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DMML: Assignment 3
Semi-Supervised Learning

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Task

Use Semi-Supervised Learning to *identify a small subset of labelled images to seed the classification process*. In the lecture, the MNIST example started with 50 clusters. Experiment with different (relatively small) values of K for these two datasets.

Method involved:

Here is the overview of the function (**SSL(K)**) assigned to perform the classification process for both datasets:

- **K-Means Clustering:**

    - The function performs K-Means clustering on X_{train} to partition data into K clusters.
    - Cluster centers are computed using the `cluster_centers_` attribute.

- **Assigning Labels to Clusters:**

    - Labels are assigned by finding the nearest labeled data point to each cluster center.

- **Creating Pseudo Labels:**

    - Pseudo labels are generated for all training points based on cluster assignments.

- **Neural Network Model:**

    - A feedforward neural network with different number of layers is defined using TensorFlow/Keras.

- **Training:**

    - The model is trained over different epochs using pseudo labels.

- **Evaluation:**

    - Model performance is evaluated on test set $(X_{\text{test}}, y_{\text{test}})$.

Fashion MNIST Dataset

Neural Network Model used:

- A feedforward neural network with three layers is defined using TensorFlow/Keras.

- Two dense layers follow:

  - 300 neurons with ReLU activation.

  - 100 neurons with ReLU activation.

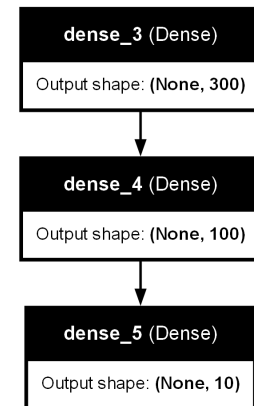- The output layer has 10 neurons with softmax activation.

Figure 1: Model Architecture

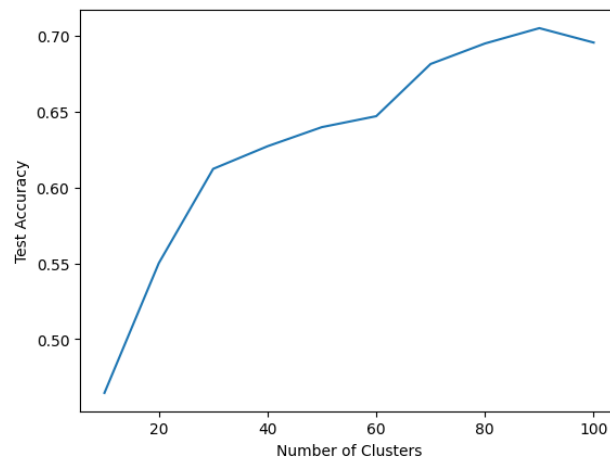Using this Neural Network Model we look at accuracy score over the different number of clusters (peak at K = 90).

Figure 2: Accuracy scores VS Clusters

Overhead MNIST dataset

Neural Network Model used:
For this dataset we worked with 4 different neural networks:

Layers (Using ReLU & Softmax)	Accuracy Score
1000, 500, 300, 200, 100, 10	0.73 (Best)
500, 300, 200, 100, 10	0.67
300, 100, 10	0.64
1000, 700, 500, 300, 200, 100, 10	0.58

Table 1: Experiment with different MLP Models

dense_12 (Dense)
Output shape: **(None, 1000)**

dense_13 (Dense)
Output shape: **(None, 500)**

dense_14 (Dense)
Output shape: **(None, 300)**

dense_15 (Dense)
Output shape: **(None, 200)**

dense_16 (Dense)
Output shape: **(None, 100)**

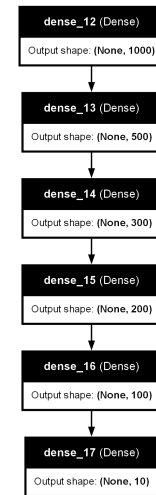| dense_17 (Dense) |
|---|
| Output shape: **(None, 10)** |

Table 2: Model Architecture for Best

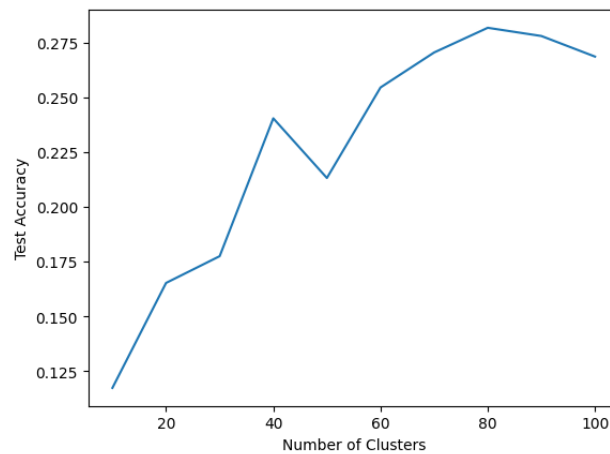Using the best Accuracy Score Layers we look at accuracy score over the different number of clusters (peak at K = 80).

Figure 3: Accuracy scores VS Clusters