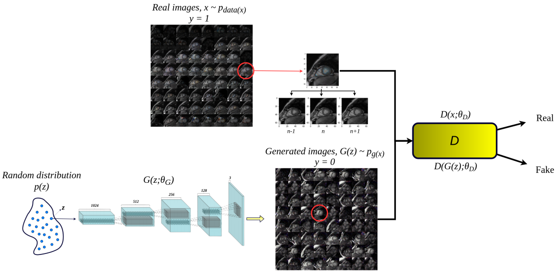

Cardiac cine-MRI sequences synthesis using deep learning generative models

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Content

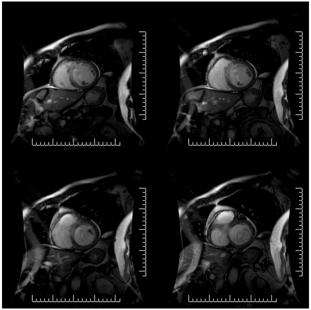
Introduction

Motivation

World Health Organization

- CVDs are the number 1 cause of death globally: more people die annually from CVDs than from any other cause.
- State of the art is full of machine learning techniques such as a neural network that are pretty dependant on the amount of data.

Dataset

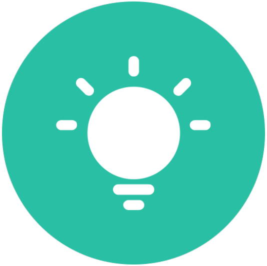


Sunnybrook Cardiac Data

- Dims: 256x256x3 to 128x128x3
- 45 cine-MRI images from a mixed of patients
- Each slice has 20 frames (Cardiac cycle).

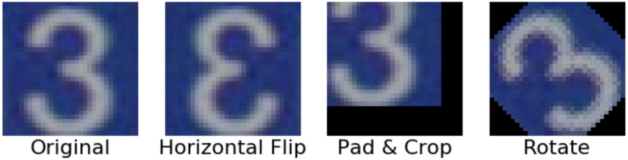
Purpose

- Cope with data scarcity in the medical area to improve machine learning methods.
- Create data close enough to a training distribution while constraining valuable aspects of the image.



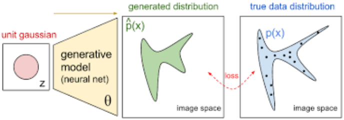
Data augmentation

Some techniques:

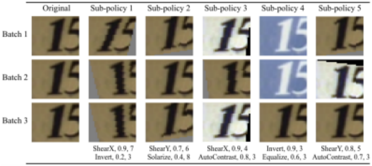


Traditional

Transformations

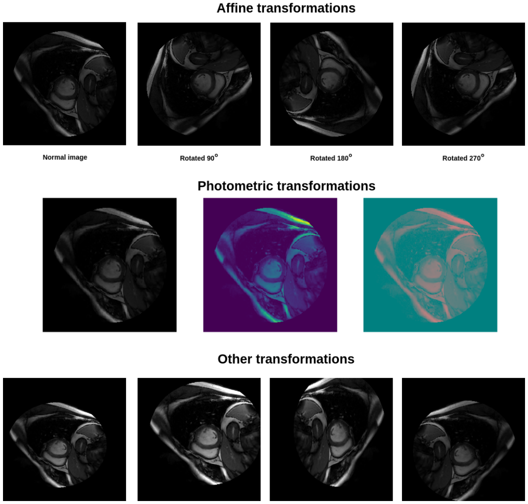


Generative models

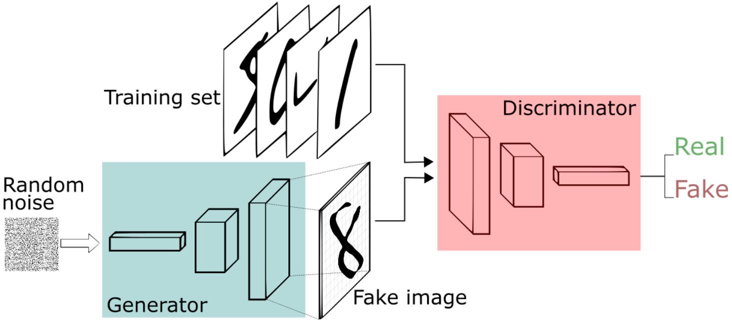


Learning the Augmentation

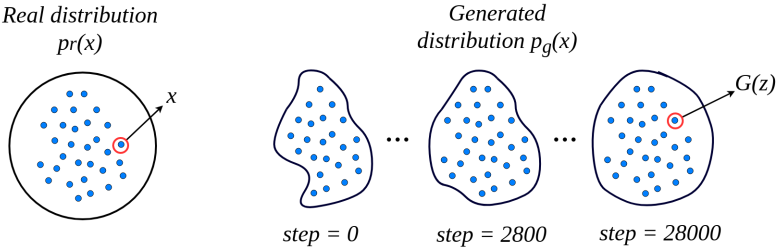
Common techniques



Generative adversarial nets



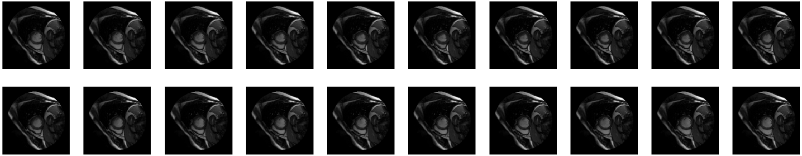
How GANs work?



$$\min_G \max_D V(D,G) = E_{x\sim p_{data}(x)}[logD(x)] + E_{z\sim p_z(z)}[log(1-D(G(z))] \tag{1}$$

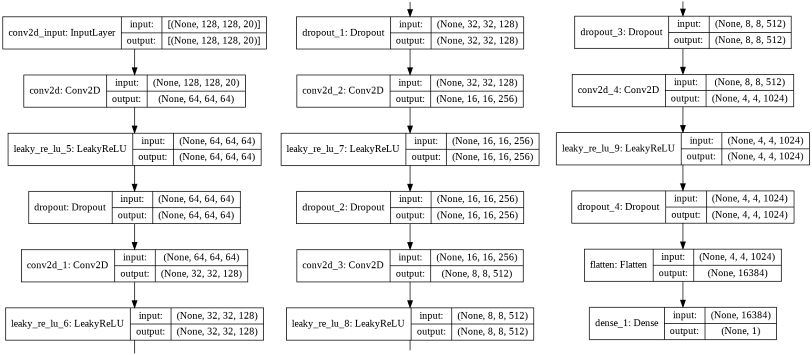
First approach
128x128 DCGAN

Training data

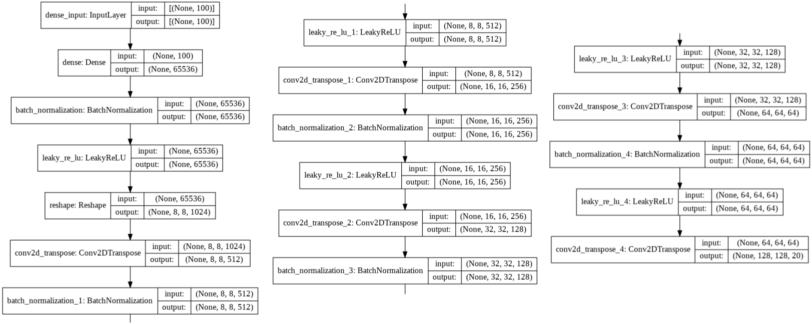


Read every image in the dataset in grayscale and downsample them to 128x128 pixels to stack them in the channels dimension.

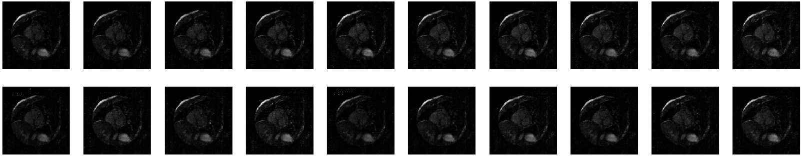
Generator architecture



Discriminator architecture



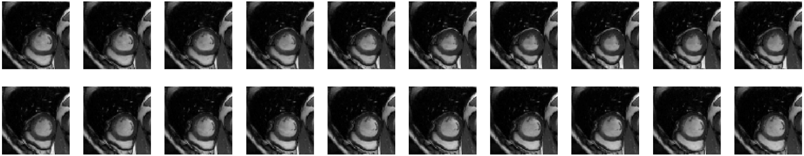
Generated images



Our first approach generated very noise samples but succeeded to learn the more general features of cine-MRI like the black contour and basic structure of the heart.

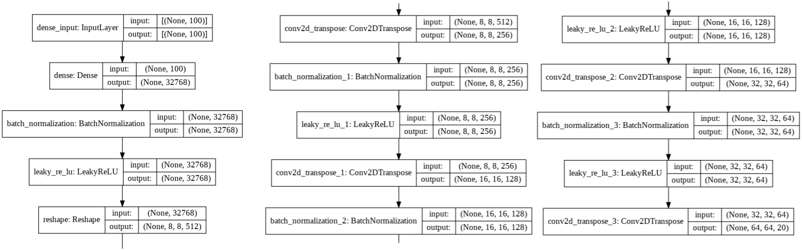
Second approach
64x64 DCGAN

Training data

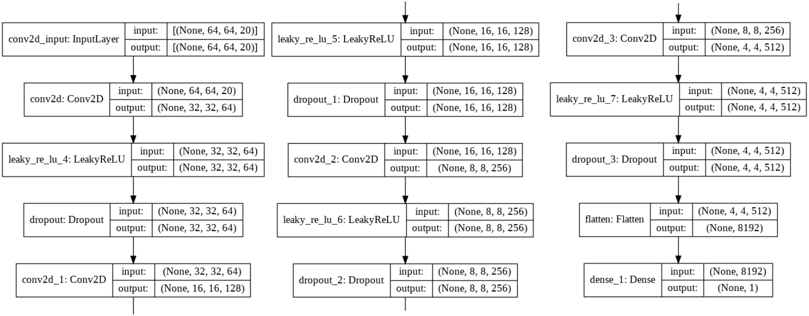


Read every image in the dataset in grayscale, crop the image until there's only the left and right ventricle remaining and downsample them to 64x64 pixels to stack them in the channels dimension.

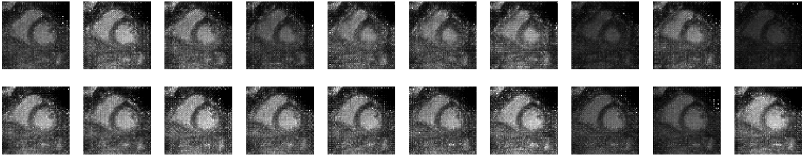
Generator architecture



Discriminator architecture



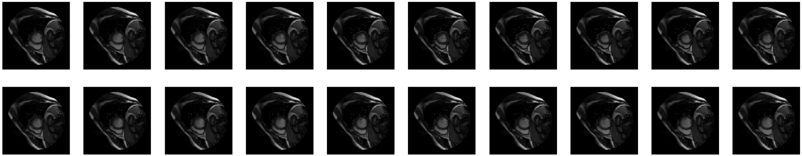
Generated images



Our second approach also generated noise samples. Nevertheless, it keeps some relationship between each frame which is key in cardiac cycles and generated a somehow correct shape for the left and right ventricle.

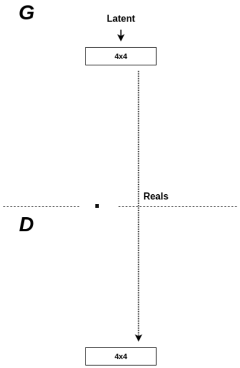
Third approach
Progressive Growing DCGAN

Training data

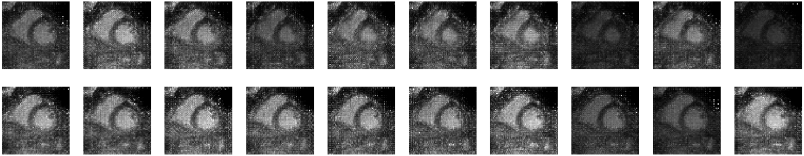


This time we will leave the images in their original size, read them in grayscale and stack them in the channels dimension.

Progressive Growing architecture

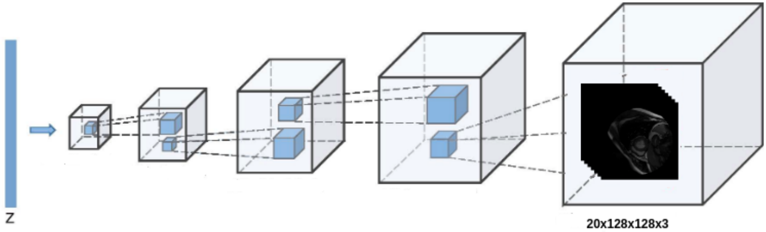


Generated images



Our first approach generated very noise samples but succeeded to learn the more general features of cine-MRI like the black contour and basic structure of the heart.

Why not using 3D DCGAN?



For more information go to:
https://github.com/Sangohe/CV-Cardiac_Cycle_Generation