Mathematical Foundations for Computer Vision and Machine Learning

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Assignment 10

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 assignment10.ipynb
- Download the notebook as a PDF file assignment10.pdf

Assignment 10

github

- Start a project or a directory for the assignment10
- Include the link to the giuhub for the assignment in the notebook
- Upload the notebook assignment10.ipynb to the github after the deadline (Note that your github project is visible to public)

Assignment 10

Submission to *eclass*

- Submit the PDF file assignment10.pdf to eclass
- Deadline is 11:59 pm on next Thursday. No extension
- Score ranges from 0 to 5

Assignment 10

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 10

Build a multi-label classifier for the digits at MNIST

- Define a linear bi-partitioning function $\tilde{f}_n$ to classify each digit $n = 0, 1, \cdots, 9$ against all the other digits using the training data at MNIST dataset
- Define the classifier $\hat{f}(x) = \arg\max_n \tilde{f}_n(x)$ using the $\arg\max$ over the index for the digits.
- Evaluate the performance of the classifier $\hat{f}$ using the testing data at MNIST dataset based on F_1 score

Assignment 10

Build a binary classifier for each digit n at MNIST

- Let $x = (x_1, x_2, \cdots, x_{784})$ be a vector that represent an image of the size 28×28 (vectorised by column-wise)
- Let f_i be a feature function such tat $f_i : \mathbb{R}^{784} \to \mathbb{R}$:

$$f_i(x) = r_i^T x, \quad r_i \sim \mathcal{N}(0, \sigma), \quad r_i \in \mathbb{R}^{784}$$

  where r_i denotes a random vector drawn from a normal distribution. (function: numpy.random.normal)
- The partitioning function $\tilde{f} : \mathbb{R}^{784} \to \mathbb{R}$ is defined by:

$$\tilde{f}(x; \theta) = \theta_1 f_1(x) + \theta_2 f_2(x) + \cdots + \theta_p f_p(x)$$

  where $\theta = (\theta_1, \theta_2, \cdots, \theta_p)$ denotes the model parameters

Assignment 10

Essential Visualisation

- Try with varying the number of parameters p with the standard deviation $\sigma = 1$ of the random feature vector r
- Present the confusion matrix $M(i, j)$ that indicates the number of classification for the digit i as the digit j
- Present the best F_1 score among the results with different number of parameters p