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ICS471 Deep Learning (241)
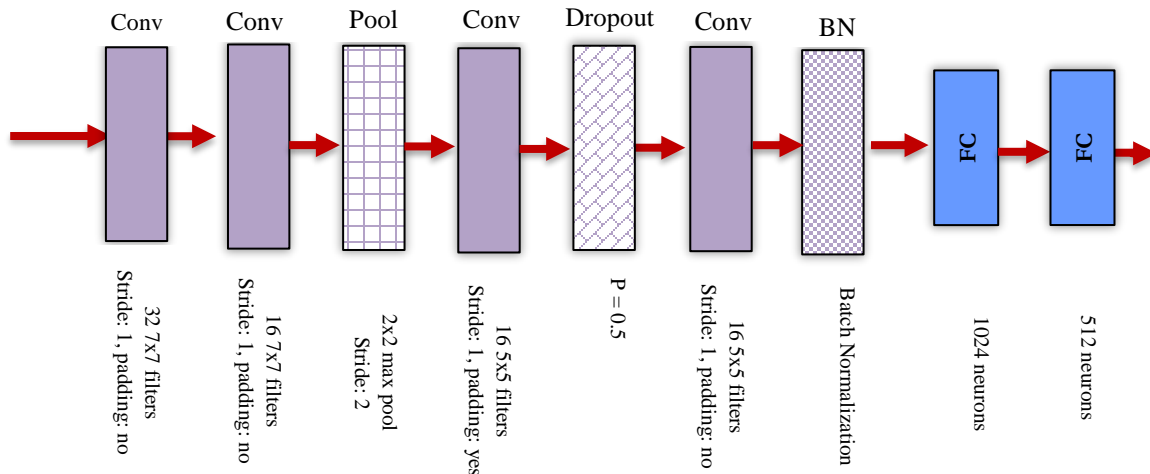
Homework 2

Date: 02/10/2024	Due date: 19/10/2024

Flowers recognition is a classification problem where a flower image is classified into one of five classes (daisy, dandelion, roses, sunflowers, tulips). In this assignment, you will use Convolutional Neural Networks (CNNs) to design an end-to-end system for **flowers classification/identification**. Your system will be given an image as input and will output the category/name of the flower shown in that image.

You will train your model on a dataset with flower images attached with this assignment. The dataset is already split into train and test. Use Jupyter notebook to show each of the following steps:

Part 01 [70 points]

1. Load the dataset and show sample from each folder\class.
2. Prepare the data by performing the following:
   a. Divide the train data into train (80%) and validation (20%)
   b. Preprocess the data.
   c. Perform data augmentation (Rotation with angle 20 and Horizontal flipping). You should do these augmentations to the correct set(s).

3. Implement the following model in Pytorch. The specifications of each layer are given under it. All convolution and FC layers are followed by ReLU activation function except the classification layer.

Conv — 32 7x7 filters, Stride: 1, padding: no
Conv — 16 7x7 filters, Stride: 1, padding: no
Pool — 2x2 max pool, Stride: 2
Conv — 16 5x5 filters, Stride: 1, padding: yes
Dropout — P = 0.5
Conv — 16 5x5 filters, Stride: 1, padding: no
BN — Batch Normalization
FC — 1024 neurons
FC — 512 neurons

4. Your implementation should include the following:

   a. Use early stopping to avoid overfitting

   b. Show the loss and accuracy of the train and validation data

   c. Plot the loss of the train and validation data in one figure

   d. Plot the accuracy of the train and validation data in one figure

   e. Show the accuracy of the test data

5. Show the performance of the following optimizers: SGD, RMSProp, Adam, and AdamW. Then, use the one with the best performance for the following steps.

6. Perform a random search to select the following model's hyperparameters: *Learning rate*, *Regularization strength*. In addition to the code, you should show the best obtained values of these two hyperparameters.

7. Display the silence map (heat map) of any convolution layer on any validation input image.

Part 02: Transfer Learning [30 points]

1. In this part, you will use transfer learning to extract features from the dataset using VGG-16 and feed them into the FC, FC, and classification layers (last layers of model shown in Part-01). The new model will have all the layers of VGG-16 up to the first FC layer with 4096 neurons. The output of VGG-16 will be used as an input to the FC layers followed by classifier. You need to train only the last layers of your model on our dataset.

2. In this question, you will do the following with InceptionV3 pretrained model:

   a. Show the results of InceptionV3 on the test data without any fine-tuning.

   b. Fine-tune the last two layers of the model and show the test results.

   c. Retrain the whole model on our dataset and report the results.

   d. Compare the results of the previous three scenarios.

Submit the code with results in the same Jupyter notebook file.

Note\ Make sure that to submit the Jupyter notebook that contains the output of your models. The grader will not have a time to retrain your models.