

# Mathematical Foundations for Computer Vision and Machine Learning

Byung-Woo Hong

Computer Science Department, Chung-Ang University

# Assignment 08

## 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 [assignment08.ipynb](#)
- Download the notebook as a PDF file [assignment08.pdf](#)

# Assignment 08

## github

- Start a project or a directory for the [assignment08](#)
- Include the link to the giuhub for the assignment in the notebook
- Upload the notebook [assignment08.ipynb](#) to the github after the deadline (Note that your github project is visible to public)

# Assignment 08

## Submission to *eclass*

- Submit the PDF file [assignment08.pdf](#) to [eclass](#)
- Deadline is 11:59 pm on next Thursday. No extension
- Score ranges from 0 to 5

# Assignment 08

## 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 08

## Build a binary classifier

- Define a linear bi-partitioning function  $\tilde{f}$  to classify digit '0' against all the other digits '1', '2', '3', '4', '5', '6', '7', '8', '9' using the training data at MNIST dataset
- Define the classifier  $\hat{f}(x) = \text{sign}(\tilde{f}(x))$  using the sign function:

$$\text{sign}(x) = \begin{cases} +1 & \text{if } x \geq 0 \\ -1 & \text{if } x < 0 \end{cases}$$

- Evaluate the performance of the classifier  $\hat{f}$  using the testing data at MNIST dataset based on TP(True Positive), FP(False Positive), TN(True Negative) and FN(False Negative)

# Assignment 08

feature function v17  
25/11/11...? p. 273

## Build a binary classifier

- Let  $x = (x_1, x_2, \dots, x_{784})$  be a vector that represent an image of the size  $28 \times 28$
- Let  $f_i$  be a feature function such tat  $f_i : \mathbb{R}^{784} \rightarrow \mathbb{R}$ :

$$f_i(x) = x_i$$

- The partitioning function  $\tilde{f} : \mathbb{R}^{784} \rightarrow \mathbb{R}$  is defined by:

$$\tilde{f}(x; \theta) = \theta_1 f_1(x) + \theta_2 f_2(x) + \dots + \theta_{784} f_{784}(x)$$

where  $\theta = (\theta_1, \theta_2, \dots, \theta_{784})$  denotes the model parameters

# Assignment 08

## Essential Visualisation

- Plot the value of the model parameters  $\theta_1, \theta_2, \dots, \theta_{784}$  in the image form ( $28 \times 28$ )
- Present the evaluation value table (TP, FP, TN, FN)
- Plot the average image ( $28 \times 28$ ) of True Positive
- Plot the average image ( $28 \times 28$ ) of False Positive
- Plot the average image ( $28 \times 28$ ) of True Negative
- Plot the average image ( $28 \times 28$ ) of False Negative