Image Denoising

Non-Linear Aggregation of Image Filters

Introduction

Noise: Might be introduced due to various factors.

- Capture Conditions: poor lighting, blurring etc.
- Sensor: sensor temperature, data transmission error, approximations during digitization etc.

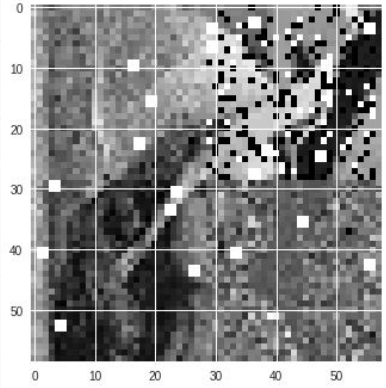
Image Denoising: Fundamental problem in image processing.

- **Aim**: Improve quality of image by removing noisy information
- **Challenge:** Removing noise while preserving existing image structure

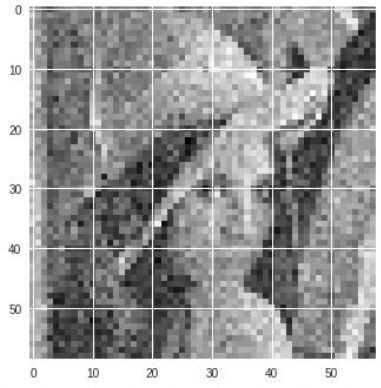
Existing Solutions: Suffer from a few limitations

- **Smoothening**: Images tend to be too smooth. Details are lost.
- **Blurring**: Edges are less sharp

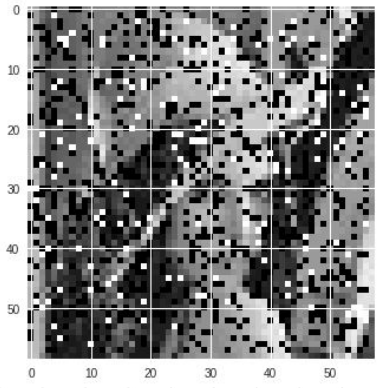
Noise Models in Digital Image Proceesing



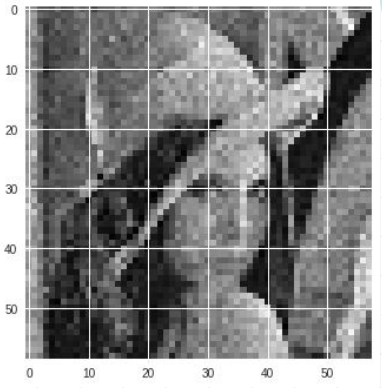
Original Image



Gaussian Noise

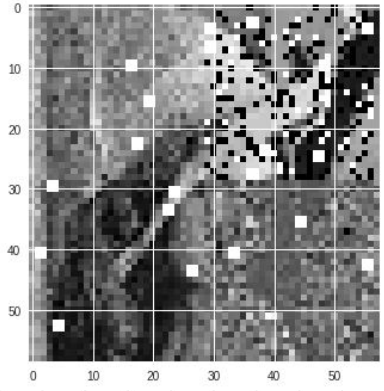


Salt and Pepper Noise

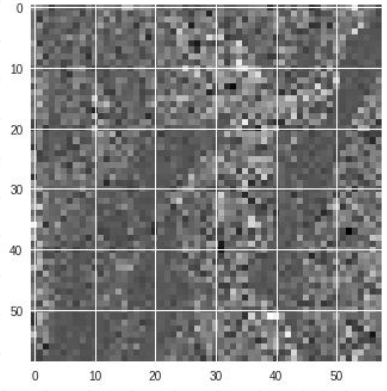


Poisson Noise

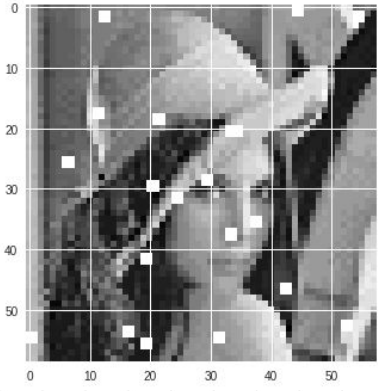
Noise Models in Digital Image Processing



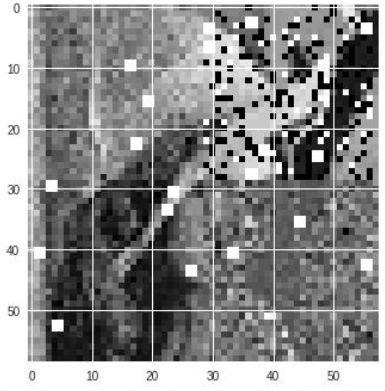
Original Image



Speckle Noise



Patch Suppression



Multi Noise

Solution: Outline

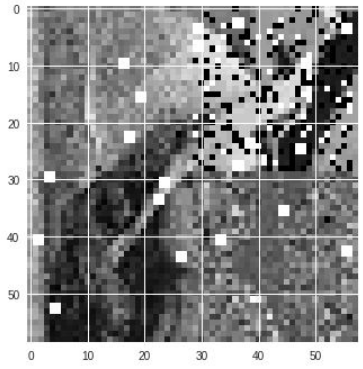
Idea: Use a combination of existing algorithms

- Each *classical* method has its pros and cons.
- Different methods work better for different kinds of noises
- For example, Salt - Min Filtering, Pepper - Max Filtering
- Make the best out of each method's strong points

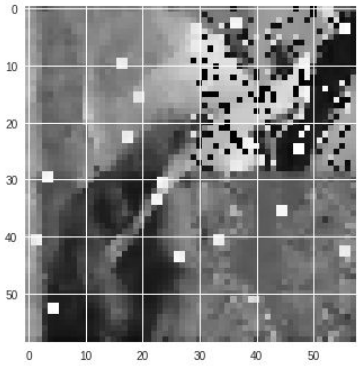
Strategy: Inspired from COBRA algorithm

- COBRA: COmBined Regression Alternative
- Uses non-linear aggregation of image filters
- Several predictions of the noisy pixel are obtained; best is chosen

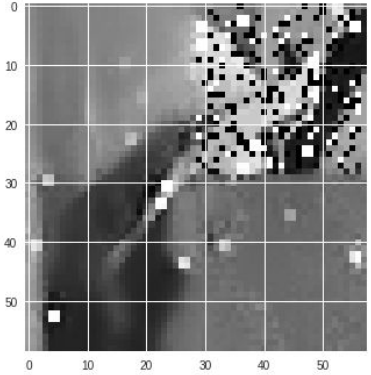
Preliminary Image Denoising Algorithms



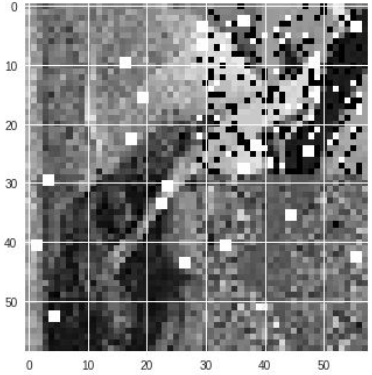
Multi Noise Image



Bilateral Filtering

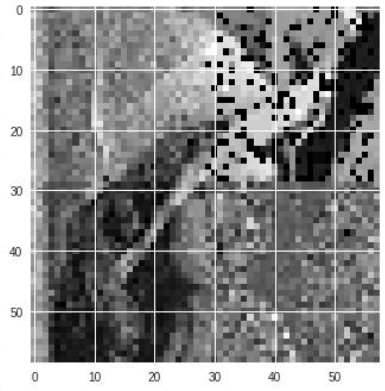


Non-local Means

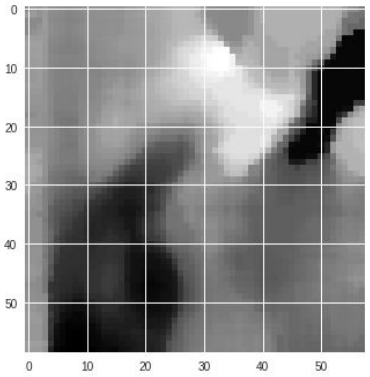


Gaussian Filtering

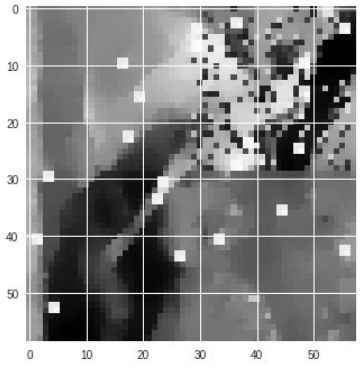
Preliminary Image Denoising Algorithms



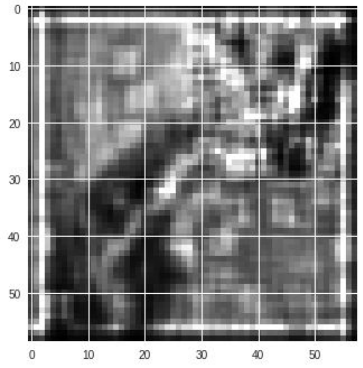
Inpainting



Median Filtering



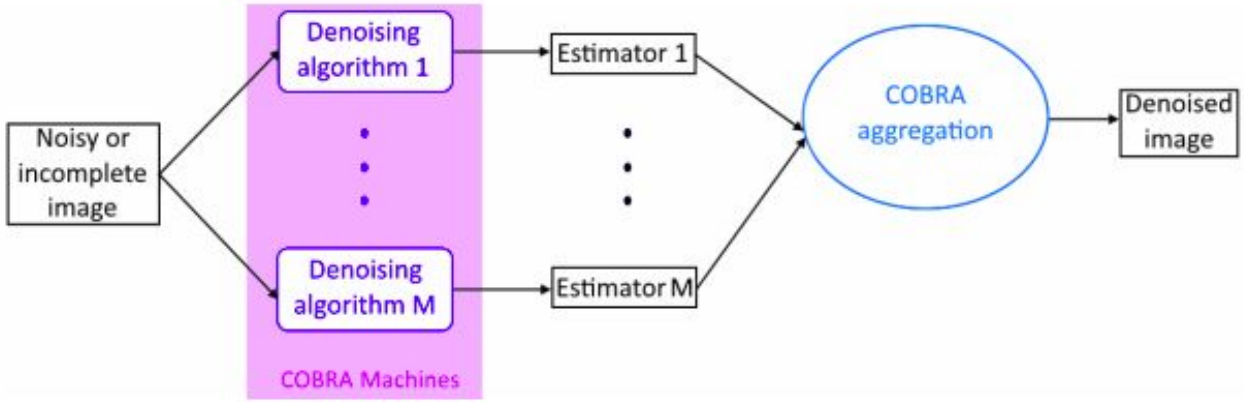
TV Chambolle



Richardson Lucy

Solution: Method

- ★ For each pixel p, call M different estimators
- ★ Aggregate these estimators by doing a weighted average



Solution: Method

★ **Estimators:**

$$f(p) = \frac{\sum_{q \in x} \omega(p,q) x(q)}{\sum_{q \in x} \omega(p,q)}$$

★ **Weights:**

$$\omega(p,q) = \mathbb{1}\left(\sum_{k=1}^{M} \mathbb{1}(|f_k(p) - f_k(q)| \leq \epsilon) \geq M\alpha \right)$$

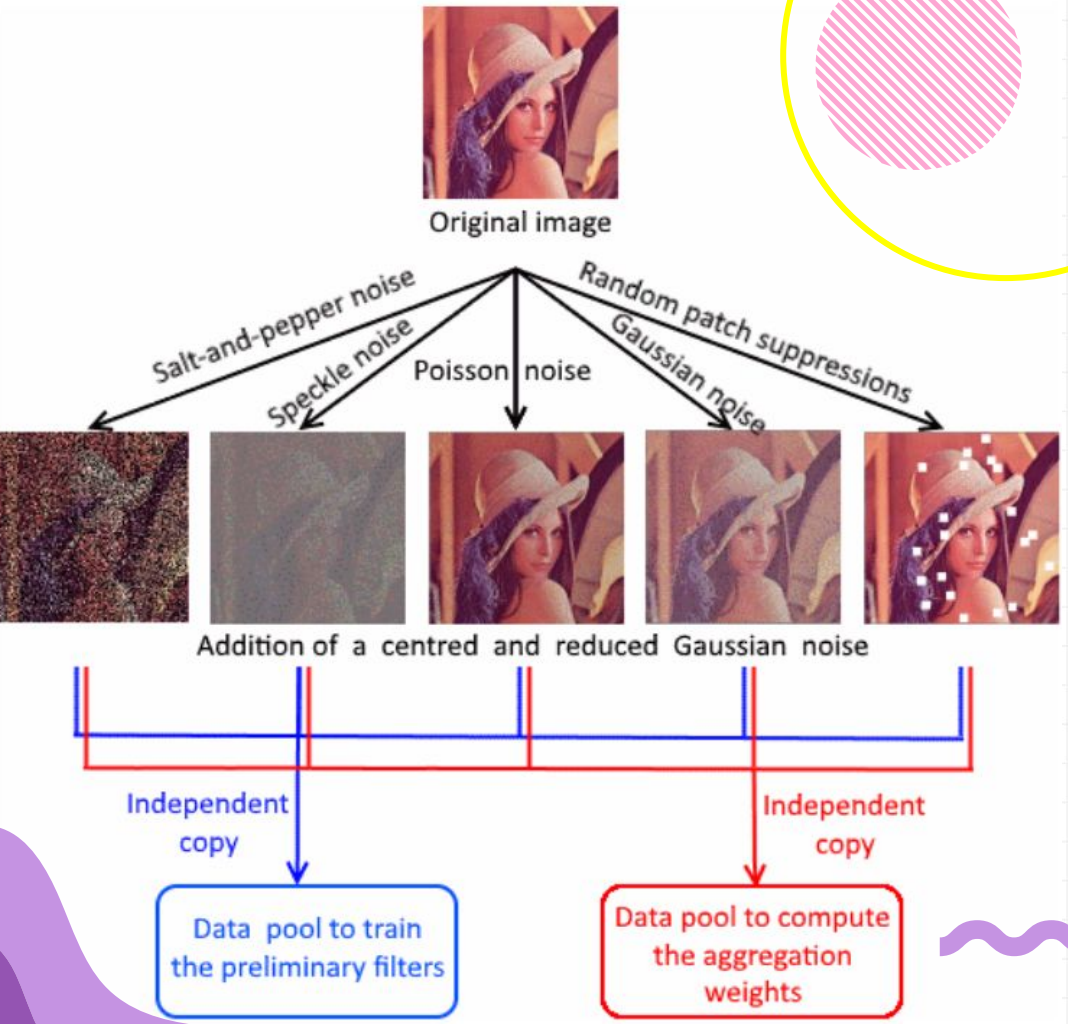


Image Dataset Creation

Add 5 noise models to 25 ground-truth images
Create copies of 125 noisy images obtained
Add normal noise to the copy set of 125 images
Desired dataset is the two pools of 125 images

Team reVision

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