localize abnormalities.



Evaluation Metrics

For each image X of study type T in the training set, you must optimized the weighted binary cross entropy loss

$$L(X, y) = -w_{T,1} \cdot y \log p(Y = 1|X)$$

$$-w_{T,0} \cdot (1 - y) \log p(Y = 0|X),$$

where y is the label of the study, $p(Y = i|X)$ is the probability that the network assigns to the label i, $w_{T,1} = |N_T|/(|A_T| + |N_T|)$, and

$w_{T,0} = |A_T|/(|A_T| + |N_T|)$ where $|A_T|$ and $|N_T|$ are the number of abnormal images and normal images of study type T in the training set, respectively.

Before feeding images into the network, we normalized each image to have the same mean and standard deviation of images in the ImageNet training set. We then scaled the variable-sized images to 320 × 320. We augmented the data during training by applying random lateral inversions and rotations of up to 30 degrees.

Project Design

From the project description and problem statement it can be inferred that computer vision can be used to arrive at a solution.

Initially data exploration will be carried out to understand possible labels, range of values for the image data and order of labels. This will help preprocess the data can end up with better predictions.

After this necessary preprocess functions will be implemented, data will be randomised and CNN will be implemented in Tensorflow/Keras.

CNN class of deep learning algorithm can be employed for this problem. Convolutional neural network to predict the probability of abnormality for each image in a study. The network uses a Dense Convolutional Network architecture which connects each layer to every other layer in a feed-forward fashion to make the optimization of deep networks tractable. We replaced the final fully connected layer with one that has a single output, after which we applied a sigmoid nonlinearity.

Finally necessary predictions on the test data will be carried out and these will be evaluated.