CSC 572 ASSIGNMENT

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Documentation of Code Setup and Output of Running Neural Network on the Mnist Dataset

Introduction

This dcoumentation describes the format and the output of the major.py script, which is used to train a neural network for the MNIST dataset through the use of the network2 module in the src package.

Imported Modules

The following modules are utilized in the main.py script:
Argparse: a built-in Python module for attribute value support of command-line arguments.
Mnistloader: A custom module within the src directory that loads the MNIST dataset.

Code Structure

The script sets up a main function, with an argument datasetpath, that refers to the position of the MNIST dataset. Within this function:

1. The MNIST dataset is loaded using mnistloader.loaddatawrapper.
2. A neural network with three layers (784, 30, 10) is created with the network2.Network class and cross-entropy as the cost function.
3. The network weights are initialized through the largeweightinitializer method.
4. Training is conducted using stochastic gradient descent (SGD) with a learning rate of 0.5, a regularization parameter of 0.1, and curve monitoring in terms of evaluation accuracy, the cost of evaluation, training accuracy, and training cost.

Output
The script, run during the training process, provides the main statistics, such as accuracy and cost.

Observation

1. Training Cost and Evaluation Cost Trends : The training cost started at 0.6189 and decreased slowly, reaching 0.2308 by epoch 29. Also, the evaluation cost followed a similar pattern, reducing from 0.7226 to 0.5476.
   The decrease in the costs shows that the model successfully minimized errors and learned meaningful patterns from the data.

2. Accuracy Improvement : The training accuracy improved from 90.88% (45441/50000) to 97.40% (48698/50000), while the evaluation accuracy increased from 90.60% (9060/10000) to 94.63% (9463/10000). This consistent improvement shows that the model is effectively learning and generalizing.

   Note: Accuracy = (Prediction / Total sample)×100

3. Convergence Point and Overfitting Detection : At epoch 17, the training accuracy had reached 97.02% (48510/ 50000), and evaluation accuracy hit 94.88% (9488 / 10000), showing the model was reaching peak performance.

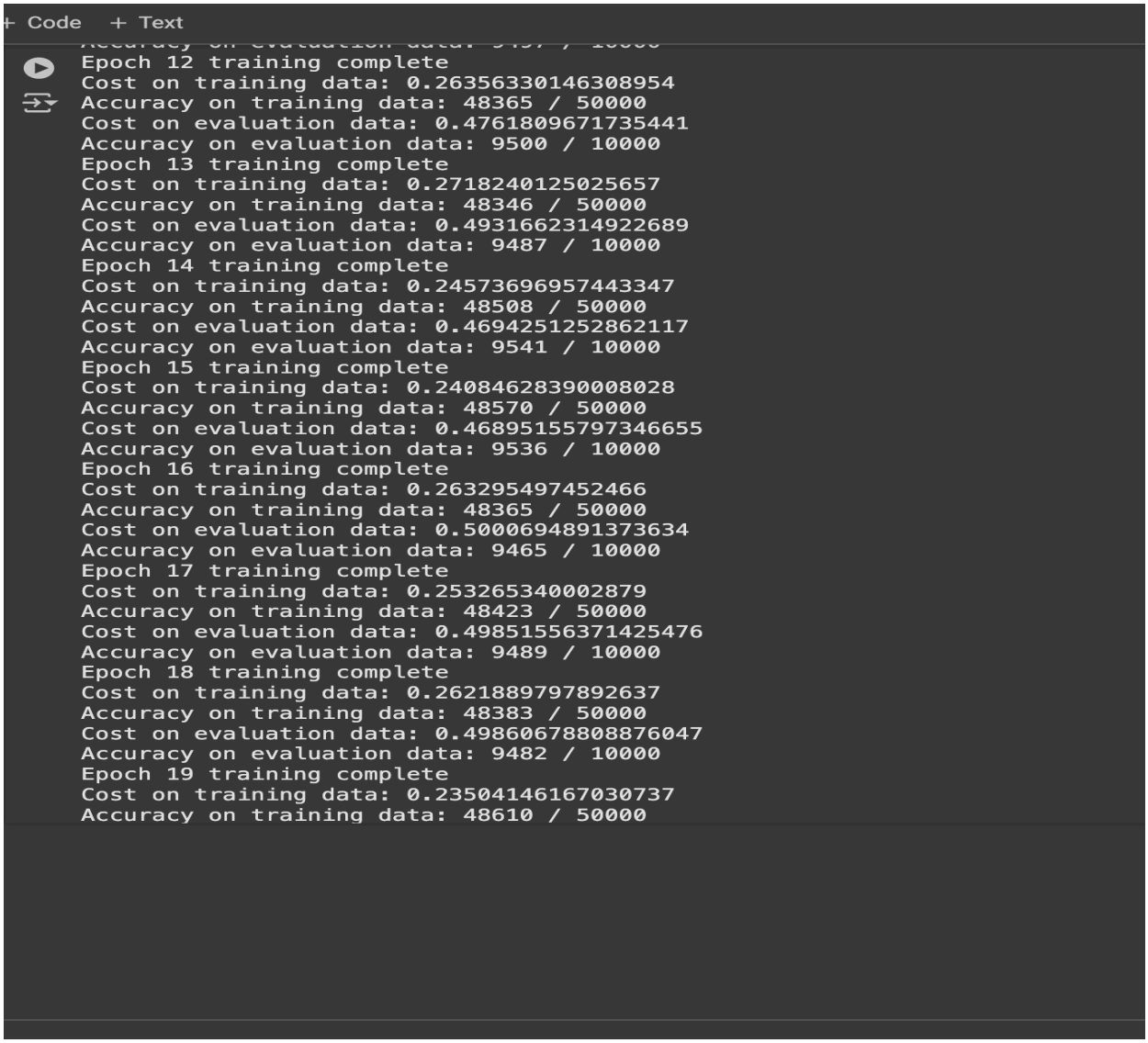
   After epoch 25, accuracy improvements became minimal, which shows that the model had learned most of what it could from the data. A slight increase in evaluation cost in later epochs suggests minor overfitting, where the model starts fitting too closely to the training data, slightly reducing generalization ability.

SOURCE CODE LINK
https://github.com/peltastic/Neural-network-and-deep-learning

Screenshots of Training Results (Epoch 0-29)

-Cost of Training
-Cost of Evaluation
-Accuracy of training data
-Accuracy of evaluation data

```
Cost on evaluation data: 0.4851178702299016
Accuracy on evaluation data: 9501 / 10000
Epoch 23 training complete
Cost on training data: 0.21244777055347958
Accuracy on training data: 48807 / 50000
Cost on evaluation data: 0.4799183130140837
Accuracy on evaluation data: 9508 / 10000
Epoch 24 training complete
Cost on training data: 0.22499867457328823
Accuracy on training data: 48660 / 50000
Cost on evaluation data: 0.49220641088938255
Accuracy on evaluation data: 9506 / 10000
Epoch 25 training complete
Cost on training data: 0.23538485957063687
Accuracy on training data: 48645 / 50000
Cost on evaluation data: 0.509072780475432
Accuracy on evaluation data: 9499 / 10000
Epoch 26 training complete
Cost on training data: 0.21525953588450508
Accuracy on training data: 48753 / 50000
Cost on evaluation data: 0.5065233831850907
Accuracy on evaluation data: 9503 / 10000
Epoch 27 training complete
Cost on training data: 0.20035918697051844
Accuracy on training data: 48945 / 50000
Cost on evaluation data: 0.4897533505736188
Accuracy on evaluation data: 9530 / 10000
Epoch 28 training complete
Cost on training data: 0.21179080713306875
Accuracy on training data: 48791 / 50000
Cost on evaluation data: 0.5070716881502548
Accuracy on evaluation data: 9489 / 10000
Epoch 29 training complete
Cost on training data: 0.2170041621871752
Accuracy on training data: 48751 / 50000
Cost on evaluation data: 0.5107190669857
Accuracy on evaluation data: 9497 / 10000
```



Screenshots of the output result.