Summer Research Internship

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Contributions

- Dataset generation: Manan Parikh and Manan Sodha
- Training model: Manan Parikh and Manan Sodha and Aditya Shah
- Determining model accuracy: Aditya Shah

Problem Statement

The problem we aim to solve is that in a nuclear reactor, we cannot have a full image of the reactions and we cannot justify what is going on inside. This is a complicated problem, so we started with some simplification. We started with creating a model that will convert masked images to unmasked full images.

Data Generation

The first obstacle for us was the lack of data, so we had to generate the data. We first created data using masking techniques and libraries using OpenCV. We first created the whole image with the Gaussian function. This is the y_{train}. Now we create a masking matrix with 1's on one side and 0's on the other. We do dot product and so we get a masked image which is our x_{train}.We created 1200 pair of images that will train our model.We use CNN to solve our problem.

Figure 1: Masked Image

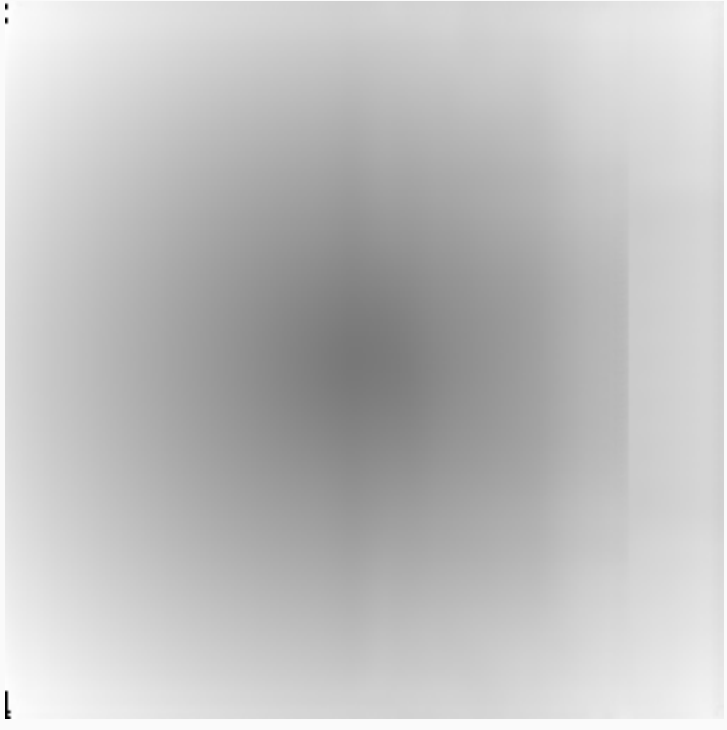


Figure 2: Unmasked Image

What is CNN..

CNN stands for Convolutional Neural Network. It is a deep learning algorithm that is designed to process and analyze visual data, particularly images, and videos. CNNs are mostly used for image recognition, image classification, and image segmentation.

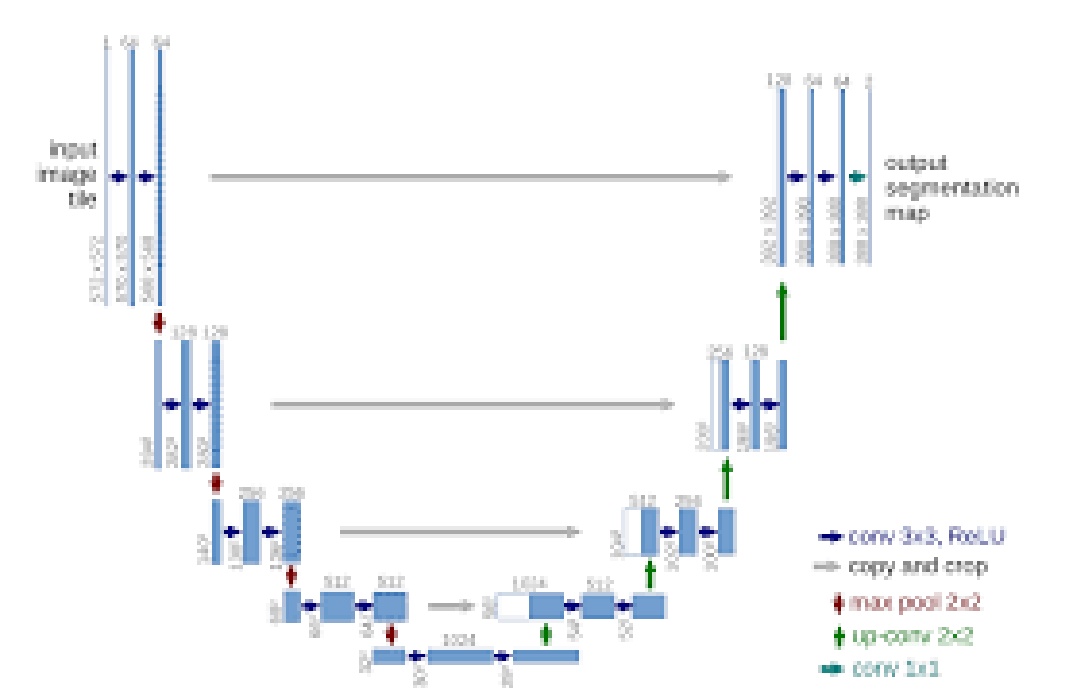
It consists of several layers such as:

- Convolutional layers
- Pooling layers
- Fully Connected layers

Using CNN in our model

The main problem is how to identify a particular image. The answer is to use CNN to identify features in images and how they are translated. In CNN, features are built upon other features using max pooling. CNN works where a window of pixels is taken and used to compare and identify features. The model learns that for each masked image, how an unmasked image would look like.

UNET Framework



The U-Net architecture is characterized by its U-shaped architecture, which looks like a "U," hence the name U-Net. We used UNET for its ability to work efficiently with only little labeled data.

UNET Framework contd...

The network has two main parts:

- Encoder: In the first part, all the pixels are gradually taken into a window and then the spatial dimensions are reduced off the input image, and feature channels are increased. This is done by using convolutional layers and pooling layers. This process helps the model identify different features of the image and also build more features on it.
- Decoder: The decoder is designed to upscale the feature map back to the original input image size. It consists of transpose convolutional called deconvolutions. It slowly expands the image, and gives it the detail of the original image.

Learnings

- We have learned how deep learning is used for different problems.
- We have learned about CNN (convolutional Neural Networks)
- We have learned about UNET architecture and how it used to implement CNN
- We learned different techniques like SSIM, residue and RMSE to test the accuracy of the model