CMPE 597 Sp. Tp. Deep Learning
Spring 2021 Project II
Due: May 23 by 11.59pm

Network

In this project, you will practice implementing a convolutional neural network (CNN) architecture using a deep learning library. You are not allowed to use off-the-shelf architectures, e.g., VGG. You will use CIFAR10 dataset in this project. A link to the dataset is provided on the project page. You will need to search for how to load the CIFAR10 data depending on the library you will use. You may implement your network in Tensorflow or Pytorch. You are not allowed to use preset functions to compile your model or get predictions (e.g., model.compile, model.predict functions in Keras).

Supervised Training

1. (15 pts) Implement data augmentation techniques, such as random flip and random crop. Do not forget to standardize or normalize your dataset before training.

2. (30 pts) Design a 3-layer CNN architecture for object classification task. A 3-layer CNN may not give you the state-of-the-art performance on CIFAR10 data. You will explore ways to obtain as high performance as possible with the 3-layer CNN.

    - Discuss the reasoning behind your choices on the kernel size, activation functions, number of feature maps, number of fully connected layers, and the size of the fully connected layers.
    - Investigate techniques to improve the performance, such as adding dropout, batch normalization, residual blocks. Discuss your observations on the effect of these techniques on the performance.

3. (15 pts) Choose one optimizer and train your network. Plot the value of the loss function with respect to number of epochs. Determine the batch size. Report training and test classification accuracy. Discuss your early stopping procedure.

4. (15 pts) After determining the final hyperparameters, try different optimizers and compare their performance and convergence properties.

5. (20 pts) Visualize the latent space of the model for the training samples (output of the feature extraction layers) in the beginning of the training, in the middle of the training, and in the end of the training. To visualize, map the latent representations into 2-D space using t-SNE. Use different colors to illustrate the categories. Compare the plots. Can you observe 10 groupings in the end of the training?

6. (5 pts) Provide a README file where I can find the steps to train, and evaluate your model.

Submission

You need to submit a zip file with the name `NameSurname_Project2.zip` containing the files below.

- A pdf report including your name, your student number, your answers to questions, and references.
- `model.py`
- `main.py`
- `eval.py`
- `README.txt`

IMPORTANT NOTE: Do not forget to cite your references and resources.