# Decision Engines

## Methods:

he two widely used denoising techniques are local denoising and non- local denoising. Local denoising corresponds to smoothing and blurring of the image to reduce noise. These techniques are local in the sense that they average the similar pixel only in the neighborhood of the original pixel. Hence, they often suffer from a resulting soft image losing edges in the image. These techniques include 2D filtering, Average blurring, Gaussian blurring, Median blurring and Bilateral filtering.

The other approach is Non-local means Denoising algorithm for denoising the images. Non-local means is quite different from other smoothing and blurring methods in a way that averages similar pixels in the entire image and not only of that of the neighborhood. The pixels that are very similar to the original pixel are given a higher weight and the pixels that rarely match the original pixel are given a smaller weight. Then the weighted average of the pixels is calculated and the similar pixels are replaced with the average value. The intuition behind this is that the noise in the images is random noise which has a zero mean. Hence by averaging many similar pixels, the noise disappears and we get a denoised image.

## Procedure:

* Used cv2 python package for denoising the image.
* Applied the local denoising techniques with different parameter values for each of the images.
* Applied non-local denoising techniques with appropriate parameters.
* Compared the results of the images by using tesseract (Google OCR algorithm) for OCR and extracting the text.
* Due to the lack of the original image with no noise, have manually compared the images from the text obtained from OCR.
* Non-local denoising was significantly better than local approaches.
* Have run different iterations of the non-local approach by changing the h value and window size.
* A large h value led to an image with less noise, but the image is way too soft, whereas a small h value had too much noise but was sharp.
* After a few manual trials found the optimal parameters possible for non-local approach.
* Have exported the resulting images using cv2.

## Denoised Images:

