DA 526 (IPML)

DENOISING NOISY DOCUMENTS

Remove noise from images of scanned text.

PRESENTED BY

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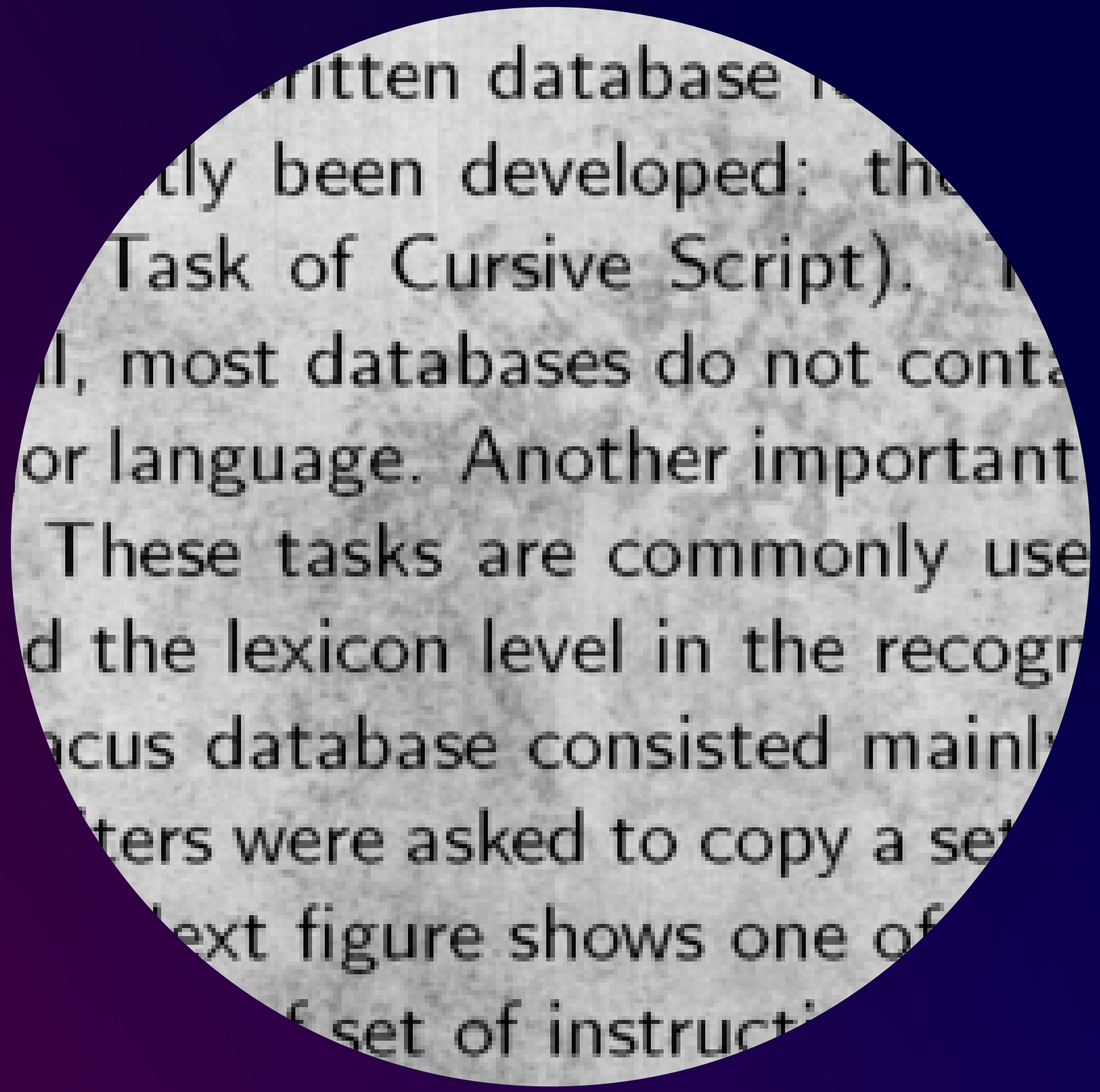

Problem Summary

- Scientific papers, historical documents/artifacts stored as paper, handwritten/typed.
- With time paper accumulates noise through dirt/ fingerprints /stains.
- Several cleaning methods used for preserving, but have risks.
- Digital denoising aimed at creating HiFi recreation of original docs.

https://www.kaggle.com/competitions/denoising-dirty-documents/

Challenge

Goal

Denoising dirty documents .

Task

Do a comparative study of traditional computer vision techniques vs deep learning networks when denoising dirty documents.

Dataset

- UC Irvine Noisy Office Dataset.
- 200 train and 200 test images.

https://drive.google.com/drive/u/0/folders/1CT3fvzjVeHbAss9tFkwN7vM48gSnIc6W

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Approach

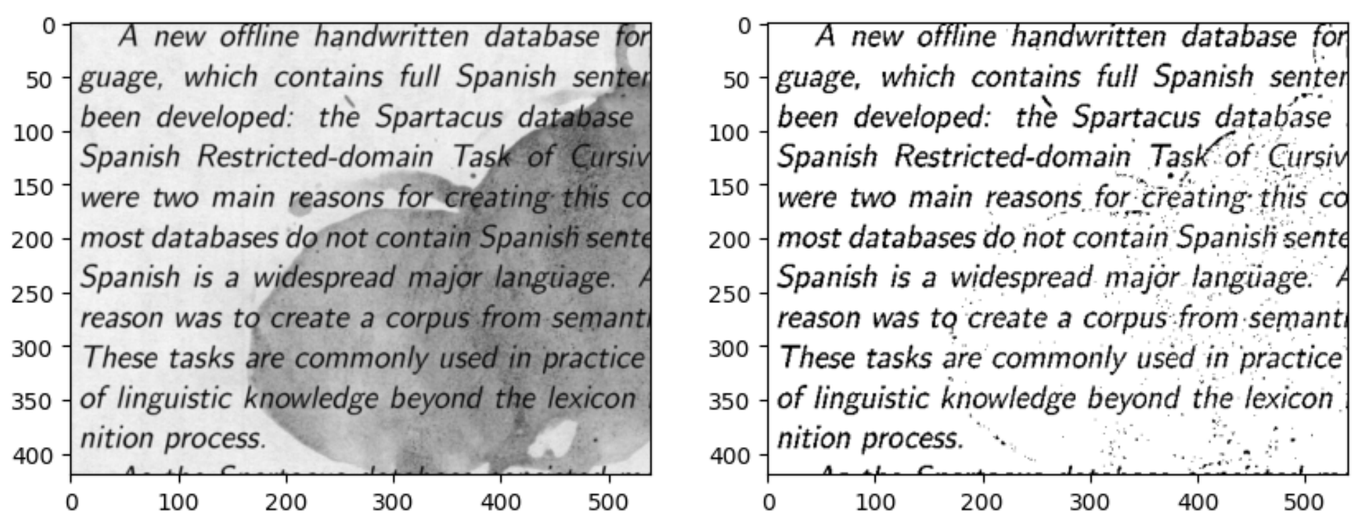
Several Approaches from traditional Computer Vision Techniques to Neural Networks.

Computer Vision — MEDIAN FILTERING, EDGE DETECTION, DILATION & EROSION, ADAPTIVE FILTERING.

ML Techniques — LINEAR REGRESSION.

DNN — AUTOENCODERS.

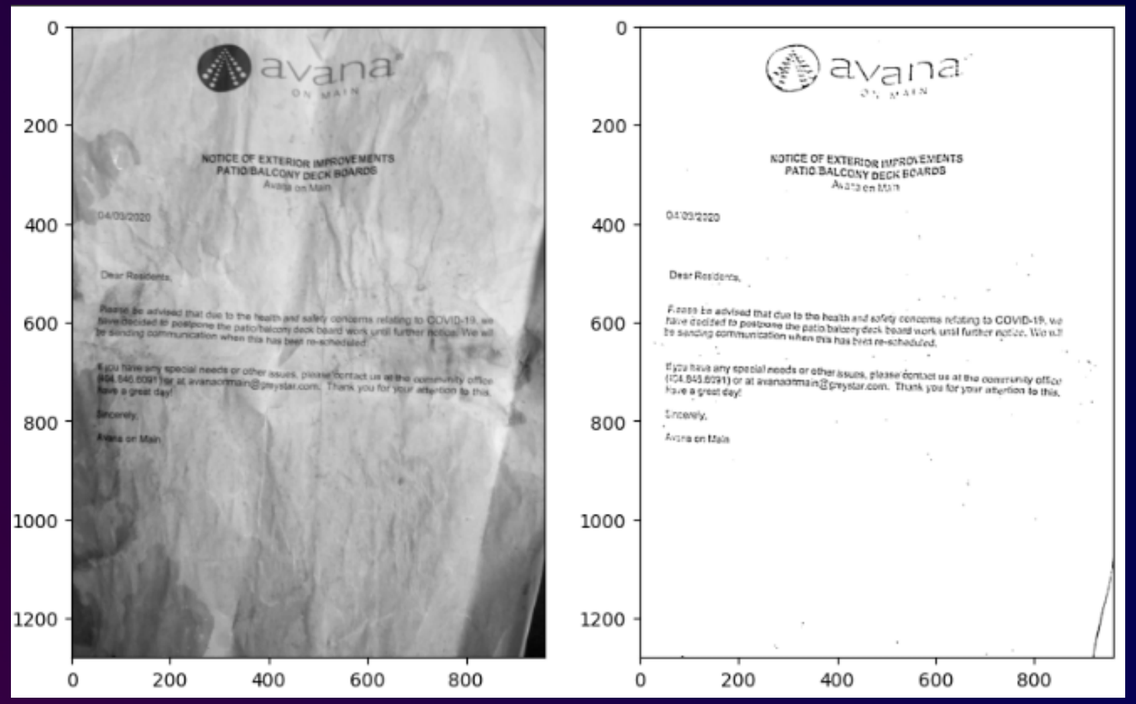
Image Thresholding



Result: (1) Dirty image (2) Denoised image by Thresholding

Thresholding is a simple image processing technique used to segment an image into regions based on intensity values.

Image Thresholding



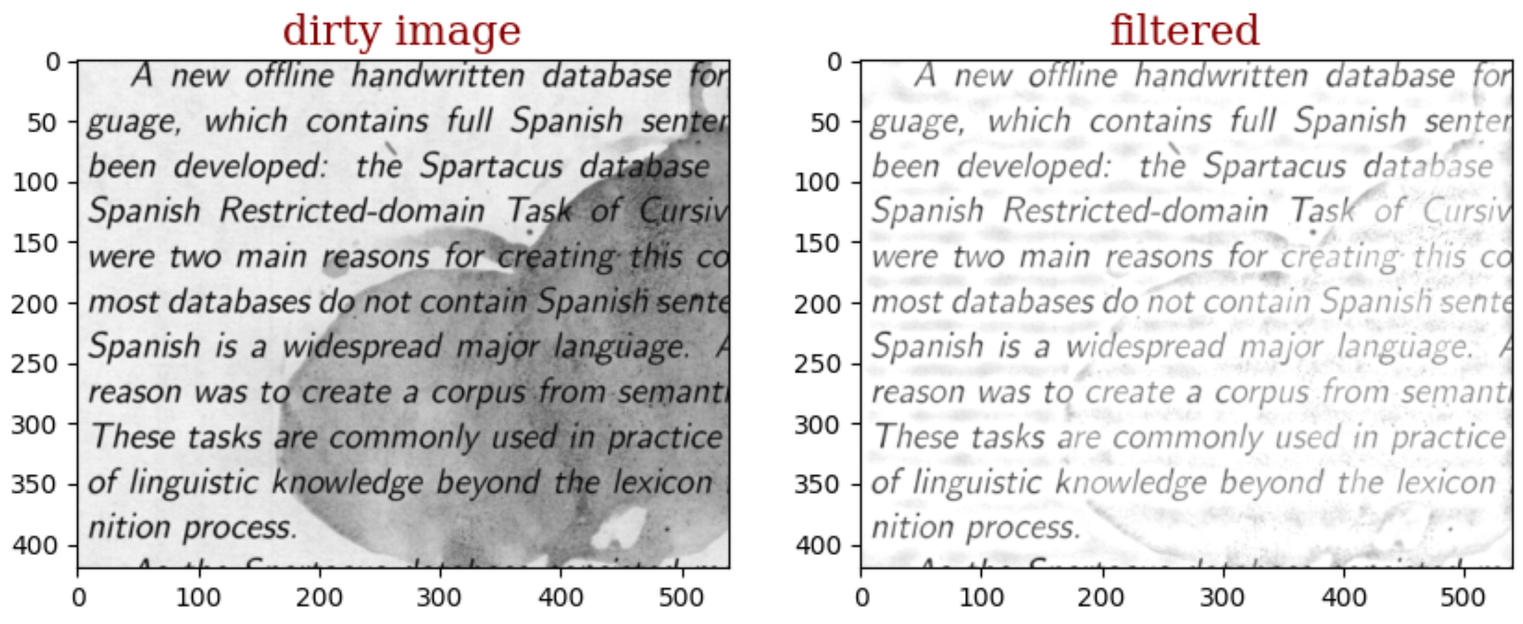
Limitations

- Limited noise removal capability
- Threshold selection
- Loss of image information

Result: Adaptive Thresholding on Actual document

Colab link

High pass filtering



- A high-pass filter is applied to the transformed image by iterating over each frequency component and setting to zero if the frequency component is within a circular region of radius 0.03.

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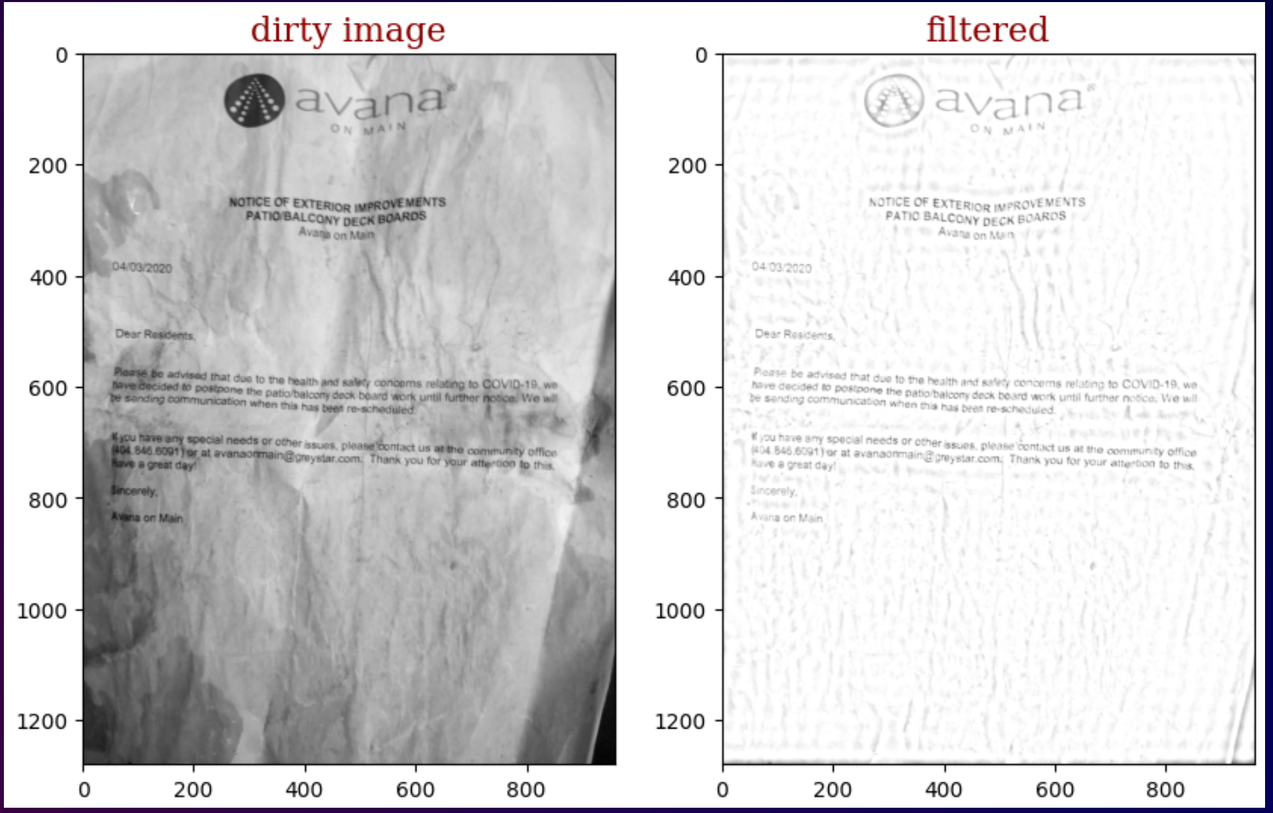
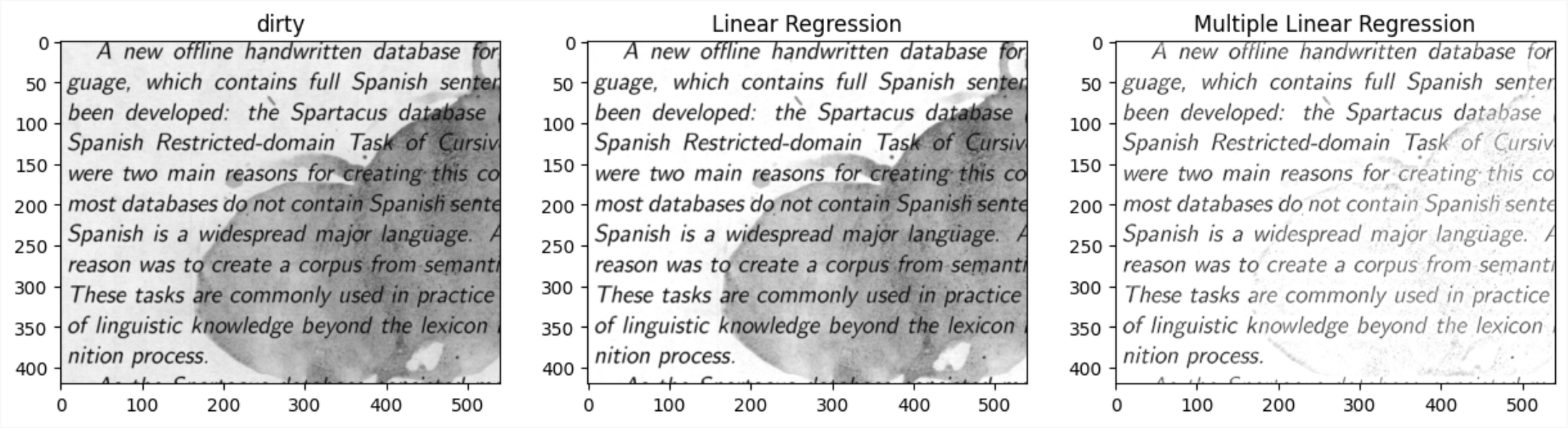
High pass filtering



- It has been observed that high pass filter can causes ringing effect due to sharp circle cut off.
- Hence the need arises for ML techniques.

https://colab.research.google.com/drive/17xeHducQZ1w1Zzwntsq5U4c0QhRSsI6v?usp=sharing

Linear Regression



Result: (1) Dirty image (2) Denoised image by Linear Regression (3) Denoised image by Multiple Linear Regression

https://colab.research.google.com/drive/1bCRAJa6FXzWrCLsal9C1Ge_PwAA34iRc?usp=sharing

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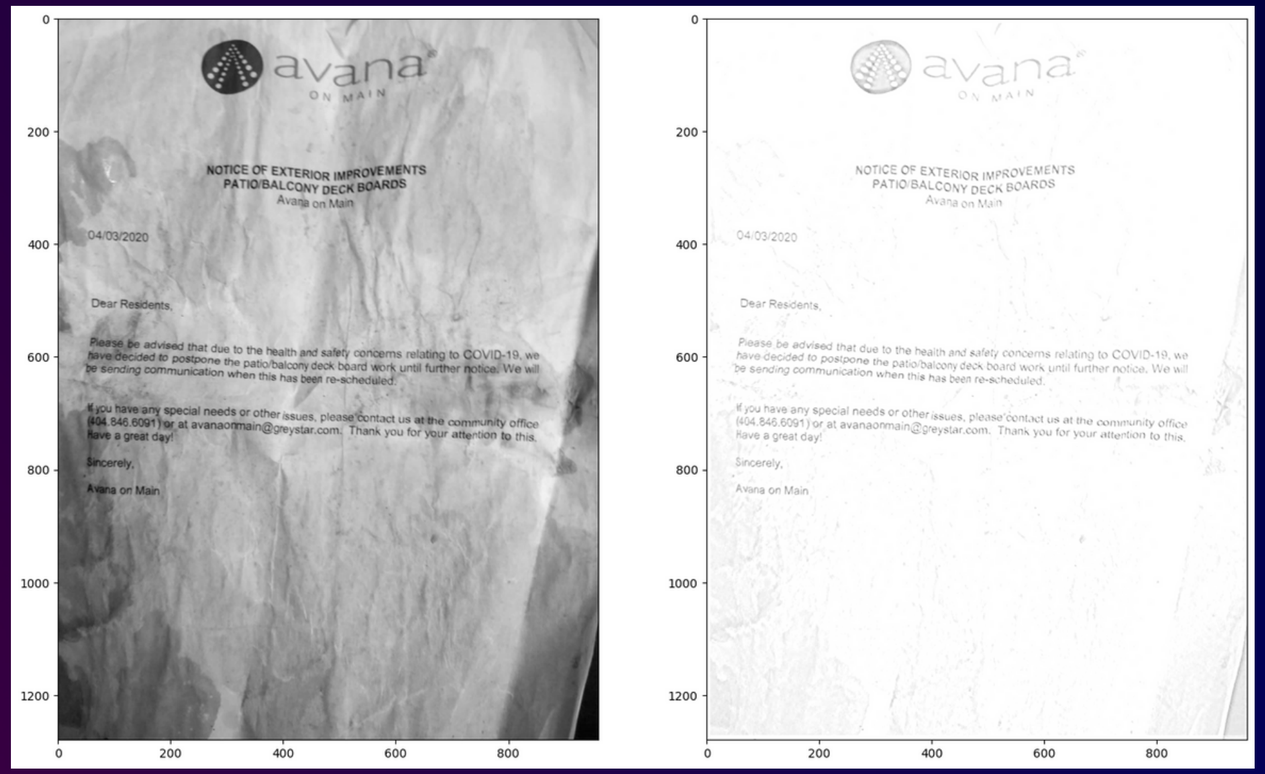
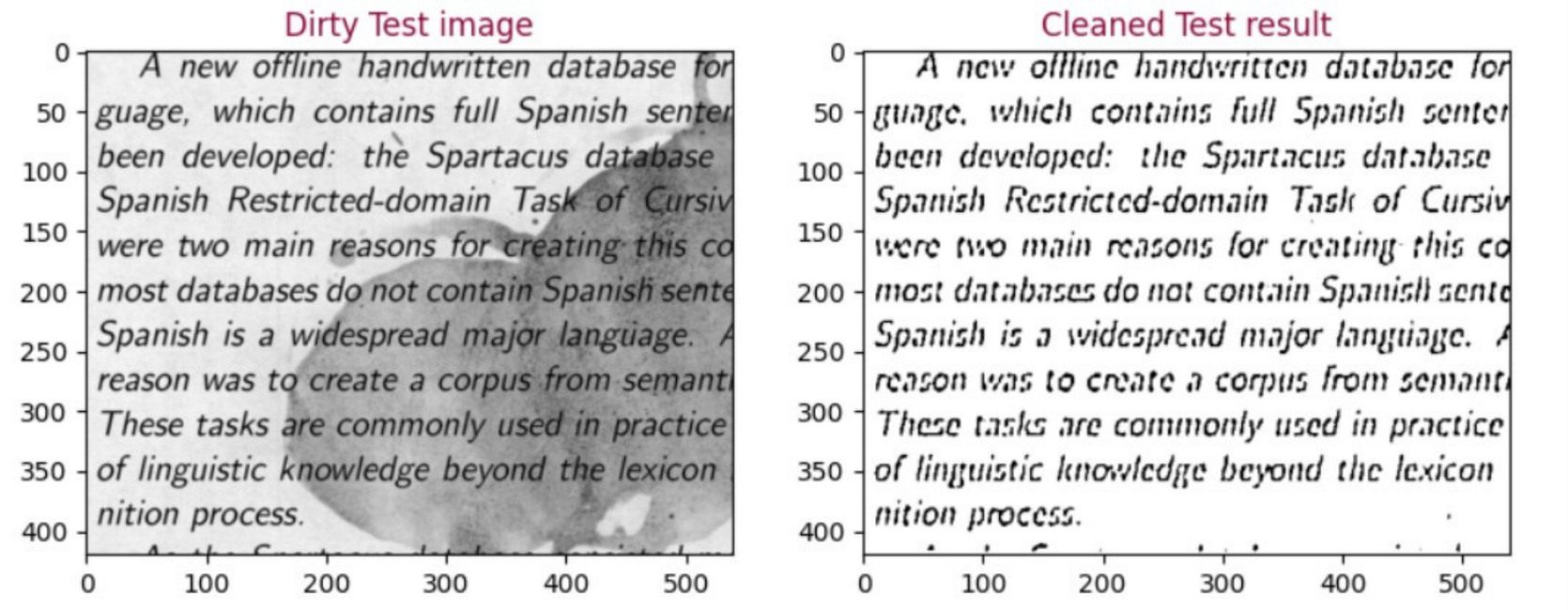
Linear Regression



- Linear Regression: one feature
- Multiple Linear Regression: multiple features
- Generation of Features
- Two models for different Patterns of stains
- More features improved results
- Features increased computing

Result: Multiple Linear Regression prediction on Actual document

Autoencoder Results



- Autoencoder removes all stains.
- However we loose some features

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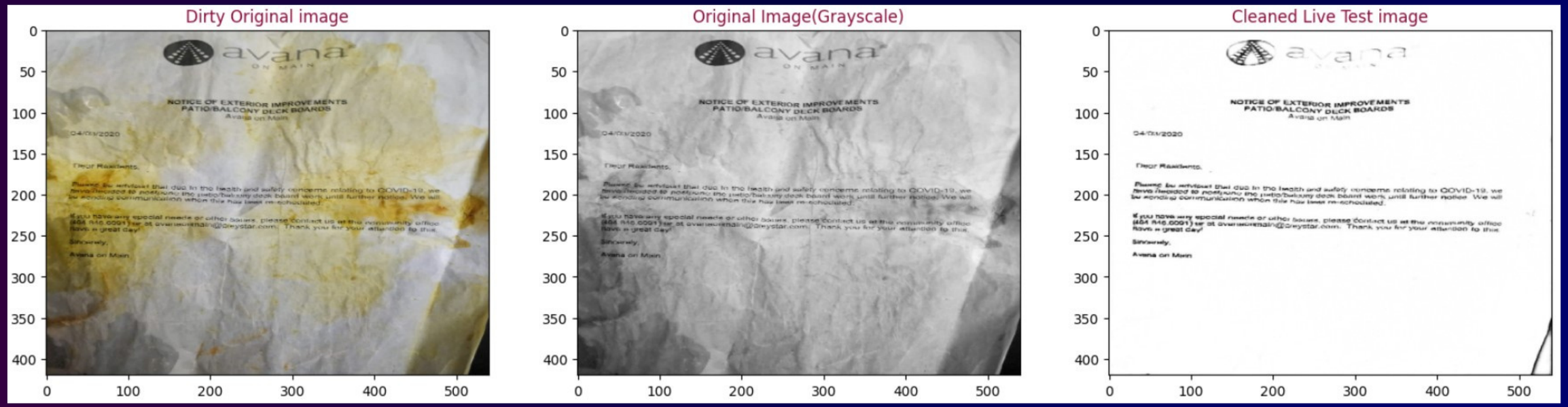
Autoencoder Results



https://colab.research.google.com/drive/1FN5TBXLgdRSz2znfuuOmnI9aGlzScA-C#scrollTo=omaqqhJtaK_C

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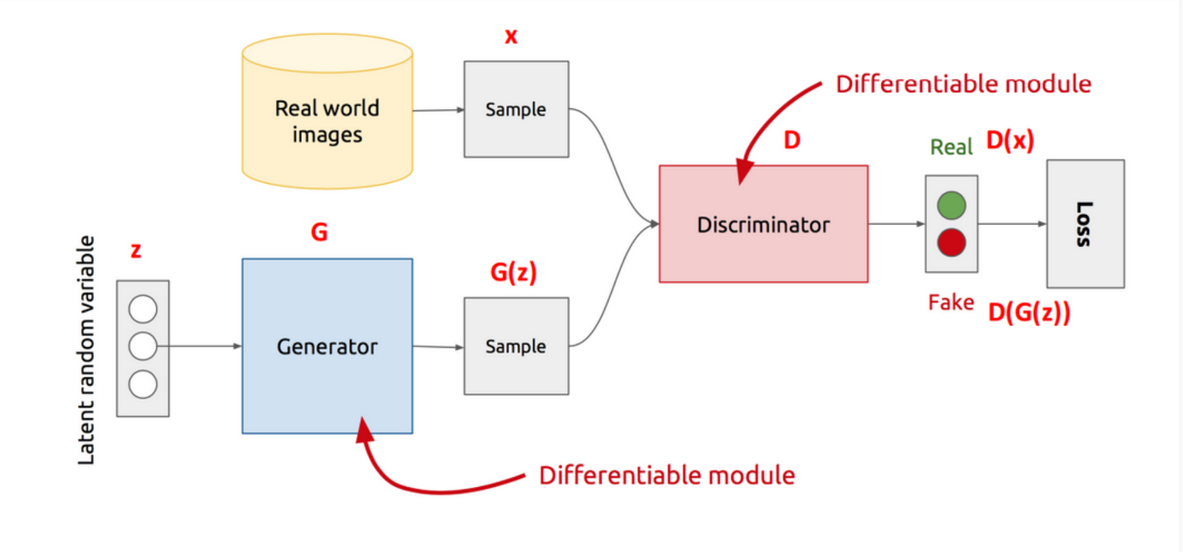
Performance Metrics of each Method

	RMSE	PSNR	UQI
Adaptive Thresholding	35.66	17.08	0.98
High Pass Filtering	15.30	64.43	0.97
Linear Regression	24.77	20.25	0.99
Autoencoder	234.29	0.735	6.409

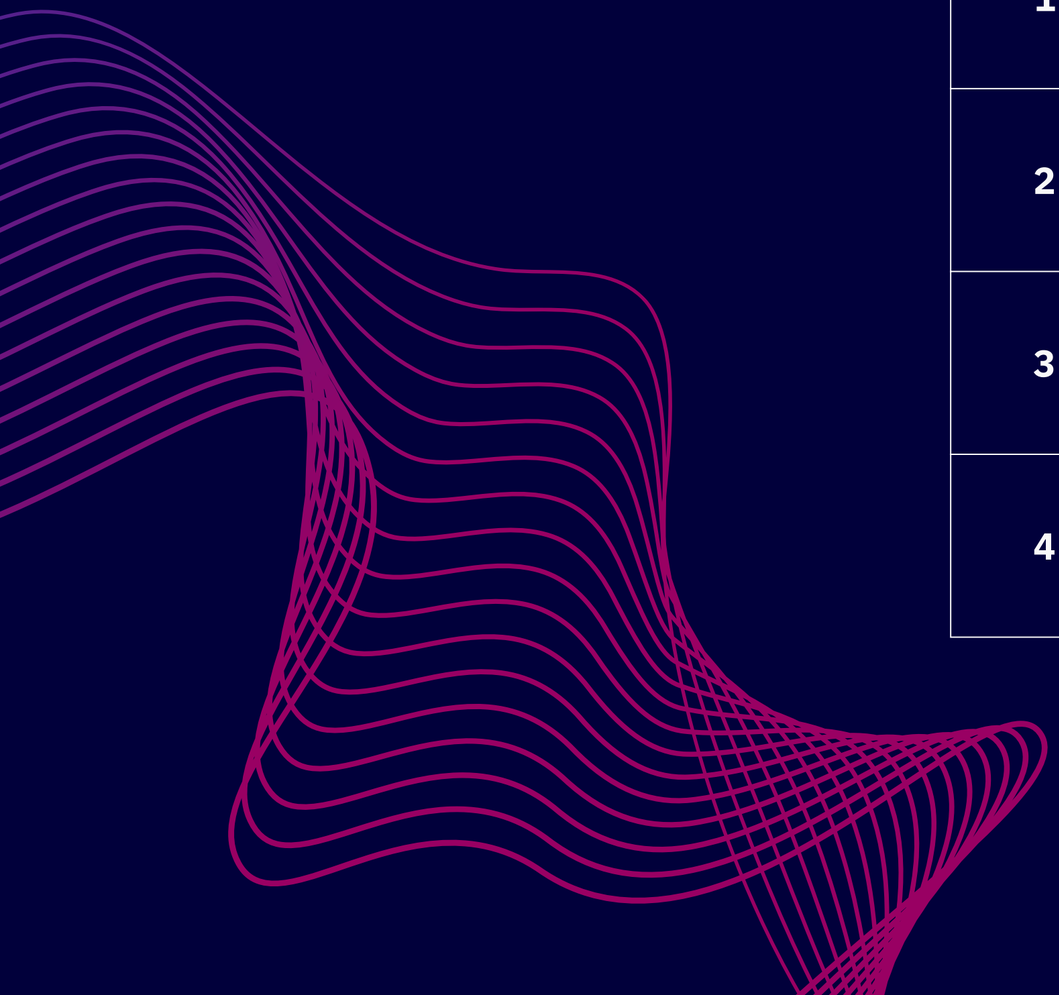
RMSE: Root Mean Square Error
PSNR: Peak Signal to Noise Ratio
UQI: Universal Quality Index

Ongoing Work

- GAN(Generative Adversarial Networks) is known to generate very realistic images.
- Generator tries to fool discriminator.
- Discriminator distinguishes between real and fake samples.
- Loss is sent as a feedback to Generator.
- In the process the model learns the salient features of the input data.



Resources



1	https://www.kaggle.com/competitions/denoising-dirty-documents
2	https://archive.ics.uci.edu/ml/datasets/NoisyOffice#
3	https://towardsdatascience.com/denoising-noisy-documents-6807c34730c4
4	Courses like IITG DA 526, Stanford's CS 229 and CS 231n.

Thanks