Deep Learning for Modeling: Concepts, Tools, and Techniques

ASSIGMENTS PART ONE

The first three questions are based on the provided template "mnistClassification.py", the classification accuracy is calculated using "accurateChecker1.py"; The 4th question is provided with a template "pytorchMnist.py", the classification accuracy is calculated using "accurateChecker2.py"; The 5th question is provided with a template "cifar10Classification.py", the classification accuracy is calculated using "accurateChecker3.py". For the first four questions, submission can be one week later than the due date, but you will only get 80% of the points for a late submission.

1. **Autodiff**:
   (a) Please implement the forward and backward process of the softmax function. (L105 and L111 of "mnistClassification.py")

$$\text{SoftMax}(x_i) = \frac{\exp x_i}{\sum_k \exp x_k} \tag{1}$$

   (b) Please implement the forward and backward process of the cross entropy loss function. (L125 and L131 of "mnistClassification.py")

$$\text{CorssEntropy}(x_i, l_i) = -\sum_i l_i \log(x_i) \tag{2}$$

   Due Date: Mar 21th 2024

2. **Optimizer**: Please implement the SGD optimization process. (L294 of "mnistClassification.py")
   Due Date: Mar 21th 2024

3. **Training**:
   (a) Please implement the Xavier initialization for the linear layer class. (L36 of "mnistClassification.py")
   (b) Please fine-tune the hyperparameters to make the classification accuracy reach at least 94%. You should only use the types of layers and the loss function provided in the template. The total number of parameters in your neural network should not surpass 2×10^5.

   Due Date: Mar 21th 2024

4. **Pytorch**: Please implement a Pytorch version of the MNIST classification, and let the accuracy reach at least 97%. You should use only FC linear layers. The total number of parameters in your neural network should not surpass 6×10^5.
   Due Date: Apr 7th 2024

5. **Competition One**: Please implement a Pytorch version of the CIFAR-10 classification, and let the accuracy reach at least 60% to get the base points. Your final score will be $\frac{\text{accuracy rate} \times 10^2}{\max(\text{number of parameters} \div 1 \times 10^4, 1)}$. All your scores will be ranked and the higher score you can reach the more points you will receive.
   Due Date: Apr 18th 2024