C:\Users\iitfypvmadmin\PycharmProjects\IIT-MSc-FYP-ML\venv\Scripts\python.exe "C:/Program Files/JetBrains/PyCharm 2023.1/plugins/python/helpers/pydev/pydevconsole.py" --mode=client --host=127.0.0.1 --port=57574

import sys; print('Python %s on %s' % (sys.version, sys.platform))

sys.path.extend(['C:\\Users\\iitfypvmadmin\\PycharmProjects\\IIT-MSc-FYP-ML'])

PyDev console: starting.

Python 3.10.10 (tags/v3.10.10:aad5f6a, Feb 7 2023, 17:20:36) [MSC v.1929 64 bit (AMD64)] on win32

runfile('C:\\Users\\iitfypvmadmin\\PycharmProjects\\IIT-MSc-FYP-ML\\ds\_train\\CNN\_Training.py', wdir='C:\\Users\\iitfypvmadmin\\PycharmProjects\\IIT-MSc-FYP-ML\\ds\_train')

Device - cpu

Full Train Set - 3840

Train Set - 3072

Validation Set - 768

Test Set - 1631

Available Classes ['අ', 'ආ', 'ඇ', 'ඈ', 'ඉ', 'ඊ', 'උ', 'එ', 'ඒ', 'ඔ', 'ඕ', 'ක', 'කා', 'කැ', 'කෑ', 'කි', 'කී', 'කු', 'කූ', 'ක්']

Net - Net(

(conv1): Conv2d(1, 16, kernel\_size=(3, 3), stride=(1, 1), padding=(1, 1))

(bn1): BatchNorm2d(16, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(conv2): Conv2d(16, 16, kernel\_size=(3, 3), stride=(1, 1), padding=(1, 1))

(bn2): BatchNorm2d(16, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(pool1): MaxPool2d(kernel\_size=2, stride=2, padding=0, dilation=1, ceil\_mode=False)

(conv3): Conv2d(16, 32, kernel\_size=(3, 3), stride=(1, 1), padding=(1, 1))

(bn3): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(conv4): Conv2d(32, 32, kernel\_size=(3, 3), stride=(1, 1), padding=(1, 1))

(bn4): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(pool2): MaxPool2d(kernel\_size=2, stride=2, padding=0, dilation=1, ceil\_mode=False)

(conv5): Conv2d(32, 64, kernel\_size=(3, 3), stride=(1, 1), padding=(1, 1))

(bn5): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(conv6): Conv2d(64, 64, kernel\_size=(3, 3), stride=(1, 1), padding=(1, 1))

(bn6): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(pool3): MaxPool2d(kernel\_size=2, stride=2, padding=0, dilation=1, ceil\_mode=False)

(fc1): Linear(in\_features=4096, out\_features=1024, bias=True)

(bn7): BatchNorm1d(1024, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(fc2): Linear(in\_features=1024, out\_features=256, bias=True)

(bn8): BatchNorm1d(256, eps=1e-05, momentum=0.1, affine=True, track\_running\_stats=True)

(fc3): Linear(in\_features=256, out\_features=31, bias=True)

)

----------------------------------------------------

EPOCH : 1

Training loss : 0.7725637520973881

Training accuracy : 79.39453125%

Validation loss : 0.2450073684255282

Validation accuracy: 93.09895833333333%

----------------------------------------------------

EPOCH : 2

Training loss : 0.08618670131545514

Training accuracy : 98.30729166666667%

Validation loss : 0.13437400882442793

Validation accuracy: 97.00520833333333%

----------------------------------------------------

EPOCH : 3

Training loss : 0.024185386622169364

Training accuracy : 99.90234375%

Validation loss : 0.15041565087934336

Validation accuracy: 96.22395833333333%

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EPOCH : 4

Training loss : 0.02483904144416253

Training accuracy : 99.77213541666667%

Validation loss : 0.19551417914529642

Validation accuracy: 95.18229166666667%

----------------------------------------------------

EPOCH : 5

Training loss : 0.04402934608515352

Training accuracy : 99.4140625%

Validation loss : 0.2370574710269769

Validation accuracy: 93.22916666666667%

----------------------------------------------------

EPOCH : 6

Training loss : 0.1042213891632855

Training accuracy : 97.65625%

Validation loss : 0.2258019900570313

Validation accuracy: 93.88020833333333%

----------------------------------------------------

EPOCH : 7

Training loss : 0.1013890429555128

Training accuracy : 97.23307291666667%

Validation loss : 0.1729802656918764

Validation accuracy: 95.96354166666667%

----------------------------------------------------

EPOCH : 8

Training loss : 0.06118078657891601

Training accuracy : 98.60026041666667%

Validation loss : 0.1847995122273763

Validation accuracy: 95.44270833333333%

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EPOCH : 9

Training loss : 0.03810453360589842

Training accuracy : 99.34895833333333%

Validation loss : 0.14016533891359964

Validation accuracy: 96.09375%

----------------------------------------------------

EPOCH : 10

Training loss : 0.016895383305381984

Training accuracy : 99.90234375%

Validation loss : 0.1264246879145503

Validation accuracy: 96.484375%

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EPOCH : 11

Training loss : 0.008641448764440915

Training accuracy : 100.0%

Validation loss : 0.09995667403563857

Validation accuracy: 97.52604166666667%

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EPOCH : 12

Training loss : 0.007605326303746551

Training accuracy : 100.0%

Validation loss : 0.11404705482224624

Validation accuracy: 97.265625%

----------------------------------------------------

EPOCH : 13

Training loss : 0.00886785564944148

Training accuracy : 100.0%

Validation loss : 0.1273490066329638

Validation accuracy: 96.875%

----------------------------------------------------

EPOCH : 14

Training loss : 0.1440672742028255

Training accuracy : 97.10286458333333%

Validation loss : 0.31685256337126094

Validation accuracy: 92.44791666666667%

----------------------------------------------------

EPOCH : 15

Training loss : 0.12939317043249807

Training accuracy : 97.03776041666667%

Validation loss : 0.179581663881739

Validation accuracy: 95.18229166666667%

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EPOCH : 16

Training loss : 0.05428838015844425

Training accuracy : 98.99088541666667%

Validation loss : 0.13647448488821587

Validation accuracy: 95.96354166666667%

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EPOCH : 17

Training loss : 0.03055123860637347

Training accuracy : 99.73958333333333%

Validation loss : 0.19373178016394377

Validation accuracy: 94.79166666666667%

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EPOCH : 18

Training loss : 0.049984819100548826

Training accuracy : 99.15364583333333%

Validation loss : 0.20599287717292705

Validation accuracy: 95.18229166666667%

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EPOCH : 19

Training loss : 0.07319667978057016

Training accuracy : 98.60026041666667%

Validation loss : 0.23262400490542254

Validation accuracy: 94.140625%

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EPOCH : 20

Training loss : 0.059873830333041646

Training accuracy : 99.08854166666667%

Validation loss : 0.12246637636174758

Validation accuracy: 96.875%

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EPOCH : 21

Training loss : 0.02974888503861924

Training accuracy : 99.77213541666667%

Validation loss : 0.1128425629188617

Validation accuracy: 97.39583333333333%

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EPOCH : 22

Training loss : 0.030152783069449168

Training accuracy : 99.57682291666667%

Validation loss : 0.13087381112078825

Validation accuracy: 96.61458333333333%

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EPOCH : 23

Training loss : 0.030873886736420292

Training accuracy : 99.93489583333333%

Validation loss : 0.13483347619573274

Validation accuracy: 96.875%

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EPOCH : 24

Training loss : 0.04401301627513021

Training accuracy : 99.51171875%

Validation loss : 0.11654213846971591

Validation accuracy: 97.39583333333333%

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GroundTruth: ඔ ඈ ඔ ක් කූ අ කු කූ කූ ඉ

Predicted: ඔ ඈ එ ක් ඊ අ කු කූ කු ඉ

Accuracy of the network on the test images: 76.885346 %

Non-normalized Confusion Matrix

Confusion Matrix for Test Set

[[ 48 0 4 3 0 0 0 0 0 0 0 0 0 0 0 0 0 5

0 0]

[ 1 44 0 2 0 0 0 0 0 0 0 0 1 0 0 0 0 0

0 0]

[ 1 1 49 9 0 0 0 0 0 0 2 0 0 0 0 0 0 1

0 0]

[ 2 2 2 44 0 0 0 0 0 0 3 0 0 0 0 0 0 1

0 0]

[ 0 0 0 0 53 0 0 0 0 0 0 0 0 0 0 0 0 0

0 3]

[ 0 0 0 0 0 35 0 3 0 0 0 0 0 0 0 3 0 0

0 2]

[ 0 0 0 0 0 0 39 0 0 0 4 0 0 0 0 0 0 0

1 0]

[ 0 0 0 0 0 0 5 52 5 2 0 0 0 0 0 1 2 0

2 0]

[ 0 0 0 0 1 1 0 0 66 0 0 0 0 0 0 0 3 0

0 10]

[ 0 0 0 0 0 0 0 1 0 58 3 3 0 0 0 3 2 1

0 0]

[ 1 0 0 0 2 1 2 4 3 2 57 2 0 0 0 4 4 0

7 0]

[ 0 2 0 0 2 0 0 1 0 5 0 54 9 2 0 0 0 36

0 0]

[ 0 5 0 0 0 0 0 0 0 3 0 1 103 1 0 0 0 3

2 0]

[ 1 0 0 0 6 1 0 2 0 0 0 0 6 85 14 0 0 3

0 0]

[ 0 0 0 0 0 0 0 0 0 0 0 2 2 6 73 0 0 5

3 0]

[ 0 0 0 2 0 1 0 0 0 0 3 2 0 0 0 71 22 0

6 3]

[ 2 0 0 3 0 5 6 10 0 1 18 0 0 0 0 14 49 0

0 1]

[ 6 10 0 0 4 1 0 5 0 2 0 2 5 3 5 0 0 52

1 0]

[ 14 1 1 2 15 2 0 2 1 1 0 2 3 1 7 0 0 10

42 0]

[ 0 5 0 0 0 2 0 2 6 0 1 0 1 2 0 2 0 0

0 75]]

Classification report

precision recall f1-score support

0 0.78 0.78 0.78 60

1 0.71 0.94 0.81 48

2 0.87 0.73 0.79 63

3 0.64 0.81 0.72 54

4 0.72 0.96 0.82 56

5 0.90 0.84 0.87 43

6 0.87 0.91 0.89 44

7 0.70 0.77 0.73 69

8 0.86 0.88 0.87 81

9 0.77 0.83 0.80 71

10 0.66 0.64 0.65 89

11 0.89 0.60 0.72 111

12 0.77 0.92 0.84 118

13 0.83 0.67 0.74 118

14 0.79 0.79 0.79 91

15 0.73 0.67 0.70 110

16 0.70 0.63 0.67 109

17 0.62 0.80 0.70 96

18 0.86 0.65 0.74 104

19 0.89 0.91 0.90 96

accuracy 0.77 1631

macro avg 0.78 0.79 0.78 1631

weighted avg 0.78 0.77 0.77 1631