Capstone Project Proposal

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Domain background

The main field of research for this project is medical imaging and computer vision.

Problem statement

In order to obtain computerized tomography (CT) high-resolution images, it's necessary to expose the patient to long scan times and subject the inpatient to higher contrast doses. In either case, expenses and risks will increase dramatically, which is rarely clinically applicable. Thus, we need ways to super-resolve CT images, artificially, in order to improve the accuracy of subsequent diagnostic and prognostic steps.

Datasets and inputs

The images provided in the deep lesion dataset will be used for this project.

"The National Institutes of Health's Clinical Center has made a large-scale dataset of CT images publicly available to help the scientific community improve detection accuracy of lesions. While most publicly available medical image datasets have less than a thousand lesions, this dataset, named DeepLesion, has over 32,000 annotated lesions identified on CT images, representing 4,400 unique patients"

https://www.nih.gov/news-events/news-releases/nih-clinical-center-releases-dataset-32000-ct-images

Solution statement

To implement a GAN based super-resolution (SR) learning algorithm, inspired by the works of You, et al. "CT super-resolution GAN constrained by the identical, residual, and cycle learning ensemble (GAN-CIRCLE)." arXiv preprint2018, arXiv:1808.04256.

Benchmark model

As a benchmark, a bicubic interpolation algorithms will be used

Evaluation metrics

- Qualitative similarity of super-resolved images to the original HR
- **PSNR**: *“Peak signal-to-noise ratio is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.”*
- **SSIM**: *“The structural similarity index measure (SSIM) is a method for predicting the perceived quality of digital television and cinematic pictures, as well as other kinds of digital images and videos. SSIM is used for measuring the similarity between two images. The SSIM index is a full reference metric; in other words, the measurement or prediction of image quality is based on an initial uncompressed or distortion-free image as reference.”*

P**roject design**

The input images are saved in .png format, with pixels values ranging from ~30000 to ~40000. These images will be transformed to the Hounsfeld Units scale and then normalize to a [0, 1] range.

For training purposes, images will be subject a distortions, like gaussian blur, random noise, flipping and rotation.

The GAN architecture will follow closely the one proposed in the CIRCLE-GAN paper and will be implemented using tensorflow and trained in a Google COLAB GPU.

Once the model is trained, the sr-generator will be saved in a .h5 format for further usage.