

HW5_Task1

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1 Applied Machine Learning Homework 5

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1.1 Task 1

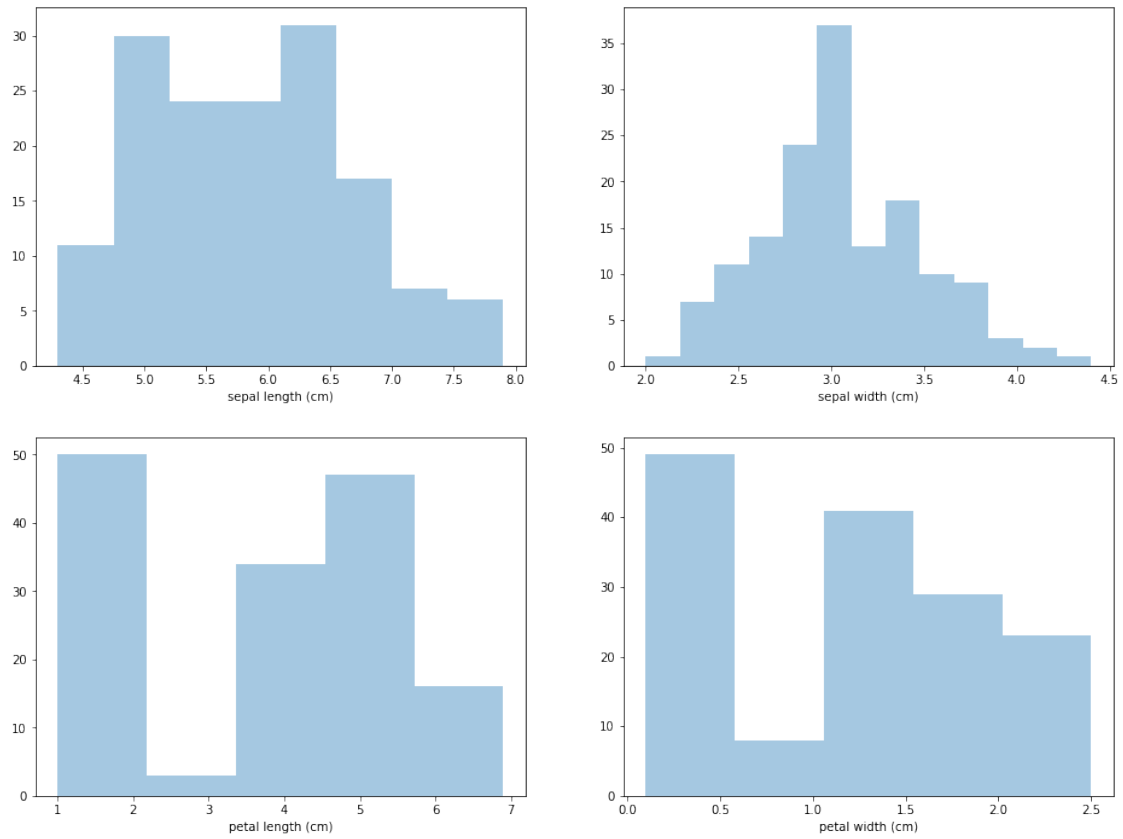
Run a multilayer perceptron (feed forward neural network) with **two hidden layers** and **rectified linear nonlinearities** on the iris dataset using the keras **Sequential** interface . Include code for selecting **regularization strength** and **number of hidden units** using **GridSearchCV** and evaluation on an independent test-set.

```
In [0]: import numpy as np
import pandas as pd
```

```
In [0]: # load iris
from sklearn import datasets
from sklearn.model_selection import train_test_split
iris = datasets.load_iris()
X_train, X_test, y_train, y_test = train_test_split(
    iris['data'], iris['target'], random_state=0)
```

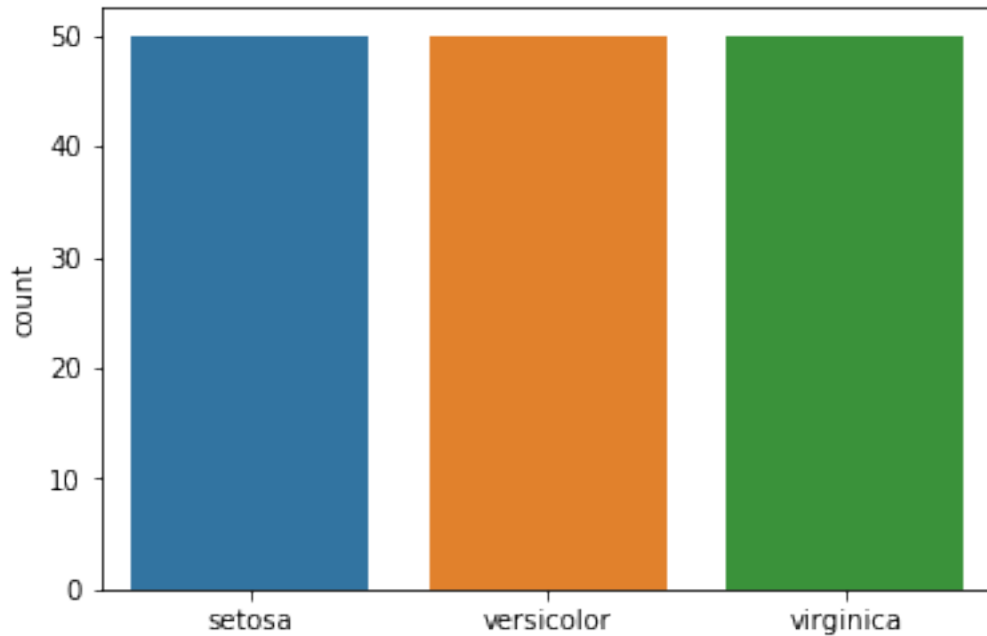
```
In [0]: # visualization
import matplotlib.pyplot as plt
import seaborn as sns
```

```
In [0]: fig, ax = plt.subplots(2, 2, figsize = (16,12))
axflat = ax.flatten()
for i in range(4):
    sns.distplot(iris['data'][:,i], ax = axflat[i], kde = False)
    axflat[i].set_xlabel(iris.feature_names[i])
```



2 Standard Scalar is required

```
In [0]: ax = sns.countplot(iris['target'])
        _ = ax.set_xticklabels(iris.target_names)
```



3 balanced data

```
In [0]: # tf
import tensorflow as tf
sess = tf.Session(config=tf.ConfigProto(log_device_placement=True))
from keras import backend
backend.tensorflow_backend._get_available_gpus()
```

Using TensorFlow backend.

```
Out[0]: ['/job:localhost/replica:0/task:0/device:GPU:0']
```

```
In [0]: # keras
from sklearn.model_selection import StratifiedShuffleSplit
from sklearn.model_selection import GridSearchCV
from keras.utils import multi_gpu_model
from keras.utils import to_categorical
from keras.models import Sequential
from keras.layers import Dense, Activation
from keras import regularizers
from keras.wrappers.scikit_learn import KerasClassifier
```

```
In [0]: # preprocessing X
from sklearn.preprocessing import StandardScaler
```

```

ss = StandardScaler()
X_train_scaled = ss.fit_transform(X_train)
X_test_scaled = ss.transform(X_test)

# preprocessing y
y_train = to_categorical(y_train, 3)
y_test = to_categorical(y_test, 3)

In [0]: def make_model(optimizer = 'adam', hidden_size1 = 16,
                        hidden_size2 = 16, strngth = 0.1):
    # initiate
    model = Sequential()

    # first layer
    model.add(Dense(hidden_size1,
                     activation = 'relu',
                     input_dim = 4,
                     kernel_regularizer = regularizers.l2(strngth)) )

    # second
    model.add(Dense(hidden_size2,
                     activation = 'relu',
                     kernel_regularizer = regularizers.l2(strngth)) )

    # output layer
    model.add(Dense(3, activation = 'softmax'))

    # compile
    model.compile(optimizer = optimizer,
                  loss = 'categorical_crossentropy',
                  metrics = ['accuracy'])

    return model

In [0]: # link keras-scikit
clf = KerasClassifier(make_model)

# param_grid
param_grid = {'epochs': [1, 3, 5],
              'hidden_size1': [2**x for x in range(5, 8)],
              'hidden_size2': [2**x for x in range(5, 8)],
              'strngth': np.logspace(-1,1,3)}

# sss
sss = StratifiedShuffleSplit(n_splits=3, random_state=0, test_size=0.2)

In [0]: # grid
grid = GridSearchCV(clf, param_grid=param_grid, cv=sss, return_train_score=True)
grid.fit(X_train_scaled, y_train)

```

```

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/op_
Instructions for updating:
Colocations handled automatically by placer.
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/ops/math_ops.py
Instructions for updating:
Use tf.cast instead.
Epoch 1/1
89/89 [=====] - 1s 12ms/step - loss: 4.9713 - acc: 0.3708
23/23 [=====] - 0s 2ms/step
89/89 [=====] - 0s 111us/step
Epoch 1/1
89/89 [=====] - 0s 3ms/step - loss: 5.3424 - acc: 0.2472
23/23 [=====] - 0s 3ms/step
89/89 [=====] - 0s 111us/step
Epoch 1/1
89/89 [=====] - 0s 3ms/step - loss: 5.1805 - acc: 0.1910
23/23 [=====] - 0s 3ms/step
89/89 [=====] - 0s 123us/step
Epoch 1/1
89/89 [=====] - 0s 4ms/step - loss: 40.2527 - acc: 0.3146
23/23 [=====] - 0s 4ms/step
89/89 [=====] - 0s 116us/step
Epoch 1/1
89/89 [=====] - 1s 6ms/step - loss: 39.8906 - acc: 0.4607
23/23 [=====] - 0s 5ms/step
89/89 [=====] - 0s 136us/step
Epoch 1/1
89/89 [=====] - 0s 5ms/step - loss: 40.8892 - acc: 0.7303
23/23 [=====] - 0s 5ms/step
89/89 [=====] - 0s 121us/step
Epoch 1/1
89/89 [=====] - 0s 5ms/step - loss: 388.4804 - acc: 0.1798
23/23 [=====] - 0s 6ms/step
89/89 [=====] - 0s 142us/step
Epoch 1/1
89/89 [=====] - 1s 6ms/step - loss: 379.7297 - acc: 0.3708
23/23 [=====] - 0s 7ms/step
89/89 [=====] - 0s 143us/step
Epoch 1/1
89/89 [=====] - 1s 6ms/step - loss: 401.1750 - acc: 0.3258
23/23 [=====] - 0s 8ms/step
89/89 [=====] - 0s 133us/step
Epoch 1/1
89/89 [=====] - 1s 7ms/step - loss: 5.9466 - acc: 0.4270
23/23 [=====] - 0s 9ms/step
89/89 [=====] - 0s 150us/step
Epoch 1/1
89/89 [=====] - 1s 8ms/step - loss: 6.0151 - acc: 0.3258

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```

23/23 [=====] - 0s 9ms/step
89/89 [=====] - 0s 156us/step
Epoch 1/1
89/89 [=====] - 1s 8ms/step - loss: 5.9631 - acc: 0.5730
23/23 [=====] - 0s 11ms/step
89/89 [=====] - 0s 142us/step
Epoch 1/1
89/89 [=====] - 1s 8ms/step - loss: 52.0549 - acc: 0.7528
23/23 [=====] - 0s 11ms/step
89/89 [=====] - 0s 157us/step
Epoch 1/1
89/89 [=====] - 1s 9ms/step - loss: 50.2733 - acc: 0.5393
23/23 [=====] - 0s 13ms/step
89/89 [=====] - 0s 178us/step
Epoch 1/1
89/89 [=====] - 1s 10ms/step - loss: 50.2825 - acc: 0.0562
23/23 [=====] - 0s 14ms/step
89/89 [=====] - 0s 143us/step
Epoch 1/1
89/89 [=====] - 1s 10ms/step - loss: 505.1564 - acc: 0.3933
23/23 [=====] - 0s 14ms/step
89/89 [=====] - 0s 174us/step
Epoch 1/1
89/89 [=====] - 1s 11ms/step - loss: 484.8363 - acc: 0.2921
23/23 [=====] - 0s 15ms/step
89/89 [=====] - 0s 157us/step
Epoch 1/1
89/89 [=====] - 1s 11ms/step - loss: 495.1950 - acc: 0.5056
23/23 [=====] - 0s 17ms/step
89/89 [=====] - 0s 193us/step
Epoch 1/1
89/89 [=====] - 1s 12ms/step - loss: 6.9853 - acc: 0.2697
23/23 [=====] - 0s 17ms/step
89/89 [=====] - 0s 167us/step
Epoch 1/1
89/89 [=====] - 1s 13ms/step - loss: 6.7965 - acc: 0.3820
23/23 [=====] - 0s 20ms/step
89/89 [=====] - 0s 156us/step
Epoch 1/1
89/89 [=====] - 1s 14ms/step - loss: 6.8031 - acc: 0.2697
23/23 [=====] - 0s 19ms/step
89/89 [=====] - 0s 150us/step
Epoch 1/1
89/89 [=====] - 1s 15ms/step - loss: 57.3060 - acc: 0.6292
23/23 [=====] - 1s 23ms/step
89/89 [=====] - 0s 135us/step
Epoch 1/1
89/89 [=====] - 1s 17ms/step - loss: 58.0959 - acc: 0.4045

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23/23 [=====] - 1s 23ms/step
89/89 [=====] - 0s 174us/step
Epoch 1/1
89/89 [=====] - 1s 16ms/step - loss: 56.3796 - acc: 0.5281
23/23 [=====] - 1s 24ms/step
89/89 [=====] - 0s 174us/step
Epoch 1/1
89/89 [=====] - 2s 17ms/step - loss: 578.9237 - acc: 0.1124
23/23 [=====] - 1s 25ms/step
89/89 [=====] - 0s 160us/step
Epoch 1/1
89/89 [=====] - 2s 19ms/step - loss: 580.8167 - acc: 0.3258
23/23 [=====] - 1s 27ms/step
89/89 [=====] - 0s 150us/step
Epoch 1/1
89/89 [=====] - 2s 19ms/step - loss: 583.8082 - acc: 0.3371
23/23 [=====] - 1s 30ms/step
89/89 [=====] - 0s 157us/step
Epoch 1/1
89/89 [=====] - 2s 19ms/step - loss: 5.8474 - acc: 0.4719
23/23 [=====] - 1s 30ms/step
89/89 [=====] - 0s 203us/step
Epoch 1/1
89/89 [=====] - 2s 20ms/step - loss: 6.3129 - acc: 0.2921
23/23 [=====] - 1s 31ms/step
89/89 [=====] - 0s 156us/step
Epoch 1/1
89/89 [=====] - 2s 20ms/step - loss: 5.9839 - acc: 0.3596
23/23 [=====] - 1s 32ms/step
89/89 [=====] - 0s 211us/step
Epoch 1/1
89/89 [=====] - 2s 22ms/step - loss: 52.2062 - acc: 0.0112
23/23 [=====] - 1s 33ms/step
89/89 [=====] - 0s 145us/step
Epoch 1/1
89/89 [=====] - 2s 22ms/step - loss: 50.8021 - acc: 0.1910
23/23 [=====] - 1s 34ms/step
89/89 [=====] - 0s 167us/step
Epoch 1/1
89/89 [=====] - 2s 23ms/step - loss: 51.0382 - acc: 0.3708
23/23 [=====] - 1s 35ms/step
89/89 [=====] - 0s 179us/step
Epoch 1/1
89/89 [=====] - 2s 24ms/step - loss: 486.8226 - acc: 0.3820
23/23 [=====] - 1s 37ms/step
89/89 [=====] - 0s 165us/step
Epoch 1/1
89/89 [=====] - 2s 25ms/step - loss: 503.2366 - acc: 0.3034

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23/23 [=====] - 1s 39ms/step
89/89 [=====] - 0s 195us/step
Epoch 1/1
89/89 [=====] - 2s 26ms/step - loss: 523.0629 - acc: 0.3596
23/23 [=====] - 1s 39ms/step
89/89 [=====] - 0s 179us/step
Epoch 1/1
89/89 [=====] - 2s 27ms/step - loss: 8.2521 - acc: 0.2472
23/23 [=====] - 1s 42ms/step
89/89 [=====] - 0s 182us/step
Epoch 1/1
89/89 [=====] - 2s 27ms/step - loss: 7.9164 - acc: 0.4607
23/23 [=====] - 1s 42ms/step
89/89 [=====] - 0s 174us/step
Epoch 1/1
89/89 [=====] - 2s 28ms/step - loss: 8.2342 - acc: 0.3146
23/23 [=====] - 1s 46ms/step
89/89 [=====] - 0s 185us/step
Epoch 1/1
89/89 [=====] - 3s 29ms/step - loss: 70.8786 - acc: 0.3371
23/23 [=====] - 1s 44ms/step
89/89 [=====] - 0s 180us/step
Epoch 1/1
89/89 [=====] - 3s 29ms/step - loss: 69.9486 - acc: 0.3258
23/23 [=====] - 1s 45ms/step
89/89 [=====] - 0s 174us/step
Epoch 1/1
89/89 [=====] - 3s 30ms/step - loss: 72.8301 - acc: 0.4045
23/23 [=====] - 1s 48ms/step
89/89 [=====] - 0s 168us/step
Epoch 1/1
89/89 [=====] - 3s 31ms/step - loss: 715.1918 - acc: 0.3708
23/23 [=====] - 1s 49ms/step
89/89 [=====] - 0s 188us/step
Epoch 1/1
89/89 [=====] - 3s 33ms/step - loss: 708.5789 - acc: 0.3034
23/23 [=====] - 1s 51ms/step
89/89 [=====] - 0s 201us/step
Epoch 1/1
89/89 [=====] - 3s 33ms/step - loss: 695.9047 - acc: 0.2921
23/23 [=====] - 1s 55ms/step
89/89 [=====] - 0s 178us/step
Epoch 1/1
89/89 [=====] - 4s 40ms/step - loss: 10.2908 - acc: 0.3146
23/23 [=====] - 1s 58ms/step
89/89 [=====] - 0s 196us/step
Epoch 1/1
89/89 [=====] - 3s 36ms/step - loss: 10.2381 - acc: 0.3483

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23/23 [=====] - 1s 54ms/step
89/89 [=====] - 0s 169us/step
Epoch 1/1
89/89 [=====] - 3s 36ms/step - loss: 10.3941 - acc: 0.2921
23/23 [=====] - 1s 56ms/step
89/89 [=====] - 0s 262us/step
Epoch 1/1
89/89 [=====] - 3s 36ms/step - loss: 94.1049 - acc: 0.1573
23/23 [=====] - 1s 58ms/step
89/89 [=====] - 0s 156us/step
Epoch 1/1
89/89 [=====] - 3s 37ms/step - loss: 94.3580 - acc: 0.2135
23/23 [=====] - 1s 58ms/step
89/89 [=====] - 0s 195us/step
Epoch 1/1
89/89 [=====] - 3s 37ms/step - loss: 91.6311 - acc: 0.2921
23/23 [=====] - 1s 60ms/step
89/89 [=====] - 0s 186us/step
Epoch 1/1
89/89 [=====] - 4s 40ms/step - loss: 933.9825 - acc: 0.1348
23/23 [=====] - 1s 63ms/step
89/89 [=====] - 0s 183us/step
Epoch 1/1
89/89 [=====] - 4s 40ms/step - loss: 919.2500 - acc: 0.3708
23/23 [=====] - 1s 65ms/step
89/89 [=====] - 0s 194us/step
Epoch 1/1
89/89 [=====] - 4s 41ms/step - loss: 909.4976 - acc: 0.2584
23/23 [=====] - 2s 68ms/step
89/89 [=====] - 0s 256us/step
Epoch 1/1
89/89 [=====] - 4s 42ms/step - loss: 6.9570 - acc: 0.1011
23/23 [=====] - 2s 69ms/step
89/89 [=====] - 0s 196us/step
Epoch 1/1
89/89 [=====] - 4s 43ms/step - loss: 6.7516 - acc: 0.7191
23/23 [=====] - 2s 68ms/step
89/89 [=====] - 0s 167us/step
Epoch 1/1
89/89 [=====] - 4s 44ms/step - loss: 6.7723 - acc: 0.4382
23/23 [=====] - 2s 71ms/step
89/89 [=====] - 0s 202us/step
Epoch 1/1
89/89 [=====] - 4s 45ms/step - loss: 60.1843 - acc: 0.1798
23/23 [=====] - 2s 71ms/step
89/89 [=====] - 0s 174us/step
Epoch 1/1
89/89 [=====] - 4s 46ms/step - loss: 59.6125 - acc: 0.5955

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23/23 [=====] - 2s 76ms/step
89/89 [=====] - 0s 194us/step
Epoch 1/1
89/89 [=====] - 4s 47ms/step - loss: 58.5867 - acc: 0.0674
23/23 [=====] - 2s 75ms/step
89/89 [=====] - 0s 207us/step
Epoch 1/1
89/89 [=====] - 4s 47ms/step - loss: 578.7740 - acc: 0.0449
23/23 [=====] - 2s 75ms/step
89/89 [=====] - 0s 203us/step
Epoch 1/1
89/89 [=====] - 4s 50ms/step - loss: 586.9278 - acc: 0.3708
23/23 [=====] - 2s 85ms/step
89/89 [=====] - 0s 196us/step
Epoch 1/1
89/89 [=====] - 4s 49ms/step - loss: 593.7628 - acc: 0.4157
23/23 [=====] - 2s 80ms/step
89/89 [=====] - 0s 170us/step
Epoch 1/1
89/89 [=====] - 4s 50ms/step - loss: 10.2466 - acc: 0.4270
23/23 [=====] - 2s 81ms/step
89/89 [=====] - 0s 188us/step
Epoch 1/1
89/89 [=====] - 5s 51ms/step - loss: 10.4153 - acc: 0.4270
23/23 [=====] - 2s 84ms/step
89/89 [=====] - 0s 172us/step
Epoch 1/1
89/89 [=====] - 5s 53ms/step - loss: 10.3999 - acc: 0.2135
23/23 [=====] - 2s 86ms/step
89/89 [=====] - 0s 165us/step
Epoch 1/1
89/89 [=====] - 5s 54ms/step - loss: 93.3215 - acc: 0.3034
23/23 [=====] - 2s 88ms/step
89/89 [=====] - 0s 204us/step
Epoch 1/1
89/89 [=====] - 5s 55ms/step - loss: 92.9903 - acc: 0.3258
23/23 [=====] - 2s 88ms/step
89/89 [=====] - 0s 180us/step
Epoch 1/1
89/89 [=====] - 5s 56ms/step - loss: 91.2655 - acc: 0.3034
23/23 [=====] - 2s 91ms/step
89/89 [=====] - 0s 188us/step
Epoch 1/1
89/89 [=====] - 5s 57ms/step - loss: 931.4821 - acc: 0.3708
23/23 [=====] - 2s 95ms/step
89/89 [=====] - 0s 195us/step
Epoch 1/1
89/89 [=====] - 5s 58ms/step - loss: 909.8974 - acc: 0.3258

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23/23 [=====] - 2s 95ms/step
89/89 [=====] - 0s 193us/step
Epoch 1/1
89/89 [=====] - 5s 59ms/step - loss: 919.4139 - acc: 0.3258
23/23 [=====] - 2s 96ms/step
89/89 [=====] - 0s 206us/step
Epoch 1/1
89/89 [=====] - 5s 59ms/step - loss: 14.6922 - acc: 0.3708
23/23 [=====] - 2s 96ms/step
89/89 [=====] - 0s 176us/step
Epoch 1/1
89/89 [=====] - 5s 60ms/step - loss: 14.5032 - acc: 0.2584
23/23 [=====] - 2s 100ms/step
89/89 [=====] - 0s 210us/step
Epoch 1/1
89/89 [=====] - 5s 62ms/step - loss: 14.4319 - acc: 0.3708
23/23 [=====] - 2s 102ms/step
89/89 [=====] - 0s 199us/step
Epoch 1/1
89/89 [=====] - 6s 62ms/step - loss: 135.0577 - acc: 0.2584
23/23 [=====] - 2s 102ms/step
89/89 [=====] - 0s 196us/step
Epoch 1/1
89/89 [=====] - 6s 63ms/step - loss: 135.1244 - acc: 0.3371
23/23 [=====] - 2s 106ms/step
89/89 [=====] - 0s 177us/step
Epoch 1/1
89/89 [=====] - 6s 65ms/step - loss: 134.9568 - acc: 0.4944
23/23 [=====] - 2s 105ms/step
89/89 [=====] - 0s 162us/step
Epoch 1/1
89/89 [=====] - 6s 66ms/step - loss: 1335.5771 - acc: 0.3146
23/23 [=====] - 2s 108ms/step
89/89 [=====] - 0s 215us/step
Epoch 1/1
89/89 [=====] - 6s 65ms/step - loss: 1329.3940 - acc: 0.1011
23/23 [=====] - 2s 108ms/step
89/89 [=====] - 0s 173us/step
Epoch 1/1
89/89 [=====] - 6s 67ms/step - loss: 1345.8600 - acc: 0.7191
23/23 [=====] - 3s 111ms/step
89/89 [=====] - 0s 207us/step
Epoch 1/3
89/89 [=====] - 6s 68ms/step - loss: 4.9088 - acc: 0.4494
Epoch 2/3
89/89 [=====] - 0s 252us/step - loss: 4.7870 - acc: 0.5169
Epoch 3/3
89/89 [=====] - 0s 242us/step - loss: 4.6686 - acc: 0.5506

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23/23 [=====] - 3s 112ms/step
89/89 [=====] - 0s 184us/step
Epoch 1/3
89/89 [=====] - 6s 68ms/step - loss: 4.9588 - acc: 0.3034
Epoch 2/3
89/89 [=====] - 0s 236us/step - loss: 4.8254 - acc: 0.3034
Epoch 3/3
89/89 [=====] - 0s 271us/step - loss: 4.6955 - acc: 0.5056
23/23 [=====] - 3s 114ms/step
89/89 [=====] - 0s 207us/step
Epoch 1/3
89/89 [=====] - 6s 69ms/step - loss: 4.8734 - acc: 0.6854
Epoch 2/3
89/89 [=====] - 0s 271us/step - loss: 4.7531 - acc: 0.6854
Epoch 3/3
89/89 [=====] - 0s 240us/step - loss: 4.6355 - acc: 0.6966
23/23 [=====] - 3s 116ms/step
89/89 [=====] - 0s 295us/step
Epoch 1/3
89/89 [=====] - 6s 71ms/step - loss: 41.0834 - acc: 0.2472
Epoch 2/3
89/89 [=====] - 0s 266us/step - loss: 39.9691 - acc: 0.2472
Epoch 3/3
89/89 [=====] - 0s 261us/step - loss: 38.8776 - acc: 0.2472
23/23 [=====] - 3s 118ms/step
89/89 [=====] - 0s 211us/step
Epoch 1/3
89/89 [=====] - 6s 72ms/step - loss: 40.0686 - acc: 0.5281
Epoch 2/3
89/89 [=====] - 0s 255us/step - loss: 38.9842 - acc: 0.5618
Epoch 3/3
89/89 [=====] - 0s 265us/step - loss: 37.9224 - acc: 0.6180
23/23 [=====] - 3s 118ms/step
89/89 [=====] - 0s 209us/step
Epoch 1/3
89/89 [=====] - 6s 71ms/step - loss: 37.8910 - acc: 0.3146
Epoch 2/3
89/89 [=====] - 0s 262us/step - loss: 36.8128 - acc: 0.2809
Epoch 3/3
89/89 [=====] - 0s 259us/step - loss: 35.7599 - acc: 0.3034
23/23 [=====] - 3s 122ms/step
89/89 [=====] - 0s 223us/step
Epoch 1/3
89/89 [=====] - 7s 76ms/step - loss: 403.5610 - acc: 0.0337
Epoch 2/3
89/89 [=====] - 0s 269us/step - loss: 392.4971 - acc: 0.0337
Epoch 3/3
89/89 [=====] - 0s 244us/step - loss: 381.6550 - acc: 0.0337

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23/23 [=====] - 3s 124ms/step
89/89 [=====] - 0s 210us/step
Epoch 1/3
89/89 [=====] - 7s 76ms/step - loss: 397.9191 - acc: 0.3820
Epoch 2/3
89/89 [=====] - 0s 258us/step - loss: 387.0182 - acc: 0.3820
Epoch 3/3
89/89 [=====] - 0s 266us/step - loss: 376.3394 - acc: 0.3933
23/23 [=====] - 3s 125ms/step
89/89 [=====] - 0s 190us/step
Epoch 1/3
89/89 [=====] - 7s 77ms/step - loss: 379.3118 - acc: 0.0225
Epoch 2/3
89/89 [=====] - 0s 248us/step - loss: 368.6829 - acc: 0.0562
Epoch 3/3
89/89 [=====] - 0s 253us/step - loss: 358.2752 - acc: 0.1011
23/23 [=====] - 3s 126ms/step
89/89 [=====] - 0s 246us/step
Epoch 1/3
89/89 [=====] - 7s 78ms/step - loss: 6.0955 - acc: 0.3596
Epoch 2/3
89/89 [=====] - 0s 259us/step - loss: 5.8988 - acc: 0.5843
Epoch 3/3
89/89 [=====] - 0s 254us/step - loss: 5.7108 - acc: 0.6854
23/23 [=====] - 3s 130ms/step
89/89 [=====] - 0s 210us/step
Epoch 1/3
89/89 [=====] - 7s 77ms/step - loss: 6.2471 - acc: 0.2697
Epoch 2/3
89/89 [=====] - 0s 271us/step - loss: 6.0426 - acc: 0.2584
Epoch 3/3
89/89 [=====] - 0s 241us/step - loss: 5.8341 - acc: 0.2472
23/23 [=====] - 3s 130ms/step
89/89 [=====] - 0s 204us/step
Epoch 1/3
89/89 [=====] - 7s 80ms/step - loss: 6.1064 - acc: 0.1910
Epoch 2/3
89/89 [=====] - 0s 259us/step - loss: 5.9073 - acc: 0.2022
Epoch 3/3
89/89 [=====] - 0s 254us/step - loss: 5.7181 - acc: 0.3708
23/23 [=====] - 3s 135ms/step
89/89 [=====] - 0s 200us/step
Epoch 1/3
89/89 [=====] - 7s 81ms/step - loss: 49.5766 - acc: 0.4045
Epoch 2/3
89/89 [=====] - 0s 284us/step - loss: 47.9170 - acc: 0.4045
Epoch 3/3
89/89 [=====] - 0s 245us/step - loss: 46.2998 - acc: 0.4494

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23/23 [=====] - 3s 137ms/step
89/89 [=====] - 0s 271us/step
Epoch 1/3
89/89 [=====] - 7s 82ms/step - loss: 49.3059 - acc: 0.5393
Epoch 2/3
89/89 [=====] - 0s 259us/step - loss: 47.6459 - acc: 0.6854
Epoch 3/3
89/89 [=====] - 0s 254us/step - loss: 46.0292 - acc: 0.7753
23/23 [=====] - 3s 137ms/step
89/89 [=====] - 0s 204us/step
Epoch 1/3
89/89 [=====] - 7s 81ms/step - loss: 49.3202 - acc: 0.3933
Epoch 2/3
89/89 [=====] - 0s 239us/step - loss: 47.6548 - acc: 0.3933
Epoch 3/3
89/89 [=====] - 0s 262us/step - loss: 46.0311 - acc: 0.4045
23/23 [=====] - 3s 135ms/step
89/89 [=====] - 0s 204us/step
Epoch 1/3
89/89 [=====] - 8s 85ms/step - loss: 504.1211 - acc: 0.0000e+00
Epoch 2/3
89/89 [=====] - 0s 256us/step - loss: 487.2725 - acc: 0.0000e+00
Epoch 3/3
89/89 [=====] - 0s 270us/step - loss: 470.8387 - acc: 0.0000e+00
23/23 [=====] - 3s 142ms/step
89/89 [=====] - 0s 215us/step
Epoch 1/3
89/89 [=====] - 8s 85ms/step - loss: 476.7736 - acc: 0.5056
Epoch 2/3
89/89 [=====] - 0s 255us/step - loss: 460.5021 - acc: 0.5169
Epoch 3/3
89/89 [=====] - 0s 234us/step - loss: 444.6443 - acc: 0.5506
23/23 [=====] - 3s 143ms/step
89/89 [=====] - 0s 219us/step
Epoch 1/3
89/89 [=====] - 8s 86ms/step - loss: 490.7238 - acc: 0.2472
Epoch 2/3
89/89 [=====] - 0s 294us/step - loss: 474.1329 - acc: 0.3258
Epoch 3/3
89/89 [=====] - 0s 250us/step - loss: 457.9556 - acc: 0.3933
23/23 [=====] - 3s 144ms/step
89/89 [=====] - 0s 225us/step
Epoch 1/3
89/89 [=====] - 8s 87ms/step - loss: 6.8858 - acc: 0.3820
Epoch 2/3
89/89 [=====] - 0s 265us/step - loss: 6.6013 - acc: 0.3820
Epoch 3/3
89/89 [=====] - 0s 255us/step - loss: 6.3301 - acc: 0.4045

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23/23 [=====] - 3s 146ms/step
89/89 [=====] - 0s 210us/step
Epoch 1/3
89/89 [=====] - 8s 88ms/step - loss: 6.9537 - acc: 0.2921
Epoch 2/3
89/89 [=====] - 0s 282us/step - loss: 6.6565 - acc: 0.6292
Epoch 3/3
89/89 [=====] - 0s 271us/step - loss: 6.3770 - acc: 0.7528
23/23 [=====] - 3s 148ms/step
89/89 [=====] - 0s 222us/step
Epoch 1/3
89/89 [=====] - 8s 90ms/step - loss: 6.9474 - acc: 0.1124
Epoch 2/3
89/89 [=====] - 0s 262us/step - loss: 6.6569 - acc: 0.2809
Epoch 3/3
89/89 [=====] - 0s 282us/step - loss: 6.3802 - acc: 0.6629
23/23 [=====] - 3s 150ms/step
89/89 [=====] - 0s 222us/step
Epoch 1/3
89/89 [=====] - 8s 91ms/step - loss: 59.5503 - acc: 0.0112
Epoch 2/3
89/89 [=====] - 0s 261us/step - loss: 57.0271 - acc: 0.0112
Epoch 3/3
89/89 [=====] - 0s 240us/step - loss: 54.5884 - acc: 0.0449
23/23 [=====] - 4s 155ms/step
89/89 [=====] - 0s 215us/step
Epoch 1/3
89/89 [=====] - 8s 92ms/step - loss: 60.0383 - acc: 0.5169
Epoch 2/3
89/89 [=====] - 0s 239us/step - loss: 57.5090 - acc: 0.6517
Epoch 3/3
89/89 [=====] - 0s 320us/step - loss: 55.0617 - acc: 0.6742
23/23 [=====] - 4s 154ms/step
89/89 [=====] - 0s 223us/step
Epoch 1/3
89/89 [=====] - 8s 93ms/step - loss: 58.0434 - acc: 0.3708
Epoch 2/3
89/89 [=====] - 0s 278us/step - loss: 55.5602 - acc: 0.3708
Epoch 3/3
89/89 [=====] - 0s 258us/step - loss: 53.1581 - acc: 0.5169
23/23 [=====] - 4s 155ms/step
89/89 [=====] - 0s 199us/step
Epoch 1/3
89/89 [=====] - 8s 94ms/step - loss: 566.3521 - acc: 0.2584
Epoch 2/3
89/89 [=====] - 0s 274us/step - loss: 541.8750 - acc: 0.2360
Epoch 3/3
89/89 [=====] - 0s 265us/step - loss: 518.1993 - acc: 0.2247

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23/23 [=====] - 4s 158ms/step
89/89 [=====] - 0s 203us/step
Epoch 1/3
89/89 [=====] - 9s 96ms/step - loss: 574.0309 - acc: 0.2584
Epoch 2/3
89/89 [=====] - 0s 264us/step - loss: 549.2567 - acc: 0.2584
Epoch 3/3
89/89 [=====] - 0s 277us/step - loss: 525.2840 - acc: 0.2921
23/23 [=====] - 4s 162ms/step
89/89 [=====] - 0s 220us/step
Epoch 1/3
89/89 [=====] - 8s 95ms/step - loss: 583.0833 - acc: 0.4382
Epoch 2/3
89/89 [=====] - 0s 272us/step - loss: 558.2449 - acc: 0.5506
Epoch 3/3
89/89 [=====] - 0s 280us/step - loss: 534.2027 - acc: 0.6180
23/23 [=====] - 4s 163ms/step
89/89 [=====] - 0s 235us/step
Epoch 1/3
89/89 [=====] - 9s 99ms/step - loss: 5.9514 - acc: 0.5843
Epoch 2/3
89/89 [=====] - 0s 269us/step - loss: 5.7563 - acc: 0.7978
Epoch 3/3
89/89 [=====] - 0s 256us/step - loss: 5.5666 - acc: 0.8202
23/23 [=====] - 4s 163ms/step
89/89 [=====] - 0s 239us/step
Epoch 1/3
89/89 [=====] - 9s 99ms/step - loss: 5.9808 - acc: 0.2921
Epoch 2/3
89/89 [=====] - 0s 239us/step - loss: 5.7761 - acc: 0.2809
Epoch 3/3
89/89 [=====] - 0s 293us/step - loss: 5.5816 - acc: 0.2809
23/23 [=====] - 4s 166ms/step
89/89 [=====] - 0s 219us/step
Epoch 1/3
89/89 [=====] - 9s 99ms/step - loss: 5.8533 - acc: 0.5056
Epoch 2/3
89/89 [=====] - 0s 257us/step - loss: 5.6630 - acc: 0.5393
Epoch 3/3
89/89 [=====] - 0s 280us/step - loss: 5.4770 - acc: 0.5843
23/23 [=====] - 4s 166ms/step
89/89 [=====] - 0s 208us/step
Epoch 1/3
89/89 [=====] - 9s 99ms/step - loss: 50.2220 - acc: 0.6966
Epoch 2/3
89/89 [=====] - 0s 260us/step - loss: 48.4941 - acc: 0.6966
Epoch 3/3
89/89 [=====] - 0s 253us/step - loss: 46.8111 - acc: 0.6966

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23/23 [=====] - 4s 169ms/step
89/89 [=====] - 0s 216us/step
Epoch 1/3
89/89 [=====] - 9s 101ms/step - loss: 51.2921 - acc: 0.4944
Epoch 2/3
89/89 [=====] - 0s 282us/step - loss: 49.5367 - acc: 0.4944
Epoch 3/3
89/89 [=====] - 0s 324us/step - loss: 47.8262 - acc: 0.5169
23/23 [=====] - 4s 174ms/step
89/89 [=====] - 0s 233us/step
Epoch 1/3
89/89 [=====] - 9s 102ms/step - loss: 49.7301 - acc: 0.4045
Epoch 2/3
89/89 [=====] - 0s 276us/step - loss: 48.0100 - acc: 0.4045
Epoch 3/3
89/89 [=====] - 0s 267us/step - loss: 46.3329 - acc: 0.4494
23/23 [=====] - 4s 170ms/step
89/89 [=====] - 0s 213us/step
Epoch 1/3
89/89 [=====] - 9s 103ms/step - loss: 490.7187 - acc: 0.0337
Epoch 2/3
89/89 [=====] - 0s 277us/step - loss: 473.5435 - acc: 0.0449
Epoch 3/3
89/89 [=====] - 0s 235us/step - loss: 456.8056 - acc: 0.0562
23/23 [=====] - 4s 171ms/step
89/89 [=====] - 0s 225us/step
Epoch 1/3
89/89 [=====] - 9s 105ms/step - loss: 492.8354 - acc: 0.4944
Epoch 2/3
89/89 [=====] - 0s 259us/step - loss: 475.6604 - acc: 0.4494
Epoch 3/3
89/89 [=====] - 0s 267us/step - loss: 458.9224 - acc: 0.4382
23/23 [=====] - 4s 175ms/step
89/89 [=====] - 0s 247us/step
Epoch 1/3
89/89 [=====] - 9s 104ms/step - loss: 476.9570 - acc: 0.3371
Epoch 2/3
89/89 [=====] - 0s 269us/step - loss: 460.0971 - acc: 0.4270
Epoch 3/3
89/89 [=====] - 0s 262us/step - loss: 443.6756 - acc: 0.5281
23/23 [=====] - 4s 177ms/step
89/89 [=====] - 0s 220us/step
Epoch 1/3
89/89 [=====] - 9s 106ms/step - loss: 8.2160 - acc: 0.3258
Epoch 2/3
89/89 [=====] - 0s 262us/step - loss: 7.8895 - acc: 0.3258
Epoch 3/3
89/89 [=====] - 0s 259us/step - loss: 7.5814 - acc: 0.3820

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23/23 [=====] - 4s 179ms/step
89/89 [=====] - 0s 192us/step
Epoch 1/3
89/89 [=====] - 10s 107ms/step - loss: 8.3146 - acc: 0.1573
Epoch 2/3
89/89 [=====] - 0s 282us/step - loss: 7.9795 - acc: 0.1685
Epoch 3/3
89/89 [=====] - 0s 271us/step - loss: 7.6644 - acc: 0.4719
23/23 [=====] - 4s 178ms/step
89/89 [=====] - 0s 221us/step
Epoch 1/3
89/89 [=====] - 10s 109ms/step - loss: 8.4007 - acc: 0.0787
Epoch 2/3
89/89 [=====] - 0s 282us/step - loss: 8.0747 - acc: 0.1348
Epoch 3/3
89/89 [=====] - 0s 294us/step - loss: 7.7646 - acc: 0.3146
23/23 [=====] - 4s 180ms/step
89/89 [=====] - 0s 195us/step
Epoch 1/3
89/89 [=====] - 10s 110ms/step - loss: 71.2085 - acc: 0.2697
Epoch 2/3
89/89 [=====] - 0s 290us/step - loss: 68.3765 - acc: 0.3596
Epoch 3/3
89/89 [=====] - 0s 282us/step - loss: 65.6310 - acc: 0.3708
23/23 [=====] - 4s 187ms/step
89/89 [=====] - 0s 218us/step
Epoch 1/3
89/89 [=====] - 10s 112ms/step - loss: 72.5369 - acc: 0.4270
Epoch 2/3
89/89 [=====] - 0s 320us/step - loss: 69.6707 - acc: 0.4157
Epoch 3/3
89/89 [=====] - 0s 292us/step - loss: 66.8886 - acc: 0.4944
23/23 [=====] - 4s 189ms/step
89/89 [=====] - 0s 195us/step
Epoch 1/3
89/89 [=====] - 10s 112ms/step - loss: 70.1219 - acc: 0.3034
Epoch 2/3
89/89 [=====] - 0s 264us/step - loss: 67.3081 - acc: 0.3820
Epoch 3/3
89/89 [=====] - 0s 280us/step - loss: 64.5796 - acc: 0.4719
23/23 [=====] - 4s 191ms/step
89/89 [=====] - 0s 227us/step
Epoch 1/3
89/89 [=====] - 10s 115ms/step - loss: 706.2439 - acc: 0.2921
Epoch 2/3
89/89 [=====] - 0s 286us/step - loss: 677.9546 - acc: 0.2809
Epoch 3/3
89/89 [=====] - 0s 275us/step - loss: 650.4995 - acc: 0.2584

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23/23 [=====] - 4s 195ms/step
89/89 [=====] - 0s 236us/step
Epoch 1/3
89/89 [=====] - 10s 116ms/step - loss: 700.9953 - acc: 0.2584
Epoch 2/3
89/89 [=====] - 0s 319us/step - loss: 672.9268 - acc: 0.3034
Epoch 3/3
89/89 [=====] - 0s 281us/step - loss: 645.6855 - acc: 0.3483
23/23 [=====] - 5s 196ms/step
89/89 [=====] - 0s 218us/step
Epoch 1/3
89/89 [=====] - 10s 118ms/step - loss: 707.3225 - acc: 0.3596
Epoch 2/3
89/89 [=====] - 0s 272us/step - loss: 679.0547 - acc: 0.5955
Epoch 3/3
89/89 [=====] - 0s 269us/step - loss: 651.6142 - acc: 0.6742
23/23 [=====] - 5s 197ms/step
89/89 [=====] - 0s 208us/step
Epoch 1/3
89/89 [=====] - 11s 119ms/step - loss: 10.4084 - acc: 0.4157
Epoch 2/3
89/89 [=====] - 0s 412us/step - loss: 9.9134 - acc: 0.6854
Epoch 3/3
89/89 [=====] - 0s 271us/step - loss: 9.4440 - acc: 0.7753
23/23 [=====] - 5s 198ms/step
89/89 [=====] - 0s 234us/step
Epoch 1/3
89/89 [=====] - 11s 118ms/step - loss: 10.1780 - acc: 0.3146
Epoch 2/3
89/89 [=====] - 0s 273us/step - loss: 9.6892 - acc: 0.5843
Epoch 3/3
89/89 [=====] - 0s 287us/step - loss: 9.2256 - acc: 0.7865
23/23 [=====] - 5s 199ms/step
89/89 [=====] - 0s 235us/step
Epoch 1/3
89/89 [=====] - 11s 120ms/step - loss: 10.3131 - acc: 0.3146
Epoch 2/3
89/89 [=====] - 0s 300us/step - loss: 9.8274 - acc: 0.5056
Epoch 3/3
89/89 [=====] - 0s 271us/step - loss: 9.3630 - acc: 0.7079
23/23 [=====] - 5s 201ms/step
89/89 [=====] - 0s 233us/step
Epoch 1/3
89/89 [=====] - 11s 121ms/step - loss: 93.5369 - acc: 0.2584
Epoch 2/3
89/89 [=====] - 0s 304us/step - loss: 89.0302 - acc: 0.3146
Epoch 3/3
89/89 [=====] - 0s 302us/step - loss: 84.6857 - acc: 0.3258

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23/23 [=====] - 5s 205ms/step
89/89 [=====] - 0s 209us/step
Epoch 1/3
89/89 [=====] - 11s 121ms/step - loss: 91.5665 - acc: 0.2809
Epoch 2/3
89/89 [=====] - 0s 328us/step - loss: 87.1212 - acc: 0.6067
Epoch 3/3
89/89 [=====] - 0s 278us/step - loss: 82.8383 - acc: 0.6966
23/23 [=====] - 5s 206ms/step
89/89 [=====] - 0s 241us/step
Epoch 1/3
89/89 [=====] - 11s 124ms/step - loss: 92.1815 - acc: 0.1573
Epoch 2/3
89/89 [=====] - 0s 279us/step - loss: 87.7145 - acc: 0.3146
Epoch 3/3
89/89 [=====] - 0s 280us/step - loss: 83.4116 - acc: 0.3708
23/23 [=====] - 5s 209ms/step
89/89 [=====] - 0s 224us/step
Epoch 1/3
89/89 [=====] - 11s 125ms/step - loss: 919.4947 - acc: 0.2135
Epoch 2/3
89/89 [=====] - 0s 310us/step - loss: 874.9552 - acc: 0.3596
Epoch 3/3
89/89 [=====] - 0s 262us/step - loss: 832.0112 - acc: 0.4494
23/23 [=====] - 5s 209ms/step
89/89 [=====] - 0s 288us/step
Epoch 1/3
89/89 [=====] - 11s 127ms/step - loss: 911.1712 - acc: 0.2697
Epoch 2/3
89/89 [=====] - 0s 315us/step - loss: 866.7516 - acc: 0.2921
Epoch 3/3
89/89 [=====] - 0s 288us/step - loss: 823.9315 - acc: 0.3146
23/23 [=====] - 5s 211ms/step
89/89 [=====] - 0s 237us/step
Epoch 1/3
89/89 [=====] - 11s 128ms/step - loss: 911.5024 - acc: 0.3708
Epoch 2/3
89/89 [=====] - 0s 274us/step - loss: 867.3004 - acc: 0.3820
Epoch 3/3
89/89 [=====] - 0s 266us/step - loss: 824.6886 - acc: 0.4719
23/23 [=====] - 5s 214ms/step
89/89 [=====] - 0s 246us/step
Epoch 1/3
89/89 [=====] - 11s 128ms/step - loss: 6.9263 - acc: 0.3933
Epoch 2/3
89/89 [=====] - 0s 272us/step - loss: 6.6354 - acc: 0.6404
Epoch 3/3
89/89 [=====] - 0s 273us/step - loss: 6.3566 - acc: 0.7079

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23/23 [=====] - 5s 215ms/step
89/89 [=====] - 0s 234us/step
Epoch 1/3
89/89 [=====] - 12s 130ms/step - loss: 6.9949 - acc: 0.2360
Epoch 2/3
89/89 [=====] - 0s 282us/step - loss: 6.6938 - acc: 0.3258
Epoch 3/3
89/89 [=====] - 0s 277us/step - loss: 6.4068 - acc: 0.6067
23/23 [=====] - 5s 217ms/step
89/89 [=====] - 0s 223us/step
Epoch 1/3
89/89 [=====] - 12s 130ms/step - loss: 7.0789 - acc: 0.3258
Epoch 2/3
89/89 [=====] - 0s 283us/step - loss: 6.7698 - acc: 0.3371
Epoch 3/3
89/89 [=====] - 0s 287us/step - loss: 6.4799 - acc: 0.3483
23/23 [=====] - 5s 221ms/step
89/89 [=====] - 0s 240us/step
Epoch 1/3
89/89 [=====] - 12s 132ms/step - loss: 59.0063 - acc: 0.1910
Epoch 2/3
89/89 [=====] - 0s 297us/step - loss: 56.3612 - acc: 0.2697
Epoch 3/3
89/89 [=====] - 0s 297us/step - loss: 53.8036 - acc: 0.3483
23/23 [=====] - 5s 216ms/step
89/89 [=====] - 0s 209us/step
Epoch 1/3
89/89 [=====] - 12s 130ms/step - loss: 57.9536 - acc: 0.3258
Epoch 2/3
89/89 [=====] - 0s 315us/step - loss: 55.3385 - acc: 0.3708
Epoch 3/3
89/89 [=====] - 0s 299us/step - loss: 52.8133 - acc: 0.4270
23/23 [=====] - 5s 222ms/step
89/89 [=====] - 0s 242us/step
Epoch 1/3
89/89 [=====] - 12s 133ms/step - loss: 60.3615 - acc: 0.1236
Epoch 2/3
89/89 [=====] - 0s 299us/step - loss: 57.6762 - acc: 0.1124
Epoch 3/3
89/89 [=====] - 0s 311us/step - loss: 55.0793 - acc: 0.0899
23/23 [=====] - 5s 226ms/step
89/89 [=====] - 0s 212us/step
Epoch 1/3
89/89 [=====] - 12s 134ms/step - loss: 572.2585 - acc: 0.2584
Epoch 2/3
89/89 [=====] - 0s 287us/step - loss: 546.0960 - acc: 0.2697
Epoch 3/3
89/89 [=====] - 0s 268us/step - loss: 520.8038 - acc: 0.2809

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23/23 [=====] - 5s 228ms/step
89/89 [=====] - 0s 255us/step
Epoch 1/3
89/89 [=====] - 12s 136ms/step - loss: 587.9951 - acc: 0.7079
Epoch 2/3
89/89 [=====] - 0s 285us/step - loss: 561.4574 - acc: 0.7416
Epoch 3/3
89/89 [=====] - 0s 288us/step - loss: 535.7923 - acc: 0.7640
23/23 [=====] - 5s 231ms/step
89/89 [=====] - 0s 240us/step
Epoch 1/3
89/89 [=====] - 12s 138ms/step - loss: 580.3548 - acc: 0.6292
Epoch 2/3
89/89 [=====] - 0s 268us/step - loss: 553.9786 - acc: 0.6517
Epoch 3/3
89/89 [=====] - 0s 251us/step - loss: 528.4734 - acc: 0.6966
23/23 [=====] - 5s 229ms/step
89/89 [=====] - 0s 219us/step
Epoch 1/3
89/89 [=====] - 12s 134ms/step - loss: 10.3674 - acc: 0.3820
Epoch 2/3
89/89 [=====] - 0s 339us/step - loss: 9.8702 - acc: 0.5056
Epoch 3/3
89/89 [=====] - 0s 266us/step - loss: 9.3996 - acc: 0.7640
23/23 [=====] - 5s 232ms/step
89/89 [=====] - 0s 240us/step
Epoch 1/3
89/89 [=====] - 12s 138ms/step - loss: 10.3583 - acc: 0.3708
Epoch 2/3
89/89 [=====] - 0s 296us/step - loss: 9.8667 - acc: 0.3708
Epoch 3/3
89/89 [=====] - 0s 320us/step - loss: 9.3949 - acc: 0.3933
23/23 [=====] - 5s 236ms/step
89/89 [=====] - 0s 237us/step
Epoch 1/3
89/89 [=====] - 13s 141ms/step - loss: 10.0002 - acc: 0.7978
Epoch 2/3
89/89 [=====] - 0s 288us/step - loss: 9.5287 - acc: 0.8315
Epoch 3/3
89/89 [=====] - 0s 274us/step - loss: 9.0736 - acc: 0.8315
23/23 [=====] - 6s 242ms/step
89/89 [=====] - 0s 237us/step
Epoch 1/3
89/89 [=====] - 13s 142ms/step - loss: 92.7048 - acc: 0.2472
Epoch 2/3
89/89 [=====] - 0s 283us/step - loss: 88.1391 - acc: 0.3034
Epoch 3/3
89/89 [=====] - 0s 307us/step - loss: 83.7413 - acc: 0.3596

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23/23 [=====] - 6s 242ms/step
89/89 [=====] - 0s 239us/step
Epoch 1/3
89/89 [=====] - 13s 145ms/step - loss: 92.7144 - acc: 0.2697
Epoch 2/3
89/89 [=====] - 0s 284us/step - loss: 88.1520 - acc: 0.3034
Epoch 3/3
89/89 [=====] - 0s 364us/step - loss: 83.7588 - acc: 0.3596
23/23 [=====] - 6s 244ms/step
89/89 [=====] - 0s 226us/step
Epoch 1/3
89/89 [=====] - 13s 146ms/step - loss: 91.3857 - acc: 0.4944
Epoch 2/3
89/89 [=====] - 0s 287us/step - loss: 86.8800 - acc: 0.5281
Epoch 3/3
89/89 [=====] - 0s 314us/step - loss: 82.5398 - acc: 0.5618
23/23 [=====] - 6s 246ms/step
89/89 [=====] - 0s 287us/step
Epoch 1/3
89/89 [=====] - 13s 145ms/step - loss: 936.9109 - acc: 0.4382
Epoch 2/3
89/89 [=====] - 0s 279us/step - loss: 890.7680 - acc: 0.4944
Epoch 3/3
89/89 [=====] - 0s 263us/step - loss: 846.2698 - acc: 0.5169
23/23 [=====] - 6s 250ms/step
89/89 [=====] - 0s 254us/step
Epoch 1/3
89/89 [=====] - 13s 149ms/step - loss: 928.9538 - acc: 0.4045
Epoch 2/3
89/89 [=====] - 0s 273us/step - loss: 883.1651 - acc: 0.4831
Epoch 3/3
89/89 [=====] - 0s 274us/step - loss: 839.0190 - acc: 0.5730
23/23 [=====] - 6s 251ms/step
89/89 [=====] - 0s 247us/step
Epoch 1/3
89/89 [=====] - 13s 149ms/step - loss: 912.4616 - acc: 0.3596
Epoch 2/3
89/89 [=====] - 0s 294us/step - loss: 867.1849 - acc: 0.3596
Epoch 3/3
89/89 [=====] - 0s 275us/step - loss: 823.5483 - acc: 0.4045
23/23 [=====] - 6s 251ms/step
89/89 [=====] - 0s 232us/step
Epoch 1/3
89/89 [=====] - 13s 150ms/step - loss: 14.4928 - acc: 0.5281
Epoch 2/3
89/89 [=====] - 0s 312us/step - loss: 13.6879 - acc: 0.5618
Epoch 3/3
89/89 [=====] - 0s 356us/step - loss: 12.9255 - acc: 0.7303

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23/23 [=====] - 6s 255ms/step
89/89 [=====] - 0s 256us/step
Epoch 1/3
89/89 [=====] - 13s 151ms/step - loss: 14.5229 - acc: 0.2809
Epoch 2/3
89/89 [=====] - 0s 298us/step - loss: 13.7018 - acc: 0.6629
Epoch 3/3
89/89 [=====] - 0s 266us/step - loss: 12.9263 - acc: 0.6966
23/23 [=====] - 6s 257ms/step
89/89 [=====] - 0s 245us/step
Epoch 1/3
89/89 [=====] - 13s 149ms/step - loss: 14.3658 - acc: 0.0000e+00
Epoch 2/3
89/89 [=====] - 0s 284us/step - loss: 13.5516 - acc: 0.4944
Epoch 3/3
89/89 [=====] - 0s 268us/step - loss: 12.7810 - acc: 0.6404
23/23 [=====] - 6s 258ms/step
89/89 [=====] - 0s 248us/step
Epoch 1/3
89/89 [=====] - 14s 153ms/step - loss: 136.2968 - acc: 0.3146
Epoch 2/3
89/89 [=====] - 0s 315us/step - loss: 128.5936 - acc: 0.4045
Epoch 3/3
89/89 [=====] - 0s 306us/step - loss: 121.2129 - acc: 0.5169
23/23 [=====] - 6s 262ms/step
89/89 [=====] - 0s 268us/step
Epoch 1/3
89/89 [=====] - 14s 155ms/step - loss: 134.2503 - acc: 0.2247
Epoch 2/3
89/89 [=====] - 0s 281us/step - loss: 126.6255 - acc: 0.2697
Epoch 3/3
89/89 [=====] - 0s 312us/step - loss: 119.3224 - acc: 0.3146
23/23 [=====] - 6s 265ms/step
89/89 [=====] - 0s 242us/step
Epoch 1/3
89/89 [=====] - 14s 156ms/step - loss: 135.0468 - acc: 0.4382
Epoch 2/3
89/89 [=====] - 0s 292us/step - loss: 127.3746 - acc: 0.5169
Epoch 3/3
89/89 [=====] - 0s 298us/step - loss: 120.0261 - acc: 0.5281
23/23 [=====] - 6s 269ms/step
89/89 [=====] - 0s 272us/step
Epoch 1/3
89/89 [=====] - 14s 158ms/step - loss: 1339.9556 - acc: 0.1461
Epoch 2/3
89/89 [=====] - 0s 326us/step - loss: 1263.7549 - acc: 0.3708
Epoch 3/3
89/89 [=====] - 0s 310us/step - loss: 1190.7271 - acc: 0.4831

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23/23 [=====] - 6s 270ms/step
89/89 [=====] - 0s 306us/step
Epoch 1/3
89/89 [=====] - 14s 158ms/step - loss: 1337.8854 - acc: 0.1798
Epoch 2/3
89/89 [=====] - 0s 294us/step - loss: 1261.8386 - acc: 0.3146
Epoch 3/3
89/89 [=====] - 0s 302us/step - loss: 1188.9585 - acc: 0.4944
23/23 [=====] - 6s 271ms/step
89/89 [=====] - 0s 263us/step
Epoch 1/3
89/89 [=====] - 14s 160ms/step - loss: 1351.3701 - acc: 0.1910
Epoch 2/3
89/89 [=====] - 0s 300us/step - loss: 1274.7673 - acc: 0.3933
Epoch 3/3
89/89 [=====] - 0s 294us/step - loss: 1201.3368 - acc: 0.5618
23/23 [=====] - 6s 270ms/step
89/89 [=====] - 0s 350us/step
Epoch 1/5
89/89 [=====] - 14s 161ms/step - loss: 4.9298 - acc: 0.3258
Epoch 2/5
89/89 [=====] - 0s 288us/step - loss: 4.8012 - acc: 0.3258
Epoch 3/5
89/89 [=====] - 0s 294us/step - loss: 4.6760 - acc: 0.3371
Epoch 4/5
89/89 [=====] - 0s 291us/step - loss: 4.5552 - acc: 0.3820
Epoch 5/5
89/89 [=====] - 0s 295us/step - loss: 4.4369 - acc: 0.4607
23/23 [=====] - 6s 275ms/step
89/89 [=====] - 0s 237us/step
Epoch 1/5
89/89 [=====] - 14s 162ms/step - loss: 4.9946 - acc: 0.2809
Epoch 2/5
89/89 [=====] - 0s 303us/step - loss: 4.8641 - acc: 0.2809
Epoch 3/5
89/89 [=====] - 0s 275us/step - loss: 4.7397 - acc: 0.2809
Epoch 4/5
89/89 [=====] - 0s 305us/step - loss: 4.6185 - acc: 0.2697
Epoch 5/5
89/89 [=====] - 0s 294us/step - loss: 4.5011 - acc: 0.2472
23/23 [=====] - 6s 276ms/step
89/89 [=====] - 0s 265us/step
Epoch 1/5
89/89 [=====] - 15s 163ms/step - loss: 4.9514 - acc: 0.1685
Epoch 2/5
89/89 [=====] - 0s 352us/step - loss: 4.8200 - acc: 0.3708
Epoch 3/5
89/89 [=====] - 0s 304us/step - loss: 4.6931 - acc: 0.5056

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Epoch 4/5
89/89 [=====] - 0s 305us/step - loss: 4.5706 - acc: 0.5730
Epoch 5/5
89/89 [=====] - 0s 310us/step - loss: 4.4529 - acc: 0.6517
23/23 [=====] - 6s 278ms/step
89/89 [=====] - 0s 240us/step
Epoch 1/5
89/89 [=====] - 15s 165ms/step - loss: 39.2483 - acc: 0.5506
Epoch 2/5
89/89 [=====] - 0s 302us/step - loss: 38.1675 - acc: 0.5843
Epoch 3/5
89/89 [=====] - 0s 302us/step - loss: 37.1088 - acc: 0.5843
Epoch 4/5
89/89 [=====] - 0s 295us/step - loss: 36.0743 - acc: 0.5843
Epoch 5/5
89/89 [=====] - 0s 299us/step - loss: 35.0633 - acc: 0.6067
23/23 [=====] - 6s 282ms/step
89/89 [=====] - 0s 232us/step
Epoch 1/5
89/89 [=====] - 15s 166ms/step - loss: 40.2688 - acc: 0.4270
Epoch 2/5
89/89 [=====] - 0s 294us/step - loss: 39.1898 - acc: 0.4494
Epoch 3/5
89/89 [=====] - 0s 283us/step - loss: 38.1325 - acc: 0.4944
Epoch 4/5
89/89 [=====] - 0s 287us/step - loss: 37.0997 - acc: 0.5393
Epoch 5/5
89/89 [=====] - 0s 290us/step - loss: 36.0893 - acc: 0.5730
23/23 [=====] - 7s 287ms/step
89/89 [=====] - 0s 258us/step
Epoch 1/5
89/89 [=====] - 15s 168ms/step - loss: 40.6417 - acc: 0.5618
Epoch 2/5
89/89 [=====] - 0s 304us/step - loss: 39.5392 - acc: 0.6404
Epoch 3/5
89/89 [=====] - 0s 318us/step - loss: 38.4602 - acc: 0.6854
Epoch 4/5
89/89 [=====] - 0s 310us/step - loss: 37.4037 - acc: 0.7528
Epoch 5/5
89/89 [=====] - 0s 309us/step - loss: 36.3711 - acc: 0.7753
23/23 [=====] - 7s 285ms/step
89/89 [=====] - 0s 270us/step
Epoch 1/5
89/89 [=====] - 15s 169ms/step - loss: 394.6681 - acc: 0.1124
Epoch 2/5
89/89 [=====] - 0s 387us/step - loss: 383.8369 - acc: 0.1124
Epoch 3/5
89/89 [=====] - 0s 298us/step - loss: 373.2257 - acc: 0.1124

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Epoch 4/5
89/89 [=====] - 0s 302us/step - loss: 362.8459 - acc: 0.1124
Epoch 5/5
89/89 [=====] - 0s 295us/step - loss: 352.6995 - acc: 0.1124
23/23 [=====] - 7s 291ms/step
89/89 [=====] - 0s 313us/step
Epoch 1/5
89/89 [=====] - 15s 171ms/step - loss: 377.7807 - acc: 0.2921
Epoch 2/5
89/89 [=====] - 0s 314us/step - loss: 367.1663 - acc: 0.2809
Epoch 3/5
89/89 [=====] - 0s 301us/step - loss: 356.7742 - acc: 0.2809
Epoch 4/5
89/89 [=====] - 0s 330us/step - loss: 346.6072 - acc: 0.3146
Epoch 5/5
89/89 [=====] - 0s 330us/step - loss: 336.6681 - acc: 0.3258
23/23 [=====] - 7s 287ms/step
89/89 [=====] - 0s 225us/step
Epoch 1/5
89/89 [=====] - 15s 171ms/step - loss: 395.1120 - acc: 0.3596
Epoch 2/5
89/89 [=====] - 0s 300us/step - loss: 384.1709 - acc: 0.3596
Epoch 3/5
89/89 [=====] - 0s 324us/step - loss: 373.4516 - acc: 0.3596
Epoch 4/5
89/89 [=====] - 0s 315us/step - loss: 362.9588 - acc: 0.3596
Epoch 5/5
89/89 [=====] - 0s 313us/step - loss: 352.6991 - acc: 0.3708
23/23 [=====] - 7s 296ms/step
89/89 [=====] - 0s 258us/step
Epoch 1/5
89/89 [=====] - 15s 172ms/step - loss: 5.8666 - acc: 0.6404
Epoch 2/5
89/89 [=====] - 0s 300us/step - loss: 5.6769 - acc: 0.6966
Epoch 3/5
89/89 [=====] - 0s 312us/step - loss: 5.4964 - acc: 0.6966
Epoch 4/5
89/89 [=====] - 0s 291us/step - loss: 5.3203 - acc: 0.6966
Epoch 5/5
89/89 [=====] - 0s 288us/step - loss: 5.1489 - acc: 0.6966
23/23 [=====] - 7s 297ms/step
89/89 [=====] - 0s 235us/step
Epoch 1/5
89/89 [=====] - 16s 176ms/step - loss: 5.9026 - acc: 0.3258
Epoch 2/5
89/89 [=====] - 0s 323us/step - loss: 5.7177 - acc: 0.3258
Epoch 3/5
89/89 [=====] - 0s 306us/step - loss: 5.5405 - acc: 0.4045

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Epoch 4/5
89/89 [=====] - 0s 286us/step - loss: 5.3679 - acc: 0.5056
Epoch 5/5
89/89 [=====] - 0s 281us/step - loss: 5.2024 - acc: 0.5843
23/23 [=====] - 7s 300ms/step
89/89 [=====] - 0s 257us/step
Epoch 1/5
89/89 [=====] - 16s 176ms/step - loss: 6.1662 - acc: 0.0112
Epoch 2/5
89/89 [=====] - 0s 316us/step - loss: 5.9642 - acc: 0.0449
Epoch 3/5
89/89 [=====] - 0s 308us/step - loss: 5.7715 - acc: 0.0899
Epoch 4/5
89/89 [=====] - 0s 327us/step - loss: 5.5862 - acc: 0.3371
Epoch 5/5
89/89 [=====] - 0s 332us/step - loss: 5.4091 - acc: 0.5843
23/23 [=====] - 7s 302ms/step
89/89 [=====] - 0s 261us/step
Epoch 1/5
89/89 [=====] - 16s 178ms/step - loss: 50.2205 - acc: 0.0899
Epoch 2/5
89/89 [=====] - 0s 298us/step - loss: 48.5333 - acc: 0.0899
Epoch 3/5
89/89 [=====] - 0s 281us/step - loss: 46.8885 - acc: 0.0899
Epoch 4/5
89/89 [=====] - 0s 378us/step - loss: 45.2880 - acc: 0.0787
Epoch 5/5
89/89 [=====] - 0s 334us/step - loss: 43.7332 - acc: 0.1011
23/23 [=====] - 7s 306ms/step
89/89 [=====] - 0s 251us/step
Epoch 1/5
89/89 [=====] - 16s 178ms/step - loss: 50.6380 - acc: 0.3258
Epoch 2/5
89/89 [=====] - 0s 288us/step - loss: 48.9481 - acc: 0.3820
Epoch 3/5
89/89 [=====] - 0s 374us/step - loss: 47.3022 - acc: 0.4944
Epoch 4/5
89/89 [=====] - 0s 364us/step - loss: 45.6989 - acc: 0.6517
Epoch 5/5
89/89 [=====] - 0s 352us/step - loss: 44.1396 - acc: 0.7416
23/23 [=====] - 7s 308ms/step
89/89 [=====] - 0s 332us/step
Epoch 1/5
89/89 [=====] - 16s 181ms/step - loss: 51.2783 - acc: 0.2809
Epoch 2/5
89/89 [=====] - 0s 305us/step - loss: 49.5789 - acc: 0.2697
Epoch 3/5
89/89 [=====] - 0s 298us/step - loss: 47.9228 - acc: 0.2472

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Epoch 4/5
89/89 [=====] - 0s 288us/step - loss: 46.3096 - acc: 0.2472
Epoch 5/5
89/89 [=====] - 0s 305us/step - loss: 44.7412 - acc: 0.2135
23/23 [=====] - 7s 306ms/step
89/89 [=====] - 0s 247us/step
Epoch 1/5
89/89 [=====] - 16s 183ms/step - loss: 493.7790 - acc: 0.2809
Epoch 2/5
89/89 [=====] - 0s 290us/step - loss: 477.1114 - acc: 0.2809
Epoch 3/5
89/89 [=====] - 0s 290us/step - loss: 460.8602 - acc: 0.3034
Epoch 4/5
89/89 [=====] - 0s 309us/step - loss: 445.0352 - acc: 0.3034
Epoch 5/5
89/89 [=====] - 0s 312us/step - loss: 429.6432 - acc: 0.3034
23/23 [=====] - 7s 315ms/step
89/89 [=====] - 0s 271us/step
Epoch 1/5
89/89 [=====] - 16s 181ms/step - loss: 502.8830 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 318us/step - loss: 485.9961 - acc: 0.3708
Epoch 3/5
89/89 [=====] - 0s 311us/step - loss: 469.5241 - acc: 0.3708
Epoch 4/5
89/89 [=====] - 0s 296us/step - loss: 453.4799 - acc: 0.3708
Epoch 5/5
89/89 [=====] - 0s 309us/step - loss: 437.8690 - acc: 0.3708
23/23 [=====] - 7s 314ms/step
89/89 [=====] - 0s 258us/step
Epoch 1/5
89/89 [=====] - 16s 185ms/step - loss: 507.0337 - acc: 0.0674
Epoch 2/5
89/89 [=====] - 0s 314us/step - loss: 490.1033 - acc: 0.0562
Epoch 3/5
89/89 [=====] - 0s 342us/step - loss: 473.5894 - acc: 0.1685
Epoch 4/5
89/89 [=====] - 0s 364us/step - loss: 457.5035 - acc: 0.2247
Epoch 5/5
89/89 [=====] - 0s 339us/step - loss: 441.8480 - acc: 0.3146
23/23 [=====] - 7s 318ms/step
89/89 [=====] - 0s 253us/step
Epoch 1/5
89/89 [=====] - 16s 184ms/step - loss: 6.8071 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 299us/step - loss: 6.5179 - acc: 0.3820
Epoch 3/5
89/89 [=====] - 0s 293us/step - loss: 6.2412 - acc: 0.5955

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Epoch 4/5
89/89 [=====] - 0s 294us/step - loss: 5.9767 - acc: 0.6742
Epoch 5/5
89/89 [=====] - 0s 295us/step - loss: 5.7271 - acc: 0.6966
23/23 [=====] - 7s 318ms/step
89/89 [=====] - 0s 304us/step
Epoch 1/5
89/89 [=====] - 17s 188ms/step - loss: 6.7919 - acc: 0.3820
Epoch 2/5
89/89 [=====] - 0s 312us/step - loss: 6.5069 - acc: 0.5618
Epoch 3/5
89/89 [=====] - 0s 303us/step - loss: 6.2381 - acc: 0.6966
Epoch 4/5
89/89 [=====] - 0s 310us/step - loss: 5.9754 - acc: 0.7528
Epoch 5/5
89/89 [=====] - 0s 337us/step - loss: 5.7288 - acc: 0.7753
23/23 [=====] - 7s 321ms/step
89/89 [=====] - 0s 275us/step
Epoch 1/5
89/89 [=====] - 17s 189ms/step - loss: 6.8340 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 313us/step - loss: 6.5560 - acc: 0.3708
Epoch 3/5
89/89 [=====] - 0s 291us/step - loss: 6.2875 - acc: 0.3708
Epoch 4/5
89/89 [=====] - 0s 314us/step - loss: 6.0302 - acc: 0.5056
Epoch 5/5
89/89 [=====] - 0s 321us/step - loss: 5.7865 - acc: 0.7079
23/23 [=====] - 7s 320ms/step
89/89 [=====] - 0s 268us/step
Epoch 1/5
89/89 [=====] - 17s 188ms/step - loss: 57.1509 - acc: 0.4382
Epoch 2/5
89/89 [=====] - 0s 321us/step - loss: 54.6843 - acc: 0.5281
Epoch 3/5
89/89 [=====] - 0s 276us/step - loss: 52.2976 - acc: 0.5506
Epoch 4/5
89/89 [=====] - 0s 325us/step - loss: 49.9974 - acc: 0.5618
Epoch 5/5
89/89 [=====] - 0s 289us/step - loss: 47.7773 - acc: 0.7079
23/23 [=====] - 8s 327ms/step
89/89 [=====] - 0s 284us/step
Epoch 1/5
89/89 [=====] - 17s 193ms/step - loss: 58.3664 - acc: 0.7191
Epoch 2/5
89/89 [=====] - 0s 303us/step - loss: 55.8875 - acc: 0.7753
Epoch 3/5
89/89 [=====] - 0s 313us/step - loss: 53.4909 - acc: 0.7753

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Epoch 4/5
89/89 [=====] - 0s 314us/step - loss: 51.1772 - acc: 0.7753
Epoch 5/5
89/89 [=====] - 0s 320us/step - loss: 48.9475 - acc: 0.7978
23/23 [=====] - 8s 331ms/step
89/89 [=====] - 0s 256us/step
Epoch 1/5
89/89 [=====] - 17s 193ms/step - loss: 59.1231 - acc: 0.5618
Epoch 2/5
89/89 [=====] - 0s 357us/step - loss: 56.6085 - acc: 0.5955
Epoch 3/5
89/89 [=====] - 0s 336us/step - loss: 54.1755 - acc: 0.6067
Epoch 4/5
89/89 [=====] - 0s 353us/step - loss: 51.8258 - acc: 0.7079
Epoch 5/5
89/89 [=====] - 0s 436us/step - loss: 49.5595 - acc: 0.8539
23/23 [=====] - 8s 331ms/step
89/89 [=====] - 0s 272us/step
Epoch 1/5
89/89 [=====] - 17s 196ms/step - loss: 569.6352 - acc: 0.3146
Epoch 2/5
89/89 [=====] - 0s 345us/step - loss: 545.0730 - acc: 0.3371
Epoch 3/5
89/89 [=====] - 0s 325us/step - loss: 521.3104 - acc: 0.3483
Epoch 4/5
89/89 [=====] - 0s 294us/step - loss: 498.3614 - acc: 0.3596
Epoch 5/5
89/89 [=====] - 0s 345us/step - loss: 476.2331 - acc: 0.3708
23/23 [=====] - 8s 335ms/step
89/89 [=====] - 0s 252us/step
Epoch 1/5
89/89 [=====] - 18s 197ms/step - loss: 575.8950 - acc: 0.3820
Epoch 2/5
89/89 [=====] - 0s 313us/step - loss: 551.0154 - acc: 0.3933
Epoch 3/5
89/89 [=====] - 0s 300us/step - loss: 526.9360 - acc: 0.4607
Epoch 4/5
89/89 [=====] - 0s 311us/step - loss: 503.6723 - acc: 0.5393
Epoch 5/5
89/89 [=====] - 0s 294us/step - loss: 481.2319 - acc: 0.6854
23/23 [=====] - 8s 332ms/step
89/89 [=====] - 0s 251us/step
Epoch 1/5
89/89 [=====] - 17s 196ms/step - loss: 580.7730 - acc: 0.3371
Epoch 2/5
89/89 [=====] - 0s 354us/step - loss: 555.8821 - acc: 0.5955
Epoch 3/5
89/89 [=====] - 0s 313us/step - loss: 531.7910 - acc: 0.6966

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Epoch 4/5
89/89 [=====] - 0s 343us/step - loss: 508.5130 - acc: 0.6966
Epoch 5/5
89/89 [=====] - 0s 311us/step - loss: 486.0570 - acc: 0.6966
23/23 [=====] - 8s 340ms/step
89/89 [=====] - 0s 265us/step
Epoch 1/5
89/89 [=====] - 18s 199ms/step - loss: 6.3584 - acc: 0.1910
Epoch 2/5
89/89 [=====] - 0s 312us/step - loss: 6.1384 - acc: 0.1910
Epoch 3/5
89/89 [=====] - 0s 284us/step - loss: 5.9267 - acc: 0.2472
Epoch 4/5
89/89 [=====] - 0s 303us/step - loss: 5.7282 - acc: 0.4719
Epoch 5/5
89/89 [=====] - 0s 322us/step - loss: 5.5369 - acc: 0.7079
23/23 [=====] - 8s 340ms/step
89/89 [=====] - 0s 271us/step
Epoch 1/5
89/89 [=====] - 18s 200ms/step - loss: 6.1413 - acc: 0.1685
Epoch 2/5
89/89 [=====] - 0s 322us/step - loss: 5.9404 - acc: 0.2584
Epoch 3/5
89/89 [=====] - 0s 332us/step - loss: 5.7475 - acc: 0.3146
Epoch 4/5
89/89 [=====] - 0s 300us/step - loss: 5.5652 - acc: 0.3708
Epoch 5/5
89/89 [=====] - 0s 295us/step - loss: 5.3885 - acc: 0.5393
23/23 [=====] - 8s 345ms/step
89/89 [=====] - 0s 341us/step
Epoch 1/5
89/89 [=====] - 18s 202ms/step - loss: 6.0546 - acc: 0.6854
Epoch 2/5
89/89 [=====] - 0s 333us/step - loss: 5.8562 - acc: 0.6966
Epoch 3/5
89/89 [=====] - 0s 310us/step - loss: 5.6641 - acc: 0.6966
Epoch 4/5
89/89 [=====] - 0s 339us/step - loss: 5.4800 - acc: 0.6966
Epoch 5/5
89/89 [=====] - 0s 319us/step - loss: 5.3014 - acc: 0.6966
23/23 [=====] - 8s 346ms/step
89/89 [=====] - 0s 277us/step
Epoch 1/5
89/89 [=====] - 18s 203ms/step - loss: 50.7050 - acc: 0.3258
Epoch 2/5
89/89 [=====] - 0s 315us/step - loss: 48.9634 - acc: 0.3371
Epoch 3/5
89/89 [=====] - 0s 311us/step - loss: 47.2665 - acc: 0.3820

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Epoch 4/5
89/89 [=====] - 0s 304us/step - loss: 45.6151 - acc: 0.4719
Epoch 5/5
89/89 [=====] - 0s 336us/step - loss: 44.0102 - acc: 0.5506
23/23 [=====] - 8s 348ms/step
89/89 [=====] - 0s 278us/step
Epoch 1/5
89/89 [=====] - 18s 204ms/step - loss: 50.2931 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 332us/step - loss: 48.5548 - acc: 0.4270
Epoch 3/5
89/89 [=====] - 0s 332us/step - loss: 46.8619 - acc: 0.4944
Epoch 4/5
89/89 [=====] - 0s 317us/step - loss: 45.2149 - acc: 0.5506
Epoch 5/5
89/89 [=====] - 0s 320us/step - loss: 43.6145 - acc: 0.6180
23/23 [=====] - 8s 352ms/step
89/89 [=====] - 0s 309us/step
Epoch 1/5
89/89 [=====] - 18s 206ms/step - loss: 50.8862 - acc: 0.5618
Epoch 2/5
89/89 [=====] - 0s 312us/step - loss: 49.1450 - acc: 0.5506
Epoch 3/5
89/89 [=====] - 0s 308us/step - loss: 47.4493 - acc: 0.5730
Epoch 4/5
89/89 [=====] - 0s 309us/step - loss: 45.7993 - acc: 0.5730
Epoch 5/5
89/89 [=====] - 0s 322us/step - loss: 44.1960 - acc: 0.5506
23/23 [=====] - 8s 347ms/step
89/89 [=====] - 0s 234us/step
Epoch 1/5
89/89 [=====] - 18s 205ms/step - loss: 488.3988 - acc: 0.3933
Epoch 2/5
89/89 [=====] - 0s 300us/step - loss: 471.2844 - acc: 0.3933
Epoch 3/5
89/89 [=====] - 0s 308us/step - loss: 454.6112 - acc: 0.4382
Epoch 4/5
89/89 [=====] - 0s 309us/step - loss: 438.3870 - acc: 0.5169
Epoch 5/5
89/89 [=====] - 0s 341us/step - loss: 422.6199 - acc: 0.6067
23/23 [=====] - 8s 356ms/step
89/89 [=====] - 0s 259us/step
Epoch 1/5
89/89 [=====] - 19s 208ms/step - loss: 497.3844 - acc: 0.1573
Epoch 2/5
89/89 [=====] - 0s 319us/step - loss: 480.0980 - acc: 0.2472
Epoch 3/5
89/89 [=====] - 0s 307us/step - loss: 463.2521 - acc: 0.3483

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Epoch 4/5
89/89 [=====] - 0s 301us/step - loss: 446.8543 - acc: 0.4607
Epoch 5/5
89/89 [=====] - 0s 326us/step - loss: 430.9127 - acc: 0.5169
23/23 [=====] - 8s 360ms/step
89/89 [=====] - 0s 232us/step
Epoch 1/5
89/89 [=====] - 19s 210ms/step - loss: 496.6739 - acc: 0.0225
Epoch 2/5
89/89 [=====] - 0s 324us/step - loss: 479.4258 - acc: 0.0112
Epoch 3/5
89/89 [=====] - 0s 307us/step - loss: 462.6169 - acc: 0.0112
Epoch 4/5
89/89 [=====] - 0s 313us/step - loss: 446.2561 - acc: 0.0112
Epoch 5/5
89/89 [=====] - 0s 345us/step - loss: 430.3513 - acc: 0.0112
23/23 [=====] - 8s 359ms/step
89/89 [=====] - 0s 243us/step
Epoch 1/5
89/89 [=====] - 19s 211ms/step - loss: 8.2789 - acc: 0.1910
Epoch 2/5
89/89 [=====] - 0s 322us/step - loss: 7.9694 - acc: 0.3596
Epoch 3/5
89/89 [=====] - 0s 333us/step - loss: 7.6715 - acc: 0.5056
Epoch 4/5
89/89 [=====] - 0s 294us/step - loss: 7.3849 - acc: 0.6404
Epoch 5/5
89/89 [=====] - 0s 311us/step - loss: 7.1096 - acc: 0.6966
23/23 [=====] - 8s 362ms/step
89/89 [=====] - 0s 240us/step
Epoch 1/5
89/89 [=====] - 19s 211ms/step - loss: 8.1667 - acc: 0.6180
Epoch 2/5
89/89 [=====] - 0s 324us/step - loss: 7.8614 - acc: 0.6966
Epoch 3/5
89/89 [=====] - 0s 304us/step - loss: 7.5669 - acc: 0.7303
Epoch 4/5
89/89 [=====] - 0s 316us/step - loss: 7.2814 - acc: 0.7416
Epoch 5/5
89/89 [=====] - 0s 377us/step - loss: 7.0071 - acc: 0.7528
23/23 [=====] - 8s 363ms/step
89/89 [=====] - 0s 263us/step
Epoch 1/5
89/89 [=====] - 19s 214ms/step - loss: 8.2482 - acc: 0.0674
Epoch 2/5
89/89 [=====] - 0s 306us/step - loss: 7.9231 - acc: 0.1348
Epoch 3/5
89/89 [=====] - 0s 303us/step - loss: 7.6156 - acc: 0.2472

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Epoch 4/5
89/89 [=====] - 0s 312us/step - loss: 7.3209 - acc: 0.5730
Epoch 5/5
89/89 [=====] - 0s 333us/step - loss: 7.0377 - acc: 0.6742
23/23 [=====] - 9s 370ms/step
89/89 [=====] - 0s 271us/step
Epoch 1/5
89/89 [=====] - 19s 215ms/step - loss: 70.2837 - acc: 0.3034
Epoch 2/5
89/89 [=====] - 0s 323us/step - loss: 67.4653 - acc: 0.3820
Epoch 3/5
89/89 [=====] - 0s 366us/step - loss: 64.7334 - acc: 0.4494
Epoch 4/5
89/89 [=====] - 0s 363us/step - loss: 62.0873 - acc: 0.5056
Epoch 5/5
89/89 [=====] - 0s 324us/step - loss: 59.5280 - acc: 0.5955
23/23 [=====] - 9s 373ms/step
89/89 [=====] - 0s 255us/step
Epoch 1/5
89/89 [=====] - 19s 217ms/step - loss: 73.8053 - acc: 0.3371
Epoch 2/5
89/89 [=====] - 0s 310us/step - loss: 70.8996 - acc: 0.3596
Epoch 3/5
89/89 [=====] - 0s 316us/step - loss: 68.0785 - acc: 0.4045
Epoch 4/5
89/89 [=====] - 0s 324us/step - loss: 65.3430 - acc: 0.4382
Epoch 5/5
89/89 [=====] - 0s 345us/step - loss: 62.6961 - acc: 0.4270
23/23 [=====] - 9s 374ms/step
89/89 [=====] - 0s 270us/step
Epoch 1/5
89/89 [=====] - 19s 217ms/step - loss: 69.3759 - acc: 0.5618
Epoch 2/5
89/89 [=====] - 0s 346us/step - loss: 66.5956 - acc: 0.5393
Epoch 3/5
89/89 [=====] - 0s 331us/step - loss: 63.8995 - acc: 0.5393
Epoch 4/5
89/89 [=====] - 0s 310us/step - loss: 61.2890 - acc: 0.6067
Epoch 5/5
89/89 [=====] - 0s 336us/step - loss: 58.7643 - acc: 0.6854
23/23 [=====] - 9s 376ms/step
89/89 [=====] - 0s 307us/step
Epoch 1/5
89/89 [=====] - 20s 220ms/step - loss: 722.2447 - acc: 0.3596
Epoch 2/5
89/89 [=====] - 0s 344us/step - loss: 693.6253 - acc: 0.5730
Epoch 3/5
89/89 [=====] - 0s 330us/step - loss: 665.8301 - acc: 0.6517

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Epoch 4/5
89/89 [=====] - 0s 302us/step - loss: 638.8792 - acc: 0.7528
Epoch 5/5
89/89 [=====] - 0s 359us/step - loss: 612.7819 - acc: 0.7640
23/23 [=====] - 9s 383ms/step
89/89 [=====] - 0s 262us/step
Epoch 1/5
89/89 [=====] - 20s 221ms/step - loss: 715.7813 - acc: 0.1910
Epoch 2/5
89/89 [=====] - 0s 338us/step - loss: 687.3902 - acc: 0.3034
Epoch 3/5
89/89 [=====] - 0s 336us/step - loss: 659.8243 - acc: 0.5393
Epoch 4/5
89/89 [=====] - 0s 313us/step - loss: 633.1035 - acc: 0.6180
Epoch 5/5
89/89 [=====] - 0s 334us/step - loss: 607.2365 - acc: 0.7079
23/23 [=====] - 9s 377ms/step
89/89 [=====] - 0s 286us/step
Epoch 1/5
89/89 [=====] - 20s 222ms/step - loss: 702.4435 - acc: 0.1348
Epoch 2/5
89/89 [=====] - 0s 395us/step - loss: 674.3320 - acc: 0.2022
Epoch 3/5
89/89 [=====] - 0s 410us/step - loss: 647.0461 - acc: 0.3258
Epoch 4/5
89/89 [=====] - 0s 373us/step - loss: 620.6028 - acc: 0.5281
Epoch 5/5
89/89 [=====] - 0s 331us/step - loss: 595.0127 - acc: 0.6292
23/23 [=====] - 9s 389ms/step
89/89 [=====] - 0s 285us/step
Epoch 1/5
89/89 [=====] - 20s 225ms/step - loss: 10.2543 - acc: 0.4045
Epoch 2/5
89/89 [=====] - 0s 323us/step - loss: 9.7725 - acc: 0.5393
Epoch 3/5
89/89 [=====] - 0s 322us/step - loss: 9.3092 - acc: 0.6404
Epoch 4/5
89/89 [=====] - 0s 361us/step - loss: 8.8670 - acc: 0.6966
Epoch 5/5
89/89 [=====] - 0s 367us/step - loss: 8.4461 - acc: 0.7303
23/23 [=====] - 9s 387ms/step
89/89 [=====] - 0s 311us/step
Epoch 1/5
89/89 [=====] - 20s 226ms/step - loss: 10.0104 - acc: 0.7191
Epoch 2/5
89/89 [=====] - 0s 347us/step - loss: 9.5369 - acc: 0.7303
Epoch 3/5
89/89 [=====] - 0s 352us/step - loss: 9.0899 - acc: 0.7416

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Epoch 4/5
89/89 [=====] - 0s 311us/step - loss: 8.6596 - acc: 0.7416
Epoch 5/5
89/89 [=====] - 0s 351us/step - loss: 8.2479 - acc: 0.7528
23/23 [=====] - 9s 391ms/step
89/89 [=====] - 0s 273us/step
Epoch 1/5
89/89 [=====] - 20s 226ms/step - loss: 10.0367 - acc: 0.1798
Epoch 2/5
89/89 [=====] - 0s 332us/step - loss: 9.5492 - acc: 0.3371
Epoch 3/5
89/89 [=====] - 0s 319us/step - loss: 9.0885 - acc: 0.6180
Epoch 4/5
89/89 [=====] - 0s 337us/step - loss: 8.6495 - acc: 0.6854
Epoch 5/5
89/89 [=====] - 0s 334us/step - loss: 8.2319 - acc: 0.6854
23/23 [=====] - 9s 390ms/step
89/89 [=====] - 0s 283us/step
Epoch 1/5
89/89 [=====] - 20s 229ms/step - loss: 92.2157 - acc: 0.4382
Epoch 2/5
89/89 [=====] - 0s 439us/step - loss: 87.7511 - acc: 0.4157
Epoch 3/5
89/89 [=====] - 0s 335us/step - loss: 83.4509 - acc: 0.4157
Epoch 4/5
89/89 [=====] - 0s 325us/step - loss: 79.3168 - acc: 0.4831
Epoch 5/5
89/89 [=====] - 0s 348us/step - loss: 75.3455 - acc: 0.5955
23/23 [=====] - 9s 390ms/step
89/89 [=====] - 0s 290us/step
Epoch 1/5
89/89 [=====] - 21s 231ms/step - loss: 92.2786 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 327us/step - loss: 87.8246 - acc: 0.3708
Epoch 3/5
89/89 [=====] - 0s 332us/step - loss: 83.5361 - acc: 0.3708
Epoch 4/5
89/89 [=====] - 0s 348us/step - loss: 79.4101 - acc: 0.3820
Epoch 5/5
89/89 [=====] - 0s 355us/step - loss: 75.4486 - acc: 0.4270
23/23 [=====] - 9s 395ms/step
89/89 [=====] - 0s 287us/step
Epoch 1/5
89/89 [=====] - 21s 234ms/step - loss: 93.1513 - acc: 0.3258
Epoch 2/5
89/89 [=====] - 0s 344us/step - loss: 88.6502 - acc: 0.3258
Epoch 3/5
89/89 [=====] - 0s 335us/step - loss: 84.3150 - acc: 0.4382

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Epoch 4/5
89/89 [=====] - 0s 367us/step - loss: 80.1441 - acc: 0.5281
Epoch 5/5
89/89 [=====] - 0s 316us/step - loss: 76.1416 - acc: 0.5955
23/23 [=====] - 9s 397ms/step
89/89 [=====] - 0s 297us/step
Epoch 1/5
89/89 [=====] - 21s 235ms/step - loss: 909.3869 - acc: 0.4944
Epoch 2/5
89/89 [=====] - 0s 331us/step - loss: 865.3027 - acc: 0.6629
Epoch 3/5
89/89 [=====] - 0s 331us/step - loss: 822.8102 - acc: 0.7416
Epoch 4/5
89/89 [=====] - 0s 305us/step - loss: 781.9336 - acc: 0.7753
Epoch 5/5
89/89 [=====] - 0s 330us/step - loss: 742.6802 - acc: 0.8427
23/23 [=====] - 9s 399ms/step
89/89 [=====] - 0s 281us/step
Epoch 1/5
89/89 [=====] - 21s 238ms/step - loss: 917.4466 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 327us/step - loss: 872.8936 - acc: 0.3708
Epoch 3/5
89/89 [=====] - 0s 325us/step - loss: 829.9393 - acc: 0.3708
Epoch 4/5
89/89 [=====] - 0s 327us/step - loss: 788.6086 - acc: 0.3708
Epoch 5/5
89/89 [=====] - 0s 313us/step - loss: 748.9162 - acc: 0.3708
23/23 [=====] - 9s 401ms/step
89/89 [=====] - 0s 269us/step
Epoch 1/5
89/89 [=====] - 21s 238ms/step - loss: 917.3530 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 309us/step - loss: 872.7935 - acc: 0.3820
Epoch 3/5
89/89 [=====] - 0s 391us/step - loss: 829.8290 - acc: 0.5843
Epoch 4/5
89/89 [=====] - 0s 366us/step - loss: 788.4891 - acc: 0.6742
Epoch 5/5
89/89 [=====] - 0s 316us/step - loss: 748.7804 - acc: 0.6966
23/23 [=====] - 9s 405ms/step
89/89 [=====] - 0s 281us/step
Epoch 1/5
89/89 [=====] - 21s 237ms/step - loss: 6.7989 - acc: 0.3596
Epoch 2/5
89/89 [=====] - 0s 337us/step - loss: 6.5103 - acc: 0.4382
Epoch 3/5
89/89 [=====] - 0s 349us/step - loss: 6.2332 - acc: 0.5955

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Epoch 4/5
89/89 [=====] - 0s 324us/step - loss: 5.9708 - acc: 0.7303
Epoch 5/5
89/89 [=====] - 0s 351us/step - loss: 5.7233 - acc: 0.7753
23/23 [=====] - 9s 411ms/step
89/89 [=====] - 0s 270us/step
Epoch 1/5
89/89 [=====] - 21s 240ms/step - loss: 6.8655 - acc: 0.6404
Epoch 2/5
89/89 [=====] - 0s 343us/step - loss: 6.5737 - acc: 0.8427
Epoch 3/5
89/89 [=====] - 0s 452us/step - loss: 6.2980 - acc: 0.8539
Epoch 4/5
89/89 [=====] - 0s 335us/step - loss: 6.0362 - acc: 0.8427
Epoch 5/5
89/89 [=====] - 0s 338us/step - loss: 5.7866 - acc: 0.8427
23/23 [=====] - 9s 410ms/step
89/89 [=====] - 0s 256us/step
Epoch 1/5
89/89 [=====] - 22s 242ms/step - loss: 6.9443 - acc: 0.4045
Epoch 2/5
89/89 [=====] - 0s 353us/step - loss: 6.6324 - acc: 0.5955
Epoch 3/5
89/89 [=====] - 0s 349us/step - loss: 6.3421 - acc: 0.6742
Epoch 4/5
89/89 [=====] - 0s 325us/step - loss: 6.0726 - acc: 0.7079
Epoch 5/5
89/89 [=====] - 0s 344us/step - loss: 5.8166 - acc: 0.7079
23/23 [=====] - 9s 411ms/step
89/89 [=====] - 0s 247us/step
Epoch 1/5
89/89 [=====] - 22s 242ms/step - loss: 59.8031 - acc: 0.6854
Epoch 2/5
89/89 [=====] - 0s 330us/step - loss: 57.1319 - acc: 0.6854
Epoch 3/5
89/89 [=====] - 0s 317us/step - loss: 54.5490 - acc: 0.6854
Epoch 4/5
89/89 [=====] - 0s 299us/step - loss: 52.0556 - acc: 0.6854
Epoch 5/5
89/89 [=====] - 0s 347us/step - loss: 49.6525 - acc: 0.6854
23/23 [=====] - 10s 414ms/step
89/89 [=====] - 0s 272us/step
Epoch 1/5
89/89 [=====] - 22s 246ms/step - loss: 59.7342 - acc: 0.2584
Epoch 2/5
89/89 [=====] - 0s 333us/step - loss: 57.0620 - acc: 0.3371
Epoch 3/5
89/89 [=====] - 0s 327us/step - loss: 54.4782 - acc: 0.3708

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Epoch 4/5
89/89 [=====] - 0s 323us/step - loss: 51.9839 - acc: 0.3933
Epoch 5/5
89/89 [=====] - 0s 335us/step - loss: 49.5807 - acc: 0.4270
23/23 [=====] - 10s 416ms/step
89/89 [=====] - 0s 325us/step
Epoch 1/5
89/89 [=====] - 22s 247ms/step - loss: 59.3343 - acc: 0.2809
Epoch 2/5
89/89 [=====] - 0s 325us/step - loss: 56.6823 - acc: 0.4719
Epoch 3/5
89/89 [=====] - 0s 339us/step - loss: 54.1200 - acc: 0.5618
Epoch 4/5
89/89 [=====] - 0s 339us/step - loss: 51.6487 - acc: 0.5843
Epoch 5/5
89/89 [=====] - 0s 348us/step - loss: 49.2673 - acc: 0.6292
23/23 [=====] - 10s 422ms/step
89/89 [=====] - 0s 261us/step
Epoch 1/5
89/89 [=====] - 22s 249ms/step - loss: 595.1201 - acc: 0.3483
Epoch 2/5
89/89 [=====] - 0s 323us/step - loss: 568.3279 - acc: 0.4607
Epoch 3/5
89/89 [=====] - 0s 310us/step - loss: 542.4095 - acc: 0.5506
Epoch 4/5
89/89 [=====] - 0s 326us/step - loss: 517.3792 - acc: 0.6292
Epoch 5/5
89/89 [=====] - 0s 338us/step - loss: 493.2462 - acc: 0.6742
23/23 [=====] - 10s 419ms/step
89/89 [=====] - 0s 275us/step
Epoch 1/5
89/89 [=====] - 22s 249ms/step - loss: 596.3863 - acc: 0.3034
Epoch 2/5
89/89 [=====] - 0s 332us/step - loss: 569.4915 - acc: 0.2921
Epoch 3/5
89/89 [=====] - 0s 380us/step - loss: 543.4736 - acc: 0.2809
Epoch 4/5
89/89 [=====] - 0s 325us/step - loss: 518.3472 - acc: 0.2697
Epoch 5/5
89/89 [=====] - 0s 343us/step - loss: 494.1274 - acc: 0.2472
23/23 [=====] - 10s 424ms/step
89/89 [=====] - 0s 258us/step
Epoch 1/5
89/89 [=====] - 22s 251ms/step - loss: 587.3969 - acc: 0.6629
Epoch 2/5
89/89 [=====] - 0s 357us/step - loss: 560.7258 - acc: 0.6742
Epoch 3/5
89/89 [=====] - 0s 322us/step - loss: 534.9257 - acc: 0.6742

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Epoch 4/5
89/89 [=====] - 0s 380us/step - loss: 510.0144 - acc: 0.6742
Epoch 5/5
89/89 [=====] - 0s 357us/step - loss: 486.0016 - acc: 0.6854
23/23 [=====] - 10s 427ms/step
89/89 [=====] - 0s 286us/step
Epoch 1/5
89/89 [=====] - 22s 252ms/step - loss: 10.2808 - acc: 0.3146
Epoch 2/5
89/89 [=====] - 0s 322us/step - loss: 9.7929 - acc: 0.3820
Epoch 3/5
89/89 [=====] - 0s 346us/step - loss: 9.3317 - acc: 0.5955
Epoch 4/5
89/89 [=====] - 0s 338us/step - loss: 8.8886 - acc: 0.7303
Epoch 5/5
89/89 [=====] - 0s 334us/step - loss: 8.4622 - acc: 0.7303
23/23 [=====] - 10s 419ms/step
89/89 [=====] - 0s 240us/step
Epoch 1/5
89/89 [=====] - 23s 254ms/step - loss: 10.3388 - acc: 0.1236
Epoch 2/5
89/89 [=====] - 0s 322us/step - loss: 9.8277 - acc: 0.3258
Epoch 3/5
89/89 [=====] - 0s 326us/step - loss: 9.3504 - acc: 0.5955
Epoch 4/5
89/89 [=====] - 0s 359us/step - loss: 8.8913 - acc: 0.6742
Epoch 5/5
89/89 [=====] - 0s 352us/step - loss: 8.4616 - acc: 0.6854
23/23 [=====] - 10s 432ms/step
89/89 [=====] - 0s 322us/step
Epoch 1/5
89/89 [=====] - 23s 256ms/step - loss: 10.2569 - acc: 0.2921
Epoch 2/5
89/89 [=====] - 0s 343us/step - loss: 9.7480 - acc: 0.6180
Epoch 3/5
89/89 [=====] - 0s 377us/step - loss: 9.2685 - acc: 0.6742
Epoch 4/5
89/89 [=====] - 0s 326us/step - loss: 8.8106 - acc: 0.6966
Epoch 5/5
89/89 [=====] - 0s 321us/step - loss: 8.3844 - acc: 0.7079
23/23 [=====] - 10s 435ms/step
89/89 [=====] - 0s 289us/step
Epoch 1/5
89/89 [=====] - 23s 258ms/step - loss: 93.1441 - acc: 0.5281
Epoch 2/5
89/89 [=====] - 0s 344us/step - loss: 88.5729 - acc: 0.5281
Epoch 3/5
89/89 [=====] - 0s 349us/step - loss: 84.1659 - acc: 0.5281

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Epoch 4/5
89/89 [=====] - 0s 330us/step - loss: 79.9291 - acc: 0.5843
Epoch 5/5
89/89 [=====] - 0s 349us/step - loss: 75.8627 - acc: 0.6629
23/23 [=====] - 10s 431ms/step
89/89 [=====] - 0s 262us/step
Epoch 1/5
89/89 [=====] - 23s 259ms/step - loss: 92.5836 - acc: 0.3820
Epoch 2/5
89/89 [=====] - 0s 356us/step - loss: 88.0303 - acc: 0.4494
Epoch 3/5
89/89 [=====] - 0s 350us/step - loss: 83.6421 - acc: 0.5393
Epoch 4/5
89/89 [=====] - 0s 336us/step - loss: 79.4231 - acc: 0.6517
Epoch 5/5
89/89 [=====] - 0s 358us/step - loss: 75.3722 - acc: 0.6966
23/23 [=====] - 10s 440ms/step
89/89 [=====] - 0s 288us/step
Epoch 1/5
89/89 [=====] - 23s 260ms/step - loss: 92.8860 - acc: 0.3034
Epoch 2/5
89/89 [=====] - 0s 299us/step - loss: 88.3224 - acc: 0.3596
Epoch 3/5
89/89 [=====] - 0s 344us/step - loss: 83.9270 - acc: 0.4382
Epoch 4/5
89/89 [=====] - 0s 340us/step - loss: 79.6990 - acc: 0.5618
Epoch 5/5
89/89 [=====] - 0s 333us/step - loss: 75.6413 - acc: 0.6854
23/23 [=====] - 10s 444ms/step
89/89 [=====] - 0s 275us/step
Epoch 1/5
89/89 [=====] - 23s 262ms/step - loss: 918.1962 - acc: 0.5955
Epoch 2/5
89/89 [=====] - 0s 342us/step - loss: 872.6614 - acc: 0.6292
Epoch 3/5
89/89 [=====] - 0s 336us/step - loss: 828.7710 - acc: 0.6404
Epoch 4/5
89/89 [=====] - 0s 349us/step - loss: 786.5505 - acc: 0.6629
Epoch 5/5
89/89 [=====] - 0s 358us/step - loss: 746.0128 - acc: 0.7528
23/23 [=====] - 10s 444ms/step
89/89 [=====] - 0s 289us/step
Epoch 1/5
89/89 [=====] - 24s 264ms/step - loss: 921.3060 - acc: 0.0449
Epoch 2/5
89/89 [=====] - 0s 333us/step - loss: 875.8922 - acc: 0.0562
Epoch 3/5
89/89 [=====] - 0s 331us/step - loss: 832.1199 - acc: 0.1685

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Epoch 4/5
89/89 [=====] - 0s 336us/step - loss: 790.0122 - acc: 0.3483
Epoch 5/5
89/89 [=====] - 0s 316us/step - loss: 749.5778 - acc: 0.4494
23/23 [=====] - 10s 452ms/step
89/89 [=====] - 0s 253us/step
Epoch 1/5
89/89 [=====] - 23s 262ms/step - loss: 917.1269 - acc: 0.6292
Epoch 2/5
89/89 [=====] - 0s 423us/step - loss: 871.7736 - acc: 0.6180
Epoch 3/5
89/89 [=====] - 0s 331us/step - loss: 828.0618 - acc: 0.6854
Epoch 4/5
89/89 [=====] - 0s 343us/step - loss: 786.0182 - acc: 0.7191
Epoch 5/5
89/89 [=====] - 0s 337us/step - loss: 745.6528 - acc: 0.7640
23/23 [=====] - 10s 454ms/step
89/89 [=====] - 0s 321us/step
Epoch 1/5
89/89 [=====] - 24s 267ms/step - loss: 14.4347 - acc: 0.2697
Epoch 2/5
89/89 [=====] - 0s 356us/step - loss: 13.6284 - acc: 0.5843
Epoch 3/5
89/89 [=====] - 0s 324us/step - loss: 12.8676 - acc: 0.6854
Epoch 4/5
89/89 [=====] - 0s 328us/step - loss: 12.1439 - acc: 0.7079
Epoch 5/5
89/89 [=====] - 0s 331us/step - loss: 11.4604 - acc: 0.7191
23/23 [=====] - 10s 448ms/step
89/89 [=====] - 0s 284us/step
Epoch 1/5
89/89 [=====] - 24s 265ms/step - loss: 14.4628 - acc: 0.2809
Epoch 2/5
89/89 [=====] - 0s 325us/step - loss: 13.6432 - acc: 0.4831
Epoch 3/5
89/89 [=====] - 0s 325us/step - loss: 12.8731 - acc: 0.7753
Epoch 4/5
89/89 [=====] - 0s 322us/step - loss: 12.1399 - acc: 0.7865
Epoch 5/5
89/89 [=====] - 0s 331us/step - loss: 11.4496 - acc: 0.7753
23/23 [=====] - 10s 453ms/step
89/89 [=====] - 0s 276us/step
Epoch 1/5
89/89 [=====] - 24s 269ms/step - loss: 14.4575 - acc: 0.6742
Epoch 2/5
89/89 [=====] - 0s 343us/step - loss: 13.6563 - acc: 0.7978
Epoch 3/5
89/89 [=====] - 0s 336us/step - loss: 12.8934 - acc: 0.8202

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Epoch 4/5
89/89 [=====] - 0s 325us/step - loss: 12.1688 - acc: 0.8202
Epoch 5/5
89/89 [=====] - 0s 315us/step - loss: 11.4809 - acc: 0.7978
23/23 [=====] - 10s 456ms/step
89/89 [=====] - 0s 303us/step
Epoch 1/5
89/89 [=====] - 24s 271ms/step - loss: 134.8386 - acc: 0.6629
Epoch 2/5
89/89 [=====] - 0s 344us/step - loss: 127.2064 - acc: 0.8090
Epoch 3/5
89/89 [=====] - 0s 341us/step - loss: 119.8915 - acc: 0.8090
Epoch 4/5
89/89 [=====] - 0s 334us/step - loss: 112.9004 - acc: 0.8090
Epoch 5/5
89/89 [=====] - 0s 324us/step - loss: 106.2308 - acc: 0.8202
23/23 [=====] - 10s 456ms/step
89/89 [=====] - 0s 265us/step
Epoch 1/5
89/89 [=====] - 25s 282ms/step - loss: 134.2604 - acc: 0.2584
Epoch 2/5
89/89 [=====] - 0s 363us/step - loss: 126.6406 - acc: 0.4607
Epoch 3/5
89/89 [=====] - 0s 350us/step - loss: 119.3455 - acc: 0.5843
Epoch 4/5
89/89 [=====] - 0s 396us/step - loss: 112.3761 - acc: 0.6180
Epoch 5/5
89/89 [=====] - 0s 349us/step - loss: 105.7282 - acc: 0.6517
23/23 [=====] - 11s 462ms/step
89/89 [=====] - 0s 315us/step
Epoch 1/5
89/89 [=====] - 24s 273ms/step - loss: 134.8557 - acc: 0.4944
Epoch 2/5
89/89 [=====] - 0s 355us/step - loss: 127.2181 - acc: 0.5955
Epoch 3/5
89/89 [=====] - 0s 366us/step - loss: 119.9020 - acc: 0.6742
Epoch 4/5
89/89 [=====] - 0s 369us/step - loss: 112.9075 - acc: 0.6966
Epoch 5/5
89/89 [=====] - 0s 366us/step - loss: 106.2360 - acc: 0.6966
23/23 [=====] - 11s 465ms/step
89/89 [=====] - 0s 333us/step
Epoch 1/5
89/89 [=====] - 24s 274ms/step - loss: 1350.6891 - acc: 0.2697
Epoch 2/5
89/89 [=====] - 0s 353us/step - loss: 1274.0341 - acc: 0.3933
Epoch 3/5
89/89 [=====] - 0s 367us/step - loss: 1200.5563 - acc: 0.4831

```

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Epoch 4/5
89/89 [=====] - 0s 333us/step - loss: 1130.2893 - acc: 0.5056
Epoch 5/5
89/89 [=====] - 0s 356us/step - loss: 1063.2395 - acc: 0.5843
23/23 [=====] - 11s 470ms/step
89/89 [=====] - 0s 349us/step
Epoch 1/5
89/89 [=====] - 25s 275ms/step - loss: 1325.1789 - acc: 0.3034
Epoch 2/5
89/89 [=====] - 0s 373us/step - loss: 1249.4468 - acc: 0.3034
Epoch 3/5
89/89 [=====] - 0s 356us/step - loss: 1176.8904 - acc: 0.3371
Epoch 4/5
89/89 [=====] - 0s 360us/step - loss: 1107.5414 - acc: 0.5393
Epoch 5/5
89/89 [=====] - 0s 343us/step - loss: 1041.4060 - acc: 0.4944
23/23 [=====] - 11s 472ms/step
89/89 [=====] - 0s 304us/step
Epoch 1/5
89/89 [=====] - 25s 278ms/step - loss: 1344.7418 - acc: 0.3708
Epoch 2/5
89/89 [=====] - 0s 362us/step - loss: 1268.4150 - acc: 0.5730
Epoch 3/5
89/89 [=====] - 0s 340us/step - loss: 1195.2597 - acc: 0.6517
Epoch 4/5
89/89 [=====] - 0s 359us/step - loss: 1125.3067 - acc: 0.7079
Epoch 5/5
89/89 [=====] - 0s 392us/step - loss: 1058.5634 - acc: 0.7191
23/23 [=====] - 11s 476ms/step
89/89 [=====] - 0s 300us/step
Epoch 1/3
112/112 [=====] - 25s 220ms/step - loss: 10.1971 - acc: 0.0625
Epoch 2/3
112/112 [=====] - 0s 440us/step - loss: 9.5607 - acc: 0.2768
Epoch 3/3
112/112 [=====] - 0s 346us/step - loss: 8.9624 - acc: 0.5179

```

```

Out[0]: GridSearchCV(cv=StratifiedShuffleSplit(n_splits=3, random_state=0, test_size=0.2,
      train_size=None),
      error_score='raise-deprecating',
      estimator=<keras.wrappers.scikit_learn.KerasClassifier object at 0x7f0ea048aac8>,
      fit_params=None, iid='warn', n_jobs=None,
      param_grid={'epochs': [1, 3, 5], 'hidden_size1': [32, 64, 128], 'hidden_size2':
      pre_dispatch='2*n_jobs', refit=True, return_train_score=True,
      scoring=None, verbose=0)

```

```

In [0]: grid.best_params_

```

```
Out[0]: {'epochs': 3, 'hidden_size1': 64, 'hidden_size2': 128, 'strangth': 0.1}
```

```
In [0]: grid.best_score_
```

```
Out[0]: 0.8550724585851034
```

```
In [0]: res = pd.DataFrame(grid.cv_results_)
```

```
In [0]: res.pivot_table(index=["param_epochs",  
                                "param_hidden_size1",  
                                "param_hidden_size2"],  
                        values=['mean_train_score', "mean_test_score"])
```

```
Out[0]:
```

			mean_test_score \
param_epochs	param_hidden_size1	param_hidden_size2	
1	32	32	0.347826
		64	0.483092
		128	0.405797
	64	32	0.333333
		64	0.376812
		128	0.285024
	128	32	0.410628
		64	0.410628
		128	0.439614
3	32	32	0.415459
		64	0.458937
		128	0.478261
	64	32	0.478261
		64	0.468599
		128	0.594203
	128	32	0.526570
		64	0.555556
		128	0.603865
5	32	32	0.473430
		64	0.483092
		128	0.690821
	64	32	0.579710
		64	0.700483
		128	0.618357
	128	32	0.637681
		64	0.676329
		128	0.753623
			mean_train_score
param_epochs	param_hidden_size1	param_hidden_size2	
1	32	32	0.359551
		64	0.461923
		128	0.416979
	64	32	0.325843

		64	0.367041
		128	0.320849
	128	32	0.395755
		64	0.401998
		128	0.454432
3	32	32	0.399501
		64	0.456929
		128	0.503121
	64	32	0.498127
		64	0.505618
		128	0.598002
	128	32	0.513109
		64	0.571785
		128	0.615481
5	32	32	0.474407
		64	0.465668
		128	0.710362
	64	32	0.569288
		64	0.691635
		128	0.651685
	128	32	0.636704
		64	0.711610
		128	0.709114

```
In [0]: grid.score(X_test_scaled, y_test)
```

```
38/38 [=====] - 11s 286ms/step
```

```
Out[0]: 0.552631582084455
```

3.1 Summary

As we can see, we performed a grid search over the sizes of the two hidden layers, as well as the epoch count and the regularization "strangth" parameter for a multi-layer perceptron model on the Iris dataset. This grid search yielded the best parameter values of:

1. epochs: 3
2. hidden_size1: 64
3. hidden_size2: 128
4. strangth: 0.1

Our score using these parameters during the grid search was about 0.86, and when applying this network to the test set, we achieved a score of about 0.55.