Homework 1

Gabor filter & applications

General Homework Guidelines

- Please attach all codes you use. Attach code at end the of the submission.
- In general, try to keep your answers concise. Use as many words as you need and no more. Also, work on your presentation skills. This means organizing your plots and displays. Always use titles and add captions to the figures when appropriate. Points will be awarded for clarity and presentation.

Python exercises

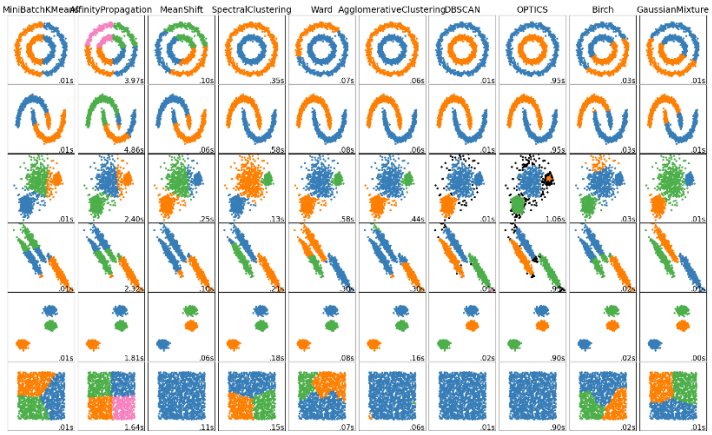
Part I: Naïve filter-bank Segmentation

In this part, you will need to construct a classifier based on the Gabor filter bank. To do so, first, capture three images of different scenes featuring an object you would like to segment and a background.

- Construct a Gabor filter bank of each of the images. Here you may use as many filters as you see fit to produce the best segmentation possible.
- Create a data structure containing each one of the filter images as a 1x(*n*x*m*) array in a stack of *t* elements (*t* number of filters).
- Use k-means to classify two groups, with k=2 being the number of groups.

Note: you are welcome to try out other classifiers besides the k-means. Attached a link to a scikit-learn page with a comparison + code of alternatives.

https://scikit-learn.org/stable/auto_examples/cluster/plot_cluster_comparison.html#sphx-glr-auto-examples-cluster-plot-cluster-comparison-py

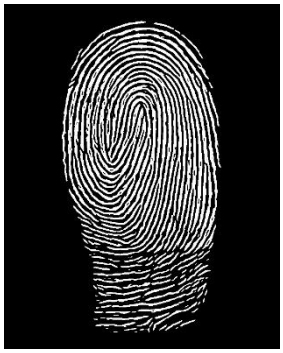


Part II: Optimizing your segmentation.

In this part, you need to improve your previous solution by reducing the number of filters used. To do so,

- Define a metric by which you can evaluate the contribution of each of the filtered images to the final segmentation. Be creative ☺
- Define a metric for the accuracy of the resulting segmentation.
- To make your solution from the part I complexity effective, identify the minimal number of filters you need to obtain the best result. Explain how you define "the best result".
- Explain the contributions of each of the parameters of the chosen optimal filters and show why these produced the best results.

Part III: Your own fingerprint image enhancer.



In this part, you are required to implement a fingerprint image enhancer using Gabor filters and other cool stuff you learned in the digital image processing course. Images of fingerprints are uploaded into moodle.

Note: A short paper on a method that proposes such an algorithm is on the moodle page and you may use it to draw some ideas. However, you are required to bring a new thing of your own into the solution.

Things to turn in:

- **A well-documented code for the three parts.**
- **A PDF contacting your results, explanations, and interpretations.**

Good luck!