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Neural Networks Final Project

Part 3: First Solution + Validation

The architecture I used was StyleGAN2-ADA-Pytorch. I chose to use a StyleGAN because they are pre-trained and the X-ray images from the MURA dataset are complex and don't have enough samples for the amount of variation thus using styleGAN to create the synthetic images is best as it can learn better. For this, I trained the StyleGAN separately, once for the positive(abnormal) x-ray images, and another time for the negative(normal) x-ray images in order to make sure the labels stayed with the proper fake images. StyleGAN2 was inspired by MSG-GAN but has an architecture to make use of multiple scales of images generation without explicitly requiring the model to do so. This is done using a resnet style skip connection between lower resolution feature maps to the final generated image. This is a big reason I chose to use it in the first place as the MURA database images are not ideal but StyleGAN2 should be able to work with them still. StyleGAN2-ADA also has an adaptive discriminator (ADA=adaptive discriminator augmentation). I also used a pytorch implementation as that seemed to work best in google colab. Below is a photo of the architecture of StyleGAN2 and StyleGAN2-ADA.

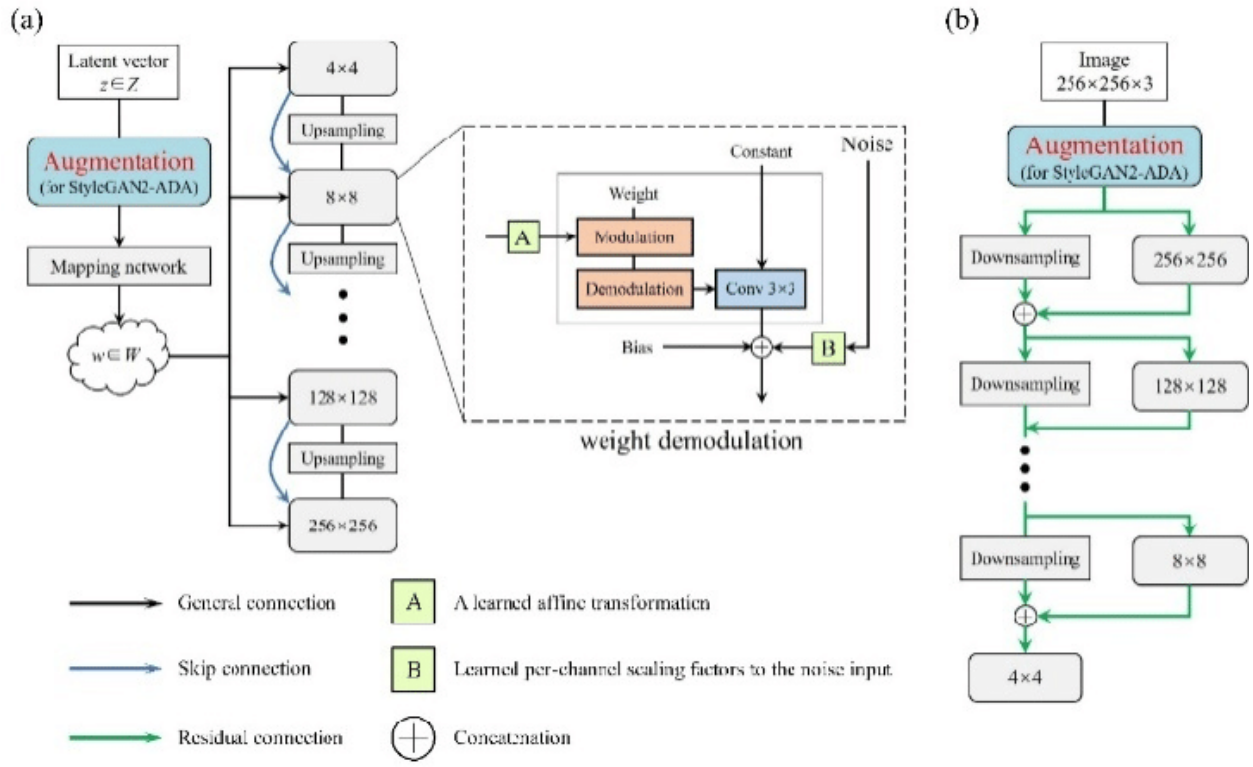

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Figure 1. StyleGAN2 and StyleGAN2-ADA architecture

The accuracy achieved can just be shown visually by looking at the fake images at the end of the training that are created and considered to "pass" as real. When looking at these images, they are not all great or passable as real x-rays mainly because some of the negative(normal) x-ray images you can see curved bones which is not a normal thing. I also picked the shoulder x-rays specifically which I think is a pretty complex bone structure in general

so that might have been tough. Some of the fake images look really realistic though. The images can be seen below.

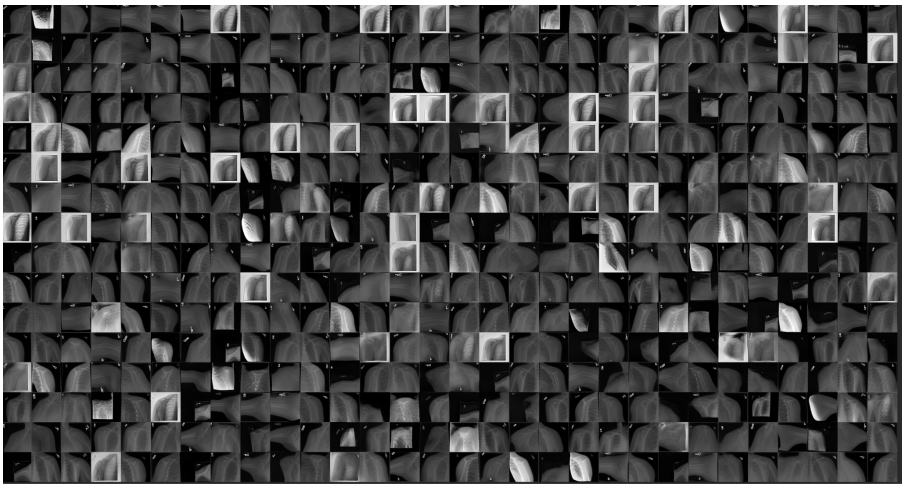

Figure 2. Negative Shoulder x-rays made from StyleGAN2-ADA

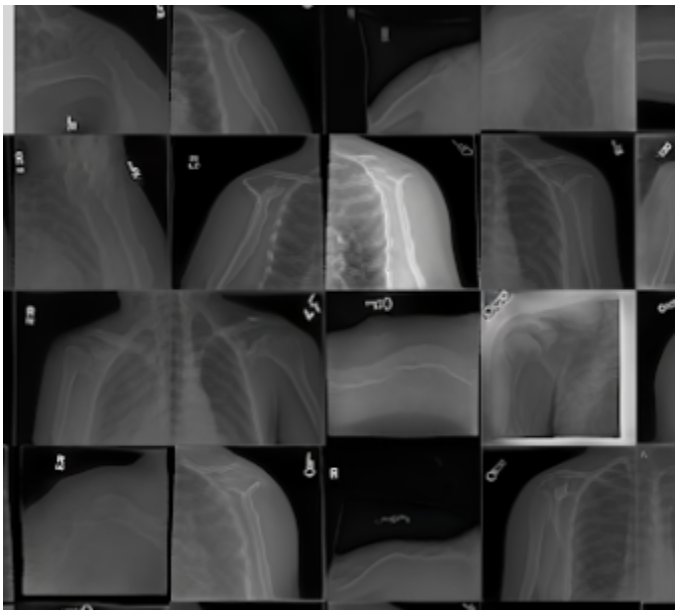

Figure 3. Close up of the C-rays from figure 2

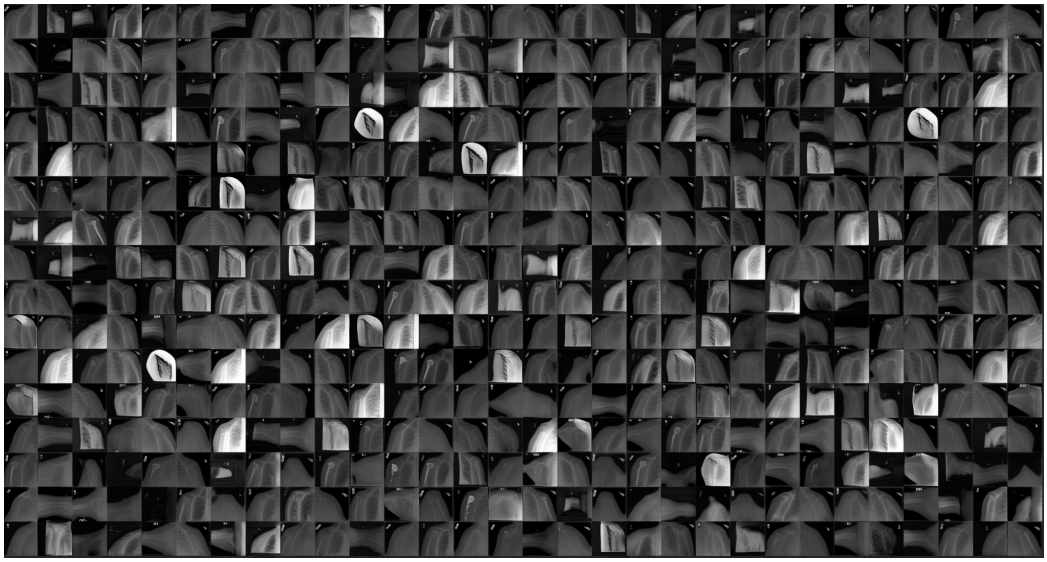

Figure 4. Positive(abnormal) shoulder X-rays made from StyleGAN2-ADA

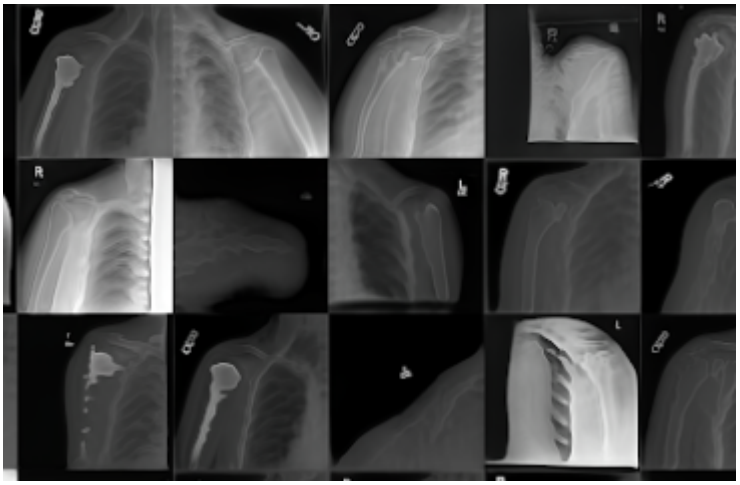

Figure 5. Close up of images from figure 4

From what I observed, it seems that the MURA database x-rays have a lot of variation in general and some of the images the x-ray portion is not fit to the whole image. This could be a big reason as to why the synthetic data made was not that great as more augmentation would have been a good idea like cropping and even sharpening the images from the database first.