Pattern Recognition and Machine Learning (PRML)
Assignment 3 (IIT Jammu)

Submission Guidelines:

- Submit a .ipynb with your implementation and output graphs.
- If any output graphs are generated, include them in a ZIP file along with your notebook.
- Ensure that your code is well-commented and structured.
- Strictly adhere to the plagiarism policy.
- Your submission should be uploaded before the deadline: 21 March 2025, 11:59 PM.

Question: You are given a dataset of 1000 handwritten digits (features extracted from images) obtained from a digit recognition task. Each digit is represented by a 64-dimensional feature vector (i.e., the dataset has 1000 samples and 64 features).

➔ K-Means Clustering:
  - ◆ Implement the K-Means clustering algorithm.
  - ◆ Choose an appropriate value of K using the Elbow Method and plot the curve.

➔ Agglomerative Hierarchical Clustering:
  - ◆ Implement Agglomerative Hierarchical Clustering.
  - ◆ Visualize the dendrogram and determine an appropriate number of clusters.

➔ DBSCAN Clustering:
  - ◆ Implement DBSCAN and experiment with different values of epsilon (ε) and minimum samples (minPts).
  - ◆ Identify the number of clusters formed and discuss its advantages over K-Means for this dataset.

➔ Gaussian Mixture Model (GMM) Clustering:
  - ◆ Implement GMM clustering using the Expectation-Maximization (EM) algorithm.
  - ◆ Compare the clustering results with K-Means, Agglomerative, and DBSCAN.
  - ◆ Discuss when GMM is preferable over K-Means and vice versa.