Signal Processing in Practice

Assignment

Date: 26 Feb, 2024

Starter code

1. **Image Classification**
   - Train a randomly initialized ResNet-18 model on the CIFAR-100 dataset(*trainset1* and *trainset2*) using Cross Entropy Loss.
   - Evaluate the accuracy on the CIFAR-100 test set.
2. **Robustness against distribution shift**
   - Evaluate the accuracy of the models trained in Q1 on the additional test set given. here
   - Perform the evaluation on this test set, using the model in two modes, *train* and *eval* mode.
   - Vary the test batch size as 4, 8, 16, 32 and report the results in each case.
3. **Self Supervised Learning**
   - Pretrain a ResNet-18 model for the CIFAR-100 dataset using the *trainset2*(without labels) in a self supervised manner using the SimClr objective.
     - For each batch of N images and its augmented version of N images resulting in 2N data points. Each image has one positive pair and 2(N-1) negative pairs. The loss function for a positive pair of examples is defined as

$$l(z_i, \tilde{z}_i) = \log \left(\frac{\exp(sim(z_i.\tilde{z}_i)/\tau)}{\sum_{k=1}^{N} 1_{[k \neq i]} \exp(sim(z_i.z_k)/\tau) + \sum_{k=1}^{N} 1_{[k \neq i]} \exp(sim(z_i.\tilde{z}_k)/\tau)} \right) \quad (1)$$

     - The SimCLR loss on the batch can be obtained as

$$\mathcal{L} = \frac{1}{2N} \sum_{k=1}^{N} l(z_k, \tilde{z}_k) + l(\tilde{z}_k, z_k) \quad (2)$$

   - Fine tune this pretrained model using the *trainset1* using Cross Entropy loss. Then evaluate on the test set.
   - Evaluate the accuracy of this finetuned model on the CIFAR-100 test set.