Mathematical Foundations for Computer Vision and Machine Learning

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Assignment 12

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 assignment12.ipynb
- Download the notebook as a PDF file assignment12.pdf

Assignment 12

github

- Start a project or a directory for the assignment12
- Include the link to the giuhub for the assignment in the notebook
- Upload the notebook assignment12.ipynb to the github after the deadline (Note that your github project is visible to public)

Assignment 12

Submission to *eclass*

- Submit the PDF file assignment12.pdf to eclass
- Deadline is 11:59 pm on next Thursday. No extension
- Score ranges from 0 to 5

Assignment 12

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 12

Polynomial fit with a regularization

- A set of data $(x_1, y_1), (x_2, y_2), \cdots, (x_n, y_n)$ is generated by the python code assignment12.py
- Define a model $\hat{f}(x; \theta) = \theta_0 x^0 + \theta_1 x^1 + \cdots + \theta_p x^p$ by the polynomial function with model parameters $\theta = (\theta_0, \theta_1, \cdots, \theta_p)$
- Find an optimal set of model parameters that provide the least square approximate solution:

$$\mathcal{E}(\theta; \lambda) = \|A\theta - y\|_2^2 + \lambda\|\theta\|_2^2$$

where i'th row of A is $(x_i^0, x_i^1, \cdots, x_i^p)^T$ and $\lambda \in \mathbb{R}$

Assignment 12

Essential Visualisation: line fitting

- Plot the noisy data (x, y_1)
- Plot the clean data (x, y_2)
- Plot the polynomial curves that fit the noisy data by the least square error with varying $p = 6, 7, \cdots, 15$
- Plot the polynomial curves that fit the noisy data by the least square error with varying $\lambda = \cdots, 2^{-3}, 2^{-2}, 2^{-1}, 2^{0}, 2^{1}, 2^{2}, 2^{3}, \cdots$ with fixed p
- Plot the energy $\mathcal{E}(\theta; \lambda)$ with varying λ