Connect-4 Neural Shrub - Leaves

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In [1]:
```
import time

from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
from sklearn.metrics import confusion_matrix

from keras.models import Sequential
from keras.layers import Dense
from sklearn.preprocessing import LabelEncoder
from keras.utils import np_utils

import numpy as np
```

```
/home/shashwati/anaconda3/envs/py35/lib/python3.5/site-packages/h5py/__init__.py:36: FutureWarn
  from ._conv import register_converters as _register_converters
Using TensorFlow backend.
```

In [2]:
```
# fix random seed for reproducibility
seed = 7
np.random.seed(seed)
```

In [3]:
```
# function returns the data in the right format
def get_data():
    dataset = np.genfromtxt("connect-4.csv", dtype='str', delimiter=",")

    preX = dataset[:,0:42]
    preY = dataset[:,42]

    X = np.zeros(preX.shape)

    for i, row in enumerate(preX):
        for j, col in enumerate(row):
            if col == 'x':
                X[i,j] = 1.0
            if col == 'o':
                X[i,j] = -1.0
```

```
                if col == 'b':
                    X[i,j] = 0.0


        encoder = LabelEncoder()
        # code: 0 - draw; 1 - loss; 2 -win
        encoded_Y = encoder.fit_transform(preY)


        # splitting the dataset into 80% training and 20% test data set
        train, test, label_train, label_test = \
                train_test_split(X, encoded_Y,test_size = 0.2)

        return train, label_train, test, label_test
```

In [4]:
```
from sklearn.tree._tree import TREE_LEAF

def prune_index(inner_tree, index, threshold):
    if inner_tree.value[index].min() < threshold:
        # turn node into a leaf by "unlinking" its children
        inner_tree.children_left[index] = TREE_LEAF
        inner_tree.children_right[index] = TREE_LEAF
    # if there are shildren, visit them as well
    if inner_tree.children_left[index] != TREE_LEAF:
        prune_index(inner_tree, inner_tree.children_left[index], threshold)
        prune_index(inner_tree, inner_tree.children_right[index], threshold)
```

In [5]:
```
# builds the decision tree of depth 12
def decision_tree(train, label):
    dt = DecisionTreeClassifier(max_depth = 12, min_samples_leaf=100)
    dt.fit(train, label)
    prune_index(dt.tree_, 0, 5)
    end = time.time()
    return dt
```

In [6]:
```
# builds the neural network for a given class
def neural_network(class_data):
    num_train = []
    num_label = []
    for x in class_data:
        num_train.append(x[0])
        num_label.append(x[1])

    num_train = np.array(num_train)
    num_label = np.array(num_label)

    # converting categorical variable into numerical values
    encoder = LabelEncoder()
```

```
        encoder.fit(num_label)

        # code: 0 - draw; 1 - loss; 2 -win
        encoded_Y = encoder.transform(num_label)
        final_label = np_utils.to_categorical(encoded_Y, 3)

        out = final_label.shape[1]
        print(out, final_label.shape, num_train.shape)
        model = Sequential()
        model.add(Dense(8, input_dim=42, activation='relu'))
        model.add(Dense(out, activation='softmax'))
        model.compile(loss='categorical_crossentropy', \
                      optimizer='adam', metrics=['accuracy'])
        model.fit(num_train, final_label, epochs=5, batch_size=5)
        return model
```

In [7]:
```
# builds the neural shrub
def neural_shrubs(tree, train, label):
    train = np.array(train)
    label = np.array(label)

    # leave_id: index of the leaf that cantains the instance
    leave_id = tree.apply(train)

    classes = dict()

    for x in range(len(train)):
        leaf = leave_id[x]

        # Gets the class for each leaf
        #.value: contains value of all the tree nodes
        #.value[leaf]: returns the value of the leaf
        #idx = tree.tree_.value[leaf][0][0]

        # insert the instance into the class
        if leaf in classes.keys():
            classes[leaf].append([train[x], label[x]])
        else:
            classes[leaf] = [[train[x], label[x]]]

    # stores the neural network for each class
    nn_models = dict()

    #stores the max time taken to build a neural network
    max_time = 0;
    for key in classes.keys():
        start = time.time()
        model = neural_network(classes[key])
```

```
                end = time.time()

                time_taken = end - start
                if max_time < time_taken:
                    max_time = time_taken

                nn_models[key] = model

            # returns a neural network for each class and the max
            # time taken to build the neural network
            return nn_models, max_time
```

In [8]:
```
# The algorithm to build the neural shrub
train, train_label, test, test_label = get_data()

dt_start = time.time()
tree = decision_tree(train, train_label)
dt_end = time.time()

shrubs, max_time = neural_shrubs(tree, train, train_label)
```

```
3 (140, 3) (140, 42)
Epoch 1/5
140/140 [==============================] - 0s 3ms/step - loss: 1.0481 - acc: 0.3429
Epoch 2/5
140/140 [==============================] - 0s 449us/step - loss: 1.0055 - acc: 0.5071
Epoch 3/5
140/140 [==============================] - 0s 530us/step - loss: 0.9700 - acc: 0.5500
Epoch 4/5
140/140 [==============================] - 0s 422us/step - loss: 0.9404 - acc: 0.6000
Epoch 5/5
140/140 [==============================] - 0s 494us/step - loss: 0.9139 - acc: 0.6143
3 (300, 3) (300, 42)
Epoch 1/5
300/300 [==============================] - 1s 2ms/step - loss: 0.7954 - acc: 0.7167
Epoch 2/5
300/300 [==============================] - 0s 510us/step - loss: 0.6442 - acc: 0.7233
Epoch 3/5
300/300 [==============================] - 0s 434us/step - loss: 0.5474 - acc: 0.7367
Epoch 4/5
300/300 [==============================] - 0s 404us/step - loss: 0.4899 - acc: 0.7467
Epoch 5/5
300/300 [==============================] - 0s 387us/step - loss: 0.4512 - acc: 0.7600
3 (146, 3) (146, 42)
Epoch 1/5
146/146 [==============================] - 0s 3ms/step - loss: 1.1830 - acc: 0.2534
Epoch 2/5
146/146 [==============================] - 0s 339us/step - loss: 1.1052 - acc: 0.3356
```

```
Epoch 3/5
146/146 [==============================] - 0s 412us/step - loss: 1.0569 - acc: 0.4315
Epoch 4/5
146/146 [==============================] - 0s 442us/step - loss: 1.0193 - acc: 0.5068
Epoch 5/5
146/146 [==============================] - 0s 385us/step - loss: 0.9909 - acc: 0.5205
3 (152, 3) (152, 42)
Epoch 1/5
152/152 [==============================] - 0s 3ms/step - loss: 1.4315 - acc: 0.1513
Epoch 2/5
152/152 [==============================] - 0s 496us/step - loss: 1.1997 - acc: 0.2829
Epoch 3/5
152/152 [==============================] - 0s 520us/step - loss: 1.0543 - acc: 0.4408
Epoch 4/5
152/152 [==============================] - 0s 473us/step - loss: 0.9567 - acc: 0.5658
Epoch 5/5
152/152 [==============================] - 0s 473us/step - loss: 0.8956 - acc: 0.6513
3 (161, 3) (161, 42)
Epoch 1/5
161/161 [==============================] - 1s 3ms/step - loss: 1.2773 - acc: 0.2298
Epoch 2/5
161/161 [==============================] - 0s 459us/step - loss: 1.1286 - acc: 0.3727
Epoch 3/5
161/161 [==============================] - 0s 1ms/step - loss: 1.0198 - acc: 0.5776
Epoch 4/5
161/161 [==============================] - 0s 580us/step - loss: 0.9219 - acc: 0.7764
Epoch 5/5
161/161 [==============================] - 0s 453us/step - loss: 0.8321 - acc: 0.7578
3 (140, 3) (140, 42)
Epoch 1/5
140/140 [==============================] - 0s 3ms/step - loss: 1.1317 - acc: 0.3143
Epoch 2/5
140/140 [==============================] - 0s 381us/step - loss: 1.0036 - acc: 0.5500
Epoch 3/5
140/140 [==============================] - 0s 384us/step - loss: 0.9243 - acc: 0.6571
Epoch 4/5
140/140 [==============================] - 0s 346us/step - loss: 0.8747 - acc: 0.6857
Epoch 5/5
140/140 [==============================] - 0s 1ms/step - loss: 0.8442 - acc: 0.6857
3 (171, 3) (171, 42)
Epoch 1/5
171/171 [==============================] - 0s 3ms/step - loss: 1.2290 - acc: 0.1754
Epoch 2/5
171/171 [==============================] - 0s 432us/step - loss: 1.1299 - acc: 0.3684
Epoch 3/5
171/171 [==============================] - 0s 458us/step - loss: 1.0642 - acc: 0.5205
Epoch 4/5
171/171 [==============================] - 0s 427us/step - loss: 1.0115 - acc: 0.5731
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Epoch 5/5
171/171 [==============================] - 0s 478us/step - loss: 0.9661 - acc: 0.5965
3 (174, 3) (174, 42)
Epoch 1/5
174/174 [==============================] - 1s 3ms/step - loss: 1.2941 - acc: 0.1437
Epoch 2/5
174/174 [==============================] - 0s 396us/step - loss: 1.1163 - acc: 0.3046
Epoch 3/5
174/174 [==============================] - 0s 409us/step - loss: 1.0063 - acc: 0.4080
Epoch 4/5
174/174 [==============================] - 0s 401us/step - loss: 0.9299 - acc: 0.4770
Epoch 5/5
174/174 [==============================] - 0s 505us/step - loss: 0.8741 - acc: 0.5172
3 (127, 3) (127, 42)
Epoch 1/5
127/127 [==============================] - 0s 4ms/step - loss: 0.9293 - acc: 0.5669
Epoch 2/5
127/127 [==============================] - 0s 484us/step - loss: 0.8767 - acc: 0.5748
Epoch 3/5
127/127 [==============================] - 0s 417us/step - loss: 0.8430 - acc: 0.5984
Epoch 4/5
127/127 [==============================] - 0s 451us/step - loss: 0.8215 - acc: 0.6378
Epoch 5/5
127/127 [==============================] - 0s 687us/step - loss: 0.8044 - acc: 0.6457
3 (119, 3) (119, 42)
Epoch 1/5
119/119 [==============================] - 1s 5ms/step - loss: 0.8524 - acc: 0.6891
Epoch 2/5
119/119 [==============================] - 0s 389us/step - loss: 0.8166 - acc: 0.6891
Epoch 3/5
119/119 [==============================] - 0s 440us/step - loss: 0.7944 - acc: 0.6807
Epoch 4/5
119/119 [==============================] - 0s 639us/step - loss: 0.7765 - acc: 0.6891
Epoch 5/5
119/119 [==============================] - 0s 620us/step - loss: 0.7604 - acc: 0.6975
3 (203, 3) (203, 42)
Epoch 1/5
203/203 [==============================] - 1s 3ms/step - loss: 1.1731 - acc: 0.2266
Epoch 2/5
203/203 [==============================] - 0s 535us/step - loss: 1.0748 - acc: 0.3941
Epoch 3/5
203/203 [==============================] - 0s 566us/step - loss: 1.0338 - acc: 0.5074
Epoch 4/5
203/203 [==============================] - 0s 427us/step - loss: 1.0088 - acc: 0.5419
Epoch 5/5
203/203 [==============================] - 0s 602us/step - loss: 0.9907 - acc: 0.5369
3 (155, 3) (155, 42)
Epoch 1/5
```

```
155/155 [==============================] - 1s 4ms/step - loss: 0.8746 - acc: 0.8387
Epoch 2/5
155/155 [==============================] - 0s 562us/step - loss: 0.6915 - acc: 0.9484
Epoch 3/5
155/155 [==============================] - 0s 534us/step - loss: 0.5141 - acc: 0.9677
Epoch 4/5
155/155 [==============================] - 0s 447us/step - loss: 0.3678 - acc: 0.9677
Epoch 5/5
155/155 [==============================] - 0s 617us/step - loss: 0.2773 - acc: 0.9677
3 (140, 3) (140, 42)
Epoch 1/5
140/140 [==============================] - 1s 4ms/step - loss: 0.9786 - acc: 0.5929
Epoch 2/5
140/140 [==============================] - 0s 433us/step - loss: 0.9245 - acc: 0.6357
Epoch 3/5
140/140 [==============================] - 0s 383us/step - loss: 0.8900 - acc: 0.6357
Epoch 4/5
140/140 [==============================] - 0s 558us/step - loss: 0.8631 - acc: 0.6500
Epoch 5/5
140/140 [==============================] - 0s 577us/step - loss: 0.8401 - acc: 0.6500
3 (137, 3) (137, 42)
Epoch 1/5
137/137 [==============================] - 1s 5ms/step - loss: 1.2828 - acc: 0.1533
Epoch 2/5
137/137 [==============================] - 0s 481us/step - loss: 1.1105 - acc: 0.3285
Epoch 3/5
137/137 [==============================] - 0s 467us/step - loss: 0.9700 - acc: 0.5255
Epoch 4/5
137/137 [==============================] - 0s 460us/step - loss: 0.8642 - acc: 0.7007
Epoch 5/5
137/137 [==============================] - 0s 542us/step - loss: 0.7926 - acc: 0.7007
3 (159, 3) (159, 42)
Epoch 1/5
159/159 [==============================] - 1s 6ms/step - loss: 0.9463 - acc: 0.4969
Epoch 2/5
159/159 [==============================] - 0s 773us/step - loss: 0.7487 - acc: 0.7987
Epoch 3/5
159/159 [==============================] - 0s 563us/step - loss: 0.5974 - acc: 0.8868
Epoch 4/5
159/159 [==============================] - 0s 609us/step - loss: 0.4985 - acc: 0.8742
Epoch 5/5
159/159 [==============================] - 0s 912us/step - loss: 0.4397 - acc: 0.8742
3 (155, 3) (155, 42)
Epoch 1/5
155/155 [==============================] - 1s 5ms/step - loss: 1.4188 - acc: 0.0903
Epoch 2/5
155/155 [==============================] - 0s 774us/step - loss: 1.2521 - acc: 0.1290
Epoch 3/5
```

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155/155 [==============================] - 0s 608us/step - loss: 1.1543 - acc: 0.2452
Epoch 4/5
155/155 [==============================] - 0s 667us/step - loss: 1.0833 - acc: 0.4516
Epoch 5/5
155/155 [==============================] - 0s 639us/step - loss: 1.0247 - acc: 0.5871
3 (101, 3) (101, 42)
Epoch 1/5
101/101 [==============================] - 1s 6ms/step - loss: 0.7893 - acc: 0.8812
Epoch 2/5
101/101 [==============================] - 0s 683us/step - loss: 0.6510 - acc: 0.9505
Epoch 3/5
101/101 [==============================] - 0s 637us/step - loss: 0.5340 - acc: 0.9604
Epoch 4/5
101/101 [==============================] - 0s 650us/step - loss: 0.4303 - acc: 0.9604
Epoch 5/5
101/101 [==============================] - 0s 648us/step - loss: 0.3530 - acc: 0.9604
3 (1173, 3) (1173, 42)
Epoch 1/5
1173/1173 [==============================] - 2s 1ms/step - loss: 1.1397 - acc: 0.3478
Epoch 2/5
1173/1173 [==============================] - 1s 501us/step - loss: 1.0087 - acc: 0.4902
Epoch 3/5
1173/1173 [==============================] - 1s 579us/step - loss: 0.9554 - acc: 0.5610
Epoch 4/5
1173/1173 [==============================] - 1s 500us/step - loss: 0.9168 - acc: 0.6070
Epoch 5/5
1173/1173 [==============================] - 1s 494us/step - loss: 0.8829 - acc: 0.6317
3 (222, 3) (222, 42)
Epoch 1/5
222/222 [==============================] - 1s 4ms/step - loss: 1.1542 - acc: 0.3063
Epoch 2/5
222/222 [==============================] - 0s 519us/step - loss: 1.1292 - acc: 0.3198
Epoch 3/5
222/222 [==============================] - 0s 532us/step - loss: 1.1096 - acc: 0.3243
Epoch 4/5
222/222 [==============================] - 0s 1ms/step - loss: 1.0946 - acc: 0.3694
Epoch 5/5
222/222 [==============================] - 0s 571us/step - loss: 1.0825 - acc: 0.4324
3 (153, 3) (153, 42)
Epoch 1/5
153/153 [==============================] - 1s 6ms/step - loss: 1.5085 - acc: 0.1373
Epoch 2/5
153/153 [==============================] - 0s 597us/step - loss: 1.3215 - acc: 0.1830
Epoch 3/5
153/153 [==============================] - 0s 566us/step - loss: 1.2164 - acc: 0.2484
Epoch 4/5
153/153 [==============================] - 0s 580us/step - loss: 1.1471 - acc: 0.2810
Epoch 5/5
```

```
153/153 [==============================] - 0s 507us/step - loss: 1.1006 - acc: 0.3529
3 (206, 3) (206, 42)
Epoch 1/5
206/206 [==============================] - 1s 4ms/step - loss: 1.2273 - acc: 0.2621
Epoch 2/5
206/206 [==============================] - 0s 554us/step - loss: 0.9808 - acc: 0.5534
Epoch 3/5
206/206 [==============================] - 0s 480us/step - loss: 0.8184 - acc: 0.7718
Epoch 4/5
206/206 [==============================] - 0s 463us/step - loss: 0.7114 - acc: 0.8204
Epoch 5/5
206/206 [==============================] - 0s 632us/step - loss: 0.6464 - acc: 0.8301
3 (127, 3) (127, 42)
Epoch 1/5
127/127 [==============================] - 1s 7ms/step - loss: 0.8660 - acc: 0.6535
Epoch 2/5
127/127 [==============================] - 0s 563us/step - loss: 0.7328 - acc: 0.8268
Epoch 3/5
127/127 [==============================] - 0s 581us/step - loss: 0.6346 - acc: 0.8425
Epoch 4/5
127/127 [==============================] - 0s 736us/step - loss: 0.5668 - acc: 0.8425
Epoch 5/5
127/127 [==============================] - 0s 562us/step - loss: 0.5235 - acc: 0.8425
3 (105, 3) (105, 42)
Epoch 1/5
105/105 [==============================] - 1s 7ms/step - loss: 1.1522 - acc: 0.2667
Epoch 2/5
105/105 [==============================] - 0s 684us/step - loss: 1.0097 - acc: 0.5810
Epoch 3/5
105/105 [==============================] - 0s 623us/step - loss: 0.8667 - acc: 0.8286
Epoch 4/5
105/105 [==============================] - 0s 535us/step - loss: 0.7240 - acc: 0.9048
Epoch 5/5
105/105 [==============================] - 0s 625us/step - loss: 0.5765 - acc: 0.9333
3 (173, 3) (173, 42)
Epoch 1/5
173/173 [==============================] - 1s 5ms/step - loss: 0.9939 - acc: 0.6647
Epoch 2/5
173/173 [==============================] - 0s 486us/step - loss: 0.8934 - acc: 0.7341
Epoch 3/5
173/173 [==============================] - 0s 553us/step - loss: 0.7990 - acc: 0.7861
Epoch 4/5
173/173 [==============================] - 0s 609us/step - loss: 0.7213 - acc: 0.7919
Epoch 5/5
173/173 [==============================] - 0s 522us/step - loss: 0.6685 - acc: 0.7919
3 (120, 3) (120, 42)
Epoch 1/5
120/120 [==============================] - 1s 7ms/step - loss: 1.0715 - acc: 0.4333
```

```
Epoch 2/5
120/120 [==============================] - 0s 461us/step - loss: 0.9941 - acc: 0.7333
Epoch 3/5
120/120 [==============================] - 0s 458us/step - loss: 0.9112 - acc: 0.8583
Epoch 4/5
120/120 [==============================] - 0s 540us/step - loss: 0.8130 - acc: 0.8750
Epoch 5/5
120/120 [==============================] - 0s 536us/step - loss: 0.7080 - acc: 0.8750
3 (200, 3) (200, 42)
Epoch 1/5
200/200 [==============================] - 1s 4ms/step - loss: 1.1641 - acc: 0.3200
Epoch 2/5
200/200 [==============================] - 0s 517us/step - loss: 1.0933 - acc: 0.4050
Epoch 3/5
200/200 [==============================] - 0s 548us/step - loss: 1.0534 - acc: 0.4400
Epoch 4/5
200/200 [==============================] - 0s 602us/step - loss: 1.0275 - acc: 0.4750
Epoch 5/5
200/200 [==============================] - 0s 539us/step - loss: 1.0081 - acc: 0.5050
3 (150, 3) (150, 42)
Epoch 1/5
150/150 [==============================] - 1s 5ms/step - loss: 1.0058 - acc: 0.2867
Epoch 2/5
150/150 [==============================] - 0s 466us/step - loss: 0.8967 - acc: 0.7067
Epoch 3/5
150/150 [==============================] - 0s 487us/step - loss: 0.8226 - acc: 0.7933
Epoch 4/5
150/150 [==============================] - 0s 619us/step - loss: 0.7672 - acc: 0.7933
Epoch 5/5
150/150 [==============================] - 0s 482us/step - loss: 0.7277 - acc: 0.7933
3 (109, 3) (109, 42)
Epoch 1/5
109/109 [==============================] - 1s 8ms/step - loss: 1.2675 - acc: 0.1376
Epoch 2/5
109/109 [==============================] - 0s 633us/step - loss: 1.0979 - acc: 0.2294
Epoch 3/5
109/109 [==============================] - 0s 672us/step - loss: 0.9494 - acc: 0.4220
Epoch 4/5
109/109 [==============================] - 0s 725us/step - loss: 0.8332 - acc: 0.5963
Epoch 5/5
109/109 [==============================] - 0s 800us/step - loss: 0.7387 - acc: 0.7523
3 (133, 3) (133, 42)
Epoch 1/5
133/133 [==============================] - 1s 8ms/step - loss: 1.1850 - acc: 0.2707
Epoch 2/5
133/133 [==============================] - 0s 826us/step - loss: 1.1441 - acc: 0.2932
Epoch 3/5
133/133 [==============================] - 0s 629us/step - loss: 1.1134 - acc: 0.3534
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```
Epoch 4/5
133/133 [==============================] - 0s 700us/step - loss: 1.0957 - acc: 0.3609
Epoch 5/5
133/133 [==============================] - 0s 643us/step - loss: 1.0809 - acc: 0.3459
3 (222, 3) (222, 42)
Epoch 1/5
222/222 [==============================] - 1s 5ms/step - loss: 1.0562 - acc: 0.4369
Epoch 2/5
222/222 [==============================] - 0s 511us/step - loss: 0.8898 - acc: 0.6667
Epoch 3/5
222/222 [==============================] - 0s 523us/step - loss: 0.7844 - acc: 0.7072
Epoch 4/5
222/222 [==============================] - 0s 593us/step - loss: 0.7300 - acc: 0.7117
Epoch 5/5
222/222 [==============================] - 0s 566us/step - loss: 0.6988 - acc: 0.7117
3 (116, 3) (116, 42)
Epoch 1/5
116/116 [==============================] - 1s 9ms/step - loss: 1.3020 - acc: 0.2155
Epoch 2/5
116/116 [==============================] - 0s 624us/step - loss: 1.2291 - acc: 0.2241
Epoch 3/5
116/116 [==============================] - 0s 561us/step - loss: 1.1822 - acc: 0.2241
Epoch 4/5
116/116 [==============================] - 0s 569us/step - loss: 1.1504 - acc: 0.2672
Epoch 5/5
116/116 [==============================] - 0s 573us/step - loss: 1.1266 - acc: 0.3190
3 (189, 3) (189, 42)
Epoch 1/5
189/189 [==============================] - 1s 5ms/step - loss: 1.1256 - acc: 0.3439
Epoch 2/5
189/189 [==============================] - 0s 504us/step - loss: 1.0474 - acc: 0.4339
Epoch 3/5
189/189 [==============================] - 0s 559us/step - loss: 1.0047 - acc: 0.5026
Epoch 4/5
189/189 [==============================] - 0s 535us/step - loss: 0.9799 - acc: 0.5397
Epoch 5/5
189/189 [==============================] - 0s 597us/step - loss: 0.9632 - acc: 0.5503
3 (191, 3) (191, 42)
Epoch 1/5
191/191 [==============================] - 1s 5ms/step - loss: 1.0814 - acc: 0.4503
Epoch 2/5
191/191 [==============================] - 0s 654us/step - loss: 1.0320 - acc: 0.5445
Epoch 3/5
191/191 [==============================] - 0s 590us/step - loss: 1.0017 - acc: 0.5497
Epoch 4/5
191/191 [==============================] - 0s 490us/step - loss: 0.9800 - acc: 0.5550
Epoch 5/5
191/191 [==============================] - 0s 481us/step - loss: 0.9669 - acc: 0.5550
```

```
3 (372, 3) (372, 42)
Epoch 1/5
372/372 [==============================] - 1s 3ms/step - loss: 1.0213 - acc: 0.4919
Epoch 2/5
372/372 [==============================] - 0s 500us/step - loss: 0.9436 - acc: 0.5591
Epoch 3/5
372/372 [==============================] - 0s 553us/step - loss: 0.9125 - acc: 0.5591
Epoch 4/5
372/372 [==============================] - 0s 482us/step - loss: 0.8935 - acc: 0.5591
Epoch 5/5
372/372 [==============================] - 0s 562us/step - loss: 0.8783 - acc: 0.5699
3 (211, 3) (211, 42)
Epoch 1/5
211/211 [==============================] - 1s 5ms/step - loss: 1.5756 - acc: 0.1422
Epoch 2/5
211/211 [==============================] - 0s 484us/step - loss: 1.3007 - acc: 0.1991
Epoch 3/5
211/211 [==============================] - 0s 530us/step - loss: 1.1328 - acc: 0.3697
Epoch 4/5
211/211 [==============================] - 0s 608us/step - loss: 1.0088 - acc: 0.4976
Epoch 5/5
211/211 [==============================] - 0s 514us/step - loss: 0.9136 - acc: 0.6588
3 (115, 3) (115, 42)
Epoch 1/5
115/115 [==============================] - 1s 9ms/step - loss: 0.8799 - acc: 0.6957
Epoch 2/5
115/115 [==============================] - 0s 603us/step - loss: 0.7674 - acc: 0.8000
Epoch 3/5
115/115 [==============================] - 0s 738us/step - loss: 0.6759 - acc: 0.8261
Epoch 4/5
115/115 [==============================] - 0s 649us/step - loss: 0.6109 - acc: 0.8261
Epoch 5/5
115/115 [==============================] - 0s 684us/step - loss: 0.5622 - acc: 0.8174
3 (116, 3) (116, 42)
Epoch 1/5
116/116 [==============================] - 1s 9ms/step - loss: 1.2961 - acc: 0.1207
Epoch 2/5
116/116 [==============================] - 0s 650us/step - loss: 1.1641 - acc: 0.1897
Epoch 3/5
116/116 [==============================] - 0s 618us/step - loss: 1.0672 - acc: 0.3534
Epoch 4/5
116/116 [==============================] - 0s 640us/step - loss: 0.9966 - acc: 0.5345
Epoch 5/5
116/116 [==============================] - 0s 533us/step - loss: 0.9438 - acc: 0.6638
3 (265, 3) (265, 42)
Epoch 1/5
265/265 [==============================] - 1s 4ms/step - loss: 1.0931 - acc: 0.2604
Epoch 2/5
```

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265/265 [==============================] - 0s 718us/step - loss: 0.8372 - acc: 0.7245
Epoch 3/5
265/265 [==============================] - 0s 561us/step - loss: 0.6246 - acc: 0.8792
Epoch 4/5
265/265 [==============================] - 0s 549us/step - loss: 0.4888 - acc: 0.8830
Epoch 5/5
265/265 [==============================] - 0s 570us/step - loss: 0.4415 - acc: 0.8830
3 (116, 3) (116, 42)
Epoch 1/5
116/116 [==============================] - 1s 9ms/step - loss: 1.1177 - acc: 0.3534
Epoch 2/5
116/116 [==============================] - 0s 567us/step - loss: 1.0717 - acc: 0.4828
Epoch 3/5
116/116 [==============================] - 0s 720us/step - loss: 1.0333 - acc: 0.5517
Epoch 4/5
116/116 [==============================] - 0s 562us/step - loss: 0.9990 - acc: 0.6034
Epoch 5/5
116/116 [==============================] - 0s 703us/step - loss: 0.9680 - acc: 0.6207
3 (201, 3) (201, 42)
Epoch 1/5
201/201 [==============================] - 1s 6ms/step - loss: 0.9750 - acc: 0.6617
Epoch 2/5
201/201 [==============================] - 0s 683us/step - loss: 0.8446 - acc: 0.7761
Epoch 3/5
201/201 [==============================] - 0s 617us/step - loss: 0.7559 - acc: 0.7761
Epoch 4/5
201/201 [==============================] - 0s 689us/step - loss: 0.6939 - acc: 0.7761
Epoch 5/5
201/201 [==============================] - 0s 590us/step - loss: 0.6484 - acc: 0.7761
3 (106, 3) (106, 42)
Epoch 1/5
106/106 [==============================] - 1s 10ms/step - loss: 1.2294 - acc: 0.1887
Epoch 2/5
106/106 [==============================] - 0s 657us/step - loss: 1.1204 - acc: 0.3774
Epoch 3/5
106/106 [==============================] - 0s 639us/step - loss: 1.0516 - acc: 0.4717
Epoch 4/5
106/106 [==============================] - 0s 655us/step - loss: 1.0035 - acc: 0.5566
Epoch 5/5
106/106 [==============================] - 0s 686us/step - loss: 0.9726 - acc: 0.6038
3 (655, 3) (655, 42)
Epoch 1/5
655/655 [==============================] - 1s 2ms/step - loss: 0.8120 - acc: 0.6427
Epoch 2/5
655/655 [==============================] - 0s 556us/step - loss: 0.3168 - acc: 0.9374
Epoch 3/5
655/655 [==============================] - 0s 577us/step - loss: 0.2627 - acc: 0.9405
Epoch 4/5
```

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655/655 [==============================] - 0s 481us/step - loss: 0.2489 - acc: 0.9405
Epoch 5/5
655/655 [==============================] - 0s 529us/step - loss: 0.2390 - acc: 0.9405
3 (126, 3) (126, 42)
Epoch 1/5
126/126 [==============================] - 1s 9ms/step - loss: 1.0918 - acc: 0.4206
Epoch 2/5
126/126 [==============================] - 0s 581us/step - loss: 1.0547 - acc: 0.4444
Epoch 3/5
126/126 [==============================] - 0s 622us/step - loss: 1.0335 - acc: 0.4762
Epoch 4/5
126/126 [==============================] - 0s 901us/step - loss: 1.0185 - acc: 0.4921
Epoch 5/5
126/126 [==============================] - 0s 930us/step - loss: 1.0025 - acc: 0.4841
3 (489, 3) (489, 42)
Epoch 1/5
489/489 [==============================] - 1s 3ms/step - loss: 1.0590 - acc: 0.4519
Epoch 2/5
489/489 [==============================] - 0s 897us/step - loss: 0.5816 - acc: 0.9755
Epoch 3/5
489/489 [==============================] - 0s 628us/step - loss: 0.2666 - acc: 0.9796
Epoch 4/5
489/489 [==============================] - 0s 549us/step - loss: 0.1476 - acc: 0.9796
Epoch 5/5
489/489 [==============================] - 0s 582us/step - loss: 0.1121 - acc: 0.9796
3 (118, 3) (118, 42)
Epoch 1/5
118/118 [==============================] - 1s 10ms/step - loss: 1.0487 - acc: 0.5254
Epoch 2/5
118/118 [==============================] - 0s 860us/step - loss: 0.9116 - acc: 0.8898
Epoch 3/5
118/118 [==============================] - 0s 862us/step - loss: 0.7684 - acc: 0.9237
Epoch 4/5
118/118 [==============================] - 0s 799us/step - loss: 0.6332 - acc: 0.9237
Epoch 5/5
118/118 [==============================] - 0s 548us/step - loss: 0.5188 - acc: 0.9237
3 (282, 3) (282, 42)
Epoch 1/5
282/282 [==============================] - 1s 5ms/step - loss: 1.1279 - acc: 0.3404
Epoch 2/5
282/282 [==============================] - 0s 612us/step - loss: 0.7877 - acc: 0.8475
Epoch 3/5
282/282 [==============================] - 0s 659us/step - loss: 0.4915 - acc: 0.9504
Epoch 4/5
282/282 [==============================] - 0s 567us/step - loss: 0.3135 - acc: 0.9504
Epoch 5/5
282/282 [==============================] - 0s 633us/step - loss: 0.2436 - acc: 0.9504
3 (686, 3) (686, 42)
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Epoch 1/5
686/686 [==============================] - 1s 2ms/step - loss: 0.8012 - acc: 0.8324
Epoch 2/5
686/686 [==============================] - 0s 557us/step - loss: 0.3000 - acc: 0.9869
Epoch 3/5
686/686 [==============================] - 0s 539us/step - loss: 0.1240 - acc: 0.9869
Epoch 4/5
686/686 [==============================] - 0s 702us/step - loss: 0.0891 - acc: 0.9869
Epoch 5/5
686/686 [==============================] - 0s 594us/step - loss: 0.0797 - acc: 0.9869
3 (110, 3) (110, 42)
Epoch 1/5
110/110 [==============================] - 1s 12ms/step - loss: 0.5219 - acc: 0.8636
Epoch 2/5
110/110 [==============================] - 0s 624us/step - loss: 0.3467 - acc: 0.9636
Epoch 3/5
110/110 [==============================] - 0s 605us/step - loss: 0.2329 - acc: 0.9909
Epoch 4/5
110/110 [==============================] - 0s 744us/step - loss: 0.1613 - acc: 1.0000
Epoch 5/5
110/110 [==============================] - 0s 598us/step - loss: 0.1158 - acc: 1.0000
3 (281, 3) (281, 42)
Epoch 1/5
281/281 [==============================] - 1s 5ms/step - loss: 1.0877 - acc: 0.3416
Epoch 2/5
281/281 [==============================] - 0s 777us/step - loss: 0.7994 - acc: 0.7153
Epoch 3/5
281/281 [==============================] - 0s 691us/step - loss: 0.6195 - acc: 0.8505
Epoch 4/5
281/281 [==============================] - 0s 629us/step - loss: 0.5242 - acc: 0.8683
Epoch 5/5
281/281 [==============================] - 0s 842us/step - loss: 0.4819 - acc: 0.8683
3 (133, 3) (133, 42)
Epoch 1/5
133/133 [==============================] - 1s 10ms/step - loss: 1.1691 - acc: 0.3609
Epoch 2/5
133/133 [==============================] - 0s 581us/step - loss: 1.0283 - acc: 0.4962
Epoch 3/5
133/133 [==============================] - 0s 638us/step - loss: 0.9305 - acc: 0.6316
Epoch 4/5
133/133 [==============================] - 0s 580us/step - loss: 0.8591 - acc: 0.6767
Epoch 5/5
133/133 [==============================] - 0s 675us/step - loss: 0.8077 - acc: 0.7068
3 (160, 3) (160, 42)
Epoch 1/5
160/160 [==============================] - 1s 9ms/step - loss: 0.9935 - acc: 0.5375
Epoch 2/5
160/160 [==============================] - 0s 730us/step - loss: 0.8791 - acc: 0.6688
```

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Epoch 3/5
160/160 [==============================] - 0s 651us/step - loss: 0.8127 - acc: 0.7125
Epoch 4/5
160/160 [==============================] - 0s 595us/step - loss: 0.7727 - acc: 0.7188
Epoch 5/5
160/160 [==============================] - 0s 661us/step - loss: 0.7495 - acc: 0.7188
3 (110, 3) (110, 42)
Epoch 1/5
110/110 [==============================] - 1s 12ms/step - loss: 1.1010 - acc: 0.5091
Epoch 2/5
110/110 [==============================] - 0s 759us/step - loss: 1.0331 - acc: 0.5182
Epoch 3/5
110/110 [==============================] - 0s 642us/step - loss: 0.9849 - acc: 0.5364
Epoch 4/5
110/110 [==============================] - 0s 592us/step - loss: 0.9496 - acc: 0.5455
Epoch 5/5
110/110 [==============================] - 0s 628us/step - loss: 0.9208 - acc: 0.5636
3 (197, 3) (197, 42)
Epoch 1/5
197/197 [==============================] - 1s 7ms/step - loss: 1.1070 - acc: 0.2995
Epoch 2/5
197/197 [==============================] - 0s 643us/step - loss: 0.8762 - acc: 0.6497
Epoch 3/5
197/197 [==============================] - 0s 610us/step - loss: 0.7220 - acc: 0.8173
Epoch 4/5
197/197 [==============================] - 0s 541us/step - loss: 0.6224 - acc: 0.8325
Epoch 5/5
197/197 [==============================] - 0s 615us/step - loss: 0.5637 - acc: 0.8325
3 (161, 3) (161, 42)
Epoch 1/5
161/161 [==============================] - 1s 9ms/step - loss: 1.3668 - acc: 0.1304
Epoch 2/5
161/161 [==============================] - 0s 742us/step - loss: 1.1824 - acc: 0.2112
Epoch 3/5
161/161 [==============================] - 0s 631us/step - loss: 1.0814 - acc: 0.4534
Epoch 4/5
161/161 [==============================] - 0s 720us/step - loss: 1.0125 - acc: 0.5714
Epoch 5/5
161/161 [==============================] - 0s 629us/step - loss: 0.9611 - acc: 0.6522
3 (131, 3) (131, 42)
Epoch 1/5
131/131 [==============================] - 1s 10ms/step - loss: 1.2174 - acc: 0.1603
Epoch 2/5
131/131 [==============================] - 0s 702us/step - loss: 1.0735 - acc: 0.3130
Epoch 3/5
131/131 [==============================] - 0s 746us/step - loss: 0.9575 - acc: 0.6565
Epoch 4/5
131/131 [==============================] - 0s 620us/step - loss: 0.8506 - acc: 0.7939
```

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Epoch 5/5
131/131 [==============================] - 0s 582us/step - loss: 0.7507 - acc: 0.8092
3 (348, 3) (348, 42)
Epoch 1/5
348/348 [==============================] - 2s 4ms/step - loss: 1.0455 - acc: 0.3218
Epoch 2/5
348/348 [==============================] - 0s 639us/step - loss: 0.8687 - acc: 0.6954
Epoch 3/5
348/348 [==============================] - 0s 632us/step - loss: 0.7372 - acc: 0.7557
Epoch 4/5
348/348 [==============================] - 0s 676us/step - loss: 0.6732 - acc: 0.7701
Epoch 5/5
348/348 [==============================] - 0s 559us/step - loss: 0.6446 - acc: 0.7701
3 (1511, 3) (1511, 42)
Epoch 1/5
1511/1511 [==============================] - 2s 2ms/step - loss: 0.6172 - acc: 0.8087
Epoch 2/5
1511/1511 [==============================] - 1s 668us/step - loss: 0.3921 - acc: 0.8868
Epoch 3/5
1511/1511 [==============================] - 1s 615us/step - loss: 0.3573 - acc: 0.8868
Epoch 4/5
1511/1511 [==============================] - 1s 639us/step - loss: 0.3326 - acc: 0.8868
Epoch 5/5
1511/1511 [==============================] - 1s 606us/step - loss: 0.3157 - acc: 0.8868
3 (1124, 3) (1124, 42)
Epoch 1/5
1124/1124 [==============================] - 2s 2ms/step - loss: 0.4910 - acc: 0.9386
Epoch 2/5
1124/1124 [==============================] - 1s 627us/step - loss: 0.0787 - acc: 0.9938
Epoch 3/5
1124/1124 [==============================] - 1s 602us/step - loss: 0.0399 - acc: 0.9938
Epoch 4/5
1124/1124 [==============================] - 1s 560us/step - loss: 0.0327 - acc: 0.9938
Epoch 5/5
1124/1124 [==============================] - 1s 595us/step - loss: 0.0300 - acc: 0.9938
3 (104, 3) (104, 42)
Epoch 1/5
104/104 [==============================] - 1s 14ms/step - loss: 1.1335 - acc: 0.3942
Epoch 2/5
104/104 [==============================] - 0s 688us/step - loss: 1.1171 - acc: 0.4038
Epoch 3/5
104/104 [==============================] - 0s 746us/step - loss: 1.1046 - acc: 0.3846
Epoch 4/5
104/104 [==============================] - 0s 845us/step - loss: 1.0934 - acc: 0.4038
Epoch 5/5
104/104 [==============================] - 0s 671us/step - loss: 1.0846 - acc: 0.4135
3 (118, 3) (118, 42)
Epoch 1/5
```

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118/118 [==============================] - 1s 12ms/step - loss: 0.9382 - acc: 0.6610
Epoch 2/5
118/118 [==============================] - 0s 596us/step - loss: 0.8089 - acc: 0.8475
Epoch 3/5
118/118 [==============================] - 0s 641us/step - loss: 0.7213 - acc: 0.8305
Epoch 4/5
118/118 [==============================] - 0s 628us/step - loss: 0.6471 - acc: 0.8390
Epoch 5/5
118/118 [==============================] - 0s 626us/step - loss: 0.5910 - acc: 0.8390
3 (153, 3) (153, 42)
Epoch 1/5
153/153 [==============================] - 2s 10ms/step - loss: 0.8364 - acc: 0.6471
Epoch 2/5
153/153 [==============================] - 0s 683us/step - loss: 0.7271 - acc: 0.7582
Epoch 3/5
153/153 [==============================] - 0s 710us/step - loss: 0.6811 - acc: 0.7843
Epoch 4/5
153/153 [==============================] - 0s 744us/step - loss: 0.6550 - acc: 0.7843
Epoch 5/5
153/153 [==============================] - 0s 698us/step - loss: 0.6379 - acc: 0.7843
3 (185, 3) (185, 42)
Epoch 1/5
185/185 [==============================] - 2s 8ms/step - loss: 1.0291 - acc: 0.4973
Epoch 2/5
185/185 [==============================] - 0s 635us/step - loss: 0.8321 - acc: 0.7676
Epoch 3/5
185/185 [==============================] - 0s 661us/step - loss: 0.6901 - acc: 0.8865
Epoch 4/5
185/185 [==============================] - 0s 668us/step - loss: 0.5834 - acc: 0.8973
Epoch 5/5
185/185 [==============================] - 0s 743us/step - loss: 0.5068 - acc: 0.8973
3 (348, 3) (348, 42)
Epoch 1/5
348/348 [==============================] - 2s 5ms/step - loss: 0.7945 - acc: 0.7960
Epoch 2/5
348/348 [==============================] - 0s 670us/step - loss: 0.4799 - acc: 0.9368
Epoch 3/5
348/348 [==============================] - 0s 687us/step - loss: 0.3310 - acc: 0.9368
Epoch 4/5
348/348 [==============================] - 0s 719us/step - loss: 0.2789 - acc: 0.9368
Epoch 5/5
348/348 [==============================] - 0s 708us/step - loss: 0.2577 - acc: 0.9368
3 (1885, 3) (1885, 42)
Epoch 1/5
1885/1885 [==============================] - 3s 1ms/step - loss: 0.4595 - acc: 0.8647
Epoch 2/5
1885/1885 [==============================] - 1s 624us/step - loss: 0.0413 - acc: 0.9973
Epoch 3/5
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1885/1885 [==============================] - 1s 657us/step - loss: 0.0214 - acc: 0.9973
Epoch 4/5
1885/1885 [==============================] - 1s 651us/step - loss: 0.0180 - acc: 0.9973
Epoch 5/5
1885/1885 [==============================] - 1s 680us/step - loss: 0.0165 - acc: 0.9973
3 (126, 3) (126, 42)
Epoch 1/5
126/126 [==============================] - 2s 13ms/step - loss: 1.7015 - acc: 0.0317
Epoch 2/5
126/126 [==============================] - 0s 671us/step - loss: 1.4286 - acc: 0.0317
Epoch 3/5
126/126 [==============================] - 0s 626us/step - loss: 1.2216 - acc: 0.1905
Epoch 4/5
126/126 [==============================] - 0s 666us/step - loss: 1.0605 - acc: 0.5079
Epoch 5/5
126/126 [==============================] - 0s 681us/step - loss: 0.9250 - acc: 0.7143
3 (100, 3) (100, 42)
Epoch 1/5
100/100 [==============================] - 2s 17ms/step - loss: 1.1480 - acc: 0.2100
Epoch 2/5
100/100 [==============================] - 0s 674us/step - loss: 1.0894 - acc: 0.3400
Epoch 3/5
100/100 [==============================] - 0s 648us/step - loss: 1.0375 - acc: 0.4700
Epoch 4/5
100/100 [==============================] - 0s 723us/step - loss: 0.9919 - acc: 0.5800
Epoch 5/5
100/100 [==============================] - 0s 806us/step - loss: 0.9490 - acc: 0.6300
3 (188, 3) (188, 42)
Epoch 1/5
188/188 [==============================] - 2s 9ms/step - loss: 0.9975 - acc: 0.5000
Epoch 2/5
188/188 [==============================] - 0s 692us/step - loss: 0.8752 - acc: 0.6968
Epoch 3/5
188/188 [==============================] - 0s 672us/step - loss: 0.7911 - acc: 0.6968
Epoch 4/5
188/188 [==============================] - 0s 623us/step - loss: 0.7428 - acc: 0.6968
Epoch 5/5
188/188 [==============================] - 0s 723us/step - loss: 0.7130 - acc: 0.6915
3 (233, 3) (233, 42)
Epoch 1/5
233/233 [==============================] - 2s 8ms/step - loss: 1.6986 - acc: 0.0644
Epoch 2/5
233/233 [==============================] - 0s 887us/step - loss: 1.2401 - acc: 0.0944
Epoch 3/5
233/233 [==============================] - 0s 666us/step - loss: 0.9488 - acc: 0.5236
Epoch 4/5
233/233 [==============================] - 0s 652us/step - loss: 0.7439 - acc: 0.8798
Epoch 5/5
```

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233/233 [==============================] - 0s 661us/step - loss: 0.5979 - acc: 0.9056
3 (128, 3) (128, 42)
Epoch 1/5
128/128 [==============================] - 2s 13ms/step - loss: 1.3607 - acc: 0.2188
Epoch 2/5
128/128 [==============================] - 0s 671us/step - loss: 1.2145 - acc: 0.3125
Epoch 3/5
128/128 [==============================] - 0s 650us/step - loss: 1.1276 - acc: 0.4219
Epoch 4/5
128/128 [==============================] - 0s 702us/step - loss: 1.0723 - acc: 0.4688
Epoch 5/5
128/128 [==============================] - 0s 739us/step - loss: 1.0278 - acc: 0.4922
3 (117, 3) (117, 42)
Epoch 1/5
117/117 [==============================] - 2s 14ms/step - loss: 1.1168 - acc: 0.3675
Epoch 2/5
117/117 [==============================] - 0s 729us/step - loss: 1.0543 - acc: 0.4615
Epoch 3/5
117/117 [==============================] - 0s 715us/step - loss: 1.0148 - acc: 0.5641
Epoch 4/5
117/117 [==============================] - 0s 690us/step - loss: 0.9884 - acc: 0.6496
Epoch 5/5
117/117 [==============================] - 0s 709us/step - loss: 0.9706 - acc: 0.6325
3 (127, 3) (127, 42)
Epoch 1/5
127/127 [==============================] - 2s 13ms/step - loss: 1.1453 - acc: 0.2441
Epoch 2/5
127/127 [==============================] - 0s 782us/step - loss: 1.1101 - acc: 0.3150
Epoch 3/5
127/127 [==============================] - 0s 862us/step - loss: 1.0895 - acc: 0.4016
Epoch 4/5
127/127 [==============================] - 0s 733us/step - loss: 1.0769 - acc: 0.5039
Epoch 5/5
127/127 [==============================] - 0s 681us/step - loss: 1.0665 - acc: 0.5433
3 (155, 3) (155, 42)
Epoch 1/5
155/155 [==============================] - 2s 11ms/step - loss: 1.1849 - acc: 0.3806
Epoch 2/5
155/155 [==============================] - 0s 698us/step - loss: 1.1377 - acc: 0.3935
Epoch 3/5
155/155 [==============================] - 0s 682us/step - loss: 1.1052 - acc: 0.3935
Epoch 4/5
155/155 [==============================] - 0s 652us/step - loss: 1.0809 - acc: 0.3871
Epoch 5/5
155/155 [==============================] - 0s 643us/step - loss: 1.0620 - acc: 0.3935
3 (118, 3) (118, 42)
Epoch 1/5
118/118 [==============================] - 2s 15ms/step - loss: 1.1119 - acc: 0.3220
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Epoch 2/5
118/118 [==============================] - 0s 796us/step - loss: 1.0799 - acc: 0.3390
Epoch 3/5
118/118 [==============================] - 0s 691us/step - loss: 1.0551 - acc: 0.3390
Epoch 4/5
118/118 [==============================] - 0s 682us/step - loss: 1.0354 - acc: 0.3475
Epoch 5/5
118/118 [==============================] - 0s 677us/step - loss: 1.0198 - acc: 0.3983
3 (146, 3) (146, 42)
Epoch 1/5
146/146 [==============================] - 2s 12ms/step - loss: 1.0464 - acc: 0.3630
Epoch 2/5
146/146 [==============================] - 0s 877us/step - loss: 0.8255 - acc: 0.9315
Epoch 3/5
146/146 [==============================] - 0s 834us/step - loss: 0.6443 - acc: 0.9932
Epoch 4/5
146/146 [==============================] - 0s 810us/step - loss: 0.4860 - acc: 1.0000
Epoch 5/5
146/146 [==============================] - 0s 972us/step - loss: 0.3560 - acc: 1.0000
3 (167, 3) (167, 42)
Epoch 1/5
167/167 [==============================] - 2s 11ms/step - loss: 0.8968 - acc: 0.7904
Epoch 2/5
167/167 [==============================] - 0s 784us/step - loss: 0.7530 - acc: 0.8263
Epoch 3/5
167/167 [==============================] - 0s 741us/step - loss: 0.6236 - acc: 0.8383
Epoch 4/5
167/167 [==============================] - 0s 759us/step - loss: 0.5398 - acc: 0.8383
Epoch 5/5
167/167 [==============================] - 0s 646us/step - loss: 0.4910 - acc: 0.8443
3 (145, 3) (145, 42)
Epoch 1/5
145/145 [==============================] - 2s 13ms/step - loss: 0.8705 - acc: 0.5793
Epoch 2/5
145/145 [==============================] - 0s 845us/step - loss: 0.8212 - acc: 0.6207
Epoch 3/5
145/145 [==============================] - 0s 688us/step - loss: 0.7907 - acc: 0.6276
Epoch 4/5
145/145 [==============================] - 0s 737us/step - loss: 0.7635 - acc: 0.6276
Epoch 5/5
145/145 [==============================] - 0s 850us/step - loss: 0.7417 - acc: 0.6621
3 (123, 3) (123, 42)
Epoch 1/5
123/123 [==============================] - 2s 15ms/step - loss: 1.2481 - acc: 0.0976
Epoch 2/5
123/123 [==============================] - 0s 674us/step - loss: 1.1573 - acc: 0.2195
Epoch 3/5
123/123 [==============================] - 0s 713us/step - loss: 1.0961 - acc: 0.3496
```

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Epoch 4/5
123/123 [==============================] - 0s 717us/step - loss: 1.0462 - acc: 0.6016
Epoch 5/5
123/123 [==============================] - 0s 691us/step - loss: 1.0004 - acc: 0.6829
3 (101, 3) (101, 42)
Epoch 1/5
101/101 [==============================] - 2s 18ms/step - loss: 1.0006 - acc: 0.3762
Epoch 2/5
101/101 [==============================] - 0s 854us/step - loss: 0.9660 - acc: 0.4059
Epoch 3/5
101/101 [==============================] - 0s 830us/step - loss: 0.9410 - acc: 0.4554
Epoch 4/5
101/101 [==============================] - 0s 783us/step - loss: 0.9210 - acc: 0.4851
Epoch 5/5
101/101 [==============================] - 0s 817us/step - loss: 0.9044 - acc: 0.5050
3 (159, 3) (159, 42)
Epoch 1/5
159/159 [==============================] - 2s 12ms/step - loss: 1.1509 - acc: 0.2453
Epoch 2/5
159/159 [==============================] - 0s 750us/step - loss: 1.0724 - acc: 0.4088
Epoch 3/5
159/159 [==============================] - 0s 803us/step - loss: 1.0189 - acc: 0.4780
Epoch 4/5
159/159 [==============================] - 0s 756us/step - loss: 0.9691 - acc: 0.5975
Epoch 5/5
159/159 [==============================] - 0s 759us/step - loss: 0.9219 - acc: 0.6289
3 (236, 3) (236, 42)
Epoch 1/5
236/236 [==============================] - 2s 8ms/step - loss: 1.1133 - acc: 0.2839
Epoch 2/5
236/236 [==============================] - 0s 739us/step - loss: 1.1029 - acc: 0.3432
Epoch 3/5
236/236 [==============================] - 0s 725us/step - loss: 1.0966 - acc: 0.3602
Epoch 4/5
236/236 [==============================] - 0s 714us/step - loss: 1.0908 - acc: 0.3814
Epoch 5/5
236/236 [==============================] - 0s 762us/step - loss: 1.0861 - acc: 0.3983
3 (232, 3) (232, 42)
Epoch 1/5
232/232 [==============================] - 2s 9ms/step - loss: 1.1277 - acc: 0.4440
Epoch 2/5
232/232 [==============================] - 0s 900us/step - loss: 1.0290 - acc: 0.4957
Epoch 3/5
232/232 [==============================] - 0s 948us/step - loss: 0.9796 - acc: 0.5474
Epoch 4/5
232/232 [==============================] - 0s 882us/step - loss: 0.9498 - acc: 0.5776
Epoch 5/5
232/232 [==============================] - 0s 869us/step - loss: 0.9268 - acc: 0.5948
```

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3 (191, 3) (191, 42)
Epoch 1/5
191/191 [==============================] - 2s 11ms/step - loss: 0.9306 - acc: 0.5183
Epoch 2/5
191/191 [==============================] - 0s 739us/step - loss: 0.8487 - acc: 0.6021
Epoch 3/5
191/191 [==============================] - 0s 731us/step - loss: 0.7960 - acc: 0.5969
Epoch 4/5
191/191 [==============================] - 0s 930us/step - loss: 0.7652 - acc: 0.5969
Epoch 5/5
191/191 [==============================] - 0s 836us/step - loss: 0.7436 - acc: 0.6073
3 (146, 3) (146, 42)
Epoch 1/5
146/146 [==============================] - 2s 13ms/step - loss: 1.0791 - acc: 0.4658
Epoch 2/5
146/146 [==============================] - 0s 693us/step - loss: 0.8525 - acc: 0.7603
Epoch 3/5
146/146 [==============================] - 0s 712us/step - loss: 0.6739 - acc: 0.8425
Epoch 4/5
146/146 [==============================] - 0s 718us/step - loss: 0.5475 - acc: 0.8973
Epoch 5/5
146/146 [==============================] - 0s 735us/step - loss: 0.4734 - acc: 0.9110
3 (132, 3) (132, 42)
Epoch 1/5
132/132 [==============================] - 2s 15ms/step - loss: 1.0228 - acc: 0.1818
Epoch 2/5
132/132 [==============================] - 0s 688us/step - loss: 0.8931 - acc: 0.5833
Epoch 3/5
132/132 [==============================] - 0s 644us/step - loss: 0.7840 - acc: 0.8333
Epoch 4/5
132/132 [==============================] - 0s 719us/step - loss: 0.6907 - acc: 0.8409
Epoch 5/5
132/132 [==============================] - 0s 963us/step - loss: 0.6178 - acc: 0.8409
3 (223, 3) (223, 42)
Epoch 1/5
223/223 [==============================] - 2s 9ms/step - loss: 1.1498 - acc: 0.3587
Epoch 2/5
223/223 [==============================] - 0s 746us/step - loss: 1.0882 - acc: 0.4395
Epoch 3/5
223/223 [==============================] - 0s 684us/step - loss: 1.0528 - acc: 0.4664
Epoch 4/5
223/223 [==============================] - 0s 709us/step - loss: 1.0294 - acc: 0.4798
Epoch 5/5
223/223 [==============================] - 0s 783us/step - loss: 1.0126 - acc: 0.4664
3 (402, 3) (402, 42)
Epoch 1/5
402/402 [==============================] - 2s 6ms/step - loss: 1.0022 - acc: 0.4975
Epoch 2/5
```

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402/402 [==============================] - 0s 829us/step - loss: 0.7291 - acc: 0.7811
Epoch 3/5
402/402 [==============================] - 0s 734us/step - loss: 0.6308 - acc: 0.7960
Epoch 4/5
402/402 [==============================] - 0s 729us/step - loss: 0.5919 - acc: 0.7960
Epoch 5/5
402/402 [==============================] - 0s 786us/step - loss: 0.5674 - acc: 0.7985
3 (701, 3) (701, 42)
Epoch 1/5
701/701 [==============================] - 2s 4ms/step - loss: 1.0354 - acc: 0.5207
Epoch 2/5
701/701 [==============================] - 1s 717us/step - loss: 0.9682 - acc: 0.6020
Epoch 3/5
701/701 [==============================] - 1s 727us/step - loss: 0.9204 - acc: 0.6091
Epoch 4/5
701/701 [==============================] - 1s 766us/step - loss: 0.8837 - acc: 0.6106
Epoch 5/5
701/701 [==============================] - 1s 761us/step - loss: 0.8533 - acc: 0.6120
3 (1188, 3) (1188, 42)
Epoch 1/5
1188/1188 [==============================] - 3s 2ms/step - loss: 0.6003 - acc: 0.8561
Epoch 2/5
1188/1188 [==============================] - 1s 747us/step - loss: 0.4359 - acc: 0.8822
Epoch 3/5
1188/1188 [==============================] - 1s 783us/step - loss: 0.3943 - acc: 0.8822
Epoch 4/5
1188/1188 [==============================] - 1s 781us/step - loss: 0.3664 - acc: 0.8822
Epoch 5/5
1188/1188 [==============================] - 1s 760us/step - loss: 0.3478 - acc: 0.8813
3 (1258, 3) (1258, 42)
Epoch 1/5
1258/1258 [==============================] - 3s 2ms/step - loss: 0.7919 - acc: 0.7178
Epoch 2/5
1258/1258 [==============================] - 1s 807us/step - loss: 0.6698 - acc: 0.7639
Epoch 3/5
1258/1258 [==============================] - 1s 811us/step - loss: 0.6277 - acc: 0.7663
Epoch 4/5
1258/1258 [==============================] - 1s 768us/step - loss: 0.5993 - acc: 0.7734
Epoch 5/5
1258/1258 [==============================] - 1s 750us/step - loss: 0.5794 - acc: 0.7798
3 (273, 3) (273, 42)
Epoch 1/5
273/273 [==============================] - 2s 8ms/step - loss: 1.3008 - acc: 0.2527
Epoch 2/5
273/273 [==============================] - 0s 768us/step - loss: 1.0204 - acc: 0.5458
Epoch 3/5
273/273 [==============================] - 0s 837us/step - loss: 0.9109 - acc: 0.6520
Epoch 4/5
```

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273/273 [==============================] - 0s 672us/step - loss: 0.8665 - acc: 0.6630
Epoch 5/5
273/273 [==============================] - 0s 826us/step - loss: 0.8392 - acc: 0.6593
3 (216, 3) (216, 42)
Epoch 1/5
216/216 [==============================] - 3s 12ms/step - loss: 1.0498 - acc: 0.5093
Epoch 2/5
216/216 [==============================] - 0s 723us/step - loss: 0.9596 - acc: 0.6111
Epoch 3/5
216/216 [==============================] - 0s 751us/step - loss: 0.8895 - acc: 0.6667
Epoch 4/5
216/216 [==============================] - 0s 702us/step - loss: 0.8318 - acc: 0.6713
Epoch 5/5
216/216 [==============================] - 0s 719us/step - loss: 0.7868 - acc: 0.6852
3 (135, 3) (135, 42)
Epoch 1/5
135/135 [==============================] - 2s 16ms/step - loss: 1.2304 - acc: 0.3037
Epoch 2/5
135/135 [==============================] - 0s 875us/step - loss: 1.1386 - acc: 0.3259
Epoch 3/5
135/135 [==============================] - 0s 781us/step - loss: 1.0735 - acc: 0.4148
Epoch 4/5
135/135 [==============================] - 0s 724us/step - loss: 1.0306 - acc: 0.4593
Epoch 5/5
135/135 [==============================] - 0s 727us/step - loss: 1.0011 - acc: 0.5037
3 (108, 3) (108, 42)
Epoch 1/5
108/108 [==============================] - 2s 20ms/step - loss: 1.3280 - acc: 0.1019
Epoch 2/5
108/108 [==============================] - 0s 790us/step - loss: 1.1906 - acc: 0.2500
Epoch 3/5
108/108 [==============================] - 0s 895us/step - loss: 1.0925 - acc: 0.4074
Epoch 4/5
108/108 [==============================] - 0s 899us/step - loss: 1.0161 - acc: 0.4907
Epoch 5/5
108/108 [==============================] - 0s 855us/step - loss: 0.9657 - acc: 0.5000
3 (142, 3) (142, 42)
Epoch 1/5
142/142 [==============================] - 2s 16ms/step - loss: 1.1446 - acc: 0.2606
Epoch 2/5
142/142 [==============================] - 0s 832us/step - loss: 1.0970 - acc: 0.3451
Epoch 3/5
142/142 [==============================] - 0s 868us/step - loss: 1.0575 - acc: 0.4296
Epoch 4/5
142/142 [==============================] - 0s 1ms/step - loss: 1.0244 - acc: 0.5000
Epoch 5/5
142/142 [==============================] - 0s 908us/step - loss: 0.9901 - acc: 0.5423
3 (364, 3) (364, 42)
```

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Epoch 1/5
364/364 [==============================] - 3s 7ms/step - loss: 0.8935 - acc: 0.6621
Epoch 2/5
364/364 [==============================] - 0s 938us/step - loss: 0.8236 - acc: 0.6648
Epoch 3/5
364/364 [==============================] - 0s 884us/step - loss: 0.7913 - acc: 0.6648
Epoch 4/5
364/364 [==============================] - 0s 836us/step - loss: 0.7679 - acc: 0.6648
Epoch 5/5
364/364 [==============================] - 0s 845us/step - loss: 0.7465 - acc: 0.6648
3 (188, 3) (188, 42)
Epoch 1/5
188/188 [==============================] - 2s 12ms/step - loss: 0.9529 - acc: 0.5904
Epoch 2/5
188/188 [==============================] - 0s 849us/step - loss: 0.7670 - acc: 0.7979
Epoch 3/5
188/188 [==============================] - 0s 773us/step - loss: 0.6536 - acc: 0.8298
Epoch 4/5
188/188 [==============================] - 0s 716us/step - loss: 0.5800 - acc: 0.8404
Epoch 5/5
188/188 [==============================] - 0s 877us/step - loss: 0.5338 - acc: 0.8511
3 (366, 3) (366, 42)
Epoch 1/5
366/366 [==============================] - 3s 7ms/step - loss: 0.9430 - acc: 0.7377
Epoch 2/5
366/366 [==============================] - 0s 693us/step - loss: 0.5823 - acc: 0.9836
Epoch 3/5
366/366 [==============================] - 0s 745us/step - loss: 0.2709 - acc: 0.9863
Epoch 4/5
366/366 [==============================] - 0s 688us/step - loss: 0.1269 - acc: 0.9863
Epoch 5/5
366/366 [==============================] - 0s 752us/step - loss: 0.0900 - acc: 0.9863
3 (121, 3) (121, 42)
Epoch 1/5
121/121 [==============================] - 2s 19ms/step - loss: 0.8382 - acc: 0.7934
Epoch 2/5
121/121 [==============================] - 0s 788us/step - loss: 0.7234 - acc: 0.8182
Epoch 3/5
121/121 [==============================] - 0s 931us/step - loss: 0.6411 - acc: 0.8264
Epoch 4/5
121/121 [==============================] - 0s 1ms/step - loss: 0.5871 - acc: 0.8347
Epoch 5/5
121/121 [==============================] - 0s 1ms/step - loss: 0.5548 - acc: 0.8430
3 (160, 3) (160, 42)
Epoch 1/5
160/160 [==============================] - 2s 15ms/step - loss: 1.0186 - acc: 0.4125
Epoch 2/5
160/160 [==============================] - 0s 893us/step - loss: 0.8841 - acc: 0.8438
```

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Epoch 3/5
160/160 [==============================] - 0s 789us/step - loss: 0.7536 - acc: 0.9375
Epoch 4/5
160/160 [==============================] - 0s 833us/step - loss: 0.6139 - acc: 0.9375
Epoch 5/5
160/160 [==============================] - 0s 721us/step - loss: 0.4925 - acc: 0.9375
3 (121, 3) (121, 42)
Epoch 1/5
121/121 [==============================] - 2s 20ms/step - loss: 1.0290 - acc: 0.4711
Epoch 2/5
121/121 [==============================] - 0s 777us/step - loss: 0.8989 - acc: 0.7603
Epoch 3/5
121/121 [==============================] - 0s 877us/step - loss: 0.7863 - acc: 0.9008
Epoch 4/5
121/121 [==============================] - 0s 949us/step - loss: 0.6900 - acc: 0.9091
Epoch 5/5
121/121 [==============================] - 0s 1ms/step - loss: 0.6060 - acc: 0.9091
3 (146, 3) (146, 42)
Epoch 1/5
146/146 [==============================] - 3s 18ms/step - loss: 1.1140 - acc: 0.3082
Epoch 2/5
146/146 [==============================] - 0s 736us/step - loss: 0.8816 - acc: 0.8630
Epoch 3/5
146/146 [==============================] - 0s 736us/step - loss: 0.6136 - acc: 0.9795
Epoch 4/5
146/146 [==============================] - 0s 1ms/step - loss: 0.3715 - acc: 0.9932
Epoch 5/5
146/146 [==============================] - 0s 830us/step - loss: 0.2191 - acc: 0.9932
3 (121, 3) (121, 42)
Epoch 1/5
121/121 [==============================] - 2s 20ms/step - loss: 0.9890 - acc: 0.5207
Epoch 2/5
121/121 [==============================] - 0s 747us/step - loss: 0.8290 - acc: 0.7769
Epoch 3/5
121/121 [==============================] - 0s 743us/step - loss: 0.7114 - acc: 0.8430
Epoch 4/5
121/121 [==============================] - 0s 774us/step - loss: 0.6332 - acc: 0.8512
Epoch 5/5
121/121 [==============================] - 0s 853us/step - loss: 0.5820 - acc: 0.8512
3 (117, 3) (117, 42)
Epoch 1/5
117/117 [==============================] - 2s 21ms/step - loss: 0.8573 - acc: 0.7863
Epoch 2/5
117/117 [==============================] - 0s 815us/step - loss: 0.7249 - acc: 0.8205
Epoch 3/5
117/117 [==============================] - 0s 769us/step - loss: 0.6283 - acc: 0.8547
Epoch 4/5
117/117 [==============================] - 0s 891us/step - loss: 0.5513 - acc: 0.8547
```

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Epoch 5/5
117/117 [==============================] - 0s 808us/step - loss: 0.5003 - acc: 0.8547
3 (203, 3) (203, 42)
Epoch 1/5
203/203 [==============================] - 2s 12ms/step - loss: 1.1251 - acc: 0.3990
Epoch 2/5
203/203 [==============================] - 0s 840us/step - loss: 0.8644 - acc: 0.6207
Epoch 3/5
203/203 [==============================] - 0s 739us/step - loss: 0.6952 - acc: 0.7783
Epoch 4/5
203/203 [==============================] - 0s 784us/step - loss: 0.5662 - acc: 0.8916
Epoch 5/5
203/203 [==============================] - 0s 832us/step - loss: 0.4609 - acc: 0.8916
3 (165, 3) (165, 42)
Epoch 1/5
165/165 [==============================] - 3s 16ms/step - loss: 1.0855 - acc: 0.2000
Epoch 2/5
165/165 [==============================] - 0s 1ms/step - loss: 0.9115 - acc: 0.5273
Epoch 3/5
165/165 [==============================] - 0s 943us/step - loss: 0.7360 - acc: 0.8424
Epoch 4/5
165/165 [==============================] - 0s 1ms/step - loss: 0.5745 - acc: 0.9030
Epoch 5/5
165/165 [==============================] - 0s 1ms/step - loss: 0.4520 - acc: 0.9273
3 (462, 3) (462, 42)
Epoch 1/5
462/462 [==============================] - 3s 6ms/step - loss: 0.3891 - acc: 0.9870
Epoch 2/5
462/462 [==============================] - 1s 1ms/step - loss: 0.1296 - acc: 0.9935
Epoch 3/5
462/462 [==============================] - 0s 986us/step - loss: 0.0673 - acc: 0.9935
Epoch 4/5
462/462 [==============================] - 0s 902us/step - loss: 0.0500 - acc: 0.9935
Epoch 5/5
462/462 [==============================] - 0s 1ms/step - loss: 0.0437 - acc: 0.9935
3 (372, 3) (372, 42)
Epoch 1/5
372/372 [==============================] - 3s 8ms/step - loss: 0.9483 - acc: 0.5161
Epoch 2/5
372/372 [==============================] - 0s 895us/step - loss: 0.5288 - acc: 0.9382
Epoch 3/5
372/372 [==============================] - 0s 1ms/step - loss: 0.2731 - acc: 0.9677
Epoch 4/5
372/372 [==============================] - 0s 1ms/step - loss: 0.1861 - acc: 0.9677
Epoch 5/5
372/372 [==============================] - 0s 1ms/step - loss: 0.1563 - acc: 0.9677
3 (113, 3) (113, 42)
Epoch 1/5
```

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113/113 [==============================] - 3s 23ms/step - loss: 1.3494 - acc: 0.0442
Epoch 2/5
113/113 [==============================] - 0s 809us/step - loss: 1.2408 - acc: 0.1327
Epoch 3/5
113/113 [==============================] - 0s 788us/step - loss: 1.1480 - acc: 0.2920
Epoch 4/5
113/113 [==============================] - 0s 844us/step - loss: 1.0614 - acc: 0.4513
Epoch 5/5
113/113 [==============================] - 0s 848us/step - loss: 0.9806 - acc: 0.5310
3 (168, 3) (168, 42)
Epoch 1/5
168/168 [==============================] - 3s 16ms/step - loss: 1.3089 - acc: 0.1845
Epoch 2/5
168/168 [==============================] - 0s 1ms/step - loss: 1.1761 - acc: 0.3214
Epoch 3/5
168/168 [==============================] - 0s 874us/step - loss: 1.0929 - acc: 0.4226
Epoch 4/5
168/168 [==============================] - 0s 841us/step - loss: 1.0410 - acc: 0.4464
Epoch 5/5
168/168 [==============================] - 0s 924us/step - loss: 0.9996 - acc: 0.4821
3 (162, 3) (162, 42)
Epoch 1/5
162/162 [==============================] - 3s 17ms/step - loss: 1.1366 - acc: 0.3519
Epoch 2/5
162/162 [==============================] - 0s 880us/step - loss: 1.0752 - acc: 0.4691
Epoch 3/5
162/162 [==============================] - 0s 856us/step - loss: 1.0341 - acc: 0.5309
Epoch 4/5
162/162 [==============================] - 0s 812us/step - loss: 1.0039 - acc: 0.5432
Epoch 5/5
162/162 [==============================] - 0s 765us/step - loss: 0.9795 - acc: 0.5494
3 (169, 3) (169, 42)
Epoch 1/5
169/169 [==============================] - 3s 19ms/step - loss: 1.0443 - acc: 0.4320
Epoch 2/5
169/169 [==============================] - 0s 961us/step - loss: 0.9833 - acc: 0.5444
Epoch 3/5
169/169 [==============================] - 0s 1ms/step - loss: 0.9420 - acc: 0.6036
Epoch 4/5
169/169 [==============================] - 0s 1ms/step - loss: 0.9097 - acc: 0.6272
Epoch 5/5
169/169 [==============================] - 0s 869us/step - loss: 0.8833 - acc: 0.6509
3 (247, 3) (247, 42)
Epoch 1/5
247/247 [==============================] - 3s 11ms/step - loss: 0.9059 - acc: 0.5992
Epoch 2/5
247/247 [==============================] - 0s 895us/step - loss: 0.7243 - acc: 0.8016
Epoch 3/5
```

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247/247 [==============================] - 0s 1ms/step - loss: 0.6119 - acc: 0.8178
Epoch 4/5
247/247 [==============================] - 0s 925us/step - loss: 0.5491 - acc: 0.8219
Epoch 5/5
247/247 [==============================] - 0s 897us/step - loss: 0.5098 - acc: 0.8219
3 (185, 3) (185, 42)
Epoch 1/5
185/185 [==============================] - 3s 15ms/step - loss: 1.0774 - acc: 0.3622
Epoch 2/5
185/185 [==============================] - 0s 1ms/step - loss: 1.0551 - acc: 0.4108
Epoch 3/5
185/185 [==============================] - 0s 1ms/step - loss: 1.0385 - acc: 0.4270
Epoch 4/5
185/185 [==============================] - 0s 1ms/step - loss: 1.0235 - acc: 0.4378
Epoch 5/5
185/185 [==============================] - 0s 1ms/step - loss: 1.0104 - acc: 0.4324
3 (249, 3) (249, 42)
Epoch 1/5
249/249 [==============================] - 3s 12ms/step - loss: 1.2561 - acc: 0.1526
Epoch 2/5
249/249 [==============================] - 0s 1ms/step - loss: 1.0480 - acc: 0.4458
Epoch 3/5
249/249 [==============================] - 0s 839us/step - loss: 0.9476 - acc: 0.5542
Epoch 4/5
249/249 [==============================] - 0s 891us/step - loss: 0.8938 - acc: 0.6345
Epoch 5/5
249/249 [==============================] - 0s 1ms/step - loss: 0.8610 - acc: 0.6386
3 (111, 3) (111, 42)
Epoch 1/5
111/111 [==============================] - 3s 25ms/step - loss: 1.3733 - acc: 0.1171
Epoch 2/5
111/111 [==============================] - 0s 876us/step - loss: 1.1998 - acc: 0.2613
Epoch 3/5
111/111 [==============================] - 0s 829us/step - loss: 1.0788 - acc: 0.3784
Epoch 4/5
111/111 [==============================] - 0s 811us/step - loss: 0.9931 - acc: 0.4595
Epoch 5/5
111/111 [==============================] - 0s 1ms/step - loss: 0.9412 - acc: 0.5225
3 (116, 3) (116, 42)
Epoch 1/5
116/116 [==============================] - 3s 24ms/step - loss: 1.2062 - acc: 0.1983
Epoch 2/5
116/116 [==============================] - 0s 800us/step - loss: 1.0081 - acc: 0.4828
Epoch 3/5
116/116 [==============================] - 0s 863us/step - loss: 0.8725 - acc: 0.6552
Epoch 4/5
116/116 [==============================] - 0s 868us/step - loss: 0.7736 - acc: 0.7845
Epoch 5/5
```

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116/116 [==============================] - 0s 844us/step - loss: 0.7041 - acc: 0.7931
3 (192, 3) (192, 42)
Epoch 1/5
192/192 [==============================] - 3s 15ms/step - loss: 1.4260 - acc: 0.1250
Epoch 2/5
192/192 [==============================] - 0s 1ms/step - loss: 1.1539 - acc: 0.2813
Epoch 3/5
192/192 [==============================] - 0s 1ms/step - loss: 0.9698 - acc: 0.5521
Epoch 4/5
192/192 [==============================] - 0s 860us/step - loss: 0.8005 - acc: 0.7500
Epoch 5/5
192/192 [==============================] - 0s 826us/step - loss: 0.6483 - acc: 0.8333
3 (100, 3) (100, 42)
Epoch 1/5
100/100 [==============================] - 3s 28ms/step - loss: 1.2004 - acc: 0.2800
Epoch 2/5
100/100 [==============================] - 0s 810us/step - loss: 1.1629 - acc: 0.3100
Epoch 3/5
100/100 [==============================] - 0s 1ms/step - loss: 1.1338 - acc: 0.3200
Epoch 4/5
100/100 [==============================] - 0s 2ms/step - loss: 1.1094 - acc: 0.3200
Epoch 5/5
100/100 [==============================] - 0s 1ms/step - loss: 1.0907 - acc: 0.3200
3 (103, 3) (103, 42)
Epoch 1/5
103/103 [==============================] - 3s 29ms/step - loss: 0.8998 - acc: 0.6214
Epoch 2/5
103/103 [==============================] - 0s 1ms/step - loss: 0.8696 - acc: 0.6311
Epoch 3/5
103/103 [==============================] - 0s 853us/step - loss: 0.8485 - acc: 0.6505
Epoch 4/5
103/103 [==============================] - 0s 885us/step - loss: 0.8301 - acc: 0.6505
Epoch 5/5
103/103 [==============================] - 0s 1ms/step - loss: 0.8142 - acc: 0.6505
3 (103, 3) (103, 42)
Epoch 1/5
103/103 [==============================] - 3s 28ms/step - loss: 1.1995 - acc: 0.1748
Epoch 2/5
103/103 [==============================] - 0s 939us/step - loss: 1.0907 - acc: 0.3010
Epoch 3/5
103/103 [==============================] - 0s 916us/step - loss: 1.0062 - acc: 0.4466
Epoch 4/5
103/103 [==============================] - 0s 936us/step - loss: 0.9371 - acc: 0.5825
Epoch 5/5
103/103 [==============================] - 0s 949us/step - loss: 0.8810 - acc: 0.6699
3 (100, 3) (100, 42)
Epoch 1/5
100/100 [==============================] - 3s 29ms/step - loss: 1.1374 - acc: 0.3200
```

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Epoch 2/5
100/100 [==============================] - 0s 828us/step - loss: 1.0000 - acc: 0.5300
Epoch 3/5
100/100 [==============================] - 0s 833us/step - loss: 0.8797 - acc: 0.7100
Epoch 4/5
100/100 [==============================] - 0s 824us/step - loss: 0.7877 - acc: 0.7700
Epoch 5/5
100/100 [==============================] - 0s 870us/step - loss: 0.7181 - acc: 0.7800
3 (124, 3) (124, 42)
Epoch 1/5
124/124 [==============================] - 3s 23ms/step - loss: 0.9812 - acc: 0.5161
Epoch 2/5
124/124 [==============================] - 0s 843us/step - loss: 0.9484 - acc: 0.5403
Epoch 3/5
124/124 [==============================] - 0s 949us/step - loss: 0.9288 - acc: 0.5565
Epoch 4/5
124/124 [==============================] - 0s 966us/step - loss: 0.9143 - acc: 0.5565
Epoch 5/5
124/124 [==============================] - 0s 804us/step - loss: 0.8991 - acc: 0.5565
3 (133, 3) (133, 42)
Epoch 1/5
133/133 [==============================] - 3s 25ms/step - loss: 1.0515 - acc: 0.4286
Epoch 2/5
133/133 [==============================] - 0s 1ms/step - loss: 0.9594 - acc: 0.4812
Epoch 3/5
133/133 [==============================] - 0s 1ms/step - loss: 0.8922 - acc: 0.5714
Epoch 4/5
133/133 [==============================] - 0s 1ms/step - loss: 0.8354 - acc: 0.6617
Epoch 5/5
133/133 [==============================] - 0s 1ms/step - loss: 0.7882 - acc: 0.6767
3 (151, 3) (151, 42)
Epoch 1/5
151/151 [==============================] - 3s 22ms/step - loss: 0.9677 - acc: 0.6821
Epoch 2/5
151/151 [==============================] - 0s 1ms/step - loss: 0.8714 - acc: 0.6821
Epoch 3/5
151/151 [==============================] - 0s 2ms/step - loss: 0.7921 - acc: 0.6821
Epoch 4/5
151/151 [==============================] - 0s 902us/step - loss: 0.7323 - acc: 0.6821
Epoch 5/5
151/151 [==============================] - 0s 907us/step - loss: 0.6894 - acc: 0.6821
3 (132, 3) (132, 42)
Epoch 1/5
132/132 [==============================] - 3s 25ms/step - loss: 1.0034 - acc: 0.4318
Epoch 2/5
132/132 [==============================] - 0s 1ms/step - loss: 0.9029 - acc: 0.5833
Epoch 3/5
132/132 [==============================] - 0s 1ms/step - loss: 0.8360 - acc: 0.6591
```

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Epoch 4/5
132/132 [==============================] - 0s 940us/step - loss: 0.7866 - acc: 0.6742
Epoch 5/5
132/132 [==============================] - 0s 1ms/step - loss: 0.7464 - acc: 0.7121
3 (121, 3) (121, 42)
Epoch 1/5
121/121 [==============================] - 3s 26ms/step - loss: 1.2149 - acc: 0.1653
Epoch 2/5
121/121 [==============================] - 0s 882us/step - loss: 1.1392 - acc: 0.2727
Epoch 3/5
121/121 [==============================] - 0s 917us/step - loss: 1.0975 - acc: 0.4132
Epoch 4/5
121/121 [==============================] - 0s 1ms/step - loss: 1.0730 - acc: 0.5372
Epoch 5/5
121/121 [==============================] - 0s 901us/step - loss: 1.0554 - acc: 0.5950
3 (190, 3) (190, 42)
Epoch 1/5
190/190 [==============================] - 3s 16ms/step - loss: 0.8896 - acc: 0.7421
Epoch 2/5
190/190 [==============================] - 0s 887us/step - loss: 0.6928 - acc: 0.8579
Epoch 3/5
190/190 [==============================] - 0s 906us/step - loss: 0.5797 - acc: 0.8579
Epoch 4/5
190/190 [==============================] - 0s 907us/step - loss: 0.5203 - acc: 0.8579
Epoch 5/5
190/190 [==============================] - 0s 1ms/step - loss: 0.4936 - acc: 0.8579
3 (117, 3) (117, 42)
Epoch 1/5
117/117 [==============================] - 3s 25ms/step - loss: 1.4432 - acc: 0.1795
Epoch 2/5
117/117 [==============================] - 0s 837us/step - loss: 1.2872 - acc: 0.1966
Epoch 3/5
117/117 [==============================] - 0s 850us/step - loss: 1.1722 - acc: 0.2051
Epoch 4/5
117/117 [==============================] - 0s 856us/step - loss: 1.0925 - acc: 0.2906
Epoch 5/5
117/117 [==============================] - 0s 826us/step - loss: 1.0307 - acc: 0.5214
3 (113, 3) (113, 42)
Epoch 1/5
113/113 [==============================] - 3s 27ms/step - loss: 1.3117 - acc: 0.0708
Epoch 2/5
113/113 [==============================] - 0s 971us/step - loss: 1.2039 - acc: 0.1593
Epoch 3/5
113/113 [==============================] - 0s 898us/step - loss: 1.1456 - acc: 0.3628
Epoch 4/5
113/113 [==============================] - 0s 961us/step - loss: 1.1067 - acc: 0.4159
Epoch 5/5
113/113 [==============================] - 0s 890us/step - loss: 1.0739 - acc: 0.5664
```

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3 (220, 3) (220, 42)
Epoch 1/5
220/220 [==============================] - 3s 14ms/step - loss: 1.3479 - acc: 0.1500
Epoch 2/5
220/220 [==============================] - 0s 859us/step - loss: 1.1013 - acc: 0.3773
Epoch 3/5
220/220 [==============================] - 0s 840us/step - loss: 0.9827 - acc: 0.5636
Epoch 4/5
220/220 [==============================] - 0s 886us/step - loss: 0.9125 - acc: 0.5773
Epoch 5/5
220/220 [==============================] - 0s 845us/step - loss: 0.8673 - acc: 0.5909
3 (192, 3) (192, 42)
Epoch 1/5
192/192 [==============================] - 3s 16ms/step - loss: 1.0596 - acc: 0.4427
Epoch 2/5
192/192 [==============================] - 0s 929us/step - loss: 0.9843 - acc: 0.5885
Epoch 3/5
192/192 [==============================] - 0s 879us/step - loss: 0.9444 - acc: 0.5885
Epoch 4/5
192/192 [==============================] - 0s 818us/step - loss: 0.9199 - acc: 0.6042
Epoch 5/5
192/192 [==============================] - 0s 866us/step - loss: 0.8931 - acc: 0.6042
3 (258, 3) (258, 42)
Epoch 1/5
258/258 [==============================] - 3s 12ms/step - loss: 1.5034 - acc: 0.1822
Epoch 2/5
258/258 [==============================] - 0s 856us/step - loss: 0.9055 - acc: 0.6240
Epoch 3/5
258/258 [==============================] - 0s 941us/step - loss: 0.5779 - acc: 0.8837
Epoch 4/5
258/258 [==============================] - 0s 880us/step - loss: 0.4365 - acc: 0.9147
Epoch 5/5
258/258 [==============================] - 0s 830us/step - loss: 0.3844 - acc: 0.9147
3 (107, 3) (107, 42)
Epoch 1/5
107/107 [==============================] - 3s 29ms/step - loss: 1.1268 - acc: 0.3738
Epoch 2/5
107/107 [==============================] - 0s 968us/step - loss: 1.0206 - acc: 0.5327
Epoch 3/5
107/107 [==============================] - 0s 998us/step - loss: 0.9431 - acc: 0.5981
Epoch 4/5
107/107 [==============================] - 0s 976us/step - loss: 0.8775 - acc: 0.6916
Epoch 5/5
107/107 [==============================] - 0s 1ms/step - loss: 0.8215 - acc: 0.7944
3 (2720, 3) (2720, 42)
Epoch 1/5
2720/2720 [==============================] - 6s 2ms/step - loss: 0.9320 - acc: 0.5915
Epoch 2/5
```

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2720/2720 [==============================] - 2s 849us/step - loss: 0.8695 - acc: 0.6206
Epoch 3/5
2720/2720 [==============================] - 2s 861us/step - loss: 0.8330 - acc: 0.6441
Epoch 4/5
2720/2720 [==============================] - 2s 885us/step - loss: 0.8080 - acc: 0.6636
Epoch 5/5
2720/2720 [==============================] - 2s 907us/step - loss: 0.7895 - acc: 0.6702
3 (518, 3) (518, 42)
Epoch 1/5
518/518 [==============================] - 4s 7ms/step - loss: 1.0634 - acc: 0.4749
Epoch 2/5
518/518 [==============================] - 0s 892us/step - loss: 0.7617 - acc: 0.7529
Epoch 3/5
518/518 [==============================] - 0s 913us/step - loss: 0.6576 - acc: 0.7510
Epoch 4/5
518/518 [==============================] - 0s 899us/step - loss: 0.6117 - acc: 0.7490
Epoch 5/5
518/518 [==============================] - 0s 919us/step - loss: 0.5778 - acc: 0.7529
3 (408, 3) (408, 42)
Epoch 1/5
408/408 [==============================] - 4s 9ms/step - loss: 0.8541 - acc: 0.7696
Epoch 2/5
408/408 [==============================] - 0s 936us/step - loss: 0.4733 - acc: 0.9436
Epoch 3/5
408/408 [==============================] - 0s 960us/step - loss: 0.2684 - acc: 0.9510
Epoch 4/5
408/408 [==============================] - 1s 1ms/step - loss: 0.2199 - acc: 0.9510
Epoch 5/5
408/408 [==============================] - 0s 1ms/step - loss: 0.2081 - acc: 0.9510
3 (161, 3) (161, 42)
Epoch 1/5
161/161 [==============================] - 3s 21ms/step - loss: 0.9449 - acc: 0.6025
Epoch 2/5
161/161 [==============================] - 0s 1ms/step - loss: 0.8753 - acc: 0.6770
Epoch 3/5
161/161 [==============================] - 0s 1ms/step - loss: 0.8212 - acc: 0.6460
Epoch 4/5
161/161 [==============================] - 0s 1ms/step - loss: 0.7714 - acc: 0.6460
Epoch 5/5
161/161 [==============================] - 0s 1ms/step - loss: 0.7302 - acc: 0.6460
3 (138, 3) (138, 42)
Epoch 1/5
138/138 [==============================] - 3s 24ms/step - loss: 0.9176 - acc: 0.5000
Epoch 2/5
138/138 [==============================] - 0s 1ms/step - loss: 0.6939 - acc: 0.7464
Epoch 3/5
138/138 [==============================] - 0s 1ms/step - loss: 0.5126 - acc: 0.9275
Epoch 4/5
```

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138/138 [==============================] - 0s 1ms/step - loss: 0.3704 - acc: 0.9565
Epoch 5/5
138/138 [==============================] - 0s 1ms/step - loss: 0.2724 - acc: 0.9783
3 (197, 3) (197, 42)
Epoch 1/5
197/197 [==============================] - 3s 16ms/step - loss: 1.0470 - acc: 0.3350
Epoch 2/5
197/197 [==============================] - 0s 990us/step - loss: 0.8669 - acc: 0.6853
Epoch 3/5
197/197 [==============================] - 0s 1ms/step - loss: 0.7306 - acc: 0.8274
Epoch 4/5
197/197 [==============================] - 0s 966us/step - loss: 0.6280 - acc: 0.8629
Epoch 5/5
197/197 [==============================] - 0s 931us/step - loss: 0.5598 - acc: 0.8731
3 (164, 3) (164, 42)
Epoch 1/5
164/164 [==============================] - 3s 19ms/step - loss: 1.1490 - acc: 0.2622
Epoch 2/5
164/164 [==============================] - 0s 988us/step - loss: 1.0122 - acc: 0.5427
Epoch 3/5
164/164 [==============================] - 0s 953us/step - loss: 0.8931 - acc: 0.8171
Epoch 4/5
164/164 [==============================] - 0s 963us/step - loss: 0.7639 - acc: 0.8720
Epoch 5/5
164/164 [==============================] - 0s 1ms/step - loss: 0.6368 - acc: 0.8841
3 (166, 3) (166, 42)
Epoch 1/5
166/166 [==============================] - 4s 21ms/step - loss: 1.0608 - acc: 0.5542
Epoch 2/5
166/166 [==============================] - 0s 962us/step - loss: 0.9906 - acc: 0.5904
Epoch 3/5
166/166 [==============================] - 0s 1ms/step - loss: 0.9326 - acc: 0.6145
Epoch 4/5
166/166 [==============================] - 0s 946us/step - loss: 0.8846 - acc: 0.6325
Epoch 5/5
166/166 [==============================] - 0s 991us/step - loss: 0.8486 - acc: 0.6386
3 (230, 3) (230, 42)
Epoch 1/5
230/230 [==============================] - 3s 14ms/step - loss: 0.9300 - acc: 0.7043
Epoch 2/5
230/230 [==============================] - 0s 810us/step - loss: 0.5848 - acc: 0.9783
Epoch 3/5
230/230 [==============================] - 0s 858us/step - loss: 0.3409 - acc: 0.9957
Epoch 4/5
230/230 [==============================] - 0s 809us/step - loss: 0.1924 - acc: 0.9957
Epoch 5/5
230/230 [==============================] - 0s 842us/step - loss: 0.1191 - acc: 0.9957
3 (107, 3) (107, 42)
```

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Epoch 1/5
107/107 [==============================] - 3s 30ms/step - loss: 0.8870 - acc: 0.6449
Epoch 2/5
107/107 [==============================] - 0s 878us/step - loss: 0.7684 - acc: 0.7944
Epoch 3/5
107/107 [==============================] - 0s 900us/step - loss: 0.6598 - acc: 0.9065
Epoch 4/5
107/107 [==============================] - 0s 878us/step - loss: 0.5630 - acc: 0.9065
Epoch 5/5
107/107 [==============================] - 0s 876us/step - loss: 0.4894 - acc: 0.9065
3 (330, 3) (330, 42)
Epoch 1/5
330/330 [==============================] - 3s 10ms/step - loss: 0.7422 - acc: 0.9212
Epoch 2/5
330/330 [==============================] - 0s 821us/step - loss: 0.3648 - acc: 0.9758
Epoch 3/5
330/330 [==============================] - 0s 798us/step - loss: 0.1926 - acc: 0.9758
Epoch 4/5
330/330 [==============================] - 0s 848us/step - loss: 0.1456 - acc: 0.9758
Epoch 5/5
330/330 [==============================] - 0s 783us/step - loss: 0.1296 - acc: 0.9758
3 (190, 3) (190, 42)
Epoch 1/5
190/190 [==============================] - 3s 17ms/step - loss: 0.9417 - acc: 0.6421
Epoch 2/5
190/190 [==============================] - 0s 837us/step - loss: 0.7180 - acc: 0.8368
Epoch 3/5
190/190 [==============================] - 0s 887us/step - loss: 0.5709 - acc: 0.9105
Epoch 4/5
190/190 [==============================] - 0s 866us/step - loss: 0.4705 - acc: 0.9316
Epoch 5/5
190/190 [==============================] - 0s 825us/step - loss: 0.3983 - acc: 0.9368
3 (152, 3) (152, 42)
Epoch 1/5
152/152 [==============================] - 3s 21ms/step - loss: 0.8210 - acc: 0.8487
Epoch 2/5
152/152 [==============================] - 0s 898us/step - loss: 0.6827 - acc: 0.8750
Epoch 3/5
152/152 [==============================] - 0s 875us/step - loss: 0.5680 - acc: 0.8816
Epoch 4/5
152/152 [==============================] - 0s 872us/step - loss: 0.4897 - acc: 0.8816
Epoch 5/5
152/152 [==============================] - 0s 892us/step - loss: 0.4420 - acc: 0.8816
3 (137, 3) (137, 42)
Epoch 1/5
137/137 [==============================] - 3s 24ms/step - loss: 0.9794 - acc: 0.4672
Epoch 2/5
137/137 [==============================] - 0s 890us/step - loss: 0.8791 - acc: 0.6058
```

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Epoch 3/5
137/137 [==============================] - 0s 888us/step - loss: 0.8264 - acc: 0.6715
Epoch 4/5
137/137 [==============================] - 0s 910us/step - loss: 0.7995 - acc: 0.6715
Epoch 5/5
137/137 [==============================] - 0s 836us/step - loss: 0.7800 - acc: 0.6788
3 (136, 3) (136, 42)
Epoch 1/5
136/136 [==============================] - 3s 24ms/step - loss: 1.2209 - acc: 0.3235
Epoch 2/5
136/136 [==============================] - 0s 998us/step - loss: 1.1579 - acc: 0.3824
Epoch 3/5
136/136 [==============================] - 0s 1ms/step - loss: 1.1197 - acc: 0.3824
Epoch 4/5
136/136 [==============================] - 0s 987us/step - loss: 1.0932 - acc: 0.4191
Epoch 5/5
136/136 [==============================] - 0s 867us/step - loss: 1.0751 - acc: 0.4485
3 (130, 3) (130, 42)
Epoch 1/5
130/130 [==============================] - 3s 25ms/step - loss: 1.0913 - acc: 0.3538
Epoch 2/5
130/130 [==============================] - 0s 820us/step - loss: 1.0697 - acc: 0.4385
Epoch 3/5
130/130 [==============================] - 0s 880us/step - loss: 1.0510 - acc: 0.4923
Epoch 4/5
130/130 [==============================] - 0s 874us/step - loss: 1.0358 - acc: 0.5385
Epoch 5/5
130/130 [==============================] - 0s 791us/step - loss: 1.0193 - acc: 0.5231
3 (166, 3) (166, 42)
Epoch 1/5
166/166 [==============================] - 3s 20ms/step - loss: 1.1390 - acc: 0.2952
Epoch 2/5
166/166 [==============================] - 0s 882us/step - loss: 1.0263 - acc: 0.5602
Epoch 3/5
166/166 [==============================] - 0s 864us/step - loss: 0.9324 - acc: 0.6687
Epoch 4/5
166/166 [==============================] - 0s 825us/step - loss: 0.8598 - acc: 0.7169
Epoch 5/5
166/166 [==============================] - 0s 911us/step - loss: 0.8032 - acc: 0.7229
3 (195, 3) (195, 42)
Epoch 1/5
195/195 [==============================] - 3s 17ms/step - loss: 1.0489 - acc: 0.4154
Epoch 2/5
195/195 [==============================] - 0s 859us/step - loss: 1.0170 - acc: 0.4462
Epoch 3/5
195/195 [==============================] - 0s 855us/step - loss: 0.9966 - acc: 0.4718
Epoch 4/5
195/195 [==============================] - 0s 827us/step - loss: 0.9834 - acc: 0.4974
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Epoch 5/5
195/195 [==============================] - 0s 912us/step - loss: 0.9706 - acc: 0.4923
3 (127, 3) (127, 42)
Epoch 1/5
127/127 [==============================] - 3s 26ms/step - loss: 1.5526 - acc: 0.0787
Epoch 2/5
127/127 [==============================] - 0s 993us/step - loss: 1.2746 - acc: 0.0866
Epoch 3/5
127/127 [==============================] - 0s 835us/step - loss: 1.0829 - acc: 0.2520
Epoch 4/5
127/127 [==============================] - 0s 953us/step - loss: 0.9249 - acc: 0.4803
Epoch 5/5
127/127 [==============================] - 0s 902us/step - loss: 0.7927 - acc: 0.7480
3 (112, 3) (112, 42)
Epoch 1/5
112/112 [==============================] - 3s 30ms/step - loss: 1.1027 - acc: 0.3571
Epoch 2/5
112/112 [==============================] - 0s 833us/step - loss: 1.0571 - acc: 0.4464
Epoch 3/5
112/112 [==============================] - 0s 849us/step - loss: 1.0297 - acc: 0.5089
Epoch 4/5
112/112 [==============================] - 0s 811us/step - loss: 1.0041 - acc: 0.5446
Epoch 5/5
112/112 [==============================] - 0s 836us/step - loss: 0.9849 - acc: 0.5357
3 (126, 3) (126, 42)
Epoch 1/5
126/126 [==============================] - 3s 27ms/step - loss: 1.0697 - acc: 0.3889
Epoch 2/5
126/126 [==============================] - 0s 847us/step - loss: 1.0356 - acc: 0.3889
Epoch 3/5
126/126 [==============================] - 0s 825us/step - loss: 1.0071 - acc: 0.3968
Epoch 4/5
126/126 [==============================] - 0s 770us/step - loss: 0.9836 - acc: 0.4683
Epoch 5/5
126/126 [==============================] - 0s 858us/step - loss: 0.9655 - acc: 0.4841
3 (137, 3) (137, 42)
Epoch 1/5
137/137 [==============================] - 3s 25ms/step - loss: 1.1565 - acc: 0.3285
Epoch 2/5
137/137 [==============================] - 0s 1ms/step - loss: 1.0735 - acc: 0.4015
Epoch 3/5
137/137 [==============================] - 0s 1ms/step - loss: 1.0142 - acc: 0.5109
Epoch 4/5
137/137 [==============================] - 0s 1ms/step - loss: 0.9712 - acc: 0.5620
Epoch 5/5
137/137 [==============================] - 0s 1ms/step - loss: 0.9332 - acc: 0.6277
3 (113, 3) (113, 42)
Epoch 1/5
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113/113 [==============================] - 3s 31ms/step - loss: 1.1840 - acc: 0.2212
Epoch 2/5
113/113 [==============================] - 0s 888us/step - loss: 1.1303 - acc: 0.3009
Epoch 3/5
113/113 [==============================] - 0s 848us/step - loss: 1.0812 - acc: 0.3982
Epoch 4/5
113/113 [==============================] - 0s 922us/step - loss: 1.0417 - acc: 0.4690
Epoch 5/5
113/113 [==============================] - 0s 991us/step - loss: 1.0039 - acc: 0.5044
3 (110, 3) (110, 42)
Epoch 1/5
110/110 [==============================] - 4s 32ms/step - loss: 1.1438 - acc: 0.4273
Epoch 2/5
110/110 [==============================] - 0s 888us/step - loss: 1.0895 - acc: 0.4364
Epoch 3/5
110/110 [==============================] - 0s 910us/step - loss: 1.0461 - acc: 0.4636
Epoch 4/5
110/110 [==============================] - 0s 950us/step - loss: 1.0067 - acc: 0.5000
Epoch 5/5
110/110 [==============================] - 0s 913us/step - loss: 0.9786 - acc: 0.5182
3 (197, 3) (197, 42)
Epoch 1/5
197/197 [==============================] - 4s 19ms/step - loss: 0.9254 - acc: 0.6142
Epoch 2/5
197/197 [==============================] - 0s 1ms/step - loss: 0.8047 - acc: 0.7005
Epoch 3/5
197/197 [==============================] - 0s 1ms/step - loss: 0.7360 - acc: 0.7563
Epoch 4/5
197/197 [==============================] - 0s 1ms/step - loss: 0.6976 - acc: 0.7563
Epoch 5/5
197/197 [==============================] - 0s 1ms/step - loss: 0.6761 - acc: 0.7563
3 (108, 3) (108, 42)
Epoch 1/5
108/108 [==============================] - 4s 35ms/step - loss: 0.8170 - acc: 0.7500
Epoch 2/5
108/108 [==============================] - 0s 1ms/step - loss: 0.6368 - acc: 0.9444
Epoch 3/5
108/108 [==============================] - 0s 989us/step - loss: 0.4980 - acc: 0.9630
Epoch 4/5
108/108 [==============================] - 0s 857us/step - loss: 0.3935 - acc: 0.9630
Epoch 5/5
108/108 [==============================] - 0s 880us/step - loss: 0.3142 - acc: 0.9630
3 (122, 3) (122, 42)
Epoch 1/5
122/122 [==============================] - 4s 29ms/step - loss: 1.7216 - acc: 0.0902
Epoch 2/5
122/122 [==============================] - 0s 873us/step - loss: 1.3961 - acc: 0.1475
Epoch 3/5
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122/122 [==============================] - 0s 909us/step - loss: 1.1329 - acc: 0.3525
Epoch 4/5
122/122 [==============================] - 0s 1ms/step - loss: 0.9271 - acc: 0.5820
Epoch 5/5
122/122 [==============================] - 0s 1ms/step - loss: 0.7799 - acc: 0.7459
3 (149, 3) (149, 42)
Epoch 1/5
149/149 [==============================] - 4s 25ms/step - loss: 0.7662 - acc: 0.8188
Epoch 2/5
149/149 [==============================] - 0s 904us/step - loss: 0.6257 - acc: 0.8658
Epoch 3/5
149/149 [==============================] - 0s 997us/step - loss: 0.5522 - acc: 0.8658
Epoch 4/5
149/149 [==============================] - 0s 1ms/step - loss: 0.5170 - acc: 0.8658
Epoch 5/5
149/149 [==============================] - 0s 907us/step - loss: 0.4986 - acc: 0.8658
3 (124, 3) (124, 42)
Epoch 1/5
124/124 [==============================] - 4s 29ms/step - loss: 0.9376 - acc: 0.7581
Epoch 2/5
124/124 [==============================] - 0s 960us/step - loss: 0.8569 - acc: 0.7823
Epoch 3/5
124/124 [==============================] - 0s 932us/step - loss: 0.7853 - acc: 0.7823
Epoch 4/5
124/124 [==============================] - 0s 1ms/step - loss: 0.7296 - acc: 0.7823
Epoch 5/5
124/124 [==============================] - 0s 1ms/step - loss: 0.6905 - acc: 0.7823
3 (280, 3) (280, 42)
Epoch 1/5
280/280 [==============================] - 4s 15ms/step - loss: 1.0336 - acc: 0.4500
Epoch 2/5
280/280 [==============================] - 0s 1ms/step - loss: 0.9860 - acc: 0.5000
Epoch 3/5
280/280 [==============================] - 0s 1ms/step - loss: 0.9490 - acc: 0.5464
Epoch 4/5
280/280 [==============================] - 0s 1ms/step - loss: 0.9197 - acc: 0.5679
Epoch 5/5
280/280 [==============================] - 0s 1ms/step - loss: 0.8929 - acc: 0.6143
3 (124, 3) (124, 42)
Epoch 1/5
124/124 [==============================] - 4s 30ms/step - loss: 0.8067 - acc: 0.7419
Epoch 2/5
124/124 [==============================] - 0s 1ms/step - loss: 0.7117 - acc: 0.7903
Epoch 3/5
124/124 [==============================] - 0s 1ms/step - loss: 0.6673 - acc: 0.7984
Epoch 4/5
124/124 [==============================] - 0s 919us/step - loss: 0.6416 - acc: 0.7984
Epoch 5/5
```

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124/124 [==============================] - 0s 890us/step - loss: 0.6229 - acc: 0.7984
3 (183, 3) (183, 42)
Epoch 1/5
183/183 [==============================] - 4s 21ms/step - loss: 1.0771 - acc: 0.3607
Epoch 2/5
183/183 [==============================] - 0s 1ms/step - loss: 0.9722 - acc: 0.5027
Epoch 3/5
183/183 [==============================] - 0s 926us/step - loss: 0.8954 - acc: 0.5847
Epoch 4/5
183/183 [==============================] - 0s 1ms/step - loss: 0.8348 - acc: 0.6066
Epoch 5/5
183/183 [==============================] - 0s 1ms/step - loss: 0.7924 - acc: 0.6284
3 (135, 3) (135, 42)
Epoch 1/5
135/135 [==============================] - 4s 32ms/step - loss: 0.9410 - acc: 0.6148
Epoch 2/5
135/135 [==============================] - 0s 1ms/step - loss: 0.8181 - acc: 0.7407
Epoch 3/5
135/135 [==============================] - 0s 1ms/step - loss: 0.7358 - acc: 0.7556
Epoch 4/5
135/135 [==============================] - 0s 1ms/step - loss: 0.6827 - acc: 0.7556
Epoch 5/5
135/135 [==============================] - 0s 1ms/step - loss: 0.6481 - acc: 0.7556
3 (146, 3) (146, 42)
Epoch 1/5
146/146 [==============================] - 4s 29ms/step - loss: 1.0070 - acc: 0.5959
Epoch 2/5
146/146 [==============================] - 0s 942us/step - loss: 0.8931 - acc: 0.7260
Epoch 3/5
146/146 [==============================] - 0s 941us/step - loss: 0.8060 - acc: 0.7466
Epoch 4/5
146/146 [==============================] - 0s 950us/step - loss: 0.7375 - acc: 0.7466
Epoch 5/5
146/146 [==============================] - 0s 879us/step - loss: 0.6911 - acc: 0.7466
3 (157, 3) (157, 42)
Epoch 1/5
157/157 [==============================] - 4s 24ms/step - loss: 0.9179 - acc: 0.6624
Epoch 2/5
157/157 [==============================] - 0s 932us/step - loss: 0.7241 - acc: 0.8025
Epoch 3/5
157/157 [==============================] - 0s 931us/step - loss: 0.6174 - acc: 0.8089
Epoch 4/5
157/157 [==============================] - 0s 921us/step - loss: 0.5651 - acc: 0.8153
Epoch 5/5
157/157 [==============================] - 0s 849us/step - loss: 0.5354 - acc: 0.8153
3 (159, 3) (159, 42)
Epoch 1/5
159/159 [==============================] - 4s 24ms/step - loss: 1.0997 - acc: 0.1258
```

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Epoch 2/5
159/159 [==============================] - 0s 953us/step - loss: 0.9601 - acc: 0.2201
Epoch 3/5
159/159 [==============================] - 0s 915us/step - loss: 0.8523 - acc: 0.5157
Epoch 4/5
159/159 [==============================] - 0s 917us/step - loss: 0.7538 - acc: 0.7610
Epoch 5/5
159/159 [==============================] - 0s 925us/step - loss: 0.6659 - acc: 0.8491
3 (102, 3) (102, 42)
Epoch 1/5
102/102 [==============================] - 4s 37ms/step - loss: 1.3765 - acc: 0.0294
Epoch 2/5
102/102 [==============================] - 0s 987us/step - loss: 1.1978 - acc: 0.2157
Epoch 3/5
102/102 [==============================] - 0s 1ms/step - loss: 1.0429 - acc: 0.5588
Epoch 4/5
102/102 [==============================] - 0s 947us/step - loss: 0.8956 - acc: 0.7059
Epoch 5/5
102/102 [==============================] - 0s 974us/step - loss: 0.7473 - acc: 0.8725
3 (248, 3) (248, 42)
Epoch 1/5
248/248 [==============================] - 4s 16ms/step - loss: 0.5345 - acc: 0.8306
Epoch 2/5
248/248 [==============================] - 0s 952us/step - loss: 0.3156 - acc: 0.9516
Epoch 3/5
248/248 [==============================] - 0s 941us/step - loss: 0.2362 - acc: 0.9516
Epoch 4/5
248/248 [==============================] - 0s 1ms/step - loss: 0.2042 - acc: 0.9516
Epoch 5/5
248/248 [==============================] - 0s 1ms/step - loss: 0.1914 - acc: 0.9516
3 (307, 3) (307, 42)
Epoch 1/5
307/307 [==============================] - 5s 15ms/step - loss: 1.1670 - acc: 0.2215
Epoch 2/5
307/307 [==============================] - 0s 1ms/step - loss: 1.0196 - acc: 0.4625
Epoch 3/5
307/307 [==============================] - 0s 1ms/step - loss: 0.8936 - acc: 0.6189
Epoch 4/5
307/307 [==============================] - 0s 1ms/step - loss: 0.7580 - acc: 0.6808
Epoch 5/5
307/307 [==============================] - 0s 974us/step - loss: 0.6610 - acc: 0.7134
3 (143, 3) (143, 42)
Epoch 1/5
143/143 [==============================] - 4s 28ms/step - loss: 1.2688 - acc: 0.0909
Epoch 2/5
143/143 [==============================] - 0s 1ms/step - loss: 1.1289 - acc: 0.2727
Epoch 3/5
143/143 [==============================] - 0s 1ms/step - loss: 1.0156 - acc: 0.5664
```

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Epoch 4/5
143/143 [==============================] - 0s 994us/step - loss: 0.9112 - acc: 0.7343
Epoch 5/5
143/143 [==============================] - 0s 988us/step - loss: 0.8101 - acc: 0.7762
3 (224, 3) (224, 42)
Epoch 1/5
224/224 [==============================] - 4s 19ms/step - loss: 1.1162 - acc: 0.3125
Epoch 2/5
224/224 [==============================] - 0s 1ms/step - loss: 1.0986 - acc: 0.3259
Epoch 3/5
224/224 [==============================] - 0s 1ms/step - loss: 1.0875 - acc: 0.3527
Epoch 4/5
224/224 [==============================] - 0s 1ms/step - loss: 1.0791 - acc: 0.3616
Epoch 5/5
224/224 [==============================] - 0s 947us/step - loss: 1.0684 - acc: 0.3839
3 (167, 3) (167, 42)
Epoch 1/5
167/167 [==============================] - 4s 25ms/step - loss: 1.1041 - acc: 0.4850
Epoch 2/5
167/167 [==============================] - 0s 1ms/step - loss: 1.0726 - acc: 0.5629
Epoch 3/5
167/167 [==============================] - 0s 1ms/step - loss: 1.0417 - acc: 0.6228
Epoch 4/5
167/167 [==============================] - 0s 1ms/step - loss: 1.0070 - acc: 0.5988
Epoch 5/5
167/167 [==============================] - 0s 1ms/step - loss: 0.9690 - acc: 0.5988
3 (203, 3) (203, 42)
Epoch 1/5
203/203 [==============================] - 4s 20ms/step - loss: 1.1815 - acc: 0.1921
Epoch 2/5
203/203 [==============================] - 0s 941us/step - loss: 1.0999 - acc: 0.4335
Epoch 3/5
203/203 [==============================] - 0s 943us/step - loss: 1.0478 - acc: 0.5517
Epoch 4/5
203/203 [==============================] - 0s 966us/step - loss: 1.0048 - acc: 0.5961
Epoch 5/5
203/203 [==============================] - 0s 1ms/step - loss: 0.9701 - acc: 0.5961
3 (104, 3) (104, 42)
Epoch 1/5
104/104 [==============================] - 4s 39ms/step - loss: 0.7767 - acc: 0.7308
Epoch 2/5
104/104 [==============================] - 0s 1ms/step - loss: 0.6806 - acc: 0.7692
Epoch 3/5
104/104 [==============================] - 0s 1ms/step - loss: 0.6279 - acc: 0.7885
Epoch 4/5
104/104 [==============================] - 0s 1ms/step - loss: 0.5885 - acc: 0.7981
Epoch 5/5
104/104 [==============================] - 0s 1ms/step - loss: 0.5663 - acc: 0.7981
```

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3 (183, 3) (183, 42)
Epoch 1/5
183/183 [==============================] - 4s 23ms/step - loss: 1.2692 - acc: 0.1257
Epoch 2/5
183/183 [==============================] - 0s 959us/step - loss: 1.0078 - acc: 0.4918
Epoch 3/5
183/183 [==============================] - 0s 964us/step - loss: 0.8507 - acc: 0.7760
Epoch 4/5
183/183 [==============================] - 0s 1ms/step - loss: 0.7293 - acc: 0.8525
Epoch 5/5
183/183 [==============================] - 0s 1ms/step - loss: 0.6396 - acc: 0.8689
3 (251, 3) (251, 42)
Epoch 1/5
251/251 [==============================] - 5s 18ms/step - loss: 1.3273 - acc: 0.1235
Epoch 2/5
251/251 [==============================] - 1s 2ms/step - loss: 1.0951 - acc: 0.4462
Epoch 3/5
251/251 [==============================] - 0s 2ms/step - loss: 0.9278 - acc: 0.7211
Epoch 4/5
251/251 [==============================] - 0s 1ms/step - loss: 0.7925 - acc: 0.7888
Epoch 5/5
251/251 [==============================] - 0s 1ms/step - loss: 0.7017 - acc: 0.7968
3 (104, 3) (104, 42)
Epoch 1/5
104/104 [==============================] - 4s 42ms/step - loss: 1.2152 - acc: 0.3654
Epoch 2/5
104/104 [==============================] - 0s 1ms/step - loss: 1.1514 - acc: 0.3558
Epoch 3/5
104/104 [==============================] - 0s 1ms/step - loss: 1.0960 - acc: 0.3942
Epoch 4/5
104/104 [==============================] - 0s 1ms/step - loss: 1.0556 - acc: 0.4135
Epoch 5/5
104/104 [==============================] - 0s 1ms/step - loss: 1.0242 - acc: 0.4327
3 (177, 3) (177, 42)
Epoch 1/5
177/177 [==============================] - 5s 26ms/step - loss: 1.1296 - acc: 0.2881
Epoch 2/5
177/177 [==============================] - 0s 1ms/step - loss: 1.0096 - acc: 0.5198
Epoch 3/5
177/177 [==============================] - ETA: 0s - loss: 0.9265 - acc: 0.614 - 0s 1ms/step -
Epoch 4/5
177/177 [==============================] - 0s 1ms/step - loss: 0.8683 - acc: 0.6949
Epoch 5/5
177/177 [==============================] - 0s 1ms/step - loss: 0.8214 - acc: 0.7232
3 (165, 3) (165, 42)
Epoch 1/5
165/165 [==============================] - 5s 28ms/step - loss: 0.9528 - acc: 0.5515
Epoch 2/5
```

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165/165 [==============================] - 0s 1ms/step - loss: 0.8032 - acc: 0.7455
Epoch 3/5
165/165 [==============================] - 0s 1ms/step - loss: 0.6959 - acc: 0.7758
Epoch 4/5
165/165 [==============================] - 0s 1ms/step - loss: 0.6437 - acc: 0.7758
Epoch 5/5
165/165 [==============================] - 0s 1ms/step - loss: 0.6127 - acc: 0.7758
3 (112, 3) (112, 42)
Epoch 1/5
112/112 [==============================] - 4s 37ms/step - loss: 1.3003 - acc: 0.3125
Epoch 2/5
112/112 [==============================] - 0s 1ms/step - loss: 1.1759 - acc: 0.3125
Epoch 3/5
112/112 [==============================] - 0s 1ms/step - loss: 1.0960 - acc: 0.3214
Epoch 4/5
112/112 [==============================] - 0s 1ms/step - loss: 1.0373 - acc: 0.3304
Epoch 5/5
112/112 [==============================] - 0s 1ms/step - loss: 0.9944 - acc: 0.4196
3 (164, 3) (164, 42)
Epoch 1/5
164/164 [==============================] - 4s 25ms/step - loss: 1.0895 - acc: 0.4390
Epoch 2/5
164/164 [==============================] - 0s 940us/step - loss: 0.9212 - acc: 0.7012
Epoch 3/5
164/164 [==============================] - 0s 964us/step - loss: 0.8050 - acc: 0.7683
Epoch 4/5
164/164 [==============================] - 0s 901us/step - loss: 0.7230 - acc: 0.7683
Epoch 5/5
164/164 [==============================] - 0s 932us/step - loss: 0.6761 - acc: 0.7683
3 (102, 3) (102, 42)
Epoch 1/5
102/102 [==============================] - 4s 40ms/step - loss: 1.1484 - acc: 0.2647
Epoch 2/5
102/102 [==============================] - 0s 1ms/step - loss: 1.1018 - acc: 0.4412
Epoch 3/5
102/102 [==============================] - 0s 1ms/step - loss: 1.0683 - acc: 0.5196
Epoch 4/5
102/102 [==============================] - 0s 1ms/step - loss: 1.0426 - acc: 0.5490
Epoch 5/5
102/102 [==============================] - 0s 1ms/step - loss: 1.0213 - acc: 0.5686
3 (167, 3) (167, 42)
Epoch 1/5
167/167 [==============================] - 5s 27ms/step - loss: 0.9740 - acc: 0.5629
Epoch 2/5
167/167 [==============================] - 0s 999us/step - loss: 0.8246 - acc: 0.7246
Epoch 3/5
167/167 [==============================] - 0s 1ms/step - loss: 0.7241 - acc: 0.7725
Epoch 4/5
```

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167/167 [==============================] - 0s 1ms/step - loss: 0.6704 - acc: 0.7665
Epoch 5/5
167/167 [==============================] - 0s 1ms/step - loss: 0.6425 - acc: 0.7665
3 (102, 3) (102, 42)
Epoch 1/5
102/102 [==============================] - 4s 44ms/step - loss: 0.8577 - acc: 0.7451
Epoch 2/5
102/102 [==============================] - 0s 1ms/step - loss: 0.7441 - acc: 0.7843
Epoch 3/5
102/102 [==============================] - 0s 1ms/step - loss: 0.6604 - acc: 0.7941
Epoch 4/5
102/102 [==============================] - 0s 1ms/step - loss: 0.6008 - acc: 0.7843
Epoch 5/5
102/102 [==============================] - 0s 1ms/step - loss: 0.5610 - acc: 0.7843
3 (107, 3) (107, 42)
Epoch 1/5
107/107 [==============================] - 5s 42ms/step - loss: 1.1461 - acc: 0.3271
Epoch 2/5
107/107 [==============================] - 0s 1ms/step - loss: 1.1154 - acc: 0.3458
Epoch 3/5
107/107 [==============================] - 0s 1ms/step - loss: 1.0904 - acc: 0.3551
Epoch 4/5
107/107 [==============================] - 0s 1ms/step - loss: 1.0697 - acc: 0.3738
Epoch 5/5
107/107 [==============================] - 0s 1ms/step - loss: 1.0481 - acc: 0.4299
3 (135, 3) (135, 42)
Epoch 1/5
135/135 [==============================] - 4s 33ms/step - loss: 1.3214 - acc: 0.1778
Epoch 2/5
135/135 [==============================] - 0s 1ms/step - loss: 1.1676 - acc: 0.3037
Epoch 3/5
135/135 [==============================] - 0s 1ms/step - loss: 1.0504 - acc: 0.4519
Epoch 4/5
135/135 [==============================] - 0s 1ms/step - loss: 0.9627 - acc: 0.6148
Epoch 5/5
135/135 [==============================] - 0s 1ms/step - loss: 0.8965 - acc: 0.6667
3 (190, 3) (190, 42)
Epoch 1/5
190/190 [==============================] - 4s 23ms/step - loss: 1.0955 - acc: 0.3053
Epoch 2/5
190/190 [==============================] - 0s 1ms/step - loss: 1.0142 - acc: 0.6000
Epoch 3/5
190/190 [==============================] - 0s 1ms/step - loss: 0.9523 - acc: 0.6842
Epoch 4/5
190/190 [==============================] - 0s 1ms/step - loss: 0.9017 - acc: 0.7053
Epoch 5/5
190/190 [==============================] - 0s 2ms/step - loss: 0.8651 - acc: 0.7000
3 (173, 3) (173, 42)
```

```
Epoch 1/5
173/173 [==============================] - 4s 26ms/step - loss: 0.8255 - acc: 0.8439
Epoch 2/5
173/173 [==============================] - 0s 1ms/step - loss: 0.6085 - acc: 0.9364
Epoch 3/5
173/173 [==============================] - 0s 1ms/step - loss: 0.4588 - acc: 0.9364
Epoch 4/5
173/173 [==============================] - 0s 976us/step - loss: 0.3608 - acc: 0.9364
Epoch 5/5
173/173 [==============================] - 0s 1ms/step - loss: 0.3121 - acc: 0.9364
3 (128, 3) (128, 42)
Epoch 1/5
128/128 [==============================] - 4s 35ms/step - loss: 1.0557 - acc: 0.4766
Epoch 2/5
128/128 [==============================] - 0s 1ms/step - loss: 1.0000 - acc: 0.4766
Epoch 3/5
128/128 [==============================] - 0s 1ms/step - loss: 0.9734 - acc: 0.4766
Epoch 4/5
128/128 [==============================] - 0s 1ms/step - loss: 0.9506 - acc: 0.5078
Epoch 5/5
128/128 [==============================] - 0s 1ms/step - loss: 0.9346 - acc: 0.5078
3 (227, 3) (227, 42)
Epoch 1/5
227/227 [==============================] - 5s 20ms/step - loss: 1.2509 - acc: 0.1850
Epoch 2/5
227/227 [==============================] - 0s 1ms/step - loss: 1.0266 - acc: 0.4141
Epoch 3/5
227/227 [==============================] - 0s 1ms/step - loss: 0.9051 - acc: 0.6564
Epoch 4/5
227/227 [==============================] - 0s 1ms/step - loss: 0.8315 - acc: 0.7048
Epoch 5/5
227/227 [==============================] - 0s 1ms/step - loss: 0.7922 - acc: 0.7137
3 (169, 3) (169, 42)
Epoch 1/5
169/169 [==============================] - 5s 27ms/step - loss: 0.9768 - acc: 0.5030
Epoch 2/5
169/169 [==============================] - 0s 961us/step - loss: 0.9058 - acc: 0.5562
Epoch 3/5
169/169 [==============================] - 0s 1ms/step - loss: 0.8598 - acc: 0.5799
Epoch 4/5
169/169 [==============================] - 0s 1ms/step - loss: 0.8228 - acc: 0.6154
Epoch 5/5
169/169 [==============================] - 0s 1ms/step - loss: 0.7966 - acc: 0.6331
3 (157, 3) (157, 42)
Epoch 1/5
157/157 [==============================] - 5s 29ms/step - loss: 0.8276 - acc: 0.7962
Epoch 2/5
157/157 [==============================] - 0s 1ms/step - loss: 0.6869 - acc: 0.8790
```

```
Epoch 3/5
157/157 [==============================] - 0s 1ms/step - loss: 0.5705 - acc: 0.8917
Epoch 4/5
157/157 [==============================] - 0s 1ms/step - loss: 0.4836 - acc: 0.8917
Epoch 5/5
157/157 [==============================] - 0s 1ms/step - loss: 0.4332 - acc: 0.8917
3 (144, 3) (144, 42)
Epoch 1/5
144/144 [==============================] - 5s 33ms/step - loss: 1.1326 - acc: 0.3403
Epoch 2/5
144/144 [==============================] - 0s 1ms/step - loss: 1.0802 - acc: 0.4444
Epoch 3/5
144/144 [==============================] - 0s 1ms/step - loss: 1.0414 - acc: 0.5278
Epoch 4/5
144/144 [==============================] - 0s 1ms/step - loss: 1.0103 - acc: 0.5347
Epoch 5/5
144/144 [==============================] - 0s 1ms/step - loss: 0.9822 - acc: 0.5417
3 (114, 3) (114, 42)
Epoch 1/5
114/114 [==============================] - 5s 41ms/step - loss: 1.3332 - acc: 0.1842
Epoch 2/5
114/114 [==============================] - 0s 1ms/step - loss: 1.2277 - acc: 0.2632
Epoch 3/5
114/114 [==============================] - 0s 1ms/step - loss: 1.1663 - acc: 0.3509
Epoch 4/5
114/114 [==============================] - 0s 1ms/step - loss: 1.1306 - acc: 0.3860
Epoch 5/5
114/114 [==============================] - 0s 1ms/step - loss: 1.1017 - acc: 0.4123
3 (166, 3) (166, 42)
Epoch 1/5
166/166 [==============================] - 5s 28ms/step - loss: 1.0899 - acc: 0.3735
Epoch 2/5
166/166 [==============================] - 0s 1ms/step - loss: 1.0391 - acc: 0.4157
Epoch 3/5
166/166 [==============================] - 0s 1ms/step - loss: 1.0042 - acc: 0.4157
Epoch 4/5
166/166 [==============================] - 0s 1ms/step - loss: 0.9804 - acc: 0.4217
Epoch 5/5
166/166 [==============================] - 0s 1ms/step - loss: 0.9634 - acc: 0.4217
3 (162, 3) (162, 42)
Epoch 1/5
162/162 [==============================] - 5s 28ms/step - loss: 1.0107 - acc: 0.5864
Epoch 2/5
162/162 [==============================] - 0s 1ms/step - loss: 0.9481 - acc: 0.6481
Epoch 3/5
162/162 [==============================] - 0s 1ms/step - loss: 0.9075 - acc: 0.6728
Epoch 4/5
162/162 [==============================] - 0s 1ms/step - loss: 0.8756 - acc: 0.6667
```

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Epoch 5/5
162/162 [==============================] - 0s 1ms/step - loss: 0.8502 - acc: 0.6667
3 (169, 3) (169, 42)
Epoch 1/5
169/169 [==============================] - 4s 26ms/step - loss: 1.0011 - acc: 0.5207
Epoch 2/5
169/169 [==============================] - 0s 1ms/step - loss: 0.9408 - acc: 0.5799
Epoch 3/5
169/169 [==============================] - 0s 1ms/step - loss: 0.8974 - acc: 0.6095
Epoch 4/5
169/169 [==============================] - 0s 990us/step - loss: 0.8656 - acc: 0.6154
Epoch 5/5
169/169 [==============================] - 0s 1ms/step - loss: 0.8382 - acc: 0.6154
3 (122, 3) (122, 42)
Epoch 1/5
122/122 [==============================] - 5s 37ms/step - loss: 1.1725 - acc: 0.1803
Epoch 2/5
122/122 [==============================] - 0s 1ms/step - loss: 1.0975 - acc: 0.4098
Epoch 3/5
122/122 [==============================] - 0s 1ms/step - loss: 1.0440 - acc: 0.5492
Epoch 4/5
122/122 [==============================] - 0s 1ms/step - loss: 0.9998 - acc: 0.6311
Epoch 5/5
122/122 [==============================] - 0s 1ms/step - loss: 0.9599 - acc: 0.6803
3 (166, 3) (166, 42)
Epoch 1/5
166/166 [==============================] - 5s 29ms/step - loss: 1.1626 - acc: 0.2651
Epoch 2/5
166/166 [==============================] - 0s 1ms/step - loss: 1.0902 - acc: 0.3795
Epoch 3/5
166/166 [==============================] - 0s 1ms/step - loss: 1.0446 - acc: 0.4880
Epoch 4/5
166/166 [==============================] - 0s 1ms/step - loss: 0.9992 - acc: 0.5964
Epoch 5/5
166/166 [==============================] - 0s 1ms/step - loss: 0.9562 - acc: 0.6446
3 (156, 3) (156, 42)
Epoch 1/5
156/156 [==============================] - 5s 30ms/step - loss: 1.1174 - acc: 0.3397
Epoch 2/5
156/156 [==============================] - 0s 1ms/step - loss: 0.9927 - acc: 0.6474
Epoch 3/5
156/156 [==============================] - 0s 1ms/step - loss: 0.8952 - acc: 0.7372
Epoch 4/5
156/156 [==============================] - 0s 2ms/step - loss: 0.8143 - acc: 0.7564
Epoch 5/5
156/156 [==============================] - 0s 2ms/step - loss: 0.7563 - acc: 0.7564
3 (104, 3) (104, 42)
Epoch 1/5
```

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104/104 [==============================] - 5s 44ms/step - loss: 1.2036 - acc: 0.2596
Epoch 2/5
104/104 [==============================] - 0s 1ms/step - loss: 1.0108 - acc: 0.5385
Epoch 3/5
104/104 [==============================] - 0s 1ms/step - loss: 0.8964 - acc: 0.5962
Epoch 4/5
104/104 [==============================] - 0s 1ms/step - loss: 0.8162 - acc: 0.6731
Epoch 5/5
104/104 [==============================] - 0s 1ms/step - loss: 0.7710 - acc: 0.6923
3 (201, 3) (201, 42)
Epoch 1/5
201/201 [==============================] - 5s 24ms/step - loss: 1.0449 - acc: 0.3980
Epoch 2/5
201/201 [==============================] - 0s 1ms/step - loss: 0.8577 - acc: 0.7114
Epoch 3/5
201/201 [==============================] - 0s 1ms/step - loss: 0.7107 - acc: 0.7910
Epoch 4/5
201/201 [==============================] - 0s 1ms/step - loss: 0.6104 - acc: 0.8010
Epoch 5/5
201/201 [==============================] - 0s 1ms/step - loss: 0.5536 - acc: 0.8010
3 (155, 3) (155, 42)
Epoch 1/5
155/155 [==============================] - 5s 30ms/step - loss: 1.1049 - acc: 0.4387
Epoch 2/5
155/155 [==============================] - 0s 1ms/step - loss: 1.0708 - acc: 0.4645
Epoch 3/5
155/155 [==============================] - 0s 1ms/step - loss: 1.0467 - acc: 0.4903
Epoch 4/5
155/155 [==============================] - 0s 1ms/step - loss: 1.0286 - acc: 0.4968
Epoch 5/5
155/155 [==============================] - 0s 1ms/step - loss: 1.0119 - acc: 0.5097
3 (116, 3) (116, 42)
Epoch 1/5
116/116 [==============================] - 5s 40ms/step - loss: 1.1732 - acc: 0.2500
Epoch 2/5
116/116 [==============================] - 0s 1ms/step - loss: 1.0925 - acc: 0.3966
Epoch 3/5
116/116 [==============================] - 0s 1ms/step - loss: 1.0380 - acc: 0.5517
Epoch 4/5
116/116 [==============================] - 0s 1ms/step - loss: 0.9895 - acc: 0.6207
Epoch 5/5
116/116 [==============================] - 0s 1ms/step - loss: 0.9525 - acc: 0.6724
3 (193, 3) (193, 42)
Epoch 1/5
193/193 [==============================] - 5s 24ms/step - loss: 1.0950 - acc: 0.4301
Epoch 2/5
193/193 [==============================] - 0s 1ms/step - loss: 0.9968 - acc: 0.5440
Epoch 3/5
```

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193/193 [==============================] - 0s 1ms/step - loss: 0.9415 - acc: 0.5959
Epoch 4/5
193/193 [==============================] - 0s 1ms/step - loss: 0.9064 - acc: 0.5959
Epoch 5/5
193/193 [==============================] - 0s 1ms/step - loss: 0.8806 - acc: 0.6062
3 (100, 3) (100, 42)
Epoch 1/5
100/100 [==============================] - 5s 47ms/step - loss: 1.0906 - acc: 0.4900
Epoch 2/5
100/100 [==============================] - 0s 1ms/step - loss: 1.0565 - acc: 0.4900
Epoch 3/5
100/100 [==============================] - 0s 1ms/step - loss: 1.0241 - acc: 0.4800
Epoch 4/5
100/100 [==============================] - 0s 1ms/step - loss: 1.0007 - acc: 0.4700
Epoch 5/5
100/100 [==============================] - 0s 1ms/step - loss: 0.9790 - acc: 0.5100
3 (379, 3) (379, 42)
Epoch 1/5
379/379 [==============================] - 5s 13ms/step - loss: 1.0392 - acc: 0.3879
Epoch 2/5
379/379 [==============================] - 0s 1ms/step - loss: 0.5474 - acc: 0.9683
Epoch 3/5
379/379 [==============================] - 0s 1ms/step - loss: 0.2704 - acc: 0.9763
Epoch 4/5
379/379 [==============================] - 0s 1ms/step - loss: 0.1755 - acc: 0.9763
Epoch 5/5
379/379 [==============================] - 0s 1ms/step - loss: 0.1478 - acc: 0.9763
3 (156, 3) (156, 42)
Epoch 1/5
156/156 [==============================] - 5s 31ms/step - loss: 1.1833 - acc: 0.2308
Epoch 2/5
156/156 [==============================] - 0s 1ms/step - loss: 1.0515 - acc: 0.5256
Epoch 3/5
156/156 [==============================] - 0s 1ms/step - loss: 0.9507 - acc: 0.6923
Epoch 4/5
156/156 [==============================] - 0s 1ms/step - loss: 0.8732 - acc: 0.7564
Epoch 5/5
156/156 [==============================] - 0s 1ms/step - loss: 0.8077 - acc: 0.7692
3 (113, 3) (113, 42)
Epoch 1/5
113/113 [==============================] - 5s 42ms/step - loss: 1.3021 - acc: 0.1770
Epoch 2/5
113/113 [==============================] - 0s 1ms/step - loss: 1.0702 - acc: 0.4159
Epoch 3/5
113/113 [==============================] - 0s 1ms/step - loss: 0.8867 - acc: 0.6814
Epoch 4/5
113/113 [==============================] - 0s 1ms/step - loss: 0.7431 - acc: 0.8938
Epoch 5/5
```

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113/113 [==============================] - 0s 1ms/step - loss: 0.6361 - acc: 0.8938
3 (203, 3) (203, 42)
Epoch 1/5
203/203 [==============================] - 5s 24ms/step - loss: 1.2512 - acc: 0.2266
Epoch 2/5
203/203 [==============================] - 0s 1ms/step - loss: 0.8610 - acc: 0.6404
Epoch 3/5
203/203 [==============================] - 0s 1ms/step - loss: 0.6052 - acc: 0.8374
Epoch 4/5
203/203 [==============================] - 0s 1ms/step - loss: 0.4691 - acc: 0.8670
Epoch 5/5
203/203 [==============================] - 0s 1ms/step - loss: 0.4120 - acc: 0.8867
3 (142, 3) (142, 42)
Epoch 1/5
142/142 [==============================] - 5s 34ms/step - loss: 1.2111 - acc: 0.2535
Epoch 2/5
142/142 [==============================] - 0s 1ms/step - loss: 1.1287 - acc: 0.3873
Epoch 3/5
142/142 [==============================] - 0s 1ms/step - loss: 1.0718 - acc: 0.4859
Epoch 4/5
142/142 [==============================] - 0s 1ms/step - loss: 1.0288 - acc: 0.5282
Epoch 5/5
142/142 [==============================] - 0s 1ms/step - loss: 0.9942 - acc: 0.5352
3 (194, 3) (194, 42)
Epoch 1/5
194/194 [==============================] - 5s 25ms/step - loss: 1.1756 - acc: 0.2835
Epoch 2/5
194/194 [==============================] - 0s 1ms/step - loss: 1.1058 - acc: 0.3918
Epoch 3/5
194/194 [==============================] - 0s 1ms/step - loss: 1.0724 - acc: 0.4588
Epoch 4/5
194/194 [==============================] - 0s 1ms/step - loss: 1.0422 - acc: 0.5000
Epoch 5/5
194/194 [==============================] - 0s 1ms/step - loss: 1.0159 - acc: 0.5361
3 (270, 3) (270, 42)
Epoch 1/5
270/270 [==============================] - 5s 18ms/step - loss: 1.4855 - acc: 0.1111
Epoch 2/5
270/270 [==============================] - 0s 1ms/step - loss: 1.2091 - acc: 0.1963
Epoch 3/5
270/270 [==============================] - 0s 1ms/step - loss: 0.9845 - acc: 0.5148
Epoch 4/5
270/270 [==============================] - 0s 1ms/step - loss: 0.7906 - acc: 0.7630
Epoch 5/5
270/270 [==============================] - 0s 1ms/step - loss: 0.6769 - acc: 0.7704
3 (129, 3) (129, 42)
Epoch 1/5
129/129 [==============================] - 5s 38ms/step - loss: 1.1865 - acc: 0.2791
```

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Epoch 2/5
129/129 [==============================] - 0s 1ms/step - loss: 1.0390 - acc: 0.4496
Epoch 3/5
129/129 [==============================] - 0s 1ms/step - loss: 0.9244 - acc: 0.6667
Epoch 4/5
129/129 [==============================] - 0s 1ms/step - loss: 0.8321 - acc: 0.7442
Epoch 5/5
129/129 [==============================] - 0s 1ms/step - loss: 0.7663 - acc: 0.7519
3 (105, 3) (105, 42)
Epoch 1/5
105/105 [==============================] - 5s 46ms/step - loss: 1.0190 - acc: 0.4952
Epoch 2/5
105/105 [==============================] - 0s 1ms/step - loss: 0.9964 - acc: 0.5524
Epoch 3/5
105/105 [==============================] - 0s 1ms/step - loss: 0.9841 - acc: 0.5619
Epoch 4/5
105/105 [==============================] - 0s 1ms/step - loss: 0.9727 - acc: 0.5714
Epoch 5/5
105/105 [==============================] - 0s 1ms/step - loss: 0.9636 - acc: 0.5714
3 (378, 3) (378, 42)
Epoch 1/5
378/378 [==============================] - 5s 14ms/step - loss: 1.1808 - acc: 0.3757
Epoch 2/5
378/378 [==============================] - 0s 1ms/step - loss: 0.8246 - acc: 0.7910
Epoch 3/5
378/378 [==============================] - 0s 1ms/step - loss: 0.5665 - acc: 0.8730
Epoch 4/5
378/378 [==============================] - 0s 1ms/step - loss: 0.4586 - acc: 0.8915
Epoch 5/5
378/378 [==============================] - 0s 1ms/step - loss: 0.4268 - acc: 0.8915
3 (405, 3) (405, 42)
Epoch 1/5
405/405 [==============================] - 6s 15ms/step - loss: 0.9495 - acc: 0.6074
Epoch 2/5
405/405 [==============================] - 1s 1ms/step - loss: 0.7407 - acc: 0.7802
Epoch 3/5
405/405 [==============================] - 1s 1ms/step - loss: 0.6651 - acc: 0.7802
Epoch 4/5
405/405 [==============================] - 1s 1ms/step - loss: 0.6371 - acc: 0.7802
Epoch 5/5
405/405 [==============================] - 1s 1ms/step - loss: 0.6211 - acc: 0.7802
3 (172, 3) (172, 42)
Epoch 1/5
172/172 [==============================] - 5s 30ms/step - loss: 0.7277 - acc: 0.7442
Epoch 2/5
172/172 [==============================] - 0s 1ms/step - loss: 0.4554 - acc: 0.9186
Epoch 3/5
172/172 [==============================] - 0s 1ms/step - loss: 0.2840 - acc: 0.9767
```

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Epoch 4/5
172/172 [==============================] - 0s 1ms/step - loss: 0.1851 - acc: 0.9826
Epoch 5/5
172/172 [==============================] - 0s 1ms/step - loss: 0.1362 - acc: 0.9826
3 (232, 3) (232, 42)
Epoch 1/5
232/232 [==============================] - 5s 22ms/step - loss: 0.7468 - acc: 0.7845
Epoch 2/5
232/232 [==============================] - 0s 1ms/step - loss: 0.4644 - acc: 0.9698
Epoch 3/5
232/232 [==============================] - 0s 1ms/step - loss: 0.2988 - acc: 0.9698
Epoch 4/5
232/232 [==============================] - 0s 1ms/step - loss: 0.2170 - acc: 0.9698
Epoch 5/5
232/232 [==============================] - 0s 1ms/step - loss: 0.1759 - acc: 0.9698
3 (106, 3) (106, 42)
Epoch 1/5
106/106 [==============================] - 5s 47ms/step - loss: 1.1944 - acc: 0.2170
Epoch 2/5
106/106 [==============================] - 0s 1ms/step - loss: 1.0425 - acc: 0.5189
Epoch 3/5
106/106 [==============================] - 0s 1ms/step - loss: 0.9132 - acc: 0.7547
Epoch 4/5
106/106 [==============================] - 0s 2ms/step - loss: 0.7880 - acc: 0.8774
Epoch 5/5
106/106 [==============================] - 0s 2ms/step - loss: 0.6740 - acc: 0.8962
3 (291, 3) (291, 42)
Epoch 1/5
291/291 [==============================] - 5s 18ms/step - loss: 1.0560 - acc: 0.4674
Epoch 2/5
291/291 [==============================] - 0s 1ms/step - loss: 0.8370 - acc: 0.8144
Epoch 3/5
291/291 [==============================] - 0s 1ms/step - loss: 0.6714 - acc: 0.8385
Epoch 4/5
291/291 [==============================] - 0s 1ms/step - loss: 0.5725 - acc: 0.8385
Epoch 5/5
291/291 [==============================] - 0s 1ms/step - loss: 0.5308 - acc: 0.8385
3 (226, 3) (226, 42)
Epoch 1/5
226/226 [==============================] - 5s 23ms/step - loss: 1.3121 - acc: 0.1549
Epoch 2/5
226/226 [==============================] - 0s 1ms/step - loss: 1.0342 - acc: 0.5044
Epoch 3/5
226/226 [==============================] - 0s 1ms/step - loss: 0.8377 - acc: 0.7257
Epoch 4/5
226/226 [==============================] - 0s 1ms/step - loss: 0.7276 - acc: 0.7478
Epoch 5/5
226/226 [==============================] - 0s 1ms/step - loss: 0.6885 - acc: 0.7434
```

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3 (113, 3) (113, 42)
Epoch 1/5
113/113 [==============================] - 5s 45ms/step - loss: 1.0990 - acc: 0.3186
Epoch 2/5
113/113 [==============================] - 0s 1ms/step - loss: 1.0443 - acc: 0.4690
Epoch 3/5
113/113 [==============================] - 0s 1ms/step - loss: 0.9986 - acc: 0.5752
Epoch 4/5
113/113 [==============================] - 0s 1ms/step - loss: 0.9614 - acc: 0.6195
Epoch 5/5
113/113 [==============================] - 0s 1ms/step - loss: 0.9290 - acc: 0.6195
3 (137, 3) (137, 42)
Epoch 1/5
137/137 [==============================] - 5s 37ms/step - loss: 1.0190 - acc: 0.3504
Epoch 2/5
137/137 [==============================] - 0s 1ms/step - loss: 0.9777 - acc: 0.4088
Epoch 3/5
137/137 [==============================] - 0s 1ms/step - loss: 0.9399 - acc: 0.5693
Epoch 4/5
137/137 [==============================] - 0s 1ms/step - loss: 0.9070 - acc: 0.6569
Epoch 5/5
137/137 [==============================] - 0s 1ms/step - loss: 0.8761 - acc: 0.7153
3 (126, 3) (126, 42)
Epoch 1/5
126/126 [==============================] - 5s 41ms/step - loss: 1.0958 - acc: 0.3968
Epoch 2/5
126/126 [==============================] - 0s 1ms/step - loss: 1.0593 - acc: 0.4365
Epoch 3/5
126/126 [==============================] - 0s 2ms/step - loss: 1.0339 - acc: 0.4524
Epoch 4/5
126/126 [==============================] - 0s 1ms/step - loss: 1.0125 - acc: 0.4841
Epoch 5/5
126/126 [==============================] - 0s 1ms/step - loss: 0.9902 - acc: 0.5317
3 (232, 3) (232, 42)
Epoch 1/5
232/232 [==============================] - 5s 23ms/step - loss: 1.2266 - acc: 0.1724
Epoch 2/5
232/232 [==============================] - 0s 1ms/step - loss: 1.0232 - acc: 0.3233
Epoch 3/5
232/232 [==============================] - 0s 1ms/step - loss: 0.8661 - acc: 0.6767
Epoch 4/5
232/232 [==============================] - 0s 1ms/step - loss: 0.7517 - acc: 0.7543
Epoch 5/5
232/232 [==============================] - 0s 1ms/step - loss: 0.6887 - acc: 0.7629
3 (169, 3) (169, 42)
Epoch 1/5
169/169 [==============================] - 5s 31ms/step - loss: 1.3979 - acc: 0.1716
Epoch 2/5
```

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169/169 [==============================] - 0s 1ms/step - loss: 1.1932 - acc: 0.2426
Epoch 3/5
169/169 [==============================] - 0s 1ms/step - loss: 1.0843 - acc: 0.4201
Epoch 4/5
169/169 [==============================] - 0s 1ms/step - loss: 1.0100 - acc: 0.5799
Epoch 5/5
169/169 [==============================] - 0s 1ms/step - loss: 0.9632 - acc: 0.5976
3 (195, 3) (195, 42)
Epoch 1/5
195/195 [==============================] - 5s 27ms/step - loss: 1.4463 - acc: 0.1282
Epoch 2/5
195/195 [==============================] - 0s 1ms/step - loss: 1.0856 - acc: 0.4256
Epoch 3/5
195/195 [==============================] - 0s 1ms/step - loss: 0.8484 - acc: 0.7333
Epoch 4/5
195/195 [==============================] - 0s 1ms/step - loss: 0.7269 - acc: 0.7692
Epoch 5/5
195/195 [==============================] - 0s 2ms/step - loss: 0.6710 - acc: 0.7744
3 (222, 3) (222, 42)
Epoch 1/5
222/222 [==============================] - 5s 24ms/step - loss: 1.1860 - acc: 0.1892
Epoch 2/5
222/222 [==============================] - 0s 1ms/step - loss: 0.8140 - acc: 0.7252
Epoch 3/5
222/222 [==============================] - 0s 1ms/step - loss: 0.5515 - acc: 0.9505
Epoch 4/5
222/222 [==============================] - 0s 1ms/step - loss: 0.3809 - acc: 0.9640
Epoch 5/5
222/222 [==============================] - 0s 1ms/step - loss: 0.2860 - acc: 0.9640
3 (186, 3) (186, 42)
Epoch 1/5
186/186 [==============================] - 5s 29ms/step - loss: 1.0688 - acc: 0.2312
Epoch 2/5
186/186 [==============================] - 0s 1ms/step - loss: 0.9079 - acc: 0.6290
Epoch 3/5
186/186 [==============================] - 0s 1ms/step - loss: 0.7273 - acc: 0.8763
Epoch 4/5
186/186 [==============================] - 0s 1ms/step - loss: 0.5663 - acc: 0.8871
Epoch 5/5
186/186 [==============================] - 0s 1ms/step - loss: 0.4686 - acc: 0.8817
3 (133, 3) (133, 42)
Epoch 1/5
133/133 [==============================] - 5s 40ms/step - loss: 1.4668 - acc: 0.1278
Epoch 2/5
133/133 [==============================] - 0s 1ms/step - loss: 1.2162 - acc: 0.2632
Epoch 3/5
133/133 [==============================] - 0s 1ms/step - loss: 1.0056 - acc: 0.5714
Epoch 4/5
```

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133/133 [==============================] - 0s 1ms/step - loss: 0.8165 - acc: 0.8571
Epoch 5/5
133/133 [==============================] - 0s 1ms/step - loss: 0.6532 - acc: 0.9098
3 (197, 3) (197, 42)
Epoch 1/5
197/197 [==============================] - 5s 27ms/step - loss: 0.9577 - acc: 0.6041
Epoch 2/5
197/197 [==============================] - 0s 1ms/step - loss: 0.7506 - acc: 0.8274
Epoch 3/5
197/197 [==============================] - 0s 1ms/step - loss: 0.6206 - acc: 0.8579
Epoch 4/5
197/197 [==============================] - 0s 1ms/step - loss: 0.5442 - acc: 0.8629
Epoch 5/5
197/197 [==============================] - 0s 1ms/step - loss: 0.5070 - acc: 0.8629
3 (155, 3) (155, 42)
Epoch 1/5
155/155 [==============================] - 5s 34ms/step - loss: 1.1265 - acc: 0.4129
Epoch 2/5
155/155 [==============================] - 0s 1ms/step - loss: 1.0606 - acc: 0.4710
Epoch 3/5
155/155 [==============================] - 0s 1ms/step - loss: 1.0118 - acc: 0.5677
Epoch 4/5
155/155 [==============================] - 0s 1ms/step - loss: 0.9738 - acc: 0.6258
Epoch 5/5
155/155 [==============================] - 0s 1ms/step - loss: 0.9386 - acc: 0.6323
3 (172, 3) (172, 42)
Epoch 1/5
172/172 [==============================] - 5s 31ms/step - loss: 1.2169 - acc: 0.1919
Epoch 2/5
172/172 [==============================] - 0s 1ms/step - loss: 1.0158 - acc: 0.4593
Epoch 3/5
172/172 [==============================] - 0s 1ms/step - loss: 0.8717 - acc: 0.7442
Epoch 4/5
172/172 [==============================] - 0s 1ms/step - loss: 0.7751 - acc: 0.7907
Epoch 5/5
172/172 [==============================] - 0s 1ms/step - loss: 0.7083 - acc: 0.7965
3 (103, 3) (103, 42)
Epoch 1/5
103/103 [==============================] - 5s 52ms/step - loss: 1.0658 - acc: 0.4951
Epoch 2/5
103/103 [==============================] - 0s 2ms/step - loss: 1.0003 - acc: 0.6117
Epoch 3/5
103/103 [==============================] - 0s 2ms/step - loss: 0.9380 - acc: 0.6893
Epoch 4/5
103/103 [==============================] - 0s 1ms/step - loss: 0.8800 - acc: 0.6893
Epoch 5/5
103/103 [==============================] - 0s 2ms/step - loss: 0.8280 - acc: 0.6990
3 (147, 3) (147, 42)
```

```
Epoch 1/5
147/147 [==============================] - 5s 37ms/step - loss: 1.2481 - acc: 0.2381
Epoch 2/5
147/147 [==============================] - 0s 1ms/step - loss: 1.1490 - acc: 0.3605
Epoch 3/5
147/147 [==============================] - 0s 1ms/step - loss: 1.0879 - acc: 0.4082
Epoch 4/5
147/147 [==============================] - 0s 1ms/step - loss: 1.0387 - acc: 0.4762
Epoch 5/5
147/147 [==============================] - 0s 1ms/step - loss: 1.0089 - acc: 0.5238
3 (152, 3) (152, 42)
Epoch 1/5
152/152 [==============================] - 6s 37ms/step - loss: 1.1534 - acc: 0.2763
Epoch 2/5
152/152 [==============================] - 0s 2ms/step - loss: 1.0864 - acc: 0.3882
Epoch 3/5
152/152 [==============================] - 0s 2ms/step - loss: 1.0404 - acc: 0.4408
Epoch 4/5
152/152 [==============================] - 0s 2ms/step - loss: 1.0050 - acc: 0.5066
Epoch 5/5
152/152 [==============================] - 0s 2ms/step - loss: 0.9759 - acc: 0.5395
3 (275, 3) (275, 42)
Epoch 1/5
275/275 [==============================] - 6s 21ms/step - loss: 1.2000 - acc: 0.1855
Epoch 2/5
275/275 [==============================] - 0s 1ms/step - loss: 1.0558 - acc: 0.4800
Epoch 3/5
275/275 [==============================] - 0s 1ms/step - loss: 0.9543 - acc: 0.7055
Epoch 4/5
275/275 [==============================] - 0s 2ms/step - loss: 0.8554 - acc: 0.7455
Epoch 5/5
275/275 [==============================] - 0s 1ms/step - loss: 0.7650 - acc: 0.7455
3 (188, 3) (188, 42)
Epoch 1/5
188/188 [==============================] - 6s 30ms/step - loss: 1.0460 - acc: 0.5266
Epoch 2/5
188/188 [==============================] - 0s 1ms/step - loss: 0.9916 - acc: 0.5426
Epoch 3/5
188/188 [==============================] - 0s 1ms/step - loss: 0.9562 - acc: 0.5904
Epoch 4/5
188/188 [==============================] - 0s 1ms/step - loss: 0.9319 - acc: 0.5851
Epoch 5/5
188/188 [==============================] - 0s 2ms/step - loss: 0.9144 - acc: 0.6011
3 (152, 3) (152, 42)
Epoch 1/5
152/152 [==============================] - 6s 37ms/step - loss: 1.2042 - acc: 0.3224
Epoch 2/5
152/152 [==============================] - 0s 2ms/step - loss: 1.1438 - acc: 0.3224
```

```
Epoch 3/5
152/152 [==============================] - 0s 1ms/step - loss: 1.1120 - acc: 0.3618
Epoch 4/5
152/152 [==============================] - 0s 1ms/step - loss: 1.0911 - acc: 0.3947
Epoch 5/5
152/152 [==============================] - 0s 1ms/step - loss: 1.0741 - acc: 0.4145
3 (105, 3) (105, 42)
Epoch 1/5
105/105 [==============================] - 6s 53ms/step - loss: 1.0904 - acc: 0.3905
Epoch 2/5
105/105 [==============================] - 0s 1ms/step - loss: 1.0491 - acc: 0.4857
Epoch 3/5
105/105 [==============================] - 0s 1ms/step - loss: 1.0196 - acc: 0.5238
Epoch 4/5
105/105 [==============================] - 0s 1ms/step - loss: 0.9993 - acc: 0.5524
Epoch 5/5
105/105 [==============================] - 0s 1ms/step - loss: 0.9798 - acc: 0.5714
3 (108, 3) (108, 42)
Epoch 1/5
108/108 [==============================] - 6s 52ms/step - loss: 1.6462 - acc: 0.1204
Epoch 2/5
108/108 [==============================] - 0s 1ms/step - loss: 1.3679 - acc: 0.1574
Epoch 3/5
108/108 [==============================] - 0s 1ms/step - loss: 1.1412 - acc: 0.3241
Epoch 4/5
108/108 [==============================] - 0s 1ms/step - loss: 0.9734 - acc: 0.5556
Epoch 5/5
108/108 [==============================] - 0s 1ms/step - loss: 0.8510 - acc: 0.6759
3 (102, 3) (102, 42)
Epoch 1/5
102/102 [==============================] - 6s 55ms/step - loss: 1.0759 - acc: 0.4902
Epoch 2/5
102/102 [==============================] - 0s 1ms/step - loss: 1.0304 - acc: 0.5098
Epoch 3/5
102/102 [==============================] - 0s 1ms/step - loss: 1.0002 - acc: 0.5098
Epoch 4/5
102/102 [==============================] - 0s 2ms/step - loss: 0.9705 - acc: 0.5098
Epoch 5/5
102/102 [==============================] - 0s 2ms/step - loss: 0.9539 - acc: 0.5392
3 (158, 3) (158, 42)
Epoch 1/5
158/158 [==============================] - 6s 37ms/step - loss: 1.0939 - acc: 0.3734
Epoch 2/5
158/158 [==============================] - 0s 2ms/step - loss: 1.0631 - acc: 0.4051
Epoch 3/5
158/158 [==============================] - 0s 1ms/step - loss: 1.0393 - acc: 0.4177
Epoch 4/5
158/158 [==============================] - 0s 1ms/step - loss: 1.0176 - acc: 0.4684
```

```
Epoch 5/5
158/158 [==============================] - 0s 1ms/step - loss: 1.0002 - acc: 0.4937
```

```
In [9]: # predicts using the neural shrub
        def neural_shrub_predict(tree, nn_model, test, label):
            label_test = np.array(label)
            test = np.array(test)

            #row - actual; col - pred
            confusion_matrix = np.array([[0, 0, 0], [0, 0, 0], [0, 0, 0]])
            correct = 0

            for i in range(len(test)):
                x = test[i]
                pred_class = tree.apply([x])
                x = np.array([x])
                nn_model_class = nn_model[pred_class[0]]
                pred = np.argmax(nn_model_class.predict(x))

                confusion_matrix[label[i]][pred] = \
                    confusion_matrix[label[i]][pred] + 1
                if pred == label[i]: correct = correct + 1

            acc_score = correct/len(test)

            return confusion_matrix, acc_score
```

```
In [10]: # Predicting
         cm, acc_score = neural_shrub_predict(tree, shrubs, test, test_label)
         print("Confusion Matrix:\n\n", cm)
```

```
Confusion Matrix:

 [[  55  338  852]
 [ 136 1890 1364]
 [ 205 1287 7385]]
```

```
In [11]: # function used to calcultate the metrics for each class
         def metrics(cm, cls, size):
             cm = np.array(cm)
             tp = cm[cls][cls]
             fp = sum(cm[x, cls] for x in range(3))-cm[cls][cls]
             fn = sum(cm[cls, x] for x in range(3))-cm[cls][cls]
             tn = size - tp - fp - fn
             precision = tp/(tp+fp)
             recall = tp/(tp+fn)
             fmeasure = 2*(precision*recall)/(precision + recall)
```

```
            accuracy = (tp + tn)/size

            return precision, recall, fmeasure, accuracy
```

```
In [12]: # metrics for class 0 (draw)
         precision0, recall0, f0, acc0 = metrics(cm, 0, len(test))
         print("                Precision Recall F-measure Accuracy")
         print("Class 0 (draw): ", round(precision0, 3), "  ", round(recall0, 3), \
               " ", round(f0, 3), "   ", round(acc0,3))
```

```
                Precision Recall F-measure Accuracy
Class 0 (draw):  0.139    0.044   0.067     0.887
```

```
In [13]: # metrics for class 1 (lose)
         precision1, recall1, f1, acc1 = metrics(cm, 1, len(test))
         print("                Precision Recall F-measure Accuracy")
         print("Class 1 (loss): ", round(precision1, 3), "  ", round(recall1, 3), \
               " ", round(f1, 3), "   ", round(acc1,3))
```

```
                Precision Recall F-measure Accuracy
Class 1 (loss):  0.538    0.558   0.547     0.769
```

```
In [14]: # metrics for class 2 (win)
         precision2, recall2, f2, acc2 = metrics(cm, 2, len(test))
         print("                Precision Recall F-measure Accuracy")
         print("Class 2 (win): ", round(precision2, 3), "  ", round(recall2, 3), \
               " ", round(f2, 3), "   ", round(acc2,3))
```

```
                Precision Recall F-measure Accuracy
Class 2 (win):  0.769    0.832   0.799     0.726
```

```
In [15]: # average metrics
         avg_p = (precision0 + precision1 + precision2)/3.0
         avg_r = (recall0 + recall1 + recall2) / 3.0
         avg_f = (f0 + f1 + f2) / 3.0
         avg_a = (acc0 + acc1 + acc2)/ 3.0
         print("        Precision Recall F-measure Accuracy")
         print("Average: ", round(avg_p, 3), "  ", round(avg_r, 3), \
               " ", round(avg_f, 3), "   ", round(avg_a,3))
```

```
        Precision Recall F-measure Accuracy
Average:  0.482    0.478   0.471     0.794
```

```
In [16]: # training time
         total_time_taken = dt_end - dt_start + max_time
         print("Training Time: %s sec" % round(total_time_taken, 5))
```

```
Training Time: 15.54949 sec
```

```
In [17]: # Number of instances correctly classified
         print("Accuracy_score: ", round(acc_score, 5))
```

```
Accuracy_score:  0.6905
```