

Exercise 3: Representation learning for bone fractures

1. Overview

In this assignment you are required to implement a bone fracture xray classification task utilizing a SSL approach with the following data set: <https://stanfordmlgroup.github.io/competitions/mura/>

"MURA is a dataset of musculoskeletal radiographs consisting of 14,863 studies from 12,173 patients, with a total of 40,561 multi-view radiographic images. Each belongs to one of seven standard upper extremity radiographic study types: elbow, finger, forearm, hand, humerus, shoulder, and wrist. Each study was manually labeled as normal or abnormal by board-certified radiologists from the Stanford Hospital .

To evaluate models and get a robust estimate of radiologist performance, we collected additional labels from six board-certified Stanford radiologists on the test set, consisting of 207 musculoskeletal studies."

	Radiologist 1	Radiologist 2	Radiologist 3	Model
Elbow	0.850 (0.830, 0.871)	0.710 (0.674, 0.745)	0.719 (0.685, 0.752)	0.710 (0.674, 0.745)
Finger	0.304 (0.249, 0.358)	0.403 (0.339, 0.467)	0.410 (0.358, 0.463)	0.389 (0.332, 0.446)
Forearm	0.796 (0.772, 0.821)	0.802 (0.779, 0.825)	0.798 (0.774, 0.822)	0.737 (0.707, 0.766)
Hand	0.661 (0.623, 0.698)	0.927 (0.917, 0.937)	0.789 (0.762, 0.815)	0.851 (0.830, 0.871)
Humerus	0.867 (0.850, 0.883)	0.733 (0.703, 0.764)	0.933 (0.925, 0.942)	0.600 (0.558, 0.642)
Shoulder	0.864 (0.847, 0.881)	0.791 (0.765, 0.816)	0.864 (0.847, 0.881)	0.729 (0.697, 0.760)
Wrist	0.791 (0.766, 0.817)	0.931 (0.922, 0.940)	0.931 (0.922, 0.940)	0.931 (0.922, 0.940)
Overall	0.731 (0.726, 0.735)	0.763 (0.759, 0.767)	0.778 (0.774, 0.782)	0.705 (0.700, 0.710)

2. Steps :

Step 1: Please perform data exploration and create a naïve baseline (e.g. can be done based on the paper <https://arxiv.org/abs/1712.06957>, or any another approach you wish).

All steps must include a description of data exploration: data distribution, visualization, thorough evaluation, visualization of results, demonstration of good and bad results.

You can focus on the 3 different bones for example – Elbow, Hand and Shoulder as was done in the example <https://github.com/Alkoby/Bone-Fracture-Detection>:

The data set we used called MURA and included 3 different bone parts, MURA is a dataset of musculoskeletal radiographs and contains 20,335 images described below:

Part	Normal	Fractured	Total
Elbow	3160	2236	5396
Hand	4330	1673	6003
Shoulder	4496	4440	8936

The data is separated into train and valid where each folder contains a folder of a patient and for each patient between 1-3 images for the same bone part

Step 2: Implement one of the following representation learning approaches listed below and provide a detailed explanation of your approach compared to the baseline (e.g. compare the results when using of 1%,10%,100% of the labeled data as done in <https://arxiv.org/pdf/2006.10029.pdf>).

- SimCLR Chen et al. <https://github.com/google-research/simclr>
- Byol Grill et al. <https://papers.nips.cc/paper/2020/file/f3ada80d5c4ee70142b17b8192b2958e-Paper.pdf>
- Moco He et al. <https://arxiv.org/pdf/1911.05722.pdf>
- SimSiam Chen et al. <https://arxiv.org/abs/2011.10566>

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