Image Super-Resolution using Deep Learning

Capstone Project Proposal for Springboard

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Project goal

The problem of image super-resolution involves taking a low quality image and increasing its resolution to a higher quality image. This problem is difficult primarily because there are many possible outputs for any single input. There are many industries that could be helped by a solution to such a problem, including security surveillance, space research, entertainment, photography etc. This is a supervised regression problem that has already been tackled by many researchers to this date. My goal is to train a deep learning model to solve this problem and put it into production. The final product will be hosted as a web service for people to upload and enhance their images.

Figure 1: Example of upscaling a low-resolution image 2x using artifact removing RDN model

Architecture

The state-of-the-art solutions to the super-resolution problem all use deep learning techniques that include both CNNs and GANs in their architecture. There are several common architures that are common for this problem, discussing all of which is beyond the scope of this proposal. However, after some research and experimentation, I found a model that is consistently performing exceptionally well and is called Residual Dense Network (RDN) for Image Super-Resolution. As the name suggests, the premise behind the architecture for this model takes advantage of both residual learning and dense connections. Figure 2 shows a diagram from the RDN paper which depicts the difference

between a residual block (a) and a dense block (b) and their combined version (c). This is the basic architecture that will be used for my model.

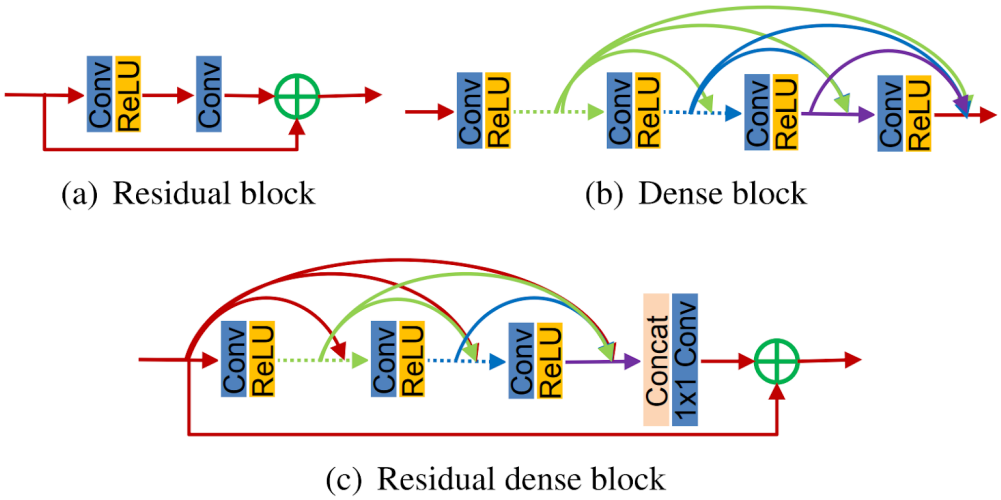

Figure 2: The idea behind residual and dense blocks are combined to create the residual dense block

Data

The RDN network was trained on the DIV2K dataset which comprises of one thousand 2K resolution images. Hence, a dataset of around 1000 images appears to be sufficient for this problem. The data for this project will include 1,000 high resolution images (1280x720), each of which will be downsampled to half the size on each side (640x360) to obtain 1,000 low resolution images. The low resolution images will be provided to the model individually as inputs. The model would then predict an image that attempts to recover the corresponding high resolution image. The data can be collected through google images using an image scraping service.

Cost

Neural networks are known to take a great deal of computational resources. To limit the resource cost, the prototypes will be made using freely available GPUs from Google's Colab environment. Once a prototype has been selected for scaling, the final model can be trained in the AWS cloud environment. The $50 worth of AWS credit provided by Springboard should be sufficient to obtain the final weights for the model.

Sources

Residual Dense Network for Image Super-Resolution Paper
Image Super-Resolution (ISR) github page
DIVerse 2K resolution image dataset