Photo-Realistic Single Image Super-Resolution Using a Generative Adversarial Network

Project Proposal

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1 The Team

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2 Problem Statement and Background

Given an image, we have to upscale the image to a higher resolution (say 4x). This task is called super-resolution. The main challenge remains to ensure that the upscaled images remain as natural as possible since a simple MSE loss function results in a less natural image which is perceived to be very different from the original image. Since we would be using a single low resolution image to generate an upscaled version, this would be an instance of the SISR problem.

The first approaches used were filtering based which oversimplified the problem and focused on edge preservation only. To reconstruct texture details in landmark images, one can also find highly correlated counterparts on the net and use the information present in that image to upscale. CNN (convolutional neural networks) based super resolution algorithms have shown improved performance as compared to the above listed approaches. A different loss function which captures perceptual difference is used to train the CNN which results in a more promising and natural (perceived to be more similar to the original image) upscaled image.

3 Data Source

We would be using the dataset from ImageNet dataset. This is an open data set consisting of high resolution images. The original images are comparatively larger so these images are first cropped (64x64 pixels) (to make the training computationally less taxing) and then downsampled to create the low resolution images (32x32 pixels). These pairs of images will be used the data on which the CNN would be trained.

Primary Source: ImageNet
Secondary Source: MIRFLICKR Download

4 Tools

- Google Colab
- Tensorflow 2.0

5 Evaluation Strategy

We would be using the PSNR (peak signal to noise ratio) and SSIM (structural similarity index) as metrics to judge the quality of the generated upscaled images. The PSNR is magnified when using the MSE loss function. However a high PSNR doesn't necessarily translate to a high quality upscale image when considering the texture details present in the image. For this reason we use the Structural Similarity Index which measures the perceived similarity between two images. The original image (64x64 pixels) would be used as a reference image to calculate SSIM.