Introduction

Goal: let students design and implement algorithms based on:

- linear algebra and convex optimization
- solve inverse problems in image processing (denoising, deblurring, inpainting, anomaly detection)
- sparse representation and sparsity as a form of regularization in learning problems.

you'll get:

- insights in linear algebra and convex optimization
- notions to approach image processing problems

Outline

- image models based on:
  - orthonormal bases
    - > Fourier
    - > Wavelets
  - Data driven basis
    - > PCA
    - > Gram-Schmidt
  - Local polynomial approximation

- Sparsity and redundancy
  - Away from orthonormal basis, redundant set of generators
  - Sparse coding
    - > ℓ_0 (OMP)
    - > ℓ_1 (convex optimization ISTA, IRLS, lasso)

- Dictionaries yielding sparse representation
- Dictionary learning (KSVD)

- Application of sparse models to image denoising, inpainting, anomaly detection and classification
- Robust fitting
  - RANSAC
  - LMEDS
  - HOUGH
  - and, counterparts for object detection

you have to learn for each one:
- theory behind
- algorithm
- application