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COMP5212: Machine Learning
Fall 2022
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Programming Homework 2

Homework Report

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1 Convolutional neural network (MLP) Implementation

1.1 Model Description

The model is a 7 layers fully-connected neural networks with ReLU activation function.

1.2 Implementation Details

The model details are shown below:

```
Batch size = 64
Number of epochs = 20
self.model = nn.Sequential(
        nn.Flatten(),
        nn.Linear(3072, 1024),  nn.ReLU(),
        nn.Linear(1024, 512),   nn.ReLU(),
        nn.Linear(512, 256),    nn.ReLU(),
        nn.Linear(256, 128),    nn.ReLU(),
        nn.Linear(128, 64),     nn.ReLU(),
        nn.Linear(64, 32),      nn.ReLU(),
        nn.Linear(32, 10),      nn.ReLU(),
)
```

1.3 Training Results

```
Total accuracy:             53%
|   plane   class accuracy:  65.8%
|   car     class accuracy:  68.8%
|   bird    class accuracy:  31.2%
|   cat     class accuracy:  33.3%
|   deer    class accuracy:  32.8%
|   dog     class accuracy:  40.5%
|   frog    class accuracy:  58.6%
|   horse   class accuracy:  72.7%
|   ship    class accuracy:  62.8%
|   truck   class accuracy:  69.1%
```

2 Multilayer perceptron (CNN) Implementation

2.1 Model Description

The model is a 7 layers convolutional neural networks, 4 convolutional layers and 3 fully- connected layers, with ReLu activation function.

2.2 Implementation Details

The model details are shown below:

```
    Batch size = 64
    Number of epochs = 20
    self.model = nn.Sequential(
            nn.Conv2d(3,64,3, stride=1, padding=1),     nn.ReLU(),
            nn.Conv2d(64,128,3, stride=2, padding=1),   nn.ReLU(),
            nn.Conv2d(128,256,3, stride=2, padding=1),  nn.ReLU(),
            nn.Conv2d(256,256,3, stride=2, padding=1),  nn.ReLU(),
            nn.Flatten(),
            nn.Linear(4096, 1024),      nn.ReLU(),
            nn.Linear(1024, 1024),      nn.ReLU(),
            nn.Linear(1024, 10),
        )
```

2.3 Training Results

```
    Total accuracy:             82%
    |   plane   class accuracy:   91.1%
    |   car     class accuracy:   91.4%
    |   bird    class accuracy:   72.0%
    |   cat     class accuracy:   58.1%
    |   deer    class accuracy:   81.7%
    |   dog     class accuracy:   77.8%
    |   frog    class accuracy:   86.7%
    |   horse   class accuracy:   87.5%
    |   ship    class accuracy:   89.1%
    |   truck   class accuracy:   87.7%
```

3 Discussion

3.1 Compare of MLP and CNN

The comparison of the average training loss of using MLP and CNN is shown in Figure 1. From the

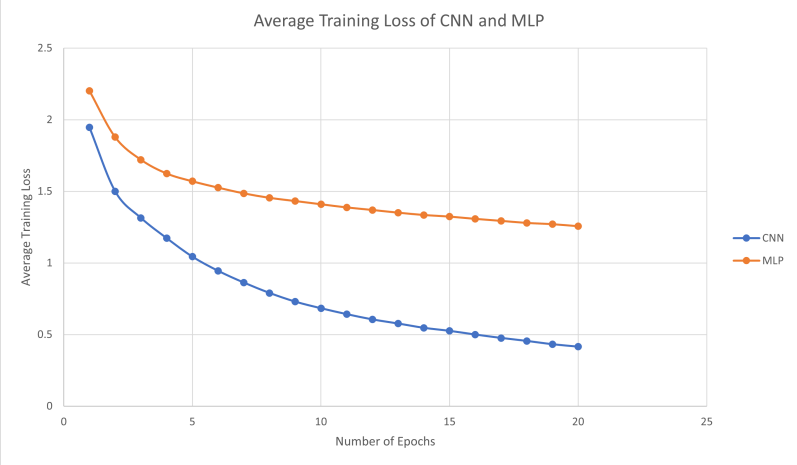

Figure 1: Loss Comparison

figure, it is shown that the loss of CNN is smaller than MLP, therefore we can infer that the CNN is more efficient than MLP.

3.2 Neural network with and without non-linear activation function

This report implement model without non-linear activation function on MLP and compare. The result is shown in Figure 2. The model without non-linear activation function is not able to converge. The model

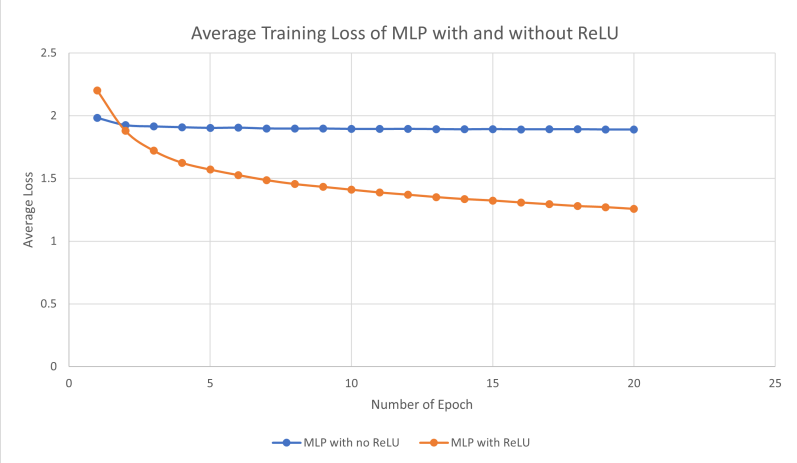

Figure 2: with and without non-linear activation function

with non-linear activation function is able to converge and get better result.