West Visayas State University

COLLEGE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

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Exercise for Unit 4

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Year and Section:_____BSCS 3-A AI_____

Note: Save your Python source codes into a single .ipynb file with the proper naming convention (see Readme on the repository), upload it to your assigned folder in the GitHub organization **CCS-248-Artificial-Neural-Networks**, *repository* **"25-26"**.

Use this file as your answer.

Study the Backpropagation implementation uploaded [here](), and perform the following:

1. Set up the code so that it will perform the **Forward Pass (FP), Backpropagation (BP)** and weight update in *1000 epochs.*

2. Modify the Optimizer class so that it will accept 3 optimizers we've discussed

    a. *Learning rate decay*
    b. *Momentum*
    c. *Adaptive Gradient*

    Hint: Updating the learning decay rate happens before running both FP and BP, implementing momentum, and vanilla SGD happens after the learning rate decay
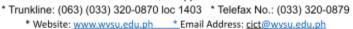
3. Display the **accuracy** once every 100 epochs have elapsed, to see if the accuracy is increasing. Paste a screenshot here of your console that shows the accuracy.

4. Compare the difference of two optimizers you've implemented in terms of: a) how many epoch did it take to *stabilize the loss*, and b) the *accuracy* of the model.

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Screenshots:

SGD with Momentum:

```
Epoch:  100
acc:  0.36666666666666664
loss:  1.0986020896528221
learning rate:  0.1

Epoch:  200
acc:  0.38
loss:  1.0985904922948289
learning rate:  0.1

Epoch:  300
acc:  0.39
loss:  1.0985810762271615
learning rate:  1.9721522630525296e-32

Epoch:  400
acc:  0.39
loss:  1.0985810762271615
learning rate:  1.2272733663244317e-92

Epoch:  500
acc:  0.39
loss:  1.0985810762271615
learning rate:  1.909335227187253e-153

Epoch:  600
acc:  0.39
loss:  1.0985810762271615
learning rate:  7.394076163542342e-274
```
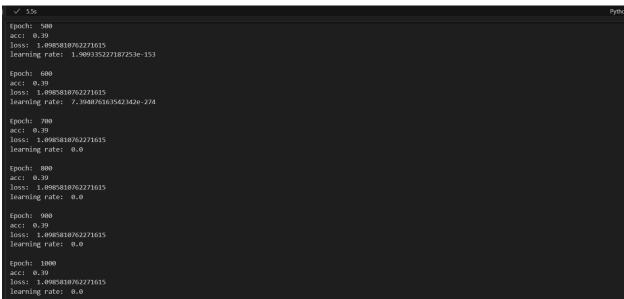
```
✓ 5.5s                                                                                    Python
Epoch:  500
acc:  0.39
loss:  1.0985810762271615
learning rate:  1.909335227187253e-153

Epoch:  600
acc:  0.39
loss:  1.0985810762271615
learning rate:  7.394076163542342e-274

Epoch:  700
acc:  0.39
loss:  1.0985810762271615
learning rate:  0.0

Epoch:  800
acc:  0.39
loss:  1.0985810762271615
learning rate:  0.0

Epoch:  900
acc:  0.39
loss:  1.0985810762271615
learning rate:  0.0

Epoch:  1000
acc:  0.39
loss:  1.0985810762271615
learning rate:  0.0
```

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Adagrad:

```
Epoch:  100
acc:  0.4266666666666667
loss:  1.0767928335955441
learning rate:  0.1

Epoch:  200
acc:  0.42
loss:  1.0764777034347404
learning rate:  0.1

Epoch:  300
acc:  0.4033333333333333
loss:  1.07409091652356
learning rate:  0.1

Epoch:  400
acc:  0.4066666666666667
loss:  1.072347935635349
learning rate:  0.1

Epoch:  500
acc:  0.42333333333333334
loss:  1.0715643309922567
learning rate:  0.1

Epoch:  600
acc:  0.4266666666666667
loss:  1.0710831246309698
learning rate:  0.1
```

```
acc:  0.42333333333333334
loss:  1.0715643309922567
learning rate:  0.1

Epoch:  600
acc:  0.4266666666666667
loss:  1.0710831246309698
learning rate:  0.1

Epoch:  700
acc:  0.4266666666666667
loss:  1.0706389526614566
learning rate:  0.1

Epoch:  800
acc:  0.4266666666666667
loss:  1.070364947668402
learning rate:  0.1

Epoch:  900
acc:  0.4266666666666667
loss:  1.0702083464659342
learning rate:  0.1

Epoch:  1000
acc:  0.4266666666666667
loss:  1.070087132815979
learning rate:  0.1
```

4. Differences of SGD with Momentum and Adagrad:

Loss Stabilization

- SGD with Momentum: 300 epochs
- Adagrad: 500 epochs

Accuracy

- SGD with Momentum: 0.39
- Adagrad: 0.4266666666666667