# Mathematical Foundations for Computer Vision and Machine Learning

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# Assignment 11

## Jupyter Notebook

- Create a new notebook for Python 3
- Include your name and the student ID in the notebook
- Write python 3 codes for the given assignment
- Try to separate the codes into meaningful blocks
- Write a comment for each block of codes
- Plot the important intermediate results
- Write a short description for each graphical result
- Use LaTeX for mathematical comments in the notebook
- Save the notebook file as assignment11.ipynb
- Download the notebook as a PDF file assignment11.pdf

# Assignment 11

## github

- Start a project or a directory for the assignment11
- Include the link to the giuhub for the assignment in the notebook
- Upload the notebook assignment11.ipynb to the github after the deadline (Note that your github project is visible to public)

# Assignment 11

## Submission to *eclass*

- Submit the PDF file assignment11.pdf to eclass
- Deadline is 11:59 pm on next Thursday. No extension
- Score ranges from 0 to 5

# Assignment 11

## Score Table

- The results should be correct
- The codes should be written in a modulated way
- The comment should be made for each block of the codes
- The important intermediate results should be presented
- The link to the github project should be included

# Assignment 11

## Image Denoising

- $f = u + \eta$ where $f$ is an input noisy image, $u$ is a desired reconstruction, and $\eta$ is a noise process
- Noise process $\eta \sim \mathcal{N}(0, \sigma^2)$ is assumed to follow the normal distribution with mean $0$ and standard deviation $\sigma$
- The reconstruction error $\mathcal{E}(u) = \|u - f\|_2^2 + \lambda \|\nabla u\|_2^2$ where $\|\nabla u\|_2^2 = \|\frac{\partial u}{\partial x}\|_2^2 + \|\frac{\partial u}{\partial y}\|_2^2$ and $\lambda \in \mathbb{R}$ is a weight
- Solve the least square problem $\|Ax - b\|_2^2$ where $x$ is a vector that is vectorised from $f$ in column-wise

# Assignment 11

## Essential Visualisation

- Try with varying the noise standard deviation $\sigma$ and the regularization parameter $\lambda$
- Present the reconstruction image with varying regularization parameter $\lambda$
- Present the reconstruction error with varying regularization parameter $\lambda$