Deep Learning
[CSE4007]

Programming Assignment-1
Weightage: 15%

Problem Definition

Multi-Class Image Classification: **Comparing the Performance of a Feed-Forward Neural Network (MLP) versus a Convolutional Neural Network (CNN).**

Compare two deep learning approaches for an image classification task focused on identifying flower types. You will build and evaluate a Feed-Forward Neural Network (Multi-Layer Perceptron, or MLP) and a Convolutional Neural Network (CNN) using the same dataset. The dataset—downloadable from the ***Google drive link*** provided below—contains a total of 234 RGB images of four flower categories (crocus, daisy, pansy, and sunflower) and corresponding binary mask images stored in two subfolders named "images" and "masks" within a "dataset" folder (*check the description of the dataset below*).

• For the MLP approach, preprocess the data by applying the provided binary masks to the original images. This step suppresses the background, allowing you to focus on the actual flower region withing the given image. The masked flower images then be used to extract features (such as color histograms as numeric vectors) that focus solely on the flower regions. The extracted features may be used to train a MLP to classify the images.

• For the CNN approach, use the raw images directly as inputs—without applying the masks or performing explicit feature extraction—letting the network learn the relevant features automatically and subsequently classifying the images (feature extractor + classifier).

• The target class labels, representing the flower categories, should be extracted directly from the image file names.

Your goal is to compare the performance of these two architectures on the classification task, considering factors like computational efficiency, model accuracy, and the overall effectiveness of feature representation.

Dataset Description

Download data from the Google drive link (*mentioned below*), the zip file must be unzipped.

This will create a folder named **dataset**. Inside this folder there will be two subfolders named - **images** and **masks**.

images folder will contain 234 images of four category of flowers - crocus, daisy, pansy and sunflower.

masks folder will contain the binary mask images corresponding to the flower images inside the images folder. The binary masks can be used to supress the background regions from the original images to take out the regions of the actual flowers.

Data Preprocessing - The binary masks need to be applied to suppress the background of the images of the flowers before extracting features (e.g., color histograms) from the images. You need to apply this step while extracting features for training the MLP.

While working with the CNN, you may use the original raw images as input (masks images need not be used while using the CNN, also no separate feature extraction is needed).

You need to extract the class labels (flower categories/target-classes) of the flowers from the names of image files themselves.

There are a total of **234 images** each image with 3 channels (RGB)

Four category of flowers - **crocus, daisy, pansy** and **sunflower**

Google Drive Link to Download the Dataset:

URL:

https://drive.google.com/file/d/1o0FbEY6UIwLkLUNSHTtYogTKQB3_S1Q7/view?usp=sharing

Submission Details

Prepare an **iPython-notebook** (text and coding cells)**. Clearly mark separate sections for the different part of the problem on the same notebook.** You need to mention the following in the iPython notebook along with the solution code and results:

1. A section providing the **Problem Statement and Expected Outcome/Deliverables** *(copy paste from the given problem statement)*

2. Add a section on **Dataset Description** *(data description, split and preprocessing)*

3. Methodology

(add details of the e.g. Neural architecture - MLP or CNN or any other approach, display the model architecture; separate subsections for MLP and CNN)

4. Experimental Results *(comparative analysis with some other methods; multiple initializations of the ANN during training; different model architectures; additional experiments for better insights – e.g., hyper-parameter tuning/data augmentation, tuning, plotting of the loss/accuracy plot of the training and validation curves, analysis of overfitting/underfitting, if applied to improve results; separate subsections for MLP and CNN)***.**

5. Conclusions

(state the insights drawn from the experiments)

Make sure to import all the necessary libraries and run the cells present in the notebook and **save all the outputs when saving the notebook.**

Upload the final ipython-notebook in the classroom *(with suitable permission and access right for viewing).*

Turn On the submission.

Deadline: 16th March 2025, 5:30 pm IST

Expected Learning Outcomes

• Understanding the fundamental differences between traditional feature extraction techniques (e.g., applying masks and computing color-histograms for an MLP) and end-to-end learning with CNNs.

• Gaining practical experience in data preprocessing, including applying binary masks to suppress background noise and extracting meaningful features for classification.

• Learning how to implement, train, and evaluate two different neural network architectures (MLP and CNN) on the same image classification problem.

• Developing skills in extracting and interpreting class labels directly from file meta-data and managing dataset organization for deep learning tasks.

• Comparing model performance in terms of accuracy, computational efficiency, and the effectiveness of feature extraction versus automatic feature learning, thereby gaining insights into architecture selection for different application scenarios.