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 η 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 σ
- The reconstruction error $\mathcal{E}(u; \lambda) = \|u - f\|_2^2 + \lambda\|\nabla u\|_2^2$ 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
- Use sparse matrix to save memory required to solve the least square problem
- If neccesary, it is allowed to reduce the size of the given image to save the memory in the computation of the least square problem

Assignment 11

Essential Visualisation

- Try with varying the noise standard deviation σ and the regularization parameter λ
- Present the reconstruction image with varying regularization parameter $\lambda = \cdots, 2^{-3}, 2^{-2}, 2^{-1}, 2^0, 2^1, 2^2, 2^3, \cdots$
- Present the reconstruction error $\mathcal{E}(u; \lambda)$ with varying regularization parameter λ