SMAI (CSE 471)
Spring-2019
Assignment-6 (100 points)
Posted on: 26/2/2019
Due on: 6/3/2019, 11:55 PM

- Questions can involve a mix of writing code/scripts and answering questions or analyzing results.
- Code: Your scripts should be of the form q-x-y.py where x is the main question, y is the sub-question. For e.g., q-1-2.py is Python script for sub-question 2 within question 1.
- Ensure that submitted assignment is your original work. Please do not copy any part from any source including your friends, seniors and/or the internet. If any such attempt is caught then serious action will be taken.
- Use suitable train-validation split for your training and validation (20% of data).
- Report should contain details of algorithm implementation, results and observations.

1. (30 points) Without using any deep learning library, Implement the forward pass of neural network shown in figure 1. Take filter weights as gaussian or random filter and pooling operation as max-pooling. Initialize the weights randomly and show output after each layer for any sample image.

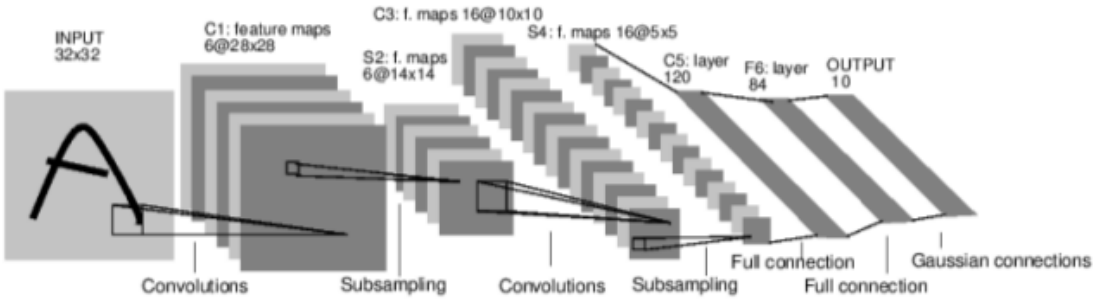

Figure 1: LeNet Architecture is [CONV-POOL-CONV-POOL-FC-FC]. Conv filters are 5x5, applied at stride 1. Pooling layers are 2x2 applied at stride 2

2. (15 points) Answer the following questions for above architecture:
    1. What are the number of parameters in 1st convolutional layers ?
    2. What are the number of parameters in pooling operation?
    3. Which of the following operations contain most number of parameters?
    (a) conv (b) pool (c) Fully connected layer (FC) (d) Activation Functions

4. Which operation consume most amount of memory?
   (a) initial convolution layers (b) fully connected layers at the end
5. Try different activation functions and describe observations.

3. (55 points) For the last part, you will be working with Tensorflow framework. Download and complete the notebook [**link**] where you will learn how the framework works and how to train a convolutional network of your own design on CIFAR-10 to get the best performance you can. The notebook contain following TODO part:

   1. Barebone Tensorflow (low level APIs)**(10 points)**
      - Implement the forward pass for the three-layer ConvNet with basic TensorFlow constructs.
      - Initialize the parameters of the three-layer network.
   2. Keras Model API**(10 points)**
      - Implement the __init__ method for a three-layer ConvNet.
      - Implement the forward pass for a three-layer ConvNet.
      - Complete the implementation of model_init_fn.
      - Complete the implementation of optimizer_init_fn.
   3. Keras Sequential API**(10 points)**
      - Construct a three-layer ConvNet using tf.keras.Sequential.
      - Complete the implementation of optimizer_init_fn.
   4. CIFAR-10 Training**(15 points)**
      - Construct a model that performs well on CIFAR-10.
      - Construct an optimizer that performs well on CIFAR-10.
   5. Write an explanation of what you did, any additional features that you implemented, and/or any graphs that you made in the process of training and evaluating your network.**(10 points)**