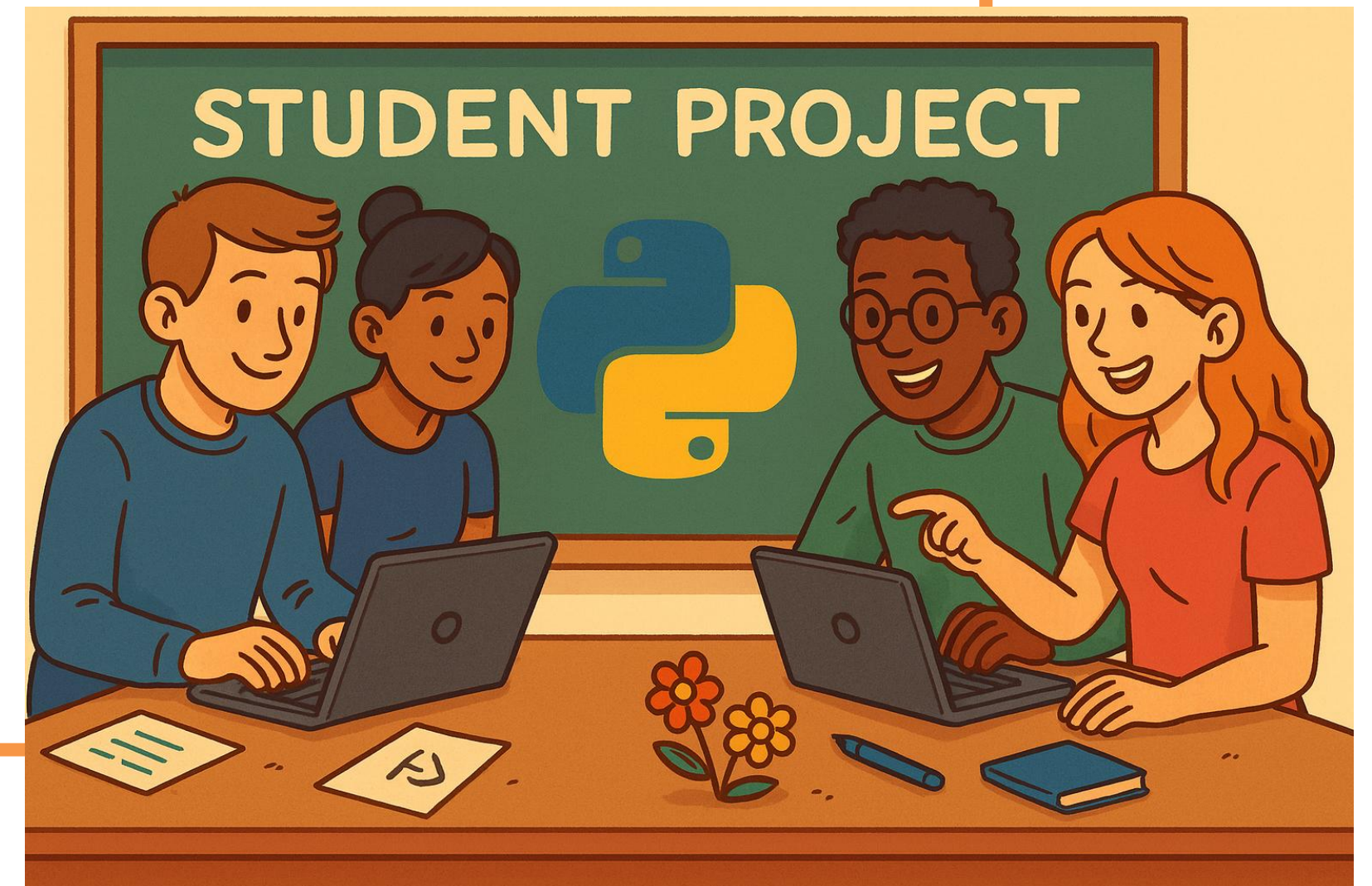


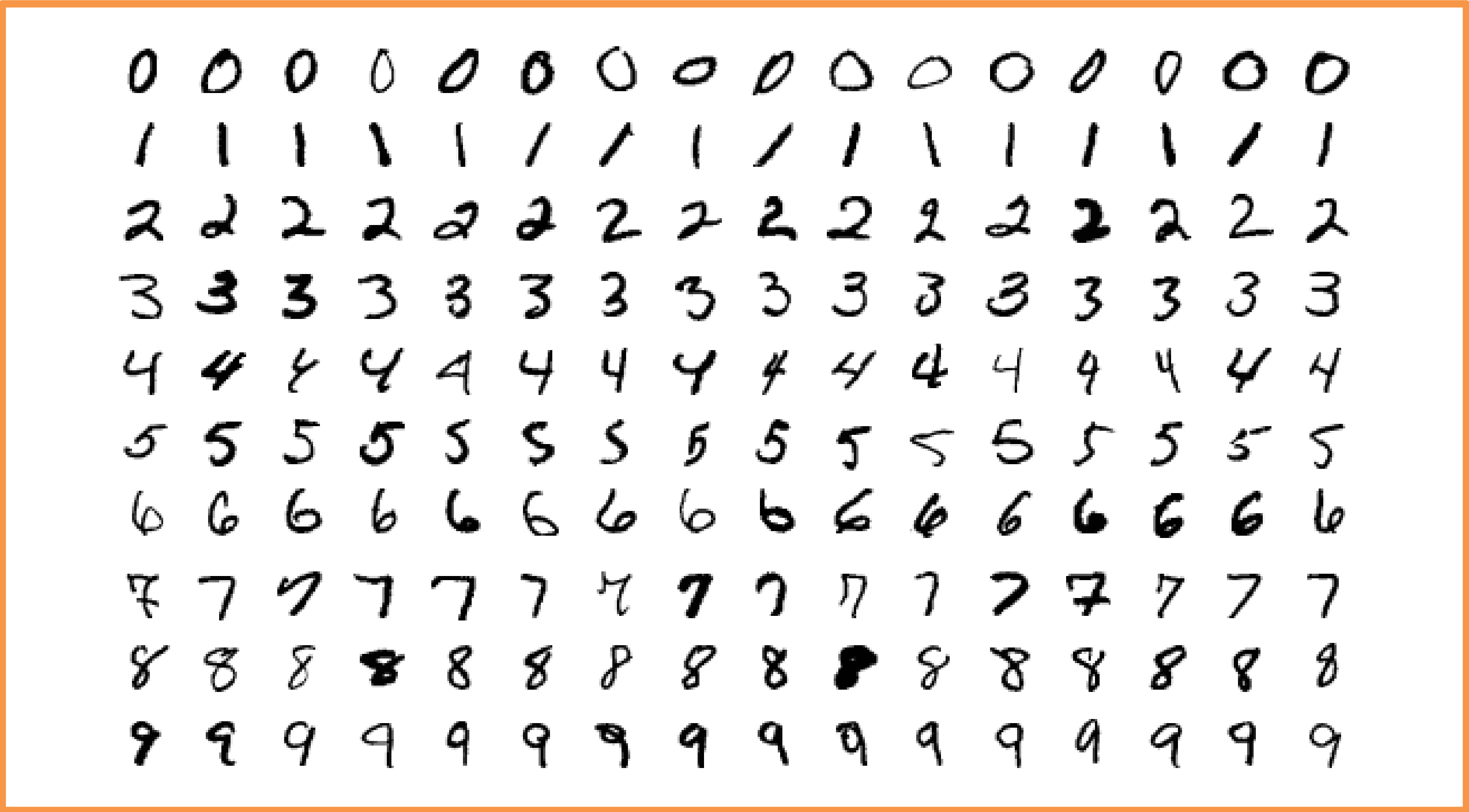
Handwritten digit recognition - with Python

Handwritten digit recognition is a classic problem in machine learning and computer vision. It involves recognizing handwritten digits from images or scanned documents. This task is widely used as a benchmark for evaluating machine learning models especially neural networks due to its simplicity and real-world applications.



What is the MNIST Handwritten Dataset?

- The MNIST handwritten dataset is one of the most well-known and widely used datasets in the field of machine learning and deep learning.
- MNIST stands for Modified National Institute of Standards and Technology.
- It is a dataset of grayscale images of handwritten digits from 0 to 9.
- Each image in the dataset is 28x28 pixels, resulting in a total of 784 pixels per image. These pixels are represented as numerical values indicating the grayscale intensity, ranging from 0 (black) to 255 (white).
- The dataset consists of 70,000 images:
 - 60,000 labeled training images used for training models.
 - 10,000 test images used for evaluating the performance of models.



Todo

- Run the code and check what is being done to train the neural network.
- Try to answer the following questions (next slide).

 IN_SYS_HS2025_SW10_Work2.ipynb

Questions

- Why do the image data need to be normalized (e.g., divided by 255.0)?
- Why must we split the data into training and test sets?
- The MNIST dataset contains grayscale images with a resolution of 28×28 pixels. If the model uses a fully connected (Dense) input layer, how many input values must be provided to the model for each image?
- What is the purpose of a Dense layer with 10 neurons in the model?
- What is the difference between a perceptron and a Dense layer?
- Why is training accuracy usually higher than test accuracy?
- What does a confusion matrix tell you about the model?
- Why is `np.argmax()` used when predicting digits?
- What happens if you feed an image with incorrect dimensions (e.g., $28 \times 28 \times 3$ instead of $28 \times 28 \times 1$)?