# Image Operator Learning based on Local Features

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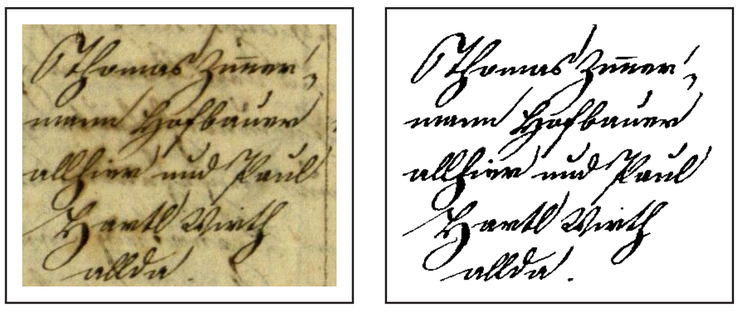
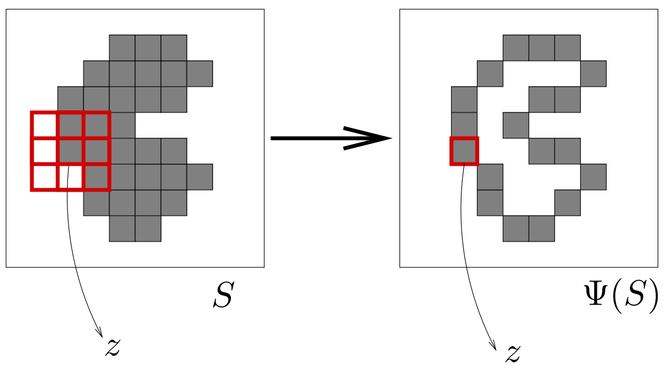
## Introduction

How to learn an image operator that performs the transformation expressed as input-output pair of images ?



## Learning Method

Pixel classification, using neighboring pixel values as features




$$\Psi(S)(z) = \psi\left( \right)$$

dimension = window size
Large windows are not viable

## Local features

We propose pixel classification based on local features.

Advantage:

Large windows → Feature Extraction → Smaller dimension

Implemented feature extractors:

- LBP
- Moments
- Fourier
- Sobel

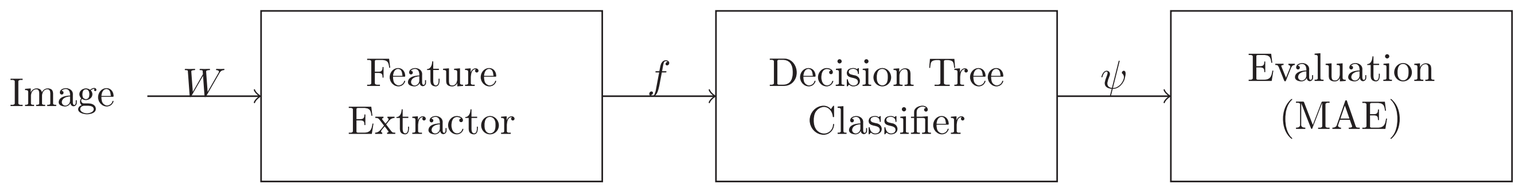
DIBCO https://vc.ee.duth.gr/dibco2017/

DRIVE
http://www.isi.uu.nl/research/databases/drive/

Hirata, N. S. T. (2009), Multilevel training of binary morphological operators, TPAMI 31 (4), 707-720

TRIOSlib https://trioslib.github.io/

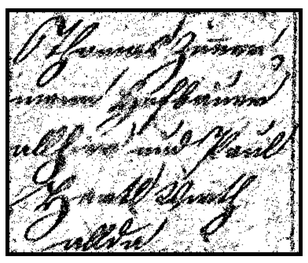
## Experiments

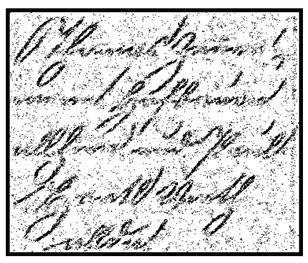


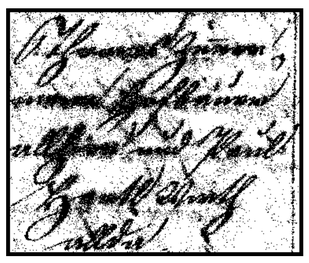

- Implementation of feature extractors using `TRIOSlib`
  - Decision tree classifier from `scikit-learn`
  - Four different datasets with different goals

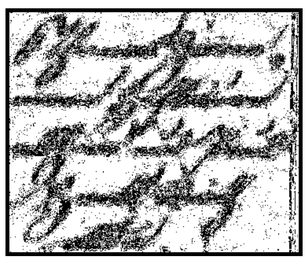
## Results

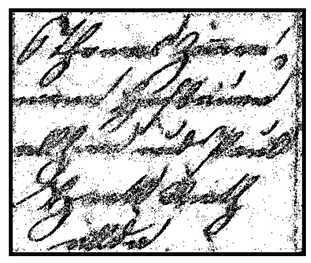
Using each of the feature extractors

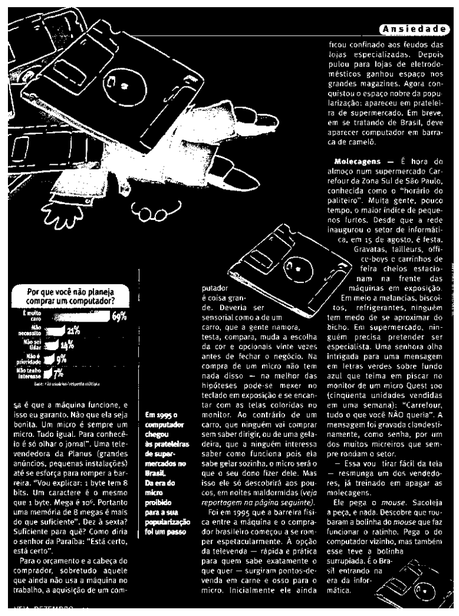

Raw


LBP


Moments

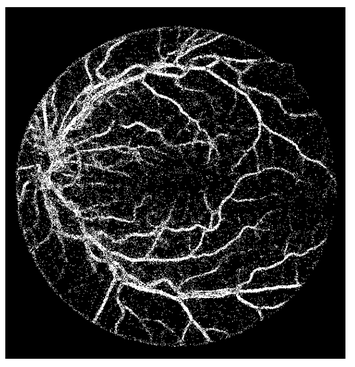

Fourier

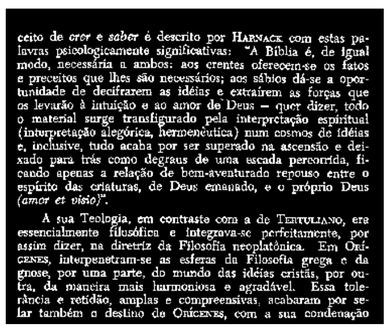

Sobel

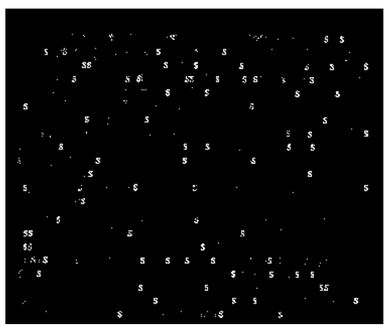

TexRev


Fourier


DRIVE


Sobel


CharS


LBP

Performance (pixel level)

| Feature | CharS | TexRev | DRIVE | DIBCO |
|---|---|---|---|---|
| Raw | 0.011 | 0.034 | 0.103 | 0.086 |
| LBP | 0.010 | 0.046 | 0.154 | 0.131 |
| Moments | 0.090 | 0.074 | 0.243 | 0.090 |
| Fourier | 0.084 | 0.042 | 0.153 | 0.125 |
| Sobel | 0.062 | 0.369 | 0.123 | 0.116 |

## Conclusion

- Features present diversity in different datasets.
- Using a smaller dimension, some features have equivalent or better performance than the raw image in certain datasets.
- Combination of features is a promising approach to deal with window size issues.